4K 95-37

SALMON RESEARCH AND DEVELOPMENT OPERATIONAL PLANS FOR THE KODIAK AND CHIGNIK MANAGEMENT AREAS, 1995

Regional Information Report[1] No. 4K95-37

Alaska Department of Fish and Game
Commercial Fisheries Management & Development Division
211 Mission Road
Kodiak, Alaska 99615

August 1995

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[1]The Regional Information Report Series was established in 1987 to provide an information access system for all unpublished division reports. These reports frequently serve diverse ad hoc informational purposes or archive basic uninterpreted data. To accommodate timely reporting of recently collected information, reports in this series undergo only limited internal review and may contain preliminary data; this information may be subsequently finalized and published in the formal literature. Consequently, these reports should not be cited without prior approval of the author or the Commercial Fisheries Management and Development Division.

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DIVIDER

KODIAK MANAGEMENT AREA SALMON CATCH SAMPLING

OPERATIONAL PLAN, 1995

Alaska Department of Fish and Game
Commercial Fisheries Management and Development Division
211 Mission Road
Kodiak, Alaska 99615

May 1995

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INTRODUCTION

The Kodiak Management Area extends from Imuya Bay north to Cape Douglas and includes Shelikof Strait and the waters of Kodiak, Afognak, and Shuyak Islands (Figure 1). The area includes 454 specified salmon streams and lakes. The management area is divided into seven districts and 98 statistical areas. The districts and statistical areas are established to facilitate stock specific management.

Five Pacific salmon species are harvested in the Kodiak Management Area. Sockeye salmon are economically the most important species followed by pink, chum, coho, and chinook salmon. The 1994 catch was 12.1 million fish comprised of 2.9 million sockeye, 2.0 million pink, 739,000 chum, 296,000 coho, and 23,000 chinook salmon. The 1995 harvest is projected to be 2.4 million sockeye, 18.2 million pink, 800,000 chum, 310,000 coho and 25,000 chinook salmon.

The Alaska Department of Fish and Game assumed the responsibility of managing Alaska's salmon resources in 1960. The goal has been to manage the resource for maximum sustained yield. Generally, achievement of this goal is accomplished by: 1) setting and implementing escapement objectives by system which will produce the greatest number of harvestable fish and; 2) deriving techniques necessary to assist fishery managers in obtaining escapement goals and optimum harvest. Assignment of catch to river system of origin is a prerequisite for evaluating escapement objectives and forecasting returns. In 1985 an expanded salmon commercial catch sampling operation was initiated in the Kodiak Management Area for establishing a data base for determining stock contribution levels, evaluating escapement goals, and forecasting. The program has continued with the current emphasis on sockeye salmon.

GOAL

Provide improved management of the Kodiak Management Area (KMA) salmon runs.

OBJECTIVES

1. Construct accurate brood tables.
2. Develop accurate run forecasts.
3. Evaluate escapement goals and accurately define run timing.
4. Estimate the composition of sockeye stocks harvested in non-terminal (interception) fisheries.

TASKS

1. Collect representative age composition data from selected sockeye fisheries.

SUPERVISION

Patti Nelson will supervise the catch sampling at the Port of Kodiak, Larson Bay, and Alitak Bay.

PERSONNEL

Personnel assignments at the Port of Kodiak, Larson Bay and Alitak Bay are defined in Table 1. Available permanent and seasonal staff will assist in catch sampling at the Port of Kodiak when necessary.

PROCEDURES

Catch Sampling For Age

Sockeye salmon catches will be sampled for age by the crew at the Port of Kodiak, Larson Bay and at Alitak according to the schedules in Table 2.

All catch sampling data are to be representative and random. To ensure that this occurs, mixed loads from non-targeted areas are not to be sampled, and there is to be no pre-selection of fish for length, sex, condition, or any other factor.

To ensure that sockeye samples are obtained, the crews will begin sampling the first day of delivery from the designated sampling areas each week (Table 2).

The standard procedures for collecting and recording salmon age data are defined in Appendix A. The accuracy of the data and scale sample quality will be the responsibility of the crew leaders. If questions or problems arise, do not hesitate to inquire with your supervisor for clarification or assistance.

Periodically inseason, the Alitak crew will send their completed (original) opscan forms and scale impression acetates to the Kodiak office for final processing. Correspondence should be directed to Patti Nelson. The crew leader will notify the Kodiak office by radio or phone that the data are being sent, and will maintain a log book of all out-going samples. The original scale cards and copies of the opscan forms should be hand carried to town at the end of the season. All scales collected by the Alitak crew will be pressed and aged at Lazy Bay (by Bruce McIntosh) prior to being mailed to Kodiak. Original gum cards and a copy of the AWL form will remain at Lazy Bay until the end of the season. An updated copy of the sampling log (Figure 2) along with acetates and AWL's should be sent weekly to the Kodiak office.

Each crew leader should review the Kodiak Management Plan contained in Appendix B.

At the end of the season the Alitak crew leader will inventory all gear at the camp and send to Kodiak that gear which needs repair. The State rifle is the only equipment that must be returned to Kodiak. All other equipment can be locked up on-site.

Age Determination

Ageing of scales will be conducted only by certified scale readers. As of 24 May, those certified to age scales are: Patricia Nelson, Bob Murphy, and Bruce McIntosh.

Table 1. Salmon catch sampling crew for Kodiak Management Area, 1995.

Location	Name	Title	PCN	Position	Period
Port of Kodiak	Patti Nelson	FB I	1417	Crew Leader	9 Jun - 15 Sept
	Chris Hicks	FT III	1827	Crew	9 Jun - 15 Sept
	Chris Anderson	FT II	7095	Crew	9 Jun - 31 Aug
Alitak	Bruce McIntosh	FT III	1594	Crew Leader	9 Jun - 31 Aug
	Rusty Hippchen	FT II	1842	Crew	30 Jun - 15 Jul
	Micah Andresen	FT II	1836	Crew	9 Jun - 15 Jul
Larson Bay	Chris Hicks	FT III	1827	Crew Leader	9 Jun - 31 Aug

Table 2. Sockeye salmon catch sampling schedule for the Kodiak Management Area, 1995.

Crew	SAMPLING AREA: District/Section	SAMPLING AREA: Geographic Area	SAMPLING AREA: Statistical Area	Season	SAMPLE: Freq.	SAMPLE: Size[a]	SAMPLE: Data
Port of Kodiak							
	Afognak District,[b]						
	Shuyak Is. Section & NW Afognak Section	Point Banks to Raspberry Cape	251-30 through 70	Jul 6-25	Weekly[c]	600[d]	Scales
	SW Afognak Section		251-10, 20	Jul 6-25	Weekly[c]	600	Scales
	Mainland District[b]						
	Dakavak Section, Outer Kukak Bay Section, Hallo Bay Section, Big River Section	Dakavak Bay to Cape Douglas	262-10 through 55	Jul 6-25	Weekly[c]	600	Scales
	Katmai and Alinchak Sections		262-60 through 70	Jul 6-25	Weekly[c]	600	Scales
	Eastside Kodiak District						
	Sitkalidak Section	Dangerous Cape to Cape Kasiak	258-10 through 53	Jul 6-25	Weekly[c]	600	Scales
Alitak							
	Mainland/Cape Igvak	Imuya Bay to Cape Aklek	262-75,80,90,95	Jun 9-Jul 15	Twice	600	Scales
				Jul 16-Aug 31	Twice	600	Scales
	Alitak Bay/Cape Alitak	Cape Alitak	257-10,20	Jun 9-Aug 31	Weekly	600	Scales
	Alitak Bay/Moser Bay	Moser/Olga Bay	257-40,41	Jun 9-Aug 31	Weekly	600	Scales
	S.W. Kodiak/ Inner, Outer Ayakulik	Red River	256-10,20	Jun 9-Aug 31	Weekly	600	Scales
	S.W. Kodiak/Halibut Bay	Halibut/Gurney Bay	256-30,25	Jul 6-Jul 25	Weekly	600	Scales
Larson Bay							
	N.W. Kodiak/Central	Uyak Bay[e]	254-10-40	Jun 9-Aug 31	Weekly	600	Scales
	N.W. Kodiak/Central	Uganik/Viekoda Bays[e]	253-11-35	Jun 9-Aug 31	Weekly	600	Scales
	S.W. Kodiak	Inner/Outer Karluk[e]	255-10 & 20	Jun 9-Aug 31	Weekly	600	Scales

-Continued-

Table 2. (page 2 of 2)

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[a] If the required 600-fish sample is not practical to obtain, reduce sample size to 480 fish.

[b] The goal is to obtain a 600-fish weekly sample from: (1) NW Afognak and Shuyak Island Sections combined; (2) the SW Afognak Section; and (3) the Dakavak Bay to Cape Douglas reach of the Mainland District. When no pure samples are available from these areas, a combined Mainland and Afognak Districts 1,200-fish sample should be taken.

[c] Sample each opening if there is more than one opening per week.

[d] Exclude fish caught terminally at Thorshiem from the mixed stock sample. However, estimate the number of fish caught terminally for each opening; if possible obtain a pure terminal sample (600 fish-ALS) aside from the regular mix-stock fishery samples.

[e] Primary sample site is Larson Bay; secondary sample site in Port of Kodiak.

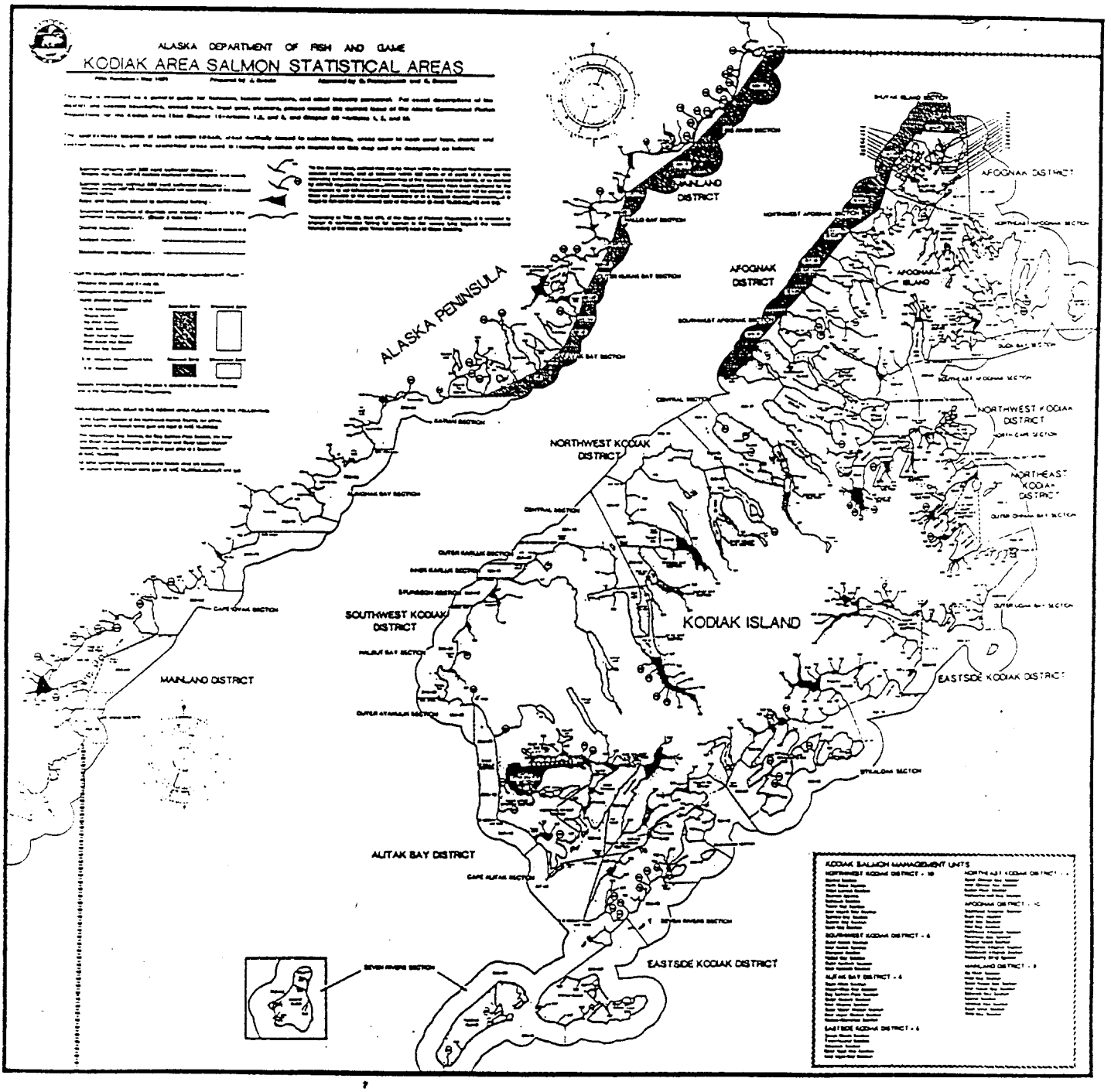

Figure 1. Kodiak Management Area districts and statistical areas, 1995.

Figure 2. Alitak catch sampling log, 1995.

GEOGRAPHIC AND STATISTICAL AREA SAMPLED	CATCH DATE	DELIVERY DATE	SPECIES SAMPLED	SAMPLE SIZE	GEAR TYPE	CREW	SCALES AGED BY	COMMENTS

APPENDIX A

Procedure for Sampling Adult Salmon for age, length, weight, and sex

Annually, salmon escapements and catches are sampled for age (scales), length, and sex (ALS) by field crews throughout the state. This database is essential for sound management of the State's salmon resources.

To be useful, data must be recorded on the mark-sense (AWL) forms neatly and accurately. Scale samples must be collected and mounted properly to ensure accurate age determination. The following procedures are to be adhered to when sampling for age, length, weight, and sex.

COMPLETING THE AWL FORMS:

A completed AWL form and accompanying gum card for sampling sockeye and chum salmon are shown in Appendix A.1-2.

Complete each section on the left side of the AWL form using a No. 2 pencil and darken the corresponding blocks as shown in the figures. Make every effort to darken the entire block as partially filled blocks are often missed by the optical scanner which reads and records the data from the AWL forms. Label only one form at a time to avoid a "carbon paper effect" resulting in stray marks.

Description:
Record the following: species/area/catch or escapement/gear type (seine, weir, etc.)/samplers

Card:
The AWL forms and corresponding gummed card(s) are numbered sequentially by date throughout the season starting with 001. A separate numbering sequence will be used for each species, district, and geographic location. Consult your port supervisor for the current card number. Sockeye scale samples will have only 1 gum card per AWL form as shown in Appendix A.1.

Species:
Refer to the reverse side of the AWL form for the correct digit.

Day, Month, Year:
Use appropriate digits for the date the fish are sampled; for catch sampling, use the date the fish were caught.

District:
List only one district. Consult area statistical map or project leader for appropriate district.

Subdistrict (Section):
List a single subdistrict if it is known and if all the potential samples were caught in that section. If more than one section is involved, list each section but do not darken the corresponding blocks. Leave blank if the section is unknown.

Stream:
Leave blank for catch sampling; escapement sampling consult area statistical map for appropriate stream number.

Location:
List the appropriate code as shown on Appendix A.3.

Period:
List the period in which the fish were caught (Appendix A.4.).

Project and Gear:
Refer to the reverse side of the AWL form for the correct code.

Mesh:
Leave blank unless specifically instructed by supervisor to do otherwise.

Type of length measurement:
Use (2) mid-eye to fork-of-tail. Refer to Appendix A.5.

# of cards:
Mark 1 (each AWL form in individually numbered).

Keep the litho codes in numerical order throughout the season and keep the AWL forms flat, dry, and clean. Fish gurry and water curling will cause data to be misinterpreted by the optical scanning machine. It is the crew leaders responsibility to make sure that all forms are carefully edited before returning them to your supervisor.

GUMMED CARDS:

Fill out the gum cards as shown in Appendices A.1

Species:
Write out completely (sockeye) and fill in appropriate number (2).

Locality:
For catch and escapement sampling, write down the area in which fish were caught, followed by catch or escapement (e.g. Karluk River escapement; Uganik Bay catch).

Stat. code and Sampling date:
Transfer the appropriate digits from the AWL form.

Gear:
Write out completely.

Collector(s):
Record the last names of person(s) sampling.

Remarks:
Record any pertinent information such as number of scales per fish sampled, vessel/tender name, etc. Transfer this same information to the top margin of the AWL.

SAMPLING PROCEDURE:

A. GENERAL

1. Place the fish on its right side to sample the left side.

2. Determine sex of the fish and darken M or F in the sex columns. If any difficulty is encountered with this procedure, write "I had trouble sexing these fish" on the top margin of the AWL and ask your supervisor for help as soon as possible before sexing additional fish.

3. Measure fish length in millimeters from the mid-eye to fork-of-tail (Appendix A.5). Record length by blackening the appropriate column blocks on the AWL form. Column 3 on the AWL form is used for fish with a length greater than 999 millimeters (Chinook). Measure all species of salmon to the nearest mm. Check the calipers periodically to ensure measurement accuracy. **When escapement sampling, take care to ensure that each length corresponds to the appropriate scale mounted on the gummed card as length at age is evaluated for each sample.**

4. Remove the "preferred scale" from the fish by grasping its exposed posterior edge with forceps and pulling free. Remove all slime, grit, and skin from the scale. The "preferred scale" is located on the left side of the fish, two rows above the lateral line on the diagonal from the posterior insertion of the dorsal fin to the anterior insertion of the anal fin (Appendix A.6.). If the "preferred scale" is missing, select a scale within the preferred area on either the left or right side of the fish. If no scales are present in the "preferred area" on either side of the fish, sample a scale as close to the preferred area as possible and darken the 8 under "age error code" on the AWL form. Do not select a scale located on the lateral line.

5. It is important to take care that scales adhere to the card, rough side up. Therefore, without turning the forceps over, clean, moisten, and mount the scale on the gummed card with your thumb or forefinger. Exert just enough pressure to spread and smooth the scales directly over the number as shown in Appendix A.6. The ridges on the sculptured side can be felt with a fingernail or forceps. Mount scale with anterior end oriented toward top of gum card. All scales should be correctly oriented on the card in the same direction (Appendix A.7.).
6. Once the length and sex have been recorded, and the scale has been collected, slide the fish into the weighing sack provided, hang it from the scale and record the weight in pounds on the back side of the AWL form (to the nearest 0.25 lbs). If weights are recorded on the back of an AWL form, transfer the litho code to the appropriate column. A completed back side of an AWL form is illustrated in Appendix A.2. **Keep in mind that not all fish will be weighed. The minimum sample size is 15 males and 15 females per week. If the process goes smoothly and you can collect more weights (25 per sex), this would be greatly appreciated.**

7. Repeat steps 1 through 4 for up to 40 fish on each AWL form.

8. When sampling at weirs you may use write in rain books to record the data. Keep the mark-sense forms in camp where they will be clean, dry, and flat. After sampling is done for the day transfer the data to the mark-sense forms. **Each length, sex, scale and weight must correspond to a single fish! It is the responsibility of the crew leader to be sure the data has been transcribed correctly and the AWL forms filled out completely.** Log books containing length, weight, and sex data should be returned to Patti Nelson at the end of the season.

SCALE SAMPLING CHECKLIST

OPERATIONAL PLAN	PENCILS (NO. 2)
GUM CARDS	FORCEPS
AWL FORMS	PLASTIC CARD HOLDERS
CALIPERS	CLIPBOARD
SPRING SCALE	WEIGHING SACK

SOME REMINDERS

1. For greater efficiency in scale reading and digitizing, mount scales with anterior end toward top of scale card.

2. AWLs should be carefully edited. Re-check header information on AWLs; make sure all available information is filled in. Take extra care to use the correct period code for the sampling or catch date. AWL numbers should not be repeated; a frequent error is to begin a week's sample with the last AWL number used the week before. This is particularly important if the data is regularly sent to town; it is easy to forget which AWL numbers were used. Crew leaders should take time to ensure that the boxes are being blackened correctly, if the boxes are sloppily marked the optical scanner records the information incorrectly or misses it entirely. Keep pencil marks within each block, filling it completely.

3. Transfer important comments from scale cards to AWLs. After pressing scales, the cards are seldom referred to again, and important remarks can be lost. Write comments in the top right margin. If there is not room on the AWL to completely explain the remarks, use a separate piece of paper.

4. Never put data from different dates on one AWL or one scale card. Even if only one scale is collected that day, begin a new AWL and gum card the next day.

5. If weights are taken, they may be noted in the right margin of the AWL during sampling,

but **be sure to transfer the weights and litho code to the appropriate columns on the reverse of the AWL before submitting it to your supervisor**.

6. The data processing program uses the "litho code" on the AWL. (It is located in the lower left margin of the AWL.) Try to keep the litho codes in numerical order. This should not be hard to do if they are arranged that way before page numbering. Those who sample different areas throughout the season can arrange the litho codes in order before each sample is taken.

7. If AWLs get wrinkled or splotched they should be transcribed onto a new AWL prior to sending in. The optical scanning computer will misread or reject wrinkled sheets. Do not use paperclips on AWL forms.

8. Be careful when collecting and mounting scales in wet conditions (rain, high humidity, etc.) Glue often obscures scale features and scales frequently adhere poorly to wet card. Protect the cards, keep them dry to avoid having to remount the scales on a new card.

9. Scan the AWL form for mistakes. A common error occurs, for instance, in placing both the 4 and 7 of a 475mm fish in the 100's column with nothing in the 10's column.

10. Record all comments explicitly on the gum card under remarks and transfer remarks to the top margin of the AWL form.

11. Responsibility for accuracy lies first with the primary data collector(s). The port supervisor will return sloppy or incomplete data to individual collectors for correction.

Gum Card front side

16 scales collected
Gum Card back side

Species: SOCKEYE Card No: 014
Locality: FRAZER ESC.
Stat. Code: 257-40-403-___
Sampling Date: Mo. 06 Day 07 Year 95
Gear: WEIR / TRAP
Collector(s): D. Pitcher, S. Peschier
Remarks:

10	9	8	7	6	5	4	3	2	1
20	19	18	17	16	15	14	13	12	11
30	29	28	27	26	25	24	23	22	21
40	39	38	37	36	35	34	33	32	31

AWL FRONT SIDE:

DESCRIPTION: SOCKEYE / FRAZER / ESC samplers: Pitcher Peschier

ADF&G ADULT SALMON AGE-LENGTH FORM VERSION 2.1

litho code 260498

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS AREA

CARD: 014
SPECIES: 2
DAY: 07
MONTH: 06
YEAR: 95
DISTRICT: 257
SUBDISTRICT: 40
STREAM: 403
LOCATION: 038
PERIOD: 24
PROJECT: 3
GEAR: 19
MESH:
TYPE OF LENGTH MEASUREMENT: 2
NUMBER SCALES/ FISH: 1
OF CARDS: 1

#	SEX	100's	LENGTH	1's	AGE GROUP	AGE ERROR CODE
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
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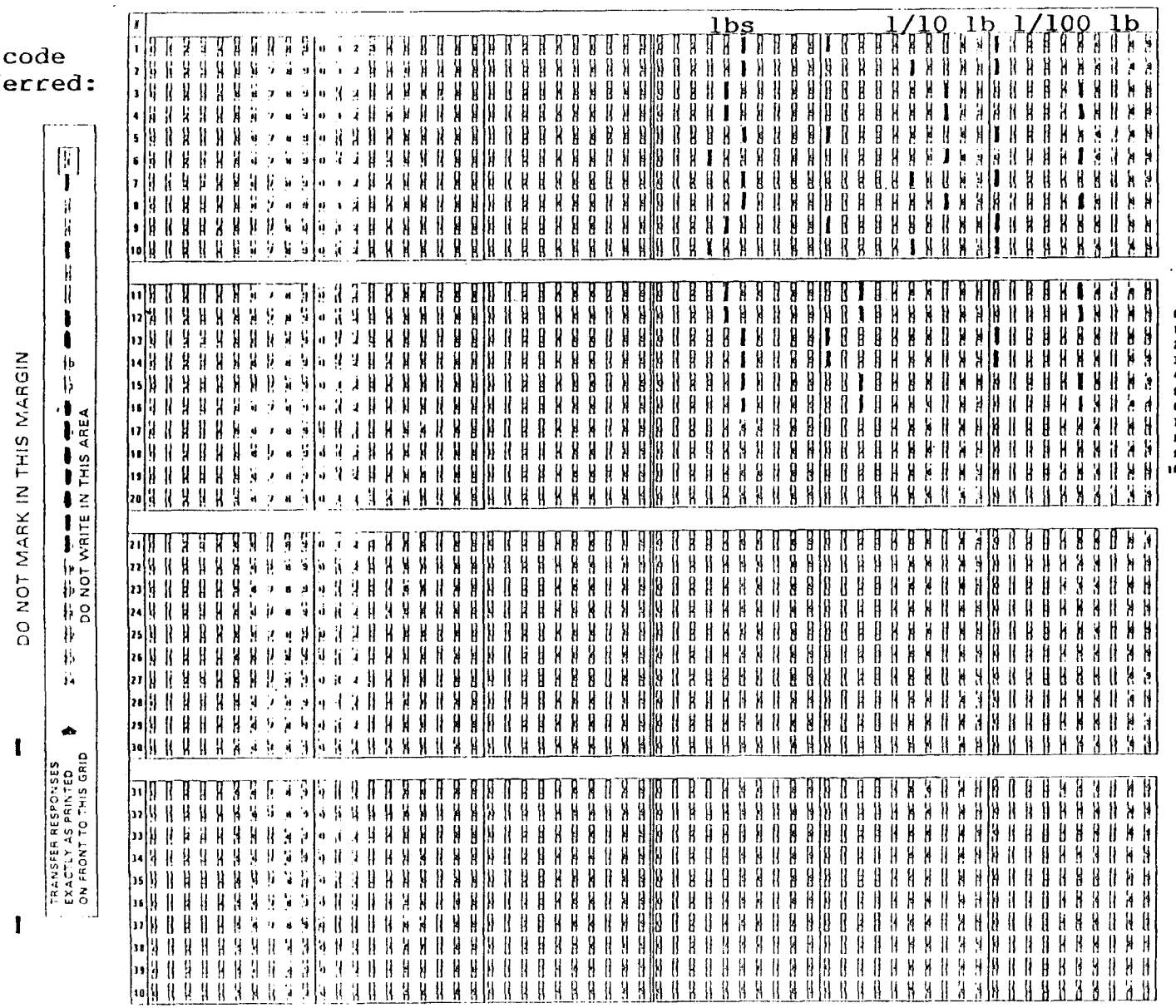
Appendix A.1. Completed AWL (front side) and associated gum card with 16 fish sampled.

AWL BACK SIDE: 16 fish sampled, 16 weights measured



CODES:

SPECIES

1 - Chinook (king)
2 - Sockeye (red)
3 - Coho (silver)
4 - Pink (humpy)
5 - Chum (dog)

PROJECT

1 - Commercial catch
2 - Subsistence catch
3 - Escapement (tower, weir, sonar site, etc)
4 - Escapement - spawning grounds
5 - Test fishing
6 - Sport catch (marine)
7 - Sport catch (freshwater)

GEAR TYPE

0 - Trap
1 - Purse seine
2 - Beach seine
3 - Drift gillnet
4 - Set gillnet
5 - Troll
6 - Long line
7 - Otter trawl
8 - Fishwheel
9 - Pots
10 - Sport hook and line
11 - Hanging purse seine
12 - Handpicked
13 - Dip net
14 - 16 Unassigned
17 - Beam trawl
18 - Shovels
19 - Weir
20 - 99 Unassigned

LENGTH TYPE

1 - Tip of snout to fork of tail
2 - Mid eye to fork of tail
3 - Post orbit to fork of tail
4 - Mid eye to hypural plate
5 - Post orbit to hypural plate
6 - Unassigned

AGE ERROR CODES

1 - Otolith
2 - Inverted
3 - Regenerated
4 - Illegible
5 - Missing
6 - Reabsorbed
7 - Wrong species
8 - Not preferred

Appendix A.2. Back side of AWL with 16 weights recorded and litho code transferred.

Appendix A.3. Assigned port and weir location codes.

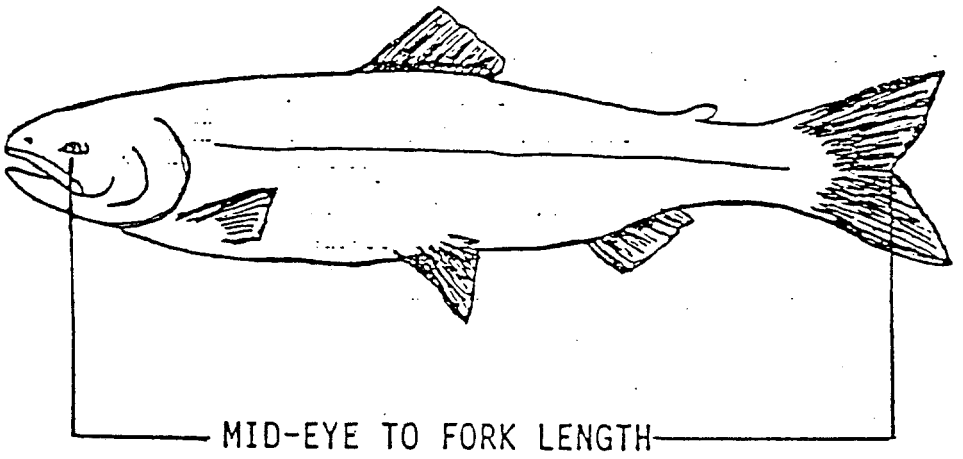
Port and Location Codes

030 - Lazy Bay
031 - Port of Kodiak
032 - Pauls Lake
033 - Thorshiem
034 - Afognak River
035 - Karluk River
036 - Red River
037 - Upper Station
038 - Frazer Lake
039 - Dog Salmon
040 - Akalura River
041 - Uganik River
042 - Malina Creek
150 - King Cove
151 - Port Moller
052 - Dutch Harbor
053 - Akutan
054 - Sand Point
055 - Bear River, ADF&G Camp
056 - Nelson River, ADF&G Camp
057 - Canoe Bay

Appendix A.4. Periods and corresponding calendar dates, 1995.

Period	Calendar Dates	Period	Calendar Dates
1	01-Jan to 03-Jan	28	05-Jul to 11-Jul
2	04-Jan to 10-Jan	29	12-Jul to 18-Jul
3	11-Jan to 17-Jan	30	19-Jul to 25-Jul
4	18-Jan to 24-Jan	31	26-Jul to 01-Aug
5	25-Jan to 31-Jan	32	02-Aug to 08-Aug
6	01-Feb to 07-Feb	33	09-Aug to 15-Aug
7	08-Feb to 14-Feb	34	16-Aug to 22-Aug
8	15-Feb to 21-Feb	35	23-Aug to 29-Aug
9	22-Feb to 28-Feb	36	30-Aug to 05-Sep
10	01-Mar to 07-Mar	37	06-Sep to 12-Sep
11	08-Mar to 14-Mar	38	13-Sep to 19-Sep
12	15-Mar to 21-Mar	39	20-Sep to 26-Sep
13	22-Mar to 28-Mar	40	27-Sep to 03-Oct
14	29-Mar to 04-Apr	41	04-Oct to 10-Oct
15	05-Apr to 11-Apr	42	11-Oct to 17-Oct
16	12-Apr to 18-Apr	43	18-Oct to 24-Oct
17	19-Apr to 25-Apr	44	25-Oct to 31-Oct
18	26-Apr to 02-May	45	01-Nov to 07-Nov
19	03-May to 09-May	46	08-Nov to 14-nov
20	10-May to 16-May	47	15-Nov to 21-Nov
21	17-may to 23-May	48	22-Nov to 28-Nov
22	24-May to 30-May	49	29-Nov to 05-Dec
23	31-may to 06-Jun	50	06-Dec to 12-Dec
24	07-Jun to 13-Jun	51	13-Dec to 19-Dec
25	14-Jun to 20-Jun	52	20-Dec to 26-Dec
26	21-Jun to 27-Jun	53	27-Dec to 31-Dec
27	28-Jun to 04-Jul		

Appendix A.5 Measuring fish length, mid-eye to fork of tail.



Mid-eye to fork lengths are taken because the length and shape of a salmon's snout changes as it approaches sexual maturity. The procedure for measuring by this method follows:

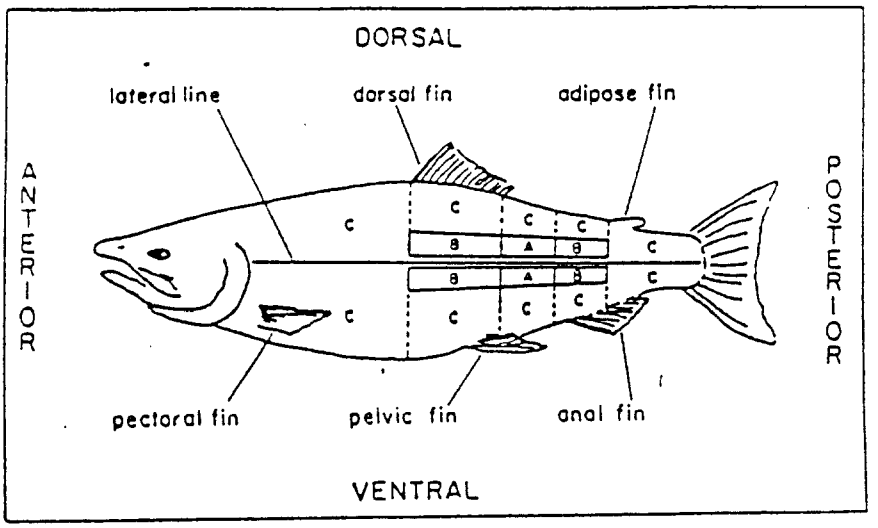
1) Place the salmon flat on its right side, with its head to your left and the dorsal fin away from you.

2) The eye should be on the line projecting from the end of the meter stick. Hold the head in place with your right hand. Sometimes you can control the fish better by placing your thumb in the fish's mouth.

3) Flatten and spread the tail against the board with your right hand.

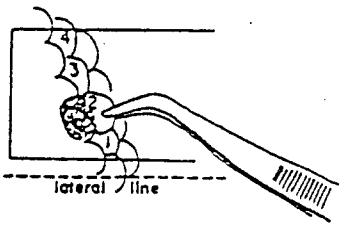
4) Read the mid-eye to fork length to the nearest millimeter.

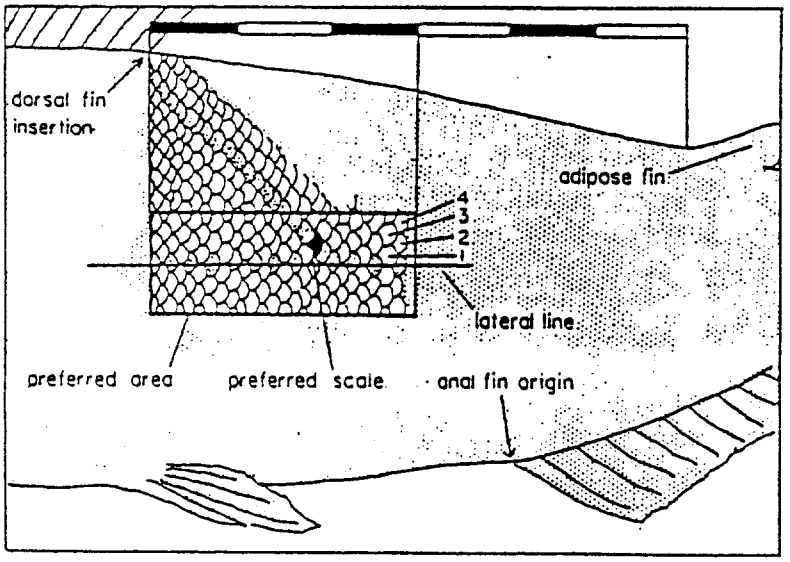
Appendix A.6. Removal and mounting of the preferred scale.



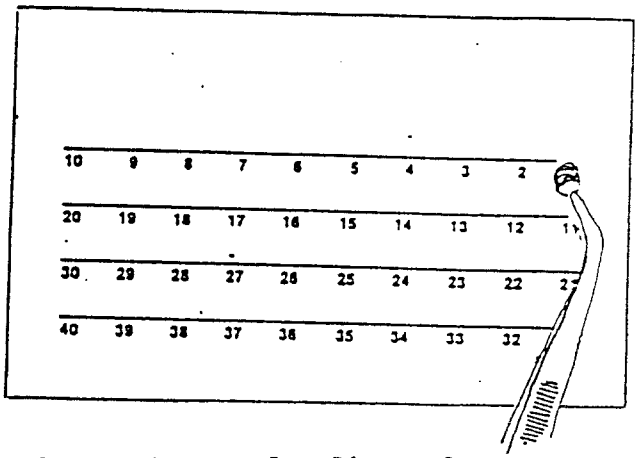
INPFC rated areas for scale removal.
Area A is the preferred area. B is the second choice if there are no scales in area A.
C designates non preferred areas. If scales on on the left side of the fish are not good, try the right side.

DO NOT TURN SCALE OVER



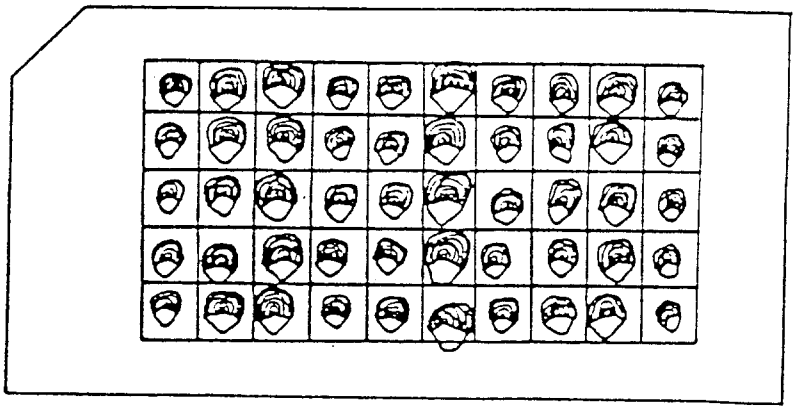


The preferred scale in this diagram is solid black. It is located 2 rows up from the lateral line, on a diagonal from the insertion (posterior) of the dorsal fin "back" towards the origin of the anal fin.

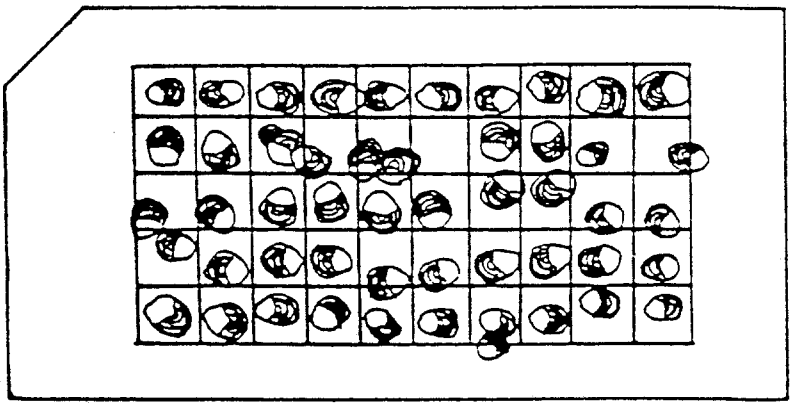


Place the scale directly over the number on the gummed card with the anterior portion (arches of the scale pointed toward the top of the card.

Appendix A.7. Scale orientation on the gummed card.



The scales are all correctly oriented on the card in the same direction, with the anterior portion of the scale pointed toward the top of the card.



The scales are incorrectly oriented in different directions. This increases the time spent to age samples.

APPENDIX B

Kodiak Area Commercial Salmon Fishery Harvest Strategy, 1995

KODIAK AREA COMMERCIAL SALMON FISHERY

HARVEST STRATEGY, 1995

By:

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Regional Information Report[1] No. 4K95-28

Alaska Department of Fish and Game
Commercial Fisheries Management and Development Division
211 Mission Road
Kodiak, Alaska 99615

May 1995

[1]The Regional Information Report Series was established in 1987 to provide an information access system for all unpublished division reports. These reports frequently serve diverse ad hoc informational purposes or archive basic uninterpreted data. To accommodate timely reporting of recently collected information, reports in this series undergo only limited internal review and may contain preliminary data; this information may be subsequently finalized and published in the formal literature. Consequently, these reports should not be cited without prior approval of the author or the Commercial Fisheries Management and Development Division.

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INTRODUCTION

In 1995, commercial salmon fisheries in the Kodiak Management Area (Area K) will be managed according to a harvest strategy which emphasizes three criteria:

(1) **To ensure that 1995 salmon escapement occurs in the proper magnitude and distribution so that the potential for maximum production of future returns is established.**

The results of ADF&G's 1995 management activities will directly affect the following future returns:

- **1997 pink salmon**
- **1998 - 1999 coho salmon**
- **1998 - 2000 chum salmon**
- **1998 - 2001 sockeye and chinook salmon**

(2) **To provide for orderly fisheries on the highest quality salmon by maximizing harvest opportunities during each fishing period.**

This requires a species oriented approach.

- For sockeye and coho salmon from major systems, management will emphasize the use of inseason weir escapement data to determine fishing time by geographical area.

- Fishing time on minor sockeye and coho systems without fish weirs will be determined by ADF&G's perception of run strength for these systems.

- For pink and chum salmon runs, management will initially use preseason forecasts to determine fishing time with inseason fishing time adjustments as the actual run strength becomes more apparent.

(3) **To adhere to the biological and allocative requirements of all Alaska Board of Fisheries (BOF) Management Plans.**

This harvest strategy is an overview of how ADF&G intends to manage the 1995 salmon fishery. Along with this overview, a basic management chronology (Figure 1) can be used as a guide to clarify when species specific management requirements will dictate inseason adjustments in harvest strategy. Sockeye salmon management requires escapement information from up to nine salmon weirs. This information is used to regulate fishing time and areas open to fishing. Prorating fishing time for sockeye salmon solely on the basis of preseason expectations, other than for the June 9 commercial test fisheries, is generally not an acceptable method of managing Kodiak's sockeye salmon stocks.

Initial fishing periods for pink salmon are based upon preseason expectations and are necessary for prosecuting a successful fishery. This can be done with little chance of adverse effects on future production and is the most acceptable way of managing the return of Kodiak's relatively large pink salmon runs.

Chum and coho salmon require a blend of these two management approaches. Both species are initially harvested as a bycatch in directed pink or sockeye salmon fisheries. Specific fisheries targeting on chum and coho salmon require proper run strength assessment before those fisheries can occur. This requires a combination of weir counts and aerial assessment of escapement. Escapement data along with inseason assessment of the bycatch rate determines if the chum and coho salmon returns can support additional near terminal area harvests.

Chinook salmon are not targeted in specific fisheries, but are harvested as a bycatch in fisheries directed toward sockeye and pink salmon.

HARVEST PROJECTIONS

Initial projections for the 1995 Kodiak commercial salmon fishery are for a harvest of approximately 21,770,000 salmon (Table 1). This harvest includes approximately 25,000 chinook, 310,000 coho, 800,000 chum, 18,235,000 pink, and 2,400,000 sockeye salmon.

In addition to the 7,965,000 pink salmon produced at the Kitoi Bay Hatchery, enhancement projects conducted by the Kodiak Regional Aquaculture Association (KRAA) and ADF&G's Commercial Fisheries Management and Development Division (CFMDD) should contribute coho, sockeye, and chum salmon to the common property fisheries of the Kodiak Area. Supplemental production may allow for approximately 246,000 sockeye, 150,000 chum, and 25,000 coho salmon to be harvested (Table 2; all supplemental production numbers are included in the total harvest projections).

A good tool for illustrating the timing and magnitude of salmon harvests is the projected harvest graphs (Appendix A.1 - A.3.). A curve can be drawn, based on the historical cumulative average salmon catch by date, that is scaled to the current preseason harvest projection. By keeping track of the actual salmon harvest by date, and plotting these on the graphs, a comparison of expected and actual returns can be made. These graphs are used for planning purposes by both ADF&G and industry to determine if management strategies need to be modified inseason because of unexpected deviations in actual run strength.

FISHING PERIODS

All fishing periods will be established by emergency order (EO) and will generally be based on inseason assessment of actual run strength (Table 3).

Opening Times

All regular fishing periods will begin at 12:00 Noon and end at 9:00 P.M., except:

- The Cape Igvak fisheries will usually open at 12:01 A.M. and close at 12:01 A.M. during the period of June 6 through July 25.

- The Inner Ayakulik Section fisheries will usually begin at approximately low tide. These will be daylight openings, and will be initiated by ADF&G "flare openings"; fishing will start when a "flare" is launched by ADF&G personnel. When such openings occur, the opening time for the Outer Ayakulik Section may be adjusted to coincide with the Inner Ayakulik Section.

- Beginning on August 16, all fishing periods will end at 6:00 P.M. instead of 9:00 P.M.

Advance Notice for Each Fishing Period

- All advance notice times will be based upon the initial announcements being made on SSB frequency 4125 Khz, following the **6:00 P.M.** daily marine weather broadcasts.

- For the **Cape Igvak fishery**, the initial fishing period will have at least a **36 hour advance notice**. All subsequent fishing periods will have at least **18 hours advance notice**, unless it is an extension of an ongoing fishing period.

- For the **June sockeye fisheries** in the Alitak, S.W. Kodiak, and N.W. Kodiak Districts, **the initial fishing periods** will have at least a **42 hour advance notice**; this includes the normal June 9 fishing period for the Alitak and N.W. Kodiak Districts and the approximate June 14 fishing period for the N.W. Kodiak District.

- **All subsequent fishing periods for the Kodiak Area prior to July 6 will have at least 18 hours advance notice.**

- For the **initial pink/chum salmon fisheries**, at least **42 hours advance notice** will be provided, with the fishery starting at 12:00 noon **on July 6**.

- **All subsequent fishing periods for the Kodiak Area after the July 6 fishing period will have at least 18 hours advance notice**.

- **All extensions** in fishing time from a previously announced fishing period will have at least **3 hours advance notice**.

Inperiod Closures

- **During the period July 6 through July 25 inperiod closures of "Seaward Zones" designated in the North Shelikof Strait Sockeye Salmon Management Plan may occur. Fishers operating in management units covered by this plan are advised that inperiod closures of "Seaward Zones" are possible. Such closures will be announced on SSB frequency 4125 kHz at 8:00 A.M., 10:00 A.M., 2:00 P.M., or 6:00 P.M. with the effective closure time occurring in as little as three hours following the initial announcement time.**

Length of Fishing Periods

Sockeye Salmon

In general, each fishing period targeting early and late sockeye salmon runs to major systems will be dependent upon weir escapement counts. This will also apply to minor systems with weirs that are targeted by the commercial fishery. The exception to this will be the June 9 commercial test fisheries in the Alitak Bay and N.W. Kodiak Districts and the June 9 fisheries in the Foul Bay and Waterfall Terminal Harvest Areas. The first period will extend from 12:00 Noon Friday June 9 through 9:00 P.M. Saturday June 10, a 33 hour period. A second 33 hour commercial test fishery will occur in the N.W. Kodiak District beginning approximately June 14. The opening date is dependent on coordination with other terminal sockeye fisheries in order to spread the fishing effort. Additional fishing time in the Alitak Bay District will depend on the results of the June 9 commercial test fishery, the ADF&G test fishery, weir escapements and sockeye salmon buildups (see Alitak Bay District Management Plan).

In conjunction with the second commercial test fishing period in the N.W. Kodiak District, there will be a 33 hour fishing period for surplus production from minor sockeye salmon systems (Afognak Lake, Saltery, etc.). Specific management units (sections) opened for this fishery depend on run strength associated with these units. The E.O. announcement for this opening will specify which sections are to be opened.

Fishing periods in the Cape Igvak Section will be in 24 hour increments running from 12:01 A.M. to 12:01 A.M.. Fishing time will be dependent upon evaluation of the Chignik System sockeye salmon run strength. Chignik sockeye salmon are the dominant contributing stock harvested in this section. A review of the Cape Igvak Management Plan (5 AAC 18.360) should clarify the biological and allocative requirements. For the 1995 season, fishing time will initially be allocated in the Cape Igvak Section based upon the criteria listed in paragraph (c) of the plan.

For most late run sockeye salmon stocks, a portion of the harvestable surplus is taken as bycatch during targeted pink salmon fishing periods. Consequently, a "blended" management strategy is needed to insure escapements are achieved by species with the upper escapement requirements not being exceeded.

Fishing periods for enhanced sockeye runs in terminal harvest areas (Figures 2-5) may result in continuous 24 hour period openings as long as there is a harvestable surplus.

Chum Salmon

The Duck Bay, Izhut Bay, and Kitoi Bay Sections may open to fishing as early as June 9. This is due to the forecasted strong return of chum salmon to Kitoi Bay Hatchery. Between the July 6 to July 25 time period fishing time for much of the Mainland District will not exceed 57 hours per week.

Pink Salmon

Preemergent pink salmon fry sampling of the Kodiak Management Area index streams conducted during March and April of 1994 indicated just fair over winter survival of the eggs and sac fry. These fry were from an excellent brood year escapement in 1993 with the indexed escapement estimate at 4.3 million pink salmon. Sampling resulted in an unweighted live fry index of 190.64 live fry per square meter of spawning area. This live fry index is the seventh highest odd year index on record. Early spring conditions in 1994 were fair for outmigration and rearing in the nearshore ocean environment. Ambient air temperatures, as measured in Kodiak, were below average in March, but well above average from April through June. Kitoi Bay hatchery manager Tim Joyce noted that compared to recent years the 1994 spring plankton bloom seemed very good, and should have had a positive affect of marine survival.

Although the live fry index was only the seventh highest on record, the number of pink salmon fry observed by salmon fishermen throughout the summer of 1994 in bays on Kodiak Island was higher than usual. This may have been a result of excellent early marine survival combined with an unusually high percentage of live fry outmigrating early from the streams. The actual 1995 combined harvest of hatchery and wild production is likely to fall between the forecasted midpoint of 18.2 million and the upper end of 26.3 million pink salmon.

In addition to the three management criteria identified in the introduction of this document, the harvest strategy for pink salmon utilizes: 1) a fixed July 6 opening date, 2) a pink salmon forecasting program to set the length of the initial fishing periods, and 3) coordination of multiple fisheries whenever possible to allow for dispersion of the purse seine fleet.

The pattern of fishing periods for management units where pink salmon are the targeted species may vary in consideration of the forecasted pink salmon run. Fishing periods are expected to be 3½ days per week from July 6 through approximately August 25. During the peak harvest period of late-July to mid-August, fishing periods may be extended up to seven days per week.

Listed below is a schedule of fishing periods which may be used for planning purposes by both ADF&G and industry.

First Period: 3½ days (81 hours) - 12:00 Noon July 6 through 9:00 P.M. July 9. This period provides important harvest data to assess early run strength of Area K pink salmon and certain chum salmon stocks. No extensions in fishing time based on pink or chum salmon harvests would occur during this period. The increased closed water area will remain in effect in the East Arm of Uganik Bay.

Second Period: 3½ days (81 hours) - 12:00 Noon July 12 through 9:00 P.M. July 15. This second period will assess run strength for both pink and chum salmon and provide harvest data. No extensions in fishing time based on pink or chum salmon harvests would occur during this period.

Third Period: 3½ days (81 hours) - 12:00 Noon July 19 through 9:00 P.M. July 22. The third period will occur following a 3½ day closure. This will allow an influx of pink and chum salmon into terminal areas to enhance the build-up of potential escapement. At this time a combination

of harvest and early escapement or build-up information will provide an indication of the actual run strength for major pink salmon stocks. Extensions in fishing time in the Duck Bay and Izhut Bay Sections may occur.

Fourth Period: 3½ days (81 hours) - 12:00 Noon July 26 through 9:00 P.M. July 29. This fourth period is critical. Harvest should increase substantially and a fairly realistic assessment of total run strength should be evident by the end of the period. Extensions in fishing time commonly occur to this period during years when the pink and chum salmon runs are strong. The initial pink salmon opening for the Kitoi Bay Section is expected to occur at the beginning of this fishing period.

Fifth Period: 3½ days (81 hours) - 12:00 Noon August 2 through 9:00 P.M. August 5. This fifth period should yield the peak harvest day and period, provided that normal run timing occurs. If preseason expectations appear valid, extensions in fishing time could occur in portions of the management area. The first significant announcement of differential fishing time by management unit may occur as heavy production areas are targeted for extensions, while moderate or lower production areas are not.

Sixth Period: 3½ days (81 hours) - 12:00 Noon August 9 through 9:00 P.M. August 12. This sixth period should be the first postpeak period. Returns to major late production systems should be evident by period's end. There may be increases in closed water sanctuaries to enhance escapement levels. Evaluation's of run strength are used to determine if reductions in fishing time are needed for the remaining periods to ensure adequate escapement. A strategy to achieve full escapement in all systems is developed from this period.

Seventh Period: 3½ days (78 hours) - 12:00 Noon August 16 through 6:00 P.M. August 19. During the seventh period, a blended multi-species management approach is used for those sections where pink salmon were the targeted species for the previous six periods. Emphasis will still be on harvesting excess, good quality pink salmon and achieving escapement goals. However, major concern will be directed toward the run strength of late run sockeye and chum salmon.

Eighth Period: 3½ days (78 hours) - 12:00 Noon August 23 through 6:00 P.M. August 26. The eighth period will primarily be a cleanup period for pink salmon stocks. Escapement requirements should be assured at this point. Excess pink salmon of acceptable quality should be available for harvest in near terminal areas. This period also will require a major emphasis on multi-species management. It is a critical management period for late run sockeye and chum salmon stocks, as well as early run coho salmon.

A change to this schedule of fishing periods should be expected if significant deviations in the actual pink salmon return occurs. Less fishing time should be expected in management units where chum salmon are the targeted management species.

Chum and Coho Salmon

A large portion of the 1995 Kodiak chum and coho salmon harvest will occur as bycatch in nonterminal locations during major pink salmon fisheries. System specific chum and coho salmon

fisheries, which occur during the pink salmon fishery, will commonly result in pertinent management units having less fishing time than management units targeting primarily pink salmon stocks. This approach emphasizes the use of more terminally located management units for targeted chum and coho salmon fisheries (i.e., Inner Kukak Section, Zachar Bay Section, Kizhuyak Section, etc.)

INSEASON EMERGENCY ORDER ANNOUNCEMENTS ("GETTING THE WORD")

Fishing period announcements may not always be predictable because the fishery is managed on data which is compiled and evaluated daily. Data used to make fishery decisions includes (1) escapement reports via weir counts or aerial surveys, (2) harvest trends (total catch and catch per unit effort) and (3) information on fish buildups in closed water sanctuaries.

After enough information has been collected to determine the fishing time needed to harvest surplus fish, an emergency order and a fishery announcement are issued in the following manner:

1) A news release is constructed detailing:
   a) The date, time, and number of the emergency order announcement.
   b) The length of the fishing period.
   c) The opening and closing times and dates of the fishing period.
   d) The areas open to fishing.
   e) The areas closed to fishing (those sections not listed as being open).
   f) The location of "closed water" marker adjustments.

2) The news release is posted at the entrance of the Kodiak ADF&G office.

3) Copies of the news release are made available at the Kodiak office. For after hours availability, copies are stored at the main entrance.

4) The news release is recorded on a 24 hour recorded message phone (Number 486-4559).

5) The news release is made available to local radio stations (KVOK and KMXT) to be played by these stations.

6) The news release is announced over SSB channel 4125 Khz following the marine weather broadcasts. Commonly, the first reading of a news release occurs after the 6:00 P.M. weather broadcast, but occasionally the initial reading comes after the 8:00 A.M. weather broadcast.

7) The news release is distributed to all registered processors either by hand, verbally on the telephone, by tele-fax, or through the ADF&G recorded message phone.

8) Information on the most current news release or emergency order can also be obtained by calling the Kodiak ADF&G office during working hours, or by calling Dave Prokopowich

(486-6007), Kevin Brennan (486-6475), or Dennis Gretsch (486-3031) after working hours or on weekends.

9) Copies of emergency orders are mailed to a current listing of required and interested recipients.

10) Many fishers, ADF&G vessels and camps, and Fish and Wildlife Protection vessels use a small tape recorder to document the exact wording of each announcement as it is broadcasted. This is advisable, when considering the complicated nature of each announcement.

NEW REGULATIONS

In March of 1995 the Alaska Board of Fisheries addressed the harvest of Cook Inlet bound sockeye in the Kodiak Area again.

No regulation changes were adopted for the 1995 season.

Listed below is a new regulation adopted by the Alaska Board of Fisheries in March of 1994.

5AAC 18.331. Gillnet Specifications and Operation.

(i) Effective January 1, 1995, in the Moser-Olga Bay Section of the Alitak District the shoreward end attachment point of a set gillnet must be attached to a point of land or rock that is no more than 2.1 feet below the surface of the water at mean lower low water at Alitak Bay. The shoreward end attachment point of a set gillnet in the Moser-Olga Bay Section that is not above the surface of the water at all times

(1) must be certified, by a registered land surveyor, to be no more than 2.1 feet below the surface of the water at mean lower low water at Alitak Bay;

(2) must be marked with a permanent survey monument by a registered land surveyor;

(3) may not be below the survey monument; and

(4) may not be more than two horizontal feet from the survey monument. A set gillnet may not be attached to the beach inside closed waters. For the purpose of this subsection, a "registered land surveyor" is a land surveyor registered by the state under AS 08.48 and 12 AAC 36.(In effect before 1983; am 4/16/83, Register 86; am 5/11/85, Register 94; am 5/31/85, Register 94; am 6/2/88, Register 106; am 4/19/90, Register 114; am 7/23/94, Register 131).

MISCELLANEOUS REGULATORY CLARIFICATIONS

Closed Water Adjustments

There have been conflicting interpretations of Alaska Statute 16.05.785 regarding the failure to remove markers. As a result there will be no inseason adjustments of closed waters unless

ADF&G personnel are able to remove old markers and install new markers, or unless inseason adjustments of closed waters are made to a specific stream terminus. All adjustments to closed waters listed in 5AAC 18.350 will be made by emergency order and announced by news release.

Closed Water Sanctuaries

5AAC 18.350 Closed Waters

Karluk Closed Water Sanctuary

There have been problems encountered in the past with the current description of the closed water sanctuary seaward of Karluk Lagoon. Consequently, the following closed water sanctuary will be in effect, by emergency order, near the entrance to Karluk Lagoon, stream no. 255-101 (Figure 6):

5AAC 18.350 CLOSED WATERS (a)(2) Southwest Kodiak District
(E) That portion of the Southwest Kodiak District (off of the entrance to Karluk Lagoon (stream no. 255-101)) enclosed by a line from 57°34'28" N. lat., 154°28'18" W. long. to 57°34'32" N. lat., 154°26'42" W. long. (NOAA Chart 16598).

Buskin River Closed Water Sanctuary

The stream mouth of the Buskin River (stream no. 259-211) has moved considerably over the past several years. The previous markers were not providing adequate protection to salmon migrating into the stream. The north shore marker has been moved and an offshore point is designated to aid in triangulation of the closed water area. The offshore point is at the reef directly east of the spit, and may be marked with a buoy. The location of the closed waters will be described in the first salmon emergency order as follows (Figure 7):

5AAC 18.350 CLOSED WATERS (a)(6) Northeast Kodiak District
(E) Buskin River: all waters inside of a line running from a marker on the bluff north of the mouth of the Buskin River at approximately 57°45'48" N. lat., 152°28'23" W. long. to a point offshore at 57°45'21" N. lat., 152°28'09" W. long. to a marker located onshore south of the river mouth at approximately 57°45'09" N. lat., 152°28'39" W. long. (NOAA Chart 16595)

Ayakulik River No. 256-201 Closed Water Sanctuary

ADF&G regulatory markers will be placed in such a manner as to better define the "stream terminus" of the Ayakulik River. The intent of this closed water sanctuary is to prevent seines from being set which completely block fish access to the river (Figure 8).

East Arm of Uganik Increased Closed Water Sanctuary

Additional fishing time is anticipated in the Northwest Kodiak District due to early run Karluk sockeye. The closed water sanctuary in the East Arm of Uganik Bay (stream no. 253-122) will be enlarged to provide for increased protection for sockeye and pink salmon bound to Uganik

Lake. This increased closed water sanctuary includes all waters east of a line from Mink Point (153°30'57" W. long. 57°43'06 N. lat) to Packers Spit at (153°30'00" W. long. 57°43'57" N. lat) and will remain in effect for the entire salmon season (Figure 9).

Remainder of the Kodiak Area

A straight line closure is in effect in areas where ADF&G has deployed regulatory markers to establish waters closed to fishing, provided that **no portion of that line is less than 500 yards from the seaward extremities of the exposed tideland banks which designates the stream mouth.** Consequently, common closed water configurations will be areas of various shapes, depending upon the nature of each individual stream mouth extending between the two regulatory markers. In areas where ADF&G has deployed regulatory markers to establish waters closed to fishing in bays a straight line closure is in effect.

ADF&G is expanding its stream marker program in the Mainland District. Fishers participating in salmon fisheries located in the Mainland District should be aware that closed water sanctuaries to protect salmon buildups may be larger in some areas due to the placement of markers.

Boundary Determinations

The latitude and longitude as plotted on a NOAA navigational chart, North American Datum 1927, approximate scale 1:80,000, will represent the **correct** boundary locations in determining the location of a particular district, section boundary, or any inseason emergency order boundary. Boundaries plotted on NOAA navigational charts using NAD 1983 may not correspond to the correct locations. Latitude and longitude as determined by Loran or Global Positioning System (GPS) bearings may represent **incorrect** boundary locations. District and Section boundaries are depicted on the current Kodiak salmon statistical area chart available at Kodiak ADF&G office.

Section Boundaries

The Raspberry Strait Section **is not** part of the Southwest Afognak Section.

Purse Seine Leads

Minimum mesh size is seven (7) inches. Double panels of web overlapped in the lead are **not** legal.

Set Gillnets - Operation of Gear

Leads

"Seine webbing" used as a lead for set gillnets is not intended to "gill salmon". Set gillnet leads which have similar mesh size and web construction to the actual set gillnet gear are not considered legal gear.

Operation of Set Gillnets

Set gillnets must be operated in substantially a straight line, except that no more than 25 fathoms of a **set gillnet** may be used as a **hook**. A **hook** may be used in any configuration. When a **set gillnet** is being operated primarily as a **"hook in any configuration"** it will be considered illegal to **actively** operate that gillnet as a purse or beach seine (such as "round hauling").

FISH TICKETS

All fishers should check the statistical area recorded on each of their fish tickets. It is required that the correct harvest location(s) be shown on each ticket and it is the responsibility of each fisher to ensure that tender operators or cannery personnel record the correct harvest location on each ticket. This information is extremely important in evaluating inseason harvest levels, stock contribution, and effort distribution.

Seiners

Please provide estimates of harvest by area to tender operators. For example "1/3 of my reds were from Cape Alitak (257-20) and the rest were from Red River (256-20). The rest of my fish were 1/2 and 1/2 from each of these areas". Prior to signing your tickets, check to make sure the proper harvest information by **STATISTICAL AREA** has been entered.

Accurate recording of the harvest from that portion of the Shelikof Strait regulated by the Shelikof Strait sockeye salmon management plan is particularly important. In order to provide an accurate accounting of sockeye salmon harvests in this area, ADF&G and Fish and Wildlife Protection will conduct extra monitoring of harvest activity and tendering operations in this area during the July 6 to July 25 time period of this plan.

Gillnetters

Because of the fixed nature of this gear, each permit holder's reporting area (statistical area) should be consistent between landings. In the event that gillnet fishers move into a new statistical area, please provide the tender operator with that information. Prior to signing your tickets, ensure that the proper harvest information by **STATISTICAL AREA** has been entered.

MANAGEMENT PLANS

Currently there are seven Board of Fisheries approved management plans which direct management activities for specific portions of the Kodiak area. Each management plan affects several management units through part or all of the salmon fishing season (Table 4). Any plan

requires the test of time and a continued review process to determine its effectiveness at accomplishing the desired biological and allocative goals.

Proper implementation of these plans in 1995 will require a major communication effort between ADF&G and the industry. All inquiries, suggestions, and concerns regarding management plans should be directed to ADF&G, Kodiak. A discussion of each plan follows.

Cape Igvak

The Cape Igvak Management Plan covers the time period from June 5 through July 25 for salmon fishing in the Cape Igvak Section of the Mainland District (Table 5). This plan has been in effect since 1978 and allocates approximately 15% of the available Chignik sockeye salmon for harvesting to Kodiak permit holders if specific biological and harvest criteria are met in the Chignik Management Area. The 1995 forecast for Chignik sockeye salmon runs indicate that early production should be above average, and that late production should be near average. Fishing time after July 25 in the Cape Igvak Section will be targeted toward pink, chum, and coho salmon bound to spawning streams in the Cape Igvak Section and in the Wide Bay Section.

Alitak Bay District

This plan covers the entire commercial salmon fishing season, and identifies the primary species by management unit throughout the season (Table 6). The plan affects the sockeye salmon stocks returning to the Frazer, Upper Station, and Akalura systems, and the pink and coho salmon stocks returning to Dog Salmon, Upper Station, Akalura, Humpy Cove, Deadman, Horse Marine, and Silver Salmon systems. This plan has been in effect since 1988.

The management chronology for Olga Bay stocks identifies the targeted stocks by approximate time period. In situations where two or more targeted stocks overlap in run timing a blended management approach will occur. Adequate fishing time will be provided to ensure that the upper escapement goals are not exceeded for the dominant stock(s), while still attempting to ensure that the lower escapement goals for the non-dominant stock(s) are achieved. As outlined in this management plan, fishing time directed on these stocks will occur simultaneously in the traditional management units for harvesting these stocks, the Cape Alitak Section and the Moser-Olga Bay Section. Management for these stocks will emphasize an aggressive strategy to contain the harvest to these traditional harvest units; this strategy also applies to the remainder of the stocks in the Alitak Bay District.

The regulation implementing this management plan (5 AAC 18.361) appears in the 1995 Commercial Finfish Regulation Book. Dates listed in the plan are approximate and may vary with changes in run timing. The June 9 commercial test fishery, however, is a firm date.
The specifics for managing the 1995 returns need to consider the expected magnitude of the targeted stocks returning to the Olga Bay systems. The sockeye salmon returns to Alitak are expected to yield relatively strong sockeye salmon production from the early run Frazer system.

Some specific points to emphasize this year are:

- The approximate June 12 through June 24 period is identified as an aggressive management time for Frazer sockeye salmon run.
- The lower biological escapement goal for Frazer sockeye salmon (140,000) will be targeted.
- The biological pink salmon escapement requirement for the Dog Salmon system ranges from 60,000 to 180,000 fish.
- In the event fishing time is required in the Upper Olga Bay management units, there will be minimal advance notice time.
- Sockeye returning to Akalura will be managed in the Inner Akalura Section, so that sockeye escapement does not exceed 60,000 fish. The lower biological escapement goal of 40,000 sockeye will be targeted.

Westside Kodiak

The Board of Fisheries adopted into regulation the Westside Kodiak Management Plan in 1989. This plan identifies a management chronology for the major Westside Kodiak salmon stocks (Table 7).

This plan was submitted as a proposed regulation to the Board of Fisheries by the Kodiak Management Staff in order to allow industry the opportunity to comment on existing harvest strategies and to clarify their intent. Kodiak fishers frequently expressed concerns over how the department would manage the Westside management units (sections) into the 1990's, when local sockeye stocks are projected to be near maximum production, since this will affect the traditional harvest opportunities between fixed and mobile gear. The annual harvest strategy has traditionally invoked a blend of fishing time between the 17 management units covered by this plan. At times this blend has not been totally understood by industry and has resulted in enough allocative uneasiness that future management stability could be jeopardized. Guidelines for this blend needed to occur in regulatory form to specifically identify inseason harvest strategy and dispel any concern or confusion. Again, the previous regulatory structure prior to this management plan did not provide the information needed by industry to evaluate inseason management decisions which affect allocation concerns of the three gear types.

The goal of this management plan is to achieve escapement and harvest objectives of sockeye salmon returning to the Karluk, Ayakulik, and other Westside minor systems. Further, it details the management of pink, chum, and coho salmon returning to systems in the Southwest Afognak, Central, North Cape, Anton Larsen Bay, Sheratin Bay, Kizhuyak Bay, Terror Bay, Inner Uganik Bay, Spiridon Bay, Zachar Bay, Uyak Bay, Outer and Inner Karluk, Sturgeon Bay, Halibut Bay, and Outer and Inner Ayakulik Sections. The intent of the Board is to insure salmon bound to these systems are harvested to the extent possible by the traditional fisheries located in all 17 sections. The plan directs the department to manage the Northwest Kodiak and the Southwest Kodiak Districts and the Southwest Afognak Section in accordance with the guidelines set out in this plan.

This management plan reflects the realization of long term management goals and identifies current management practices both of which were initially implemented in 1971. The basis for these goals and practices was primarily to rebuild depleted Karluk and depressed Ayakulik sockeye salmon stocks. This plan provides a predictable management framework for these rebuilt stocks, as well as major pink, chum and coho salmon stocks of westside Kodiak. It also helps to stabilize fishing opportunities between the three gear types on the highest quality fish in these districts and sections.

Sockeye returning to Karluk Lake will be managed so that an escapement of 200,000 sockeye salmon is attained for the early run and an escapement of 400,000 sockeye salmon is attained for the late run.

The regulatory wording of this plan appears in the 1995 Commercial Finfish Regulation Book under 5AAC 18.362.

North Shelikof Strait Sockeye Salmon

The Board of Fisheries in December 1989 created the North Shelikof Strait Sockeye Salmon Management Plan in response to their concerns that the fishing patterns and quantities of sockeye harvested by Area K seiners in 1988 represented the onset of an expansion of the interception of Cook Inlet bound sockeye in Kodiak Area waters. This plan was meant to contain this interception by not exceeding estimated historical interception levels while still providing for traditional opportunities to harvest high quality local pink and chum salmon stocks. **The major impact of this plan was to create "sockeye harvest caps" for portions of the North Shelikof which encompasses eight (8) management units. After these sockeye harvest caps are met, commercial salmon fishing is restricted in these 8 management units to inshore waters (Figure 6).**

During the January 1993 Board of Fisheries meeting in Kodiak, a modification of the management plan was made to allow for the traditional near shore seine fisheries to continue in the Southwest Afognak Section, in the event the sockeye harvest cap was reached. After the harvest cap is met, fishing will be restricted in waters inside of a 0.5 mile corridor (Figure 10).

The regulatory wording for this management plan is listed below and under 5AAC 18.363.

From July 6 through July 25 in the Dakavak Bay, Outer Kukak Bay, Inner Kukak Bay, Hallo Bay, and Big River Sections of the Mainland District, and in the Shuyak Island and Northwest Afognak Sections of the Afognak District, the department shall manage the fishery as follows:

- **Management of the fishery must be based on local stocks;**

- **the fishery may remain open during normal fishing periods until the harvest exceeds 15,000 sockeye salmon;**

- **when the harvest exceeds 15,000 sockeye salmon, the department shall restrict the fishery by emergency order to waters of the shoreward zones, as described below:**

  - Dakavak Bay, Outer Kukak Bay, Inner Kukak Bay, Hallo Bay. and Big River Sections west of a line from Cape Douglas at 58°51'06" N. lat, 153°14'54" W. long, to a point at 58°42'40" N. lat, 153°26'18" W. long, to a point east of Swikshak River at 58°38'06" N. lat., 153°35'24" W. long., to Cape Chiniak at 58°31' N. lat., 153°54'21" W. long., to Cape Nukshak at 58°23'30" N. lat., 153°57' W. long., to Cape Ugyak at 58°16'36" N. lat., 154°06'03" W. long., to Cape Gull at 58°13' N. lat, 154°08'30" W. long., to Cape Kuliak at 58°08'11" N. lat., 154°12'34" W. long., to Cape Atushagvik at 58°05' N. lat., 154°18'48" W. long., to Cape Ilktugitak at 58°01'12" N. lat., 154°34'48" W. long to the southern entrance of Dakavak Bay at 58°01' N. lat., 154°43'30" W. long.

  - Shuyak Island and Northwest Afognak Sections south and east of a line from Point Banks at 58°38' N. lat., 152°18'54" W. long., to Dark Island at 58°38'45" N. lat., 152°33'05" W. long., to Gull Island at 58°35'48" N. lat., 152°38'45" W. long., to the northern entrance of Big Bay at 58°34'06" N. lat., 152°40'12" W. long., to the western entrance of Blue Fox Bay at 58°27'41" N. lat., 152°43'42" W. long., to Black Cape at 58°24'33" N. lat., 152°53'09" W. long., to Cape Paramanof at 58°18'21" N. lat., 153°02'45" W. long.

From July 6 through July 25 in the Southwest Afognak Section of the Afognak District, the department shall manage the fishery as follows:

- **management of the fishery must be based on local stocks;**

- **the fishery may remain open during normal fishing periods until the harvest exceeds 50,000 sockeye salmon;**

- **when the harvest exceeds 50,000 sockeye salmon, the department shall restrict the fishery by emergency order to waters of the Southwest Afognak Section Shoreward Zones** east of a line from one-half nautical mile west of Cape Paramanof at 58°18'21" N. lat., 153°02'45" W. long., to one-half nautical mile west of Tanaak Cape at 58°15'36" N. lat., 153°06'09" W. long., to one-half nautical mile west of Steep Cape at 58°12'05" N. lat., 153°12'33" W. long., to one-half nautical mile west of a point at 58°08'25" N. lat., 153°18'52" W. long., to one-half nautical mile west of Raspberry Cape at 58°03'35" N. lat., 153°25'06" W., long.

All fishers and tender operators should familiarize themselves with the boundaries of these "seaward" and "shoreward" zones in each of these eight management units. Also, it will be the responsibility of both the permit holder and the tender operator to make sure fish tickets for fish harvested in the geographical area covered by this plan properly reflect the poundage and quantities of salmon by species. If there are questions on this management plan contact the ADF&G Kodiak staff.

Crescent Lake

The Crescent Lake Management Plan is associated with a relatively small coho enhancement project which could impact the subsistence fishery in the vicinity of Port Lions. This plan clarifies the harvest priorities for coho salmon returning to the Settler Cove area near Port Lions. This plan was slightly modified by the Board of Fisheries, during the January 1993 meeting in Kodiak. Previously the plan allowed commercial harvest inside the breakwater at Port Lions only after September 16; the date is now September 10. In addition, the time period that this plan is in effect was changed from the entire salmon season to the time period July 15 through October 31. The wording of the regulations guiding this plan are listed below as well as in the 1995 Commercial Finfish Regulation Book under 5AAC 18.364.

5AAC 18.364. Crescent Lake Coho Salmon Management Plan.

(a) From July 15 through October 31, the Department shall manage the commercial, sport, and subsistence fisheries in Settler Cove to provide for full utilization of the enhanced stock of coho salmon returning to Crescent Lake in accordance with the Crescent Lake Coho Salmon Management Plan in this section.

(b) Sport and subsistence fisheries are allowed in all waters of Settler Cove consistent with 5AAC 64 and 5AAC 01.

(c) The department may open, by emergency order, those waters of Settler Cove between the causeway and a line from the seaward end of the Port Lions breakwater to a department marker located directly across Settler Cove from the breakwater, to the commercial taking of salmon only as follows:

(1) the department may not allow the commercial taking of salmon before September 10; and

(2) before opening the fishery, the department shall determine that 500 or more coho salmon are available in Settler Cove for harvest.

Eastside Afognak

The Board of Fisheries, during the January 1993 meeting in Kodiak, adopted the Eastside Afognak Management Plan. Prior to the adoption of the management plan the commercial salmon fisheries of the eastside of Afognak Island were managed under an informal management plan formulated by Kodiak Area management biologists and Kitoi Bay hatchery manager. The goal of this plan is to achieve broodstock requirements for the hatchery, escapement requirements for local stocks, and specify the requirements for fishing time in the Southeast Afognak, Duck Bay, Izhut Bay, and Kitoi Bay Sections (Table 8). The regulatory wording of this plan is listed below as well as in the 1995 Commercial Finfish Regulation Book.

5AAC 18.365. Eastside Afognak Management Plan.

(a) The goal of the Eastside Afognak Management Plan is to achieve escapement and harvest objectives of sockeye, pink, coho, and chum salmon returning to natural spawning systems in the Southeast Afognak, Duck Bay, Izhut Bay, and Kitoi Bay Sections, and broodstock to Kitoi Bay hatchery. It is the intent of the board that salmon bound for these systems be harvested by the commercial fisheries located in these sections.

(b) The Southeast Afognak Section shall be managed on sockeye salmon returning to Afognak Lake during the period from June 9 through July 5. From July 6 through August 24, fishing opportunities will be based on pink salmon returning to major systems in Afognak, Kazakof (Danger), and Marka Bays. After August 24, fishing time will be dependent on coho salmon returning to this section.

(c) The Duck Bay Section shall be managed on early chum or sockeye salmon returns to Kitoi Bay hatchery during the period June 9 through July 18. From July 19 through August 24, fishing time will be based on returning mixed wild and hatchery pink salmon. After August 24, this section shall be managed on local coho salmon runs.

(d) The Izhut Bay Section shall be managed on the early chum or sockeye salmon returning to Kitoi Bay hatchery during the period June 9 through July 18. From July 19 through August 1, this section may remain closed to fishing to assure that pink salmon cost recovery goals are achieved at Kitoi Bay hatchery. If hatchery cost recovery harvests are not required, fishing time in this section will depend on returning wild and hatchery pink salmon from July 19 through August 24. After August 24, fishing time will be dependent on returns of local coho salmon and late hatchery sockeye salmon runs.

(e) The Kitoi Bay Section shall be managed on early run chum or sockeye salmon returning to the Kitoi Bay hatchery, from June 9 through July 20. From July 3 through July 20, fishing opportunities will not occur until chum salmon broodstock requirements for the hatchery are assured. After July 20 through August 20, this section will be managed for pink salmon cost recovery and broodstock requirements. If there is no pink salmon cost recovery, the section may be managed to harvest pink salmon that exceed broodstock needs. After August 20, fishing opportunities may be provided to harvest returning late sockeye and coho that exceed broodstock needs.

Spiridon Bay Sockeye Salmon

The Kodiak Regional Aquaculture Association, in conjunction with ADF&G, has developed a supplemental run of sockeye salmon in Spiridon Bay. Sockeye fry are stocked in Spiridon Lake to rear and then migrate into Spiridon Bay. Because of the steep topography of the creek leading to the lake the returning sockeye can not ascend to naturally spawn. All returning sockeye are intended for common property fisheries. ADF&G, KRAA, and the U.S. Fish and Wildlife Service have developed a management plan which attempts to fully utilize these salmon while protecting local stocks. The Spiridon Bay Sockeye Salmon Management Plan was adopted into regulation by the Board of Fisheries at the January 1993 meeting in Kodiak.

5AAC 18.366. Spiridon Lake Sockeye Salmon Management Plan.

(a) The department shall manage the commercial, sport, and subsistence fisheries in Spiridon Bay to provide for full use of the enhanced stock of sockeye salmon returning to Spiridon Lake.

(b) The purpose of the Spiridon Bay harvest strategy is to allow for the orderly harvest of sockeye salmon returning to Telrod Cove from the Spiridon Lake enhancement project while providing adequate protection for local natural salmon stocks returning to other streams of the bay. The intent of the enhancement project is for the harvest of returning enhanced salmon to occur in traditional commercial fishing areas of the Northwest Kodiak District during openings directed at harvesting Karluk sockeye and westside pink and chum salmon stocks.

(c) Only that portion of the Spiridon Bay Special Harvest Area in Telrod Cove Proper will be open to fishing (Figure 2). **(New for 1995.)**

(d) Only purse seine and beach seines may be operated in the Spiridon Bay Special Harvest Area.

(e) If a harvestable surplus of enhanced sockeye salmon is in the special harvest area, fishing periods will run 24 hours per day. When possible, openings will be coordinated to occur at the beginning of openings in the Northwest Kodiak District. **(New for 1995.)**

Eastside Kodiak

The Eastside Kodiak Salmon Management Plan shows which species effect fishing time in management units located in the Northeast and Eastside Kodiak Districts throughout the season (Table 9). Although not in regulation, this plan reflects fishing opportunities which have been implemented annually since 1978.

SOCKEYE SALMON ESCAPEMENTS GOALS FOR AREA K MAJOR SOCKEYE SALMON SYSTEMS

The amount of fishing time for targeted sockeye salmon fisheries on systems having fish weirs is dependent on actual escapements. These include the Karluk, Ayakulik, Upper Station, and Frazer systems (major systems) and for the Akalura, Saltery, Buskin, Litnik, Pauls, and Thorsheim systems (minor systems). For sockeye salmon systems without weirs, fishing time is generally conservative and occurs at the discretion of ADF&G, in proportion to the perceived system specific run strength.

Upper and lower biological escapement requirements have been identified for each river's sockeye salmon stocks (Table 10). A basic management function is to achieve at least the lower

escapement goals for stocks exploited by targeted fisheries, even if it means that directed fishing time on those stocks does not occur. When the possibility exists that the upper escapement goals may be exceeded and significant deviations from optimum production could occur because of that excess; maximum directed fishing time on these stocks would be allowed, even if it requires continuous stream terminus fishing to contain the escapement at or near the upper levels. This is the extreme case occasionally needed to manage the Kodiak Area sockeye salmon runs. More common is a moderate amount of directed fishing time required to harvest sockeye salmon surplus and provide escapement approaching desired levels.

Escapement graphs by stream are a good tool for illustrating escapements, similar to preseason harvest projections (Appendix B.1. - B.5.). These are curves drawn based on historical average cumulative escapement by day, scaled to the upper and lower biological escapement goal for each particular system. Actual escapements can be plotted on these graphs to compare with the projected cumulative count. Since fishing time is strongly tied to escapement levels, these graphs can be valuable aids in understanding current ADF&G management actions, and in planning for future fisheries. Actual inseason escapement counts can be heard daily at 8:15 A.M. on SSB channel 3230 Khz.

Table 1. Commercial salmon harvest in 1994 and harvest projections for the Kodiak Management Area, 1995.

	CHINOOK	SOCKEYE	COHO	PINK	CHUM	TOTAL
1994 Projected Harvest	25,000	2,428,100	325,000	13,700,000	610,000	17,088,100
1994 Actual Harvest	22,600	2,877,500	296,200	8,162,600	738,800	12,097,700
1995 Projected Harvest	25,000	2,400,000	310,000	18,235,000	800,000	21,770,000

FISHERY	1994 HARVEST[a] Projection	1994 HARVEST[a] Actual[c]	1995 HARVEST[a,b] Projection as of 1/5/95
Early Run Sockeye Salmon Fisheries (6/9-7/15)			
Cape Igvak	262,500	295,700	280,000
Karluk	400,000	652,800	200,000
Ayakulik	105,000	0	45,000
Frazer	420,000	477,200	420,000
Upper Station	70,000	57,700	50,000
Minor Systems	70,000	36,100	50,000
Minor Enhancements	-	4,900	90,000
Other	100,000	142,500	70,000
SubTotal	**1,427,500**	**1,666,900**	**1,205,000**
Late Run Sockeye Salmon Fisheries (7/16-9/15)			
Afognak (Hatchery)	5,000	9,300	30,000
Cape Igvak	140,600	26,600	120,000
Karluk	175,000	355,200	350,000
Ayakulik	65,000	106,300	30,000
Frazer	105,000	119,300	105,000
Upper Station	250,000	277,700	300,000
Minor Systems	75,000	8,300	75,000
Spiridon	135,000	263,800	160,000
Other	50,000	44,100	25,000
SubTotal	**1,000,600**	**1,210,600**	**1,195,000**
TOTAL SOCKEYE	**2,428,100**	**2,877,500**	**2,400,000**
Coho Salmon Fisheries (8/1-10/1)			
Afognak (Hatchery)	75,000	45,900	15,000
Afognak (Natural)	40,000	47,100	35,000
Westside	85,000	107,100	135,000
Alitak	20,000	32,200	25,000
Eastside/Northend Kodiak	75,000	43,100	60,000
Mainland	30,000	20,800	40,000
SubTotal	**325,000**	**296,200**	**310,000**
Pink Salmon Fisheries (7/6-9/5)			
Afognak (Hatchery)	1,400,000	2,051,400	7,965,000
Afognak (Natural)	700,000	623,400	1,150,000
Westside Kodiak	5,000,000	3,315,000	4,650,000
Alitak	2,000,000	1,120,800	2,365,000
Eastside/Northend Kodiak	3,500,000	858,200	1,750,000
Mainland	1,100,000	193,800	355,000
SubTotal	**13,700,000**	**8,162,600**	**18,235,000**

-Continued-

Table 1. (page 2 of 2)

FISHERY	1994 HARVEST[a] Projection	1994 HARVEST[a] Actual[c]	1995 HARVEST[a,b] Projection as of 1/5/95
Chum Salmon Fisheries (6/6-9/5)			
Afognak (Hatchery)	10,000	5,000	150,000
Afognak (Natural)	50,000	34,900	31,000
Westside Kodiak	250,000	286,100	213,000
Alitak	50,000	112,100	38,000
Eastside/Northend Kodiak	150,000	209,700	148,000
Mainland	100,000	91,000	220,000
SubTotal	**610,000**	**738,800**	**800,000**
GRAND TOTAL	**17,088,100[d]**	**12,097,700[e]**	**21,770,000[f]**

[a] Numbers of fish.
[b] 1995 harvest projections as of 1/5/9.
[c] Actual harvest estimates by fishery as of 1/5/95.
[d] Includes 25,000 chinook - projected harvest.
[e] Includes 22,600 chinook - actual harvest.
[f] Includes 25,000 chinook - projected harvest.

Table 2. Expected harvest from supplemental salmon production, by system and species for the Kodiak Management Area, 1995.[a]

System	Sockeye	Pink	Coho	Chum
Kitoi Bay Hatchery Complex[b]	32,000[c]	7,965,000	15,000	150,000
Spiridon Lake[d]	160,000	0	0	0
Hidden Lake	21,000	0	0	0
Waterfall Lake	20,000	0	0	0
Crescent Lake[e]	13,000	0	5,000	0
Katmai Lake	0	0	2,000	0
Kodiak Road System Lakes	0	0	3,000	0
Total	246,000	7,965,000	25,000	150,000

[a] Harvest estimates by KRAA and Kitoi Bay Hatchery staff.
[b] See Eastside Afognak Salmon Management Plan.
[c] Harvest is expected to occur during fisheries targeting pink salmon.
[d] See Spiridon Lake Sockeye Salmon Management Plan.
[e] See Crescent Lake Salmon Management Plan.

Table 3. Commercial salmon season opening times and dates by species for the Kodiak Area, 1995.

FISHERY	EARLIEST OPENING TIME/DATE	
	Firm Time/Date	Approximate Time/Date
Early Run Sockeye Salmon Fisheries		
Cape Igvak Section [a]	-	12:01 A.M. June 5-9
N.W. Kodiak District [b]	12:00 Noon June 9	
Inner Ayakulik and Outer Ayakulik Sections [c]	-	Low tide June 7-9
Alitak District [b]	12:00 Noon June 9	
Minor Systems [d]		
Uganik	-	12:00 Noon June 14
Paramanof	-	12:00 Noon June 14
Pauls/Perenosa	-	12:00 Noon June 14
Litnik/Waterfall Lake/Hidden Lake	-	12:00 Noon June 9-14
Saltery	-	12:00 Noon June 14
Kaflia/Swikshak	-	12:00 Noon June 14
Pink/Chum Salmon Fisheries [e]		
Mainland District	12:00 Noon July 6	-
Afognak District	12:00 Noon July 6	-
N.W. Kodiak District	12:00 Noon July 6	-
S.W. Kodiak District	12:00 Noon July 6	-
Alitak District	12:00 Noon July 6	-
Eastside Kodiak District	12:00 Noon July 6	-
N.E. Kodiak District	12:00 Noon July 6	-
Late Run Sockeye Salmon Fishery		
Cape Igvak Section [f]	-	12:01 A.M. July (?)
All remaining late run sockeye fisheries [g]	-	12:00 Noon July 15
System Specific Coho Salmon Fisheries [h]		
Mainland District	-	12:00 Noon Sept. 1
Afognak District	-	12:00 Noon Aug. 15
N.W. Kodiak District	-	12:00 Noon Sept. 1
S.W. Kodiak District	-	12:00 Noon Sept. 1
Alitak District	-	12:00 Noon Sept. 1
Eastside Kodiak District	-	12:00 Noon Sept. 5
N.E. Kodiak District	-	12:00 Noon Sept. 5

-Continued-

Table 3. (page 2 of 2)

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[a] Actual opening date will be determined by sockeye escapement levels into the Chignik River system. Fishing time will be in 24 hour increments.

[b] Actual opening time/date is as shown. This opening is considered a commercial test fishery; fishing time for this initial period will be 33 hours (12:00 nooon 6/9 through 9:00 P.M. 6/10).

[c] Actual opening date will be determined by the sockeye escapement level into Ayakulik River and opening time by low tide timing during daylight hours.

[d] Actual opening time will be determined by sockeye escapement levels into minor systems. Fishing time for this period will be 33 hours (12:00 noon through 9:00 P.M.)

[e] Actual opening time/date is as shown. Fishing time for this initial period will be 105 hours (12:00 noon 7/6 through 9:00 P.M. 7/10). See section on Fishing Periods for additional information.

[f] Actual opening date will be determined by sockeye escapement levels into the Chignik River System. Fishing time will be in 24 hour increments.

[g] Actual opening date for system specific fishing time will be determined by sockeye escapement levels into major systems. All fishing periods will begin at 12:00 noon and end at 9:00 P.M. prior to 8/16 and end at 6:00 P.M. from 8/16 to season's end.

[h] Actual opening date for system specific fishing time will be determined by overall coho run strength evaluation and by escapement levels into major systems and minor systems with reliable escapement data.

Table 4. Regulatory fishery management plans for the Kodiak Management Area, 1995.

MANAGEMENT PLAN	YEAR INITIATED	MGMT. UNITS AFFECTED	DATES IN EFFECT
Cape Igvak Salmon Management Plan	1978	Cape Igvak Section Wide Bay Section	6/5 - 7/25
Alitak Bay District Salmon Management Plan	1987	Alitak Bay District	6/9 - 10/1
Westside Kodiak Management Plan	1990	N.W. Kodiak District S.W. Kodiak District S.W. Afognak Section	6/9 - 10/1
Crescent Lake Coho Salmon Management Plan	1990	Portion of the Central Section in Vicinity of Port Lions	8/1 - 9/15
North Shelikof Strait Sockeye Salmon Management Plan	1990	S.W. Afognak Section N.W. Afognak Section Shuyak Section Big River Section Hallo Bay Section Inner and Outer Kukak Sect. Dakavak Section	7/6 - 7/25
Eastside Afognak Management Plan	1993	Kitoi Bay Section Izhut Bay Section Duck Bay Section	6/9 - 10/1
Spiridon Bay Sockeye Salmon Management Plan	1993	Special Harvest Area in Spiridon Bay Section	6/9 - 10/1

Table 5. Biological and allocative criteria, and the management chronology, of the Cape Igvak Management Plan for the Kodiak Management Area, 1995.

BIOLOGICAL AND ALLOCATIVE CRITERIA FOR MANAGING THE CAPE IGVAK FISHERY ON CHIGNIK BOUND SOCKEYE

BIOLOGICAL REQUIREMENTS			ALLOCATIVE REQUIREMENTS		
REGULATION 5AAC 18.360	ESCAPEMENT NEEDS CHIGNIK (EARLY RUN)	ESCAPEMENT NEEDS CHIGNIK (LATE RUN)	REGULATION 5AAC 18.360	CHIGNIK MINIMUM HARVEST	IGVAK %
(a) (b) (c)	THROUGH 6/30 350,000-400,000	-	(a)	EXPECTATIONS OF LESS THAN 600,000	CLOSED
-	-	-	(b)	EXPECTATIONS OF 600,000 ARE IN DOUBT	CLOSED
(a) (b) (c)	-	THROUGH 7/30 195,000-200,000	(c)	EXPECTATIONS OF 600,000 OCCUR	OPEN TO ACHEIVE 15%
-	-	-	(d)	CHIGNIK SALMON % INTERCEPTION CALCULATIONS	80% OF CATCH AT IGVAK ARE CHIGNIK SOCKEYE
-	-	-	(e)	ALLOCATION PERIOD 600,000	6/5 - 7/25 % NOT APPLICABLE
(f)	FROM JUNE 26 - JULY 9 CAPE IGVAK SECTION CLOSED OR SEVERLY LIMITED UNTIL CHIGNIK LAKE RUN EVALUATED		-	-	-
-	-	-	(g)	-	ONE DAY ADVANCE NOTICE
	400,000	250,000		600,000 MINIMUM	15 %

MANAGEMENT CHRONOLOGY FOR CHIGNIK BOUND SOCKEYE AND KODIAK SALMON

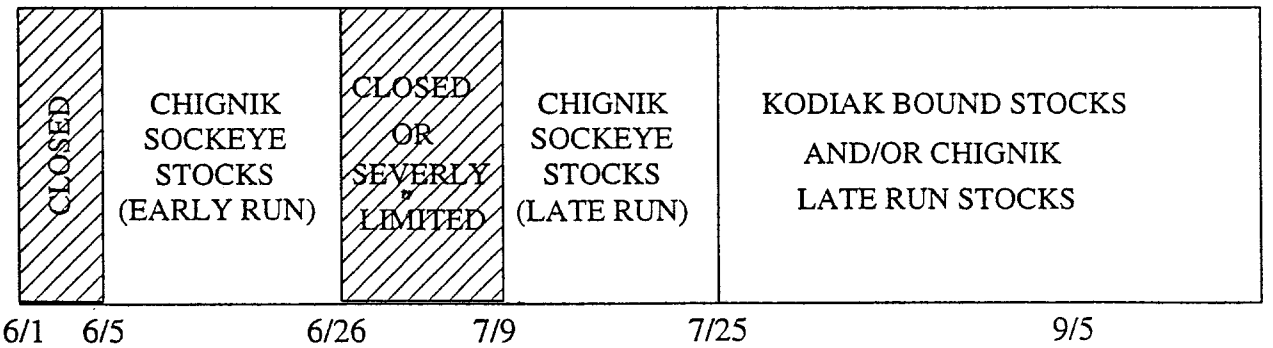


Table 6. Primary management species and fishery chronology of the Alitak Bay District Salmon Management Plan for the Kodiak Management Area, 1995.

ALITAK BAY DISTRICT MANAGEMENT PLAN

CAPE ALITAK SECTION (SEINE)	CLOSED	XXXXXXXX	FRAZER SOCKEYE (AGGRESSIVE MANAGEMENT STRATEGY)	FRAZER SOCKEYE (CONSERVATIVE MANAGEMENT STRATEGY)	ODD YEAR CYCLE FRAZER PINK SALMON EVEN YEAR CYCLE UP.STATION SOCKEYE (LATE RUN)	ODD YEAR CYCLE UP.STATION SOCKEYE EVEN YEAR CYCLE UP.STATION SOCKEYE & FRAZER PINK SALMON		ALL ALITAK DISTRICT COHO SYSTEMS
MOSER/OLGA BAY SECTION (GILLNET) (TRADITIONAL)	CLOSED	XXXXXXXX	FRAZER SOCKEYE (AGGRESSIVE MANAGEMENT STRATEGY)	FRAZER SOCKEYE (CONSERVATIVE MANAGEMENT STRATEGY)	ODD YEAR CYCLE FRAZER PINK SALMON EVEN YEAR CYCLE UP.STATION SOCKEYE (LATE RUN)	ODD YEAR CYCLE UP.STATION SOCKEYE EVEN YEAR CYCLE UP.STATION SOCKEYE & FRAZER PINK SALMON		ALL OLGA BAY COHO SYSTEMS
OUTER UPPER & INNER UPPER STATION (GILLNET) (NON-TRADITIONAL)	CLOSED	CLOSED	UPPER STATION SOCKEYE (EARLY RUN)		UPPER STATION SOCKEYE (LATE RUN)		UP. STATION SOCK & COHO	UPPER STATION COHO
OUTER AKALURA & IN. AKALURA SECTIONS (GILLNET) (NON-TRADITIONAL)	CLOSED	CLOSED	AKALURA SOCKEYE (EARLY RUN)		AKALURA SOCKEYE (LATE RUN)		AKALURA SOCK & COHO	AKALURA COHO
DOG SALMON FLATS SECTION (GILLNET) (NON-TRADITIONAL)	CLOSED	CLOSED	FRAZER SOCKEYE (MOP UP FISHERY)		FRAZER PINK SALMON		FRAZER AND HORSE MARINE COHO	
HUMPY/DEADMAN SECTION (SEINE)	CLOSED	XXXXXXXX	FRAZER SOCKEYE (AGRESSIVE MANAGEMENT STRATEGY)	FRAZER SOCKEYE (CONSERVATIVE MANAGEMENT STRATEGY)	ALITAK BAY PINK, CHUM, AND COHO			

6/1 6/9-10 6/24 7/9 7/15 8/9 8/20 8/26 9/25

xx = Commercial Test Fisheries

ALITAK BAY DISTRICT - PRIMARY MANAGEMENT SPECIES BY STREAM BY TIME

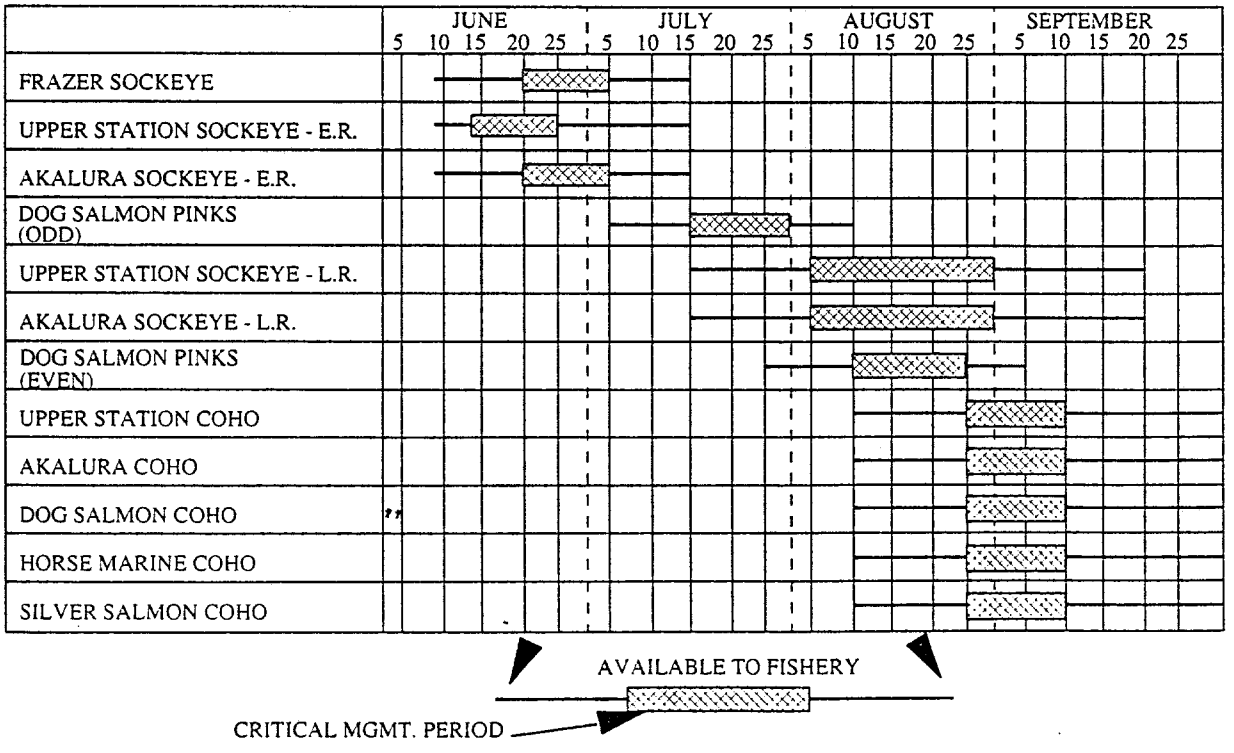


Table 7. Primary management species and fishery chronology of the Westside Kodiak Management Plan for the Kodiak Management Area, 1995.

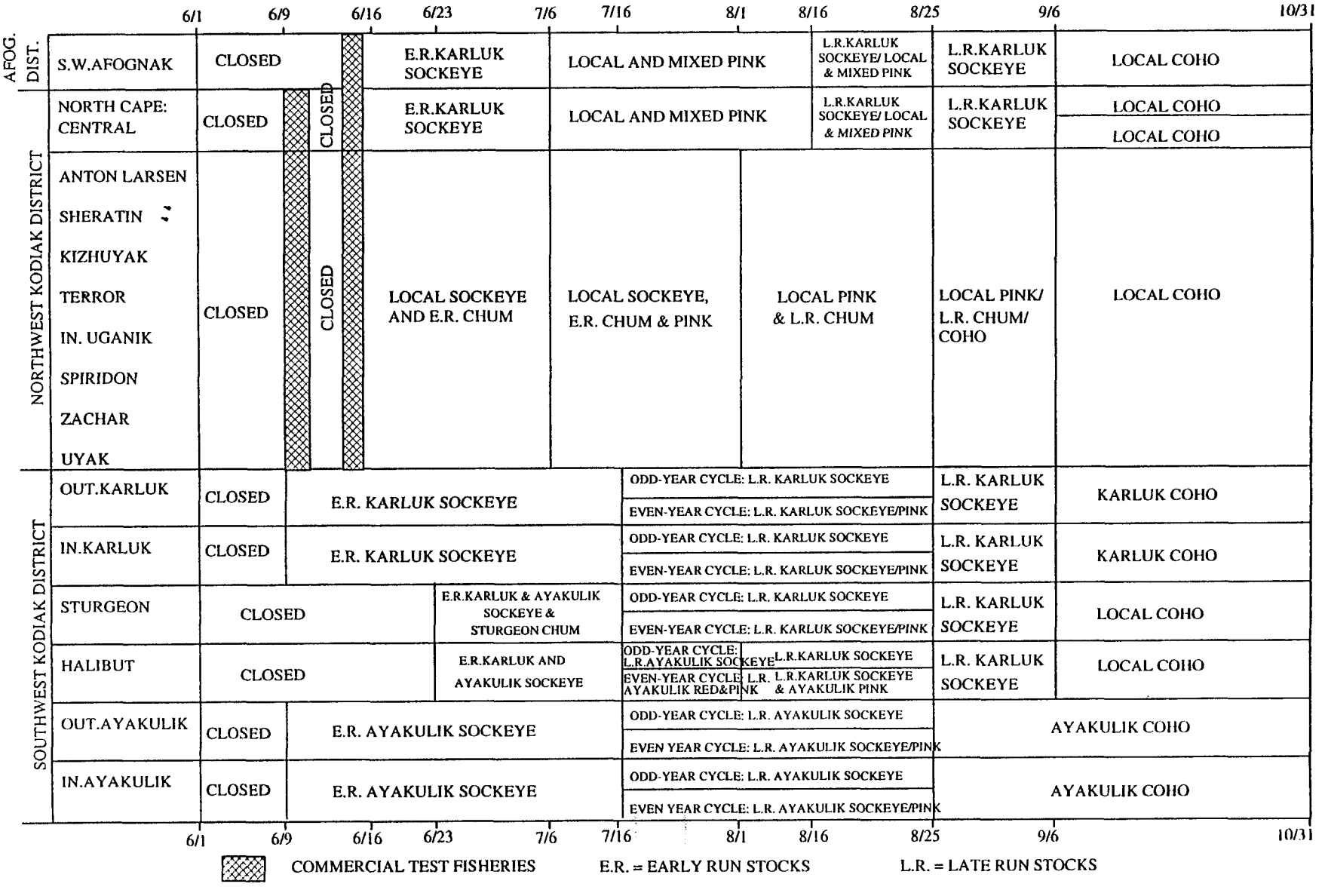
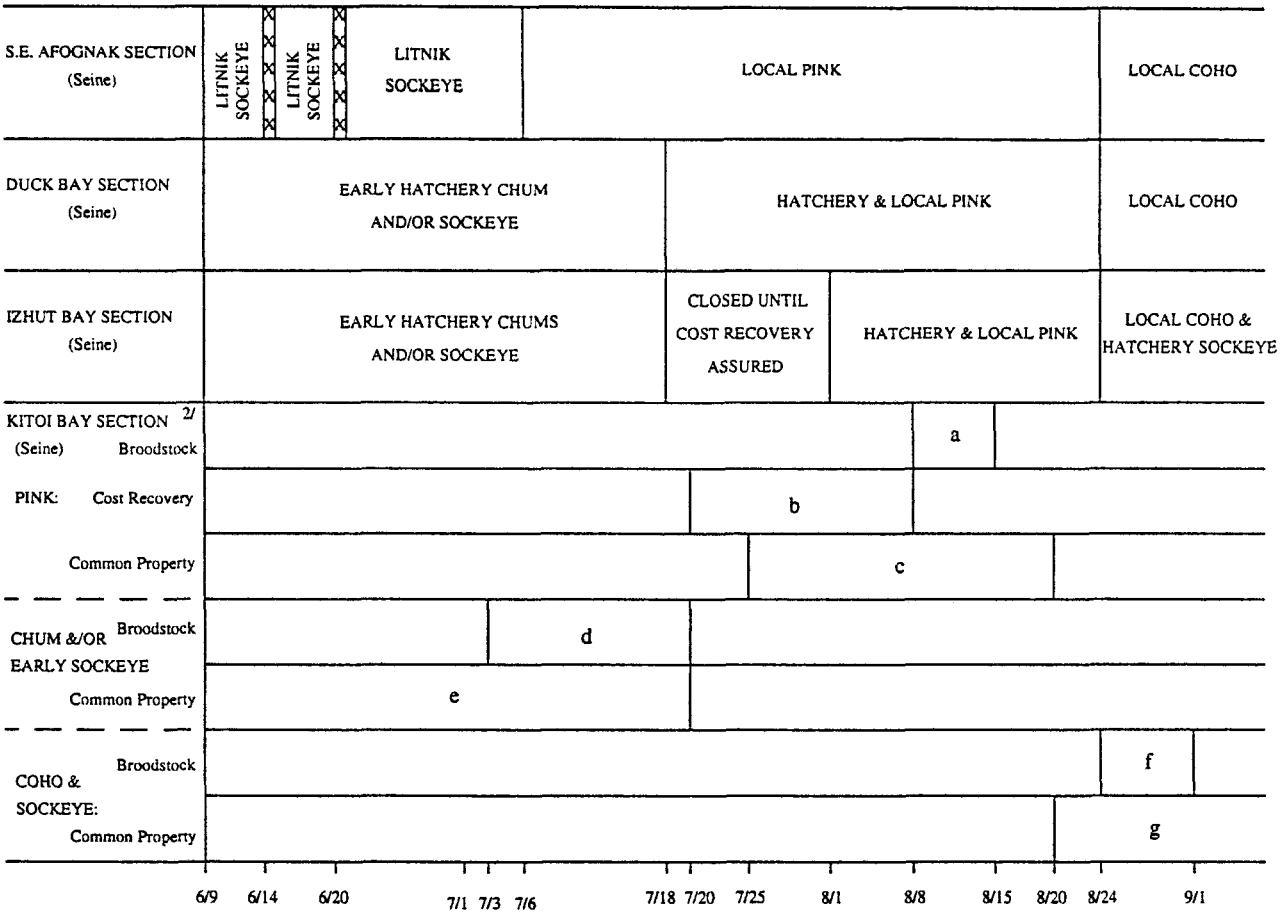


Table 8. Primary management species and fishery chronology of the Eastside Afognak Management Plan for the Kodiak Management Area, 1995.

TARGETED SPECIES BY SYSTEM AND TIME FOR SPECIFIC MANAGEMENT UNITS [1/]



- fishing time dependant upon sockeye escapement into Litnik system.

1 Included in this management plan are the harvest strategies for current natural and hatchery prodution as well as future hatchery production.

2 The management plan required for the Kitoi Bay Section is rather complicated in order to achieve broodstock, cost recovery, and common harvest requirements. This is further complicated by the multispecies production currently occurring at Kitoi Bay hatchery. The diagram shown attempts to approximate dates for when specific management strategies should be implemented to insure achievement of hatchery goals and an orderly harvest of quality common property fish.

a Hatchery pink salmon broodstock captured.
b Hatchery pink salmon cost recovery fishery when necessary.
c Hatchery pink salmon common property fishery.
d Hatchery chum and/or early sockeye salmon broodstock captured.
e Hatchery chum and/or early sockeye salmon common property fishery.
f Hatchery coho and late sockeye salmon broodstock captured.
g Hatchery coho and late sockeye salmon common property fishery.

Table 9. Management chronology by management unit for eastside salmon stocks, Kodiak Management Area, 1995.

	DATE	6/1	6/14	6/21	7/6	7/10	8/25	9/6	10/31
	MANAGEMENT UNIT								
NORTHEAST KODIAK DISTRICT	OUTER CHINIAK BAY	CLOSED			LOCAL AND MIXED PINK			LOCAL PINK, COHO	LOCAL COHO
	INNER CHINIAK BAY	CLOSED			LOCAL AND MIXED PINK AND CHUM			LOCAL PINK, COHO	LOCAL COHO
	BUSKIN RIVER	CLOSED			LOCAL PINK BUSKIN SOCKEYE	LOCAL PINK AND CHUM		LOCAL PINK, COHO, CHUM	LOCAL COHO
	MONASHKA/MILL BAY	CLOSED			LOCAL AND MIXED PINK			LOCAL PINK, COHO	LOCAL COHO
EASTSIDE KODIAK DISTRICT	SEVEN RIVERS	CLOSED	CLOSED	CLOSED	LOCAL AND MIXED PINK AND CHUM			LOCAL PINK, COHO	LOCAL COHO
	TWO HEADED	CLOSED	CLOSED	CLOSED	LOCAL AND MIXED PINK AND CHUM			LOCAL PINK, COHO	LOCAL COHO
	SITKALIDAK	CLOSED	CLOSED	CLOSED	LOCAL AND MIXED PINK AND CHUM			LOCAL PINK, CHUM, COHO	LOCAL COHO
	OUTER UGAK BAY	CLOSED	CLOSED	PASAGSHAK SOCKEYE	LOCAL AND MIXED PINK AND CHUM			LOCAL PINK, CHUM, COHO	LATE CHUM, COHO
	INNER UGAK BAY	CLOSED	CLOSED	SALTERY SOCKEYE	LOCAL PINK & CHUM SALTERY SOCKEYE	LOCAL PINK AND CHUM		LOCAL PINK, COHO	COHO

Local and mixed sockeye 33 hour fishing period.

Table 10. Sockeye salmon escapement goals for major and minor systems in millions of fish, for the Kodiak Management Area, 1995.[a]

	Early Run (Before 7/15)		Late Run (After 7/15)		Total	
	Minimum	Desired	Minimum	Desired	Min.	Des.
Major Systems						
Karluk [b]	.150	.250	.400	.550	.550	.800
Ayakulik	.160	.220	.040	.080	.200	.300
Upper Station [b]	.050	.075	.150	.200	.200	.275
Frazer [c]	.140	.200	-	-	.140	.200
Subtotal	**.500**	**.745**	**.590**	**.830**	**1.090**	**1.575**
Minor Systems						
Akalura [b]	.010	.015	.030	.045	.040	.060
Saltery [c]	.020	.040	-	-	.020	.030
Buskin [c]	.010	.015	-	-	.010	.015
Litnik [c]	.040	.060	-	-	.040	.060
Pauls [c]	.020	.040	-	-	.020	.040
Thorsheim [c]	.005	.010	-	-	.005	.010
Subtotal	**.105**	**.180**	**.030**	**.045**	**.135**	**.205**
GRAND TOTAL	**.605**	**.925**	**.620**	**.875**	**1.225**	**1.790**

[a] This listing of systems identifies only those systems whose escapement is monitored by fish weir total escapement counts. The escapement into these systems represents approximately 85% of the Kodiak Area's total sockeye escapement.

[b] Sockeye escapement into these systems characterized by two distinct stocks as identified by bimodal escapement pattern, i.e. an early stock where the cumulative escapement occurs through July 15 and a late stock where the cumulative escapement occurs primarily from July 16 through season's end.

[c] Sockeye escapement into these systems characterized by one distinct escapement pattern and where escapement is essentially completed by approximately July 25. Escapement goals for Pauls Bay are currently being reevaluated.

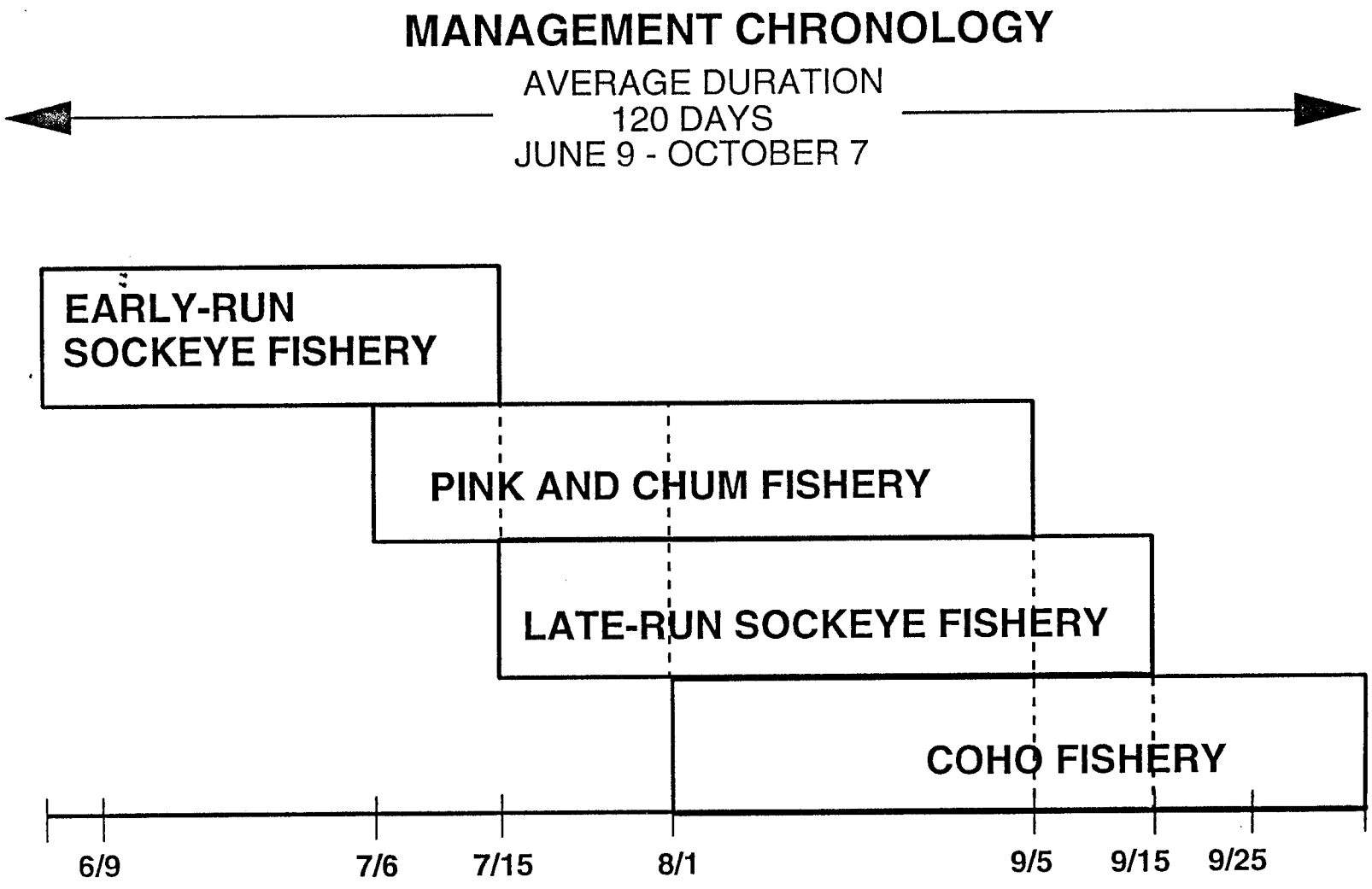


Figure 1. Commercial salmon fishery chronology, by specie, in the Kodiak Management Area.

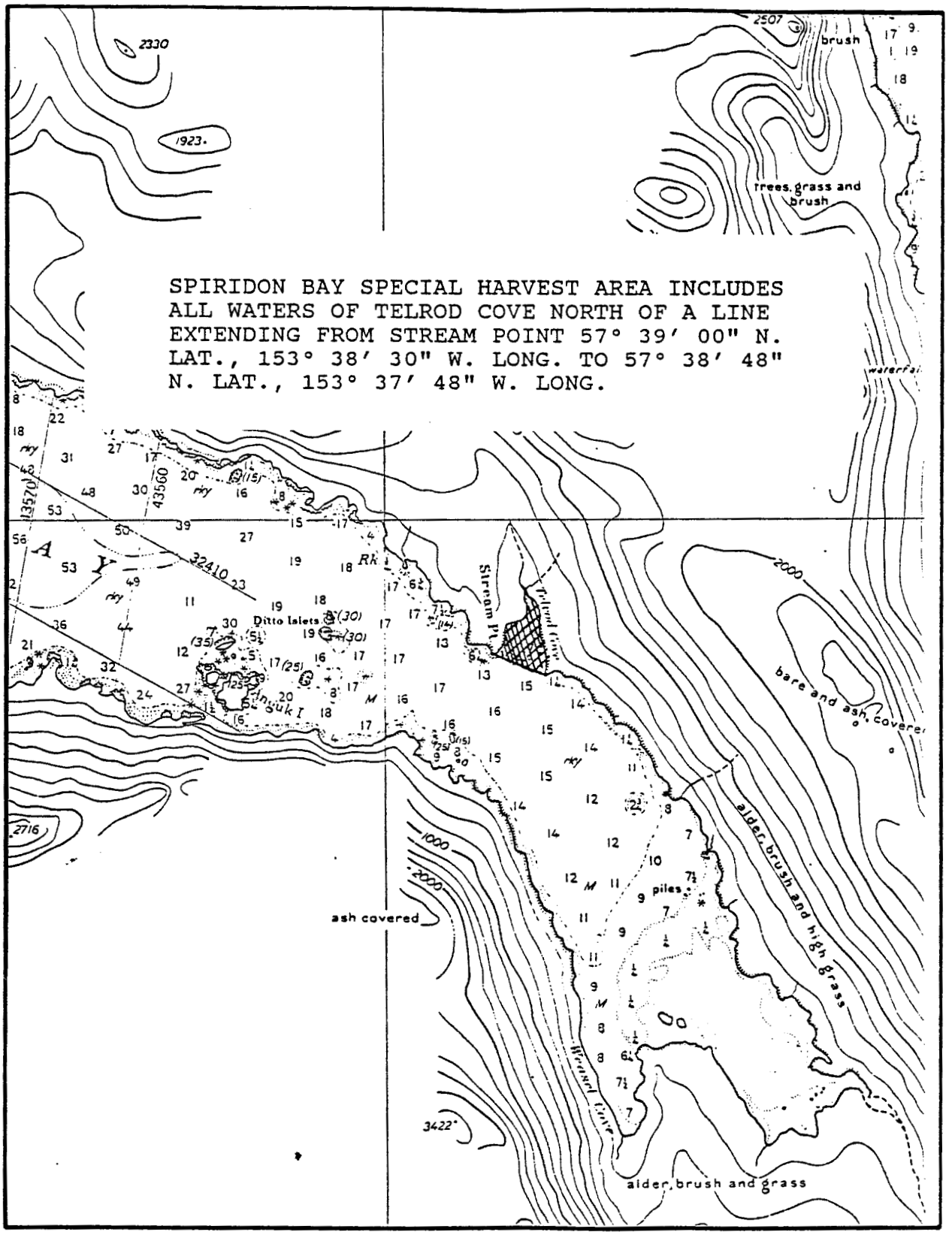


Figure 2. Approximate boundaries of the Spiridon Bay Special Harvest Area.

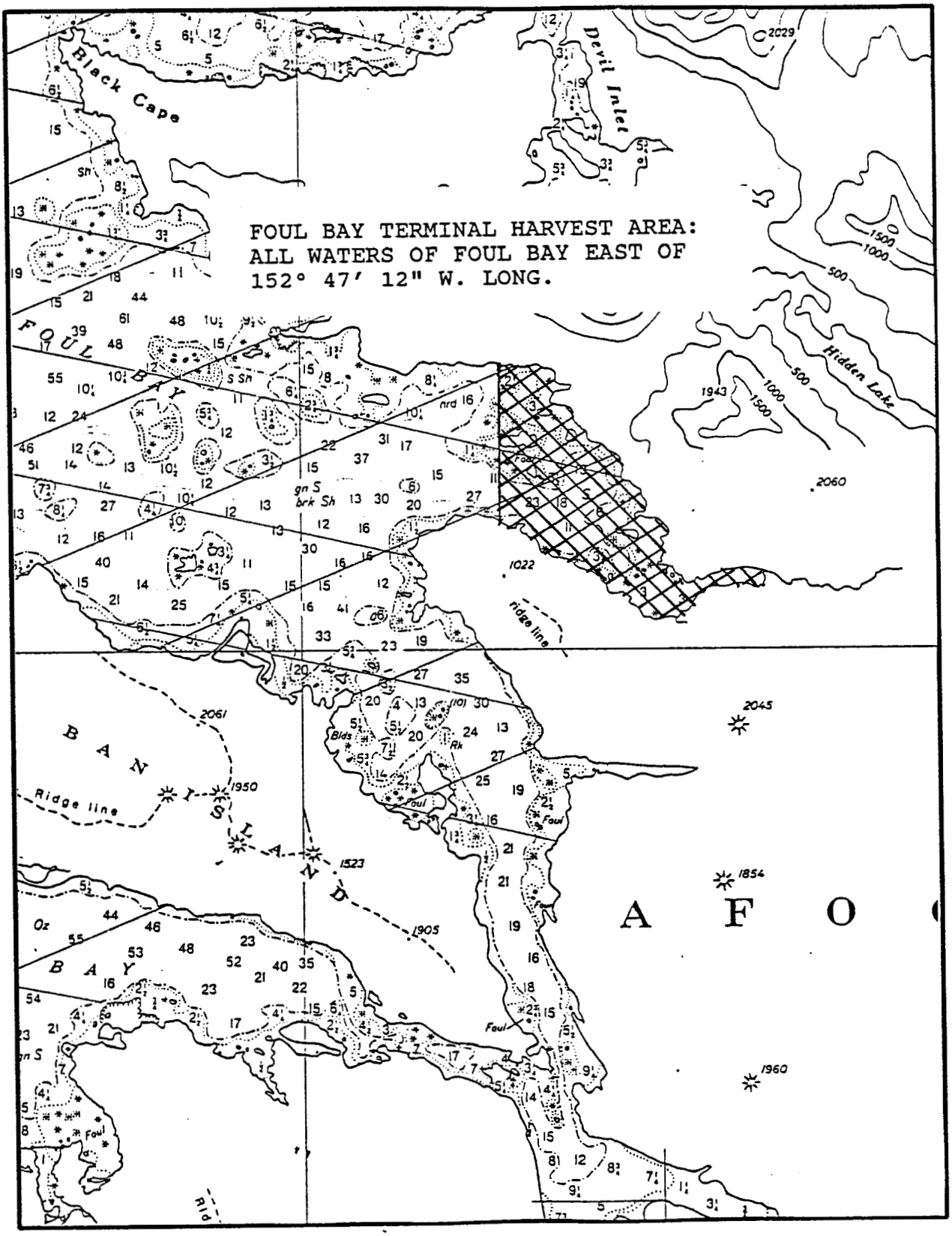


Figure 3. Foul Bay Terminal harvest Area.

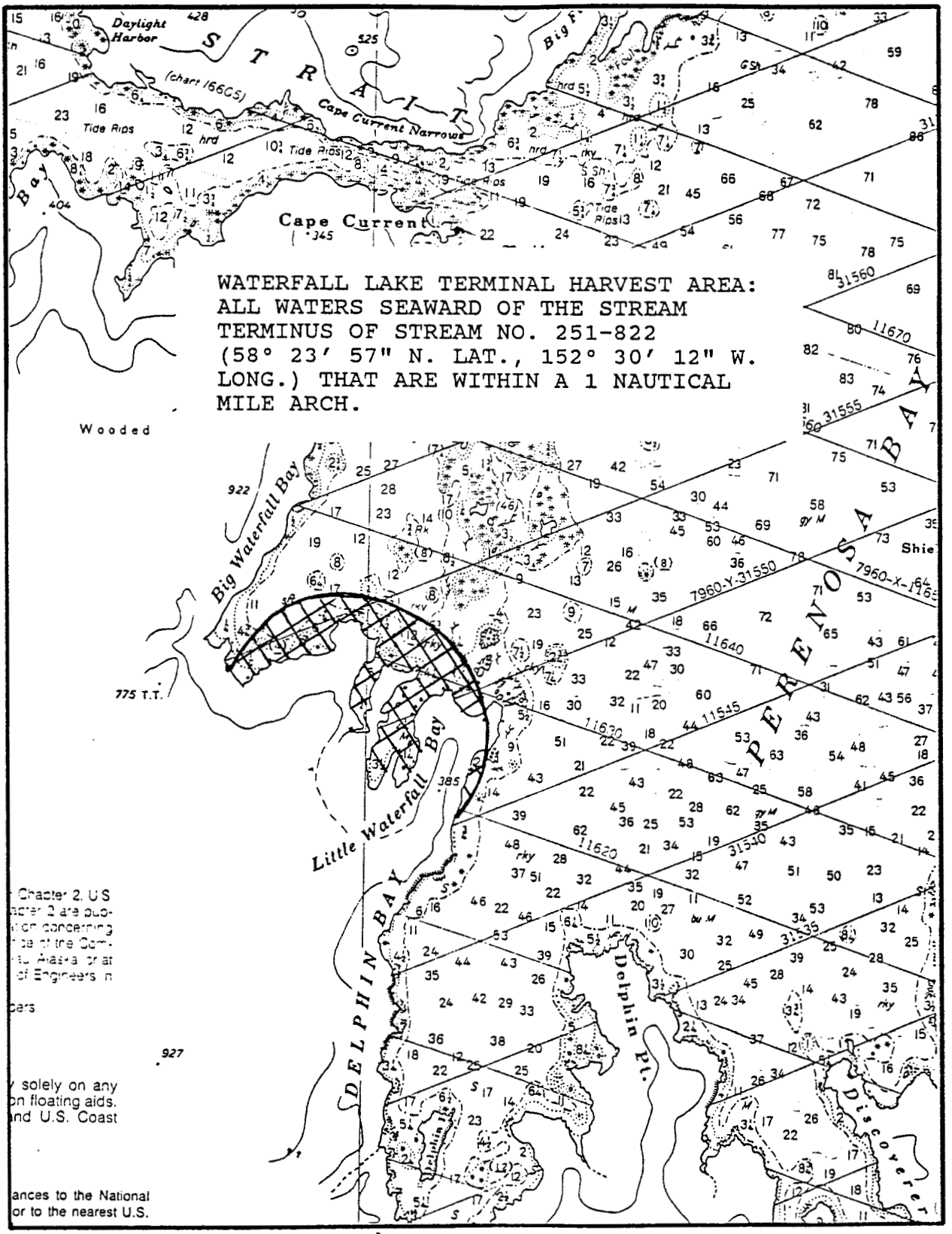


Figure 4. Waterfall Lake Terminal Harvest Area.

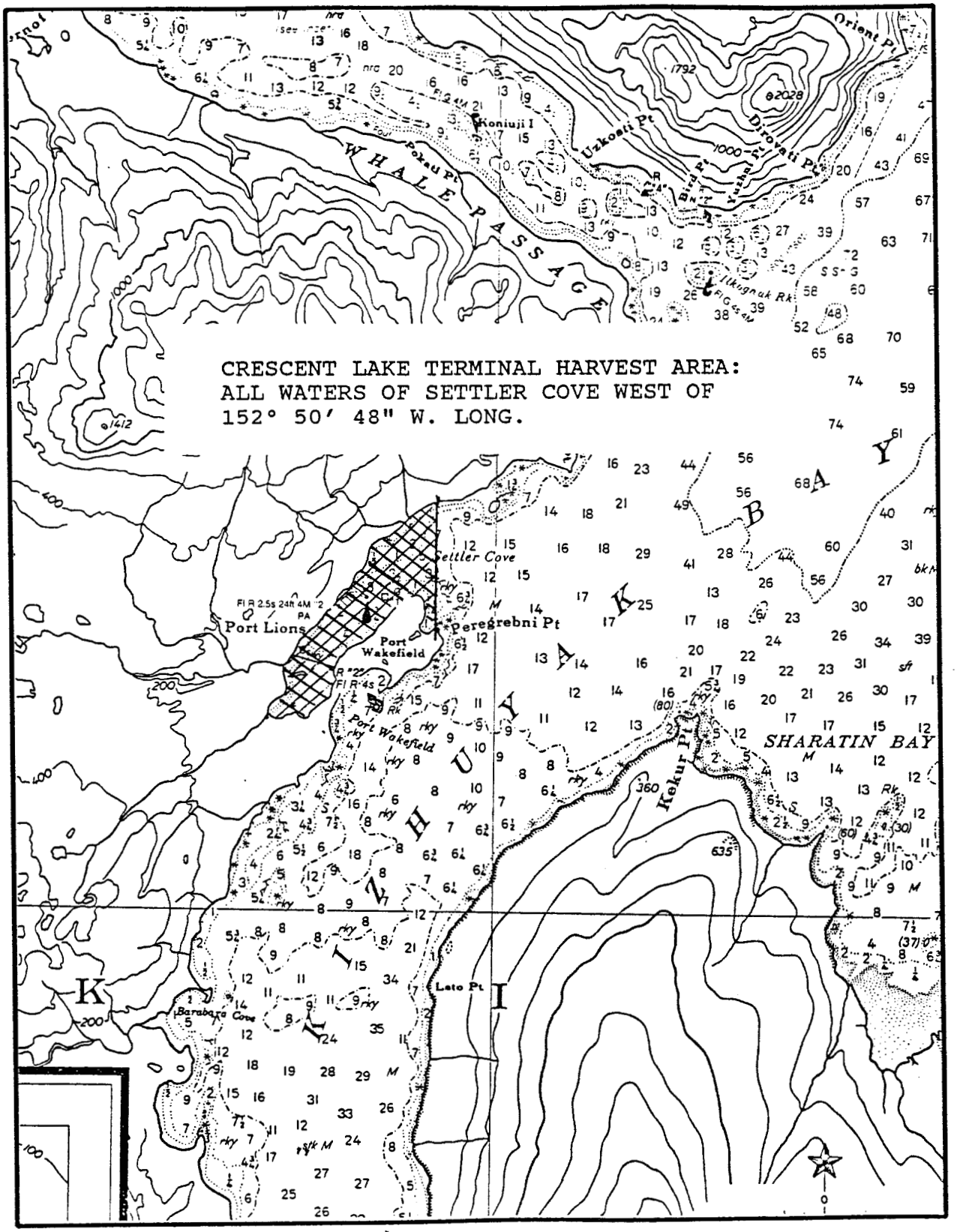


Figure 5. Crescent Lake Terminal Harvest Area.

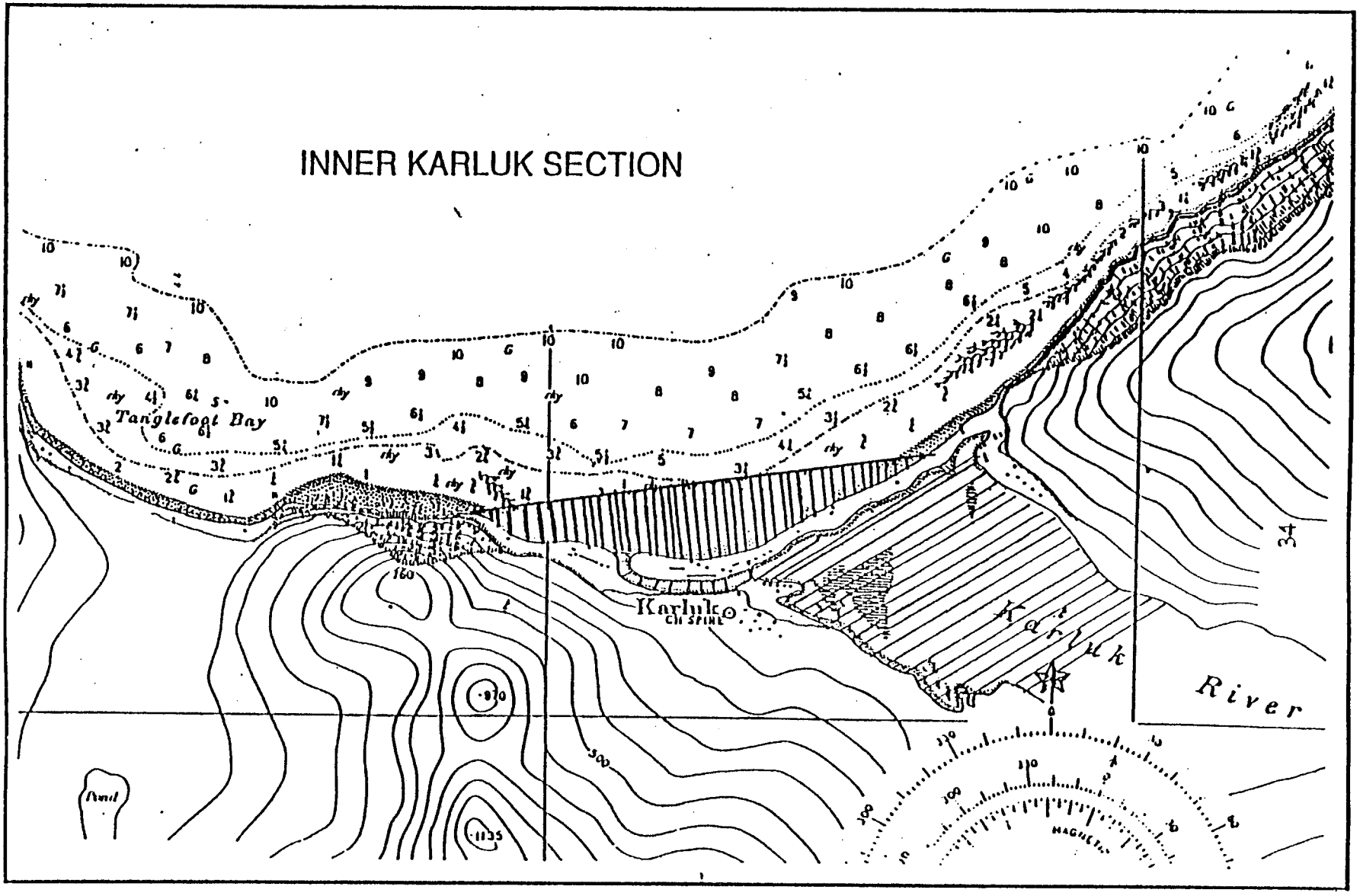


Figure 6. Karluk River closed water sanctuary in the Kodiak Management Area, 1995.

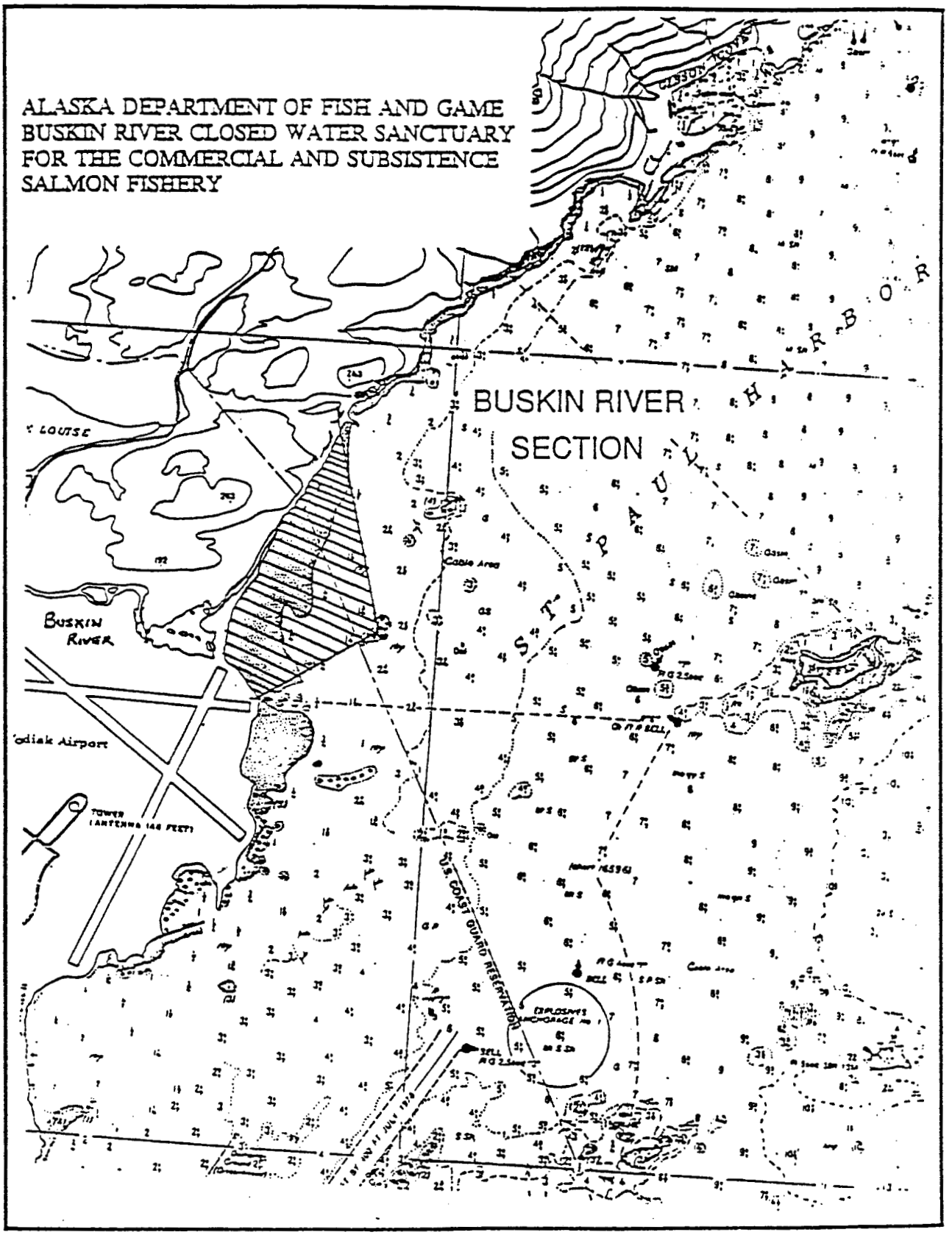


Figure 7. Buskin River closed water sanctuary in the Kodiak Management Area, 1995.

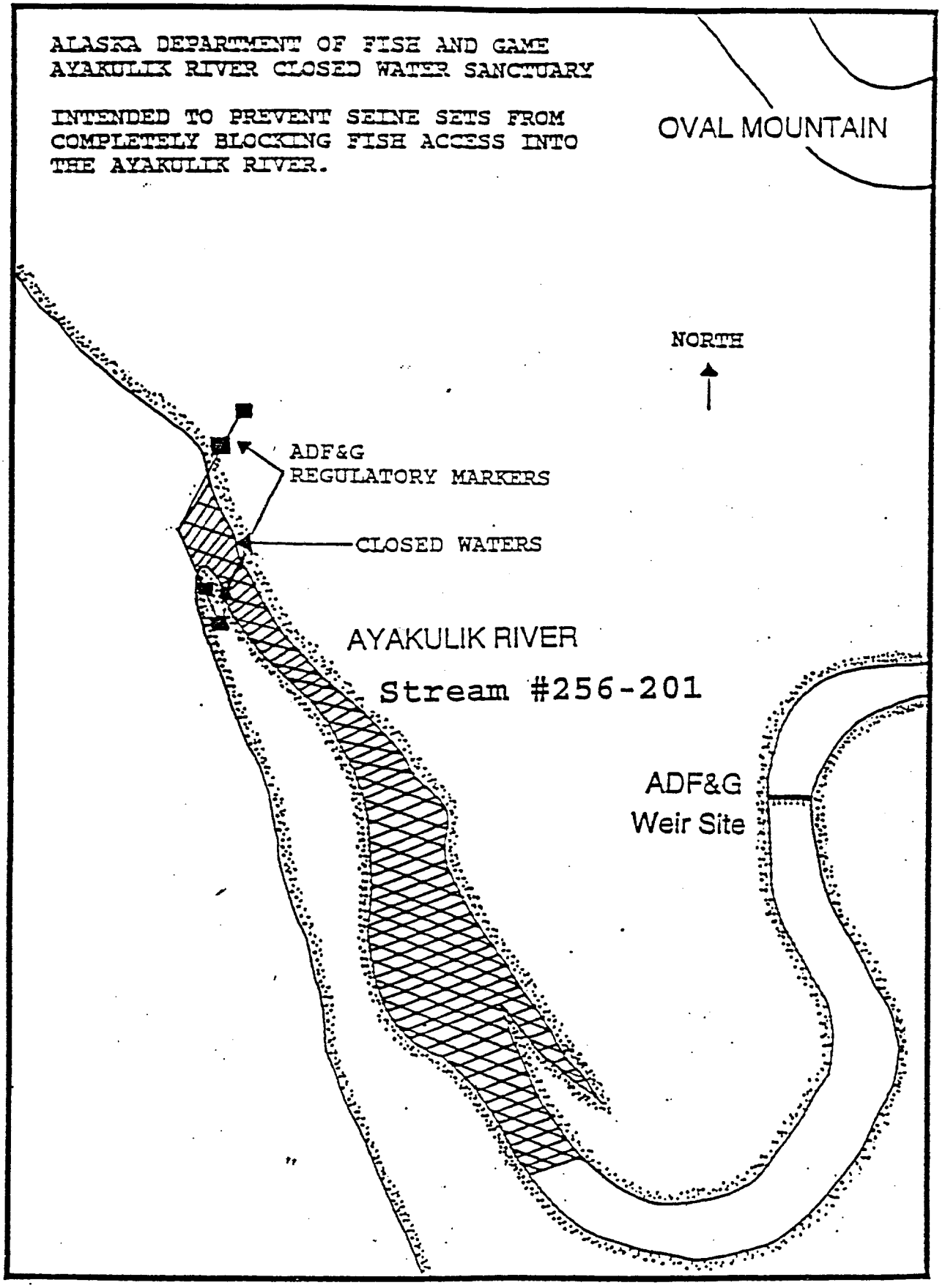


Figure 8. Ayakulik River closed water sanctuary, Kodiak Management Area, 1995.

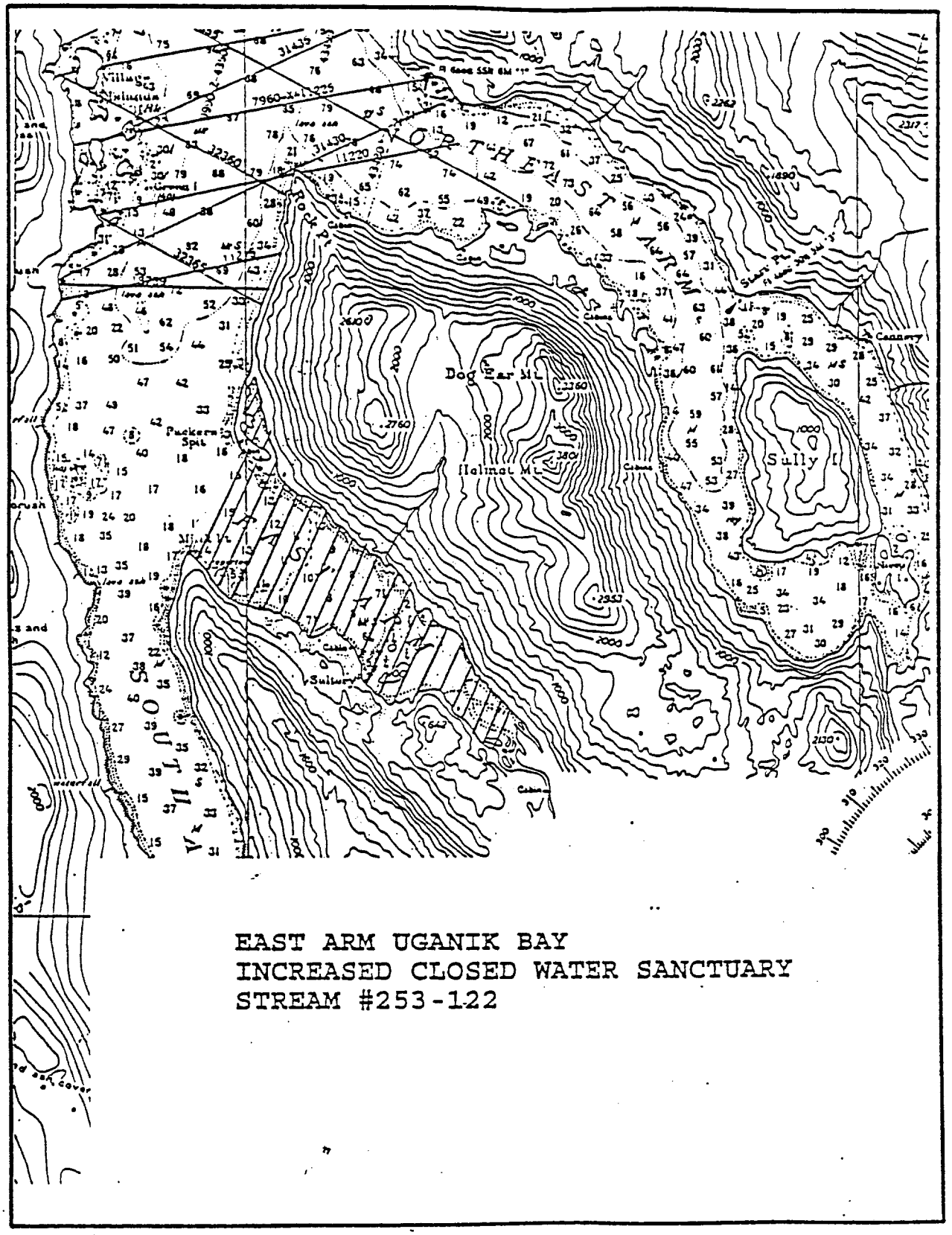
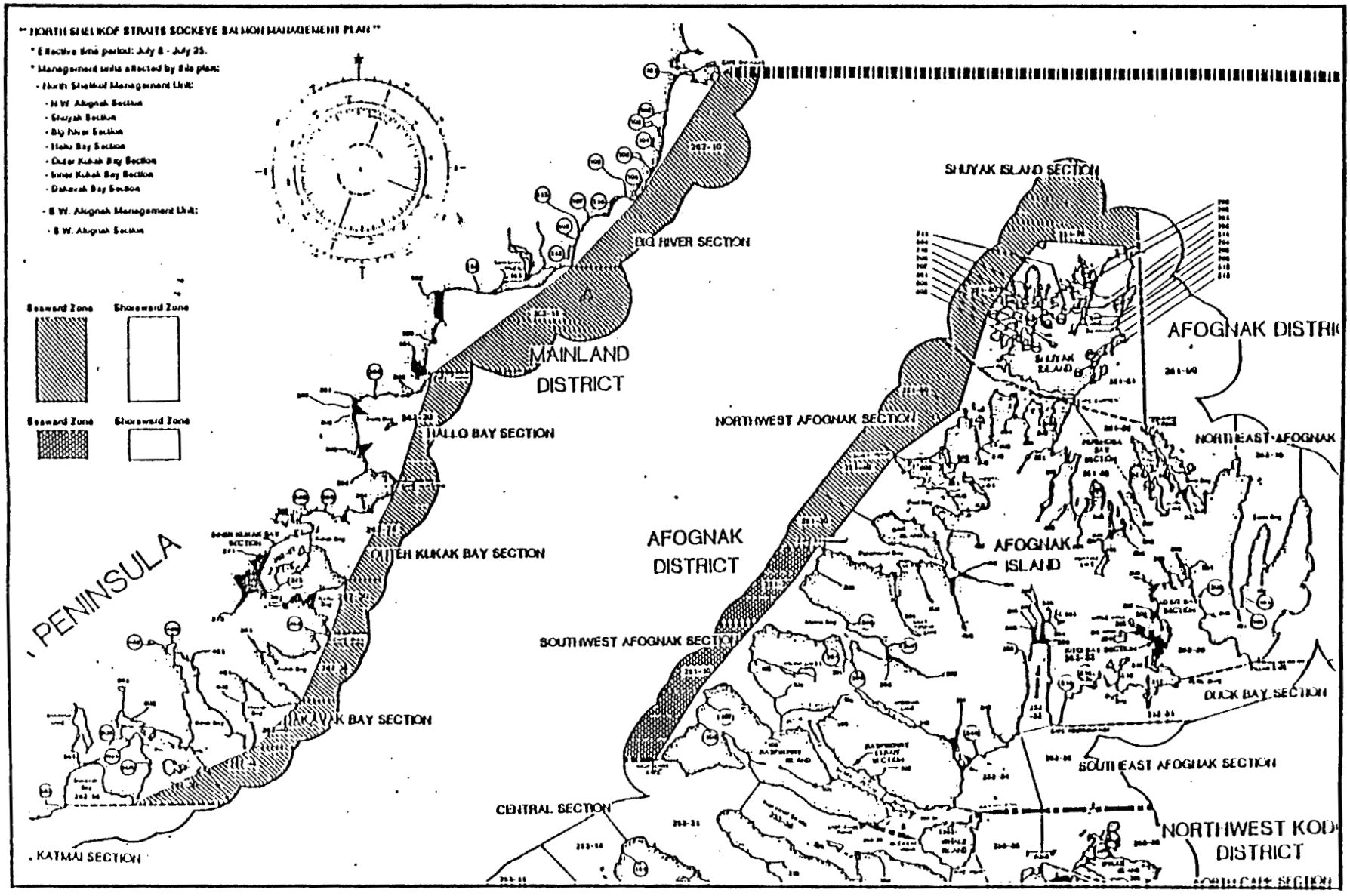
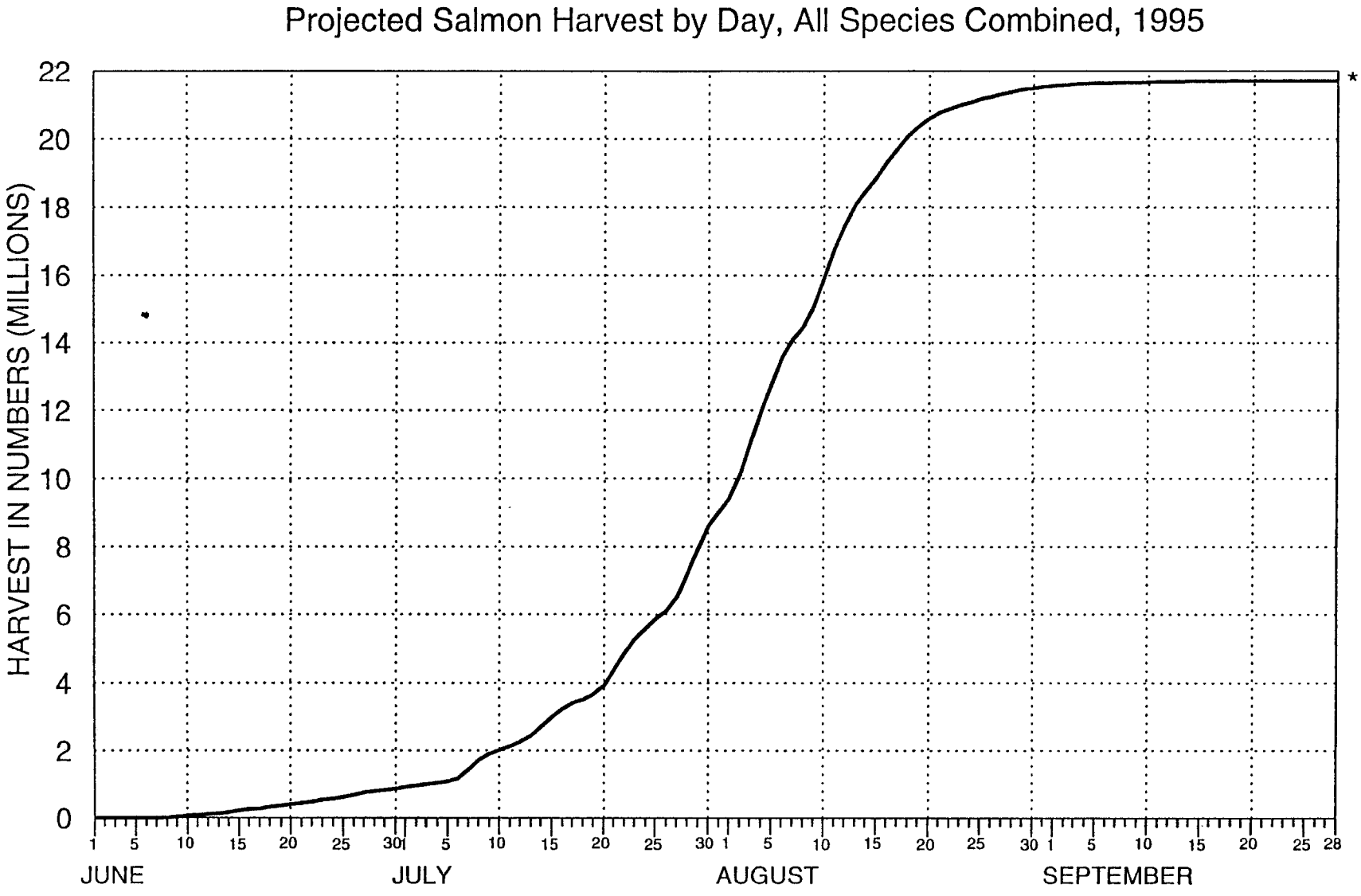


Figure 9. East Arm Uganik Bay increased closed water sanctuary, Kodiak Management Area, 1995.

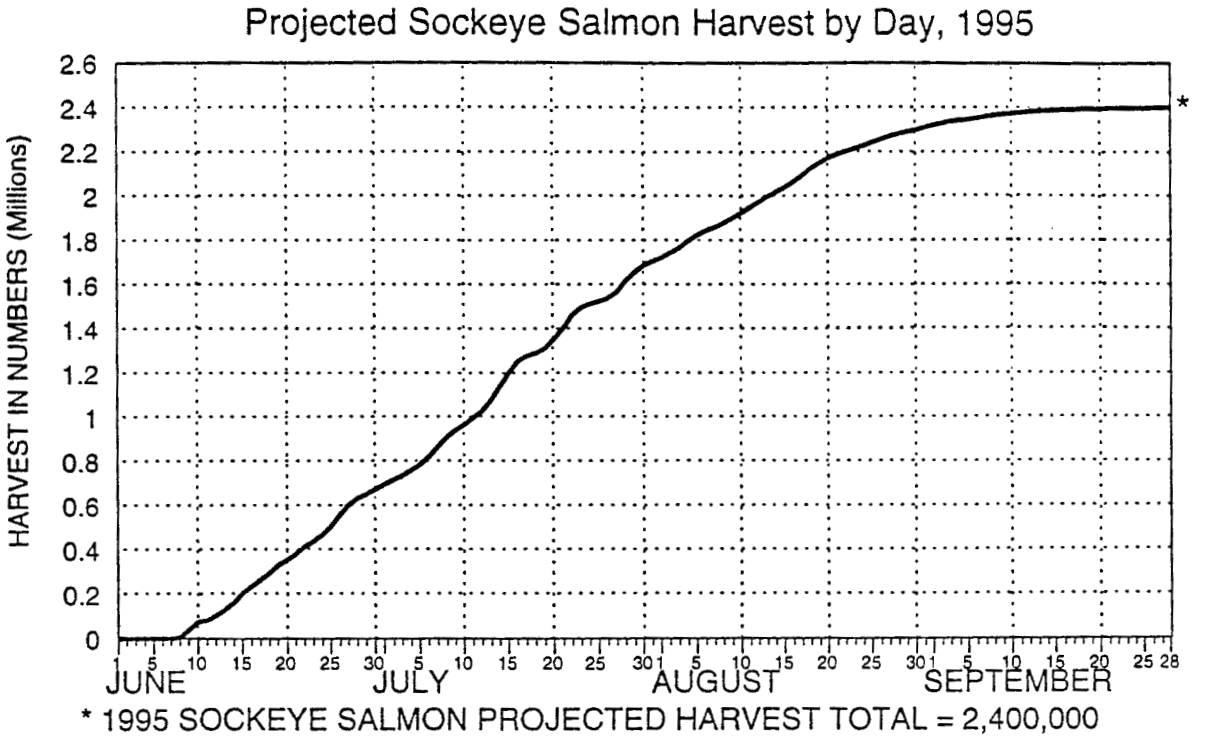


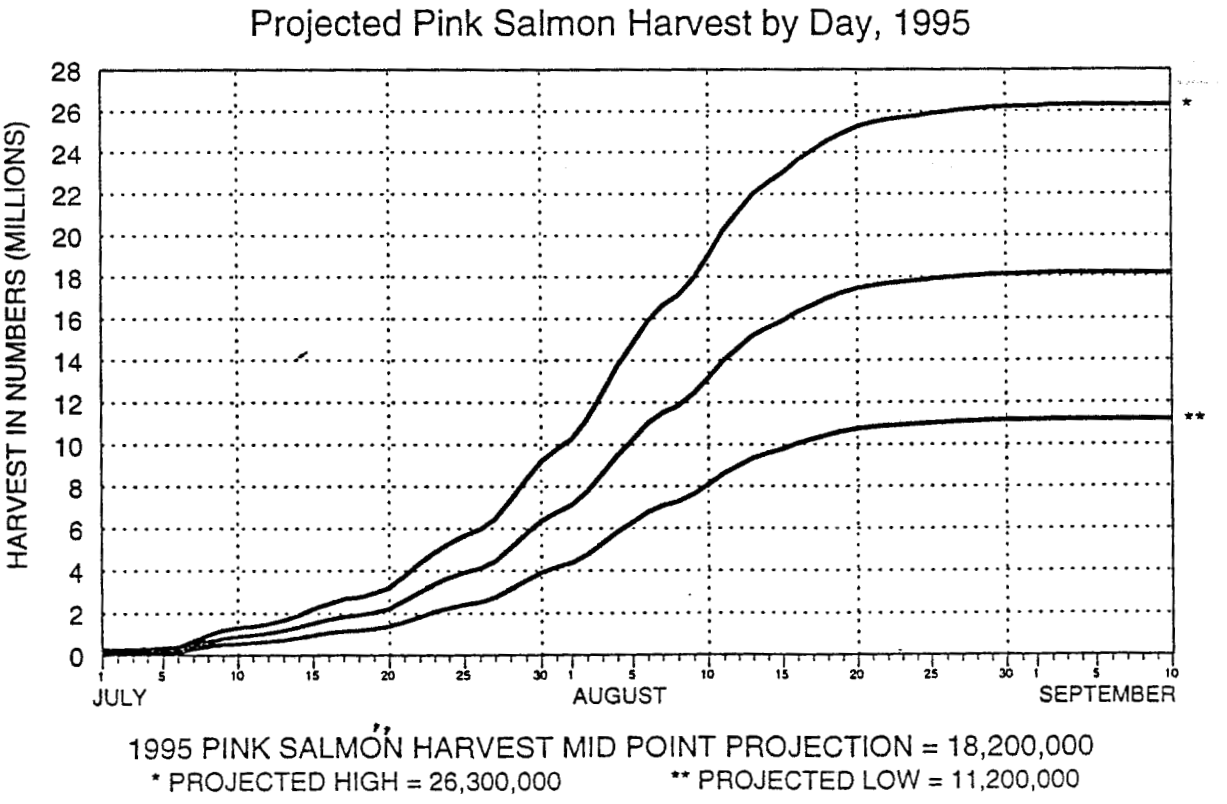
ɔure 10. Approximate boundaries of the "North Shelikof Strait Seaward Zone" and the "Southwest Afognak Seaward Zone" of the North Shelikof Strait Sockeye Salmon Management Plan for the Kodiak Management Area, 1995.

APPENDIX

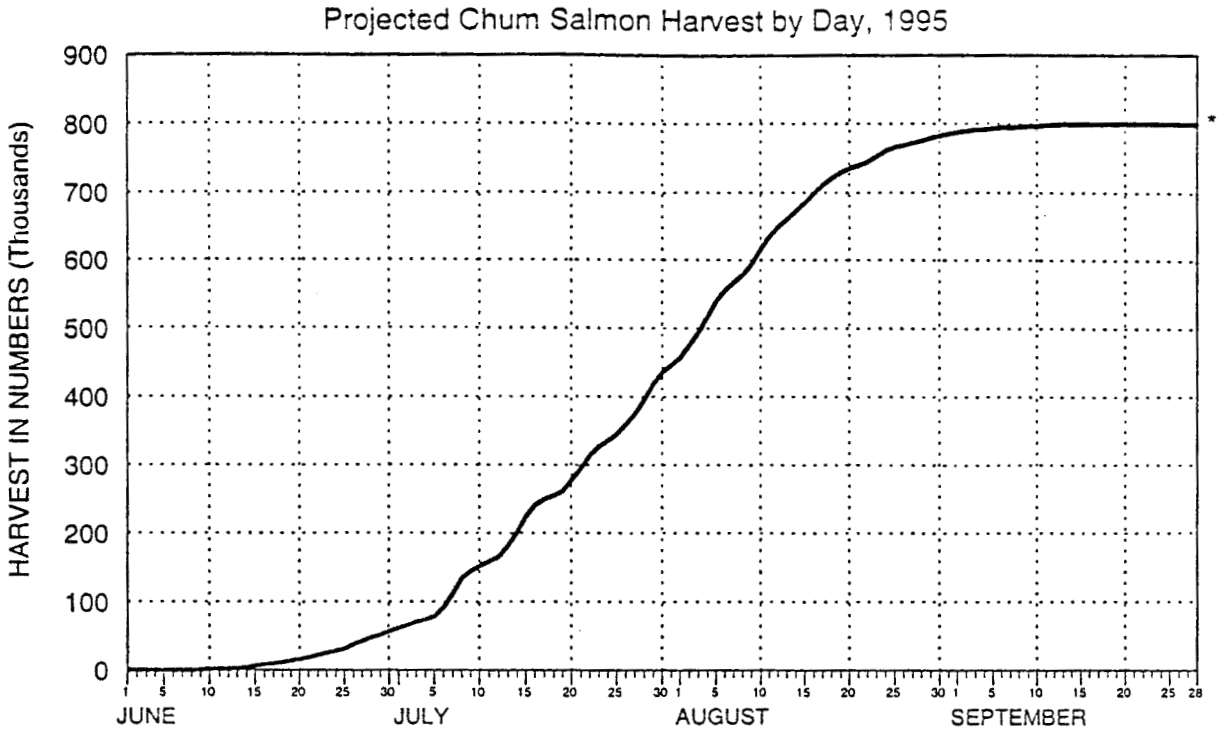


Appendix A.1. Projected salmon harvest curve, all species combined, for the Kodiak Management Area, 1995.

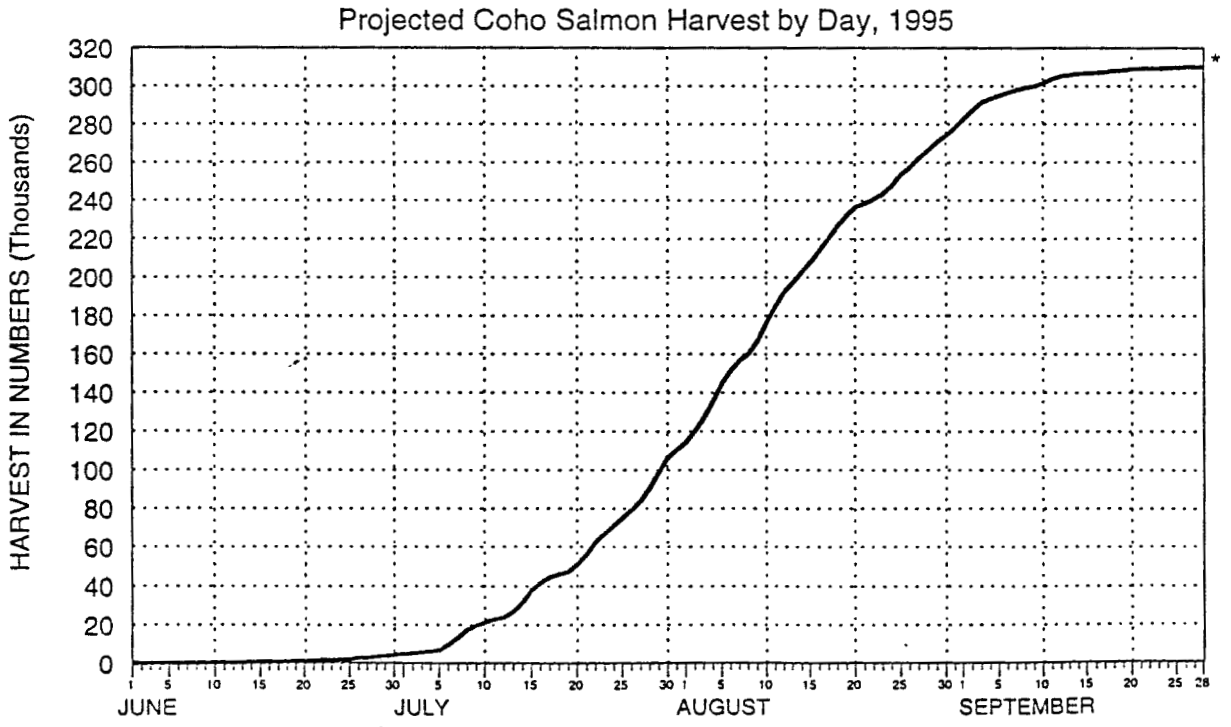




Appendix A.2. Projected sockeye and pink salmon harvest curves for the Kodiak Management Area, 1995.

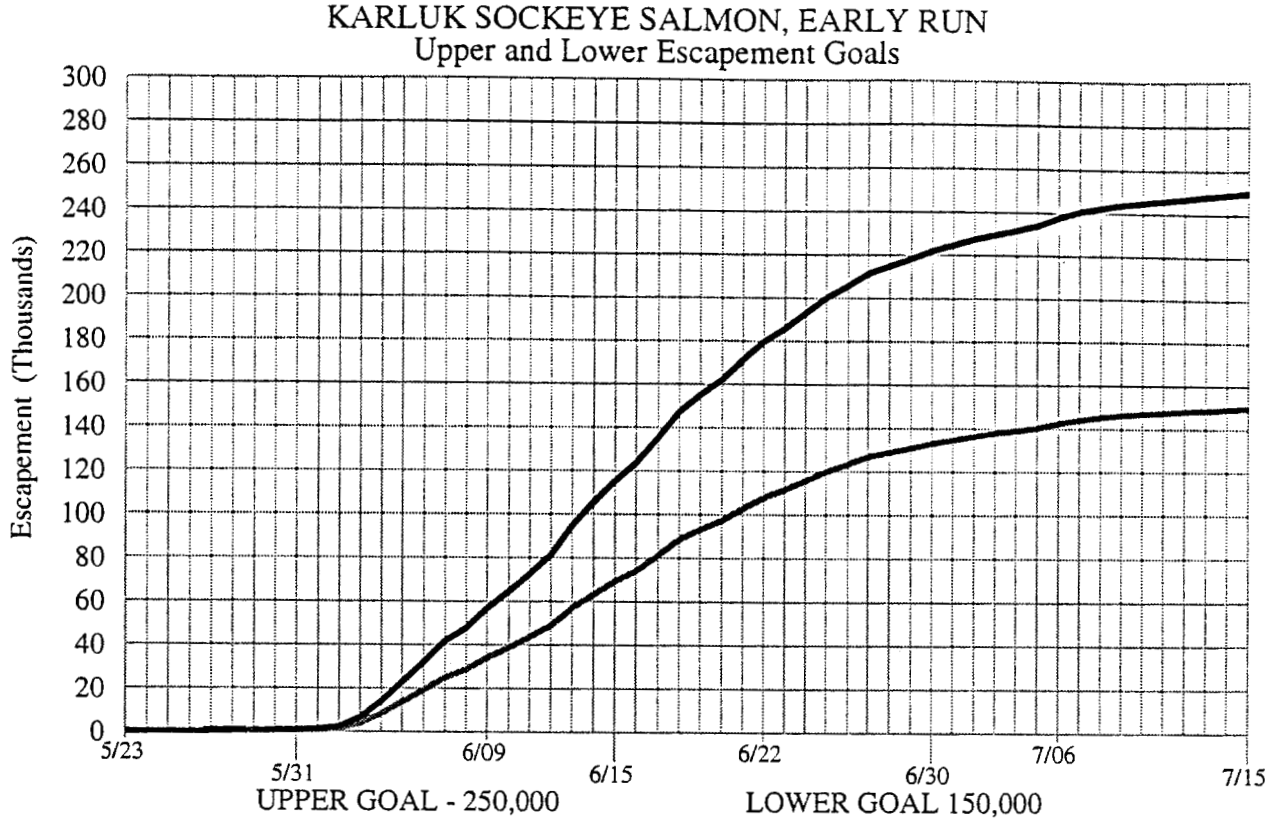


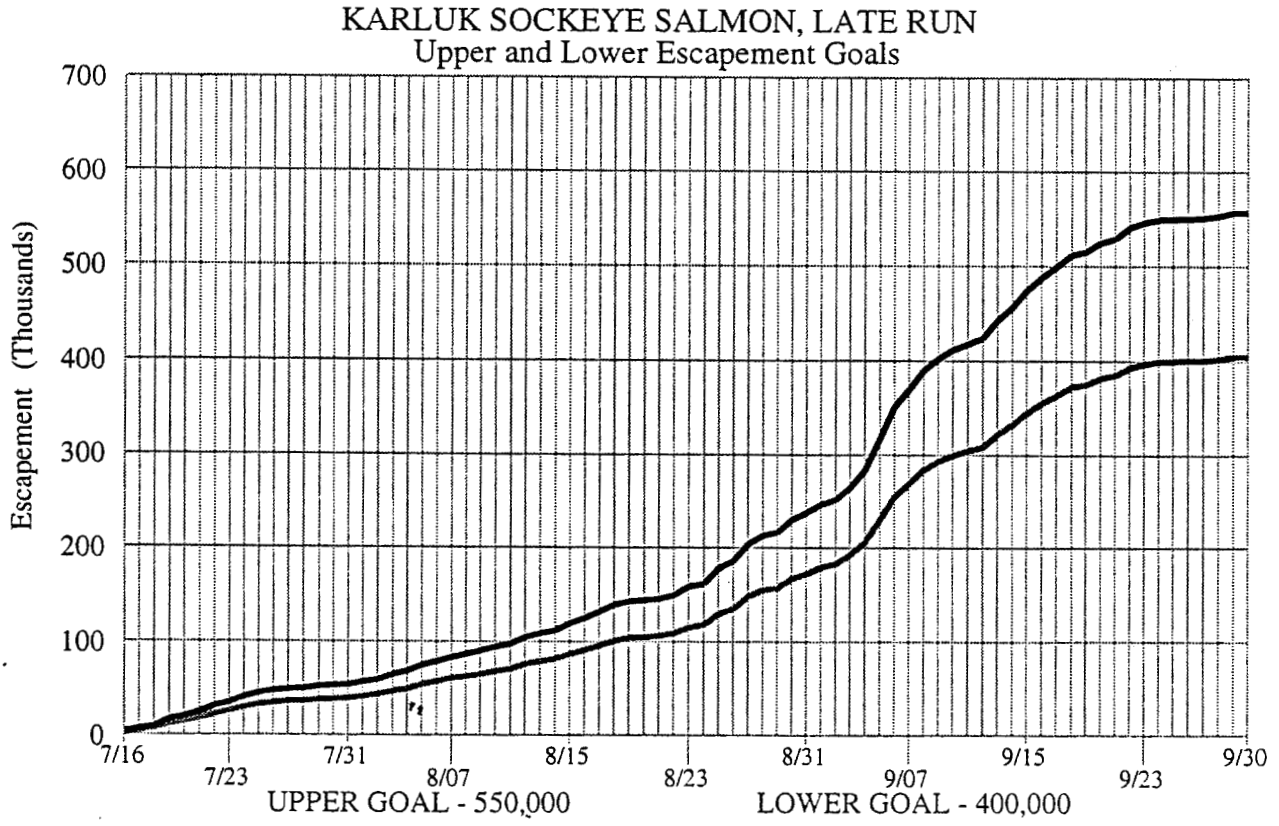
* 1995 CHUM SALMON PROJECTED HARVEST TOTAL = 800,000



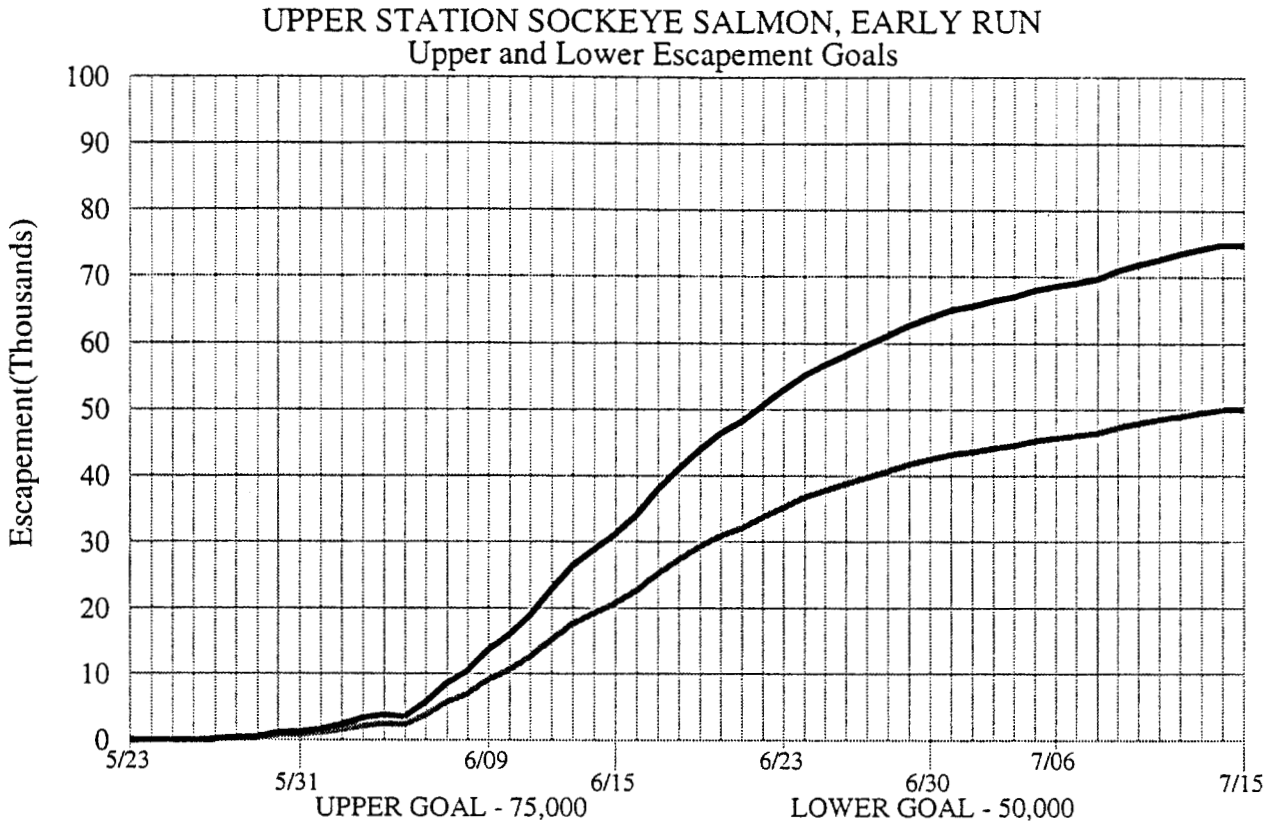
* 1995 COHO SALMON PROJECTED HARVEST TOTAL = 310,000

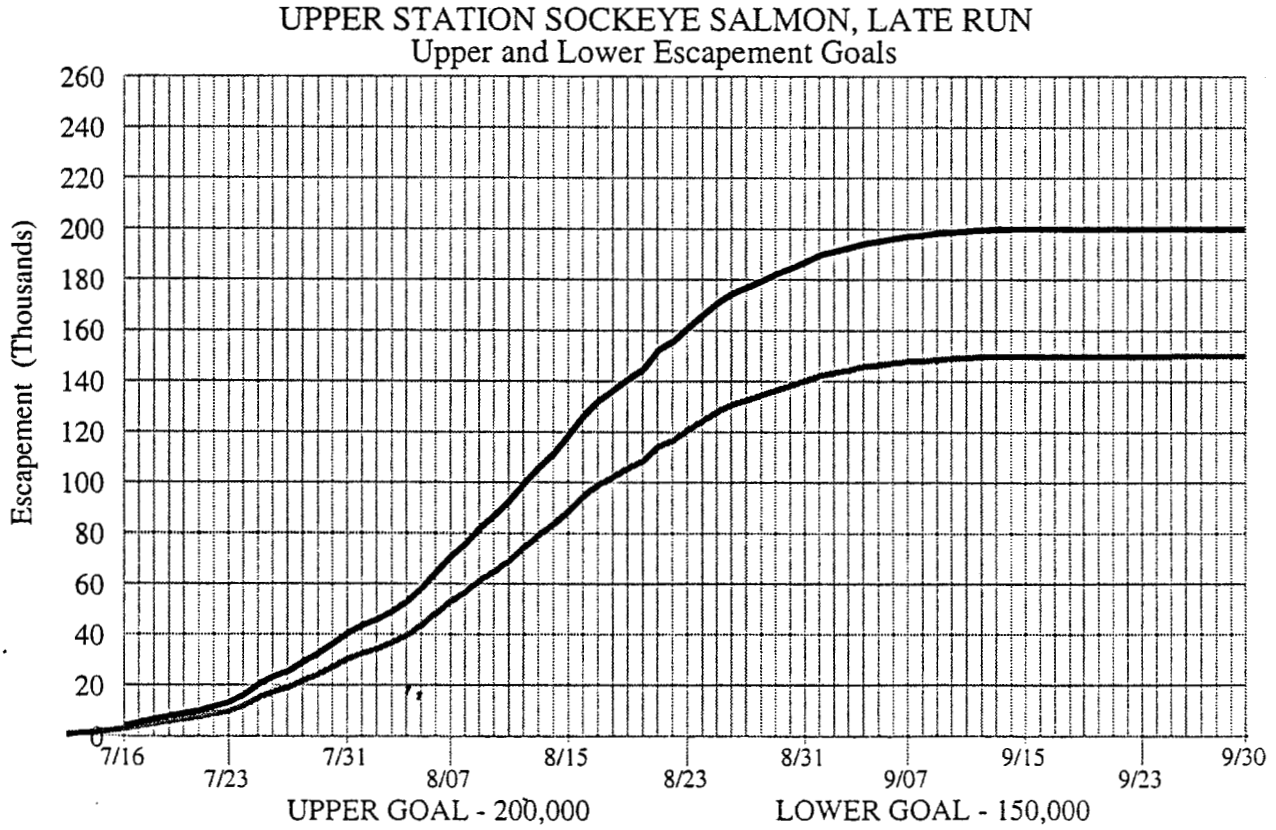
Appendix A.3. Projected chum and coho salmon harvest curves for the Kodiak Management Area, 1995.



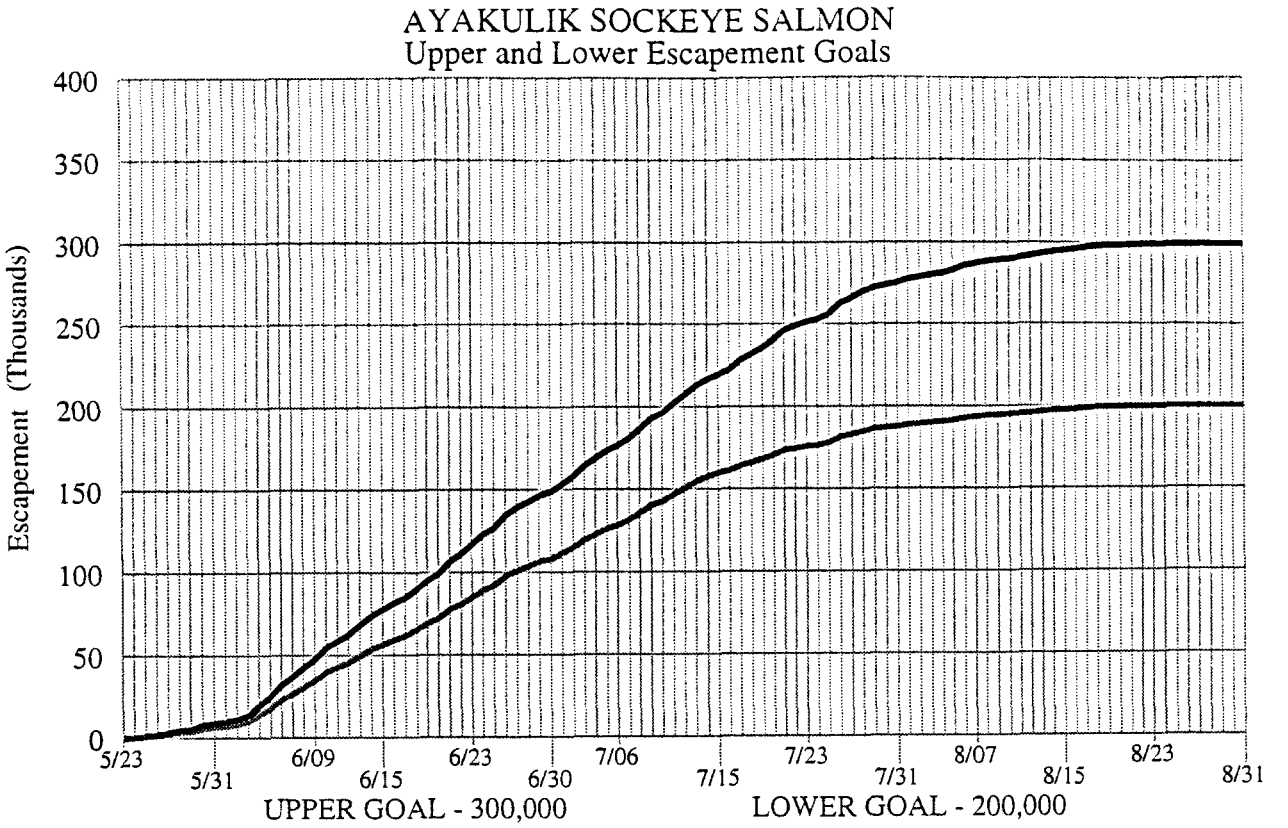


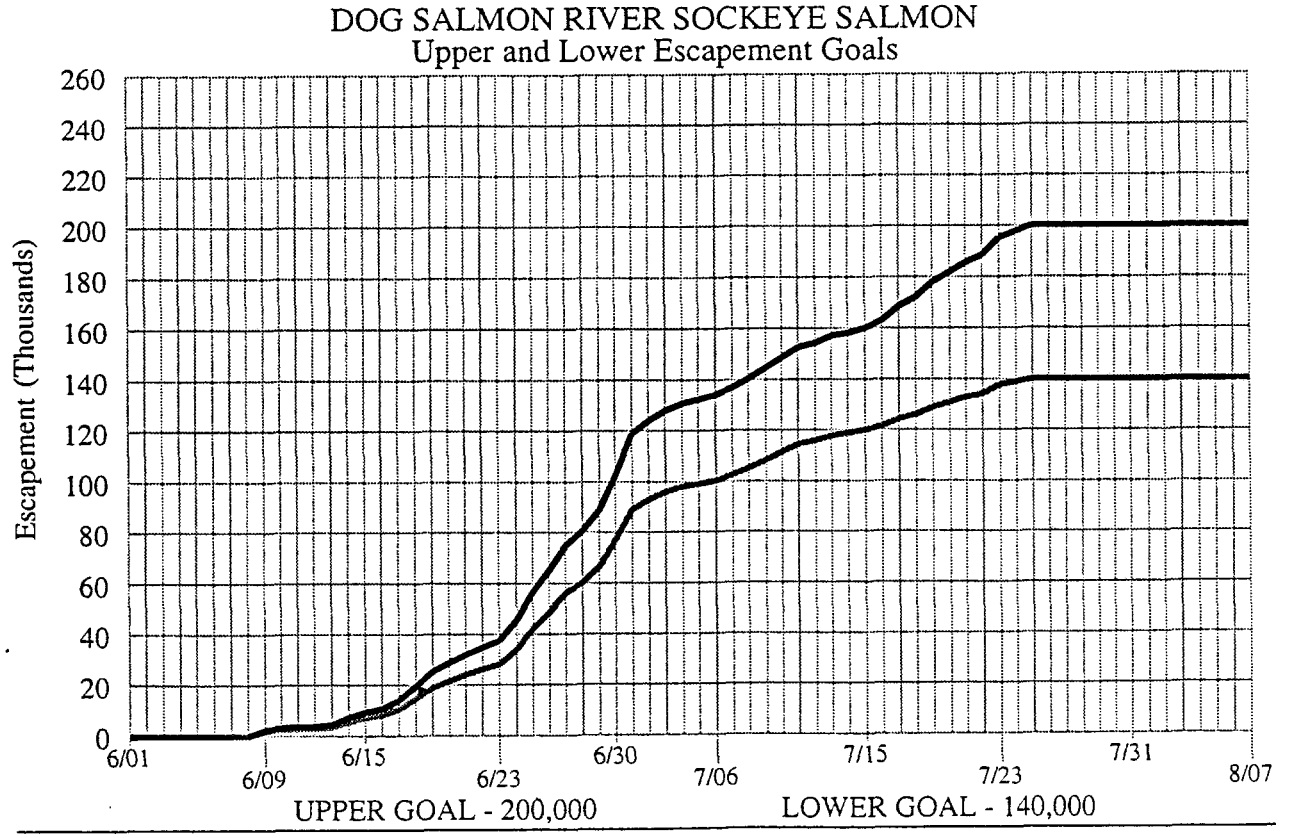
Appendix B1. Upper and lower escapement goal curves for the early and late run's of Karluk sockeye salmon in the Kodiak Management Area, 1995.



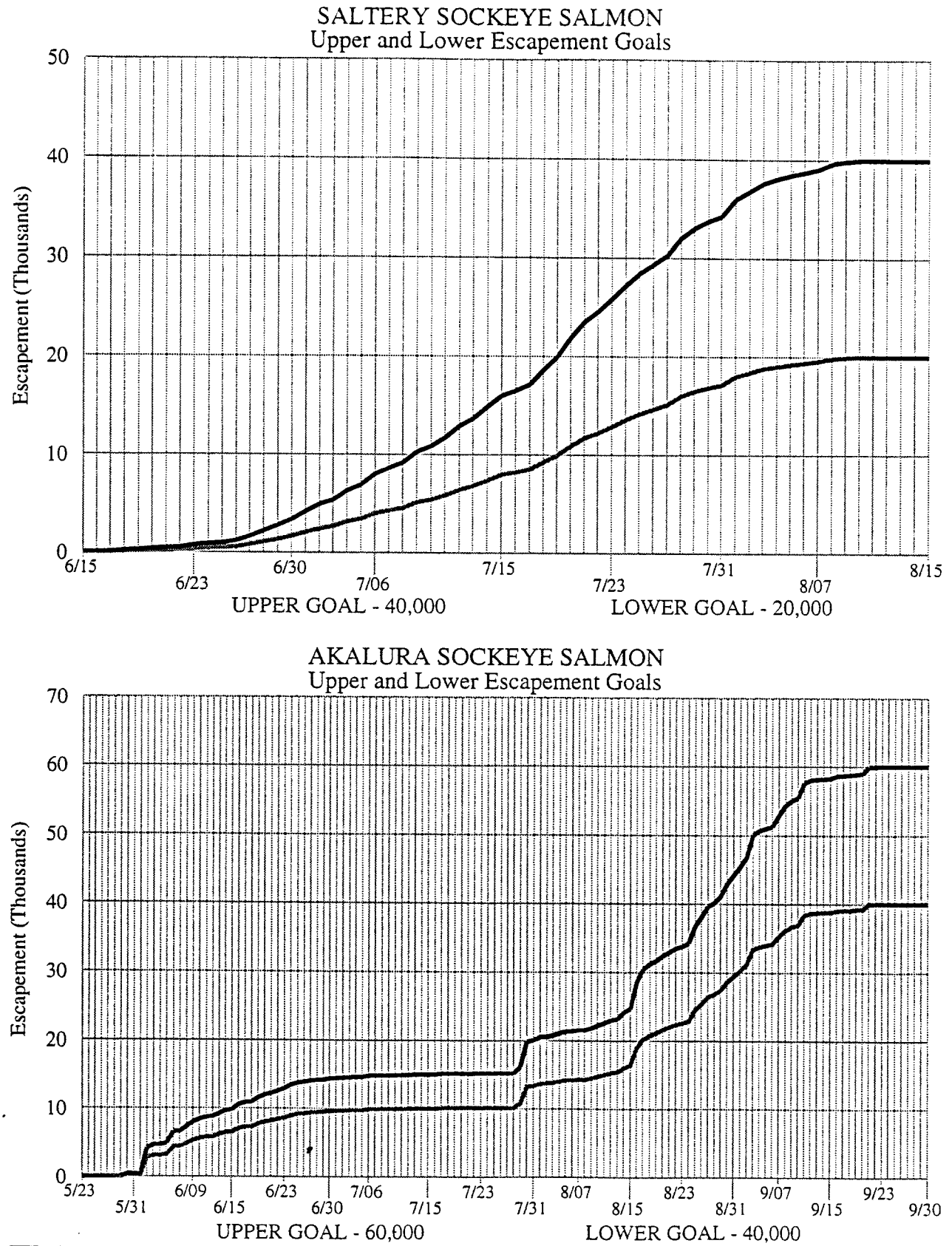


Appendix B.2. Upper and lower escapement curves for the early and late run's of Upper Station sockeye salmon in the Kodiak Management Area, 1995.

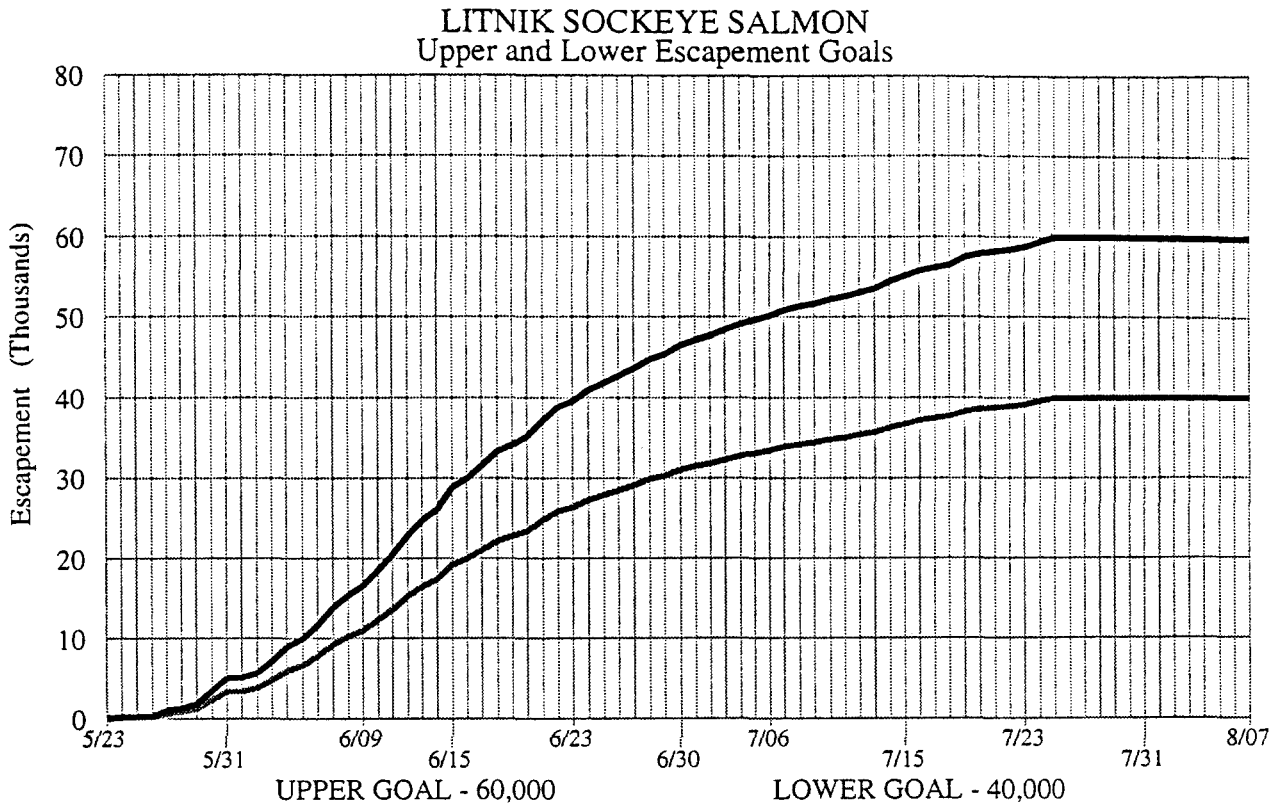


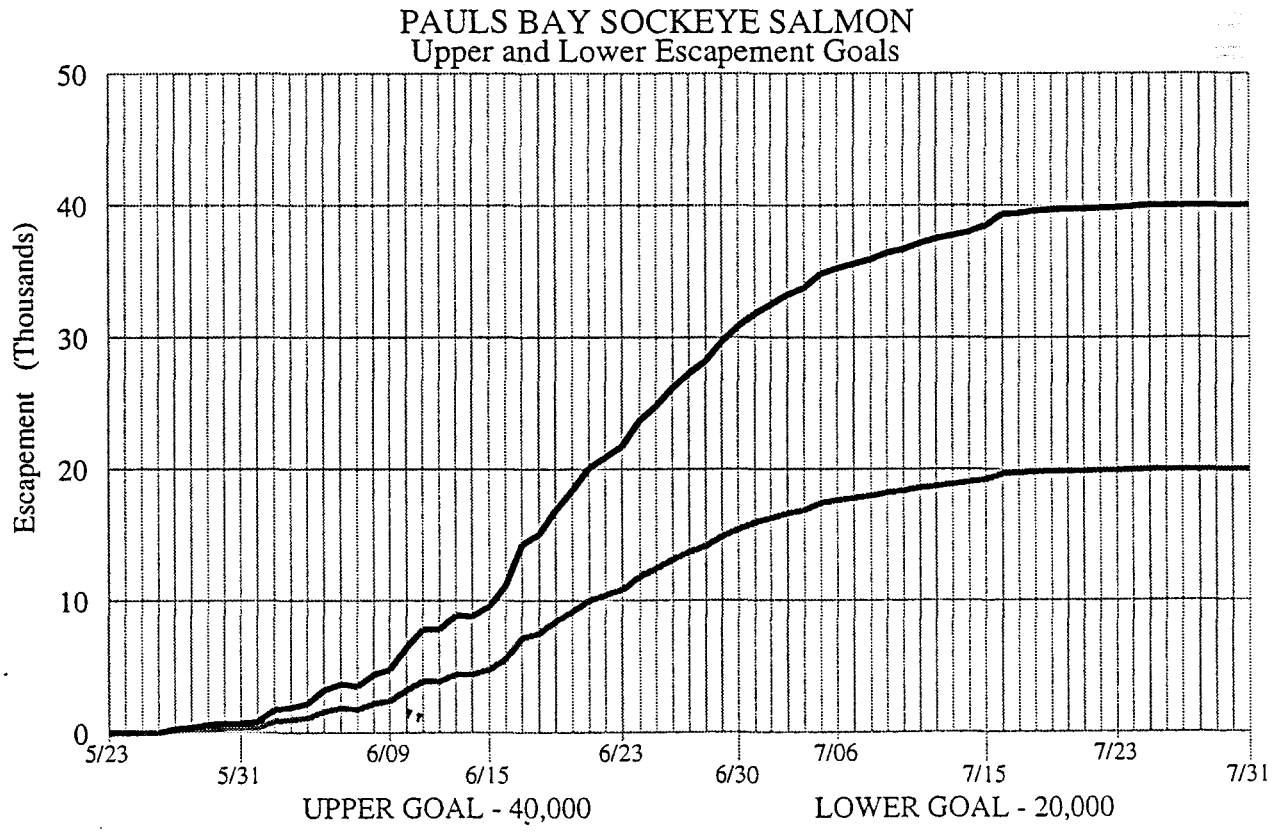


Appendix B3. Upper and lower escapement curves for the Ayakulik and Dog Salmon Rivers sockeye salmon in the Kodiak Management Area, 1995.



Appendix B.4. Upper and lower escapement curves for the Saltery and Akalura Rivers sockeye salmon in the Kodiak Management Area, 1995.





Appendix B.5. Upper and lower escapement curves for the Litnik and Pauls Bay sockeye salmon in the Kodiak Management Area, 1995.

DIVIDER

KODIAK MANAGEMENT AREA SALMON ESCAPEMENT SAMPLING

OPERATIONAL PLAN, 1995

Alaska Department of Fish and Game
Commercial Fisheries Management and Development Division
211 Mission Road
Kodiak, Alaska 99615

MAY 1995

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B. Kodiak Area Commercial Salmon Fishery Harvest Strategy, 1995 20

INTRODUCTION

Annually, sockeye salmon escapements are sampled for age, length, and sex from major and minor systems by field personnel within the Kodiak Management Area (KMA). Management and research biologists rely on this data for forecasting, escapement goal evaluation, catch apportionment, and run timing estimation. As the demand on our salmon resource increases, so does the intrinsic value of this data.

Stock identification projects using scale pattern analysis as well as age marker analysis have been conducted within the Afognak, NW Kodiak , SW Kodiak, Alitak Bay, and Mainland Districts. The foundation for these projects are the scale samples that are collected. It is imperative that scales collected be of the highest quality possible. In recent years, an attempt was made to use average weights as a possible method of stock separation by area. Fish ticket weights were used as individual fish weights by system were not available. In order to evaluate length-weight relationships by system throughout the KMA area, weights will be taken along with ALS at seven locations during 1995.

GOAL

Provide improved management of the Kodiak Management Area salmon runs by optimizing escapement requirements thereby insuring maximum harvest opportunities.

OBJECTIVES

1. Construct accurate brood tables (spawner-recruitment relationships).
2. Develop accurate run forecasts.
3. Evaluate escapement goals and accurately define run timing.
4. Provide samples suitable for scale pattern analysis as required for addressing mixed stock fishery issues.
5. Evaluate length-weight relationships at Afognak, Spiridon, Karluk, Ayakulik, Upper Station, Frazer, and Saltery Rivers.

TASKS

1. Collect representative age, length, and sex data from all major and selected minor sockeye salmon systems within the KMA.

2. Collect a mixed assortment of weight data from selected sockeye salmon systems within the KMA.

SUPERVISION

Regional Finfish Research Supervisor, Charles Swanton will supervise escapement sampling at Frazer Fishpass and Akalura weir. All other KMA escapement crews will be directly supervised by Kodiak Management Area staff. Regional Salmon Research Biologist, Patricia Nelson will monitor weekly escapement sampling and review incoming data for quality, quantity, and timeliness. A log book will be maintained tracking weekly samples, and weir crew leader's will be notified periodically regarding data quality.

PROCEDURES

Weekly sockeye salmon escapement sampling for age, length, weight, and sex (ALWS), will be conducted at Karluk River, Upper Station, Ayakulik River, and Frazer Lake (Figure 1). Samples will be collected using a live box trap (Figure 2) according to the schedules in Table 1. If the required number of fish are not taken within a single day, obtain the balance of the sample on the following day.

Minor systems will be sampled with reduced intensity following the sampling schedule in Table 1. Litnik (Afognak) weir personnel will collect two 480 fish ALS samples from both early and late sockeye run components. Additionally, 200 individual fish weights (100 male and 100 female) will be collected from the early and late run components. Two 480 fish ALS samples from both early and late sockeye run components will be collected at Akalura weir. A single 480 fish sample will be collected at the Saltery weir during the peak escapement and 200 individual fish weights will be measured (100 male and 100 female). Sport Fisheries Division (S.F.D.) personnel will sample the Buskin River sockeye escapement with a goal of 140 fish every two

weeks, for six weeks (sample size specified by S.F.D. biometrician). S.F.D. will similarly sample the Buskin River sockeye subsistence harvest. Development section personnel will collect ALS data from Malina Lake, Little Kitoi, and Pauls Bay following the sampling schedule presented in Table 1. Additionally, samples for ALWS will be collected at the Telrod Cove Terminal Harvest Area with a targeted sample size of 240 ALS and 30 weight samples (15 males and 15 females) per week.

It is essential that all ALS data be representative of the true escapement, therefore avoid bias by NOT pre-selecting fish based upon size, sex, condition or any other factor. Sampling and recording procedures are presented in Appendix A. **Weight samples on the other hand should not be random**. It is important that we obtain the greatest variety of lengths available at each system. Therefore, try to sample the smallest and largest fish during the sampling period as well as a wide variety of lengths between the largest and smallest fish. Weights are to be measured using a Chatillon spring scale to 25 lbs. Weigh fish to the nearest 0.25 lb and record weight on the back of the AWL form (right side). Check calibration of scale before use and periodically during the season using a 3 lb can of coffee. Remember that we are evaluating weight at length so take care to ensure that each weight corresponds to the appropriate length. Specific procedures for collecting and recording weight data are described in Appendix A.

DATA REPORTING

Crew leaders will notify Dave Prokopowich, Kevin Brennan, or Dennis Gretsch via SSB radio upon completion of weekly sampling. Karluk weir will mail completed ALS data to Kodiak (return receipt from the Karluk village post office), and notify the office of the mailing date (via radio). All other field camp personnel will send completed samples back to town on return grocery flights. These packages should be clearly labeled to include: system, sample dates, and Attn.: Patti Nelson. The pilot should be notified to call Fish and Game at 486-1855 for package pick up.

Table 1. Sockeye salmon escapement sampling schedule, 1995.

Location	Sampling Frequency	Date Starting	Date Ending	ALS Sample Size	Weight Sample Size
Akalura weir (early)	once	May 15	Jul 15	480	N/A
Akalura weir (late)	once	Jul 16	Sep 15	480	N/A
Ayakulik weir	weekly	May 30	Sep 30	240	30
Buskin Lake weir[a]	biweekly	Jun 01	Aug 01	140	N/A
Buskin Subsistence Harvest[a]	biweekly	Jun 01	Aug 01	140	N/A
Frazer Fishpass	weekly	Jun 15	Aug 30	240	30
Karluk weir	weekly	May 30	Sep 30	240	30
Litnik (Afognak) weir (early)	once	Jun 07	Jun 15	480	200
Litnik (Afognak) weir (late)	once	Jul 14	Jul 20	480	200
Malina Lake weir[b]	intermittently	Jun 01	Aug 15	600	N/A
Little Kitoi[b]	intermittently	Jun 01	Aug 15	600	N/A
Pauls Bay[b]	biweekly	Jun 06	Jul 03	200	N/A
Saltery River weir	once	Jul 07	Jul 20	480	200
Upper Station	weekly	Jun 06	Sep 30	240	30
Telrod Cove[b]	weekly	Aug 01	Sept 15	240	30

[a] Sampled by Sport Fish Division (sample size determined by S.F. Biometrician).
[b] Sampled by Development Section personnel.

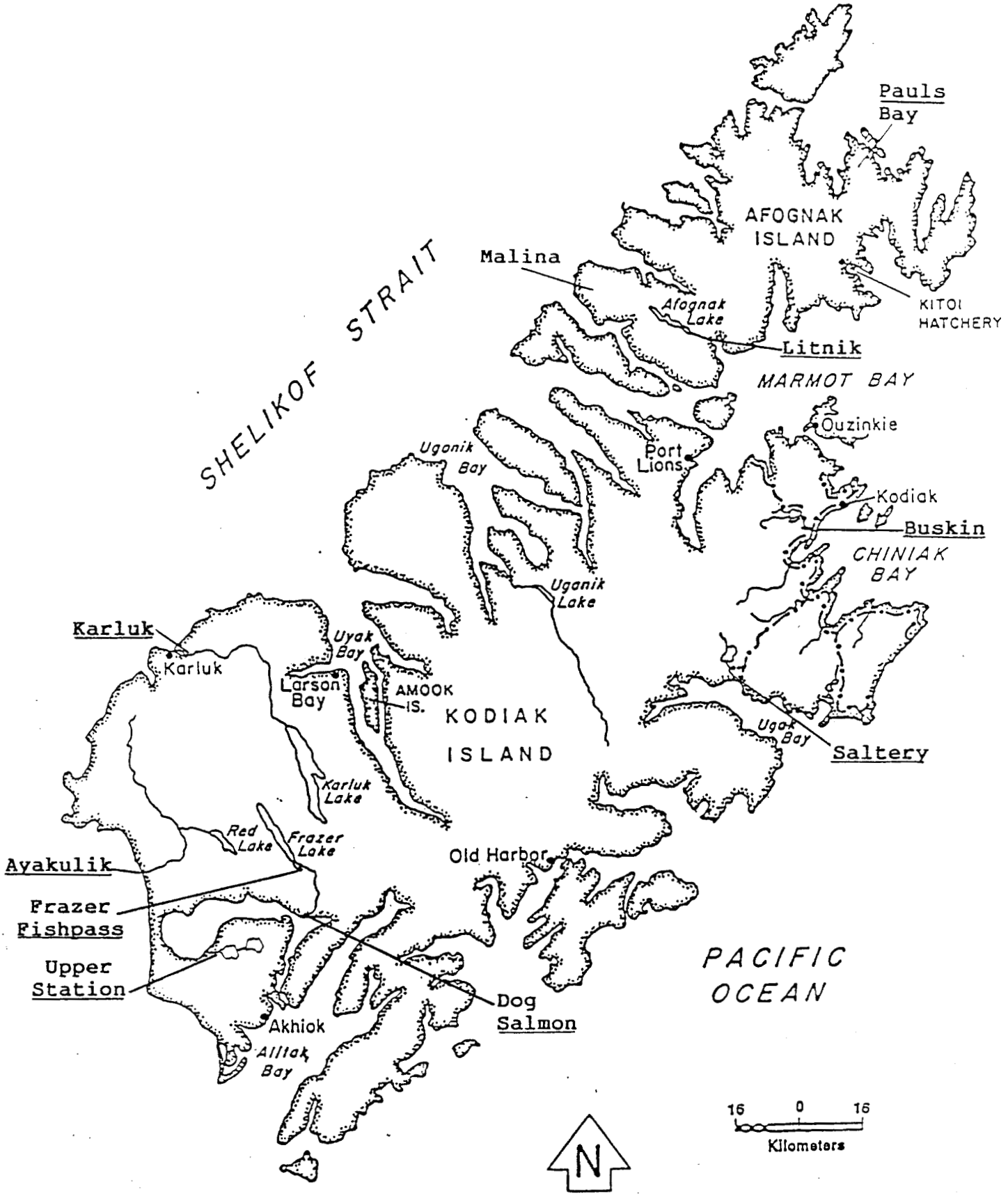


Figure 1. Location of salmon weirs in the Kodiak Management Area.

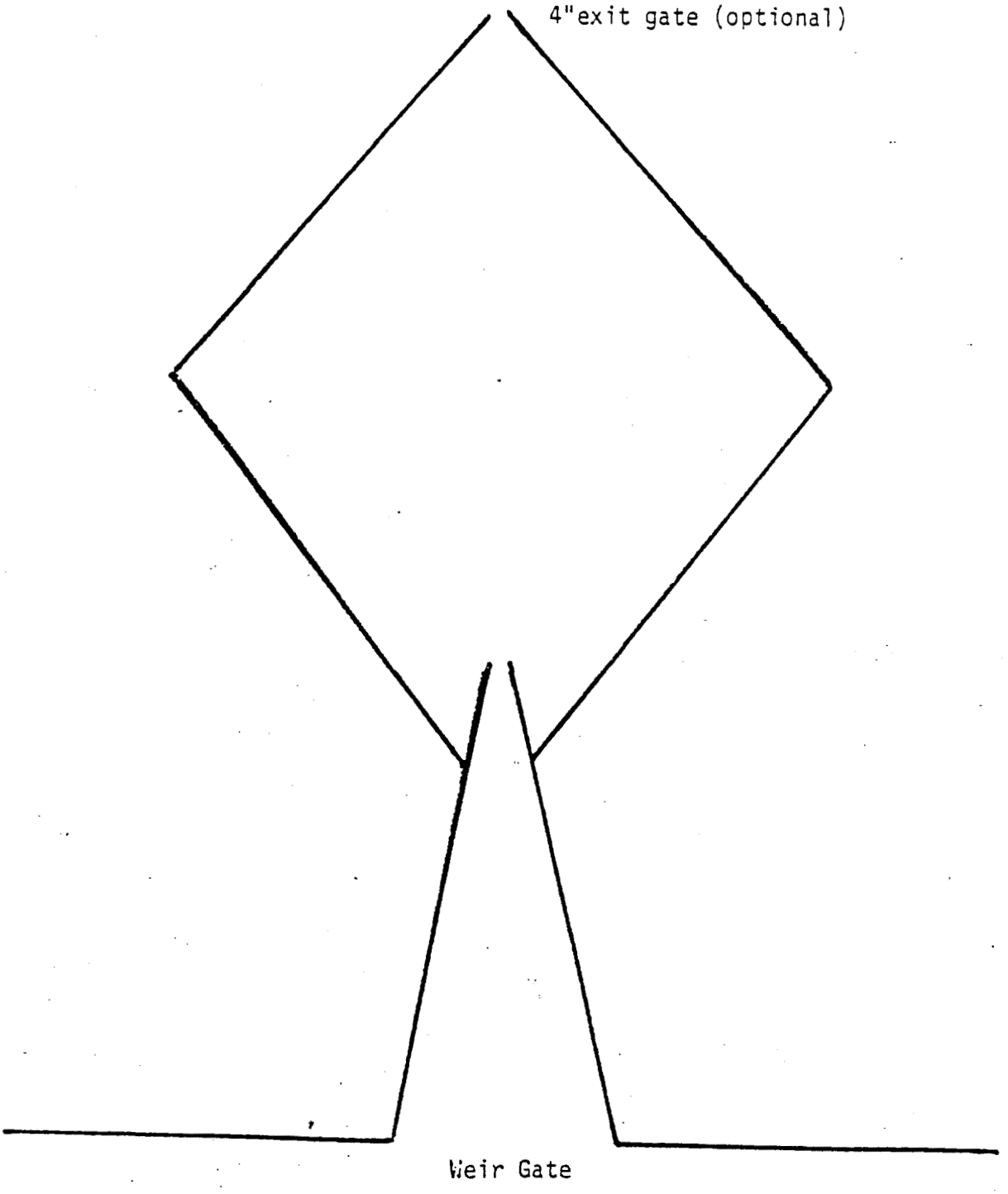


Figure 2. The "Scott" six panel salmon trap.

APPENDIX A

Procedure for Sampling Adult Salmon for age, length, weight, and sex

Annually, salmon escapements and catches are sampled for age (scales), length, and sex (ALS) by field crews throughout the state. This database is essential for sound management of the State's salmon resources.

To be useful, data must be recorded on the mark-sense (AWL) forms neatly and accurately. Scale samples must be collected and mounted properly to ensure accurate age determination. The following procedures are to be adhered to when sampling for age, length, weight, and sex.

COMPLETING THE AWL FORMS:

A completed AWL form and accompanying gum card for sampling sockeye and chum salmon are shown in Appendix A.1-2.

Complete each section on the left side of the AWL form using a No. 2 pencil and darken the corresponding blocks as shown in the figures. Make every effort to darken the entire block as partially filled blocks are often missed by the optical scanner which reads and records the data from the AWL forms. Label only one form at a time to avoid a "carbon paper effect" resulting in stray marks.

Description:
Record the following: species/area/catch or escapement/gear type (seine, weir, etc.)/samplers

Card:
The AWL forms and corresponding gummed card(s) are numbered sequentially by date throughout the season starting with 001. A separate numbering sequence will be used for each species, district, and geographic location. Consult your port supervisor for the current card number. Sockeye scale samples will have only 1 gum card per AWL form as shown in Appendix A.1.

Species:
Refer to the reverse side of the AWL form for the correct digit.

Day, Month, Year:
Use appropriate digits for the date the fish are sampled; for catch sampling, use the date the fish were caught.

District:
List only one district. Consult area statistical map or project leader for appropriate district.

Subdistrict (Section):
List a single subdistrict if it is known and if all the potential samples were caught in that section. If more than one section is involved, list each section but do not darken the corresponding blocks. Leave blank if the section is unknown.

Stream:
Leave blank for catch sampling; escapement sampling consult area statistical map for appropriate stream number.

Location:
List the appropriate code as shown on Appendix A.3.

Period:
List the period in which the fish were caught (Appendix A.4.).

Project and Gear:
Refer to the reverse side of the AWL form for the correct code.

Mesh:
Leave blank unless specifically instructed by supervisor to do otherwise.

Type of length measurement:
Use (2) mid-eye to fork-of-tail. Refer to Appendix A.5.

# of cards:
Mark 1 (each AWL form in individually numbered).

Keep the litho codes in numerical order throughout the season and keep the AWL forms flat, dry, and clean. Fish gurry and water curling will cause data to be misinterpreted by the optical scanning machine. It is the crew leaders responsibility to make sure that all forms are carefully edited before returning them to your supervisor.

GUMMED CARDS:

Fill out the gum cards as shown in Appendices A.1

Species:
Write out completely (sockeye) and fill in appropriate number (2).

Locality:
For catch and escapement sampling, write down the area in which fish were caught, followed by catch or escapement (e.g. Karluk River escapement; Uganik Bay catch).

Stat. code and Sampling date:
Transfer the appropriate digits from the AWL form.

Gear:
Write out completely.

Collector(s):
Record the last names of person(s) sampling.

Remarks:
Record any pertinent information such as number of scales per fish sampled, vessel/tender name, etc. Transfer this same information to the top margin of the AWL.

SAMPLING PROCEDURE:

A. GENERAL

1. Place the fish on its right side to sample the left side.

2. Determine sex of the fish and darken M or F in the sex columns. If any difficulty is encountered with this procedure, write "I had trouble sexing these fish" on the top margin of the AWL and ask your supervisor for help as soon as possible before sexing additional fish.

3. Measure fish length in millimeters from the mid-eye to fork-of-tail (Appendix A.5). Record length by blackening the appropriate column blocks on the AWL form. Column 3 on the AWL form is used for fish with a length greater than 999 millimeters (Chinook). Measure all species of salmon to the nearest mm. Check the calipers periodically to ensure measurement accuracy. **When escapement sampling, take care to ensure that each length corresponds to the appropriate scale mounted on the gummed card as length at age is evaluated for each sample.**

4. Remove the "preferred scale" from the fish by grasping its exposed posterior edge with forceps and pulling free. Remove all slime, grit, and skin from the scale. The "preferred scale" is located on the left side of the fish, two rows above the lateral line on the diagonal from the posterior insertion of the dorsal fin to the anterior insertion of the anal fin (Appendix A.6.). If the "preferred scale" is missing, select a scale within the preferred area on either the left or right side of the fish. If no scales are present in the "preferred area" on either side of the fish, sample a scale as close to the preferred area as possible and darken the 8 under "age error code" on the AWL form. Do not select a scale located on the lateral line.

5. It is important to take care that scales adhere to the card, rough side up. Therefore, without turning the forceps over, clean, moisten, and mount the scale on the gummed card with your thumb or forefinger. Exert just enough pressure to spread and smooth the scales directly over the number as shown in Appendix A.6. The ridges on the sculptured side can be felt with a fingernail or forceps. Mount scale with anterior end oriented toward top of gum card. All scales should be correctly oriented on the card in the same direction (Appendix A.7.).

6. Once the length and sex have been recorded, and the scale has been collected, slide the fish into the weighing sack provided, hang it from the scale and record the weight in pounds on

the back side of the AWL form (to the nearest 0.25 lbs). If weights are recorded on the back of an AWL form, transfer the litho code to the appropriate column. A completed back side of an AWL form is illustrated in Appendix A.2. **Keep in mind that not all fish will be weighed. The minimum sample size is 15 males and 15 females per week. If the process goes smoothly and you can collect more weights (25 per sex), this would be greatly appreciated.**

7. Repeat steps 1 through 4 for up to 40 fish on each AWL form.

8. When sampling at weirs you may use write in rain books to record the data. Keep the mark-sense forms in camp where they will be clean, dry, and flat. After sampling is done for the day transfer the data to the mark-sense forms. **Each length, sex, scale and weight must correspond to a single fish! It is the responsibility of the crew leader to be sure the data has been transcribed correctly and the AWL forms filled out completely.** Log books containing length, weight, and sex data should be returned to Patti Nelson at the end of the season.

SCALE SAMPLING CHECKLIST

OPERATIONAL PLAN	PENCILS (NO. 2)
GUM CARDS	FORCEPS
AWL FORMS	PLASTIC CARD HOLDERS
CALIPERS	CLIPBOARD
SPRING SCALE	WEIGHING SACK

SOME REMINDERS

1. For greater efficiency in scale reading and digitizing, mount scales with anterior end toward top of scale card.

2. AWLs should be carefully edited. Re-check header information on AWLs; make sure all available information is filled in. Take extra care to use the correct period code for the sampling or catch date. AWL numbers should not be repeated; a frequent error is to begin a week's sample with the last AWL number used the week before. This is particularly important if the data is regularly sent to town; it is easy to forget which AWL numbers were used. Crew leaders should take time to ensure that the boxes are being blackened correctly, if the boxes are sloppily marked the optical scanner records the information incorrectly or misses it entirely. Keep pencil marks within each block, filling it completely.

3. Transfer important comments from scale cards to AWLs. After pressing scales, the cards are seldom referred to again, and important remarks can be lost. Write comments in the top right margin. If there is not room on the AWL to completely explain the remarks, use a separate piece of paper.

4. Never put data from different dates on one AWL or one scale card. Even if only one scale is collected that day, begin a new AWL and gum card the next day.

5. If weights are taken, they may be noted in the right margin of the AWL during sampling, but **be sure to transfer the weights and litho code to the appropriate columns on the reverse of the AWL before submitting it to your supervisor**.

6. The data processing program uses the "litho code" on the AWL. (It is located in the lower left margin of the AWL.) Try to keep the litho codes in numerical order. This should not be hard to do if they are arranged that way before page numbering. Those who sample different areas throughout the season can arrange the litho codes in order before each sample is taken.

7. If AWLs get wrinkled or splotched they should be transcribed onto a new AWL prior to sending in. The optical scanning computer will misread or reject wrinkled sheets. Do not use paperclips on AWL forms.

8. Be careful when collecting and mounting scales in wet conditions (rain, high humidity, etc.) Glue often obscures scale features and scales frequently adhere poorly to wet card. Protect the cards, keep them dry to avoid having to remount the scales on a new card.

9. Scan the AWL form for mistakes. A common error occurs, for instance, in placing both the 4 and 7 of a 475mm fish in the 100's column with nothing in the 10's column.

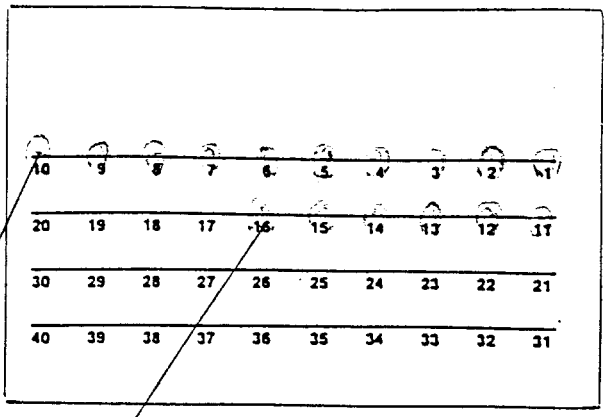
10. Record all comments explicitly on the gum card under remarks and transfer remarks to the top margin of the AWL form.

11. Responsibility for accuracy lies first with the primary data collector(s). The port supervisor will return sloppy or incomplete data to individual collectors for correction.

Gum Card front side

16 scales collected
Gum Card back side

Species: SOCKEYE Card No: 014
Locality: FRAZER ESC.
Stat. Code: 257-40-403-___
Sampling Date: Mo. 06 Day 07 Year 95
Gear: WEIR / TRAP
Collector(s): D. Pitcher, S. Peschier
Remarks: _____



AWL FRONT SIDE:

samplers:
Pitcher
Peschier

DESCRIPTION: SOCKEYE / FRAZER / ESC

litho code

DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS AREA
260498

CARD: 014
SPECIES: 2
DAY: 07
MONTH: 06
YEAR: 95
DISTRICT: 257
SUBDISTRICT: 40
STREAM: 403
LOCATION: 038
PERIOD: 24
PROJECT: 3
GEAR: 19
MESH:
TYPE OF LENGTH MEASUREMENT: 2
NUMBER SCALES/ FISH: 1
OF CARDS: 1

ADF&G ADULT SALMON AGE-LENGTH FORM VERSION 2.1

#	SEX	LENGTH 100's	LENGTH 1's	AGE GROUP	AGE ERROR CODE
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
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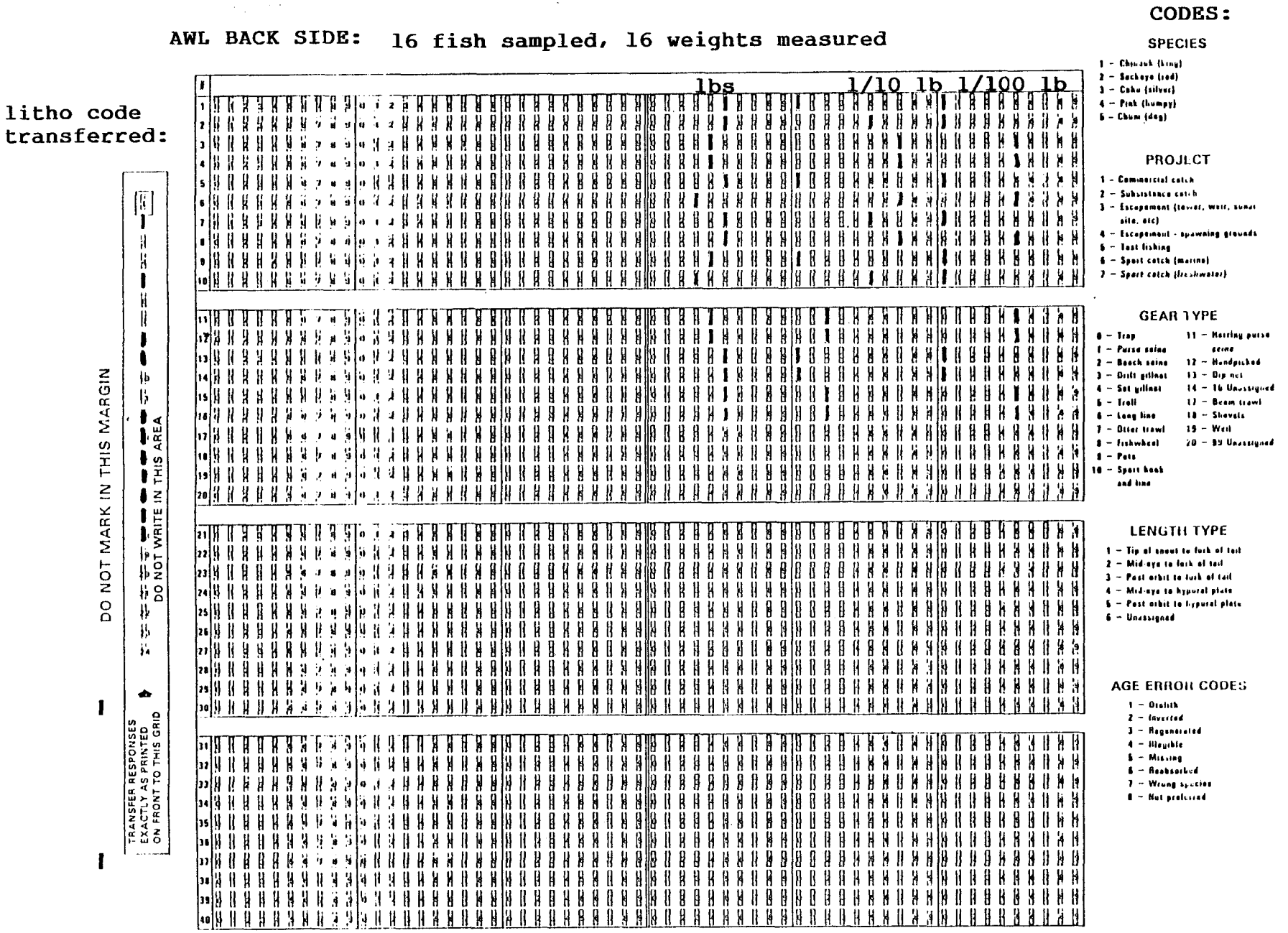
Appendix A.1. Completed AWL (front side) and associated gum ca
16 fish sampled.



Appendix A.2. Back side of AWL with 16 weights recorded and litho code transferred.

Appendix A.3. Assigned port and weir location codes.

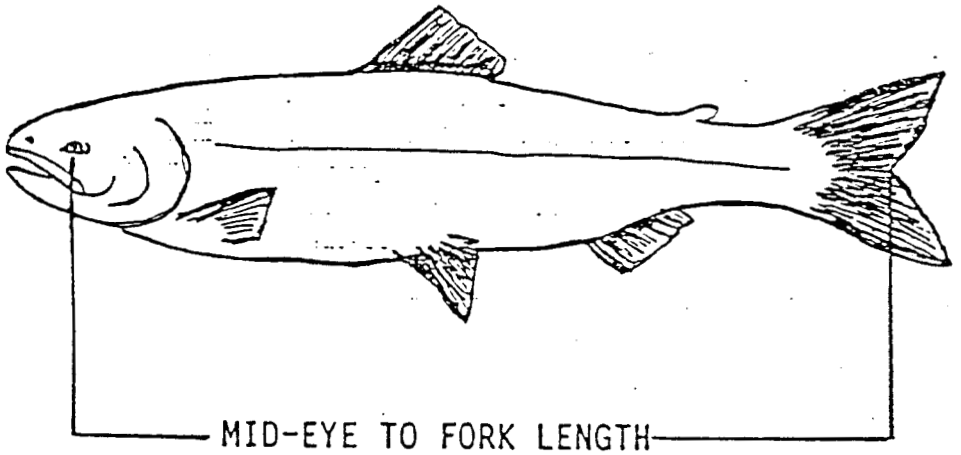
Port and Location Codes

030 - Lazy Bay
031 - Port of Kodiak
032 - Pauls Lake
033 - Thorshiem
034 - Afognak River
035 - Karluk River
036 - Red River
037 - Upper Station
038 - Frazer Lake
039 - Dog Salmon
040 - Akalura River
041 - Uganik River
042 - Malina Creek
150 - King Cove
151 - Port Moller
052 - Dutch Harbor
053 - Akutan
054 - Sand Point
055 - Bear River, ADF&G Camp
056 - Nelson River, ADF&G Camp
057 - Canoe Bay

Appendix A.4. Periods and corresponding calendar dates, 1995.

Period	Calendar Dates	Period	Calendar Dates
1	01-Jan to 03-Jan	28	05-Jul to 11-Jul
2	04-Jan to 10-Jan	29	12-Jul to 18-Jul
3	11-Jan to 17-Jan	30	19-Jul to 25-Jul
4	18-Jan to 24-Jan	31	26-Jul to 01-Aug
5	25-Jan to 31-Jan	32	02-Aug to 08-Aug
6	01-Feb to 07-Feb	33	09-Aug to 15-Aug
7	08-Feb to 14-Feb	34	16-Aug to 22-Aug
8	15-Feb to 21-Feb	35	23-Aug to 29-Aug
9	22-Feb to 28-Feb	36	30-Aug to 05-Sep
10	01-Mar to 07-Mar	37	06-Sep to 12-Sep
11	08-Mar to 14-Mar	38	13-Sep to 19-Sep
12	15-Mar to 21-Mar	39	20-Sep to 26-Sep
13	22-Mar to 28-Mar	40	27-Sep to 03-Oct
14	29-Mar to 04-Apr	41	04-Oct to 10-Oct
15	05-Apr to 11-Apr	42	11-Oct to 17-Oct
16	12-Apr to 18-Apr	43	18-Oct to 24-Oct
17	19-Apr to 25-Apr	44	25-Oct to 31-Oct
18	26-Apr to 02-May	45	01-Nov to 07-Nov
19	03-May to 09-May	46	08-Nov to 14-nov
20	10-May to 16-May	47	15-Nov to 21-Nov
21	17-may to 23-May	48	22-Nov to 28-Nov
22	24-May to 30-May	49	29-Nov to 05-Dec
23	31-may to 06-Jun	50	06-Dec to 12-Dec
24	07-Jun to 13-Jun	51	13-Dec to 19-Dec
25	14-Jun to 20-Jun	52	20-Dec to 26-Dec
26	21-Jun to 27-Jun	53	27-Dec to 31-Dec
27	28-Jun to 04-Jul		

Appendix A.5 Measuring fish length, mid-eye to fork of tail.



Mid-eye to fork lengths are taken because the length and shape of a salmon's snout changes as it approaches sexual maturity. The procedure for measuring by this method follows:

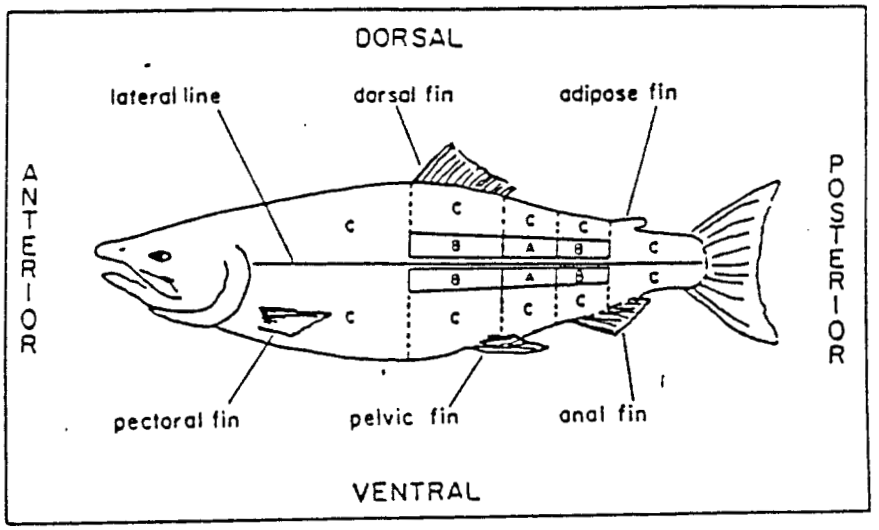
1) Place the salmon flat on its right side, with its head to your left and the dorsal fin away from you.

2) The eye should be on the line projecting from the end of the meter stick. Hold the head in place with your right hand. Sometimes you can control the fish better by placing your thumb in the fish's mouth.

3) Flatten and spread the tail against the board with your right hand.

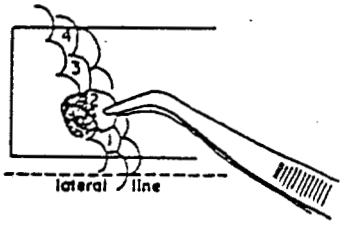
4) Read the mid-eye to fork length to the nearest millimeter.

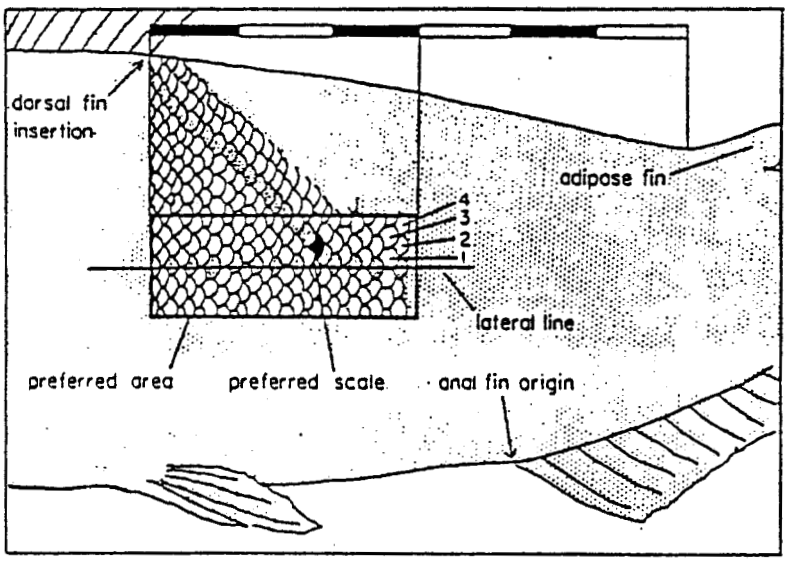
Appendix A.6. Removal and mounting of the preferred scale.



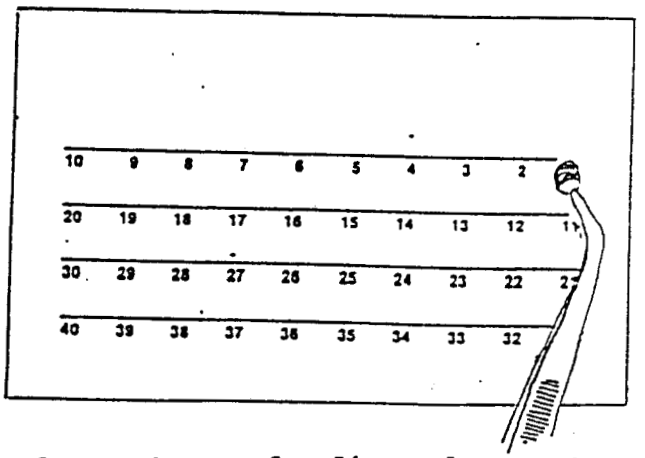
INPFC rated areas for scale removal.
Area A is the preferred area. B is the second choice if there are no scales in area A.
C designates non preferred areas. If scales on on the left side of the fish are not good, try the right side.

DO NOT TURN SCALE OVER



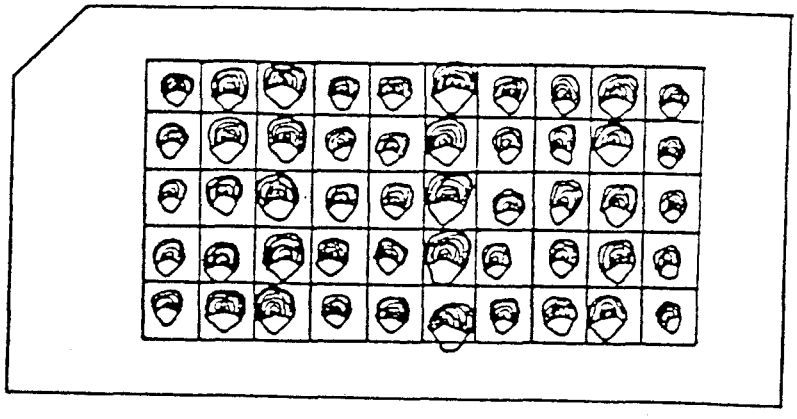


The preferred scale in this diagram is solid black. It is located 2 rows up from the lateral line, on a diagonal from the insertion (posterior) of the dorsal fin "back" towards the origin of the anal fin.

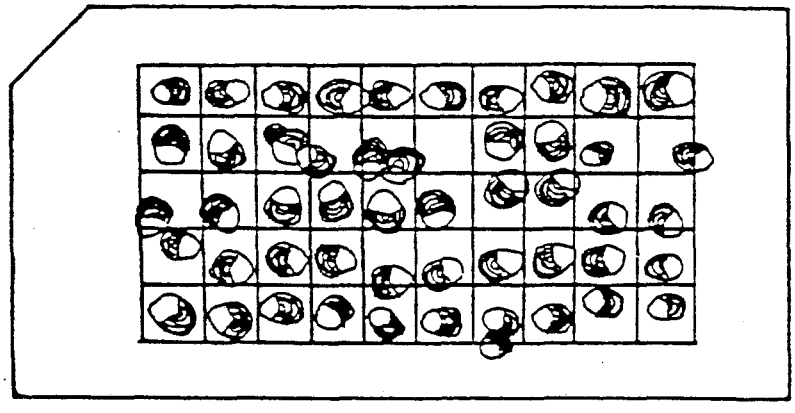


Place the scale directly over the number on the gummed card with the anterior portion (arche of the scale pointed toward the top of the card.

Appendix A.7. Scale orientation on the gummed card.



The scales are all correctly oriented on the card in the same direction, with the anterior portion of the scale pointed toward the top of the card.



The scales are incorrectly oriented in different directions. This increases the time spent to age samples.

APPENDIX B

Kodiak Area Commercial Salmon Fishery
Harvest Strategy, 1995

KODIAK AREA COMMERCIAL SALMON FISHERY

HARVEST STRATEGY, 1995

By:

Dave Prokopowich
Kevin Brennan
Dennis Gretsch

Regional Information Report[1] No. 4K95-28

Alaska Department of Fish and Game
Commercial Fisheries Management and Development Division
211 Mission Road
Kodiak, Alaska 99615

May 1995

[1]The Regional Information Report Series was established in 1987 to provide an information access system for all unpublished division reports. These reports frequently serve diverse ad hoc informational purposes or archive basic uninterpreted data. To accommodate timely reporting of recently collected information, reports in this series undergo only limited internal review and may contain preliminary data; this information may be subsequently finalized and published in the formal literature. Consequently, these reports should not be cited without prior approval of the author or the Commercial Fisheries Management and Development Division.

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INTRODUCTION

In 1995, commercial salmon fisheries in the Kodiak Management Area (Area K) will be managed according to a harvest strategy which emphasizes three criteria:

(1) **To ensure that 1995 salmon escapement occurs in the proper magnitude and distribution so that the potential for maximum production of future returns is established.**

The results of ADF&G's 1995 management activities will directly affect the following future returns:

- **1997 pink salmon**
- **1998 - 1999 coho salmon**
- **1998 - 2000 chum salmon**
- **1998 - 2001 sockeye and chinook salmon**

(2) **To provide for orderly fisheries on the highest quality salmon by maximizing harvest opportunities during each fishing period.**

This requires a species oriented approach.

- For sockeye and coho salmon from major systems, management will emphasize the use of inseason weir escapement data to determine fishing time by geographical area.

- Fishing time on minor sockeye and coho systems without fish weirs will be determined by ADF&G's perception of run strength for these systems.

- For pink and chum salmon runs, management will initially use preseason forecasts to determine fishing time with inseason fishing time adjustments as the actual run strength becomes more apparent.

(3) **To adhere to the biological and allocative requirements of all Alaska Board of Fisheries (BOF) Management Plans.**

This harvest strategy is an overview of how ADF&G intends to manage the 1995 salmon fishery. Along with this overview, a basic management chronology (Figure 1) can be used as a guide to clarify when species specific management requirements will dictate inseason adjustments in harvest strategy. Sockeye salmon management requires escapement information from up to nine salmon weirs. This information is used to regulate fishing time and areas open to fishing. Prorating fishing time for sockeye salmon solely on the basis of preseason expectations, other than for the June 9 commercial test fisheries, is generally not an acceptable method of managing Kodiak's sockeye salmon stocks.

Initial fishing periods for pink salmon are based upon preseason expectations and are necessary for prosecuting a successful fishery. This can be done with little chance of adverse effects on future production and is the most acceptable way of managing the return of Kodiak's relatively large pink salmon runs.

Chum and coho salmon require a blend of these two management approaches. Both species are initially harvested as a bycatch in directed pink or sockeye salmon fisheries. Specific fisheries targeting on chum and coho salmon require proper run strength assessment before those fisheries can occur. This requires a combination of weir counts and aerial assessment of escapement. Escapement data along with inseason assessment of the bycatch rate determines if the chum and coho salmon returns can support additional near terminal area harvests.

Chinook salmon are not targeted in specific fisheries, but are harvested as a bycatch in fisheries directed toward sockeye and pink salmon.

HARVEST PROJECTIONS

Initial projections for the 1995 Kodiak commercial salmon fishery are for a harvest of approximately 21,770,000 salmon (Table 1). This harvest includes approximately 25,000 chinook, 310,000 coho, 800,000 chum, 18,235,000 pink, and 2,400,000 sockeye salmon.

In addition to the 7,965,000 pink salmon produced at the Kitoi Bay Hatchery, enhancement projects conducted by the Kodiak Regional Aquaculture Association (KRAA) and ADF&G's Commercial Fisheries Management and Development Division (CFMDD) should contribute coho, sockeye, and chum salmon to the common property fisheries of the Kodiak Area. Supplemental production may allow for approximately 246,000 sockeye, 150,000 chum, and 25,000 coho salmon to be harvested (Table 2; all supplemental production numbers are included in the total harvest projections).

A good tool for illustrating the timing and magnitude of salmon harvests is the projected harvest graphs (Appendix A.1 - A.3.). A curve can be drawn, based on the historical cumulative average salmon catch by date, that is scaled to the current preseason harvest projection. By keeping track of the actual salmon harvest by date, and plotting these on the graphs, a comparison of expected and actual returns can be made. These graphs are used for planning purposes by both ADF&G and industry to determine if management strategies need to be modified inseason because of unexpected deviations in actual run strength.

FISHING PERIODS

All fishing periods will be established by emergency order (EO) and will generally be based on inseason assessment of actual run strength (Table 3).

Opening Times

All regular fishing periods will begin at 12:00 Noon and end at 9:00 P.M., except:

- The Cape Igvak fisheries will usually open at 12:01 A.M. and close at 12:01 A.M. during the period of June 6 through July 25.

- The Inner Ayakulik Section fisheries will usually begin at approximately low tide. These will be daylight openings, and will be initiated by ADF&G "flare openings"; fishing will start when a "flare" is launched by ADF&G personnel. When such openings occur, the opening time for the Outer Ayakulik Section may be adjusted to coincide with the Inner Ayakulik Section.

- Beginning on August 16, all fishing periods will end at 6:00 P.M. instead of 9:00 P.M.

Advance Notice for Each Fishing Period

- All advance notice times will be based upon the initial announcements being made on SSB frequency 4125 Khz, following the **6:00 P.M.** daily marine weather broadcasts.

- For the **Cape Igvak fishery**, the initial fishing period will have at least a **36 hour advance notice**. All subsequent fishing periods will have at least **18 hours advance notice**, unless it is an extension of an ongoing fishing period.

- For the **June sockeye fisheries** in the Alitak, S.W. Kodiak, and N.W. Kodiak Districts, **the initial fishing periods** will have at least a **42 hour advance notice**; this includes the normal June 9 fishing period for the Alitak and N.W. Kodiak Districts and the approximate June 14 fishing period for the N.W. Kodiak District.

- **All subsequent fishing periods for the Kodiak Area prior to July 6 will have at least 18 hours advance notice.**

- For the **initial pink/chum salmon fisheries**, at least **42 hours advance notice** will be provided, with the fishery starting at 12:00 noon **on July 6**.

- **All subsequent fishing periods for the Kodiak Area after the July 6 fishing period will have at least 18 hours advance notice**.

- **All extensions** in fishing time from a previously announced fishing period will have at least **3 hours advance notice**.

Inperiod Closures

- **During the period July 6 through July 25 inperiod closures of "Seaward Zones" designated in the North Shelikof Strait Sockeye Salmon Management Plan may occur. Fishers operating in management units covered by this plan are advised that inperiod closures of "Seaward Zones" are possible. Such closures will be announced on SSB frequency 4125 kHz at 8:00 A.M., 10:00 A.M., 2:00 P.M., or 6:00 P.M. with the effective closure time occurring in as little as three hours following the initial announcement time.**

Length of Fishing Periods

Sockeye Salmon

In general, each fishing period targeting early and late sockeye salmon runs to major systems will be dependent upon weir escapement counts. This will also apply to minor systems with weirs that are targeted by the commercial fishery. The exception to this will be the June 9 commercial test fisheries in the Alitak Bay and N.W. Kodiak Districts and the June 9 fisheries in the Foul Bay and Waterfall Terminal Harvest Areas. The first period will extend from 12:00 Noon Friday June 9 through 9:00 P.M. Saturday June 10, a 33 hour period. A second 33 hour commercial test fishery will occur in the N.W. Kodiak District beginning approximately June 14. The opening date is dependent on coordination with other terminal sockeye fisheries in order to spread the fishing effort. Additional fishing time in the Alitak Bay District will depend on the results of the June 9 commercial test fishery, the ADF&G test fishery, weir escapements and sockeye salmon buildups (see Alitak Bay District Management Plan).

In conjunction with the second commercial test fishing period in the N.W. Kodiak District, there will be a 33 hour fishing period for surplus production from minor sockeye salmon systems (Afognak Lake, Saltery, etc.). Specific management units (sections) opened for this fishery depend on run strength associated with these units. The E.O. announcement for this opening will specify which sections are to be opened.

Fishing periods in the Cape Igvak Section will be in 24 hour increments running from 12:01 A.M. to 12:01 A.M.. Fishing time will be dependent upon evaluation of the Chignik System sockeye salmon run strength. Chignik sockeye salmon are the dominant contributing stock harvested in this section. A review of the Cape Igvak Management Plan (5 AAC 18.360) should clarify the biological and allocative requirements. For the 1995 season, fishing time will initially be allocated in the Cape Igvak Section based upon the criteria listed in paragraph (c) of the plan.

For most late run sockeye salmon stocks, a portion of the harvestable surplus is taken as bycatch during targeted pink salmon fishing periods. Consequently, a "blended" management strategy is needed to insure escapements are achieved by species with the upper escapement requirements not being exceeded.

Fishing periods for enhanced sockeye runs in terminal harvest areas (Figures 2-5) may result in continuous 24 hour period openings as long as there is a harvestable surplus.

Chum Salmon

The Duck Bay, Izhut Bay, and Kitoi Bay Sections may open to fishing as early as June 9. This is due to the forecasted strong return of chum salmon to Kitoi Bay Hatchery. Between the July 6 to July 25 time period fishing time for much of the Mainland District will not exceed 57 hours per week.

Pink Salmon

Preemergent pink salmon fry sampling of the Kodiak Management Area index streams conducted during March and April of 1994 indicated just fair over winter survival of the eggs and sac fry. These fry were from an excellent brood year escapement in 1993 with the indexed escapement estimate at 4.3 million pink salmon. Sampling resulted in an unweighted live fry index of 190.64 live fry per square meter of spawning area. This live fry index is the seventh highest odd year index on record. Early spring conditions in 1994 were fair for outmigration and rearing in the nearshore ocean environment. Ambient air temperatures, as measured in Kodiak, were below average in March, but well above average from April through June. Kitoi Bay hatchery manager Tim Joyce noted that compared to recent years the 1994 spring plankton bloom seemed very good, and should have had a positive affect of marine survival.

Although the live fry index was only the seventh highest on record, the number of pink salmon fry observed by salmon fishermen throughout the summer of 1994 in bays on Kodiak Island was higher than usual. This may have been a result of excellent early marine survival combined with an unusually high percentage of live fry outmigrating early from the streams. The actual 1995 combined harvest of hatchery and wild production is likely to fall between the forecasted midpoint of 18.2 million and the upper end of 26.3 million pink salmon.

In addition to the three management criteria identified in the introduction of this document, the harvest strategy for pink salmon utilizes: 1) a fixed July 6 opening date, 2) a pink salmon forecasting program to set the length of the initial fishing periods, and 3) coordination of multiple fisheries whenever possible to allow for dispersion of the purse seine fleet.

The pattern of fishing periods for management units where pink salmon are the targeted species may vary in consideration of the forecasted pink salmon run. Fishing periods are expected to be 3½ days per week from July 6 through approximately August 25. During the peak harvest period of late-July to mid-August, fishing periods may be extended up to seven days per week.

Listed below is a schedule of fishing periods which may be used for planning purposes by both ADF&G and industry.

First Period: 3½ days (81 hours) - 12:00 Noon July 6 through 9:00 P.M. July 9. This period provides important harvest data to assess early run strength of Area K pink salmon and certain chum salmon stocks. No extensions in fishing time based on pink or chum salmon harvests would occur during this period. The increased closed water area will remain in effect in the East Arm of Uganik Bay.

Second Period: 3½ days (81 hours) - 12:00 Noon July 12 through 9:00 P.M. July 15. This second period will assess run strength for both pink and chum salmon and provide harvest data. No extensions in fishing time based on pink or chum salmon harvests would occur during this period.

Third Period: 3½ days (81 hours) - 12:00 Noon July 19 through 9:00 P.M. July 22. The third period will occur following a 3½ day closure. This will allow an influx of pink and chum salmon into terminal areas to enhance the build-up of potential escapement. At this time a combination

of harvest and early escapement or build-up information will provide an indication of the actual run strength for major pink salmon stocks. Extensions in fishing time in the Duck Bay and Izhut Bay Sections may occur.

Fourth Period: 3½ days (81 hours) - 12:00 Noon July 26 through 9:00 P.M. July 29. This fourth period is critical. Harvest should increase substantially and a fairly realistic assessment of total run strength should be evident by the end of the period. Extensions in fishing time commonly occur to this period during years when the pink and chum salmon runs are strong. The initial pink salmon opening for the Kitoi Bay Section is expected to occur at the beginning of this fishing period.

Fifth Period: 3½ days (81 hours) - 12:00 Noon August 2 through 9:00 P.M. August 5. This fifth period should yield the peak harvest day and period, provided that normal run timing occurs. If preseason expectations appear valid, extensions in fishing time could occur in portions of the management area. The first significant announcement of differential fishing time by management unit may occur as heavy production areas are targeted for extensions, while moderate or lower production areas are not.

Sixth Period: 3½ days (81 hours) - 12:00 Noon August 9 through 9:00 P.M. August 12. This sixth period should be the first postpeak period. Returns to major late production systems should be evident by period's end. There may be increases in closed water sanctuaries to enhance escapement levels. Evaluation's of run strength are used to determine if reductions in fishing time are needed for the remaining periods to ensure adequate escapement. A strategy to achieve full escapement in all systems is developed from this period.

Seventh Period: 3½ days (78 hours) - 12:00 Noon August 16 through 6:00 P.M. August 19. During the seventh period, a blended multi-species management approach is used for those sections where pink salmon were the targeted species for the previous six periods. Emphasis will still be on harvesting excess, good quality pink salmon and achieving escapement goals. However, major concern will be directed toward the run strength of late run sockeye and chum salmon.

Eighth Period: 3½ days (78 hours) - 12:00 Noon August 23 through 6:00 P.M. August 26. The eighth period will primarily be a cleanup period for pink salmon stocks. Escapement requirements should be assured at this point. Excess pink salmon of acceptable quality should be available for harvest in near terminal areas. This period also will require a major emphasis on multi-species management. It is a critical management period for late run sockeye and chum salmon stocks, as well as early run coho salmon.

A change to this schedule of fishing periods should be expected if significant deviations in the actual pink salmon return occurs. Less fishing time should be expected in management units where chum salmon are the targeted management species.

Chum and Coho Salmon

A large portion of the 1995 Kodiak chum and coho salmon harvest will occur as bycatch in nonterminal locations during major pink salmon fisheries. System specific chum and coho salmon

fisheries, which occur during the pink salmon fishery, will commonly result in pertinent management units having less fishing time than management units targeting primarily pink salmon stocks. This approach emphasizes the use of more terminally located management units for targeted chum and coho salmon fisheries (i.e., Inner Kukak Section, Zachar Bay Section, Kizhuyak Section, etc.)

INSEASON EMERGENCY ORDER ANNOUNCEMENTS ("GETTING THE WORD")

Fishing period announcements may not always be predictable because the fishery is managed on data which is compiled and evaluated daily. Data used to make fishery decisions includes (1) escapement reports via weir counts or aerial surveys, (2) harvest trends (total catch and catch per unit effort) and (3) information on fish buildups in closed water sanctuaries.

After enough information has been collected to determine the fishing time needed to harvest surplus fish, an emergency order and a fishery announcement are issued in the following manner:

1) A news release is constructed detailing:
   a) The date, time, and number of the emergency order announcement.
   b) The length of the fishing period.
   c) The opening and closing times and dates of the fishing period.
   d) The areas open to fishing.
   e) The areas closed to fishing (those sections not listed as being open).
   f) The location of "closed water" marker adjustments.

2) The news release is posted at the entrance of the Kodiak ADF&G office.

3) Copies of the news release are made available at the Kodiak office. For after hours availability, copies are stored at the main entrance.

4) The news release is recorded on a 24 hour recorded message phone (Number 486-4559).

5) The news release is made available to local radio stations (KVOK and KMXT) to be played by these stations.

6) The news release is announced over SSB channel 4125 Khz following the marine weather broadcasts. Commonly, the first reading of a news release occurs after the 6:00 P.M. weather broadcast, but occasionally the initial reading comes after the 8:00 A.M. weather broadcast.

7) The news release is distributed to all registered processors either by hand, verbally on the telephone, by tele-fax, or through the ADF&G recorded message phone.

8) Information on the most current news release or emergency order can also be obtained by calling the Kodiak ADF&G office during working hours, or by calling Dave Prokopowich

(486-6007), Kevin Brennan (486-6475), or Dennis Gretsch (486-3031) after working hours or on weekends.

9) Copies of emergency orders are mailed to a current listing of required and interested recipients.

10) Many fishers, ADF&G vessels and camps, and Fish and Wildlife Protection vessels use a small tape recorder to document the exact wording of each announcement as it is broadcasted. This is advisable, when considering the complicated nature of each announcement.

NEW REGULATIONS

In March of 1995 the Alaska Board of Fisheries addressed the harvest of Cook Inlet bound sockeye in the Kodiak Area again.

No regulation changes were adopted for the 1995 season.

Listed below is a new regulation adopted by the Alaska Board of Fisheries in March of 1994.

5AAC 18.331. Gillnet Specifications and Operation.

(i) Effective January 1, 1995, in the Moser-Olga Bay Section of the Alitak District the shoreward end attachment point of a set gillnet must be attached to a point of land or rock that is no more than 2.1 feet below the surface of the water at mean lower low water at Alitak Bay. The shoreward end attachment point of a set gillnet in the Moser-Olga Bay Section that is not above the surface of the water at all times

(1) must be certified, by a registered land surveyor, to be no more than 2.1 feet below the surface of the water at mean lower low water at Alitak Bay;

(2) must be marked with a permanent survey monument by a registered land surveyor;

(3) may not be below the survey monument; and

(4) may not be more than two horizontal feet from the survey monument. A set gillnet may not be attached to the beach inside closed waters. For the purpose of this subsection, a "registered land surveyor" is a land surveyor registered by the state under AS 08.48 and 12 AAC 36.(In effect before 1983; am 4/16/83, Register 86; am 5/11/85, Register 94; am 5/31/85, Register 94; am 6/2/88, Register 106; am 4/19/90, Register 114; am 7/23/94, Register 131).

MISCELLANEOUS REGULATORY CLARIFICATIONS

Closed Water Adjustments

There have been conflicting interpretations of Alaska Statute 16.05.785 regarding the failure to remove markers. As a result there will be no inseason adjustments of closed waters unless

ADF&G personnel are able to remove old markers and install new markers, or unless inseason adjustments of closed waters are made to a specific stream terminus. All adjustments to closed waters listed in 5AAC 18.350 will be made by emergency order and announced by news release.

Closed Water Sanctuaries

5AAC 18.350 Closed Waters

Karluk Closed Water Sanctuary

There have been problems encountered in the past with the current description of the closed water sanctuary seaward of Karluk Lagoon. Consequently, the following closed water sanctuary will be in effect, by emergency order, near the entrance to Karluk Lagoon, stream no. 255-101 (Figure 6):

5AAC 18.350 CLOSED WATERS (a)(2) Southwest Kodiak District
(E) That portion of the Southwest Kodiak District (off of the entrance to Karluk Lagoon (stream no. 255-101)) enclosed by a line from 57°34'28" N. lat., 154°28'18" W. long. to 57°34'32" N. lat., 154°26'42" W. long. (NOAA Chart 16598).

Buskin River Closed Water Sanctuary

The stream mouth of the Buskin River (stream no. 259-211) has moved considerably over the past several years. The previous markers were not providing adequate protection to salmon migrating into the stream. The north shore marker has been moved and an offshore point is designated to aid in triangulation of the closed water area. The offshore point is at the reef directly east of the spit, and may be marked with a buoy. The location of the closed waters will be described in the first salmon emergency order as follows (Figure 7):

5AAC 18.350 CLOSED WATERS (a)(6) Northeast Kodiak District
(E) Buskin River: all waters inside of a line running from a marker on the bluff north of the mouth of the Buskin River at approximately 57°45'48" N. lat., 152°28'23" W. long. to a point offshore at 57°45'21" N. lat., 152°28'09" W. long. to a marker located onshore south of the river mouth at approximately 57°45'09" N. lat., 152°28'39" W. long. (NOAA Chart 16595)

Ayakulik River No. 256-201 Closed Water Sanctuary

ADF&G regulatory markers will be placed in such a manner as to better define the "stream terminus" of the Ayakulik River. The intent of this closed water sanctuary is to prevent seines from being set which completely block fish access to the river (Figure 8).

East Arm of Uganik Increased Closed Water Sanctuary

Additional fishing time is anticipated in the Northwest Kodiak District due to early run Karluk sockeye. The closed water sanctuary in the East Arm of Uganik Bay (stream no. 253-122) will be enlarged to provide for increased protection for sockeye and pink salmon bound to Uganik

Lake. This increased closed water sanctuary includes all waters east of a line from Mink Point (153°30'57" W. long. 57°43'06 N. lat) to Packers Spit at (153°30'00" W. long. 57°43'57" N. lat) and will remain in effect for the entire salmon season (Figure 9).

Remainder of the Kodiak Area

A straight line closure is in effect in areas where ADF&G has deployed regulatory markers to establish waters closed to fishing, provided that **no portion of that line is less than 500 yards from the seaward extremities of the exposed tideland banks which designates the stream mouth.** Consequently, common closed water configurations will be areas of various shapes, depending upon the nature of each individual stream mouth extending between the two regulatory markers. In areas where ADF&G has deployed regulatory markers to establish waters closed to fishing in bays a straight line closure is in effect.

ADF&G is expanding its stream marker program in the Mainland District. Fishers participating in salmon fisheries located in the Mainland District should be aware that closed water sanctuaries to protect salmon buildups may be larger in some areas due to the placement of markers.

Boundary Determinations

The latitude and longitude as plotted on a NOAA navigational chart, North American Datum 1927, approximate scale 1:80,000, will represent the **correct** boundary locations in determining the location of a particular district, section boundary, or any inseason emergency order boundary. Boundaries plotted on NOAA navigational charts using NAD 1983 may not correspond to the correct locations. Latitude and longitude as determined by Loran or Global Positioning System (GPS) bearings may represent **incorrect** boundary locations. District and Section boundaries are depicted on the current Kodiak salmon statistical area chart available at Kodiak ADF&G office.

Section Boundaries

The Raspberry Strait Section **is not** part of the Southwest Afognak Section.

Purse Seine Leads

Minimum mesh size is seven (7) inches. Double panels of web overlapped in the lead are **not** legal.

Set Gillnets - Operation of Gear

Leads

"Seine webbing" used as a lead for set gillnets is not intended to "gill salmon". Set gillnet leads which have similar mesh size and web construction to the actual set gillnet gear are not considered legal gear.

Operation of Set Gillnets

Set gillnets must be operated in substantially a straight line, except that no more than 25 fathoms of a **set gillnet** may be used as a **hook**. A **hook** may be used in any configuration. When a **set gillnet** is being operated primarily as a **"hook in any configuration"** it will be considered illegal to **actively** operate that gillnet as a purse or beach seine (such as "round hauling").

FISH TICKETS

All fishers should check the statistical area recorded on each of their fish tickets. It is required that the correct harvest location(s) be shown on each ticket and it is the responsibility of each fisher to ensure that tender operators or cannery personnel record the correct harvest location on each ticket. This information is extremely important in evaluating inseason harvest levels, stock contribution, and effort distribution.

Seiners

Please provide estimates of harvest by area to tender operators. For example "1/3 of my reds were from Cape Alitak (257-20) and the rest were from Red River (256-20). The rest of my fish were 1/2 and 1/2 from each of these areas". Prior to signing your tickets, check to make sure the proper harvest information by **STATISTICAL AREA** has been entered.

Accurate recording of the harvest from that portion of the Shelikof Strait regulated by the Shelikof Strait sockeye salmon management plan is particularly important. In order to provide an accurate accounting of sockeye salmon harvests in this area, ADF&G and Fish and Wildlife Protection will conduct extra monitoring of harvest activity and tendering operations in this area during the July 6 to July 25 time period of this plan.

Gillnetters

Because of the fixed nature of this gear, each permit holder's reporting area (statistical area) should be consistent between landings. In the event that gillnet fishers move into a new statistical area, please provide the tender operator with that information. Prior to signing your tickets, ensure that the proper harvest information by **STATISTICAL AREA** has been entered.

MANAGEMENT PLANS

Currently there are seven Board of Fisheries approved management plans which direct management activities for specific portions of the Kodiak area. Each management plan affects several management units through part or all of the salmon fishing season (Table 4). Any plan

requires the test of time and a continued review process to determine its effectiveness at accomplishing the desired biological and allocative goals.

Proper implementation of these plans in 1995 will require a major communication effort between ADF&G and the industry. All inquiries, suggestions, and concerns regarding management plans should be directed to ADF&G, Kodiak. A discussion of each plan follows.

Cape Igvak

The Cape Igvak Management Plan covers the time period from June 5 through July 25 for salmon fishing in the Cape Igvak Section of the Mainland District (Table 5). This plan has been in effect since 1978 and allocates approximately 15% of the available Chignik sockeye salmon for harvesting to Kodiak permit holders if specific biological and harvest criteria are met in the Chignik Management Area. The 1995 forecast for Chignik sockeye salmon runs indicate that early production should be above average, and that late production should be near average. Fishing time after July 25 in the Cape Igvak Section will be targeted toward pink, chum, and coho salmon bound to spawning streams in the Cape Igvak Section and in the Wide Bay Section.

Alitak Bay District

This plan covers the entire commercial salmon fishing season, and identifies the primary species by management unit throughout the season (Table 6). The plan affects the sockeye salmon stocks returning to the Frazer, Upper Station, and Akalura systems, and the pink and coho salmon stocks returning to Dog Salmon, Upper Station, Akalura, Humpy Cove, Deadman, Horse Marine, and Silver Salmon systems. This plan has been in effect since 1988.

The management chronology for Olga Bay stocks identifies the targeted stocks by approximate time period. In situations where two or more targeted stocks overlap in run timing a blended management approach will occur. Adequate fishing time will be provided to ensure that the upper escapement goals are not exceeded for the dominant stock(s), while still attempting to ensure that the lower escapement goals for the non-dominant stock(s) are achieved. As outlined in this management plan, fishing time directed on these stocks will occur simultaneously in the traditional management units for harvesting these stocks, the Cape Alitak Section and the Moser-Olga Bay Section. Management for these stocks will emphasize an aggressive strategy to contain the harvest to these traditional harvest units; this strategy also applies to the remainder of the stocks in the Alitak Bay District.

The regulation implementing this management plan (5 AAC 18.361) appears in the 1995 Commercial Finfish Regulation Book. Dates listed in the plan are approximate and may vary with changes in run timing. The June 9 commercial test fishery, however, is a firm date.
The specifics for managing the 1995 returns need to consider the expected magnitude of the targeted stocks returning to the Olga Bay systems. The sockeye salmon returns to Alitak are expected to yield relatively strong sockeye salmon production from the early run Frazer system.

Some specific points to emphasize this year are:

- The approximate June 12 through June 24 period is identified as an aggressive management time for Frazer sockeye salmon run.
- The lower biological escapement goal for Frazer sockeye salmon (140,000) will be targeted.
- The biological pink salmon escapement requirement for the Dog Salmon system ranges from 60,000 to 180,000 fish.
- In the event fishing time is required in the Upper Olga Bay management units, there will be minimal advance notice time.
- Sockeye returning to Akalura will be managed in the Inner Akalura Section, so that sockeye escapement does not exceed 60,000 fish. The lower biological escapement goal of 40,000 sockeye will be targeted.

Westside Kodiak

The Board of Fisheries adopted into regulation the Westside Kodiak Management Plan in 1989. This plan identifies a management chronology for the major Westside Kodiak salmon stocks (Table 7).

This plan was submitted as a proposed regulation to the Board of Fisheries by the Kodiak Management Staff in order to allow industry the opportunity to comment on existing harvest strategies and to clarify their intent. Kodiak fishers frequently expressed concerns over how the department would manage the Westside management units (sections) into the 1990's, when local sockeye stocks are projected to be near maximum production, since this will affect the traditional harvest opportunities between fixed and mobile gear. The annual harvest strategy has traditionally invoked a blend of fishing time between the 17 management units covered by this plan. At times this blend has not been totally understood by industry and has resulted in enough allocative uneasiness that future management stability could be jeopardized. Guidelines for this blend needed to occur in regulatory form to specifically identify inseason harvest strategy and dispel any concern or confusion. Again, the previous regulatory structure prior to this management plan did not provide the information needed by industry to evaluate inseason management decisions which affect allocation concerns of the three gear types.

The goal of this management plan is to achieve escapement and harvest objectives of sockeye salmon returning to the Karluk, Ayakulik, and other Westside minor systems. Further, it details the management of pink, chum, and coho salmon returning to systems in the Southwest Afognak, Central, North Cape, Anton Larsen Bay, Sheratin Bay, Kizhuyak Bay, Terror Bay, Inner Uganik Bay, Spiridon Bay, Zachar Bay, Uyak Bay, Outer and Inner Karluk, Sturgeon Bay, Halibut Bay, and Outer and Inner Ayakulik Sections. The intent of the Board is to insure salmon bound to these systems are harvested to the extent possible by the traditional fisheries located in all 17 sections. The plan directs the department to manage the Northwest Kodiak and the Southwest Kodiak Districts and the Southwest Afognak Section in accordance with the guidelines set out in this plan.

This management plan reflects the realization of long term management goals and identifies current management practices both of which were initially implemented in 1971. The basis for these goals and practices was primarily to rebuild depleted Karluk and depressed Ayakulik sockeye salmon stocks. This plan provides a predictable management framework for these rebuilt stocks, as well as major pink, chum and coho salmon stocks of westside Kodiak. It also helps to stabilize fishing opportunities between the three gear types on the highest quality fish in these districts and sections.

Sockeye returning to Karluk Lake will be managed so that an escapement of 200,000 sockeye salmon is attained for the early run and an escapement of 400,000 sockeye salmon is attained for the late run.

The regulatory wording of this plan appears in the 1995 Commercial Finfish Regulation Book under 5AAC 18.362.

North Shelikof Strait Sockeye Salmon

The Board of Fisheries in December 1989 created the North Shelikof Strait Sockeye Salmon Management Plan in response to their concerns that the fishing patterns and quantities of sockeye harvested by Area K seiners in 1988 represented the onset of an expansion of the interception of Cook Inlet bound sockeye in Kodiak Area waters. This plan was meant to contain this interception by not exceeding estimated historical interception levels while still providing for traditional opportunities to harvest high quality local pink and chum salmon stocks. **The major impact of this plan was to create "sockeye harvest caps" for portions of the North Shelikof which encompasses eight (8) management units. After these sockeye harvest caps are met, commercial salmon fishing is restricted in these 8 management units to inshore waters (Figure 6).**

During the January 1993 Board of Fisheries meeting in Kodiak, a modification of the management plan was made to allow for the traditional near shore seine fisheries to continue in the Southwest Afognak Section, in the event the sockeye harvest cap was reached. After the harvest cap is met, fishing will be restricted in waters inside of a 0.5 mile corridor (Figure 10).

The regulatory wording for this management plan is listed below and under 5AAC 18.363.

From July 6 through July 25 in the Dakavak Bay, Outer Kukak Bay, Inner Kukak Bay, Hallo Bay, and Big River Sections of the Mainland District, and in the Shuyak Island and Northwest Afognak Sections of the Afognak District, the department shall manage the fishery as follows:

- **Management of the fishery must be based on local stocks;**

- **the fishery may remain open during normal fishing periods until the harvest exceeds 15,000 sockeye salmon;**

- **when the harvest exceeds 15,000 sockeye salmon, the department shall restrict the fishery by emergency order to waters of the shoreward zones, as described below:**

  - Dakavak Bay, Outer Kukak Bay, Inner Kukak Bay, Hallo Bay. and Big River Sections west of a line from Cape Douglas at 58°51'06" N. lat, 153°14'54" W. long, to a point at 58°42'40" N. lat, 153°26'18" W. long, to a point east of Swikshak River at 58°38'06" N. lat., 153°35'24" W. long., to Cape Chiniak at 58°31' N. lat., 153°54'21" W. long., to Cape Nukshak at 58°23'30" N. lat., 153°57' W. long., to Cape Ugyak at 58°16'36" N. lat., 154°06'03" W. long., to Cape Gull at 58°13' N. lat, 154°08'30" W. long., to Cape Kuliak at 58°08'11" N. lat., 154°12'34" W. long., to Cape Atushagvik at 58°05' N. lat., 154°18'48" W. long., to Cape Ilktugitak at 58°01'12" N. lat., 154°34'48" W. long to the southern entrance of Dakavak Bay at 58°01' N. lat., 154°43'30" W. long.

  - Shuyak Island and Northwest Afognak Sections south and east of a line from Point Banks at 58°38' N. lat., 152°18'54" W. long., to Dark Island at 58°38'45" N. lat., 152°33'05" W. long., to Gull Island at 58°35'48" N. lat., 152°38'45" W. long., to the northern entrance of Big Bay at 58°34'06" N. lat., 152°40'12" W. long., to the western entrance of Blue Fox Bay at 58°27'41" N. lat., 152°43'42" W. long., to Black Cape at 58°24'33" N. lat., 152°53'09" W. long., to Cape Paramanof at 58°18'21" N. lat., 153°02'45" W. long.

From July 6 through July 25 in the Southwest Afognak Section of the Afognak District, the department shall manage the fishery as follows:

- **management of the fishery must be based on local stocks;**

- **the fishery may remain open during normal fishing periods until the harvest exceeds 50,000 sockeye salmon;**

- **when the harvest exceeds 50,000 sockeye salmon, the department shall restrict the fishery by emergency order to waters of the Southwest Afognak Section Shoreward Zones** east of a line from one-half nautical mile west of Cape Paramanof at 58°18'21" N. lat., 153°02'45" W. long., to one-half nautical mile west of Tanaak Cape at 58°15'36" N. lat., 153°06'09" W. long., to one-half nautical mile west of Steep Cape at 58°12'05" N. lat., 153°12'33" W. long., to one-half nautical mile west of a point at 58°08'25" N. lat., 153°18'52" W. long., to one-half nautical mile west of Raspberry Cape at 58°03'35" N. lat., 153°25'06" W., long.

All fishers and tender operators should familiarize themselves with the boundaries of these "seaward" and "shoreward" zones in each of these eight management units. Also, it will be the responsibility of both the permit holder and the tender operator to make sure fish tickets for fish harvested in the geographical area covered by this plan properly reflect the poundage and quantities of salmon by species. If there are questions on this management plan contact the ADF&G Kodiak staff.

Crescent Lake

The Crescent Lake Management Plan is associated with a relatively small coho enhancement project which could impact the subsistence fishery in the vicinity of Port Lions. This plan clarifies the harvest priorities for coho salmon returning to the Settler Cove area near Port Lions. This plan was slightly modified by the Board of Fisheries, during the January 1993 meeting in Kodiak. Previously the plan allowed commercial harvest inside the breakwater at Port Lions only after September 16; the date is now September 10. In addition, the time period that this plan is in effect was changed from the entire salmon season to the time period July 15 through October 31. The wording of the regulations guiding this plan are listed below as well as in the 1995 Commercial Finfish Regulation Book under 5AAC 18.364.

5AAC 18.364. Crescent Lake Coho Salmon Management Plan.

(a) From July 15 through October 31, the Department shall manage the commercial, sport, and subsistence fisheries in Settler Cove to provide for full utilization of the enhanced stock of coho salmon returning to Crescent Lake in accordance with the Crescent Lake Coho Salmon Management Plan in this section.

(b) Sport and subsistence fisheries are allowed in all waters of Settler Cove consistent with 5AAC 64 and 5AAC 01.

(c) The department may open, by emergency order, those waters of Settler Cove between the causeway and a line from the seaward end of the Port Lions breakwater to a department marker located directly across Settler Cove from the breakwater, to the commercial taking of salmon only as follows:

(1) the department may not allow the commercial taking of salmon before September 10; and

(2) before opening the fishery, the department shall determine that 500 or more coho salmon are available in Settler Cove for harvest.

Eastside Afognak

The Board of Fisheries, during the January 1993 meeting in Kodiak, adopted the Eastside Afognak Management Plan. Prior to the adoption of the management plan the commercial salmon fisheries of the eastside of Afognak Island were managed under an informal management plan formulated by Kodiak Area management biologists and Kitoi Bay hatchery manager. The goal of this plan is to achieve broodstock requirements for the hatchery, escapement requirements for local stocks, and specify the requirements for fishing time in the Southeast Afognak, Duck Bay, Izhut Bay, and Kitoi Bay Sections (Table 8). The regulatory wording of this plan is listed below as well as in the 1995 Commercial Finfish Regulation Book.

5AAC 18.365. Eastside Afognak Management Plan.

(a) The goal of the Eastside Afognak Management Plan is to achieve escapement and harvest objectives of sockeye, pink, coho, and chum salmon returning to natural spawning systems in the Southeast Afognak, Duck Bay, Izhut Bay, and Kitoi Bay Sections, and broodstock to Kitoi Bay hatchery. It is the intent of the board that salmon bound for these systems be harvested by the commercial fisheries located in these sections.

(b) The Southeast Afognak Section shall be managed on sockeye salmon returning to Afognak Lake during the period from June 9 through July 5. From July 6 through August 24, fishing opportunities will be based on pink salmon returning to major systems in Afognak, Kazakof (Danger), and Marka Bays. After August 24, fishing time will be dependent on coho salmon returning to this section.

(c) The Duck Bay Section shall be managed on early chum or sockeye salmon returns to Kitoi Bay hatchery during the period June 9 through July 18. From July 19 through August 24, fishing time will be based on returning mixed wild and hatchery pink salmon. After August 24, this section shall be managed on local coho salmon runs.

(d) The Izhut Bay Section shall be managed on the early chum or sockeye salmon returning to Kitoi Bay hatchery during the period June 9 through July 18. From July 19 through August 1, this section may remain closed to fishing to assure that pink salmon cost recovery goals are achieved at Kitoi Bay hatchery. If hatchery cost recovery harvests are not required, fishing time in this section will depend on returning wild and hatchery pink salmon from July 19 through August 24. After August 24, fishing time will be dependent on returns of local coho salmon and late hatchery sockeye salmon runs.

(e) The Kitoi Bay Section shall be managed on early run chum or sockeye salmon returning to the Kitoi Bay hatchery, from June 9 through July 20. From July 3 through July 20, fishing opportunities will not occur until chum salmon broodstock requirements for the hatchery are assured. After July 20 through August 20, this section will be managed for pink salmon cost recovery and broodstock requirements. If there is no pink salmon cost recovery, the section may be managed to harvest pink salmon that exceed broodstock needs. After August 20, fishing opportunities may be provided to harvest returning late sockeye and coho that exceed broodstock needs.

Spiridon Bay Sockeye Salmon

The Kodiak Regional Aquaculture Association, in conjunction with ADF&G, has developed a supplemental run of sockeye salmon in Spiridon Bay. Sockeye fry are stocked in Spiridon Lake to rear and then migrate into Spiridon Bay. Because of the steep topography of the creek leading to the lake the returning sockeye can not ascend to naturally spawn. All returning sockeye are intended for common property fisheries. ADF&G, KRAA, and the U.S. Fish and Wildlife Service have developed a management plan which attempts to fully utilize these salmon while protecting local stocks. The Spiridon Bay Sockeye Salmon Management Plan was adopted into regulation by the Board of Fisheries at the January 1993 meeting in Kodiak.

5AAC 18.366. Spiridon Lake Sockeye Salmon Management Plan.

(a) The department shall manage the commercial, sport, and subsistence fisheries in Spiridon Bay to provide for full use of the enhanced stock of sockeye salmon returning to Spiridon Lake.

(b) The purpose of the Spiridon Bay harvest strategy is to allow for the orderly harvest of sockeye salmon returning to Telrod Cove from the Spiridon Lake enhancement project while providing adequate protection for local natural salmon stocks returning to other streams of the bay. The intent of the enhancement project is for the harvest of returning enhanced salmon to occur in traditional commercial fishing areas of the Northwest Kodiak District during openings directed at harvesting Karluk sockeye and westside pink and chum salmon stocks.

(c) Only that portion of the Spiridon Bay Special Harvest Area in Telrod Cove Proper will be open to fishing (Figure 2). **(New for 1995.)**

(d) Only purse seine and beach seines may be operated in the Spiridon Bay Special Harvest Area.

(e) If a harvestable surplus of enhanced sockeye salmon is in the special harvest area, fishing periods will run 24 hours per day. When possible, openings will be coordinated to occur at the beginning of openings in the Northwest Kodiak District. **(New for 1995.)**

Eastside Kodiak

The Eastside Kodiak Salmon Management Plan shows which species effect fishing time in management units located in the Northeast and Eastside Kodiak Districts throughout the season (Table 9). Although not in regulation, this plan reflects fishing opportunities which have been implemented annually since 1978.

SOCKEYE SALMON ESCAPEMENTS GOALS FOR AREA K MAJOR SOCKEYE SALMON SYSTEMS

The amount of fishing time for targeted sockeye salmon fisheries on systems having fish weirs is dependent on actual escapements. These include the Karluk, Ayakulik, Upper Station, and Frazer systems (major systems) and for the Akalura, Saltery, Buskin, Litnik, Pauls, and Thorsheim systems (minor systems). For sockeye salmon systems without weirs, fishing time is generally conservative and occurs at the discretion of ADF&G, in proportion to the perceived system specific run strength.

Upper and lower biological escapement requirements have been identified for each river's sockeye salmon stocks (Table 10). A basic management function is to achieve at least the lower

escapement goals for stocks exploited by targeted fisheries, even if it means that directed fishing time on those stocks does not occur. When the possibility exists that the upper escapement goals may be exceeded and significant deviations from optimum production could occur because of that excess; maximum directed fishing time on these stocks would be allowed, even if it requires continuous stream terminus fishing to contain the escapement at or near the upper levels. This is the extreme case occasionally needed to manage the Kodiak Area sockeye salmon runs. More common is a moderate amount of directed fishing time required to harvest sockeye salmon surplus and provide escapement approaching desired levels.

Escapement graphs by stream are a good tool for illustrating escapements, similar to preseason harvest projections (Appendix B.1. - B.5.). These are curves drawn based on historical average cumulative escapement by day, scaled to the upper and lower biological escapement goal for each particular system. Actual escapements can be plotted on these graphs to compare with the projected cumulative count. Since fishing time is strongly tied to escapement levels, these graphs can be valuable aids in understanding current ADF&G management actions, and in planning for future fisheries. Actual inseason escapement counts can be heard daily at 8:15 A.M. on SSB channel 3230 Khz.

Table 1. Commercial salmon harvest in 1994 and harvest projections for the Kodiak Management Area, 1995.

	CHINOOK	SOCKEYE	COHO	PINK	CHUM	TOTAL
1994 Projected Harvest	25,000	2,428,100	325,000	13,700,000	610,000	17,088,100
1994 Actual Harvest	22,600	2,877,500	296,200	8,162,600	738,800	12,097,700
1995 Projected Harvest	25,000	2,400,000	310,000	18,235,000	800,000	21,770,000

FISHERY	1994 HARVEST[a] Projection	1994 HARVEST[a] Actual[c]	1995 HARVEST[a,b] Projection as of 1/5/95
Early Run Sockeye Salmon Fisheries (6/9-7/15)			
Cape Igvak	262,500	295,700	280,000
Karluk	400,000	652,800	200,000
Ayakulik	105,000	0	45,000
Frazer	420,000	477,200	420,000
Upper Station	70,000	57,700	50,000
Minor Systems	70,000	36,100	50,000
Minor Enhancements	-	4,900	90,000
Other	100,000	142,500	70,000
SubTotal	**1,427,500**	**1,666,900**	**1,205,000**
Late Run Sockeye Salmon Fisheries (7/16-9/15)			
Afognak (Hatchery)	5,000	9,300	30,000
Cape Igvak	140,600	26,600	120,000
Karluk	175,000	355,200	350,000
Ayakulik	65,000	106,300	30,000
Frazer	105,000	119,300	105,000
Upper Station	250,000	277,700	300,000
Minor Systems	75,000	8,300	75,000
Spiridon	135,000	263,800	160,000
Other	50,000	44,100	25,000
SubTotal	**1,000,600**	**1,210,600**	**1,195,000**
TOTAL SOCKEYE	**2,428,100**	**2,877,500**	**2,400,000**
Coho Salmon Fisheries (8/1-10/1)			
Afognak (Hatchery)	75,000	45,900	15,000
Afognak (Natural)	40,000	47,100	35,000
Westside	85,000	107,100	135,000
Alitak	20,000	32,200	25,000
Eastside/Northend Kodiak	75,000	43,100	60,000
Mainland	30,000	20,800	40,000
SubTotal	**325,000**	**296,200**	**310,000**
Pink Salmon Fisheries (7/6-9/5)			
Afognak (Hatchery)	1,400,000	2,051,400	7,965,000
Afognak (Natural)	700,000	623,400	1,150,000
Westside Kodiak	5,000,000	3,315,000	4,650,000
Alitak	2,000,000	1,120,800	2,365,000
Eastside/Northend Kodiak	3,500,000	858,200	1,750,000
Mainland	1,100,000	193,800	355,000
SubTotal	**13,700,000**	**8,162,600**	**18,235,000**

-Continued-

Table 1. (page 2 of 2)

FISHERY	1994 HARVEST[a] Projection	1994 HARVEST[a] Actual[c]	1995 HARVEST[a,b] Projection as of 1/5/95
Chum Salmon Fisheries (6/6-9/5)			
Afognak (Hatchery)	10,000	5,000	150,000
Afognak (Natural)	50,000	34,900	31,000
Westside Kodiak	250,000	286,100	213,000
Alitak	50,000	112,100	38,000
Eastside/Northend Kodiak	150,000	209,700	148,000
Mainland	100,000	91,000	220,000
SubTotal	**610,000**	**738,800**	**800,000**
GRAND TOTAL	**17,088,100[d]**	**12,097,700[e]**	**21,770,000[f]**

[a] Numbers of fish.
[b] 1995 harvest projections as of 1/5/9.
[c] Actual harvest estimates by fishery as of 1/5/95.
[d] Includes 25,000 chinook - projected harvest.
[e] Includes 22,600 chinook - actual harvest.
[f] Includes 25,000 chinook - projected harvest.

Table 2. Expected harvest from supplemental salmon production, by system and species for the Kodiak Management Area, 1995.[a]

System	Sockeye	Pink	Coho	Chum
Kitoi Bay Hatchery Complex[b]	32,000[c]	7,965,000	15,000	150,000
Spiridon Lake[d]	160,000	0	0	0
Hidden Lake	21,000	0	0	0
Waterfall Lake	20,000	0	0	0
Crescent Lake[e]	13,000	0	5,000	0
Katmai Lake	0	0	2,000	0
Kodiak Road System Lakes	0	0	3,000	0
Total	246,000	7,965,000	25,000	150,000

[a] Harvest estimates by KRAA and Kitoi Bay Hatchery staff.
[b] See Eastside Afognak Salmon Management Plan.
[c] Harvest is expected to occur during fisheries targeting pink salmon.
[d] See Spiridon Lake Sockeye Salmon Management Plan.
[e] See Crescent Lake Salmon Management Plan.

Table 3. Commercial salmon season opening times and dates by species for the Kodiak Area, 1995.

FISHERY	EARLIEST OPENING TIME/DATE	
	Firm Time/Date	Approximate Time/Date
Early Run Sockeye Salmon Fisheries		
Cape Igvak Section [a]	-	12:01 A.M. June 5-9
N.W. Kodiak District [b]	12:00 Noon June 9	
Inner Ayakulik and Outer Ayakulik Sections [c]	-	Low tide June 7-9
Alitak District [b]	12:00 Noon June 9	
Minor Systems [d]		
Uganik	-	12:00 Noon June 14
Paramanof	-	12:00 Noon June 14
Pauls/Perenosa	-	12:00 Noon June 14
Litnik/Waterfall Lake/Hidden Lake	-	12:00 Noon June 9-14
Saltery	-	12:00 Noon June 14
Kaflia/Swikshak	-	12:00 Noon June 14
Pink/Chum Salmon Fisheries [e]		
Mainland District	12:00 Noon July 6	-
Afognak District	12:00 Noon July 6	-
N.W. Kodiak District	12:00 Noon July 6	-
S.W. Kodiak District	12:00 Noon July 6	-
Alitak District	12:00 Noon July 6	-
Eastside Kodiak District	12:00 Noon July 6	-
N.E. Kodiak District	12:00 Noon July 6	-
Late Run Sockeye Salmon Fishery		
Cape Igvak Section [f]	-	12:01 A.M. July (?)
All remaining late run sockeye fisheries [g]	-	12:00 Noon July 15
System Specific Coho Salmon Fisheries [h]		
Mainland District	-	12:00 Noon Sept. 1
Afognak District	-	12:00 Noon Aug. 15
N.W. Kodiak District	-	12:00 Noon Sept. 1
S.W. Kodiak District	-	12:00 Noon Sept. 1
Alitak District	-	12:00 Noon Sept. 1
Eastside Kodiak District	-	12:00 Noon Sept. 5
N.E. Kodiak District	-	12:00 Noon Sept. 5

-Continued-

Table 3. (page 2 of 2)

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[a] Actual opening date will be determined by sockeye escapement levels into the Chignik River system. Fishing time will be in 24 hour increments.

[b] Actual opening time/date is as shown. This opening is considered a commercial test fishery; fishing time for this initial period will be 33 hours (12:00 nooon 6/9 through 9:00 P.M. 6/10).

[c] Actual opening date will be determined by the sockeye escapement level into Ayakulik River and opening time by low tide timing during daylight hours.

[d] Actual opening time will be determined by sockeye escapement levels into minor systems. Fishing time for this period will be 33 hours (12:00 noon through 9:00 P.M.)

[e] Actual opening time/date is as shown. Fishing time for this initial period will be 105 hours (12:00 noon 7/6 through 9:00 P.M. 7/10). See section on Fishing Periods for additional information.

[f] Actual opening date will be determined by sockeye escapement levels into the Chignik River System. Fishing time will be in 24 hour increments.

[g] Actual opening date for system specific fishing time will be determined by sockeye escapement levels into major systems. All fishing periods will begin at 12:00 noon and end at 9:00 P.M. prior to 8/16 and end at 6:00 P.M. from 8/16 to season's end.

[h] Actual opening date for system specific fishing time will be determined by overall coho run strength evaluation and by escapement levels into major systems and minor systems with reliable escapement data.

Table 4. Regulatory fishery management plans for the Kodiak Management Area, 1995.

MANAGEMENT PLAN	YEAR INITIATED	MGMT. UNITS AFFECTED	DATES IN EFFECT
Cape Igvak Salmon Management Plan	1978	Cape Igvak Section Wide Bay Section	6/5 - 7/25
Alitak Bay District Salmon Management Plan	1987	Alitak Bay District	6/9 - 10/1
Westside Kodiak Management Plan	1990	N.W. Kodiak District S.W. Kodiak District S.W. Afognak Section	6/9 - 10/1
Crescent Lake Coho Salmon Management Plan	1990	Portion of the Central Section in Vicinity of Port Lions	8/1 - 9/15
North Shelikof Strait Sockeye Salmon Management Plan	1990	S.W. Afognak Section N.W. Afognak Section Shuyak Section Big River Section Hallo Bay Section Inner and Outer Kukak Sect. Dakavak Section	7/6 - 7/25
Eastside Afognak Management Plan	1993	Kitoi Bay Section Izhut Bay Section Duck Bay Section	6/9 - 10/1
Spiridon Bay Sockeye Salmon Management Plan	1993	Special Harvest Area in Spiridon Bay Section	6/9 - 10/1

Table 5. Biological and allocative criteria, and the management chronology, of the Cape Igvak Management Plan for the Kodiak Management Area, 1995.

BIOLOGICAL AND ALLOCATIVE CRITERIA FOR MANAGING THE CAPE IGVAK FISHERY ON CHIGNIK BOUND SOCKEYE

BIOLOGICAL REQUIREMENTS			ALLOCATIVE REQUIREMENTS		
REGULATION 5AAC 18.360	ESCAPEMENT NEEDS CHIGNIK (EARLY RUN)	ESCAPEMENT NEEDS CHIGNIK (LATE RUN)	REGULATION 5AAC 18.360	CHIGNIK MINIMUM HARVEST	IGVAK %
(a) (b) (c)	THROUGH 6/30 350,000-400,000	-	(a)	EXPECTATIONS OF LESS THAN 600,000	CLOSED
-	-	-	(b)	EXPECTATIONS OF 600,000 ARE IN DOUBT	CLOSED
(a) (b) (c)	-	THROUGH 7/30 195,000-200,000	(c)	EXPECTATIONS OF 600,000 OCCUR	OPEN TO ACHEIVE 15%
-	-	-	(d)	CHIGNIK SALMON % INTERCEPTION CALCULATIONS	80% OF CATCH AT IGVAK ARE CHIGNIK SOCKEYE
-	-	-	(e)	ALLOCATION PERIOD 600,000	6/5 - 7/25 % NOT APPLICABLE
(f)	FROM JUNE 26 - JULY 9 CAPE IGVAK SECTION CLOSED OR SEVERLY LIMITED UNTIL CHIGNIK LAKE RUN EVALUATED		-	-	-
-	-	-	(g)	-	ONE DAY ADVANCE NOTICE
	400,000	250,000		600,000 MINIMUM	15 %

MANAGEMENT CHRONOLOGY FOR CHIGNIK BOUND SOCKEYE AND KODIAK SALMON

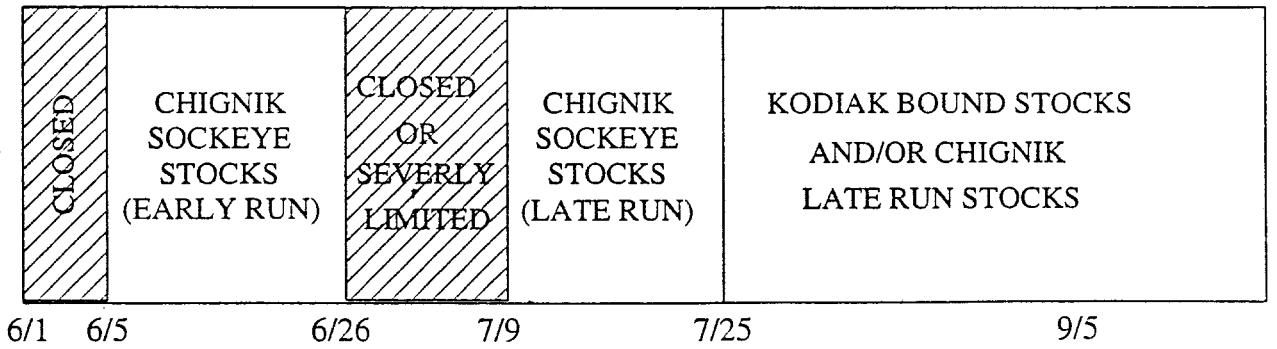


Table 6. Primary management species and fishery chronology of the Alitak Bay District Salmon Management Plan for the Kodiak Management Area, 1995.

ALITAK BAY DISTRICT MANAGEMENT PLAN

CAPE ALITAK SECTION (SEINE)	CLOSED	XXXXXXXX	FRAZER SOCKEYE (AGGRESSIVE MANAGEMENT STRATEGY)	FRAZER SOCKEYE (CONSERVATIVE MANAGEMENT STRATEGY)	ODD YEAR CYCLE FRAZER PINK SALMON / EVEN YEAR CYCLE UP.STATION SOCKEYE (LATE RUN)	ODD YEAR CYCLE UP.STATION SOCKEYE / EVEN YEAR CYCLE UP.STATION SOCKEYE & FRAZER PINK SALMON	ALL ALITAK DISTRICT COHO SYSTEMS
MOSER/OLGA BAY SECTION (GILLNET) (TRADITIONAL)	CLOSED	XXXXXXXX	FRAZER SOCKEYE (AGGRESSIVE MANAGEMENT STRATEGY)	FRAZER SOCKEYE (CONSERVATIVE MANAGEMENT STRATEGY)	ODD YEAR CYCLE FRAZER PINK SALMON / EVEN YEAR CYCLE UP.STATION SOCKEYE (LATE RUN)	ODD YEAR CYCLE UP.STATION SOCKEYE / EVEN YEAR CYCLE UP.STATION SOCKEYE & FRAZER PINK SALMON	ALL OLGA BAY COHO SYSTEMS
OUTER UPPER & INNER UPPER STATION (GILLNET) (NON-TRADITIONAL)	CLOSED	CLOSED	UPPER STATION SOCKEYE (EARLY RUN)		UPPER STATION SOCKEYE (LATE RUN)	UP. STATION SOCK & COHO	UPPER STATION COHO
OUTER AKALURA & IN. AKALURA SECTIONS (GILLNET) (NON-TRADITIONAL)	CLOSED	CLOSED	AKALURA SOCKEYE (EARLY RUN)		AKALURA SOCKEYE (LATE RUN)	AKALURA SOCK & COHO	AKALURA COHO
DOG SALMON FLATS SECTION (GILLNET) (NON-TRADITIONAL)	CLOSED	CLOSED	FRAZER SOCKEYE (MOP UP FISHERY)		FRAZER PINK SALMON	FRAZER AND HORSE MARINE COHO	
HUMPY/DEADMAN SECTION (SEINE)	CLOSED	XXXXXXXX	FRAZER SOCKEYE (AGRESSIVE MANAGEMENT STRATEGY)	FRAZER SOCKEYE (CONSERVATIVE MANAGEMENT STRATEGY)	ALITAK BAY PINK, CHUM, AND COHO		

6/1 6/9-10 6/24 7/9 7/15 8/9 8/20 8/26 9/25

xx = Commercial Test Fisheries

ALITAK BAY DISTRICT - PRIMARY MANAGEMENT SPECIES BY STREAM BY TIME

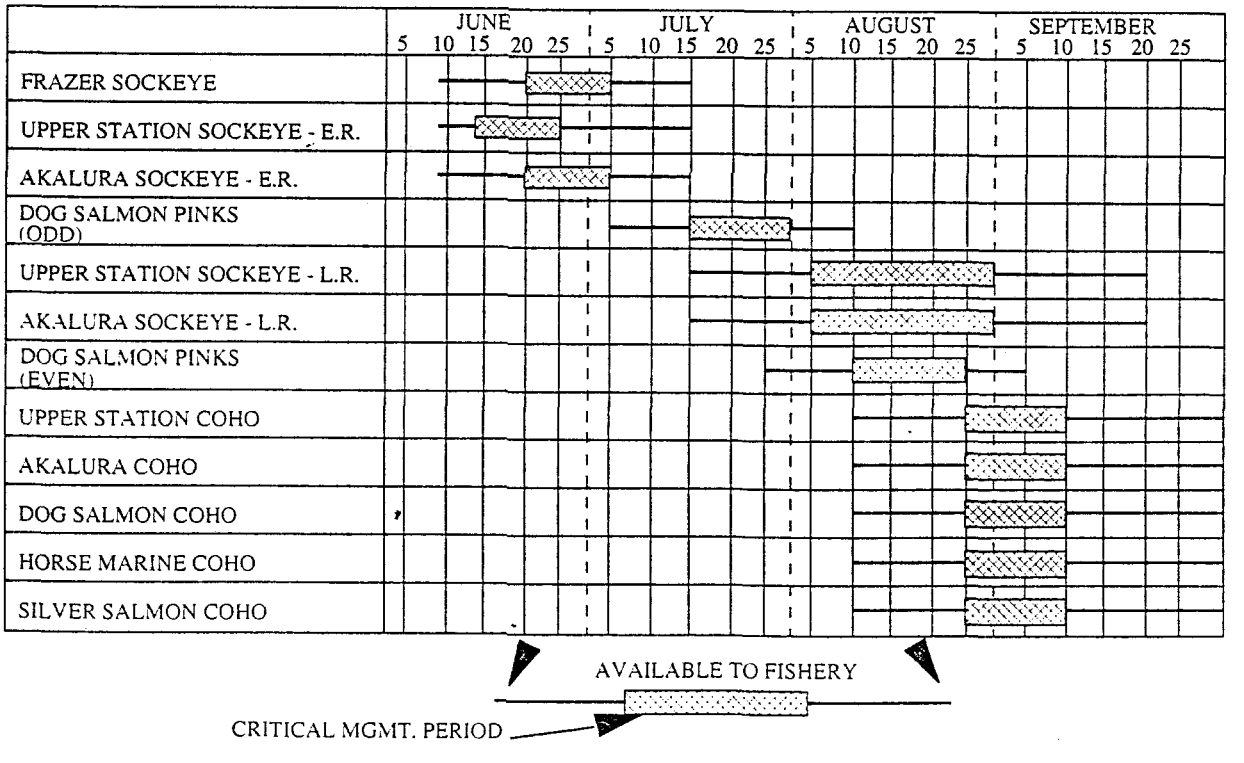


Table 7. Primary management species and fishery chronology of the Westside Kodiak Management Plan for the Kodiak Management Area, 1995.

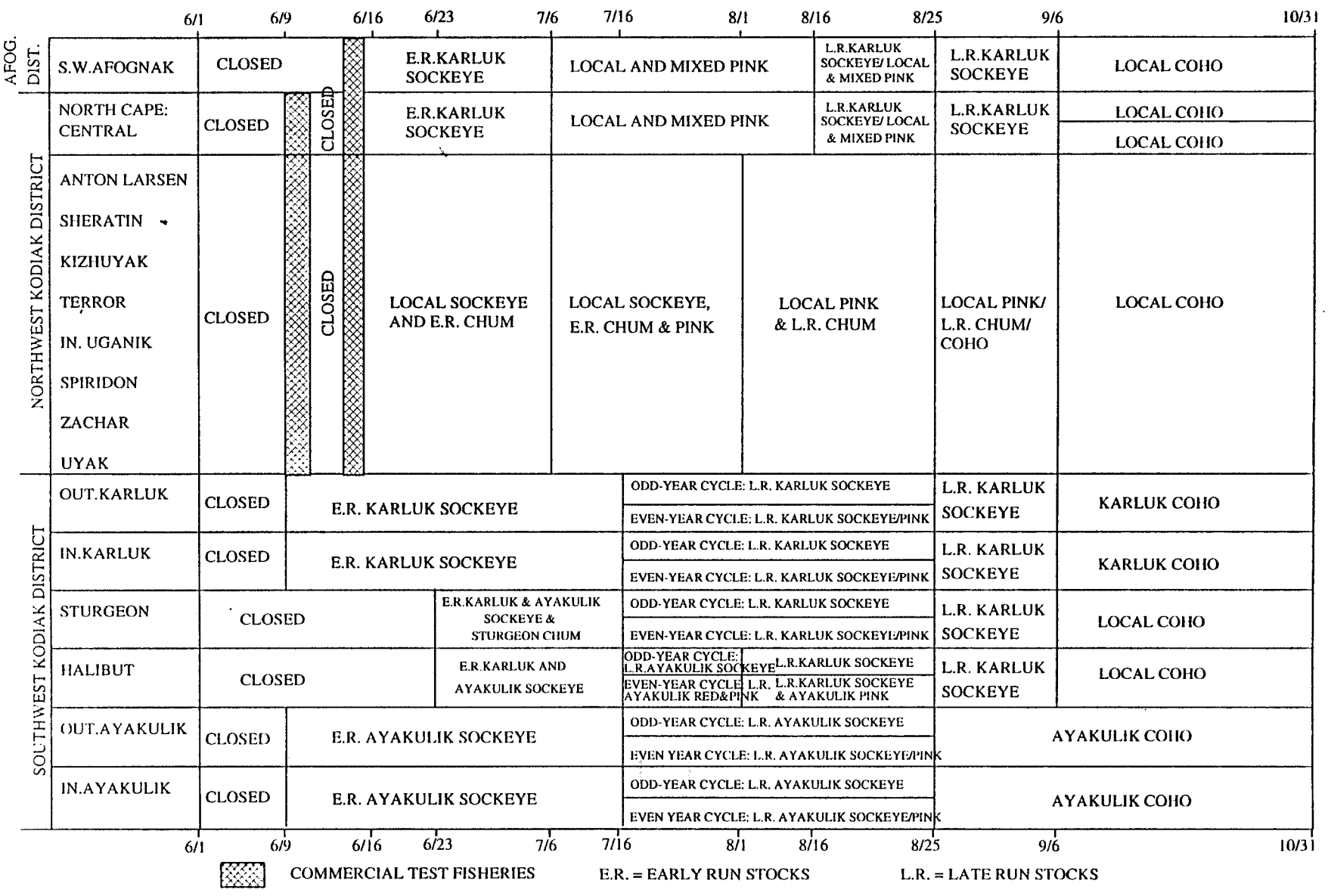
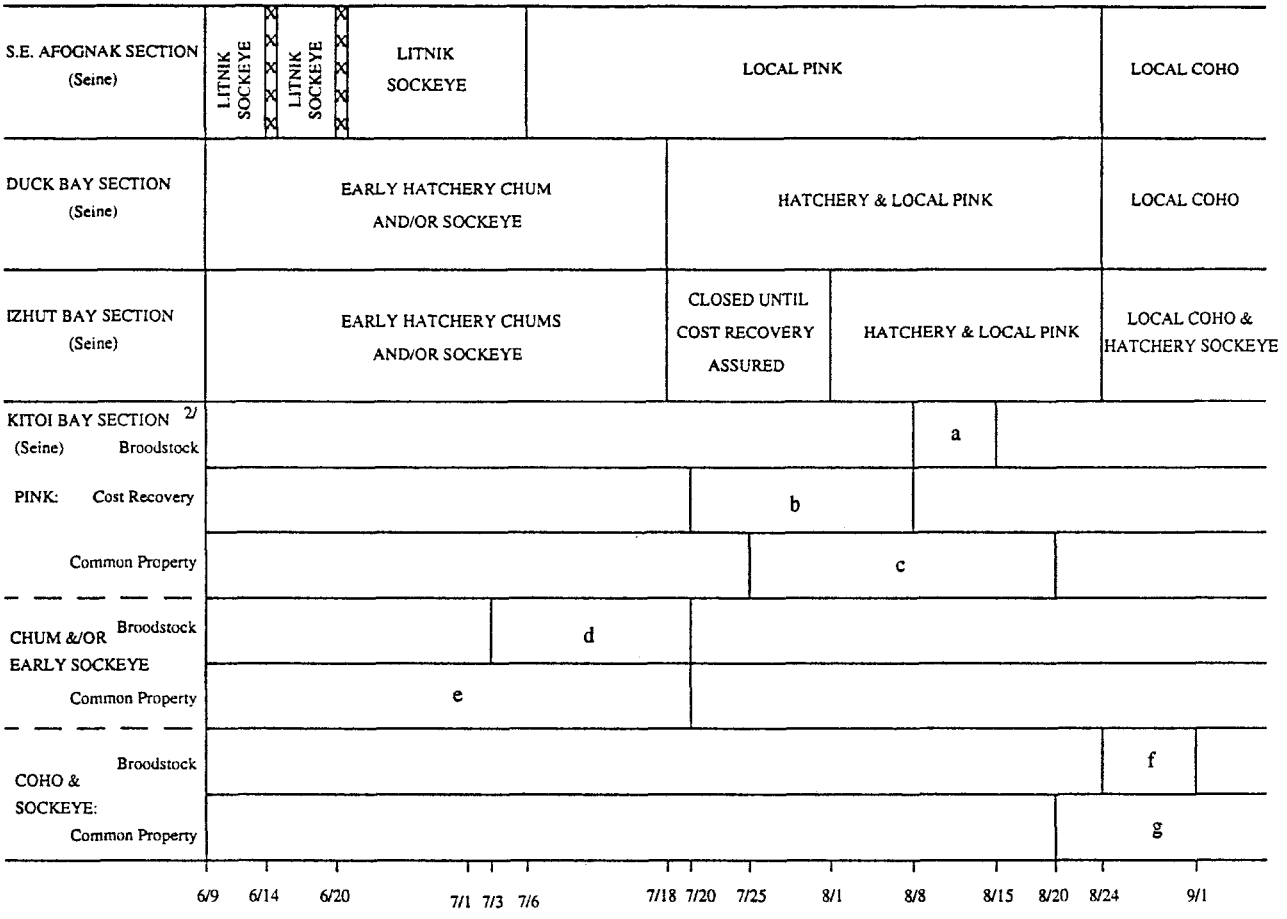


Table 8. Primary management species and fishery chronology of the Eastside Afognak Management Plan for the Kodiak Management Area, 1995.

TARGETED SPECIES BY SYSTEM AND TIME FOR SPECIFIC MANAGEMENT UNITS [1/]



- fishing time dependant upon sockeye escapement into Litnik system.

1 Included in this management plan are the harvest strategies for current natural and hatchery prodution as well as future hatchery production.

2 The management plan required for the Kitoi Bay Section is rather complicated in order to achieve broodstock, cost recovery, and common harvest requirements. This is further complicated by the multispecies production currently occurring at Kitoi Bay hatchery. The diagram shown attempts to approximate dates for when specific management strategies should be implemented to insure achievement of hatchery goals and an orderly harvest of quality common property fish.

a Hatchery pink salmon broodstock captured.
b Hatchery pink salmon cost recovery fishery when necessary.
c Hatchery pink salmon common property fishery.
d Hatchery chum and/or early sockeye salmon broodstock captured.
e Hatchery chum and/or early sockeye salmon common property fishery.
f Hatchery coho and late sockeye salmon broodstock captured.
g Hatchery coho and late sockeye salmon common property fishery.

Table 9. Management chronology by management unit for eastside salmon stocks, Kodiak Management Area, 1995.

	DATE	6/1	6/14	6/21	7/6	7/10	8/25	9/6	10/31
	MANAGEMENT UNIT								
NORTHEAST KODIAK DISTRICT	OUTER CHINIAK BAY	CLOSED			LOCAL AND MIXED PINK		LOCAL PINK, COHO	LOCAL COHO	
	INNER CHINIAK BAY	CLOSED			LOCAL AND MIXED PINK AND CHUM		LOCAL PINK, COHO	LOCAL COHO	
	BUSKIN RIVER	CLOSED			LOCAL PINK BUSKIN SOCKEYE	LOCAL PINK AND CHUM	LOCAL PINK, COHO, CHUM	LOCAL COHO	
	MONASHKA/MILL BAY	CLOSED			LOCAL AND MIXED PINK		LOCAL PINK, COHO	LOCAL COHO	
EASTSIDE KODIAK DISTRICT	SEVEN RIVERS	CLOSED	CLOSED	CLOSED	LOCAL AND MIXED PINK AND CHUM		LOCAL PINK, COHO	LOCAL COHO	
	TWO HEADED	CLOSED	CLOSED	CLOSED	LOCAL AND MIXED PINK AND CHUM		LOCAL PINK, COHO	LOCAL COHO	
	SITKALIDAK	CLOSED	CLOSED	CLOSED	LOCAL AND MIXED PINK AND CHUM		LOCAL PINK, CHUM, COHO	LOCAL COHO	
	OUTER UGAK BAY	CLOSED	CLOSED	PASAGSHAK SOCKEYE	LOCAL AND MIXED PINK AND CHUM		LOCAL PINK, CHUM, COHO	LATE CHUM, COHO	
	INNER UGAK BAY	CLOSED	CLOSED	SALTERY SOCKEYE	LOCAL PINK & CHUM SALTERY SOCKEYE	LOCAL PINK AND CHUM	LOCAL PINK, COHO	COHO	

[1] Local and mixed sockeye 33 hour fishing period.

Table 10. Sockeye salmon escapement goals for major and minor systems in millions of fish, for the Kodiak Management Area, 1995.[a]

	Early Run (Before 7/15)		Late Run (After 7/15)		Total	
	Minimum	Desired	Minimum	Desired	Min.	Des.
Major Systems						
Karluk [b]	.150	.250	.400	.550	.550	.800
Ayakulik	.160	.220	.040	.080	.200	.300
Upper Station [b]	.050	.075	.150	.200	.200	.275
Frazer [c]	.140	.200	-	-	.140	.200
Subtotal	**.500**	**.745**	**.590**	**.830**	**1.090**	**1.575**
Minor Systems						
Akalura [b]	.010	.015	.030	.045	.040	.060
Saltery [c]	.020	.040	-	-	.020	.030
Buskin [c]	.010	.015	-	-	.010	.015
Litnik [c]	.040	.060	-	-	.040	.060
Pauls [c]	.020	.040	-	-	.020	.040
Thorsheim [c]	.005	.010	-	-	.005	.010
Subtotal	**.105**	**.180**	**.030**	**.045**	**.135**	**.205**
GRAND TOTAL	**.605**	**.925**	**.620**	**.875**	**1.225**	**1.790**

[a] This listing of systems identifies only those systems whose escapement is monitored by fish weir total escapement counts. The escapement into these systems represents approximately 85% of the Kodiak Area's total sockeye escapement.

[b] Sockeye escapement into these systems characterized by two distinct stocks as identified by bimodal escapement pattern, i.e. an early stock where the cumulative escapement occurs through July 15 and a late stock where the cumulative escapement occurs primarily from July 16 through season's end.

[c] Sockeye escapement into these systems characterized by one distinct escapement pattern and where escapement is essentially completed by approximately July 25. Escapement goals for Pauls Bay are currently being reevaluated.

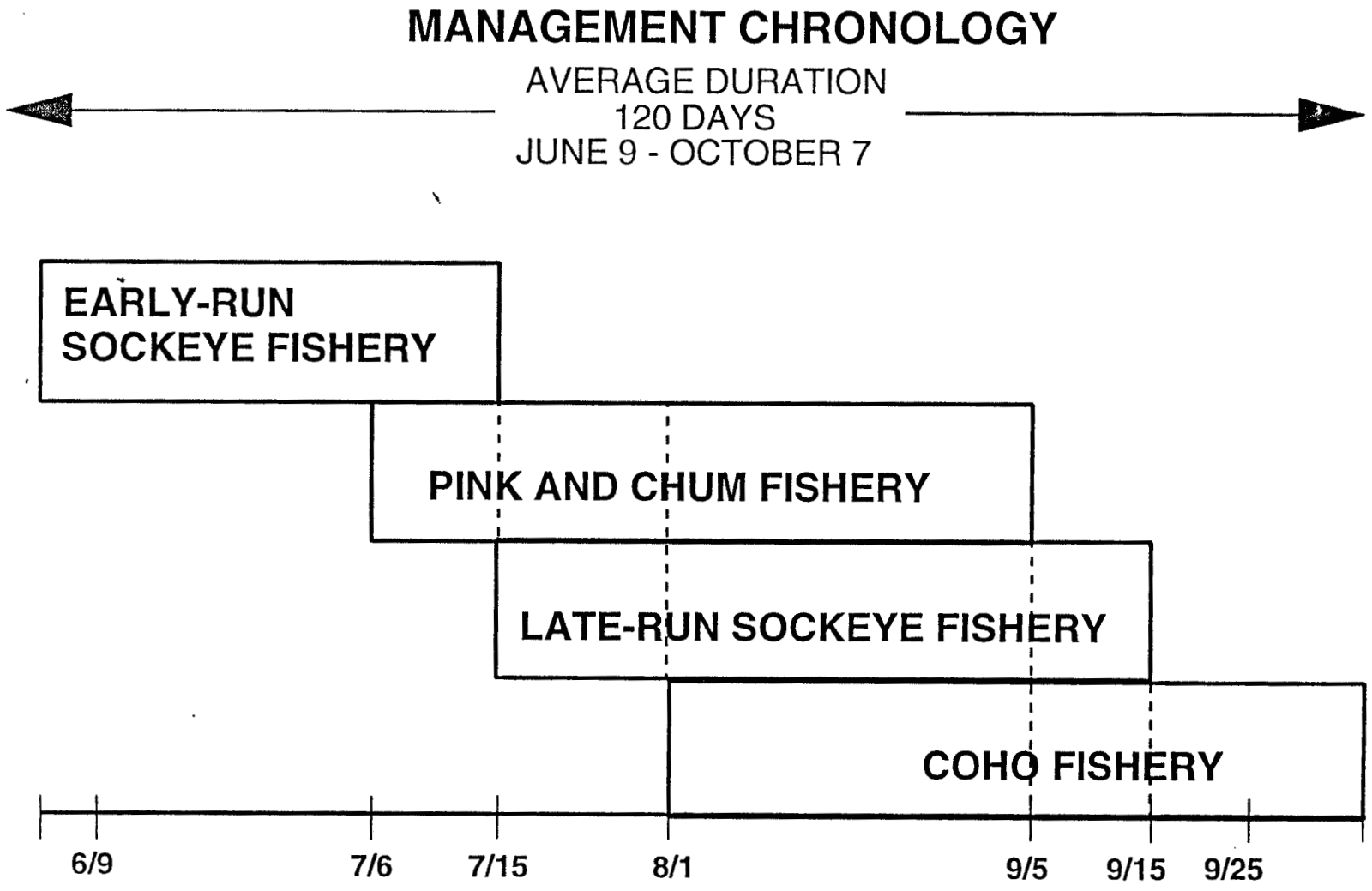


Figure 1. Commercial salmon fishery chronology, by specie, in the Kodiak Management Area.

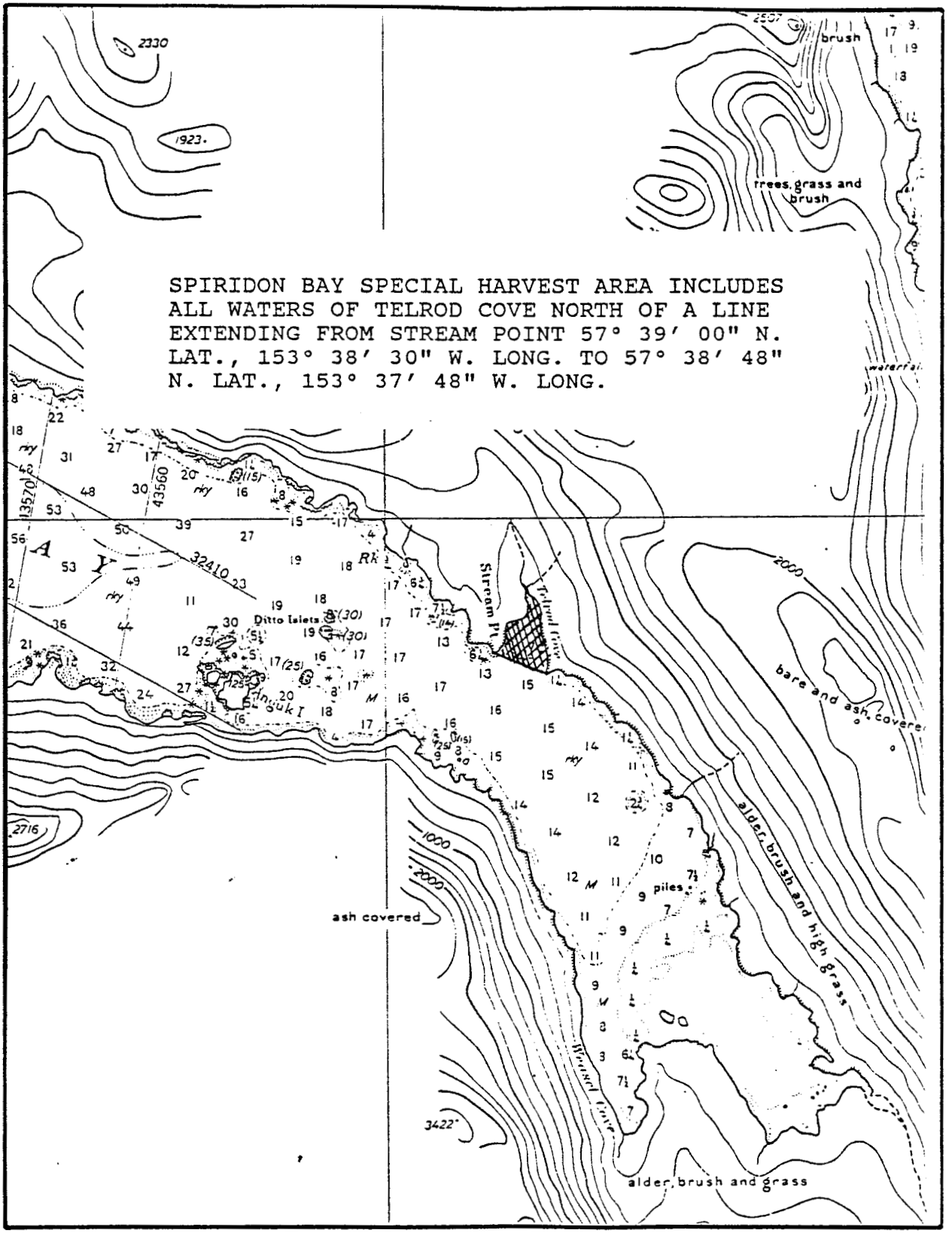


Figure 2. Approximate boundaries of the Spiridon Bay Special Harvest Area.

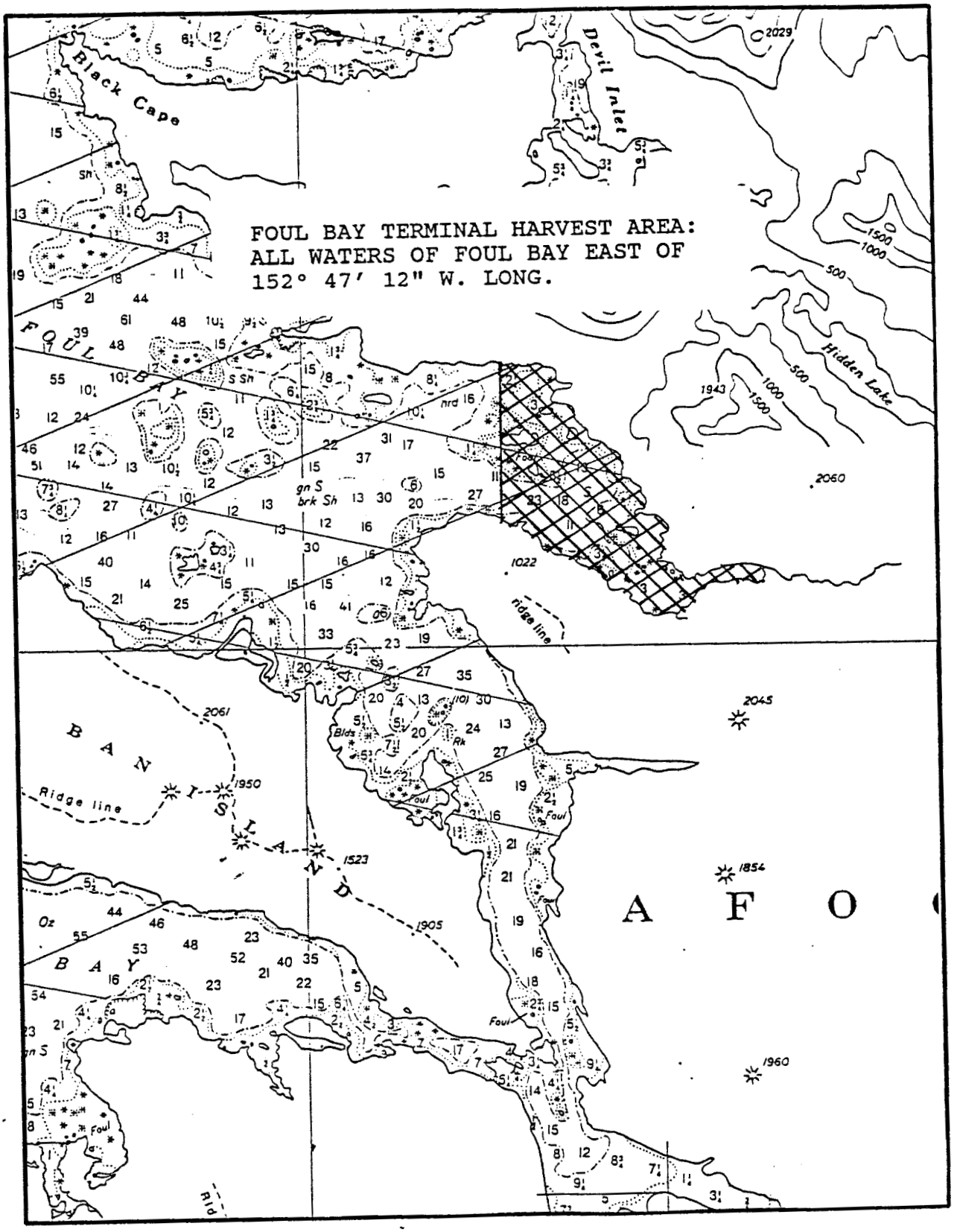


Figure 3. Foul Bay Terminal harvest Area.

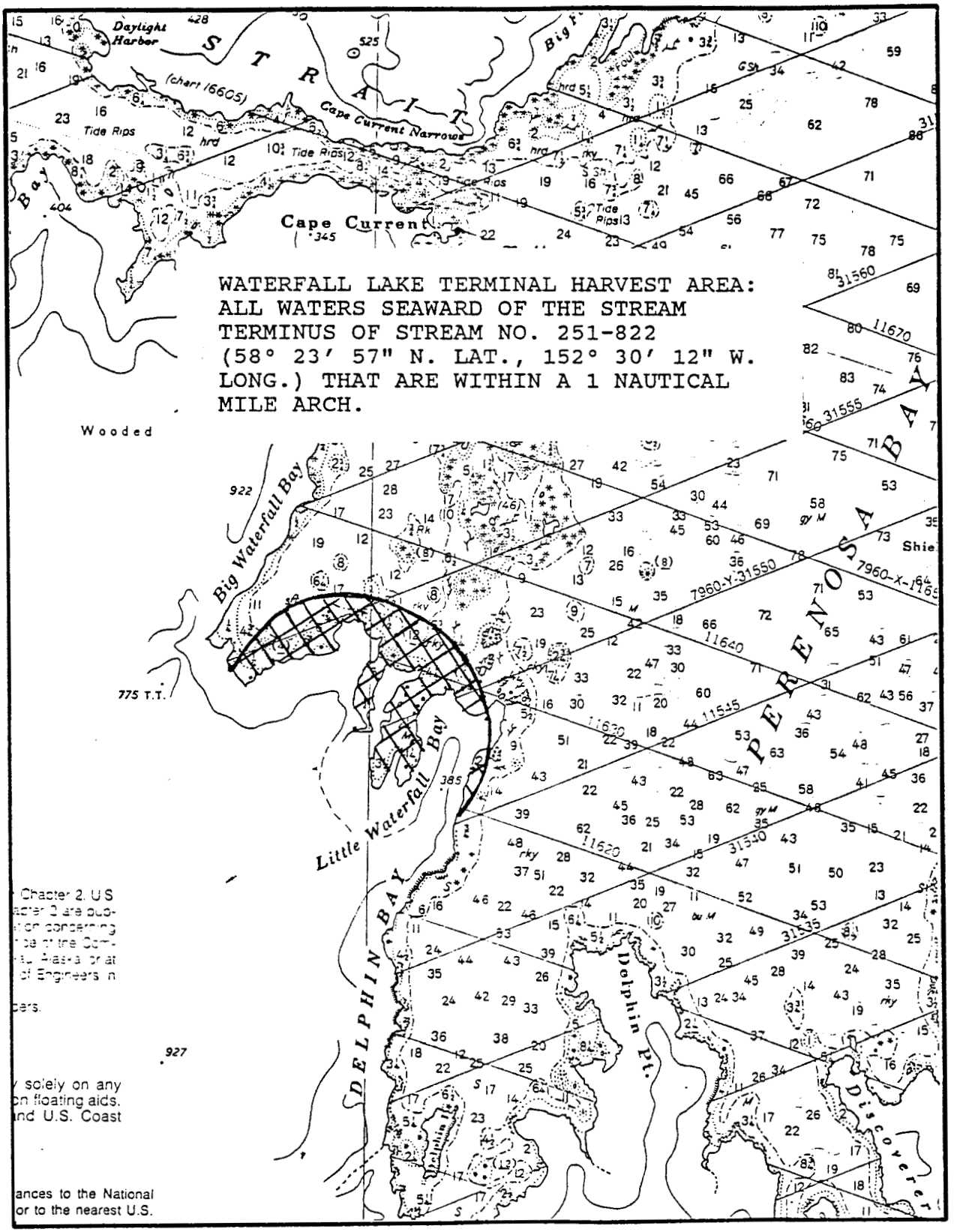


Figure 4. Waterfall Lake Terminal Harvest Area.

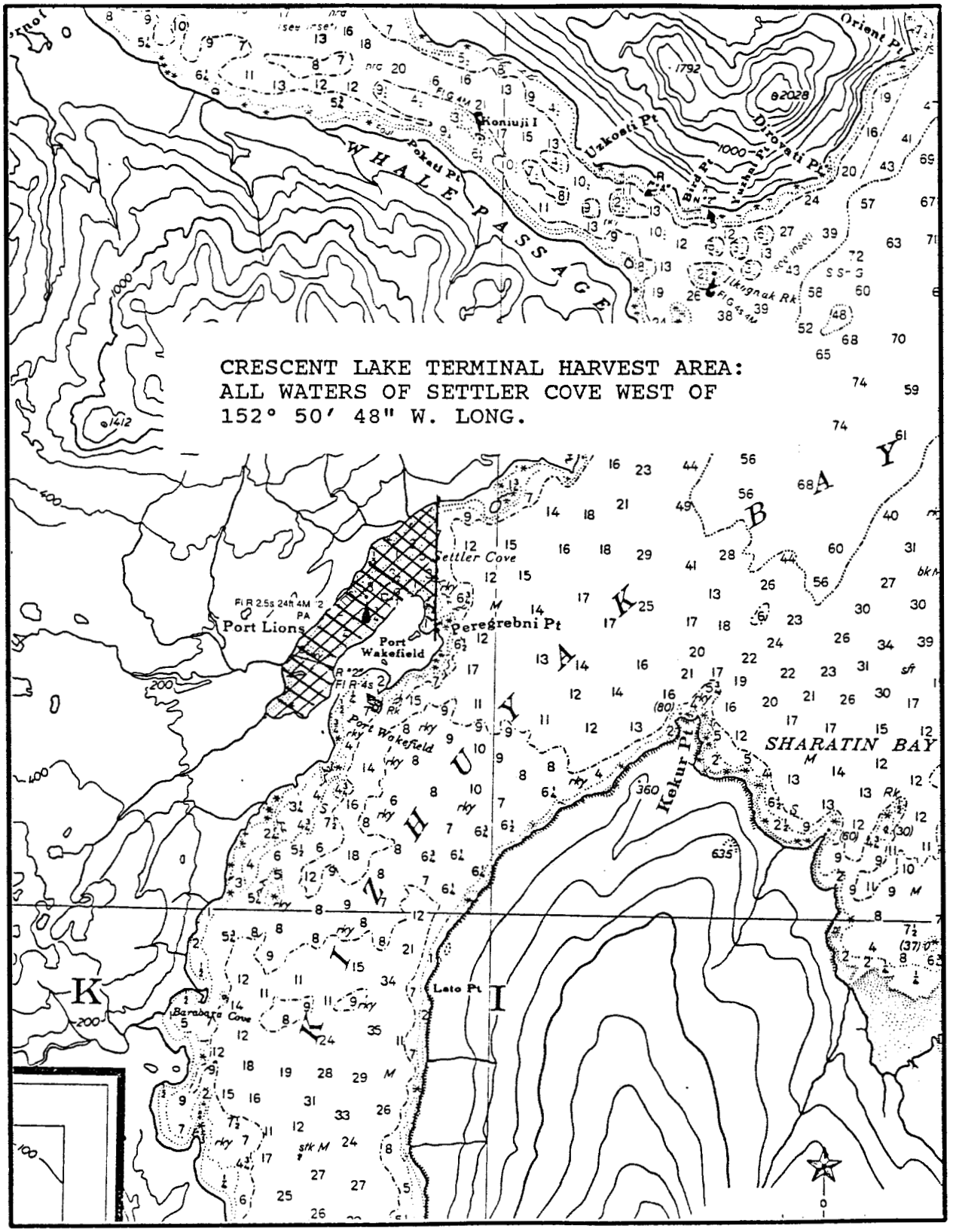


Figure 5. Crescent Lake Terminal Harvest Area.

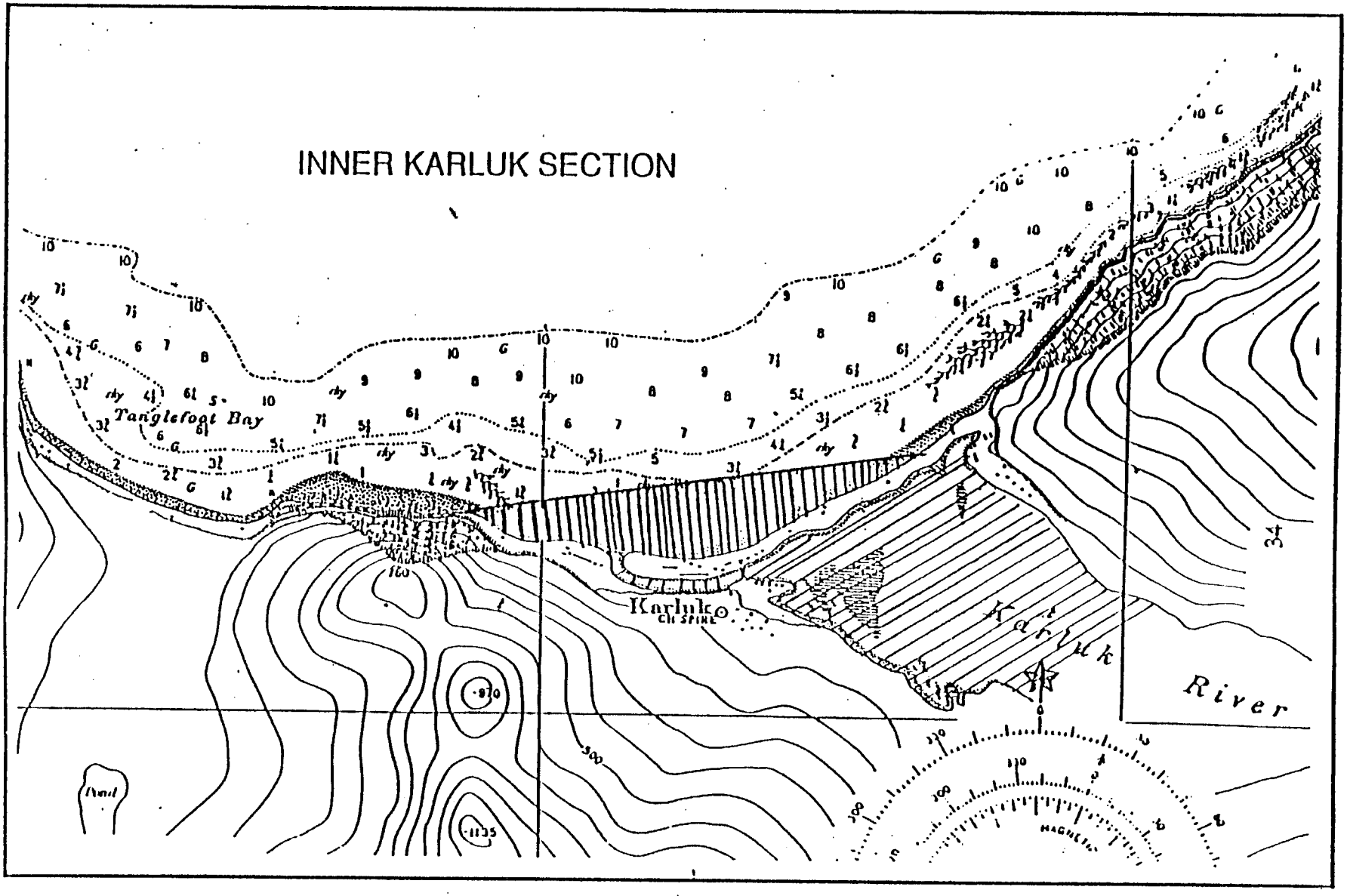


Figure 6. Karluk River closed water sanctuary in the Kodiak Management Area, 1995.

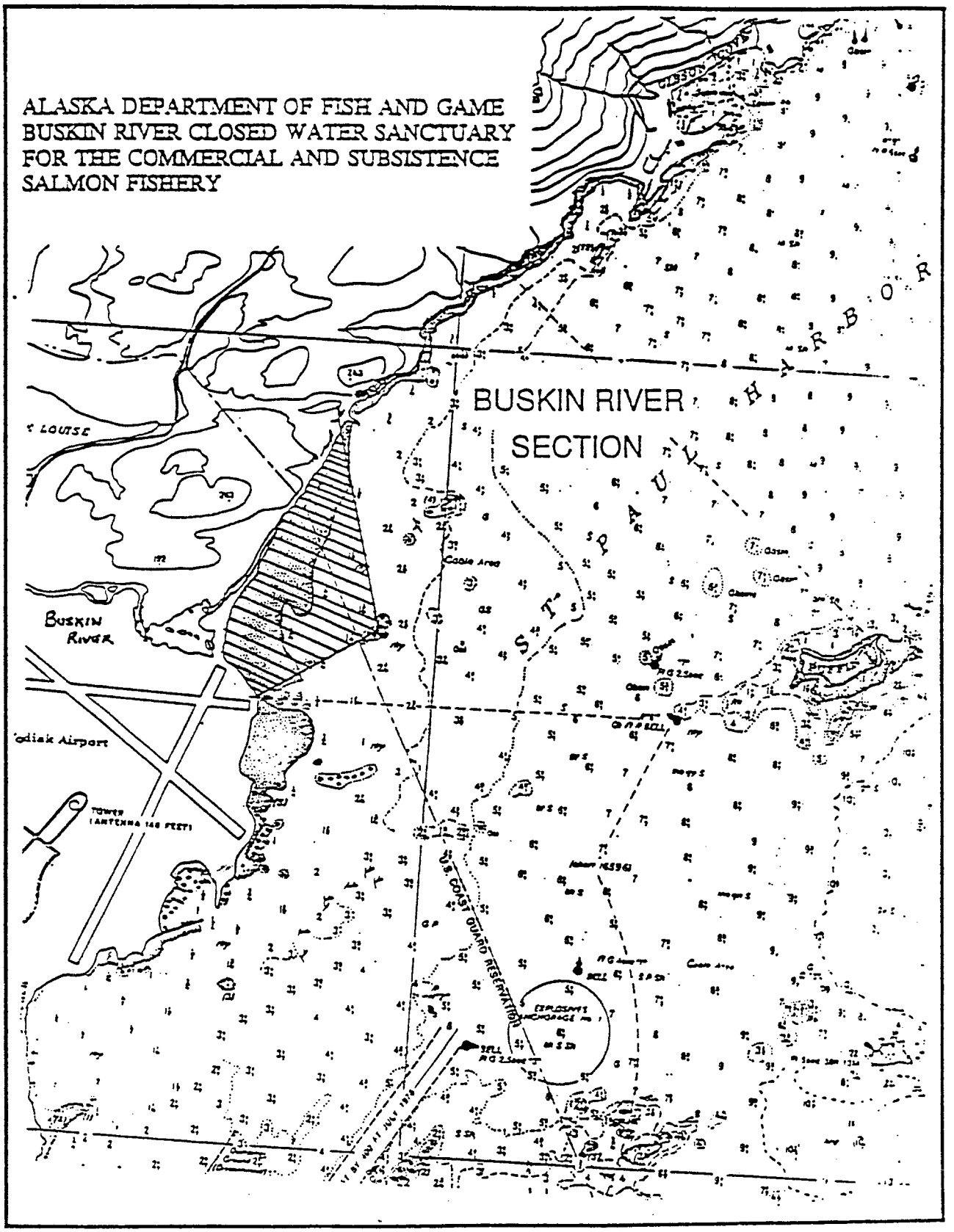


Figure 7. Buskin River closed water sanctuary in the Kodiak Management Area, 1995.

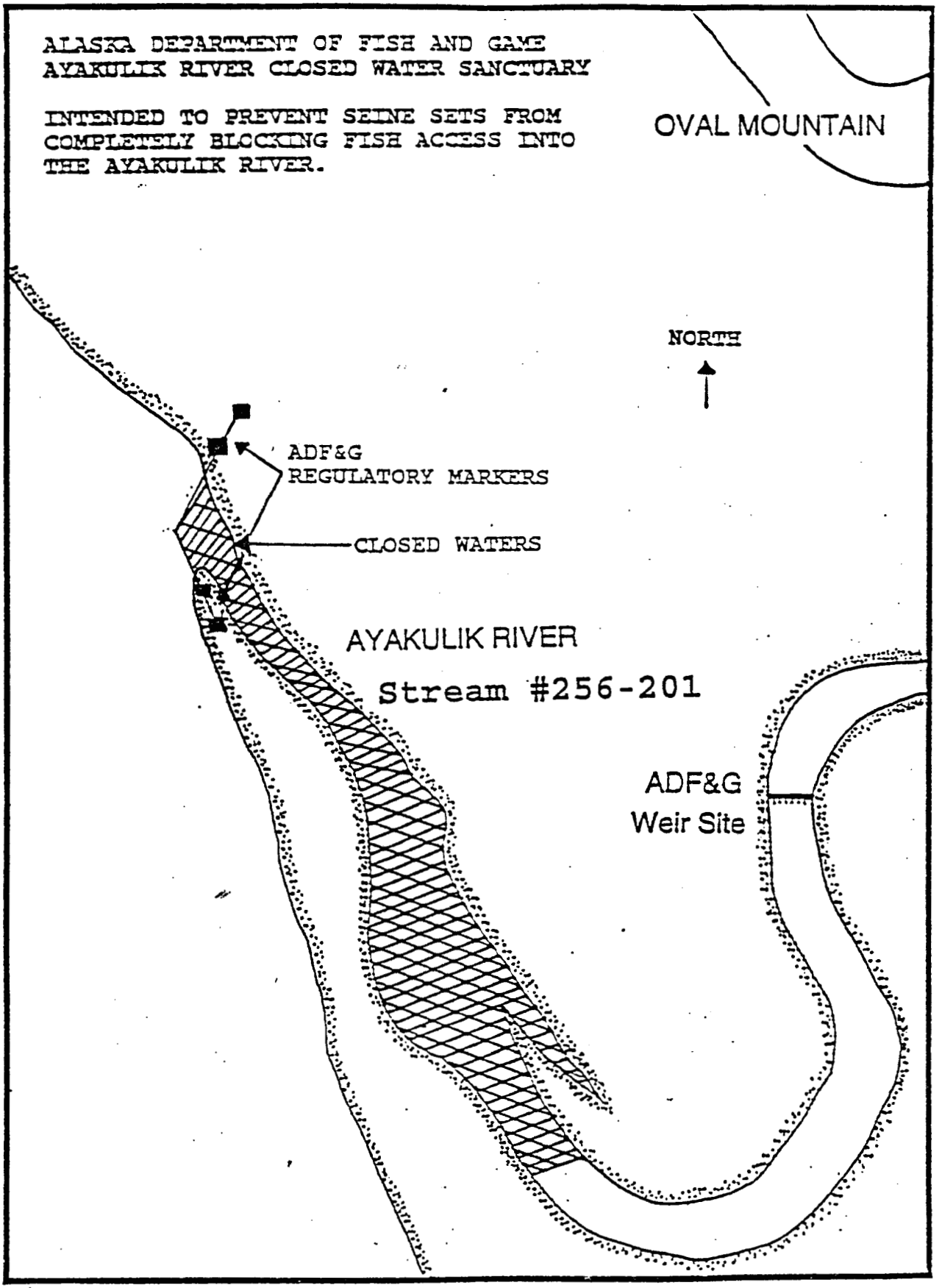


Figure 8. Ayakulik River closed water sanctuary, Kodiak Management Area, 1995.

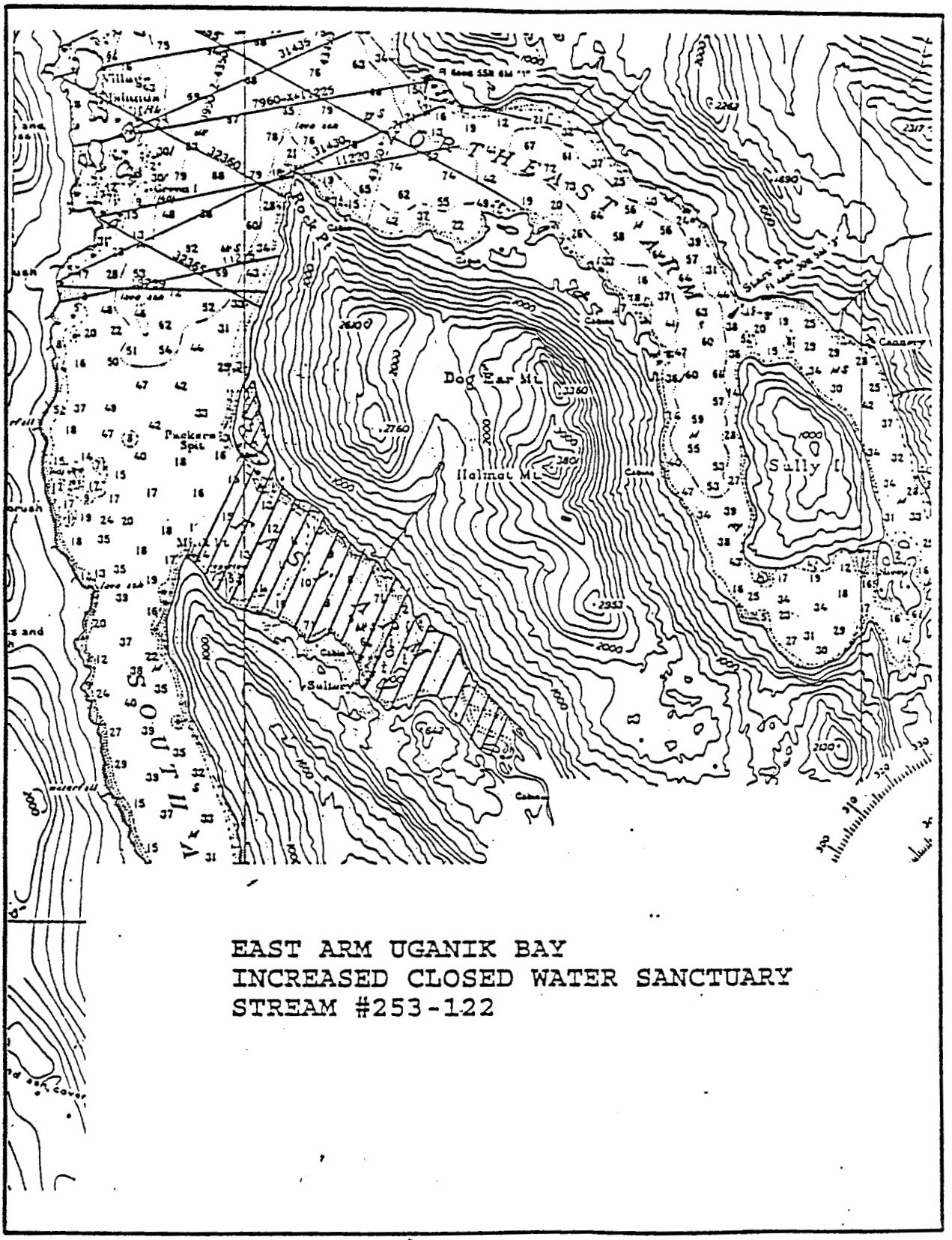


Figure 9. East Arm Uganik Bay increased closed water sanctuary, Kodiak Management Area, 1995.

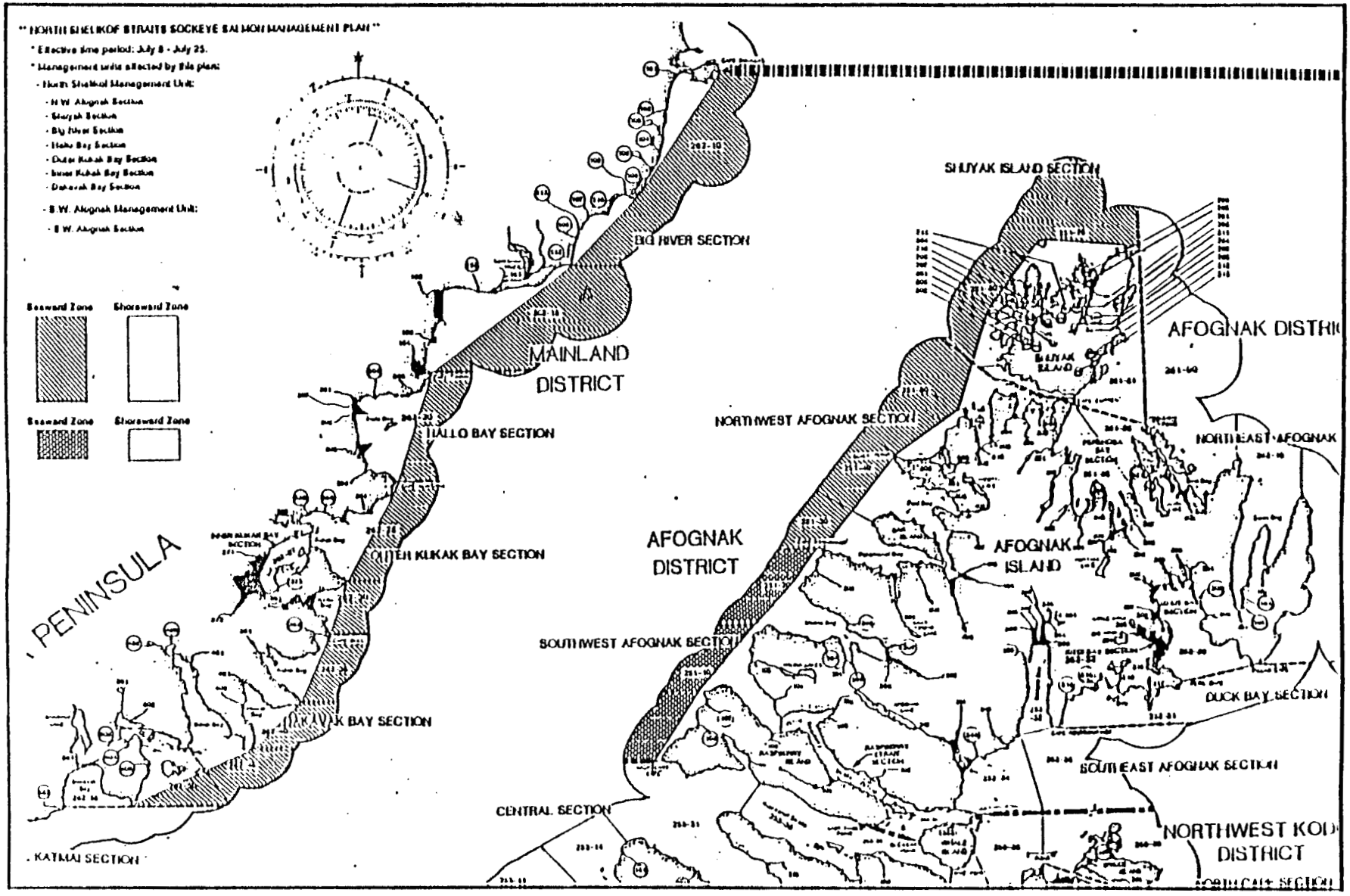
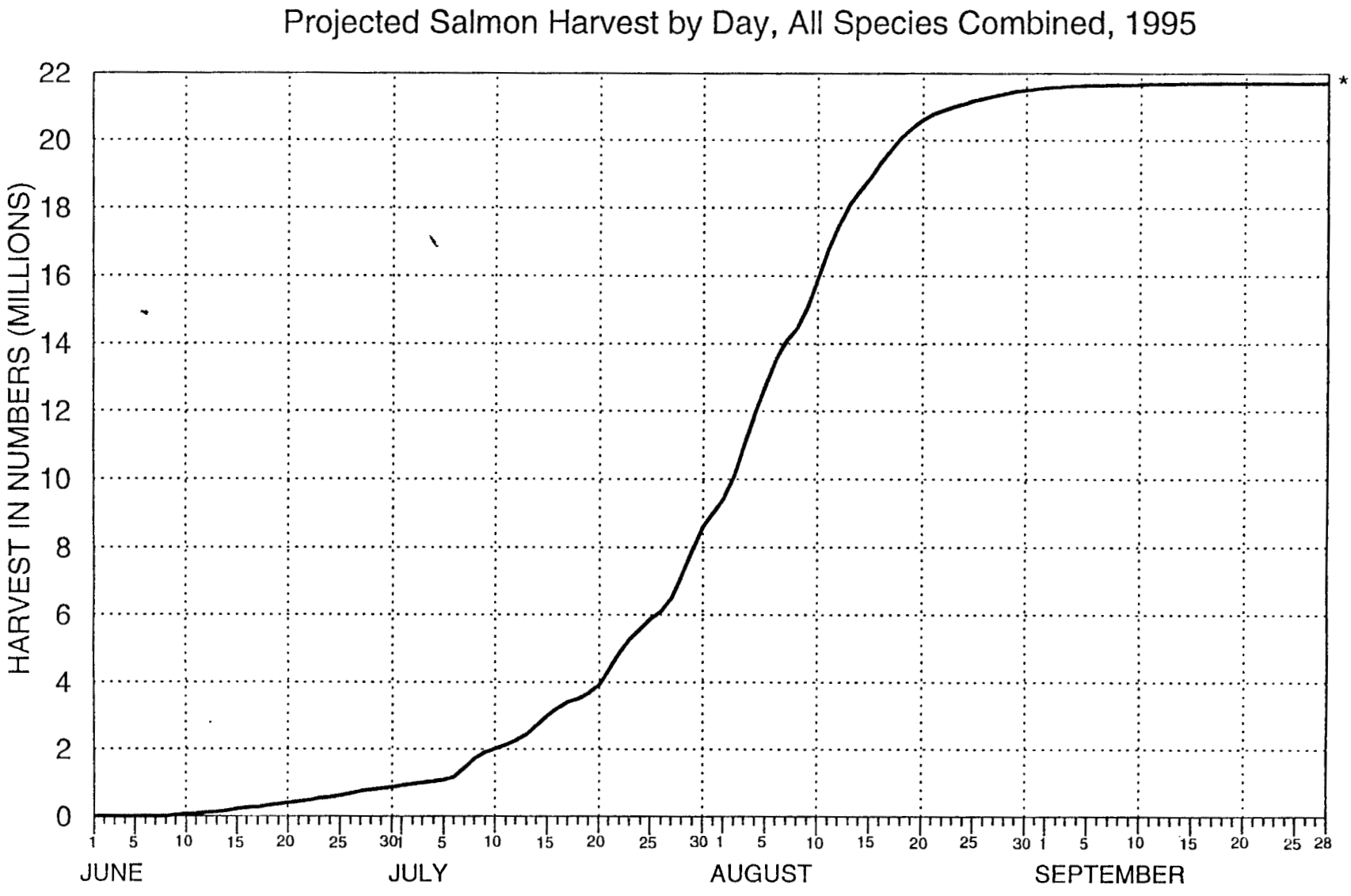


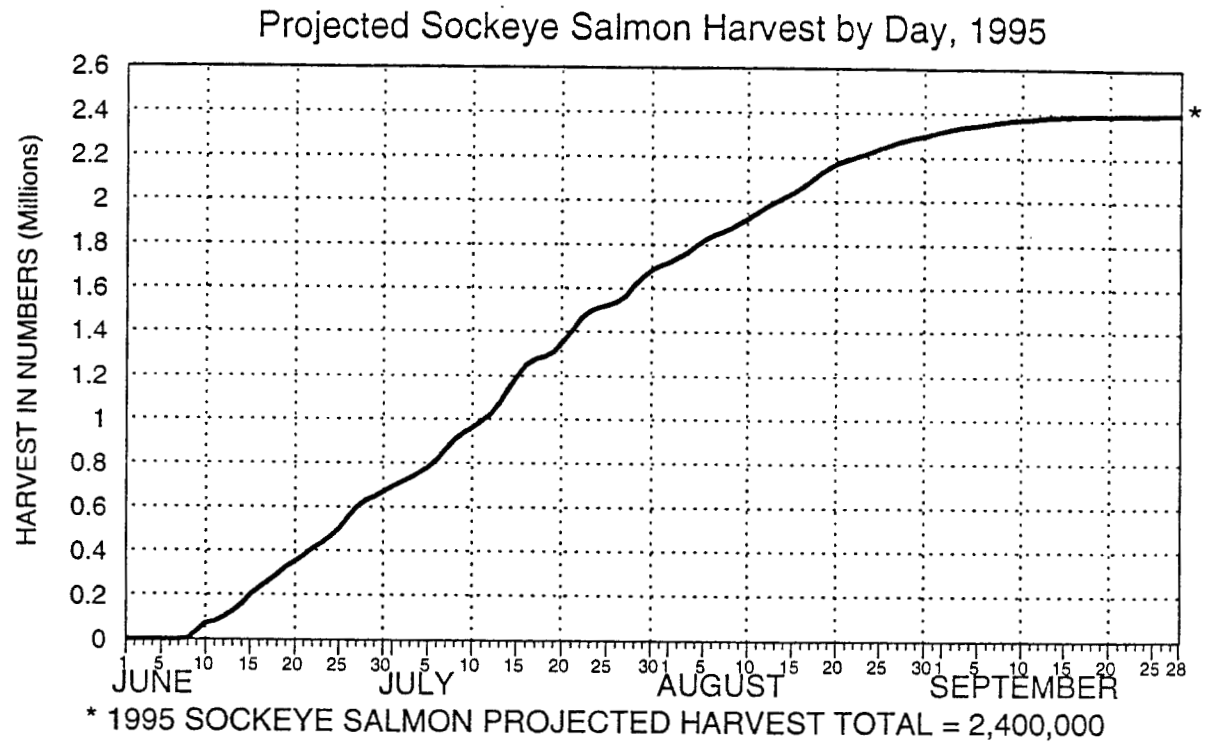
Figure 10. Approximate boundaries of the "North Shelikof Strait Seaward Zone" and the "Southwest Afognak Seaward Zone" of the North Shelikof Strait Sockeye Salmon Management Plan for the Kodiak Management Area, 1995.

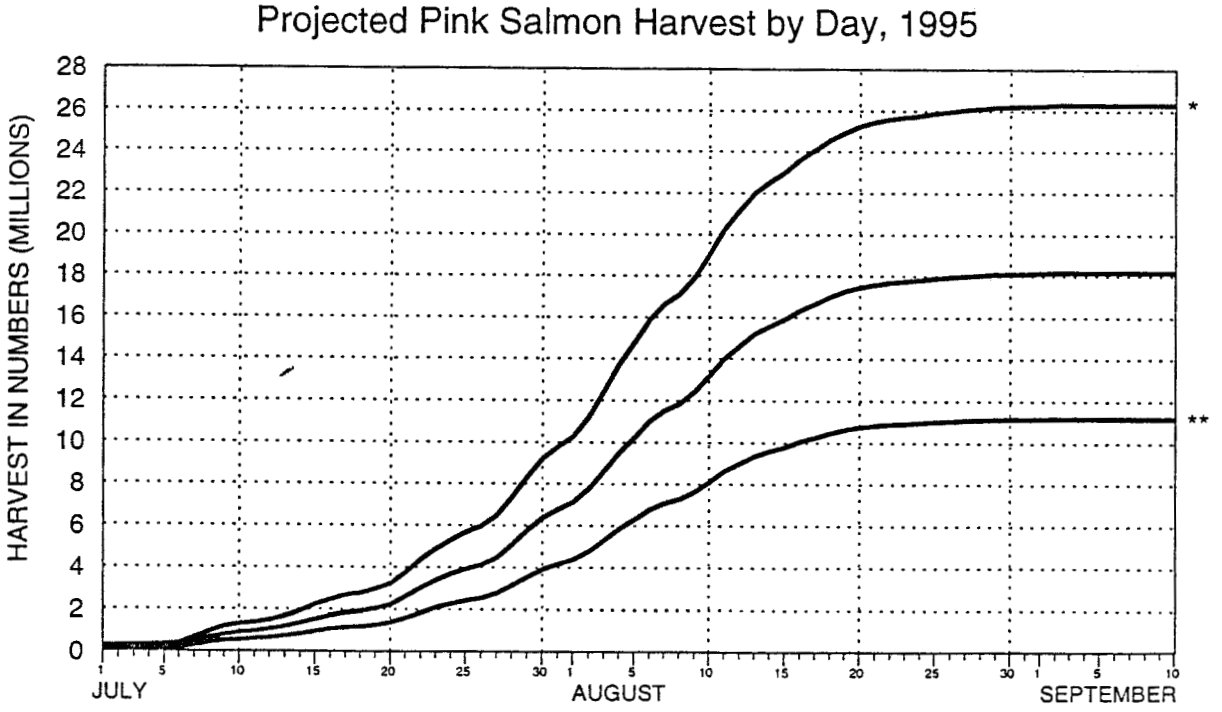
APPENDIX



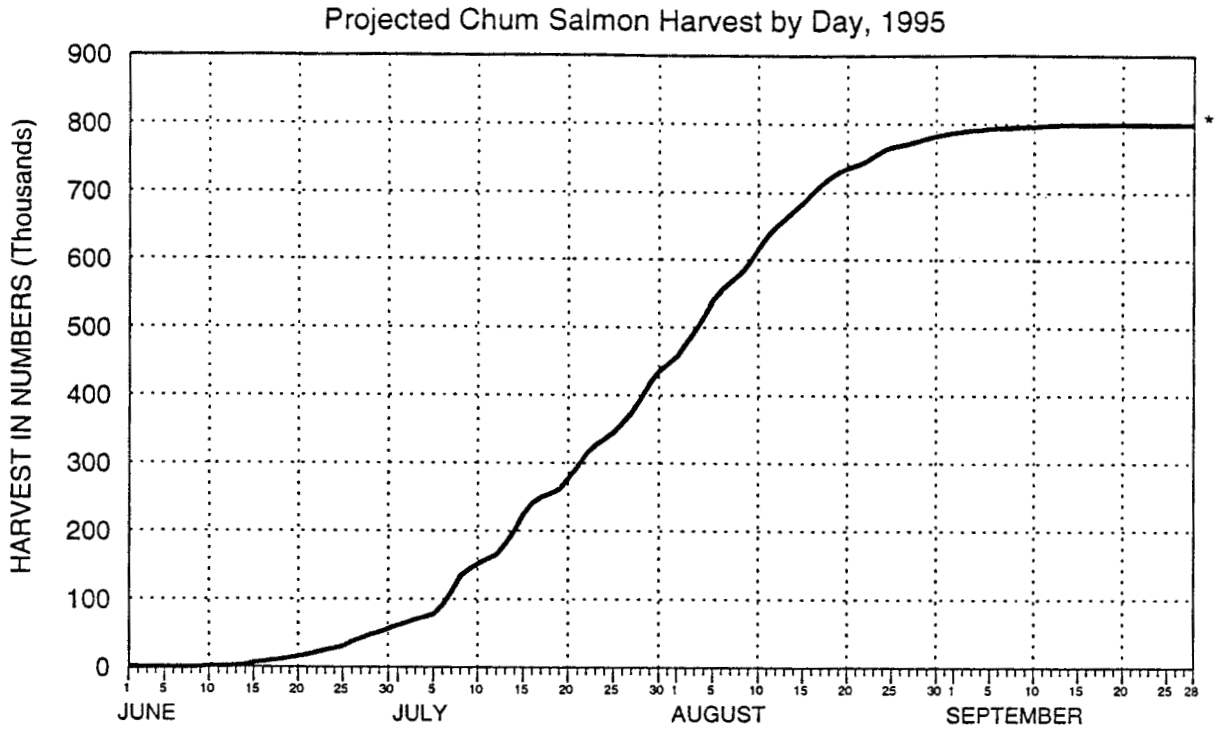
* 1995 ALL SALMON SPECIES PROJECTED HARVERST TOTAL = 21,770,000

Appendix A.1. Projected salmon harvest curve, all species combined, for the Kodiak Management Area, 1995.

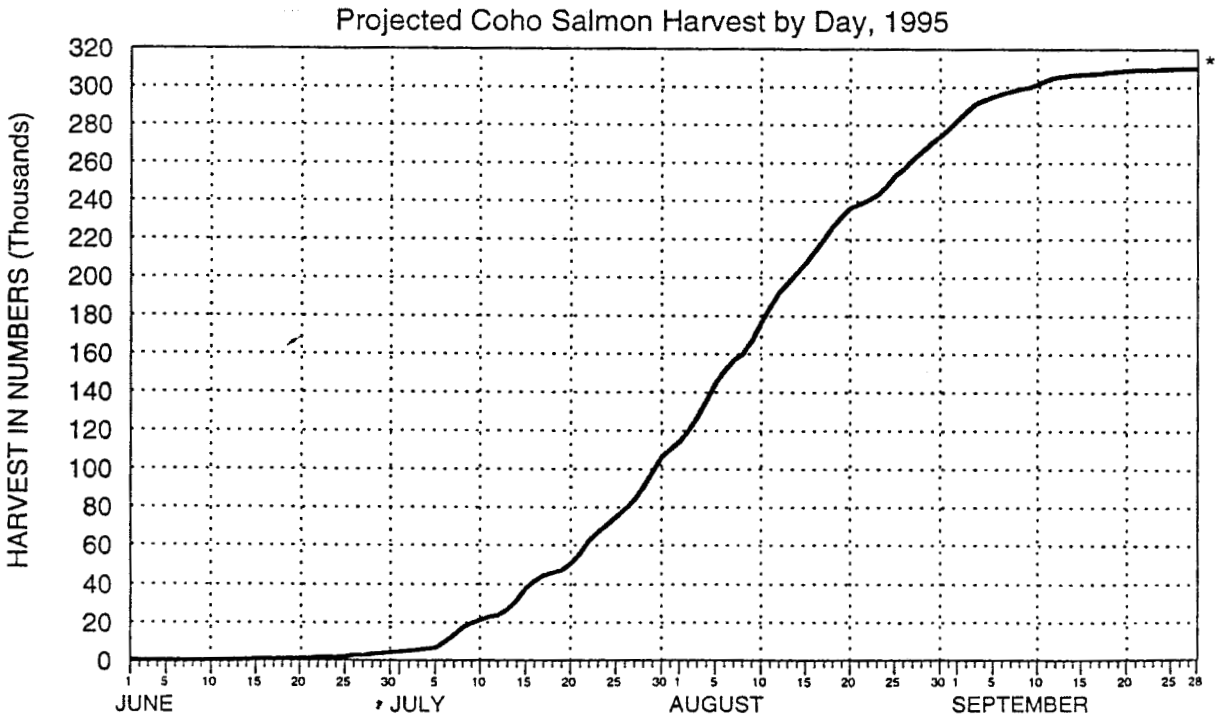




Appendix A.2. Projected sockeye and pink salmon harvest curves for the Kodiak Management Area, 1995.

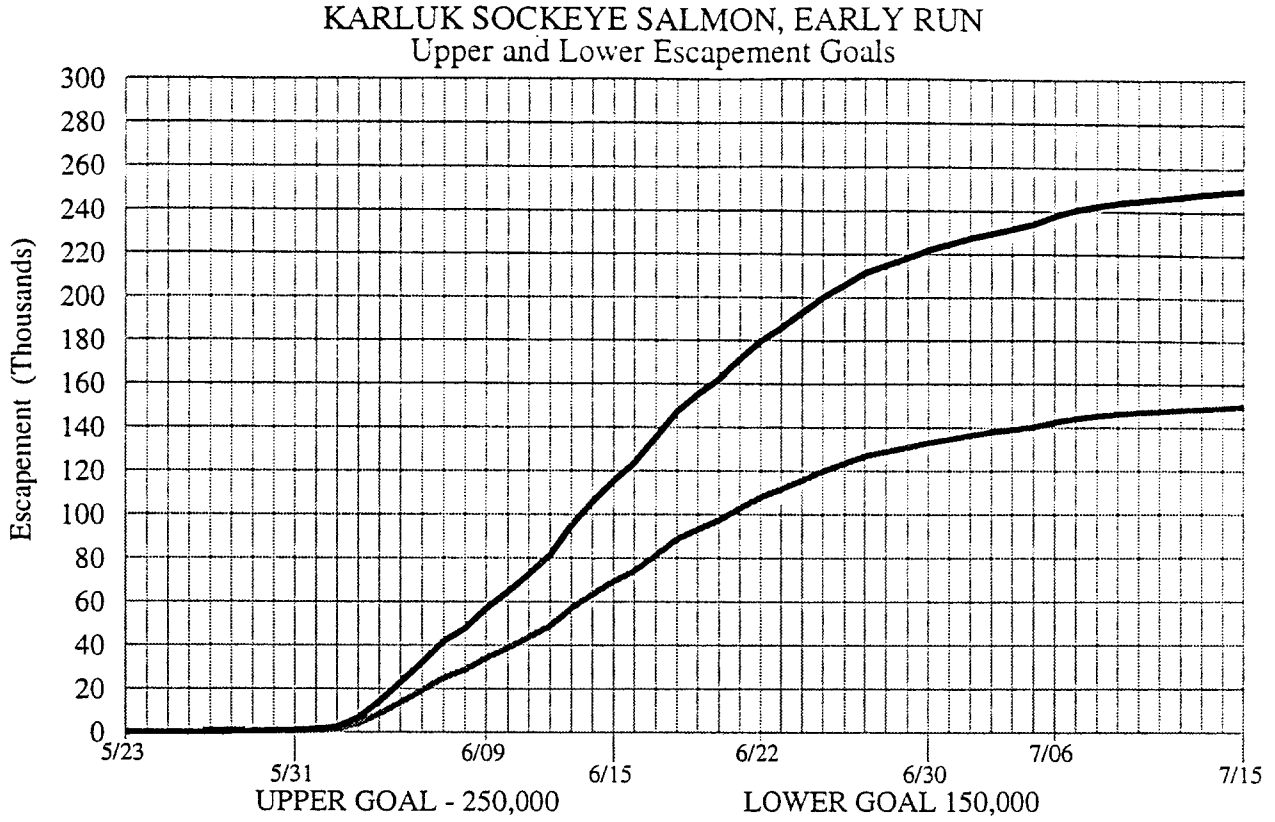


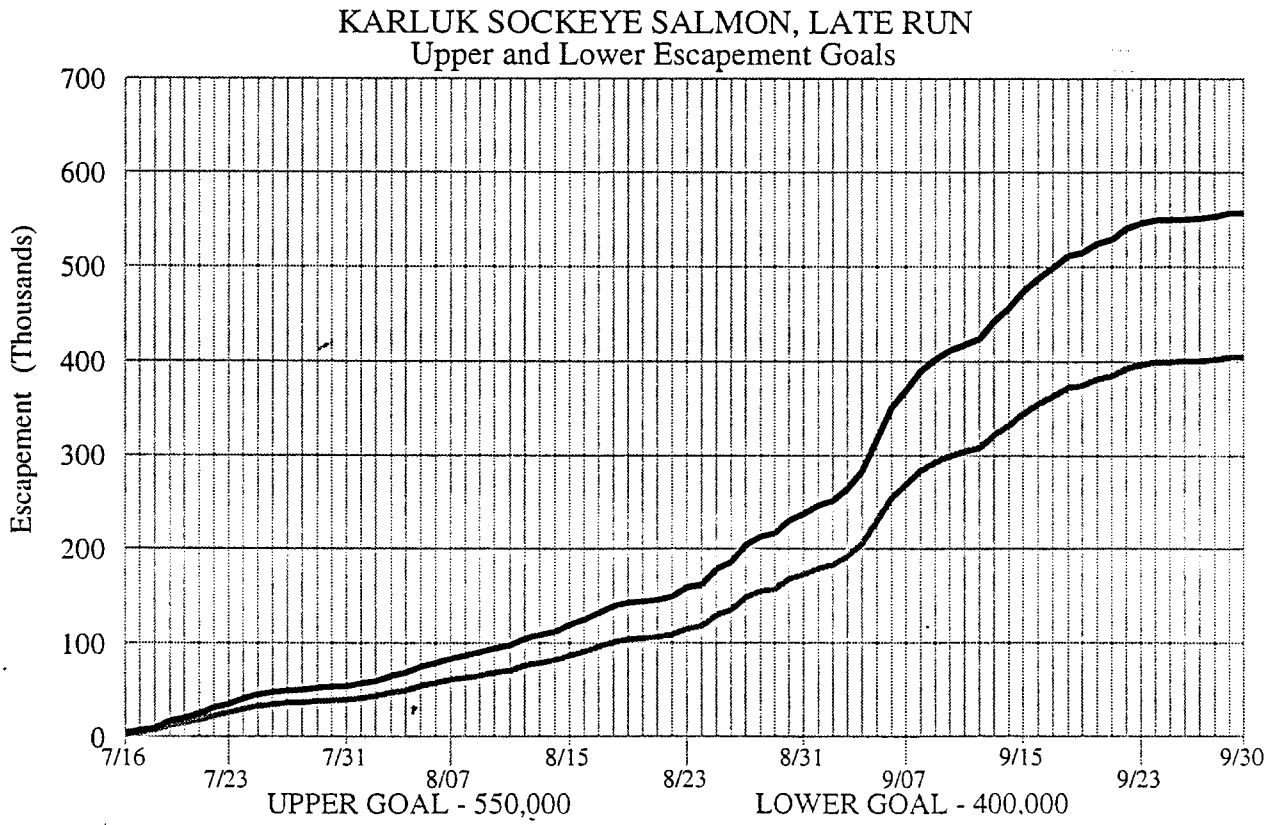
* 1995 CHUM SALMON PROJECTED HARVEST TOTAL = 800,000



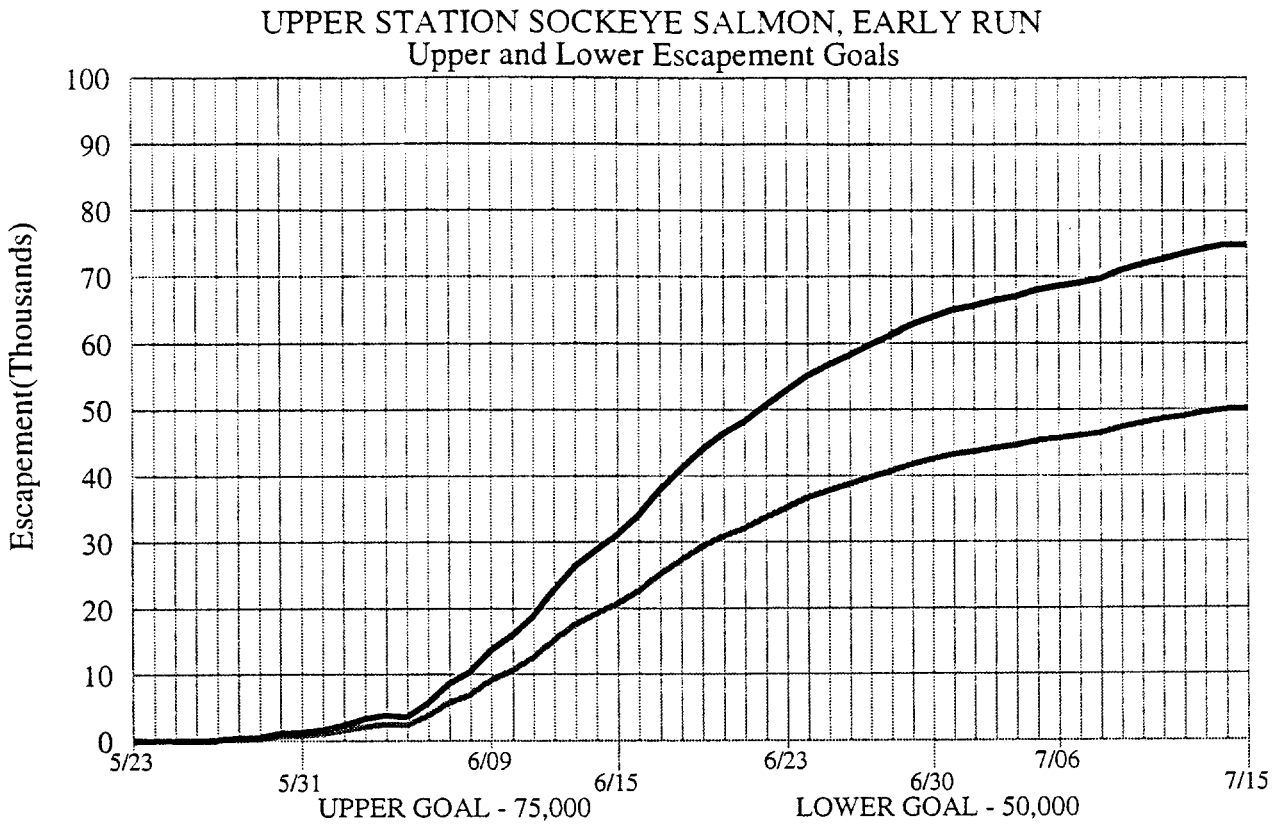
* 1995 COHO SALMON PROJECTED HARVEST TOTAL = 310,000

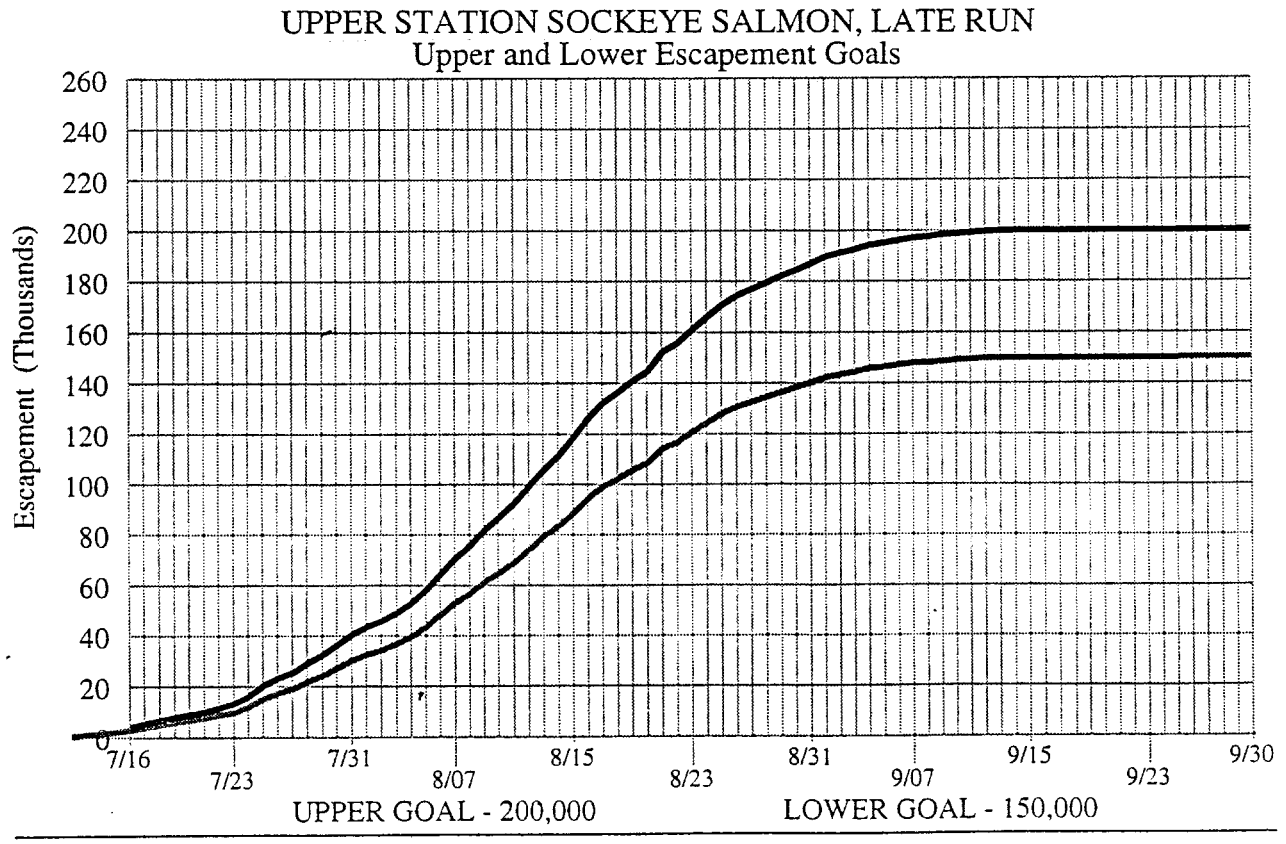
Appendix A.3. Projected chum and coho salmon harvest curves for the Kodiak Management Area, 1995.



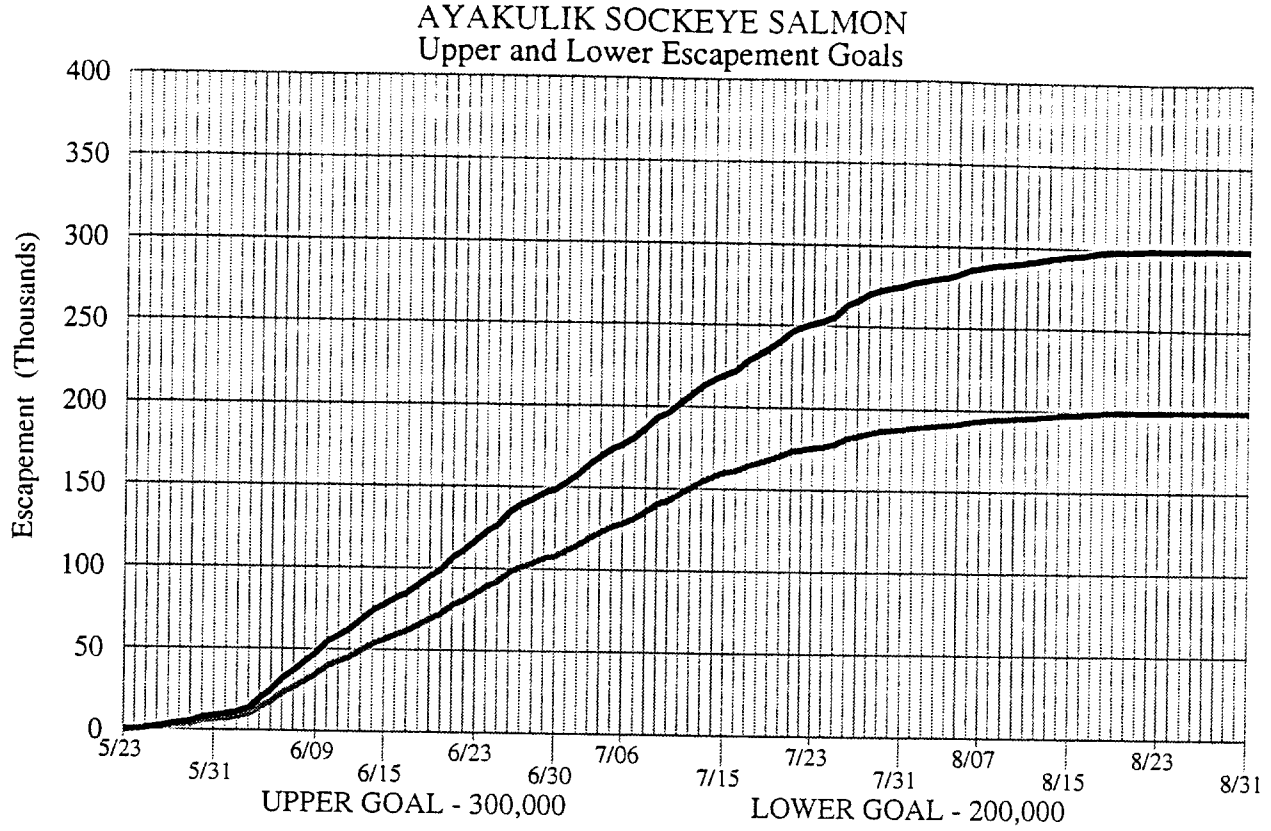


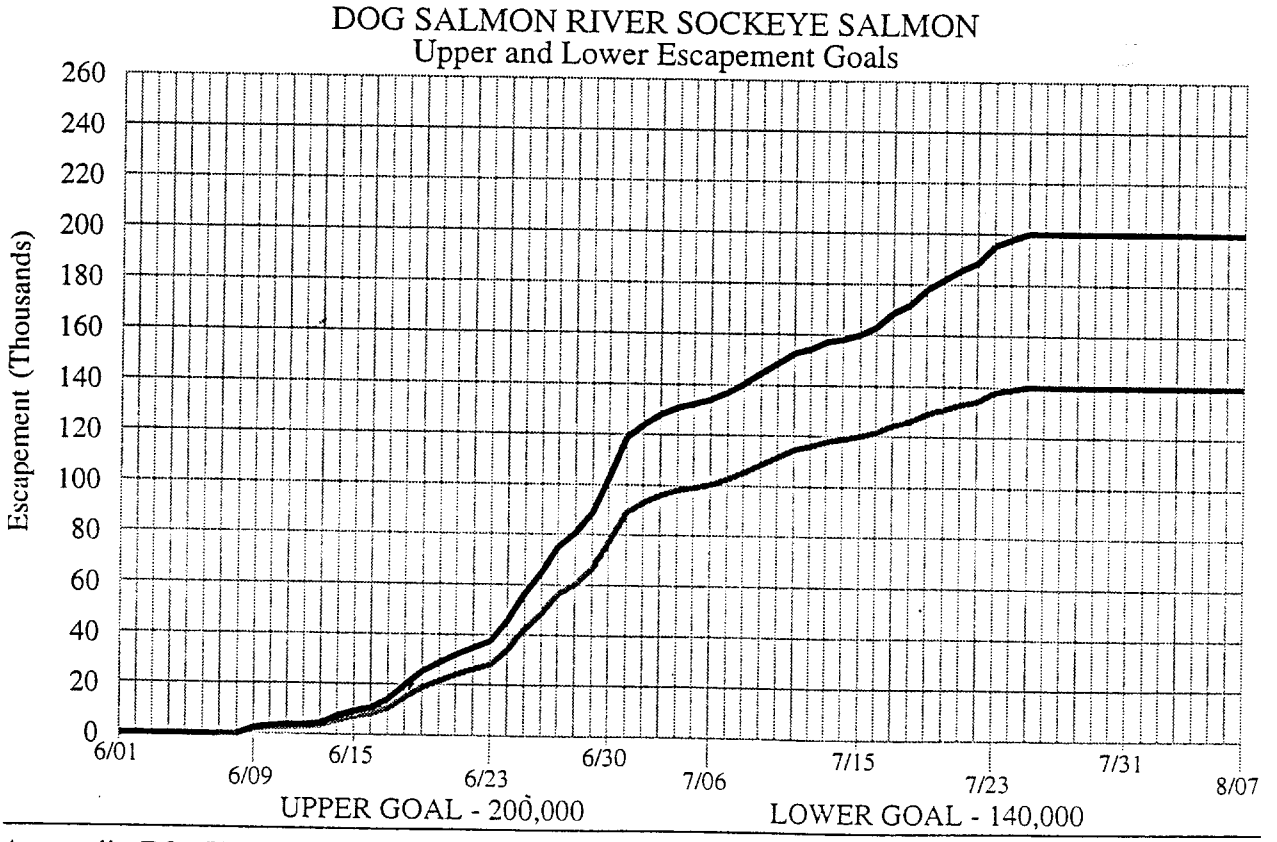
Appendix B1. Upper and lower escapement goal curves for the early and late run's of Karluk sockeye salmon in the Kodiak Management Area, 1995.



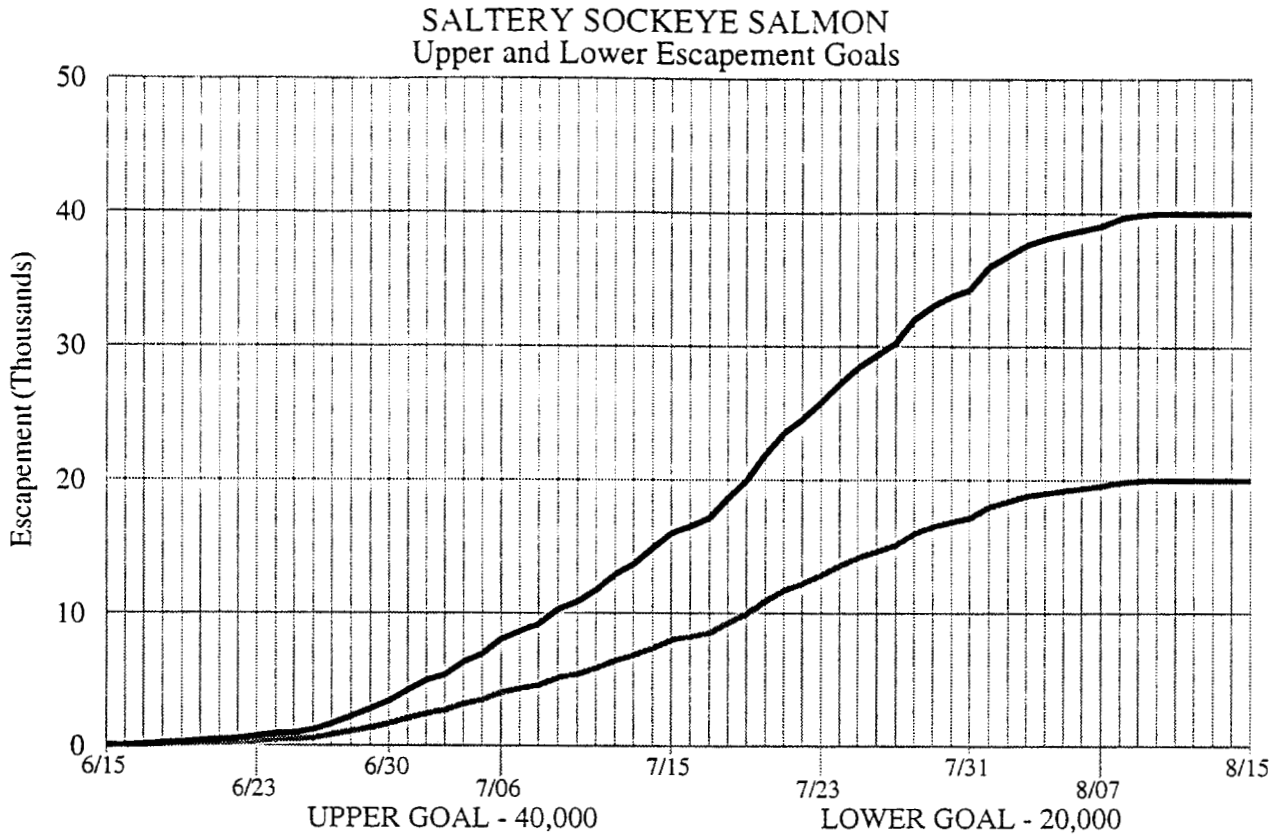


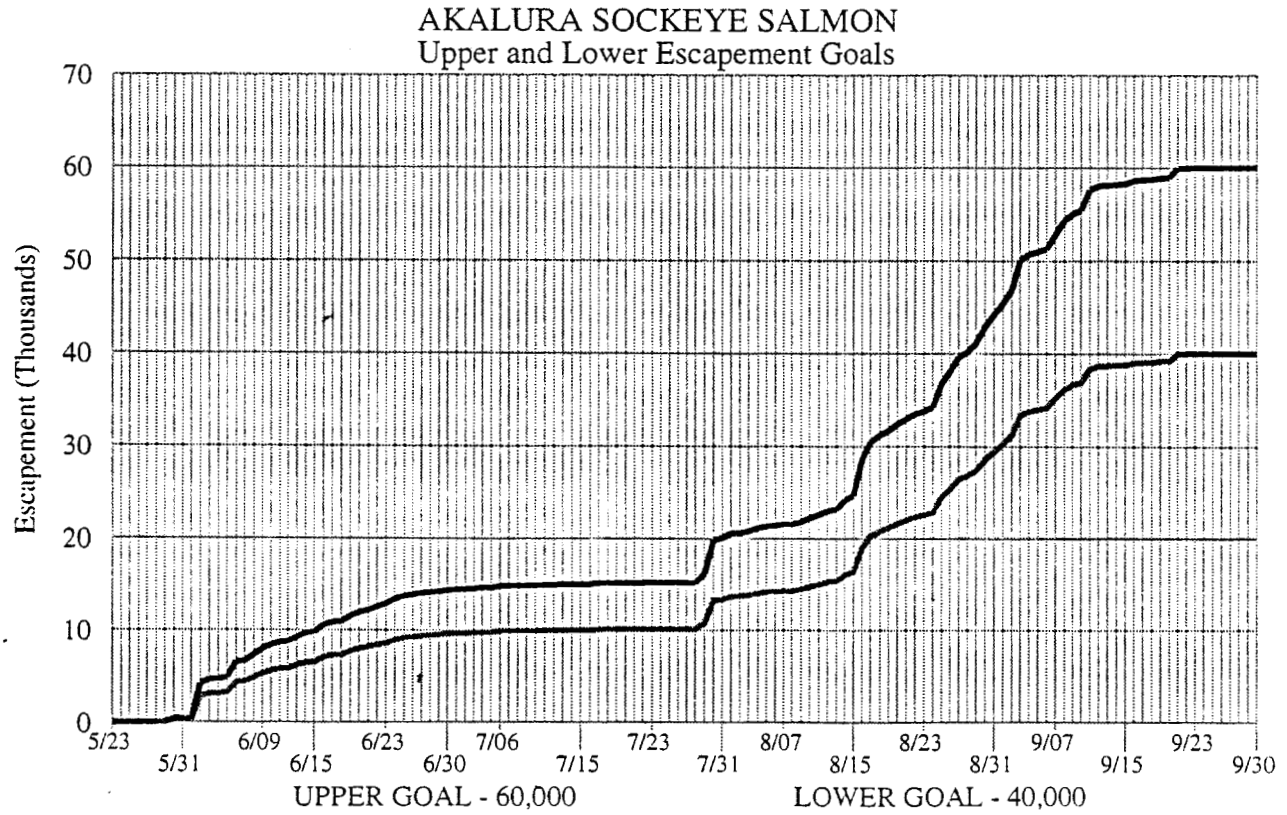
Appendix B.2. Upper and lower escapement curves for the early and late run's of Upper Station sockeye salmon in the Kodiak Management Area, 1995.



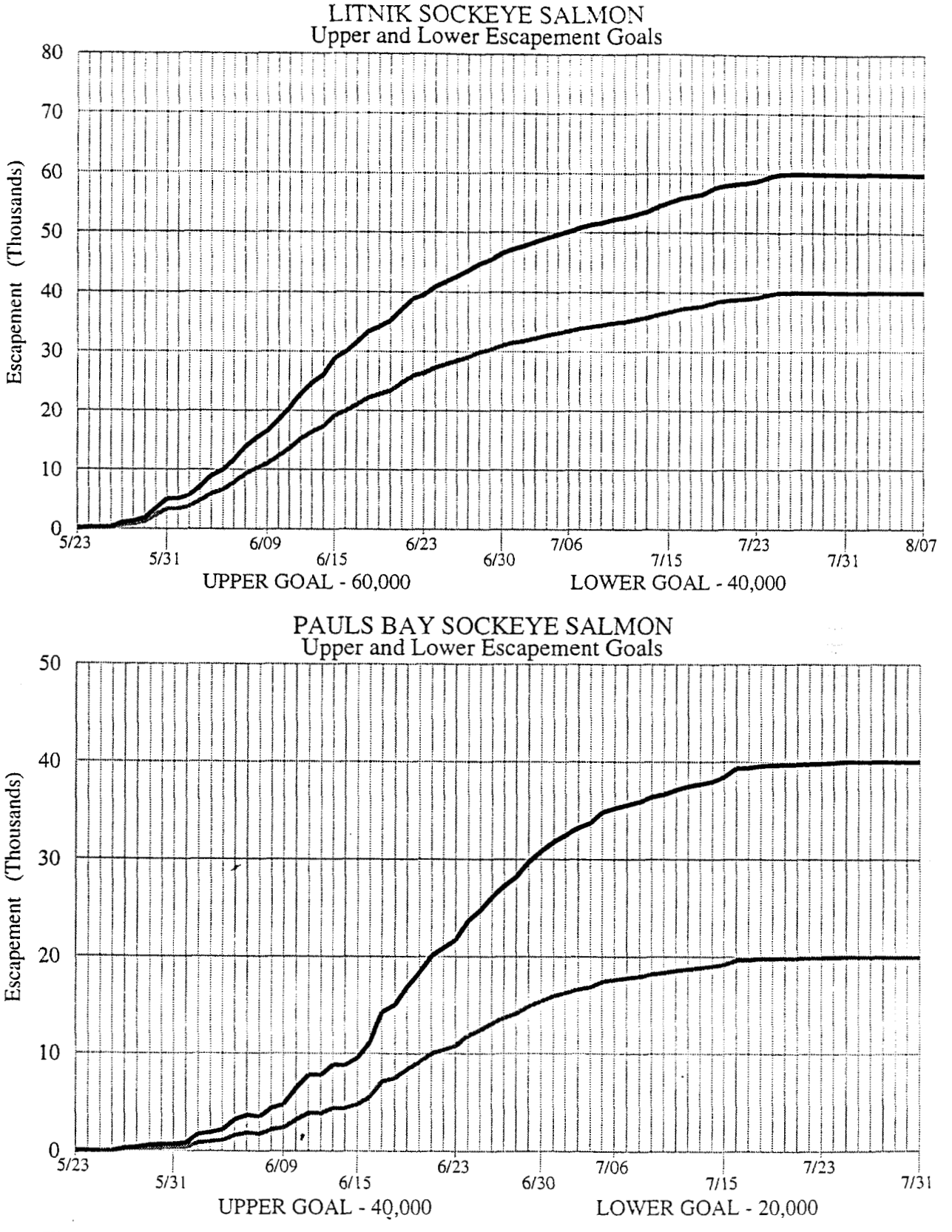


Appendix B3. Upper and lower escapement curves for the Ayakulik and Dog Salmon Rivers sockeye salmon in the Kodiak Management Area, 1995.





Appendix B.4. Upper and lower escapement curves for the Saltery and Akalura Rivers sockeye salmon in the Kodiak Management Area, 1995.



Appendix B.5. Upper and lower escapement curves for the Litnik and Pauls Bay sockeye salmon in the Kodiak Management Area, 1995.

DIVIDER

ALITAK BAY JUNE SOCKEYE SALMON TEST FISHERY OPERATIONAL PLAN, 1995

Alaska Department of Fish and Game
Commercial Fisheries Management and Development Division
211 Mission Road
Kodiak, Alaska 99615

May 1995

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INTRODUCTION

In the Kodiak Management Area, Alitak Bay District, there are two principal early sockeye runs, Upper Station and Frazer Lake, typically the latter is dominant. Both runs contribute to important westside Kodiak salmon fisheries mainly in the Alitak Bay District in June and early July. A reliable inseason run strength estimate to these systems is necessary to maximize harvest potential and ensure optimum escapement. Currently, the primary inseason method for assessing run strength is a combination of the escapement counts at the Dog Salmon and Upper Station weirs, aerial surveys of escapement buildup on the Dog Salmon flats, and the 9 June Alitak Bay District commercial catch. This information has not always been timely enough to ensure maximum harvest of surplus production in traditional fishing areas and the achievement of optimum escapement objectives. An inseason test fishery in Upper Moser Bay in conjunction with stock composition estimates from the Cape Alitak Section commercial fishery should provide a timely and accurate gauge of the run strength and timing of the Frazer Lake and Upper Station early run stocks.

OBJECTIVES

1. Daily, estimate the number of early run sockeye salmon entering Olga Bay.

2. Inseason, periodically estimate the stock composition of the early sockeye run entering Olga Bay.

TASKS

1. Fish a 50-fathom 4.75" stretch mesh set gillnet with 120' lead three hours daily at high tide.

2. Sample the daily test-fish catch for age.

3. Construct discriminant models which provide at least 75% correct classification accuracy for estimating the Upper Station and Frazer stock's age-2.2 and -2.3 catch contributions.

4. Periodically, digitize age-2.2 and -2.3 scales from the Cape Alitak and Moser-Olga Bay catch.

5. Generate stock composition estimates and apportion the daily test fishery catch.

PROCEDURES

Test fishing will be conducted daily from 29 May through 15 July on the northeast side of Chip Cove in upper Moser Bay (Figure 1). A 50 fathom, 40 mesh deep, 4.75 inch stretch mesh gillnet attached to a 120 ft. lead will be fished daily for three hours, irrespective of whether a commercial fishery is in progress. Daily, each set will commence 1.5 hrs. before high tide and terminate 1.5 hrs. after high tide. The sequence will be to fish every other high tide except that there will be no night fishing. When a high tide at night falls within the sequence, the previous high tide will be fished, and the sequence of fishing every other tide will re-start from that tide. Fishing will be discontinued during a set if more than 250 sockeye salmon are in the net. In addition, catch numbers, climatological data and fishing conditions will be recorded on the form in Figure 2.

The time and height of high tide for Chip Cove will be determined using tidal correction factors for Moser Bay (Time: +0:13; height: x 1.39) as they apply to Kodiak tides (Appendix A).

The gillnet used in the test fishery will be maintained in good condition throughout the season. Daily the gillnet will be inspected, cleaned, and repaired as required to ensure the net is in good fishing condition.

Since the catch is to be sold, utmost care must be given to ensure product quality. To avoid spoilage and loss of freshness, all catch fish are to be held in ice until delivery except during age sampling.

The catch will be sold to the processor at Alitak. Fish ticket receipts will be issued to the State of Alaska, Department of Fish and Game, Division of Commercial Fisheries Management and Development, Kodiak. Prior to delivering the catch to the processor sockeye salmon will be catch sampled for age (one per fish). Within 24 hours of sampling the scales will be aged.

Linear discriminant analysis (Fisher 1936) using measured scale variables will be used to estimate the stock composition of sockeye salmon caught within the Cape Alitak and Moser-Olga Bay sections independently. Attempts will be made to generate stock composition estimates for age-2.2 and -2.3 catches from each section on a weekly basis starting with the fishery scheduled for 9-10 June. Prior to the 9 June commercial fishery age-2.2 and -2.3 standards will be generated and discriminant models constructed. The age-2.2 standard will be derived by measuring at least 200 age-2.1 scales from both Frazer and Upper Station early run escapement scale samples collected in 1994. Age-2.2 fish are forecast to comprise 64% of the Upper Station and 46% of the Frazer Lake runs in 1995 (Table 1). An age-2.3 stock model will also be developed. The standards will be 200 age-2.2 Upper Station and Frazer Lake scales sampled in the 1994 escapements. Age 2.3 fish are expected to be 29% of the Upper Station and 30% of the Frazer Lake run in 1995.

During 1995 the Biosonics Optical Pattern Recognition System (OPRS) will replace the FRI developed scale digitizing system. Age specific scale impressions will be enlarged 200X onto a digitizing tablet and the intercirculi distances measured along with circuli counts and recorded on separate raw data files (Appendix A). Once these are measured age specific scale variables will be constructed using program REFORM1. Again, models should have better than 75% correct classification accuracy. For constructing unknowns 100 scales from each age class from the respective commercial fishing section will be measured. Inseason, age-2.2 and -2.3 discriminant models will be applied to the weekly, age specific unknowns from each section to estimate the Frazer and Upper Station stocks contributions. All point estimates of stock composition will be adjusted for misclassification error using the approach of Cook and Lord (1978). Variance estimates and subsequent 90% confidence intervals will be computed employing the procedure of Pella and Robertson (1979).

Stock composition estimates other than for the age-2.2 and -2.3 fish will be estimated by combining the results from SPA with the age composition of the forecasted Upper Station and Frazer Lake runs (Table 1). The underlining assumption is that the stock composition of the minor ages will be the same as estimated for ages-2.2 and -2.3 combined. Stock composition estimates based on SPA results will be made within 24 hours after the collection of each 100 fish age-2.2 and age 2.3 catch sample. The target date for the first stock composition estimate is 11 June.

Age composition estimates will be generated for both the test fishery catch and commercial catch samples. Test fishery age composition will be generated by date based upon a sample size of 100 ageable scales. Commercial catch age composition estimates will be summarized by catch date for both sections.

REPORTING

Daily, catch data will enumerated and then recorded on a standard form (Figure 2). Then communicated to the Kodiak office via the 3230 frequency as soon as possible. Daily radio reports will include the number of fish caught by species and the total number of minutes fished. Age and stock composition estimates will be transmitted upon completion. In addition, daily catches will be posted for commercial fishers at Alitak and Moser Bay.

LITERATURE CITED

Cook, R.C. and G.A. Lord. 1978. Identification of stocks of Bristol Bay sockeye salmon by evaluating scale patterns with a polynomial discriminant method. U.S. Fish and Wildlife Service, Fisheries Bulletin 76(2): 415-423.

Fisher, R.A. 1936. The use of multiple measurements in taxonomic problems. Annals of Eugenics 7:179-188.

Pella, J. and T. Robertson. 1979. Assessment of composition of stock mixtures. Fishery Bulletin 77(2):387-398.

Table 1. Age composition of the 1995 Frazer Lake and early Upper Station sockeye run forecasts.

System	Age Composition (Percent) 1.2	1.3	2.2	2.3	3.2[a]	Total Run Number
Frazer Lake	1.0	4.0	39.0	26.0	30.0	725,000
Early Upper Station	1.0	6.0	64.0	29.0		100,000

[a] Our experience with forecasting 3. freshwater age fish for Frazer is tenuous; therefore the actual numbers for this age class could be much higher.

Table 2. Moser Bay test fishery time table, 1995.

Date	Net In	High tide	Net Out	Tide Height
05/29	02:15 PM	03:45 PM	05:15 PM	7.0
05/30	02:48 PM	04:18 PM	05:48 PM	7.0
05/31	03:21 PM	04:51 PM	06:21 PM	6.9
06/01	03:56 PM	05:26 PM	06:56 PM	6.8
06/02	04:33 PM	06:03 PM	07:33 PM	6.7
06/03	05:13 PM	06:43 PM	08:13 PM	6.6
06/04	05:57 PM	07:27 PM	08:57 PM	6.6
06/05	06:45 PM	08:15 PM	09:45 PM	6.8
06/06	07:37 PM	09:07 PM	10:37 PM	7.1
06/07	07:45 AM	09:15 AM	10:45 AM	5.9
06/08	09:06 AM	10:36 AM	12:06 PM	5.8
06/09	10:23 AM	11:53 AM	01:23 PM	6.0
06/10	11:30 AM	01:00 PM	02:30 PM	6.5
06/11	12:28 PM	01:58 PM	03:28 PM	6.9
06/12	01:20 PM	02:50 PM	04:20 PM	7.4
06/13	02:09 PM	03:39 PM	05:09 PM	7.7
06/14	02:57 PM	04:27 PM	05:57 PM	7.9
06/15	03:45 PM	05:15 PM	06:45 PM	7.9
06/16	04:33 PM	06:03 PM	07:33 PM	7.9
06/17	05:22 PM	06:52 PM	08:22 AM	7.8
06/18	06:13 PM	07:43 PM	09:13 PM	7.8
06/19	07:07 PM	08:37 PM	10:07 PM	7.7
06/20	07:01 AM	08:31 AM	10:01 AM	6.1
06/21	08:37 AM	10:07 AM	11:37 AM	5.5
06/22	10:02 AM	11:32 AM	01:02 PM	5.4
06/23	11:12 AM	12:42 PM	02:12 PM	5.6
06/24	12:07 PM	01:37 PM	03:07 PM	5.9
06/25	12:50 PM	02:20 PM	03:50 PM	6.2
06/26	01:28 PM	02:58 PM	04:28 PM	6.5
06/27	02:01 PM	03:31 PM	05:01 PM	6.8
06/28	02:32 PM	04:02 PM	05:32 PM	6.9
06/29	03:02 PM	04:32 PM	06:02 PM	7.0
06/30	03:33 PM	05:03 PM	06:33 PM	7.1
07/01	04:06 PM	05:36 PM	07:06 PM	7.2
07/02	04:40 PM	06:10 PM	07:40 PM	7.3
07/03	05:18 PM	06:48 PM	08:18 PM	7.4
07/04	06:01 PM	07:31 PM	09:01 PM	7.6
07/05	06:50 PM	08:20 PM	09:50 PM	7.8
07/06	07:13 AM	08:43 AM	10:13 AM	5.7
07/07	08:37 AM	10:07 AM	11:37 AM	5.4
07/08	10:05 AM	11:35 AM	01:05 PM	5.5
07/09	11:19 PM	12:49 PM	02:19 PM	6.0
07/10	12:19 PM	01:49 PM	03:19 PM	6.6
07/11	01:09 PM	02:39 PM	04:09 PM	7.2
07/12	01:55 PM	03:25 PM	04:55 PM	7.7
07/13	02:39 PM	04:09 PM	05:39 PM	8.1
07/14	03:22 PM	04:52 PM	06:22 PM	8.3
07/15	04:04 PM	05:34 PM	07:04 PM	8.4

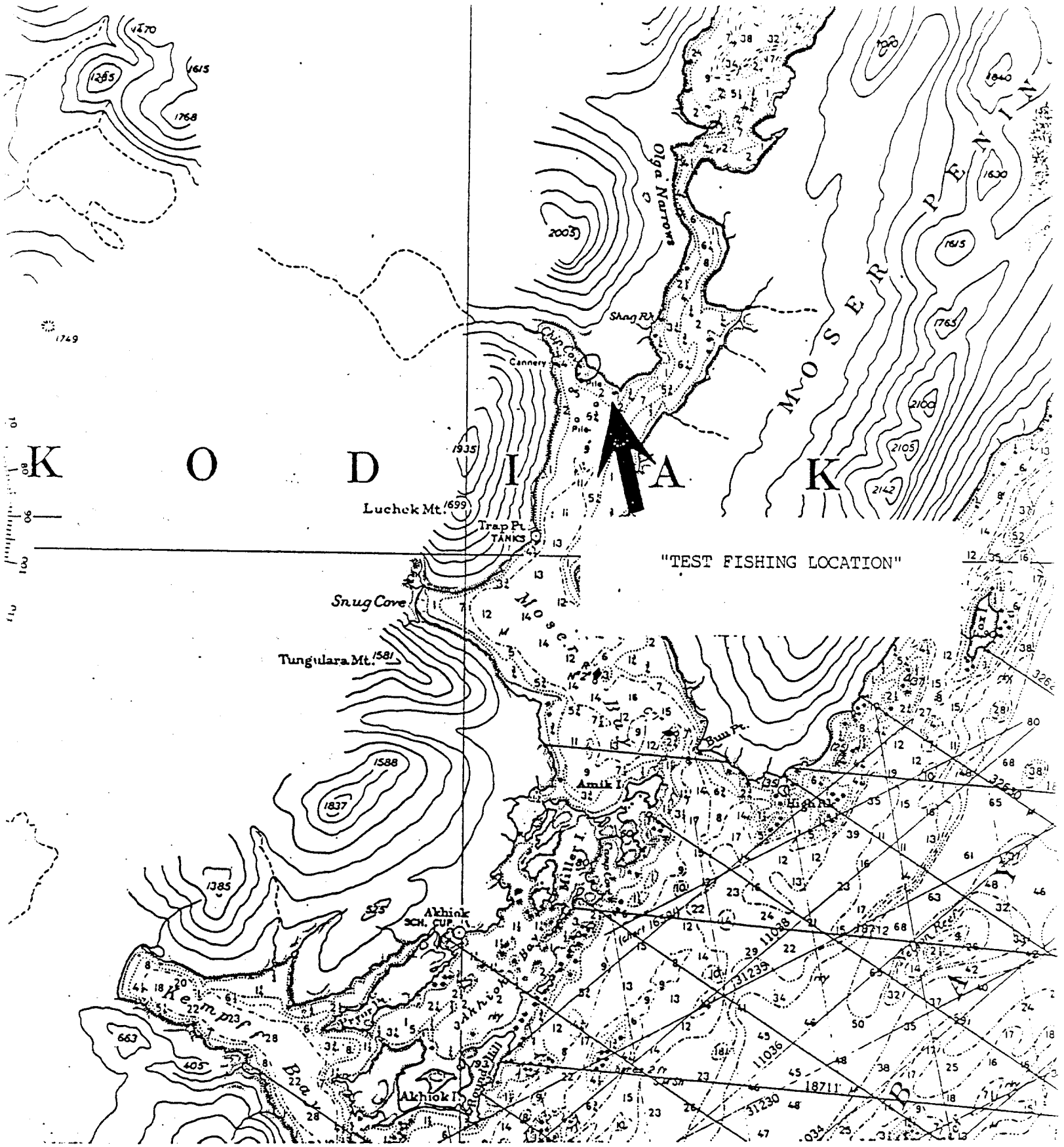

Figure 1. Map of Moser Bay with the location of the test fishing site identified.

Figure 2. Test fish catch reporting form.

SET NET SITE: _____ **YEAR:** _____

DATE	FISHING TIME 1/			CATCH			WEATHER 2/								SECCHI DISK (meter)	REMARKS 2/
							TIDE		Wave Height (Ft.)	Wind Dir.	Wind Vel. (mph.)	TEMPERATURE		% Cloud Cover		
	Start	End	Total Min.	Sockeye	Chum	Other	Ht.	Time				Air	Water			

he nearest minute and specify a.m. or p.m.
ide tables with correction factor for Moser Bay. Record cloud cover to nearest 10%; wave height to nearest foot; wind direction from compass
ocity to nearest 5 mph; and temperture to nearest degree.
ction for the majority of the fish hitting the net.

APPENDIX A

MANUAL FOR CONDUCTING SCALE PATTERN ANALYSIS WITHIN THE WESTWARD REGION

PART I. INSTRUCTIONS FOR THE OPRS SYSTEM STEPS:

1) At C-prompt type: start (i.e. C:>start) then hard return (enter key)

   Voila.. you should have before your eyes a MENU which at the top says "BATCH FILE FOR OPRS". If not... PANIC.... no just get back to the C-Prompt and do a C:>cd\ then repeat (1) from above.

2) At the menu type: 1 for "load OPRS SYSTEM", and then hard return.

   What you should observe now is a bunch of colors, logos... ect. flashing before you.. then after all the excitement the logo page stays and at the bottom the prompt to hit any key to continue... do so

   a) Now in front of you should appear a spectrum of windows with a prompt at the top of the page to select a window.

      THE ONLY WINDOWS OF CONCERN TO YOU ARE:

      CONFIGURATION
      QUIT
      PAGE
      LENS CALIBRATION
      DIRECTORIES AND PATHNAMES

      WARNING: IF YOU KNOW WHAT'S GOOD FOR YOU AND YOUR PRODUCTIVE TIME, TAKE SOME GOOD ADVICE AND LEAVE THE OTHER ONES ALONE!!!!!!

   b) Hit the red mouse button and using the mouse move to the configuration page and cover the load choice and hit the red mouse button again (within this step you will have depressed the red button twice).

      The machine response will be a flashing signal at the top of the page, regardless of what is there type: SWANTON making sure that there is no trailing suffix, if so remove it.

      NOTE: The SWANTON file is a configuration file (set up previously) that defines all needed parameters allowing for consistent scale measurements to be collected and sets calibration rulers and screen color.

3) Turn on video (T.V.) screen (Green button), compound microscope (Black button bottom left), and video camera (Button on top left of tower)

   NOTE: The video screen should be a purple color, if not go back and repeat step 2b (Load Function and check for a trailing suffix after SWANTON).

4) Move mouse to the PAGE window, cover the RAD page, then click the red mouse key.

NOTE: You should observe in front of you the RAD (Radial Adjusted Distance) page with RUN window on top left, followed by FILE to the right.

*******THE PAGES OF CONCERN HERE ARE*******
RUN
FILE
PAGE
LENS CALIBRATION

****

a) Move the mouse to the file page and cover FILE:TESTDATA.DAT and type in your file specification.

Examples of file specs are:
1) Nelson Lagoon 1990 age 1.2: nl9012.dat
2) Frazer Lake 1994 age 2.1: FZ9421.dat

b) Imperative to organizing files generated is keeping records of those created at each step. Regardless of whether files are standards or unknowns, write down dates samples were measured from, sample size, and file names and suffixes. This is important so that you can keep track of raw, ascii, reformatted, and SAS files all of which will be created.

c) Place acetate in card holder, and using the ocular, lens changer (black wafer looking thing), horizontal-vertical and focus knobs, bring a premarked (age of interest) scale into focus. IT SHOULD APPEAR ON THE VIDEO SCREEN. Adjust the ocular and lens changer powers so that the freshwater zone is as large as possible, without loosing any of the circuli of interest from the screen.

NOTE: You may want to go through several acetate cards of different stocks and years to get an idea of the variability within an age class which would require changing the ocular or lens changer powers i.e. from 10X to 4X or 1.0 to 1.5 ect. Also, make sure that the lenses are well seated when you move them, otherwise you will get a gray screen.

5) With the mouse move to the RUN page and cover ACQUIRE then click the red mouse key. The screen will blink and double right facing arrows should appear to the left of your choice.

NOTE: Whenever you make a choice of the various functions, double arrows will appear to the left of your selection.

a) Move mouse to LENS CALIBRATION WINDOW and choose the ruler having the description of your ocular and lens changer power's, using the red key for selection.

EXAMPLE: If you have 10X ocular and 1.0X lens changer values selected then you would use ruler #1, again double arrows appear.

b) If at any time you change the ocular or lens changer for measurement of a larger or smaller scale impression, you need to also change the ruler in the lens calibration window. Additionally, you may have to modify and describe your new ruler.

c) With the mouse go to the top of the RAD page and click the red key while covering ACQUIRE, now move to the RUN window and cover REFLN (REFERENCE LINE) and click red key again.

NOTE: A green arrow should appear on the screen, move it with the mouse to the bottom left corner while keeping it visible and click the red key. The reference line is now anchored on the left, drag the line to the right corner while making sure that the line is perfectly horizontal, then click the red key.

The reference line is for all subsequent measurements made for the predefined data file that has been set up. It allows for being able to properly orienting scale impressions for measures, as you will see it tells you the angle you are measuring on. It will need to be reset for each file that you are working on whether it is a standard or unknown.

6) Now move to DRAW RADIAL within the RUN page and click the red key.

a) ON T.V. screen will appear a scale image, the reference line, and a green arrow. If not then go back to (5c) and repeat steps.

b) Place arrow at the center of scale focus, click the red Key, and drag the line (while watching the right hand corner of the screen) to the last circulus that you want to include as freshwater growth. Before clicking the red mouse key, make sure that the angle of measure is either 90 or 73 degrees. We have in the past used both within the Westward Region. Then click the red mouse key.

c) Tick marks should appear at the outer edge of each circuli and in a few places where they should not be. To remove unwanted tick marks use the blue key and to add tick marks use the green key. When tick marks are set where you want them, depress the white mouse key, which returns you to the RUN PAGE.

d) Now cover the SAVE TO FILE under the run page, you should hear a beep, which means that the scale measures were saved to the specified data file. After which, repeat all of STEP 6 until you have either met the desired sample size for either the standard or unknown file.

7) After all measures are completed for a file (say 200 for a standard) the raw (***.dat) data needs to be converted from binary (anything generated with the OPRS with a .dat suffix) to ASCII. You should only do this after you have completed the file thus eliminating file stage confusion.

a) Go to the PAGE, cover edit (EDT) and click on the red mouse key; proceed to record (top left) cover and click red key, numbers should be scrolling by, with the final number being the sample size for that file.

b) Now look at the INPUT and OUTPUT file pages; the input data file should be the one you are interested in converting, if not go back to the CON page and start again; if it is cover the OUTPUT data file and type A: or B: ***.ASC; move to convert to ASCII page, cover output data and headers and click red key. You should hear the drive A or B working and data being converted onto your diskette. When this has been successfully completed, ITEM will appear on the top right above all the pages.

c) Now go to CON page, click and exit system. Keep in mind that an unconverted binary data file is saved within the system so for additional backup you should copy these files onto a backup diskette labeled appropriately.

8) If you previously only partially completed a data file and now want to finish adding data records (scale measures) to it complete the following steps.

a) Go through start up procedures (STEPS 1-4) and at step 4a bring up the unfinished file. Now go to the EDIT (EDT) page and cover record, and click red key to bring up all previously saved scale records for that file. Then proceed with steps 5-6 as before. Note that you have to do this every time that you want to add data records to an old file, otherwise the file will only have in it the number of scales previously measured. They also will not be consecutively numbered and will have to be added to the original file for processing. This could induce errors or duplicate scale measures.

CAUTIONARY NOTES:

1) When measuring make sure that you periodically check the file under the file page, that it is the one you want scale measures to go to.

2) Every so often glance at the lens calibration page to make sure the lens description is the one you are using.

3) Go through a prepatory exercise of all previous and following steps prior to actually measuring scales and conducting any type of analysis.

PART II. REFORMATTING AND DATA EDITING

1) Get into the C:\stcksep directory and call up program REFORM1 by typing it in and then hard return. This program is user interactive and very simple.

   a) A prompt will request the file specification for the ASCII formatted scale data file (From OPRS system) which you want to reformat. Also, you will be requested to state a drive and file name for where the reformatted data is to go. Reformatting will need to be performed on both standard and unknown files.

      NOTE: File names should have a suffix which identifies them as reformatted, and will hopefully provide for minimal file confusion.

Examples:

A) Reformatted Chignik Lake 1991 age 2.2: Chg9122.s, where the S signifies it as a standard file.

B) Reformatted Chignik Lagoon catch 1991 age 2.3: CL91231.k, where the 1 following the age is the first fishing period or whatever and the K represents that the file is an unknown.

   Note: Throughout this manual reformatted standard and unknown files will be referred to as S and K files.

   The reformatting process using this program is structuring the data records such that all header line information (measurement parameters, axis...ect), and scale measurement data are all on a horizontal axis for each scale measured, rapping around as one continuous line when printed.

2) After S and K files are developed editing is the next step. Editing consists of scanning all data records for errors which occurred during the measurement process. Common errors are 1) scale measurements collected on an axis other than 90 or 73 degrees, and 2) scale data records with only several measures saved.

   Editing in XYRITE is relatively easy so will not be explained, if questions arise consult the manual. Any erroneous data records such as those mentioned above should be removed from the data file. We have used plus or minus 2 degrees as the criteria for erroneous axis measures. Additionally, for all following procedures the header line (top line of the file) with a file specification and other descriptive information must be removed. The final edited version of the file will have no header line (Do not confuse this with the parameters which start each data record) and should be saved on diskette using the S and K suffixes.

PART III. CONSTRUCTING STANDARD AND UNKNOWN SAS FILES

1) The first step is understanding SAS and it's idiosyncrasies and requirements. Within C:> are two directories of interest SAS and DATA. Within the SAS directory is a subdirector named KDK or TF which is where files created within SAS will be stored.

a) Prior to beginning your SAS session you need to copy all edited S and K files into the DATA directory. This directory is used for formatted and edited data only!!!

b) Once your files are in the DATA directory, you can start your SAS session by constructing STANDARD AND UNKNOWN FILES for a particular age class. Get in by C:>cd\sas then hard return and typing SAS. Before your eyes should be three windows OUTPUT (AT TOP OF SCREEN), LOG, AND PROGRAM EDITOR. With command below the page designation.

c) From Appendix A.1. you will find instructions for constructing sas data files both standards and unknown files) with descriptions of what is going on at each step. Also included are actual SAS commands that if followed while modifying the variable formats to match those that have come from the REFORM1 program will allow you to create both standard and unknown files within sas. Again these should be followed exactly as given and then submitted using the F10 key. The created files will be automatically saved within the C:\sas\tf or KDK subdirectory with an SSD suffix. However it will not save the output, whereby if you want the output printed in hard copy form then use the file 'prn' command line of any of the three pages.

PART IV. MODEL BUILDING USING SAS

1) The first step used should be screening (frequency histograms) of all constructed variables from each stock for the analysis. Using lotus 2.2 or similar spread sheet construct frequency histograms for all variables for each stock being considered for inclusion within each standard. All variables should be approximately univariate normal. Only those variables that are approximately normal should be included, while those that show departures from normality excluded. In some cases it is informative to look at pairwise bivariate plots which may provide qualitative incite into what one might perceive to be multivariate normality.

2) After variables have been screened the next step is to conduct stepwise variable selection for standard file construction. This is easily completed within SAS using PROC STEPDISC Appendix A.2). I have used the default values provided within SAS for defining the F-to-enter and remove values. These correspond to α=0.1 which I have been using to retain a majority of variables constructed. Other approaches have used α=0.05 as an F-to-enter along with including variables which are negatively correlated with variables already in the model, these methods are not included within this manual.

3) The SAS program and associated commands for completing the discriminant analyses are given in Appendix A.3. Note that within the command lines POOL=YES employs a linear discriminant function while POOL=NO uses a quadratic function. With large per stock sample sizes (N=200) the quadratic and linear functions are similar in results with the quadratic function providing slightly higher classification accuracy and balance in misclassification error rates.

PART V. USING THE COOK AND LORD (1978) CLASSIFICATION MATRIX CORRECTION PROCEDURE

1) Within the C:\stcksep directory is located a program called SCOTT.EXE, this is the program used for correcting raw stock composition estimates from unknowns for misclassification error rates.

2) First type SCOTT.EXE at the prompt within the STCKSEP directory and it will come up with the question intermediate results?, type N and hard return.

3) The program will come back with the question Number of Stocks here type in the number of stocks within the standard file.

4) Next it will come back with model name here make sure that you give it a name which stands out with little confusion.

5) Now it will respond with "INPUT TEST CLASSIFICATION MATRIX IN NUMBER OF FISH". This information should be from your SAS SPA analysis results titled resubstitution results and will be the number of fish correctly classified to stock of origin followed by a comma then return and do the same for the next stock. Remember to keep track of the stock that you typed in first. Prior to running this analysis hit the Control key and P key at the same time to get a continuous print of the results.

6) Now type in the sample sizes for all stocks with a comma separating each stock.

7) Response will be "unknown name" here type whatever you want say for example Cape Alitak June 9-10 Age 2.2 unknown or alike.

8) The program will come back with first order estimates in number of fish. Here go again to the output from the SAS discriminant analysis and get the first order estimates from the end of the printed output. Example: with a mixed stock sample size of 100 of which 87 were classified to stock 1 and 17 to stock 2, then type in these numbers separated by a comma and then hard return. Make sure that your printer is turned on and that it is printing every time that you hit the return key, if not then hit the Control and P keys again.

   Now the output should be printing with first and second order estimates. The second order estimates are the ones that have been corrected for misclassification error and should be the ones that are used in subsequent analysis or reporting. Note that with only two stocks in the analysis you can put confidence intervals around the estimates by assuming normality and using the appropriate tabled values. With greater than two stocks the Chi-square approximation holds and you should go to this table for critical values.

Appendix A.1. Example and explanation of SAS commands required to set up standard and unknown files.

---

libname kdk 'c:\sas\kdk';* This tells SAS where you want your sas files sent after construction and also where SAS files for analysis are located.*****

filename incg1 'c:\data\chg9022.s';*** This initializes a work file within SAS which is named cg1 and tells the system that it is located within the c:\data\ directory.*****

filename inbk1 'c:\data\bk9022.s';** Same as above but represents a second stock.**

***** THE FOLLOWING ARE SPECIFIC SAS INSTRUCTIONS ON HOW TO SET UP A SAS STANDARD FILE FOR SUBSEQUENT ANALYSES*****

data cg1; ** This tells SAS what to call the work file.**
infile incg1; ** Tells SAS where the data is within SAS.**
input var1 53-54 var2 59-62 var3 63-66 var4 67-70 var5 71-74 var6 75-78 var7 79-82 var8 83-86 var9 87-90 var10 91-94 var11 95-98 var12 99-102 var13 103-106; *** This statement is setting up the SAS data file, initializing and locating variables which were generated within the OPRS system and telling SAS what to call each of the measures.***

NOTE: That you will have to figure out what the maximum number of variables will be by determining the maximum and minimum number of circuli are for a given scale within each of your measured stock specific files. EXAMPLE: If you have an age-2.2 scale within a standard which has only 12 circuli and this is the fewest for all scales measured for that standard, then the maximum number of variables for that standard will be 13, one circuli count and 12 incremental circuli distances. The variables listed defined as var1-circuli count (irrespective of age) and var2-var13 being consecutive incremental distance measures. If you have a total of say 19 circuli you can figure out the remaining format string by starting with var14 as 107-109 ect... The variable string is usually three columns long but bring up the file in XYRITE and count just to make sure... If you misplace or miscount columns at this point your SAS program to create these files will BLOW UP.....

system="chignik";* This tells SAS that the data presented is from the Chignik Lake standard.***
run;*End Statement***

ACTUAL SAS STANDARD FILE SETUP PROCEDURES

The following is how it should be typed without descriptive statements and when you substitute actual variable names and a standard file will be how it is actually referenced within the model building stage.

-Continued-

```
libname kdk 'c:\sas\kdk';
filename incg1 'c:\data\chg9122.s';
filename inbk1 'c:\data\blk9122.s';
data cg1;
infile incg1;
input var1 53-54 var2 59-62 var3 63-66 var4 67-70 var5 71-73 var6 74-77 var7 78-80 var8 81-83
var9 84-86 var10 87-90;
system="chignik":
run;
data bk1;
infile inbk1;
input var1 53-54 var2 59-62 var3 63-66 var4 67-70 var5 71-73 var6 74-77 var7 78-80 var8 81-83
var9 84-86 var10 87-90;
system="blackl";
run;
data kdk.s91221;
set cg1 bk1;
v1=var1;v2=var2;v3=var3;v4=var4;v5=var5;v6=var6;v7=var7;v8=var8;v9=var9;v10=var10;
keep v1-v10 system;
run;
```

THE ABOVE STATEMENT FROM DATA KDK.S91SS1 ON CREATES A SAS STANDARD FILE INCLUSIVE OF DATA COLLECTED FROM BOTH CHIGNIK AND BLACK LAKE ESCAPEMENT AGE 2.2 SAMPLES AND AFTER IT IS RUN WILL STORE IT WITHIN THE C:\SAS\KDK SUBDIRECTORY. AFTER IT IS CREATED IT CAN BE ACCESSED AT ANY TIME AND EACH STANDARD AND UNKNOWN FILE SHOULD BE STORED ON A DISC JUST FOR SAS DATA FILES.

THE FOLLOWING IS HOW AN UNKNOWN FILE IS TO BE CREATED.

```
libname kdk 'c:\sas\kdk';
filename incl1 'c:\data\cl91221.k';
data cl1;
infile incl1;
input var1 53-54 var2 59-62 var3 63-66 var4 67-70 var5 71-73 var6 74-77 var7 78-80 var8
81-83 var9 84-86 var10 87-90;
run;
data kdk.cl91221;
set cl1;
v1=var1;v2=var2;v3=var3;v4=var4;v5=var5;v6=var6;v7=var7;v8=var8;v9=var9;v10=var10;
keep v1-v10;
run;
```

-Continued-

Appendix A.1. (page 3 of 3)

THIS WILL CREATE AN UNKNOWN FILE CL91221.SSD WHICH WILL ALSO BE STORED IN THE SUBDIRECTORY C:\SAS\KDK AND CAN BE ACCESSED AT ANY TIME IN THE FUTURE. To access this file within SAS after it has been created it must be preceded by KDK or whatever your libname prefix is.

The Function "F" keys are

F7- This key expands the page and can be used with the page up or down keys
F5- This one moves you between pages Output, Log, and Program Editor.
F9- If used within the program editor page will bring back the program you just submitted for editing which is now located in the log page.
F10- Submits your program for processing and carries other the commands stated.

TO PRINT A FILE SAY OF COMMAND LINES AT ANY TIME GO TO THE COMMAND LINE SPACE OVER ONE FROM THE RIGHT FACING ARROWS AND TYPE file 'prn' THEN HARD RETURN.

TO SAVE A SAS PROGRAM TO A FILE TYPE : FILE 'A: OR C: \AFILENAME';
THEN HIT HARD RETURN. THIS PRINTS THE PROGRAM TO THE FILE AND DRIVE YOU SPECIFY.

Appendix A.2. SAS commands to run a stepwise variable selection analysis.

This will all be typed within the Program Editor page of SAS

libname kdk 'c:\sas\kdk';
proc stepdisc data=kdk.s91221 maxstep=10 short;
class system;
var v1-v15;
run;

To submit this to SAS you will have to use the F10 key, once it has been typed the output will appear within the OUTPUT page of the SAS screen. To print the output go to the OUTPUT page by either the arrow keys or using F5, and then following a space type **file 'prn'** then a hard return.

Appendix A.3. SAS program for conducting both linear and quadratic discriminant function analysis.

```
libname kdk 'c:\sas\kdk';
proc discrim data=kdk.s91221 testdata=kdk.cl91221 method=normal pool=yes crossvalidate;
class system;
var v1-v13;
run;
proc discrim data=kdk.s91221 testdata=kdk.cl91221 method=normal pool=no
crossvalidate;
class system;
var v1-v13;
run;
```

Again to submit one of these for analysis use the F10 key, to print output use the file 'prn' command at the Output command line. The output using this program will provide constants, classification and misclassification accuracy from both resubstitution and crossvalidation approaches. I have used the resubstitiution results solely. The only part of this program which will need changing in "REAL LIFE" will be the number and name of variables actually used.

DIVIDER

FRAZER LAKE

OPERATIONAL PLAN, 1995

Alaska Department of Fish and Game
Commercial Fisheries Management and Development Division
211 Mission Road
Kodiak, AK 99615

May 1995

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INTRODUCTION

Frazer Lake is located on the Southern end of Kodiak Island and is the second largest lake within the Kodiak Archipelago (Figure 1). Frazer is 14.2 km long, 1.6 km wide, with a surface area of 16.1 km^2. Prior to 1951 Frazer Lake was void of sockeye salmon *Oncorhynchus nerka* owing to a 10 meter barrier falls prohibiting anadromous fish from entering the lake (Russell 1972). Egg, fry and adult transplants (1951-1971) from sockeye systems on Kodiak Island (Karluk and Red Lakes) and the Alaska Peninsula (Becharof Lake) established a sockeye salmon run with adults returning for the first time in 1956 (Russell 1972). From 1956-1961 returning adults were back-packed over the falls, and in 1962 a fishpass was constructed to promote access to the lake environment. A second fishpass was installed in 1979 allowing for increased passage capacity during peak migration periods.

Since 1956, enumeration of adults and AWL sampling has been conducted at the Frazer fishpass. Spawning ground surveys have been performed since 1964. Annually, smolt migration timing and magnitude, zooplankton density and community composition, along with limnological characteristics are measured.

Conservative fishery management practices have been very successful at building this run (1970-1985) from 25,000 in 1971 to 645,739 fish in 1985. Blackett (1975) established an escapement goal of 383,000 adults based upon limnological and spawning habitat calculations. Subsequent declines in smolt condition factor, and shifts in zooplankton size and community composition published by Kyle et al. (1986) prompted lowering of the escapement goal to 140,000-200,000 adults. The Frazer Lake sockeye stock is now considered of major importance to the Island wide salmon fishery. Also, this introduced run provides for an enhanced food resource for the local Kodiak brown bear population, stimulating increases in bear densities along Frazer Lake and Dog Salmon Creek streams.

In 1986, ADF&G Fisheries Rehabilitation and Enhancement (FRED) Division transferred operation of the Frazer fishpass facility to the Commercial Fisheries Division which now operates the program. FRED Division since 1988 has applied fertilizer (mixture of Nitrogen and Phosphorous) to the lake hoping to stimulate survival of lake rearing sockeye fry. This program was instituted in response to the dramatic declines in smolt size and weight resulting from excessive escapements which occurred during 1980-1982 and 1985 and was terminated after the 1992 field season.

During 1983, a second weir was installed on Dog Salmon Creek 0.7 km upstream from lower Olga Bay to provide more timely sockeye and pink salmon *Oncorhynchus gorbuscha* escapement counts relevant to managing the commercial fishery. Weir personnel also enumerate chinook *O. tshawytscha*, coho *O. kisutch*, chum *O. keta*, steelhead and rainbow trout *O. mykiss*, and Dolly Varden char *Salvelinus malma*.

OBJECTIVES

The Commercial Fisheries Management and Development Division's goal for the Frazer Lake project is optimizing natural sockeye production, and collection of data relevant to generating accurate preseason run forecasts and escapement goal evaluation. For 1995 specific tasks are:

1. Determine sockeye smolt abundance, timing, age composition, and length and weight at age.
2. Provide unobstructed and timely adult fish passage into the lake environment.
3. Determine escapement timing, magnitude, and spawner distribution.
4. Collect age, sex, and length data from the sockeye escapement.

SUPERVISION

The project leader is Charlie Swanton (in the interim) with Don Pitcher being the crew leader. Don is responsible for scheduling daily work assignments, assuring collected data adheres to plan standards, and that safety is priority. A brief chronology of assignments is presented (Table 1). Mr. Pitcher responsible for making sure that the crew have read and understand the Departments **field safety policy** and have signed the **EMPLOYEE SAFETY SOP VERIFICATION** and made sure that these documents are secured by the project leader prior to departing for the field. In addition, a written season summary report will be required from the crew leader.

PROCEDURES

Smolt Sampling and Population Estimation

The smolt program has two components, abundance estimation and AWL sampling. Abundance will be derived using catches from one incline plane trap operated from about 9 May to about 1 July. The trap will be checked about every 30 minutes each night and catch enumerated by species, recorded (Figure 2), and released. Trap catch efficiency will be generated from mark-recapture experiments using Bismark brown-Y dye. The sample size for marked fish is 1,000 smolt collected (optimally in a single night) over a maximum of three days. Smolt transport will be from the holding tank (covered to reduce stress) adjacent to the trap to the dyed smolt release site located about 1.0 km upstream of the trap site. Transport will be in 30 gallon plastic tubs attached to the trailer and aerated continuously. After transport, smolt will be placed in the instream holding tank and monitored for 30 minutes prior to initiating the dye process. The amount of dye will be 1.9 g per 15 gallons of water (30 gal of solution should be adequate for 1,000 fish); smolt should be immersed in the dye solution tank (with cover) for 30 minutes. All dyed smolt prior to release are to be held for about 60 minutes or longer within the instream holding tank and scrutinized for abnormal behavior; any smolt which show signs of stress will NOT be released. Dyed smolt are to be released evenly spaced across the stream at a site providing suitable cover. Timing of the process should be 1700-1800 hrs, with release of the

smolt scheduled around 2200 hrs. The dyed fish total recorded should reflect only those fish which were actually released (Figure 3). Monitoring marked-unmarked fish recovery will commence the evening of dyed smolt release and continue for the next two consecutive smolt days. During the initial stages of smolt outmigration monitoring, smolt numbers may be such that the 1,000 fish sample size is not attainable. In these instances, a minimum of 150 smolt from both traps combined in a single night will be the benchmark for instituting a dye test, and again the following night. This will provide for a minimum sample size of 300 smolt captured over a two day period. If this situation exists, all smolt will be subjected to the dye process and released in a single night. Smolt age, weight, and length sampling will be 70 smolt per day sampled for five consecutive days. Typically no samples will be collected on Wednesday and Sunday with a dye test conducted on one of these days. Daily, during the smolt outmigration climatological data, stream depth and water temperature data will be collected at 1800 hrs and recorded (Figure 5). **Data will be recorded on standard AWL forms consecutively numbered corresponding to slides** (Appendix A). Essentially this means that the first sample of the season will be on AWL Numbers 001-002 (40 fish records on (001) and 30 on 002). In order for the optical scanning machine to collect all data recorded the litho code (left hand side on the front of AWL form) needs to be transcribed to the back of the form. AWL litho codes should be consecutively ordered by number which allows for database manipulation. Microscope slides will have scales from five fish aligned in rows and separated so that ageing is possible. **Blank slides and AWL forms will be used for each day of sampling.**

Escapement Passage

The old fishpass will be operated from approximately 15 June-21 August, with the starting date scheduled to minimize smolt passage through the fishpass. The diversion weirs should be installed prior to 21 May. Commencement of fishpass operations will occur the day after sockeye are first counted through Dog Salmon weir. New fishpass operation will proceed only after consultation with the project leader and/or Charlie Swanton. This structure has not been used for fish passage since about 1986. Diversion weirs above and below the Frazer falls will be inspected daily for holes, and cleaned when required. Specific instructions for fishpass maintenance and operation are provided (Appendix B). These steps prevent fish from escaping above the lower diversion weir which has been a major problem in the past. All weir panels on the lower diversion weir should be wired tightly together at the base and secured using boards to the tripods. All gaps between weir panels greater than about 76 mm (1.5 inches) should be covered with perforated plate and holes at the base of the weir blocked with sandbags or large rocks. To reduce erosion the bottom of the fishpass entrance should be covered with large rocks (not sandbags) as the bears enjoy playing volleyball with sandbags.

Escapement counting frequency will be scheduled to minimize migration delay. Specifically, counts will be made at least four times daily, and during peak escapement with increased frequency. Individual counts by species will be recorded using hand-held tally counters and data recorded (Figure 5). A standard escapement counting and sampling week will extend from Sunday to Sunday (statistical week; Appendix C).

Escapement Sampling

Sockeye escapement age, length, and sex (ALS) sampling will be conducted weekly (statistical week) over a one to two day period. Sample size per week is 240 fish (Table 1). If possible collect the sample during a single day, but do not extend beyond two consecutive days even if fewer than a 240 fish sample has been collected. Procedures for collecting and recording ALS data are given (Appendix C).

Stream and Lake Escapement Surveys

The primary objective of lake and stream surveys are to document distribution and abundance of sockeye within stream and lake shoal areas. Surveys will be conducted weekly from 15 July-21 August on Linda and Midway Creeks, only. Streams will be surveyed to the upper limits of spawner distribution and live and dead fish recorded (Figure 6). Additionally, spawner limits will be noted in a verbal description of the approximate distance upstream with a physical description. Stream mouth counts will be recorded separate from actual stream counts. Observers will survey on foot and enumerate live and dead sockeye using polarized glasses, and tally counters. Before conducting surveys, tally counters will be inspected for proper functioning. While conducting these surveys it has been found that using one person to count and the other as the stream guard (against bears) has generally been the approach that works best.

Rearing Fry Sampling

Three lake littoral sites will be sampled using a 16.6m fry seine weekly from 16 May-1 August. Specific sites are described in Figure 1. A single seine set will be made at each station between 1300 and 1600 hrs, attempting to minimize diurnal influence in catches. Catch will be recorded by species (Figure 7), and all sockeye at each site will be measured for length (tip-of-snout to fork-of-tail) to the nearest 1mm and data recorded.

Season Summary Report

The summary report should be a brief synopsis of the field season and include: (1) a chronology of sampling events and data collection :(1) problems incurred during the season including sampling and field camp operations; (2) suggestions for improvements/modifications to the enumeration and sampling programs; (3) equipment/building supplies for following field season. In addition, the crew leader is responsible for writing a performance evaluation for the field crew. The evaluation should be discussed with the technician prior to forwarding it to the project leader.

MAINTENANCE AND BUILDING PROJECTS

Several building projects will be completed on a time available basis during the 1994 field season they are: (1) Modification and improving sections of the lake to facility trail; and (2) replacing the adult sockeye sampling shed. The storage shed proposed at the lake outlet will be completed during late August or early September.

Table 1. Season summary of events.

Date	Event	Frequency
5/10	Open camp, install lower diversion weir and smolt traps.	
5/11-8/24	Camp and equipment maintenance as needed	
5/11-6/15	Fishpass maintenance as needed	
5/10--7/1	Sockeye smolt	enumeration as necessary daily; sample 70/day 5 days/week; mark-recapture 1,000/week (if available).
5/16-8/1	Fry	Seine and sample length of all sockeye fry caught weekly at three sites on lake.
~6/15-8/25	Adult sockeye	enumeration daily ALS sample 240 once a week.
7/15-8/25	Foot surveys	Linda and Midway Creeks (once a week).
~8/25	Close camp	

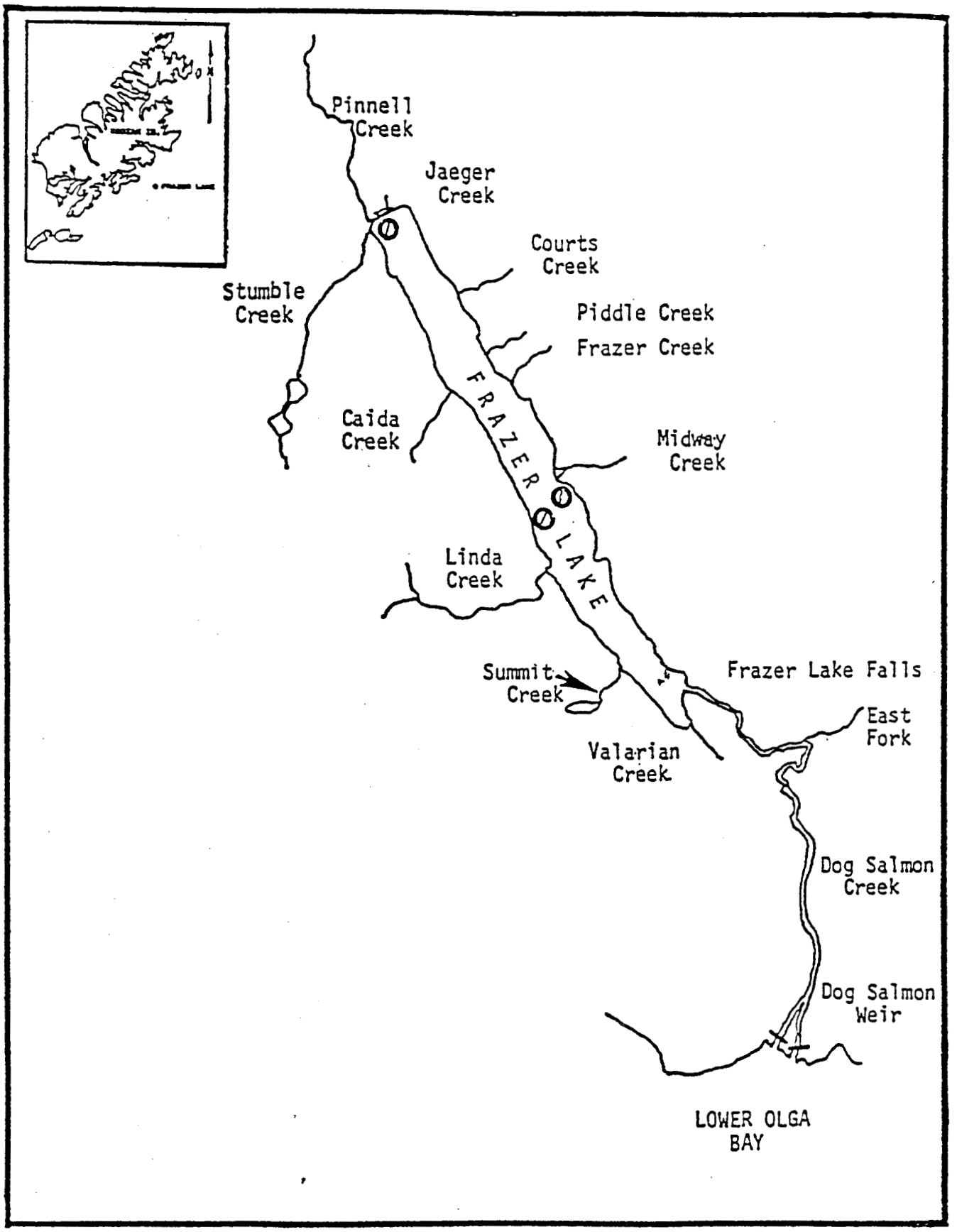


Figure 1. Map depicting Frazer Lake inlet streams and littoral beach seining sites.

Figure 2.

DAILY SMOLT CATCH REPORTING FORM

TRAP NUMBER _____ PROJECT LOCATION _____ DATE _____

TIME (MILITARY)	SOCKEYE SMOLT (numbers)			OTHER (numbers)			COMMENTS 2/
	CATCH 1/	EXAMINED FOR MARKS	MARKED RECOVERIES	COHO	DOLLY V.	STICKLEB.	
TOTAL							

1/ Catch number does not include marked recoveries.

2/ To be included in comments: estimate young-of-year fry numbers by species and number of sockeye smolt mortalities.

Figure 3.

SMOLT DYE RELEASE FORM

DATE (actual): _____

CREW NAMES (print) _____

PROJECT LOCATION _____

NUMBER OF FISH COLLECTED: _____
(from live box)

CREW LEADER _____
(signature)

	COLLECTION LIVE BOX	TRANSPORT BUCKET	RECOVERY CONTAINER	DYE TUB	RECOVERY CONTAINER	TRANSPORT BUCKET	STREAM RELEASE
START TIME (military)							
START TEMP (degree celsius)							
END MORTALITY (number of fish)							
OXYGEN SUPPLEMENT O2 or aerator (A)							

DYE SOLUTION (mixture): _____ Dye (grams); _____ Water (gallons)

RELEASE SITE LOCATION (distance upstream of trap site, in miles) _____

TOTAL NUMBER OF DYED FISH RELEASED: _____

COMMENTS:

Figure 4. SOCKEYE SALMON SMOLT SUMMARY FORM

TRAP NUMBER _____ PROJECT LOCATION : _____

DATE 1/	NUMBER OF SMOLT					
	CAUGHT 2/					
	DAILY	CUMULATIVE	MORTALITIES	DYED	EXAMINED	MARKED RECOVERIES

1/ Each date covers a 24-hour period extending from noon to noon and identifies the starting date.
2/ Numbers of fish caught does not include marked recoveries.

Figure 5. CLIMATOLOGICAL OBSERVATIONS

PROJECT LOCATION: _____

DATE	TIME	TEMPERATURE		CLOUD COVER (%)	WIND		STREAM GAUGE[a] (in cm)	COMMENTS
		AIR(°C)	WATER(°C)		DIRECTION	VEL. (MPH)		

[a] Round to nearest 1 cm.

Figure 6.

ALASKA DEPARTMENT OF FISH AND GAME
KODIAK MANAGEMENT AREA
WEEKLY SALMON WEIR CAMP REPORT FOR YEAR: _____

WEIR CAMP NAME: _____ PERSONNEL: _____ NO. _____ WEEKLY REPORT FOR WEEK ENDING (SATURDAY) _____

DATE	DAILY TOTAL SALMON ESCAPEMENT						DAILY TOTALS	JACK	REDS	STEELHEAD		DOLLYS	GILLNET MARKED		H2O LEVEL		H2O TEMP	WEATHER		
	REDS	L. REDS	KINGS	PINKS	COHOS	CHUMS		NO.	%	DOWN	UP	UP	REDS	OTHERS	UP	DOWN		CEIL.	VIS.	WIND DIR/SPD
SUN D																				
SUN A																				
MON D																				
MON A																				
TUE D																				
TUE A																				
WED D																				
WED A																				
THU D																				
THU A																				
FRI D																				
FRI A																				
SAT D																				
SAT A																				
TOTAL FOR WK															COMMENTS:					
ACCUM THRU WK															COMMENTS:					
WEIR MORTS FOR WK TOT ACCUM															COMMENTS:					
AWL SAMP FOR WK TOT ACCUM													COMMENTS:							

ADDITIONAL COMMENTS: BEAR AND PEOPLE PROBLEMS; SMOLT MIGRATION; WEIR PROBLEMS; CABIN REPAIR; NOTE AIRCRAFT TRAFFIC

Figure 7.

SOCKEYE SALMON STREAM SURVEY LOG

Stream Name	Date	Observer	Mouth			Stream					Stream temp (C	Remarks
			Survey Cond.	Meth.	Live Count	Survey Cond.	Meth.	Count Live	Dead	Total		

Figure 8. Seine catch log form.

Lake:_____ Time:_____ Remarks:

Date:_____ H_2O temp: _____

Location:_____

Seine length:_____ Crew:_____

TOTAL CATCH					
SOCKEYE	COHO	DOLLY V.	STICKLEBACK	RAINBOW	OTHER

	SOCKEYE LENGTH SAMPLE						
1		26		51		76	
2		27		52		77	
3		28		53		78	
4		29		54		79	
5		30		55		80	
6		31		56		81	
7		32		57		82	
8		33		58		83	
9		34		59		84	
10		35		60		85	
11		36		61		86	
12		37		62		87	
13		38		63		88	
14		39		64		89	
15		40		65		90	
16		41		66		91	
17		42		67		92	
18		43		68		93	
19		44		69		94	
20		45		70		95	
21		46		71		96	
22		47		72		97	
23		48		73		98	
24		49		74		99	
25		50		75		100	

APPENDIX A

Procedures for Sampling Salmon Smolt for Age, Length, and Weight

The sample size is 70 sockeye salmon smolt per day, five days a week. If daily sampling objectives are being met, sampling will not occur on Wednesday and Sunday. It is essential that the sample be taken randomly. In the event that more than the required sample size is in the smolt trap at the time of sampling, the trap is to be stirred to assure randomness. When the smolt are randomly distributed, a small dip net will be used to remove a subsample. This procedure will be repeated until the sample goal is met.

AWL Forms

Smolt length and weight will be recorded on AWL forms (Appendix A.1). Using a No. 2 pencil, complete each section of the left side of the AWL and darken the corresponding blocks:

Description: Include species (sockeye smolt), location, year, and samplers.

Card: The AWL forms and corresponding slides are numbered sequentially by date throughout the season starting with # 001. A new, consecutively numbered, card is used each day even if the previous card is not completed. There may be a minimum of one fish and a maximum of 40 fish (8 slides) per AWL.

Species: Refer to the reverse side of the AWL form to obtain species; sockeye = 2.

Day, Month, Year: Use the appropriate digits for the date the fish are sampled.

District, Subdistrict, Stream, Location: The appropriate codes for Frazer Lake are 257-District; 40-Subdistrict; and 403-Stream number.

Period: List the period in which the fish were sampled using Appendix A.2.

Project: Refer to the reverse side of the AWL form to obtain code; code 4 will be used as default since a specific smolt code does not exist.

Gear: Refer to the reverse side of the AWL form to obtain code; 00 = trap.

Mesh: Leave blank.

Type of Length Measurement: Refer to the reverse side of the AWL form to obtain code; 1 = Tip-of-snout to fork-of-tail.

Number of Scales: Mark 1 (refers to 1 smear/fish)

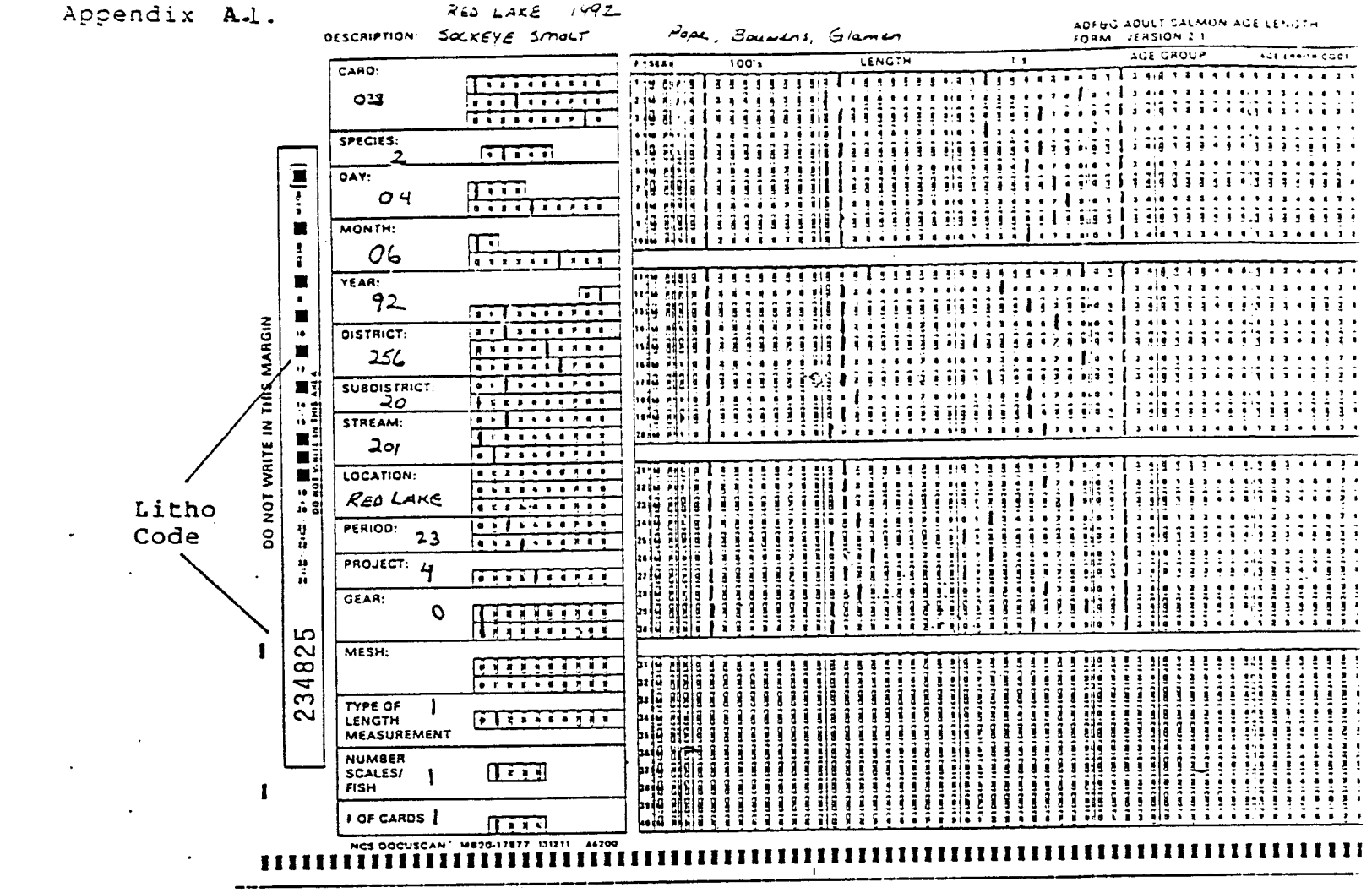
# of Cards: Mark 1 (each AWL form is individually numbered). Keep the litho codes in numerical order throughout the season and be sure to transfer the litho code from the front left side to the backside of the AWL form. These forms will be optically scanned and stray marks may be misinterpreted. It is the crew leaders responsibility to make sure that all forms are carefully edited before returning them to your supervisor.

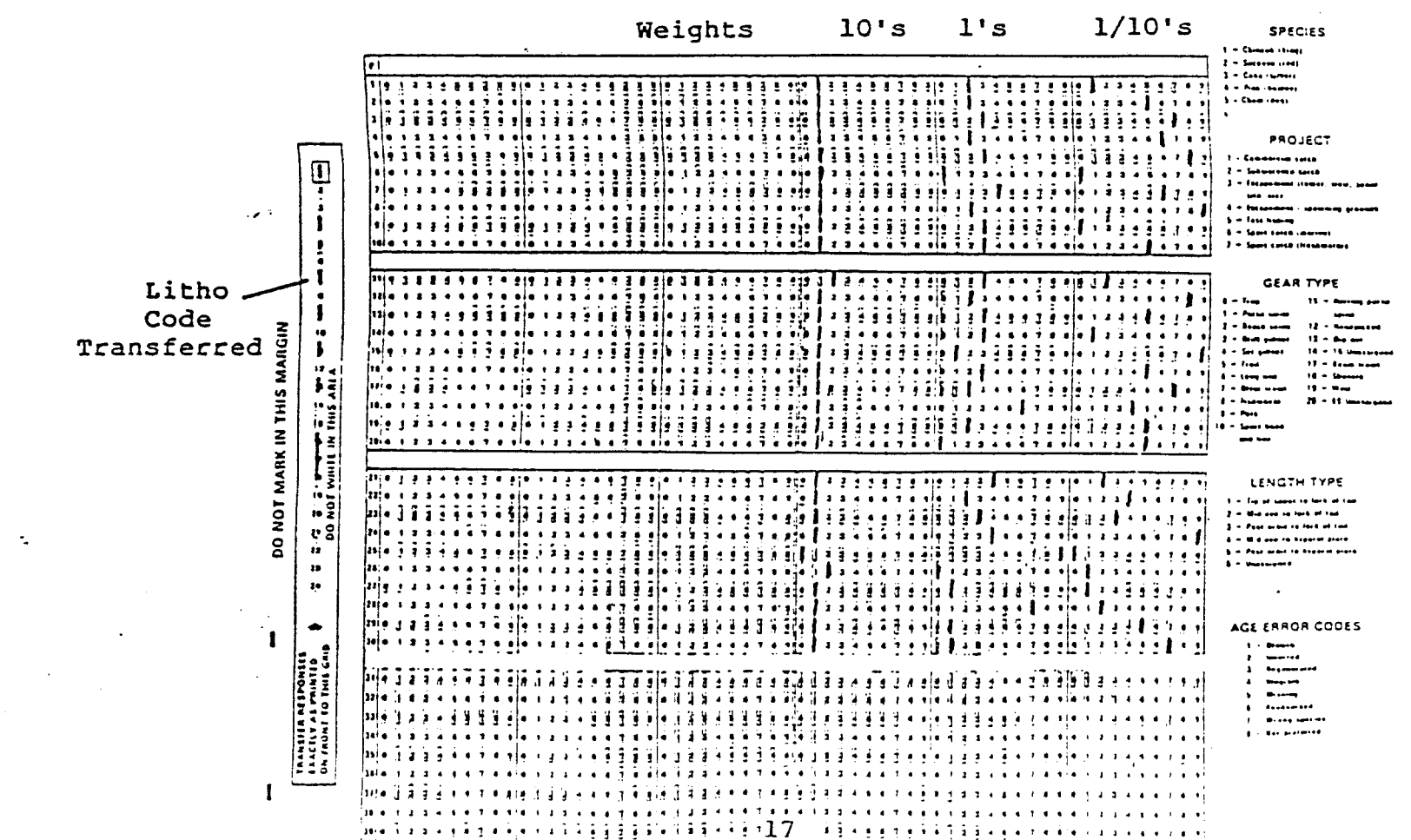
Sampling procedure

Smolt will be kept alive and sampled the day of capture. MS222 will be used to anesthetize the fish. The use of this chemical will be demonstrated in the field. A flattened probe will be used to remove 5-10 scales from the preferred area, Appendix A.3. The scales will be mounted on a glass slide as illustrated in Appendix A.4. The left portion of each slide will be labeled: location, date, AWL #'(card #), and fish numbers (1-5, 6-10, 11-15, etc.). When the slides are completed, return them to the box in order, and label the box as shown in Appendix A.4.. Smolt lengths will be measured in millimeters from the tip of the snout to the fork of the tail, Appendix A.5. Record each length by darkening the appropriate column blocks on the AWL form.

Excess water will be removed from the smolt before weighing by using a paper towel blotter. Individual smolt weights will be recorded to the nearest 0.1 gram on the backside (right side) of the AWL form (Appendix A.1). Each length and weight measurement must represent the corresponding scale smear.

Appendix A.1.

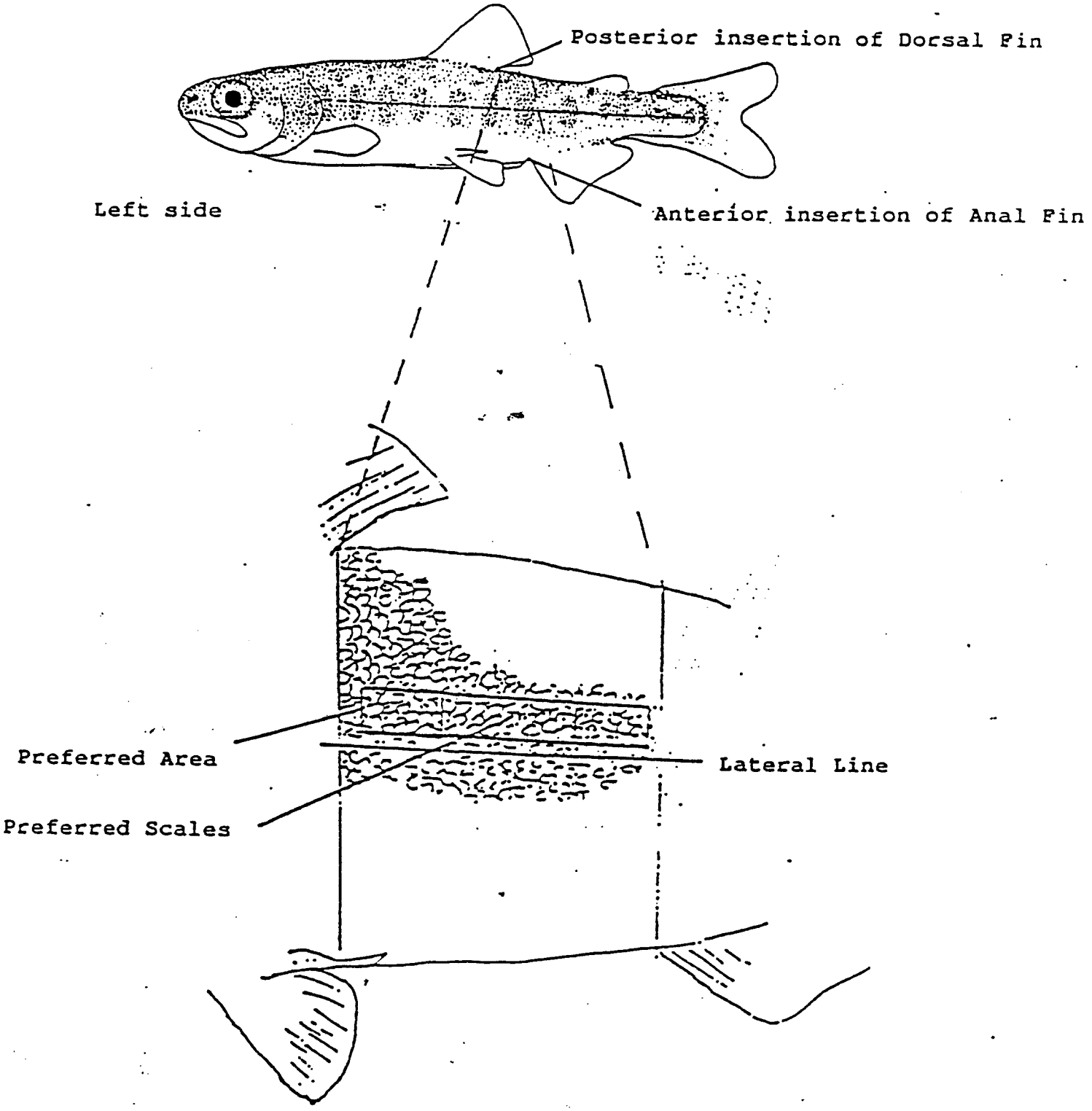

RED LAKE 1992
DESCRIPTION: SOCKEYE SMOLT
Pope, Bowers, Glamen
ADF&G ADULT SALMON AGE LENGTH
FORM VERSION 2.1
CARD: 033
SPECIES: 2
DAY: 04
MONTH: 06
YEAR: 92
DISTRICT: 256
SUBDISTRICT: 20
STREAM: 201
LOCATION: RED LAKE
PERIOD: 23
PROJECT: 4
GEAR: 0
MESH:
TYPE OF LENGTH MEASUREMENT 1
NUMBER SCALES/ FISH 1
OF CARDS 1
234825
DO NOT WRITE IN THIS MARGIN
Litho Code
SEX
100's
LENGTH
1's
AGE GROUP


Weights
10's
1's
1/10's
SPECIES
PROJECT
GEAR TYPE
LENGTH TYPE
AGE ERROR CODES
DO NOT MARK IN THIS MARGIN
Litho Code Transferred
TRANSFER RESPONSES EXACTLY AS PRINTED ON FRONT TO THIS GRID
DO NOT WRITE IN THIS AREA

Appendix A.2. Period codes and corresponding dates.

Period	Dates	Period	Dates
1	01-Jan to 03-Jan	28	05-July to 11-July
2	04-Jan to 10-Jan	29	12-July to 18-July
3	11-Jan to 17-Jan	30	19-July to 25-July
4	18-Jan to 24-Jan	31	26-July to 01-Aug
5	25-Jan to 31-Jan	32	02-Aug to 08-Aug
6	01-Feb to 07-Feb	33	09-Aug to 15-Aug
7	08-Feb to 14-Feb	34	16-Aug to 22-Aug
8	15-Feb to 21-Feb	35	23-Aug to 29-Aug
9	22-Feb to 28-Feb	36	30-Aug to 05-Sep
10	01-Mar to 07-Mar	37	06-Sep to 12-Sep
11	08-Mar to 14-Mar	38	13-Sep to 19-Sep
12	15-Mar to 21-Mar	39	20-Sep to 26-Sep
13	22-Mar to 28-Mar	40	27-Sep to 03-Oct
14	29-Mar to 04-Apr	41	04-Oct to 10-Oct
15	05-Apr to 11-Apr	42	11-Oct to 17-Oct
16	12-Apr to 18-Apr	43	18-Oct to 24-Oct
17	19-Apr to 25-Apr	44	25-Oct to 31-Oct
18	26-Apr to 02-May	45	01-Nov to 07-Nov
19	03-May to 09-May	46	08-Nov to 14-Nov
20	10-May to 16-May	47	15-Nov to 21-Nov
21	17-May to 23-May	48	22-Nov to 28-Nov
22	24-May to 30-May	49	29-Nov to 05-Dec
23	31-May to 06-June	50	06-Dec to 12-Dec
24	07-June to 13-June	51	13-Dec to 19-Dec
25	14-June to 20-June	52	20-Dec to 26-Dec
26	21-June to 27-June	53	27-Dec to 31-Dec
27	28-June to 04-July		

Appendix A.3. Scale sampling procedure showing the preferred area on a smolt salmon.

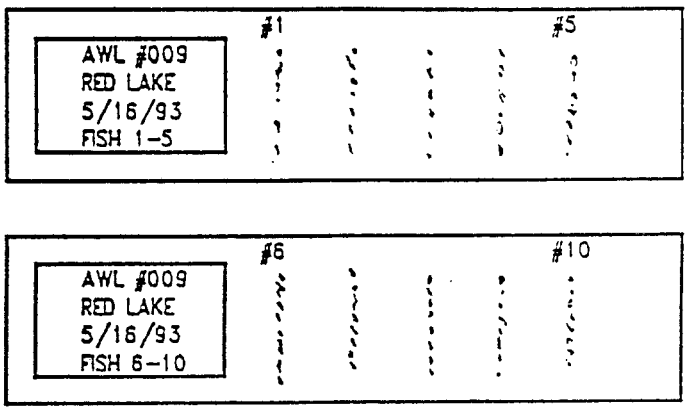


Appendix A .4.

SALMON SMOLT GLASS SLIDE EXAMPLE

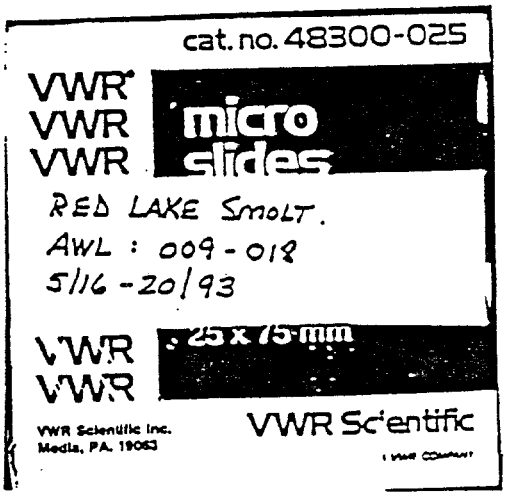
The following information should be legibly written on the slide label:

1. AWL #
2. Location
3. date (mo/day/yr)
4. Fish # (1-5, 6-10, etc.)



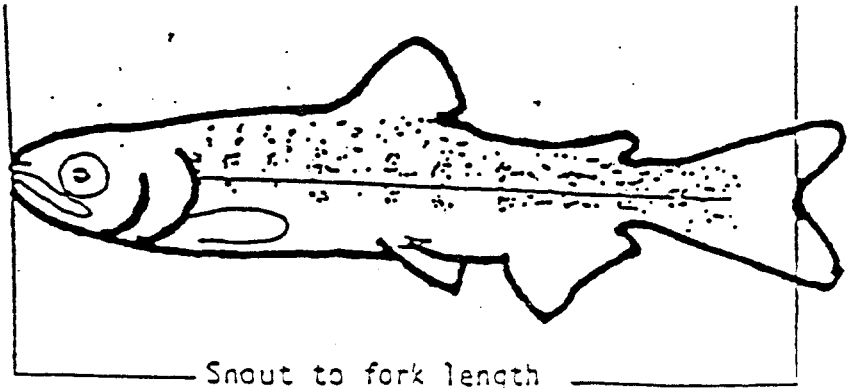
When the slides are completed, return them to the box in order by AWL # and fish#, and label the slide box on top with the following information:

Location (RED LAKE)
AWL Numbers (AWL # 009 - 018)
Beginning and ending dates (5/16 - 20/93)



Appendix A.5

MEASURING SMOLT LENGTH



A Guide to the Collection and Identification of Presmolt Pacific Salmon in Alaska with an Illustrated Key

MILTON B. TRAUTMAN[1]

ABSTRACT

This field and laboratory key contains recommendations for types of equipment needed, instructions for preserving and labeling specimens, and descriptions of the characters used in identifying five species of Pacific salmon. The key is illustrated with six line figures: 1) juvenile salmon, 2) the first gill arch, 3) head with gill arch in situ, 4) first gill arch and eye for comparison with longest rakers, 5) method of counting anal fin rays, and 6) ventral surface of head showing branchiostegals. Five plates of stippled line drawings of five lengths (25 to 110 mm fork length) for each of the five species of Pacific salmon, an annotated opposable key, and a glossary are also included.

INTRODUCTION

As adults, the five species[2] of Pacific salmon of the genus *Oncorhynchus* inhabiting western North American waters are easily identified, but as subadults or as smolts in silvery coloration, they are less easily recognized. As juveniles less than 125 mm (5 inches) in fork length (FL), they may be quite difficult to identify. In addition, characters by which presmolt juveniles can be distinguished may vary with geographic area.

Several keys for identification of juvenile salmon have been published, most of which utilize the number, length, and shape of the gill rakers on the first gill arch; number of pyloric caeca and branchiostegals; and absence of parr marks, or if present, their size and shape (Foerster and Pritchard, 1935; Schultz, 1936; Haig-Brown, 1947; Clemens and Wilby, 1961; McPhail and Lindsey, 1970; Wilimovsky[3]). In addition to the above characters, the key in this paper emphasizes and illustrates the distribution of those chromatophores (usually melanophores) which are reliable enough to aid in the specific identification of juveniles.

This key describes the characters typical of presmolt juveniles of the five species of Pacific salmon in Alaska. The common names recommended by the American Fisheries Society (Bailey et al., 1970, p. 17) are used, despite the fact that other names appear to be in more general use. These other names are inserted in parentheses after their respective species. Trouts, Atlantic salmon (*Salmo salar*), and some other salmonoids are included in the key because of their resemblance to Pacific salmon.

Before presenting the key, it appears advisable to describe the equipment and methods I recommend for preserving specimens, labeling specimens, and counting, measuring, and removing parts of specimens, so that those not acquainted with my procedures may more accurately and quickly identify their material.

---

[1] Professor Emeritus of Zoology, Ohio State University, Columbus, OH 43210. The author was employed in Alaska by the National Marine Fisheries Service Auke Bay Fisheries Laboratory during the summers of 1959 and 1961. The specimens were obtained and most of the drawings made at that time.

[2] A sixth species, *O. masou* (Brevoort), inhabits the streams of eastern Asia from the Okhotsk Sea to Formosa.

[3] N. J. Wilimovsky, 1958. Provisional keys to the fishes of Alaska. On file Natl. Mar. Fish. Serv., Auke Bay Fish. Lab., Auke Bay, AK 99821.

RECOMMENDED EQUIPMENT

Magnifiers: Magnification in the range of 4 to 30 will prove helpful in identification of juvenile salmon. A binocular microscope having such a range is the most satisfactory, but any type of magnifier of more than 4 power and less than 30 may be used provided it is not necessary to use one's hand to hold it—usually both hands are needed to manipulate a specimen. In the field, a binocular unit containing lenses inserted in a frame or headstrap or a jeweler's eye magnifier (especially if one wears glasses) may be used.

Forceps: Four or five inches long with straight or curved tips—for lifting fins, holding back gill covers, etc.

Scalpel: A sharp blade an inch or two long—for removing gill arches, opening body cavities, etc.

Teasing needle: A needle inserted in a wooden or metal handle—for separating closely set gill rakers, etc.

Dividers: For measuring and comparing various body parts; dividers in which one or both legs can be "broken" are the most satisfactory.

Scissors: About 6 inches long with the blades or cutting surface of about 1 inch.

Ruler: Graduated in millimeters to measure fish lengths and parts; one which includes inches also desirable.

PRESERVING SPECIMENS

The careful preserving of specimens cannot be too strongly emphasized. Much time is lost in attempting to identify improperly preserved fishes; it is only when properly preserved that they may be rapidly and correctly identified. Frequently, juvenile salmon that have died in nets become soft, bleached, and torn. For the sake of accuracy it is better not to attempt to identify such material.

To preserve juveniles, upon capture place them in a solution of 1 part Formalin to 9 parts water. If live fishes are placed in too strong a Formalin solution, they may die with their mouths widely agape or the chromatophores may close so tightly as to be difficult to detect. If placed in too weak a Formalin solution, the fishes become bleached and soft and may decompose. If fishes are to be preserved for more than a year (or permanently), leave them in the Formalin solution at least 1 wk and if possible no longer than 4 mo. When fish are removed from the Formalin solution, soak them in water for 24 to 48 hr; then place them in a solution containing 70% ethyl alcohol and 30% water or 35% isopropyl alcohol and 65% water.

Do not crowd or pack fishes in a container, especially if they are alive or only recently dead. Fresh fishes, if packed too tightly, will become permanently deformed upon hardening in Formalin, will be bleached where their bodies come in close contact, or will decompose. A container is too crowded if the fishes will not readily move as the container is slowly rotated or shaken. When sufficient room is allowed, identification will be facilitated because the fishes will harden without discoloring; bodies and fins will not be deformed, twisted, or broken; and the chromatophores will remain nearly or fully open.

LABELING SPECIMENS

Labeling specimens fully and properly is of great importance; unlabeled or mislabeled specimens are of little or no value. Put the label with the specimens at the time the fishes are preserved. Label paper should remain firm when wet and should not become pulpy. Write clearly with pencil or permanent ink, recording the following data.

Field Number

Use your own or a department number. A satisfactory method is to use the first initial of your surname or your full surname, the last two digits of the year, and your collection number. Thus, if Joe Brown in 1962 preserves his fifth collection, he writes B-62-5 or Brown-62-5; if for the Department of Salmon Investigations he writes, SI-62-5. When a departmental symbol is used, it often is desirable for the collector to add his initials or name to the label.

Name of Water Body and Locality

Use names on standard maps. Whenever possible, avoid temporary or local names, such as

Brown's fishing camp. An example of a brief but adequate recording is: Alaska, Naknek River System, Katmai National Monument, Brooks Lake.

Date

Include the month, day, and year and, if pertinent, the hour.

The following additional information may be needed at times.

Method of Capture

Describe type of gear and size if significant, i.e., seine (2 cm mesh), fry net (1 cm mesh), trawl (1 cm bag), etc.

Temperature

Measure temperature of air and/or water. If water is ice-covered, what percent?

Other Water Conditions

If a *stream:* estimate its average width and maximum depth; if tidal and brackish, to what extent; degree of turbidity and source—glacial silt, plankton, etc.; degree of gradient—low, moderate, or high; percentage of stream in pools, with or without current; percentage of stream in riffles, whether flow is sluggish, moderate, or swift; dominant bottom types—sand, gravel, boulders, bedrock, muck, silt, etc.; aquatic vegetation—submerged, emergent, or both (name dominant species or genera if known). If a *lake or bay:* state whether fresh, brackish, or saline; if tidal, state to what extent; estimate size and possible depth; give degree of turbidity, type of bottom, and amount and kinds of aquatic vegetation.

Remarks

Describe anything that may aid in identification of the fishes, such as peculiar markings, habits, or habitats.

CHARACTERS USED IN IDENTIFYING SPECIES

A juvenile salmon is shown in Figure 1 to assist in recognizing and defining the characters and the counts and measurements used when keying out a specimen.

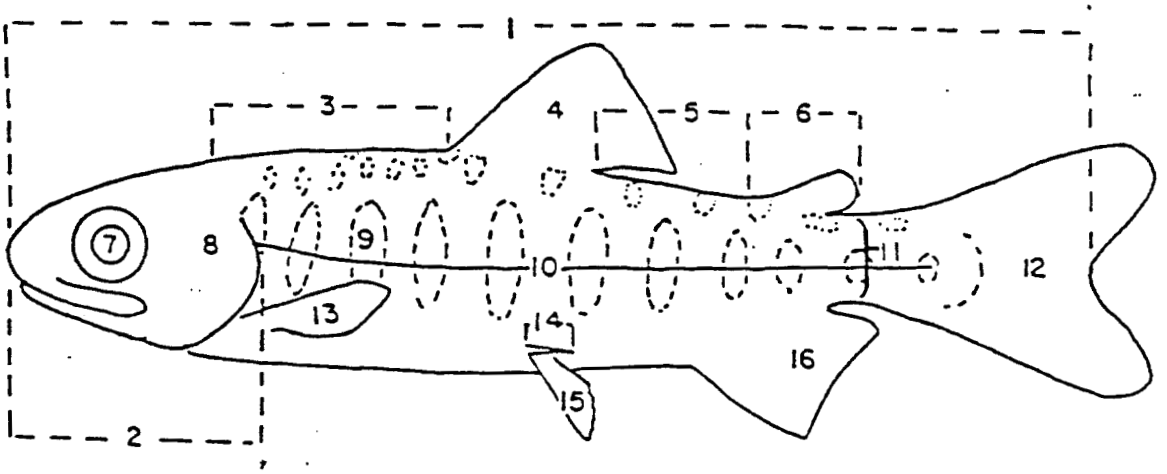
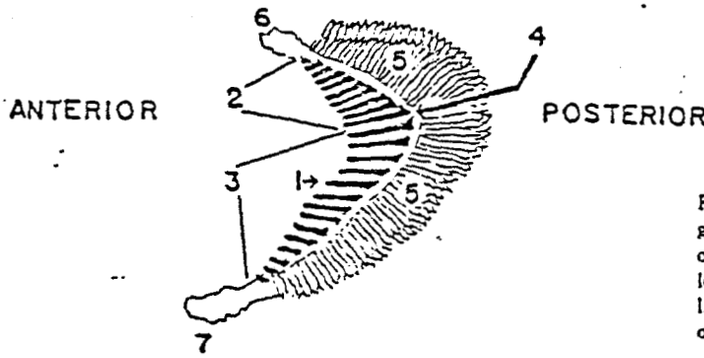


Figure 1.—Juvenile salmon, illustrating parts and methods of measuring: 1) fork length; 2) head length; 3) predorsal ridge; 4) dorsal fin; 5) portion of postdorsal ridge between posterior end of dorsal fin base and origin of adipose fin; 6) adipose fin; 7) pupil of eye; 8) gill cover, beneath which is gill chamber containing gill arches; 9) a parr mark; 10) lateral line; 11) caudal peduncle; 12) caudal fin or tail; 13) pectoral fin; 14) axillary process or scale; 15) pelvic fin; 16) anal fin.

First Gill Arch

Beneath each gill cover are four fully formed gill arches; the first gill arch on either side is the part used for specific identification. A gill arch (Fig. 2) consists primarily of a bony central arch to which the gill rakers are attached anteriorly, the gill filaments (lamellae) posteriorly. The gill rakers prevent solid substances such as food from being carried out through the branchial clefts and protect the delicate gill filaments. The numbers of gill rakers vary somewhat among individuals of each species of salmon, but the difference in average number between some species is sufficiently great to enable one to use them as specific characters.

The rakers on the gill arch may be counted as a unit, or the upper and lower limbs may be counted separately. The two limbs are joined



at an angle, the upper being the shorter. When a raker is situated astride the angle, it is included in the lower limb count. When all of the rakers on the arch are counted as a unit, a single number is given; otherwise, both limbs are recorded separately (the upper limb first), and then added, thus 12 + 20 = 32.

The gill rakers nearest the angle of the arch are the longest; the rakers become progressively shorter as they approach the attachment ends of each arch. The rakers near the ends are often rudimentary and can be counted only under magnification.

It may be difficult to count all of the rakers accurately while the first gill arch is in place, in which case it will be necessary to remove the arch. To do this, turn back or cut away gill cover as shown in Figure 3. Lift the first gill arch upward. With a sharp scalpel, cut between the dorsal ends of the first and second arches, making a deep incision parallel with them; then cut the remainder of the attachment away. Next cut the ventral attachment in the same manner; and when both ends are free, remove the arch. Great care must be taken so that all rudimentary rakers may be removed and counted. After finishing the examination of the arch, reinsert it in the gill chamber for possible future examination.

Gill Raker and Eye Comparison

The longest rakers are compared with the length of the eye (Fig. 4). With dividers, obtain the measurement of the length of the longest raker; then place one point of the dividers at the anterior edge of the eye, the other extending

Figure 2.—First gill arch of salmon after removal from left gill chamber: 1) gill raker; 2) gill rakers attached to upper or shorter limb of arch; 3) gill rakers attached to lower or longer limb of arch; 4) angle of arch (junction of the two limbs or bones); 5) gill filaments (lamellae); 6) upper point of arch attachment; 7) lower point of arch attachment.

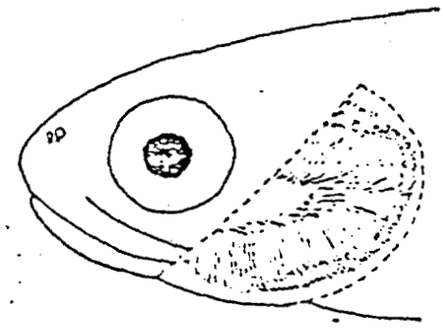


Figure 3.—Head of salmon. Dotted lines indicate that portion of gill cover which has been removed to show first gill arch in place.

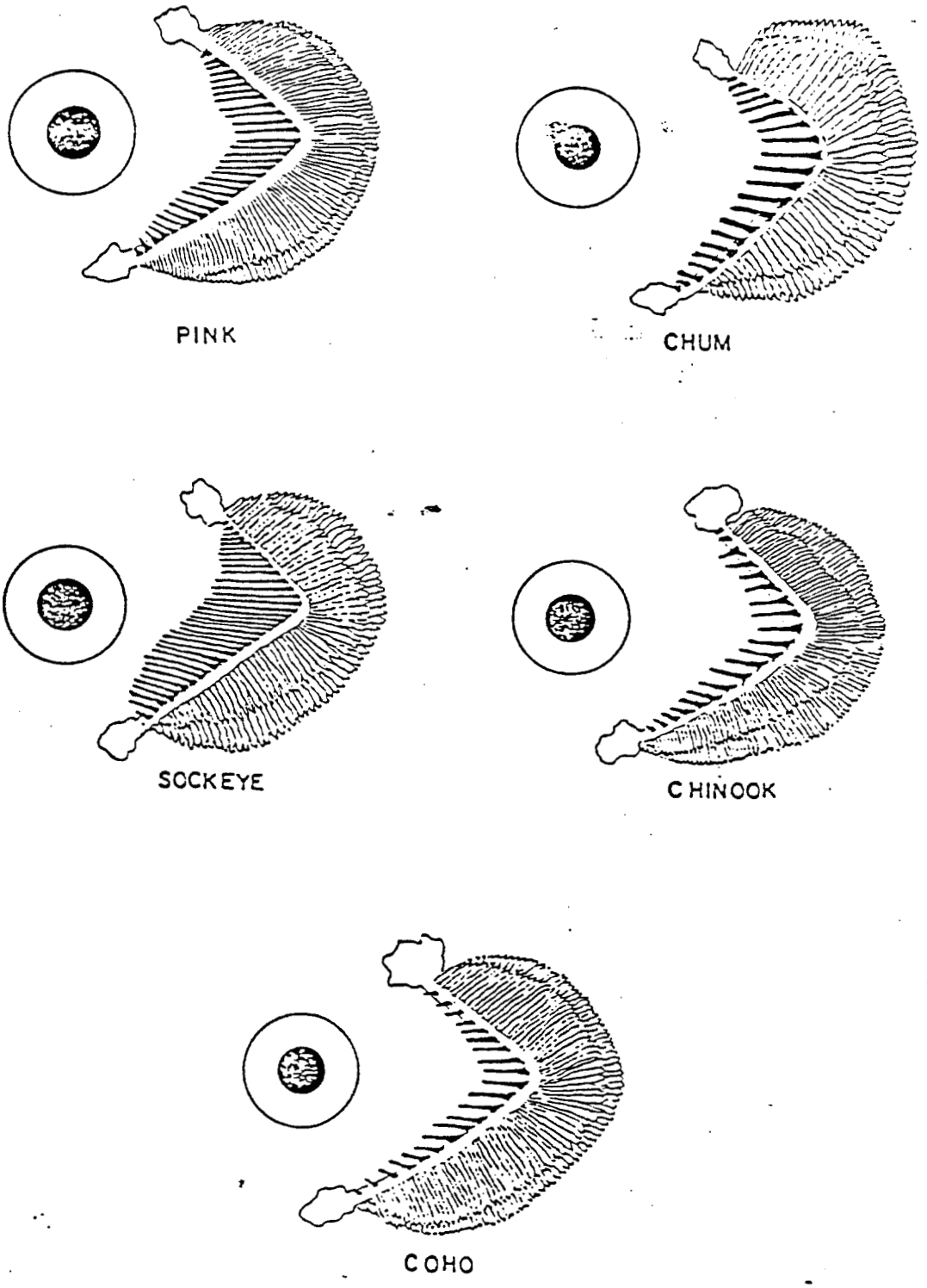


Figure 4.—First gill arch and eye for comparison with longest gill raker length of five species of Pacific salmon.

toward the opposite edge. Because the raker is shorter than the eye length in juvenile salmon, it is simplest to note where the raker reaches in relation to the pupil. Like many body part ratios, the gill raker-eye size ratios change as the juvenile salmon increases in length. For example, in specimens about 40 mm FL, the longest raker may be contained about 3 times the eye length, but in 140 mm specimens of the same species, the raker may be contained only about 2 times. This and other proportional changes must be considered.

Anal Fin Measurement and Count

To compare the length of the fin base with the longest ray, measure the anal fin base with dividers; then project the posterior leg of the dividers forward to the opposite tip of the longest ray as shown in Figure 5 by dotted line.

In counting the number of rays (Fig. 5), do not count those anteriormost ones which are less than half the length of the longest rays, such as those marked "0." Count all rays, such as No. 1, that are half (or more than half) the length of the longest ray, taking great care to observe the last ray—No. 15 in Figure 5. The last ray is usually split to its base and appears superficially as two rays, but it is in reality only one and should be counted as such.

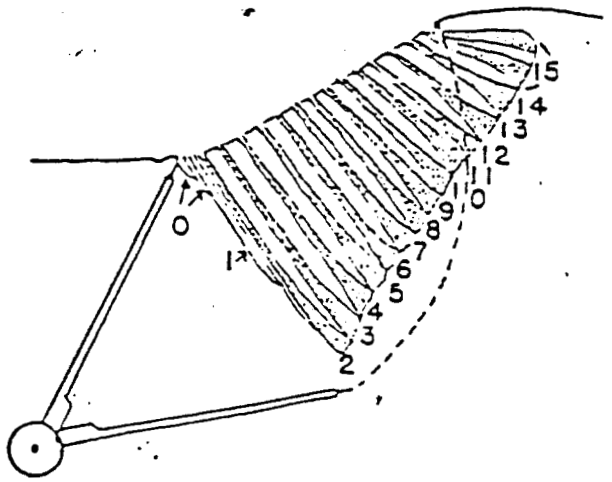


Figure 5.—Anal fin of salmon, illustrating method of measuring length of fin base and of counting rays (rays 2 to 15 are stippled here for emphasis).

Branchiostegal Count

All branchiostegals (Fig. 6), including the smallest, anteriormost ones are counted. Usually this may be accomplished satisfactorily only under magnification, and with juveniles longer than 40 mm FL. The branchiostegal count is used primarily as an additional character in specimens otherwise difficult to identify, and is especially valuable in separating the chinook salmon (usually 15 or 16) from the coho salmon (usually 13 or 14).

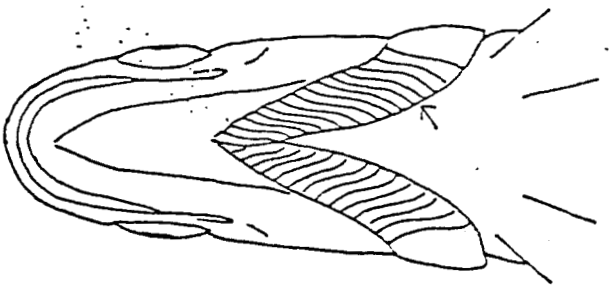


Figure 6.—Ventral surface of head of salmon. Arrow points to one of 14 branchiostegals on left side of head.

Pyloric Caeca Count[4]

With a scalpel, widely open the abdominal cavity. Sever the esophagus as far forward as possible; then cut off the intestine near the posterior end of the stomach. The stomach and caeca can now be removed as a unit (Fig. 7). Use magnification and teasing needle as aids in counting. Counts of pyloric caeca are useful chiefly as an additional character for questionable specimens, especially in separating the chinook salmon (more than 100 caeca) from the coho salmon (fewer than 90).

Color Pattern Variations

Juvenile salmon from certain waters or at certain stages of development may have their parr marks or other markings masked by a bluish-

[4]In the key, I have used pyloric caeca counts of my own, plus published accounts of others and especially the more recent ones, such as Clemens and Wilby (1961) and McPhail and Lindsey (1970).

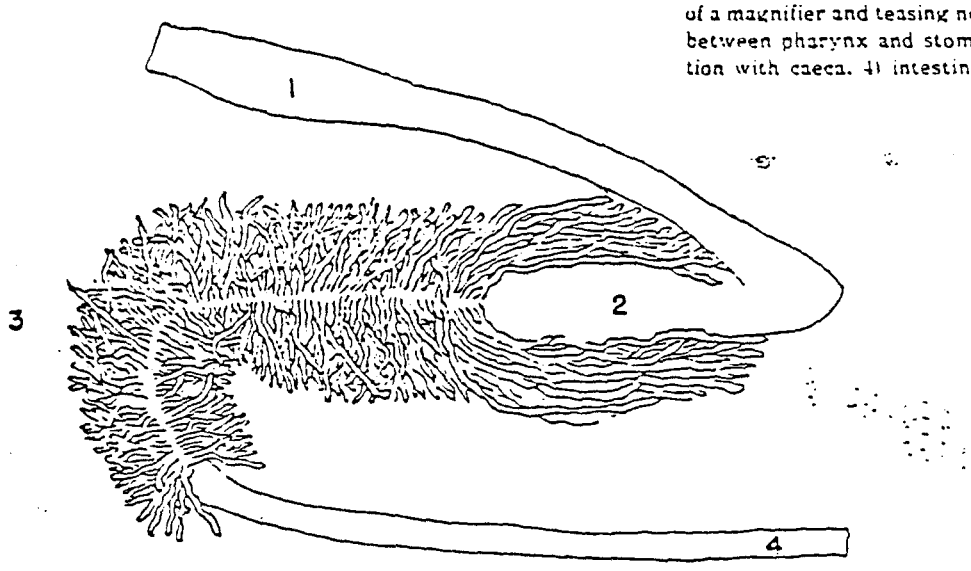


Figure 7. – Major portion of alimentary tract of salmon with pyloric caeca spread apart preparatory to counting with aid of a magnifier and teasing needle: 1) esophagus (part of tract between pharynx and stomach), 2) stomach, 3) pyloric section with caeca, 4) intestine.

or greenish-silvery sheen, especially when they are alive. To identify these fish, it may be necessary to preserve them first in Formalin to intensify their markings.

Juveniles of one species from certain waters, such as habitually turbid ones, may have their melanophores restricted in size or distribution, thereby resembling superficially another species. As an example, coho salmon normally have the adipose and anal fins densely speckled with rather large melanophores. But in some specimens, the melanophores may be reduced in size or distribution, so that coho salmon superficially resemble chinook salmon. Conversely, juvenile chinook salmon may have the melanophores unusually numerous and well developed, thereby resembling coho salmon. To avoid error in identification, compare the size and number of melanophores on the fins with those on the body; if few and small on the body, they should be few and small on the fins.

Color variations also occur regionally. An example is the predorsal stripe in chinook salmon, which in fish from some waters is normally a solid dark bar in specimens less than 80 mm FL; in chinook salmon in other waters the stripe may be reduced to a series of oblong blotches.

The length when individuals attain smolt coloration varies greatly, both regionally and in specimens from the same locality; some fish of the same species may lose parr and other presmolt markings when only half as large as other fish.

HOW TO USE KEY

Because of the variations in morphology and coloring, it is advisable to use the key in conjunction with the figures and plates and to check a large combination of characters.

In using the key, first make certain your specimen is a Pacific salmon by examining the characters under the two opposable groups labeled "1." Next, note the absence or presence of parr marks (see sections "*Combination of*" under opposable groups 2). If no parr marks are present and your specimen has not entered the silvery smolt stage, it is probably a pink salmon, but to make sure, compare it with the identifying characters between opposable groups 2. If parr marks are present, note the absence or presence of melanophores on adipose and anal fins (see groups 3). If melanophores are absent, see sections "*Combination of*" under groups 4; if present, see "*Combination of*" sections under groups 5. Decide which "*Combination of*" most closely fits your specimen, then verify it by comparing the descriptions of the identifying characters for the opposable groups.

KEY TO PRESMOLT JUVENILE SALMON

Salmonoid fishes having fewer than 20 rays in the dorsal fin (excludes grayling); strong teeth on jaws and tongue (excludes ciscoes and whitefishes); many pyloric caeca (excludes smelts, family Osmeridae); an axillary process or scaly appendage above pelvic fin (Fig. 1, No. 14); an adipose fin; cycloid scales; upper jaw formed by both premaxillary and maxillary ..... 1.

1a Base of anal fin *shorter* than longest ray (Fig. 5). Anal rays usually 9 to 12 (rarely 8 or 13). Gill rakers normally fewer than 20 on first gill arch (Fig. 3). Dorsal fin of larger juveniles of some species with several blackish spots.
CHAR, TROUTS, ATLANTIC SALMON ..... Not in this key.

1b Base of anal fin *longer* than longest ray (Fig. 5). Anal rays usually 13 to 17 (rarely 12, 18, or 19). Gill rakers normally 20 to 40 on first gill arch (rarely 19). Dorsal fin of larger juveniles lack blackish spots but tip of fin may be blackish.
PACIFIC SALMON—genus *Oncorhynchus* ..... 2.

2a *Combination of: No* parr marks on sides and *no* prominent specklings on back of presmolt juveniles. Usually no melanophores on anal and adipose fins; if melanophores present, they are few and very small, and if on adipose, are restricted to its posterior, free edge.
PINK (HUMPBACK) SALMON—*O. gorbuscha* ..... Plate 1.

General development—Similar to chum salmon in that yolk sac may not disappear until juvenile is more than 34 mm FL, after which development toward smolt shape and coloration is rapid. When less than 50 mm FL, this species is similar to chum salmon in being more terete than the sockeye, chinook, and coho salmon; body depth immediately before dorsal fin usually more than 1.5 times head length.

Parr marks—Only species of salmon lacking parr marks in the presmolt juvenile.

Coloration of body—*Preserved material*—In juveniles less than 40 mm FL, back is dark to lateral line and ventral half of body light when bicolored; dorsal third of body is darkest, sides lighter, ventral third lightest (usually milky-white or silvery) when tricolored. Few or no melanophores on lower sides and belly. In juveniles more than 40 mm FL, bicolored or tricolored condition is normally not evident, the dark back lightening gradually downward to the very light belly. *Living specimens*—Dorsal half of body bright bluish or greenish with much silvery reflection; ventral half milky or silvery-white.

Fins—Anal and dorsal fins averaging smaller than in chum salmon; these fins in this species and in chum salmon distinctly smaller than in sockeye, chinook, or coho salmon. In specimens less than 40 mm FL the longest anal ray, when measured into head length, extends from tip of snout to about center of eye; in larger presmolt juveniles, this measurement extends from tip of snout to anterior half of eye. Anal rays usually 14 to 16 (extremes 13 to 17). *Dorsal fin* has few specklings and only a slight tendency toward a dark anterior edge in juveniles less than 50 mm FL; over 50 mm, blackish anterior edge becomes pronounced and tip of fin dusky. *Caudal fin* has speckling confined to basal half in juveniles less than 50 mm; with increasing length of juveniles, specklings appear along rays, and in large presmolt juveniles lobes tend to become blackish.

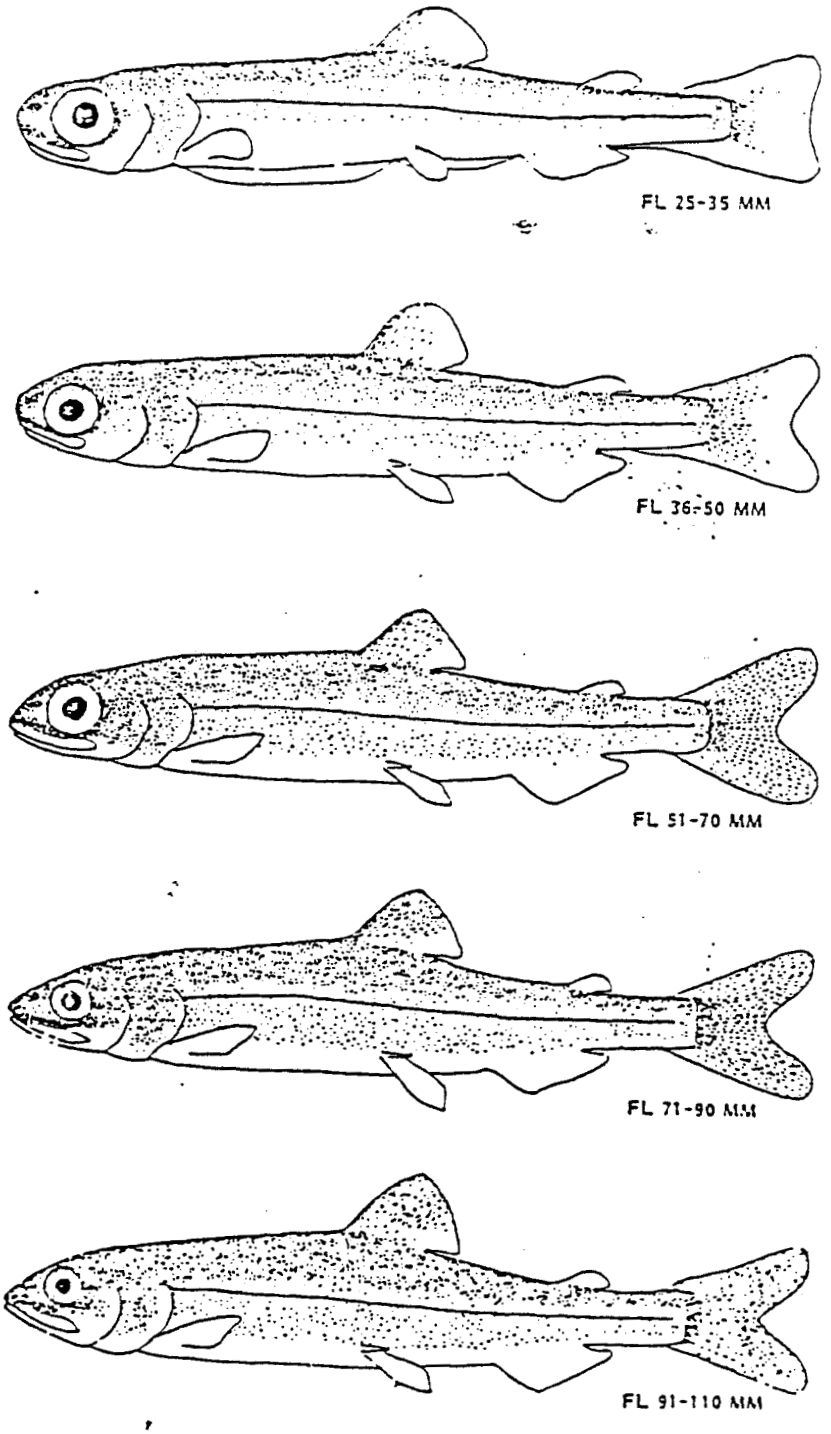


Plate 1.—Pink salmon.

Gill rakers (see Fig. 4)—Eleven to fourteen on upper limb, 14 to 19 on lower, total usually ranging between 27 and 33 (extremes 25 and 35); rakers slender and rather long; most similar in size and number to sockeye salmon but shorter and usually fewer (normally less than 31).

Pyloric caeca—Usually 130 to 195 (extremes 95 to 224); slender and rather long; differ sufficiently in numbers from coho and sockeye salmon, which have fewer than 100, to be a distinct aid in specific identification.

Branchiostegal rays—Usually 11 to 14 (rarely 10 or 15); average number less than in other species, almost invariably less than in chinook salmon, which usually has 15 to 18 (rarely 14).

Scales in lateral line—More than 170, more than in any other of the Pacific salmon; lateral line scale counts may be obtained under magnification in specimens longer than 60 mm FL.

Habits—Shortest life span of any species, between 18 mo and 2 yr. Only a comparatively small proportion of adults make extended migration in fresh water. Majority spawn in fresh waters within a short distance of brackish water or in intertidal waters. Many young enter brackish or salt waters within a few hours or days after emerging from redds, and comparatively few are found in fresh water when more than 45 mm FL.

Combination of: Both parr marks on sides and dark spottings on back usually obvious in living, presmolt juveniles and always in preserved specimens under magnification (may be faint in fishes from turbid waters); parr marks become faint and disappear as juvenile assumes smolt coloration ..... 3.

2b

No melanophores normally present on adipose and anal fins of presmolt juveniles, or if present, few and quite small. Parr marks occupy a larger area above lateral line than below it, and in some specimens anterior parr marks may be almost entirely above the lateral line.

3a

CHUM AND SOCKEYE SALMON ..... 4.

Melanophores normally obvious on adipose fin in living specimens and always in preserved specimens under magnification (may be indistinct in juveniles from silty waters). Anteriormost parr marks appear to occupy as large (or almost as large) an area below lateral line as above it; these parr marks are usually large, long, and wide.

3b

CHINOOK AND COHO SALMON ..... 5.

Combination of: Gill rakers 19 to 26 (average 23), notably fewer and much shorter than in sockeye salmon, which have more than 28. Normally *no* melanophores on adipose and anal fins. Anterior squarish (quadrate) parr marks situated almost or entirely above lateral line in specimens less than 50 mm FL; in presmolt juveniles more than 50 mm FL, anterior parr marks tend to be long and very narrow and sometimes may extend well below lateral line.

4a

CHUM (DOG) SALMON—*O. keta* ..... Plate 2.

General development—Similar to pink salmon in that yolk sac may not disappear until juvenile is more than 34 mm FL, after which development toward smolt shape is rapid. Also similar to pink salmon in being more terete (when less than 50 mm FL) than the sockeye, chinook, and coho salmon; body depth immediately before dorsal fin usually 1.5 to 1.8 times head length.

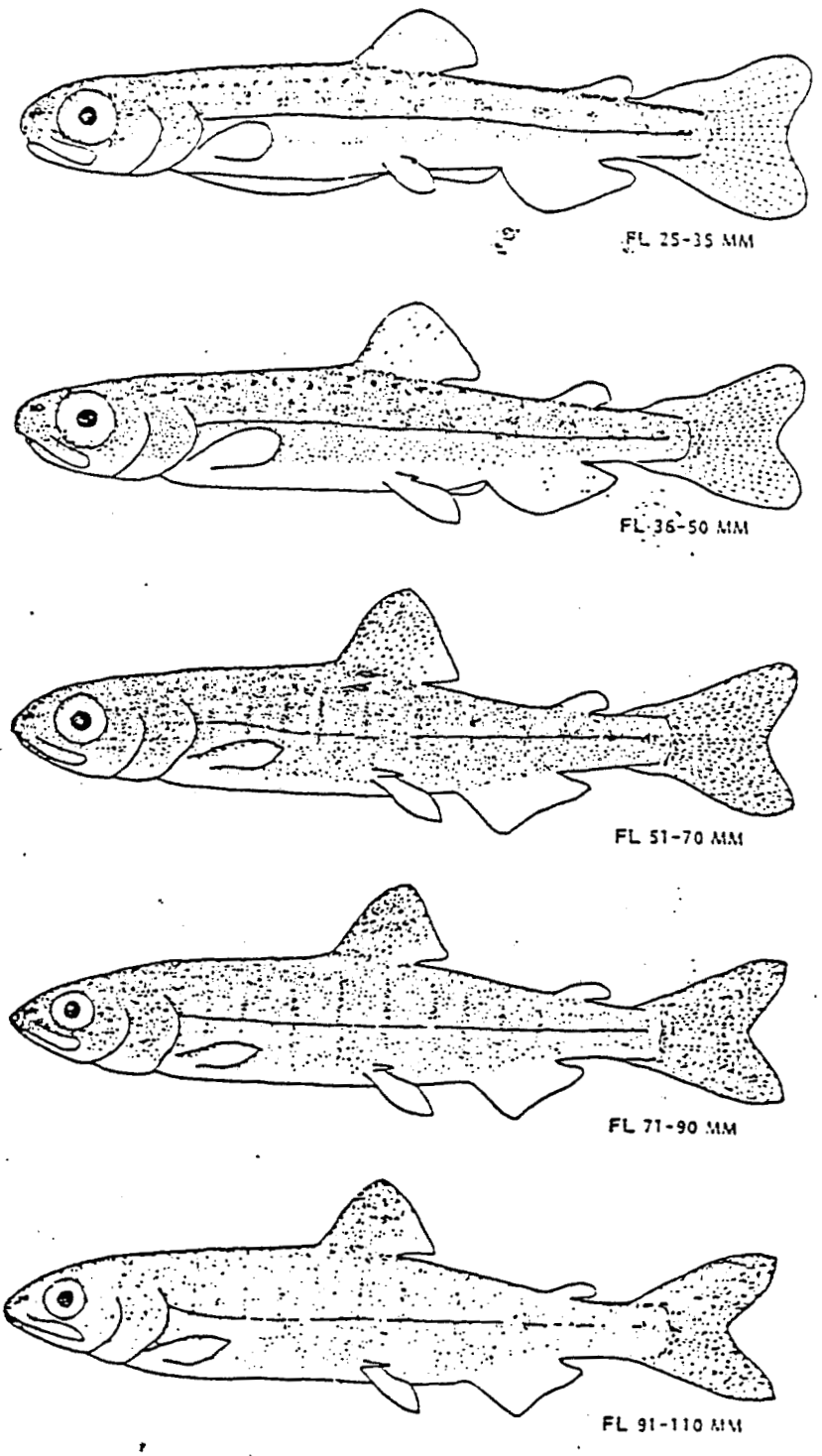


Plate 2.—Chum salmon.

Parr marks—Anterior parr marks in specimens less than 50 mm FL are more squarish (quadrate) and do not extend quite so far below lateral line as in sockeye salmon; in presmolt juveniles more than 50 mm FL, parr marks tend to become longer and more narrow than in sockeye salmon, and some tend to extend well below lateral line.

Coloration of body—*Preserved material*—Dorsal ridge stripe usually present, sometimes a series of blotches in juveniles less than 50 mm FL, becoming faint or disappearing in presmolt juveniles more than 50 mm FL; a prominent irregular row of spots and blotchings between dorsal ridge and upper edge of parr marks, these usually most distinct in specimens between 34 and 50 mm, often fading or disappearing in larger juveniles. *Living specimens*—Markings may be obscured by greenish or bluish overcast of dorsal half of body and whitish or silverish sheen of ventral half.

Fins—Anal and dorsal fins small, averaging slightly larger in size than those of pink salmon and averaging considerably smaller in height and area than those of sockeye salmon. Length of longest anal ray, when measured from snout to eye, reaches to, or almost to, center of eye; in sockeye salmon this measurement usually extends well beyond center of eye. Anal rays usually 13 or 14 (extremes 13 to 17). *Dorsal fin* has few or no distinct spottings in specimens less than 50 mm FL; in larger presmolt juveniles a dusky spot develops on tip. *Caudal fin* has faint spots largely confined to basal half in juveniles less than 50 mm FL; in larger juveniles lobes become blackish.

Gill rakers (see Fig. 4)—Seven to twelve on upper limb, 12 to 19 on lower, total usually ranging between 20 and 26 (extremes 19 to 30); rakers blunt and short, in sharp contrast to thinner, longer, and more numerous rakers of sockeye salmon, which has 30 to 39.

Pyloric caeca—Usually 160 to 185 (extremes 140 to 249); differ sufficiently in numbers from sockeye and coho salmon, which usually have fewer than 100, to be an aid in specific identification.

Branchiostegal rays—Usually 13 or 14 (extremes 12 to 16); of value primarily in separating this species from chinook salmon, which generally has more than 15.

Scales in lateral line—Between 125 and 155; of value chiefly in separating this species from pink salmon.

Habits—Life span usually 3 to 5 yr, for majority, 4 yr, some less than 3 yr. Jacks may occur. Majority spawn in fresh waters only a comparatively short distance from brackish water or in intertidal waters. Many young enter brackish or salt waters very shortly after emerging from redd, and few juveniles are found in fresh waters when more than 45 mm FL.

Combination of: Gill rakers 30 to 39 (average 36); notably more numerous, longer, and more slender than in chum salmon, which have fewer than 27. Normally *no* melanophores on adipose and anal fins. Anterior parr marks more rectangular
4b than squarish in outline in specimens less than 45 mm FL and sometimes extend as much as a third to a half below lateral line; these oblong parr marks tend to shorten in presmolt juveniles more than 50 mm FL and to be mostly above lateral line.

SOCKEYE (RED) SALMON—*O. nerka*. . . . . Plate 3.

General development—Yolk sac usually disappears, except for trace, before juveniles reach 30 mm FL. Body deeper and species more slab-sided in all presmolt lengths than in chum and pink salmons—body depth immediately before dorsal fin usually less than 1.5 times head length.

Parr marks—See "*Combination of*" above.

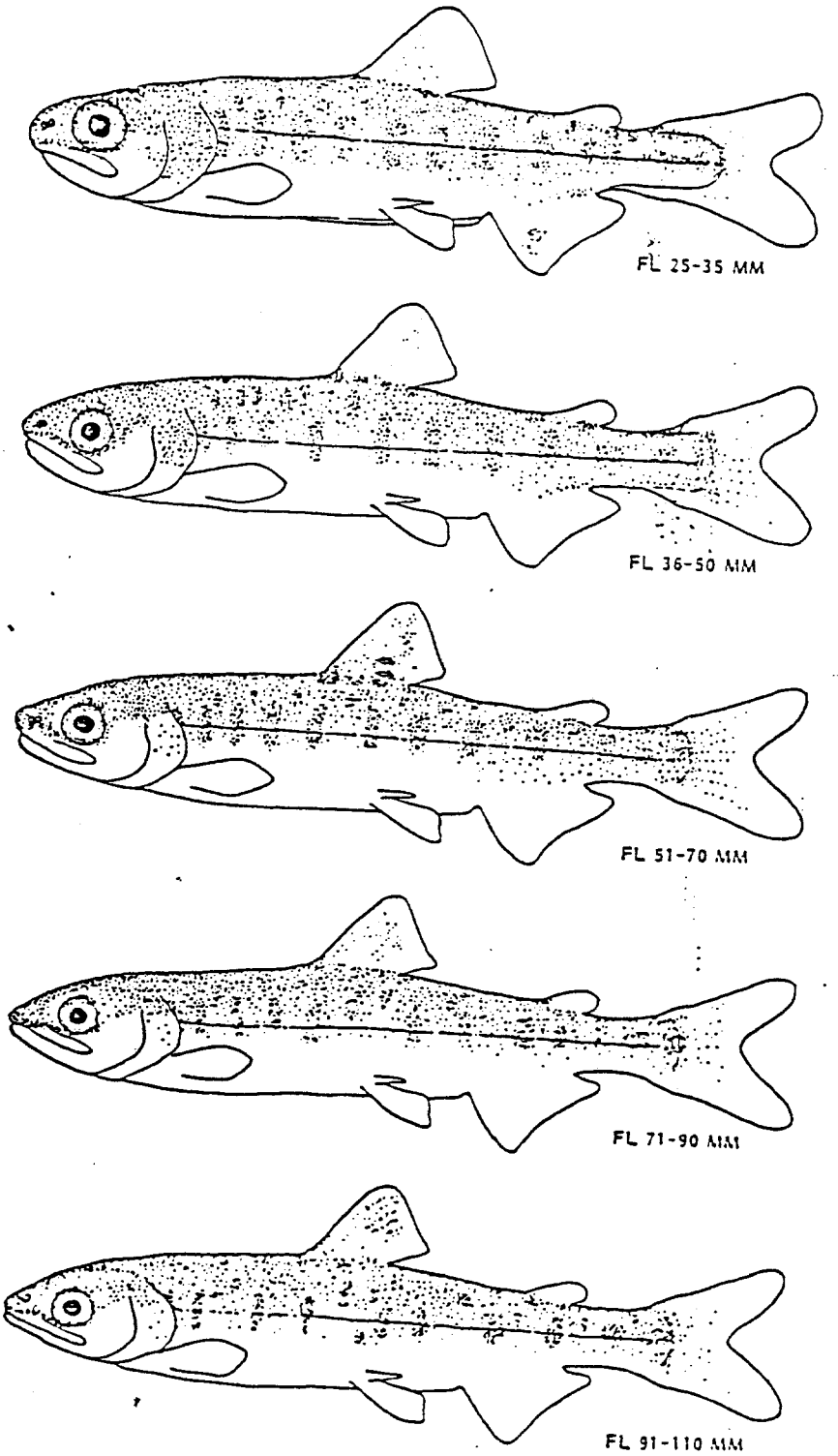


Plate 3.—Sockeye salmon.

Coloration of body—*Preserved material*—Dorsal ridge usually contains a series of more or less distinct spots in specimens less than 35 mm FL, becoming more confluent in fishes between 40 and 55 mm FL and sometimes merging into a dusky bar; in presmolt juveniles over 60 mm FL, spots or bars may disappear, after which a series of roundish spots become apparent on both sides of, and adjacent to, dorsal ridge, especially that portion behind dorsal fin; in addition to these spots, in fishes more than 35 mm FL, another longitudinal row of spots develops between dorsal ridge and upper halves of parr marks. *Living specimens*—Markings may be obscured by greenish or bluish overcast of dorsal half of body and whitish or silverish sheen of ventral half.

Fins—Anal and dorsal fins average larger in height and area than in chum and pink salmon. Length of longest anal ray, when measured from snout to eye, reaches usually from snout to beyond center of eye. Anal rays usually 14 to 16 (extremes 13 to 16). *Dorsal fin* normally has few or no distinct specklings in specimens less than 60 mm FL; a rather faint dorsal spot develops in larger presmolt juveniles in upper portion of fin, the fin being bordered on its free edges with whitish (see lowest figure, Plate 3). *Caudal fin* has few specklings on basal half, the lobes having few or no melanophores, even in rather large juveniles.

Gill rakers (see Fig. 4)—Twelve to sixteen on upper limb, 18 to 23 on lower, total usually ranging between 32 and 37 (extremes 30 to 39); rakers long and slender, averaging longer than in any other species, in sharp contrast to fewer, blunter rakers of chum salmon, which has 19 to 30.

Pyloric caeca—Usually 65 to 95 (extremes 45 to 115); usually considerably fewer than in pink, chum, and chinook salmon, and averaging more than in coho salmon.

Branchiostegal rays—Usually 13 to 15 (extremes 11 to 16); of value chiefly in separating this species from chinook salmon, which average more.

Scales in lateral line—Between 125 and 140; of value chiefly in separating this species from pink salmon, which has a higher number.

Habits—Life span usually 4 or 5 yr, some only 3. Jacks may occur. Majority of individuals highly migratory. Adults usually spawn in streams tributary to lakes; a small minority spawn in streams without a lake, in lake outlets, or on lake beaches. After rising from redd, young move downstream rather rapidly to a lake, remaining usually 1, sometimes 2, and rarely 3 yr in fresh water before entering brackish or salt water.

Combination of: Melanophores on adipose fin usually most numerous on posterior half and generally forming a dark border (see Plate 4); anterior half of adipose with few melanophores or none. Anal fin with few melanophores or none, but when
5a melanophores are present, often quite large. Tip of dorsal fin and lobes of caudal fin darker in larger presmolt juveniles.

CHINOOK (KING) SALMON—*O. tshawytscha*. . . . . Plate 4.

General development—Yolk sac usually disappears or is reduced to a trace before juveniles reach 32 mm FL. Body deeper and species more slab-sided in all presmolt lengths than in chum and pink salmon; body depth immediately before dorsal fin usually less than 1.5 times head length (range 1.1 to 1.5).

Parr marks—Almost invariably rectangular and long vertically; marks usually situated equidistant on each side of lateral line; dark parr marks and other markings contrast sharply with lighter background of body in some living and most preserved specimens.

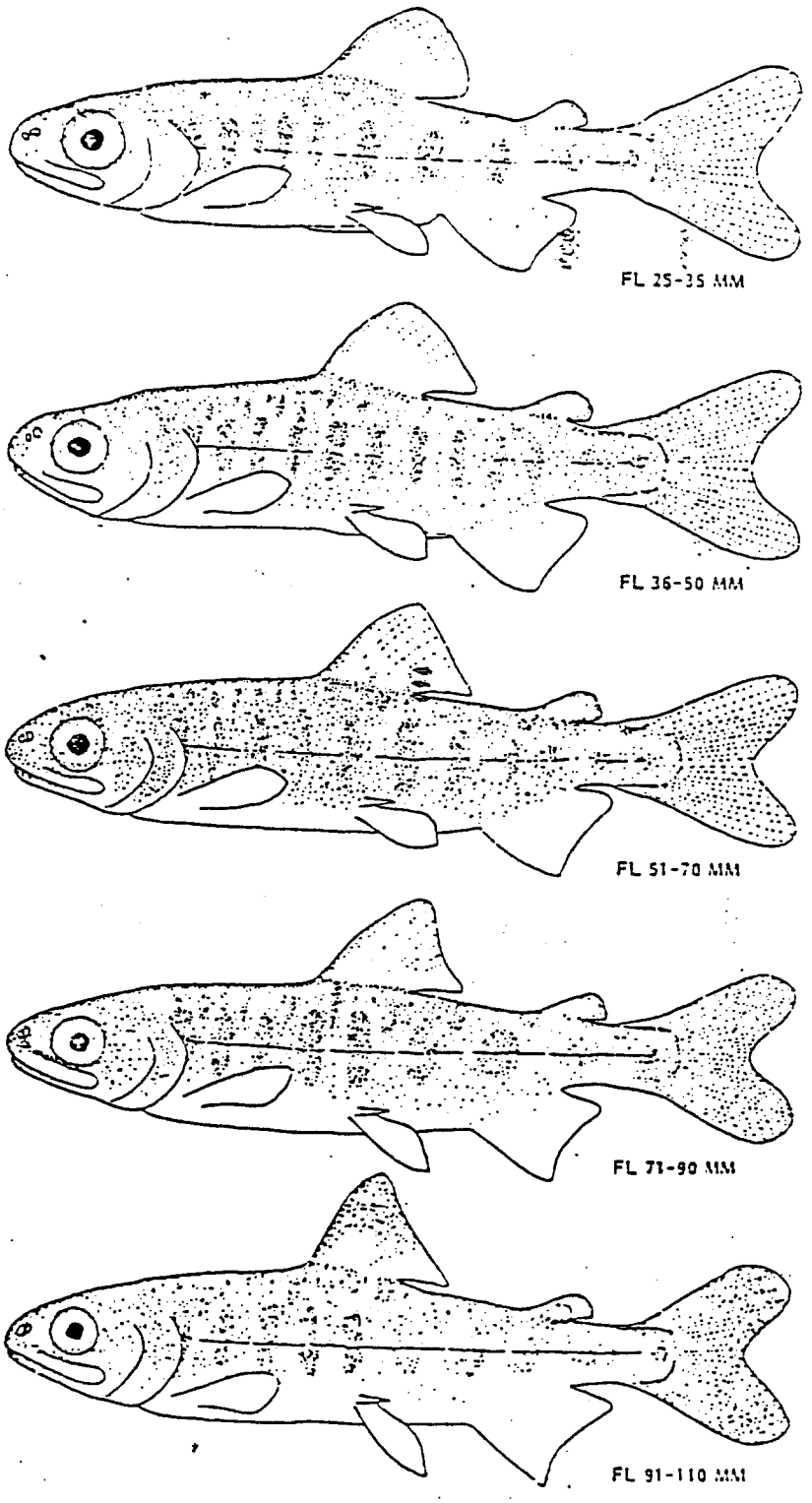


Plate 4.—Chinook salmon.

Coloration of body—*Preserved material*—Background color of body generally much lighter than body color of coho salmon, usually contrasting sharply with dark dorsal stripe or spotting, parr marks, and prominent dorsal spottings; blackish band astride dorsal ridge usually bold and unbroken in specimens less than 80 mm FL and especially on ridge before dorsal fin; in larger juveniles dorsal band often breaks up into series of spots, disappearing in larger presmolts as other spottings on dorsal half of body become more numerous and distinct; spottings between dorsal ridge and parr marks absent in fishes less than 35 mm FL, developing rapidly thereafter into many large and small spots and increasing in numbers as juveniles approach smolt stage. *Living specimens*—Parr marks and other markings may be obscured by bluish-silvery color of dorsal half of body and silvery sheen of ventral half.

Fins—Anal and dorsal fins averaging considerably larger in area than those of the chum and pink salmon and slightly larger than in the sockeye salmon; length of longest anal rays, when measured into head length, reaching from snout tip to beyond posterior edge of pupil and sometimes beyond posterior edge of eye; distal edge of anal slightly falcate in specimens more than 40 mm FL but averaging less falcate than does the free edge of the anal of the coho salmon. Anal rays 15 to 19, averaging higher in number than in any other species. *Dorsal fin* in young less than 60 mm FL usually has few or no distinct spottings, a blackish spot developing in the upper portion of the fin as the juveniles approach the smolt stage (see Plate 4). *Caudal fin* has comparatively few melanophores rather generally distributed in the smaller individuals, the lobes darkening as the fishes approach the presmolt stage.

Gill rakers (see Fig. 4)—Seven to twelve on upper limb, 10 to 16 on lower, total usually ranging between 20 and 25 (extremes 19 to 28); rakers short and similar in size and number to chum and coho salmon.

Pyloric caeca—Usually 140 to 185 (extremes 90 to 240); of value in separating this species from coho salmon, which normally has fewer than 85.

Branchiostegal rays—Usually 16 to 18 (extremes 13 to 19); average number greater than in any other species.

Scales in lateral line—Between 132 and 152; usually of most value in separating this species from pink salmon.

Habits—Life span 2 to 8 yr, usually 4 to 6. Jacks may occur. A portion of the juveniles enter salt water during first year of life; remainder stay in fresh waters more than 1 yr but rarely 2 yr. Juveniles of presmolt stage found in fresh waters when as long as 150 mm FL.

Combination of: Melanophores usually numerous and rather evenly distributed on adipose fin; occasionally in larger juveniles, posterior or free edge may be darker than remainder, thereby resembling somewhat melanophore distribution on adipose of chinook salmon. Anal fin in specimens larger than 30 mm FL more falcate and anterior tip more pronounced than in other species, including chinook salmon; in all except smallest specimens, anterior or leading edge of anal fin is whitish, with a dark bar parallel and posterior to it; remaining, posterior portion of fin usually abundantly speckled with melanophores except for distal and posterior edges (see Plate 5).

COHO (SILVER) SALMON—*O. kisutch*. . . . . F

General development—Yolk sac usually disappears, except for a trace, before juveniles reach 32 mm FL. Body deeper and species more slab-sided in all pre-

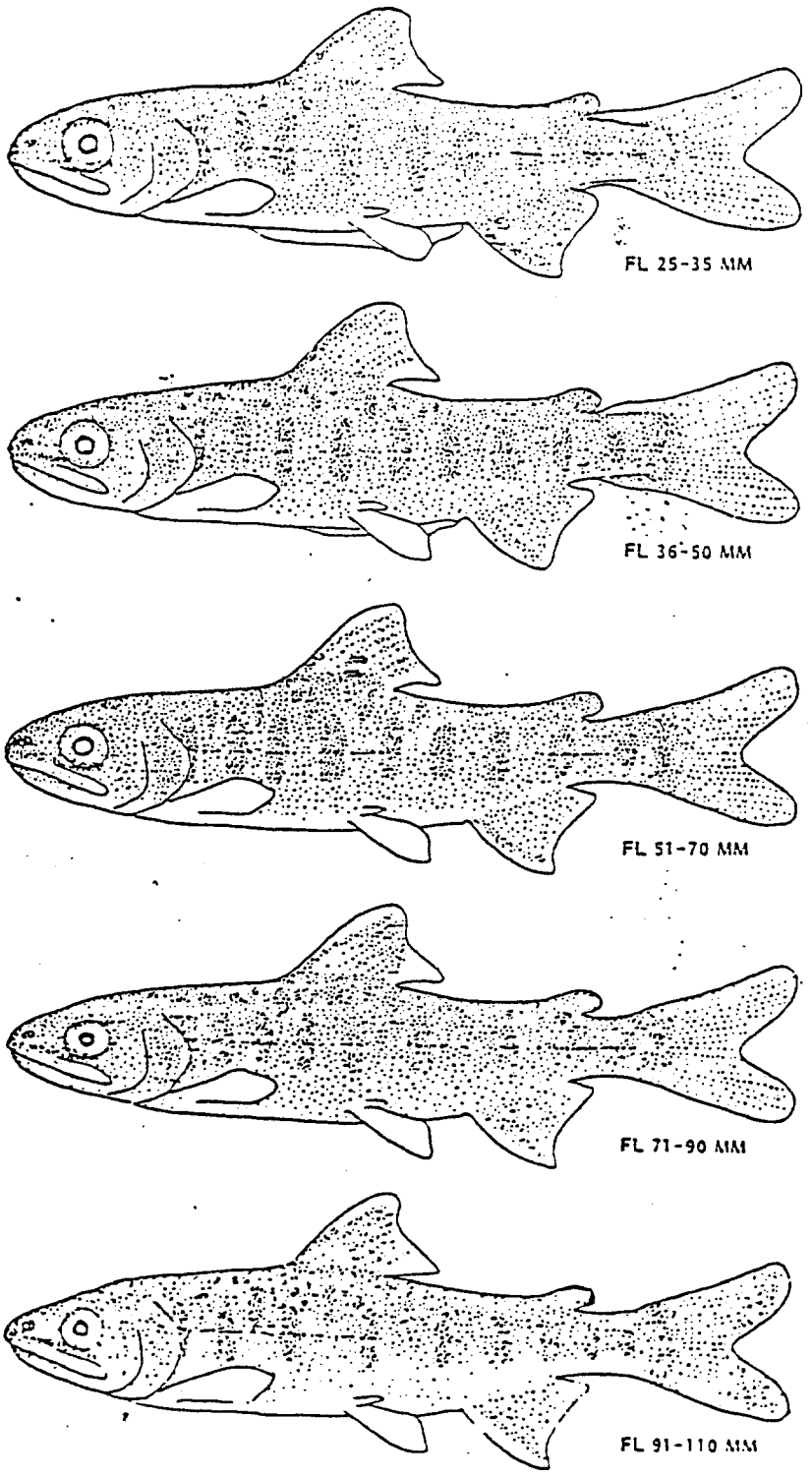


Plate 5.—Coho salmon.

smolt lengths than in chum and pink salmon: body depth immediately before dorsal fin usually less than 1.5 times head length (range 0.9 to 1.5).

Parr marks—Anterior parr marks always large and long vertically, their upper and lower ends more rounded than rectangular-shaped parr marks of chinook salmon: marks usually situated equidistant on each side of lateral line: usually less contrast between color of parr marks and body than in chinook salmon.

Coloration of body—*Preserved material*—In all but smallest specimens, contrast between all body marks and background color of body is not as pronounced as in other species: dark bar along dorsal ridge usually distinct and unbroken in juveniles less than 50 mm FL, breaking up into spots or disappearing in larger specimens; back spottings on both sides of dorsal ridge usually prominent in all except smallest specimens; spots between parr marks often elongate and extending downward between them, sometimes to lateral line (see bottom figure, Plate 5); spots on dorsal half of body often increase in number and/or decrease in size as individuals approach smolt stage. *Living specimens*—Parr marks and other body markings may be obscured by dark coloration of body or by bluish sheen.

Fins—Anal and adipose fins described under "*Combination of*" (this section). Anal rays usually 13 or 14 (extremes 13 to 16). *Dorsal fin* has comparatively few melanophores scattered over it in smallest specimens; in those more than 32 mm FL the number of melanophores increases, especially on or adjacent to anterior or leading edge; this results in a dark bar along the anterior edge behind which melanophores are rather evenly distributed; as fishes approach presmolt stage, a white anterior (or leading) edge and a whitish tip develops, followed by a dark parallel bar (see bottom figure, Plate 5). *Caudal fin* has rather even distribution of melanophores along rays in all except smallest young, this increasing in color intensity and number as fish increases in size.

Gill rakers (see Fig. 4)—Eight to thirteen on upper limb, 9 to 14 on lower, total number usually ranging between 19 and 27 (extremes 18 to 27); rakers short and rather similar in size and number to chum and chinook salmon.

Pyloric caeca—Usually 50 to 85 (extremes 45 to 114); of value in separating this species from chinook, pink, and chum salmon, which normally have more than 100.

Branchiostegal rays—Usually 13 or 14 (extremes 12 to 15); average number less than in chinook salmon, which normally has 15 or more.

Scales in lateral line—Between 120 and 140 (average 128); usually averaging fewer than in any other species.

Habits—Life span 2 to 4 yr. Jacks may occur. Majority appear to spend 1 or 2 yr in fresh waters, a few 3 yr. Some juveniles in presmolt stage are found in fresh waters when 150 mm FL.

GLOSSARY

Adipose fin A fleshy, finlike, rayless structure situated on dorsal ridge between dorsal and caudal fins (Fig. 1, No. 6).

Anal fin The fin situated medially and immediately behind vent between posterior end of abdomen and anterior end of caudal peduncle (Fig. 1, No. 16).

Axillary process or scale An accessory enlarged scale attached to upper or anterior base of pelvic fin (Fig. 1, No. 14).

Gill opening Opening between opercle or gill cover and side of head.

Branchiostegals or branchiostegal rays Elongated bones arranged fanwise within branchiostegal membranes, situated on ventral edge of gill covers (Fig. 6).

Caudal fin Terminal or tail fin of fishes (Fig. 1, No. 12).

Caudal peduncle That region of body between base of posterior ray of anal fin and base of caudal fin (Fig. 1, No. 11).

Chromatophores Color cells which under control of sympathetic nervous system can be altered in shape, producing color changes.

Cycloid scales Smooth-edged scales of soft-rayed fishes having an evenly curved posterior border devoid of minute spines.

Dorsal fin In salmons, a single fin composed of rays situated dorsally on body approximately halfway between head and tail (Fig. 1, No. 4).

Dorsal ridge Apex or dorsal junction of left and right sides of body; dorsal and adipose fins are situated on this ridge (Fig. 1, No. 3-6).

Dorsal stripe A band on dorsal ridge which is lighter or darker than adjacent areas.

Falcate Curved like a sickle; a fin is falcate when its distal edge is concave, having middle rays shorter than anterior and usually posterior rays.

Filaments See *gill filaments*.

Fork length Distance in a straight line from anteriormost part of tip of upper jaw or snout of juvenile salmons to apex of angle produced by two lobes of caudal fin (Fig. 1, No. 1).

Gill arch Branchial skeleton which contains gill rakers and gill filaments, or lamellae (Fig. 2).

Gill cover, opercle, or operculum Large, very flat, thin bones on each side of head which cover gills (see Fig. 3, which has the major portion of the gill cover removed).

Gill filaments (lamellae) Pleated folds of skin, richly supplied with blood vessels, attached to posterior edge of gill arch (Fig. 2, No. 5).

Gill rakers Projections on anterior edge of first gill arch (Fig. 2, No. 1).

Head length Distance in a straight line from anteriormost part of upper jaw or snout to posterior margin of opercle (Fig. 1, No. 2).

Hypural Complex of expanded and fused bones of last few vertebrae which support caudal fins in certain fishes.

Jack Precocious male salmon which spawn after spending a year or two less in the ocean than the majority of individuals; they are notably smaller than average size of spawning males of their species.

Juvenile As used here, a salmon between 25 and 110 mm FL which has not entered smolt stage.

Lamellae See *gill filaments*.

Lateral line A line formed by a series of sensory tubes and pores extending along sides from head to tail (Fig. 1, No. 10).

Lateral line scale count A count of pored scales from first scale on body behind head posteriorly to above hypural.

Melanophores Chromatophores with dark or black pigment.

Parr marks Squarish or oblong blotches or pigmented areas along sides of presmolt salmonids (Fig. 1, No. 9).

Pectoral fins Anterior or uppermost of paired fins of fishes, one on each side of breast immediately behind head (Fig. 1, No. 13).

Pelvic fins A ventral pair of fins, abdominal in salmonids (Fig. 1, No. 15).

Postdorsal ridge That portion of dorsal ridge behind dorsal fin (Fig. 1, No. 5).

Predorsal ridge That portion of dorsal ridge before dorsal fin (Fig. 1, No. 3).

Presmolt A juvenile salmon with parr marks; in pink salmon, which lack parr marks, demarcation between a presmolt and smolt is slight, differing chiefly in latter's more adult shape.

Pupil of eye Opening in iris of eye by which light reaches retina. It is circular in fishes (Fig. 1, No. 7).

Pyloric caeca Fingerlike diverticula, usually glandular, which open into alimentary canal

of most fishes at junction of stomach and intestine in region of pylorus (Fig. 7, No. 3).

Rakers See *gill rakers*.

Redd Excavation or nest made by a spawning salmon.

Rudimentary Very small and poorly formed, pertaining here chiefly to smallest gill rakers and anal rays (Fig. 5, "0").

Slab-sided When depth of body, measured before dorsal fin, is considerably greater than width of body.

Smolt As used here, a young salmon which has lost its parr marks. Pink and chum salmon fry usually go to the ocean within a few days of emerging from the streambed and usually do not undergo a visible change in morphology or color in fresh water.

Subadult An individual similar to an adult and approaching adulthood in age and size but still incapable of breeding.

Terete Nearly cylindrical in cross section and tapering toward the front and rear.

ACKNOWLEDGMENTS

Publications such as this are possible only because of aid given by many individuals. I wish to acknowledge the aid and encouragement given me by Robert J. Ellis, George Y. Harry, Jr., Wilbur L. Hartman, William R. Heard, David T. Hoopes, Theodore R. Merrell, Jr., Jay C. Quast, and William A. Smoker, and to the many field men, students, and others who have tested the key.

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Key to Field Identification of Anadromous Juvenile Salmonids in the Pacific Northwest

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ABSTRACT

A key is presented with descriptive illustrations to help in field identification of live, juvenile salmonids in fresh waters of the Pacific Northwest. Other juvenile fish that may be mistakenly identified as salmonids are included.

INTRODUCTION

Species identification of live, anadromous juvenile salmonids is frequently a problem to the field biologist. The purpose of this key is to list and illustrate the external characteristics which will expedite field identification of juvenile salmonids in the Pacific Northwest.

Five species of Pacific salmon (pink, chum, sockeye, chinook, and coho); four species of trout (cutthroat, brown, Dolly Varden, and rainbow or steelhead); and other juvenile and adult fish [1] that may be mistaken for salmon or trout in fresh water are described in this key.

USE OF KEY

The characteristics for identification are listed in a series of alternative statements, some of which are illustrated. To use the key, examine the first statement; if applicable, proceed to the next and continue to successive statements until the species is identified. If a statement is not applicable, pass to the alternative characteristics indicated by numbers in parentheses (numbers on the drawings correspond to numbers of statements in the key). Continue in this manner until the specimen is identified. Some external characteristics are positive separating features (marked with asterisk), whereas others are not. Therefore, two or more statements should be considered before final rejection. If a precise identification cannot be made using the external characteristics —and the fish can be sacrificed, a positive identification can usually be made from internal features (marked with double asterisks). A bibliography of keys that utilize more descriptive internal characteristics is included in this paper.

KEY

1. (47) Adipose fin and scales present. (Fig. 1)
2. (48) Fleshy appendage at base of pelvic fins present.
3. (49) Mouth large, reaching at least to center of eye.

Family Salmonidae

[1] Especially adult smelt, family Osmeridae.

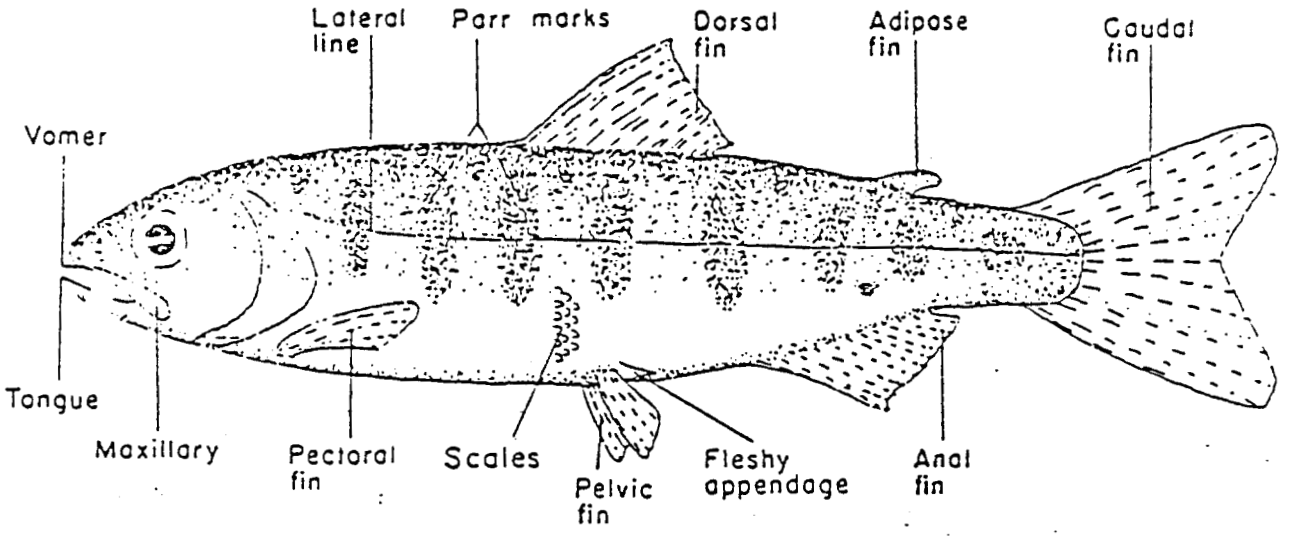


Figure 1.—A hypothetical salmonid showing external characteristics.

4. (17) Anal fin higher than long, with 8 to 12 developed rays (Fig. 2A)
5. (52) *Teeth on head and shaft of vomer. (Fig. 3A)

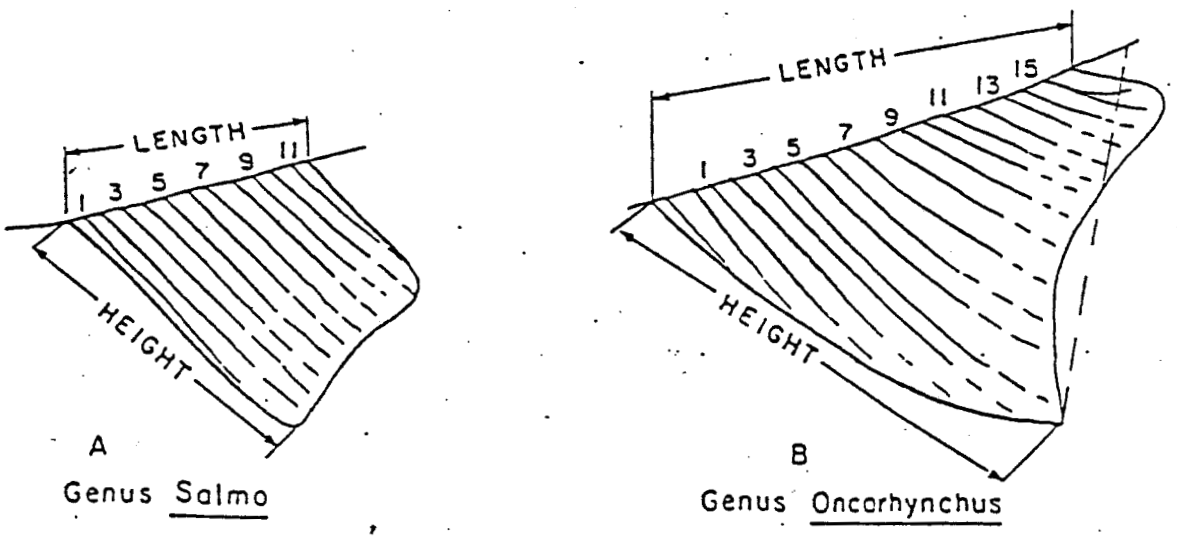


Figure 2.—Anal fins: (A) Trout, genus *Salmo;* (B) Pacific salmon, genus *Oncorhynchus.* The two drawings show differences in structure and fin ray count. (Note that the length of the anal fin is its overall basal length, and its height is that distance from the origin of the fin to the tip of the anterior lobe. In counting fin rays, include only those which originate from the base and terminate at the outer margin of the fin or are half as long as [or greater than] the longest ray.)

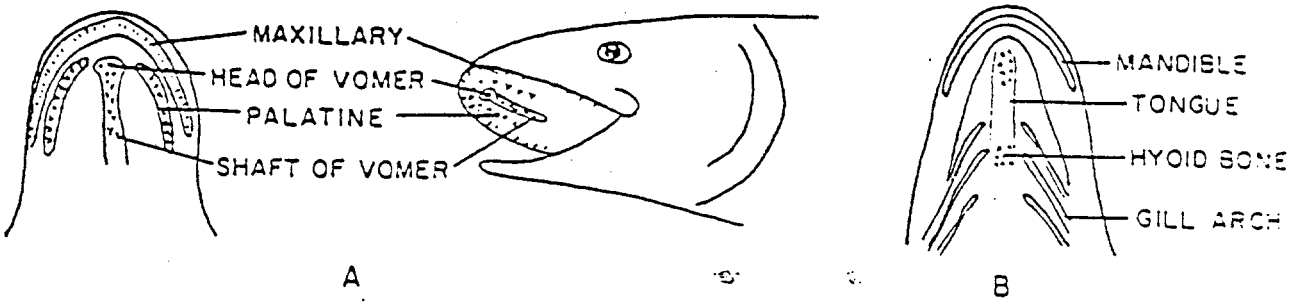
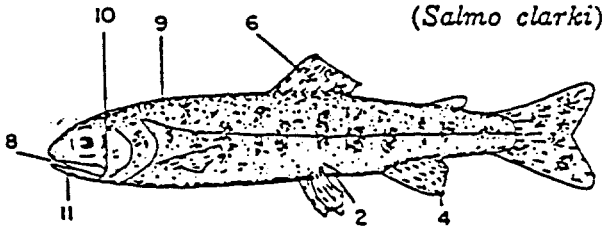


Figure 3.—Location of dentition in (A) the roof and (B) the floor of the mouth of salmonid fishes. (Presence or absence of teeth on the vomer or tongue may be determined by use of the little finger or a blunt instrument. The small hyoid teeth at the base of the tongue are located between the gill arches of the lower jaw and are difficult to find.)

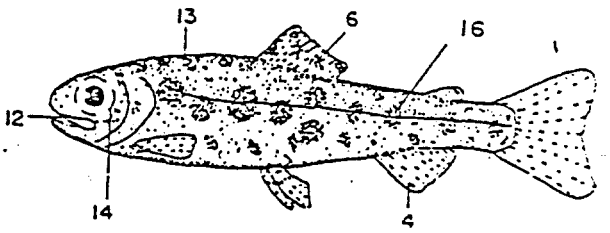
6. (18) Dorsal fin with large dark spots.
Trout
Genus *Salmo*

7. (53) Adipose fin not orange; no row of pale round spots along lateral line.
8. (12) *Small hyoid teeth at base of tongue. (Fig. 3B)
9. (13) Not more than five parr marks on mid-dorsal ahead of dorsal fin.
10. (14) Maxillary reaching past posterior margin of eye.
11. (15) Red or yellowish hyoid mark under lower jaw. Tail usually black spotted.
Cutthroat trout
(*Salmo clarki*)



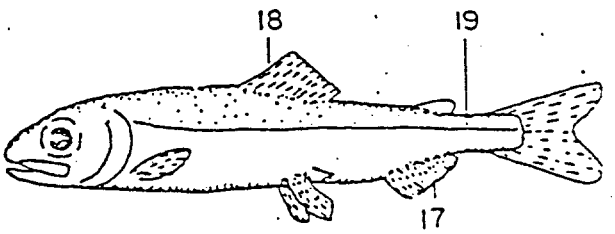
12. (8) *No teeth at base of tongue.
13. (9) Five to 10 parr marks along mid-dorsal ridge ahead of dorsal fin.
14. (10) Maxillary short, not reaching past posterior margin of eye.
15. (11) No hyoid mark under lower jaw. Few or no spots on tail.

16. (20) Parr marks almost round.
Rainbow or
steelhead trout
(*Salmo gairdneri*)



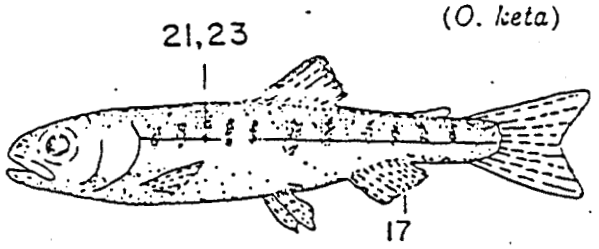
17. (4) Anal fin longer than high, with 13 or more developed rays. (Fig. 2B)
18. (6) Dorsal fin without large dark spots, may be black tipped.
Pacific salmon
Genus *Oncorhynchus*

19. (20) No parr marks. Fry leave fresh water while small—approximately 1.75 inches (45 mm) long.
Pink salmon
(*O. gorbuscha*)



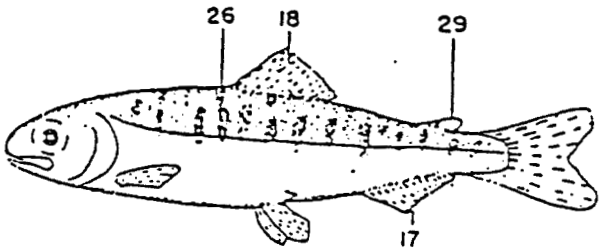
20. (16) Parr marks present as vertical bars or oval spots.
21. (30) Parr marks short, extending little, if any, below lateral line.
22. (25) Gill rakers on first arch, 19 to 26. ** Pyloric caeca, 140 to 186.
23. (26) Parr marks faint. Sides below lateral line iridescent green.
24. (27) Small when migrating from fresh water, approximately 1.5 inches (40 mm) long.

Chum salmon
(*O. keta*)



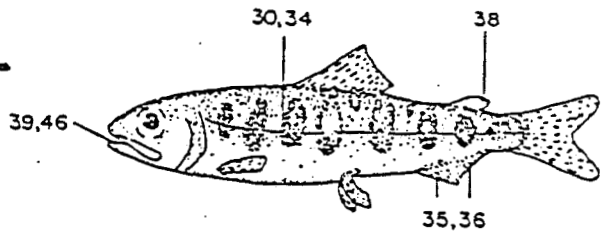
25. (22) Gill rakers on first arch, 30 to 40. **Pyloric caeca 60 to 115.
26. (23) Parr marks usually sharply defined. Sides below lateral line silvery, not iridescent green.
27. (24) Relatively large when migrating from fresh water, approximately 3 to 5 inches (80 to 126 mm) long.
28. (31) Gill rakers long and slender, more than 29 on first arch.
29. (32) Adipose fin clear, not pigmented.

Sockeye salmon
(*O. nerka*)



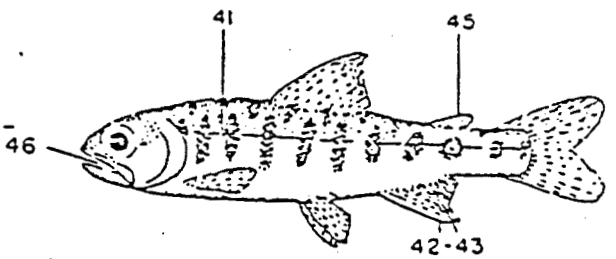
30. (21) Parr marks large, vertical bars centered by lateral line.
31. (28) **Gill rakers short and thick, fewer than 29 on first arch.
32. (29) Adipose fin at least partially pigmented.
33. (40) **Plyloric caeca more than 90.
34. (41) Parr marks broader than interspaces.
35. (42) Anterior rays of anal fin not distinctly longer than rest, not white edged.
36. (43) Anal fin not pigmented.
37. (44) Black spots, when present, on both lobes of caudal fin.
38. (45) Adipose fin not completely mottled, clear area at anterior base of fin.
39. (46) Black gums along base of lower teeth.

Chinook salmon
(*O. tshawytscha*)



40. (33) **Plyloric caeca less than 80.
41. (34) Parr marks narrower than interspaces.
42. (35) Anterior rays of anal fin elongated; when depressed they extend to base of last ray. (Fig. 2B)
43. (36) Anal fin pigmented between rays, resulting in black banding.
44. (37) Black spots, when present, on upper lobe of caudal.
45. (38) Adipose fin completely pigmented.
46. (36) Mouth gray to white.

Coho salmon
(*O. kisutch*)



47. (1) Adipose fin not present; scales present or lacking.

Not Salmonidae

48. (2) No fleshy appendage at base of pelvic fins.

Smelts
Family Osmeridae

49. (3) Mouth small, not reaching center of eye; teeth weak or absent.

50. (51) Depressed dorsal fin, shorter than head.

Whitefishes
Genus *Coregonus*

51. (50) Depressed dorsal fin, longer than head.

Arctic grayling
(*Thymallus arcticus*)

52. (5) **Teeth on head of vomer only.

Chars
Genus *Salvelinus*
Dolly Varden (*S. malma*)

53. (7) Adipose fin orange; row of distinct pale round spots along lateral line.

Brown trout
(*Salmo trutta*)

ACKNOWLEDGMENTS

We especially thank Dr. Arthur D. Welander, Professor of Fisheries, and Dr. Bruce S. Miller, Research Biologist, College of Fisheries, University of Washington, Seattle, for their valuable suggestions. We also thank Galen H. Maxfield, Fishery Biologist, and Dr. Alan J. Beardsley, Fishery Biologist, both from the NMFS Northwest Fisheries Center, Seattle.

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APPENDIX B

Fishpass Maintenance and Operation

Initial maintenance of the fishpass will be completed prior to 1 June to insure proper functioning of the facility.

Maintenance consists of:

1. Thorough inspection of the fishpasses for structural damage.
2. Installing modified I-beam supports on diversion weir above falls.
3. Cleaning of debris from fishpass tanks and runs.
4. Clean entrance tanks and add rocks to top.
5. Clearing rocks and streambed materials from exit tank, channel, stop-log base of water control weir, and entrance tanks.
6. Pad the inside of tank lids with astroturf to reduce fish mortality while insuring that it is securely fastened.
7. Replace damaged plywood fishpass covers.

Fishpass opening procedures:

1. Wood drain plugs inserted from inside tanks into drain holes. Plugs should fit tightly, so that internal tank water pressure holds plug in place. Install tank caps screwed on from outside.
2. Tank covers positioned and stop-logs removed slowly from exit tank. Bottom stop-log remains in place. Note that if stop-logs are removed rapidly gravel is deposited into tank.
3. Make sure no holes are present where fish could escape uncounted.

The fishpass will be operated so that steeppass is about 3/4 full of water. This volume is necessary to attract sockeye salmon to the entrance tank and promote optimum fish passage. A water level of 1.8-1.9 feet should be maintained on the staff gauge by removing or placing stop logs at the water control diversion (top of falls). At this level the old fishpass will be 3/4 full. Try to keep stop logs relatively even level across the weir to prevent excessive errosion in certain sections.

A vertical slot "door" is placed at the entrance tank during annual sockeye run. This door will be checked daily during fish passage to assure it is completely down. It can open when sockeye hit against it, so diligence is necessary. The opening space (23 cm) is needed to maintain velocity for fish attraction. The door can be opened to 1 foot (30 cm) at seasons end to further attract fish.

The fishpass will be checked daily for cover tightness and unobstructed water flow. Under no circumstances should obstructive materials be placed in the exit tank or steeppasses.

Avoid allowing detergents or chemicals from entering the fishpass water supply. Visitors and all other personnel will not be allowed on the fishpass nor interfere with salmon passage.

Fishpass closing procedures (approximately 25 August):

1. Remove stop-logs and I-beam supports from water control weir. Stack logs on stream bank and store I-beams (well greased) in tractor shed. Replace stop-logs in exit tank and visqueen as necessary to stop water flow between logs.

2. Remove all drain caps by lightly tapping them from outside tanks, store plugs in tractor shed. All water should be drained from tanks. All residual materials within tanks should be removed.

3. Remove vertical slot door and replace it with a solid door to prevent unwanted animals entering.

4. Inspect fishpass and facility for needed repairs and list needed materials in the daily log/annual report. Also include fuel caches and propane so that we know what is left behind.

5. When lower weir is removed, panels will be stored on the lower stream banks. Bolts on the weir should be tightened and replaced if necessary. Catwalk and stringer materials should be inspected and replaced if required. Add lumber needs to materials list.

APPENDIX C

Procedure for Sampling Adult Salmon for age, length, and sex

Annually, salmon escapements and catches are sampled for age (scales), length, and sex (ALS) by field crews throughout the state. This database is essential for sound management of the State's salmon resources.

To be useful, data must be recorded on the mark-sense (AWL) forms neatly and accurately. Scale samples must be collected and mounted properly to ensure accurate age determination. The following procedures are to be adhered to when sampling for age, length, and sex.

COMPLETING THE AWL FORMS:

A completed AWL form and accompanying gum card for sampling sockeye and chum salmon are shown in Appendix C.1.

Complete each section of the left side of the AWL form using a No. 2 pencil and darken the corresponding blocks as shown in the figures. Make every effort to darken the entire block as partially filled blocks are often missed by the optical scanner which reads and records the data from the AWL forms. Label only one form at a time to avoid a "carbon paper effect" resulting in stray marks.

Description:
Record the following: species/area/catch or escapement/gear type (seine, weir, etc.)/samplers

Card:
The AWL forms and corresponding gummed card(s) are numbered sequentially by date throughout the season starting with 001. A separate numbering sequence will be used for each species, district, and geographic location. Consult your port supervisor for the current card number. Sockeye scale samples will have only 1 gum card per AWL form as shown in Appendix C.1.

Species:
Refer to the reverse side of the AWL form for the correct digit.

Day, Month, Year:
Use appropriate digits for the date the fish are caught.

District:
List only one district. Consult area statistical map or project leader for appropriate district.

Subdistrict (Section):
List a single subdistrict if it is known and if all the potential samples were caught in that section. If more than one section is involved, list each section but do not darken the corresponding blocks. Leave blank if the section is unknown.

Stream:
Leave blank for catch sampling; escapement sampling consult area statistical map for appropriate stream number.

Location:
List the appropriate code as shown on Appendix C.3. Frazer Lake is 038.

Period:
List the period in which the fish were caught (Appendix C.4.).

Project and Gear:
Refer to the reverse side of the AWL form for the correct code.

Mesh:
Leave blank unless specifically instructed by supervisor to do otherwise.

Type of length measurement:
Use (2) mid-eye to fork-of-tail. Refer to Appendix C.5.

# of cards:
Mark 1 (each AWL form in individually numbered) when sampling sockeye, chum, coho, and chinook salmon.

Keep the litho codes in numerical order throughout the season and keep the AWL forms flat, dry, and clean. Fish gurry and water curling will cause data to be misinterpreted by the optical scanning machine. It is the crew leaders responsibility to make sure that all forms are carefully edited before returning them to your supervisor.

GUMMED CARDS:

Fill out the gum cards as shown in Appendices C.1 and C.2.

Species:
Write out completely (i.e., chinook, sockeye, etc.).

Locality:
For catch and escapement sampling, write down the area in which fish were caught, followed by catch or escapement (e.g. Karluk River escapement; Uganik Bay catch).

Stat. code and Sampling date:
Transfer the appropriate digits from the AWL form.

Gear:
Write out completely.

Collector(s):
Record the last names of person(s) sampling.

Remarks:

Record any pertinent information such as number of scales per fish sampled, vessel/tender name, etc. Transfer this same information to the top margin of the AWL.

SAMPLING PROCEDURE:

A. GENERAL

1. Place the fish on its right side to sample the left side.

2. Determine sex of the fish and darken M or F in the sex columns. If any difficulty is encountered with this procedure, write "I had trouble sexing these fish" on the top margin of the AWL and ask your supervisor for help as soon as possible before sexing additional fish.

3. Measure fish length in millimeters from the mid-eye to fork-of-tail (Appendix C.5.) Record length by blackening the appropriate column blocks on the AWL form. Column 3 on the AWL form is used for fish with a length greater than 999 millimeters (Chinook). Measure all species of salmon to the nearest mm. Check the calipers periodically to ensure measurement accuracy.

4. Remove the "preferred scale" from the fish by grasping its exposed posterior edge with forceps and pulling free. Remove all slime, grit, and skin from the scale. The "preferred scale" is located on the left side of the fish, two rows above the lateral line on the diagonal from the posterior insertion of the dorsal fin to the anterior insertion of the anal fin (Appendix C.6.). If the "preferred scale" is missing, select a scale within the preferred area on either the left or right side of the fish. If no scales are present in the "preferred area" on either side of the fish, sample a scale as close to the preferred area as possible and darken the 8 under "age error code" on the AWL form. Do not select a scale located on the lateral line.

5. It is important to take care that scales adhere to the card, rough side up. Therefore, without turning the forceps over, clean, moisten, and mount the scale on the gummed card with your thumb or forefinger. Exert just enough pressure to spread and smooth the scales directly over the number as shown in Appendix C.6. The ridges on the sculptured side can be felt with a fingernail or forceps. Mount scale with anterior end oriented toward top of gum card. All scales should be correctly oriented on the card in the same direction (Appendix C.7).

6. When sampling sockeye repeat steps 1 through 4 for up to 40 fish on each AWL form.

7. When sampling at weirs you may use write in rain books to record the data. Keep the mark-sense forms in camp where they will be clean, dry, and flat. After sampling is done for the day transfer the data to the mark-sense forms. **It is the responsibility of the crew leader to be sure the data has been transcribed correctly and the AWL forms filled out completely. It also important to: (a) double check all AWL data forms with a second**

and possbily third read-through so that any mistakes in transcription are corrected; and (b) IT IS THE CREW LEADERS RESPONSIBILTY TO MAKE SURE THAT ALL DATA IS VIRTUALLY ERROR FREE OTHERWISE YOUR TIME WILL BE SPENT DATA EDITING AT SEASONS END!!!

SCALE SAMPLING CHECKLIST

OPERATIONAL PLAN	PENCILS (NO. 2)
GUM CARDS	FORCEPS
AWL FORMS	PLASTIC CARD HOLDERS
CALIPERS	CLIPBOARD

SOME REMINDERS

1. For greater efficiency in scale reading and digitizing, mount scales with anterior end toward top of scale card.

2. AWLs should be carefully edited. Re-check header information on AWLs; make sure all available information is filled in. Take extra care to use the correct period code for the sampling or catch date. AWL numbers should not be repeated; a frequent error is to begin a week's sample with the last AWL number used the week before. This is particularly important if the data is regularly sent to town; it is easy to forget which AWL numbers were used. Crew leaders should take time to ensure that the boxes are being blackened correctly, if the boxes are sloppily marked the optical scanner records the information incorrectly or misses it entirely. Keep pencil marks within each block, filling it completely.

3. Transfer important comments from scale cards to AWLs. After pressing scales, the cards are seldom referred to again, and important remarks can be lost. Write comments in the top right margin. If there is not room on the AWL to completely explain the remarks, use a separate piece of paper.

4. Never put data from different dates on one AWL or one scale card. Even if only one scale is collected that day, begin a new AWL and gum card the next day.

5. If weights are taken, they may be noted in the right margin of the AWL during sampling, but be sure to transfer the weights and litho code to the appropriate columns on the reverse of the AWL before submitting it to your supervisor.

6. The data processing program uses the "litho code" on the AWL. (It is located in the lower left margin of the AWL.) Try to keep the litho codes in numerical order. This should not be hard to do if they are arranged that way before page numbering. Those who sample

different areas throughout the season can arrange the litho codes in order before each sample is taken.

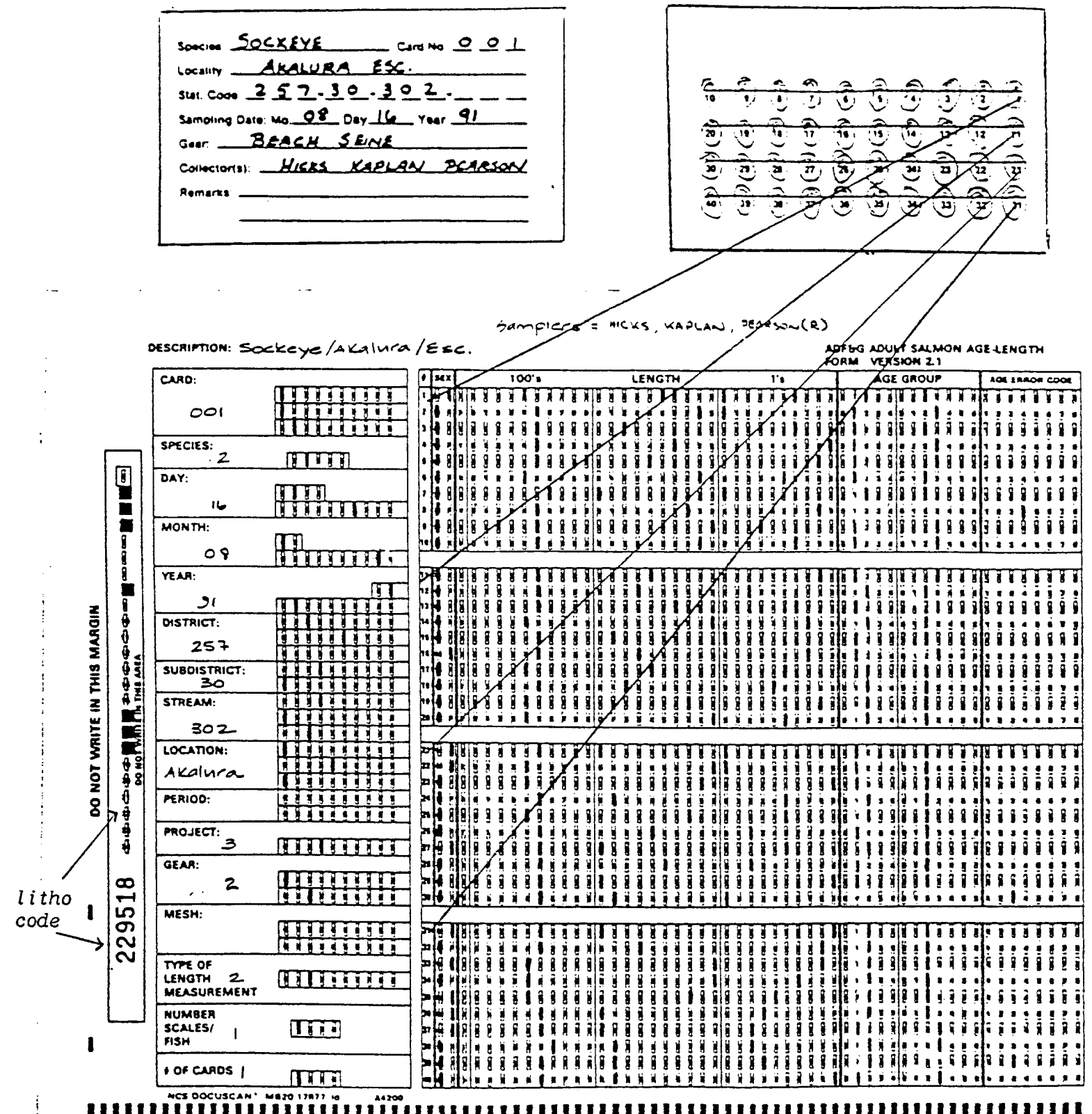
7. If AWLs get wrinkled or splotched they should be transcribed onto a new AWL prior to sending in. The optical scanning computer will misread or reject wrinkled sheets. Do not use paperclips on AWL forms.

8. Be careful when collecting and mounting scales in wet conditions (rain, high humidity, etc.) Glue often obscures scale features and scales frequently adhere poorly to wet card. Protect the cards, keep them dry to avoid having to remount the scales on a new card.

9. Scan the AWL form for mistakes. A common error occurs, for instance, in placing both the 4 and 7 of a 475mm fish in the 100's column with nothing in the 10's column.

10. Record all comments explicitly on the gum card under remarks and transfer remarks to the top margin of the AWL form.

11. Responsibility for accuracy lies first with the primary data collector(s). The port supervisor will return sloppy or incomplete data to individual collectors for correction.



SPECIES

1 – Chinook (king)
2 – Sockeye (red)
3 – Coho (silver)
4 – Pink (humpy)
5 – Chum (dog)

PROJECT

1 – Commercial catch
2 – Subsistence catch
3 – Escapement (tower, weir, sonar site, etc)
4 – Escapement - spawning grounds
5 – Test fishing
6 – Sport catch (marine)
7 – Sport catch (freshwater)

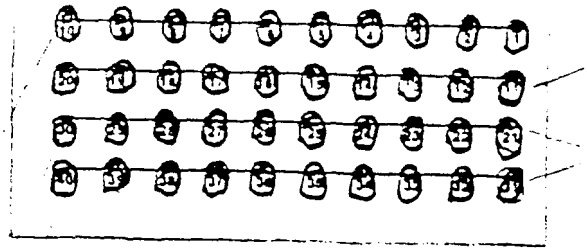
GEAR TYPE

0 – Trap
1 – Purse seine
2 – Beach seine
3 – Drift gillnet
4 – Set gillnet
5 – Troll
6 – Long line
7 – Otter trawl
8 – Fishwheel
9 – Pots
10 – Sport hook and line
11 – Herring purse seine
12 – Handpicked
13 – Dip net
14 – 16 Unassigned
17 – Beam trawl
18 – Shovels
19 – Weir
20 – 99 Unassigned

Appendix C.1 AWL and scale card for sampling 1 scale per fish

Species COHO Card No 001A
Locality KARLUK ESC
Stat Code 255-10-101-___
Sampling Date Mo 08 Day 29 Year 91
Gear WEIR / TRAP
Collector(s): T. STACK, S. BROWN, J. FOX
Remarks 2 SCALES / FISH

card: 001A



DESCRIPTION: COHO / KARLUK / ESC
2 SCALES / FISH

SAMPLERS:
T. STACK - W
S. BROWN - P
J. FOX - R

ADF&G ADULT SALMON AGE LENGTH FORM VERSION 2.1

CARD: 001A+B
SPECIES: COHO
DAY: 29
MONTH: 08
YEAR: 91
DISTRICT: 255
SUBDISTRICT: 10
STREAM: 101
LOCATION: 35
PERIOD: —
PROJECT: ESC
GEAR: WEIR/TRAP
MESH: —
TYPE OF LENGTH MEASUREMENT: 2
NUMBER SCALES/ FISH: 2
OF CARDS: 1

SEX | 100's LENGTH 1's | AGE GROUP | AGE ERROR CODE

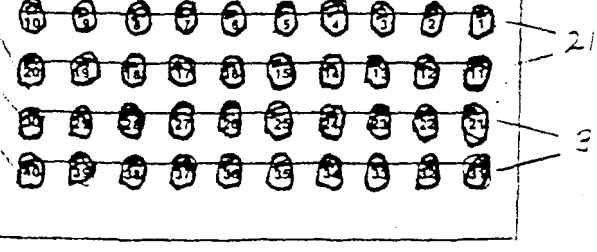
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS AREA
216854

litho code

NCS DOCUSCAN MB30-17877 1/89 A5200

Species: COHO Card No 001B
Locality: KARLUK ESC
Stat. Code: 255-10-101-___
Sampling Date: Mo. 08 Day 29 Year 91
Gear: WEIR / TRAP
Collector(s): T. STACK, S. BROWN, J. FOX
Remarks: 2 SCALES / FISH

card: 001B



Appendix C.2. AWL and scale cards for sampling 2 scales per fish.

Appendix C.3. Assigned port and weir location codes.

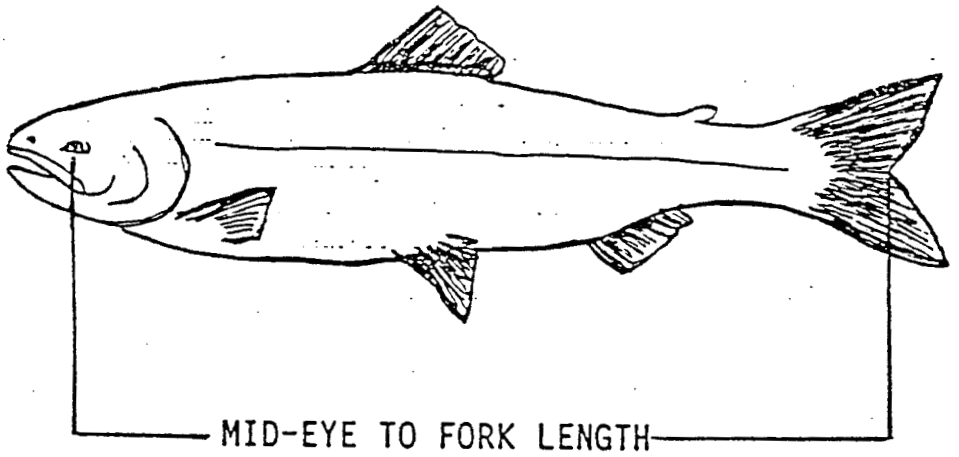
Port and Location Codes

030 - Lazy Bay
031 - Port of Kodiak
032 - Pauls Lake
033 - Thorshiem
034 - Afognak River
035 - Karluk River
036 - Red River
037 - Upper Station
038 - Frazer Lake
039 - Dog Salmon
040 - Akalura River
041 - Uganik River
042 - Malina Creek
150 - King Cove
151 - Port Moller
052 - Dutch Harbor
053 - Akutan
054 - Sand Point
055 - Bear River, ADF&G Camp
056 - Nelson River, ADF&G Camp
057 - Canoe Bay

Appendix C.4. Periods and corresponding calendar dates.

Period	Calendar Dates	Period	Calendar Dates
1	01-Jan to 03-Jan	28	05-Jul to 11-Jul
2	04-Jan to 10-Jan	29	12-Jul to 18-Jul
3	11-Jan to 17-Jan	30	19-Jul to 25-Jul
4	18-Jan to 24-Jan	31	26-Jul to 01-Aug
5	25-Jan to 31-Jan	32	02-Aug to 08-Aug
6	01-Feb to 07-Feb	33	09-Aug to 15-Aug
7	08-Feb to 14-Feb	34	16-Aug to 22-Aug
8	15-Feb to 21-Feb	35	23-Aug to 29-Sep
9	22-Feb to 28-Feb	36	30-Aug to 05-Sep
10	01-Mar to 07-Mar	37	06-Sep to 12-Sep
11	08-Mar to 14-Mar	38	13-Sep to 19-Sep
12	15-Mar to 21-Mar	39	20-Sep to 26-Sep
13	22-Mar to 28-Mar	40	27-Sep to 03-Oct
14	29-Mar to 04-Apr	41	04-Oct to 10-Oct
15	05-Apr to 11-Apr	42	11-Oct to 17-Oct
16	12-Apr to 18-Apr	43	18-Oct to 24-Oct
17	19-Apr to 25-Apr	44	25-Oct to 31-Oct
18	26-Apr to 02-May	45	01-Nov to 07-Nov
19	03-May to 09-May	46	08-Nov to 14-Nov
20	10-May to 16-May	47	15-Nov to 21-Nov
21	17-May to 23-May	48	22-Nov to 28-Nov
22	24-May to 30-May	49	29-Nov to 05-Dec
23	31-May to 06-Jun	50	06-Dec to 12-Dec
24	07-Jun to 13-Jun	51	13-Dec to 19-Dec
25	14-Jun to 20-Jun	52	20-Dec to 26-Dec
26	21-Jun to 27-Jun	53	27-Dec to 31-Dec
27	28-Jun to 04-Jul		

Appendix C.5 Measuring fish length, mid-eye to fork of tail.



Mid-eye to fork lengths are taken because the length and shape of a salmon's snout changes as it approaches sexual maturity. The procedure for measuring by this method follows:

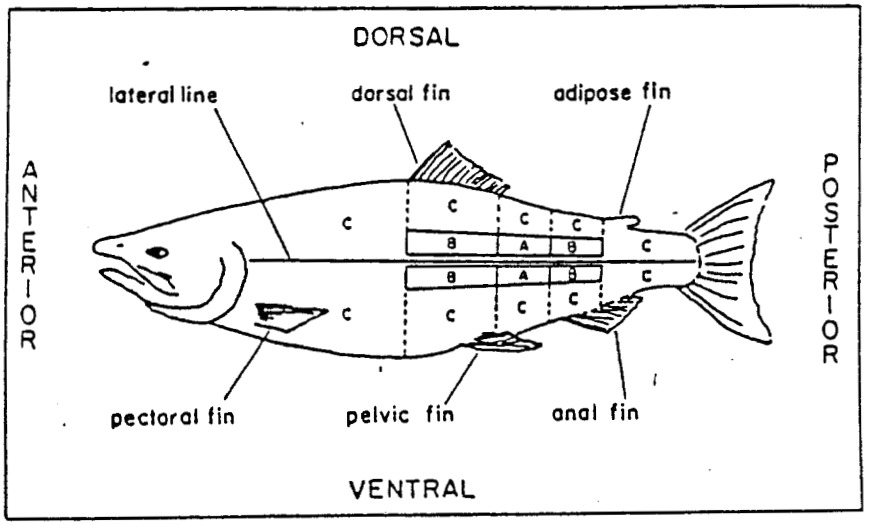
1) Place the salmon flat on its right side, with its head to your left and the dorsal fin away from you.

2) The eye should be on the line projecting from the end of the meter stick. Hold the head in place with your right hand. Sometimes you can control the fish better by placing your thumb in the fish's mouth.

3) Flatten and spread the tail against the board with your right hand.

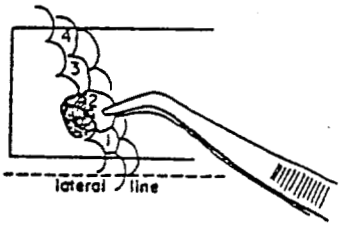
4) Read the mid-eye to fork length to the nearest millimeter.

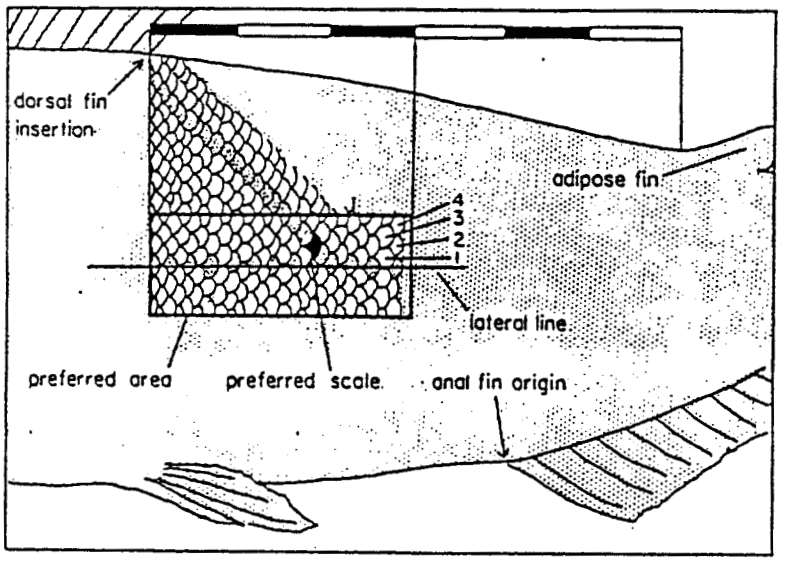
Appendix C.6. Removal and mounting of the preferred scale.



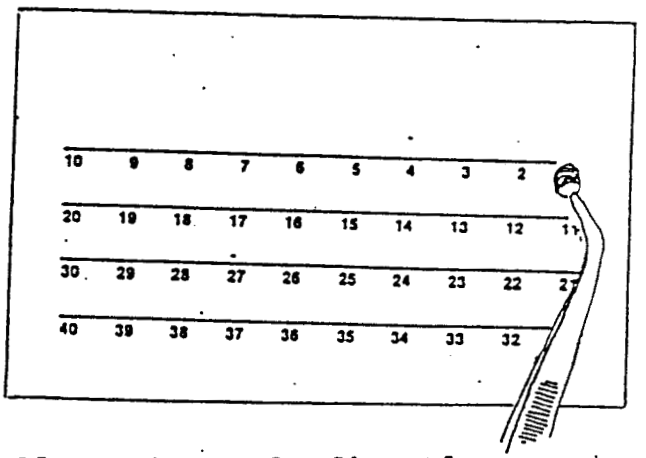
INPFC rated areas for scale removal. Area A is the preferred area. B is the second choice if there are no scales in area A. C designates non preferred areas. If scales on on the left side of the fish are not good, try the right side.

DO NOT TURN SCALE OVER



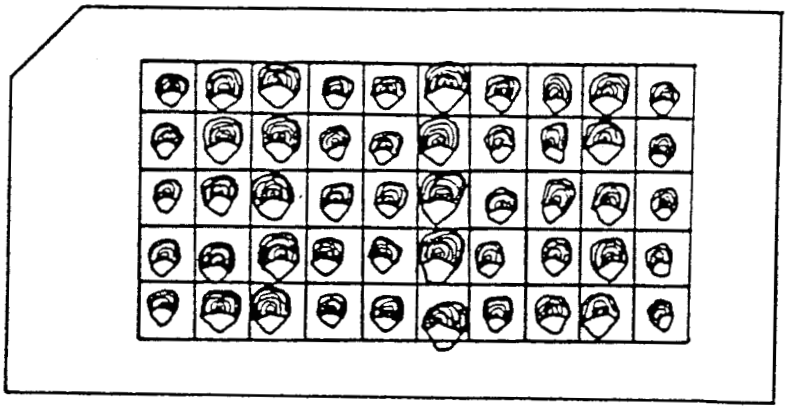


The preferred scale in this diagram is solid black. It is located 2 rows up from the lateral line, on a diagonal from the insertion (posterior) of the dorsal fin "back" towards the origin of the anal fin.

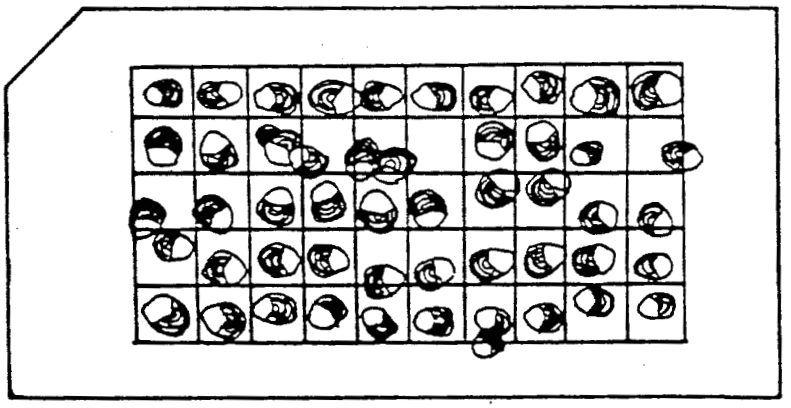


Place the scale directly over the number on the gummed card with the anterior portion (arches of the scale pointed toward the top of the card.

Appendix C.7. Scale orientation on the gummed card.



The scales are all correctly oriented on the card in the same direction, with the anterior portion of the scale pointed toward the top of the card.



The scales are incorrectly oriented in different directions. This increases the time spent to age samples.

DIVIDER

OPERATIONAL PLAN
RED, AKALURA, AND FRAZER LAKES
SOCKEYE SMOLT STUDIES, 1995

Alaska Department of Fish and Game
Commercial Fisheries Management and Development Division
211 Mission Road
Kodiak, Alaska 99615

April 1995

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INTRODUCTION

In 1989 the commercial sockeye salmon *Oncorhynchus nerka* fisheries were curtailed in most of the Kodiak Management Area due to oil contamination from the 24 March 1989 EXXON VALDEZ spill. As a consequence several sockeye systems had excessive escapements. For example, the Red Lake system where the escapement objective is 200,000 to 300,000 fish had a 770,000 escapement. There is concern that the large escapements may damage future returns by a combination of factors in the freshwater environment including disease, fry starvation, and shifts in the plankton community caused by excessive predation. The project covered here addresses sockeye smolt production.

Goal

The goal is to determine whether smolt production has been impacted due to surplus sockeye escapements in 1989 at Red and Akalura Lakes using Frazer Lake as a control. Specific objectives and tasks are:

Objectives

1. Estimate the total number of outmigrant smolt by age class;

2. Estimate smolt age composition and average smolt length, weight, and condition factor by age class;

3. Estimate the timing of the smolt outmigration by age class.

4. Estimate seasonal use of Red Lake nearshore areas by young-of-year sockeye salmon fry.

Tasks

1. Operate Canadian fan trap(s) continuously through the smolt migration;

2. Enumerate the daily catch by species;

3. Sample 70 sockeye smolt per day, five days each week, for age, length, and weight through the migration;

4. One day each week, mark and release 500 sockeye smolt at Red and Akalura Lakes and 1,000 smolt at Frazer Lake using Bismark Brown Y dye approximately 0.5 miles upstream of the index trap(s) to determine trap efficiency;

5. At Red Lake, using a 50 ft seine, weekly sample four selected lake shoal areas to index sockeye salmon fry abundance and growth.

SUPERVISION

The field staff and crew leaders are:

Red Lake	Jim Brighenti	- Crew Leader
	Dylan Avery	- Crew
Akalura	David "Rusty" Hippchen	- Crew Leader
Frazer	Don Pitcher	- Crew Leader
	Suzanne Peschier	- Crew
	Chris Hicks	- Crew (May)

The crew leaders are responsible for making daily work assignments and ensuring that operations are conducted safely and according to the standards defined in this manual. It is also the crew leaders responsibility for making sure that all crew members have read and understand the Department's field safety policy and have signed the EMPLOYEE SAFETY SOP VERIFICATION. Swanton and Nelson will administratively oversee the program which will include ensuring that adequate logistic, equipment, and technical support are provided.

PROCEDURES

Trap Location, Set-up, and Maintenance

At Red and Akalura Lakes, traps will be fished in the outlet creek at least one mile below each lake. All traps are to be operating by 5 May 1994. At Frazer Lake a single incline plane trap will be located about 100m upstream of the fishpass diversion weir. Generally each trap will be situated at the tail of a riffle where velocity (>1 ft/sec) and depth (>1 ft.) are sufficient for enough flow through the trap to minimize fish avoidance problems. Depending on the flow conditions and size of the trap aperture, perforated smolt panels may be used for leads to enhance trap efficiency. After the initial set-up and evaluation, if a trap is repositioned or lead material

is added or deleted, the action should be well documented in the comment section of the Daily Catch Reporting Form (Figure 1). In addition, trap catch efficiency will be determined as soon after modifications are made as possible.

Each trap will be checked as often as necessary to maintain trap efficiency and minimize any fish mortalities. Minimally, the traps should be checked every 30 minutes between sunset and sunrise. During daylight hours a check once every four hours is usually adequate. The last trap check will be at the conclusion of the smolt day (1200 hrs). Although smolt generally outmigrate in the evening hours, there is evidence of large smolt movements occurring in hours of mid afternoon coinciding with major weather changes including rain storms. It is essential that each crew keep a close vigilance on the assigned smolt trap. Unfortunately there are numerous instances where crew vigilance has been less than desirable and thousands of smolt have been overcrowded and killed solely due to crew inattentiveness.

Species Identification and Quantification of Trap Catch

There are two methods for determining the number of fish caught in a trap by species. The simplest and most common procedure is to individually count the fish by species while emptying the live box with a dip net. This number will be recorded on the Daily Smolt Catch Reporting Form (Figure 1.). The second method involves a catch-weight sampling procedure where the catch is transferred by dip net into a small mesh netted basket suspended over the creek from a hanging scale. This station should be set up immediately after trap placement. The aggregate weight of the catch is then recorded and the process is continued until the live box is emptied (Figure 2.). During the catch-weight sampling process, samples are taken to determine species count by weight. This involves counting the number of fish by species from a known aggregate weight obtained using a hanging scale. Generally the rule will be to sample every tenth dip net of fish for a species count by weight. The second method should only be used when there are relatively large numbers of smolt being caught, and there is not enough time to count all the fish without incurring mortalities. It should be noted in the comments section of the daily smolt reporting form when the catch weight method is used. The last daily smolt count will occur at 1200 hrs completing the daily smolt enumeration. The daily total will be recorded on the Sockeye Salmon Smolt Summary Form (Figure 3).

All catch will be identified and counted by species. Species identification keys are provided in Appendix A. It will be the responsibility of the crew leaders to insure that the crews use the keys to properly identify the catch.

Trap Efficiency

Once a week (or more frequently if necessary), trap efficiency will be estimated by marking sockeye smolt, releasing these smolt, and counting the number of recaptured smolt. Marking is accomplished by the use of Bismark Brown Y dye. The dyeing process can be stressful on sockeye smolt which is important to keep in mind at all times during the procedure. Minimizing unnecessary stress is the key in the dyeing process. Excessive handling (netting), elevated water temperature, and exposure to the dye itself, are the primary stress factors. Timing of the process should be late afternoon/early evening (1900-2100 hrs). All of these can induce mortality alone, so if one or more of these are combined, significant mortality may occur. Again if modifications are made to the trap which might affect trap efficiency, conduct a test as soon as possible. The following steps should be followed to minimize mortality and assure valid results:

1. **Collect 500 to 525 sockeye smolt.** The goal is to be consistent in the weekly timing and number for mark and release trials. Do not hold smolt for more than three nights when trying to collect the 500 for marking. Mark what you have collected after three days. A minimum of 250 smolt should be used if an extended collection time is required. Record the time, water temperature, and number of smolt collected on the Smolt Dye Release Form (Figure 4.). Note that at Frazer the dye release number is 1,000 smolt.

2. **Set up dyeing station at release site.** The release site will be no less than 0.5 miles upstream of smolt trap in an area of relatively calm water. A holding box will be placed in the stream, preferably in a "pool" area, for initial release of marked smolt. Assemble other marking equipment: 30 gallon garbage can or tote, Bismark Brown Y dye, supplemental oxygen (02 bottle, regulator, tubing, air stone), aerators, thermometer, log book.

3. **Move smolt to release site.** Use 3 or more buckets to hold the smolt. An aerator will be used to aerate the water in each bucket. Split the 500 smolt between at least three buckets. It is important to be efficient when moving the smolt to the release site. Record the water temperature prior to transport to the release site.

4. **Dye and release smolt.** Upon reaching the release site, hold the smolt in a live box or tote anchored in the stream for a minimum of 30 minutes. Record the water temperature at the start of the recovery period and any mortality at the end of the recovery period. If the stream temperature is > 8 C or there are obvious signs of stress, oxygenate the water using the portable aerators and/or oxygen bottle. For dying the smolt, use 1 gram of BBY dye per 30 liters (8 gallons) of water. Mix water (15 gallons) and dye (1.9g) in a 30 gallon container. Use an aerator and supplemental oxygen to maintain oxygen level. Record the water temperature in the dye container. Using a dipnet, place the smolt into the dye/water mixture for 30 minutes. Keep the dye container (with the lid on) in the stream to maintain ambient water temperature. Record any mortality that occurs. After the smolt are dyed,

place them into the instream holding box until release which should occur between 2200 and 2300 hrs. At the time of release, transfer only the robust smolt to water filled buckets and release them evenly across the stream. Record the number of healthy smolt released, time of release, water temperatures and other data on the Smolt Dye Release Form (Figure 4). All sick and dead smolt will be disposed of in a manner which will not attract animals or influence trap catches.

5. **Examine for marked smolt.** For three smolt days (which includes 3 nights) following the release of dyed smolt, daily smolt catch (all fish if physically possible) will be examined for marked fish. The first day of smolt examination is the day of release. The last smolt examination will occur on the 3rd day after release at 1200 hrs. Trap efficiency is measured by the number of marked fish recovered relative to the number released. Record mark recapture data on the Daily Smolt Catch Reporting Form (Figure 1) and summarize the data on the Sockeye Salmon Smolt Summary Form (Figure 3). Remember that the number of smolt examined in a day equals marked and non-marked smolt caught that day. Daily smolt catch will then equal the number examined minus the number marked since marked smolt were previously counted. If all fish are not examined, be sure to record it with an explanation in the comments section of the Daily Smolt Catch Reporting Form (Figure 1).

Age, Weight, and Length Sampling

At each location, 70 sockeye smolt per day, five days per week, are to be sampled for age, length, and weight. If daily sampling objectives are being met, sampling will not occur on Wednesday and Sunday. Specific procedures for collecting and recording the information is in Appendix B. Each sample will be taken from a single days catch. Do not mix samples between days. If less than 70 fish are caught in a day, the sample size for that day will be the number of fish caught on that day. If 70 fish are sampled, the first AWL will include fish #1-40. The following AWL will include fish #1-30 **(not #41-70)**. Since smolt primarily migrate at night, a single sampling day will be the 24-h period from noon to noon and will be identified by the calendar date corresponding to the first noon.

Red Lake Fry Sampling

Weekly, sample four selected shoal areas using a 50-ft length beach seine. At each location, the catch will be sorted and counted by species, and lengths will be taken on all sockeye salmon in the catch. Data will be recorded on the Seine Catch Log Form (Figure 5). The site locations were marked in 1992 by placement of a metal fence post on the shore at each site. The approximate location of seine sites are identified in Figure 6.

Climate Data

Climatological data will be collected at each location daily at approximately 1800 hrs. The information will be recorded on the Climatological Observation Form and will include water and air temperatures (C), stream height (cm), percent cloud cover, and wind direction and velocity (Figure 7.).

Daily Smolt Radio Schedule

Daily and cumulative smolt catch, dye test information, and current trap efficiency will be reported daily at approximately 2020 hrs on frequency 3230. This information should be recorded on the Daily Smolt Radio Schedule Reporting Form (Figure 8) and carefully edited prior to radio schedule.

PROJECT TERMINATION

The smolt trap(s) at Red, Akalura, and Frazer Lakes will be removed at the end of the smolt migration which is expected to be about 30 June. The exact date for trap removal will be determined by Swanton based on trap catch rate performance compared to previous years and consultation with field crews.

Figure 1. DAILY SMOLT CATCH REPORTING FORM

TRAP NUMBER_____ PROJECT LOCATION _____ DATE _____

TIME (MILITARY)	SOCKEYE SMOLT (numbers)			OTHER (numbers)			COMMENTS 2/
	CATCH 1/	EXAMINED FOR MARKS	MARKED RECOVERIES	COHO	DOLLY V.	STICKLEB.	
TOTAL							

1/ Catch number does not include marked recoveries.

2/ To be included in comments: estimate young-of-year fry numbers by species and number of sockeye smolt mortalities.

Figure 2. Catch-weight sampling form (work sheet for estimating smolt trap catch).

Date:_____ Time Period (military):_____ to _____ Project Location: _____

Basket Weight (wet): _____

Basket #	Weight (fish + basket)	Basket #	Weight (fish + basket)	Basket #	Weight (fish + basket)	Basket #	Weight (fish + basket)
1.		11.		21.		31.	
2.		12.		22.		32.	
3.		13.		23.		33.	
4.		14.		24.		34.	
5.		15.		25.		35.	
6.		16.		26.		36.	
7.		17.		27.		37.	
8.		18.		28.		38.	
.		19.		29.		39.	
10.		20.		30.		40.	
TOTAL:		TOTAL:		TOTAL:		TOTAL:	

GRAND TOTAL _____ LESS BASKET WEIGHTS _____ = _____ (a)

Sample Biomass (Fish plus basket weight)	CATCH	
	Sockeye Smolt	Other
1.		
2.		
3.		
4.		
5.		
TOTAL:	(c)	

GRAND TOTAL _____ LESS BASKET WEIGHTS _____ = _____

ESTIMATED CATCH: _____ SMOLT (ac/b); _____ OTH

Figure 3.

SOCKEYE SALMON SMOLT SUMMARY FORM

PROJECT LOCATION :

TRAP NUMBER:

DATE 1/	NUMBER OF SMOLT					
	CAUGHT 2/					MARKED 3/
	DAILY	CUM.	MORTS.	DYED	EXAMINED	RECOVERIES

1/ Each date covers a 24-hour period extending from noon to noon and identifies the starting date.
2/ Numbers of fish caught does not include marked recoveries.
3/ Marked recoveries are not included in the catch because they represent previously caught smolt.

Figure 4.

SMOLT DYE RELEASE FORM

DATE (actual): _____

PROJECT LOCATION _____

NUMBER OF FISH COLLECTED: _____
(from live box)

CREW NAMES (print) _____

_____

CREW LEADER _____
(signature)

	COLLECTION LIVE BOX	TRANSPORT BUCKET	RECOVERY CONTAINER	DYE TUB	RECOVERY CONTAINER	TRANSPORT BUCKET	STREAM RELEASE
START TIME (military)							
START TEMP (degree celsius)							
END MORTALITY (number of fish)							
OXYGEN SUPPLEMENT O2 or aerator (A)							

DYE SOLUTION (mixture): _____ Dye (grams); _____ Water (gallons)

RELEASE SITE LOCATION (distance upstream of trap site, in miles) _____

TOTAL NUMBER OF DYED FISH RELEASED: _____

COMMENTS:

Figure 5. CLIMATOLOGICAL OBSERVATIONS

PROJECT LOCATION: _____

DATE	TIME	TEMPERATURE		CLOUD COVER (%)	WIND		STREAM GAUGE[a] (in cm)	COMMENTS
		AIR(°C)	WATER(°C)		DIRECTION	VEL. (MPH)		

[a] Round to nearest 1 cm.

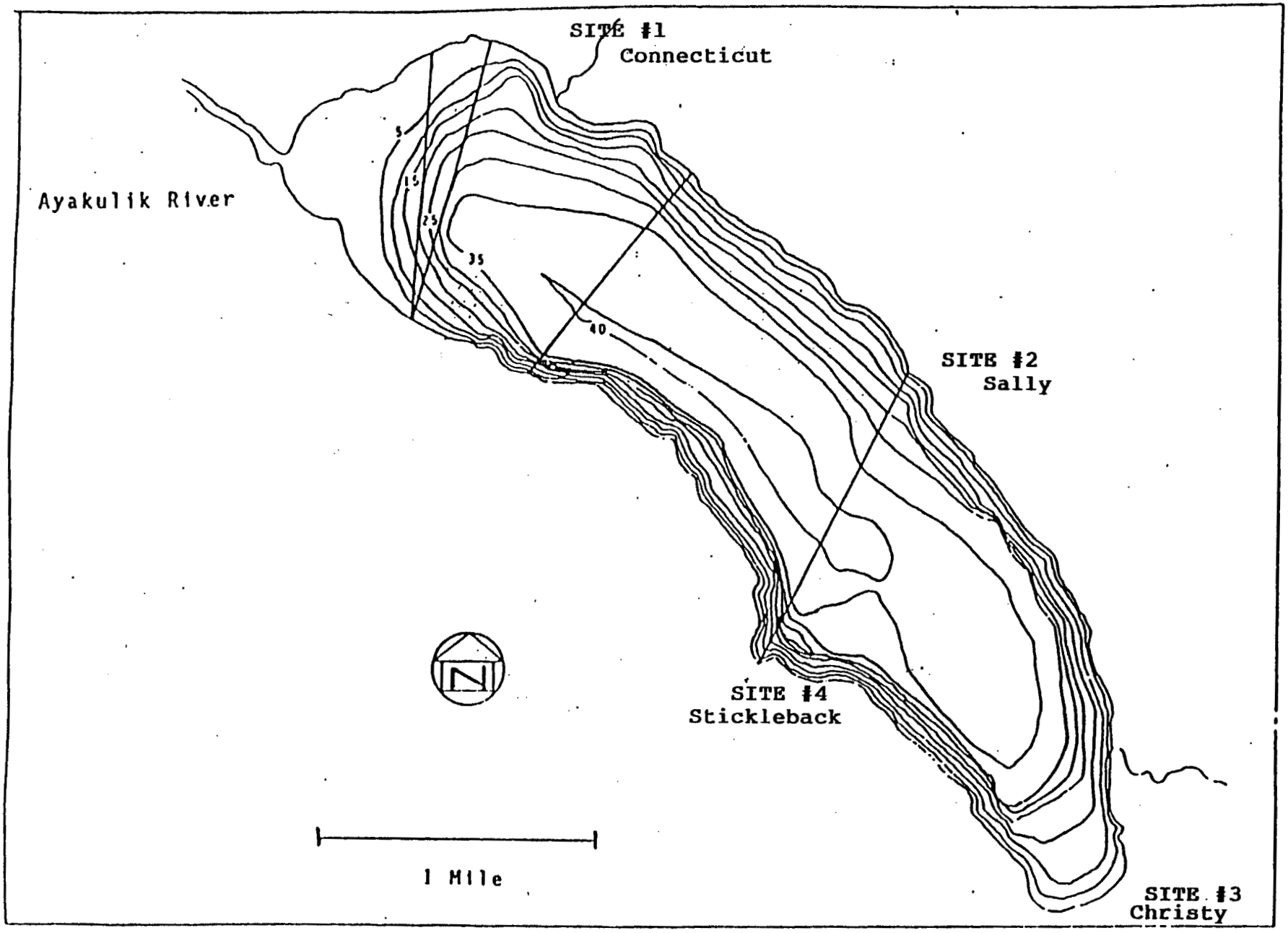

Figure 6. Morphometric map of Red Lake on Kodiak Island.

Figure 7. Seine catch log form.

Lake:_____ Time:_____ Remarks:

Date:_____ H_2O temp: _____

Location:_____

Seine length:_____ Crew:_____

TOTAL CATCH					
SOCKEYE	COHO	DOLLY V.	STICKLEBACK	RAINBOW	OTHER

	SOCKEYE LENGTH SAMPLE						
1		26		51		76	
2		27		52		77	
3		28		53		78	
4		29		54		79	
5		30		55		80	
6		31		56		81	
7		32		57		82	
8		33		58		83	
9		34		59		84	
10		35		60		85	
11		36		61		86	
12		37		62		87	
13		38		63		88	
14		39		64		89	
15		40		65		90	
16		41		66		91	
17		42		67		92	
18		43		68		93	
19		44		69		94	
20		45		70		95	
21		46		71		96	
22		47		72		97	
23		48		73		98	
24		49		74		99	
25		50		75		100	

Figure 8. **DAILY SMOLT RADIO SCHEDULE REPORTING FORM**

PROJECT:

SMOLT DATE	INDEX TRAP SMOLT CATCH		DYE/ RELEASE	NUMBER RECAPTURES	CURRENT TRAP EFFICIENCY	COMMENTS: (include # AWL sampled)
	DAILY	CUMULATIVE				

APPENDIX A

Presmolt Salmon Key
and
Anadromous Juvenile Salmonides Key

A Guide to the Collection and Identification of Presmolt Pacific Salmon in Alaska with an Illustrated Key

MILTON B. TRAUTMAN[1]

ABSTRACT

This field and laboratory key contains recommendations for types of equipment needed, instructions for preserving and labeling specimens, and descriptions of the characters used in identifying five species of Pacific salmon. The key is illustrated with six line figures: 1) juvenile salmon, 2) the first gill arch, 3) head with gill arch in situ, 4) first gill arch and eye for comparison with longest rakers, 5) method of counting anal fin rays, and 6) ventral surface of head showing branchiostegals. Five plates of stippled line drawings of five lengths (25 to 110 mm fork length) for each of the five species of Pacific salmon, an annotated opposable key, and a glossary are also included.

INTRODUCTION

As adults, the five species[2] of Pacific salmon of the genus *Oncorhynchus* inhabiting western North American waters are easily identified, but as subadults or as smolts in silvery coloration, they are less easily recognized. As juveniles less than 125 mm (5 inches) in fork length (FL), they may be quite difficult to identify. In addition, characters by which presmolt juveniles can be distinguished may vary with geographic area.

Several keys for identification of juvenile salmon have been published, most of which utilize the number, length, and shape of the gill rakers on the first gill arch; number of pyloric caeca and branchiostegals; and absence of parr marks, or if present, their size and shape (Foerster and Pritchard, 1935; Schultz, 1936; Haig-Brown, 1947; Clemens and Wilby, 1961; McPhail and Lindsey, 1970; Wilimovsky[3]). In addition to the above characters, the key in this paper emphasizes and illustrates the distribution of those chromatophores (usually melanophores) which are reliable enough to aid in the specific identification of juveniles.

This key describes the characters typical of presmolt juveniles of the five species of Pacific salmon in Alaska. The common names recommended by the American Fisheries Society (Bailey et al., 1970, p. 17) are used, despite the fact that other names appear to be in more general use. These other names are inserted in parentheses after their respective species. Trouts, Atlantic salmon (*Salmo salar*), and some other salmonoids are included in the key because of their resemblance to Pacific salmon.

Before presenting the key, it appears advisable to describe the equipment and methods I recommend for preserving specimens, labeling specimens, and counting, measuring, and removing parts of specimens, so that those not acquainted with my procedures may more accurately and quickly identify their material.

---

[1] Professor Emeritus of Zoology, Ohio State University, Columbus, OH 43210. The author was employed in Alaska by the National Marine Fisheries Service Auke Bay Fisheries Laboratory during the summers of 1959 and 1961. The specimens were obtained and most of the drawings made at that time.

[2] A sixth species, *O. masou* (Brevoort), inhabits the streams of eastern Asia from the Okhotsk Sea to Formosa.

[3] N. J. Wilimovsky, 1958. Provisional keys to the fishes of Alaska. On file Natl. Mar. Fish. Serv., Auke Bay Fish. Lab., Auke Bay, AK 99821.

RECOMMENDED EQUIPMENT

Magnifiers: Magnification in the range of 4 to 30 will prove helpful in identification of juvenile salmon. A binocular microscope having such a range is the most satisfactory, but any type of magnifier of more than 4 power and less than 30 may be used provided it is not necessary to use one's hand to hold it—usually both hands are needed to manipulate a specimen. In the field, a binocular unit containing lenses inserted in a frame or headstrap or a jeweler's eye magnifier (especially if one wears glasses) may be used.

Forceps: Four or five inches long with straight or curved tips—for lifting fins, holding back gill covers, etc.

Scalpel: A sharp blade an inch or two long—for removing gill arches, opening body cavities, etc.

Teasing needle: A needle inserted in a wooden or metal handle—for separating closely set gill rakers, etc.

Dividers: For measuring and comparing various body parts; dividers in which one or both legs can be "broken" are the most satisfactory.

Scissors: About 6 inches long with the blades or cutting surface of about 1 inch.

Ruler: Graduated in millimeters to measure fish lengths and parts; one which includes inches also desirable.

PRESERVING SPECIMENS

The careful preserving of specimens cannot be too strongly emphasized. Much time is lost in attempting to identify improperly preserved fishes; it is only when properly preserved that they may be rapidly and correctly identified. Frequently, juvenile salmon that have died in nets become soft, bleached, and torn. For the sake of accuracy it is better not to attempt to identify such material.

To preserve juveniles, upon capture place them in a solution of 1 part Formalin to 9 parts water. If live fishes are placed in too strong a Formalin solution, they may die with their mouths widely agape or the chromatophores may close so tightly as to be difficult to detect. If placed in too weak a Formalin solution, the fishes become bleached and soft and may decompose. If fishes are to be preserved for more than a year (or permanently), leave them in the Formalin solution at least 1 wk and if possible no longer than 4 mo. When fish are removed from the Formalin solution, soak them in water for 24 to 48 hr; then place them in a solution containing 70% ethyl alcohol and 30% water or 35% isopropyl alcohol and 65% water.

Do not crowd or pack fishes in a container, especially if they are alive or only recently dead. Fresh fishes, if packed too tightly, will become permanently deformed upon hardening in Formalin, will be bleached where their bodies come in close contact, or will decompose. A container is too crowded if the fishes will not readily move as the container is slowly rotated or shaken. When sufficient room is allowed, identification will be facilitated because the fishes will harden without discoloring; bodies and fins will not be deformed, twisted, or broken; and the chromatophores will remain nearly or fully open.

LABELING SPECIMENS

Labeling specimens fully and properly is of great importance; unlabeled or mislabeled specimens are of little or no value. Put the label with the specimens at the time the fishes are preserved. Label paper should remain firm when wet and should not become pulpy. Write clearly with pencil or permanent ink, recording the following data.

Field Number

Use your own or a department number. A satisfactory method is to use the first initial of your surname or your full surname, the last two digits of the year, and your collection number. Thus, if Joe Brown in 1962 preserves his fifth collection, he writes B-62-5 or Brown-62-5; if for the Department of Salmon Investigations he writes, SI-62-5. When a departmental symbol is used, it often is desirable for the collector to add his initials or name to the label.

Name of Water Body and Locality

Use names on standard maps. Whenever possible, avoid temporary or local names, such as

Brown's fishing camp. An example of a brief but adequate recording is: Alaska, Naknek River System, Katmai National Monument, Brooks Lake.

Date

Include the month, day, and year and, if pertinent, the hour.

The following additional information may be needed at times.

Method of Capture

Describe type of gear and size if significant, i.e., seine (2 cm mesh), fry net (1 cm mesh), trawl (1 cm bag), etc.

Temperature

Measure temperature of air and/or water. If water is ice-covered, what percent?

Other Water Conditions

If a *stream:* estimate its average width and maximum depth; if tidal and brackish, to what extent; degree of turbidity and source—glacial silt, plankton, etc.; degree of gradient—low, moderate, or high; percentage of stream in pools, with or without current; percentage of stream in riffles, whether flow is sluggish, moderate, or swift; dominant bottom types—sand, gravel, boulders, bedrock, muck, silt, etc.; aquatic vegetation—submerged, emergent, or both (name dominant species or genera if known). If a *lake or bay:* state whether fresh, brackish, or saline; if tidal, state to what extent; estimate size and possible depth; give degree of turbidity, type of bottom, and amount and kinds of aquatic vegetation.

Remarks

Describe anything that may aid in identification of the fishes, such as peculiar markings, habits, or habitats.

CHARACTERS USED IN IDENTIFYING SPECIES

A juvenile salmon is shown in Figure 1 to assist in recognizing and defining the characters and the counts and measurements used when keying out a specimen.

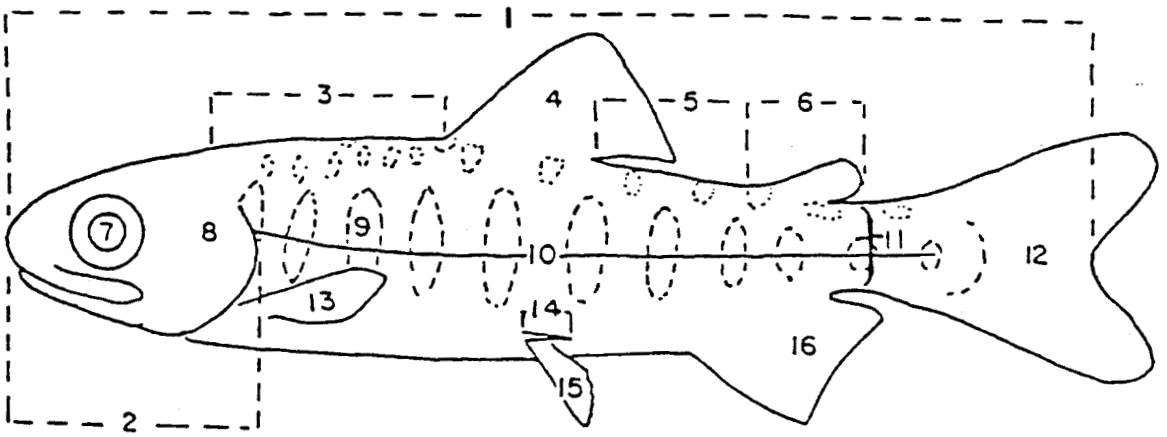

Figure 1.—Juvenile salmon, illustrating parts and methods of measuring: 1) fork length; 2) head length; 3) predorsal ridge; 4) dorsal fin; 5) portion of postdorsal ridge between posterior end of dorsal fin base and origin of adipose fin; 6) adipose fin; 7) pupil of eye; 8) gill cover, beneath which is gill chamber containing gill arches; 9) a parr mark; 10) lateral line; 11) caudal peduncle; 12) caudal fin or tail; 13) pectoral fin; 14) axillary process or scale; 15) pelvic fin; 16) anal fin.

First Gill Arch

Beneath each gill cover are four fully formed gill arches; the first gill arch on either side is the part used for specific identification. A gill arch (Fig. 2) consists primarily of a bony central arch to which the gill rakers are attached anteriorly, the gill filaments (lamellae) posteriorly. The gill rakers prevent solid substances such as food from being carried out through the branchial clefts and protect the delicate gill filaments. The numbers of gill rakers vary somewhat among individuals of each species of salmon, but the difference in average number between some species is sufficiently great to enable one to use them as specific characters.

The rakers on the gill arch may be counted as a unit, or the upper and lower limbs may be counted separately. The two limbs are joined

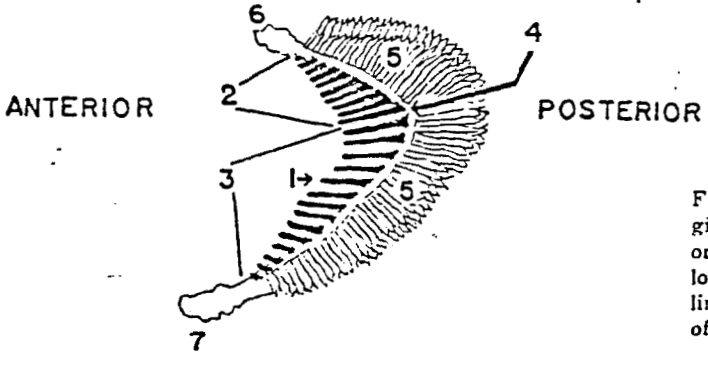

Figure 2.—First gill arch of salmon after removal from left gill chamber: 1) gill raker; 2) gill rakers attached to upper or shorter limb of arch; 3) gill rakers attached to lower or longer limb of arch; 4) angle of arch (junction of the two limbs or bones); 5) gill filaments (lamellae); 6) upper point of arch attachment; 7) lower point of arch attachment.

at an angle, the upper being the shorter. When a raker is situated astride the angle, it is included in the lower limb count. When all of the rakers on the arch are counted as a unit, a single number is given; otherwise, both limbs are recorded separately (the upper limb first), and then added, thus 12 + 20 = 32.

The gill rakers nearest the angle of the arch are the longest; the rakers become progressively shorter as they approach the attachment ends of each arch. The rakers near the ends are often rudimentary and can be counted only under magnification.

It may be difficult to count all of the rakers accurately while the first gill arch is in place, in which case it will be necessary to remove the arch. To do this, turn back or cut away gill cover as shown in Figure 3. Lift the first gill arch upward. With a sharp scalpel, cut between the dorsal ends of the first and second arches, making a deep incision parallel with them; then cut the remainder of the attachment away. Next cut the ventral attachment in the same manner; and when both ends are free, remove the arch. Great care must be taken so that all rudimentary rakers may be removed and counted. After finishing the examination of the arch, reinsert it in the gill chamber for possible future examination.

Gill Raker and Eye Comparison

The longest rakers are compared with the length of the eye (Fig. 4). With dividers, obtain the measurement of the length of the longest raker; then place one point of the dividers at the anterior edge of the eye, the other extending

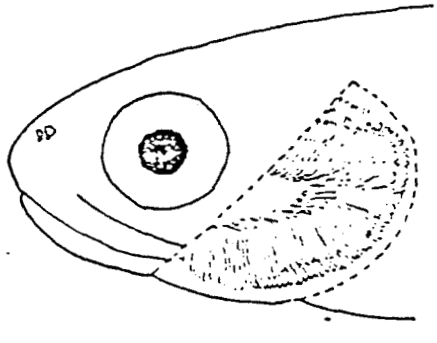

Figure 3.—Head of salmon. Dotted lines indicate that portion of gill cover which has been removed to show first gill arch in place.

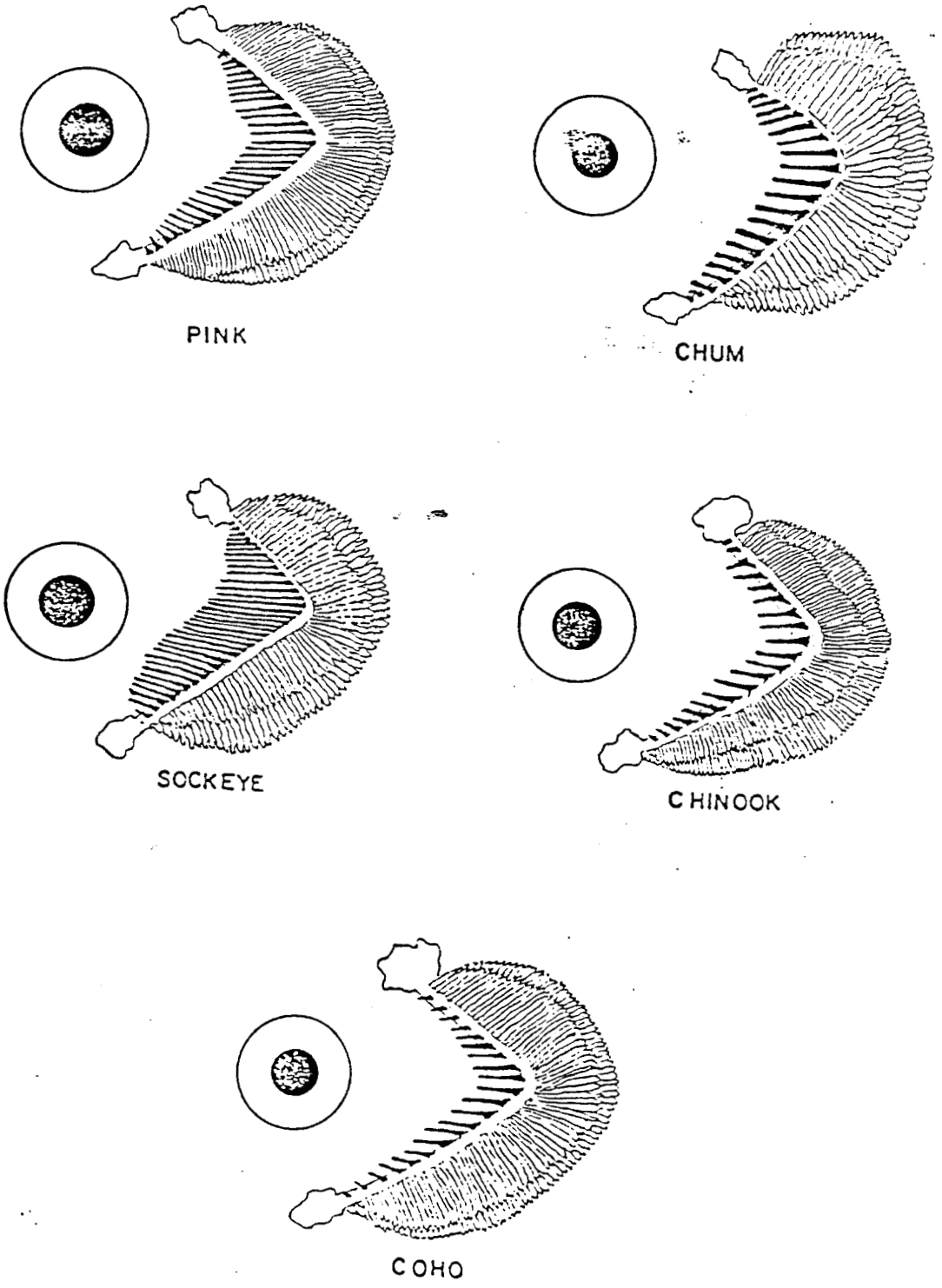

Figure 4. – First gill arch and eye for comparison with longest gill raker length of five species of Pacific salmon.

toward the opposite edge. Because the raker is shorter than the eye length in juvenile salmon, it is simplest to note where the raker reaches in relation to the pupil. Like many body part ratios, the gill raker-eye size ratios change as the juvenile salmon increases in length. For example, in specimens about 40 mm FL, the longest raker may be contained about 3 times the eye length, but in 140 mm specimens of the same species, the raker may be contained only about 2 times. This and other proportional changes must be considered.

Anal Fin Measurement and Count

To compare the length of the fin base with the longest ray, measure the anal fin base with dividers; then project the posterior leg of the dividers forward to the opposite tip of the longest ray as shown in Figure 5 by dotted line.

In counting the number of rays (Fig. 5), do not count those anteriormost ones which are less than half the length of the longest rays, such as those marked "0." Count all rays, such as No. 1, that are half (or more than half) the length of the longest ray, taking great care to observe the last ray—No. 15 in Figure 5. The last ray is usually split to its base and appears superficially as two rays, but it is in reality only one and should be counted as such.

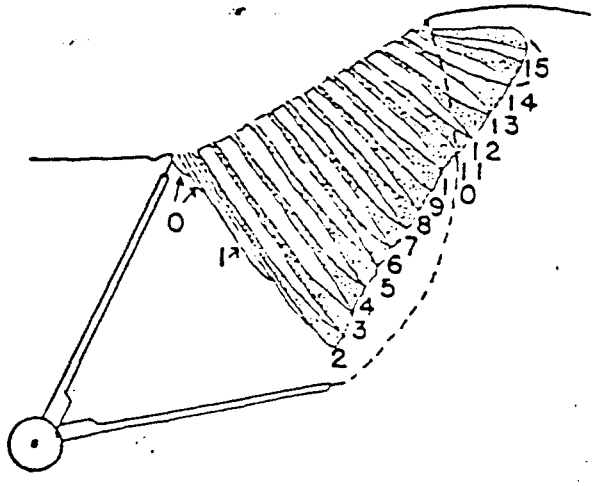

Figure 5.—Anal fin of salmon, illustrating method of measuring length of fin base and of counting rays (rays 2 to 15 are stippled here for emphasis).

Branchiostegal Count

All branchiostegals (Fig. 6), including the smallest, anteriormost ones are counted. Usually this may be accomplished satisfactorily only under magnification, and with juveniles longer than 40 mm FL. The branchiostegal count is used primarily as an additional character in specimens otherwise difficult to identify, and is especially valuable in separating the chinook salmon (usually 15 or 16) from the coho salmon (usually 13 or 14).

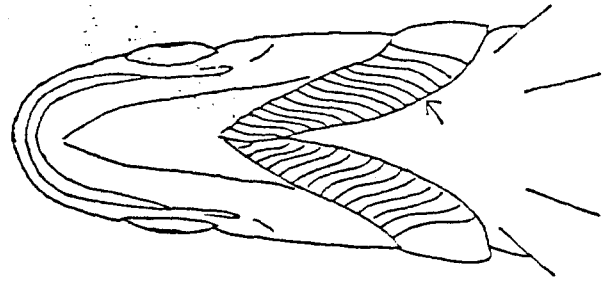

Figure 6.—Ventral surface of head of salmon. Arrow points to one of 14 branchiostegals on left side of head.

Pyloric Caeca Count[4]

With a scalpel, widely open the abdominal cavity. Sever the esophagus as far forward as possible; then cut off the intestine near the posterior end of the stomach. The stomach and caeca can now be removed as a unit (Fig. 7). Use magnification and teasing needle as aids in counting. Counts of pyloric caeca are useful chiefly as an additional character for questionable specimens, especially in separating the chinook salmon (more than 100 caeca) from the coho salmon (fewer than 90).

Color Pattern Variations

Juvenile salmon from certain waters or at certain stages of development may have their parr marks or other markings masked by a bluish-

[4]In the key, I have used pyloric caeca counts of my own, plus published accounts of others and especially the more recent ones, such as Clemens and Wilby (1961) and McPhail and Lindsey (1970).

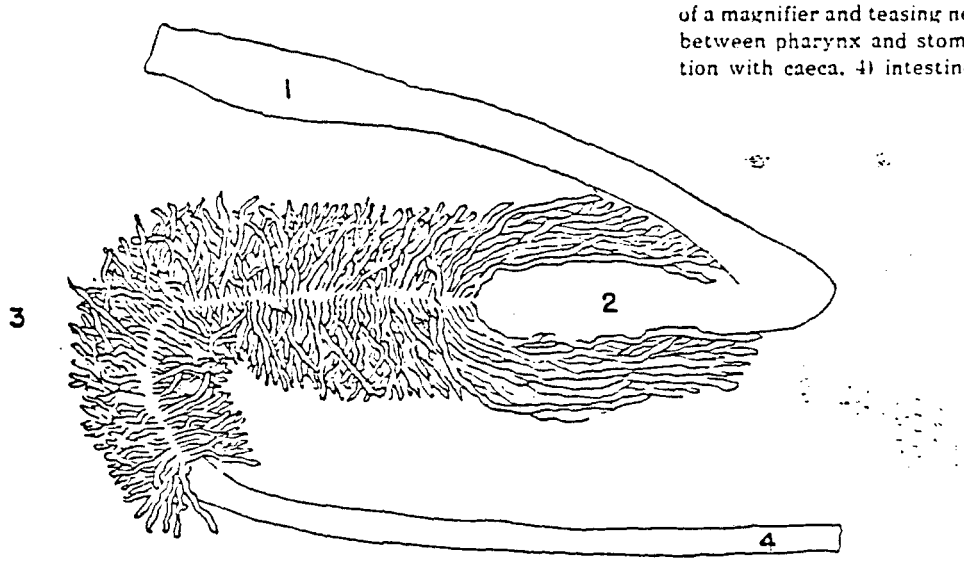

Figure 7. – Major portion of alimentary tract of salmon with pyloric caeca spread apart preparatory to counting with aid of a magnifier and teasing needle: 1) esophagus (part of tract between pharynx and stomach), 2) stomach, 3) pyloric section with caeca, 4) intestine.

or greenish-silvery sheen, especially when they are alive. To identify these fish, it may be necessary to preserve them first in Formalin to intensify their markings.

Juveniles of one species from certain waters, such as habitually turbid ones, may have their melanophores restricted in size or distribution, thereby resembling superficially another species. As an example, coho salmon normally have the adipose and anal fins densely speckled with rather large melanophores. But in some specimens, the melanophores may be reduced in size or distribution, so that coho salmon superficially resemble chinook salmon. Conversely, juvenile chinook salmon may have the melanophores unusually numerous and well developed, thereby resembling coho salmon. To avoid error in identification, compare the size and number of melanophores on the fins with those on the body; if few and small on the body, they should be few and small on the fins.

Color variations also occur regionally. An example is the predorsal stripe in chinook salmon, which in fish from some waters is normally a solid dark bar in specimens less than 80 mm FL; in chinook salmon in other waters the stripe may be reduced to a series of oblong blotches.

The length when individuals attain smolt coloration varies greatly, both regionally and in specimens from the same locality; some fish of the same species may lose parr and other presmolt markings when only half as large as other fish.

HOW TO USE KEY

Because of the variations in morphology and coloring, it is advisable to use the key in conjunction with the figures and plates and to check a large combination of characters.

In using the key, first make certain your specimen is a Pacific salmon by examining the characters under the two opposable groups labeled "1." Next, note the absence or presence of parr marks (see sections *"Combination of"* under opposable groups 2). If no parr marks are present and your specimen has not entered the silvery smolt stage, it is probably a pink salmon, but to make sure, compare it with the identifying characters between opposable groups 2. If parr marks are present, note the absence or presence of melanophores on adipose and anal fins (see groups 3). If melanophores are absent, see sections *"Combination of"* under groups 4; if present, see *"Combination of"* sections under groups 5. Decide which *"Combination of"* most closely fits your specimen, then verify it by comparing the descriptions of the identifying characters for the opposable groups.

KEY TO PRESMOLT JUVENILE SALMON

Salmonoid fishes having fewer than 20 rays in the dorsal fin (excludes grayling); strong teeth on jaws and tongue (excludes ciscoes and whitefishes); many pyloric caeca (excludes smelts, family Osmeridae); an axillary process or scaly appendage above pelvic fin (Fig. 1, No. 14); an adipose fin; cycloid scales; upper jaw formed by both premaxillary and maxillary ..... 1.

1a Base of anal fin *shorter* than longest ray (Fig. 5). Anal rays usually 9 to 12 (rarely 8 or 13). Gill rakers normally fewer than 20 on first gill arch (Fig. 3). Dorsal fin of larger juveniles of some species with several blackish spots.
CHAR, TROUTS, ATLANTIC SALMON. ..... Not in this key.

1b Base of anal fin *longer* than longest ray (Fig. 5). Anal rays usually 13 to 17 (rarely 12, 18, or 19). Gill rakers normally 20 to 40 on first gill arch (rarely 19). Dorsal fin of larger juveniles lack blackish spots but tip of fin may be blackish.
PACIFIC SALMON—genus *Oncorhynchus*. ..... 2.

2a *Combination of: No* parr marks on sides and *no* prominent specklings on back of presmolt juveniles. Usually no melanophores on anal and adipose fins; if melanophores present, they are few and very small, and if on adipose, are restricted to its posterior, free edge.
PINK (HUMPBACK) SALMON—*O. gorbuscha*. ..... Plate 1.

General development—Similar to chum salmon in that yolk sac may not disappear until juvenile is more than 34 mm FL, after which development toward smolt shape and coloration is rapid. When less than 50 mm FL, this species is similar to chum salmon in being more terete than the sockeye, chinook, and coho salmon; body depth immediately before dorsal fin usually more than 1.5 times head length.

Parr marks—Only species of salmon lacking parr marks in the presmolt juvenile.

Coloration of body—*Preserved material*—In juveniles less than 40 mm FL, back is dark to lateral line and ventral half of body light when bicolored; dorsal third of body is darkest, sides lighter, ventral third lightest (usually milky-white or silvery) when tricolored. Few or no melanophores on lower sides and belly. In juveniles more than 40 mm FL, bicolored or tricolored condition is normally not evident, the dark back lightening gradually downward to the very light belly. *Living specimens*—Dorsal half of body bright bluish or greenish with much silvery reflection; ventral half milky or silvery-white.

Fins—Anal and dorsal fins averaging smaller than in chum salmon; these fins in this species and in chum salmon distinctly smaller than in sockeye, chinook, or coho salmon. In specimens less than 40 mm FL the longest anal ray, when measured into head length, extends from tip of snout to about center of eye; in larger presmolt juveniles, this measurement extends from tip of snout to anterior half of eye. Anal rays usually 14 to 16 (extremes 13 to 17). *Dorsal fin* has few specklings and only a slight tendency toward a dark anterior edge in juveniles less than 50 mm FL; over 50 mm, blackish anterior edge becomes pronounced and tip of fin dusky. *Caudal fin* has speckling confined to basal half in juveniles less than 50 mm; with increasing length of juveniles, specklings appear along rays, and in large presmolt juveniles lobes tend to become blackish.

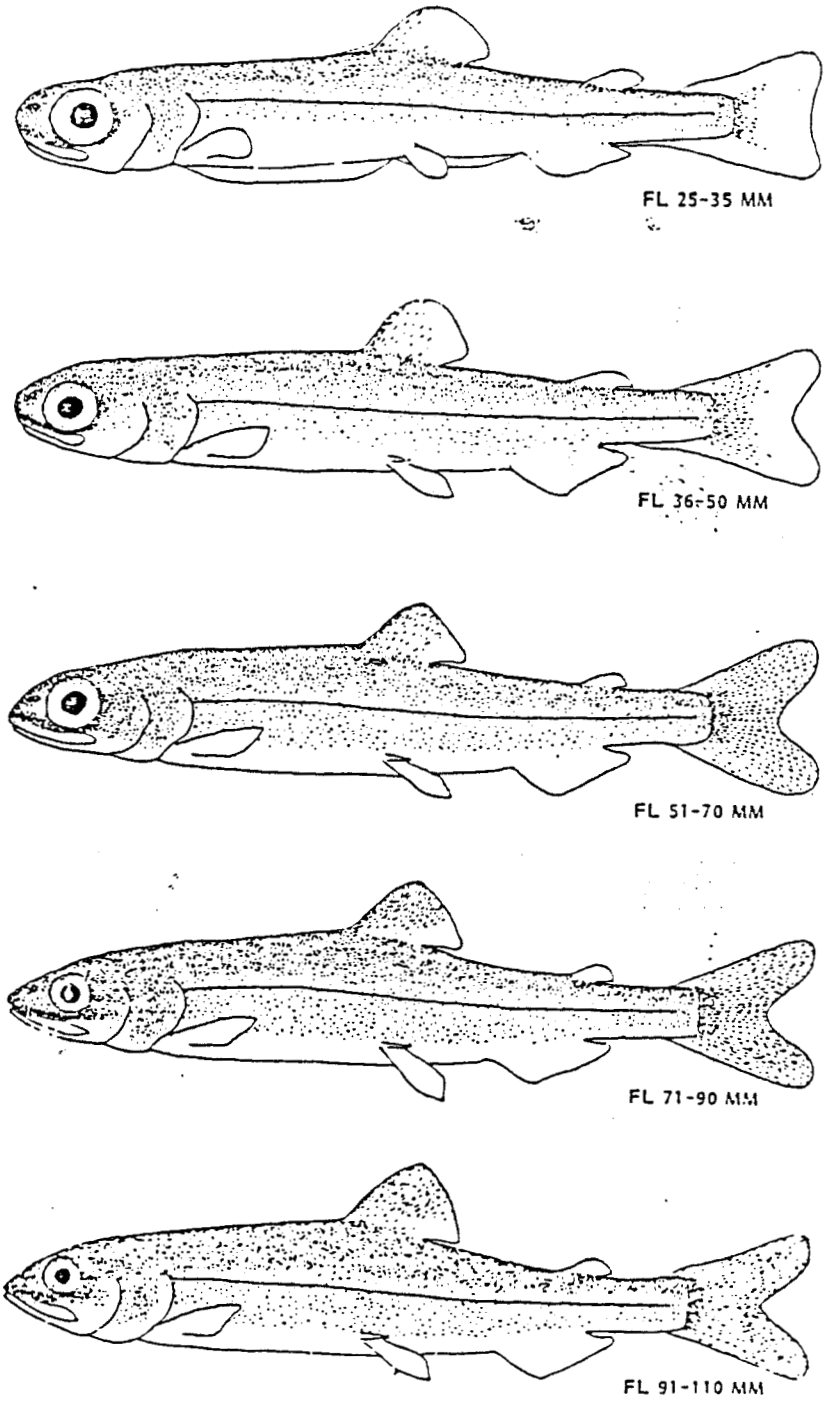

Plate 1.—Pink salmon.

Gill rakers (see Fig. 4)—Eleven to fourteen on upper limb, 14 to 19 on lower, total usually ranging between 27 and 33 (extremes 25 and 35); rakers slender and rather long; most similar in size and number to sockeye salmon but shorter and usually fewer (normally less than 31).

Pyloric caeca—Usually 130 to 195 (extremes 95 to 224); slender and rather long; differ sufficiently in numbers from coho and sockeye salmon, which have fewer than 100, to be a distinct aid in specific identification.

Branchiostegal rays—Usually 11 to 14 (rarely 10 or 15); average number less than in other species, almost invariably less than in chinook salmon, which usually has 15 to 18 (rarely 14).

Scales in lateral line—More than 170, more than in any other of the Pacific salmon; lateral line scale counts may be obtained under magnification in specimens longer than 60 mm FL.

Habits—Shortest life span of any species, between 18 mo and 2 yr. Only a comparatively small proportion of adults make extended migration in fresh water. Majority spawn in fresh waters within a short distance of brackish water or in intertidal waters. Many young enter brackish or salt waters within a few hours or days after emerging from redds, and comparatively few are found in fresh water when more than 45 mm FL.

Combination of: Both parr marks on sides and dark spottings on back usually obvious in living, presmolt juveniles and always in preserved specimens under magnification (may be faint in fishes from turbid waters); parr marks become faint and disappear as juvenile assumes smolt coloration ..... 3.

2b

No melanophores normally present on adipose and anal fins of presmolt juveniles, or if present, few and quite small. Parr marks occupy a larger area above lateral line than below it, and in some specimens anterior parr marks may be almost entirely above the lateral line.

3a

CHUM AND SOCKEYE SALMON ..... 4.

Melanophores normally obvious on adipose fin in living specimens and always in preserved specimens under magnification (may be indistinct in juveniles from silty waters). Anteriormost parr marks appear to occupy as large (or almost as large) an area below lateral line as above it; these parr marks are usually large, long, and wide.

3b

CHINOOK AND COHO SALMON ..... 5.

Combination of: Gill rakers 19 to 26 (average 23), notably fewer and much shorter than in sockeye salmon, which have more than 28. Normally *no* melanophores on adipose and anal fins. Anterior squarish (quadrate) parr marks situated almost or entirely above lateral line in specimens less than 50 mm FL; in presmolt juveniles more than 50 mm FL, anterior parr marks tend to be long and very narrow and sometimes may extend well below lateral line.

4a

CHUM (DOG) SALMON—*O. keta* ..... Plate 2.

General development—Similar to pink salmon in that yolk sac may not disappear until juvenile is more than 34 mm FL, after which development toward smolt shape is rapid. Also similar to pink salmon in being more terete (when less than 50 mm FL) than the sockeye, chinook, and coho salmon; body depth immediately before dorsal fin usually 1.5 to 1.8 times head length.

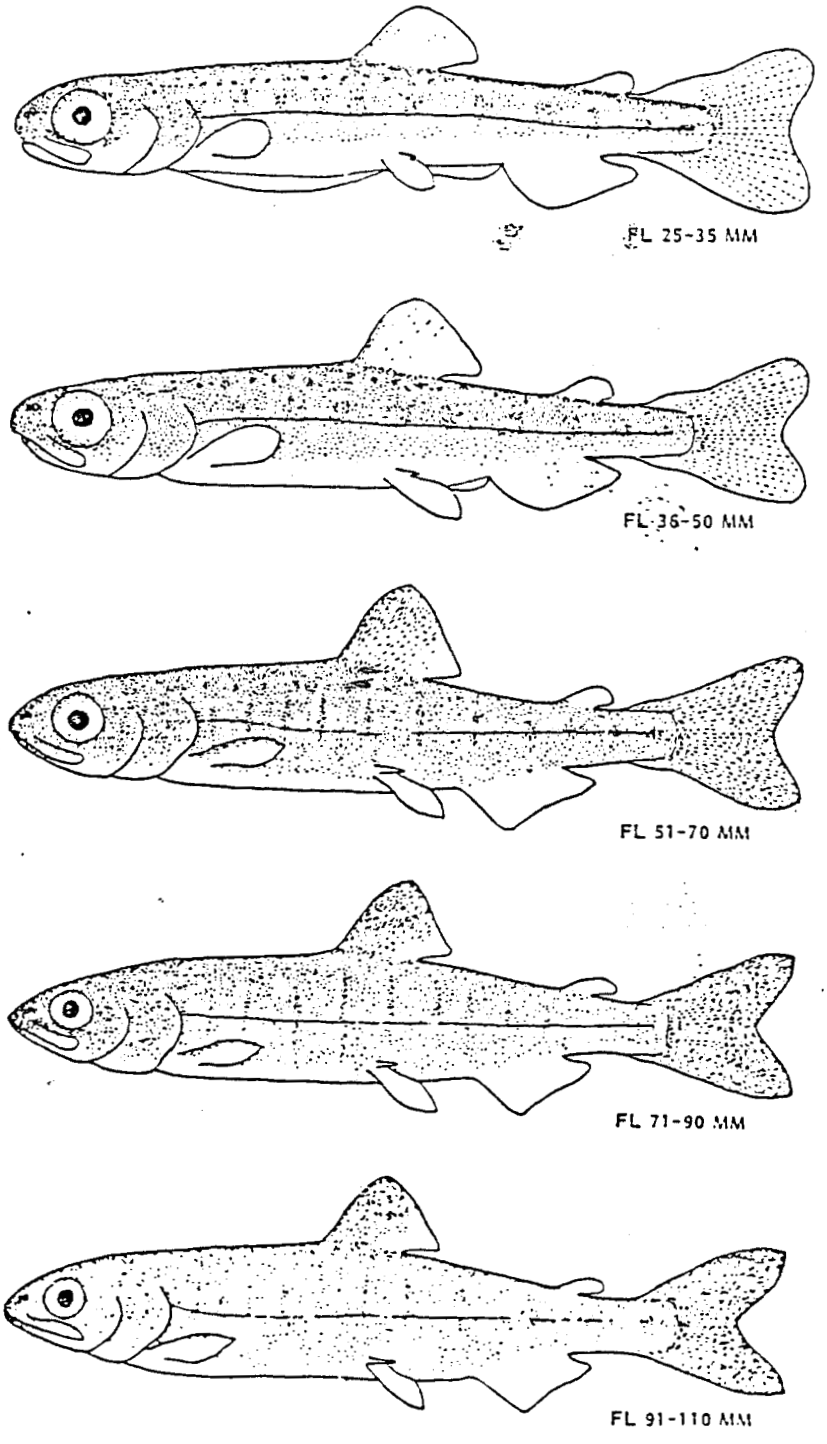

Plate 2.—Chum salmon.

Parr marks—Anterior parr marks in specimens less than 50 mm FL are more squarish (quadrate) and do not extend quite so far below lateral line as in sockeye salmon; in presmolt juveniles more than 50 mm FL, parr marks tend to become longer and more narrow than in sockeye salmon, and some tend to extend well below lateral line.

Coloration of body—*Preserved material*—Dorsal ridge stripe usually present, sometimes a series of blotches in juveniles less than 50 mm FL, becoming faint or disappearing in presmolt juveniles more than 50 mm FL; a prominent irregular row of spots and blotchings between dorsal ridge and upper edge of parr marks, these usually most distinct in specimens between 34 and 50 mm, often fading or disappearing in larger juveniles. *Living specimens*—Markings may be obscured by greenish or bluish overcast of dorsal half of body and whitish or silverish sheen of ventral half.

Fins—Anal and dorsal fins small, averaging slightly larger in size than those of pink salmon and averaging considerably smaller in height and area than those of sockeye salmon. Length of longest anal ray, when measured from snout to eye, reaches to, or almost to, center of eye; in sockeye salmon this measurement usually extends well beyond center of eye. Anal rays usually 13 or 14 (extremes 13 to 17). *Dorsal fin* has few or no distinct spottings in specimens less than 50 mm FL; in larger presmolt juveniles a dusky spot develops on tip. *Caudal fin* has faint spots largely confined to basal half in juveniles less than 50 mm FL; in larger juveniles lobes become blackish.

Gill rakers (see Fig. 4)—Seven to twelve on upper limb, 12 to 19 on lower, total usually ranging between 20 and 26 (extremes 19 to 30); rakers blunt and short, in sharp contrast to thinner, longer, and more numerous rakers of sockeye salmon, which has 30 to 39.

Pyloric caeca—Usually 160 to 185 (extremes 140 to 249); differ sufficiently in numbers from sockeye and coho salmon, which usually have fewer than 100, to be an aid in specific identification.

Branchiostegal rays—Usually 13 or 14 (extremes 12 to 16); of value primarily in separating this species from chinook salmon, which generally has more than 15.

Scales in lateral line—Between 125 and 155; of value chiefly in separating this species from pink salmon.

Habits—Life span usually 3 to 5 yr, for majority, 4 yr, some less than 3 yr. Jacks may occur. Majority spawn in fresh waters only a comparatively short distance from brackish water or in intertidal waters. Many young enter brackish or salt waters very shortly after emerging from redd, and few juveniles are found in fresh waters when more than 45 mm FL.

Combination of: Gill rakers 30 to 39 (average 36); notably more numerous, longer, and more slender than in chum salmon, which have fewer than 27. Normally *no* melanophores on adipose and anal fins. Anterior parr marks more rectangular than squarish in outline in specimens less than 45 mm FL and sometimes extend as much as a third to a half below lateral line; these oblong parr marks tend to shorten in presmolt juveniles more than 50 mm FL and to be mostly above lateral line.

4b

SOCKEYE (RED) SALMON—*O. nerka*. . . . . Plate 3.

General development—Yolk sac usually disappears, except for trace, before juveniles reach 30 mm FL. Body deeper and species more slab-sided in all presmolt lengths than in chum and pink salmons—body depth immediately before dorsal fin usually less than 1.5 times head length.

Parr marks—See "*Combination of*" above.

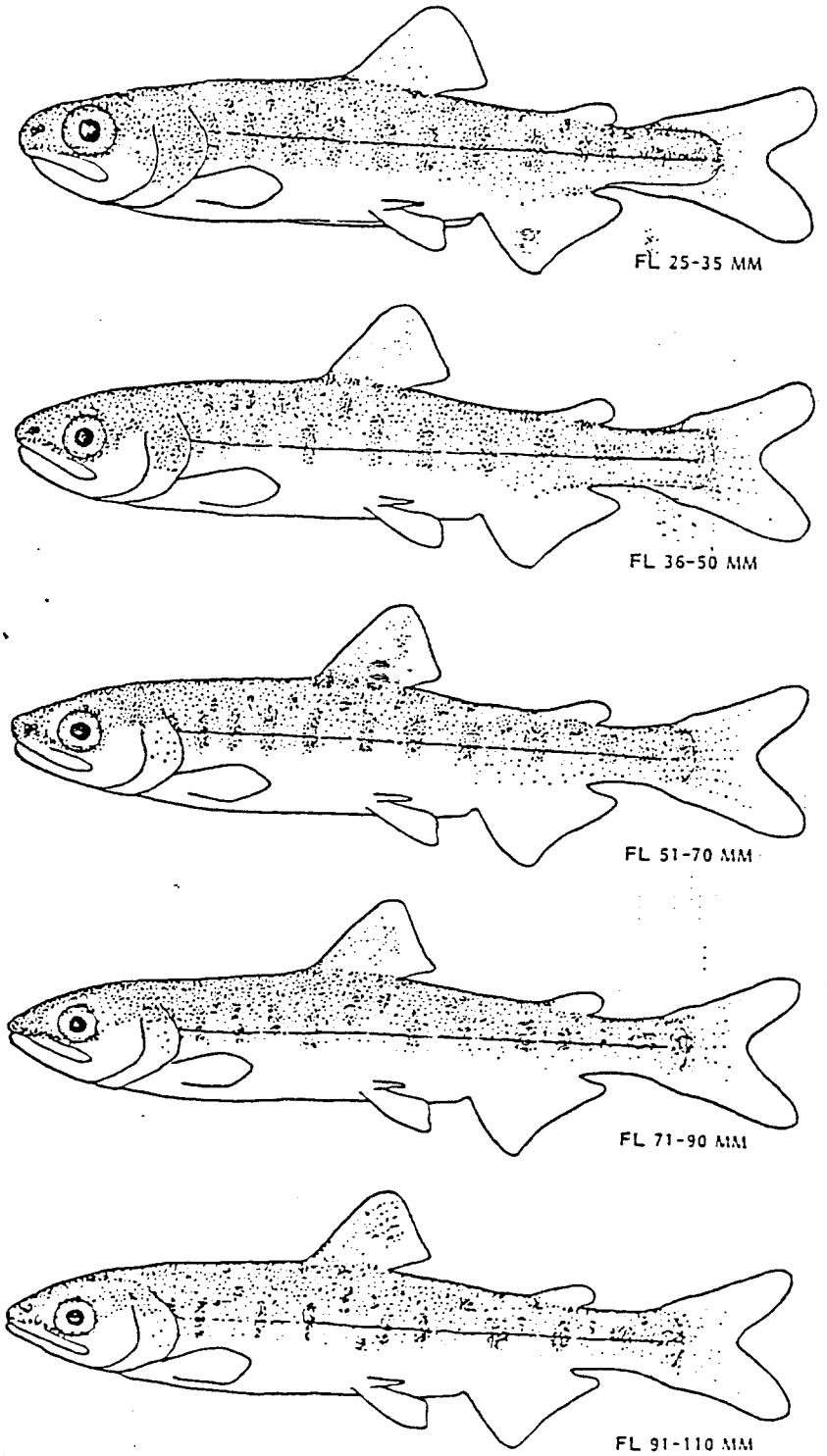

Plate 3.—Sockeye salmon.

Coloration of body—*Preserved material*—Dorsal ridge usually contains a series of more or less distinct spots in specimens less than 35 mm FL, becoming more confluent in fishes between 40 and 55 mm FL and sometimes merging into a dusky bar; in presmolt juveniles over 60 mm FL, spots or bars may disappear, after which a series of roundish spots become apparent on both sides of, and adjacent to, dorsal ridge, especially that portion behind dorsal fin; in addition to these spots, in fishes more than 35 mm FL, another longitudinal row of spots develops between dorsal ridge and upper halves of parr marks. *Living specimens*—Markings may be obscured by greenish or bluish overcast of dorsal half of body and whitish or silverish sheen of ventral half.

Fins—Anal and dorsal fins average larger in height and area than in chum and pink salmon. Length of longest anal ray, when measured from snout to eye, reaches usually from snout to beyond center of eye. Anal rays usually 14 to 16 (extremes 13 to 16). *Dorsal fin* normally has few or no distinct specklings in specimens less than 60 mm FL; a rather faint dorsal spot develops in larger presmolt juveniles in upper portion of fin, the fin being bordered on its free edges with whitish (see lowest figure, Plate 3). *Caudal fin* has few specklings on basal half, the lobes having few or no melanophores, even in rather large juveniles.

Gill rakers (see Fig. 4)—Twelve to sixteen on upper limb, 18 to 23 on lower, total usually ranging between 32 and 37 (extremes 30 to 39); rakers long and slender, averaging longer than in any other species, in sharp contrast to fewer, blunter rakers of chum salmon, which has 19 to 30.

Pyloric caeca—Usually 65 to 95 (extremes 45 to 115); usually considerably fewer than in pink, chum, and chinook salmon, and averaging more than in coho salmon.

Branchiostegal rays—Usually 13 to 15 (extremes 11 to 16); of value chiefly in separating this species from chinook salmon, which average more.

Scales in lateral line—Between 125 and 140; of value chiefly in separating this species from pink salmon, which has a higher number.

Habits—Life span usually 4 or 5 yr, some only 3. Jacks may occur. Majority of individuals highly migratory. Adults usually spawn in streams tributary to lakes; a small minority spawn in streams without a lake, in lake outlets, or on lake beaches. After rising from redd, young move downstream rather rapidly to a lake, remaining usually 1, sometimes 2, and rarely 3 yr in fresh water before entering brackish or salt water.

Combination of: Melanophores on adipose fin usually most numerous on posterior half and generally forming a dark border (see Plate 4); anterior half of adipose with few melanophores or none. Anal fin with few melanophores or none, but when
5a melanophores are present, often quite large. Tip of dorsal fin and lobes of caudal fin darker in larger presmolt juveniles.

CHINOOK (KING) SALMON—*O. tshawytscha*. . . . . Plate 4.

General development—Yolk sac usually disappears or is reduced to a trace before juveniles reach 32 mm FL. Body deeper and species more slab-sided in all presmolt lengths than in chum and pink salmon; body depth immediately before dorsal fin usually less than 1.5 times head length (range 1.1 to 1.5).

Parr marks—Almost invariably rectangular and long vertically; marks usually situated equidistant on each side of lateral line; dark parr marks and other markings contrast sharply with lighter background of body in some living and most preserved specimens.

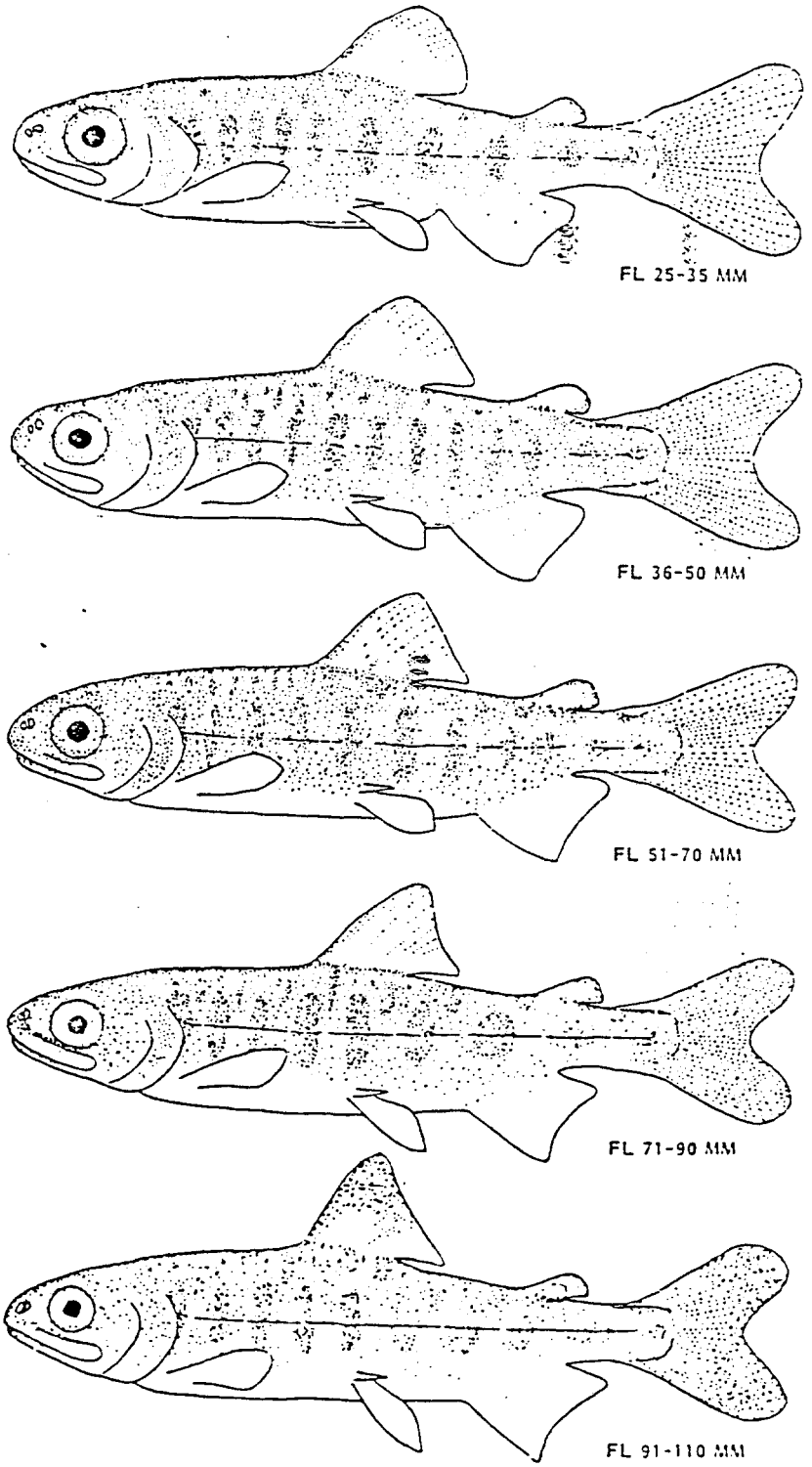

Plate 4.—Chinook salmon.

Coloration of body—*Preserved material*—Background color of body generally much lighter than body color of coho salmon, usually contrasting sharply with dark dorsal stripe or spotting, parr marks, and prominent dorsal spottings; blackish band astride dorsal ridge usually bold and unbroken in specimens less than 80 mm FL and especially on ridge before dorsal fin; in larger juveniles dorsal band often breaks up into series of spots, disappearing in larger presmolts as other spottings on dorsal half of body become more numerous and distinct; spottings between dorsal ridge and parr marks absent in fishes less than 35 mm FL, developing rapidly thereafter into many large and small spots and increasing in numbers as juveniles approach smolt stage. *Living specimens*—Parr marks and other markings may be obscured by bluish-silvery color of dorsal half of body and silvery sheen of ventral half.

Fins—Anal and dorsal fins averaging considerably larger in area than those of the chum and pink salmon and slightly larger than in the sockeye salmon; length of longest anal rays, when measured into head length, reaching from snout tip to beyond posterior edge of pupil and sometimes beyond posterior edge of eye; distal edge of anal slightly falcate in specimens more than 40 mm FL but averaging less falcate than does the free edge of the anal of the coho salmon. Anal rays 15 to 19, averaging higher in number than in any other species. *Dorsal fin* in young less than 60 mm FL usually has few or no distinct spottings, a blackish spot developing in the upper portion of the fin as the juveniles approach the smolt stage (see Plate 4). *Caudal fin* has comparatively few melanophores rather generally distributed in the smaller individuals, the lobes darkening as the fishes approach the presmolt stage.

Gill rakers (see Fig. 4)—Seven to twelve on upper limb, 10 to 16 on lower, total usually ranging between 20 and 25 (extremes 19 to 28); rakers short and similar in size and number to chum and coho salmon.

Pyloric caeca—Usually 140 to 185 (extremes 90 to 240); of value in separating this species from coho salmon, which normally has fewer than 85.

Branchiostegal rays—Usually 16 to 18 (extremes 13 to 19); average number greater than in any other species.

Scales in lateral line—Between 132 and 152; usually of most value in separating this species from pink salmon.

Habits—Life span 2 to 8 yr, usually 4 to 6. Jacks may occur. A portion of the juveniles enter salt water during first year of life; remainder stay in fresh waters more than 1 yr but rarely 2 yr. Juveniles of presmolt stage found in fresh waters when as long as 150 mm FL.

Combination of: Melanophores usually numerous and rather evenly distributed on adipose fin; occasionally in larger juveniles, posterior or free edge may be darker than remainder, thereby resembling somewhat melanophore distribution on adipose of chinook salmon. Anal fin in specimens larger than 30 mm FL more falcate and anterior tip more pronounced than in other species, including chinook salmon; in all except smallest specimens, anterior or leading edge of anal fin is whitish, with a dark bar parallel and posterior to it; remaining, posterior portion of fin usually abundantly speckled with melanophores except for distal and posterior edges (see Plate 5).

COHO (SILVER) SALMON—*O. kisutch*. . . . . Plate 5.

General development—Yolk sac usually disappears, except for a trace, before juveniles reach 32 mm FL. Body deeper and species more slab-sided in all pre-

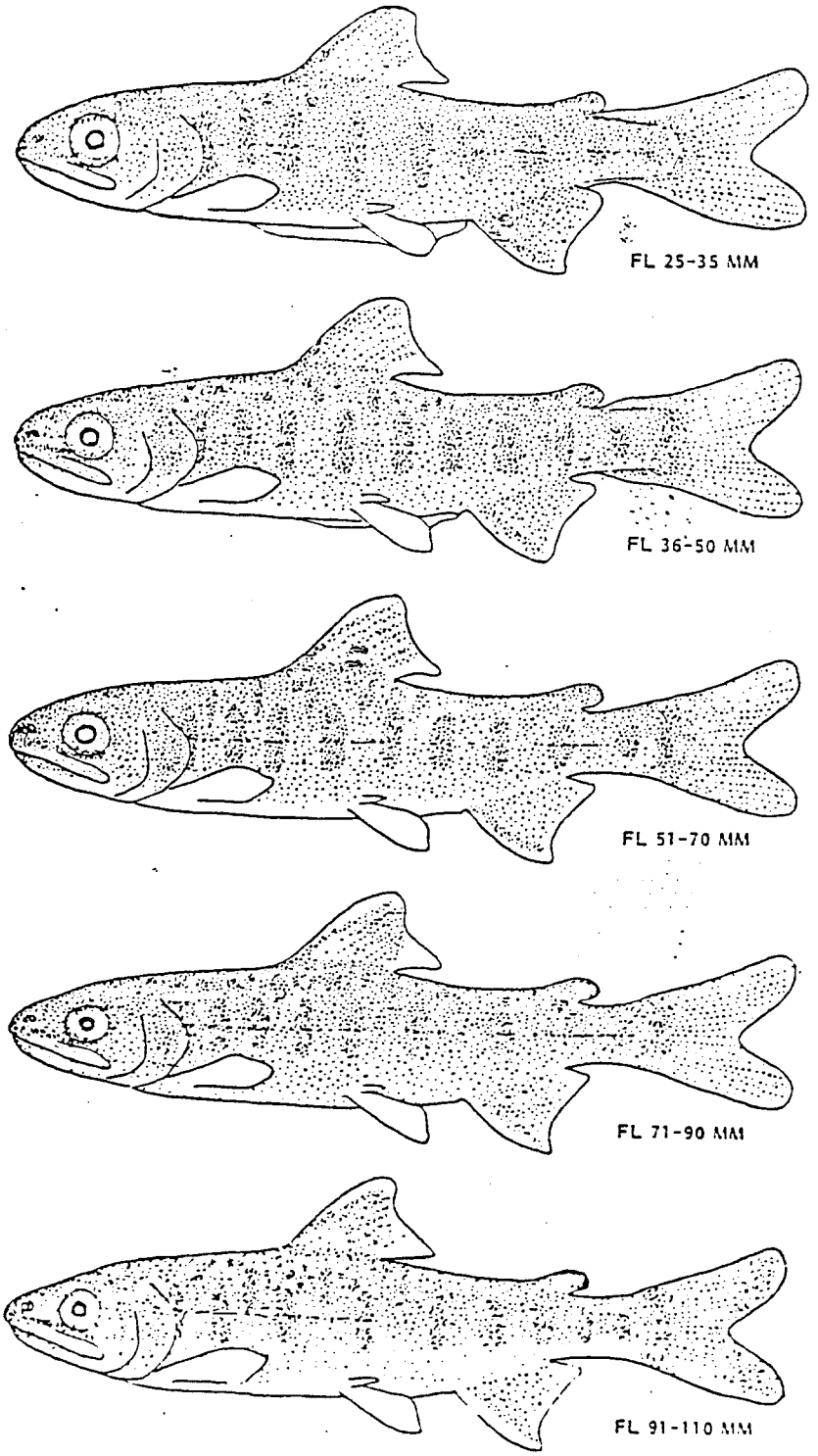

Plate 5.—Coho salmon.

smolt lengths than in chum and pink salmon; body depth immediately before dorsal fin usually less than 1.5 times head length (range 0.9 to 1.5).

Parr marks—Anterior parr marks always large and long vertically, their upper and lower ends more rounded than rectangular-shaped parr marks of chinook salmon; marks usually situated equidistant on each side of lateral line; usually less contrast between color of parr marks and body than in chinook salmon.

Coloration of body—*Preserved material*—In all but smallest specimens, contrast between all body marks and background color of body is not as pronounced as in other species; dark bar along dorsal ridge usually distinct and unbroken in juveniles less than 50 mm FL, breaking up into spots or disappearing in larger specimens; back spottings on both sides of dorsal ridge usually prominent in all except smallest specimens; spots between parr marks often elongate and extending downward between them, sometimes to lateral line (see bottom figure, Plate 5); spots on dorsal half of body often increase in number and/or decrease in size as individuals approach smolt stage. *Living specimens*—Parr marks and other body markings may be obscured by dark coloration of body or by bluish sheen.

Fins—Anal and adipose fins described under "*Combination of*" (this section). Anal rays usually 13 or 14 (extremes 13 to 16). *Dorsal fin* has comparatively few melanophores scattered over it in smallest specimens; in those more than 32 mm FL the number of melanophores increases, especially on or adjacent to anterior or leading edge; this results in a dark bar along the anterior edge behind which melanophores are rather evenly distributed; as fishes approach presmolt stage, a white anterior (or leading) edge and a whitish tip develops, followed by a dark parallel bar (see bottom figure, Plate 5). *Caudal fin* has rather even distribution of melanophores along rays in all except smallest young, this increasing in color intensity and number as fish increases in size.

Gill rakers (see Fig. 4)—Eight to thirteen on upper limb, 9 to 14 on lower, total number usually ranging between 19 and 27 (extremes 18 to 27); rakers short and rather similar in size and number to chum and chinook salmon.

Pyloric caeca—Usually 50 to 85 (extremes 45 to 114); of value in separating this species from chinook, pink, and chum salmon, which normally have more than 100.

Branchiostegal rays—Usually 13 or 14 (extremes 12 to 15); average number less than in chinook salmon, which normally has 15 or more.

Scales in lateral line—Between 120 and 140 (average 128); usually averaging fewer than in any other species.

Habits—Life span 2 to 4 yr. Jacks may occur. Majority appear to spend 1 or 2 yr in fresh waters, a few 3 yr. Some juveniles in presmolt stage are found in fresh waters when 150 mm FL.

GLOSSARY

Adipose fin A fleshy, finlike, rayless structure situated on dorsal ridge between dorsal and caudal fins (Fig. 1, No. 6).

Anal fin The fin situated medially and immediately behind vent between posterior end of abdomen and anterior end of caudal peduncle (Fig. 1, No. 16).

Axillary process or scale An accessory enlarged scale attached to upper or anterior base of pelvic fin (Fig. 1, No. 14).

Gill opening Opening between opercle or gill cover and side of head.

Branchiostegals or branchiostegal rays Elongated bones arranged fanwise within branchiostegal membranes, situated on ventral edge of gill covers (Fig. 6).

Caudal fin Terminal or tail fin of fishes (Fig. 1, No. 12).

Caudal peduncle That region of body between base of posterior ray of anal fin and base of caudal fin (Fig. 1, No. 11).

Chromatophores Color cells which under control of sympathetic nervous system can be altered in shape, producing color changes.

Cycloid scales Smooth-edged scales of soft-rayed fishes having an evenly curved posterior border devoid of minute spines.

Dorsal fin In salmons, a single fin composed of rays situated dorsally on body approximately halfway between head and tail (Fig. 1, No. 4).

Dorsal ridge Apex or dorsal junction of left and right sides of body; dorsal and adipose fins are situated on this ridge (Fig. 1, No. 3-6).

Dorsal stripe A band on dorsal ridge which is lighter or darker than adjacent areas.

Falcate Curved like a sickle; a fin is falcate when its distal edge is concave, having middle rays shorter than anterior and usually posterior rays.

Filaments See *gill filaments.*

Fork length Distance in a straight line from anteriormost part of tip of upper jaw or snout of juvenile salmons to apex of angle produced by two lobes of caudal fin (Fig. 1, No. 1).

Gill arch Branchial skeleton which contains gill rakers and gill filaments, or lamellae (Fig. 2).

Gill cover, opercle, or operculum Large, very flat, thin bones on each side of head which cover gills (see Fig. 3, which has the major portion of the gill cover removed).

Gill filaments (lamellae) Pleated folds of skin, richly supplied with blood vessels, attached to posterior edge of gill arch (Fig. 2, No. 5).

Gill rakers Projections on anterior edge of first gill arch (Fig. 2, No. 1).

Head length Distance in a straight line from anteriormost part of upper jaw or snout to posterior margin of opercle (Fig. 1, No. 2).

Hypural Complex of expanded and fused bones of last few vertebrae which support caudal fins in certain fishes.

Jack Precocious male salmon which spawn after spending a year or two less in the ocean than the majority of individuals; they are notably smaller than average size of spawning males of their species.

Juvenile As used here, a salmon between 25 and 110 mm FL which has not entered smolt stage.

Lamellae See *gill filaments.*

Lateral line A line formed by a series of sensory tubes and pores extending along sides from head to tail (Fig. 1, No. 10).

Lateral line scale count A count of pored scales from first scale on body behind head posteriorly to above hypural.

Melanophores Chromatophores with dark or black pigment.

Parr marks Squarish or oblong blotches or pigmented areas along sides of presmolt salmonids (Fig. 1, No. 9).

Pectoral fins Anterior or uppermost of paired fins of fishes, one on each side of breast immediately behind head (Fig. 1, No. 13).

Pelvic fins A ventral pair of fins, abdominal in salmonids (Fig. 1, No. 15).

Postdorsal ridge That portion of dorsal ridge behind dorsal fin (Fig. 1, No. 5).

Predorsal ridge That portion of dorsal ridge before dorsal fin (Fig. 1, No. 3).

Presmolt A juvenile salmon with parr marks; in pink salmon, which lack parr marks, demarcation between a presmolt and smolt is slight, differing chiefly in latter's more adult shape.

Pupil of eye Opening in iris of eye by which light reaches retina. It is circular in fishes (Fig. 1, No. 7).

Pyloric caeca Fingerlike diverticula, usually glandular, which open into alimentary canal

of most fishes at junction of stomach and intestine in region of pylorus (Fig. 7, No. 3).

Rakers See *gill rakers.*

Redd Excavation or nest made by a spawning salmon.

Rudimentary Very small and poorly formed, pertaining here chiefly to smallest gill rakers and anal rays (Fig. 5, "0").

Slab-sided When depth of body, measured before dorsal fin, is considerably greater than width of body.

Smolt As used here, a young salmon which has lost its parr marks. Pink and chum salmon fry usually go to the ocean within a few days of emerging from the streambed and usually do not undergo a visible change in morphology or color in fresh water.

Subadult An individual similar to an adult and approaching adulthood in age and size but still incapable of breeding.

Terete Nearly cylindrical in cross section and tapering toward the front and rear.

ACKNOWLEDGMENTS

Publications such as this are possible only because of aid given by many individuals. I wish to acknowledge the aid and encouragement given me by Robert J. Ellis, George Y. Harry, Jr., Wilbur L. Hartman, William R. Heard, David T. Hoopes, Theodore R. Merrell, Jr., Jay C. Quast, and William A. Smoker, and to the many field men, students, and others who have tested the key.

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Key to Field Identification of Anadromous Juvenile Salmonids in the Pacific Northwest

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ABSTRACT

A key is presented with descriptive illustrations to help in field identification of live, juvenile salmonids in fresh waters of the Pacific Northwest. Other juvenile fish that may be mistakenly identified as salmonids are included.

INTRODUCTION

Species identification of live, anadromous juvenile salmonids is frequently a problem to the field biologist. The purpose of this key is to list and illustrate the external characteristics which will expedite field identification of juvenile salmonids in the Pacific Northwest.

Five species of Pacific salmon (pink, chum, sockeye, chinook, and coho); four species of trout (cutthroat, brown, Dolly Varden, and rainbow or steelhead); and other juvenile and adult fish [1] that may be mistaken for salmon or trout in fresh water are described in this key.

USE OF KEY

The characteristics for identification are listed in a series of alternative statements, some of which are illustrated. To use the key, examine the first statement; if applicable, proceed to the next and continue to successive statements until the species is identified. If a statement is not applicable, pass to the alternative characteristics indicated by numbers in parentheses (numbers on the drawings correspond to numbers of statements in the key). Continue in this manner until the specimen is identified. Some external characteristics are positive separating features (marked with asterisk), whereas others are not. Therefore, two or more statements should be considered before final rejection. If a precise identification cannot be made using the external characteristics —and the fish can be sacrificed, a positive identification can usually be made from internal features (marked with double asterisks). A bibliography of keys that utilize more descriptive internal characteristics is included in this paper.

[1] Especially adult smelt, family Osmeridae.

KEY

1. (47) Adipose fin and scales present. (Fig. 1)
2. (48) Fleshy appendage at base of pelvic fins present.
3. (49) Mouth large, reaching at least to center of eye.

Family Salmonidae

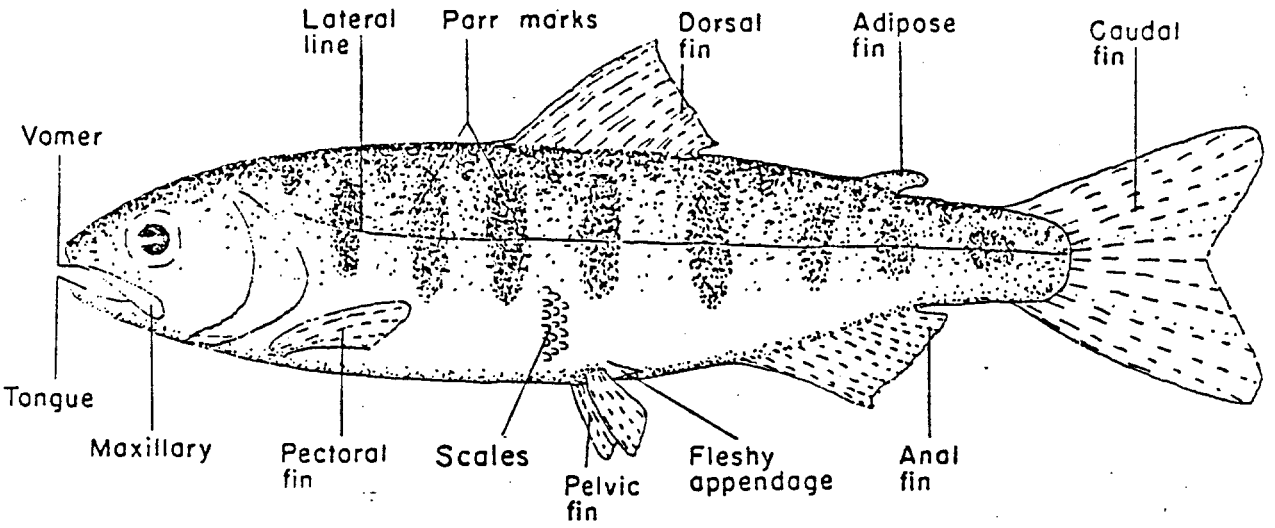


Figure 1.—A hypothetical salmonid showing external characteristics.

4. (17) Anal fin higher than long, with 8 to 12 developed rays (Fig. 2A)
5. (52) *Teeth on head and shaft of vomer. (Fig. 3A)

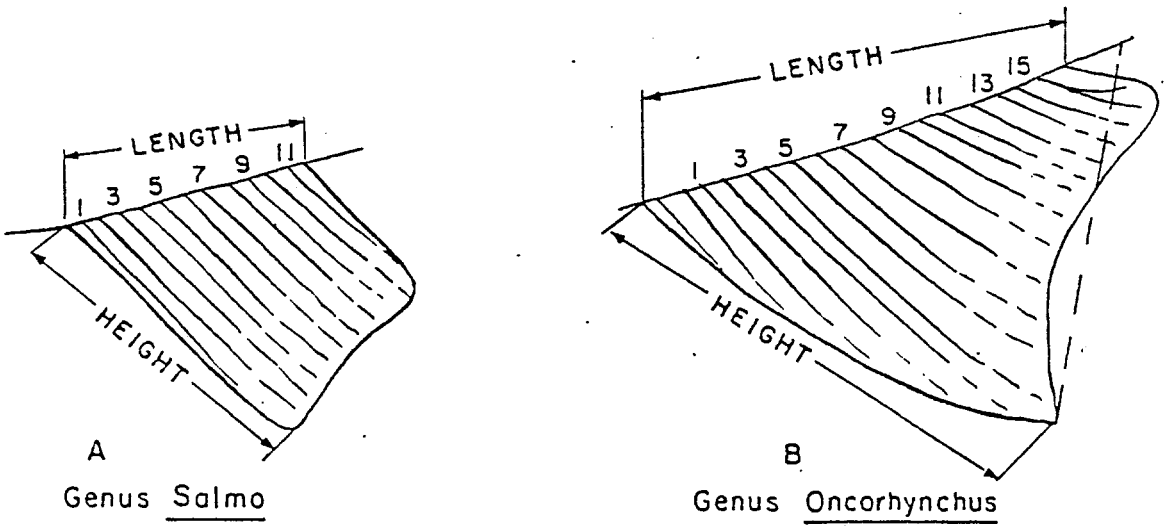


Figure 2.—Anal fins: (A) Trout, genus *Salmo;* (B) Pacific salmon, genus *Oncorhynchus.* The two drawings show differences in structure and fin ray count. (Note that the length of the anal fin is its overall basal length, and its height is that distance from the origin of the fin to the tip of the anterior lobe. In counting fin rays, include only those which originate from the base and terminate at the outer margin of the fin or are half as long as [or greater than] the longest ray.)

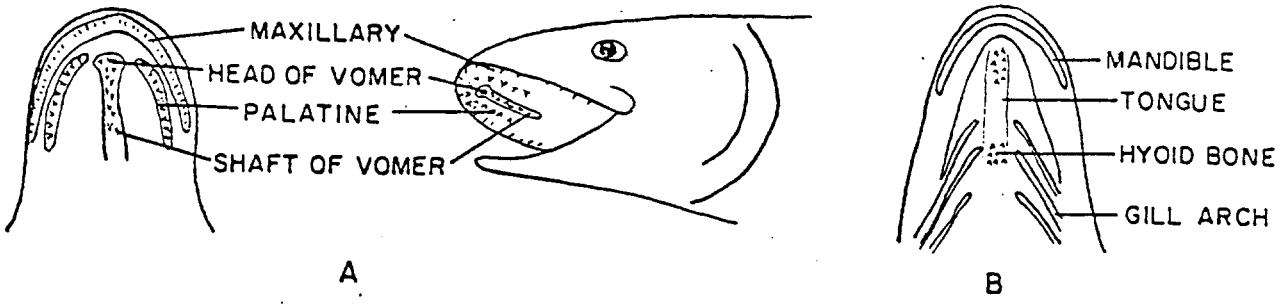
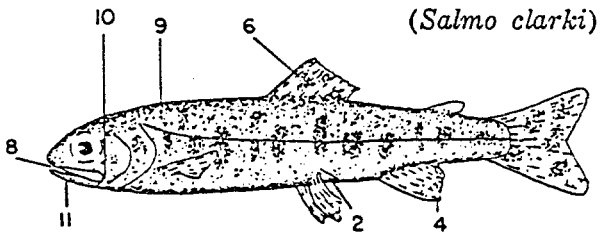


Figure 3.—Location of dentition in (A) the roof and (B) the floor of the mouth of salmonid fishes. (Presence or absence of teeth on the vomer or tongue may be determined by use of the little finger or a blunt instrument. The small hyoid teeth at the base of the tongue are located between the gill arches of the lower jaw and are difficult to find.)

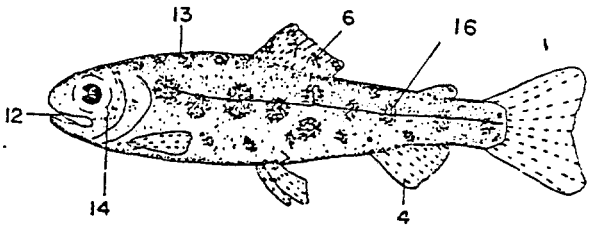
6. (18) Dorsal fin with large dark spots.
   Trout
   Genus *Salmo*

7. (53) Adipose fin not orange; no row of pale round spots along lateral line.
8. (12) *Small hyoid teeth at base of tongue. (Fig. 3B)
9. (13) Not more than five parr marks on mid-dorsal ahead of dorsal fin.
10. (14) Maxillary reaching past posterior margin of eye.
11. (15) Red or yellowish hyoid mark under lower jaw. Tail usually black spotted.
    Cutthroat trout
    (*Salmo clarki*)



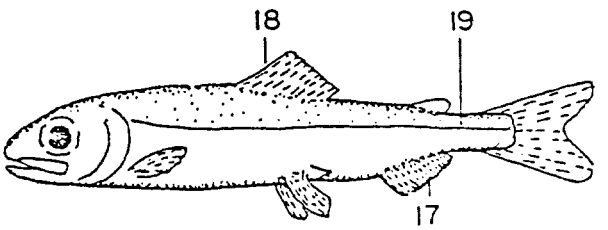
12. (8) *No teeth at base of tongue.
13. (9) Five to 10 parr marks along mid-dorsal ridge ahead of dorsal fin.
14. (10) Maxillary short, not reaching past posterior margin of eye.
15. (11) No hyoid mark under lower jaw. Few or no spots on tail.

16. (20) Parr marks almost round.
    Rainbow or
    steelhead trout
    (*Salmo gairdneri*)



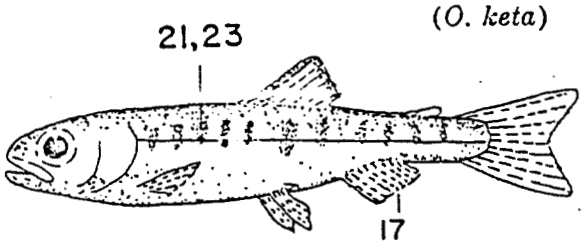
17. (4) Anal fin longer than high, with 13 or more developed rays. (Fig. 2B)
18. (6) Dorsal fin without large dark spots, may be black tipped.
    Pacific salmon
    Genus *Oncorhynchus*

19. (20) No parr marks. Fry leave fresh water while small—approximately 1.75 inches (45 mm) long.
    Pink salmon
    (*O. gorbuscha*)



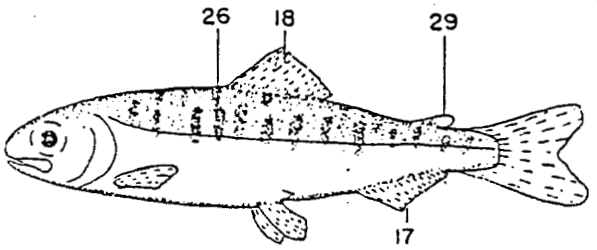
20. (16) Parr marks present as vertical bars or oval spots.
21. (30) Parr marks short, extending little, if any, below lateral line.
22. (25) Gill rakers on first arch, 19 to 26. ** Pyloric caeca, 140 to 186.
23. (26) Parr marks faint. Sides below lateral line iridescent green.
24. (27) Small when migrating from fresh water, approximately 1.5 inches (40 mm) long.

Chum salmon
(*O. keta*)



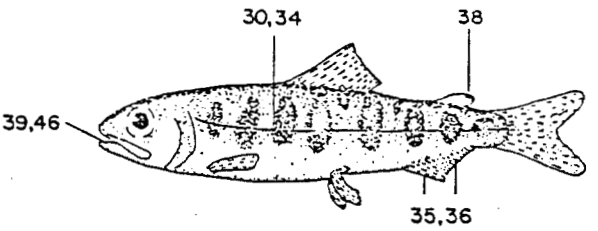
25. (22) Gill rakers on first arch, 30 to 40. **Pyloric caeca 60 to 115.
26. (23) Parr marks usually sharply defined. Sides below lateral line silvery, not iridescent green.
27. (24) Relatively large when migrating from fresh water, approximately 3 to 5 inches (80 to 126 mm) long.
28. (31) Gill rakers long and slender, more than 29 on first arch.
29. (32) Adipose fin clear, not pigmented.

Sockeye salmon
(*O. nerka*)



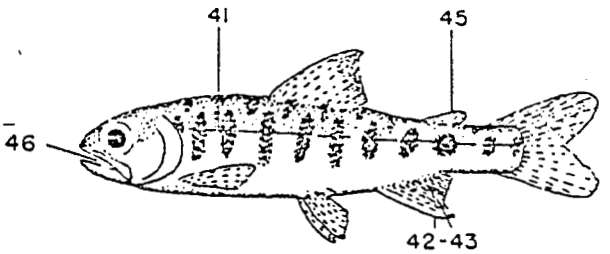
30. (21) Parr marks large, vertical bars centered by lateral line.
31. (28) **Gill rakers short and thick, fewer than 29 on first arch.
32. (29) Adipose fin at least partially pigmented.
33. (40) **Plyloric caeca more than 90.
34. (41) Parr marks broader than interspaces.
35. (42) Anterior rays of anal fin not distinctly longer than rest, not white edged.
36. (43) Anal fin not pigmented.
37. (44) Black spots, when present, on both lobes of caudal fin.
38. (45) Adipose fin not completely mottled, clear area at anterior base of fin.
39. (46) Black gums along base of lower teeth.

Chinook salmon
(*O. tshawytscha*)



40. (33) **Plyloric caeca less than 80.
41. (34) Parr marks narrower than interspaces.
42. (35) Anterior rays of anal fin elongated; when depressed they extend to base of last ray. (Fig. 2B)
43. (36) Anal fin pigmented between rays, resulting in black banding.
44. (37) Black spots, when present, on upper lobe of caudal.
45. (38) Adipose fin completely pigmented.
46. (36) Mouth gray to white.

Coho salmon
(*O. kisutch*)



47. (1) Adipose fin not present; scales present or lacking.

Not Salmonidae

48. (2) No fleshy appendage at base of pelvic fins.

Smelts
Family Osmeridae

49. (3) Mouth small, not reaching center of eye; teeth weak or absent.

50. (51) Depressed dorsal fin, shorter than head.

Whitefishes
Genus *Coregonus*

51. (50) Depressed dorsal fin, longer than head.

Arctic grayling
(*Thymallus arcticus*)

52. (5) **Teeth on head of vomer only.

Chars
Genus *Salvelinus*
Dolly Varden (*S. malma*)

53. (7) Adipose fin orange; row of distinct pale round spots along lateral line.

Brown trout
(*Salmo trutta*)

ACKNOWLEDGMENTS

We especially thank Dr. Arthur D. Welander, Professor of Fisheries, and Dr. Bruce S. Miller, Research Biologist, College of Fisheries, University of Washington, Seattle, for their valuable suggestions. We also thank Galen H. Maxfield, Fishery Biologist, and Dr. Alan J. Beardsley, Fishery Biologist, both from the NMFS Northwest Fisheries Center, Seattle.

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APPENDIX B

Procedures for Sampling Salmon Smolt for Age, Length, and Weight

The sample size is 70 sockeye salmon smolt per day, five days a week. If daily sampling objectives are being met, sampling will not occur on Wednesday and Sunday. It is essential that the sample be taken randomly. In the event that more than the required sample size is in the smolt trap at the time of sampling, the trap is to be stirred to assure randomness. When the smolt are randomly distributed, a small dip net will be used to remove a subsample. This procedure will be repeated until the sample size goal is met.

AWL Forms

Smolt length and weight will be recorded on AWL forms (Appendix B.1). Using a No. 2 pencil, complete each section of the left side of the AWL and darken the corresponding blocks:

Description: Include species (sockeye smolt), location, year, and samplers.

Card: The AWL forms and corresponding slides are numbered sequentially by date throughout the season starting with # 001. A new, consecutively numbered, card is used each day even if the previous card is not completed. There may be a minimum of one fish and a maximum of 40 fish (8 slides) per AWL.

Species: Refer to the reverse side of the AWL form to obtain species; sockeye = 2.

Day, Month, Year: Use the appropriate digits for the date the fish are sampled.

District, Subdistrict, Stream, Location: Consult project leader for the appropriate codes.

Period: List the period in which the fish were sampled using Appendix B.2.

Project: Refer to the reverse side of the AWL form to obtain code; code 4 will be used as default since a specific smolt code does not exist.

Gear: Refer to the reverse side of the AWL form to obtain code; 00 = trap.

Mesh: Leave blank.

Type of Length Measurement: Refer to the reverse side of the AWL form to obtain code; 1 = Tip-of-snout to fork-of-tail.

Number of Scales: Mark 1 (refers to 1 smear/fish)

# of Cards: Mark 1 (each AWL form is individually numbered)

Keep the litho codes in numerical order throughout the season and be sure to transfer the litho code from the front left side to the backside of the AWL form. These forms will be optically scanned and stray marks may be misinterpreted. It is the crew leaders responsibility to make sure that all forms are carefully edited before returning them to your supervisor.

Sampling procedure

Smolt will be kept alive and sampled the day of capture. MS222 will be used to anesthetize the fish. The use of this chemical will be demonstrated in the field. A flattened probe will be used to remove 5-10 scales from the preferred area, consult Appendix B.3. The scales will be mounted on a glass slide as illustrated in Appendix B.4. The left portion of each slide will be labeled: location, date, AWL # (card #), and fish numbers (1-5, 6-10, 11-15, etc.). When the slides are completed, return them to the box in order, and label the box as shown in Appendix B.4.. Smolt lengths will be measured in millimeters from the tip of the snout to the fork of the tail, Appendix B.5. Record each length by darkening the appropriate column blocks on the AWL form.

Excess water will be removed from the smolt before weighing by using a paper towel blotter. Individual smolt weights will be recorded to the nearest 0.1 gram on the backside (right side) of the AWL form (Appendix B.1).

Take care to ensure length and weight data corresponds to the appropriate scale smear as this information is used to calculate condition factor at age. When sampling for age, length, and weight, rite-in-rain books may be used to record data. After sampling is done, transfer the data carefully to the AWL forms. **It is the responsibility of the crew leader to make sure the data has been transferred correctly and the AWL form is filled out completely.**

Appendix B.1.

RED LAKE 1992

DESCRIPTION: SOCKEYE SMOLT

Pope, Bouwens, Glamen

ADF&G ADULT SALMON AGE LENGTH FORM VERSION 2.1

CARD:	038
SPECIES:	2
DAY:	04
MONTH:	06
YEAR:	92
DISTRICT:	256
SUBDISTRICT:	20
STREAM:	201
LOCATION:	RED LAKE
PERIOD:	23
PROJECT:	4
GEAR:	0
MESH:	
TYPE OF LENGTH MEASUREMENT	1
NUMBER SCALES/ FISH	1
# OF CARDS	1

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS AREA

234825

Litho Code

NCS DOCUSCAN MR20-17877 131211 A4200

Weights 10's 1's 1/10's

Litho Code Transferred

DO NOT MARK IN THIS MARGIN

DO NOT WRITE IN THIS AREA

TRANSFER RESPONSES EXACTLY AS PRINTED ON FRONT TO THIS GRID

SPECIES

1 - Chinook (king)
2 - Sockeye (red)
3 - Coho (silver)
4 - Pink (humpy)
5 - Chum (dog)

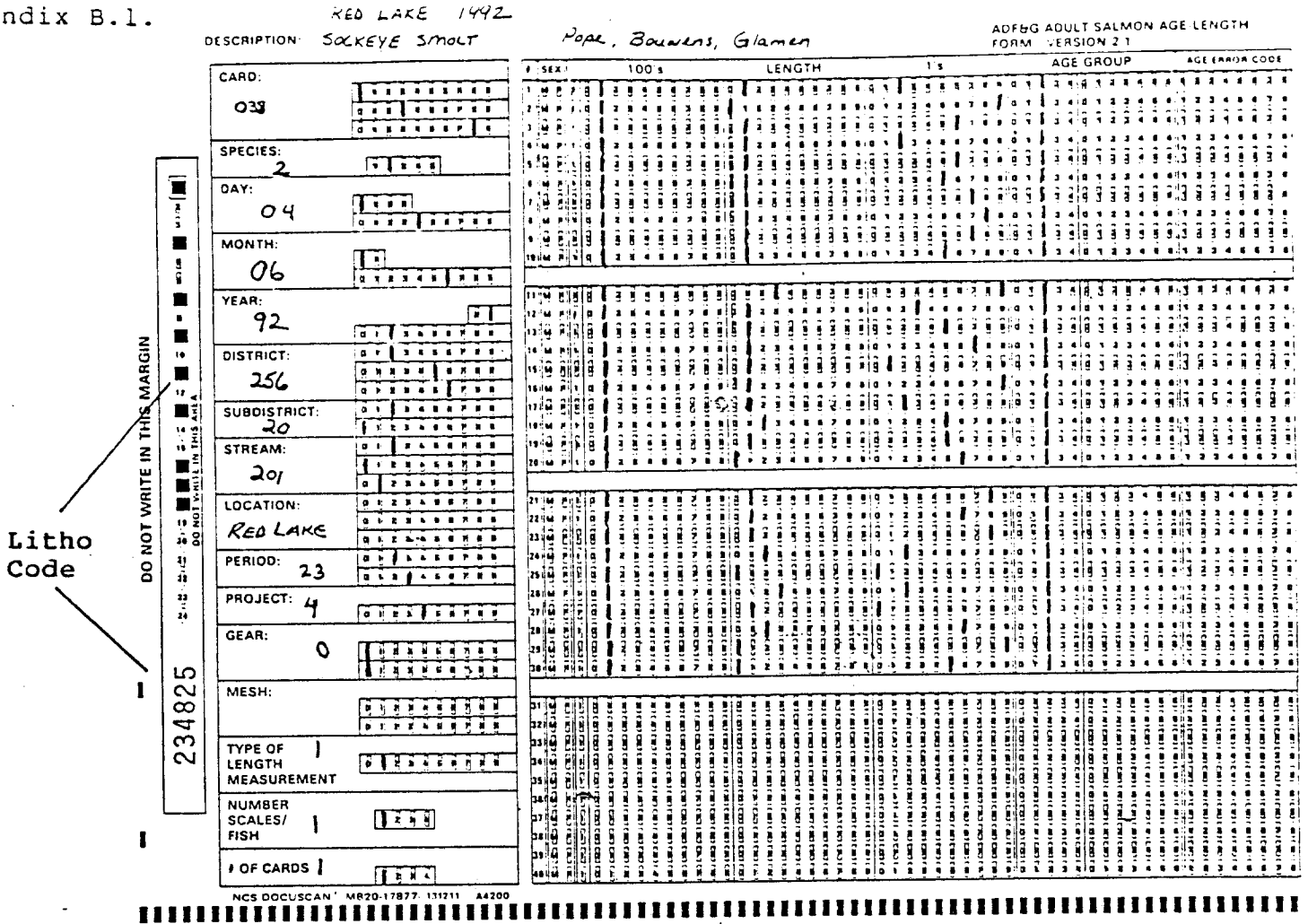
PROJECT

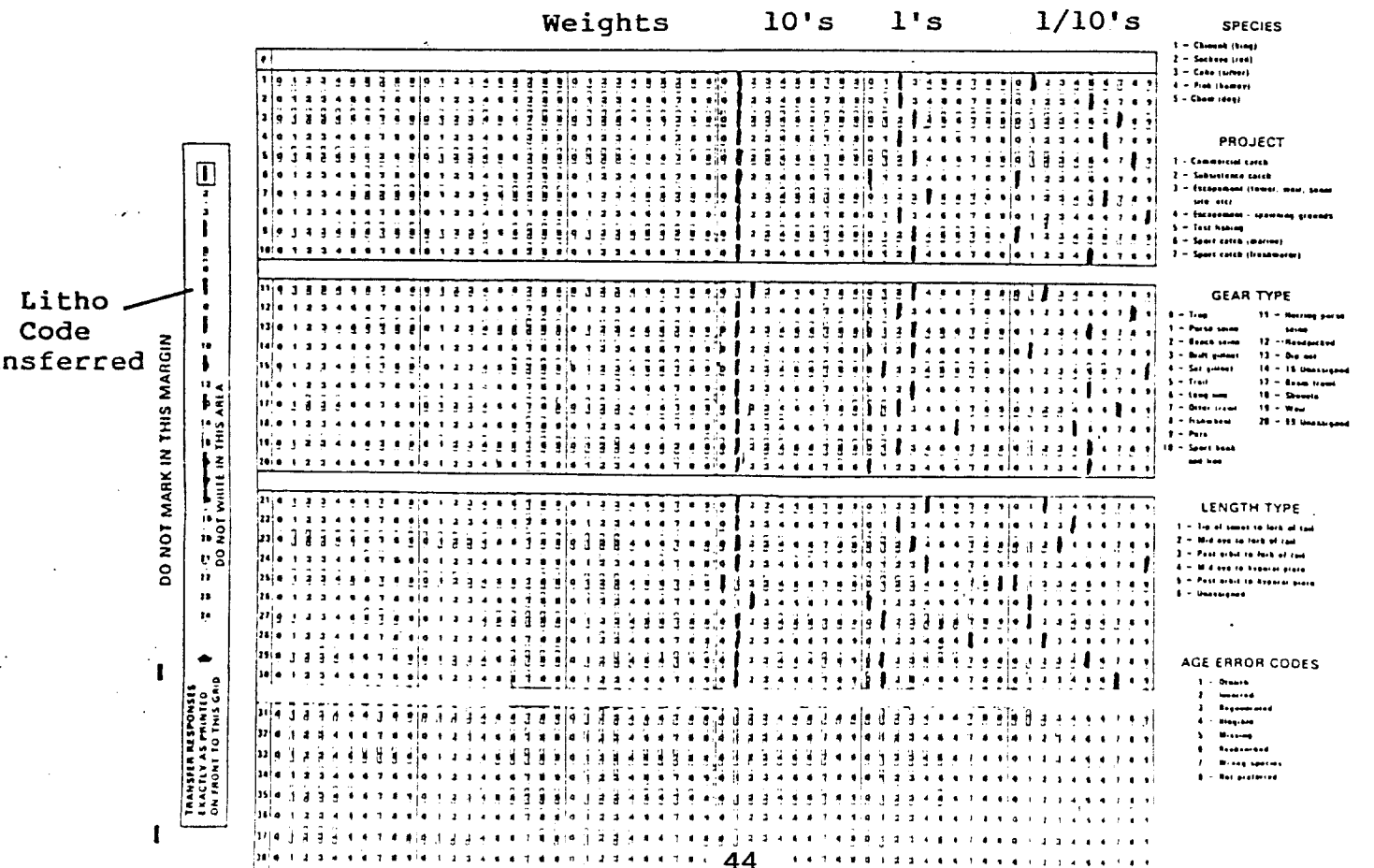
1 - Commercial catch
2 - Subsistence catch
3 - Escapement (tower, weir, sonar site, etc)
4 - Escapement - spawning grounds
5 - Test fishing
6 - Sport catch (marine)
7 - Sport catch (freshwater)

GEAR TYPE

0 - Trap
1 - Purse seine
2 - Beach seine
3 - Drift gillnet
4 - Set gillnet
5 - Trail
6 - Long line
7 - Otter trawl
8 - Fishwheel
9 - Pure
10 - Sport hook and line
11 - Herring purse seine
12 - Handpicked
13 - Dip net
14 - 15 Unassigned
17 - Beam trawl
18 - Shovels
19 - Weir
20 - 19 Unassigned

LENGTH TYPE





1 - Tip of snout to fork of tail
2 - Mid eye to fork of tail
3 - Post orbit to fork of tail
4 - Mid eye to hypural plate
5 - Post orbit to hypural plate
6 - Unassigned

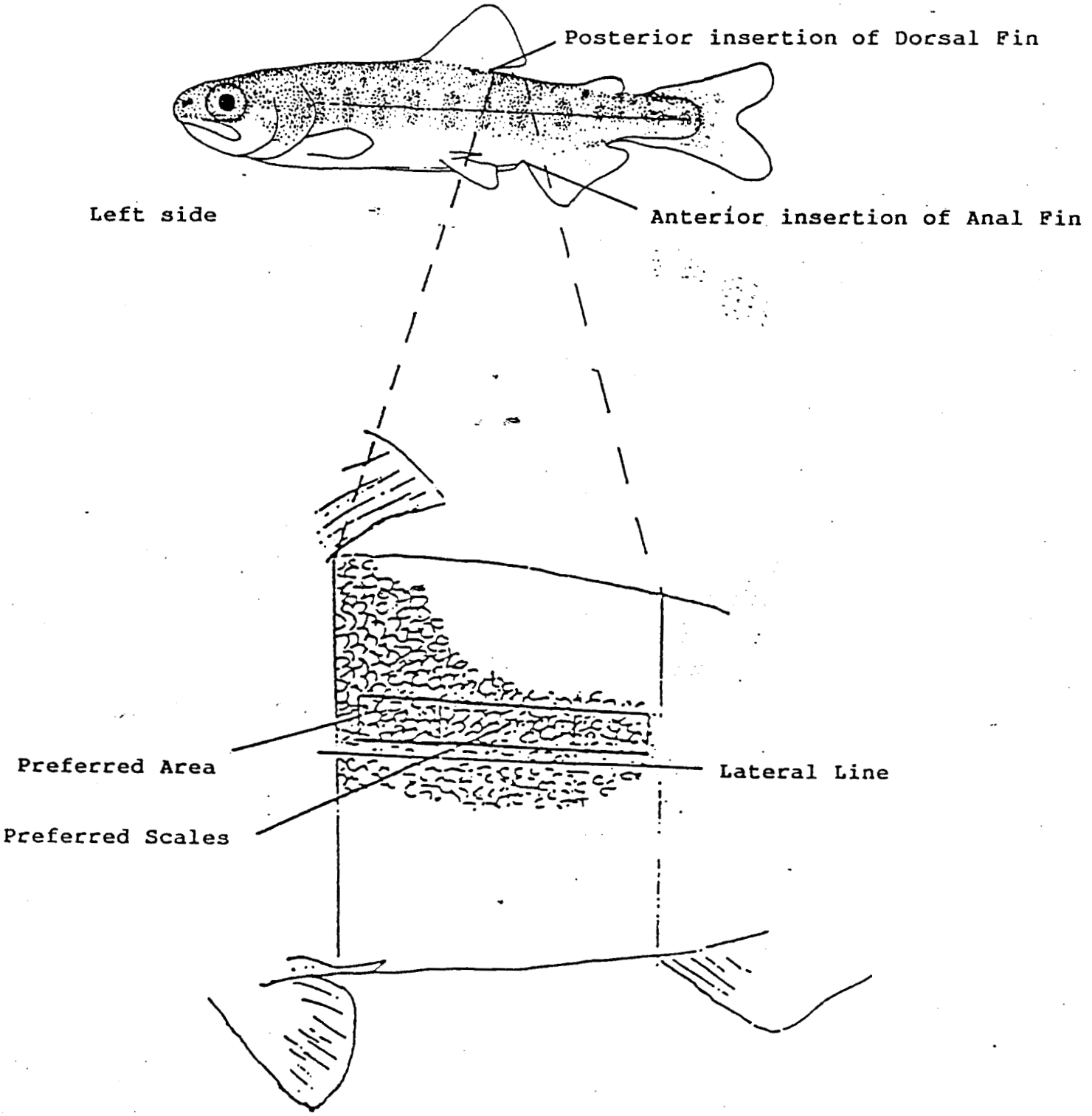
AGE ERROR CODES

1 - Otoliths
2 - Inverted
3 - Regenerated
4 - Illegible
5 - Missing
6 - Readsorbed
7 - Wrong species
8 - Not preferred

Appendix B.2. Period codes and corresponding dates.

Period	Dates	Period	Dates
1	01-Jan to 03-Jan	28	05-July to 11-July
2	04-Jan to 10-Jan	29	12-July to 18-July
3	11-Jan to 17-Jan	30	19-July to 25-July
4	18-Jan to 24-Jan	31	26-July to 01-Aug
5	25-Jan to 31-Jan	32	02-Aug to 08-Aug
6	01-Feb to 07-Feb	33	09-Aug to 15-Aug
7	08-Feb to 14-Feb	34	16-Aug to 22-Aug
8	15-Feb to 21-Feb	35	23-Aug to 29-Aug
9	22-Feb to 28-Feb	36	30-Aug to 05-Sep
10	01-Mar to 07-Mar	37	06-Sep to 12-Sep
11	08-Mar to 14-Mar	38	13-Sep to 19-Sep
12	15-Mar to 21-Mar	39	20-Sep to 26-Sep
13	22-Mar to 28-Mar	40	27-Sep to 03-Oct
14	29-Mar to 04-Apr	41	04-Oct to 10-Oct
15	05-Apr to 11-Apr	42	11-Oct to 17-Oct
16	12-Apr to 18-Apr	43	18-Oct to 24-Oct
17	19-Apr to 25-Apr	44	25-Oct to 31-Oct
18	26-Apr to 02-May	45	01-Nov to 07-Nov
19	03-May to 09-May	46	08-Nov to 14-Nov
20	10-May to 16-May	47	15-Nov to 21-Nov
21	17-May to 23-May	48	22-Nov to 28-Nov
22	24-May to 30-May	49	29-Nov to 05-Dec
23	31-May to 06-June	50	06-Dec to 12-Dec
24	07-June to 13-June	51	13-Dec to 19-Dec
25	14-June to 20-June	52	20-Dec to 26-Dec
26	21-June to 27-June	53	27-Dec to 31-Dec
27	28-June to 04-July		

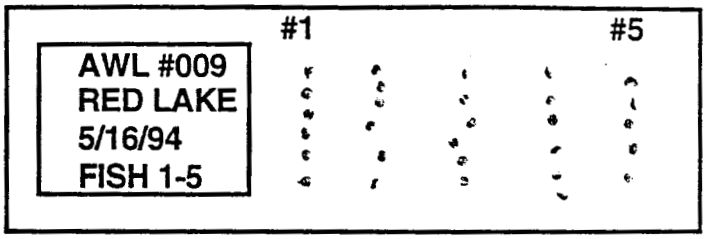
Appendix B.3. Scale sampling procedure showing the preferred area on a smolt salmon.

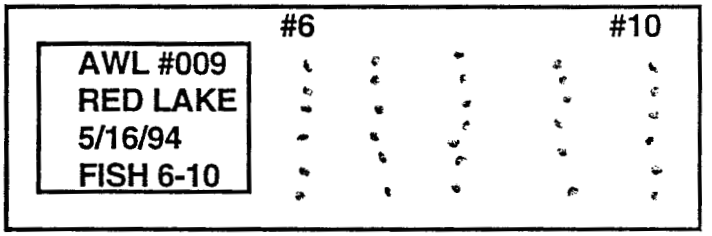


Appendix B.4 Salmon smolt glass slide example.

The following information should be legibly written on the slide label:

1. AWL #
2. Location
3. date (mo/day/yr)
4. Fish # (1-5, 6-10,...35-40)



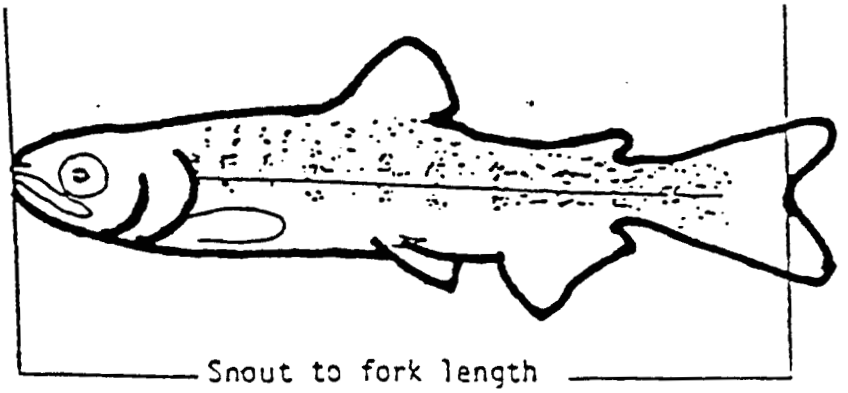


When the slides are completed, return them to the box in order by AWL #, date, and fish #. Label the slide box on top with the following information:

LOCATION (RED LAKE)
AWL NUMBERS (AWL # 009 - 018)
BEGINNING AND ENDING DATES (5/16 - 20/94)

Appendix B.5

MEASURING SMOLT LENGTH



DIVIDER

OPERATIONAL PLAN

CHIGNIK

SOCKEYE SMOLT STUDIES, 1995

Alaska Department of Fish and Game
Commercial Fisheries Management and Development Division
211 Mission Road
Kodiak, Alaska 99615

April 1995

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INTRODUCTION

For 1995, the Department of Fish and Game, Division of Commercial Fisheries Management and Development and Management has been contracted by the Chignik Regional Aquaculture to principally evaluate the sockeye salmon *Oncorhynchus nerka* smolt outmigration from the Chignik system.

The objectives and tasks associated with this endeavor are:

Objectives

1. Estimate the total number of outmigrant sockeye smolt by age class from the Chignik River system in 1995.

2. Estimate sockeye smolt timing and growth characteristics (length, weight, and condition) by age class for the Chignik system in 1995.

3. Archive the smolt scales for later SPA use in determining stock composition of the 1995 outmigration; the known scale patterns for Black Lake and Chignik Lake stocks would be obtained from future adult returns.

Tasks

1. In Chignik River, operate two rotary screw traps continuously from 8 May through 30 June.

2. Quantify the daily catch of sockeye smolt per trap.

3. Sample 70 sockeye smolt per day, five days each week for age (scales), length, and weight through the migration.

4. At minimum once each week, mark and release 1,000 sockeye smolt approximately 0.5 miles upstream of the screw traps to determine trap efficiency. The marking will be conducted using Bismark Brown Y dye.

5. By 21 October 1995, publish a completion report summarizing the 1995 smolt studies.

SUPERVISION

The field staff are:

Tom Vania - Crew Leader
Keith Weible - Crew

The crew leader is responsible for making daily work assignments and ensuring that operations are conducted safely and according to the standards defined in this manual. It is also the crew leaders responsibility for making sure that the crew has read and understood the Department's field safety policy, and have signed the EMPLOYEE SAFETY SOP VERIFICATION. Note that the Chignik Area Management Biologist, Dave Owen, is technically in charge of all Chignik ADF&G operations and due respect and cooperation is to be extended to him and his staff at ALL times. Charlie Swanton is responsible for administratively oversee the smolt program which will include ensuring that adequate logistic, equipment, and technical support are provided.

PROCEDURES

Trap Location, Set-up, and Maintenance

Two rotary screw traps will be sited in Chignik River at a field site located directly down stream of the "King Hole". The traps will be the same as used during 1993 in the Chignik and Black Rivers (Ruggerone 1994). Ideally, both traps will be operated in tandem, but alternatively they are to be situated parallel to each other off opposite river banks. At the placement location, water velocity should be approximately 5 ft/sec (150 cm/sec.) to provide a trap operating speed of about 5-6 rpm. To further reduce smolt avoidance, each trap should be routinely adjusted to fish in relatively close proximately (< 0.5 ft) to the river bed. Both traps are to be operating in the Chignik River by 8 May 1995. Inshore leads should be used on the traps, if possible. Perforated smolt panels and vexar will be available for lead material. After initial trap set-up and evaluation, if a trap is repositioned or lead material is added or deleted, the action should be well documented in the comment section of the Daily Catch Reporting Form (Figure 1). In addition, trap catch efficiency MUST be determined as soon as possible after modifications are made.

Each trap will be checked as often as necessary to maintain trap efficiency and minimize any fish mortalities. Minimally, the traps should be checked every 30 minutes between sunset and sunrise. During daylight hours a check once every five hours is usually adequate. The last trap check will be at the conclusion of the smolt day (1200 hrs). Although smolt generally outmigrate in the evening hours, there is evidence of large smolt movements occurring in hours of mid afternoon coinciding with major weather changes including rain storms. It is essential that close vigilance be maintained to all reasonable degree. Unfortunately there are numerous instances where crew

vigilance has been less than desirable and thousands of smolt have been overcrowded and killed solely due to crew inattentiveness.

Quantification and Species Identification of Trap Catch

For determining the number of fish caught in the traps dipnetting the smolt and counting them from the livebox is the simplest and most common procedure. All sockeye smolt enumerated will be recorded on the Daily Smolt Catch Recording Form (Figure 1). The second method involves a catch-weight sampling procedure where the catch is transferred by a dip net into a small mesh netted basket suspended over the river from a hanging scale. The equipment for this operation should be set up immediately after trap placement thereby being readily available should excessive numbers of smolt be caught. In prosecuting the catch-weight method, the aggregate weight of the catch is recorded for each weighing and the process is continued until the live box is emptied (Figure 2). During the catch-weight sampling process, samples are to be taken to determine species count by weight. This involves counting the number of fish by species from a known aggregate weight obtained using the hanging scale. Generally the rule will be to sample every tenth dip net of fish for a species count by weight. The second method should only be used when there are relatively large numbers of smolt being caught, and there is not enough time to count all the fish without incurring mortalities. It should be noted in the comments section of the daily smolt reporting form when the catch-weight method is used. The last daily smolt count will occur at 1200 hrs completing the daily smolt enumeration. The daily total will be recorded on the Sockeye Salmon Smolt Summary Form (Figure 3).

All sockeye catch will be identified and counted (regardless of size), catch of other species will be estimated and recorded but not directly counted. Species identification keys are provided in Appendix A. It will be the responsibility of the crew leader to insure that the staff uses the keys to properly identify the catch.

Trap Efficiency

Once a week (or more frequently if necessary), trap efficiency will be estimated by marking sockeye smolt, releasing these smolt, and counting the number of recaptured smolt. Marking will be accomplished by using Bismark Brown Y dye. The marking process can be stressful on sockeye smolt which should be kept in mind at all times during the procedure. Minimizing unnecessary stress is the key. Excessive handling (netting), elevated water temperature, and exposure to the dye itself, are the primary stress factors. All of these can induce mortality alone, so if one or more of these are combined, significant losses may occur. The following steps should be followed to minimize mortality and assure valid results:

1. **Collect 1,000 to 1,100 sockeye smolt.** The goal is to be consistent in the weekly timing and number for mark and release trials. Do not hold smolt for more than three nights when trying to collect the 1,000 for marking. Mark what you have collected after three days. A minimum of 500 smolt should be used if an extended collection time is required. Record the time, water temperature, and number of smolt collected on the Smolt Dye Release Form (Figure 4).

2. **Set up marking station at release site.** The release site should be no less than 0.5 miles upstream of the smolt traps in an area of relatively calm water. A holding box will be placed in the river, preferably in a "pool" area, for initial release of marked smolt. Assemble other marking equipment: one or more 30 gallon totes, Bismark Brown Y dye, supplemental oxygen (02 bottle, regulator, tubing, air stone), aerators, thermometer, log book.

3. **Move smolt to release site.** Use two or more totes to hold the smolt. An aerator will be used to aerate the water in each container. Split the 1,000 smolt about evenly between transport containers. It is important to be efficient when moving the smolt to the release site. Record the water temperature prior to transport to the release site.

4. **Mark and release smolt.** Upon reaching the release site, hold the smolt in a live container box or tote anchored in the river for a minimum of 30 minutes. Record the water temperature at the start of the recovery period and any mortality at the end of the recovery period. To reduce stress, oxygenate the water using the portable aerators and/or oxygen bottle.

   The dye mixture will be 1.9 grams of BBY dye per 57 liters (15 gallons) of water. Mix in a 30 gallon container. Importantly, use an aerator and supplemental oxygen to maintain oxygen level. Record the water temperature in the dye container. Using a dipnet, place the smolt into the dye/water mixture for 30 minutes. Keep the dye container (with the lid on) in the river to maintain ambient water temperature. Record any mortality that occurs. After the smolt are dyed, place them into the inriver holding box until release which should occur between 2200 and 2300 hrs. At the time of release, transfer only the robust smolt to water filled buckets and release them evenly across the river. Record the number of healthy smolt released, time of release, water temperatures and other data on the Smolt Dye Release Form (Figure 4). All sick and dead smolt will be disposed of in a manner which will not attract animals or influence trap catches.

5. **Examine for marked smolt.** For three smolt days (which includes 3 nights) following the release of dyed smolt, all smolt caught in the traps are to be examined for marks. The first day of smolt examination will be the day of release. The last smolt examination will occur on the 3rd day after release at 1200 hrs. Trap efficiency is measured by the number of marked fish recovered relative to the number released. Record mark recapture data on the

Daily Smolt Catch Reporting Form (Figure 1) and summarize the data on the Sockeye Salmon Smolt Summary Form (Figure 3). **Remember that the number of smolt examined in a day equals marked and non-marked smolt caught that day. Daily smolt catch will then equal the number examined minus the number marked since marked smolt were previously counted.** If all fish are not examined, be CERTAIN to record it with an explanation in the comments section of the Daily Smolt Catch Reporting Form (Figure 1).

Remember, stay vigilant and work the gear to minimize smolt avoidance. As a gauge, shoot for a combined trap efficiency of 3% minimum and 10% maximum.

Age, Weight, and Length Sampling

At total of 70 sockeye smolt per day, five days per week, are to be sampled for age, length, and weight. If daily sampling objectives are being met, sampling will not occur on Wednesday and Sunday. Specific procedures for collecting and recording the information is in Appendix B. Each sample will be taken from a single days catch. Do not mix samples between days. If less than 70 fish are caught in a day, the sample size for that day will be the number of fish caught on that day. Since smolt primarily migrate at night, a single sampling day will be the 24-h period from noon to noon and will be identified by the calendar date corresponding to the first noon. Note that during the 1994 season and as reported in Stopha and Barrett (1994) the sockeye smolt trap catch was stratified by fish subjectively identified as being < 55 mm and those greater than. During 1995, this procedure will not be done. All sockeye smolt catch will regardless of size will be enumerated and subject to age, weight, and length sampling.

Daily inseason, reporting of information (daily and cumulative smolt catch, mark-recapture results, etc. should be faxed attention Charlie Swanton preferably prior to 8:30am. Once this information is available either the crew or one of the daytime office staff should fax it to the Kodiak office so that it can be integrated into our daily smolt report. This is also an oppertunity to check daily and cumulative trap catches and make sure that they add up. The phone is not going to be the primary mode of transmitting information unless to make corrections, discuss problems, or for asking questions. Charlie Swantons phone numbers are: 486-1852 (office) or 486-5663 (home).

Climate Data

Climatological data will be collected at the Chignik weir bulkhead daily at approximately 1800 hrs. The information will be recorded on the Climatological Observation Form and will include

water and air temperatures (C), river height (cm), percent cloud cover, and wind direction and velocity (Figure 5).

PROJECT TERMINATION

The rotary screw-traps will be removed at the end of the smolt migration which is expected to be about 1 July. An inventory of all equipment, suggestions for field operational plan modifications and future equipment purchases will be forwarded to the project supervisor at the end of the season (No ifs, ands, or buts). The exact date for trap removal will be determined by Swanton and Vania based on trap catch rates.

Figure 1. DAILY SMOLT CATCH REPORTING FORM

TRAP NUMBER _____ PROJECT LOCATION _____ DATE _____

TIME (MILITARY)	SOCKEYE SMOLT (numbers)			OTHER (numbers)			COMMENTS 2/
	CATCH 1/	EXAMINED FOR MARKS	MARKED RECOVERIES	COHO	DOLLY V.	STICKLEB.	
TOTAL							

1/ Catch number does not include marked recoveries.

2/ To be included in comments: estimate young-of-year fry numbers by species and number of sockeye smolt mortalities.

Figure 2. Catch-weight sampling form (work sheet for estimating smolt trap catch).

Date:_____ Time Period (military):_____ to _____ Project Location: _____

Basket Weight (wet): _____

Basket #	Weight (fish + basket)	Basket #	Weight (fish + basket)	Basket #	Weight (fish + basket)	Basket #	Weight (fish + basket)
1.		11.		21.		31.	
2.		12.		22.		32.	
3.		13.		23.		33.	
4.		14.		24.		34.	
5.		15.		25.		35.	
6.		16.		26.		36.	
7.		17.		27.		37.	
8.		18.		28.		38.	
9.		19.		29.		39.	
10.		20.		30.		40.	
TOTAL:		TOTAL:		TOTAL:		TOTAL:	

GRAND TOTAL _____ LESS BASKET WEIGHTS _____ = _____ (a)

Sample Biomass (Fish plus basket weight)	CATCH	
	Sockeye Smolt	Other
1.		
2.		
3.		
4.		
5.		
TOTAL:	(c)	(d)

GRAND TOTAL _____ LESS BASKET WEIGHTS _____ = _____ (b)

ESTIMATED CATCH: _____ SMOLT (ac/b); _____ OTHER (ad/b)

Figure 3.

SOCKEYE SALMON SMOLT SUMMARY FORM

PROJECT LOCATION :

TRAP NUMBER:

DATE 1/	NUMBER OF SMOLT					
	CAUGHT 2/					MARKED 3/
	DAILY	CUM.	MORTS.	DYED	EXAMINED	RECOVERIES

1/ Each date covers a 24-hour period extending from noon to noon and identifies the starting date.
2/ Numbers of fish caught does not include marked recoveries.
3/ Marked recoveries are not included in the catch because they represent previously caught smolt.

Figure 4.

SMOLT DYE RELEASE FORM

DATE (actual): _____

CREW NAMES (print) _____

PROJECT LOCATION _____

NUMBER OF FISH COLLECTED: _____
(from live box)

CREW LEADER
(signature) _____

	COLLECTION LIVE BOX	TRANSPORT BUCKET	RECOVERY CONTAINER	DYE TUB	RECOVERY CONTAINER	TRANSPORT BUCKET	STREAM RELEASE
START TIME (military)							
START TEMP (degree celsius)							
END MORTALITY (number of fish)							
OXYGEN SUPPLEMENT O2 or aerator (A)							

DYE SOLUTION (mixture): _____ Dye (grams); _____ Water (gallons)

RELEASE SITE LOCATION (distance upstream of trap site, in miles) _____

TOTAL NUMBER OF DYED FISH RELEASED: _____

COMMENTS:

Figure 5. CLIMATOLOGICAL OBSERVATIONS

PROJECT LOCATION: _____

DATE	TIME	TEMPERATURE		CLOUD COVER (%)	WIND		STREAM GAUGE[a] (in cm)	COMMENTS
		AIR (°C)	WATER (°C)		DIRECTION	VEL. (MPH)		

[a] Round to nearest 1 cm.

APPENDIX A

Presmolt Salmon Key
and
Anadromous Juvenile Salmonides Key

A Guide to the Collection and Identification of Presmolt Pacific Salmon in Alaska with an Illustrated Key

MILTON B. TRAUTMAN[1]

ABSTRACT

This field and laboratory key contains recommendations for types of equipment needed, instructions for preserving and labeling specimens, and descriptions of the characters used in identifying five species of Pacific salmon. The key is illustrated with six line figures: 1) juvenile salmon, 2) the first gill arch, 3) head with gill arch in situ, 4) first gill arch and eye for comparison with longest rakers, 5) method of counting anal fin rays, and 6) ventral surface of head showing branchiostegals. Five plates of stippled line drawings of five lengths (25 to 110 mm fork length) for each of the five species of Pacific salmon, an annotated opposable key, and a glossary are also included.

INTRODUCTION

As adults, the five species[2] of Pacific salmon of the genus *Oncorhynchus* inhabiting western North American waters are easily identified, but as subadults or as smolts in silvery coloration, they are less easily recognized. As juveniles less than 125 mm (5 inches) in fork length (FL), they may be quite difficult to identify. In addition, characters by which presmolt juveniles can be distinguished may vary with geographic area.

Several keys for identification of juvenile salmon have been published, most of which utilize the number, length, and shape of the gill rakers on the first gill arch; number of pyloric caeca and branchiostegals; and absence of parr marks, or if present, their size and shape (Foerster and Pritchard, 1935; Schultz, 1936; Haig-Brown, 1947; Clemens and Wilby, 1961; McPhail and Lindsey, 1970; Wilimovsky[3]). In addition to the above characters, the key in this paper emphasizes and illustrates the distribution of those chromatophores (usually melanophores) which are reliable enough to aid in the specific identification of juveniles.

This key describes the characters typical of presmolt juveniles of the five species of Pacific salmon in Alaska. The common names recommended by the American Fisheries Society (Bailey et al., 1970, p. 17) are used, despite the fact that other names appear to be in more general use. These other names are inserted in parentheses after their respective species. Trouts, Atlantic salmon (*Salmo salar*), and some other salmonoids are included in the key because of their resemblance to Pacific salmon.

Before presenting the key, it appears advisable to describe the equipment and methods I recommend for preserving specimens, labeling specimens, and counting, measuring, and removing parts of specimens, so that those not acquainted with my procedures may more accurately and quickly identify their material.

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[1] Professor Emeritus of Zoology, Ohio State University, Columbus, OH 43210. The author was employed in Alaska by the National Marine Fisheries Service Auke Bay Fisheries Laboratory during the summers of 1959 and 1961. The specimens were obtained and most of the drawings made at that time.

[2] A sixth species, *O. masou* (Brevoort), inhabits the streams of eastern Asia from the Okhotsk Sea to Formosa.

[3] N. J. Wilimovsky, 1958. Provisional keys to the fishes of Alaska. On file Natl. Mar. Fish. Serv., Auke Bay Fish. Lab., Auke Bay, AK 99821.

RECOMMENDED EQUIPMENT

Magnifiers: Magnification in the range of 4 to 30 will prove helpful in identification of juvenile salmon. A binocular microscope having such a range is the most satisfactory, but any type of magnifier of more than 4 power and less than 30 may be used provided it is not necessary to use one's hand to hold it—usually both hands are needed to manipulate a specimen. In the field, a binocular unit containing lenses inserted in a frame or headstrap or a jeweler's eye magnifier (especially if one wears glasses) may be used.

Forceps: Four or five inches long with straight or curved tips—for lifting fins, holding back gill covers, etc.

Scalpel: A sharp blade an inch or two long—for removing gill arches, opening body cavities, etc.

Teasing needle: A needle inserted in a wooden or metal handle—for separating closely set gill rakers, etc.

Dividers: For measuring and comparing various body parts; dividers in which one or both legs can be "broken" are the most satisfactory.

Scissors: About 6 inches long with the blades or cutting surface of about 1 inch.

Ruler: Graduated in millimeters to measure fish lengths and parts; one which includes inches also desirable.

PRESERVING SPECIMENS

The careful preserving of specimens cannot be too strongly emphasized. Much time is lost in attempting to identify improperly preserved fishes; it is only when properly preserved that they may be rapidly and correctly identified. Frequently, juvenile salmon that have died in nets become soft, bleached, and torn. For the sake of accuracy it is better not to attempt to identify such material.

To preserve juveniles, upon capture place them in a solution of 1 part Formalin to 9 parts water. If live fishes are placed in too strong a Formalin solution, they may die with their mouths widely agape or the chromatophores may close so tightly as to be difficult to detect. If placed in too weak a Formalin solution, the fishes become bleached and soft and may decompose. If fishes are to be preserved for more than a year (or permanently), leave them in the Formalin solution at least 1 wk and if possible no longer than 4 mo. When fish are removed from the Formalin solution, soak them in water for 24 to 48 hr; then place them in a solution containing 70% ethyl alcohol and 30% water or 35% isopropyl alcohol and 65% water.

Do not crowd or pack fishes in a container, especially if they are alive or only recently dead. Fresh fishes, if packed too tightly, will become permanently deformed upon hardening in Formalin, will be bleached where their bodies come in close contact, or will decompose. A container is too crowded if the fishes will not readily move as the container is slowly rotated or shaken. When sufficient room is allowed, identification will be facilitated because the fishes will harden without discoloring; bodies and fins will not be deformed, twisted, or broken; and the chromatophores will remain nearly or fully open.

LABELING SPECIMENS

Labeling specimens fully and properly is of great importance; unlabeled or mislabeled specimens are of little or no value. Put the label with the specimens at the time the fishes are preserved. Label paper should remain firm when wet and should not become pulpy. Write clearly with pencil or permanent ink, recording the following data.

Field Number

Use your own or a department number. A satisfactory method is to use the first initial of your surname or your full surname, the last two digits of the year, and your collection number. Thus, if Joe Brown in 1962 preserves his fifth collection, he writes B-62-5 or Brown-62-5; if for the Department of Salmon Investigations he writes, SI-62-5. When a departmental symbol is used, it often is desirable for the collector to add his initials or name to the label.

Name of Water Body and Locality

Use names on standard maps. Whenever possible, avoid temporary or local names, such a

Brown's fishing camp. An example of a brief but adequate recording is: Alaska, Naknek River System, Katmai National Monument, Brooks Lake.

Date

Include the month, day, and year and, if pertinent, the hour.

The following additional information may be needed at times.

Method of Capture

Describe type of gear and size if significant, i.e., seine (2 cm mesh), fry net (1 cm mesh), trawl (1 cm bag), etc.

Temperature

Measure temperature of air and/or water. If water is ice-covered, what percent?

Other Water Conditions

If a *stream:* estimate its average width and maximum depth; if tidal and brackish, to what extent; degree of turbidity and source—glacial silt, plankton, etc.; degree of gradient—low, moderate, or high; percentage of stream in pools, with or without current; percentage of stream in riffles, whether flow is sluggish, moderate, or swift; dominant bottom types—sand, gravel, boulders, bedrock, muck, silt, etc.; aquatic vegetation—submerged, emergent, or both (name dominant species or genera if known). If a *lake or bay:* state whether fresh, brackish, or saline; if tidal, state to what extent; estimate size and possible depth; give degree of turbidity, type of bottom, and amount and kinds of aquatic vegetation.

Remarks

Describe anything that may aid in identification of the fishes, such as peculiar markings, habits, or habitats.

CHARACTERS USED IN IDENTIFYING SPECIES

A juvenile salmon is shown in Figure 1 to assist in recognizing and defining the characters and the counts and measurements used when keying out a specimen.

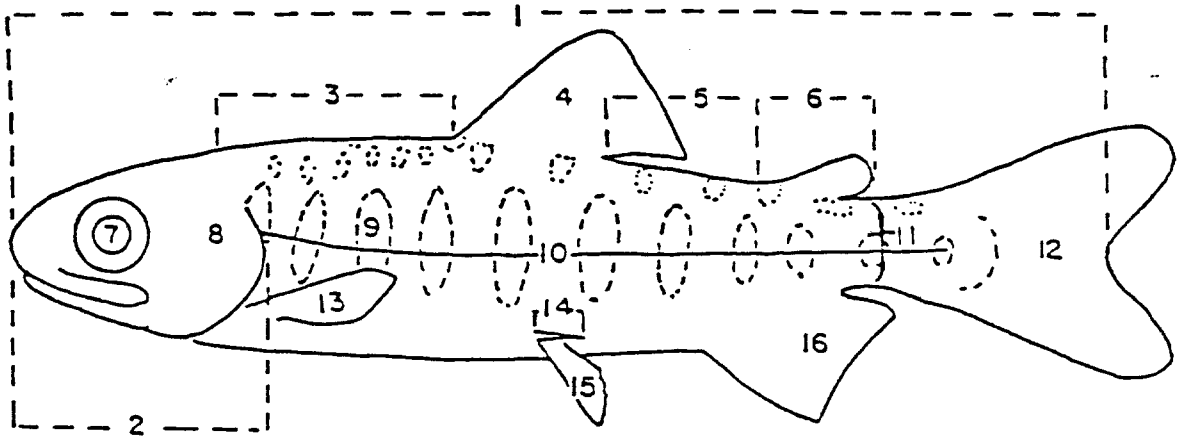


Figure 1.—Juvenile salmon, illustrating parts and methods of measuring: 1) fork length; 2) head length; 3) predorsal ridge; 4) dorsal fin; 5) portion of postdorsal ridge between posterior end of dorsal fin base and origin of adipose fin; 6) adipose fin; 7) pupil of eye; 8) gill cover, beneath which is gill chamber containing gill arches; 9) a parr mark; 10) lateral line; 11) caudal peduncle; 12) caudal fin or tail; 13) pectoral fin; 14) axillary process or scale; 15) pelvic fin; 16) anal fin.

First Gill Arch

Beneath each gill cover are four fully formed gill arches; the first gill arch on either side is the part used for specific identification. A gill arch (Fig. 2) consists primarily of a bony central arch to which the gill rakers are attached anteriorly, the gill filaments (lamellae) posteriorly. The gill rakers prevent solid substances such as food from being carried out through the branchial clefts and protect the delicate gill filaments. The numbers of gill rakers vary somewhat among individuals of each species of salmon, but the difference in average number between some species is sufficiently great to enable one to use them as specific characters.

The rakers on the gill arch may be counted as a unit, or the upper and lower limbs may be counted separately. The two limbs are joined

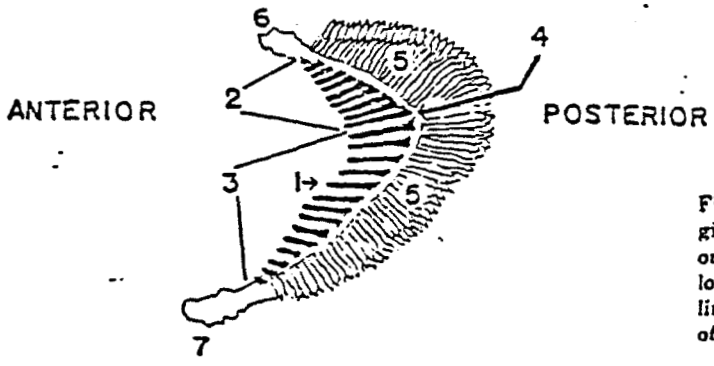


Figure 2.—First gill arch of salmon after removal from left gill chamber: 1) gill raker; 2) gill rakers attached to upper or shorter limb of arch; 3) gill rakers attached to lower or longer limb of arch; 4) angle of arch (junction of the two limbs or bones); 5) gill filaments (lamellae); 6) upper point of arch attachment; 7) lower point of arch attachment.

at an angle, the upper being the shorter. When a raker is situated astride the angle, it is included in the lower limb count. When all of the rakers on the arch are counted as a unit, a single number is given; otherwise, both limbs are recorded separately (the upper limb first), and then added, thus $12 + 20 = 32$.

The gill rakers nearest the angle of the arch are the longest; the rakers become progressively shorter as they approach the attachment ends of each arch. The rakers near the ends are often rudimentary and can be counted only under magnification.

It may be difficult to count all of the rakers accurately while the first gill arch is in place, in which case it will be necessary to remove the arch. To do this, turn back or cut away gill cover as shown in Figure 3. Lift the first gill arch upward. With a sharp scalpel, cut between the dorsal ends of the first and second arches, making a deep incision parallel with them; then cut the remainder of the attachment away. Next cut the ventral attachment in the same manner; and when both ends are free, remove the arch. Great care must be taken so that all rudimentary rakers may be removed and counted. After finishing the examination of the arch, reinsert it in the gill chamber for possible future examination.

Gill Raker and Eye Comparison

The longest rakers are compared with the length of the eye (Fig. 4). With dividers, obtain the measurement of the length of the longest raker; then place one point of the dividers at the anterior edge of the eye, the other extending

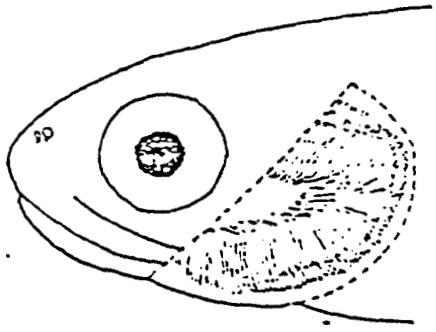


Figure 3.—Head of salmon. Dotted lines indicate that portion of gill cover which has been removed to show first gill arch in place.

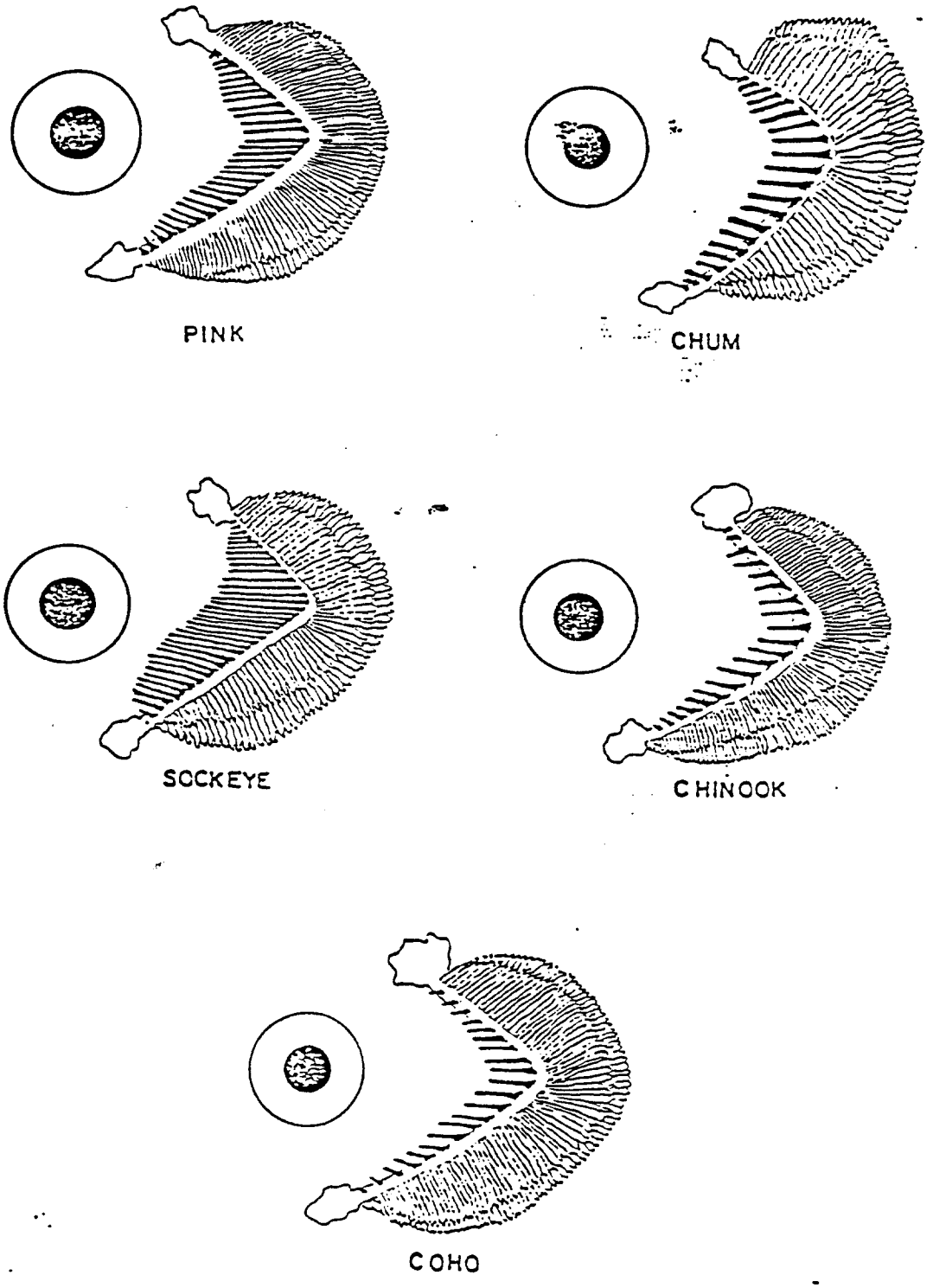


Figure 4.—First gill arch and eye for comparison with longest gill raker length of five species of Pacific salmon.

toward the opposite edge. Because the raker is shorter than the eye length in juvenile salmon, it is simplest to note where the raker reaches in relation to the pupil. Like many body part ratios, the gill raker-eye size ratios change as the juvenile salmon increases in length. For example, in specimens about 40 mm FL, the longest raker may be contained about 3 times the eye length, but in 140 mm specimens of the same species, the raker may be contained only about 2 times. This and other proportional changes must be considered.

Anal Fin Measurement and Count

To compare the length of the fin base with the longest ray, measure the anal fin base with dividers; then project the posterior leg of the dividers forward to the opposite tip of the longest ray as shown in Figure 5 by dotted line.

In counting the number of rays (Fig. 5), do not count those anteriormost ones which are less than half the length of the longest rays, such as those marked "0." Count all rays, such as No. 1, that are half (or more than half) the length of the longest ray, taking great care to observe the last ray—No. 15 in Figure 5. The last ray is usually split to its base and appears superficially as two rays, but it is in reality only one and should be counted as such.

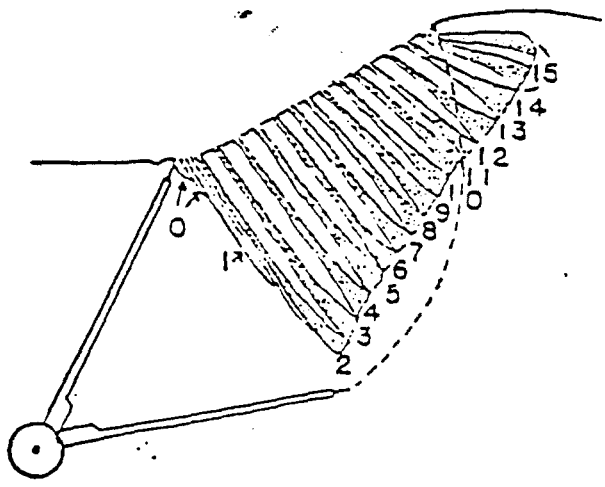


Figure 5.—Anal fin of salmon, illustrating method of measuring length of fin base and of counting rays (rays 2 to 15 are stippled here for emphasis).

Branchiostegal Count

All branchiostegals (Fig. 6), including the smallest, anteriormost ones are counted. Usually this may be accomplished satisfactorily only under magnification, and with juveniles longer than 40 mm FL. The branchiostegal count is used primarily as an additional character in specimens otherwise difficult to identify, and is especially valuable in separating the chinook salmon (usually 15 or 16) from the coho salmon (usually 13 or 14).

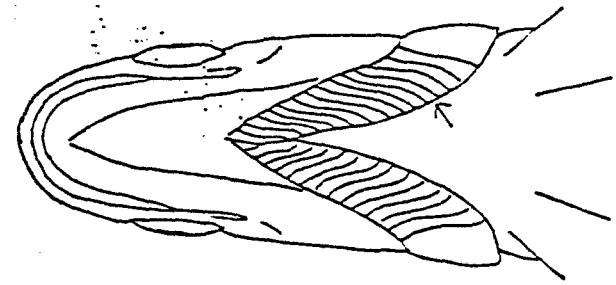


Figure 6.—Ventral surface of head of salmon. Arrow points to one of 14 branchiostegals on left side of head.

Pyloric Caeca Count[4]

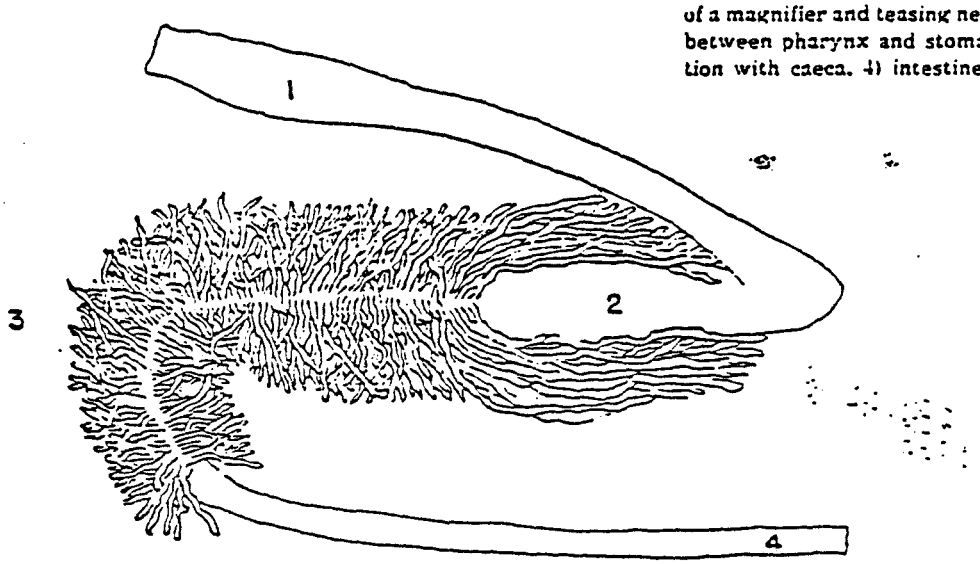
With a scalpel, widely open the abdominal cavity. Sever the esophagus as far forward as possible; then cut off the intestine near the posterior end of the stomach. The stomach and caeca can now be removed as a unit (Fig. 7). Use magnification and teasing needle as aids in counting. Counts of pyloric caeca are useful chiefly as an additional character for questionable specimens, especially in separating the chinook salmon (more than 100 caeca) from the coho salmon (fewer than 90).

Color Pattern Variations

Juvenile salmon from certain waters or at certain stages of development may have their parr marks or other markings masked by a bluis

[4]In the key, I have used pyloric caeca counts of my plus published accounts of others and especially th recent ones, such as Clemens and Wilby (1961) and and Lindsey (1970).

Figure 7.—Major portion of alimentary tract of salmon with pyloric caeca spread apart preparatory to counting with aid of a magnifier and teasing needle: 1) esophagus (part of tract between pharynx and stomach), 2) stomach, 3) pyloric section with caeca, 4) intestine.



or greenish-silvery sheen, especially when they are alive. To identify these fish, it may be necessary to preserve them first in Formalin to intensify their markings.

Juveniles of one species from certain waters, such as habitually turbid ones, may have their melanophores restricted in size or distribution, thereby resembling superficially another species. As an example, coho salmon normally have the adipose and anal fins densely speckled with rather large melanophores. But in some specimens, the melanophores may be reduced in size or distribution, so that coho salmon superficially resemble chinook salmon. Conversely, juvenile chinook salmon may have the melanophores unusually numerous and well developed, thereby resembling coho salmon. To avoid error in identification, compare the size and number of melanophores on the fins with those on the body; if few and small on the body, they should be few and small on the fins.

Color variations also occur regionally. An example is the predorsal stripe in chinook salmon, which in fish from some waters is normally a solid dark bar in specimens less than 80 mm FL; in chinook salmon in other waters the stripe may be reduced to a series of oblong blotches.

The length when individuals attain smolt coloration varies greatly, both regionally and in specimens from the same locality; some fish of the same species may lose parr and other presmolt markings when only half as large as other fish.

HOW TO USE KEY

Because of the variations in morphology and coloring, it is advisable to use the key in conjunction with the figures and plates and to check a large combination of characters.

In using the key, first make certain your specimen is a Pacific salmon by examining the characters under the two opposable groups labeled "1." Next, note the absence or presence of parr marks (see sections "*Combination of*" under opposable groups 2). If no parr marks are present and your specimen has not entered the silvery smolt stage, it is probably a pink salmon, but to make sure, compare it with the identifying characters between opposable groups 2. If parr marks are present, note the absence or presence of melanophores on adipose and anal fins (see groups 3). If melanophores are absent, see sections "*Combination of*" under groups 4; if present, see "*Combination of*" sections under groups 5. Decide which "*Combination of*" most closely fits your specimen, then verify it by comparing the descriptions of the identifying characters for the opposable groups.

KEY TO PRESMOLT JUVENILE SALMON

Salmonoid fishes having fewer than 20 rays in the dorsal fin (excludes grayling): strong teeth on jaws and tongue (excludes ciscoes and whitefishes): many pyloric caeca (excludes smelts, family Osmeridae): an axillary process or scaly appendage above pelvic fin (Fig. 1, No. 14): an adipose fin; cycloid scales; upper jaw formed by both premaxillary and maxillary ..... 1.

Base of anal fin *shorter* than longest ray (Fig. 5). Anal rays usually 9 to 12 (rarely 8 or 13). Gill rakers normally fewer than 20 on first gill arch (Fig. 3). Dorsal
1a fin of larger juveniles of some species with several blackish spots.
CHAR, TROUTS, ATLANTIC SALMON ..... Not in this key.

Base of anal fin *longer* than longest ray (Fig. 5). Anal rays usually 13 to 17 (rarely 12, 18, or 19). Gill rakers normally 20 to 40 on first gill arch (rarely 19). Dorsal
1b fin of larger juveniles lack blackish spots but tip of fin may be blackish.
PACIFIC SALMON—genus *Oncorhynchus* ..... 2.

Combination of: No parr marks on sides and *no* prominent specklings on back of presmolt juveniles. Usually no melanophores on anal and adipose fins; if melano-
2a phores present, they are few and very small, and if on adipose, are restricted to its posterior, free edge.
PINK (HUMPBACK) SALMON—*O. gorbuscha* ..... Plate 1.

General development—Similar to chum salmon in that yolk sac may not disappear until juvenile is more than 34 mm FL, after which development toward smolt shape and coloration is rapid. When less than 50 mm FL, this species is similar to chum salmon in being more terete than the sockeye, chinook, and coho salmon; body depth immediately before dorsal fin usually more than 1.5 times head length.

Parr marks—Only species of salmon lacking parr marks in the presmolt juvenile.

Coloration of body—*Preserved material*—In juveniles less than 40 mm FL, back is dark to lateral line and ventral half of body light when bicolored; dorsal third of body is darkest, sides lighter, ventral third lightest (usually milky-white or silvery) when tricolored. Few or no melanophores on lower sides and belly. In juveniles more than 40 mm FL, bicolored or tricolored condition is normally not evident, the dark back lightening gradually downward to the very light belly. *Living specimens*—Dorsal half of body bright bluish or greenish with much silvery reflection; ventral half milky or silvery-white.

Fins—Anal and dorsal fins averaging smaller than in chum salmon; these fins in this species and in chum salmon distinctly smaller than in sockeye, chinook, or coho salmon. In specimens less than 40 mm FL the longest anal ray, when measured into head length, extends from tip of snout to about center of eye; in larger presmolt juveniles, this measurement extends from tip of snout to anterior half of eye. Anal rays usually 14 to 16 (extremes 13 to 17). *Dorsal fin* has few specklings and only a slight tendency toward a dark anterior edge in juveniles less than 50 mm FL; over 50 mm, blackish anterior edge becomes pronounced and tip of fin dusky. *Caudal fin* has speckling confined to basal half in juveniles less than 50 mm; with increasing length of juveniles, specklings appear along rays, and in large presmolt juveniles lobes tend to become blackish.

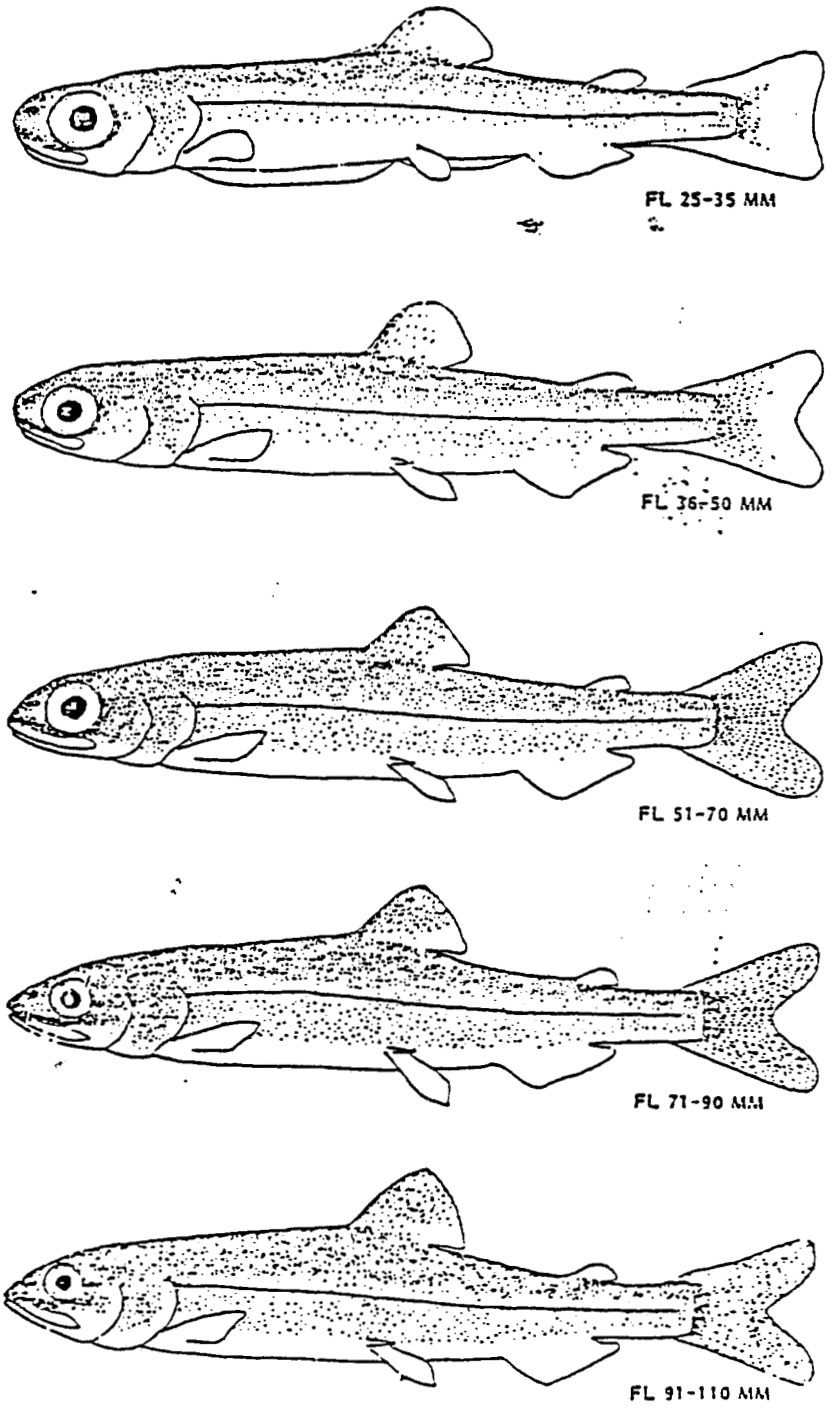


Plate 1.—Pink salmon.

Gill rakers (see Fig. 4)—Eleven to fourteen on upper limb, 14 to 19 on lower, total usually ranging between 27 and 33 (extremes 25 and 35); rakers slender and rather long; most similar in size and number to sockeye salmon but shorter and usually fewer (normally less than 31).

Pyloric caeca—Usually 130 to 195 (extremes 95 to 224); slender and rather long; differ sufficiently in numbers from coho and sockeye salmon, which have fewer than 100, to be a distinct aid in specific identification.

Branchiostegal rays—Usually 11 to 14 (rarely 10 or 15); average number less than in other species, almost invariably less than in chinook salmon, which usually has 15 to 18 (rarely 14).

Scales in lateral line—More than 170, more than in any other of the Pacific salmon; lateral line scale counts may be obtained under magnification in specimens longer than 60 mm FL.

Habits—Shortest life span of any species, between 18 mo and 2 yr. Only a comparatively small proportion of adults make extended migration in fresh water. Majority spawn in fresh waters within a short distance of brackish water or in intertidal waters. Many young enter brackish or salt waters within a few hours or days after emerging from redds, and comparatively few are found in fresh water when more than 45 mm FL.

Combination of: Both parr marks on sides and dark spottings on back usually obvious in living, presmolt juveniles and always in preserved specimens under magnifi-
2b cation (may be faint in fishes from turbid waters); parr marks become faint and disappear as juvenile assumes smolt coloration ..... 3.

No melanophores normally present on adipose and anal fins of presmolt juveniles, or if present, few and quite small. Parr marks occupy a larger area above lateral
3a line than below it, and in some specimens anterior parr marks may be almost entirely above the lateral line.

CHUM AND SOCKEYE SALMON ..... 4.

Melanophores normally obvious on adipose fin in living specimens and always in preserved specimens under magnification (may be indistinct in juveniles from silty
3b waters). Anteriormost parr marks appear to occupy as large (or almost as large) an area below lateral line as above it; these parr marks are usually large, long, and wide.

CHINOOK AND COHO SALMON ..... 5.

Combination of: Gill rakers 19 to 26 (average 23), notably fewer and much shorter than in sockeye salmon, which have more than 28. Normally *no* melanophores on adipose and anal fins. Anterior squarish (quadrate) parr marks situated almost
4a or entirely above lateral line in specimens less than 50 mm FL; in presmolt juveniles more than 50 mm FL, anterior parr marks tend to be long and very narrow and sometimes may extend well below lateral line.

CHUM (DOG) SALMON—*O. keta* ..... Plate 2.

General development—Similar to pink salmon in that yolk sac may not disappear until juvenile is more than 34 mm FL, after which development toward smolt shape is rapid. Also similar to pink salmon in being more terete (when less than 50 mm FL) than the sockeye, chinook, and coho salmon; body depth immediately before dorsal fin usually 1.5 to 1.8 times head length.

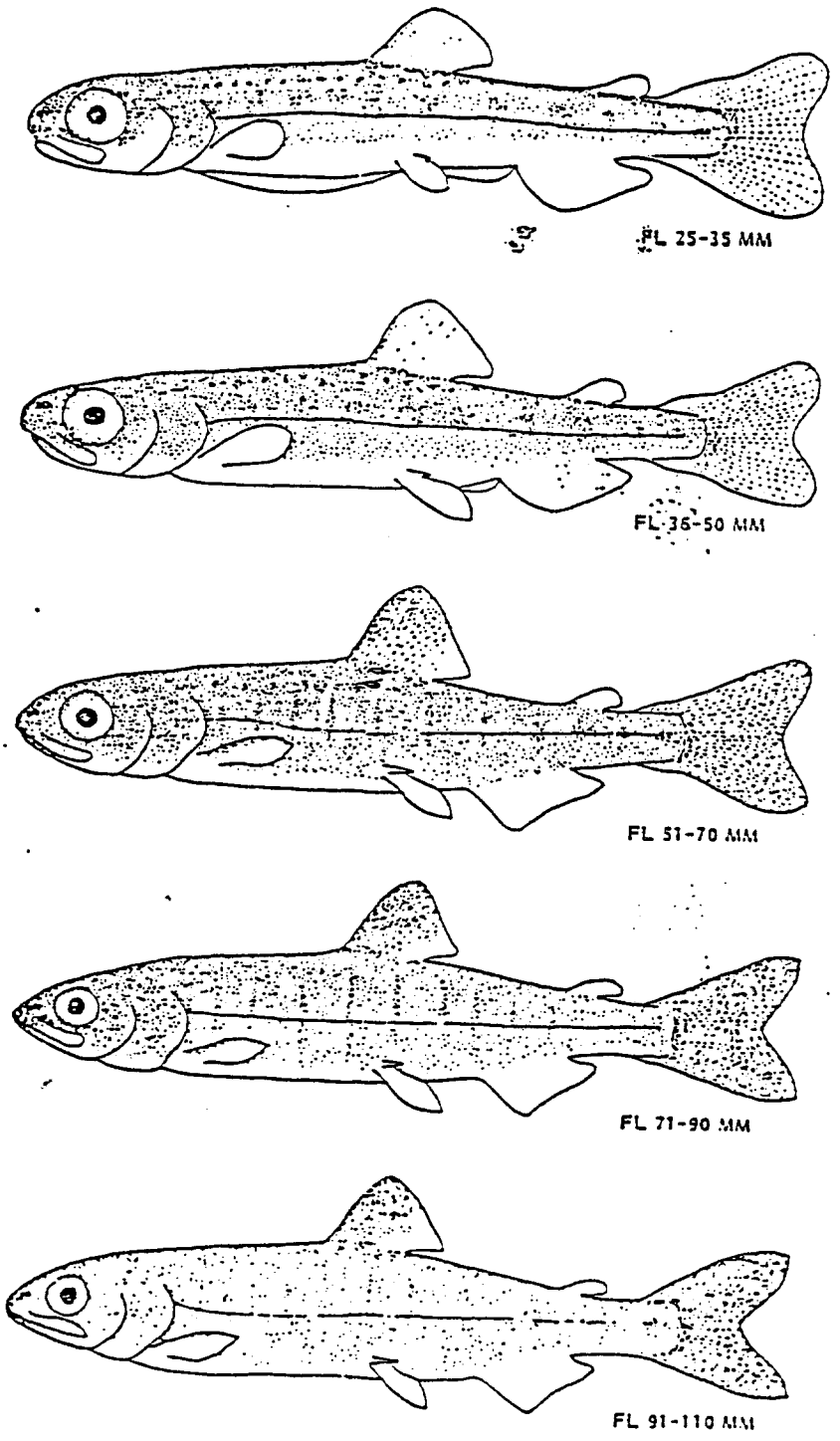


Plate 2.—Chum salmon.

Parr marks—Anterior parr marks in specimens less than 50 mm FL are more squarish (quadrate) and do not extend quite so far below lateral line as in sockeye salmon; in presmolt juveniles more than 50 mm FL, parr marks tend to become longer and more narrow than in sockeye salmon, and some tend to extend well below lateral line.

Coloration of body—*Preserved material*—Dorsal ridge stripe usually present, sometimes a series of blotches in juveniles less than 50 mm FL, becoming faint or disappearing in presmolt juveniles more than 50 mm FL; a prominent irregular row of spots and blotchings between dorsal ridge and upper edge of parr marks, these usually most distinct in specimens between 34 and 50 mm, often fading or disappearing in larger juveniles. *Living specimens*—Markings may be obscured by greenish or bluish overcast of dorsal half of body and whitish or silverish sheen of ventral half.

Fins—Anal and dorsal fins small, averaging slightly larger in size than those of pink salmon and averaging considerably smaller in height and area than those of sockeye salmon. Length of longest anal ray, when measured from snout to eye, reaches to, or almost to, center of eye; in sockeye salmon this measurement usually extends well beyond center of eye. Anal rays usually 13 or 14 (extremes 13 to 17). *Dorsal fin* has few or no distinct spottings in specimens less than 50 mm FL; in larger presmolt juveniles a dusky spot develops on tip. *Caudal fin* has faint spots largely confined to basal half in juveniles less than 50 mm FL; in larger juveniles lobes become blackish.

Gill rakers (see Fig. 4)—Seven to twelve on upper limb, 12 to 19 on lower, total usually ranging between 20 and 26 (extremes 19 to 30); rakers blunt and short, in sharp contrast to thinner, longer, and more numerous rakers of sockeye salmon, which has 30 to 39.

Pyloric caeca—Usually 160 to 185 (extremes 140 to 249); differ sufficiently in numbers from sockeye and coho salmon, which usually have fewer than 100, to be an aid in specific identification.

Branchiostegal rays—Usually 13 or 14 (extremes 12 to 16); of value primarily in separating this species from chinook salmon, which generally has more than 15.

Scales in lateral line—Between 125 and 155; of value chiefly in separating this species from pink salmon.

Habits—Life span usually 3 to 5 yr, for majority, 4 yr, some less than 3 yr. Jacks may occur. Majority spawn in fresh waters only a comparatively short distance from brackish water or in intertidal waters. Many young enter brackish or salt waters very shortly after emerging from redd, and few juveniles are found in fresh waters when more than 45 mm FL.

Combination of: Gill rakers 30 to 39 (average 36); notably more numerous, longer, and more slender than in chum salmon, which have fewer than 27. Normally *no* melanophores on adipose and anal fins. Anterior parr marks more rectangular
4b than squarish in outline in specimens less than 45 mm FL and sometimes extend as much as a third to a half below lateral line; these oblong parr marks tend to shorten in presmolt juveniles more than 50 mm FL and to be mostly above lateral line.

SOCKEYE (RED) SALMON—*O. nerka*. . . . . Plate 3.

General development—Yolk sac usually disappears, except for trace, before juveniles reach 30 mm FL. Body deeper and species more slab-sided in all presmolt lengths than in chum and pink salmons—body depth immediately before dorsal fin usually less than 1.5 times head length.

Parr marks—See "*Combination of*" above.

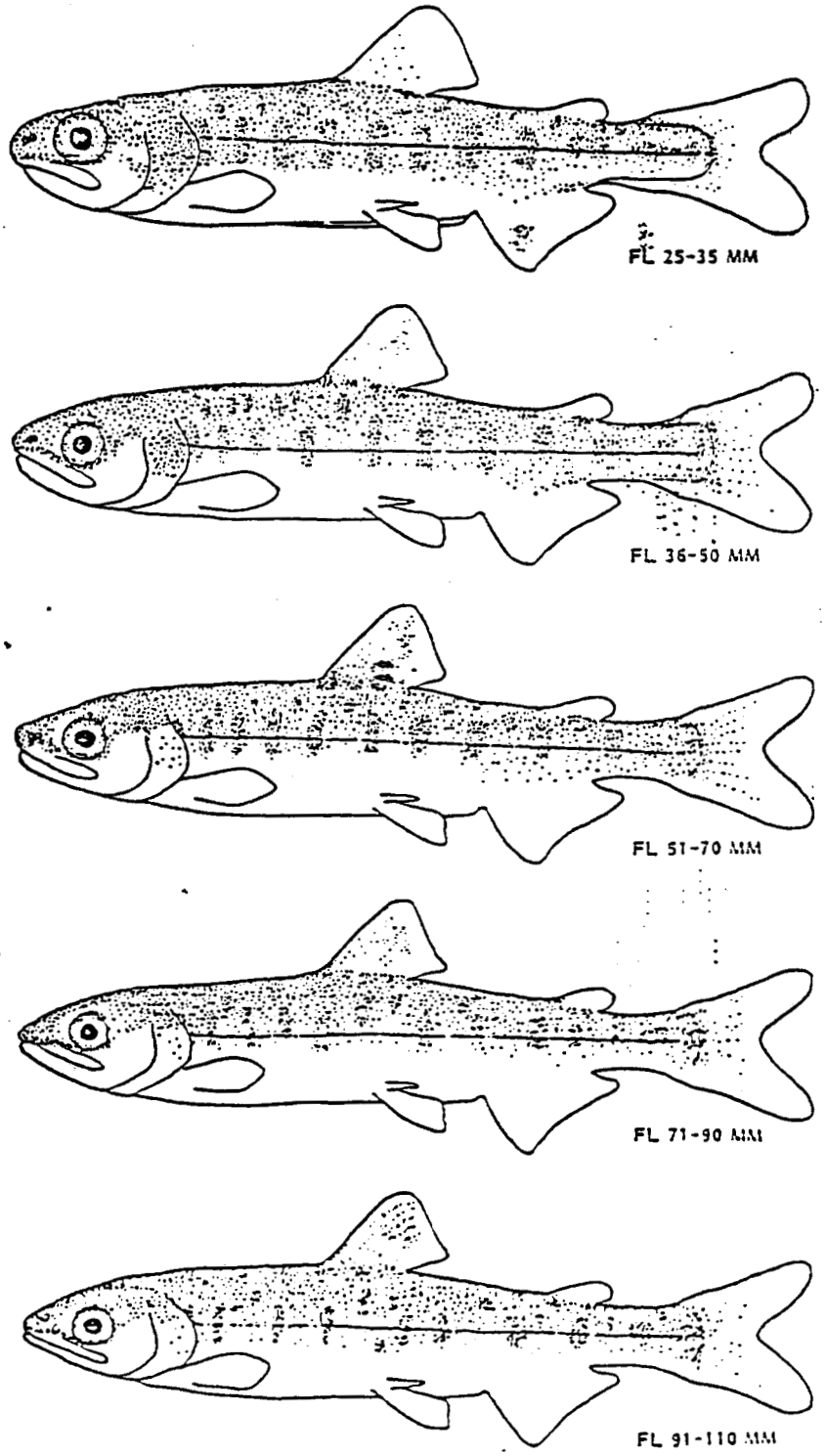


Plate 3.—Sockeye salmon.

Coloration of body—*Preserved material*—Dorsal ridge usually contains a series of more or less distinct spots in specimens less than 35 mm FL, becoming more confluent in fishes between 40 and 55 mm FL and sometimes merging into a dusky bar; in presmolt juveniles over 60 mm FL, spots or bars may disappear, after which a series of roundish spots become apparent on both sides of, and adjacent to, dorsal ridge, especially that portion behind dorsal fin; in addition to these spots, in fishes more than 35 mm FL, another longitudinal row of spots develops between dorsal ridge and upper halves of parr marks. *Living specimens*—Markings may be obscured by greenish or bluish overcast of dorsal half of body and whitish or silverish sheen of ventral half.

Fins—Anal and dorsal fins average larger in height and area than in chum and pink salmon. Length of longest anal ray, when measured from snout to eye, reaches usually from snout to beyond center of eye. Anal rays usually 14 to 16 (extremes 13 to 16). *Dorsal fin* normally has few or no distinct specklings in specimens less than 60 mm FL; a rather faint dorsal spot develops in larger presmolt juveniles in upper portion of fin, the fin being bordered on its free edges with whitish (see lowest figure, Plate 3). *Caudal fin* has few specklings on basal half, the lobes having few or no melanophores, even in rather large juveniles.

Gill rakers (see Fig. 4)—Twelve to sixteen on upper limb, 18 to 23 on lower, total usually ranging between 32 and 37 (extremes 30 to 39); rakers long and slender, averaging longer than in any other species, in sharp contrast to fewer, blunter rakers of chum salmon, which has 19 to 30.

Pyloric caeca—Usually 65 to 95 (extremes 45 to 115); usually considerably fewer than in pink, chum, and chinook salmon, and averaging more than in coho salmon.

Branchiostegal rays—Usually 13 to 15 (extremes 11 to 16); of value chiefly in separating this species from chinook salmon, which average more.

Scales in lateral line—Between 125 and 140; of value chiefly in separating this species from pink salmon, which has a higher number.

Habits—Life span usually 4 or 5 yr, some only 3. Jacks may occur. Majority of individuals highly migratory. Adults usually spawn in streams tributary to lakes; a small minority spawn in streams without a lake, in lake outlets, or on lake beaches. After rising from redd, young move downstream rather rapidly to a lake, remaining usually 1, sometimes 2, and rarely 3 yr in fresh water before entering brackish or salt water.

Combination of: Melanophores on adipose fin usually most numerous on posterior half and generally forming a dark border (see Plate 4); anterior half of adipose with few melanophores or none. Anal fin with few melanophores or none, but when
5a melanophores are present, often quite large. Tip of dorsal fin and lobes of caudal fin darker in larger presmolt juveniles.

CHINOOK (KING) SALMON—*O. tshawytscha*. . . . . Plate 4.

General development—Yolk sac usually disappears or is reduced to a trace before juveniles reach 32 mm FL. Body deeper and species more slab-sided in all presmolt lengths than in chum and pink salmon; body depth immediately before dorsal fin usually less than 1.5 times head length (range 1.1 to 1.5).

Parr marks—Almost invariably rectangular and long vertically; marks usually situated equidistant on each side of lateral line; dark parr marks and other markings contrast sharply with lighter background of body in some living and most preserved specimens.

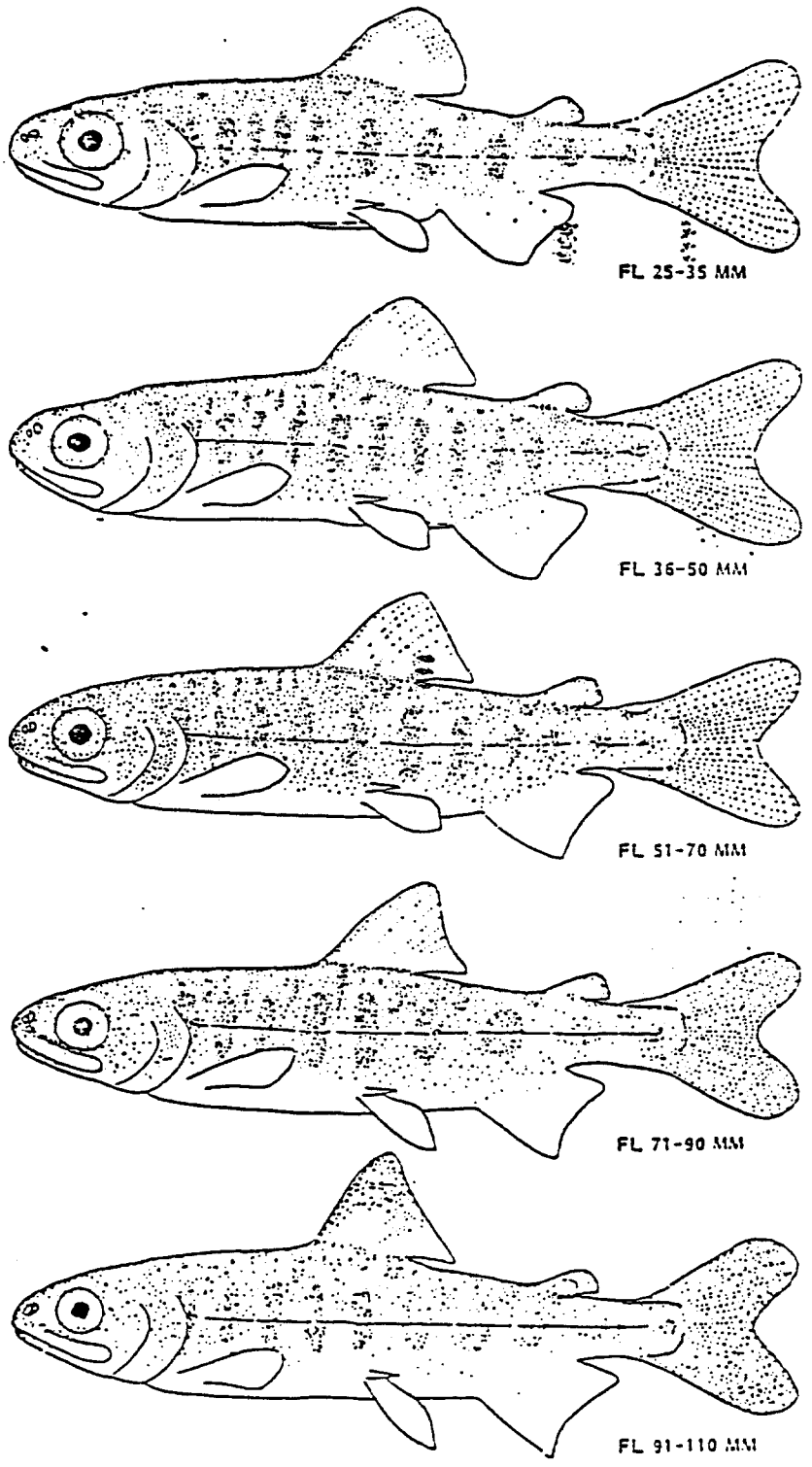


Plate 4.—Chinook salmon.

Coloration of body—*Preserved material*—Background color of body generally much lighter than body color of coho salmon, usually contrasting sharply with dark dorsal stripe or spotting, parr marks, and prominent dorsal spottings: blackish band astride dorsal ridge usually bold and unbroken in specimens less than 80 mm FL and especially on ridge before dorsal fin; in larger juveniles dorsal band often breaks up into series of spots, disappearing in larger presmolts as other spottings on dorsal half of body become more numerous and distinct; spottings between dorsal ridge and parr marks absent in fishes less than 35 mm FL, developing rapidly thereafter into many large and small spots and increasing in numbers as juveniles approach smolt stage. *Living specimens*—Parr marks and other markings may be obscured by bluish-silvery color of dorsal half of body and silvery sheen of ventral half.

Fins—Anal and dorsal fins averaging considerably larger in area than those of the chum and pink salmon and slightly larger than in the sockeye salmon; length of longest anal rays, when measured into head length, reaching from snout tip to beyond posterior edge of pupil and sometimes beyond posterior edge of eye; distal edge of anal slightly falcate in specimens more than 40 mm FL but averaging less falcate than does the free edge of the anal of the coho salmon. Anal rays 15 to 19, averaging higher in number than in any other species. *Dorsal fin* in young less than 60 mm FL usually has few or no distinct spottings, a blackish spot developing in the upper portion of the fin as the juveniles approach the smolt stage (see Plate 4). *Caudal fin* has comparatively few melanophores rather generally distributed in the smaller individuals, the lobes darkening as the fishes approach the presmolt stage.

Gill rakers (see Fig. 4)—Seven to twelve on upper limb, 10 to 16 on lower, total usually ranging between 20 and 25 (extremes 19 to 28); rakers short and similar in size and number to chum and coho salmon.

Pyloric caeca—Usually 140 to 185 (extremes 90 to 240); of value in separating this species from coho salmon, which normally has fewer than 85.

Branchiostegal rays—Usually 16 to 18 (extremes 13 to 19); average number greater than in any other species.

Scales in lateral line—Between 132 and 152; usually of most value in separating this species from pink salmon.

Habits—Life span 2 to 8 yr, usually 4 to 6. Jacks may occur. A portion of the juveniles enter salt water during first year of life; remainder stay in fresh waters more than 1 yr but rarely 2 yr. Juveniles of presmolt stage found in fresh waters when as long as 150 mm FL.

Combination of: Melanophores usually numerous and rather evenly distributed on adipose fin; occasionally in larger juveniles, posterior or free edge may be darker than remainder, thereby resembling somewhat melanophore distribution on adipose of chinook salmon. Anal fin in specimens larger than 30 mm FL more falcate and anterior tip more pronounced than in other species, including chinook salmon; in all except smallest specimens, anterior or leading edge of anal fin is whitish, with a dark bar parallel and posterior to it; remaining, posterior portion of fin usually abundantly speckled with melanophores except for distal and posterior edges (see Plate 5).

COHO (SILVER) SALMON—*O. kisutch*. . . . . P!

General development—Yolk sac usually disappears, except for a trace, before juveniles reach 32 mm FL. Body deeper and species more slab-sided in all pre-

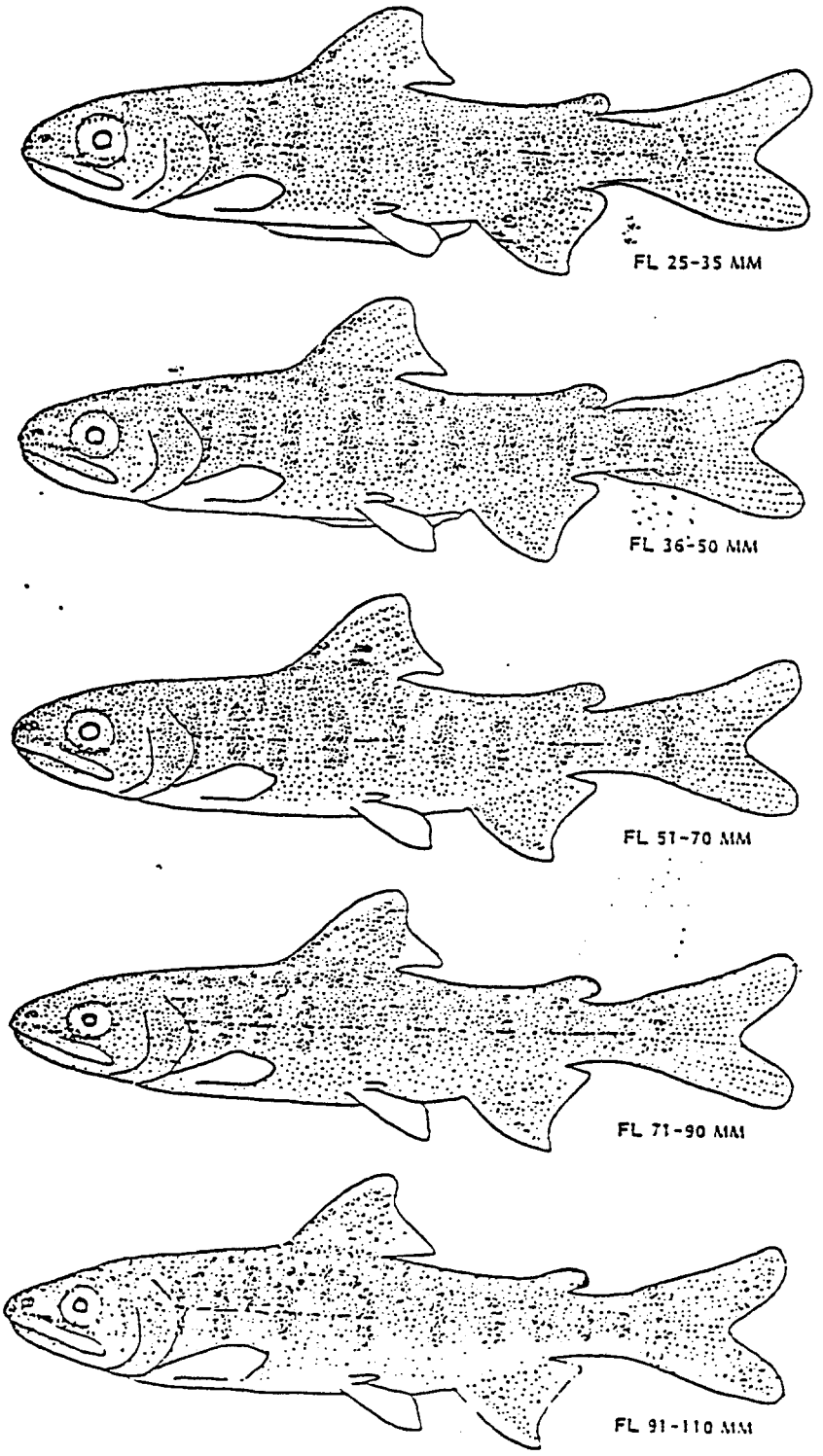


Plate 5.—Coho salmon.

smolt lengths than in chum and pink salmon; body depth immediately before dorsal fin usually less than 1.5 times head length (range 0.9 to 1.5).

Parr marks—Anterior parr marks always large and long vertically, their upper and lower ends more rounded than rectangular-shaped parr marks of chinook salmon; marks usually situated equidistant on each side of lateral line; usually less contrast between color of parr marks and body than in chinook salmon.

Coloration of body—*Preserved material*—In all but smallest specimens, contrast between all body marks and background color of body is not as pronounced as in other species; dark bar along dorsal ridge usually distinct and unbroken in juveniles less than 50 mm FL, breaking up into spots or disappearing in larger specimens; back spottings on both sides of dorsal ridge usually prominent in all except smallest specimens; spots between parr marks often elongate and extending downward between them, sometimes to lateral line (see bottom figure, Plate 5); spots on dorsal half of body often increase in number and/or decrease in size as individuals approach smolt stage. *Living specimens*—Parr marks and other body markings may be obscured by dark coloration of body or by bluish sheen.

Fins—Anal and adipose fins described under "*Combination of*" (this section). Anal rays usually 13 or 14 (extremes 13 to 16). *Dorsal fin* has comparatively few melanophores scattered over it in smallest specimens; in those more than 32 mm FL the number of melanophores increases, especially on or adjacent to anterior or leading edge; this results in a dark bar along the anterior edge behind which melanophores are rather evenly distributed; as fishes approach presmolt stage, a white anterior (or leading) edge and a whitish tip develops, followed by a dark parallel bar (see bottom figure, Plate 5). *Caudal fin* has rather even distribution of melanophores along rays in all except smallest young, this increasing in color intensity and number as fish increases in size.

Gill rakers (see Fig. 4)—Eight to thirteen on upper limb, 9 to 14 on lower, total number usually ranging between 19 and 27 (extremes 18 to 27); rakers short and rather similar in size and number to chum and chinook salmon.

Pyloric caeca—Usually 50 to 85 (extremes 45 to 114); of value in separating this species from chinook, pink, and chum salmon, which normally have more than 100.

Branchiostegal rays—Usually 13 or 14 (extremes 12 to 15); average number less than in chinook salmon, which normally has 15 or more.

Scales in lateral line—Between 120 and 140 (average 128); usually averaging fewer than in any other species.

Habits—Life span 2 to 4 yr. Jacks may occur. Majority appear to spend 1 or 2 yr in fresh waters, a few 3 yr. Some juveniles in presmolt stage are found in fresh waters when 150 mm FL.

GLOSSARY

Adipose fin A fleshy, finlike, rayless structure situated on dorsal ridge between dorsal and caudal fins (Fig. 1, No. 6).

Anal fin The fin situated medially and immediately behind vent between posterior end of abdomen and anterior end of caudal peduncle (Fig. 1, No. 16).

Axillary process or scale An accessory enlarged scale attached to upper or anterior base of pelvic fin (Fig. 1, No. 14).

Gill opening Opening between opercle or gill cover and side of head.

Branchiostegals or branchiostegal rays Elongated bones arranged fanwise within branchiostegal membranes, situated on ventral edge of gill covers (Fig. 6).

Caudal fin Terminal or tail fin of fishes (Fig. 1, No. 12).

Caudal peduncle That region of body between base of posterior ray of anal fin and base of caudal fin (Fig. 1, No. 11).

Chromatophores Color cells which under control of sympathetic nervous system can be altered in shape, producing color changes.

Cycloid scales Smooth-edged scales of soft-rayed fishes having an evenly curved posterior border devoid of minute spines.

Dorsal fin In salmons, a single fin composed of rays situated dorsally on body approximately halfway between head and tail (Fig. 1, No. 4).

Dorsal ridge Apex or dorsal junction of left and right sides of body; dorsal and adipose fins are situated on this ridge (Fig. 1, No. 3-6).

Dorsal stripe A band on dorsal ridge which is lighter or darker than adjacent areas.

Falcate Curved like a sickle; a fin is falcate when its distal edge is concave, having middle rays shorter than anterior and usually posterior rays.

Filaments See *gill filaments.*

Fork length Distance in a straight line from anteriormost part of tip of upper jaw or snout of juvenile salmons to apex of angle produced by two lobes of caudal fin (Fig. 1, No. 1).

Gill arch Branchial skeleton which contains gill rakers and gill filaments, or lamellae (Fig. 2).

Gill cover, opercle, or operculum Large, very flat, thin bones on each side of head which cover gills (see Fig. 3, which has the major portion of the gill cover removed).

Gill filaments (lamellae) Pleated folds of skin, richly supplied with blood vessels, attached to posterior edge of gill arch (Fig. 2, No. 5).

Gill rakers Projections on anterior edge of first gill arch (Fig. 2, No. 1).

Head length Distance in a straight line from anteriormost part of upper jaw or snout to posterior margin of opercle (Fig. 1, No. 2).

Hypural Complex of expanded and fused bones of last few vertebrae which support caudal fins in certain fishes.

Jack Precocious male salmon which spawn after spending a year or two less in the ocean than the majority of individuals; they are notably smaller than average size of spawning males of their species.

Juvenile As used here, a salmon between 25 and 110 mm FL which has not entered smolt stage.

Lamellae See *gill filaments.*

Lateral line A line formed by a series of sensory tubes and pores extending along sides from head to tail (Fig. 1, No. 10).

Lateral line scale count A count of pored scales from first scale on body behind head posteriorly to above hypural.

Melanophores Chromatophores with dark or black pigment.

Parr marks Squarish or oblong blotches or pigmented areas along sides of presmolt salmonids (Fig. 1, No. 9).

Pectoral fins Anterior or uppermost of paired fins of fishes, one on each side of breast immediately behind head (Fig. 1, No. 13).

Pelvic fins A ventral pair of fins, abdominal in salmonids (Fig. 1, No. 15).

Postdorsal ridge That portion of dorsal ridge behind dorsal fin (Fig. 1, No. 5).

Predorsal ridge That portion of dorsal ridge before dorsal fin (Fig. 1, No. 3).

Presmolt A juvenile salmon with parr marks; in pink salmon, which lack parr marks, demarcation between a presmolt and smolt is slight, differing chiefly in latter's more adult shape.

Pupil of eye Opening in iris of eye by which light reaches retina. It is circular in fishes (Fig. 1, No. 7).

Pyloric caeca Fingerlike diverticula, usually glandular, which open into alimentary canal

of most fishes at junction of stomach and intestine in region of pylorus (Fig. 7, No. 3).

Rakers See *gill rakers*.

Redd Excavation or nest made by a spawning salmon.

Rudimentary Very small and poorly formed, pertaining here chiefly to smallest gill rakers and anal rays (Fig. 5, "0").

Slab-sided When depth of body, measured before dorsal fin, is considerably greater than width of body.

Smolt As used here, a young salmon which has lost its parr marks. Pink and chum salmon fry usually go to the ocean within a few days of emerging from the streambed and usually do not undergo a visible change in morphology or color in fresh water.

Subadult An individual similar to an adult and approaching adulthood in age and size but still incapable of breeding.

Tercte Nearly cylindrical in cross section and tapering toward the front and rear.

ACKNOWLEDGMENTS

Publications such as this are possible only because of aid given by many individuals. I wish to acknowledge the aid and encouragement given me by Robert J. Ellis, George Y. Harry, Jr., Wilbur L. Hartman, William R. Heard, David T. Hoopes, Theodore R. Merrell, Jr., Jay C. Quast, and William A. Smoker, and to the many field men, students, and others who have tested the key.

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Key to Field Identification of Anadromous Juvenile Salmonids in the Pacific Northwest

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ABSTRACT

A key is presented with descriptive illustrations to help in field identification of live, juvenile salmonids in fresh waters of the Pacific Northwest. Other juvenile fish that may be mistakenly identified as salmonids are included.

INTRODUCTION

Species identification of live, anadromous juvenile salmonids is frequently a problem to the field biologist. The purpose of this key is to list and illustrate the external characteristics which will expedite field identification of juvenile salmonids in the Pacific Northwest.

Five species of Pacific salmon (pink, chum, sockeye, chinook, and coho); four species of trout (cutthroat, brown, Dolly Varden, and rainbow or steelhead); and other juvenile and adult fish [1] that may be mistaken for salmon or trout in fresh water are described in this key.

USE OF KEY

The characteristics for identification are listed in a series of alternative statements, some of which are illustrated. To use the key, examine the first statement; if applicable, proceed to the next and continue to successive statements until the species is identified. If a statement is not applicable, pass to the alternative characteristics indicated by numbers in parentheses (numbers on the drawings correspond to numbers of statements in the key). Continue in this manner until the specimen is identified. Some external characteristics are positive separating features (marked with asterisk), whereas others are not. Therefore, two or more statements should be considered before final rejection. If a precise identification cannot be made using the external characteristics —and the fish can be sacrificed, a positive identification can usually be made from internal features (marked with double asterisks). A bibliography of keys that utilize more descriptive internal characteristics is included in this paper.

[1] Especially adult smelt, family Osmeridae.

KEY

1. (47) Adipose fin and scales present. (Fig. 1)
2. (48) Fleshy appendage at base of pelvic fins present.
3. (49) Mouth large, reaching at least to center of eye.

Family Salmonidae

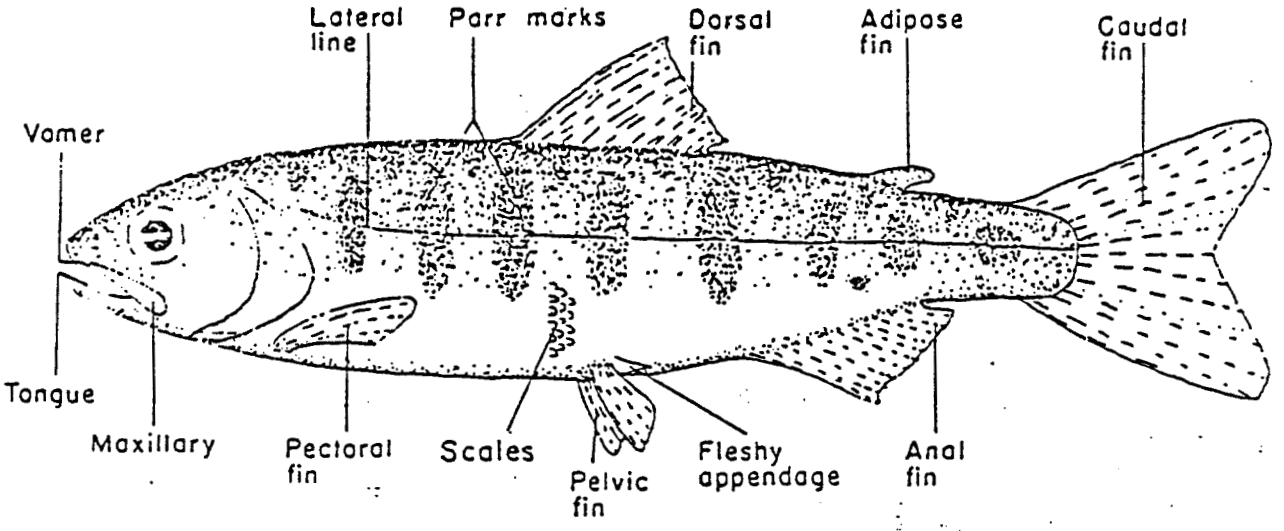


Figure 1.—A hypothetical salmonid showing external characteristics.

4. (17) Anal fin higher than long, with 8 to 12 developed rays (Fig. 2A)
5. (52) *Teeth on head and shaft of vomer. (Fig. 3A)

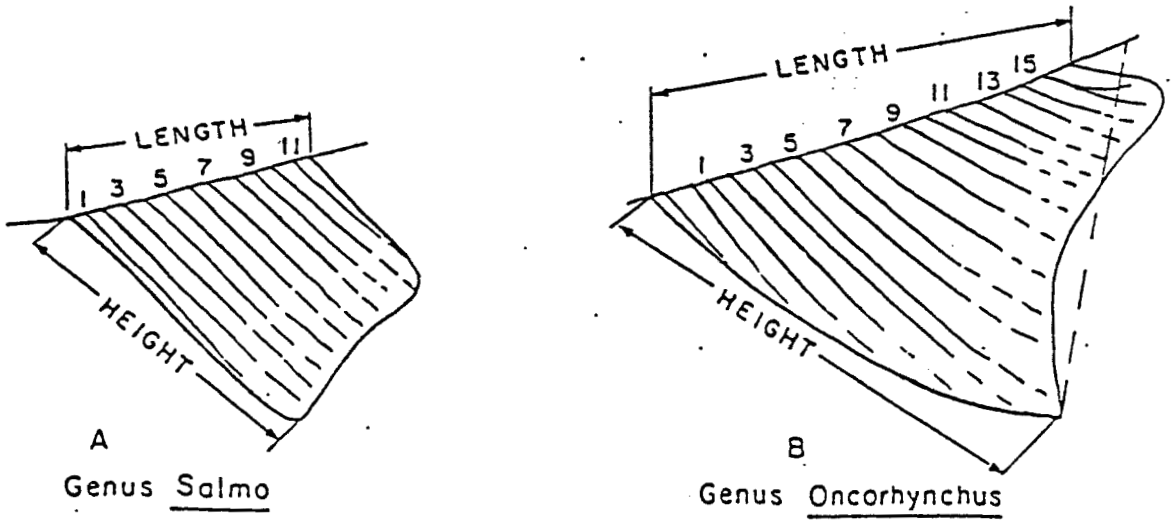


Figure 2.—Anal fins: (A) Trout, genus *Salmo;* (B) Pacific salmon, genus *Oncorhynchus.* The two drawings show differences in structure and fin ray count. (Note that the length of the anal fin is its overall basal length, and its height is that distance from the origin of the fin to the tip of the anterior lobe. In counting fin rays, include only those which originate from the base and terminate at the outer margin of the fin or are half as long as [or greater than] the longest ray.)

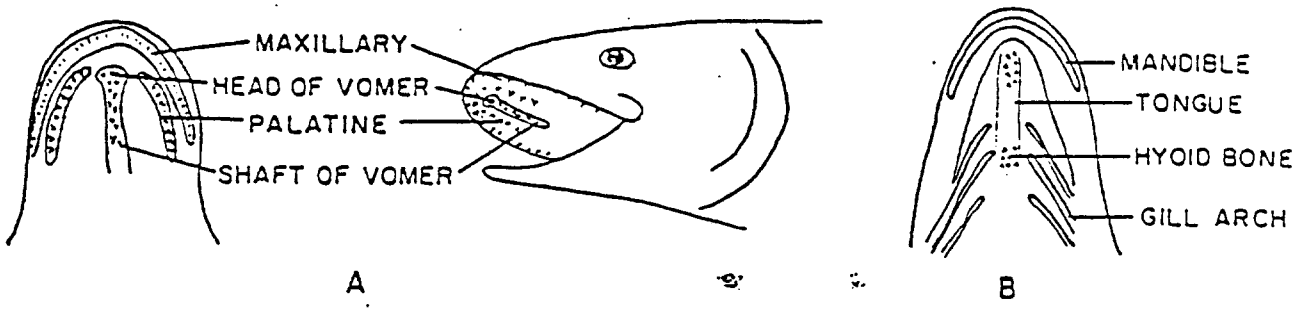
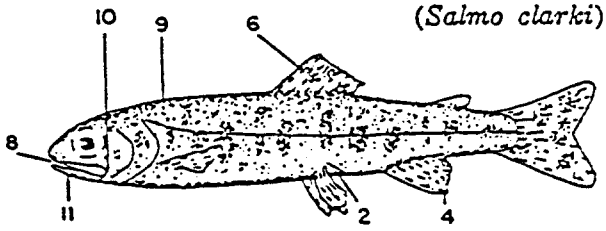


Figure 3.—Location of dentition in (A) the roof and (B) the floor of the mouth of salmonid fishes. (Presence or absence of teeth on the vomer or tongue may be determined by use of the little finger or a blunt instrument. The small hyoid teeth at the base of the tongue are located between the gill arches of the lower jaw and are difficult to find.)

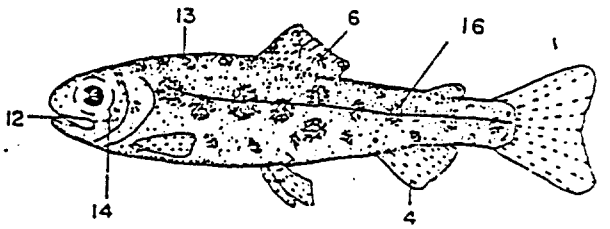
6. (18) Dorsal fin with large dark spots.
Trout
Genus *Salmo*

7. (53) Adipose fin not orange; no row of pale round spots along lateral line.
8. (12) *Small hyoid teeth at base of tongue. (Fig. 3B)
9. (13) Not more than five parr marks on mid-dorsal ahead of dorsal fin.
10. (14) Maxillary reaching past posterior margin of eye.
11. (15) Red or yellowish hyoid mark under lower jaw. Tail usually black spotted.
Cutthroat trout
(*Salmo clarki*)



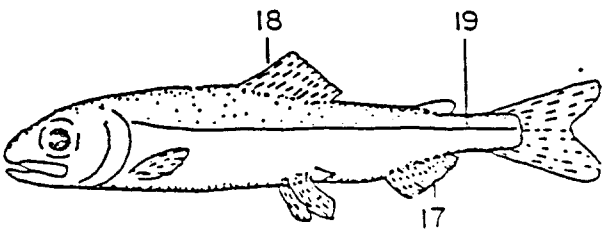
12. (8) *No teeth at base of tongue.
13. (9) Five to 10 parr marks along mid-dorsal ridge ahead of dorsal fin.
14. (10) Maxillary short, not reaching past posterior margin of eye.
15. (11) No hyoid mark under lower jaw. Few or no spots on tail.

16. (20) Parr marks almost round.
Rainbow or
steelhead trout
(*Salmo gairdneri*)



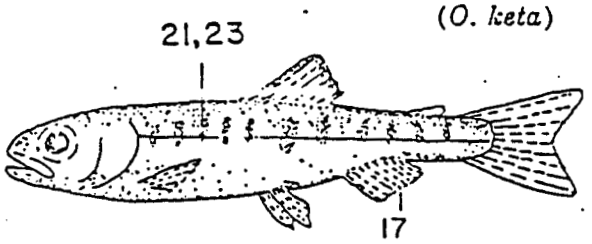
17. (4) Anal fin longer than high, with 13 or more developed rays. (Fig. 2B)
18. (6) Dorsal fin without large dark spots, may be black tipped.
Pacific salmon
Genus *Oncorhynchus*

19. (20) No parr marks. Fry leave fresh water while small—approximately 1.75 inches (45 mm) long.
Pink salmon
(*O. gorbuscha*)



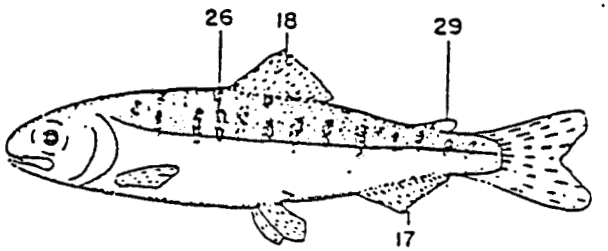
20. (16) Parr marks present as vertical bars or oval spots.
21. (30) Parr marks short, extending little, if any, below lateral line.
22. (25) Gill rakers on first arch, 19 to 26. ** Pyloric caeca, 140 to 186.
23. (26) Parr marks faint. Sides below lateral line iridescent green.
24. (27) Small when migrating from fresh water, approximately 1.5 inches (40 mm) long.

Chum salmon
(*O. keta*)



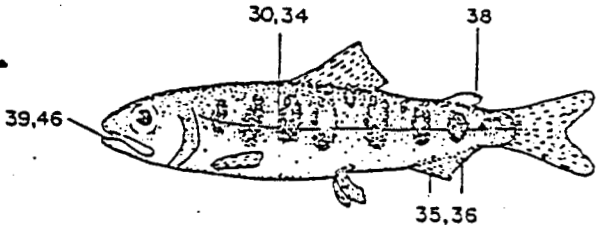
25. (22) Gill rakers on first arch, 30 to 40. **Pyloric caeca 60 to 115.
26. (23) Parr marks usually sharply defined. Sides below lateral line silvery, not iridescent green.
27. (24) Relatively large when migrating from fresh water, approximately 3 to 5 inches (80 to 126 mm) long.
28. (31) Gill rakers long and slender, more than 29 on first arch.
29. (32) Adipose fin clear, not pigmented.

Sockeye salmon
(*O. nerka*)



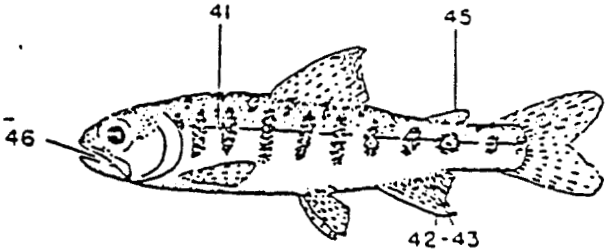
30. (21) Parr marks large, vertical bars centered by lateral line.
31. (28) **Gill rakers short and thick, fewer than 29 on first arch.
32. (29) Adipose fin at least partially pigmented.
33. (40) **Plyloric caeca more than 90.
34. (41) Parr marks broader than interspaces.
35. (42) Anterior rays of anal fin not distinctly longer than rest, not white edged.
36. (43) Anal fin not pigmented.
37. (44) Black spots, when present, on both lobes of caudal fin.
38. (45) Adipose fin not completely mottled, clear area at anterior base of fin.
39. (46) Black gums along base of lower teeth.

Chinook salmon
(*O. tshawytscha*)



40. (33) **Plyloric caeca less than 80.
41. (34) Parr marks narrower than interspaces.
42. (35) Anterior rays of anal fin elongated; when depressed they extend to base of last ray. (Fig. 2B)
43. (36) Anal fin pigmented between rays, resulting in black banding.
44. (37) Black spots, when present, on upper lobe of caudal.
45. (38) Adipose fin completely pigmented.
46. (36) Mouth gray to white.

Coho salmon
(*O. kisutch*)



47. (1) Adipose fin not present; scales present or lacking.

Not Salmonidae

48. (2) No fleshy appendage at base of pelvic fins.

Smelts
Family Osmeridae

49. (3) Mouth small, not reaching center of eye; teeth weak or absent.

50. (51) Depressed dorsal fin, shorter than head.

Whitefishes
Genus *Coregonus*

51. (50) Depressed dorsal fin, longer than head.

Arctic grayling
(*Thymallus arcticus*)

52. (5) **Teeth on head of vomer only.

Chars
Genus *Salvelinus*
Dolly Varden (*S. malma*)

53. (7) Adipose fin orange; row of distinct pale round spots along lateral line.

Brown trout
(*Salmo trutta*)

ACKNOWLEDGMENTS

We especially thank Dr. Arthur D. Welander, Professor of Fisheries, and Dr. Bruce S. Miller, Research Biologist, College of Fisheries, University of Washington, Seattle, for their valuable suggestions. We also thank Galen H. Maxfield, Fishery Biologist, and Dr. Alan J. Beardsley, Fishery Biologist, both from the NMFS Northwest Fisheries Center, Seattle.

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APPENDIX B

Procedures for Sampling Salmon Smolt for Age, Length, and Weight

The sample size is 70 sockeye salmon smolt per day, five days a week. If daily sampling objectives are being met, sampling will not occur on Wednesday and Sunday. It is essential that the sample be taken randomly. In the event that more than the required sample size is in the smolt trap at the time of sampling, the trap is to be stirred to assure randomness. When the smolt are randomly distributed, a small dip net will be used to remove a subsample. This procedure will be repeated until the sample size goal is met.

AWL Forms

Smolt length and weight will be recorded on AWL forms (Appendix B.1). Using a No. 2 pencil, complete each section of the left side of the AWL and darken the corresponding blocks:

Description: Include species (sockeye smolt), location, year, and samplers.

Card: The AWL forms and corresponding slides are numbered sequentially by date throughout the season starting with # 001. A new, consecutively numbered, card is used each day even if the previous card is not completed. There may be a minimum of one fish and a maximum of 40 fish (8 slides) per AWL.

Species: Refer to the reverse side of the AWL form to obtain species; sockeye = 2.

Day, Month, Year: Use the appropriate digits for the date the fish are sampled.

District, Subdistrict, Stream, Location: Consult project leader for the appropriate codes.

Period: List the period in which the fish were sampled using Appendix B.2.

Project: Refer to the reverse side of the AWL form to obtain code; code 4 will be used as default since a specific smolt code does not exist.

Gear: Refer to the reverse side of the AWL form to obtain code; 00 = trap.

Mesh: Leave blank.

Type of Length Measurement: Refer to the reverse side of the AWL form to obtain code; 1 = Tip-of-snout to fork-of-tail.

Number of Scales: Mark 1 (refers to 1 smear/fish)

# of Cards: Mark 1 (each AWL form is individually numbered)
Keep the litho codes in numerical order throughout the season and be sure to transfer the litho code from the front left side to the backside of the AWL form. These forms will be optically scanned and stray marks may be misinterpreted. It is the crew leaders responsibility to make sure that all forms are carefully edited before returning them to your supervisor.

Sampling procedure

Smolt will be kept alive and sampled the day of capture. MS222 will be used to anesthetize the fish. The use of this chemical will be demonstrated in the field. A flattened probe will be used to remove 5-10 scales from the preferred area, consult Appendix B.3. The scales will be mounted on a glass slide as illustrated in Appendix B.4. The left portion of each slide will be labeled: location, date, AWL # (card #), and fish numbers (1-5, 6-10, 11-15, etc.). When the slides are completed, return them to the box in order, and label the box as shown in Appendix B.4.. Smolt lengths will be measured in millimeters from the tip of the snout to the fork of the tail, Appendix B.5. Record each length by darkening the appropriate column blocks on the AWL form.

Excess water will be removed from the smolt before weighing by using a paper towel blotter. Individual smolt weights will be recorded to the nearest 0.1 gram on the backside (right side) of the AWL form (Appendix B.1).

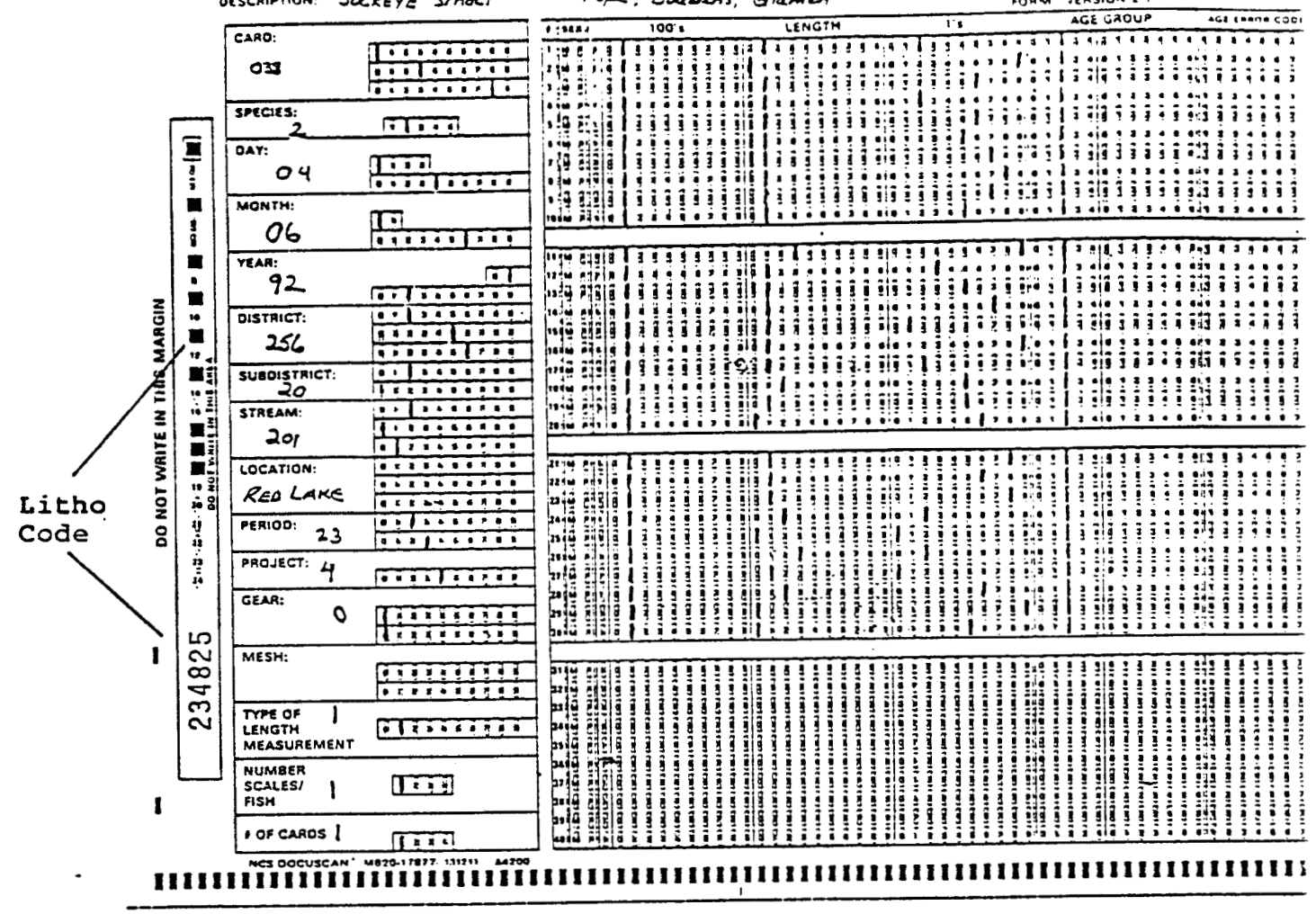
Take care to ensure length and weight data corresponds to the appropriate scale smear as this information is used to calculate condition factor at age. When sampling for age, length, and weight, rite-in-rain books may be used to record data. After sampling is done, transfer the data carefully to the AWL forms. **It is the responsibility of the crew leader to make sure the data has been transferred correctly and the AWL form is filled out completely.**

Appendix B.1.

RED LAKE 1992

DESCRIPTION: SOCKEYE SMOLT Pope, Bowers, Glamen

ADF&G ADULT SALMON AGE LENGTH FORM VERSION 2.1



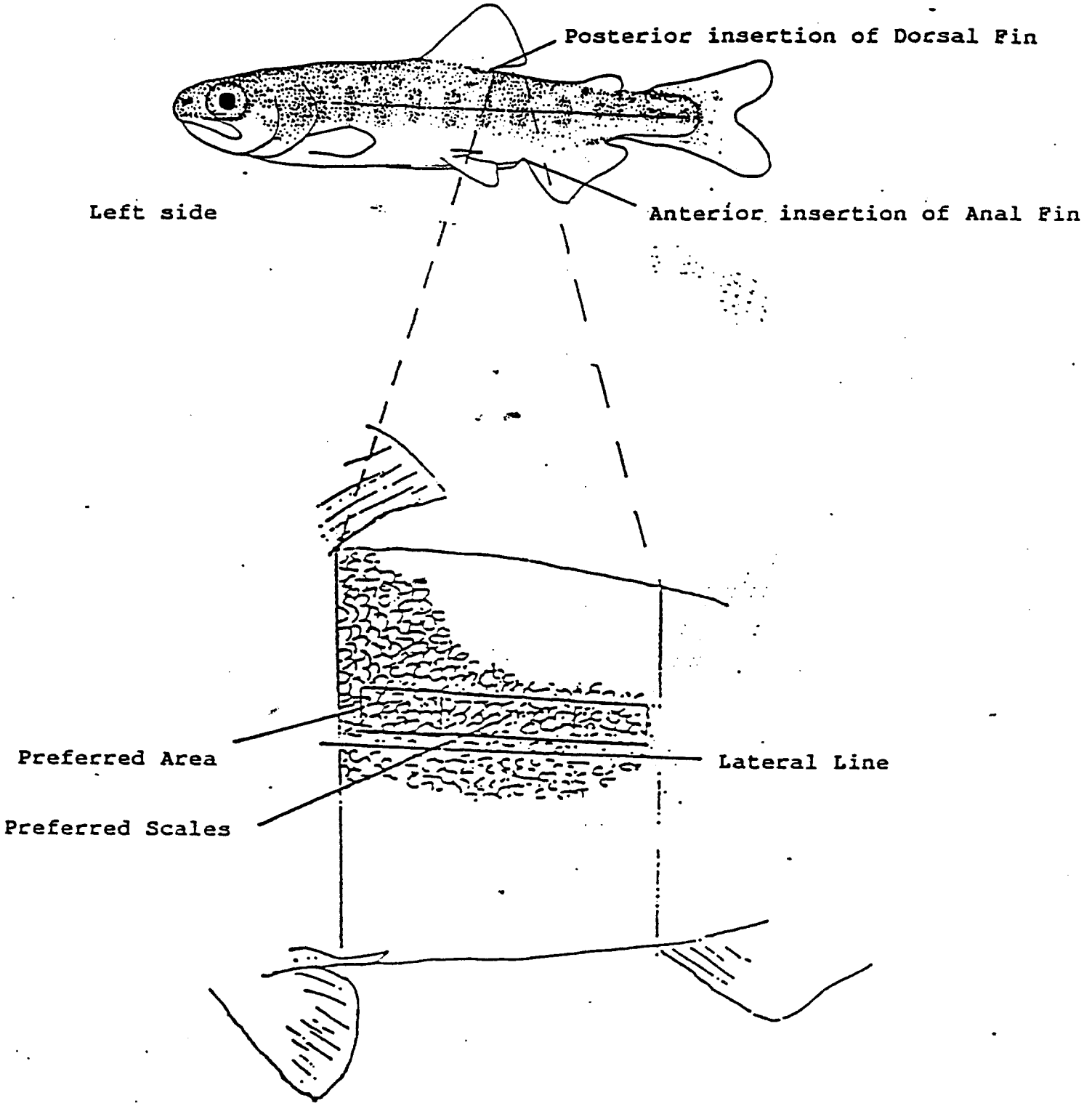
Litho Code

Litho Code Transferred

Appendix B.2. Period codes and corresponding dates.

Period	Dates	Period	Dates
1	01-Jan to 03-Jan	28	05-July to 11-July
2	04-Jan to 10-Jan	29	12-July to 18-July
3	11-Jan to 17-Jan	30	19-July to 25-July
4	18-Jan to 24-Jan	31	26-July to 01-Aug
5	25-Jan to 31-Jan	32	02-Aug to 08-Aug
6	01-Feb to 07-Feb	33	09-Aug to 15-Aug
7	08-Feb to 14-Feb	34	16-Aug to 22-Aug
8	15-Feb to 21-Feb	35	23-Aug to 29-Aug
9	22-Feb to 28-Feb	36	30-Aug to 05-Sep
10	01-Mar to 07-Mar	37	06-Sep to 12-Sep
11	08-Mar to 14-Mar	38	13-Sep to 19-Sep
12	15-Mar to 21-Mar	39	20-Sep to 26-Sep
13	22-Mar to 28-Mar	40	27-Sep to 03-Oct
14	29-Mar to 04-Apr	41	04-Oct to 10-Oct
15	05-Apr to 11-Apr	42	11-Oct to 17-Oct
16	12-Apr to 18-Apr	43	18-Oct to 24-Oct
17	19-Apr to 25-Apr	44	25-Oct to 31-Oct
18	26-Apr to 02-May	45	01-Nov to 07-Nov
19	03-May to 09-May	46	08-Nov to 14-Nov
20	10-May to 16-May	47	15-Nov to 21-Nov
21	17-May to 23-May	48	22-Nov to 28-Nov
22	24-May to 30-May	49	29-Nov to 05-Dec
23	31-May to 06-June	50	06-Dec to 12-Dec
24	07-June to 13-June	51	13-Dec to 19-Dec
25	14-June to 20-June	52	20-Dec to 26-Dec
26	21-June to 27-June	53	27-Dec to 31-Dec
27	28-June to 04-July		

Appendix B.3. Scale sampling procedure showing the preferred area on a smolt salmon.

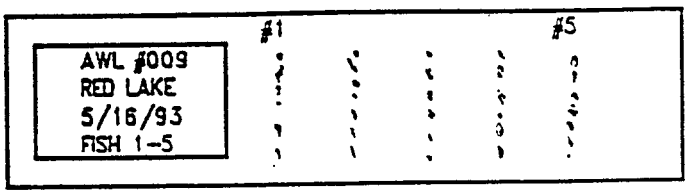


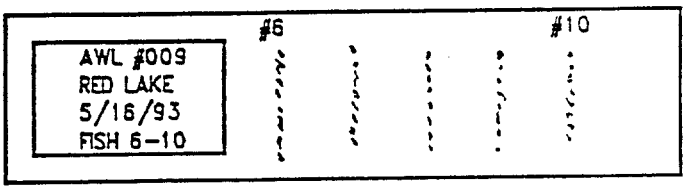
Appendix B.4.

SALMON SMOLT GLASS SLIDE EXAMPLE

The following information should be legibly written on the slide label:

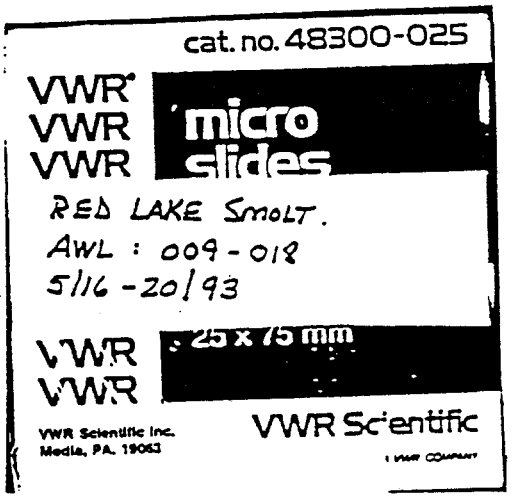
1. AWL #
2. Location
3. date (mo/day/yr)
4. Fish # (1-5, 6-10, etc.)





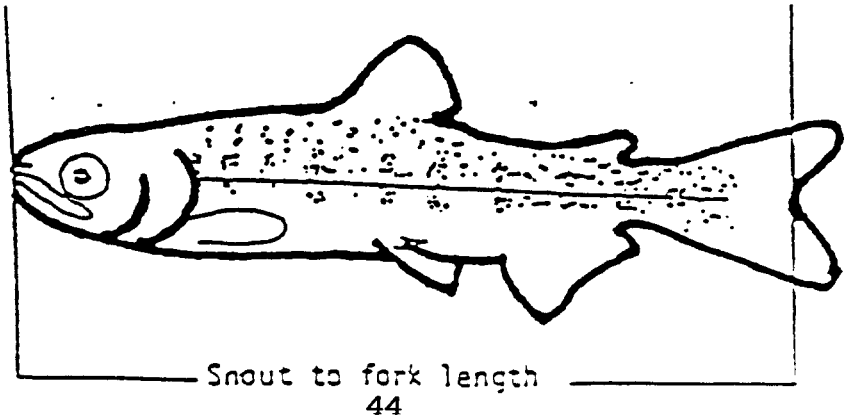
When the slides are completed, return them to the box in order by AWL # and fish#, and label the slide box on top with the following information:

Location (RED LAKE)
AWL Numbers (AWL # 009 - 018)
Beginning and ending dates (5/16 - 20/93)



Appendix B.5

MEASURING SMOLT LENGTH



DIVIDER

OPERATIONAL PLAN
SPIRIDON LAKE PROJECT, 1995

By

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and
Steve Schrof

Alaska Department of Fish and Game
Commercial Fisheries Management and Development Division
211 Mission Road
Kodiak, AK 99615

May 1995

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INTRODUCTION

From 1992 - 1994, 2.2, 4.3, and 5.7 million sockeye salmon fry were stocked into Spiridon Lake, respectively, to produce adult returns for commercial harvest. The Spiridon enhancement project consists of a smolt bypass system (trap system and pipeline) to allow migration past a barrier falls in the outlet creek draining Spiridon Lake. Smolt production, age and condition are assessed in May and June while operating this system. Since Spiridon Lake is located on Kodiak National Wildlife Refuge (KNWR), a significant portion of the project's focus is on wildlife and Dolly Varden monitoring as required by the Environmental Assessment (EA). The first harvestable return of sockeye salmon adults occurred in 1994. The project is also responsible for fishery monitoring activity, including run size estimates, age assessment, and providing for an orderly fishery.

Goal

The goal of this project is to evaluate the survival of sockeye fry stocked into Spiridon Lake, to the smolt life stage, to insure that smolt outmigrate through the bypass system with minimal mortality, as well as to determine the number of adults produced, and to monitor the commercial fishery. Additionally, to comply with the monitoring requirements of the EA in agreement with the Kodiak National Wildlife Refuge.

Objectives

1. Estimate the number and timing of sockeye smolt outmigrating from Spiridon Lake.
2. Determine the age composition, and average size of sockeye smolt outmigrating.
3. Determine Dolly Varden catch per unit effort (CPUE) in Spiridon Lake.
4. Estimate the seabird, marine mammal, and other wildlife abundance in Spiridon Bay.
5. Monitor run strength to facilitate a commercial fishery.
6. Estimate the run of pink and sockeye salmon returning to Telrod Cove and Telrod Creek.
7. Determine the age composition of the sockeye run in the Terminal Harvest Area.
8. Determine baseline parameters for disease and genetics of Spiridon River sockeye and chum salmon.

Tasks

1. Operate a smolt bypass system throughout the sockeye smolt outmigration. Target date: April 27 to end of migration.

2. Estimate the daily migration of sockeye salmon smolt by time counts.

3. Sample 70 smolt per day, three days per week, for scales, length and weight data.

4. Sample 70 smolt per day, two days per week, for scales alone.

5. Collect physical data daily.

6. Collect juvenile Dolly Varden samples for CPUE at South, East and West Creek locations, in late June and in August.

7. Collect adult Dolly Varden for CPUE from West Creek area, for two 24 hour fishing period in late June and in August.

8. Sample all captured adult Dolly Varden for weight (0.1 g) and lengths to nearest millimeter (snout to tail fork).

9. Conduct wildlife surveys in Spiridon Bay on July 14, August 4, and August 25.

10. Conduct foot surveys to the barrier falls of Telrod Cove Creek during the wildlife surveys in August.

11. Transfer fishery monitoring camp from Anguk Island to Telrod Cove and install barrier seine by 20 July.

12. Sample 240 adult sockeye/week (~1,600 total) for age and length in the commercial fishery of Spiridon Bay/Telrod Cove area; in addition, sample 30/week (15 male and 15 female) for weight.

13. Monitor the salmon build up and vessel activity during fishery openings.

14. Collect 60 IHNV samples each from sockeye and chum salmon in the Spiridon River drainage in August (chum) and September (sockeye).

15. Collect 100 samples from Spiridon River sockeye to genetically characterize the stock.

SUPERVISION

Project Biologists: Steve Honnold and Steve Schrof

Honnold and Schrof will be responsible for logistical support, equipment, and technical support.

Field Staff: Mark Kansteiner - crew leader - Smolt (4/27-6/9)
Greg Watchers, Tim Sands, PJ Purdy, FT I - crew
Tim Sands - crew leader - Smolt (6/10-6/30); Fishery Monitoring (7/17 - 9/1)
PJ Purdy, Mary Bingham, Helen Knut, and Sport Fish Division Tech. - crew

The crew leader will schedule daily tasks and oversee field operations and safety. Steve Schrof will opwn fishery monitoring camp and train Tim Sands. Greg Watchers will be the crew leader from 9/1 through the end of fishery monitoring.

PROCEDURES

Trap Installation, Monitoring and Maintenance

The location of two canadian fan traps will be similar to 1994 in a point, mid channel, as indicated by permanent bank markers. Once in place the trap will be anchored by cable to a turnbuckle permanently attached to a previously anchored duckbill on the stream bank. Two inch diameter pipe in 10 - 12 foot sections erected with NU-RAIL fittings, will be used as a frame to secure and support the traps. Come-a-longs, secured to the overhead steel pipe cross members, will be used to elevate the downstream ends of the traps to . Additional support will be provided (cable and 3/4 inch rope) from the traps to the overhead pipes.

The de-watering tanks will be placed downstream of the traps and secured by cable to previously positioned duckbill anchors on the stream banks. Next, each trap will be connected to the de-watering tanks with sections of aluminum trough and secured with threaded rod run through previously drilled holes. Rubber and foam pipe insulation material will be used to assure a tight fit between the ends of troughs and the tanks and traps.

A diversion weir will be installed upstream of the traps using a frame made from five foot (legs), and eight foot (cross members), two inch diameter pipe and NU-RAIL fittings, and attached four by eight sheets of aluminum perforated plate. The perforated plate will be secured to the traps and screwed in place, with each upstream piece overlapping six or so inches and resting on the stream bed. A wooden dam will be installed where the weir meets the stream banks to minimize smolt avoidance near shore. The base of the weir will be sandbagged and lortex used to prevent smolt from escaping. Lortex will also be used at the seams of the perforated plate and any other areas of potential injury to smolt. Similarly, the inside of each trap will be lined with tarp material and/or lortex.

Pipeline sections will then be attached to the downstream ends of the de-watering tanks which lead to the counting tank. The pipeline is open ended at the counting tank with both pieces resting on the lip of the tank. A stand pipe is used to adjust the water level in the counting tank; and come-a-long adjustment adjusts the flow into the traps and de-watering tanks.

The traps should be operated to maintain efficiency and minimize smolt mortality. This will require frequent monitoring and maintenance. Keep in mind the significance of smolt survival to the overall adult return. Significant mortality can occur in a short period of time. Fish tend to hold in the tanks and pipeline during the day periods and any loss of flow through the system can result in mortality of fish in those areas. Some mortality will occur due to the high water pressure and smolt being pinned on perforated plate. Keep an accurate account of the mortality to include in the daily outmigration estimate. All dead smolt will be removed from the system and disposed of in Spiridon Lake.

Smolt Migration Estimates (Time Counts)

Time counts of smolt passing through the bypass system will be used to estimate daily outmigration. Counts will be conducted every 30 minutes from 2300 hours through 0500 hours at the "counting box" (most downstream tank), with a target count of 1,000 smolt/period. The counting period (every 1/2 hour) will range from 1.5 minutes (minimum) to 8.0 minutes (maximum). The duration of the period will be determined by the rate of smolt movement, with the minimum time used during large migrations and the maximum used during slower smolt movements. Counts will be undertaken by moving one of the entrance pipes over a catch basket submerged in the tank and using a stop watch. The counts will be alternated between the two pipes each 30 minutes. If smolt movements occur during the day then the aforementioned procedures will be also be used. The past procedure of crowding and estimating holding smolt in the de-watering and counting tanks will only be conducted if excessive injury or mortality is observed or, in the crew leader's judgement, has the potential to occur. If several days of holding smolt begin to migrate, time counts will proceed as usual; note when this occurs. An estimate of the number holding at the end of each smolt day (noon) will be recorded, but not added to the daily count. The migration estimate per ½ hour will be determined by: (number of smolt counted per time period) x (time period/30 minutes). Record time counts, migration estimates, and remarks on the Spiridon Smolt Daily Reporting Form (Appendix A) and summarize daily trapping data on Sockeye Salmon Summary Report Form (Appendix B).

Age, Weight and Length Sampling

A sample of 70 sockeye smolt per day, three days per week, are to be sampled for age, length, and weight. On alternate days (two days a week), scales only will be collected. Each sample will be taken from a single day's catch. Do not mix samples between days. Since smolt primarily migrate at night, a single sampling day will be the 24 hour period from noon to noon and will be identified by the calendar date corresponding to the first noon.

It is essential that the sample be taken randomly. In the event that more than the required sample size is in the smolt trap at the time of sampling, the trap is to be stirred to assure randomness.

When the smolt are randomly distributed, a small dip net will be used to remove a subsample, this procedure will be repeated until the sample goal is met.

Smolt samples will be kept alive and worked the day of capture. MS222 will be used to anesthetize the fish. Latex gloves should be worn to prevent direct exposure to MS222 (see attached MSDS sheet). The use of this chemical will be demonstrated in the field. Age, weight, and length data will be recorded on adult AWL forms (computer forms) (Appendix C.1), as no smolt AWL forms exist. Refer to Appendix C.2 on the standard procedures for recording data on an AWL form. Record sampling personnel at the top of each AWL form.

A knife or scalpel will be used to remove 5-10 scales from the preferred area (Appendix C.3). The scales will be mounted on a glass slide as illustrated in Appendix C.4. Label the left portion of each slide with the sample AWL number, location, date, and fish number. Smolt lengths will be measured to the nearest millimeter, from the tip of the snout to the fork of the tail.

Excess water will be removed from the smolt before weighing by using a paper towel as a blotter. Individual smolt weights will be recorded to the nearest 0.1 gram.

All data (slides, forms) will be forwarded to the area office and reviewed on a frequent basis (weekly or earliest available plane to town). Be sure to duplicate the data forms in case originals are misplaced in transit. **Please be conscientious in the quality control of <u>all</u> data prior to sending into Kodiak. Take the time to thoroughly review slides and forms to see they are filled out properly. This is especially important for the computer AWL forms.** Avoid the following:

1) Scales mounted poorly - avoid too many scales in a smear and avoid slime or debris when mounting; also keep smears far enough apart to avoid mistaking one fish or another.

2) Numbering AWL form improperly - for example, if 70 smolt are sampled the first day (day 1) the AWL numbers should be 001 (fish 1-40; 8 slides), 002 (1-30; 6 slides), do not continue from 40 to 41-70. The next day will start with AWL 003 (fish 1-40) and so on.

3) Numbering when two scales per fish is required - these should be numbered 001 A, B, not 001-002.

4) "# of cards" mislabeled - use one even if there are two scale cards or slides.

5) Damage AWL form (computer - mark sense) - do not bend, fold, tape, staple, paper clip, etc. these forms. The computer will not read them correctly, otherwise.

Quality control check will be made by project biologists with feedback provided to crew leader in a timely manner. If there are questions concerning any procedures, please ask for assistance. Requesting assistance is better than improper sampling or form completion.

Physical Data

Physical data will be collected at the smolt site at approximately 1100 and 2300 hours. Information will be recorded on the Daily Physical Observation form (Appendix D) and will include: water and air temperatures, stream height, percent cloud cover, wind direction and velocity, and precipitation.

Dolly Varden Sampling

Dolly Varden juveniles will be collected for CPUE by beach seine at three locations (Appendix E) once in late June, and again in August. During each sampling period, two sets will be made from permanent marker (fence post); one on each side. Dolly Varden and sockeye fry will be enumerated and stickleback and sculpin numbers estimated and summarized on the Dolly Varden Sampling form (Appendix F). Sockeye fry weights (0.1 g) and lengths (mm) will be recorded.

A variable mesh gillnet will be set on the lake bottom at the permanent sampling site at West Creek. Gillnet sets will be, approximately 30 meters from shore, marked with a fence post. All adult Dolly Varden caught over a 24 hour period will be sampled for weight (0.1 gram), and length (mm) FL (Appendix G). All adult Dolly Varden will be eviscerated to examine stomach contents. Contents will be visually identified to assess the degree of sockeye fry predation.

Wildlife Surveys

Wildlife surveys will be conducted on 7/14, 8/4 and 8/25 in Telrod Cove and Spiridon Bay. Bird and sea mammal counts will be made along transects developed previously. Refer to Appendix H for procedures and necessary data forms.

Stream Surveys

Foot surveys will be conducted in August (during wildlife surveys) in lower Spiridon Creek and Telrod Cove. Live and dead adult salmon will be enumerated. Survey data will be recorded in a rite-n-rain log book.

Fishery Monitoring and Sampling

From July 15 to September 15, the commercial salmon fishery will be monitored in Telrod Cove and Spiridon Bay. The camp will be relocated from Anguk Island to Telrod Cove (Appendix I). Once the camp is established, a barrier net will be installed across Telrod Cove to prevent adult sockeye salmon from escaping into Telrod Cove Creek (Appendix I). The barrier net will be monitored in such a manner to avoid mortality to fish and wildlife. A system will be developed to pass approximately 100 - 200 pink salmon over the net to allow to spawn in Telrod Cove Creek. The net will be kept free of debris and cleaned regularly. Daily surveys will be conducted in Telrod Cove and Spiridon Bay to assess sockeye salmon run strength with information relayed to the Commercial Fishery Managers at 0800 and 2000 hour radio schedules. Crew leader will be responsible for coordinating opening of fishery under direction of

Commercial Fishery Managers. During the fishery, vessel names, fishing location , and estimated catch by species will be logged.

The adult sockeye salmon run will be examined for age and length data with a goal of sampling ~1,600 fish from 01 August through the end of the run. The weekly goal will be 240 fish. In addition, 30 sockeye (1:1 sex ratio) will be sampled weekly for weight. A variety of fish will be sampled each day from the smallest to the largest to accurately reflect a weight range. Refer to Appendix J "Kodiak Management Area Salmon Escapement Sampling Operational Plan, 1995" for procedures.

Pathology and Genetic Sampling

Ovarian fluid samples will be collected from 60 female sockeye (spawners or post-spawners) at Munsey's Lake. The adult sockeye will be collected by beach seining along the lake shore where spawning has been observed. Once fish have been captured, ovarian fluid will be collected as described in Appendix K, IHNV sampling protocol.

Virology samples will also be collected from female chum salmon in the Spiridon River drainage using the same sampling procedures.

In addition, the collection of genetic samples from adult sockeye salmon will be coordinated with the pathology sampling. Fish will be captured by beach seining at Munsey's Lake and sampled according to the guidelines outlined in the genetics sampling protocol (Appendix L).

OTHER REQUIREMENTS

Additional Data Collection

During the course of daily activities, also note any wildlife activities and their locations. This includes bear observations, waterfowl activity (Harlequin Duck activity on Spiridon Lake), bald eagle activity during smolt outmigration, and marine mammal occurrence. Also, record human activity as associated with the commercial fishery (hiking to view bears under the falls, etc.). It is especially important to document any fishing violations, either by photo or video.

Safety and Radio Schedule

Each employee will receive CPR/First Aid Certification as required by the Department SOP, prior to assignment to the Spiridon Project. In addition, each employee will review the required sections of the ADF&G SOP and sign the Employee Safety SOP Verification form. Specific SOP's to review include Safety Policy/Standards, Building Safety, Field Camp Safety, Aircraft Safety/Passenger, Emergency/Survival Equipment Required in Aircraft, Boating Safety, Vehicle Safety, Laboratory Safety, Small Tool Handling, and Firearm/Bear Safety. There is additional information in the office safety files to supplement the SOP and is also available for review.

Project crew leaders will be responsible for providing the necessary equipment and information to field technicians. **Each employee is responsible for receiving his/her own safety training.**

Field camps will be contacted by office personnel by SSB radio. The Development Section, CFM&D Division, morning radio schedule will be from 0845 - 0900 hours Monday through Friday and the evening 2100 - 2115 hours Sunday through Thursday. During smolt season the "morning" schedule will be 1300 - 1315 hours. If contact is necessary at other times information can be relayed vie the Commercial Fish Management Section schedule at 0800 and 2000 hours. (Appendix M). The frequency for Fish and Game contact is 3230. **ALL FIELD PERSONNEL WILL BE AWARE OF EMERGENCY CONTACT PROCEDURE POSTED ON EACH RADIO AND AT WHICH LONGITUDE AND LATITUDE COORDINATES THEIR CAMP IS LOCATED.**

Air Charters

All air charters will be set up through Kodiak staff. Appropriate information in regard to charters will be relayed through daily radio contact. It is important to contact office personnel when any data, equipment or other freight will be "back hauled" to Kodiak.

Reporting

Crew leaders will be responsible for reporting all of the job activities and compiling biological data. Be sure to use pencil rather than a pen for data entry. Data forms and a field log will be completed daily. Use "rite in the rain" field log books in the field and transfer data onto rite in the rain data forms after field work is completed. Data will be reported to Kodiak staff via SSB radio as previously mentioned. Completed data forms will be sent to Kodiak weekly. Make sure that data that is sent to Kodiak is properly packaged and labelled.

A report of project activities will be sent to town weekly or on soonest available plane . A one page weekly report is sufficient (Appendix N). In addition to weekly reporting, crew leaders will be responsible for writing a report summarizing Spiridon Project activities for the season. Please follow the enclosed format when writing this document (Appendix O). Specific information on hardware installation and removal, and system operation should be included.

Inventory

Upon completion of the project, crew leaders will complete a thorough inventory of all project equipment. The final location of each inventoried item will be noted (i.e. at Spiridon, warehouse bin, etc.).

Video/Photo Documentation

Crew leaders will be responsible for photo documenting project activities. Specific aspects such as trap installations, weir construction, and other detailed tasks are important to photograph. When possible, State cameras and film will be used. If, however, State cameras are not available, film will be provided for use with personal cameras. The use of personal cameras is suggested in this case but not required.

Performance Appraisal

Crew leaders will be responsible for evaluation of each crew members performance during the Spiridon Project operations. A Performance Evaluation will be written for each crew member at the end of the project. These evaluations will be written on the State of Alaska Performance Evaluation form (Appendix P). The individuals that write these project evaluations will be referred to in the final evaluation written by the Project Biologist. Crew leaders should keep crew members appraised of their performance during the project.

Timesheets

All timesheets are to be in the Kodiak office by the 15th and 30th of each month. When the employee is working in the field and receives hazard pay, the timesheet "Comments" column is to have the location of the field camp. If there was overtime worked, the employee must state a choice each pay period whether to be paid for the overtime hours worked or accrue compensatory leave (comp time). The comp time should be put on the timesheet as overtime, and at the top of the timesheet write the following: "I wish to receive compensatory leave in lieu of overtime." Comp time is calculated each pay period by multiplying the number of hours of eligible overtime by 1.5. If the employee has comp time at the end of the field season, they are to use the comp time before being put on seasonal leave without pay. Employees cannot collect unemployment while on comp time. Crew leaders should plan work activities to be completed in a 7.5 hour day. All overtime worked will be pre-authorized by the Project Biologist.

APPENDIX

APPENDIX A

SPIRIDON SMOLT DAILY
REPORTING FORM

Date _____

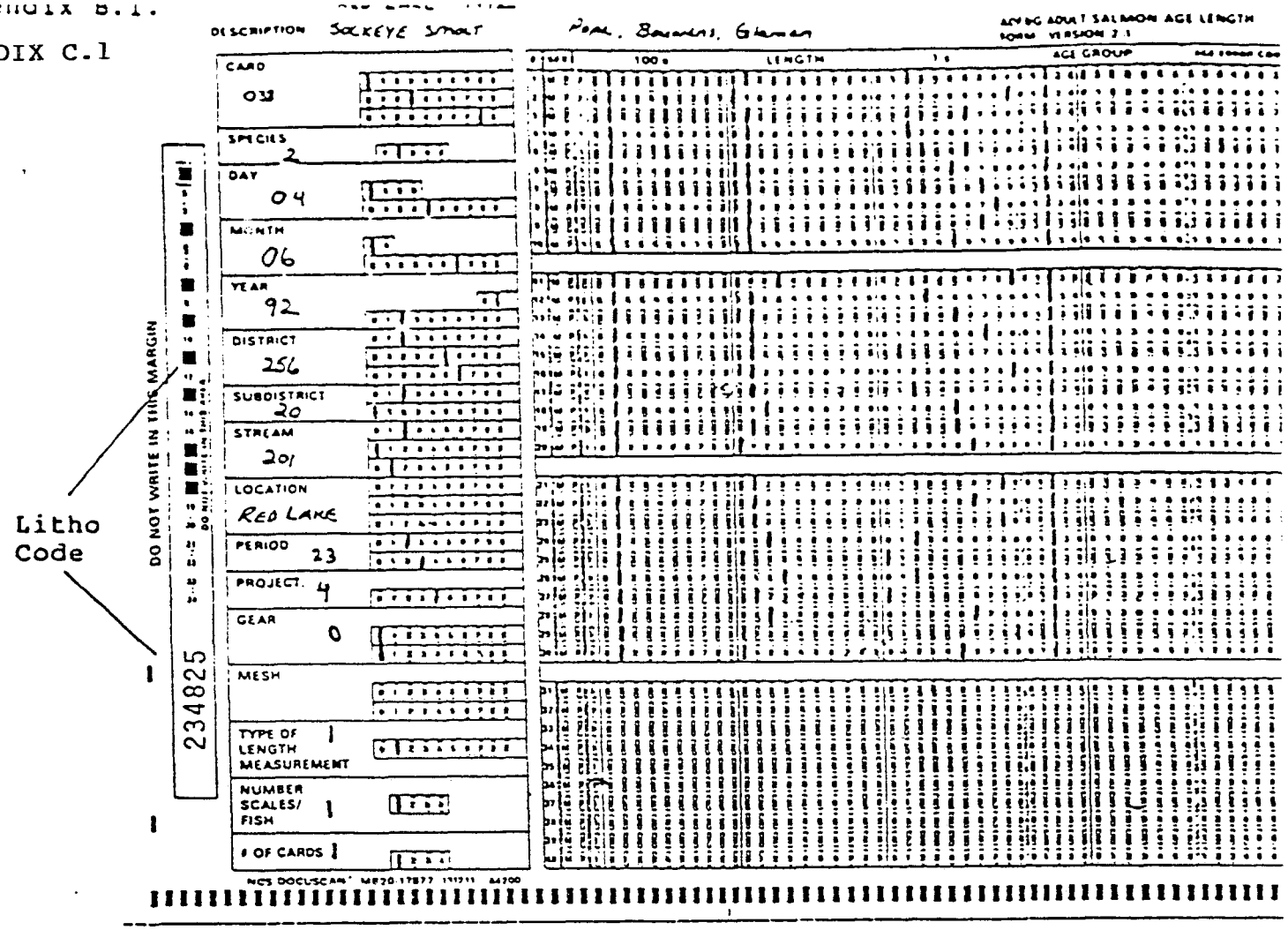
Period (Military)	Time (Min:Sec)	Multiple (30 Min. /Time)	Live Count x 2	Live Count x Multiple	Mort. Count x 2	Mort. Count x Multiple	Remarks

APPENDIX B

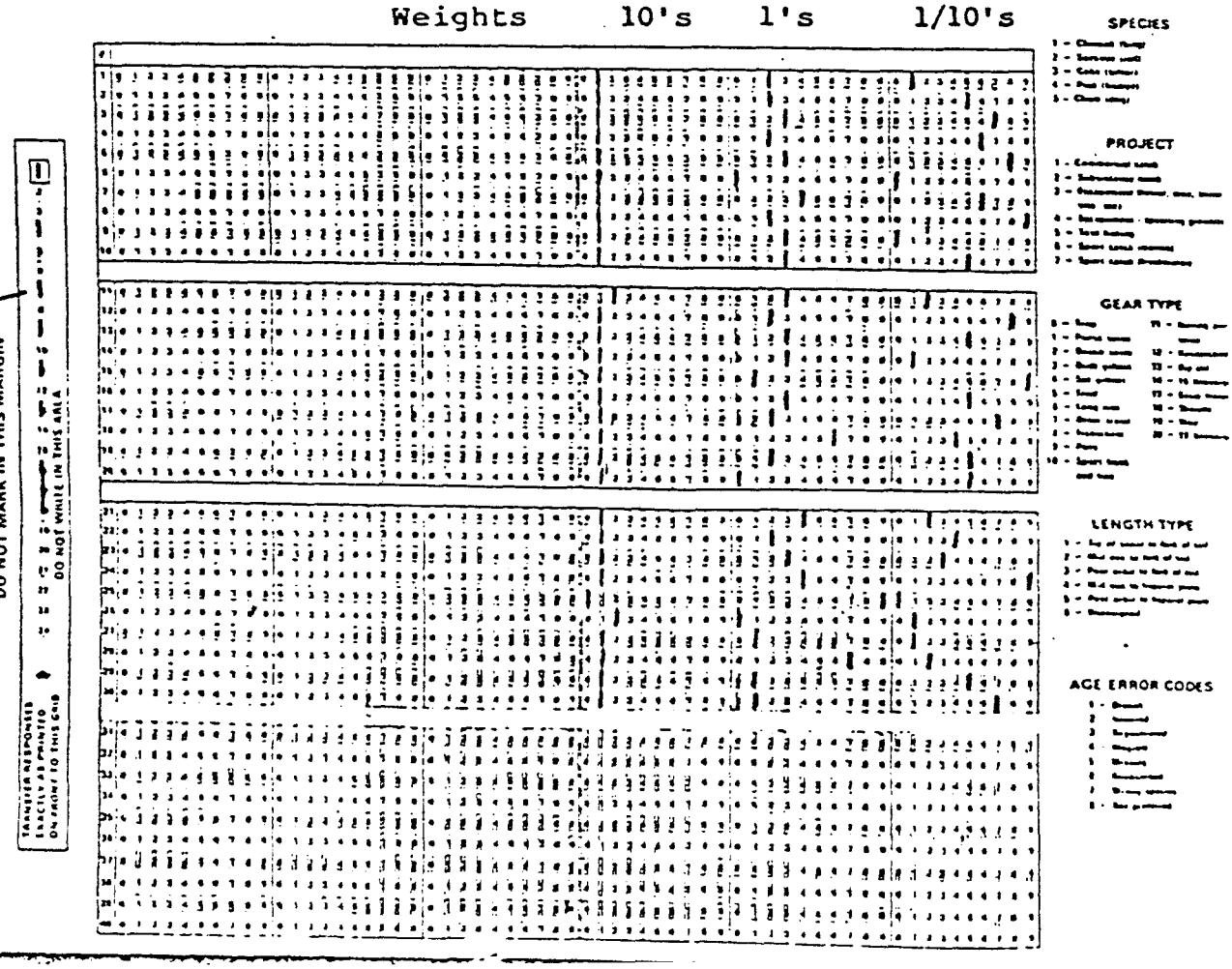
SPIRIDON
SOCKEYE SALMON SMOLT SUMMARY

Date	Timed Live	Timed Dead	Other Live	Other Dead	Total Live	Total Dead	Accumulated Live	Accumulated Dead	Accumulated Live and Dead

APPENDIX C.1



Litho Code



Litho Code Transferred

The sample size is 70 sockeye salmon smolt per day, five days a week. If daily sampling objectives are being met, sampling will not occur on Wednesday and Sunday. It is essential that the sample be taken randomly. In the event that more than the required sample size is in the smolt trap at the time of sampling, the trap is to be stirred to assure randomness. When the smolt are randomly distributed, a small dip net will be used to remove a subsample. This procedure will be repeated until the sample goal is met.

AWL Forms

Smolt length and weight will be recorded on AWL forms (Appendix B.1). Using a No. 2 pencil, complete each section of the left side of the AWL and darken the corresponding blocks:

Description: Include species (sockeye smolt), location, year, and samplers.

Card: The AWL forms and corresponding slides are numbered sequentially by date throughout the season starting with # 001. A new, consecutively numbered, card is used each day even if the previous card is not completed. There may be a minimum of one fish and a maximum of 40 fish (8 slides) per AWL.

Species: Refer to the reverse side of the AWL form to obtain species; sockeye = 2.

Day, Month, Year: Use the appropriate digits for the date the fish are sampled.

District, Subdistrict, Stream, Location: Consult project leader for the appropriate codes.

Period: List the period in which the fish were sampled using Appendix B.2.

Project: Refer to the reverse side of the AWL form to obtain code; code 4 will be used as default since a specific smolt code does not exist.

Gear: Refer to the reverse side of the AWL form to obtain code; 00 = trap.

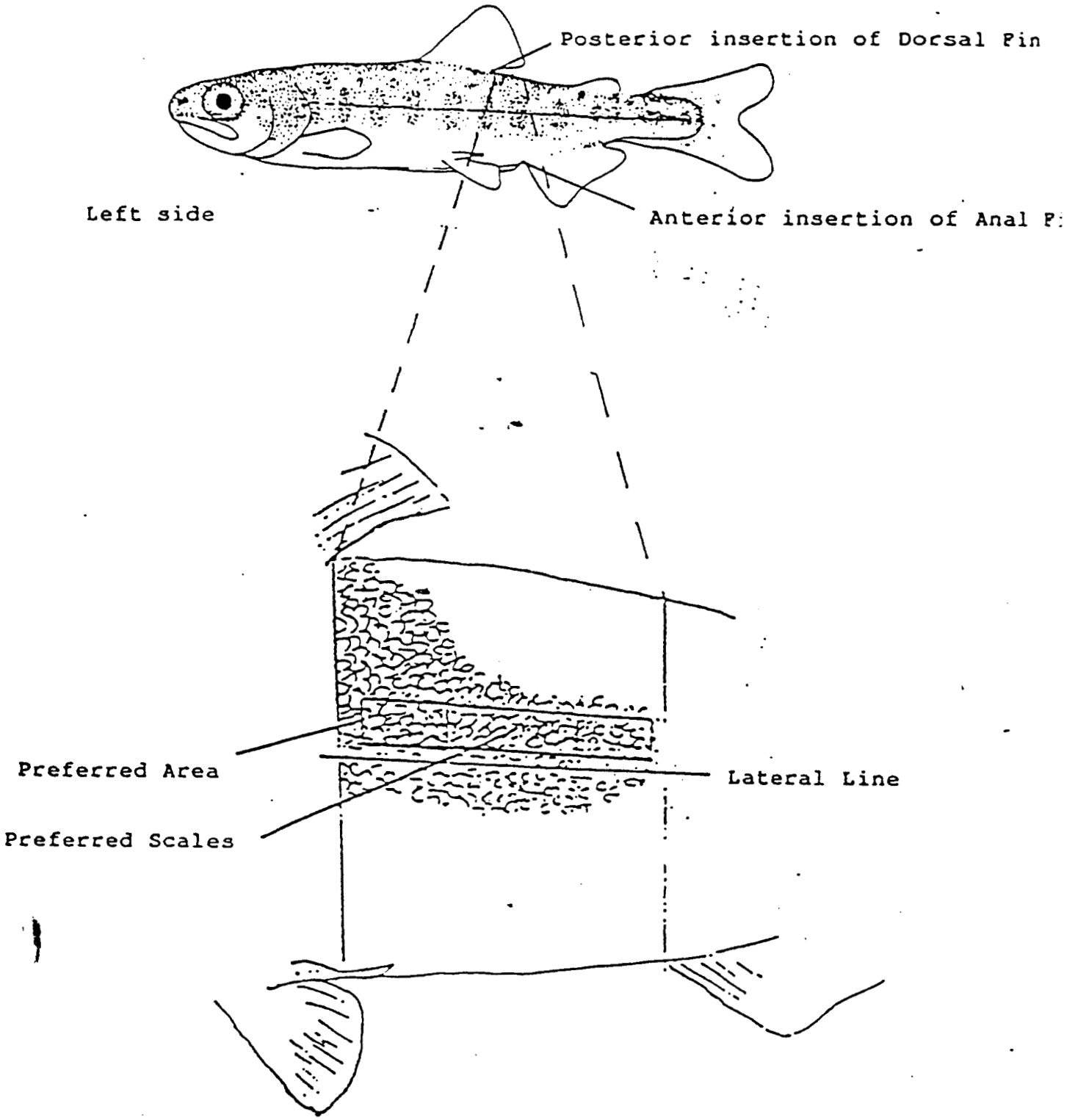
Mesh: Leave blank.

Type of Length Measurement: Refer to the reverse side of the AWL form to obtain code; 1 = Tip-of-snout to fork-of-tail.

Number of Scales: Mark 1 (refers to 1 smear/fish)

# of Cards: Mark 1 (each AWL form is individually numbered)
Keep the litho codes in numerical order throughout the season and be sure to transfer the litho code from the front left side to the backside of the AWL form. These forms will be optically scanned and stray marks may be misinterpreted. It is the crew leaders responsibility to make sure that all forms are carefully edited before returning them to your supervisor.

Appendix C.3. Scale sampling procedure showing the preferred area on a smolt salmon.

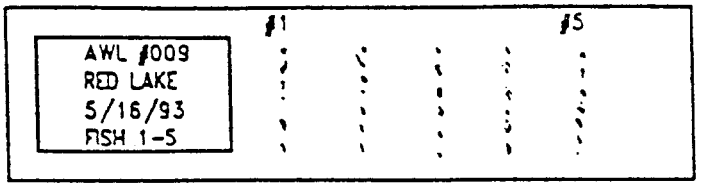


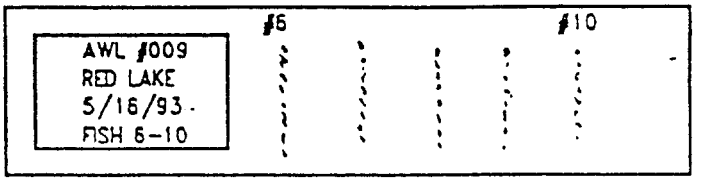
Appendix C .4.

SALMON SMOLT GLASS SLIDE EXAMPLE

The following information should be legibly written on the slide label:

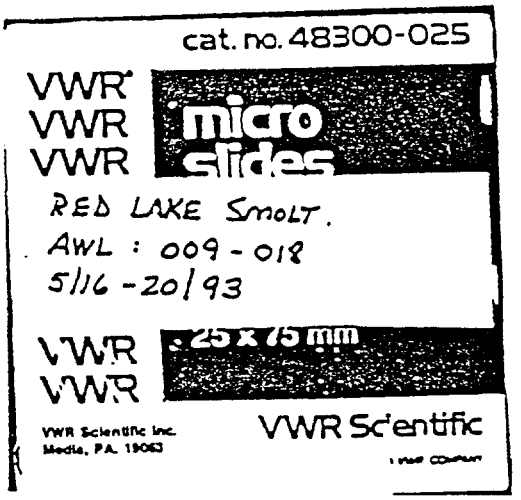
1. AWL #
2. Location
3. date (mo/day/yr)
4. Fish # (1-5, 6-10, etc.)





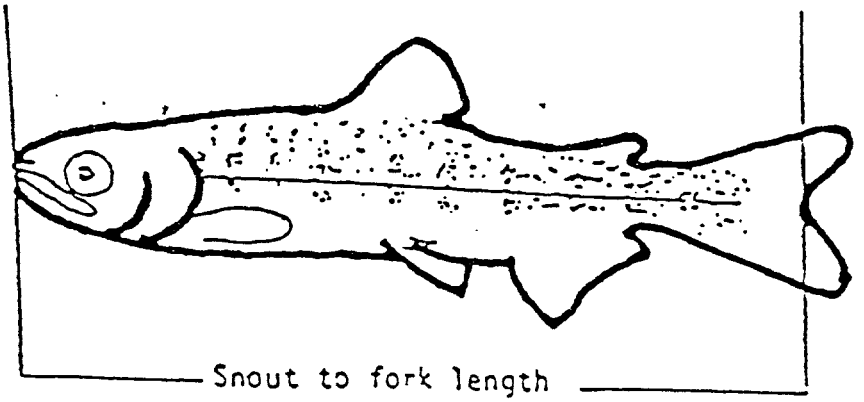
When the slides are completed, return them to the box in order by AWL # and fish#, and label the slide box on top with the following information:

Location (RED LAKE)
AWL Numbers (AWL # 009 - 018)
Beginning and ending dates (5/16 - 20/93)



Appendix B.5

MEASURING SMOLT LENGTH



APPENDIX D

DAILY PHYSICAL OBSERVATIONS

Project:
Location:

Date	Time	Temperature				Guage	Weather
		Air		Water			
		Min.	Max.	Min.	Max.		

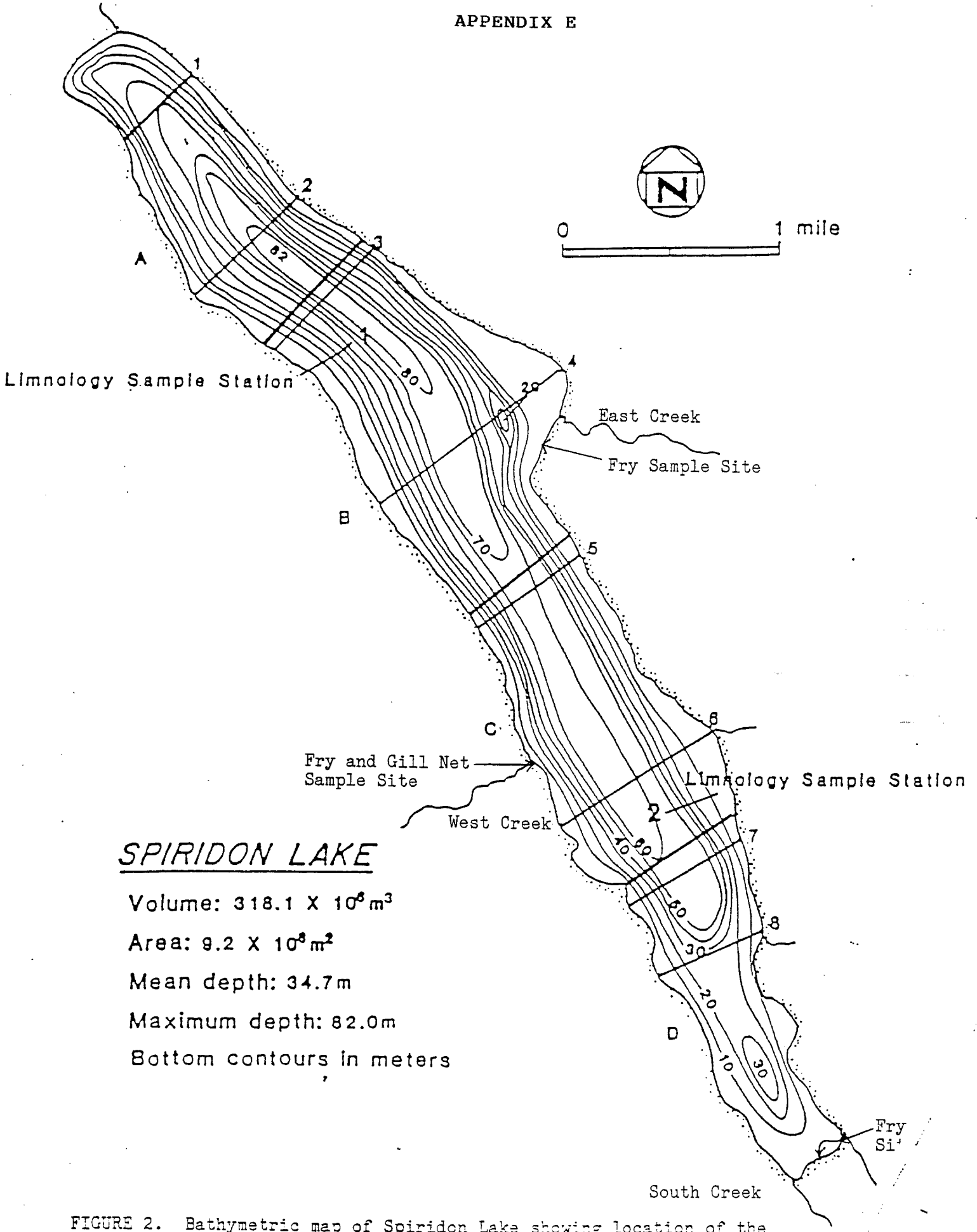


FIGURE 2. Bathymetric map of Spiridon Lake showing location of the limnological sampling stations, hydroacoustic areas (A-D) and transects (1-8).

APPENDIX F

Spiridon Lake Dolly Varden Juvenile Beach Seining Reporting Form

Date:

Seine Sites	Sockeye	Sticklebacks	Dolly Varden	Sculpin	Comments
West Beach					
1st Set					
2nd Set					
Total/Site:					
East Beach					
1st Set					
2nd Set					
Total/Site:					
South Beach					
1st Set					
2nd Set					
Total/Site:					

Total Fish Numbers:

APPENDIX G

Spiridon Lake Dolly Varden Gillnet Survey Form

Personnel:
Data collected on:

Gillnet set (date/time):
Gillnet pulled (date/time):

Fish Number	Length (mm)	Weight (g)	Fish Number	Length (mm)	Weight (g)
1			34		
2			35		
3			36		
4			37		
5			38		
6			39		
7			40		
8			41		
9			42		
10			43		
11			44		
12			45		
13			46		
14			47		
15			48		
16			49		
17			50		
18			51		
19			52		
20			53		
21			54		
22			55		
23			56		
24			57		
25			58		
26			59		
27			60		
28			61		
29			62		
30			63		
31			64		
32			65		
33			66		
Average:					

APPENDIX H

OBSERVER MANUAL FOR BOAT SURVEYS FOR MARINE BIRDS AND MAMMALS

MARINE AND COASTAL BIRD PROJECT

MIGRATORY BIRD MANAGEMENT

U.S. FISH & WILDLIFE SERVICE

ANCHORAGE, ALASKA

MAY 1991

I. INTRODUCTION

The purpose of this guide is to acquaint the reader with sampling protocols for Marine and Coastal Bird Project boat surveys for seabirds and mammals. This handbook has been designed to give new observers a working knowledge of data collection techniques before entering the field. Sampling design (the way transects are chosen and the number and size of boats used to survey) is not addressed in this manual.

1. Crew

The number of crew on a boat will depend on survey design and boat size. For example, the 25' Boston Whaler Revenge is operated by a three person team. One crew member acts as boat operator while the other 2 make observations. Duties may be rotated among crew members. One person may act as boat leader and is responsible for daily survey logistics and data quality control.

2. Transects

In general, two types of transects are used in Marine and Coastal Bird Project surveys: shoreline transects for areas within 200m of shore, and pelagic transects for areas greater than 200m from shore.

Shoreline transects are surveyed at a distance of 100m from shore at a cruising speed of 5-10 kts. The inside observer surveys from the boat to the shore ("inside"), while the outside observer surveys from the boat seaward an additional 100m ("outside"). In this manner, all birds within the 200m strip adjacent to shore are counted Figure 1 illustrates a typical shoreline transect. The cross-hatched area represents the 200m wide strip that is sampled by the observers.

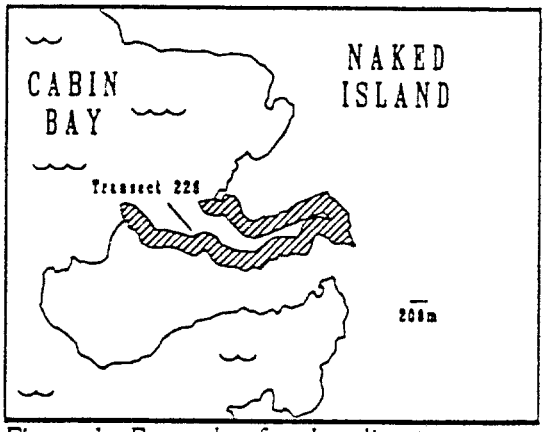


Figure 1. Example of a shoreline transect.

Offshore areas are subdivided with a grid because of the large area to be surveyed. Straight-line transects are subsampled randomly or systematically within grid blocks. Figure 2 illustrates transects which sample pelagic block P17.

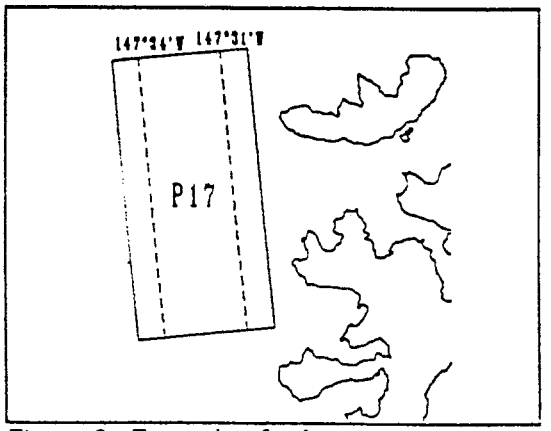


Figure 2. Example of pelagic transects which sample block P17.

3. Rocks and Islands

Sightings of animals on rocks in the transect should be coded as on land (codes for location of sightings are described in the data recording section). Rocks are considered land even if they are not contiguous with the shoreline. This leads to the seemingly cryptic but correct description of an animal located greater than 100m from shore, on land.

If a rock appears to be exposed at mean high water (MHW) and has terrestrial vegetation, it is considered a small island. When an island occurs in the transect, the surveyed area is expanded to include a 200m transect buffer around the island (transect areas are not expanded around rocks that are not exposed at MHW and do not have terrestrial vegetation). Sightings within 100m of the island shoreline are recorded as "inside" and those from 100m to 200m from the island are recorded as "outside".

4. Ice

If ice obstructs your ability to adequately see portions of the transect, estimate the percentage of the transect area that was unsurveyable and record this value in the comments section of the data sheet. Remember to draw a picture of the ice coverage on the back of the data sheet. The estimate of unsurveyable area and map can be used to calculate a correction factor for unsurveyed habitat.

5. Flushing and Diving

The question of animals that flush or dive ahead of the boat comes down to a single point: did the activity of the survey vessel cause the animal to alter its behavior? For example, if an eagle sighted in a tree several hundred meters ahead of the boat took flight, did he flush because of the boat, or did he fly off to feed? If the survey vessel caused the animal to flush or dive before it was in the sampling window, then it should be included as a sighting. If the animal would have moved out of the sampling window area regardless of the vessel, the sighting should not be included. Since this is largely a subjective decision on the part of the observer, the only rule is to use good judgement and common sense. Feel free to discuss the situation with the other crew members. The final call should go to the observer who made the sighting in the first place.

6. Rollup

A special case of flushing is known as rollup. This occurs when birds flushed by the survey vessel fly ahead and land farther along in the transect. These animals could then be counted multiple times, depending on their behavior and the length of the

transect. Again, use common sense. If a flock of 12 harlequin ducks (HADU) flush forward into the transect, and immediately around the next bend you sight "another" flock of 12 HADUs, consider the possibility that they are the same flock. If you think they are the same individuals, do not record them a second time.

A flock that flies forward in a transect may also join another flock. In this case, the number of birds in the original flock should be subtracted from the second flock sighting for the correct number of new sightings. For this reason, it is important to attempt to keep track of where birds are flying when they flush in the transect.

Mammals may also reappear in the transect if they dive and surface again ahead of the boat. Individual characteristics may be helpful in confirming resightings of the same individual(s).

7. Species Identification

If you cannot identify an animal to the level of species, identify the genus (murrelet, murre, cormorant, etc.). Avoid assuming the species based on relative abundance in the survey area (assuming the species based on relative abundance may only serve to perpetuate the illusion that one species is more abundant than the other). The most common occurrence of this is with marbled murrelets (MAMU) and Kittlitz's murrelet (KIMU). If you do not see adequate field marks, do not assume it is a MAMU. Record it as an identified murrelet of the genus *Brachyramphus* (BRMU).

Similarly, when counting mixed flocks, do not identify birds to species based on association with other individuals in the flock. For example, if there are 25 gulls on a rock, and 22 of them are positively identified as mew gulls (MEGU), but the remaining 3 gulls are obscured so no field marks can be seen, do not assume them to be MEGUs. Record those 3 as unidentified gulls (UNGU). If you aren't satisfied with that identification, then maneuver the boat for a better view so you can see field marks. The exception to this rule is for waterfowl. Often, hens are difficult to identify to species. However, if a flock of hens and drakes are sighted, it is relatively safe to count them all as the same species.

8. Estimation of Distances

The estimation of a distance between the boat and an animal can be improved by practicing with a plastic duck decoy at the end of a pre-measured length of fishing line. For example, 100m of line can be cast out from the boat to sight the decoy at the edge of the sampling window. This technique should be used to practice sightings nearshore and offshore as the estimation of distances can be very different in the two contexts.

9. Distance Inland

The primary objective of this survey is not to record terrestrial animals. However, non-target species that are sighted opportunistically should be recorded. Do not record sightings of animals that are greater than 100m inland from the shoreline. This includes birds located far upstream, or bald eagles (BAEA) soaring or perched in trees well inland. If you make a really spectacular sighting of a terrestrial mammal that doesn't belong on the data sheet and feel you have to tell someone about it, record it in the comments section.

III. DATA RECORDING

For the following sections on data recording, refer to the sample data sheet attached at the end of the guide.

A. Header Information

Prior to the start of each transect, environmental and observer data are collected. These data are also referred to as "header" information, since they are recorded at the top of the data sheet. Some of this information may need to be recorded and/or updated after completion of a transect. For example, if the weather changes abruptly during the transect, such that over 50% of the transect was surveyed under the new weather conditions, change the weather code to reflect this occurrence.

The following is an item-by-item description of the header data to be collected for each transect.

1. Transect#

Record the survey transect number or code. Simple numeric fields should not be padded with leading zeroes. Alphanumeric transect codes should be recorded without blanks, hyphens, slashes, or other embellishments.

Incorrect	Correct
007	7
P 70 E	P70E
C-188-W	C188W

2. Observation Conditions

Observation conditions is a single-digit numeric field, with valid codes listed at the bottom of the data sheet, ranging from 3 (fair) to 7 (optimum). Factors affecting observation conditions include glare, wave action, precipitation, fog, etc. Assessment of observation conditions is somewhat subjective, but try to remain consistent.

Code	Description
3	fair
5	good
6	excellent
7	optimum

Always record as a single digit; ranges and decimals are not allowed.

Incorrect	Correct
6-7	either 6 or 7
5.5	either 5 or 6

3. Weather

Weather is recorded as a 2-digit numeric field, with valid codes listed on the data sheet. This variable is simply the existing weather conditions in the general area of the transect.

Code	Description
00	<50% clouds
03	>50% clouds
41	patchy fog
43	solid fog
68	rain
69	fog & drizzle
70	drizzle/mist
71	snow
72	fog & rain
87	hail

If two or more codes may apply, record the one that has the most profound effect on survey conditions. Example: if it is raining, do not record "03,68". The fact that it is raining implies cloud cover. Record this situation as "68". If a novel weather situation occurs for which no existing single weather code is applicable, write the conditions on the data sheet. Upon return to camp, a new weather code can be created.

4. Date

Transect date should be recorded in the mm/dd/yy format. Do not omit the year, since surveys may be conducted over several years. Always double check the date field.

Incorrect	Correct
6/20	6/20/90
09JUL90	7/09/90

5. Wind Speed

Record the wind speed in miles per hour using the "wind wizard" wind gauge. If the wind is too light to measure, record as "LT." or "light". If no wind is detectable, record as "0" (do not leave blank). Decimal values are allowed, ranges are not.

Incorrect	Correct
4kts	5.0 (mph)
6-7	6.5

6. Wind Direction

Record the direction of the wind in degrees (magnetic). Smoke from the engines, or hanging a piece of toilet paper at arm's length can help determine direction of light winds. If wind is nonexistent, or variable, record the bearing as "0". If the wind is from due north, record as "360". Ranges are not allowed. Do not leave blank.

7. Time

Record the start time of the transect in military (24-hour) time as hhmm. Rounding off to the nearest 5-minute mark is suggested.

Incorrect	Correct
10:30	1030
2:45PM	1445

8. Seas

Record the Beaufort sea state code as a single-digit numeric value.

Code	Description
0	calm
1	rippled
2	wavelets <2′
3	2′ to 4′
4	4′ to 8′

Sea state, like observation conditions, is somewhat subjective. Again, try to remain consistent throughout the season. Decimals and ranges are not allowed. If conditions are truly borderline, record the higher of the two sea states.

Incorrect	Correct
1-2	2
2.5	3

9. Tide

Record the tidal state at the start of the transect as determined from a tide table. Some interpolation of cutoff times between tidal states is usually necessary. Use the single-digit tide codes listed at the bottom of the data sheet. An expanded description of these codes is listed below.

Code	Description
1	High *tide*
2	3/4 *of high tide,* outgoing *direction*
3	1/2 *of high tide,* outgoing *direction*
4	1/4 *of high tide,* outgoing *direction*
5	Low *tide*
6	1/4 *of high tide,* incoming *direction*
7	1/2 *of high tide,* incoming *direction*
8	3/4 *of high tide,* incoming *direction*

10. Inside Observer

Record the last name or initials of the inside observer. Be consistent.

11. Water Temperature

Record the water temperature in degrees Celsius. This should be determined by hanging a thermometer overboard for at least 30 seconds. The Coastal Navigator (CN) units also have a water temperature function. Verify the CN readings with a thermometer reading before relying solely on the CN for water temperature. Double check the CN water temperature at least once a day. Decimals are allowed, ranges are not.

11. Air Temperature

Record the air temperature in degrees Celsius. This should be determined by holding a thermometer in air for at least 30 seconds. Make sure the thermometer is dry, and not in the sunlight or wind. If water temperature is to be determined with the same thermometer, obtain the air temperature first.

12. Outside Observer

Record in the same manner as inside observer.

13. Ice Type

If ice is present on transect, record the single-digit ice code (glacial or shore). If both types are present, record the predominant type. If no ice is present, record as "0". Do not leave blank.

Code	Description
1	glacial ice
2	shore ice

14. Ice Cover

Record the total surface area of the transect that is covered by ice in octas (eighths). If no ice is present, record as "0". Decimals and ranges are not allowed. Do not leave blank. If possible, draw a picture of the transect and ice cover on the back of the data sheet.

Code	Description
0	< 1 octa
1	1 octa
8	8 octas
9	8 octas with no openings

15. Vessel

Record the name of the survey vessel.

16. Human Disturbance Code

Airplanes, helicopters, and other boats are also recorded as sighting events. The real concern with these objects is not necessarily their distribution and abundance, but rather their effect on the sampling of the transect. The disturbance code attempts to identify if the birds and beasts that inhabit a given area have been disturbed from their usual patterns of behavior. This code should be entered after the end of the transect. Valid disturbance codes are listed below. If no disturbance occurred, enter a "0". *If a disturbance code greater than 0 is entered, be sure to describe the disturbance in the comment section* (see below). You would be wholly correct to notice that our survey vessels are themselves a disturbance factor, but please do not record as such.

Code	Disturbance
0	No disturbance
1	Slight disturbance
2	Moderate disturbance
3	Severe disturbance

17. Comments

Record any general comments for that transect. These could include comments on disturbance factors, locations of eagle nests, equipment problems that interrupt survey effort, etc. Leave blank if no comments are necessary.

B. Sighting Information

After the header information has been recorded and the survey vessel is "on transect", the outside observer/data recorder records all bird and mammal sightings on the data sheet. Individual sighting events are recorded by writing the number of animals on the appropriate line. Sighting events are separated from each other by a comma.

Codes for the most commonly observed species are already listed on the data sheet. Sightings of other animals should be recorded in the extra space at the bottom of the data sheet using common names rather than species codes (to avoid cryptic or misused codes). A list codes for commonly observed species is attached to this manual. Species not included in this list should be coded following standards of the American Ornithologists Union (also attached).

In addition to the number of animals, a modifier is used to represent whether the animal was on land, water, or in the air at the time of sighting. The default condition (no modifier) is used to indicate that the animal was in or on the water. A line under the sighting indicates the animal was on land. This category includes birds sitting in trees, or standing at the water's edge with their feet submerged. A line over the sighting indicates the animal was in the air (flying). One exception to this is when the animal flies up from behind and proceeds ahead in the same direction as the survey vessel. This behavior is considered "following", and is indicated by drawing a circle around the sighting. The final sighting modifier is for animals sitting or standing on floating objects (buoys, logs, icebergs, etc.). Use the sighting modifier that represents the location of the animal at the moment you first see the animal. If you see 2 marbled murrelets (MAMU) flying up ahead of the boat, do not infer that they were probably sitting on the water. Record this sighting as 2 MAMUs in air. Call them as you see them. For this reason, the 1989 data base contains a single record of a humpback whale in the air.

Sea otter pups require an additional note. If a mother/pup pair are sighted, record it as "1(1)". If a group of 7 adult otters, 2 with pups is sighted, record as "7(2)". Do not write "1 w/pup" on the data sheet, as this takes up too much space. Do not create a separate column for sea otter pups as removes the association between the mother/pup pair.

Do not erase data from the data sheets. When data sheets get wet, pencil marks become somewhat faded, and can look like erasures. During keypunching, someone else will have to decide which is which. The easiest way to prevent this problem is to *cross items out instead of erasing.*

Understand that while the boat is moving and the inside observer and driver are calling out sightings, the outside observer has the double responsibility of observing and data recording. It can get hectic. However, *the importance of clearly written data cannot be understated.* Remember that someone will have to read your writing when keypunching the data into a computer. If you can't decipher your own handwriting immediately after completion of a transect, imagine how it will look months from now to someone else back at the office.

IV. ADDITIONAL INFORMATION

Contact Karen Laing, Marine & Coastal Bird Project, Migratory Bird Management, U.S. Fish & Wildlife Service, 1011 E. Tudor Road, Anchorage, AK 99503, (907) 786-3444, for additional information regarding this manual or regarding a Paradox software data entry program.

V. ACKNOWLEDGEMENTS

The following individuals are gratefully acknowledged for their contribution to this manual: Douglas Burn, Janey Fadely, Dave Irons, Steve Klosiewski, Karen Laing, Dave Nysewander, and John Trapp.

SHORELINE Boat Surveys -- Data Sheet # Field Checked by KL

Transect # 251	Obs Conditions 5	Weather ØØ
Date 6Ø/ØØ/ØØ	Wind Speed 5	Dir 16Ø
Time 1315	Seas 1	Tide 3
Inside Observer KKL	Water T 3	Air T 5
Outside Observer JBF	Ice Type Ø	Ice Cover Ø
Vessel PREDATOR	Human Disturbance Code Ø	
Comments		

Loons, Grebes, Storm-Petrels and Cormorants

	(INSIDE 100 M)	(OUTSIDE 100 M)
COLO		
RTLO		
UNLO		
RNGR		2,
UNGR		
SOSH		
FTSP		
DCCO		
PECO		1, 3,
UNCO		1,
GBHE		

Waterfowl

	(INSIDE 100 M)	(OUTSIDE 100 M)
CAGO		
MALL	3, 3,	
UNPD		
BLSC		
WWSC		
SUSC	7,	3,
USCO		
GRSC		
USCA		
HADU	6, 13, 5	
BAGO		
COGO		
UNGO		
COME		
UNDD		1,

Shorebirds, Gulls and Alcids

	(INSIDE 100 M)	(OUTSIDE 100 M)
BLOY		
RNPH		
PAJA		
POJA		
HEGU		
MEGU	14,	1, 1,
BOGU		
GWGU		
BLKI		
UNGU	(1)	
ARTE		
COMU		
UNMU		
PIGU		
MAMU		
KIMU		
BRMU		
HOPU		
TUPU		

Other Birds, Mammals and Boats

	(INSIDE 100 M)	(OUTSIDE 100 M)
BAEA	1,	
CORA		
NOCR		
SEOT	1(1),	1,
RIOT		
STSL	(3)	
HASE		
BOAT		

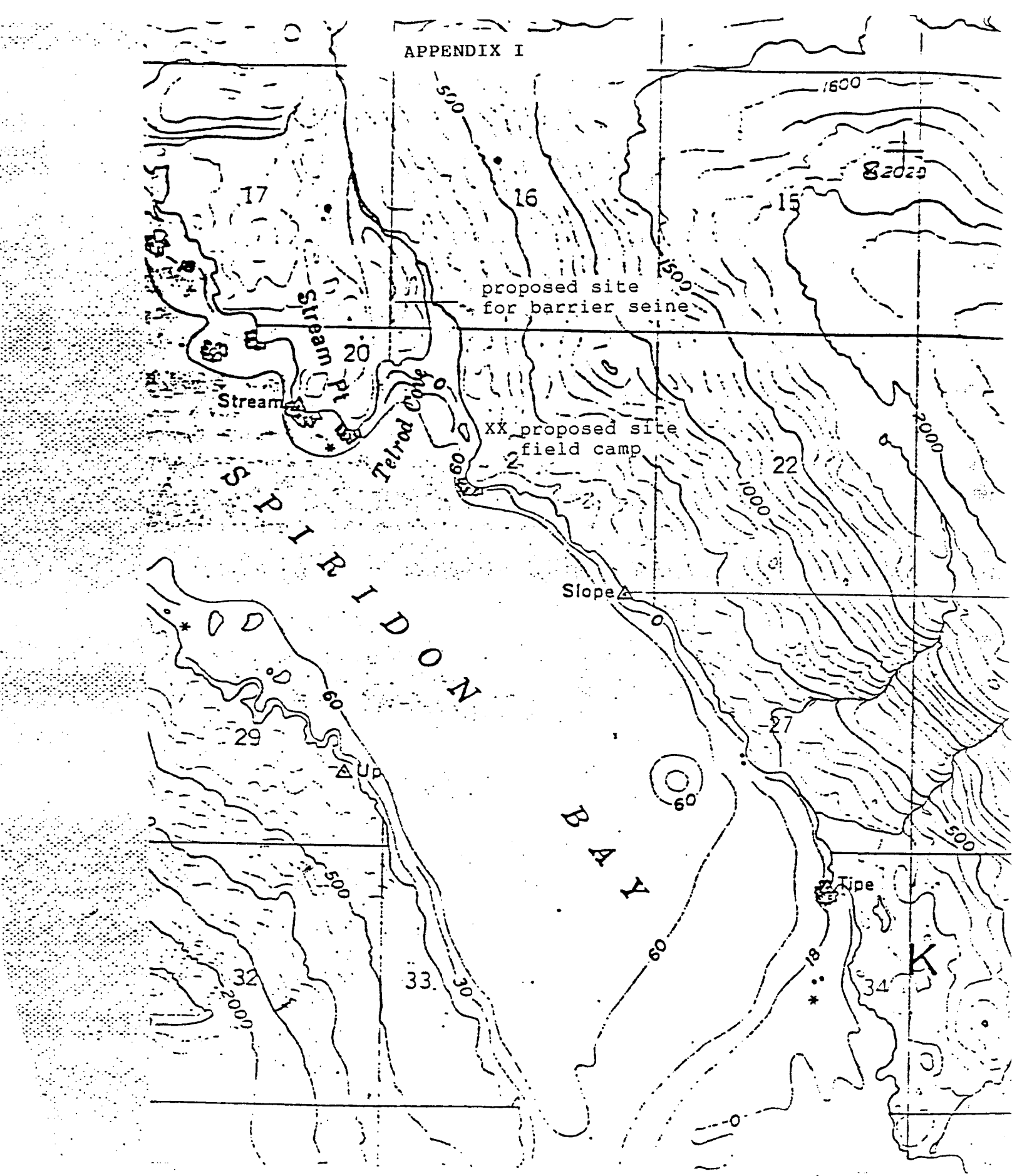


Figure . Locations proposed for the barrier seine and field camp. Spiridon Lake Project.

APPENDIX J

KODIAK MANAGEMENT AREA SALMON ESCAPEMENT SAMPLING

OPERATIONAL PLAN, 1994

Alaska Department of Fish and Game
Commercial Fisheries Management and Development Division
211 Mission Road
Kodiak, Alaska 99615

MAY 1994

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INTRODUCTION

Annually, sockeye salmon escapements are sampled for age, length, and sex from major and minor systems by field personnel within the Kodiak Management Area. Management and research biologists rely on this data for forecasting, escapement goal evaluation, catch apportionment, and run timing estimation. As the demand on our salmon resource increases, so does the intrinsic value of this data.

During the last several years, stock identification projects using scale pattern analysis have been conducted within the Alitak Bay, Afognak, and Mainland Districts. The foundation for these projects are the scale samples that are collected. It is imperative that scales collected be of the highest quality possible.

GOAL

Provide improved management of the Kodiak Management Area salmon runs by optimizing escapement requirements thereby insuring maximum harvest opportunities.

OBJECTIVES

1. Construct accurate brood tables (spawner-recruitment relationships).
2. Develop accurate run forecasts.
3. Evaluate escapement goals and accurately define run timing.
4. Provide samples suitable for scale pattern analysis as required for addressing mixed stock fishery issues.

TASKS

1. Collect representative age, length, and sex data from all major and selected minor sockeye salmon systems within the Kodiak Management Area (KMA).

SUPERVISION

Area Research Biologist, Charles Swanton will supervise escapement sampling at Frazer Fishpass and Akalura weir. All other KMA escapement crews will be directly supervised by Kodiak Management Area staff. Biologist Patricia Nelson will monitor weekly escapement sampling and review incoming data for quality, quantity, and timeliness. A log book will be maintained tracking weekly samples, and weir crew leader's will be notified periodically regarding data quality.

PROCEDURES

Weekly sockeye salmon escapement sampling for age, length, and sex (ALS), will be conducted at Karluk River, Upper Station, Ayakulik River, and Frazer Lake (Figure 1). Samples will be collected using a live box trap (Figure 2) according to the schedules in Table 1. If the required number of fish are not taken within a single day, obtain the balance of the sample on the following day.

Minor systems will be sampled with reduced intensity following the sampling schedule in Table 1. Litnik (Afognak) and Akalura weir personnel will collect two 480 fish samples from both early and late sockeye run components. A single 480 fish sample will be collected at the Saltery weir during the peak escapement subject to staff availability. Sport Fisheries Division (S.F.D.) personnel will sample the Buskin River sockeye escapement with a goal of 140 fish every two weeks, for six weeks (sample size specified by S.F.D. biometrician). S.F.D. will similarly sample the Buskin River sockeye subsistence harvest. Development section personnel will collect one 480 fish sample each from Malina Lake and Pauls Bay during peak escapement.

Remote sampling at Uganik Lake is contingent upon staff availability.

It is essential that all ALS data be representative of the true escapement, therefore avoid bias by NOT pre-selecting fish based upon size, sex, condition or any other factor. Sampling and recording procedures are presented in Appendix A.

DATA REPORTING

Crew leaders will notify Dave Prokopowich or Kevin Brennan via SSB radio upon completion of weekly sampling. Karluk weir will mail completed ALS data to Kodiak (return receipt from the Karluk village post office), and notify the office of the mailing date (via radio). All other field camp personnel will send completed samples back to town on return grocery flights. These packages should be clearly labeled to include: system, sample dates, and Attn.: Patti Nelson. The pilot should be notified to call Fish and Game at 486-1808 or 486-1855 for package pick up.

Table 1. Sockeye salmon escapement sampling schedule, 1994.

Location	Sampling Frequency	Date		Sample Size
		Starting	Ending	
Akalura weir (early)	once	May 15	Jul 15	480
Akalura weir (late)	once	Jul 16	Sep 15	480
Ayakulik weir	weekly	May 30	Sep 30	240
Buskin Lake weir[a]	biweekly	Jun 01	Aug 01	140
Buskin Subsistence Harvest[a]	biweekly	Jun 01	Aug 01	140
Frazer Fishpass	weekly	Jun 15	Aug 30	240
Karluk weir	weekly	May 30	Sep 30	240
Litnik (Afognak) weir (early)	once	Jun 07	Jun 15	480
Litnik (Afognak) weir (late)	once	Jul 14	Jul 20	480
Malina Lake weir[b]	once	Jun 02	Sep 30	480
Pauls Bay[b]	once	Jun 06	Jul 03	480
Saltery River weir[c]	once	Jul 07	Jul 20	480
Upper Station	weekly	Jun 06	Sep 30	240
Uganik Lake[c]	once	Jul 05	Jul 26	600

[a] Sampled by Sport Fisheries Division (sample size determined by S.F.D. Biometrician).
[b] Sampled by Development Section personnel.
[c] Subject to staff availability.

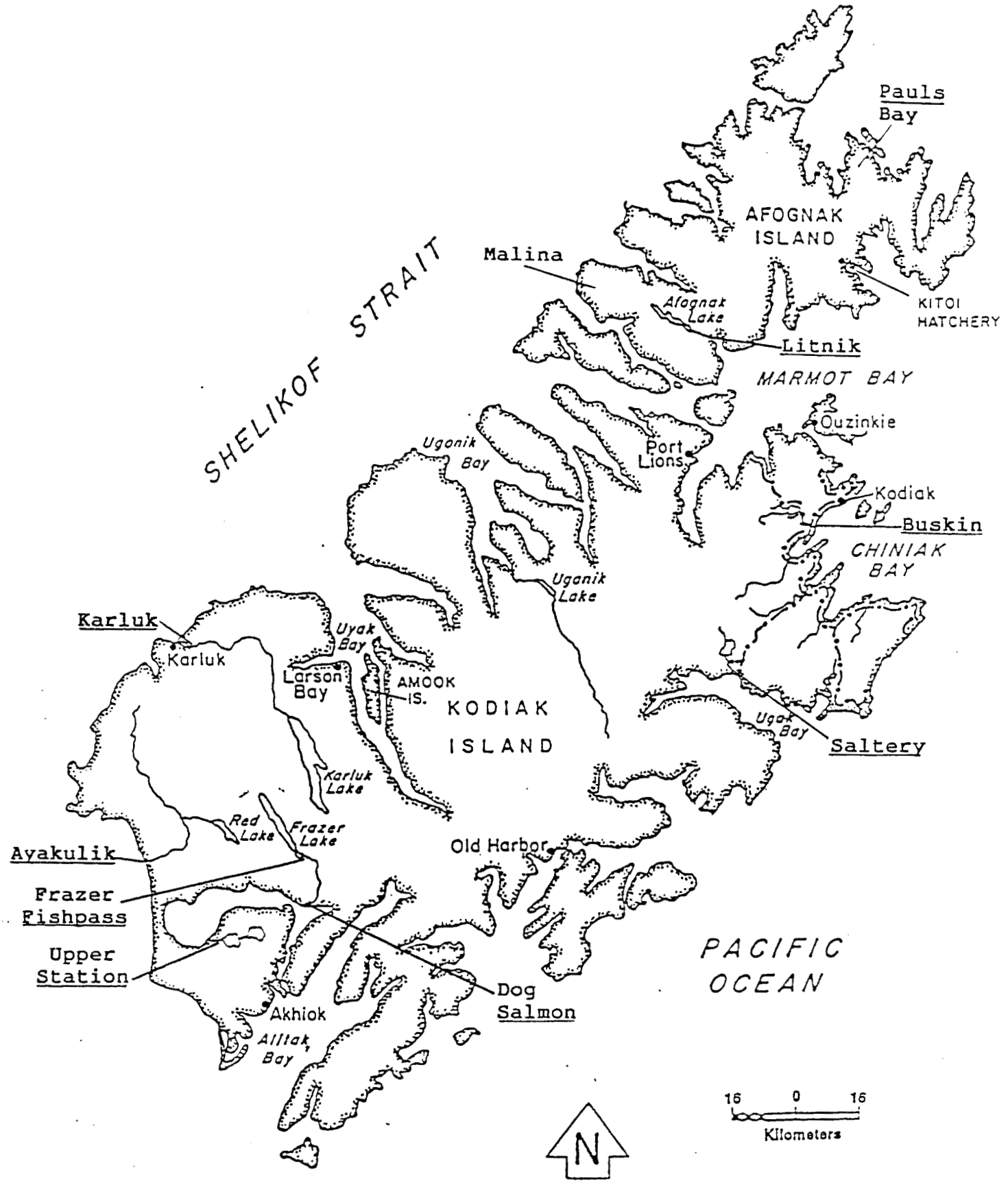


Figure 1. Location of salmon weirs in the Kodiak Management Area, 1993.

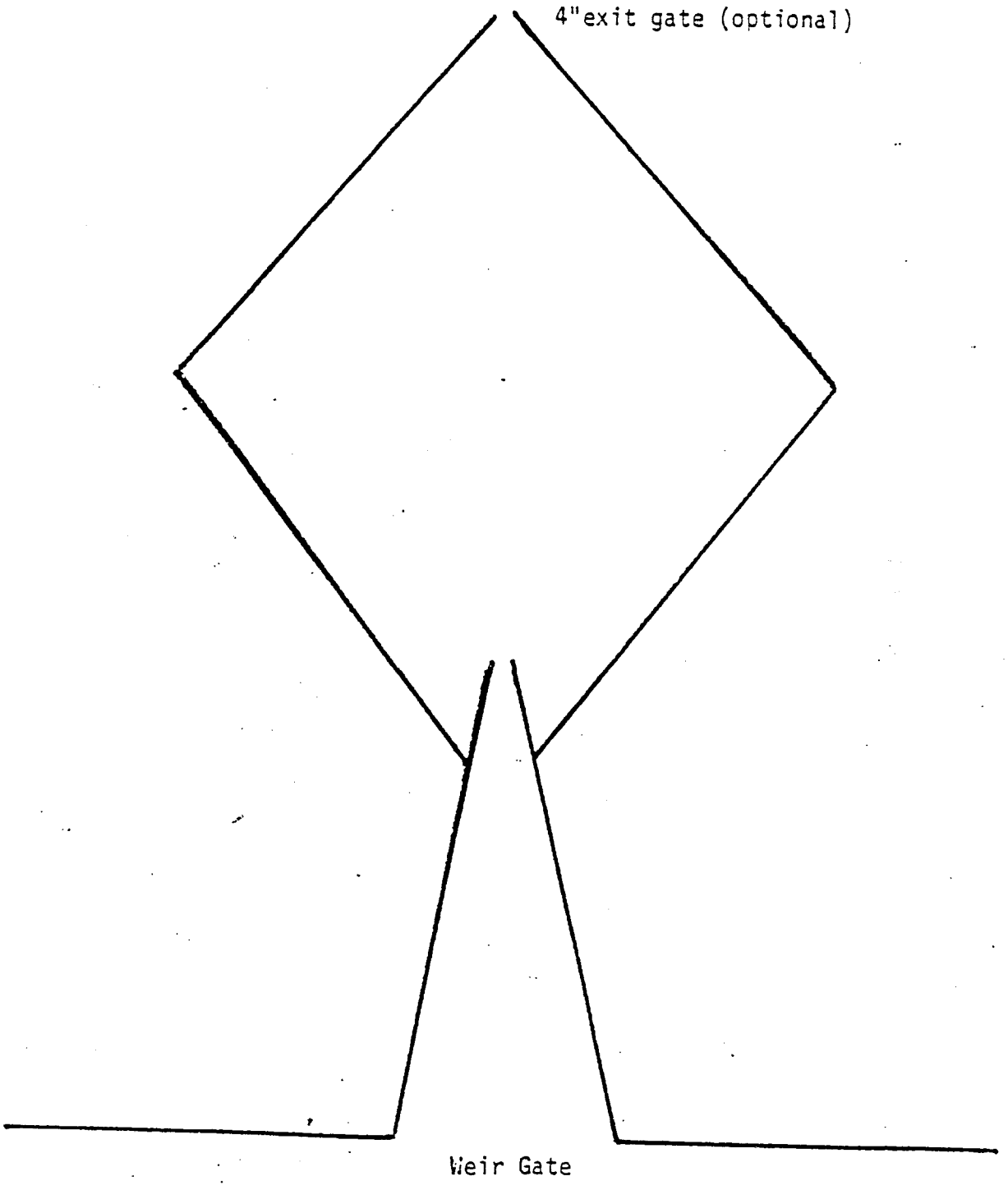


Figure 2. The "Scott" six panel salmon trap.

APPENDIX A

Procedure for Sampling Adult Salmon for age, length, and sex

Annually, salmon escapements and catches are sampled for age (scales), length, and sex (ALS) by field crews throughout the state. This database is essential for sound management of the State's salmon resources.

To be useful, data must be recorded on the mark-sense (AWL) forms neatly and accurately. Scale samples must be collected and mounted properly to ensure accurate age determination. The following procedures are to be adhered to when sampling for age, length, and sex.

COMPLETING THE AWL FORMS:

A completed AWL form and accompanying gum card for sampling sockeye and chum salmon are shown in Appendix A.1. Similar examples for sampling chinook and coho salmon are shown in Appendix A.2.

Complete each section on the left side of the AWL form using a No. 2 pencil and darken the corresponding blocks as shown in the figures. Make every effort to darken the entire block as partially filled blocks are often missed by the optical scanner which reads and records the data from the AWL forms. Label only one form at a time to avoid a "carbon paper effect" resulting in stray marks.

Description:
Record the following: species/area/catch or escapement/gear type (seine, weir, etc.)/samplers

Card:
The AWL forms and corresponding gummed card(s) are numbered sequentially by date throughout the season starting with 001. A separate numbering sequence will be used for each species, district, and geographic location. Consult your port supervisor for the current card number. Sockeye and chum scale samples will have only 1 gum card per AWL form as shown in Appendix A.1. Coho and chinook samples will use up to four gum cards per AWL form as shown in Appendix A.2.

Species:
Refer to the reverse side of the AWL form for the correct digit.

Day, Month, Year:
Use appropriate digits for the date the fish are sampled; catch sampling use the date the fish were caught.

District:
List only one district. Consult area statistical map or project leader for appropriate district.

Subdistrict (Section):
List a single subdistrict if it is known and if all the potential samples were caught in that section. If more than one section is involved, list each section but do not darken the corresponding blocks. Leave blank if the section is unknown.

Stream:
Leave blank for catch sampling; escapement sampling consult area statistical map for appropriate stream number.

Location:
List the appropriate code as shown on Appendix A.3.

Period:
List the period in which the fish were caught (Appendix A.4.).

Project and Gear:
Refer to the reverse side of the AWL form for the correct code.

Mesh:
Leave blank unless specifically instructed by supervisor to do otherwise.

Type of length measurement:
Use (2) mid-eye to fork-of-tail. Refer to Appendix A.5.

# of cards:
Mark 1 (each AWL form in individually numbered) when sampling sockeye, chum, coho, and chinook salmon.

Keep the litho codes in numerical order throughout the season and keep the AWL forms flat, dry, and clean. Fish gurry and water curling will cause data to be misinterpreted by the optical scanning machine. It is the crew leaders responsibility to make sure that all forms are carefully edited before returning them to your supervisor.

GUMMED CARDS:

Fill out the gum cards as shown in Appendices A.1 and A.2.

Species:
Write out completely (i.e., chinook, sockeye, etc.).

Locality:
For catch and escapement sampling, write down the area in which fish were caught, followed by catch or escapement (e.g. Karluk River escapement; Uganik Bay catch).

Stat. code and Sampling date:
Transfer the appropriate digits from the AWL form.

Gear:
Write out completely.

Collector(s):

Record the last names of person(s) sampling.

Remarks:

Record any pertinent information such as number of scales per fish sampled, vessel/tender name, etc. Transfer this same information to the top margin of the AWL.

SAMPLING PROCEDURE:

A. GENERAL

1. Place the fish on its right side to sample the left side.

2. Determine sex of the fish and darken M or F in the sex columns. If any difficulty is encountered with this procedure, write "I had trouble sexing these fish" on the top margin of the AWL and ask your supervisor for help as soon as possible before sexing additional fish.

3. Measure fish length in millimeters from the mid-eye to fork-of-tail (Appendix A.5). Record length by blackening the appropriate column blocks on the AWL form. Column 3 on the AWL form is used for fish with a length greater than 999 millimeters (Chinook). Measure all species of salmon to the nearest mm. Check the calipers periodically to ensure measurement accuracy. **When escapement sampling, take care to ensure that each length corresponds to the appropriate scale mounted on the gummed card as length at age is evaluated for each sample.**

4. Remove the "preferred scale" from the fish by grasping its exposed posterior edge with forceps and pulling free. Remove all slime, grit, and skin from the scale. The "preferred scale" is located on the left side of the fish, two rows above the lateral line on the diagonal from the posterior insertion of the dorsal fin to the anterior insertion of the anal fin (Appendix A.6.). If the "preferred scale" is missing, select a scale within the preferred area on either the left or right side of the fish. If no scales are present in the "preferred area" on either side of the fish, sample a scale as close to the preferred area as possible and darken the 8 under "age error code" on the AWL form. Do not select a scale located on the lateral line.

5. It is important to take care that scales adhere to the card, rough side up. Therefore, without turning the forceps over, clean, moisten, and mount the scale on the gummed card with your thumb or forefinger. Exert just enough pressure to spread and smooth the scales directly over the number as shown in Appendix A.6. The ridges on the sculptured side can be felt with a fingernail or forceps. Mount scale with anterior end oriented toward top of gum card. All scales should be correctly oriented on the card in the same direction (Appendix A.7).

6. When sampling sockeye and chum salmon, repeat steps 1 through 4 for up to 40 fish on each AWL form.

7. When taking multiple scales per fish as with chinook and coho salmon, sample the "preferred scale" and scale #2 as shown in Appendix A.6. Scale #2 is one inch to the left of the "preferred scale," and is 2 rows above the lateral line. Mount the 2 scales from fish #1 over 1 and 11 on the gum card as shown in Appendix A.2. Continue to mount the 2 scales from fish #2 over 2 and 12, etc. If sampling 3 scales, mount the scales over #1, #11, #21, etc.

8. When sampling at weirs you may use write in rain books to record the data. Keep the mark-sense forms in camp where they will be clean, dry, and flat. After sampling is done for the day transfer the data to the mark-sense forms. **It is the responsibility of the crew leader to be sure the data has been transcribed correctly and the AWL forms filled out completely.**

SCALE SAMPLING CHECKLIST

OPERATIONAL PLAN	PENCILS (NO. 2)
GUM CARDS	FORCEPS
AWL FORMS	PLASTIC CARD HOLDERS
CALIPERS	CLIPBOARD

SOME REMINDERS

1. For greater efficiency in scale reading and digitizing, mount scales with anterior end toward top of scale card.

2. AWLs should be carefully edited. Re-check header information on AWLs; make sure all available information is filled in. Take extra care to use the correct period code for the sampling or catch date. AWL numbers should not be repeated; a frequent error is to begin a week's sample with the last AWL number used the week before. This is particularly important if the data is regularly sent to town; it is easy to forget which AWL numbers were used. Crew leaders should take time to ensure that the boxes are being blackened correctly, if the boxes are sloppily marked the optical scanner records the information incorrectly or misses it entirely. Keep pencil marks within each block, filling it completely.

3. Transfer important comments from scale cards to AWLs. After pressing scales, the cards are seldom referred to again, and important remarks can be lost. Write comments in the top right margin. If there is not room on the AWL to completely explain the remarks, use a separate piece of paper.

4. Never put data from different dates on one AWL or one scale card. Even if only one scale is collected that day, begin a new AWL and gum card the next day.

5. If weights are taken, they may be noted in the right margin of the AWL during sampling, but be sure to transfer the weights and litho code to the appropriate columns on the reverse of the AWL before submitting it to your supervisor.

6. The data processing program uses the "litho code" on the AWL. (It is located in the lower left margin of the AWL.) Try to keep the litho codes in numerical order. This should not be hard to do if they are arranged that way before page numbering. Those who sample different areas throughout the season can arrange the litho codes in order before each sample is taken.

7. If AWLs get wrinkled or splotched they should be transcribed onto a new AWL prior to sending in. The optical scanning computer will misread or reject wrinkled sheets. Do not use paperclips on AWL forms.

8. Be careful when collecting and mounting scales in wet conditions (rain, high humidity, etc.) Glue often obscures scale features and scales frequently adhere poorly to wet card. Protect the cards, keep them dry to avoid having to remount the scales on a new card.

9. Scan the AWL form for mistakes. A common error occurs, for instance, in placing both the 4 and 7 of a 475mm fish in the 100's column with nothing in the 10's column.

10. Record all comments explicitly on the gum card under remarks and transfer remarks to the top margin of the AWL form.

11. Responsibility for accuracy lies first with the primary data collector(s). The port supervisor will return sloppy or incomplete data to individual collectors for correction.

Species SOCKEYE Card No 001

Locality AKALURA ESC.

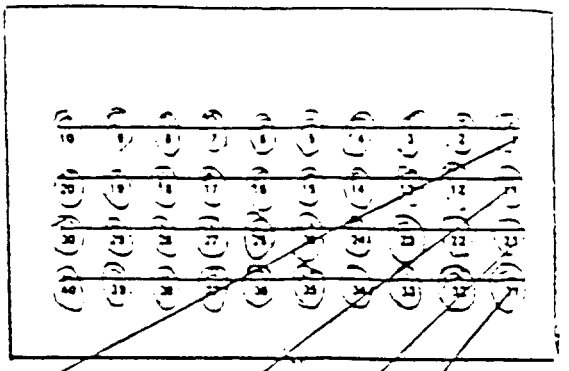
Stat Code 257-30-302-___

Sampling Date Mo 08 Day 16 Year 91

Gear BEACH SEINE

Collector(s) HICKS KAPLAN PEARSON

Remarks



samplers = HICKS, KAPLAN, PEARSON(R)

DESCRIPTION: Sockeye/Akalura/Esc.

ADF&G ADULT SALMON AGE-LENGTH FORM VERSION 2.1

CARD: 001

SPECIES: 2

DAY: 16

MONTH: 09

YEAR: 91

DISTRICT: 257

SUBDISTRICT: 30

STREAM: 302

LOCATION: Akalura

PERIOD: 34

PROJECT: 3

GEAR: 2

MESH:

TYPE OF LENGTH MEASUREMENT 2

NUMBER SCALES/ FISH 1

OF CARDS 1

DO NOT WRITE IN THIS MARGIN

229518

litho code

#	MX	100's	LENGTH	1's	AGE GROUP	AGE ERROR CODE
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						

NCS DOCUSCAN MB20 17977 10 A4206

SPECIES

1 - Chinook (king)
2 - Sockeye (red)
3 - Coho (silver)
4 - Pink (humpy)
5 - Chum (dog)

PROJECT

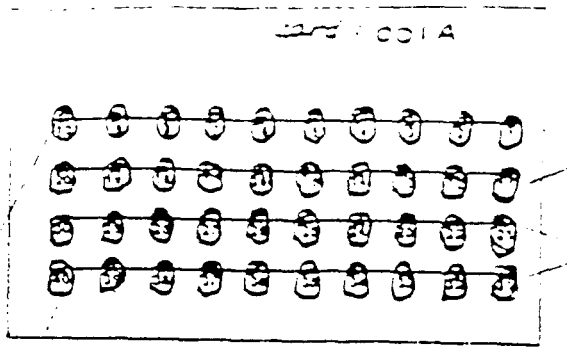
1 - Commercial catch
2 - Subsistence catch
3 - Escapement (tower, weir, sonar aids, etc)
4 - Escapement - spawning grounds
5 - Test fishing
6 - Sport catch (marine)
7 - Sport catch (freshwater)

GEAR TYPE

0 - Troll
1 - Purse seine
2 - Beach seine
3 - Drift gillnet
4 - Set gillnet
5 - Trap
6 - Long line
7 - Otter trawl
8 - Fresh water
9 - Pots
10 - Skiff boat
11 - Herring purse seine
12 - Handpicked
13 - Dip net
14 - 16 Unused
17 - Beam tr
18 - Shovel
19 - Weir
20 - 99

Appendix A.1 AWL and scale card for sampling 1 scale per fi

Species COHO Card No 001A
Locality KARLUK ESC
Stat Code 255-10-101-___
Sampling Date Mo 08 Day 29 Year 91
Gear WEIR / TRAP
Collector(s) T. STACK, S. BROWN, T. FOX
Remarks 2 SCALES / FISH



DESCRIPTION: COHO / KARLUK / ESC
2 SCALES / FISH

SAMPLERS:
T. STACK - W
S. BROWN - B
T. FOX - R

AOF&G ADULT SALMON AGE LENGTH
FORM VERSION 2.1

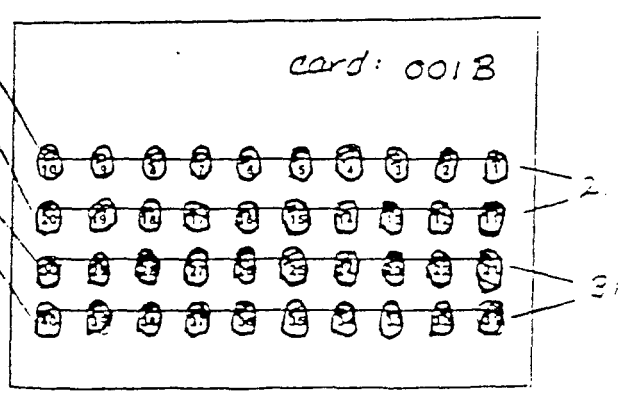
CARD:	001 A+B
SPECIES:	COHO
DAY:	29
MONTH:	08
YEAR:	91
DISTRICT:	255
SUBDISTRICT:	10
STREAM:	101
LOCATION:	35
PERIOD:	- 3
PROJECT:	ESC
GEAR:	WEIR/TRAP
MESH:	
TYPE OF LENGTH MEASUREMENT	2
NUMBER SCALES/ FISH	2
# OF CARDS	1

SER | 100's | LENGTH | 1's | AGE GROUP | AGE ERROR CODE

DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS AREA
litho code → 216854

NCS DOCUSCAN M820-17877 AA200

Species COHO Card No 001B
Locality KARLUK ESC
Stat. Code 255-10-101-___
Sampling Date: Mo. 08 Day 29 Year 91
Gear WEIR / TRAP
Collector(s): T. STACK, S. BROWN, T. FOX
Remarks 2 scales / FISH



Appendix A.2. AWL and scale cards for sampling 2 scales per fish.

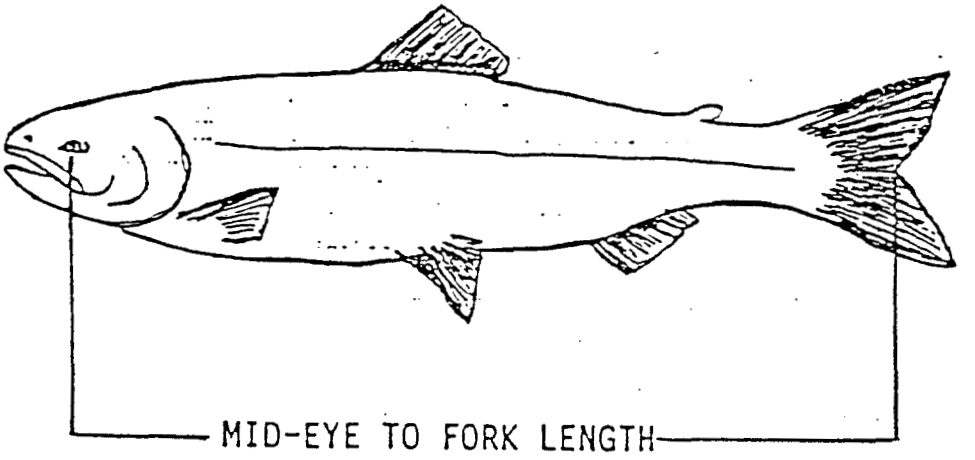
Appendix A.3. Assigned port and weir location codes.

Port and Location Codes
030 - Lazy Bay
031 - Port of Kodiak
032 - Pauls Lake
033 - Thorshiem
034 - Afognak River
035 - Karluk River
036 - Red River
037 - Upper Station
038 - Frazer Lake
039 - Dog Salmon
040 - Akalura River
041 - Uganik River
042 - Malina Creek
150 - King Cove
151 - Port Moller
052 - Dutch Harbor
053 - Akutan
054 - Sand Point
055 - Bear River, ADF&G Camp
056 - Nelson River, ADF&G Camp
057 - Canoe Bay

Appendix A.4. Periods and corresponding calendar dates, 1993.

Period	Calendar Dates	Period	Calendar Dates
1	01-Jan to 03-Jan	28	05-Jul to 11-Jul
2	04-Jan to 10-Jan	29	12-Jul to 18-Jul
3	11-Jan to 17-Jan	30	19-Jul to 25-Jul
4	18-Jan to 24-Jan	31	26-Jul to 01-Aug
5	25-Jan to 31-Jan	32	02-Aug to 08-Aug
6	01-Feb to 07-Feb	33	09-Aug to 15-Aug
7	08-Feb to 14-Feb	34	16-Aug to 22-Aug
8	15-Feb to 21-Feb	35	23-Aug to 29-Sep
9	22-Feb to 28-Feb	36	30-Aug to 05-Sep
10	01-Mar to 07-Mar	37	06-Sep to 12-Sep
11	08-Mar to 14-Mar	38	13-Sep to 19-Sep
12	15-Mar to 21-Mar	39	20-Sep to 26-Sep
13	22-Mar to 28-Mar	40	27-Sep to 03-Oct
14	29-Mar to 04-Apr	41	04-Oct to 10-Oct
15	05-Apr to 11-Apr	42	11-Oct to 17-Oct
16	12-Apr to 18-Apr	43	18-Oct to 24-Oct
17	19-Apr to 25-Apr	44	25-Oct to 31-Oct
18	26-Apr to 02-May	45	01-Nov to 07-Nov
19	03-May to 09-May	46	08-Nov to 14-Nov
20	10-May to 16-May	47	15-Nov to 21-Nov
21	17-May to 23-May	48	22-Nov to 28-Nov
22	24-May to 30-May	49	29-Nov to 05-Dec
23	31-May to 06-Jun	50	06-Dec to 12-Dec
24	07-Jun to 13-Jun	51	13-Dec to 19-Dec
25	14-Jun to 20-Jun	52	20-Dec to 26-Dec
26	21-Jun to 27-Jun	53	27-Dec to 31-Dec
27	28-Jun to 04-Jul		

Appendix A.5 Measuring fish length, mid-eye to fork of tail.



Mid-eye to fork lengths are taken because the length and shape of a salmon's snout changes as it approaches sexual maturity. The procedure for measuring by this method follows:

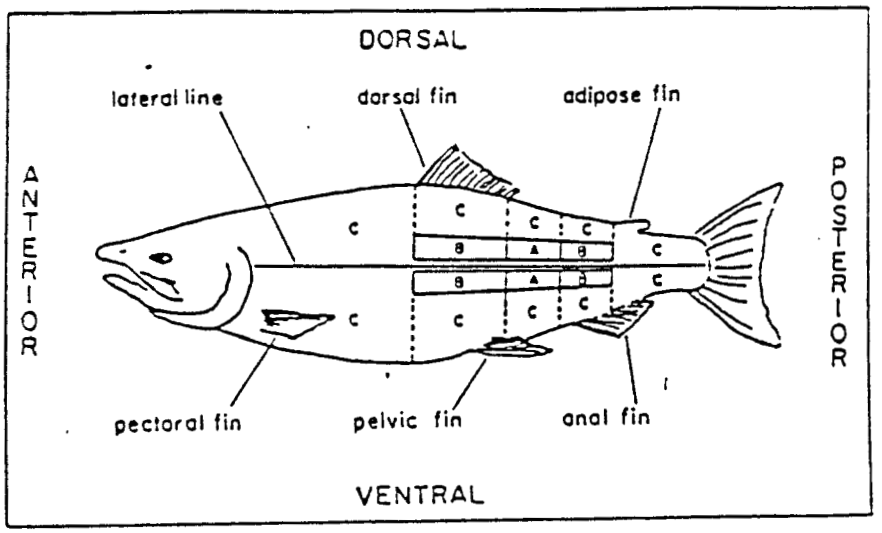
1) Place the salmon flat on its right side, with its head to your left and the dorsal fin away from you.

2) The eye should be on the line projecting from the end of the meter stick. Hold the head in place with your right hand. Sometimes you can control the fish better by placing your thumb in the fish's mouth.

3) Flatten and spread the tail against the board with your right hand.

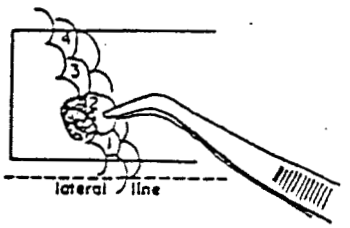
4) Read the mid-eye to fork length to the nearest millimeter.

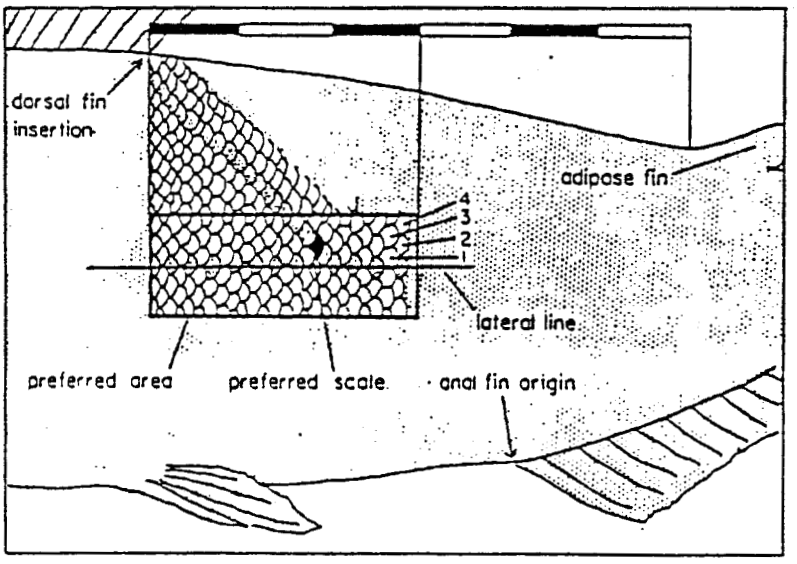
Appendix A.6. Removal and mounting of the preferred scale.



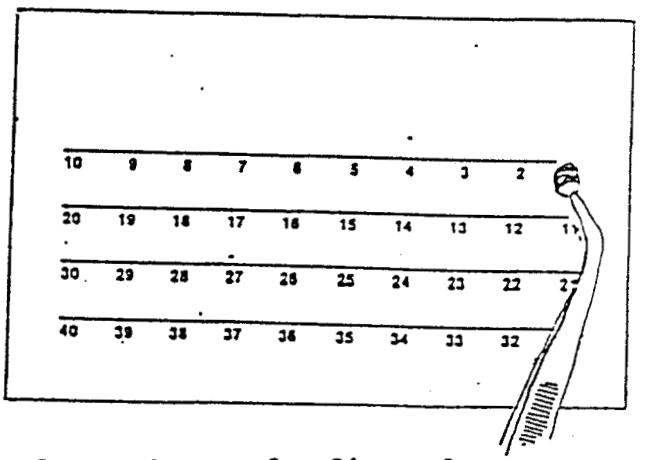
INPFC rated areas for scale removal.
Area A is the preferred area. B is the second choice if there are no scales in area A.
C designates non preferred areas. If scales on on the left side of the fish are not good, try the right side.

DO NOT TURN SCALE OVER



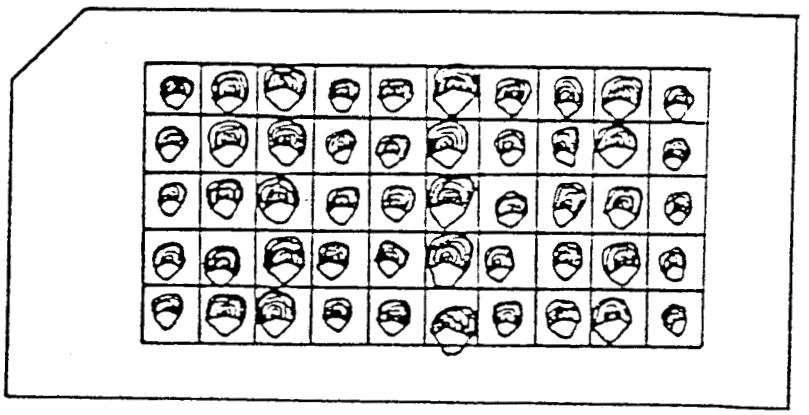


The preferred scale in this diagram is solid black. It is located 2 rows up from the lateral line, on a diagonal from the insertion (posterior) of the dorsal fin "back" towards the origin of the anal fin.

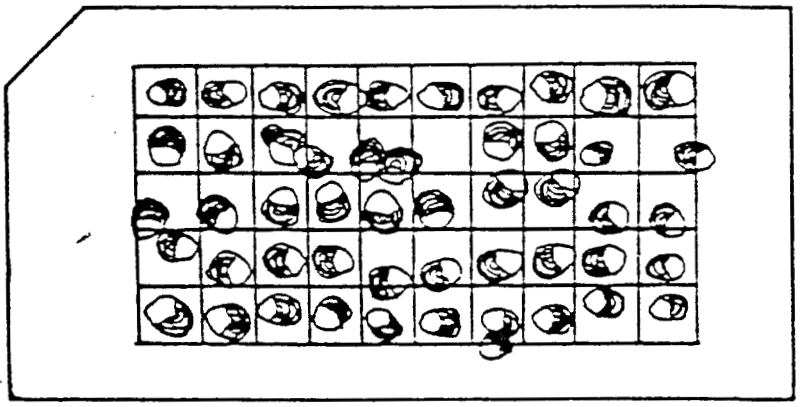


Place the scale directly over the number on the gummed card with the anterior portion (arche of the scale pointed toward the top of the card.

Appendix A.7. Scale orientation on the gummed card.



The scales are all correctly oriented on the card in the same direction, with the anterior portion of the scale pointed toward the top of the card.



The scales are incorrectly oriented in different directions. This increases the time spent to age samples.

APPENDIX B

Kodiak Area Commercial Salmon Fishery Harvest Strategy, 1994

APPENDIX K

SAMPLE COLLECTION FOR ROUTINE BROODSTOCK EXAMINATION FOR VIROLOGY

Supplies:

Ice chest and cold packs
Screw cap centrifuge tubes (VWR 21008725)
Paper cups (dixie cups)
Iodine disinfectant or 70% ethanol
Paper towels
Whirl-pak bags
Zak knife, scalpel, fillet knife
Forceps
Sharpened spoon for kidney samples
Labels and marking pen
Large plastic bags

Procedures:

Ovarian fluids - virology

1. Partially strip a single fish's ovarian fluids (ripe or post-spawner) into a paper cup avoiding the extrusion of blood and fecal material. Do not handle the lip or inside of the cup.

2. Crimp the edges of the cup to form a spout and pour fluid into a centrifuge tube. This will strain out unwanted materials and eggs. Discard the cup at each fish.

3. Repeat the procedure for a total of at least 60 fish, 65 is preferable.

4. Cap the tubes **tightly**. Label the rack with stock of fish, sample location, and date. Place tubes upright in rack in cooler with frozen cold packs.

Tissue - virology

Occasionally tissues from adult fish are requested for virology processing. In this case, use disinfection procedures similar to those detailed for ELISA/FAT but include a liver and spleen sample in each Whirl-pak for each fish.

Shipping:

Pack all samples in an ice chest with frozen cold packs or ice packaged in a plastic bag. Samples should be packaged in such a way to remain at 4 C or less for at least overnight.

Close, seal and label ice chest with "refigerate" and perishable".

Ship to the Fish Pathology Lab immediately, arranging for the sample to be kept cool. Samples should not be held for more than two days before processing. Tissues should be frozen if they will be delayed more than two days. Ovarians should be held at 4 C rather than freezing for up to five days. This can be discussed when you first notify the lab that you are taking samples.

Arrange for Alaska Pony Express, (907) 337-3317 in Anchorage to deliver the samples to the lab. Tell them the airline, freight or express, time of arrival and airbill number. Notify the Fish Pathology Section in Anchorage, 267-2244 of the time of the samples. Do not assume that the samples will be adequately delivered if you do not specifically talk to a pathology staff person subsequent to sending samples.

We would like to receive these samples fresh if at all possible. Therefore, it would be best to take all of the samples on the same day. To minimize the impact on the fishery, the fish can be all postspawners and the kidneys can be taken from the males as well as the females.

APPENDIX L

April 26, 1994

Collection of Finfish Genetic Samples

ADF&G Genetics Laboratory, Anchorage

I. General info

We use tissue samples from muscle, liver, heart, and eye from individual fish to determine the genetic characteristics and profile of a particular run or stock of fish. The most important thing to remember in collecting samples is that tissues need to be as **fresh** and as **cold** as possible at all times.

II. Sample size

A sample size of 100 adult fish is preferred for the baseline electrophoretic study. Samples of juveniles are statistically less desirable and sample sizes will need to be larger than for adults; generally a sample size of 150-200 juveniles is necessary.

III. Tissue sampling

A. List of sampling supplies

Cryotube- small (2ml) plastic vile or test tube. The cryotubes have plastic seals and screw on caps to withstand liquid nitrogen storage
Cryotube rack- white plastic block with holes in it for holding cryotubes
Cryocane- long aluminum cane. Five or six cryotubes are snapped onto the cryocane and placed in the liquid nitrogen canister
Forceps-tweezers
Pipettes-plastic droppers for sampling eye fluid (vitreous humor).
Liquid nitrogen dewer- large bottle in wooden box. It holds liquid nitrogen that can keep the samples very cold for an extended period of time
Liquid nitrogen canister- cylindrical canister that fits inside the dewer. The dewer will arrive filled with six canisters

B. General set up

To insure that the tissues are kept fresh and cold, working fast is necessary. It is important to have your sampling area and supplies set up **before** the fish are caught.

1. Label the empty plastic cryotubes (night before?) with the adhesive labels provided in sampling kit. Four separate tubes, corresponding to the four tissues (muscle, heart, eye, and liver), should be labeled for each individual. The color on the side of each label should help keep the tissues separate. Place the cryotubes in the cryotube racks in an order that will allow you to work quickly. We find it easiest to

set up by individual. For example, all the tissues for fish number one is in row number one of the cyrotube rack.

2. Get set up in as comfortable a place as possible. You might use a portable table, piece of plywood, or anything to give you a surface at a good height.

3. Have the caps for the tubes set out along with the sampling tools provided.

C. Actual sampling

Please take samples from freshly killed fish. From each fish gather a small amount of muscle, heart, liver, and eye and place in separate cryotubes label with the same number (Fish #1 has it's tissues loaded in cryotubes labelled muscle #1, liver #1 etc,...).

Fill the tubes with tissue approximately 3/4 full or to the 1.8 ml mark, leaving air space at the top and cap securely. **Overfilling the tubes can cause them to burst when frozen.** Please minimize the amount of blood, dirt, skin, and fat in the sample.

1. Muscle: Muscle samples should be "white"skeletal muscle, not muscle from along the lateral line. Use a piece of muscle dorsal (above) to the lateral line. If you have trouble getting the tissue into the tubes, cut it into smaller pieces.

2. Liver: An incision down the belly from the anus to between the gills helps to retrieve the liver and heart quickly. The liver is (generally) located on the fish's left side, just behind the pectoral fin. Please do not include the gall bladder (the small green/yellow sac of fluid attached to the liver).

3. Heart: Once you have taken the liver, it is easy to get the heart by just opening the belly incision towards the head.

4. Eye: There are two ways to take the eyes. If the eyes are small enough (juveniles), they can be placed intact into a cryotube. This is the easiest method. If they are too large, you must pipette out the liquid and black retinal fluid. Using a sharp scalpel or knife, cut a small slit in the surface of the eye, then insert a pipette into the slit and suck out the fluid and black retinal material. Scraping the tip of the pipette around the eye helps to mix up the fluid making it easier to suck the fluid out. Squirt this into the cryotube.

It is important to wipe your knife, other sampling tools, and sampling area off before sampling the next fish to avoid cross contamination between fish.

Once tubes have been filled, place them in liquid nitrogen within 20 minutes of sampling. Put the cryotubes in the cryocanes. We find it easiest to set up four cryocanes simultaneously and organize the samples in canes by tissue. Thus, muscle tissue from fish 1-5 would all be in one cane. Place the cryocanes in a liquid nitrogen canister and into the liquid nitrogen dewer.

D.) Use of liquid nitrogen

The working time of the liquid nitrogen container under normal conditions is 81 days (35VHC) or 50 days (18HC). To prolong the liquid nitrogen, samples can be pre-frozen (if a freezer or dry ice is available) and added in a group to minimize the number of times the container is opened. The liquid nitrogen level can be checked periodically with a flashlight or actually measured with a stick (2.3 liters/inch in 35VHC; 1.25 liters/inch in 18HC).
Send canister back if less than 4 inches of liquid nitrogen remains in the can.

"Large" 35 VHC container:
30 cryocanes will fit in each of the six canisters. Five cryotubes will fit on a cryocane comfortably or six in a pinch. Total capacity is 900 - 1080 cryotubes.

"Small" 18HC container:
Seventeen cryocanes will fit in each of the six canisters. The total capacity is 510 - 612 cryotubes.

Safety with liquid nitrogen:

1. Wear gloves, protective eyewear, and protective footwear when placing samples in container. Liquid nitrogen boils at -196°, and it will spit and boil when samples are added.

2. Do not tip the tank over as it does not seal.

3. Keep lid on liquid nitrogen container at all times when you are not placing samples in it.

4. Use a small cooler with ice, snow, or blue ice to hold canes until an adequate number are collected to be put in liquid nitrogen container. Depending on the conditions and the speed of sampling, place samples in liquid nitrogen within about one hour of sampling.

5. Use liquid nitrogen only in well ventilated areas (usually not a problem in the field). Avoid directly breathing the vapor.

6. Hazardous Materials Forms need to be filled out when shipping a filled liquid nitrogen container by air cargo.

E.) Data to Record.

We would like sex of the fish recorded. Data forms will be included in the sampling kit for this purpose. However, if your project includes taking scales, and recording age and length and you are using data sheets of your own, if you would prefer to photocopy your own data sheets and send us a copy once back from the field, this will be fine.

We appreciate your help with the sampling. If you have any questions, please give us a call.

Lisa Seeb	Jim Seeb	Penny Crane
267-2249	267-2385	267-2140

Laboratory 267-2247

APPENDIX M

COMMERCIAL FISHERIES MANAGEMENT & DEVELOPMENT
Regional Radio Schedule - 3230

EXISTING

0001 - 0645	OPEN STANDBY
0645 - 0700	DILLINGHAM
0700 - 0715	KING SALMON
0715 - 0740	CHIGNIK - PENINSULA
0740 - 0800	BETHEL - AYK
0800 - 0830	KODIAK
0830 - 0845	FRED DILLINGHAM
0845 - 0900	GAME/SPORT FISH/KING SALMON
0900 - 0930	HOMER
0930 - 1000	CORDOVA
1000 - 1020	CHIGNIK - PENINSULA
1020 - 1530	OPEN STANDBY
1530 - 1600	CHIGNIK - PENINSULA
1600 - 1630	HOMER
1630 - 1700	CORDOVA
1700 - 1730	BETHEL - AYK
1730 - 1845	OPEN STANDBY
1845 - 1900	CHIGNIK - PENINSULA
1900 - 1930	KING SALMON
1930 - 1950	DILLINGHAM
1950 - 2000	FRED DILLINGHAM
2000 - 2045	KODIAK
2030 - 2400	OPEN STANDBY

PROPOSED

0001 - 0730	OPEN
0730 - 0815	BETHEL/AYK
0815 - 0900	KODIAK
0900 - 0925	PENINSULA
0925 - 0930	CHIGNIK
0930 - 1000	CORDOVA
1000 - 1030	HOMER/SOLDOTNA
1030 - 1600	OPEN
1600 - 1630	HOMER/SOLDOTNA
1630 - 1700	CORDOVA
1700 - 1730	BETHEL/AYK
1730 - 1930	OPEN
1930 - 2000	PENINSULA/CHIGNIK
2000 - 2045	KODIAK
2045 - 2400	OPEN

APPENDIX N

Date: 6/3/91

~~Title~~:

To: Lonnie White
Area Biologist - FRED

Weeks: 21, 22, and 23

From: Steve Schrof
Fish Culturist I - FRED

Subject: Spiridon Lake Sockeye Smolt Project

Activities:

Week 21:

Materials for tent platform arrived on 5/23. Began building platform on 5/24, completed and moved tent onto platform, 5/26. Tent platform is built approximately 150 ft. from the lakeshore, paralleling the outlet stream.

Sockeye smolt movement is minimal at this point. Smolt count from 5/23 to 5/25 is 102 fish passed. Daily counts have ranged from 8 to 49 smolts passed. The holding pen for sockeye smolts is stressful. Strong water flow through the pen creates too much stress on the smolts. The pen needs to be enclosed on all sides to reduce flow speed. Due to low temps. and low numbers of fish, adequate oxygen levels should not be a concern.

Worked gillnet for adult Dolly Vardens on 5/24 and 5/25. Catches for adult Dollies were 10 and 7, respectively. The gillnet was set on the west creek. CPUE was 20.5 hrs, and 23.5 hrs.

Week 22:

Smolt counts still slow from 5/26 - 5/30, total fish

in the greatest numbers to date on 5/31 and 6/1. Total numbers for the two days: 5/31 - 501 ; 6/1 - 118. We are still seeing a high percentage of mortalities in the holding box before sampling.

Set the gillnet on the south creek shoreline, 5/29 and 5/30. Catches for adult Dolly Vardens, 9 and 10, respectively. CPUE 16.0 hrs. and 23.5 hrs. Length, weight, and otolith samples taken.

Made beach seine sets for juvenile Dolly Varden on south creek (2 sets), outlet creek (1 set), west creek (1 set), and east creek (1 set) sites on 5/29. We did not capture any juvenile Dollies, some miscellaneous numbers of sculpins and sticklebacks. We surveyed east and west creeks for any sign of juveniles up in there respective systems. We saw no sign of juveniles walking either system.

Week 23:

Smolt counts slowing down again. Counts on 6/2 were 6 smolts, and 6/3 were 6 smolts.

Attempted to work on lake 6/3, beach seining and setting the gillnet. High winds from the southeast created white capping and unstable conditions on the lake.

Significant Events:

Discharge smolt counts started out slow but a rise in water level triggered smolt to migrate downstream on 5/31 and 6/1.

Juvenile Dolly Varden are not being apprehended using the beach seine. Scouting along the lakeshore,

Significant Events cont.

visual sightings of juveniles.

Anticipated Activities:

Due to minimal smolt movement, we will be concentrating on beach seining, and setting the gillnet for the collection of Dolly Varden.

Continue to sample sockeye smolts migrating downstream.

APPENDIX C

MEMORANDUM **STATE OF ALASKA**

TO: Distribution

DATE: July 14, 1994

FILE: memorpt.94

FROM: Steve Hommold

SUBJECT: Project Reports: format/example

Attached is an updated version of the required format for Annual Project Reports plus a copy of a report written by management personnel. This format is general and modification will be needed for individual projects. The example report is not specifically written to follow the current format, as it was drafted several years ago. Each crew leader will be responsible for drafting a report for each project worked during the season. Crew members should also participate in the writing of the report. I recommend that crew leaders delegate specific sections of the report, based on each crew members experience on the projects. I would like a draft of the report to review prior to the end of the field season, preferably, early enough to provide feedback to allow revision.

The initial draft of the report can be handwritten and later, after final revision, will be typed by clerical staff. I encourage each crew leader to work on these reports in-season while activity is ongoing. I realize how busy the field season is, however, data summary is much easier while it is fresh. The necessary time required for revision will be scheduled when things slow down and field personnel are in town.

If any clarification and or assistance is needed to write the reports, please let the appropriate staff know. I would be more than happy to help out anytime.

I will look forward to seeing your reports. Keep in mind that these reports are important documents which provide significant information for future implementation of our projects.

cc: All Development staff

CREW LEADER ANNUAL REPORTS

I. INTRODUCTION

Description of Project Location

Include general and specific location characteristics (stream width, depth, flow, tidal influence, etc.) and effect on project.

History of Project

Brief history of program.

Purpose of Project

Objectives

Purpose of Report

II. METHODS AND MATERIALS

Precisely describe all components of your work that produced the results reported:

Employees

List employees on site and for what periods, as well as job classes, previous time spent on the job, etc.

Weir/traps

Type of weirs and traps and installation, dates of installation and trapping, maintenance schedule; enumeration techniques, how sampled, when, how estimates were made, adult, smolt and other sampling techniques, etc.

Monitoring

Regulatory duties such as setting or moving markers or monitoring the fishery, etc.

Fish Pass Maintenance

Seasonal maintenance schedule - removing and installing doors, type of repairs, performance before and after, fish usage, etc.

Other Duties and Misc.

Physical data, safety, bear avoidance or activity, sport and subsistence fishing activity, etc.

Generally, following the operational plan procedures section will assist with this section. Also, maps, photographs and diagrams are useful for this section.

III. RESULTS

Base your results on the objectives and what was accomplished: be specific as to #'s, dates, etc. Generate specifics here as far as data collected, etc. Address each category listed in the Methods section. For example, smolt enumeration, timing, number sampled, mortality, adult escapements and timing by species, adult sampling numbers, spawning surveys, fish pass usage, etc. Simple tables and graphs should be constructed to summarize significant data.

IV. DISCUSSION AND RECOMMENDATIONS

Elaborate on results, techniques, significant findings, problems, etc.; be thorough - things you would want to know if you did not have any involvement in the project, but may in the future.

Recommend changes, modifications, etc. This should include all aspects of the project. Items that may be addressed:

improvement of weir/trap installation, maintenance and operation, changes or improvement of sampling techniques, camp and support improvements. Necessary or optional equipment/gear lists would be helpful in this section.

APPENDIX P

STATE OF ALASKA
PERFORMANCE EVALUATION WORKSHEET

NAME	SOCIAL SECURITY NO.	DEPARTMENT	DIVISION

PCN	JOB CLASSIFICATION TITLE	REPORT COVERAGE FROM	REPORT COVERAGE TO

REASON FOR REPORT

☐ ANNUAL ☐ RESIGNATION ☐ COMPLETION OF PROBATION
☐ OTHER (SPECIFY) _____

POSITION DESCRIPTION REVIEWED BY RATER

YES ☐ NO ☐ If no, explain:

SPECIFIC RATING AREAS

	* U	A	O
PERFORMANCE	☐	☐	☐

(As shown by: quantity, quality, accuracy, and completeness of work; knowledge of job fundamentals; judgment shown on the job; willingness and ability to carry out new assignments; independence of performance; attitude towards job.)

WORK HABITS	☐	☐	☐

(As shown by: attendance; punctuality; appearance and grooming; safety.)

INTERPERSONAL RELATIONSHIPS	☐	☐	☐

(As shown by: consideration of public and co-workers; acceptance of supervision.)

SUPERVISORY (for Supervisory Employees Only)	☐	☐	☐

(As shown by: training and directing subordinates; evaluating subordinates; planning and organizing work, including delegation; problem solving and decision-making ability; affirmative action achievement; cost effectiveness; and, Labor Contract Administration).

* U = Unacceptable, A = Acceptable
O = Outstanding

NARRATIVE SECTION

Overall Effectiveness on the Job U (1☐) Acceptable (2☐ 3☐ 4☐) O (5☐)

(Overall Effectiveness **MUST** be explained. Other performance consideration, such as strong points and areas needing improvement, should be included.)

Rater's Recommended Action: _____
(See Instructions on back)

Rating was discussed with employee ☐ Yes ☐ No If no, explain: _____

Signature of Rater _____ Title _____ Date _____

Employee: ☐ Concur with Rating ☐ Disagree (Employee comments on back)

Signature _____ Date _____

REVIEWED AND APPROVED BY:
Division
Signature: _____ Title _____ Date _____
Department
Signature: _____ Title _____ Date _____

02-252WC (REV 8-83)

DIVIDER

KITOI EVALUATION PROJECT
OPERATIONAL PLAN, 1995

by

Steven G. Honnold

and

Peter M. Cleary

Alaska Department of Fish and Game
Commercial Fisheries Management and Development Division
211 Mission Road
Kodiak, Alaska 99615

May 1995

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INTRODUCTION

In 1989, Kitoi Bay Hatchery, located on Afognak Island, began a program to develop a sockeye brood stock using Upper Station underyearlings. Juvenile underyearlings that have been incubated and reared at the hatchery and are released into the Little Kitoi Bay to parallel the timing of Upper Station smolt entry into Olga Bay. Early marine life history parameters of hatchery reared underyearlings, as well as growth data are necessary for evaluation of this program. In 1994, brood stock development expanded to include pre-smolt and smolt releases. Also, monitoring of sockeye smolt from a remnant wild stock at Little Kitoi is necessary to differentiate from hatchery releases. In addition, Big Kitoi chum salmon brood stock age structure is needed to determine brood year returns and survivals. Also, assessing the quality of Jennifer Lake sockeye smolts and assuring coho as well as sockeye smolt passage is necessary to assure adult returns. Lastly, limnological assessment of Little Kitoi, Ruth, Sorg, Pillar, and Jennifer lakes is required to monitor water quality and the sockeye food base (macrozooplankton).

Goal

The goal of this project is to evaluate hatchery reared sockeye production as well as assess Little Kitoi wild stock sockeye contribution. Also, chum salmon brood stock age structure will be evaluated, as well as surveys completed at the outlet creeks of Jennifer and Ruth Lakes to assure clearance for sockeye and coho smolt passage. An additional goal of this project is to assess the primary and secondary production of Kitoi Area lakes and continue evaluating the restoration of Little Kitoi Lake through removal of the hydrogen sulfide layer.

Objectives

1. Estimate sockeye smolt outmigration from Little Kitoi Lake.

2. Determine the differential survival of early and late run pre-smolt's stocked into Little Kitoi Lake.

3. Assess age, weight and length of sockeye smolt outmigration from Little Kitoi and Jennifer lakes.

4. Monitor the coho and sockeye smolt migration from Jennifer and Ruth Lakes.

5. Monitor baseline age and growth of hatchery reared yearling and underyearling sockeye and determine fin regeneration of marked fish, as well as determine the length frequency of coho smolt.

6. Monitor hatchery coho and sockeye smolt saltwater challenges, and determine blood sodium levels of smolt prior to release.

7. Monitor fry marking program for quality control. * Send data to Kodiak.

8. Monitoring salinity, temperatures, and plankton blooms in Kitoi Bay and behind the oil booms in Little Kitoi lagoon during the juvenile salmon rearing period.

9. Enumerate Little Kitoi Lake sockeye escapement and assess age composition, sex ratio, and average length.

10. Evaluate adult sockeye straying rate and differential survival of juveniles stocked in Little Kitoi Bay.

11. Monitor commercial sockeye harvest in Kitoi Bay area and relay information on delivery to Kodiak.

12. Assess the sex, age and length of sockeye salmon from commercial harvest if time permits.

13. Monitor hydrogen sulfide layer in Little Kitoi Lake.

14. Determine the age structure of Big Kitoi chum salmon brood stock.

15. Evaluate the water quality and juvenile sockeye forage base at Lower and Upper Jennifer, Sorg, Little Kitoi, Ruth and Pillar Lakes.

Tasks

1. Monitor the Little Kitoi smolt collection/counting structure. Target date: 20 May-23 June

2. Enumerate the daily smolt outmigration, differentiate by species, and account for all fin clipped sockeye.

3. Conduct pre and post sockeye smolt migration hydroacoustic surveys to estimate smolt numbers leaving Little Kitoi Lake. Target Dates: May 1 and June 26.

4. Sample 70 sockeye smolt per day, five days a week for age, length and weight data - track all fin clipped smolt .

5. Conduct 2-3 surveys of Jennifer and Ruth lakes outlet creek (also between lakes) during the months of May and June to keep debris or low water from preventing coho and sockeye smolt outmigration.

6. Collect physical data daily from permanent guage site at smolting locations and weir compound.

7. Sample 30 age-1 sockeye smolt per raceway, with assistance from the project fish culturist, for scale, length, and weight data, just prior to release into Little Kitoi estuary. Sample 200 zero-age sockeye salmon, and 200 coho smolt for age, length and weight prior to release.

8. Document results of sockeye and coho smolt salt water challenges; collect blood sodium samples from a minimum of 30 sockeye and 30 coho smolt prior to release.

9. Make a daily check of marking program progress in terms of quantity and quality. A sample of 240 smolt, previously fin clipped, will be examined for fin regeneration (just prior to release; coordinate this with #7). (coordinate with hatchery personnell).

10. Collect salinities and temperatures each week of pen operations at Little Kitoi using a YSI meter.

11. Collect marine plankton samples weekly at each of the two stations by conducting two replicate vertical tows in May and up until all sockeye and pink salmon are released.

12. Install adult weir at Little Kitoi sampling compound. Target date: May 15 - August 15.

13. Enumerate salmon passing through the weir on a daily basis.

14. Collect sex, length data and scales from a maximum of 600 sockeye per year. Inspect 20% of the escapement for fin clips and collect length and scales from any marked fish.

15. Coordinate inspection of ~7,500 and ~13,000 adults from sockeye escapement at Paul's and Afognak weirs, respectively, for fin clips.

16. Monitor commercial fleet during pink fishery in Kitoi Bay, recording vessel name and delivery point in Kodiak. Age and length samples of sockeye salmon will be collected if feasible, on site or in Kodiak.

17. Collect seasonal hydrogen sulfide parameters (DO, temperature, salinity, water for odor) from both basins of Little Kitoi Lake.

18. Collect a maximum of 240 adult chum salmon scales and lengths, weekly, during hatchery egg takes (600/year).

19. Collect and process lake limnology samples from Little Kitoi, Upper and Lower Jennifer, Sorg, Pillar, and Ruth lakes every six weeks, from May through September.

20. Document pink, chum, coho, and sockeye salmon releases.

21. Build summary tables of project production data, including hatchery survivals, escapements and smolt data, etc.

SUPERVISION

Project Biologists: Steve Honnold, Pete Cleary.

Responsibilities: supervision and technical support.

Fishery Techician III: Rob Markle

Responsibilities: Fishery Technician III will schedule daily tasks and oversee field operations and follow Kitoi Bay Hatchery SOP. Also, will be responsible for following hatchery safety guidelines, as well as ADF&G safety SOP. The incumbent will work in coordination with the Project Fish Culturist on all tasks dealing with hatchery production of juvenile coho and sockeye salmon as outlined in this Operational Plan. The Project Fish Culturist will coordinate with the field technician to assist with duties associated with sockeye and coho salmon production monitoring as outlined in the Plan.

FIELD OPERATIONS

Smolt Trapping

The smolt trapping structure will require frequent monitoring and maintenance. If an electronic counting head is used for smolt enumeration, two daily samples should be hand counted to assure it's accuracy and determine species composition. It is important to keep to a schedule when monitoring the trap. Significant mortality could occur if a schedule is not adhered to. For other Afognak sockeye systems, peak migration is usually between 2300 hours and 0100 hours. Most of the samples in 1994 were obtained by dip netting them out of the compound.

Trap Catch and Species Enumeration

If the smolt trapping compound or fyke trap (Jennifer Lake) is used, everything caught in the trap will be enumerated. Please refer to identification keys if questions arise regarding species identification (Appendix A). Feel free to contact the Project biologists if any questions regarding identification occur. Also, all sockeye smolt captured will be examined for Right Ventral (RV) and RV Adipose fin clips. Record the number of each type of clip observed. Handle sockeye smolt gently as they are very sensitive to any stress and mortality can occur with the loss of just a few scales. A tally wacker should be used to count the sockeye smolt to assure an accurate count. In the event an extremely large outmigration occurs in a relatively short time period, and time will not permit counting individual smolt without mortalities, collect enough smolt for a daily sample and then pull the trapping structures so that the trap is not fishing. This will prevent unnecessary mortality. This method should only occur when there are relatively large number of smolt being caught, and there is not enough time to count all the fish without incurring mortalities. Enter all data on the Daily Catch Reporting Form (Appendix B) each time the trap is checked. Also, record any mortality on the form each day. Summarize daily trapping data on Sockeye Salmon Summary Report Form (Appendix C).

Age, Weight, and Length Sampling

From 20 May through 20 June, 70 sockeye smolt will be sampled during a three day period each week (~200 per week) for age, length, and weight. Each sample will be taken from a single

day's catch. Do not mix samples between days. If less than 70 fish are caught in a day, the sample size for that day will be the number of fish caught on that day. Since smolt primarily migrate at night, a single sampling day will be the 24 hour period from noon to noon and will be identified by the calendar date corresponding to the first noon.

It is essential that the sample be taken randomly. In the event that more than the required sample size is in the smolt trap at the time of sampling, the trap is to be "stirred" to assure randomness. When the smolt are randomly distributed, a small dip net will be used to remove a subsample, this procedure will be repeated until the sample goal is met.

Smolt samples will be kept alive and worked the day of capture. MS222 will be used to anesthetize the fish. Latex gloves should be worn to prevent direct exposure to MS222 (see attached MSDS sheet). The use of this chemical will be demonstrated in the field. Age, weight, and length data will be recorded on adult AWL forms (Appendix D.1), as no smolt AWL forms exist. Refer to Appendix D on the standard procedures for recording data on an AWL form. Record at the top of each AWL form: personnel collecting the data.

A knife or scalpel will be used to remove 5-10 scales from the preferred area (Appendix D.3). The scales will be mounted on a glass slide as illustrated in Appendix D.4. The left portion of each slide will be labeled with: sample AWL number, location, date, and fish number. Smolt lengths will be measured to the nearest millimeter, from the tip of the snout to the fork of the tail.

Excess water will be removed from the smolt before weighing by using a paper towel as a blotter. Individual smolt weights will be recorded to the nearest 0.1 gram.

All data (slides, forms) will be forwarded to the area office and reviewed on a frequent basis (weekly or earliest available plane to town). Be sure to duplicate the data forms in case originals are misplaced in transit. **Please be conscientious in the quality control of <u>all</u> data prior to sending into Kodiak. Take the time to thoroughly review slides and forms to see they are filled out properly. This is especially important for the computer AWL forms.** These are some common mistakes which should be avoided:

1. Scales mounted poorly - avoid too many scales in a smear and avoid slime or debris when mounting; also, keep smears far enough apart to avoid mistaking one fish for another.

2. Numbering AWL form improperly - for example, if 70 smolt are sampled in one day (day 1) the AWL numbers should be 001 (fish 1-40; 8 slides), 002 (1-30; 6 slides), do not continue from 40 to 41-70. The next day will start with AWL 003 (fish 1-40) and so on.

3. Numbering when two smears (or scales for adults) per fish is required - these should be numbered 001 A, B not 001-002.

4. "# of cards" mislabeled - use one even if there are two scale cards or slides.

5. Damage AWL form (computer - Mark sense) - do not bend, fold, tape, staple, paper clip, etc. these forms. The computer will not read them correctly, otherwise.

Quality control check will be made by Project Biologist's with feedback provided to crew leader in a timely manner.

Smolt Estimation by Hydroacoustics

Hydroacoustic surveys will be conducted in Little Kitoi Lake prior to smolt outmigration in late April or early May, and after smolt migration is complete, in late June. The population estimates generated from these surveys will be compared to estimate sockeye smolt abundance.

Coho and Sockeye Smolt Clearance at Jennifer and Ruth Lakes

During the months of May-June, weekly surveys will be conducted at Jennifer and Ruth lakes outlet creek and between the lakes. All debris will be removed, if necessary, as well as water diversion if a low water situation arises. Also there are two lakes above Little Kitoi Lake that will need to be checked periodically.

Physical Data

Physical data will be collected at the smolt site at approximately 1100 and 2300 hours. Information will be recorded on the Daily Physical Observation form (Appendix E) and will include: water and air temperatures, stream height, percent cloud cover, wind direction and velocity, and precipitation.

Raceway Rearing Smolt Samples

As sockeye smolt reach their target size for release (this will be determined by hatchery personnel), 180 age-1 (30 per raceway) and 200 zero-age smolt from the total release number will be sampled for scale, weight and length data. Follow sampling guidelines previously outlined in the Age, Weight, and Length Sampling section. This activity will be coordinated with the project fish culturist to assure that hatchery sockeye procedures are followed. Also, 200 coho smolt will be sampled for scale, weight and length in the same manner.

Salt Water Challenge and Blood Sodium Sampling

Hatchery personnel will determine when salt water challenges are necessary and the proper number of smolt to be challenged. It is recommended that samples be collected prior to ponding into salt water net pens and held for 24 hours to assure no feeding activity has taken place. These smolt should then be transported to salt water and held for 24 hours with salinity and temperature recorded. After the holding period, smolt survival and mortality will be recorded. In addition, a minimum of 30 sockeye and 30 coho smolt will be sampled for blood sodium levels after this holding period. Blood samples will be collected from anesthitized smolt by cutting the the tail at the caudal peduncle and massaging the heart. Blood from individual fish

will be collected in heparinized hematocrit tubes and chilled. Each fish will be sampled for weight and length. Blood samples will be pooled if insufficeint bleeding occurs to collect the minimum size sample (~400 cc's). The blood samples will be chilled and shipped to Kodiak within 24 hours for analysis.

Fish Marking Quality Control

Late run sockeye fry will be marked at Kitoi Bay Hatchery in 1994. Quality checks will be made by the project culturist to assure fry are being fin clipped properly. Quality checking data will be copied at Kitoi and sent in for recording. Also 240 smolt, which were clipped in mid-winter, will be examined just prior to release for fin regeneration. Quality control and fin regeneration data will be entered on the Fry Marking Form (Appendix F).

Salinity, Temperature, and Plankton Monitoring

Sampling will take place at two stations in 1995. Salinities and temperatures will be taken each week using a YSI meter, at the surface and depths of 1/2 meter to 5 meters, then every meter to 20 meters. Additionally, the same procedure will be applied to an area just inside and just outside of "boomed" rearing area (salinity and temperatures to 3 meters in boomed area). Data will be recorded on Temperature, Salinity and Zooplankton Sampling Form (Appendix G). Plankton samples will be collected weekly at each of the three stations by conducting two replicate vertical tows at 0.5 m/s, using a Kitahara-type quantitative plankton net. Samples will be preserved with 10% buffered formalin in 250 ml polybottles. Each bottle will be labeled with station number, tow depth, preservative, sampling personnel and net size. Our program at Kitoi should parallel the PWSAC plankton watch (see 1992 Operation Plan) as much as possible.

During the time of daily field operations while collecting the previously discussed information, any salmon smolt behavior observed will be recorded. Criteria of importance includes: migration location, numbers, time of open water migration, rearing location, and etc.

Adult Enumeration

The Little Kitoi adult weir site will be operational by May 16. When fish begin building up behind the weir, a gate will be opened in the weir and fish will be counted. A tally wacker will be used to assure accurate counts. Daily and cumulative counts will be recorded on the Little Kitoi Fish Pass Salmon Count form (Appendix H). The weir should be checked a minimum of once a day to assure it is fish tight and twice a day during peak migration.

Age and Length Sampling

Approximately 600 sockeye salmon will be sampled for scale and length. Sampling will be proportional to run strength. Please refer to Appendix I for specifics on sampling procedure. Throughout the duration of the run, sockeye will be checked for fin clips and enumerated by sex

and number on the Little Kitoi Fish Pass Count form. Any marked fish will be processed for length, sex and two scales collected for aging. Approximately, 20% fo the run will be inspected for marks. Inspection for marks during the September egg take at Little Kitoi will be coordinated with hatchery personnel. The Project Biologist (Cleary) will determine the most appropriate method to inspect the required number of sockeye. Marks to look for are Left Ventral (LV),and RV. Jack sockeye should be inspected proportionaltely to their occurence in the run. All RV clips will be jacks.

Coordination of Fin Clip Inspections at Paul's Bay and Afognak Lake

The Project Biologist (Cleary) will be responsible for coordination with Management weir operations at Afognak River, as well as the Development camp at Paul's Bay, to facilitate inspection of the sockeye run for LV and RV fin clips. These fish were marked from 1992 - 1994 and 1994 to evaluate the survival and straying rate of early run (Afognak stock) and late run (Upper Station stock) smolt releases at Little Kitoi Bay. The number examined, number of clipped fish found, length and sex of clipped fish will be recorded. In addition, two scales will be collected for aging. Thereafter, the status of sampling will be monitored via SSB radio schedules. In addition, during commercial, subsistence and sport fishing at each site, fishery technician III will coordinate and participate, when necessary, in collection of the aforementioned data.

Commercial Fishery Monitoring

During the commercial fishery at Kitoi, sockeye salmon harvest will be monitored. Sockeye scales will be collected from commercially caught sockeye (600/year) for age data. Scales wil be aged at the Kodiak ADFG office.

Hydrogen Sulfide Removal and Sample Collection

Plans have been made in 1995 by hatchery staff to repair the pipeline in Little Kitoi Lake. The layer of hydrogen sulfide will be siphoned out in the fall. During limnology sampling at Little Kitoi Lake, deep water and transition layer samples will be monitorred for hydrogen sulfide at the two limnology stations (one in each basin). Salinity readings, dissolved oxygen, temperature, and "odor" will be noted.

Chum Salmon Brood Stock Sampling

During the chum salmon egg take, a maximum of 240 brood fish will be sampled weekly (600/year), following procedures identified in the Age and Length Sampling section.

Limnology Sampling

Lake limnology sampling will be conducted as described in the Lake Assessment Operation Plan (Appendix J). At Pillar Lake, an initial station will be set in the deepest basin and an additional zooplankton sampling station will be set in the shallower basin. Water will be filtered in the Kitoi hatchery, labeled and shipped to Kodiak in a cooler on the next available charter flight. Care must be taken to assure that Kodiak staff are prepared to receive the samples so they are not left at the air charter office.

Project Production Data Reporting

All data collection will be thoroughly checked for errors with all forms reviewed and corrections made. Data will be summarized in spreadsheet tables using Region Information Report (RIR) Format. As 1995 data is summarized, a narrative will be written, again using the RIR Format. The project biologist's will assign specific subject area to the crew (Tech III).

OTHER REQUIREMENTS

Safety

Each employee will receive CPR/First Aid Certification as required by the Department SOP, prior to assignment to the Kitoi Project. In addition, each employee will review the required sections of the ADF&G SOP and sign the Employee Safety SOP Verification form. Specific SOP's to review include Safety Policy/Standards, Building Safety, Field Camp Safety, Aircraft safety, Emergency/Survival Equipment Required in Aircraft, Boating Safety, Vehicle Safety, Laboratory Safety, Small Tool Handling, and Firearm/Bear Safety. There is additional information in the office safety files to supplement the SOP and is also available for review. The fishery Technician III will watch survival videos at the bunkhouse in Kodiak before departing to the field.

Project crew leaders will be responsible for providing the necessary equipment and information to field technicians. **Each employee is responsible for receiving his/her own safety training.**

Air Charters

All air charters will be set up through Kodiak staff. Appropriate information in regard to charters will be relayed through daily telephone contact. It is important to contact office personnel when any data, equipment or other freight will be "back hauled" to Kodiak.

Reporting

Crew leaders will be responsible for reporting all of the job activities, compiling biological data and assuring quality control. Be sure to use pencil rather than a pen for data entry. Data forms and a field log will be completed daily. Use "rite in the rain" field log books in the field and

transfer data onto rite in the rain data forms after field work is completed. Completed data forms will be sent to Kodiak weekly. Make sure that data that is sent to Kodiak is properly packaged and labelled. A portable computer will be provided for data entry and weekly reports.

A report of project activities will be sent to town weekly or on soonest available plane . A one page weekly report is sufficient (Appendix K). In addition to weekly reporting, crew leaders will be responsible for writing a report summarizing Kitoi Evalulation Project activities for the season. Please follow the enclosed format when writing this document (Appendix L).

Inventory

Upon completion of the project, crew leaders will complete a thorough inventory of all project equipment. The final location of each inventoried item will be noted (i.e. at Kitoi, warehouse bin, etc.).

Video/Photo Documentation

Crew leaders will be responsible for documenting project activities by video and/or photograph. Specific aspects such as trap installations, weir construction, and other detailed tasks are important to document. When possible, State video and 35 mm cameras and film will be used. If, however, State equipment is not available, film will be provided for use with personal cameras. The use of personal cameras is suggested in this case but not required.

Timesheets

All timesheets are to be in the Kodiak office by the 15th and 30th of each month. When the employee is working in the field and receives hazard pay, the timesheet "Comments" column is to have the location of the field camp. If there was overtime worked, the employee must state a choice <u>each pay period</u> whether to be paid for the overtime hours worked or accrue compensatory leave (comp time). The comp time should be put on the timesheet as overtime, and at the top of the timesheet write the following: "I wish to receive compensatory leave in lieu of overtime." Comp time is calculated each pay period by multiplying the number of hours of eligible overtime by 1.5. If the employee has comp time at the end of the field season, they are to use the comp time before being put on seasonal leave without pay. Employees cannot collect unemployment while on comp time. Crew leaders should plan work activities to be completed in a 7.5 hour day. All overtime worked will be pre-authorized by the Project Biologists.

Appendix A

A Guide to the Collection and Identification of Presmolt Pacific Salmon in Alaska with an Illustrated Key

Appendix A.

A Guide to the Collection and Identification of Presmolt Pacific Salmon in Alaska with an Illustrated Key

MILTON B. TRAUTMAN[1]

ABSTRACT

This field and laboratory key contains recommendations for types of equipment needed, instructions for preserving and labeling specimens, and descriptions of the characters used in identifying five species of Pacific salmon. The key is illustrated with six line figures: 1) juvenile salmon, 2) the first gill arch, 3) head with gill arch in situ, 4) first gill arch and eye for comparison with longest rakers, 5) method of counting anal fin rays, and 6) ventral surface of head showing branchiostegals. Five plates of stippled line drawings of five lengths (25 to 110 mm fork length) for each of the five species of Pacific salmon, an annotated opposable key, and a glossary are also included.

INTRODUCTION

As adults, the five species[2] of Pacific salmon of the genus *Oncorhynchus* inhabiting western North American waters are easily identified, but as subadults or as smolts in silvery coloration, they are less easily recognized. As juveniles less than 125 mm (5 inches) in fork length (FL), they may be quite difficult to identify. In addition, characters by which presmolt juveniles can be distinguished may vary with geographic area.

Several keys for identification of juvenile salmon have been published, most of which utilize the number, length, and shape of the gill rakers on the first gill arch; number of pyloric caeca and branchiostegals; and absence of parr marks, or if present, their size and shape (Foerster and Pritchard, 1935; Schultz, 1936; Haig-Brown, 1947; Clemens and Wilby, 1961; McPhail and Lindsey, 1970; Wilimovsky[3]). In addition to the above characters, the key in this paper emphasizes and illustrates the distribution of those chromatophores (usually melanophores) which are reliable enough to aid in the specific identification of juveniles.

This key describes the characters typical of presmolt juveniles of the five species of Pacific salmon in Alaska. The common names recommended by the American Fisheries Society (Bailey et al., 1970, p. 17) are used, despite the fact that other names appear to be in more general use. These other names are inserted in parentheses after their respective species. Trouts, Atlantic salmon (*Salmo salar*), and some other salmonoids are included in the key because of their resemblance to Pacific salmon.

Before presenting the key, it appears advisable to describe the equipment and methods I recommend for preserving specimens, labeling specimens, and counting, measuring, and removing parts of specimens, so that those not acquainted with my procedures may more accurately and quickly identify their material.

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[1] Professor Emeritus of Zoology, Ohio State University, Columbus, OH 43210. The author was employed in Alaska by the National Marine Fisheries Service Auke Bay Fisheries Laboratory during the summers of 1959 and 1961. The specimens were obtained and most of the drawings made at that time.

[2] A sixth species, *O. masou* (Brevoort), inhabits the streams of eastern Asia from the Okhotsk Sea to Formosa.

[3] N. J. Wilimovsky, 1958. Provisional keys to the fishes of Alaska. On file Natl. Mar. Fish. Serv., Auke Bay Fish. Lab., Auke Bay, AK 99821.

RECOMMENDED EQUIPMENT

Magnifiers: Magnification in the range of 4 to 30 will prove helpful in identification of juvenile salmon. A binocular microscope having such a range is the most satisfactory, but any type of magnifier of more than 4 power and less than 30 may be used provided it is not necessary to use one's hand to hold it—usually both hands are needed to manipulate a specimen. In the field, a binocular unit containing lenses inserted in a frame or headstrap or a jeweler's eye magnifier (especially if one wears glasses) may be used.

Forceps: Four or five inches long with straight or curved tips—for lifting fins, holding back gill covers, etc.

Scalpel: A sharp blade an inch or two long—for removing gill arches, opening body cavities, etc.

Teasing needle: A needle inserted in a wooden or metal handle—for separating closely set gill rakers, etc.

Dividers: For measuring and comparing various body parts; dividers in which one or both legs can be "broken" are the most satisfactory.

Scissors: About 6 inches long with the blades or cutting surface of about 1 inch.

Ruler: Graduated in millimeters to measure fish lengths and parts; one which includes inches also desirable.

PRESERVING SPECIMENS

The careful preserving of specimens cannot be too strongly emphasized. Much time is lost in attempting to identify improperly preserved fishes; it is only when properly preserved that they may be rapidly and correctly identified. Frequently, juvenile salmon that have died in nets become soft, bleached, and torn. For the sake of accuracy it is better not to attempt to identify such material.

To preserve juveniles, upon capture place them in a solution of 1 part Formalin to 9 parts water. If live fishes are placed in too strong a Formalin solution, they may die with their mouths widely agape or the chromatophores may close so tightly as to be difficult to detect. If placed in too weak a Formalin solution, the fishes become bleached and soft and may decompose. If fishes are to be preserved for more than a year (or permanently), leave them in the Formalin solution at least 1 wk and if possible no longer than 4 mo. When fish are removed from the Formalin solution, soak them in water for 24 to 48 hr; then place them in a solution containing 70% ethyl alcohol and 30% water or 35% isopropyl alcohol and 65% water.

Do not crowd or pack fishes in a container, especially if they are alive or only recently dead. Fresh fishes, if packed too tightly, will become permanently deformed upon hardening in Formalin, will be bleached where their bodies come in close contact, or will decompose. A container is too crowded if the fishes will not readily move as the container is slowly rotated or shaken. When sufficient room is allowed, identification will be facilitated because the fishes will harden without discoloring; bodies and fins will not be deformed, twisted, or broken; and the chromatophores will remain nearly or fully open.

LABELING SPECIMENS

Labeling specimens fully and properly is of great importance; unlabeled or mislabeled specimens are of little or no value. Put the label with the specimens at the time the fishes are preserved. Label paper should remain firm when wet and should not become pulpy. Write clearly with pencil or permanent ink, recording the following data.

Field Number

Use your own or a department number. A satisfactory method is to use the first initial of your surname or your full surname, the last two digits of the year, and your collection number. Thus, if Joe Brown in 1962 preserves his fifth collection, he writes B-62-5 or Brown-62-5; if for the Department of Salmon Investigations he writes, SI-62-5. When a departmental symbol is used, it often is desirable for the collector to add his initials or name to the label.

Name of Water Body and Locality

Use names on standard maps. Whenever possible, avoid temporary or local names, such as

Brown's fishing camp. An example of a brief but adequate recording is: Alaska, Naknek River System, Katmai National Monument, Brooks Lake.

Date

Include the month, day, and year and, if pertinent, the hour.

The following additional information may be needed at times.

Method of Capture

Describe type of gear and size if significant, i.e., seine (2 cm mesh), fry net (1 cm mesh), trawl (1 cm bag), etc.

Temperature

Measure temperature of air and/or water. If water is ice-covered, what percent?

Other Water Conditions

If a *stream:* estimate its average width and maximum depth; if tidal and brackish, to what extent; degree of turbidity and source—glacial silt, plankton, etc.; degree of gradient—low, moderate, or high; percentage of stream in pools, with or without current; percentage of stream in riffles, whether flow is sluggish, moderate, or swift; dominant bottom types—sand, gravel, boulders, bedrock, muck, silt, etc.; aquatic vegetation—submerged, emergent, or both (name dominant species or genera if known). If a *lake or bay:* state whether fresh, brackish, or saline; if tidal, state to what extent; estimate size and possible depth; give degree of turbidity, type of bottom, and amount and kinds of aquatic vegetation.

Remarks

Describe anything that may aid in identification of the fishes, such as peculiar markings, habits, or habitats.

CHARACTERS USED IN IDENTIFYING SPECIES

A juvenile salmon is shown in Figure 1 to assist in recognizing and defining the characters and the counts and measurements used when keying out a specimen.

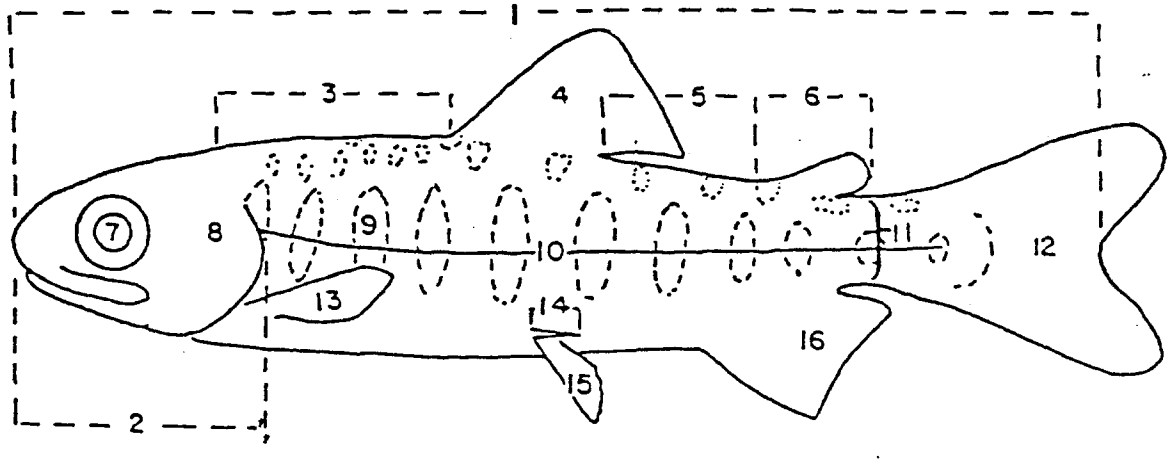

Figure 1.—Juvenile salmon, illustrating parts and methods of measuring: 1, fork length; 2, head length; 3, predorsal ridge; 4, dorsal fin; 5, portion of postdorsal ridge between posterior end of dorsal fin base and origin of adipose fin; 6, adipose fin; 7, pupil of eye; 8, gill cover, beneath which is gill chamber containing gill arches; 9, a parr mark; 10, lateral line; 11, caudal peduncle; 12, caudal fin or tail; 13, pectoral fin; 14, axillary process or scale; 15, pelvic fin; 16, anal fin.

First Gill Arch

Beneath each gill cover are four fully formed gill arches; the first gill arch on either side is the part used for specific identification. A gill arch (Fig. 2) consists primarily of a bony central arch to which the gill rakers are attached anteriorly, the gill filaments (lamellae) posteriorly. The gill rakers prevent solid substances such as food from being carried out through the branchial clefts and protect the delicate gill filaments. The numbers of gill rakers vary somewhat among individuals of each species of salmon, but the difference in average number between some species is sufficiently great to enable one to use them as specific characters.

The rakers on the gill arch may be counted as a unit, or the upper and lower limbs may be counted separately. The two limbs are joined

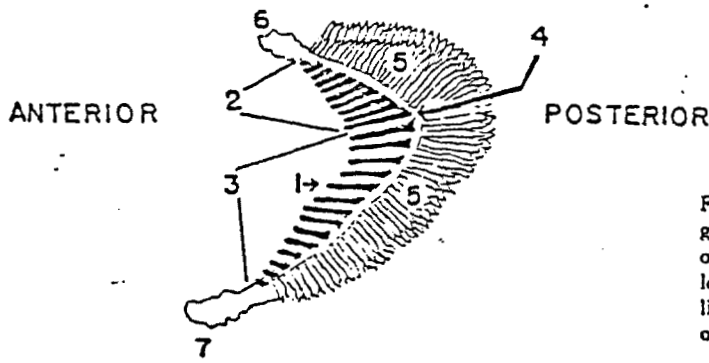

Figure 2.—First gill arch of salmon after removal from left gill chamber: 1) gill raker; 2) gill rakers attached to upper or shorter limb of arch; 3) gill rakers attached to lower or longer limb of arch; 4) angle of arch (junction of the two limbs or bones); 5) gill filaments (lamellae); 6) upper point of arch attachment; 7) lower point of arch attachment.

at an angle, the upper being the shorter. When a raker is situated astride the angle, it is included in the lower limb count. When all of the rakers on the arch are counted as a unit, a single number is given; otherwise, both limbs are recorded separately (the upper limb first), and then added, thus 12 + 20 = 32.

The gill rakers nearest the angle of the arch are the longest; the rakers become progressively shorter as they approach the attachment ends of each arch. The rakers near the ends are often rudimentary and can be counted only under magnification.

It may be difficult to count all of the rakers accurately while the first gill arch is in place, in which case it will be necessary to remove the arch. To do this, turn back or cut away gill cover as shown in Figure 3. Lift the first gill arch upward. With a sharp scalpel, cut between the dorsal ends of the first and second arches, making a deep incision parallel with them; then cut the remainder of the attachment away. Next cut the ventral attachment in the same manner; and when both ends are free, remove the arch. Great care must be taken so that all rudimentary rakers may be removed and counted. After finishing the examination of the arch, reinsert it in the gill chamber for possible future examination.

Gill Raker and Eye Comparison

The longest rakers are compared with the length of the eye (Fig. 4). With dividers, obtain the measurement of the length of the longest raker; then place one point of the dividers at the anterior edge of the eye, the other extending

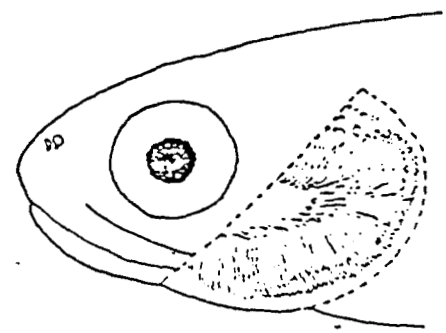

Figure 3.—Head of salmon. Dotted lines indicate that portion of gill cover which has been removed to show first gill arch in place.

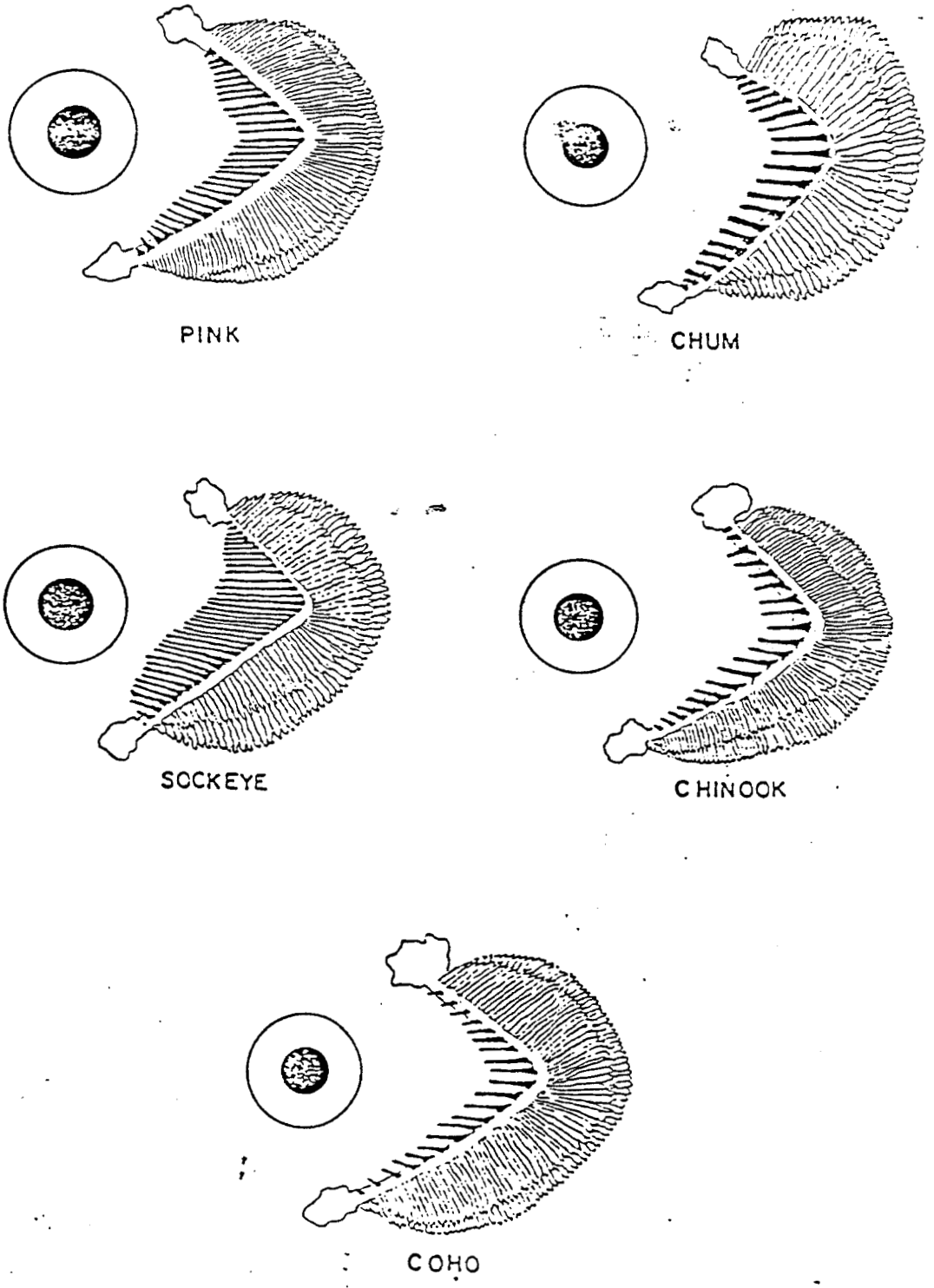

Figure 4.—First gill arch and eye for comparison with longest gill raker length of five species of Pacific salmon.

toward the opposite edge. Because the raker is shorter than the eye length in juvenile salmon, it is simplest to note where the raker reaches in relation to the pupil. Like many body part ratios, the gill raker-eye size ratios change as the juvenile salmon increases in length. For example, in specimens about 40 mm FL, the longest raker may be contained about 3 times the eye length, but in 140 mm specimens of the same species, the raker may be contained only about 2 times. This and other proportional changes must be considered.

Anal Fin Measurement and Count

To compare the length of the fin base with the longest ray, measure the anal fin base with dividers; then project the posterior leg of the dividers forward to the opposite tip of the longest ray as shown in Figure 5 by dotted line.

In counting the number of rays (Fig. 5), do not count those anteriormost ones which are less than half the length of the longest rays, such as those marked "0." Count all rays, such as No. 1, that are half (or more than half) the length of the longest ray, taking great care to observe the last ray—No. 15 in Figure 5. The last ray is usually split to its base and appears superficially as two rays, but it is in reality only one and should be counted as such.

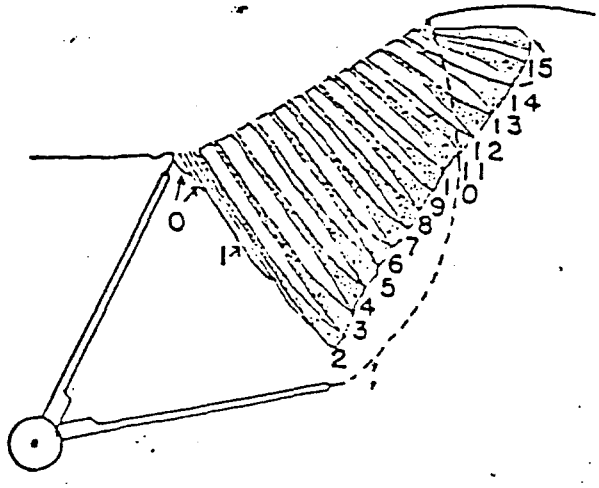

Figure 5.—Anal fin of salmon, illustrating method of measuring length of fin base and of counting rays (rays 2 to 15 are stippled here for emphasis).

Branchiostegal Count

All branchiostegals (Fig. 6), including the smallest, anteriormost ones are counted. Usually this may be accomplished satisfactorily only under magnification, and with juveniles longer than 40 mm FL. The branchiostegal count is used primarily as an additional character in specimens otherwise difficult to identify, and is especially valuable in separating the chinook salmon (usually 15 or 16) from the coho salmon (usually 13 or 14).

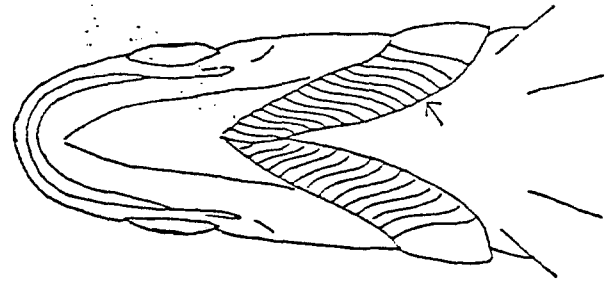

Figure 6.—Ventral surface of head of salmon. Arrow points to one of 14 branchiostegals on left side of head.

Pyloric Caeca Count[4]

With a scalpel, widely open the abdominal cavity. Sever the esophagus as far forward as possible; then cut off the intestine near the posterior end of the stomach. The stomach and caeca can now be removed as a unit (Fig. 7). Use magnification and teasing needle as aids in counting. Counts of pyloric caeca are useful chiefly as an additional character for questionable specimens, especially in separating the chinook salmon (more than 100 caeca) from the coho salmon (fewer than 90).

Color Pattern Variations

Juvenile salmon from certain waters or at certain stages of development may have their parr marks or other markings masked by a bluish-

[4]In the key, I have used pyloric caeca counts of my own, plus published accounts of others and especially the more recent ones, such as Clemens and Wilby (1961) and McPhail and Lindsey (1970).

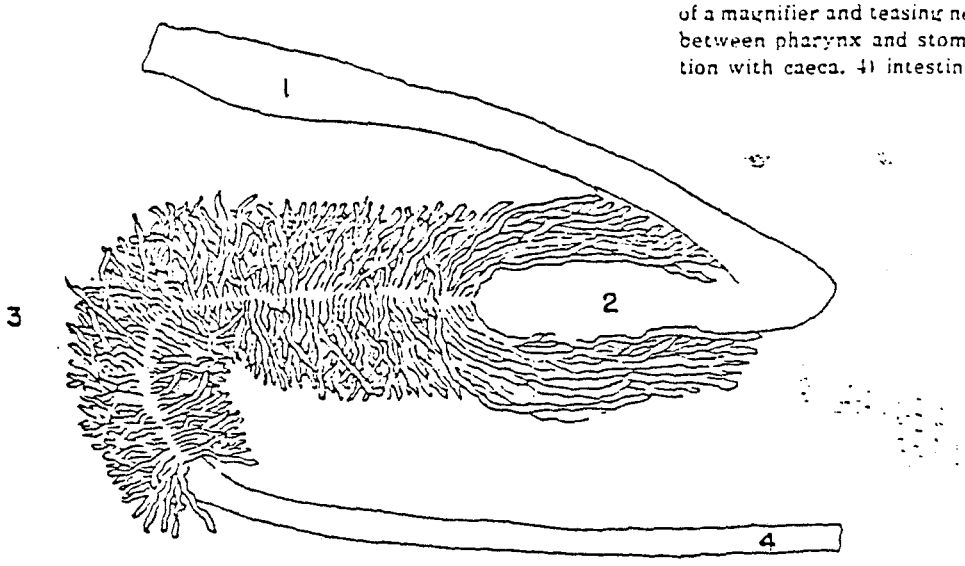

Figure 7.—Major portion of alimentary tract of salmon with pyloric caeca spread apart preparatory to counting with aid of a magnifier and teasing needle: 1) esophagus (part of tract between pharynx and stomach), 2) stomach, 3) pyloric section with caeca, 4) intestine.

or greenish-silvery sheen, especially when they are alive. To identify these fish, it may be necessary to preserve them first in Formalin to intensify their markings.

Juveniles of one species from certain waters, such as habitually turbid ones, may have their melanophores restricted in size or distribution, thereby resembling superficially another species. As an example, coho salmon normally have the adipose and anal fins densely speckled with rather large melanophores. But in some specimens, the melanophores may be reduced in size or distribution, so that coho salmon superficially resemble chinook salmon. Conversely, juvenile chinook salmon may have the melanophores unusually numerous and well developed, thereby resembling coho salmon. To avoid error in identification, compare the size and number of melanophores on the fins with those on the body; if few and small on the body, they should be few and small on the fins.

Color variations also occur regionally. An example is the predorsal stripe in chinook salmon, which in fish from some waters is normally a solid dark bar in specimens less than 80 mm FL; in chinook salmon in other waters the stripe may be reduced to a series of oblong blotches.

The length when individuals attain smolt coloration varies greatly, both regionally and in specimens from the same locality; some fish of the same species may lose parr and other presmolt markings when only half as large as other fish.

HOW TO USE KEY

Because of the variations in morphology and coloring, it is advisable to use the key in conjunction with the figures and plates and to check a large combination of characters.

In using the key, first make certain your specimen is a Pacific salmon by examining the characters under the two opposable groups labeled "1." Next, note the absence or presence of parr marks (see sections *"Combination of"* under opposable groups 2). If no parr marks are present and your specimen has not entered the silvery smolt stage, it is probably a pink salmon, but to make sure, compare it with the identifying characters between opposable groups 2. If parr marks are present, note the absence or presence of melanophores on adipose and anal fins (see groups 3). If melanophores are absent, see sections *"Combination of"* under groups 4; if present, see *"Combination of"* sections under groups 5. Decide which *"Combination of"* most closely fits your specimen, then verify it by comparing the descriptions of the identifying characters for the opposable groups.

KEY TO PRESMOLT JUVENILE SALMON

Salmonoid fishes having fewer than 20 rays in the dorsal fin (excludes grayling); strong teeth on jaws and tongue (excludes ciscoes and whitefishes); many pyloric caeca (excludes smelts, family Osmeridae); an axillary process or scaly appendage above pelvic fin (Fig. 1, No. 14); an adipose fin; cycloid scales; upper jaw formed by both premaxillary and maxillary ..... 1.

1a Base of anal fin *shorter* than longest ray (Fig. 5). Anal rays usually 9 to 12 (rarely 8 or 13). Gill rakers normally fewer than 20 on first gill arch (Fig. 3). Dorsal fin of larger juveniles of some species with several blackish spots.
CHAR, TROUTS, ATLANTIC SALMON ..... Not in this key.

1b Base of anal fin *longer* than longest ray (Fig. 5). Anal rays usually 13 to 17 (rarely 12, 18, or 19). Gill rakers normally 20 to 40 on first gill arch (rarely 19). Dorsal fin of larger juveniles lack blackish spots but tip of fin may be blackish.
PACIFIC SALMON—genus *Oncorhynchus* ..... 2.

2a *Combination of: No* parr marks on sides and *no* prominent specklings on back of presmolt juveniles. Usually no melanophores on anal and adipose fins; if melanophores present, they are few and very small, and if on adipose, are restricted to its posterior, free edge.
PINK (HUMPBACK) SALMON—*O. gorbuscha* ..... Plate 1.

General development—Similar to chum salmon in that yolk sac may not disappear until juvenile is more than 34 mm FL, after which development toward smolt shape and coloration is rapid. When less than 50 mm FL, this species is similar to chum salmon in being more terete than the sockeye, chinook, and coho salmon; body depth immediately before dorsal fin usually more than 1.5 times head length.

Parr marks—Only species of salmon lacking parr marks in the presmolt juvenile.

Coloration of body—*Preserved material*—In juveniles less than 40 mm FL, back is dark to lateral line and ventral half of body light when bicolored; dorsal third of body is darkest, sides lighter, ventral third lightest (usually milky-white or silvery) when tricolored. Few or no melanophores on lower sides and belly. In juveniles more than 40 mm FL, bicolored or tricolored condition is normally not evident, the dark back lightening gradually downward to the very light belly. *Living specimens*—Dorsal half of body bright bluish or greenish with much silvery reflection; ventral half milky or silvery-white.

Fins—Anal and dorsal fins averaging smaller than in chum salmon; these fins in this species and in chum salmon distinctly smaller than in sockeye, chinook, or coho salmon. In specimens less than 40 mm FL the longest anal ray, when measured into head length, extends from tip of snout to about center of eye; in larger presmolt juveniles, this measurement extends from tip of snout to anterior half of eye. Anal rays usually 14 to 16 (extremes 13 to 17). *Dorsal fin* has few specklings and only a slight tendency toward a dark anterior edge in juveniles less than 50 mm FL; over 50 mm, blackish anterior edge becomes pronounced and tip of fin dusky. *Caudal fin* has speckling confined to basal half in juveniles less than 50 mm; with increasing length of juveniles, specklings appear along rays, and in large presmolt juveniles lobes tend to become blackish.

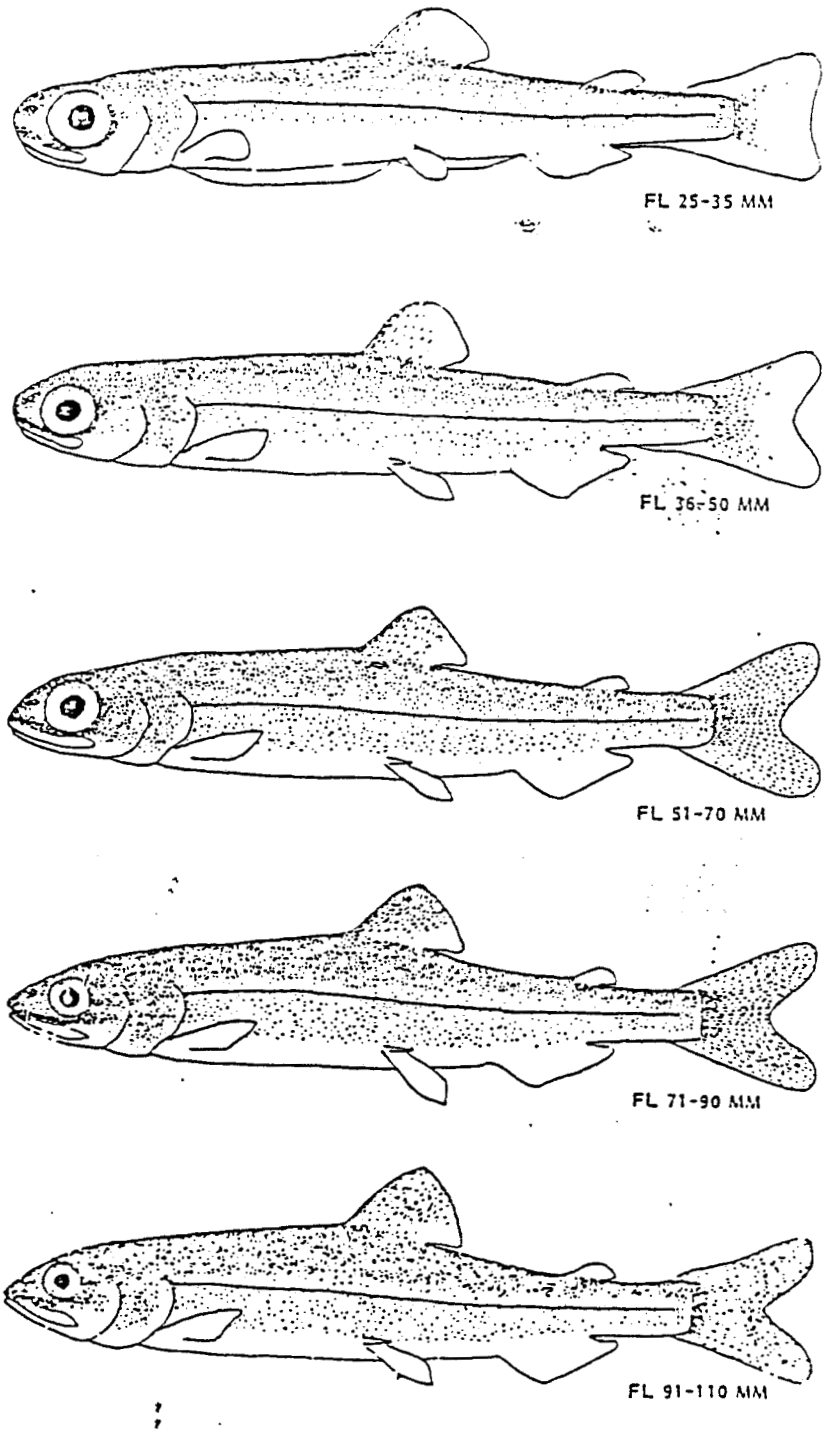

Plate 1.—Pink salmon.

Gill rakers (see Fig. 4)—Eleven to fourteen on upper limb, 14 to 19 on lower, total usually ranging between 27 and 33 (extremes 25 and 35); rakers slender and rather long; most similar in size and number to sockeye salmon but shorter and usually fewer (normally less than 31).

Pyloric caeca—Usually 130 to 195 (extremes 95 to 224); slender and rather long; differ sufficiently in numbers from coho and sockeye salmon, which have fewer than 100, to be a distinct aid in specific identification.

Branchiostegal rays—Usually 11 to 14 (rarely 10 or 15); average number less than in other species, almost invariably less than in chinook salmon, which usually has 15 to 18 (rarely 14).

Scales in lateral line—More than 170, more than in any other of the Pacific salmon; lateral line scale counts may be obtained under magnification in specimens longer than 60 mm FL.

Habits—Shortest life span of any species, between 18 mo and 2 yr. Only a comparatively small proportion of adults make extended migration in fresh water. Majority spawn in fresh waters within a short distance of brackish water or in intertidal waters. Many young enter brackish or salt waters within a few hours or days after emerging from redds, and comparatively few are found in fresh water when more than 45 mm FL.

Combination of: Both parr marks on sides and dark spottings on back usually obvious in living, presmolt juveniles and always in preserved specimens under magnification (may be faint in fishes from turbid waters); parr marks become faint and disappear as juvenile assumes smolt coloration ..... 3.

2b

No melanophores normally present on adipose and anal fins of presmolt juveniles, or if present, few and quite small. Parr marks occupy a larger area above lateral line than below it, and in some specimens anterior parr marks may be almost entirely above the lateral line.

3a

CHUM AND SOCKEYE SALMON ..... 4.

Melanophores normally obvious on adipose fin in living specimens and always in preserved specimens under magnification (may be indistinct in juveniles from silty waters). Anteriormost parr marks appear to occupy as large (or almost as large) an area below lateral line as above it; these parr marks are usually large, long, and wide.

3b

CHINOOK AND COHO SALMON ..... 5.

Combination of: Gill rakers 19 to 26 (average 23), notably fewer and much shorter than in sockeye salmon, which have more than 28. Normally *no* melanophores on adipose and anal fins. Anterior squarish (quadrate) parr marks situated almost or entirely above lateral line in specimens less than 50 mm FL; in presmolt juveniles more than 50 mm FL, anterior parr marks tend to be long and very narrow and sometimes may extend well below lateral line.

4a

CHUM (DOG) SALMON—*O. keta* ..... Plate 2.

General development—Similar to pink salmon in that yolk sac may not disappear until juvenile is more than 34 mm FL, after which development toward smolt shape is rapid. Also similar to pink salmon in being more terete (when less than 50 mm FL) than the sockeye, chinook, and coho salmon; body depth immediately before dorsal fin usually 1.5 to 1.8 times head length.

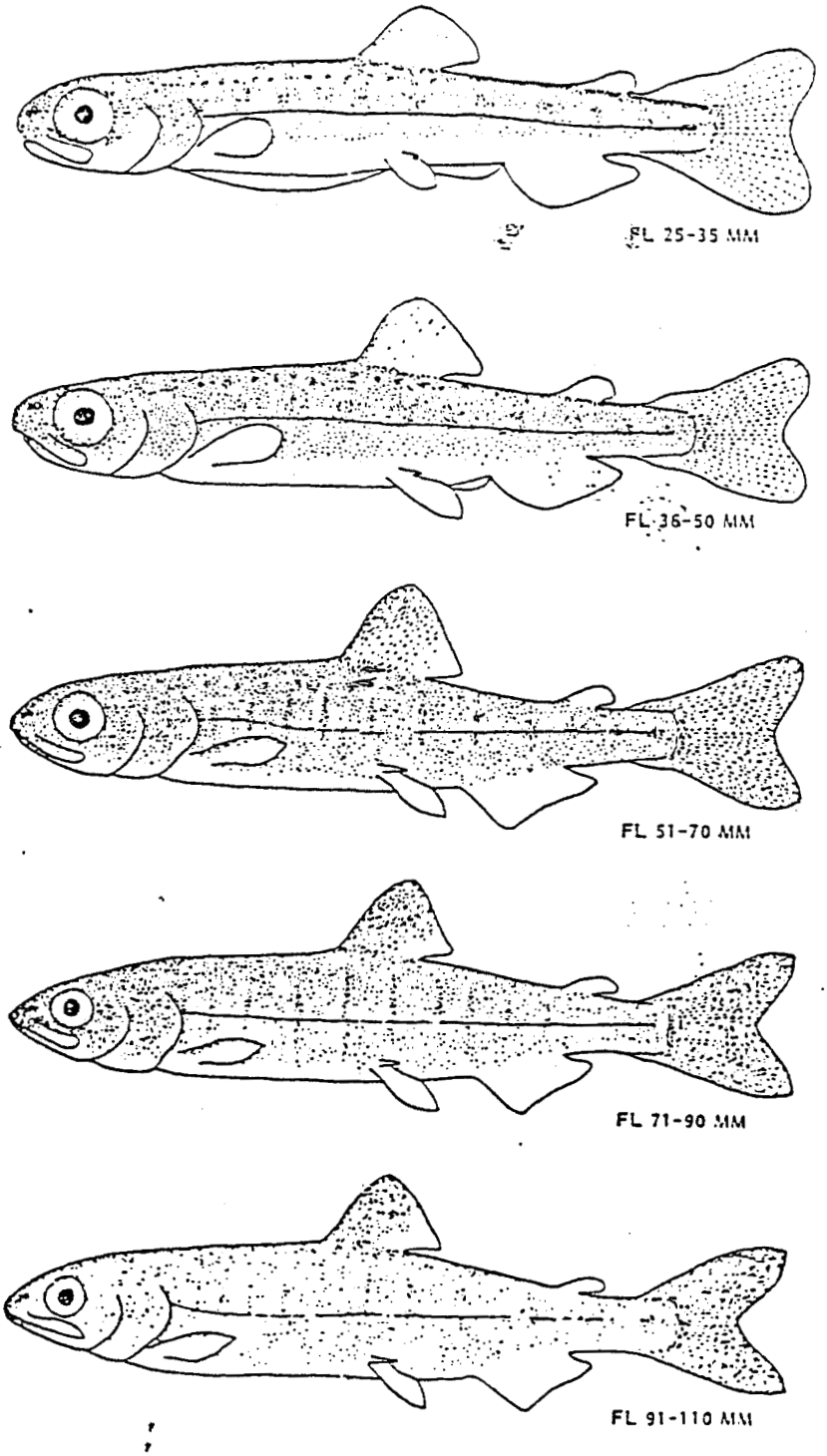

Plate 2.—Chum salmon.

Parr marks—Anterior parr marks in specimens less than 50 mm FL are more squarish (quadrate) and do not extend quite so far below lateral line as in sockeye salmon; in presmolt juveniles more than 50 mm FL, parr marks tend to become longer and more narrow than in sockeye salmon, and some tend to extend well below lateral line.

Coloration of body—*Preserved material*—Dorsal ridge stripe usually present, sometimes a series of blotches in juveniles less than 50 mm FL, becoming faint or disappearing in presmolt juveniles more than 50 mm FL; a prominent irregular row of spots and blotchings between dorsal ridge and upper edge of parr marks, these usually most distinct in specimens between 34 and 50 mm, often fading or disappearing in larger juveniles. *Living specimens*—Markings may be obscured by greenish or bluish overcast of dorsal half of body and whitish or silverish sheen of ventral half.

Fins—Anal and dorsal fins small, averaging slightly larger in size than those of pink salmon and averaging considerably smaller in height and area than those of sockeye salmon. Length of longest anal ray, when measured from snout to eye, reaches to, or almost to, center of eye; in sockeye salmon this measurement usually extends well beyond center of eye. Anal rays usually 13 or 14 (extremes 13 to 17). *Dorsal fin* has few or no distinct spottings in specimens less than 50 mm FL; in larger presmolt juveniles a dusky spot develops on tip. *Caudal fin* has faint spots largely confined to basal half in juveniles less than 50 mm FL; in larger juveniles lobes become blackish.

Gill rakers (see Fig. 4)—Seven to twelve on upper limb, 12 to 19 on lower, total usually ranging between 20 and 26 (extremes 19 to 30); rakers blunt and short, in sharp contrast to thinner, longer, and more numerous rakers of sockeye salmon, which has 30 to 39.

Pyloric caeca—Usually 160 to 185 (extremes 140 to 249); differ sufficiently in numbers from sockeye and coho salmon, which usually have fewer than 100, to be an aid in specific identification.

Branchiostegal rays—Usually 13 or 14 (extremes 12 to 16); of value primarily in separating this species from chinook salmon, which generally has more than 15.

Scales in lateral line—Between 125 and 155; of value chiefly in separating this species from pink salmon.

Habits—Life span usually 3 to 5 yr, for majority, 4 yr, some less than 3 yr. Jacks may occur. Majority spawn in fresh waters only a comparatively short distance from brackish water or in intertidal waters. Many young enter brackish or salt waters very shortly after emerging from redd, and few juveniles are found in fresh waters when more than 45 mm FL.

Combination of: Gill rakers 30 to 39 (average 36); notably more numerous, longer, and more slender than in chum salmon, which have fewer than 27. Normally *no* melanophores on adipose and anal fins. Anterior parr marks more rectangular
4b than squarish in outline in specimens less than 45 mm FL and sometimes extend as much as a third to a half below lateral line; these oblong parr marks tend to shorten in presmolt juveniles more than 50 mm FL and to be mostly above lateral line.

SOCKEYE (RED) SALMON—*O. nerka*. . . . . Plate 3.

General development—Yolk sac usually disappears, except for trace, before juveniles reach 30 mm FL. Body deeper and species more slab-sided in all presmolt lengths than in chum and pink salmons—body depth immediately before dorsal fin usually less than 1.5 times head length.

Parr marks—See "*Combination of*" above.

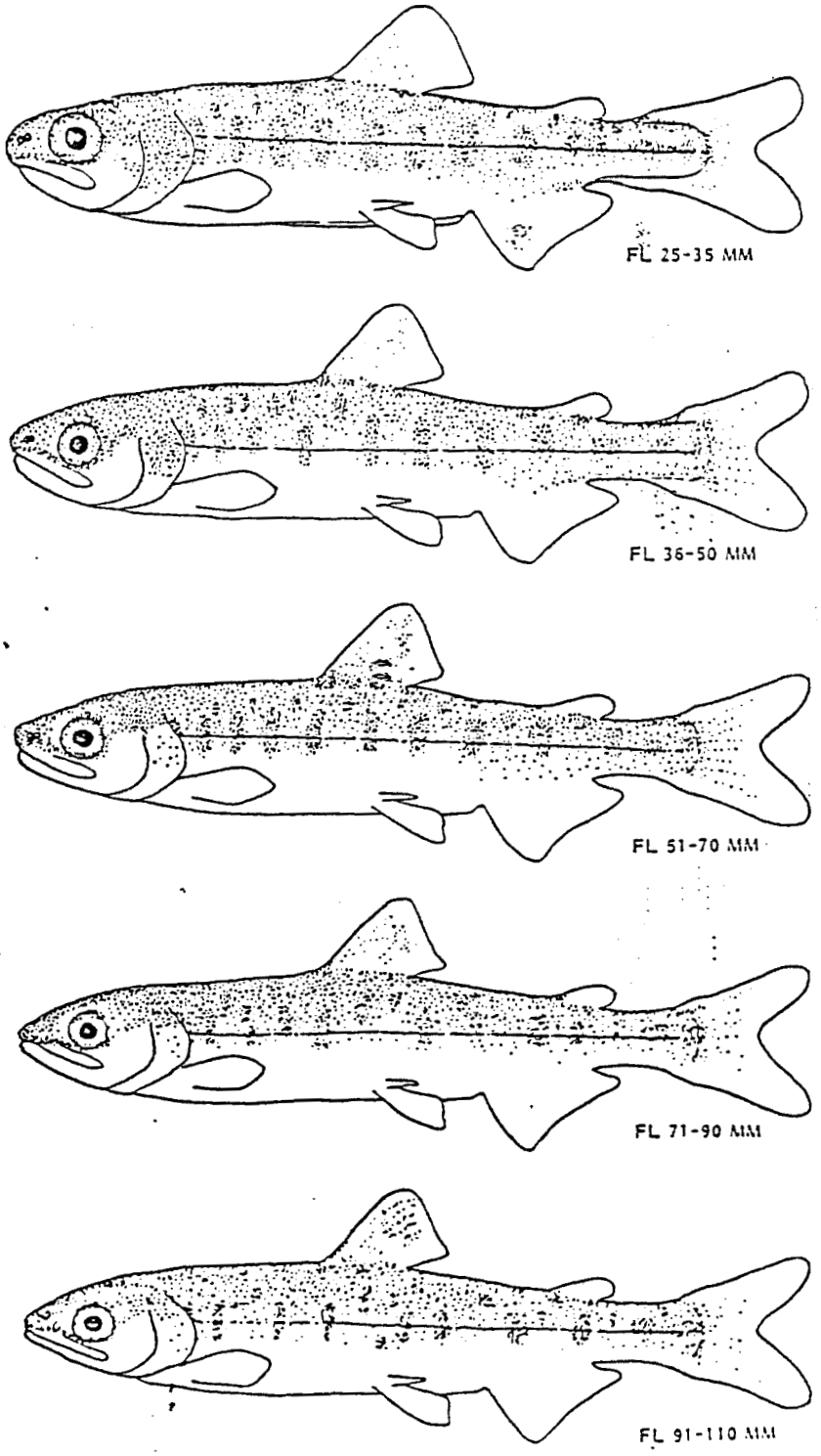

Plate 3.—Sockeye salmon.

Coloration of body—*Preserved material*—Dorsal ridge usually contains a series of more or less distinct spots in specimens less than 35 mm FL, becoming more confluent in fishes between 40 and 55 mm FL and sometimes merging into a dusky bar; in presmolt juveniles over 60 mm FL, spots or bars may disappear, after which a series of roundish spots become apparent on both sides of, and adjacent to, dorsal ridge, especially that portion behind dorsal fin; in addition to these spots, in fishes more than 35 mm FL, another longitudinal row of spots develops between dorsal ridge and upper halves of parr marks. *Living specimens*—Markings may be obscured by greenish or bluish overcast of dorsal half of body and whitish or silverish sheen of ventral half.

Fins—Anal and dorsal fins average larger in height and area than in chum and pink salmon. Length of longest anal ray, when measured from snout to eye, reaches usually from snout to beyond center of eye. Anal rays usually 14 to 16 (extremes 13 to 16). *Dorsal fin* normally has few or no distinct specklings in specimens less than 60 mm FL; a rather faint dorsal spot develops in larger presmolt juveniles in upper portion of fin, the fin being bordered on its free edges with whitish (see lowest figure, Plate 3). *Caudal fin* has few specklings on basal half, the lobes having few or no melanophores, even in rather large juveniles.

Gill rakers (see Fig. 4)—Twelve to sixteen on upper limb, 18 to 23 on lower, total usually ranging between 32 and 37 (extremes 30 to 39); rakers long and slender, averaging longer than in any other species, in sharp contrast to fewer, blunter rakers of chum salmon, which has 19 to 30.

Pyloric caeca—Usually 65 to 95 (extremes 45 to 115); usually considerably fewer than in pink, chum, and chinook salmon, and averaging more than in coho salmon.

Branchiostegal rays—Usually 13 to 15 (extremes 11 to 16); of value chiefly in separating this species from chinook salmon, which average more.

Scales in lateral line—Between 125 and 140; of value chiefly in separating this species from pink salmon, which has a higher number.

Habits—Life span usually 4 or 5 yr, some only 3. Jacks may occur. Majority of individuals highly migratory. Adults usually spawn in streams tributary to lakes; a small minority spawn in streams without a lake, in lake outlets, or on lake beaches. After rising from redd, young move downstream rather rapidly to a lake, remaining usually 1, sometimes 2, and rarely 3 yr in fresh water before entering brackish or salt water.

Combination of: Melanophores on adipose fin usually most numerous on posterior half and generally forming a dark border (see Plate 4); anterior half of adipose with few melanophores or none. Anal fin with few melanophores or none, but when
5a melanophores are present, often quite large. Tip of dorsal fin and lobes of caudal fin darker in larger presmolt juveniles.

CHINOOK (KING) SALMON—*O. tshawytscha*. . . . . Plate 4.

General development—Yolk sac usually disappears or is reduced to a trace before juveniles reach 32 mm FL. Body deeper and species more slab-sided in all presmolt lengths than in chum and pink salmon; body depth immediately before dorsal fin usually less than 1.5 times head length (range 1.1 to 1.5).

Parr marks—Almost invariably rectangular and long vertically; marks usually situated equidistant on each side of lateral line; dark parr marks and other markings contrast sharply with lighter background of body in some living and most preserved specimens.

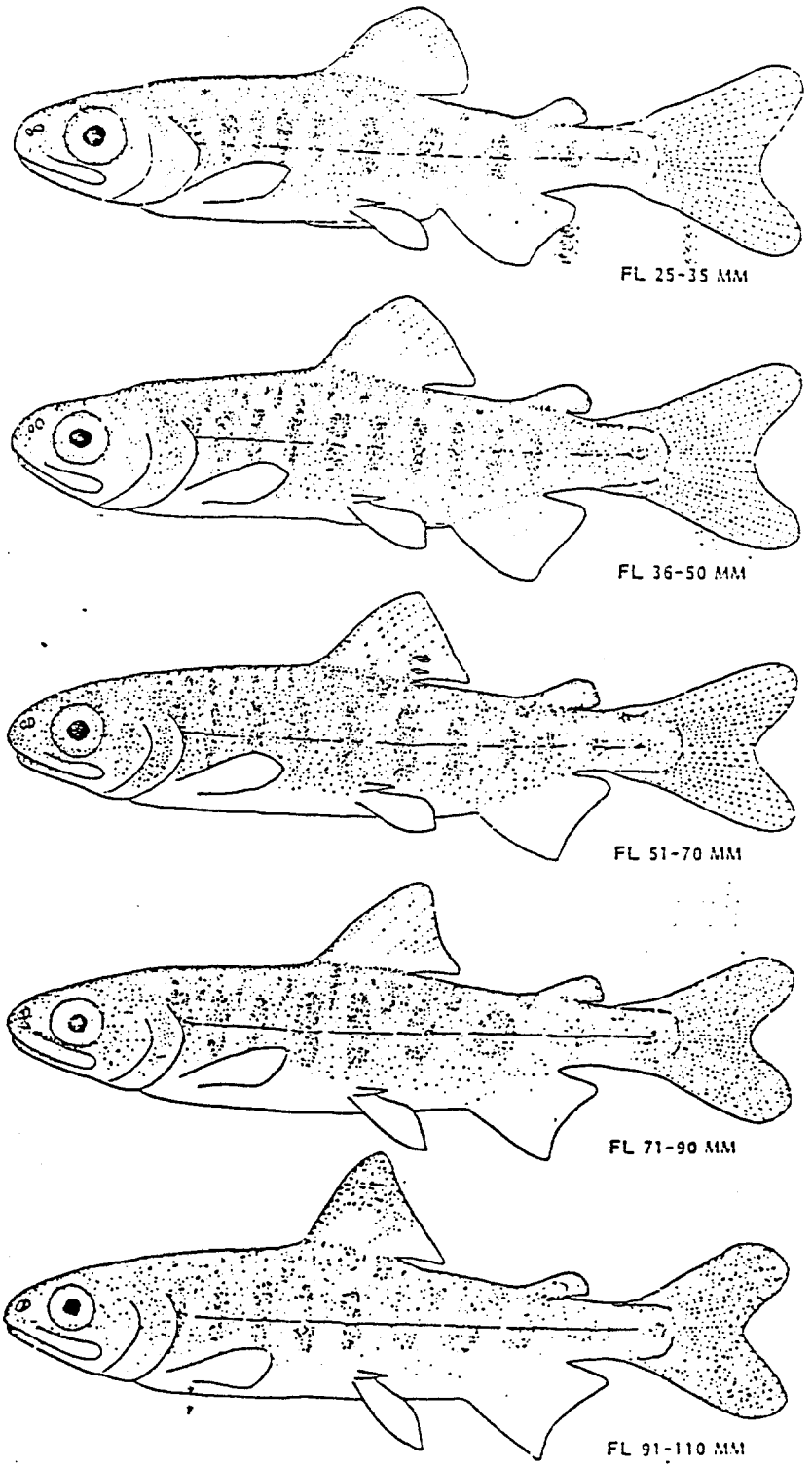

Plate 4.—Chinook salmon.

Coloration of body—*Preserved material*—Background color of body generally much lighter than body color of coho salmon, usually contrasting sharply with dark dorsal stripe or spotting, parr marks, and prominent dorsal spottings; blackish band astride dorsal ridge usually bold and unbroken in specimens less than 80 mm FL and especially on ridge before dorsal fin; in larger juveniles dorsal band often breaks up into series of spots, disappearing in larger presmolts as other spottings on dorsal half of body become more numerous and distinct; spottings between dorsal ridge and parr marks absent in fishes less than 35 mm FL, developing rapidly thereafter into many large and small spots and increasing in numbers as juveniles approach smolt stage. *Living specimens*—Parr marks and other markings may be obscured by bluish-silvery color of dorsal half of body and silvery sheen of ventral half.

Fins—Anal and dorsal fins averaging considerably larger in area than those of the chum and pink salmon and slightly larger than in the sockeye salmon; length of longest anal rays, when measured into head length, reaching from snout tip to beyond posterior edge of pupil and sometimes beyond posterior edge of eye; distal edge of anal slightly falcate in specimens more than 40 mm FL but averaging less falcate than does the free edge of the anal of the coho salmon. Anal rays 15 to 19, averaging higher in number than in any other species. *Dorsal fin* in young less than 60 mm FL usually has few or no distinct spottings, a blackish spot developing in the upper portion of the fin as the juveniles approach the smolt stage (see Plate 4). *Caudal fin* has comparatively few melanophores rather generally distributed in the smaller individuals, the lobes darkening as the fishes approach the presmolt stage.

Gill rakers (see Fig. 4)—Seven to twelve on upper limb, 10 to 16 on lower, total usually ranging between 20 and 25 (extremes 19 to 28); rakers short and similar in size and number to chum and coho salmon.

Pyloric caeca—Usually 140 to 185 (extremes 90 to 240); of value in separating this species from coho salmon, which normally has fewer than 85.

Branchiostegal rays—Usually 16 to 18 (extremes 13 to 19); average number greater than in any other species.

Scales in lateral line—Between 132 and 152; usually of most value in separating this species from pink salmon.

Habits—Life span 2 to 8 yr, usually 4 to 6. Jacks may occur. A portion of the juveniles enter salt water during first year of life; remainder stay in fresh waters more than 1 yr but rarely 2 yr. Juveniles of presmolt stage found in fresh waters when as long as 150 mm FL.

Combination of: Melanophores usually numerous and rather evenly distributed on adipose fin; occasionally in larger juveniles, posterior or free edge may be darker than remainder, thereby resembling somewhat melanophore distribution on adipose of chinook salmon. Anal fin in specimens larger than 30 mm FL more falcate and anterior tip more pronounced than in other species, including chinook salmon; in all except smallest specimens, anterior or leading edge of anal fin is whitish, with a dark bar parallel and posterior to it; remaining, posterior portion of fin usually abundantly speckled with melanophores except for distal and posterior edges (see Plate 5).

COHO (SILVER) SALMON—*O. kisutch*. . . . . Plate 5.

General development—Yolk sac usually disappears, except for a trace, before juveniles reach 32 mm FL. Body deeper and species more slab-sided in all pre-

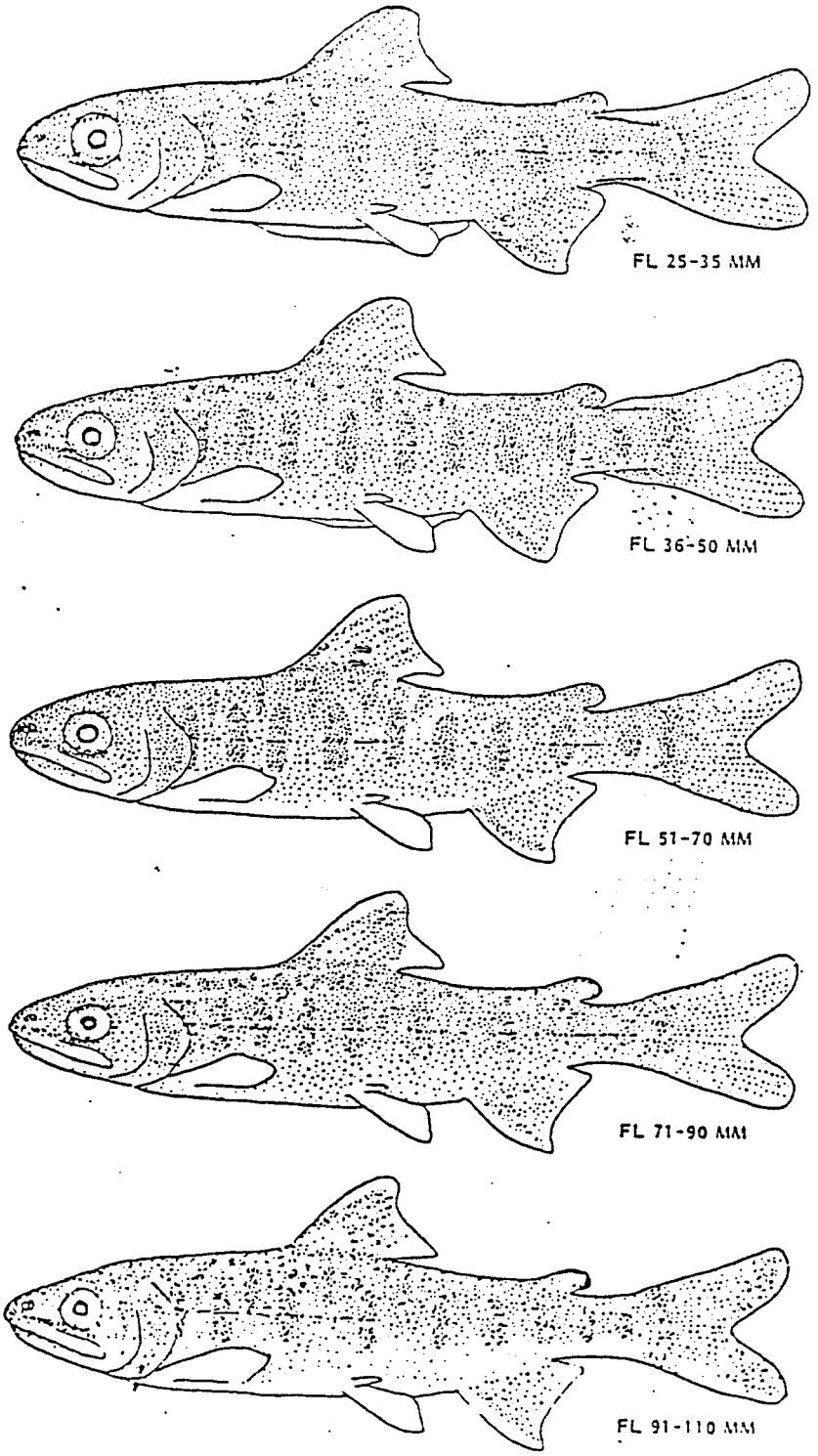

Plate 5.—Coho salmon.

smolt lengths than in chum and pink salmon; body depth immediately before dorsal fin usually less than 1.5 times head length (range 0.9 to 1.5).

Parr marks—Anterior parr marks always large and long vertically, their upper and lower ends more rounded than rectangular-shaped parr marks of chinook salmon; marks usually situated equidistant on each side of lateral line; usually less contrast between color of parr marks and body than in chinook salmon.

Coloration of body—*Preserved material*—In all but smallest specimens, contrast between all body marks and background color of body is not as pronounced as in other species; dark bar along dorsal ridge usually distinct and unbroken in juveniles less than 50 mm FL, breaking up into spots or disappearing in larger specimens; back spottings on both sides of dorsal ridge usually prominent in all except smallest specimens; spots between parr marks often elongate and extending downward between them, sometimes to lateral line (see bottom figure, Plate 5); spots on dorsal half of body often increase in number and/or decrease in size as individuals approach smolt stage. *Living specimens*—Parr marks and other body markings may be obscured by dark coloration of body or by bluish sheen.

Fins—Anal and adipose fins described under "*Combination of*" (this section). Anal rays usually 13 or 14 (extremes 13 to 16). *Dorsal fin* has comparatively few melanophores scattered over it in smallest specimens; in those more than 32 mm FL the number of melanophores increases, especially on or adjacent to anterior or leading edge; this results in a dark bar along the anterior edge behind which melanophores are rather evenly distributed; as fishes approach presmolt stage, a white anterior (or leading) edge and a whitish tip develops, followed by a dark parallel bar (see bottom figure, Plate 5). *Caudal fin* has rather even distribution of melanophores along rays in all except smallest young, this increasing in color intensity and number as fish increases in size.

Gill rakers (see Fig. 4)—Eight to thirteen on upper limb, 9 to 14 on lower, total number usually ranging between 19 and 27 (extremes 18 to 27); rakers short and rather similar in size and number to chum and chinook salmon.

Pyloric caeca—Usually 50 to 85 (extremes 45 to 114); of value in separating this species from chinook, pink, and chum salmon, which normally have more than 100.

Branchiostegal rays—Usually 13 or 14 (extremes 12 to 15); average number less than in chinook salmon, which normally has 15 or more.

Scales in lateral line—Between 120 and 140 (average 128); usually averaging fewer than in any other species.

Habits—Life span 2 to 4 yr. Jacks may occur. Majority appear to spend 1 or 2 yr in fresh waters, a few 3 yr. Some juveniles in presmolt stage are found in fresh waters when 150 mm FL.

GLOSSARY

Adipose fin A fleshy, finlike, rayless structure situated on dorsal ridge between dorsal and caudal fins (Fig. 1, No. 6).

Anal fin The fin situated medially and immediately behind vent between posterior end of abdomen and anterior end of caudal peduncle (Fig. 1, No. 16).

Axillary process or scale An accessory enlarged scale attached to upper or anterior base of pelvic fin (Fig. 1, No. 14).

Gill opening Opening between opercle or gill cover and side of head.

Branchiostegals or branchiostegal rays Elongated bones arranged fanwise within branchiostegal membranes, situated on ventral edge of gill covers (Fig. 6).

Caudal fin Terminal or tail fin of fishes (Fig. 1, No. 12).

Caudal peduncle That region of body between base of posterior ray of anal fin and base of caudal fin (Fig. 1, No. 11).

Chromatophores Color cells which under control of sympathetic nervous system can be altered in shape, producing color changes.

Cycloid scales Smooth-edged scales of soft-rayed fishes having an evenly curved posterior border devoid of minute spines.

Dorsal fin In salmons, a single fin composed of rays situated dorsally on body approximately halfway between head and tail (Fig. 1, No. 4).

Dorsal ridge Apex or dorsal junction of left and right sides of body; dorsal and adipose fins are situated on this ridge (Fig. 1, No. 3-6).

Dorsal stripe A band on dorsal ridge which is lighter or darker than adjacent areas.

Falcate Curved like a sickle; a fin is falcate when its distal edge is concave, having middle rays shorter than anterior and usually posterior rays.

Filaments See *gill filaments.*

Fork length Distance in a straight line from anteriormost part of tip of upper jaw or snout of juvenile salmons to apex of angle produced by two lobes of caudal fin (Fig. 1, No. 1).

Gill arch Branchial skeleton which contains gill rakers and gill filaments, or lamellae (Fig. 2).

Gill cover, opercle, or operculum Large, very flat, thin bones on each side of head which cover gills (see Fig. 3, which has the major portion of the gill cover removed).

Gill filaments (lamellae) Pleated folds of skin, richly supplied with blood vessels, attached to posterior edge of gill arch (Fig. 2, No. 5).

Gill rakers Projections on anterior edge of first gill arch (Fig. 2, No. 1).

Head length Distance in a straight line from anteriormost part of upper jaw or snout to posterior margin of opercle (Fig. 1, No. 2).

Hypural Complex of expanded and fused bone of last few vertebrae which support caudal fins in certain fishes.

Jack Precocious male salmon which spawn after spending a year or two less in the ocean than the majority of individuals; they are notably smaller than average size of spawning males of their species.

Juvenile As used here, a salmon between 25 and 110 mm FL which has not entered smolt stage.

Lamellae See *gill filaments.*

Lateral line A line formed by a series of sensory tubes and pores extending along sides from head to tail (Fig. 1, No. 10).

Lateral line scale count A count of pored scales from first scale on body behind head posteriorly to above hypural.

Melanophores Chromatophores with dark or black pigment.

Parr marks Squarish or oblong blotches or pigmented areas along sides of presmolt salmonids (Fig. 1, No. 9).

Pectoral fins Anterior or uppermost of paired fins of fishes, one on each side of breast immediately behind head (Fig. 1, No. 13).

Pelvic fins A ventral pair of fins, abdominal in salmonids (Fig. 1, No. 15).

Postdorsal ridge That portion of dorsal ridge behind dorsal fin (Fig. 1, No. 5).

Predorsal ridge That portion of dorsal ridge before dorsal fin (Fig. 1, No. 3).

Presmolt A juvenile salmon with parr marks; in pink salmon, which lack parr marks, demarcation between a presmolt and smolt is slight, differing chiefly in latter's more adult shape.

Pupil of eye Opening in iris of eye by which light reaches retina. It is circular in fishes (Fig. 1, No. 7).

Pyloric caeca Fingerlike diverticula, usually glandular, which open into alimentary canal

of most fishes at junction of stomach and intestine in region of pylorus (Fig. 7, No. 3).

Rakers See *gill rakers*.

Redd Excavation or nest made by a spawning salmon.

Rudimentary Very small and poorly formed, pertaining here chiefly to smallest gill rakers and anal rays (Fig. 5, "0").

Slab-sided When depth of body, measured before dorsal fin, is considerably greater than width of body.

Smolt As used here, a young salmon which has lost its parr marks. Pink and chum salmon fry usually go to the ocean within a few days of emerging from the streambed and usually do not undergo a visible change in morphology or color in fresh water.

Subadult An individual similar to an adult and approaching adulthood in age and size but still incapable of breeding.

Tercte Nearly cylindrical in cross section and tapering toward the front and rear.

ACKNOWLEDGMENTS

Publications such as this are possible only because of aid given by many individuals. I wish to acknowledge the aid and encouragement given me by Robert J. Ellis, George Y. Harry, Jr., Wilbur L. Hartman, William R. Heard, David T. Hoopes, Theodore R. Merrell, Jr., Jay C. Quast, and William A. Smoker, and to the many field men, students, and others who have tested the key.

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Key to Field Identification of Anadromous Juvenile Salmonids in the Pacific Northwest

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ABSTRACT

A key is presented with descriptive illustrations to help in field identification of live, juvenile salmonids in fresh waters of the Pacific Northwest. Other juvenile fish that may be mistakenly identified as salmonids are included.

INTRODUCTION

Species identification of live, anadromous juvenile salmonids is frequently a problem to the field biologist. The purpose of this key is to list and illustrate the external characteristics which will expedite field identification of juvenile salmonids in the Pacific Northwest.

Five species of Pacific salmon (pink, chum, sockeye, chinook, and coho); four species of trout (cutthroat, brown, Dolly Varden, and rainbow or steelhead); and other juvenile and adult fish [1] that may be mistaken for salmon or trout in fresh water are described in this key.

USE OF KEY

The characteristics for identification are listed in a series of alternative statements, some of which are illustrated. To use the key, examine the first statement; if applicable, proceed to the next and continue to successive statements until the species is identified. If a statement is not applicable, pass to the alternative characteristics indicated by numbers in parentheses (numbers on the drawings correspond to numbers of statements in the key). Continue in this manner until the specimen is identified. Some external characteristics are positive separating features (marked with asterisk), whereas others are not. Therefore, two or more statements should be considered before final rejection. If a precise identification cannot be made using the external characteristics —and the fish can be sacrificed, a positive identification can usually be made from internal features (marked with double asterisks). A bibliography of keys that utilize more descriptive internal characteristics is included in this paper.

[1] Especially adult smelt, family Osmeridae.

KEY

1. (47) Adipose fin and scales present. (Fig. 1)
2. (48) Fleshy appendage at base of pelvic fins present.
3. (49) Mouth large, reaching at least to center of eye.

Family Salmonidae

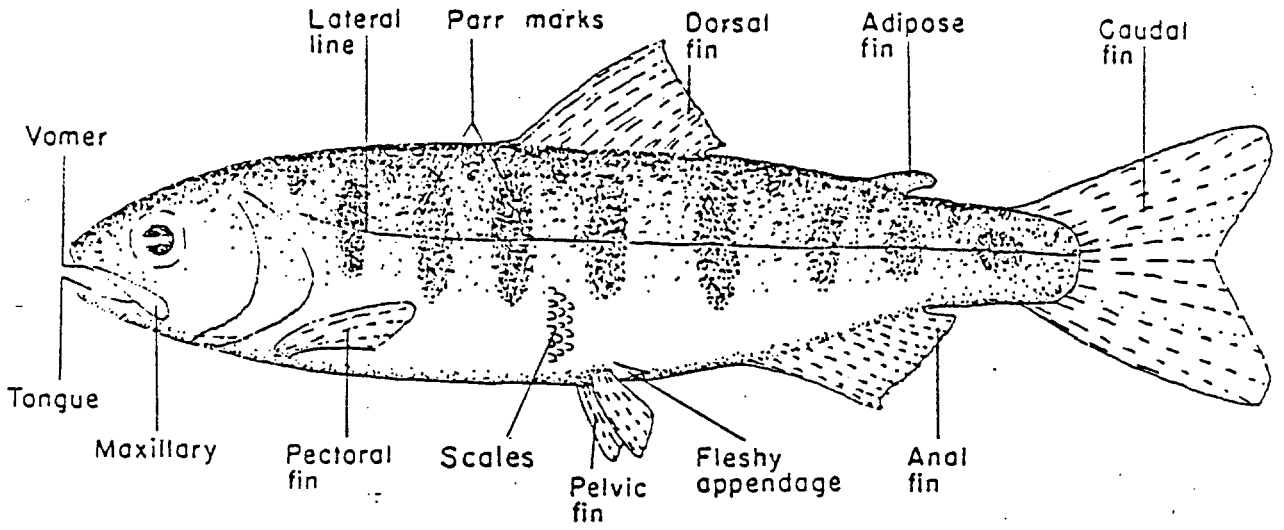


Figure 1.—A hypothetical salmonid showing external characteristics.

4. (17) Anal fin higher than long, with 8 to 12 developed rays (Fig. 2A)
5. (52) *Teeth on head and shaft of vomer. (Fig. 3A)

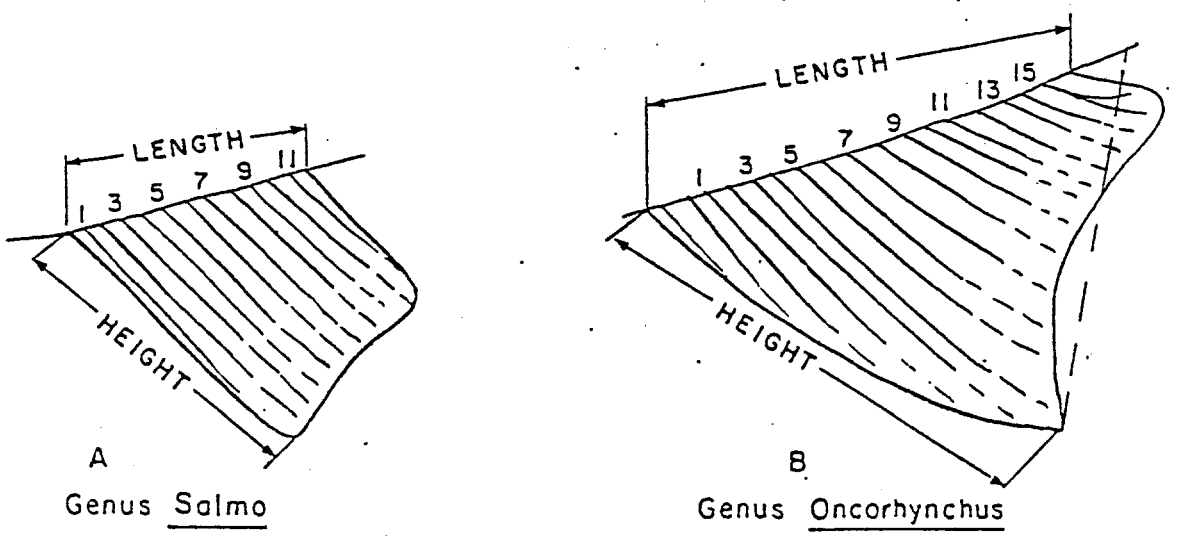


Figure 2.—Anal fins: (A) Trout, genus *Salmo;* (B) Pacific salmon, genus *Oncorhynchus.* The two drawings show differences in structure and fin ray count. (Note that the length of the anal fin is its overall basal length, and its height is that distance from the origin of the fin to the tip of the anterior lobe. In counting fin rays, include only those which originate from the base and terminate at the outer margin of the fin or are half as long as [or greater than] the longest ray.)

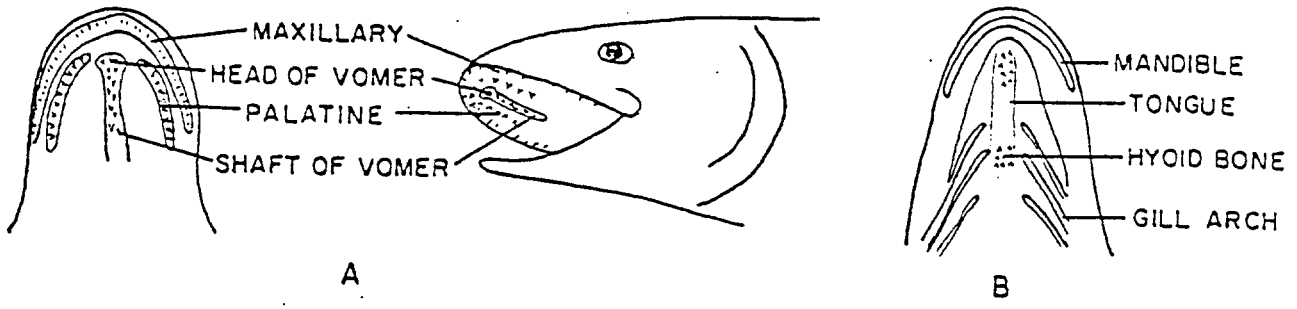
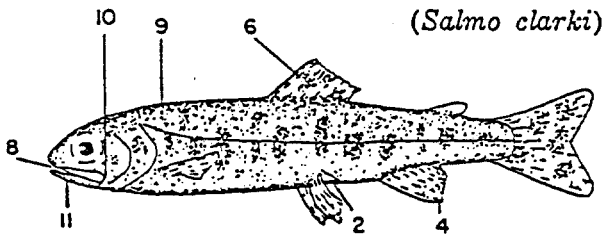


Figure 3.—Location of dentition in (A) the roof and (B) the floor of the mouth of salmonid fishes. (Presence or absence of teeth on the vomer or tongue may be determined by use of the little finger or a blunt instrument. The small hyoid teeth at the base of the tongue are located between the gill arches of the lower jaw and are difficult to find.)

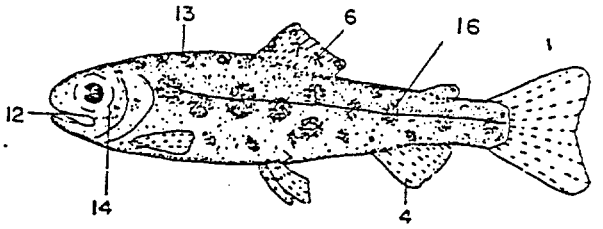
6. (18) Dorsal fin with large dark spots.
Trout
Genus *Salmo*

7. (53) Adipose fin not orange; no row of pale round spots along lateral line.
8. (12) *Small hyoid teeth at base of tongue. (Fig. 3B)
9. (13) Not more than five parr marks on mid-dorsal ahead of dorsal fin.
10. (14) Maxillary reaching past posterior margin of eye.
11. (15) Red or yellowish hyoid mark under lower jaw. Tail usually black spotted.
Cutthroat trout
(*Salmo clarki*)



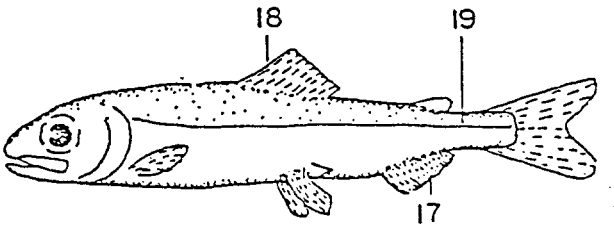
12. (8) *No teeth at base of tongue.
13. (9) Five to 10 parr marks along mid-dorsal ridge ahead of dorsal fin.
14. (10) Maxillary short, not reaching past posterior margin of eye.
15. (11) No hyoid mark under lower jaw. Few or no spots on tail.

16. (20) Parr marks almost round.
Rainbow or steelhead trout
(*Salmo gairdneri*)



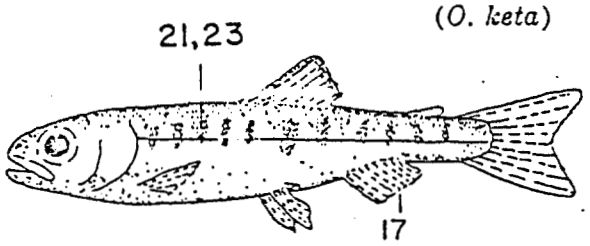
17. (4) Anal fin longer than high, with 13 or more developed rays. (Fig. 2B)
18. (6) Dorsal fin without large dark spots, may be black tipped.
Pacific salmon
Genus *Oncorhynchus*

19. (20) No parr marks. Fry leave fresh water while small—approximately 1.75 inches (45 mm) long.
Pink salmon
(*O. gorbuscha*)



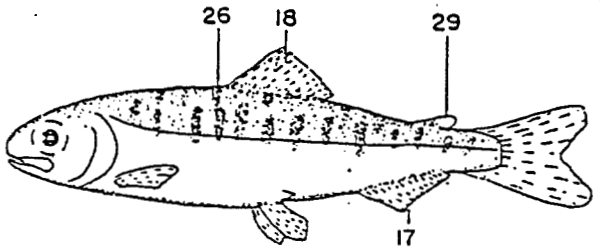
20. (16) Parr marks present as vertical bars or oval spots.
21. (30) Parr marks short, extending little, if any, below lateral line.
22. (25) Gill rakers on first arch, 19 to 26. ** Pyloric caeca, 140 to 186.
23. (26) Parr marks faint. Sides below lateral line iridescent green.
24. (27) Small when migrating from fresh water, approximately 1.5 inches (40 mm) long.

Chum salmon
(*O. keta*)



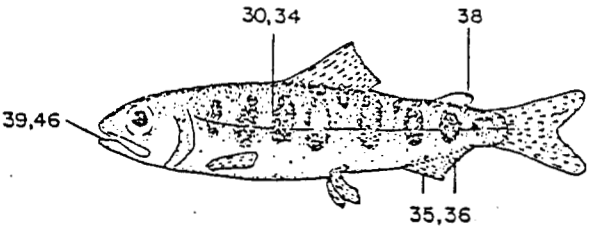
25. (22) Gill rakers on first arch, 30 to 40. **Pyloric caeca 60 to 115.
26. (23) Parr marks usually sharply defined. Sides below lateral line silvery, not iridescent green.
27. (24) Relatively large when migrating from fresh water, approximately 3 to 5 inches (80 to 126 mm) long.
28. (31) Gill rakers long and slender, more than 29 on first arch.
29. (32) Adipose fin clear, not pigmented.

Sockeye salmon
(*O. nerka*)



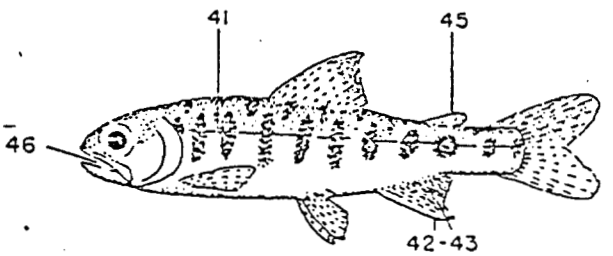
30. (21) Parr marks large, vertical bars centered by lateral line.
31. (28) **Gill rakers short and thick, fewer than 29 on first arch.
32. (29) Adipose fin at least partially pigmented.
33. (40) **Plyloric caeca more than 90.
34. (41) Parr marks broader than interspaces.
35. (42) Anterior rays of anal fin not distinctly longer than rest, not white edged.
36. (43) Anal fin not pigmented.
37. (44) Black spots, when present, on both lobes of caudal fin.
38. (45) Adipose fin not completely mottled, clear area at anterior base of fin.
39. (46) Black gums along base of lower teeth.

Chinook salmon
(*O. tshawytscha*)



40. (33) **Plyloric caeca less than 80.
41. (34) Parr marks narrower than interspaces.
42. (35) Anterior rays of anal fin elongated; when depressed they extend to base of last ray. (Fig. 2B)
43. (36) Anal fin pigmented between rays, resulting in black banding.
44. (37) Black spots, when present, on upper lobe of caudal.
45. (38) Adipose fin completely pigmented.
46. (36) Mouth gray to white.

Coho salmon
(*O. kisutch*)



47. (1) Adipose fin not present; scales present or lacking.

Not Salmonidae

48. (2) No fleshy appendage at base of pelvic fins.

Smelts
Family Osmeridae

49. (3) Mouth small, not reaching center of eye; teeth weak or absent.

50. (51) Depressed dorsal fin, shorter than head.

Whitefishes
Genus *Coregonus*

51. (50) Depressed dorsal fin, longer than head.

Arctic grayling
(*Thymallus arcticus*)

52. (5) **Teeth on head of vomer only.

Chars
Genus *Salvelinus*
Dolly Varden (*S. malma*)

53. (7) Adipose fin orange; row of distinct pale round spots along lateral line.

Brown trout
(*Salmo trutta*)

ACKNOWLEDGMENTS

We especially thank Dr. Arthur D. Welander, Professor of Fisheries, and Dr. Bruce S. Miller, Research Biologist, College of Fisheries, University of Washington, Seattle, for their valuable suggestions. We also thank Galen H. Maxfield, Fishery Biologist, and Dr. Alan J. Beardsley, Fishery Biologist, both from the NMFS Northwest Fisheries Center, Seattle.

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Appendix B

Daily Smolt Catch Reporting Form

DAILY SMOLT CATCH REPORTING FORM

TRAP NUMBER _____ PROJECT LOCATION _____ DATE _____

TIME (MILITARY)	SOCKEYE SMOLT (numbers)			OTHER (numbers)			COMMENTS 2/
	CATCH 1/	EXAMINED FOR MARKS	MARKED RECOVERIES	COHO	DOLLY V.	STICKLEB.	
TOTAL							

1/ Catch number does not include marked recoveries.
2/ To be included in comments: estimate young-of-year fry numbers by species and number of sockeye smolt mortalities.

Appendix C

Sockeye Salmon Smolt Summary Form

SOCKEYE SALMON SMOLT SUMMARY FORM

TRAP NUMBER _____ PROJECT LOCATION : _____

DATE 1/	NUMBER OF SMOLT					
	CAUGHT 2/ DAILY	CUMULATIVE	MORTALITIES	DYED	EXAMINED	MARKED RECOVERIES

1/ Each date covers a 24-hour period extending from noon to noon and identifies the starting date.
2/ Numbers of fish caught does not include marked recoveries.

Appendix D

Standard Procedures For Recording Data on AWL Form

The sample size is 70 sockeye salmon smolt per day, five days a week. If daily sampling objectives are being met, sampling will not occur on Wednesday and Sunday. It is essential that the sample be taken randomly. In the event that more than the required sample size is in the smolt trap at the time of sampling, the trap is to be stirred to assure randomness. When the smolt are randomly distributed, a small dip net will be used to remove a subsample. This procedure will be repeated until the sample size goal is met.

AWL Forms

Smolt length and weight will be recorded on AWL forms (Appendix D.1). Using a No. 2 pencil, complete each section of the left side of the AWL and darken the corresponding blocks:

Description: Include species (sockeye smolt), location, year, and samplers.

Card: The AWL forms and corresponding slides are numbered sequentially by date throughout the season starting with # 001. A new, consecutively numbered, card is used each day even if the previous card is not completed. There may be a minimum of one fish and a maximum of 40 fish (8 slides) per AWL.

Species: Refer to the reverse side of the AWL form to obtain species; sockeye = 2.

Day, Month, Year: Use the appropriate digits for the date the fish are sampled.

District, Subdistrict, Stream, Location: Consult project leader for the appropriate codes.

Period: List the period in which the fish were sampled using Appendix D.2.

Project: Refer to the reverse side of the AWL form to obtain code; code 4 will be used as default since a specific smolt code does not exist.

Gear: Refer to the reverse side of the AWL form to obtain code; 00 = trap.

Mesh: Leave blank.

Type of Length Measurement: Refer to the reverse side of the AWL form to obtain code; 1 = Tip-of-snout to fork-of-tail.

Number of Scales: Mark 1 (refers to 1 smear/fish)

# of Cards: Mark 1 (each AWL form is individually numbered)
Keep the litho codes in numerical order throughout the season and be sure to transfer the litho code from the front left side to the backside of the AWL form. These forms will be optically scanned and stray marks may be misinterpreted. It is the crew leaders responsibility to make sure that all forms are carefully edited before returning them to your supervisor.

Sampling procedure

Smolt will be kept alive and sampled the day of capture. MS222 will be used to anesthetize the fish. The use of this chemical will be demonstrated in the field. A flattened probe will be used to remove 5-10 scales from the preferred area, consult Appendix D.3. The scales will be mounted on a glass slide as illustrated in Appendix D.4. The left portion of each slide will be labeled: location, date, AWL # (card #), and fish numbers (1-5, 6-10, 11-15, etc.). When the slides are completed, return them to the box in order, and label the box as shown in Appendix D.4. Smolt lengths will be measured in millimeters from the tip of the snout to the fork of the tail, Appendix D.5. Record each length by darkening the appropriate column blocks on the AWL form.

Excess water will be removed from the smolt before weighing by using a paper towel blotter. Individual smolt weights will be recorded to the nearest 0.1 gram on the backside (right side) of the AWL form (Appendix D.1).

Take care to ensure length and weight data corresponds to the appropriate scale smear as this information is used to calculate condition factor at age. When sampling for age, length, and weight, rite-in-rain books may be used to record data. After sampling is done, transfer the data carefully to the AWL forms. **It is the responsibility of the crew leader to make sure the data has been transferred correctly and the AWL form is filled out completely.**

Appendix D.1.

RED LAKE 1992

DESCRIPTION SOCKEYE SMOLT

Pope, Bouwens, Glamen

ADF&G ADULT SALMON AGE LENGTH FORM VERSION 2.1

CARD:	033
SPECIES:	2
DAY:	04
MONTH:	06
YEAR:	92
DISTRICT:	256
SUBDISTRICT:	20
STREAM:	201
LOCATION:	RED LAKE
PERIOD:	23
PROJECT:	4
GEAR:	0
MESH:	
TYPE OF LENGTH MEASUREMENT	1
NUMBER SCALES/ FISH	1
# OF CARDS	1

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS AREA

234825

Litho Code

NCS DOCUSCAN MR20-17877-131211 A4200

Weights 10's 1's 1/10's

SPECIES

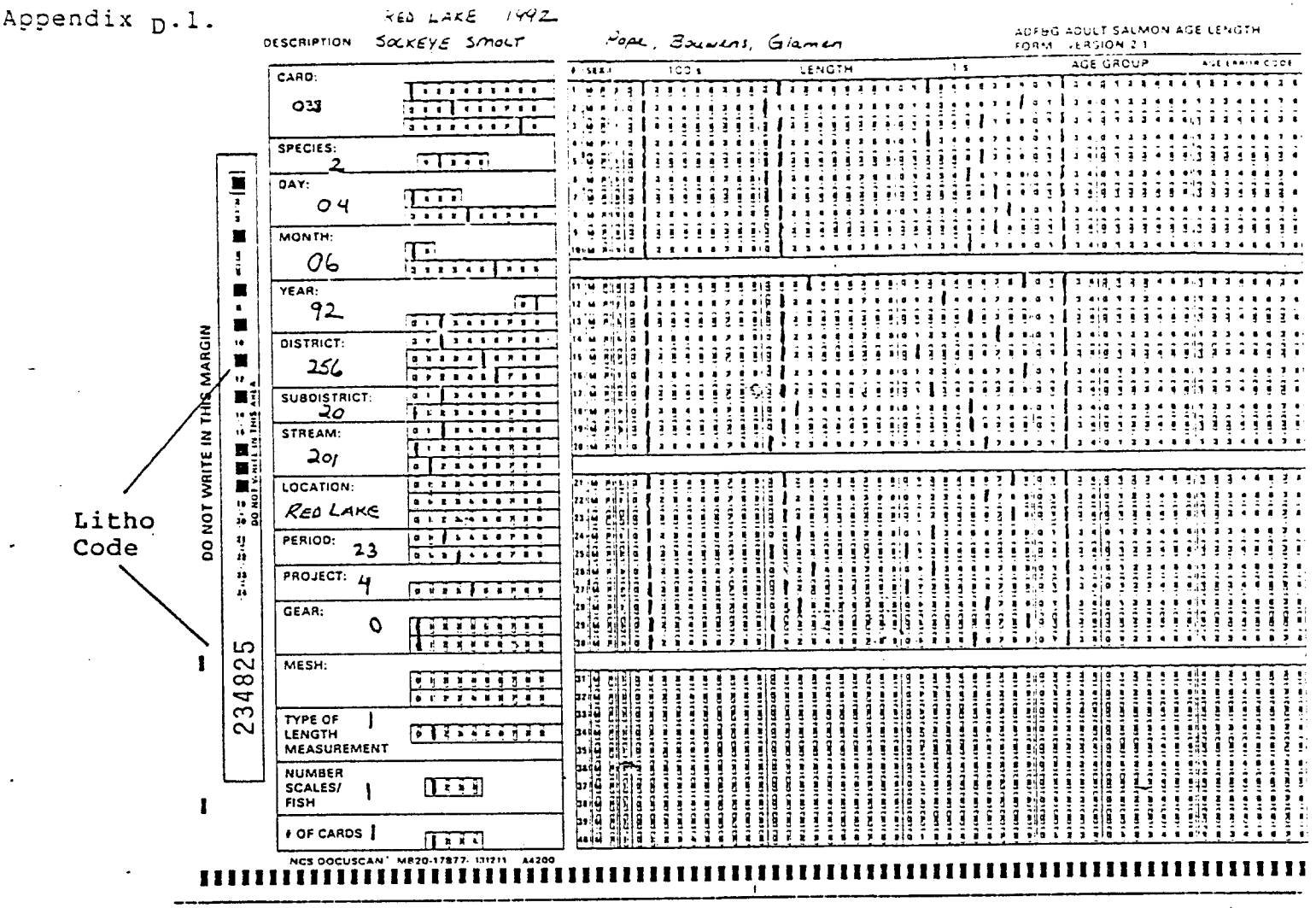
PROJECT

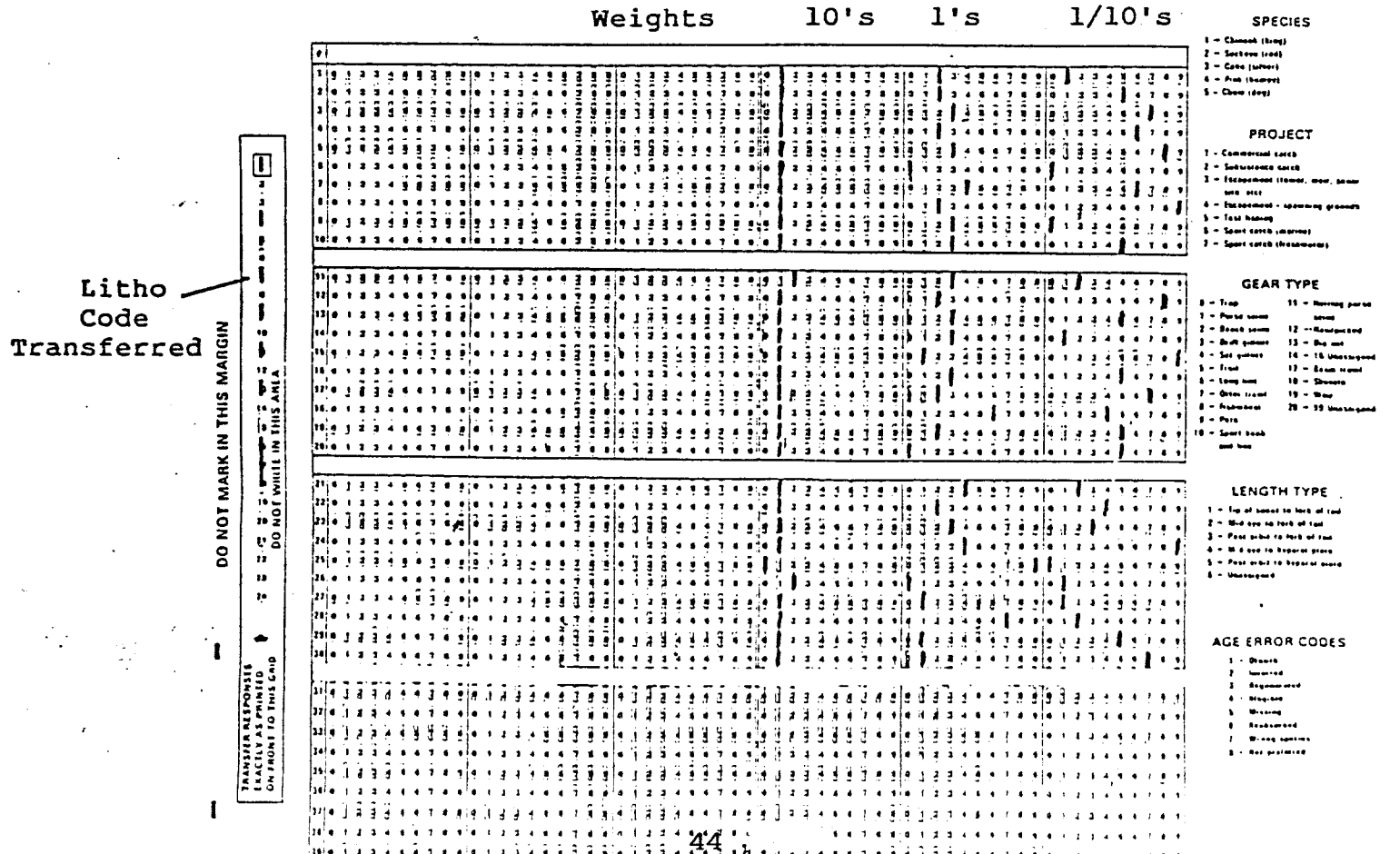
GEAR TYPE

LENGTH TYPE

AGE ERROR CODES

Litho Code Transferred





DO NOT MARK IN THIS MARGIN

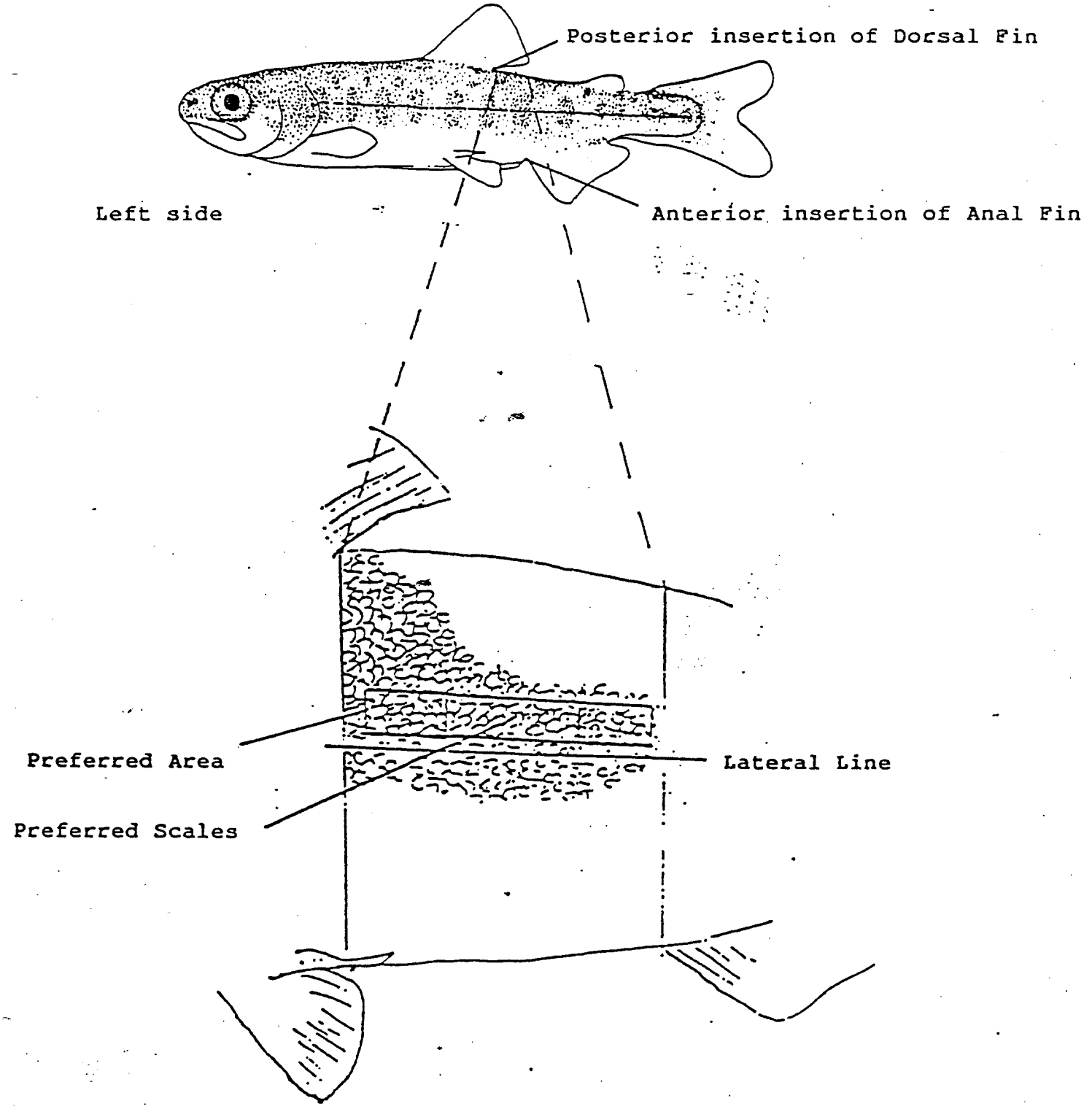
DO NOT WRITE IN THIS AREA

TRANSFER RESPONSES EXACTLY AS PRINTED ON FRONT TO THIS GRID

Appendix D .2. Period codes and corresponding dates.

Period	Dates	Period	Dates
1	01-Jan to 03-Jan	28	05-July to 11-July
2	04-Jan to 10-Jan	29	12-July to 18-July
3	11-Jan to 17-Jan	30	19-July to 25-July
4	18-Jan to 24-Jan	31	26-July to 01-Aug
5	25-Jan to 31-Jan	32	02-Aug to 08-Aug
6	01-Feb to 07-Feb	33	09-Aug to 15-Aug
7	08-Feb to 14-Feb	34	16-Aug to 22-Aug
8	15-Feb to 21-Feb	35	23-Aug to 29-Aug
9	22-Feb to 28-Feb	36	30-Aug to 05-Sep
10	01-Mar to 07-Mar	37	06-Sep to 12-Sep
11	08-Mar to 14-Mar	38	13-Sep to 19-Sep
12	15-Mar to 21-Mar	39	20-Sep to 26-Sep
13	22-Mar to 28-Mar	40	27-Sep to 03-Oct
14	29-Mar to 04-Apr	41	04-Oct to 10-Oct
15	05-Apr to 11-Apr	42	11-Oct to 17-Oct
16	12-Apr to 18-Apr	43	18-Oct to 24-Oct
17	19-Apr to 25-Apr	44	25-Oct to 31-Oct
18	26-Apr to 02-May	45	01-Nov to 07-Nov
19	03-May to 09-May	46	08-Nov to 14-Nov
20	10-May to 16-May	47	15-Nov to 21-Nov
21	17-May to 23-May	48	22-Nov to 28-Nov
22	24-May to 30-May	49	29-Nov to 05-Dec
23	31-May to 06-June	50	06-Dec to 12-Dec
24	07-June to 13-June	51	13-Dec to 19-Dec
25	14-June to 20-June	52	20-Dec to 26-Dec
26	21-June to 27-June	53	27-Dec to 31-Dec
27	28-June to 04-July		

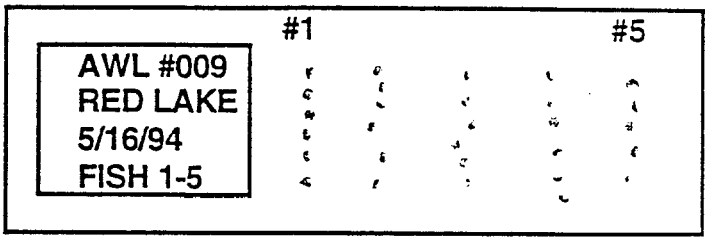
Appendix D.3. Scale sampling procedure showing the preferred area on a smolt salmon.

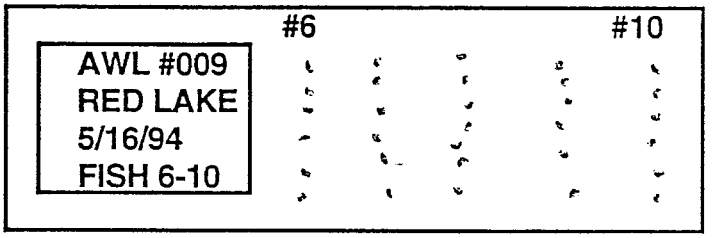


Appendix D.4 Salmon smolt glass slide example.

The following information should be legibly written on the slide label:

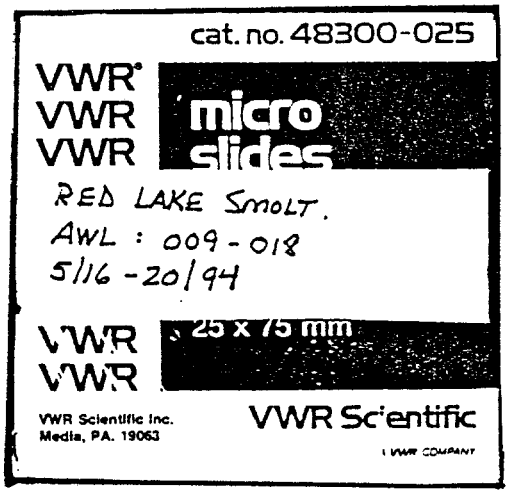
1. AWL #
2. Location
3. date (mo/day/yr)
4. Fish # (1-5, 6-10,...35-40)





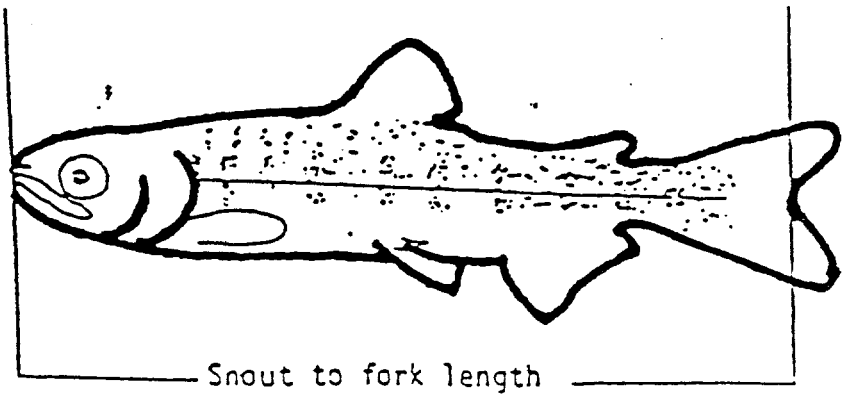
When the slides are completed, return them to the box in order by AWL #, date, and fish #. Label the slide box on top with the following information:

LOCATION (RED LAKE)
AWL NUMBERS (AWL # 009 - 018)
BEGINNING AND ENDING DATES (5/16 - 20/94)



Appendix B.5

MEASURING SMOLT LENGTH



Appendix E

Daily Physical Observations Form

DAILY PHYSICAL OBSERVATIONS

199__

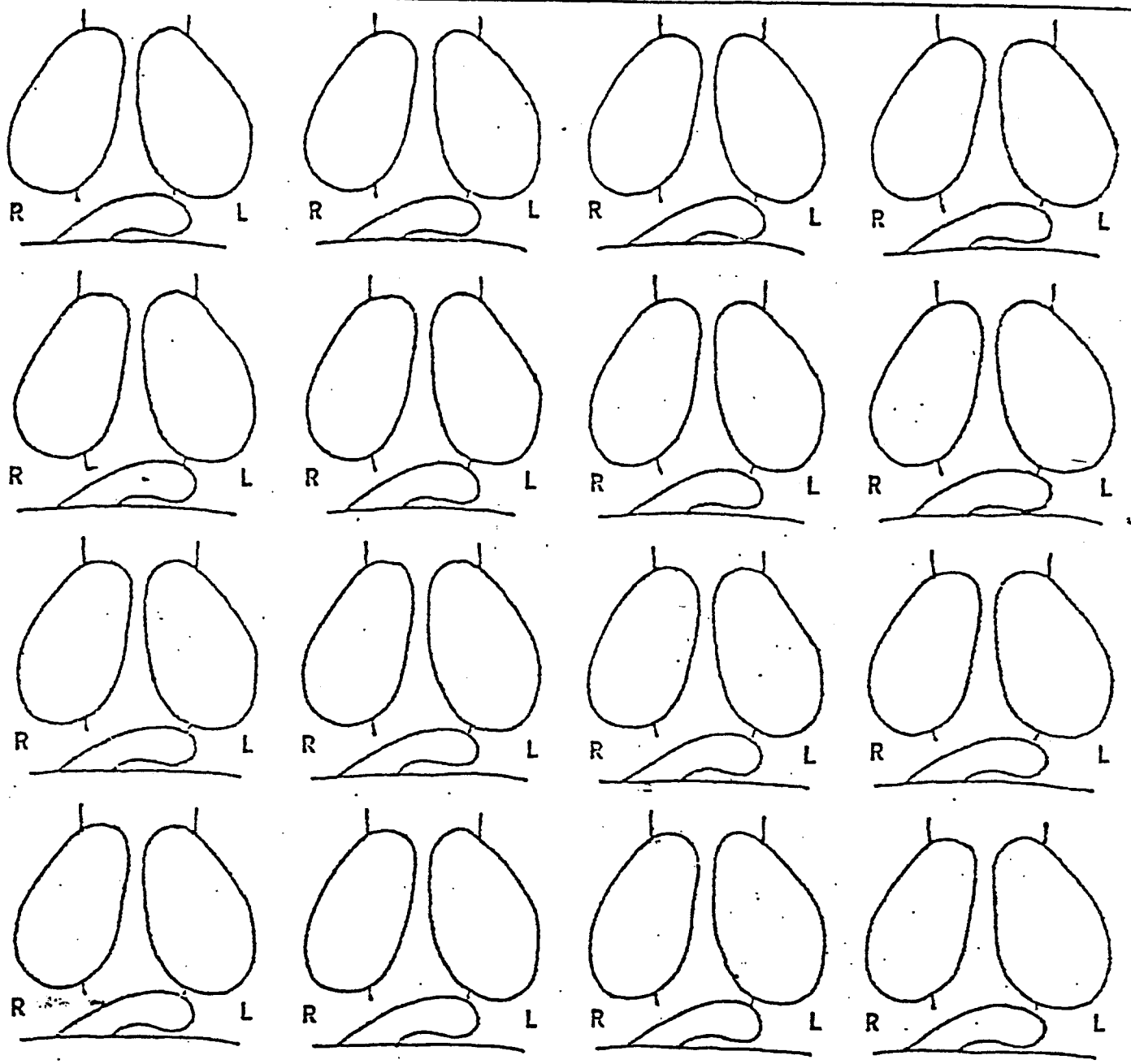
Project:
Location:

Date	Time	Temperature		Guage	Weather
		Air	Water		

Appendix F

Fry Marking Form

FRY MARKING FORM



DATE _____ PLACE _____

MARKER _____ SCORE _____

SET NO. _____ AREA _____

NO. EXAMINED _____

NO. MARKED _____

REMARKS

Appendix G

Temperature, Salinity, and Zooplankton Sampling Form

TEMPERATURE, SALINITY AND ZOOPLANKTON SAMPLING FORM

LOCATION: WEATHER:

SAMPLING STATION:

DATE: SAMPLING PERSONNEL:

DEPTH (M)	TEMPERATURE (C)	SALINITY (PPT)	COMMENTS
surface			
0.5			
1.0			
2.0			
3.0			
4.0			
5.0			
6.0			
7.0			
8.0			
9.0			
10.0			
11.0			
12.0			
13.0			
14.0			
15.0			
16.0			
17.0			
18.0			
19.0			
20.0			

Zooplankton

No. of Tows:

Tow depth:

Tow angle:

Net size:

Preservative:

Comments:

Appendix H

Little Kitoi Fishpass Salmon Count Form

LITTLE KITOI FISHPASS
SALMON COUNT

Year _____

Date	Sockeye		Coho		Pink		Other		Mortality	Remarks	Weather
	Daily	Cum	Daily	Cum	Daily	Cum	Daily	Cum			

Appendix I

Kodiak Management Area Salmon Escapement Sampling Operational Plan, 1995

KODIAK MANAGEMENT AREA SALMON ESCAPEMENT SAMPLING

OPERATIONAL PLAN, 1995

Alaska Department of Fish and Game
Commercial Fisheries Management and Development Division
211 Mission Road
Kodiak, Alaska 99615

MAY 1995

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B. Kodiak Area Commercial Salmon Fishery Harvest Strategy, 1995 20

INTRODUCTION

Annually, sockeye salmon escapements are sampled for age, length, and sex from major and minor systems by field personnel within the Kodiak Management Area (KMA). Management and research biologists rely on this data for forecasting, escapement goal evaluation, catch apportionment, and run timing estimation. As the demand on our salmon resource increases, so does the intrinsic value of this data.

Stock identification projects using scale pattern analysis as well as age marker analysis have been conducted within the Afognak, NW Kodiak , SW Kodiak, Alitak Bay, and Mainland Districts. The foundation for these projects are the scale samples that are collected. It is imperative that scales collected be of the highest quality possible. In recent years, an attempt was made to use average weights as a possible method of stock separation by area. Fish ticket weights were used as individual fish weights by system were not available. In order to evaluate length-weight relationships by system throughout the KMA area, weights will be taken along with ALS at seven locations during 1995.

GOAL

Provide improved management of the Kodiak Management Area salmon runs by optimizing escapement requirements thereby insuring maximum harvest opportunities.

OBJECTIVES

1. Construct accurate brood tables (spawner-recruitment relationships).
2. Develop accurate run forecasts.
3. Evaluate escapement goals and accurately define run timing.
4. Provide samples suitable for scale pattern analysis as required for addressing mixed stock fishery issues.
5. Evaluate length-weight relationships at Afognak, Spiridon, Karluk, Ayakulik, Upper Station, Frazer, and Saltery Rivers.

TASKS

1. Collect representative age, length, and sex data from all major and selected minor sockeye salmon systems within the KMA.

2. Collect a mixed assortment of weight data from selected sockeye salmon systems within the KMA.

SUPERVISION

Regional Finfish Research Supervisor, Charles Swanton will supervise escapement sampling at Frazer Fishpass and Akalura weir. All other KMA escapement crews will be directly supervised by Kodiak Management Area staff. Regional Salmon Research Biologist, Patricia Nelson will monitor weekly escapement sampling and review incoming data for quality, quantity, and timeliness. A log book will be maintained tracking weekly samples, and weir crew leader's will be notified periodically regarding data quality.

PROCEDURES

Weekly sockeye salmon escapement sampling for age, length, weight, and sex (ALWS), will be conducted at Karluk River, Upper Station, Ayakulik River, and Frazer Lake (Figure 1). Samples will be collected using a live box trap (Figure 2) according to the schedules in Table 1. If the required number of fish are not taken within a single day, obtain the balance of the sample on the following day.

Minor systems will be sampled with reduced intensity following the sampling schedule in Table 1. Litnik (Afognak) weir personnel will collect two 480 fish ALS samples from both early and late sockeye run components. Additionally, 200 individual fish weights (100 male and 100 female) will be collected from the early and late run components. Two 480 fish ALS samples from both early and late sockeye run components will be collected at Akalura weir. A single 480 fish sample will be collected at the Saltery weir during the peak escapement and 200 individual fish weights will be measured (100 male and 100 female). Sport Fisheries Division (S.F.D.) personnel will sample the Buskin River sockeye escapement with a goal of 140 fish every two

weeks, for six weeks (sample size specified by S.F.D. biometrician). S.F.D. will similarly sample the Buskin River sockeye subsistence harvest. Development section personnel will collect ALS data from Malina Lake, Little Kitoi, and Pauls Bay following the sampling schedule presented in Table 1. Additionally, samples for ALWS will be collected at the Telrod Cove Terminal Harvest Area with a targeted sample size of 240 ALS and 30 weight samples (15 males and 15 females) per week.

It is essential that all ALS data be representative of the true escapement, therefore avoid bias by NOT pre-selecting fish based upon size, sex, condition or any other factor. Sampling and recording procedures are presented in Appendix A. **Weight samples on the other hand should not be random**. It is important that we obtain the greatest variety of lengths available at each system. Therefore, try to sample the smallest and largest fish during the sampling period as well as a wide variety of lengths between the largest and smallest fish. Weights are to be measured using a Chatillon spring scale to 25 lbs. Weigh fish to the nearest 0.25 lb and record weight on the back of the AWL form (right side). Check calibration of scale before use and periodically during the season using a 3 lb can of coffee. Remember that we are evaluating weight at length so take care to ensure that each weight corresponds to the appropriate length. Specific procedures for collecting and recording weight data are described in Appendix A.

DATA REPORTING

Crew leaders will notify Dave Prokopowich, Kevin Brennan, or Dennis Gretsch via SSB radio upon completion of weekly sampling. Karluk weir will mail completed ALS data to Kodiak (return receipt from the Karluk village post office), and notify the office of the mailing date (via radio). All other field camp personnel will send completed samples back to town on return grocery flights. These packages should be clearly labeled to include: system, sample dates, and Attn.: Patti Nelson. The pilot should be notified to call Fish and Game at 486-1855 for package pick up.

Table 1. Sockeye salmon escapement sampling schedule, 1995.

Location	Sampling Frequency	Date Starting	Date Ending	ALS Sample Size	Weight Sample Size
Akalura weir (early)	once	May 15	Jul 15	480	N/A
Akalura weir (late)	once	Jul 16	Sep 15	480	N/A
Ayakulik weir	weekly	May 30	Sep 30	240	30
Buskin Lake weir[a]	biweekly	Jun 01	Aug 01	140	N/A
Buskin Subsistence Harvest[a]	biweekly	Jun 01	Aug 01	140	N/A
Frazer Fishpass	weekly	Jun 15	Aug 30	240	30
Karluk weir	weekly	May 30	Sep 30	240	30
Litnik (Afognak) weir (early)	once	Jun 07	Jun 15	480	200
Litnik (Afognak) weir (late)	once	Jul 14	Jul 20	480	200
Malina Lake weir[b]	intermittently	Jun 01	Aug 15	600	N/A
Little Kitoi[b]	intermittently	Jun 01	Aug 15	600	N/A
Pauls Bay[b]	biweekly	Jun 06	Jul 03	200	N/A
Saltery River weir	once	Jul 07	Jul 20	480	200
Upper Station	weekly	Jun 06	Sep 30	240	30
Telrod Cove[b]	weekly	Aug 01	Sept 15	240	30

[a] Sampled by Sport Fish Division (sample size determined by S.F. Biometrician).
[b] Sampled by Development Section personnel.

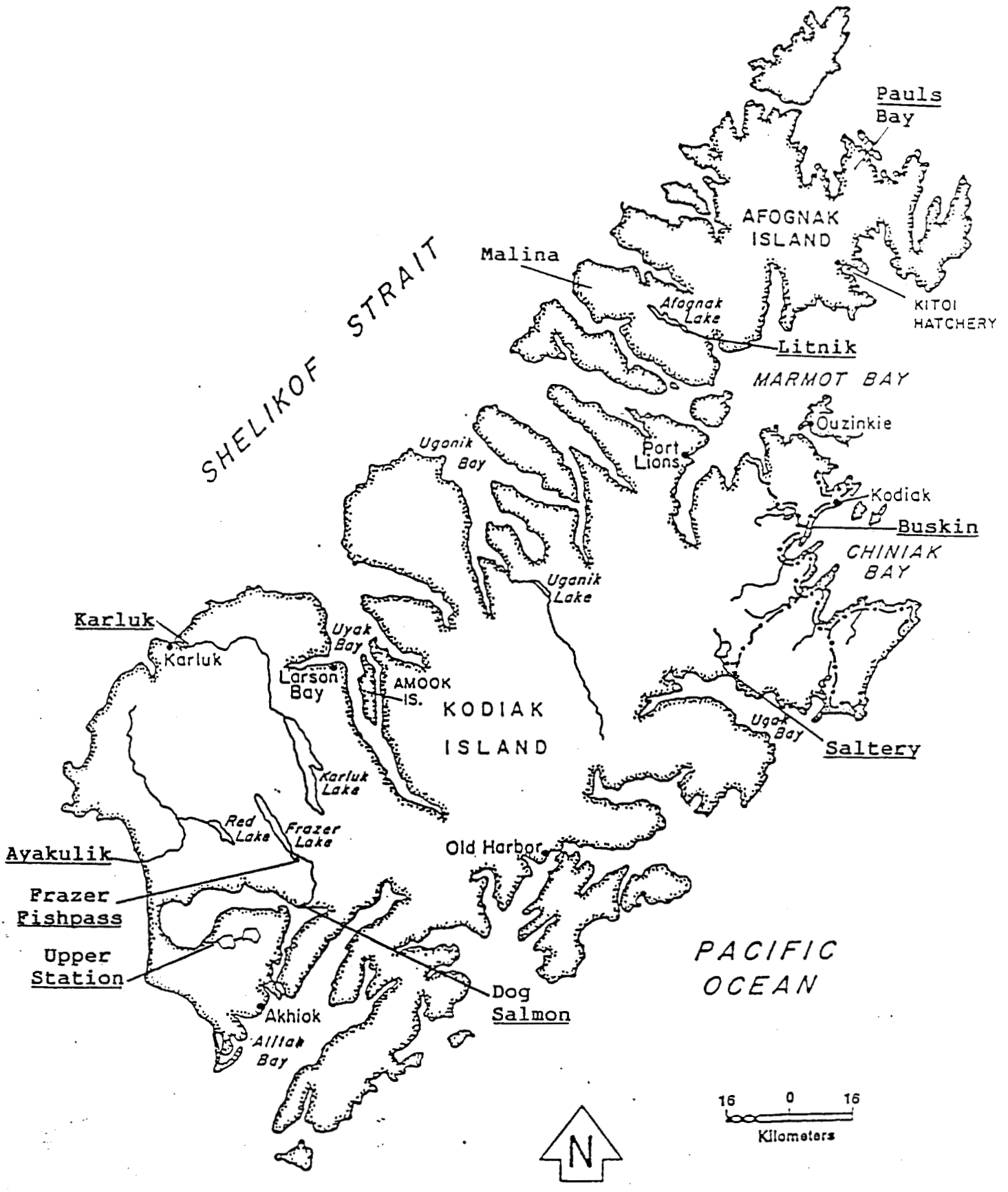


Figure 1. Location of salmon weirs in the Kodiak Management

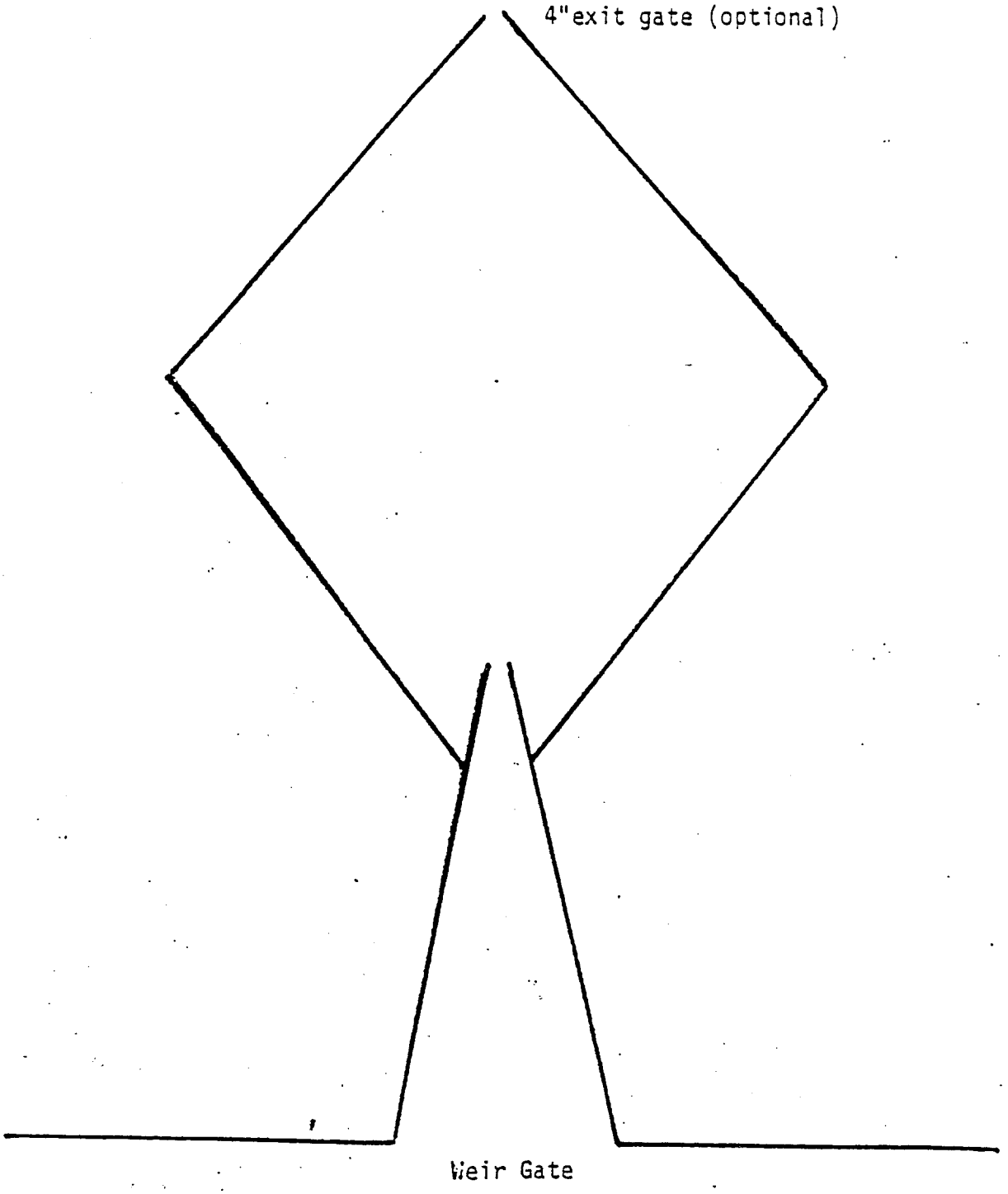


Figure 2. The "Scott" six panel salmon trap.

APPENDIX A

Procedure for Sampling Adult Salmon for age, length, weight, and sex

Annually, salmon escapements and catches are sampled for age (scales), length, and sex (ALS) by field crews throughout the state. This database is essential for sound management of the State's salmon resources.

To be useful, data must be recorded on the mark-sense (AWL) forms neatly and accurately. Scale samples must be collected and mounted properly to ensure accurate age determination. The following procedures are to be adhered to when sampling for age, length, weight, and sex.

COMPLETING THE AWL FORMS:

A completed AWL form and accompanying gum card for sampling sockeye and chum salmon are shown in Appendix A.1-2.

Complete each section on the left side of the AWL form using a No. 2 pencil and darken the corresponding blocks as shown in the figures. Make every effort to darken the entire block as partially filled blocks are often missed by the optical scanner which reads and records the data from the AWL forms. Label only one form at a time to avoid a "carbon paper effect" resulting in stray marks.

Description:
Record the following: species/area/catch or escapement/gear type (seine, weir, etc.)/samplers

Card:
The AWL forms and corresponding gummed card(s) are numbered sequentially by date throughout the season starting with 001. A separate numbering sequence will be used for each species, district, and geographic location. Consult your port supervisor for the current card number. Sockeye scale samples will have only 1 gum card per AWL form as shown in Appendix A.1.

Species:
Refer to the reverse side of the AWL form for the correct digit.

Day, Month, Year:
Use appropriate digits for the date the fish are sampled; for catch sampling, use the date the fish were caught.

District:
List only one district. Consult area statistical map or project leader for appropriate district.

Subdistrict (Section):
List a single subdistrict if it is known and if all the potential samples were caught in that section. If more than one section is involved, list each section but do not darken the corresponding blocks. Leave blank if the section is unknown.

Stream:
Leave blank for catch sampling; escapement sampling consult area statistical map for appropriate stream number.

Location:
List the appropriate code as shown on Appendix A.3.

Period:
List the period in which the fish were caught (Appendix A.4.).

Project and Gear:
Refer to the reverse side of the AWL form for the correct code.

Mesh:
Leave blank unless specifically instructed by supervisor to do otherwise.

Type of length measurement:
Use (2) mid-eye to fork-of-tail. Refer to Appendix A.5.

# of cards:
Mark 1 (each AWL form in individually numbered).

Keep the litho codes in numerical order throughout the season and keep the AWL forms flat, dry, and clean. Fish gurry and water curling will cause data to be misinterpreted by the optical scanning machine. It is the crew leaders responsibility to make sure that all forms are carefully edited before returning them to your supervisor.

GUMMED CARDS:

Fill out the gum cards as shown in Appendices A.1

Species:
Write out completely (sockeye) and fill in appropriate number (2).

Locality:
For catch and escapement sampling, write down the area in which fish were caught, followed by catch or escapement (e.g. Karluk River escapement; Uganik Bay catch).

Stat. code and Sampling date:
Transfer the appropriate digits from the AWL form.

Gear:
Write out completely.

Collector(s):
Record the last names of person(s) sampling.

Remarks:
Record any pertinent information such as number of scales per fish sampled, vessel/tender name, etc. Transfer this same information to the top margin of the AWL.

SAMPLING PROCEDURE:

A. GENERAL

1. Place the fish on its right side to sample the left side.

2. Determine sex of the fish and darken M or F in the sex columns. If any difficulty is encountered with this procedure, write "I had trouble sexing these fish" on the top margin of the AWL and ask your supervisor for help as soon as possible before sexing additional fish.

3. Measure fish length in millimeters from the mid-eye to fork-of-tail (Appendix A.5). Record length by blackening the appropriate column blocks on the AWL form. Column 3 on the AWL form is used for fish with a length greater than 999 millimeters (Chinook). Measure all species of salmon to the nearest mm. Check the calipers periodically to ensure measurement accuracy. **When escapement sampling, take care to ensure that each length corresponds to the appropriate scale mounted on the gummed card as length at age is evaluated for each sample.**

4. Remove the "preferred scale" from the fish by grasping its exposed posterior edge with forceps and pulling free. Remove all slime, grit, and skin from the scale. The "preferred scale" is located on the left side of the fish, two rows above the lateral line on the diagonal from the posterior insertion of the dorsal fin to the anterior insertion of the anal fin (Appendix A.6.). If the "preferred scale" is missing, select a scale within the preferred area on either the left or right side of the fish. If no scales are present in the "preferred area" on either side of the fish, sample a scale as close to the preferred area as possible and darken the 8 under "age error code" on the AWL form. Do not select a scale located on the lateral line.

5. It is important to take care that scales adhere to the card, rough side up. Therefore, without turning the forceps over, clean, moisten, and mount the scale on the gummed card with your thumb or forefinger. Exert just enough pressure to spread and smooth the scales directly over the number as shown in Appendix A.6. The ridges on the sculptured side can be felt with a fingernail or forceps. Mount scale with anterior end oriented toward top of gum card. All scales should be correctly oriented on the card in the same direction (Appendix A.7.).

6. Once the length and sex have been recorded, and the scale has been collected, slide the fish into the weighing sack provided, hang it from the scale and record the weight in pounds on

the back side of the AWL form (to the nearest 0.25 lbs). If weights are recorded on the back of an AWL form, transfer the litho code to the appropriate column. A completed back side of an AWL form is illustrated in Appendix A.2. **Keep in mind that not all fish will be weighed. The minimum sample size is 15 males and 15 females per week. If the process goes smoothly and you can collect more weights (25 per sex), this would be greatly appreciated.**

7. Repeat steps 1 through 4 for up to 40 fish on each AWL form.

8. When sampling at weirs you may use write in rain books to record the data. Keep the mark-sense forms in camp where they will be clean, dry, and flat. After sampling is done for the day transfer the data to the mark-sense forms. **Each length, sex, scale and weight must correspond to a single fish! It is the responsibility of the crew leader to be sure the data has been transcribed correctly and the AWL forms filled out completely.** Log books containing length, weight, and sex data should be returned to Patti Nelson at the end of the season.

SCALE SAMPLING CHECKLIST

OPERATIONAL PLAN	PENCILS (NO. 2)
GUM CARDS	FORCEPS
AWL FORMS	PLASTIC CARD HOLDERS
CALIPERS	CLIPBOARD
SPRING SCALE	WEIGHING SACK

SOME REMINDERS

1. For greater efficiency in scale reading and digitizing, mount scales with anterior end toward top of scale card.

2. AWLs should be carefully edited. Re-check header information on AWLs; make sure all available information is filled in. Take extra care to use the correct period code for the sampling or catch date. AWL numbers should not be repeated; a frequent error is to begin a week's sample with the last AWL number used the week before. This is particularly important if the data is regularly sent to town; it is easy to forget which AWL numbers were used. Crew leaders should take time to ensure that the boxes are being blackened correctly, if the boxes are sloppily marked the optical scanner records the information incorrectly or misses it entirely. Keep pencil marks within each block, filling it completely.

3. Transfer important comments from scale cards to AWLs. After pressing scales, the cards are seldom referred to again, and important remarks can be lost. Write comments in the top right margin. If there is not room on the AWL to completely explain the remarks, use a separate piece of paper.

4. Never put data from different dates on one AWL or one scale card. Even if only one scale is collected that day, begin a new AWL and gum card the next day.

5. If weights are taken, they may be noted in the right margin of the AWL during sampling, but **be sure to transfer the weights and litho code to the appropriate columns on the reverse of the AWL before submitting it to your supervisor.**

6. The data processing program uses the "litho code" on the AWL. (It is located in the lower left margin of the AWL.) Try to keep the litho codes in numerical order. This should not be hard to do if they are arranged that way before page numbering. Those who sample different areas throughout the season can arrange the litho codes in order before each sample is taken.

7. If AWLs get wrinkled or splotched they should be transcribed onto a new AWL prior to sending in. The optical scanning computer will misread or reject wrinkled sheets. Do not use paperclips on AWL forms.

8. Be careful when collecting and mounting scales in wet conditions (rain, high humidity, etc.) Glue often obscures scale features and scales frequently adhere poorly to wet card. Protect the cards, keep them dry to avoid having to remount the scales on a new card.

9. Scan the AWL form for mistakes. A common error occurs, for instance, in placing both the 4 and 7 of a 475mm fish in the 100's column with nothing in the 10's column.

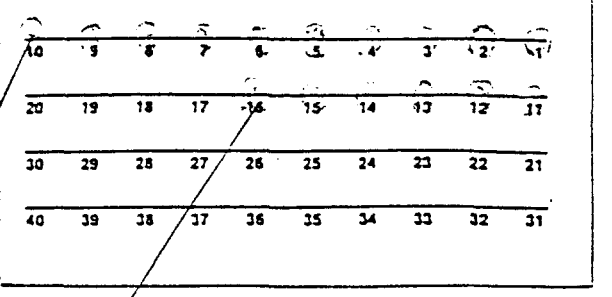
10. Record all comments explicitly on the gum card under remarks and transfer remarks to the top margin of the AWL form.

11. Responsibility for accuracy lies first with the primary data collector(s). The port supervisor will return sloppy or incomplete data to individual collectors for correction.

Gum Card front side

16 scales collected
Gum Card back side

Species: SOCKEYE Card No: 014
Locality: FRAZER ESC.
Stat. Code: 257-40-403-___
Sampling Date: Mo. 06 Day 07 Year 95
Gear: WEIR / TRAP
Collector(s): D. Pitcher, S. Peschier
Remarks: ___



AWL FRONT SIDE:

DESCRIPTION: SOCKEYE / FRAZER / ESC samplers: Pitcher Peschier

ADF&G ADULT SALMON AGE-LENGTH FORM VERSION 2.1

litho code 260498

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS AREA

CARD: 014
SPECIES: 2
DAY: 07
MONTH: 06
YEAR: 95
DISTRICT: 257
SUBDISTRICT: 40
STREAM: 403
LOCATION: 038
PERIOD: 24
PROJECT: 3
GEAR: 19
MESH:
TYPE OF LENGTH MEASUREMENT: 2
NUMBER SCALES/ FISH: 1
OF CARDS: 1

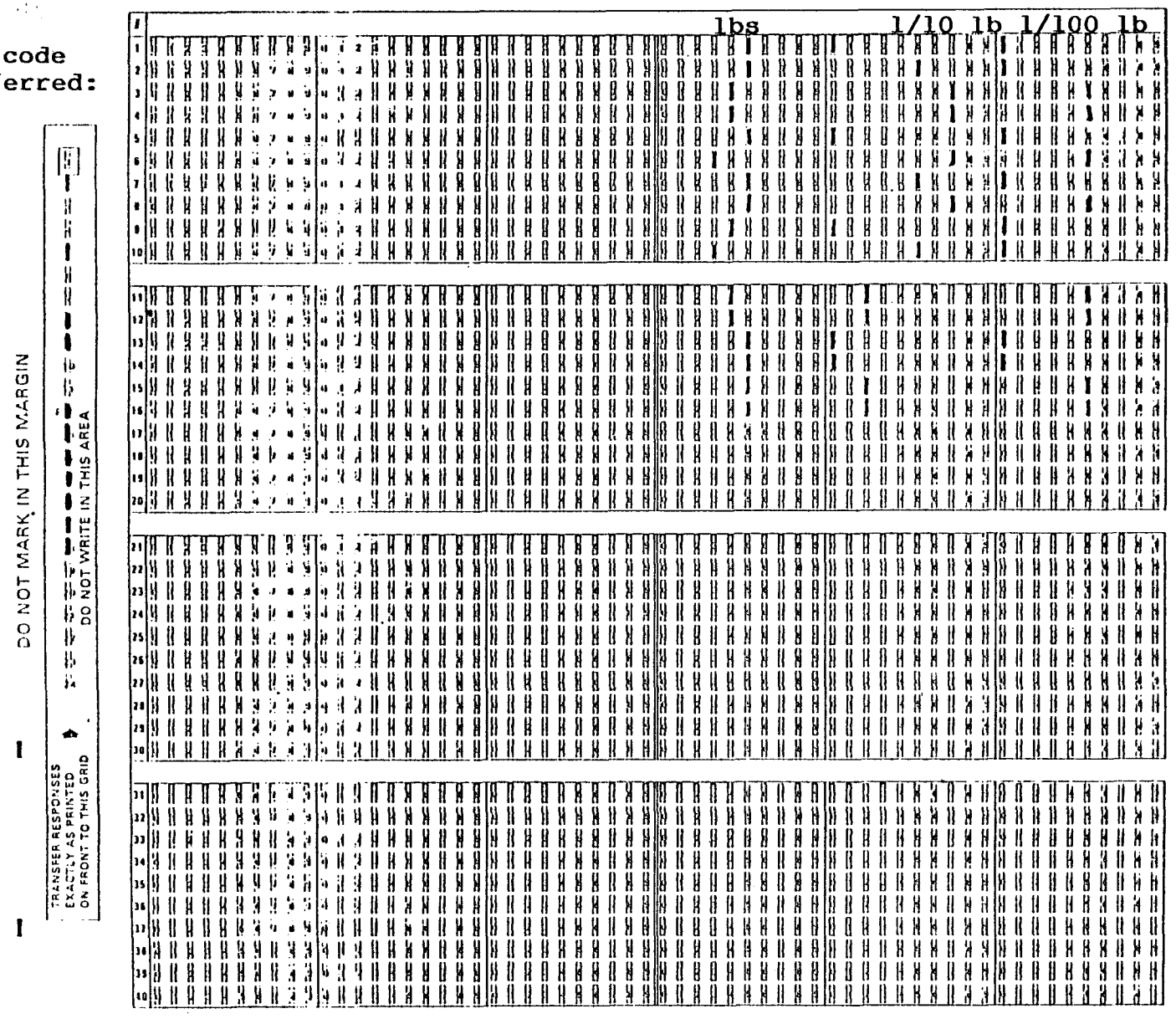
#	SEX	100's	LENGTH	1's	AGE GROUP	AGE ERROR CODE

NCS DOCUSCAN M020-17877 161514 A4200

Appendix A.1. Completed AWL (front side) and associated gum card with 16 fish sampled.

AWL BACK SIDE: 16 fish sampled, 16 weights measured

litho code transferred:



CODES:

SPECIES

1 - Chinook (king)
2 - Sockeye (red)
3 - Coho (silver)
4 - Pink (humpy)
5 - Chum (dog)

PROJECT

1 - Commercial catch
2 - Subsistence catch
3 - Escapement (tower, weir, sonar site, etc)
4 - Escapement - spawning grounds
5 - Test fishing
6 - Sport catch (marine)
7 - Sport catch (freshwater)

GEAR TYPE

0 - Trap
1 - Purse seine
2 - Beach seine
3 - Drift gillnet
4 - Set gillnet
5 - Troll
6 - Long line
7 - Otter trawl
8 - Fishwheel
9 - Pots
10 - Sport hook and line
11 - Hanging purse seine
12 - Handpicked
13 - Dip net
14 - 16 Unassigned
17 - Beam trawl
18 - Shovels
19 - Weir
20 - 99 Unassigned

LENGTH TYPE

1 - Tip of snout to fork of tail
2 - Mid eye to fork of tail
3 - Post orbit to fork of tail
4 - Mid eye to hypural plate
5 - Post orbit to hypural plate
6 - Unassigned

AGE ERROR CODES

1 - Otolith
2 - Inverted
3 - Regenerated
4 - Illegible
5 - Missing
6 - Rechecked
7 - Wrong species
8 - Not processed

Appendix A.2. Back side of AWL with 16 weights recorded and litho code transferred.

Appendix A.3. Assigned port and weir location codes.

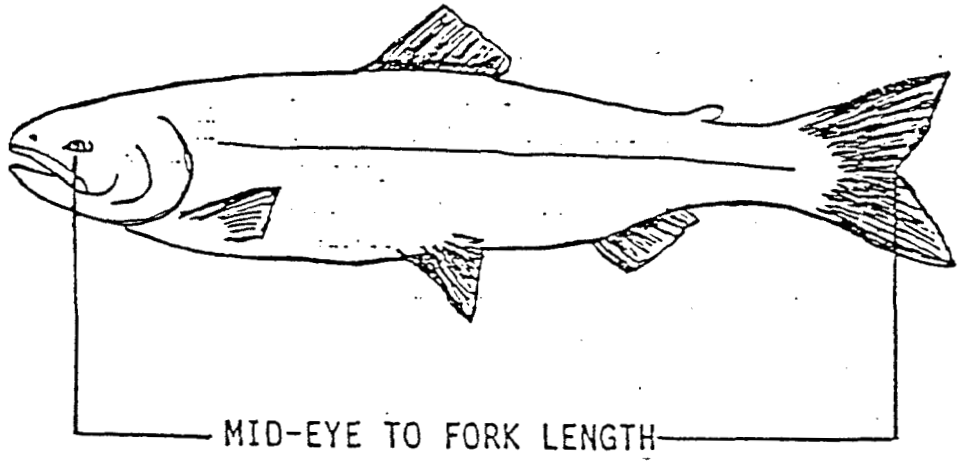
Port and Location Codes

030 - Lazy Bay
031 - Port of Kodiak
032 - Pauls Lake
033 - Thorshiem
034 - Afognak River
035 - Karluk River
036 - Red River
037 - Upper Station
038 - Frazer Lake
039 - Dog Salmon
040 - Akalura River
041 - Uganik River
042 - Malina Creek
150 - King Cove
151 - Port Moller
052 - Dutch Harbor
053 - Akutan
054 - Sand Point
055 - Bear River, ADF&G Camp
056 - Nelson River, ADF&G Camp
057 - Canoe Bay

Appendix A.4. Periods and corresponding calendar dates, 1995.

Period	Calendar Dates	Period	Calendar Dates
1	01-Jan to 03-Jan	28	05-Jul to 11-Jul
2	04-Jan to 10-Jan	29	12-Jul to 18-Jul
3	11-Jan to 17-Jan	30	19-Jul to 25-Jul
4	18-Jan to 24-Jan	31	26-Jul to 01-Aug
5	25-Jan to 31-Jan	32	02-Aug to 08-Aug
6	01-Feb to 07-Feb	33	09-Aug to 15-Aug
7	08-Feb to 14-Feb	34	16-Aug to 22-Aug
8	15-Feb to 21-Feb	35	23-Aug to 29-Aug
9	22-Feb to 28-Feb	36	30-Aug to 05-Sep
10	01-Mar to 07-Mar	37	06-Sep to 12-Sep
11	08-Mar to 14-Mar	38	13-Sep to 19-Sep
12	15-Mar to 21-Mar	39	20-Sep to 26-Sep
13	22-Mar to 28-Mar	40	27-Sep to 03-Oct
14	29-Mar to 04-Apr	41	04-Oct to 10-Oct
15	05-Apr to 11-Apr	42	11-Oct to 17-Oct
16	12-Apr to 18-Apr	43	18-Oct to 24-Oct
17	19-Apr to 25-Apr	44	25-Oct to 31-Oct
18	26-Apr to 02-May	45	01-Nov to 07-Nov
19	03-May to 09-May	46	08-Nov to 14-nov
20	10-May to 16-May	47	15-Nov to 21-Nov
21	17-may to 23-May	48	22-Nov to 28-Nov
22	24-May to 30-May	49	29-Nov to 05-Dec
23	31-may to 06-Jun	50	06-Dec to 12-Dec
24	07-Jun to 13-Jun	51	13-Dec to 19-Dec
25	14-Jun to 20-Jun	52	20-Dec to 26-Dec
26	21-Jun to 27-Jun	53	27-Dec to 31-Dec
27	28-Jun to 04-Jul		

Appendix A.5 Measuring fish length, mid-eye to fork of tail.



Mid-eye to fork lengths are taken because the length and shape of a salmon's snout changes as it approaches sexual maturity. The procedure for measuring by this method follows:

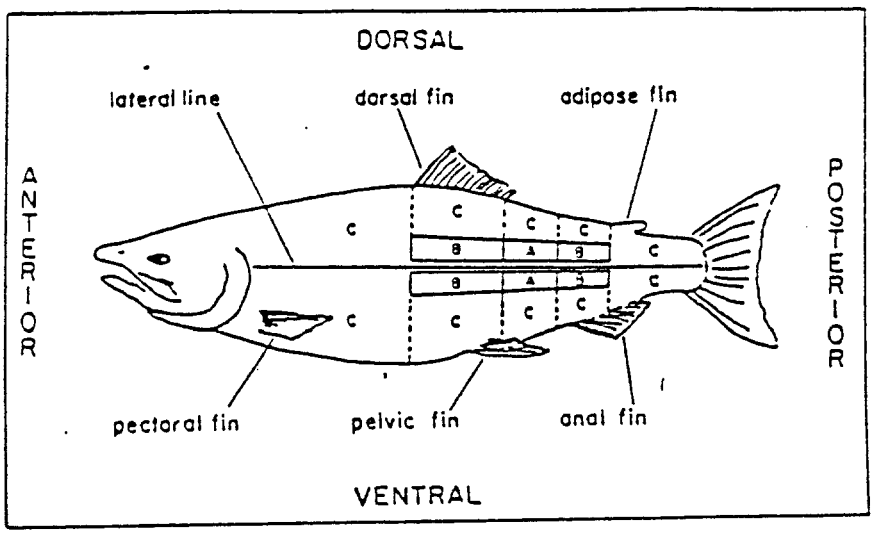
1) Place the salmon flat on its right side, with its head to your left and the dorsal fin away from you.

2) The eye should be on the line projecting from the end of the meter stick. Hold the head in place with your right hand. Sometimes you can control the fish better by placing your thumb in the fish's mouth.

3) Flatten and spread the tail against the board with your right hand.

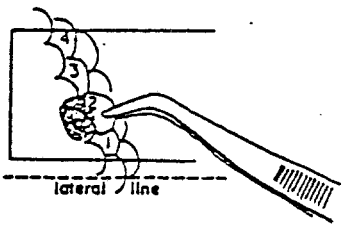
4) Read the mid-eye to fork length to the nearest millimeter.

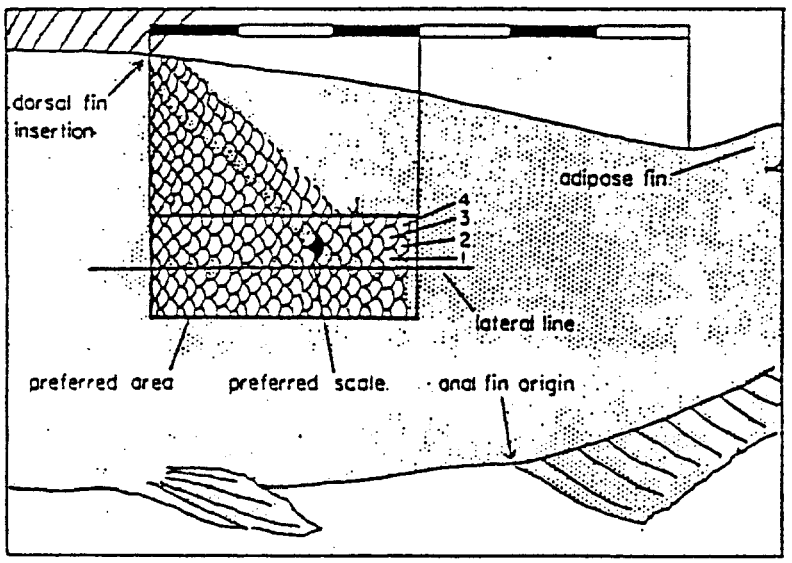
Appendix A.6. Removal and mounting of the preferred scale.



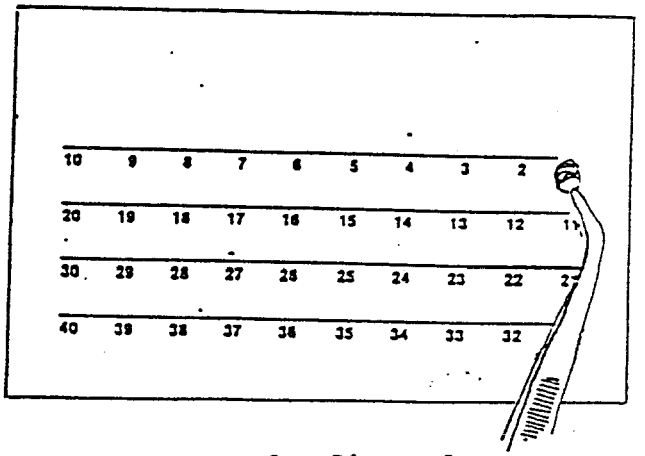
INPFC rated areas for scale removal.
Area A is the preferred area. B is the second choice if there are no scales in area A.
C designates non preferred areas. If scales on on the left side of the fish are not good, try the right side.

DO NOT TURN SCALE OVER



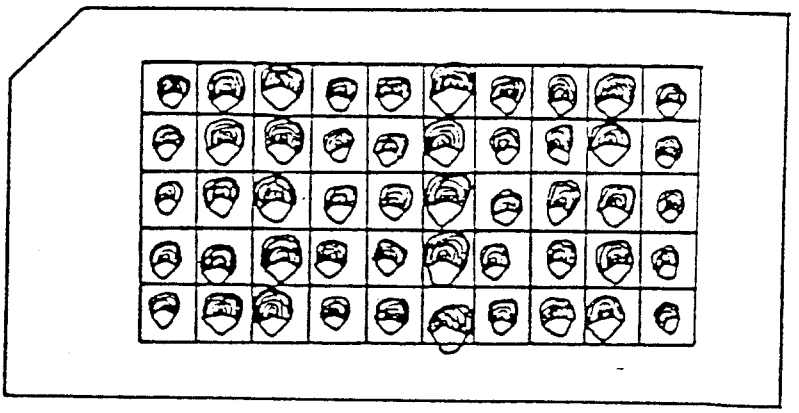


The preferred scale in this diagram is solid black. It is located 2 rows up from the lateral line, on a diagonal from the insertion (posterior) of the dorsal fin "back" towards the origin of the anal fin.

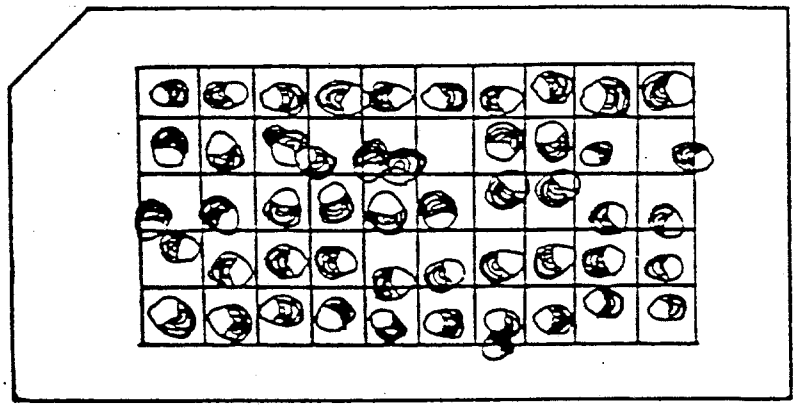


Place the scale directly over the number on the gummed card with the anterior portion (arche of the scale pointed toward the top of the card.

Appendix A.7. Scale orientation on the gummed card.



The scales are all correctly oriented on the card in the same direction, with the anterior portion of the scale pointed toward the top of the card.



The scales are incorrectly oriented in different directions. This increases the time spent to age samples.

Appendix J

Lake Assessment Operational Plan

KODIAK ISLAND AND SOUTHWEST ALASKA LAKE ASSESSMENT/LIMNOLOGY PROJECT OPERATIONAL PLAN, 1995

by

Steven G. Honnold

and

Steve Schrof

Alaska Department of Fish and Game
Commercial Fisheries Management and Development Division
211 Mission Road
Kodiak, Alaska 99615

June 1995

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INTRODUCTION

The Lake Assessment Project for Kodiak Island and Southwest Alaska includes limnology field sampling, lab processing, and analysis of lake trophic-level dynamics for 19 Kodiak and 8 Southwest Alaska lakes. These samples provide data with which lake productivity and sockeye smolt production can be assessed. Using this information, appropriate rehabilitation or enhancement strategies can then be applied to each salmon system.

Goal

The goal of this project is to determine the productivity status of Kodiak Island and Southwest Alaska lakes as related to development and restoration of sockeye salmon stocks.

Objectives

1. Provide samples for water quality, nutrient and chlorophyll a analysis.
2. Estimate density, biomass, size and species composition of the macrozooplankton community.
3. Estimate the compensation depth (EZD) for algal photosynthesis.
4. Determine the temperature and dissolved oxygen regime.

Tasks

1. Collect three carboys of lake water at 1 m, 2 m and mid-hypolimnion at each standard limnology sampling station from lakes being fertilized and/or stocked lakes.
2. Collect a zooplankton sample by vertical towing at each station in each lake.
3. Collect upward directed light readings at each standard limnology (original) station.
4. Measure dissolved oxygen and temperatures from the lake surface to the lake bottom at each standard limnology (original) station.
5. Collect secchi disk reading at each standard limnology (original) station.

SUPERVISION

Project Biologists: Steve Honnold, Steve Schrof,
Pete Cleary (Kitoi Lakes)

Field Staff:

Kodiak: Rob Markle (Kitoi Lakes)
Steve Schrof, P.J. Purdy, Mary Bingham

Southwest Alaska: Wade Wilson

The field staff is responsible for scheduling air charters for sampling and completing field sampling on schedule. Field staff are responsible for reviewing the Department's safety SOP, with emphasis on aircraft safety, and signing the Employee Safety SOP Verification form.

The project biologists are responsible for project oversight, including logistics and technical support as well as data quality control.

PROCEDURES

Water Sampling

At each limnology sampling station (Appendices A and B), water samples will be collected at 1 m, 2 m and at mid-hypolimnion (~75% of lake depth). Lakes that are not currently being fertilized or considered candidates for fertilization will not have water samples collected for analysis (Kodiak Island). Set up Van Dorn sampler and lower to sampling depth. Attach messenger to rope and release; wait for Van Dorn bottle to close, will be able to feel bottle closing; if not give a couple quick jerks to rope. Pull up the sampler and rinse clean (see lab processing section for cleaning procedure) carboy with portion of sample and discard. **Discard any samples that contain sediment and take another sample.** Pour sample into rinsed carboy labeled with name of lake, station and depth. Repeat process (without rinsing) until carboy is 2/3

to 3/4 full for 1 m and "deep" sample and 1/2 full for 2 m sample. Record sampling depths, stations, and other appropriate comments on Detailed Lake Survey (DLS) form (Appendix C). See the Field Sampling Equipment List (Appendix D) for the necessary collection gear.

Zooplankton Sampling

At each sampling station, vertical tows will be conducted to collect zooplankton. One tow will be conducted at each sample site. In 1994, additional stations were set in larger lakes or lakes with more than one basin to assess spatial variance in zooplankton density and biomass. Prepare a clearly marked morphometric map showing station locations, and forward to the Kodiak office, as well as the Limnology Lab.

To conduct tows, rinse zooplankton net and collection basin with distilled or filtered water before use. Slowly lower zooplankton net to sampling depth. Pull the net up vertically at 0.5 m/sec., stopping at the lake surface pulling the rim of the net just out of the water. Rinse the net by immersing several times in the lake to just above the collection basin without submerging the rim (wide end) of the net. Remove the collection basin from the net and pour the contents into a 125 ml polybottle **containing 12.5 ml (10% of volume) of buffered formalin**. Rinse the remaining tow contents off of the collection basin screen, without immersing, and continue to pour the sample into polybottle. If contents remain on the screen, use a washbottle containing filtered water to rinse off. Make sure the bottles are labeled with lake, station, date, time, depth, etc.

Phytoplankton Sampling

Phytoplankton samples will be collected four times per season **only at lakes being fertilized or being considered for fertilization (Appendix A)**. Samples will only be collected at the original limnology station and at the two meter depth.

Light Measurement and Secchi Disc Depth

Light levels will be measured at each standard limnology station, using an electronic photometer. Light readings will be recorded, beginning just above the lake surface (incidence), then just below the surface (subsurface), at 0.5 m intervals to 5 m, and at every meter, thereafter, until the light level is 1% of subsurface reading. Record only "up" measurements. Record data on the DLS form. **Please calculate the actual foot candle readings (this can be done in the office if it is preferred).** Repeat at each station.

Temperature and Dissolved Oxygen Measurement

Water temperature and dissolved oxygen (DO) will be measured at each standard limnology station, each sampling period. A YSI meter will be used as well as a handheld thermometer, to verify surface temperature. Prior to use, the YSI meter will be red lined and zeroed. Also, the DO's will be calibrated to the surface water temperature. This will be done by taking a surface water temperature and then adjusting the DO reading at the surface, based on the chart on the rear of the meter. This calibration will be repeated at each lake at each sampling date. This calibration can also be accomplished in the lab prior to sampling by using a HACH Kit. If this method is used, double check using the preceding method in the field.

At each limnology station, take DO and temperature readings from the surface to the bottom at 1 m intervals. During isothermic periods (spring and fall), readings can be taken at 5 - 10 m intervals. Record data on DLS form.

Secchi Disk (SD) transparency will be recorded at each station. Lower the SD until it disappears from view and record the depth on the DLS form. Pull SD up until it reappears and record the depth on the DLS form. Repeat at each station.

Note: It is best to measure light level and SD depth on the shaded or lee side of the boat or plane.

Metals

Processing water samples for metals has been discontinued.

Water Sample Processing

Water samples collected in the field will be processed in the Kodiak, Kitoi Hatchery or Russell Creek Hatchery labs.

Lab Set Up/Cleaning

Wash glass and poly filtration gear (filter towers, flasks) and graduated cylinders with phosphate free soap and rinse the first four times with tap water and then rinse four times with filtered water (do not need to wash waste water flasks). Wash carboys with phosphate free soap and rinse three times with filtered water. (If using the same carboys at the same lake and the same depth, then just rinse two times with tap water and two times with filtered water.) Wash nutrient poly plastic bottles with phosphate free soap and rinse with tap water four times, then rinse with filtered water two times. For equipment needed to process samples in the lab, refer to Appendix E. Label poly bottles and cover filter apparatus with tin foil until ready to process samples. Prepare all reagents and necessary equipment; set up vacuum pump with filter; **pump should be set at 15psi**. Reagent preparation is outlined in **Limnology Field and Laboratory Manual.**

Processing should be done as soon as possible after field sampling. Do not let carboys of water build up in refrigerator for more than three days. Process each carboy one at a time. Prepare polybottles and graduated cylinders by rinsing with a small portion of water sample. Using a rinsed graduated cylinder, measure for the following subsamples:

Unfiltered refrigerated: 500 ml into 500 ml polybottle; seal and refrigerate.
Unfiltered frozen: 200 ml into 250 ml polybottle; seal and freeze.

Phytoplankton: 100 ml into 125 ml polybottle; add 2 ml of Lugols acetate; seal and leave at room temperature. **Collect 2 m phytoplankton samples, only at lakes being fertilized or considered for fertilization, four times a year (Appendices A and B).**

Particulates: Using sterile forceps, place sterile Whatman GF/F filter(s) on the filter apparatus(es) and draw 50 ml of filtered water through filters. Using a wash bottle with filtered water, rinse tower and discard water from flask. Measure 1000 ml (1 Liter) of sample into graduated cylinder for each of the four particulate samples (CHLA,N,P,C). For 2m carboy, CHLA particulated only. Pour portion of sample from graduated cylinder(s) into filter tower(s) and turn on vacuum pump; as sample filters, add more from g. cylinder until all 1000 ml is filtered; let all samples filter through completely except the filter for chlorophyll a; as the last 50 ml of this sample is filtered add 5 ml of MgCO3 solution and 5 ml of filtered water to the filter; turn off pump when all towers are empty. Remove particulate nutrient filters from filter apparatus and place in appropriate, labelled petri slides; store frozen.

Unfiltered frozen: Save approximately 450 ml of filtrate from filtrate flask and after rinsing 500 ml bottle with small portion of filtrate, pour into bottle and seal; store frozen.

After samples have been processed, they will be shipped to Soldotna lab in sealed cooler. Samples should be **shipped via ERA airlines within five days after field sampling**. Include zooplankton samples but keep separate from other samples (ziplock) and seal bottles with electricians tape. Avoid shipping samples on Friday and be sure to call lab personnel to **inform of arrival time**. Ship original DLS forms to Lab and make a copy for our files.

Supply Ordering

P.J. Purdy will be responsible for seeing that all field sampling and lab processing equipment and supplies are in working order and/or stocked. Supplies will be ordered directly from the appropriate vendors. Check with a biologist before placing an order. Likewise, equipment will

be repaired or maintained through the appropriate company. The Soldotna Limnology Lab will only supply labels and bottles. Refer to Appendix F for important limnology reminders.

Miscellaneous

Zooplankton bottles (125 ml) can not be used for water samples if they have contained formalin (for preserving). Glassware that has been used for mixing reagents and formalin should not be used to measure water samples.

APPENDIX

Appendix A. Kodiak limnology sampling, 1995.

Lake Fertilization (3)	Station #	Sampling Depths (M) Zoop.	Deep H_2O	Chla	Phyto	Comments
Portage	1	15	15	1 & 2	2	
	2	14	-	-	-	
Laura	1	35	35	1 & 2	2	
	2	35	-	-	-	
Afognak	1	17	13	1 & 2	2	
	2	11	11	1 & 2	2	
	3	22	-	-	-	
	4	23	-	-	-	
Malina (lower)	1	10	10	1 & 2	2	
(upper)	2	27	27	1 & 2	2	
(upper)	3	29	-	-	-	
Little Waterfall Bay	1	15	15	1 & 2	2	
	2	12	-	-	-	
Stocking (4)						
Jennifer (upper)	1	26	-	-	-	Water samples will
(lower)	2	26	-	-	-	not be collected
Crescent	1	26	-	-	-	Water samples will
	2	21	-	-	-	not be collected
Hidden	1	40	40	1 & 2	-	
	2	23	-	-	-	
Spiridon	1	50	50	1 & 2	-	
	2	50	50	1 & 2	-	
	3	50	-	-	-	
	4	50	-	-	-	
Post Fertilization (6)						
Karluk (Main)	3	50	-	-	-	Water samples will
(O'Malley)	4	50	-	-	-	not be collected
Frazer	1	24	24	1 & 2	-	
(oil control)	3	50	50	1 & 2	-	
	2	50	-	-	-	
	3	50	-	-	-	
	4	50	-	-	-	
Oil (4)						
Red	1	38	38	1 & 2	-	
	2	38	38	1 & 2	-	
	3	37	-	-	-	
	4	37	-	-	-	
Akalura	1	16	16	1 & 2	-	
	2	14	14	1 & 2	-	
	3	12	-	-	-	
Development (6)						
McDonalds	1	17	-	-	-	Water samples will
(Sorg)						not be collected
Ruth	1	15	-	-	-	" "
	2	8	-	-	-	
Little Kitoi	1	19	18	1 & 2	2	
	2	15	15	1 & 2	2	
Saltry	1	33	-	-	-	Water samples will
	2	28	-	-	-	not be collected
Pillar	1	TBD	-	-	-	Water samples will not be collected
Upper Station	1	50	-	-	-	Not sampled in 1994
	2	24	-	-	-	

TBD = To be determined

Appendix B. Alaska Peninsula limnology sampling, 1995.

Lake Fertilization	Station #	Sampling Depths (M)		Comments
		Zoo.	Deep Water	
Bear	1	50	50	
	2			
Charlie Hansen	1	13	13	
Morzhovoi	1	2.5	--	Water samples
Orzinski	1	15	--	not collected
Sandy	1	6	6	
Sapsuk	1	50	50	
	2			
Thin Point	1	2	--	Water samples
Wildman	1	12	--	not collected

Appendix C. (page 1 of 2)

DETAILED LAKE SURVEY

Field Form

CFMD Division
Limnology Section

Lake identification (note name, drainage, bay or fjord receiving draingage) ________________________________ Sample station designation and depth ______________ (m). Weather & lake surface conditions ________________________________

Date ____________ Name(s) of sampling personnel ______________________________

PHYSICAL & CHEMICAL PARAMETERS:

Depth (m)	Temperature (°C)	Dissolved Oxygen (mg/l)	% Oxygen Saturation	Solar Illuminence (Foot Candles)		% Incident Light Level	
				Up	Down	Up	Down
Incidence							
Surface							
0.5							
1.0							
1.5							
2.0							
2.5							
3.0							
3.5							
4.0							
4.5							
5.0							
6.0							
7.0							
8.0							
9.0							
10.0							
11.0							
12.0							
13.0							
14.0							
15.0							
16.0							
17.0							
18.0							
19.0							
20.0							

Comments: Sampling Time: Surface: Deep Water H_2O Seechi Disk
Air Temp: Plankton
D.O. Meter: Light Meter: Water Temp: Bottom

(over)

Appendix C. (page 2 of 2)

Water samples collected for lab analyses 2 Depths samples were tak
(m) and (m) Samples filtered in lab yes or field

Comments

Secchi disc: Depth(s) disc disappeared/reappeared / (m) Mean disc reading

BIOLOGICAL PARAMETERS:

Phytoplankton: ^{14}C conducted Dosimetry badges worn (initial of sampling personnel) .

Vial Number	Depth (m)	Bottle	pH	Time Set	Time Pulled
		Light			
		Light			
		Dark			
		Kill			
		Light			
		Light			
		Dark			
		Kill			
		Light			
		Light			
		Dark			
		Kill			

^{14}C samples filtered in lab or field .

Periphyton: Site designation and/or location of colonization plates

Incubation time (3 wk) (6 wk). Was one plate contents preserv
. Was other plate filtered for Chl a in lab or field
. Comments

Zooplankton: Number of tows taken 2 Tow depth (m) Tow angle (vertical or specify angle) Net size 20 cm x 147 u

Each tow preserved separately. yes Comments: Preserved with 10% buffered formalin by volume.

Benthic invertebrates: Site designation and/or location of Hester-Dendy samplers

Incubation time Comments

Additional Information or Comments:

Appendix D. Field sampling equipment list.

Equipment	Task
Van dorn bottle	Water samples
Rope marked in Meters	"
Messenger	"
Carboys 3 per original station	"
20-cm x 153-um mesh Plankton net	Zooplankton samples
Rope marked in meters	"
2 125 ml polybottles (Per station) with **12.5 ml of 100% buffered formalin in each bottle.**	Zooplankton samples
D.O./temperature meter (cord marked in meters)	Temp/DO readings
Photometer (cord marked in 1/2 meters) Secchi disk	Light level readings Turbidity reading
Clip board/rite in rain paper	Data entry
Anchors (1 per station), chain lead, rope and buoy.	Station set up

Appendix E. Lab processing equipment list.

Equipment		Task
Polybottles (labeled)		
per Carboy 1 M sample:	(2) 500 ml	500 ml unfilt. refrig. 500 ml filtrate frozen
	(2) 125 ml	1-phytoplankton 1-metals
	(1) 250 ml	200 ml unfilt. frozen
per Carboy 2 m sample:	(1) 125 ml	1-phytoplankton
per Carboy deep sample:		
	(2) 500 ml	500 ml unfilt. refrig. 500 ml filtrate frozen
	(1) 250 ml	200 ml unfilt. frozen
Whatman GF/F filters/petri slides		
per Carboy 1 m and deep sample:	(4) 4.25-cm	Particulate filtering (CHLA, N, P,C)
per Carboy 2 m sample:	(1)	Particulate CHLA
Graduated cylinders		Sample measurement
Filter apparatus:	filter tower (4) filtrate flask (1) vacuum pump vacuum hose vacuum filter Waste water flask	Particulate filtering filtr. frozen samples
Wash bottle with **filtered** water		Rinsing filter apparatus btw stations
Phosphate free detergent		Washing bottles, carboys, glassware
Filtered water		Rinsing bottles, carboys,-glassware after washing
Sterile forceps		Handling filters
Lugols acetate		Phytoplankton preservation
Magnesium Carbonate		Chlorophyll preservation
Tin foil/cellophane		Covering filter apparatus after disinfection

Appendix F. Important limnology reminders.

Sampling

1. **Record the meters used** for sampling on DLS form.
2. Take a **hand held thermometer temperature** at the surface to compare to YSI meter.
3. **Complete all labels and all parts of DLS form.**
4. **Don't forget to calibrate DO meter.**
5. Have other lakes that are due for sampling, in the location of target lakes, in mind as "backup" in case weather is a problem. **Surface winds of greater than 15 mph usually means sampling will have to be aborted.** Do not try to push the weather limitation to collect a sample. Quality is desired, not quantity.
6. Use 100% formalin at **10% volume of polybottle (12.5 ml)** to preserve zooplankton tows.
7. Calculate light reading - should be **in foot candles on DLS form.**
8. It is important to be **consistant in sampling** with regards to station locations and sampling procedures. Make sure to **note any change in station location** and **attempt to relocate station** prior to sampling. Also, **zooplankton** and **deep water** sampling should be taken at **same depths each time sampled.**
9. It is a good idea to have a **station "set up" along** at each time of sampling in case bouy is missing or anchor is consistently moving.

Lab

1. Prior to working in the lab be sure that ADF&G lab safety SOP has been reviewed and Employee Safety SOP Vertification is signed.
2. When in doubt, **rinse liberally with filtered H_20** (DI) - all bottles, filter equipment and glassware.
3. **Do not use bottles previously used for zooplankton** or that are known to **have contained formalin** for any samples other than zooplankton.

-Continued-

4. **Complete all labels.**
5. Be considerate of other lab personnel when using chemicals; **mix and pour chemicals under "hood"**. Be careful when using chemicals.
6. Keep Chl. A filter tower in same location on manifold.

Shipping

1. **Double check labels and DLS forms; make copy of DLS forms.**
2. Make sure zooplankton bottles are **sealed with electrical tape. Keep separate** from other samples.
3. **Keep phytoplankton separate** from other samples. Ziplocks will work to isolate.

4. Make sure that samples being shipped are charged to the appropriate account (KRAA, ADF&G, or Clean Lakes).
5. Remove all old labels from cooler or box used to ship; use shipping label and seal with strapping tape. If cooler isn't full, pack it so nothing can move - this will minimize spilling or damage.
6. At airline, make sure they **know the importance of the samples**. Ask them to put the **appropriate labels** on the coolers, i.e. chill, freeze, etc.
7. Always **call to verify that the flight has left** Kodiak. Also, call Soldotna and **inform them of arrival time**. Finally, **call Soldotna to verify that they received the samples.**

Appendix K

Weekly Report Example

Date: 6/3/91

To: Lonnie White
Area Biologist - FRED

Weeks: 21, 22, and 23

From: Steve Schrof
Fish Culturist I - FRED

Subject: Spiridon Lake Sockeye Smolt Project

Activities:

Week 21:

Materials for tent platform arrived on 5/23. Began building platform on 5/24, completed and moved tent onto platform, 5/26. Tent platform is built approximately 150 ft. from the lakeshore, paralleling the outlet stream.

Sockeye smolt movement is minimal at this point. Smolt count from 5/23 to 5/25 is 102 fish passed. Daily counts have ranged from 8 to 49 smolts passed. The holding pen for sockeye smolts is stressful. Strong water flow through the pen creates too much stress on the smolts. The pen needs to be enclosed on all sides to reduce flow speed. Due to low temps. and low numbers of fish, adequate oxygen levels should not be a concern.

Worked gillnet for adult Dolly Vardens on 5/24 and 5/25. Catches for adult Dollies were 10 and 7, respectively. The gillnet was set on the west creek. CPUE was 20.5 hrs. and 23.5 hrs.

Week 22:

Smolt counts still slow from 5/26 - 5/30, total fish passed 32. Rain and lots of wet weather raised water levels

in the greatest numbers to date on 5/31 and 6/1. Total numbers for the two days: 5/31 - 501 ; 6/1 - 118. We are still seeing a high percentage of mortalities in the holding box before sampling.

Set the gillnet on the south creek shoreline, 5/29 and 5/30. Catches for adult Dolly Vardens, 9 and 10, respectively. CPUE 16.0 hrs. and 23.5 hrs. Length, weight, and otolith sampler taken.

Made beach seine sets for juvenile Dolly Varden on south creek (2 sets), outlet creek (1 set), west creek (1 set), and east creek (1 set) sites on 5/29. We did not capture any juvenile Dollies, some miscellaneous numbers of sculpins and sticklebacks. We surveyed east and west creeks for any sign of juveniles up in there respective systems. We saw no sign of juveniles walking either system.

Week 23:

Smolt counts slowing down again. Counts on 6/2 were 6 smolts, and 6/3 were 6 smolts.

Attempted to work on lake 6/3, beach seining and setting the gillnet. High winds from the southeast created white capping and unstable conditions on the lake.

Significant Events:

Sockeye smolt counts started out slow but a rise in water level triggered smolt to migrate downstream on 5/31 and 6/1.

Juvenile Dolly Varden are not being apprehended using the beach seine. Scouting along the lakeshore,

Significant Events cont.

visual sightings of juveniles.

Anticipated Activities:

Due to minimal smolt movement, we will be concentrating on beach seining, and setting the gillnet for the collection of Dolly Varden.

Continue to sample sockeye smolts migrating downstream.

Appendix L

Annual Report Format

MEMORANDUM **STATE OF ALASKA**

TO: Distribution

DATE: July 14, 1994

FILE: memorpt.94

FROM: Steve Hommold

SUBJECT: Project Reports: format/example

Attached is an updated version of the required format for Annual Project Reports plus a copy of a report written by management personnel. This format is general and modification will be needed for individual projects. The example report is not specifically written to follow the current format, as it was drafted several years ago. Each crew leader will be responsible for drafting a report for each project worked during the season. Crew members should also participate in the writing of the report. I recommend that crew leaders delegate specific sections of the report, based on each crew members experience on the projects. I would like a draft of the report to review prior to the end of the field season, preferably, early enough to provide feedback to allow revision.

The initial draft of the report can be handwritten and later, after final revision, will be typed by clerical staff. I encourage each crew leader to work on these reports in-season while activity is ongoing. I realize how busy the field season is, however, data summary is much easier while it is fresh. The necessary time required for revision will be scheduled when things slow down and field personnel are in town.

If any clarification and or assistance is needed to write the reports, please let the appropriate staff know. I would be more than happy to help out anytime.

I will look forward to seeing your reports. Keep in mind that these reports are important documents which provide significant information for future implementation of our projects.

cc: All Development staff

CREW LEADER ANNUAL REPORTS

I. INTRODUCTION

Description of Project Location

Include general and specific location characteristics (stream width, depth, flow, tidal influence, etc.) and effect on project.

History of Project

Brief history of program.

Purpose of Project

Objectives

Purpose of Report

II. METHODS AND MATERIALS

Precisely describe all components of your work that produced the results reported:

Employees

List employees on site and for what periods, as well as job classes, previous time spent on the job, etc.

Weir/traps

Type of weirs and traps and installation, dates of installation and trapping, maintenance schedule; enumeration techniques, how sampled, when, how estimates were made, adult, smolt and other sampling techniques, etc.

Monitoring

Regulatory duties such as setting or moving markers or monitoring the fishery, etc.

Fish Pass Maintenance

Seasonal maintenance schedule - removing and installing doors, type of repairs, performance before and after, fish usage, etc.

Other Duties and Misc.

Physical data, safety, bear avoidance or activity, sport and subsistence fishing activity, etc.

Generally, following the operational plan procedures section will assist with this section. Also, maps, photographs and diagrams are useful for this section.

III. RESULTS

Base your results on the objectives and what was accomplished: be specific as to #'s, dates, etc. Generate specifics here as far as data collected, etc. Address each category listed in the Methods section. For example, smolt enumeration, timing, number sampled, mortality, adult escapements and timing by species, adult sampling numbers, spawning surveys, fish pass usage, etc. Simple tables and graphs should be constructed to summarize significant data.

IV. DISCUSSION AND RECOMMENDATIONS

Elaborate on results, techniques, significant findings, problems, etc.; be thorough - things you would want to know if you did not have any involvement in the project, but may in the future.

Recommend changes, modifications, etc. This should include all aspects of the project. Items that may be addressed:

improvement of weir/trap installation, maintenance and operation, changes or improvement of sampling techniques, camp and support improvements. Necessary or optional equipment/gear lists would be helpful in this section.

DIVIDER

PERENOSA REHABILITATION AND ENHANCEMENT PROJECT OPERATIONAL PLAN, 1995

by

Steven G. Honnold
and
Peter M. Cleary

Alaska Department of Fish and Game
Commercial Fisheries Management and Development Division
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June 1995

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INTRODUCTION

The Perenosa Rehabilitation and Enhancement Project includes Alaska Department of Fish and Game activity on northern Afognak Island at systems located in Perenosa Bay (Pauls/Laura and Gretchen Creeks, Portage Creek, and Little Waterfall Creek).

The Pauls/Laura and Gretchen Creek "sub-project" includes sockeye salmon rehabilitation and coho salmon monitoring work. A sockeye salmon run was developed here in the 1950's and 1960's through the construction of fish passes at barrier falls in Paul's/Laura and Gretchen Creeks and the planting of sockeye eggs in Gretchen Creek. Sockeye escapements have been as high as 33,000 in 1984 and averaged ~12,000 from 1985 to 1994. In 1991, a very low escapement of 3,200 occurred. Activities here include weir operation at Paul's Bay, smolt sampling, commercial and subsistence fishery monitoring at Paul's Bay, escapement sampling, fish pass maintenance and construction, peak spawner stream surveys, and fall hydroacoustic/trawl surveys. In addition, Kodiak Regional Aquaculture Association (KRAA), Pillar Creek Hatchery, will collect eggs to supplement natural production through sockeye stocking in 1995.

At Portage Creek, a fish pass constructed in the 1960's bypasses a barrier falls allowing sockeye salmon (as well as pink and coho salmon) access to Portage Lake and associated spawning tributaries. The optimum sockeye escapement at the Portage Lake system has been determined to be 8,000 sockeye. The sockeye escapement, however, has averaged ~5,000 since 1990. Activities in 1995 at Portage include smolt sampling, fish pass maintenance, and stream surveys.

At Little Waterfall Creek three fish passes of 30, 40, and 90 foot lengths, respectively, allow pink and coho salmon access to spawning areas previously blocked by barrier falls. Pink salmon escapement has increased from 7,000 to an average of 53,000 due to Little Waterfall enhancement activities. Sockeye fry were stocked in the Waterfall lakes, a barren system, in 1992 and 1993. There are approximately 12,000 sockeye expected to return to Little Waterfall bay in 1995. In 1995, activities at Little Waterfall include: smolt sampling, commercial fishery monitoring, age and length sampling, fish pass maintenance, stream surveys and fall hydroacoustic and trawl surveys.

Goals

Paul's/Laura - The goal of this sub component is to facilitate, evaluate, and monitor ongoing sockeye restoration (lake enrichment, fry supplementation, and barrier bypass operation). Also, to monitor coho run strength.

Portage - Similarly to Paul's/Laura, the goal of this sub component is to facilitate, evaluate, and monitor ongoing sockeye restoration (lake enrichment, and barrier bypass operation).

Little Waterfall - The goal of this sub component is to facilitate, evaluate, and monitor ongoing sockeye and pink salmon enhancement (juvenile sockeye supplementation, lake enrichment, and barrier bypass operation).

Objectives

1. Monitor the initial commercial, sport, and subsistence sockeye salmon fishery and estimate the harvest at Little Waterfall Bay.

2. Determine the age and size composition of L. Waterfall sockeye salmon harvested in the commercial catch.

3. Determine the hold over rate of hatchery stocked sockeye pre-smolt (1994) and smolt (1995) in Little Waterfall Lake.

4. Assess the age and size of sockeye smolt migrating from Portage, Laura and Little Waterfall Bay Lakes.

5. Further determine sockeye smolt mortality, if any, associated with barrier falls at Little Waterfall Creek.

6. Determine Paul's system sockeye and coho escapement and assess sockeye age structure.

7. Estimate Portage Creek sockeye and Little Waterfall pink escapements.

8. Facilitate the optimum spawning habitat usage for pink salmon at Little Waterfall and sockeye salmon at Pauls, Gretchen and Portage fish passes.

9. Determine pink salmon spawning distribution at Little Waterfall Creek, focusing on area of optimum spawning habitat.

10. Estimate sockeye escapement into spawning habitat at Gretchen Creek and Portage tributaries and lake shore at Laura Lake.

11. Determine annual water resident time for Little Waterfall, Portage and Laura lakes by collecting flow data twice monthly.

13. Estimate the number of rearing juvenile sockeye and their condition at Laura, Portage and Little Waterfall Lakes by conducting hydroacoustic/trawl surveys.

14. Summarize all project activities in a written report.

Project Biologists: Steve Honnold, Pete Cleary.

Field Staff: Crew leader - Mark Kansteiner

Crew - Wesley Gormley

Specific Tasks

1. Install barrier net at Little Waterfall Bay and fishpass #1 diversion weir.
   Target date: May 28

2. Install smolt trap at Little Waterfall Creek and fyke trap at Paul's and Portage creeks to sample sockeye smolt outmigration and enumerate the daily trap catch by species.
   Target Date: 20 May - 15 June - Waterfall
   01 June - 15 June - Paul's and Portage

3. Collect and sample a total of 200 sockeye smolt during a 3-5 day period, weekly, for age, weight and length data at Waterfall and Pauls; collect 240 sockeye smolt total at Portage. Daily sample should be approximately 70 smolt. Target Date: 20 May-15 June.

4. Enumerate mortality or damage to smolt associated with falls at Little Waterfall Creek.

5. Collect 480 scales total (100 per week) from sockeye harvested at Little Waterfall (commercial, sport or subsistence).

6. Estimate the daily sockeye harvest by boat and location in Big and Little Waterfall Bays (Terminal Harvest Area); including sport and subsistence harvest.

7. Open Paul's Bay camp, install adult weir and conduct foot survey of Paul's system to estimate sockeye salmon upstream of weir. Enumerate all salmon through weir until July 15 and, again, beginning August 5 through September 2.
   Target Date: June 1

8. Sample approximately 600 adult sockeye at Paul's system for age and length data; examine for fin clips.

9. Conduct foot surveys to estimate sockeye escapement at Portage Creek.
   Target Date: Begin June 15 - weekly through end of run.

12. Collect physical data daily - air and water temperature, stream water depth and weather observations at trap and weir sites.

13. Remove fish pass doors at Waterfall, Laura, Portage, and Gretchen and conduct maintenance inventory.
   Target Date: June 15, or after smolt work is complete.

14. Replace fish pass covers and cables and repair or construct diversion structures, if necessary, at Paul's, Gretchen and Portage fish passes; install Little Waterfall fish pass weir and diversions.
   Target Date: July 1 - 10; July 20

15. Evaluate the need for a diversion weir at Gretchen fish pass.
   Target Date: July 25

16. Conduct stream surveys of the entire Waterfall system (including an estuary estimate) up to barrier falls to determine pink salmon escapement and distribution.
Target Date: August 2 - 27

17. Conduct stream surveys at Portage tributaries and at Gretchen Creek during peak spawning period; prior to peak spawning period, monitor build up at the mouth of Gretchen and/or Laura Creek to provide information to Pillar Creek hatchery manager for egg take purposes.
Target Date: Portage tributaries - August 20
Gretchen - August 25

18. Remove and store weirs and diversion boards.
Target Date: Paul's - September 2
Waterfall and Gretchen - September 3

20. Inventory and secure Paul's Bay and Waterfall camps and close for the season.
Target Date: September 2, 1995

21. Conduct hydroacoustics and trawl/tow net survey at Laura, Portage and Waterfall lakes and conduct lake shore surveys for sockeye spawners.
Target Date: October 1

22. Install fish pass doors and winterize equipment.
Target Date: October 31

23. Write Project Summary Report, specifically addressing objectives and make recommendations for changes/improvements in 1996.
Target Date: October 1

PROCEDURES

Barrier Net and Weir Installation and Maintenance

A barrier net approximately 20' deep and 25 fathoms (150') long will be anchored, and secured at the most terminal area of L.Waterfall Bay (the bay is actually located between Big and Little Waterfall Bays, and drains Little Waterfall Bay Lake) to prevent sockeye salmon escapement into L.Waterfall Creek. The net will be cleaned of kelp and other debris daily and inspected to insure that it is "fish tight". A buoyed line will be installed ~50' in front of the net to serve as a no fishing zone

A aluminum panel weir, supported by cables, will be installed at most downstream fish pass (FP #1). This weir will be susceptible to high flow periods and will be cabled to the creek bank substrate.

Smolt Collection and Sampling

Refer to the appropriate sections of the Smolt Evaluation Operational Plan, 1995.

Little Waterfall Migration/Injury Evaluation

Sockeye smolt captured in the incline plane trap will be assessed for injury and mortality as a result of migrating over the barrier falls. All smolt captured will be examined for lacerations and excess scale loss, as a result of passage over the falls. Observation will be recorded on the Smolt Catch Report form. Any mortality attributed to falls, observed during trapping, will also be recorded. Smolt with falls injuries will be placed in a holding box for 24 hours to assess delayed mortality. An additional 50 healthy, uninjured smolt will be held in a separate box during the same 24 hour period as a control. During this evaluation, any injury or mortality that can be attributed to the trap will also be recorded. Lastly, when the daily smolt AWL samples are taken, the same criteria will be evaluated and recorded.

During one smolt trapping period, an additional trap (fyke) will be fished in the creek below the largest barrier falls, above the third fish pass. The preceding evaluation of falls injury/mortality will be performed at this location. AWL samples will not be collected at this site. The incline plane and fyke traps will be fished simultaneously, to avoid any recapture in the lower trap from the upper trap releases.

Paul's Bay Weir Installation, Operation and Maintenance

The weir will be installed by 6/6/95. Paul's Bay weir is small (<20 feet), consisting of the standard drilled angle iron and aluminum conduit material. Paul's main weir was installed upstream of the beam between the rock and shore. The beam is cabled to the bank but does float around at high water. The best method for installation require that the drilled angle iron be placed at a slight downstream angle to the weir. Sandbags will be placed under the bottom channel for support (for both weirs), between, and on top of the channel pieces to secure it. Also, a rope will be secured from the far bank around the upstream side of the side weir and back to the far side to prevent the weir from being pushed into the lake during high water events.

Fish will be enumerated by species as they pass through the weir using a tally wacker to assure accurate counts. Daily and cumulative counts will be recorded on the Weir Counts Form (Figure 1) counts will begin at 0000 hr.(midnight) and end the following 0000 hr. Counts will be relayed to the Kodiak ADF&G Management staff during the 0800 hour radio schedule.

Fishery Monitoring and Sampling

During subsistence, sport, and commercial fishery periods, monitoring will include surveys to assess run strength of sockeye, pink and coho at Little Waterfall, Portage (Discover Bay) and Paul's Bay and the recording vessel names, fishing location, and estimated catch by species.

Refer to the Kodiak Area Commercial Salmon Fishery Harvest Strategy, 1995 (Appendix A) for supplemental information.

Adult sockeye will be collected by seining in Paul's Lake near the inlet creek. 600 fish will be sampled for age and length data. Sampling will be distributed throughout the escapement period. Refer to the Kodiak Management Area Salmon Escapement Sampling Operational Plan, 1995 (Appendix B) for specifics on sampling procedures. In addition, a sample of 200 Little Waterfall Creek adult sockeye will be sampled. At Paul's, all fish collected will be examined for fin clips. The number of fish examined, and number of clips found, will be recorded; two scales and lengths will be collected from clipped fish. Additional fish (above the 500 samples) will be examined as time permits from escapement samples as well as the subsistence fishery. Refer to the Little Kitoi Evaluation Operational Plan, 1995 for details on examination for marked fish.

Stream Surveys

Weekly, surveys by foot and via boat will be conducted at Portage to track the sockeye run and escapement. Surveys will be conducted as needed at L.Waterfall to determine sockeye run strength. Approximately 12,000 sockeye are expected to return in 1995 as a result of fry planted in Little Waterfall Lake in 1992 and 1993.

Since pink salmon will not be counted through the fish passes at Waterfall, stream surveys will be conducted every 7 days, for 3 weeks, of the entire system during the peak escapement period (August) to estimate escapement. Survey counts above the upstream (fish pass 3) will be delineated into five section areas (Figure 2) and recorded on the Waterfall Survey Counts form (Figure 3). Record live and dead counts for all surveys. Sockeye salmon escapement survey data can be recorded in the weir counts form. Information on run strength will be relayed to Management biologists during the 0800 hr radio schedule.

At Gretchen and Portage tributary creeks one to two foot surveys will be conducted during the peak spawning period (mid to late August) to determine spawner distribution. Record live and dead counts and enter data on Foot Survey Counts form (Figure 4). An earlier survey will be conducted at Gretchen to determine sockeye build up at the mouth of the creek. This information will be relayed to the Pillar Creek Hatchery Manager to assist planning for an egg take.

Physical Data

Physical data will be collected daily at the weirs and smolt trapping sites. Information will be recorded on the Daily Physical Observation form (Figure 5) and will include: water and air temperatures, stream height, percent cloud cover, wind direction and velocity, and precipitation. A stream gauge will be placed at each site for measuring stream height.

Fish Pass Door Removal, Inventory, and Maintenance

Once the sockeye smolt outmigration is complete, plywood doors on the upstream ends of fish passes will be removed and stored on sight. An inventory of fish pass condition and needed repairs will be conducted at this time. Any damaged plywood fish pass covers will be replaced with aluminum covers. Cross braces will be tightened and replaced if damaged. Cables that secure the fish pass sections in place will be tightened and replaced if necessary. Any debris that could block fish passage will be removed from the fish passes. This can be accomplished prior to door removal when flow through the fish pass is minimal. Remove any gravel and debris that has built up upstream of the fish passes. At the most upstream fish pass at Waterfall, **a safety railing will be secured prior to any work.**

Diversion Board and Weir Installation and Maintenance

At low flow periods, diversion boards will be installed at Portage, the two downstream fish passes at Waterfall and at Gretchen. These boards will be placed upstream to divert more water into the fish passes. Boards (2 x 12's) will be attached to pipe that is presently secured to the stream bottom substrate. At Portage, pipe will be secured to the creek bottom in the same manner as previously accomplished at Gretchen Creek. These boards/pipe can be left in place during high flow periods but will be removed at the end of the season.

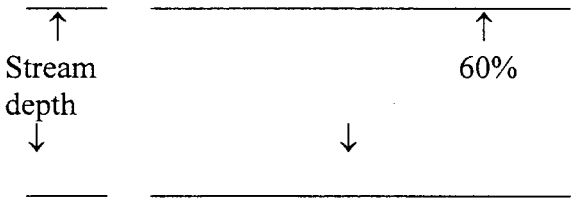
Diversion weirs will be installed at Waterfall prior to the pink salmon escapement. Both weirs are located at the lower end of the fish passes to divert salmon into the fish pass entrances. These weirs are susceptible to high flow periods and will be cabled to the creek bank substrate. The use of Gretchen fish pass will be evaluated to determine if a diversion weir will be necessary to keep fish from being wasted under the falls. Carcasses and debris will be removed as needed from the weirs, and they will be checked regularly to assure they remain fish tight.

The most upstream fish pass at Waterfall will be renovated in 1995. A construction contractor will be responsible for the work. Construction workers will operate completely independent of the ADF&G facilities, providing their own ATV transportation, camp facilities, equipment staging area, tools, etc. The work is scheduled to be completed within 120 days, once the contract is awarded. The Project Biologist's will be responsible for oversight of the renovation, assuring that contract specifications are followed. The crew leader will share this responsibility on a day to day basis. The renovation of the fishpass was planned for 1994, when pink salmon run strength was weak. Funding delays, however, resulted in the current construction schedule to occur when pink salmon run strength is anticipated to be strong. Thus, the contract specifies that the fishpass remain operational, if at all possible, during the peak escapement period. With strong returns, it may be necessary to design a procedure to move fish past the fish pass during construction. The methodology for this process will be determined in the field. The diversion weir may also need to be relocated downstream, at this time, to facilitate construction.

Stream Discharge Data

Stream flow will be measured twice monthly, at Little Waterfall, Laura and Portage creeks, with a Marsh McBirney flow meter. Flow measurements will be taken at the same locations as in

1994. A metric or standard tape measure will be used to make the transects. Flows and water depth will be recorded at every 1 foot (1/3 meter) increments from bank to bank in the stream. The rod sensor position should be at 60% of the water depth at a given location and should be pointed into the flow.



Weir and Diversion Structure Removal and Storage

Upon completion of project objectives, all weirs and diversion structures will be removed and stored on site in secure areas. At Gretchen and Waterfall, these items should be secured to the stream banks, since high flows are common during winter months.

Camp Inventories and Close Up

Paul's Bay and Waterfall camps will be inventoried for all gear prior to camp close up. Items of high value, will be returned to Kodiak and stored in the ADF&G warehouse in appropriate lockers. Record all items, their location, and list equipment needed for the 1996 field season. Secure cabins and out buildings prior to leaving field sites.

Project Summary Report

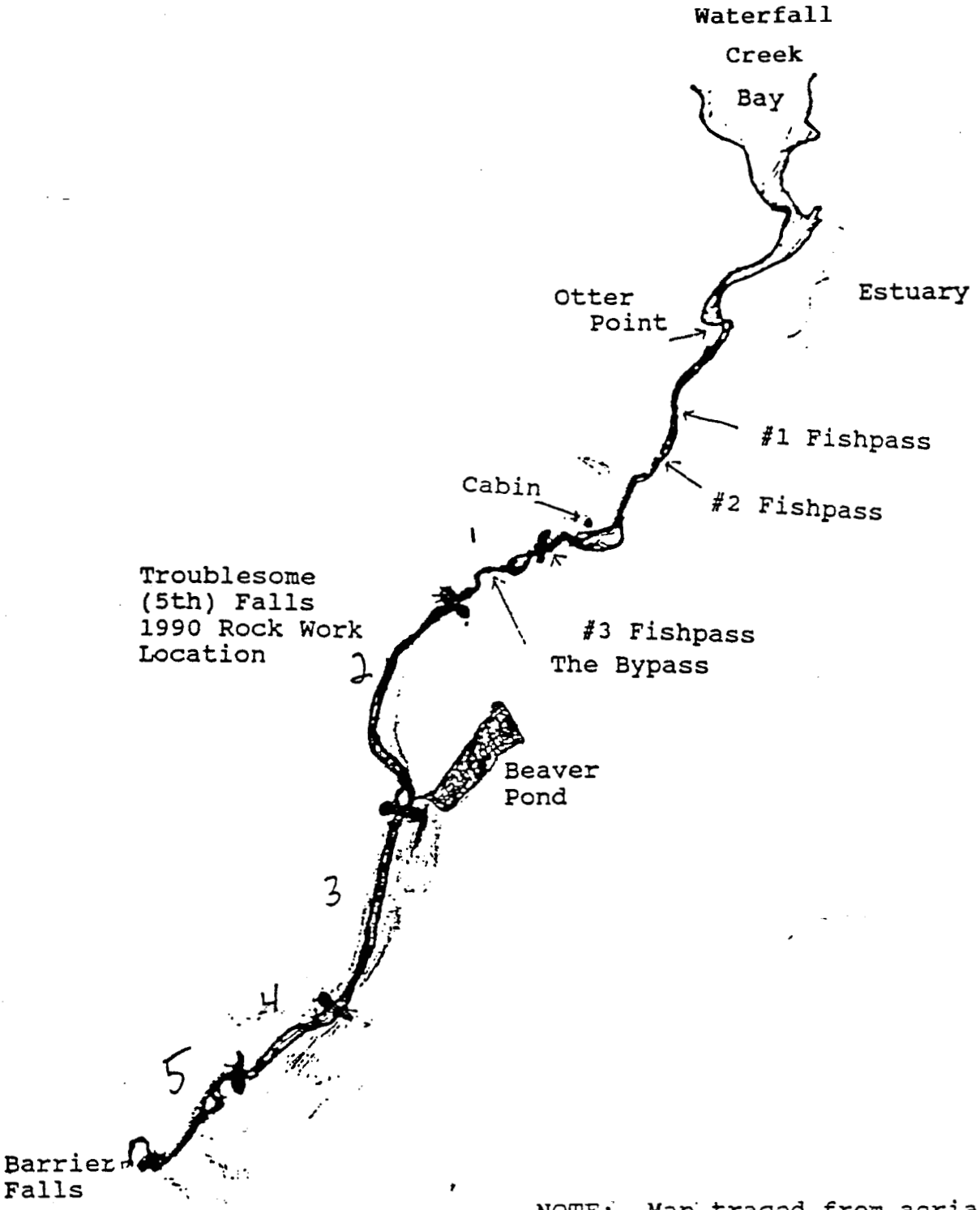
The crew leader will be responsible for providing a Project Summary Report to the project biologist by October 1. The report will be written according to the attached (Appendix C) format. Sections of the report can be delegated to crew members, however, the crew leader is ultimately responsible for report content. This report will serve the following functions: 1) summarization of all data associated with the projects; 2) summarization of all operations and activities (including dates) of the project; 3) provide a thorough "field analysis" of the project, based on the current objectives, with resultant recommendations for modifications and/or improvements for the 1996 season; and 4) lastly, assist the project biologists with technical project reporting. Please review the Little Waterfall, Portage and Laura lakes pre-fertilization reports for the type of information that will be helpful.

Figure 1. Paul's Bay weir counts forms.

PAUL'S BAY WEIR COUNTS

YEAR _____ PAGE _____

DATE	NUMBER OF FISH					COMMENTS
	SOCKEYE	CUM	PINK	COHO	OTHER	



NOTE: Map traced from aerial photograph shaded areas represent meadows.

Figure 2. Stream survey section numbers and boundaries, Waterfall Creek Bay to Barrier Falls.

Figure 3. Waterfall survey counts forms.

WATERFALL SURVEY COUNTS

YEAR _____ AREA _____ PAGE _____

DATE	SECTION NO.	NUMBER OF FISH			COMMENTS
		PINK	COHO	OTHER	

Figure 4. Foot survey counts form.

FOOT SURVEY COUNTS

YEAR _____ AREA _____ PAGE _____

DATE	DISTANCE	NUMBER OF FISH		COMMENTS
		SOCKEYE	OTHER	

Figure 5. Daily physical observation form.

DAILY PHYSICAL OBSERVATIONS

Project:_____ **Location:** _____

DATE	TIME	TEMPERATURE				GAUGE	WEATHER
		AIR		WATER			
		MIN	MAX	MIN	MAX		

APPENDIX

APPENDIX A

Kodiak Area Commercial Salmon Fishery Harvest Strategy, 1995

KODIAK AREA COMMERCIAL SALMON FISHERY

HARVEST STRATEGY, 1995

By:

Dave Prokopowich
Kevin Brennan
Dennis Gretsch

Regional Information Report[1] No. 4K95-28

Alaska Department of Fish and Game
Commercial Fisheries Management and Development Division
211 Mission Road
Kodiak, Alaska 99615

May 1995

[1]The Regional Information Report Series was established in 1987 to provide an information access system for all unpublished division reports. These reports frequently serve diverse ad hoc informational purposes or archive basic uninterpreted data. To accommodate timely reporting of recently collected information, reports in this series undergo only limited internal review and may contain preliminary data; this information may be subsequently finalized and published in the formal literature. Consequently, these reports should not be cited without prior approval of the author or the Commercial Fisheries Management and Development Division.

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INTRODUCTION

In 1995, commercial salmon fisheries in the Kodiak Management Area (Area K) will be managed according to a harvest strategy which emphasizes three criteria:

(1) **To ensure that 1995 salmon escapement occurs in the proper magnitude and distribution so that the potential for maximum production of future returns is established.**

The results of ADF&G's 1995 management activities will directly affect the following future returns:

- **1997 pink salmon**
- **1998 - 1999 coho salmon**
- **1998 - 2000 chum salmon**
- **1998 - 2001 sockeye and chinook salmon**

(2) **To provide for orderly fisheries on the highest quality salmon by maximizing harvest opportunities during each fishing period.**

This requires a species oriented approach.

- For sockeye and coho salmon from major systems, management will emphasize the use of inseason weir escapement data to determine fishing time by geographical area.

- Fishing time on minor sockeye and coho systems without fish weirs will be determined by ADF&G's perception of run strength for these systems.

- For pink and chum salmon runs, management will initially use preseason forecasts to determine fishing time with inseason fishing time adjustments as the actual run strength becomes more apparent.

(3) **To adhere to the biological and allocative requirements of all Alaska Board of Fisheries (BOF) Management Plans.**

This harvest strategy is an overview of how ADF&G intends to manage the 1995 salmon fishery. Along with this overview, a basic management chronology (Figure 1) can be used as a guide to clarify when species specific management requirements will dictate inseason adjustments in harvest strategy. Sockeye salmon management requires escapement information from up to nine salmon weirs. This information is used to regulate fishing time and areas open to fishing. Prorating fishing time for sockeye salmon solely on the basis of preseason expectations, other than for the June 9 commercial test fisheries, is generally not an acceptable method of managing Kodiak's sockeye salmon stocks.

Initial fishing periods for pink salmon are based upon preseason expectations and are necessary for prosecuting a successful fishery. This can be done with little chance of adverse effects on future production and is the most acceptable way of managing the return of Kodiak's relatively large pink salmon runs.

Chum and coho salmon require a blend of these two management approaches. Both species are initially harvested as a bycatch in directed pink or sockeye salmon fisheries. Specific fisheries targeting on chum and coho salmon require proper run strength assessment before those fisheries can occur. This requires a combination of weir counts and aerial assessment of escapement. Escapement data along with inseason assessment of the bycatch rate determines if the chum and coho salmon returns can support additional near terminal area harvests.

Chinook salmon are not targeted in specific fisheries, but are harvested as a bycatch in fisheries directed toward sockeye and pink salmon.

HARVEST PROJECTIONS

Initial projections for the 1995 Kodiak commercial salmon fishery are for a harvest of approximately 21,770,000 salmon (Table 1). This harvest includes approximately 25,000 chinook, 310,000 coho, 800,000 chum, 18,235,000 pink, and 2,400,000 sockeye salmon.

In addition to the 7,965,000 pink salmon produced at the Kitoi Bay Hatchery, enhancement projects conducted by the Kodiak Regional Aquaculture Association (KRAA) and ADF&G's Commercial Fisheries Management and Development Division (CFMDD) should contribute coho, sockeye, and chum salmon to the common property fisheries of the Kodiak Area. Supplemental production may allow for approximately 246,000 sockeye, 150,000 chum, and 25,000 coho salmon to be harvested (Table 2; all supplemental production numbers are included in the total harvest projections).

A good tool for illustrating the timing and magnitude of salmon harvests is the projected harvest graphs (Appendix A.1 - A.3.). A curve can be drawn, based on the historical cumulative average salmon catch by date, that is scaled to the current preseason harvest projection. By keeping track of the actual salmon harvest by date, and plotting these on the graphs, a comparison of expected and actual returns can be made. These graphs are used for planning purposes by both ADF&G and industry to determine if management strategies need to be modified inseason because of unexpected deviations in actual run strength.

FISHING PERIODS

All fishing periods will be established by emergency order (EO) and will generally be based on inseason assessment of actual run strength (Table 3).

Opening Times

All regular fishing periods will begin at 12:00 Noon and end at 9:00 P.M., except:

- The Cape Igvak fisheries will usually open at 12:01 A.M. and close at 12:01 A.M. during the period of June 6 through July 25.

- The Inner Ayakulik Section fisheries will usually begin at approximately low tide. These will be daylight openings, and will be initiated by ADF&G "flare openings"; fishing will start when a "flare" is launched by ADF&G personnel. When such openings occur, the opening time for the Outer Ayakulik Section may be adjusted to coincide with the Inner Ayakulik Section.

- Beginning on August 16, all fishing periods will end at 6:00 P.M. instead of 9:00 P.M.

Advance Notice for Each Fishing Period

- All advance notice times will be based upon the initial announcements being made on SSB frequency 4125 Khz, following the **6:00 P.M.** daily marine weather broadcasts.

- For the **Cape Igvak fishery**, the initial fishing period will have at least a **36 hour advance notice**. All subsequent fishing periods will have at least **18 hours advance notice**, unless it is an extension of an ongoing fishing period.

- For the **June sockeye fisheries** in the Alitak, S.W. Kodiak, and N.W. Kodiak Districts, **the initial fishing periods** will have at least a **42 hour advance notice**; this includes the normal June 9 fishing period for the Alitak and N.W. Kodiak Districts and the approximate June 14 fishing period for the N.W. Kodiak District.

- **All subsequent fishing periods for the Kodiak Area prior to July 6 will have at least 18 hours advance notice.**

- For the **initial pink/chum salmon fisheries**, at least **42 hours advance notice** will be provided, with the fishery starting at 12:00 noon **on July 6.**

- **All subsequent fishing periods for the Kodiak Area after the July 6 fishing period will have at least 18 hours advance notice.**

- **All extensions** in fishing time from a previously announced fishing period will have at least **3 hours advance notice.**

Inperiod Closures

- **During the period July 6 through July 25 inperiod closures of "Seaward Zones" designated in the North Shelikof Strait Sockeye Salmon Management Plan may occur. Fishers operating in management units covered by this plan are advised that inperiod closures of "Seaward Zones" are possible. Such closures will be announced on SSB frequency 4125 kHz at 8:00 A.M., 10:00 A.M., 2:00 P.M., or 6:00 P.M. with the effective closure time occurring in as little as three hours following the initial announcement time.**

Length of Fishing Periods

Sockeye Salmon

In general, each fishing period targeting early and late sockeye salmon runs to major systems will be dependent upon weir escapement counts. This will also apply to minor systems with weirs that are targeted by the commercial fishery. The exception to this will be the June 9 commercial test fisheries in the Alitak Bay and N.W. Kodiak Districts and the June 9 fisheries in the Foul Bay and Waterfall Terminal Harvest Areas. The first period will extend from 12:00 Noon Friday June 9 through 9:00 P.M. Saturday June 10, a 33 hour period. A second 33 hour commercial test fishery will occur in the N.W. Kodiak District beginning approximately June 14. The opening date is dependent on coordination with other terminal sockeye fisheries in order to spread the fishing effort. Additional fishing time in the Alitak Bay District will depend on the results of the June 9 commercial test fishery, the ADF&G test fishery, weir escapements and sockeye salmon buildups (see Alitak Bay District Management Plan).

In conjunction with the second commercial test fishing period in the N.W. Kodiak District, there will be a 33 hour fishing period for surplus production from minor sockeye salmon systems (Afognak Lake, Saltery, etc.). Specific management units (sections) opened for this fishery depend on run strength associated with these units. The E.O. announcement for this opening will specify which sections are to be opened.

Fishing periods in the Cape Igvak Section will be in 24 hour increments running from 12:01 A.M. to 12:01 A.M.. Fishing time will be dependent upon evaluation of the Chignik System sockeye salmon run strength. Chignik sockeye salmon are the dominant contributing stock harvested in this section. A review of the Cape Igvak Management Plan (5 AAC 18.360) should clarify the biological and allocative requirements. For the 1995 season, fishing time will initially be allocated in the Cape Igvak Section based upon the criteria listed in paragraph (c) of the plan.

For most late run sockeye salmon stocks, a portion of the harvestable surplus is taken as bycatch during targeted pink salmon fishing periods. Consequently, a "blended" management strategy is needed to insure escapements are achieved by species with the upper escapement requirements not being exceeded.

Fishing periods for enhanced sockeye runs in terminal harvest areas (Figures 2-5) may result in continuous 24 hour period openings as long as there is a harvestable surplus.

Chum Salmon

The Duck Bay, Izhut Bay, and Kitoi Bay Sections may open to fishing as early as June 9. This is due to the forecasted strong return of chum salmon to Kitoi Bay Hatchery. Between the July 6 to July 25 time period fishing time for much of the Mainland District will not exceed 57 hours per week.

Pink Salmon

Preemergent pink salmon fry sampling of the Kodiak Management Area index streams conducted during March and April of 1994 indicated just fair over winter survival of the eggs and sac fry. These fry were from an excellent brood year escapement in 1993 with the indexed escapement estimate at 4.3 million pink salmon. Sampling resulted in an unweighted live fry index of 190.64 live fry per square meter of spawning area. This live fry index is the seventh highest odd year index on record. Early spring conditions in 1994 were fair for outmigration and rearing in the nearshore ocean environment. Ambient air temperatures, as measured in Kodiak, were below average in March, but well above average from April through June. Kitoi Bay hatchery manager Tim Joyce noted that compared to recent years the 1994 spring plankton bloom seemed very good, and should have had a positive affect of marine survival.

Although the live fry index was only the seventh highest on record, the number of pink salmon fry observed by salmon fishermen throughout the summer of 1994 in bays on Kodiak Island was higher than usual. This may have been a result of excellent early marine survival combined with an unusually high percentage of live fry outmigrating early from the streams. The actual 1995 combined harvest of hatchery and wild production is likely to fall between the forecasted midpoint of 18.2 million and the upper end of 26.3 million pink salmon.

In addition to the three management criteria identified in the introduction of this document, the harvest strategy for pink salmon utilizes: 1) a fixed July 6 opening date, 2) a pink salmon forecasting program to set the length of the initial fishing periods, and 3) coordination of multiple fisheries whenever possible to allow for dispersion of the purse seine fleet.

The pattern of fishing periods for management units where pink salmon are the targeted species may vary in consideration of the forecasted pink salmon run. Fishing periods are expected to be 3½ days per week from July 6 through approximately August 25. During the peak harvest period of late-July to mid-August, fishing periods may be extended up to seven days per week.

Listed below is a schedule of fishing periods which may be used for planning purposes by both ADF&G and industry.

First Period: 3½ days (81 hours) - 12:00 Noon July 6 through 9:00 P.M. July 9. This period provides important harvest data to assess early run strength of Area K pink salmon and certain chum salmon stocks. No extensions in fishing time based on pink or chum salmon harvests would occur during this period. The increased closed water area will remain in effect in the East Arm of Uganik Bay.

Second Period: 3½ days (81 hours) - 12:00 Noon July 12 through 9:00 P.M. July 15. This second period will assess run strength for both pink and chum salmon and provide harvest data. No extensions in fishing time based on pink or chum salmon harvests would occur during this period.

Third Period: 3½ days (81 hours) - 12:00 Noon July 19 through 9:00 P.M. July 22. The third period will occur following a 3½ day closure. This will allow an influx of pink and chum salmon into terminal areas to enhance the build-up of potential escapement. At this time a combination

of harvest and early escapement or build-up information will provide an indication of the actual run strength for major pink salmon stocks. Extensions in fishing time in the Duck Bay and Izhut Bay Sections may occur.

Fourth Period: 3½ days (81 hours) - 12:00 Noon July 26 through 9:00 P.M. July 29. This fourth period is critical. Harvest should increase substantially and a fairly realistic assessment of total run strength should be evident by the end of the period. Extensions in fishing time commonly occur to this period during years when the pink and chum salmon runs are strong. The initial pink salmon opening for the Kitoi Bay Section is expected to occur at the beginning of this fishing period.

Fifth Period: 3½ days (81 hours) - 12:00 Noon August 2 through 9:00 P.M. August 5. This fifth period should yield the peak harvest day and period, provided that normal run timing occurs. If preseason expectations appear valid, extensions in fishing time could occur in portions of the management area. The first significant announcement of differential fishing time by management unit may occur as heavy production areas are targeted for extensions, while moderate or lower production areas are not.

Sixth Period: 3½ days (81 hours) - 12:00 Noon August 9 through 9:00 P.M. August 12. This sixth period should be the first postpeak period. Returns to major late production systems should be evident by period's end. There may be increases in closed water sanctuaries to enhance escapement levels. Evaluation's of run strength are used to determine if reductions in fishing time are needed for the remaining periods to ensure adequate escapement. A strategy to achieve full escapement in all systems is developed from this period.

Seventh Period: 3½ days (78 hours) - 12:00 Noon August 16 through 6:00 P.M. August 19. During the seventh period, a blended multi-species management approach is used for those sections where pink salmon were the targeted species for the previous six periods. Emphasis will still be on harvesting excess, good quality pink salmon and achieving escapement goals. However, major concern will be directed toward the run strength of late run sockeye and chum salmon.

Eighth Period: 3½ days (78 hours) - 12:00 Noon August 23 through 6:00 P.M. August 26. The eighth period will primarily be a cleanup period for pink salmon stocks. Escapement requirements should be assured at this point. Excess pink salmon of acceptable quality should be available for harvest in near terminal areas. This period also will require a major emphasis on multi-species management. It is a critical management period for late run sockeye and chum salmon stocks, as well as early run coho salmon.

A change to this schedule of fishing periods should be expected if significant deviations in the actual pink salmon return occurs. Less fishing time should be expected in management units where chum salmon are the targeted management species.

Chum and Coho Salmon

A large portion of the 1995 Kodiak chum and coho salmon harvest will occur as bycatch in nonterminal locations during major pink salmon fisheries. System specific chum and coho salmon

fisheries, which occur during the pink salmon fishery, will commonly result in pertinent management units having less fishing time than management units targeting primarily pink salmon stocks. This approach emphasizes the use of more terminally located management units for targeted chum and coho salmon fisheries (i.e., Inner Kukak Section, Zachar Bay Section, Kizhuyak Section, etc.)

INSEASON EMERGENCY ORDER ANNOUNCEMENTS ("GETTING THE WORD")

Fishing period announcements may not always be predictable because the fishery is managed on data which is compiled and evaluated daily. Data used to make fishery decisions includes (1) escapement reports via weir counts or aerial surveys, (2) harvest trends (total catch and catch per unit effort) and (3) information on fish buildups in closed water sanctuaries.

After enough information has been collected to determine the fishing time needed to harvest surplus fish, an emergency order and a fishery announcement are issued in the following manner:

1) A news release is constructed detailing:
   a) The date, time, and number of the emergency order announcement.
   b) The length of the fishing period.
   c) The opening and closing times and dates of the fishing period.
   d) The areas open to fishing.
   e) The areas closed to fishing (those sections not listed as being open).
   f) The location of "closed water" marker adjustments.

2) The news release is posted at the entrance of the Kodiak ADF&G office.

3) Copies of the news release are made available at the Kodiak office. For after hours availability, copies are stored at the main entrance.

4) The news release is recorded on a 24 hour recorded message phone (Number 486-4559).

5) The news release is made available to local radio stations (KVOK and KMXT) to be played by these stations.

6) The news release is announced over SSB channel 4125 Khz following the marine weather broadcasts. Commonly, the first reading of a news release occurs after the 6:00 P.M. weather broadcast, but occasionally the initial reading comes after the 8:00 A.M. weather broadcast.

7) The news release is distributed to all registered processors either by hand, verbally on the telephone, by tele-fax, or through the ADF&G recorded message phone.

8) Information on the most current news release or emergency order can also be obtained by calling the Kodiak ADF&G office during working hours, or by calling Dave Prokopowich

(486-6007), Kevin Brennan (486-6475), or Dennis Gretsch (486-3031) after working hours or on weekends.

9) Copies of emergency orders are mailed to a current listing of required and interested recipients.

10) Many fishers, ADF&G vessels and camps, and Fish and Wildlife Protection vessels use a small tape recorder to document the exact wording of each announcement as it is broadcasted. This is advisable, when considering the complicated nature of each announcement.

NEW REGULATIONS

In March of 1995 the Alaska Board of Fisheries addressed the harvest of Cook Inlet bound sockeye in the Kodiak Area again.

No regulation changes were adopted for the 1995 season.

Listed below is a new regulation adopted by the Alaska Board of Fisheries in March of 1994.

5AAC 18.331. Gillnet Specifications and Operation.

(i) Effective January 1, 1995, in the Moser-Olga Bay Section of the Alitak District the shoreward end attachment point of a set gillnet must be attached to a point of land or rock that is no more than 2.1 feet below the surface of the water at mean lower low water at Alitak Bay. The shoreward end attachment point of a set gillnet in the Moser-Olga Bay Section that is not above the surface of the water at all times

(1) must be certified, by a registered land surveyor, to be no more than 2.1 feet below the surface of the water at mean lower low water at Alitak Bay;

(2) must be marked with a permanent survey monument by a registered land surveyor;

(3) may not be below the survey monument; and

(4) may not be more than two horizontal feet from the survey monument. A set gillnet may not be attached to the beach inside closed waters. For the purpose of this subsection, a "registered land surveyor" is a land surveyor registered by the state under AS 08.48 and 12 AAC 36.(In effect before 1983; am 4/16/83, Register 86; am 5/11/85, Register 94; am 5/31/85, Register 94; am 6/2/88, Register 106; am 4/19/90, Register 114; am 7/23/94, Register 131).

MISCELLANEOUS REGULATORY CLARIFICATIONS

Closed Water Adjustments

There have been conflicting interpretations of Alaska Statute 16.05.785 regarding the failure to remove markers. As a result there will be no inseason adjustments of closed waters unless

ADF&G personnel are able to remove old markers and install new markers, or unless inseason adjustments of closed waters are made to a specific stream terminus. All adjustments to closed waters listed in 5AAC 18.350 will be made by emergency order and announced by news release.

Closed Water Sanctuaries

5AAC 18.350 Closed Waters

Karluk Closed Water Sanctuary

There have been problems encountered in the past with the current description of the closed water sanctuary seaward of Karluk Lagoon. Consequently, the following closed water sanctuary will be in effect, by emergency order, near the entrance to Karluk Lagoon, stream no. 255-101 (Figure 6):

5AAC 18.350 CLOSED WATERS (a)(2) Southwest Kodiak District
(E) That portion of the Southwest Kodiak District (off of the entrance to Karluk Lagoon (stream no. 255-101)) enclosed by a line from 57°34'28" N. lat., 154°28'18" W. long. to 57°34'32" N. lat., 154°26'42" W. long. (NOAA Chart 16598).

Buskin River Closed Water Sanctuary

The stream mouth of the Buskin River (stream no. 259-211) has moved considerably over the past several years. The previous markers were not providing adequate protection to salmon migrating into the stream. The north shore marker has been moved and an offshore point is designated to aid in triangulation of the closed water area. The offshore point is at the reef directly east of the spit, and may be marked with a buoy. The location of the closed waters will be described in the first salmon emergency order as follows (Figure 7):

5AAC 18.350 CLOSED WATERS (a)(6) Northeast Kodiak District
(E) Buskin River: all waters inside of a line running from a marker on the bluff north of the mouth of the Buskin River at approximately 57°45'48" N. lat., 152°28'23" W. long. to a point offshore at 57°45'21" N. lat., 152°28'09" W. long. to a marker located onshore south of the river mouth at approximately 57°45'09" N. lat., 152°28'39" W. long. (NOAA Chart 16595)

Ayakulik River No. 256-201 Closed Water Sanctuary

ADF&G regulatory markers will be placed in such a manner as to better define the "stream terminus" of the Ayakulik River. The intent of this closed water sanctuary is to prevent seines from being set which completely block fish access to the river (Figure 8).

East Arm of Uganik Increased Closed Water Sanctuary

Additional fishing time is anticipated in the Northwest Kodiak District due to early run Karluk sockeye. The closed water sanctuary in the East Arm of Uganik Bay (stream no. 253-122) will be enlarged to provide for increased protection for sockeye and pink salmon bound to Uganik

Lake. This increased closed water sanctuary includes all waters east of a line from Mink Point (153°30'57" W. long. 57°43'06 N. lat) to Packers Spit at (153°30'00" W. long. 57°43'57" N. lat) and will remain in effect for the entire salmon season (Figure 9).

Remainder of the Kodiak Area

A straight line closure is in effect in areas where ADF&G has deployed regulatory markers to establish waters closed to fishing, provided that **no portion of that line is less than 500 yards from the seaward extremities of the exposed tideland banks which designates the stream mouth.** Consequently, common closed water configurations will be areas of various shapes, depending upon the nature of each individual stream mouth extending between the two regulatory markers. In areas where ADF&G has deployed regulatory markers to establish waters closed to fishing in bays a straight line closure is in effect.

ADF&G is expanding its stream marker program in the Mainland District. Fishers participating in salmon fisheries located in the Mainland District should be aware that closed water sanctuaries to protect salmon buildups may be larger in some areas due to the placement of markers.

Boundary Determinations

The latitude and longitude as plotted on a NOAA navigational chart, North American Datum 1927, approximate scale 1:80,000, will represent the **correct** boundary locations in determining the location of a particular district, section boundary, or any inseason emergency order boundary. Boundaries plotted on NOAA navigational charts using NAD 1983 may not correspond to the correct locations. Latitude and longitude as determined by Loran or Global Positioning System (GPS) bearings may represent **incorrect** boundary locations. District and Section boundaries are depicted on the current Kodiak salmon statistical area chart available at Kodiak ADF&G office.

Section Boundaries

The Raspberry Strait Section **is not** part of the Southwest Afognak Section.

Purse Seine Leads

Minimum mesh size is seven (7) inches. Double panels of web overlapped in the lead are **not** legal.

Set Gillnets - Operation of Gear

Leads

"Seine webbing" used as a lead for set gillnets is not intended to "gill salmon". Set gillnet leads which have similar mesh size and web construction to the actual set gillnet gear are not considered legal gear.

Operation of Set Gillnets

Set gillnets must be operated in substantially a straight line, except that no more than 25 fathoms of a **set gillnet** may be used as a **hook**. A **hook** may be used in any configuration. When a **set gillnet** is being operated primarily as a **"hook in any configuration"** it will be considered illegal to **actively** operate that gillnet as a purse or beach seine (such as "round hauling").

FISH TICKETS

All fishers should check the statistical area recorded on each of their fish tickets. It is required that the correct harvest location(s) be shown on each ticket and it is the responsibility of each fisher to ensure that tender operators or cannery personnel record the correct harvest location on each ticket. This information is extremely important in evaluating inseason harvest levels, stock contribution, and effort distribution.

Seiners

Please provide estimates of harvest by area to tender operators. For example "1/3 of my reds were from Cape Alitak (257-20) and the rest were from Red River (256-20). The rest of my fish were 1/2 and 1/2 from each of these areas". Prior to signing your tickets, check to make sure the proper harvest information by **STATISTICAL AREA** has been entered.

Accurate recording of the harvest from that portion of the Shelikof Strait regulated by the Shelikof Strait sockeye salmon management plan is particularly important. In order to provide an accurate accounting of sockeye salmon harvests in this area, ADF&G and Fish and Wildlife Protection will conduct extra monitoring of harvest activity and tendering operations in this area during the July 6 to July 25 time period of this plan.

Gillnetters

Because of the fixed nature of this gear, each permit holder's reporting area (statistical area) should be consistent between landings. In the event that gillnet fishers move into a new statistical area, please provide the tender operator with that information. Prior to signing your tickets, ensure that the proper harvest information by **STATISTICAL AREA** has been entered.

MANAGEMENT PLANS

Currently there are seven Board of Fisheries approved management plans which direct management activities for specific portions of the Kodiak area. Each management plan affects several management units through part or all of the salmon fishing season (Table 4). Any plan

requires the test of time and a continued review process to determine its effectiveness at accomplishing the desired biological and allocative goals.

Proper implementation of these plans in 1995 will require a major communication effort between ADF&G and the industry. All inquiries, suggestions, and concerns regarding management plans should be directed to ADF&G, Kodiak. A discussion of each plan follows.

Cape Igvak

The Cape Igvak Management Plan covers the time period from June 5 through July 25 for salmon fishing in the Cape Igvak Section of the Mainland District (Table 5). This plan has been in effect since 1978 and allocates approximately 15% of the available Chignik sockeye salmon for harvesting to Kodiak permit holders if specific biological and harvest criteria are met in the Chignik Management Area. The 1995 forecast for Chignik sockeye salmon runs indicate that early production should be above average, and that late production should be near average. Fishing time after July 25 in the Cape Igvak Section will be targeted toward pink, chum, and coho salmon bound to spawning streams in the Cape Igvak Section and in the Wide Bay Section.

Alitak Bay District

This plan covers the entire commercial salmon fishing season, and identifies the primary species by management unit throughout the season (Table 6). The plan affects the sockeye salmon stocks returning to the Frazer, Upper Station, and Akalura systems, and the pink and coho salmon stocks returning to Dog Salmon, Upper Station, Akalura, Humpy Cove, Deadman, Horse Marine, and Silver Salmon systems. This plan has been in effect since 1988.

The management chronology for Olga Bay stocks identifies the targeted stocks by approximate time period. In situations where two or more targeted stocks overlap in run timing a blended management approach will occur. Adequate fishing time will be provided to ensure that the upper escapement goals are not exceeded for the dominant stock(s), while still attempting to ensure that the lower escapement goals for the non-dominant stock(s) are achieved. As outlined in this management plan, fishing time directed on these stocks will occur simultaneously in the traditional management units for harvesting these stocks, the Cape Alitak Section and the Moser-Olga Bay Section. Management for these stocks will emphasize an aggressive strategy to contain the harvest to these traditional harvest units; this strategy also applies to the remainder of the stocks in the Alitak Bay District.

The regulation implementing this management plan (5 AAC 18.361) appears in the 1995 Commercial Finfish Regulation Book. Dates listed in the plan are approximate and may vary with changes in run timing. The June 9 commercial test fishery, however, is a firm date.
The specifics for managing the 1995 returns need to consider the expected magnitude of the targeted stocks returning to the Olga Bay systems. The sockeye salmon returns to Alitak are expected to yield relatively strong sockeye salmon production from the early run Frazer system.

Some specific points to emphasize this year are:

- The approximate June 12 through June 24 period is identified as an aggressive management time for Frazer sockeye salmon run.
- The lower biological escapement goal for Frazer sockeye salmon (140,000) will be targeted.
- The biological pink salmon escapement requirement for the Dog Salmon system ranges from 60,000 to 180,000 fish.
- In the event fishing time is required in the Upper Olga Bay management units, there will be minimal advance notice time.
- Sockeye returning to Akalura will be managed in the Inner Akalura Section, so that sockeye escapement does not exceed 60,000 fish. The lower biological escapement goal of 40,000 sockeye will be targeted.

Westside Kodiak

The Board of Fisheries adopted into regulation the Westside Kodiak Management Plan in 1989. This plan identifies a management chronology for the major Westside Kodiak salmon stocks (Table 7).

This plan was submitted as a proposed regulation to the Board of Fisheries by the Kodiak Management Staff in order to allow industry the opportunity to comment on existing harvest strategies and to clarify their intent. Kodiak fishers frequently expressed concerns over how the department would manage the Westside management units (sections) into the 1990's, when local sockeye stocks are projected to be near maximum production, since this will affect the traditional harvest opportunities between fixed and mobile gear. The annual harvest strategy has traditionally invoked a blend of fishing time between the 17 management units covered by this plan. At times this blend has not been totally understood by industry and has resulted in enough allocative uneasiness that future management stability could be jeopardized. Guidelines for this blend needed to occur in regulatory form to specifically identify inseason harvest strategy and dispel any concern or confusion. Again, the previous regulatory structure prior to this management plan did not provide the information needed by industry to evaluate inseason management decisions which affect allocation concerns of the three gear types.

The goal of this management plan is to achieve escapement and harvest objectives of sockeye salmon returning to the Karluk, Ayakulik, and other Westside minor systems. Further, it details the management of pink, chum, and coho salmon returning to systems in the Southwest Afognak, Central, North Cape, Anton Larsen Bay, Sheratin Bay, Kizhuyak Bay, Terror Bay, Inner Uganik Bay, Spiridon Bay, Zachar Bay, Uyak Bay, Outer and Inner Karluk, Sturgeon Bay, Halibut Bay, and Outer and Inner Ayakulik Sections. The intent of the Board is to insure salmon bound to these systems are harvested to the extent possible by the traditional fisheries located in all 17 sections. The plan directs the department to manage the Northwest Kodiak and the Southwest Kodiak Districts and the Southwest Afognak Section in accordance with the guidelines set out in this plan.

This management plan reflects the realization of long term management goals and identifies current management practices both of which were initially implemented in 1971. The basis for these goals and practices was primarily to rebuild depleted Karluk and depressed Ayakulik sockeye salmon stocks. This plan provides a predictable management framework for these rebuilt stocks, as well as major pink, chum and coho salmon stocks of westside Kodiak. It also helps to stabilize fishing opportunities between the three gear types on the highest quality fish in these districts and sections.

Sockeye returning to Karluk Lake will be managed so that an escapement of 200,000 sockeye salmon is attained for the early run and an escapement of 400,000 sockeye salmon is attained for the late run.

The regulatory wording of this plan appears in the 1995 Commercial Finfish Regulation Book under 5AAC 18.362.

North Shelikof Strait Sockeye Salmon

The Board of Fisheries in December 1989 created the North Shelikof Strait Sockeye Salmon Management Plan in response to their concerns that the fishing patterns and quantities of sockeye harvested by Area K seiners in 1988 represented the onset of an expansion of the interception of Cook Inlet bound sockeye in Kodiak Area waters. This plan was meant to contain this interception by not exceeding estimated historical interception levels while still providing for traditional opportunities to harvest high quality local pink and chum salmon stocks. **The major impact of this plan was to create "sockeye harvest caps" for portions of the North Shelikof which encompasses eight (8) management units. After these sockeye harvest caps are met, commercial salmon fishing is restricted in these 8 management units to inshore waters (Figure 6).**

During the January 1993 Board of Fisheries meeting in Kodiak, a modification of the management plan was made to allow for the traditional near shore seine fisheries to continue in the Southwest Afognak Section, in the event the sockeye harvest cap was reached. After the harvest cap is met, fishing will be restricted in waters inside of a 0.5 mile corridor (Figure 10).

The regulatory wording for this management plan is listed below and under 5AAC 18.363.

From July 6 through July 25 in the Dakavak Bay, Outer Kukak Bay, Inner Kukak Bay, Hallo Bay, and Big River Sections of the Mainland District, and in the Shuyak Island and Northwest Afognak Sections of the Afognak District, the department shall manage the fishery as follows:

- **Management of the fishery must be based on local stocks;**

  - **the fishery may remain open during normal fishing periods until the harvest exceeds 15,000 sockeye salmon;**

- **when the harvest exceeds 15,000 sockeye salmon, the department shall restrict the fishery by emergency order to waters of the shoreward zones, as described below:**

  - Dakavak Bay, Outer Kukak Bay, Inner Kukak Bay, Hallo Bay. and Big River Sections west of a line from Cape Douglas at 58°51'06" N. lat, 153°14'54" W. long, to a point at 58°42'40" N. lat, 153°26'18" W. long, to a point east of Swikshak River at 58°38'06" N. lat., 153°35'24" W. long., to Cape Chiniak at 58°31' N. lat., 153°54'21" W. long., to Cape Nukshak at 58°23'30" N. lat., 153°57' W. long., to Cape Ugyak at 58°16'36" N. lat., 154°06'03" W. long., to Cape Gull at 58°13' N. lat, 154°08'30" W. long., to Cape Kuliak at 58°08'11" N. lat., 154°12'34" W. long., to Cape Atushagvik at 58°05' N. lat., 154°18'48" W. long., to Cape Ilktugitak at 58°01'12" N. lat., 154°34'48" W. long to the southern entrance of Dakavak Bay at 58°01' N. lat., 154°43'30" W. long.

  - Shuyak Island and Northwest Afognak Sections south and east of a line from Point Banks at 58°38' N. lat., 152°18'54" W. long., to Dark Island at 58°38'45" N. lat., 152°33'05" W. long., to Gull Island at 58°35'48" N. lat., 152°38'45" W. long., to the northern entrance of Big Bay at 58°34'06" N. lat., 152°40'12" W. long., to the western entrance of Blue Fox Bay at 58°27'41" N. lat., 152°43'42" W. long., to Black Cape at 58°24'33" N. lat., 152°53'09" W. long., to Cape Paramanof at 58°18'21" N. lat., 153°02'45" W. long.

From July 6 through July 25 in the Southwest Afognak Section of the Afognak District, the department shall manage the fishery as follows:

- **management of the fishery must be based on local stocks;**

- **the fishery may remain open during normal fishing periods until the harvest exceeds 50,000 sockeye salmon;**

- **when the harvest exceeds 50,000 sockeye salmon, the department shall restrict the fishery by emergency order to waters of the Southwest Afognak Section Shoreward Zones** east of a line from one-half nautical mile west of Cape Paramanof at 58°18'21" N. lat., 153°02'45" W. long., to one-half nautical mile west of Tanaak Cape at 58°15'36" N. lat., 153°06'09" W. long., to one-half nautical mile west of Steep Cape at 58°12'05" N. lat., 153°12'33" W. long., to one-half nautical mile west of a point at 58°08'25" N. lat., 153°18'52" W. long., to one-half nautical mile west of Raspberry Cape at 58°03'35" N. lat., 153°25'06" W., long.

All fishers and tender operators should familiarize themselves with the boundaries of these "seaward" and "shoreward" zones in each of these eight management units. Also, it will be the responsibility of both the permit holder and the tender operator to make sure fish tickets for fish harvested in the geographical area covered by this plan properly reflect the poundage and quantities of salmon by species. If there are questions on this management plan contact the ADF&G Kodiak staff.

Crescent Lake

The Crescent Lake Management Plan is associated with a relatively small coho enhancement project which could impact the subsistence fishery in the vicinity of Port Lions. This plan clarifies the harvest priorities for coho salmon returning to the Settler Cove area near Port Lions. This plan was slightly modified by the Board of Fisheries, during the January 1993 meeting in Kodiak. Previously the plan allowed commercial harvest inside the breakwater at Port Lions only after September 16; the date is now September 10. In addition, the time period that this plan is in effect was changed from the entire salmon season to the time period July 15 through October 31. The wording of the regulations guiding this plan are listed below as well as in the 1995 Commercial Finfish Regulation Book under 5AAC 18.364.

5AAC 18.364. Crescent Lake Coho Salmon Management Plan.

(a) From July 15 through October 31, the Department shall manage the commercial, sport, and subsistence fisheries in Settler Cove to provide for full utilization of the enhanced stock of coho salmon returning to Crescent Lake in accordance with the Crescent Lake Coho Salmon Management Plan in this section.

(b) Sport and subsistence fisheries are allowed in all waters of Settler Cove consistent with 5AAC 64 and 5AAC 01.

(c) The department may open, by emergency order, those waters of Settler Cove between the causeway and a line from the seaward end of the Port Lions breakwater to a department marker located directly across Settler Cove from the breakwater, to the commercial taking of salmon only as follows:

(1) the department may not allow the commercial taking of salmon before September 10; and

(2) before opening the fishery, the department shall determine that 500 or more coho salmon are available in Settler Cove for harvest.

Eastside Afognak

The Board of Fisheries, during the January 1993 meeting in Kodiak, adopted the Eastside Afognak Management Plan. Prior to the adoption of the management plan the commercial salmon fisheries of the eastside of Afognak Island were managed under an informal management plan formulated by Kodiak Area management biologists and Kitoi Bay hatchery manager. The goal of this plan is to achieve broodstock requirements for the hatchery, escapement requirements for local stocks, and specify the requirements for fishing time in the Southeast Afognak, Duck Bay, Izhut Bay, and Kitoi Bay Sections (Table 8). The regulatory wording of this plan is listed below as well as in the 1995 Commercial Finfish Regulation Book.

5AAC 18.365. Eastside Afognak Management Plan.

(a) The goal of the Eastside Afognak Management Plan is to achieve escapement and harvest objectives of sockeye, pink, coho, and chum salmon returning to natural spawning systems in the Southeast Afognak, Duck Bay, Izhut Bay, and Kitoi Bay Sections, and broodstock to Kitoi Bay hatchery. It is the intent of the board that salmon bound for these systems be harvested by the commercial fisheries located in these sections.

(b) The Southeast Afognak Section shall be managed on sockeye salmon returning to Afognak Lake during the period from June 9 through July 5. From July 6 through August 24, fishing opportunities will be based on pink salmon returning to major systems in Afognak, Kazakof (Danger), and Marka Bays. After August 24, fishing time will be dependent on coho salmon returning to this section.

(c) The Duck Bay Section shall be managed on early chum or sockeye salmon returns to Kitoi Bay hatchery during the period June 9 through July 18. From July 19 through August 24, fishing time will be based on returning mixed wild and hatchery pink salmon. After August 24, this section shall be managed on local coho salmon runs.

(d) The Izhut Bay Section shall be managed on the early chum or sockeye salmon returning to Kitoi Bay hatchery during the period June 9 through July 18. From July 19 through August 1, this section may remain closed to fishing to assure that pink salmon cost recovery goals are achieved at Kitoi Bay hatchery. If hatchery cost recovery harvests are not required, fishing time in this section will depend on returning wild and hatchery pink salmon from July 19 through August 24. After August 24, fishing time will be dependent on returns of local coho salmon and late hatchery sockeye salmon runs.

(e) The Kitoi Bay Section shall be managed on early run chum or sockeye salmon returning to the Kitoi Bay hatchery, from June 9 through July 20. From July 3 through July 20, fishing opportunities will not occur until chum salmon broodstock requirements for the hatchery are assured. After July 20 through August 20, this section will be managed for pink salmon cost recovery and broodstock requirements. If there is no pink salmon cost recovery, the section may be managed to harvest pink salmon that exceed broodstock needs. After August 20, fishing opportunities may be provided to harvest returning late sockeye and coho that exceed broodstock needs.

Spiridon Bay Sockeye Salmon

The Kodiak Regional Aquaculture Association, in conjunction with ADF&G, has developed a supplemental run of sockeye salmon in Spiridon Bay. Sockeye fry are stocked in Spiridon Lake to rear and then migrate into Spiridon Bay. Because of the steep topography of the creek leading to the lake the returning sockeye can not ascend to naturally spawn. All returning sockeye are intended for common property fisheries. ADF&G, KRAA, and the U.S. Fish and Wildlife Service have developed a management plan which attempts to fully utilize these salmon while protecting local stocks. The Spiridon Bay Sockeye Salmon Management Plan was adopted into regulation by the Board of Fisheries at the January 1993 meeting in Kodiak.

5AAC 18.366. Spiridon Lake Sockeye Salmon Management Plan.

(a) The department shall manage the commercial, sport, and subsistence fisheries in Spiridon Bay to provide for full use of the enhanced stock of sockeye salmon returning to Spiridon Lake.

(b) The purpose of the Spiridon Bay harvest strategy is to allow for the orderly harvest of sockeye salmon returning to Telrod Cove from the Spiridon Lake enhancement project while providing adequate protection for local natural salmon stocks returning to other streams of the bay. The intent of the enhancement project is for the harvest of returning enhanced salmon to occur in traditional commercial fishing areas of the Northwest Kodiak District during openings directed at harvesting Karluk sockeye and westside pink and chum salmon stocks.

(c) Only that portion of the Spiridon Bay Special Harvest Area in Telrod Cove Proper will be open to fishing (Figure 2). **(New for 1995.)**

(d) Only purse seine and beach seines may be operated in the Spiridon Bay Special Harvest Area.

(e) If a harvestable surplus of enhanced sockeye salmon is in the special harvest area, fishing periods will run 24 hours per day. When possible, openings will be coordinated to occur at the beginning of openings in the Northwest Kodiak District. **(New for 1995.)**

Eastside Kodiak

The Eastside Kodiak Salmon Management Plan shows which species effect fishing time in management units located in the Northeast and Eastside Kodiak Districts throughout the season (Table 9). Although not in regulation, this plan reflects fishing opportunities which have been implemented annually since 1978.

SOCKEYE SALMON ESCAPEMENTS GOALS FOR AREA K MAJOR SOCKEYE SALMON SYSTEMS

The amount of fishing time for targeted sockeye salmon fisheries on systems having fish weirs is dependent on actual escapements. These include the Karluk, Ayakulik, Upper Station, and Frazer systems (major systems) and for the Akalura, Saltery, Buskin, Litnik, Pauls, and Thorsheim systems (minor systems). For sockeye salmon systems without weirs, fishing time is generally conservative and occurs at the discretion of ADF&G, in proportion to the perceived system specific run strength.

Upper and lower biological escapement requirements have been identified for each river's sockeye salmon stocks (Table 10). A basic management function is to achieve at least the lower

escapement goals for stocks exploited by targeted fisheries, even if it means that directed fishing time on those stocks does not occur. When the possibility exists that the upper escapement goals may be exceeded and significant deviations from optimum production could occur because of that excess; maximum directed fishing time on these stocks would be allowed, even if it requires continuous stream terminus fishing to contain the escapement at or near the upper levels. This is the extreme case occasionally needed to manage the Kodiak Area sockeye salmon runs. More common is a moderate amount of directed fishing time required to harvest sockeye salmon surplus and provide escapement approaching desired levels.

Escapement graphs by stream are a good tool for illustrating escapements, similar to preseason harvest projections (Appendix B.1. - B.5.). These are curves drawn based on historical average cumulative escapement by day, scaled to the upper and lower biological escapement goal for each particular system. Actual escapements can be plotted on these graphs to compare with the projected cumulative count. Since fishing time is strongly tied to escapement levels, these graphs can be valuable aids in understanding current ADF&G management actions, and in planning for future fisheries. Actual inseason escapement counts can be heard daily at 8:15 A.M. on SSB channel 3230 Khz.

Table 1. Commercial salmon harvest in 1994 and harvest projections for the Kodiak Management Area, 1995.

	CHINOOK	SOCKEYE	COHO	PINK	CHUM	TOTAL
1994 Projected Harvest	25,000	2,428,100	325,000	13,700,000	610,000	17,088,100
1994 Actual Harvest	22,600	2,877,500	296,200	8,162,600	738,800	12,097,700
1995 Projected Harvest	25,000	2,400,000	310,000	18,235,000	800,000	21,770,000

FISHERY	1994 HARVEST[a] Projection	1994 HARVEST[a] Actual[c]	1995 HARVEST[a,b] Projection as of 1/5/95
Early Run Sockeye Salmon Fisheries (6/9-7/15)			
Cape Igvak	262,500	295,700	280,000
Karluk	400,000	652,800	200,000
Ayakulik	105,000	0	45,000
Frazer	420,000	477,200	420,000
Upper Station	70,000	57,700	50,000
Minor Systems	70,000	36,100	50,000
Minor Enhancements	-	4,900	90,000
Other	100,000	142,500	70,000
SubTotal	**1,427,500**	**1,666,900**	**1,205,000**
Late Run Sockeye Salmon Fisheries (7/16-9/15)			
Afognak (Hatchery)	5,000	9,300	30,000
Cape Igvak	140,600	26,600	120,000
Karluk	175,000	355,200	350,000
Ayakulik	65,000	106,300	30,000
Frazer	105,000	119,300	105,000
Upper Station	250,000	277,700	300,000
Minor Systems	75,000	8,300	75,000
Spiridon	135,000	263,800	160,000
Other	50,000	44,100	25,000
SubTotal	**1,000,600**	**1,210,600**	**1,195,000**
TOTAL SOCKEYE	**2,428,100**	**2,877,500**	**2,400,000**
Coho Salmon Fisheries (8/1-10/1)			
Afognak (Hatchery)	75,000	45,900	15,000
Afognak (Natural)	40,000	47,100	35,000
Westside	85,000	107,100	135,000
Alitak	20,000	32,200	25,000
Eastside/Northend Kodiak	75,000	43,100	60,000
Mainland	30,000	20,800	40,000
SubTotal	**325,000**	**296,200**	**310,000**
Pink Salmon Fisheries (7/6-9/5)			
Afognak (Hatchery)	1,400,000	2,051,400	7,965,000
Afognak (Natural)	700,000	623,400	1,150,000
Westside Kodiak	5,000,000	3,315,000	4,650,000
Alitak	2,000,000	1,120,800	2,365,000
Eastside/Northend Kodiak	3,500,000	858,200	1,750,000
Mainland	1,100,000	193,800	355,000
SubTotal	**13,700,000**	**8,162,600**	**18,235,000**

-Continued-

Table 1. (page 2 of 2)

FISHERY	1994 HARVEST[a] Projection	1994 HARVEST[a] Actual[c]	1995 HARVEST[a,b] Projection as of 1/5/95
Chum Salmon Fisheries (6/6-9/5)			
Afognak (Hatchery)	10,000	5,000	150,000
Afognak (Natural)	50,000	34,900	31,000
Westside Kodiak	250,000	286,100	213,000
Alitak	50,000	112,100	38,000
Eastside/Northend Kodiak	150,000	209,700	148,000
Mainland	100,000	91,000	220,000
SubTotal	**610,000**	**738,800**	**800,000**
GRAND TOTAL	**17,088,100[d]**	**12,097,700[e]**	**21,770,000[f]**

[a] Numbers of fish.
[b] 1995 harvest projections as of 1/5/9.
[c] Actual harvest estimates by fishery as of 1/5/95.
[d] Includes 25,000 chinook - projected harvest.
[e] Includes 22,600 chinook - actual harvest.
[f] Includes 25,000 chinook - projected harvest.

Table 2. Expected harvest from supplemental salmon production, by system and species for the Kodiak Management Area, 1995.[a]

System	Sockeye	Pink	Coho	Chum
Kitoi Bay Hatchery Complex[b]	32,000[c]	7,965,000	15,000	150,000
Spiridon Lake[d]	160,000	0	0	0
Hidden Lake	21,000	0	0	0
Waterfall Lake	20,000	0	0	0
Crescent Lake[e]	13,000	0	5,000	0
Katmai Lake	0	0	2,000	0
Kodiak Road System Lakes	0	0	3,000	0
Total	246,000	7,965,000	25,000	150,000

[a] Harvest estimates by KRAA and Kitoi Bay Hatchery staff.
[b] See Eastside Afognak Salmon Management Plan.
[c] Harvest is expected to occur during fisheries targeting pink salmon.
[d] See Spiridon Lake Sockeye Salmon Management Plan.
[e] See Crescent Lake Salmon Management Plan.

Table 3. Commercial salmon season opening times and dates by species for the Kodiak Area, 1995.

FISHERY	EARLIEST OPENING TIME/DATE	
	Firm Time/Date	Approximate Time/Date
Early Run Sockeye Salmon Fisheries		
Cape Igvak Section [a]	-	12:01 A.M. June 5-9
N.W. Kodiak District [b]	12:00 Noon June 9	
Inner Ayakulik and Outer Ayakulik Sections [c]	-	Low tide June 7-9
Alitak District [b]	12:00 Noon June 9	
Minor Systems [d]		
Uganik	-	12:00 Noon June 14
Paramanof	-	12:00 Noon June 14
Pauls/Perenosa	-	12:00 Noon June 14
Litnik/Waterfall Lake/Hidden Lake	-	12:00 Noon June 9-14
Saltery	-	12:00 Noon June 14
Kaflia/Swikshak	-	12:00 Noon June 14
Pink/Chum Salmon Fisheries [e]		
Mainland District	12:00 Noon July 6	-
Afognak District	12:00 Noon July 6	-
N.W. Kodiak District	12:00 Noon July 6	-
S.W. Kodiak District	12:00 Noon July 6	-
Alitak District	12:00 Noon July 6	-
Eastside Kodiak District	12:00 Noon July 6	-
N.E. Kodiak District	12:00 Noon July 6	-
Late Run Sockeye Salmon Fishery		
Cape Igvak Section [f]	-	12:01 A.M. July (?)
All remaining late run sockeye fisheries [g]	-	12:00 Noon July 15
System Specific Coho Salmon Fisheries [h]		
Mainland District	-	12:00 Noon Sept. 1
Afognak District	-	12:00 Noon Aug. 15
N.W. Kodiak District	-	12:00 Noon Sept. 1
S.W. Kodiak District	-	12:00 Noon Sept. 1
Alitak District	-	12:00 Noon Sept. 1
Eastside Kodiak District	-	12:00 Noon Sept. 5
N.E. Kodiak District	-	12:00 Noon Sept. 5

-Continued-

Table 3. (page 2 of 2)

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[a] Actual opening date will be determined by sockeye escapement levels into the Chignik River system. Fishing time will be in 24 hour increments.

[b] Actual opening time/date is as shown. This opening is considered a commercial test fishery; fishing time for this initial period will be 33 hours (12:00 nooon 6/9 through 9:00 P.M. 6/10).

[c] Actual opening date will be determined by the sockeye escapement level into Ayakulik River and opening time by low tide timing during daylight hours.

[d] Actual opening time will be determined by sockeye escapement levels into minor systems. Fishing time for this period will be 33 hours (12:00 noon through 9:00 P.M.)

[e] Actual opening time/date is as shown. Fishing time for this initial period will be 105 hours (12:00 noon 7/6 through 9:00 P.M. 7/10). See section on Fishing Periods for additional information.

[f] Actual opening date will be determined by sockeye escapement levels into the Chignik River System. Fishing time will be in 24 hour increments.

[g] Actual opening date for system specific fishing time will be determined by sockeye escapement levels into major systems. All fishing periods will begin at 12:00 noon and end at 9:00 P.M. prior to 8/16 and end at 6:00 P.M. from 8/16 to season's end.

[h] Actual opening date for system specific fishing time will be determined by overall coho run strength evaluation and by escapement levels into major systems and minor systems with reliable escapement data.

Table 4. Regulatory fishery management plans for the Kodiak Management Area, 1995.

MANAGEMENT PLAN	YEAR INITIATED	MGMT. UNITS AFFECTED	DATES IN EFFECT
Cape Igvak Salmon Management Plan	1978	Cape Igvak Section Wide Bay Section	6/5 - 7/25
Alitak Bay District Salmon Management Plan	1987	Alitak Bay District	6/9 - 10/1
Westside Kodiak Management Plan	1990	N.W. Kodiak District S.W. Kodiak District S.W. Afognak Section	6/9 - 10/1
Crescent Lake Coho Salmon Management Plan	1990	Portion of the Central Section in Vicinity of Port Lions	8/1 - 9/15
North Shelikof Strait Sockeye Salmon Management Plan	1990	S.W. Afognak Section N.W. Afognak Section Shuyak Section Big River Section Hallo Bay Section Inner and Outer Kukak Sect. Dakavak Section	7/6 - 7/25
Eastside Afognak Management Plan	1993	Kitoi Bay Section Izhut Bay Section Duck Bay Section	6/9 - 10/1
Spiridon Bay Sockeye Salmon Management Plan	1993	Special Harvest Area in Spiridon Bay Section	6/9 - 10/1

Table 5. Biological and allocative criteria, and the management chronology, of the Cape Igvak Management Plan for the Kodiak Management Area, 1995.

BIOLOGICAL AND ALLOCATIVE CRITERIA FOR MANAGING THE CAPE IGVAK FISHERY ON CHIGNIK BOUND SOCKEYE

BIOLOGICAL REQUIREMENTS			ALLOCATIVE REQUIREMENTS		
REGULATION 5AAC 18.360	ESCAPEMENT NEEDS CHIGNIK (EARLY RUN)	ESCAPEMENT NEEDS CHIGNIK (LATE RUN)	REGULATION 5AAC 18.360	CHIGNIK MINIMUM HARVEST	IGVAK %
(a) (b) (c)	THROUGH 6/30 350,000-400,000	-	(a)	EXPECTATIONS OF LESS THAN 600,000	CLOSED
-	-	-	(b)	EXPECTATIONS OF 600,000 ARE IN DOUBT	CLOSED
(a) (b) (c)	-	THROUGH 7/30 195,000-200,000	(c)	EXPECTATIONS OF 600,000 OCCUR	OPEN TO ACHEIVE 15%
-	-	-	(d)	CHIGNIK SALMON % INTERCEPTION CALCULATIONS	80% OF CATCH AT IGVAK ARE CHIGNIK SOCKEYE
-	-	-	(e)	ALLOCATION PERIOD 600,000	6/5 - 7/25 % NOT APPLICABLE
(f)	FROM JUNE 26 - JULY 9 CAPE IGVAK SECTION CLOSED OR SEVERLY LIMITED UNTIL CHIGNIK LAKE RUN EVALUATED		-	-	-
-	-	-	(g)	-	ONE DAY ADVANCE NOTICE
	400,000	250,000		600,000 = MINIMUM	15 %

MANAGEMENT CHRONOLOGY FOR CHIGNIK BOUND SOCKEYE AND KODIAK SALMON

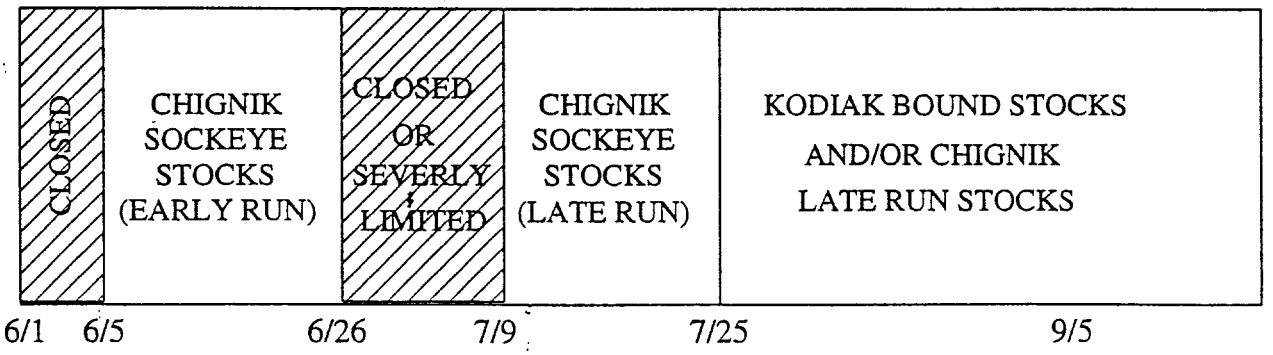


Table 6. Primary management species and fishery chronology of the Alitak Bay District Salmon Management Plan for the Kodiak Management Area, 1995.

ALITAK BAY DISTRICT MANAGEMENT PLAN

CAPE ALITAK SECTION (SEINE)	CLOSED XXXXXXX	FRAZER SOCKEYE (AGGRESSIVE MANAGEMENT STRATEGY)	FRAZER SOCKEYE (CONSERVATIVE MANAGEMENT STRATEGY)	ODD YEAR CYCLE FRAZER PINK SALMON / EVEN YEAR CYCLE UP.STATION SOCKEYE (LATE RUN)	ODD YEAR CYCLE UP.STATION SOCKEYE / EVEN YEAR CYCLE UP.STATION SOCKEYE & FRAZER PINK SALMON	ALL ALITAK DISTRICT COHO SYSTEMS
MOSER/OLGA BAY SECTION (GILLNET) (TRADITIONAL)	CLOSED XXXXXXX	FRAZER SOCKEYE (AGGRESSIVE MANAGEMENT STRATEGY)	FRAZER SOCKEYE (CONSERVATIVE MANAGEMENT STRATEGY)	ODD YEAR CYCLE FRAZER PINK SALMON / EVEN YEAR CYCLE UP.STATION SOCKEYE (LATE RUN)	ODD YEAR CYCLE UP.STATION SOCKEYE / EVEN YEAR CYCLE UP.STATION SOCKEYE & FRAZER PINK SALMON	ALL OLGA BAY COHO SYSTEMS
OUTER UPPER & INNER UPPER STATION (GILLNET) (NON-TRADITIONAL)	CLOSED CLOSED	UPPER STATION SOCKEYE (EARLY RUN)		UPPER STATION SOCKEYE (LATE RUN)	UP. STATION SOCK & COHO	UPPER STATION COHO
OUTER AKALURA & IN. AKALURA SECTIONS (GILLNET) (NON-TRADITIONAL)	CLOSED CLOSED	AKALURA SOCKEYE (EARLY RUN)		AKALURA SOCKEYE (LATE RUN)	AKALURA SOCK & COHO	AKALURA COHO
DOG SALMON FLATS SECTION (GILLNET) (NON-TRADITIONAL)	CLOSED CLOSED	FRAZER SOCKEYE (MOP UP FISHERY)		FRAZER PINK SALMON	FRAZER AND HORSE MARINE COHO	
HUMPY/DEADMAN SECTION (SEINE)	CLOSED XXXXXXX	FRAZER SOCKEYE (AGRESSIVE MANAGEMENT STRATEGY)	FRAZER SOCKEYE (CONSERVATIVE MANAGEMENT STRATEGY)	ALITAK BAY PINK, CHUM, AND COHO		

6/1 6/9-10 6/24 7/9 7/15 8/9 8/20 8/26 9/25

xx = Commercial Test Fisheries

ALITAK BAY DISTRICT - PRIMARY MANAGEMENT SPECIES BY STREAM BY TIME

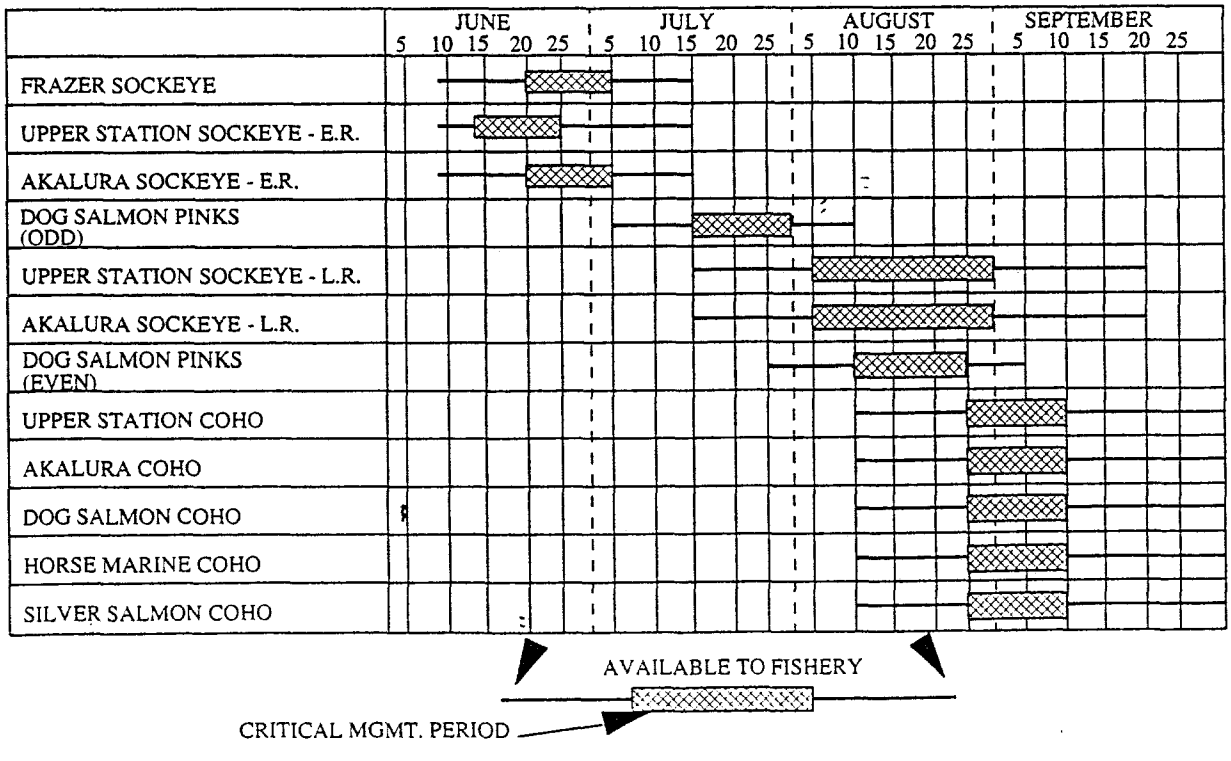


Table 7. Primary management species and fishery chronology of the Westside Kodiak Management Plan for the Kodiak Management Area, 1995.

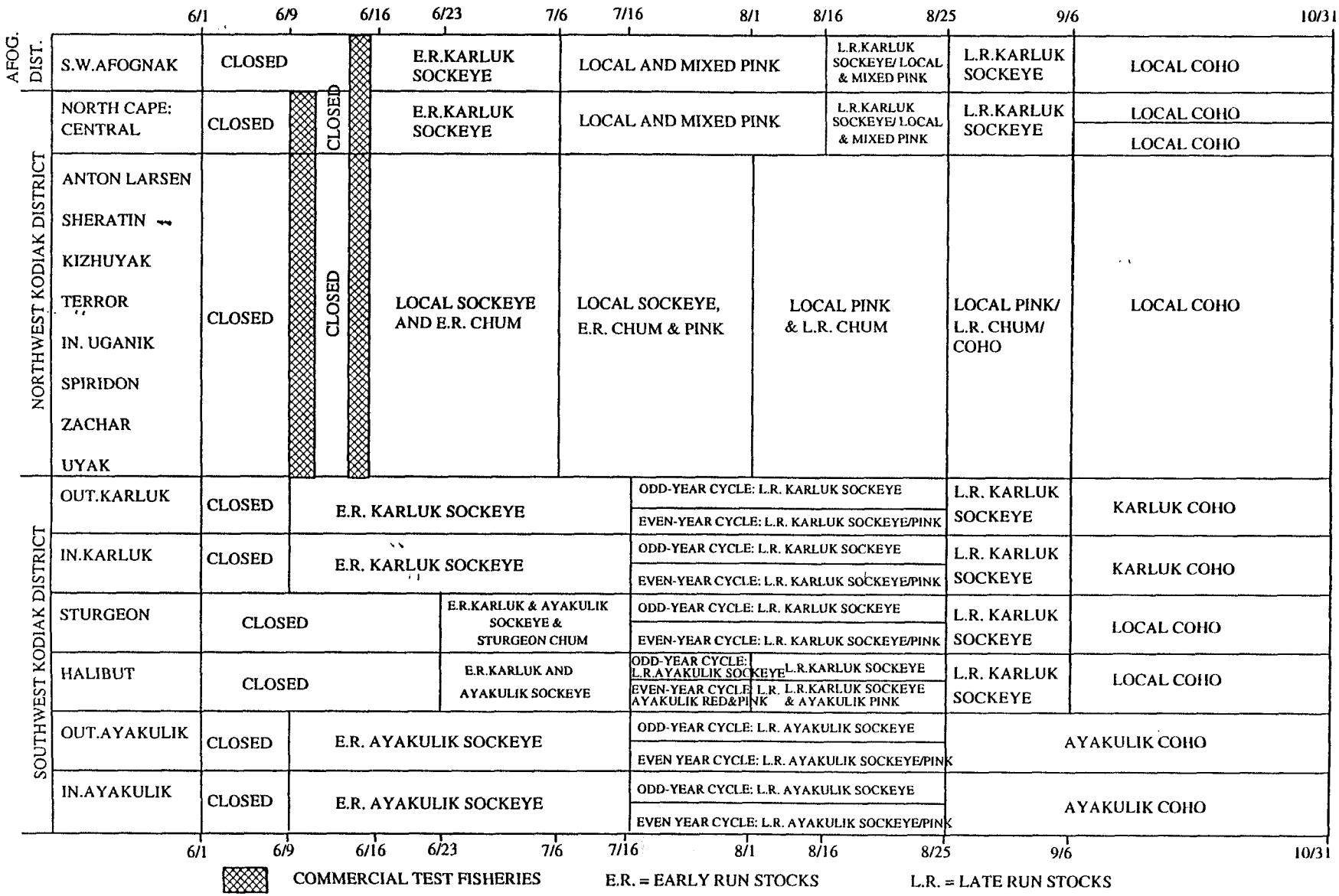
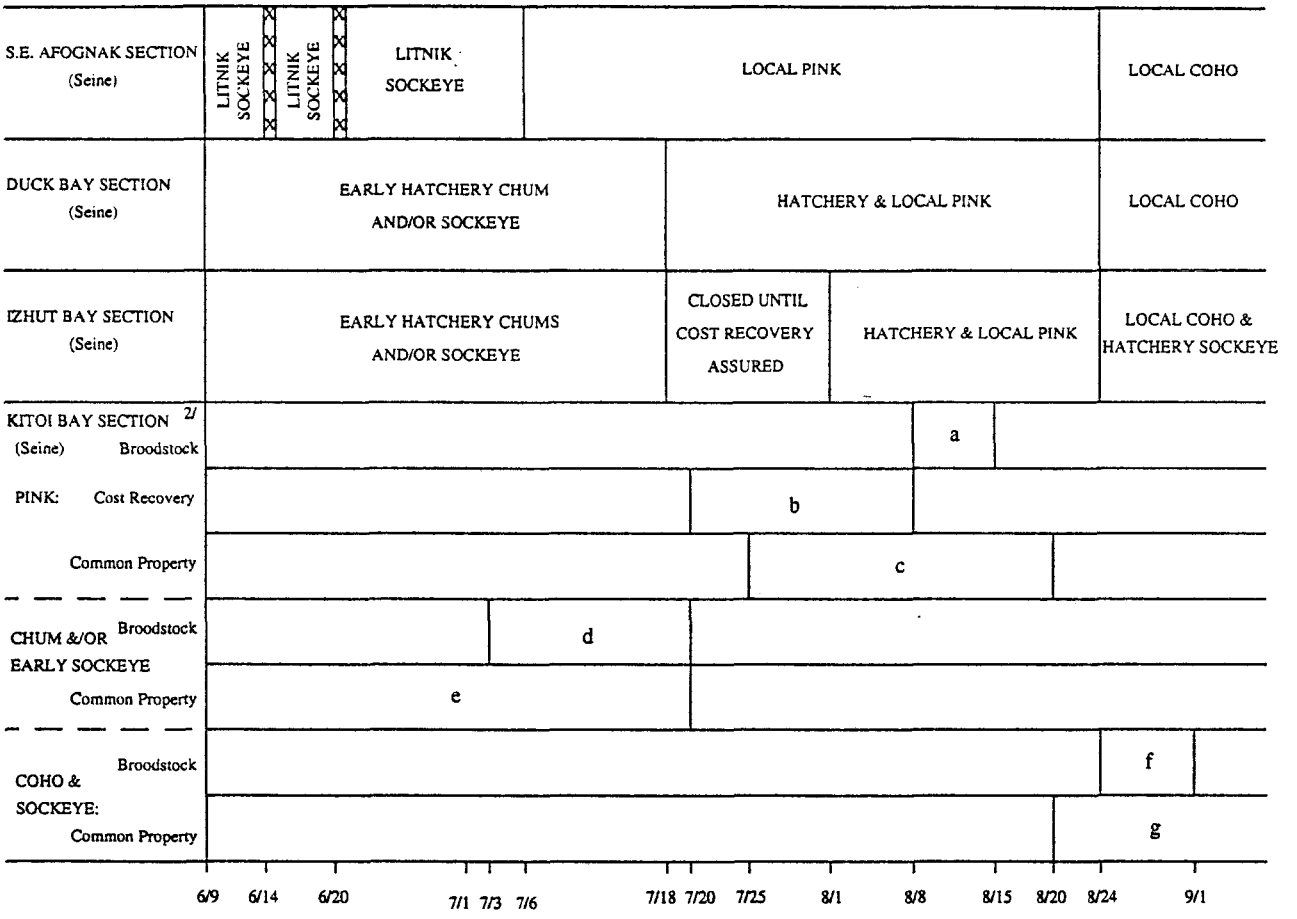


Table 8. Primary management species and fishery chronology of the Eastside Afognak Management Plan for the Kodiak Management Area, 1995.

TARGETED SPECIES BY SYSTEM AND TIME FOR SPECIFIC MANAGEMENT UNITS [1/]



- fishing time dependant upon sockeye escapement into Litnik system.

1 Included in this management plan are the harvest strategies for current natural and hatchery prodution as well as future hatchery production.

2 The management plan required for the Kitoi Bay Section is rather complicated in order to achieve broodstock, cost recovery, and common harvest requirements. This is further complicated by the multispecies production currently occurring at Kitoi Bay hatchery. The diagram shown attempts to approximate dates for when specific management strategies should be implemented to insure achievement of hatchery goals and an orderly harvest of quality common property fish.

a Hatchery pink salmon broodstock captured.
b Hatchery pink salmon cost recovery fishery when necessary.
c Hatchery pink salmon common property fishery.
d Hatchery chum and/or early sockeye salmon broodstock captured.
e Hatchery chum and/or early sockeye salmon common property fishery.
f Hatchery coho and late sockeye salmon broodstock captured.
g Hatchery coho and late sockeye salmon common property fishery.

Table 9. Management chronology by management unit for eastside salmon stocks, Kodiak Management Area, 1995.

	DATE	6/1	6/14	6/21	7/6	7/10	8/25	9/6	10/31
	MANAGEMENT UNIT								
NORTHEAST KODIAK DISTRICT	OUTER CHINIAK BAY	CLOSED			LOCAL AND MIXED PINK		LOCAL PINK, COHO	LOCAL COHO	
	INNER CHINIAK BAY	CLOSED			LOCAL AND MIXED PINK AND CHUM		LOCAL PINK, COHO	LOCAL COHO	
	BUSKIN RIVER	CLOSED			LOCAL PINK BUSKIN SOCKEYE	LOCAL PINK AND CHUM	LOCAL PINK, COHO, CHUM	LOCAL COHO	
	MONASHKA/MILL BAY	CLOSED			LOCAL AND MIXED PINK		LOCAL PINK, COHO	LOCAL COHO	
EASTSIDE KODIAK DISTRICT	SEVEN RIVERS	CLOSED	CLOSED	CLOSED	LOCAL AND MIXED PINK AND CHUM		LOCAL PINK, COHO	LOCAL COHO	
	TWO HEADED	CLOSED	CLOSED	CLOSED	LOCAL AND MIXED PINK AND CHUM		LOCAL PINK, COHO	LOCAL COHO	
	SITKALIDAK	CLOSED	CLOSED	CLOSED	LOCAL AND MIXED PINK AND CHUM		LOCAL PINK, CHUM, COHO	LOCAL COHO	
	OUTER UGAK BAY	CLOSED	CLOSED	PASAGSHAK SOCKEYE	LOCAL AND MIXED PINK AND CHUM		LOCAL PINK, CHUM, COHO	LATE CHUM, COHO	
	INNER UGAK BAY	CLOSED	CLOSED	SALTERY SOCKEYE	LOCAL PINK & CHUM SALTERY SOCKEYE	LOCAL PINK AND CHUM	LOCAL PINK, COHO	COHO	

Local and mixed sockeye 33 hour fishing period.

Table 10. Sockeye salmon escapement goals for major and minor systems in millions of fish, for the Kodiak Management Area, 1995.[a]

	Early Run (Before 7/15)		Late Run (After 7/15)		Total	
	Minimum	Desired	Minimum	Desired	Min.	Des.
Major Systems						
Karluk [b]	.150	.250	.400	.550	.550	.800
Ayakulik	.160	.220	.040	.080	.200	.300
Upper Station [b]	.050	.075	.150	.200	.200	.275
Frazer [c]	.140	.200	-	-	.140	.200
Subtotal	**.500**	**.745**	**.590**	**.830**	**1.090**	**1.575**
Minor Systems						
Akalura [b]	.010	.015	.030	.045	.040	.060
Saltery [c]	.020	.040	-	-	.020	.030
Buskin [c]	.010	.015	-	-	.010	.015
Litnik [c]	.040	.060	-	-	.040	.060
Pauls [c]	.020	.040	-	-	.020	.040
Thorsheim [c]	.005	.010	-	-	.005	.010
Subtotal	**.105**	**.180**	**.030**	**.045**	**.135**	**.205**
GRAND TOTAL	**.605**	**.925**	**.620**	**.875**	**1.225**	**1.790**

[a] This listing of systems identifies only those systems whose escapement is monitored by fish weir total escapement counts. The escapement into these systems represents approximately 85% of the Kodiak Area's total sockeye escapement.

[b] Sockeye escapement into these systems characterized by two distinct stocks as identified by bimodal escapement pattern, i.e. an early stock where the cumulative escapement occurs through July 15 and a late stock where the cumulative escapement occurs primarily from July 16 through season's end.

[c] Sockeye escapement into these systems characterized by one distinct escapement pattern and where escapement is essentially completed by approximately July 25. Escapement goals for Pauls Bay are currently being reevaluated.

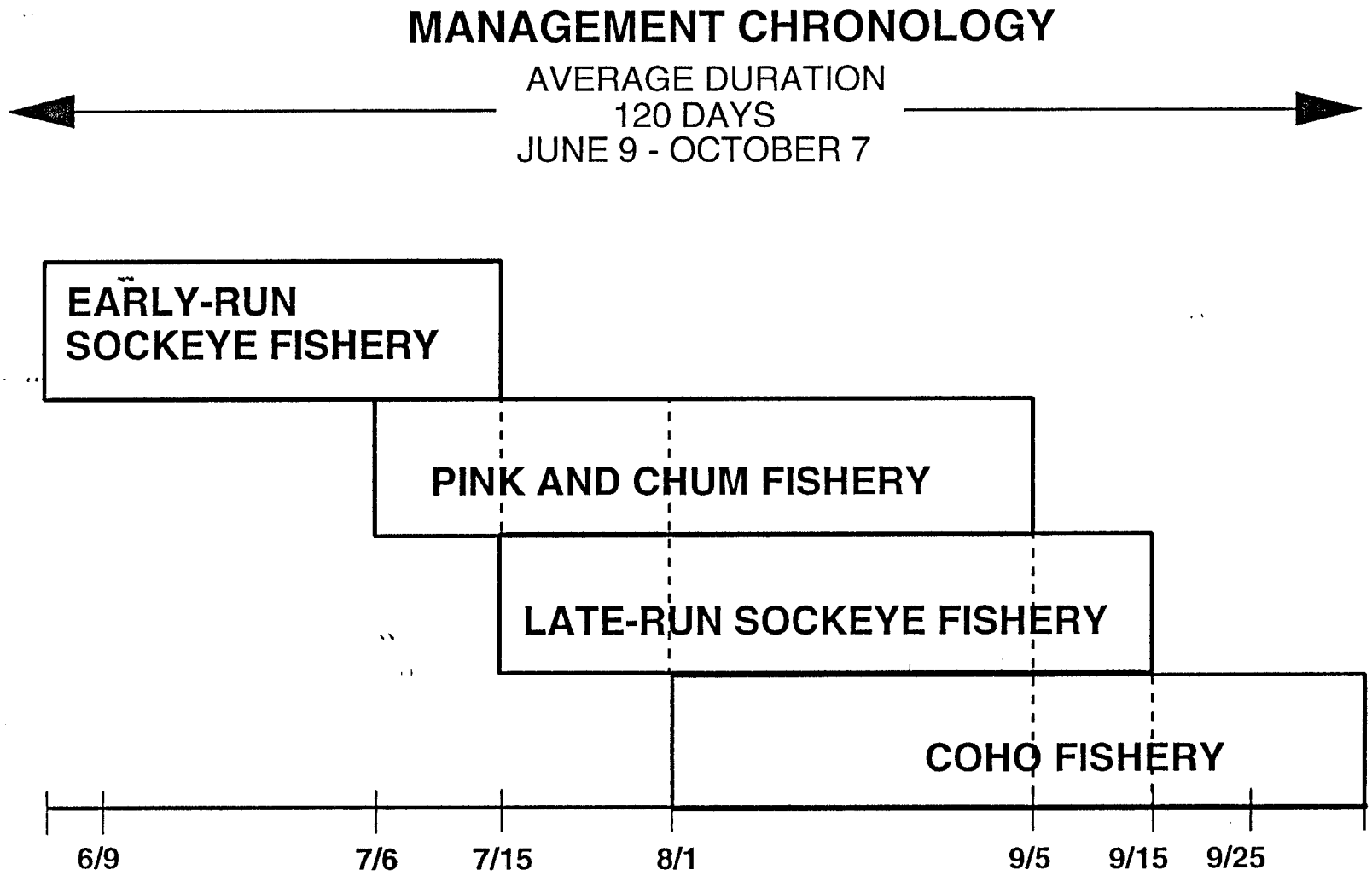


Figure 1. Commercial salmon fishery chronology, by specie, in the Kodiak Management Area.

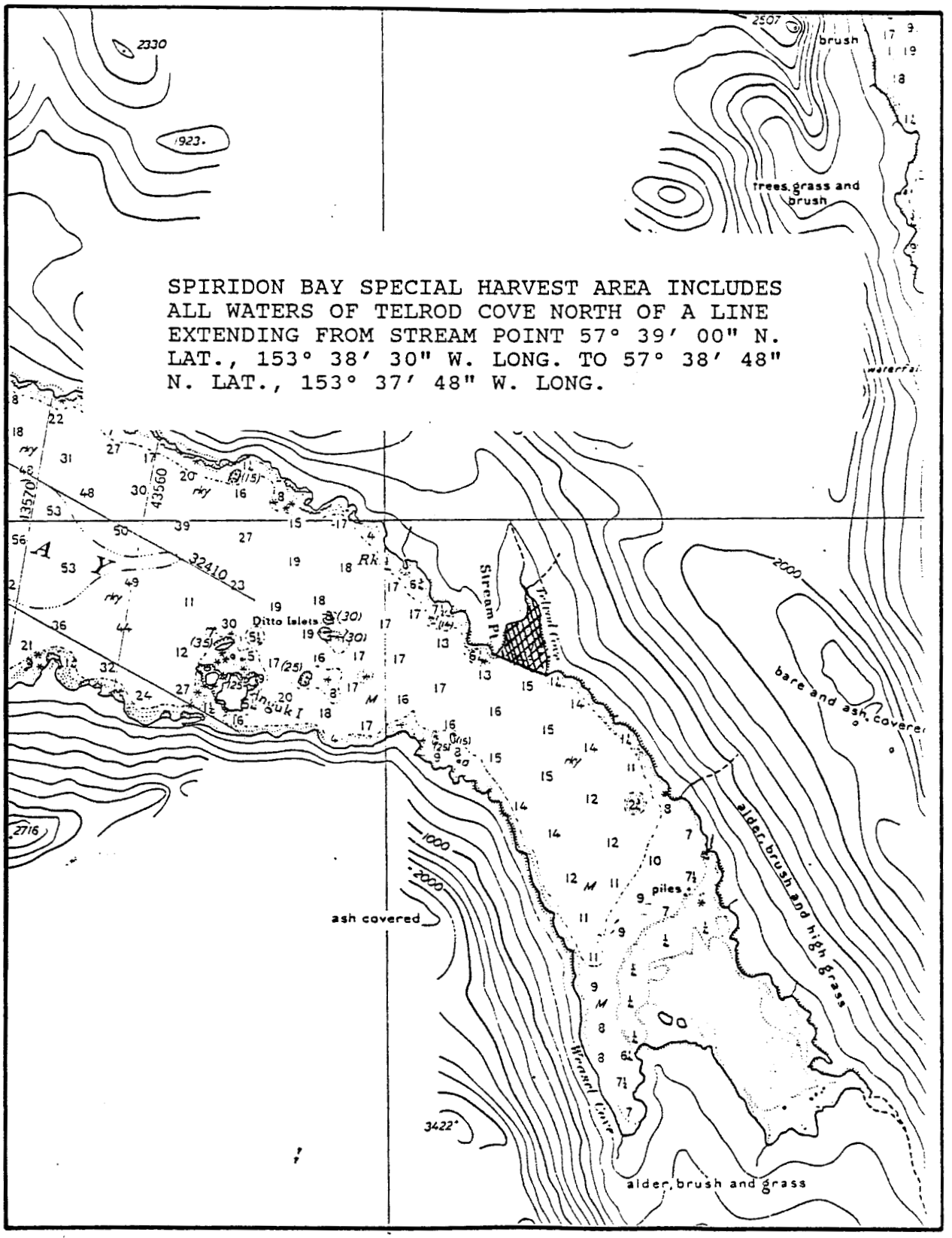


Figure 2. Approximate boundaries of the Spiridon Bay Special Harvest Area.

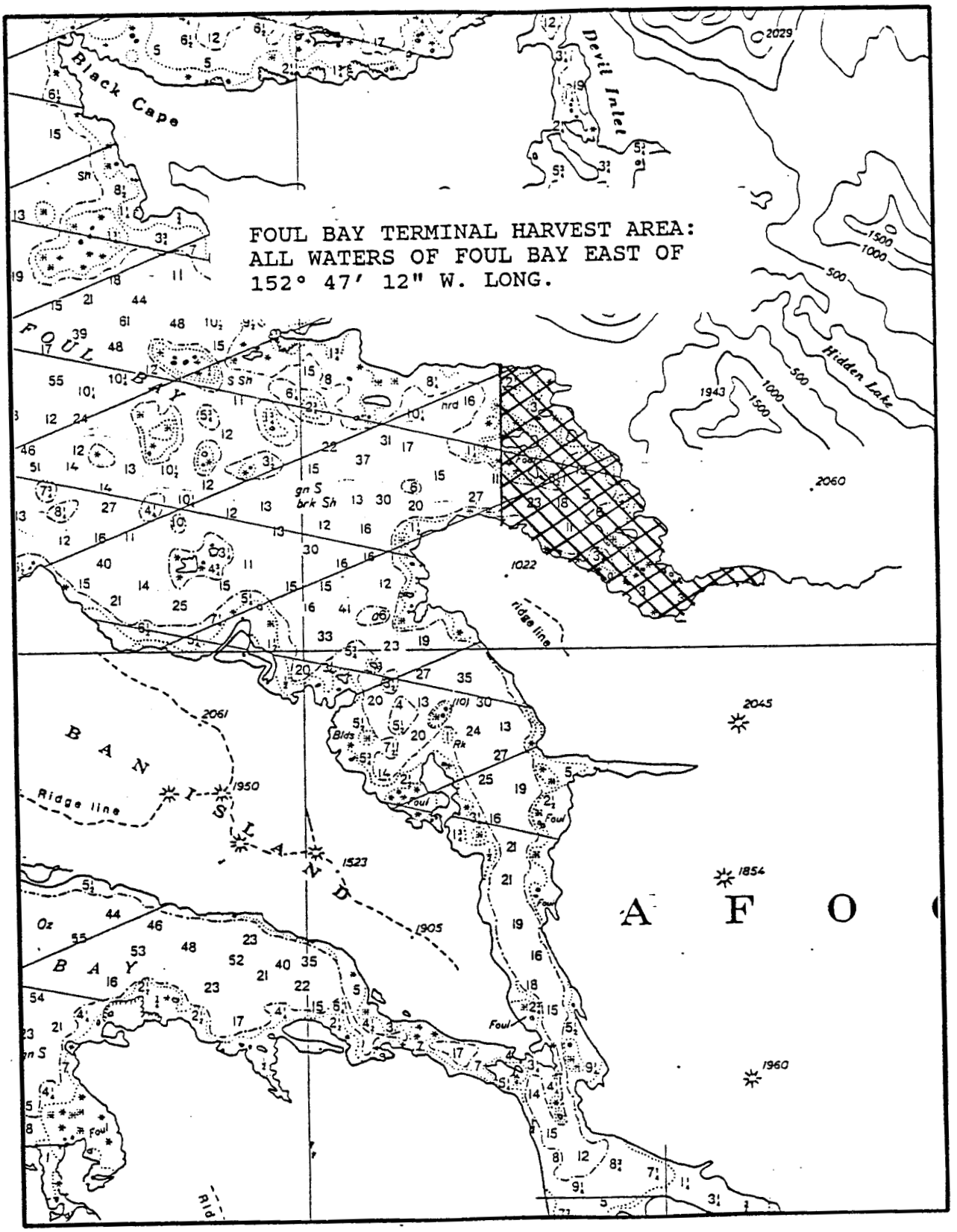


Figure 3. Foul Bay Terminal harvest Area.

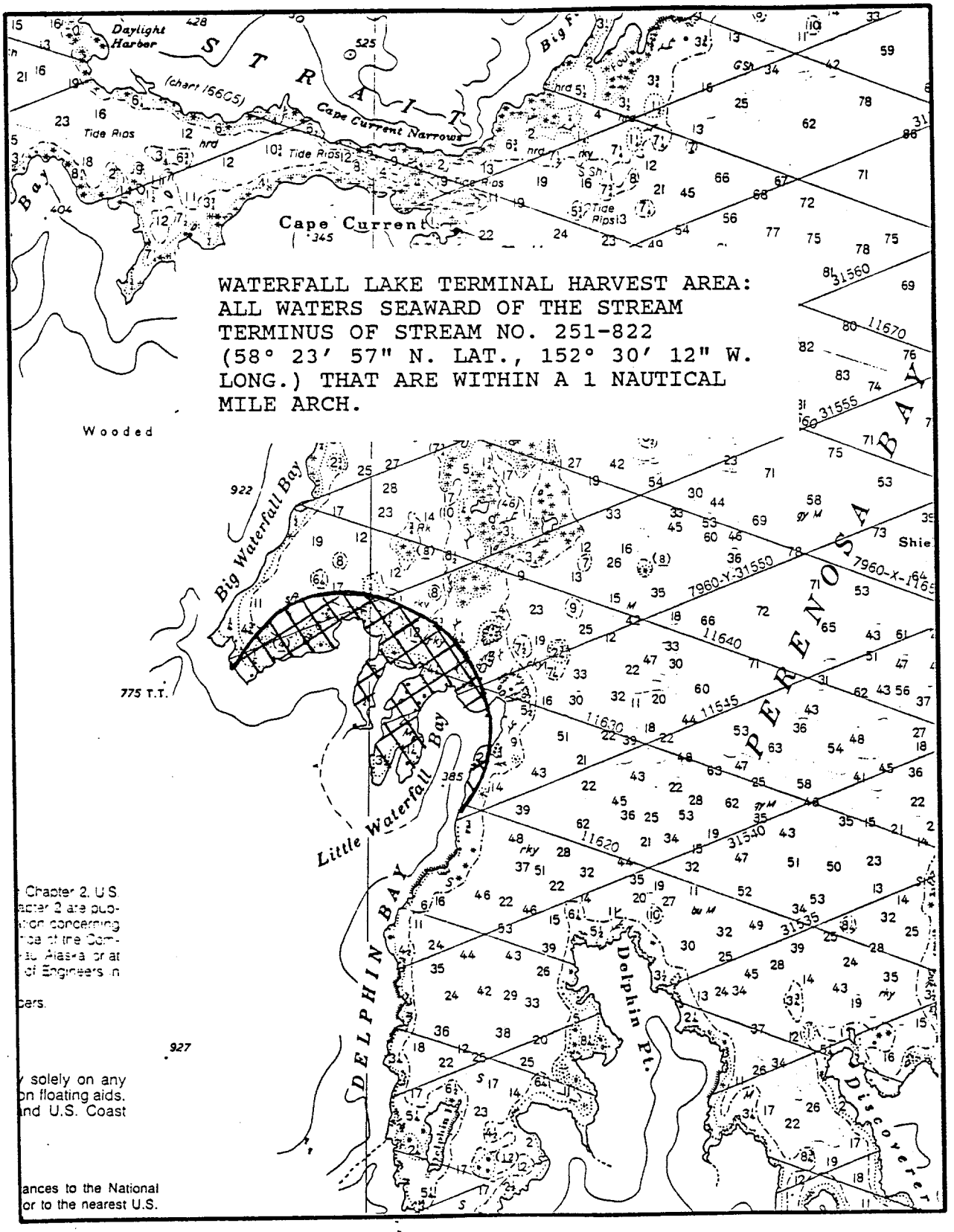


Figure 4. Waterfall Lake Terminal Harvest Area.

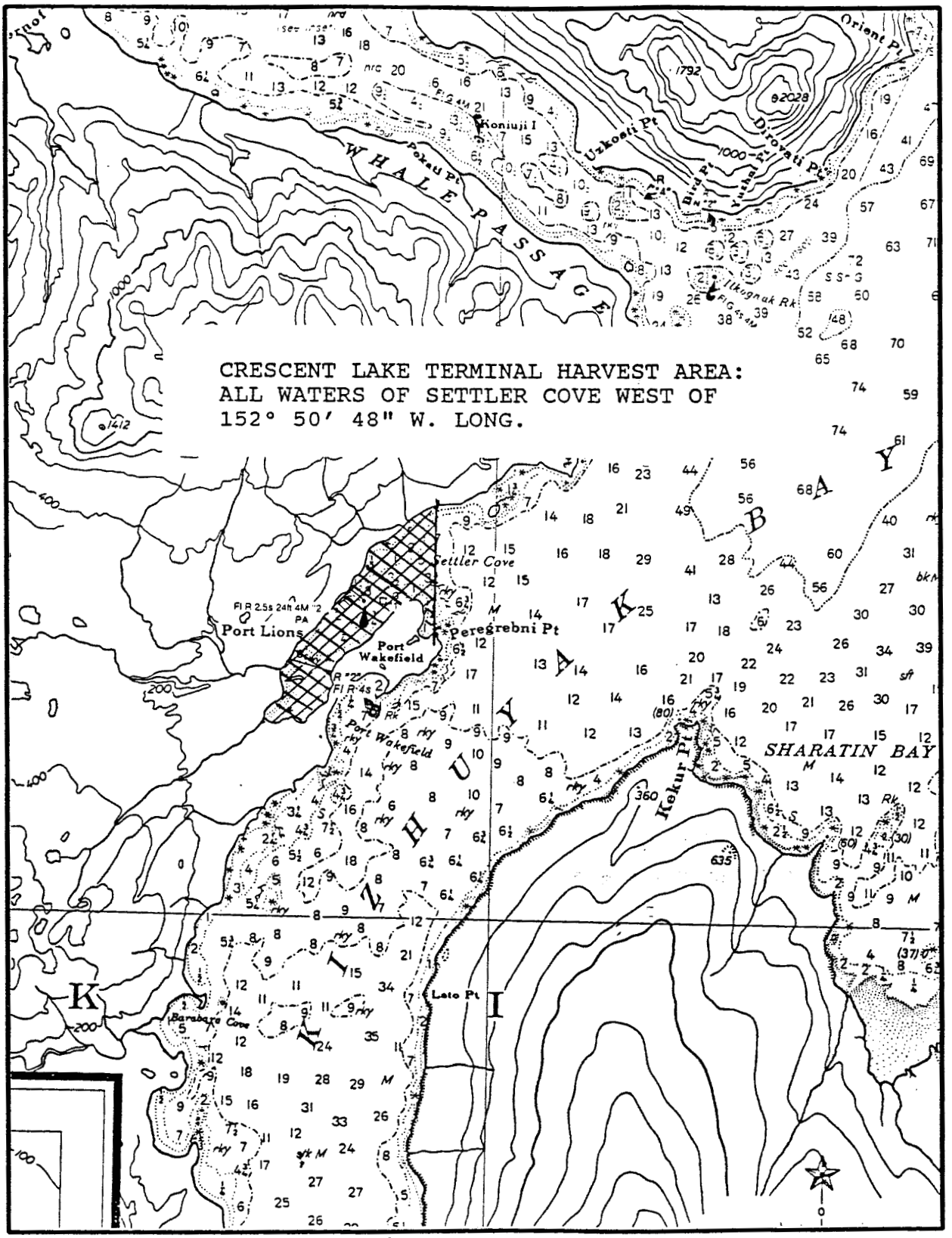


Figure 5. Crescent Lake Terminal Harvest Area.

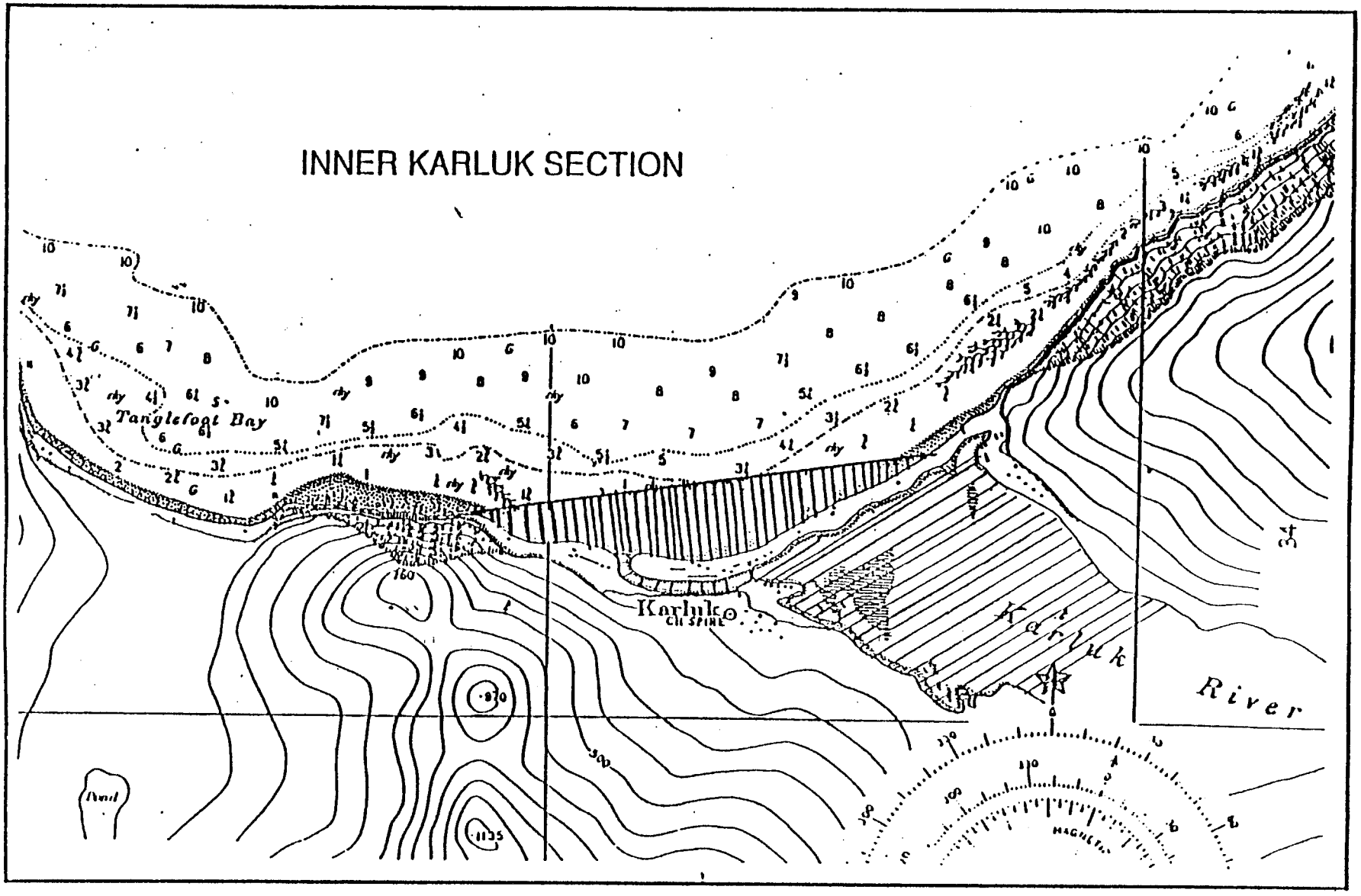


Figure 6. Karluk River closed water sanctuary in the Kodiak Management Area, 1995.

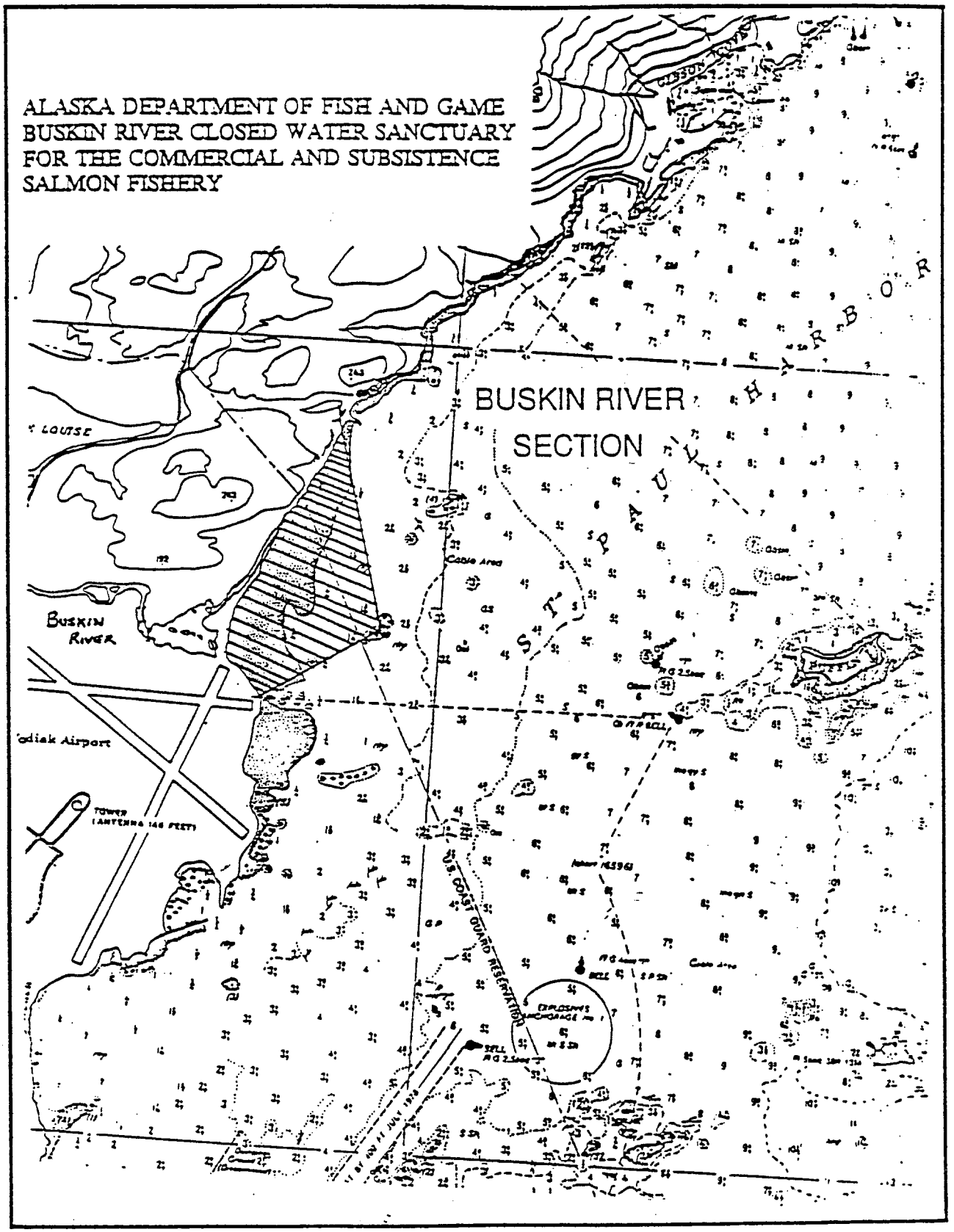


Figure 7. Buskin River closed water sanctuary in the Kodiak Management Area, 1995.

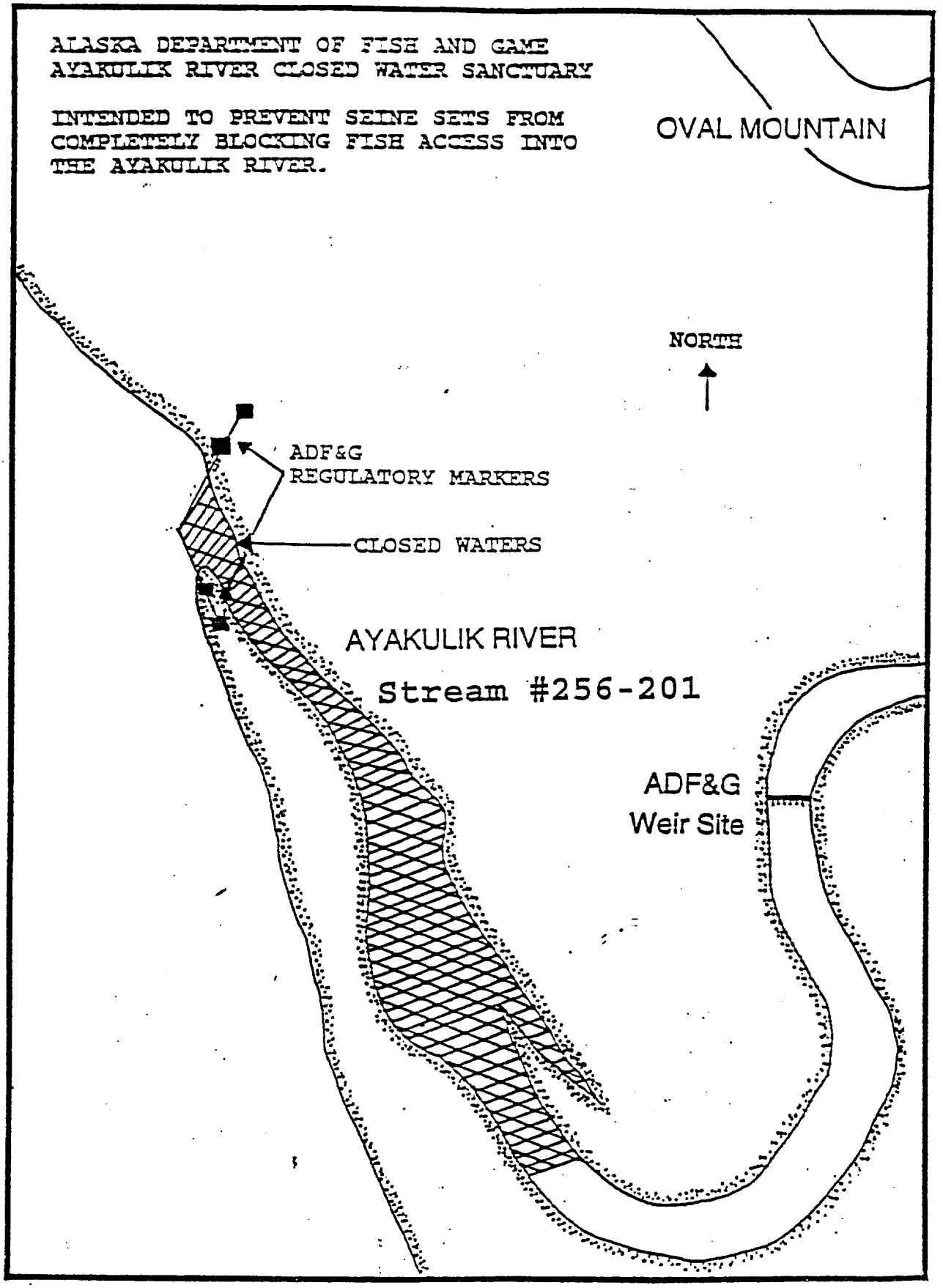


Figure 8. Ayakulik River closed water sanctuary, Kodiak Management Area, 1995.

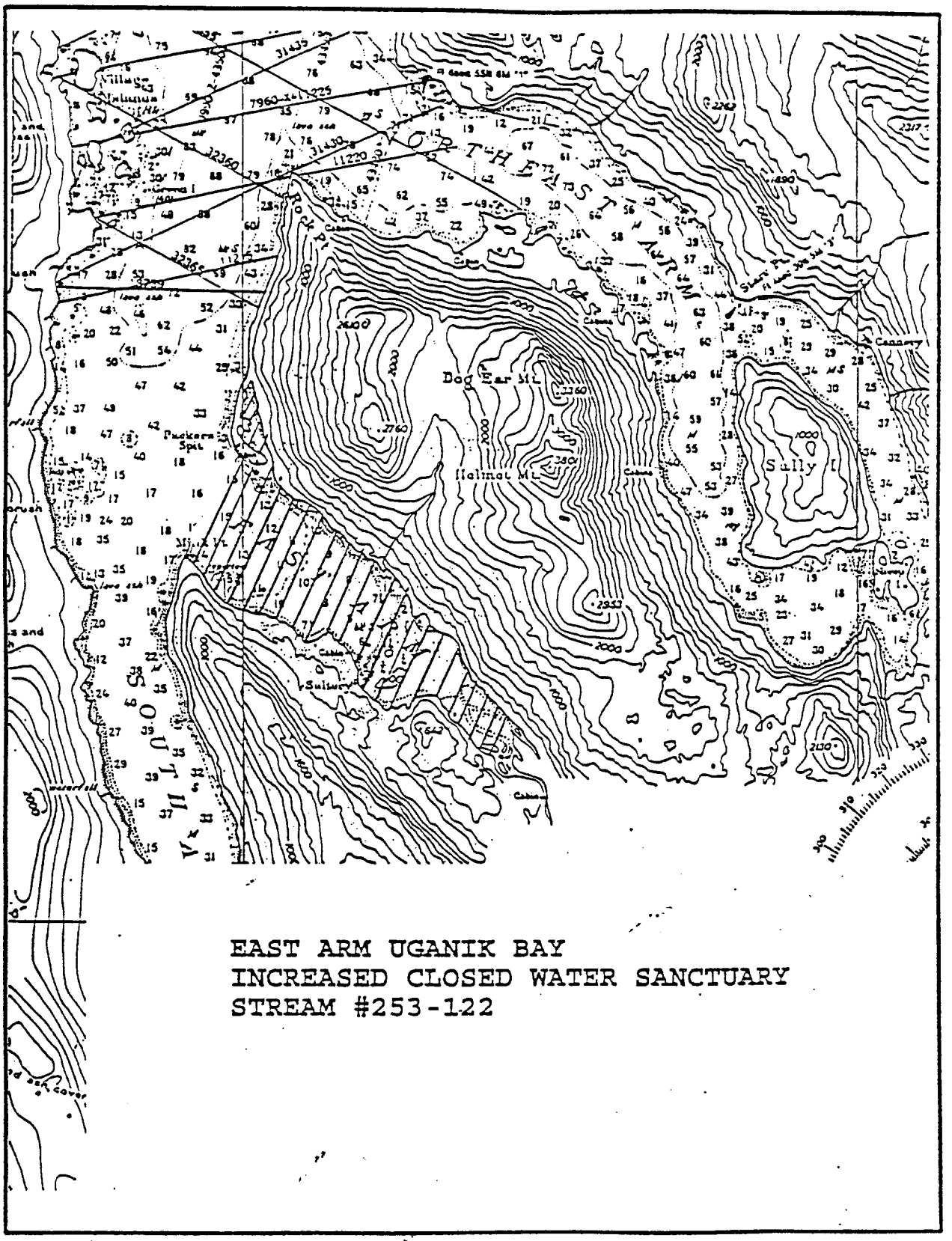


Figure 9. East Arm Uganik Bay increased closed water sanctuary, Kodiak Management Area, 1995.

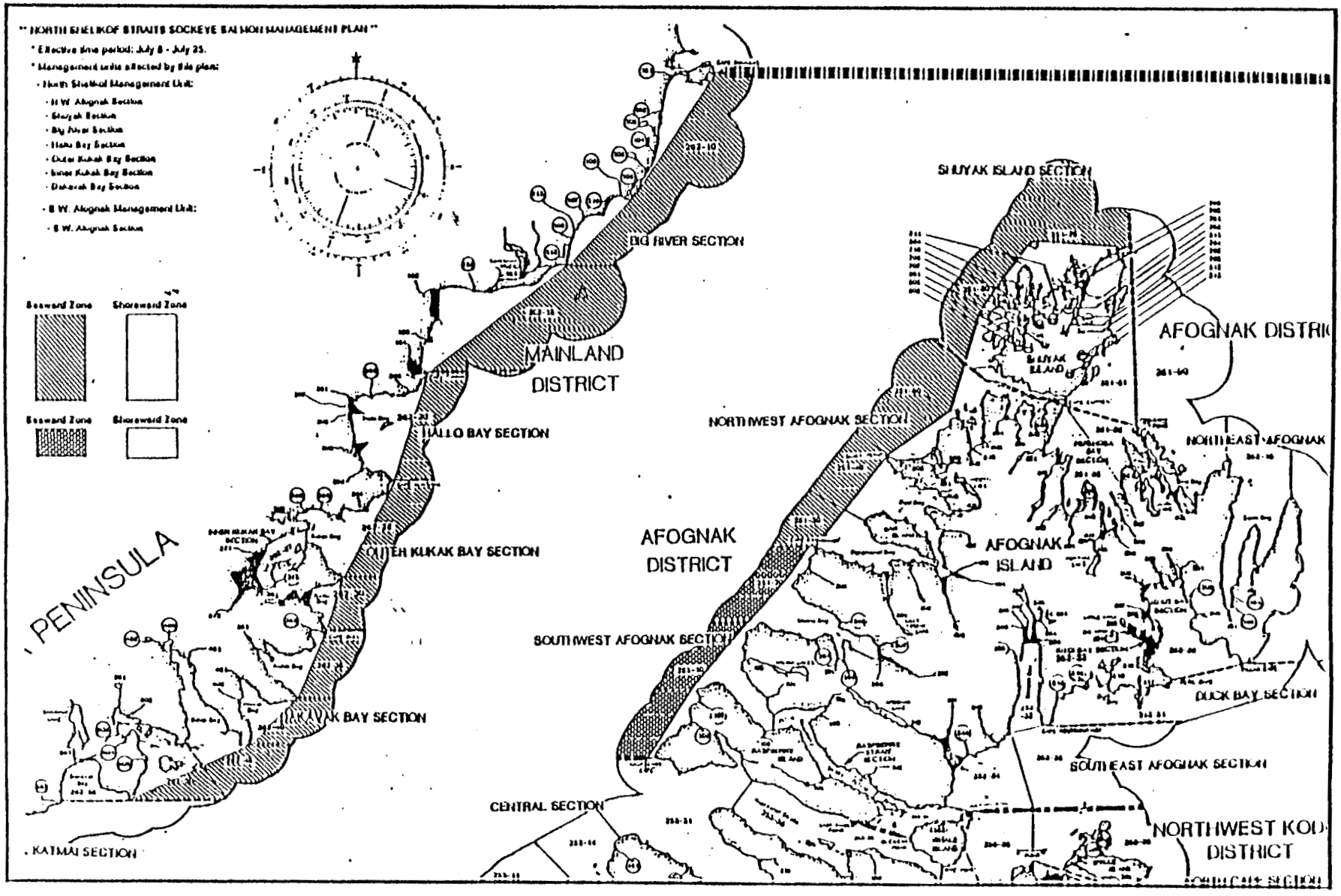
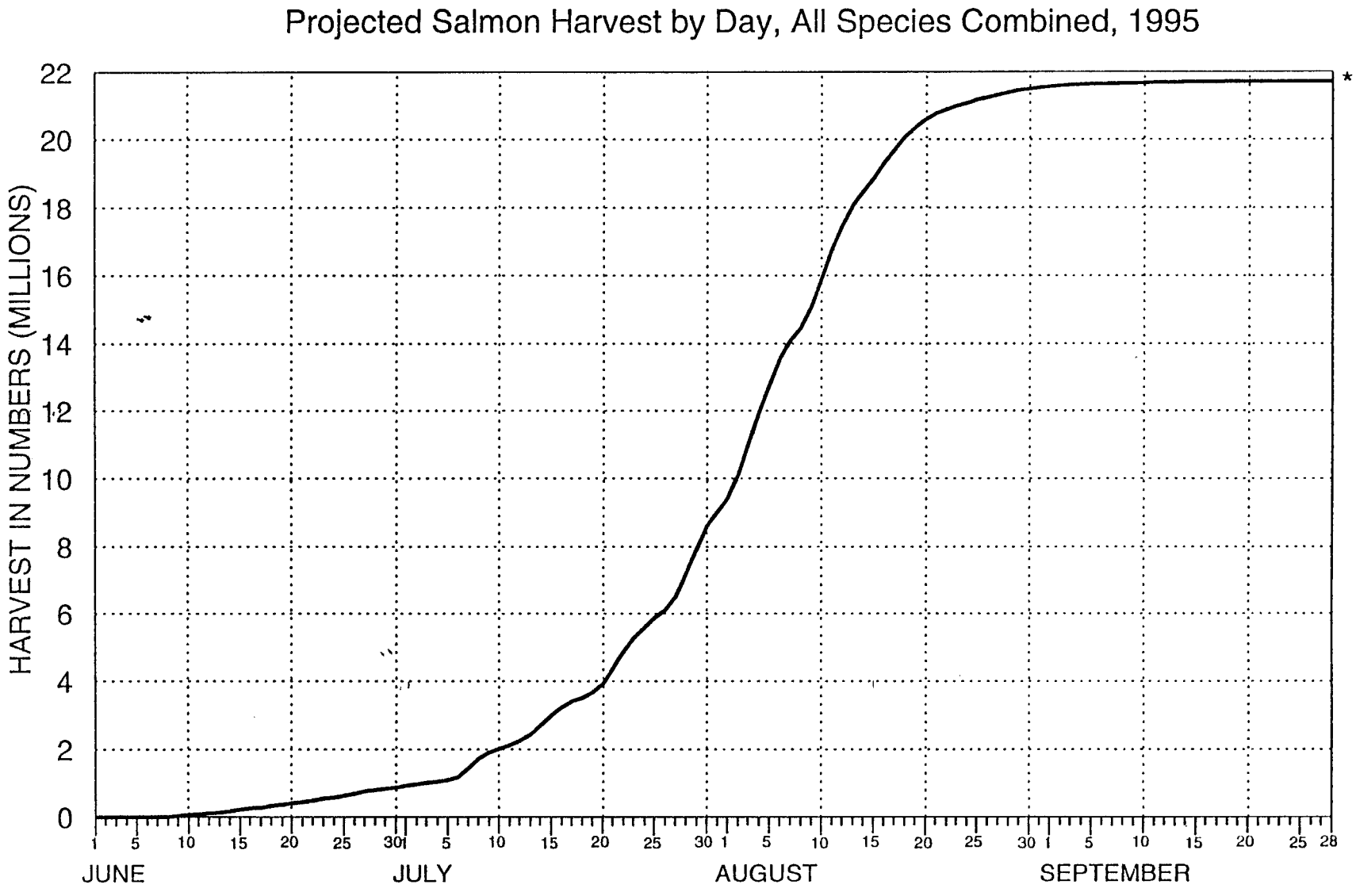
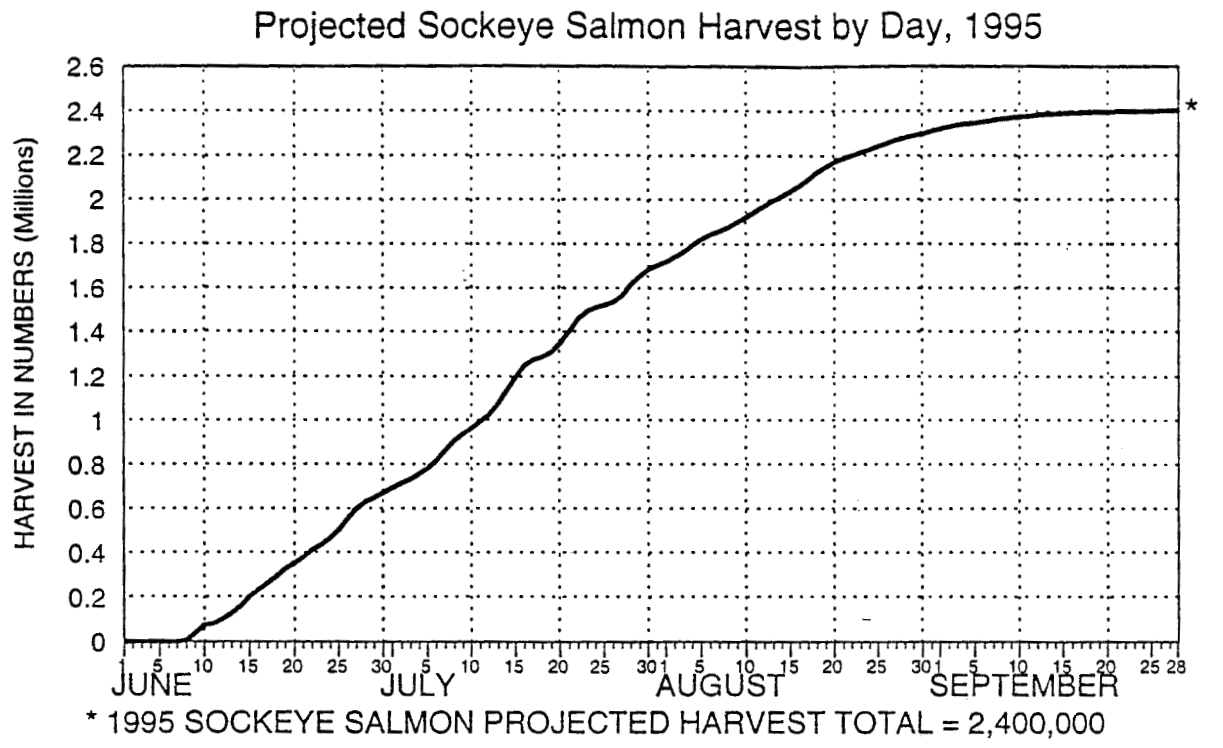


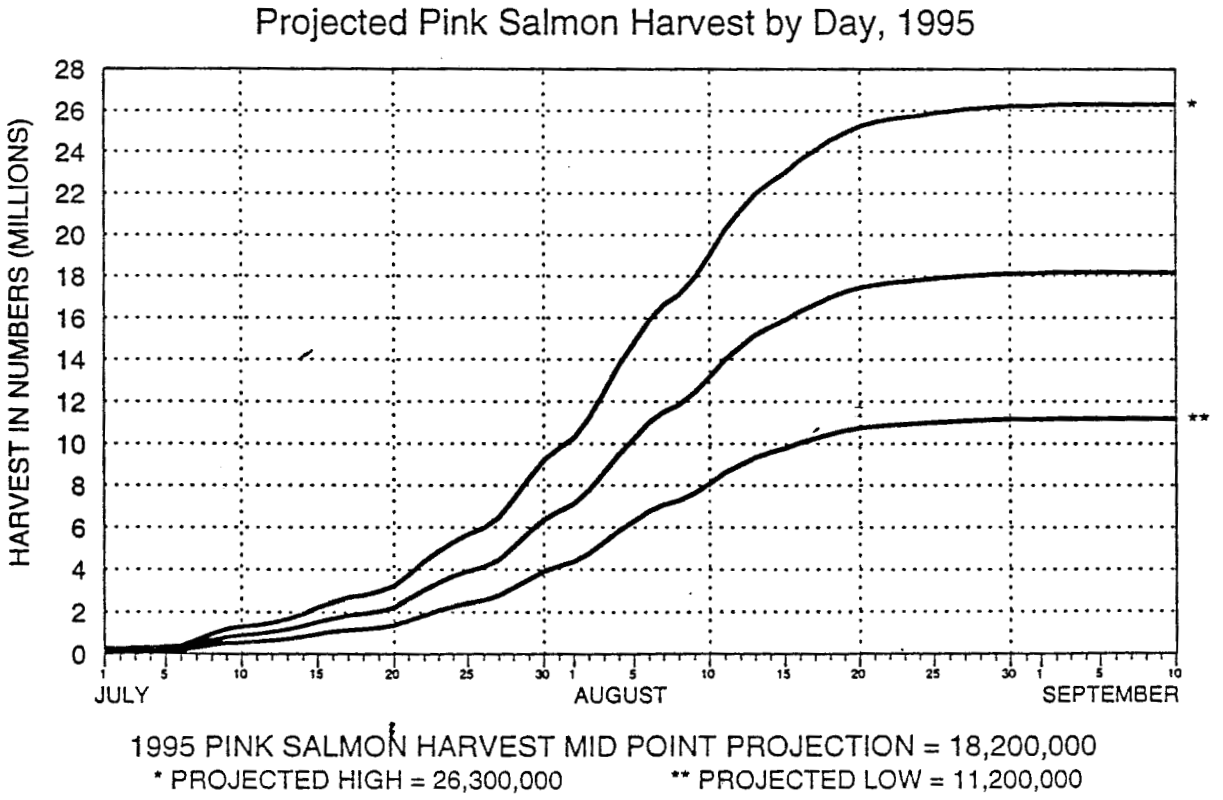
Figure 10. Approximate boundaries of the "North Shelikof Strait Seaward Zone" and the "Southwest Afognak Seaward Zone" of the North Shelikof Strait Sockeye Salmon Management Plan for the Kodiak Management Area, 1995.

APPENDIX

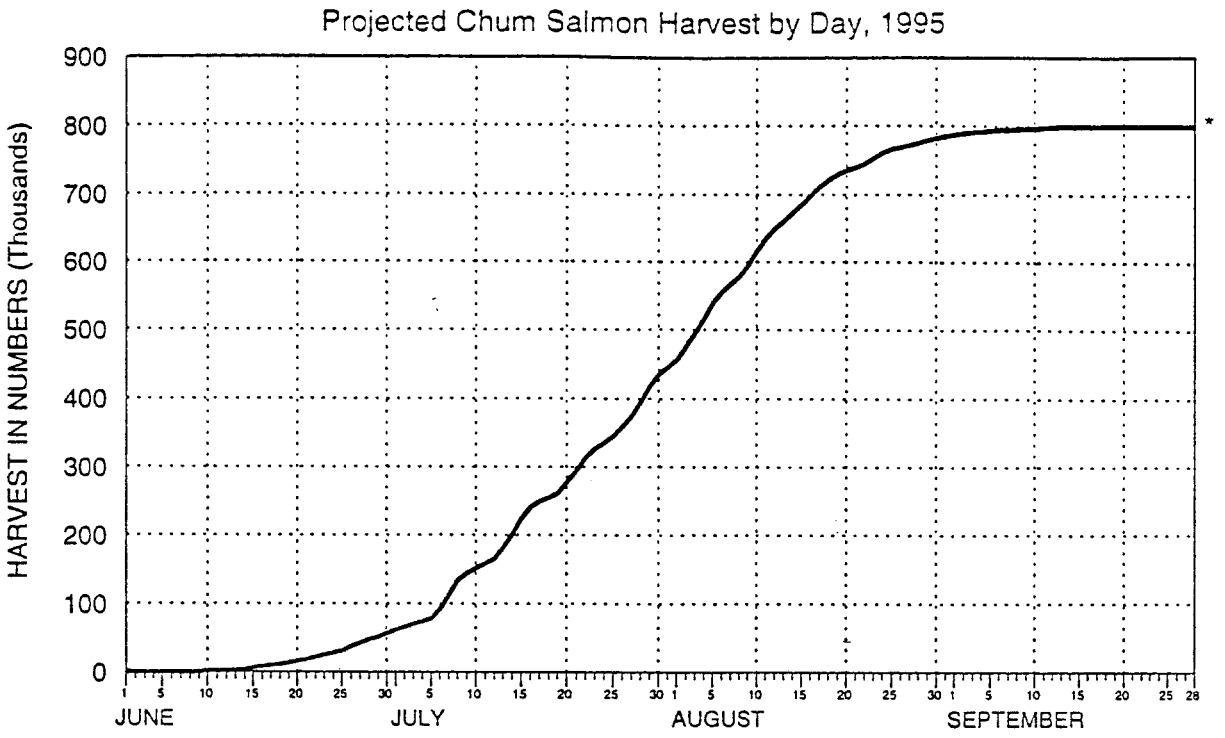


Appendix A.1. Projected salmon harvest curve, all species combined, for the Kodiak Management Area, 1995.

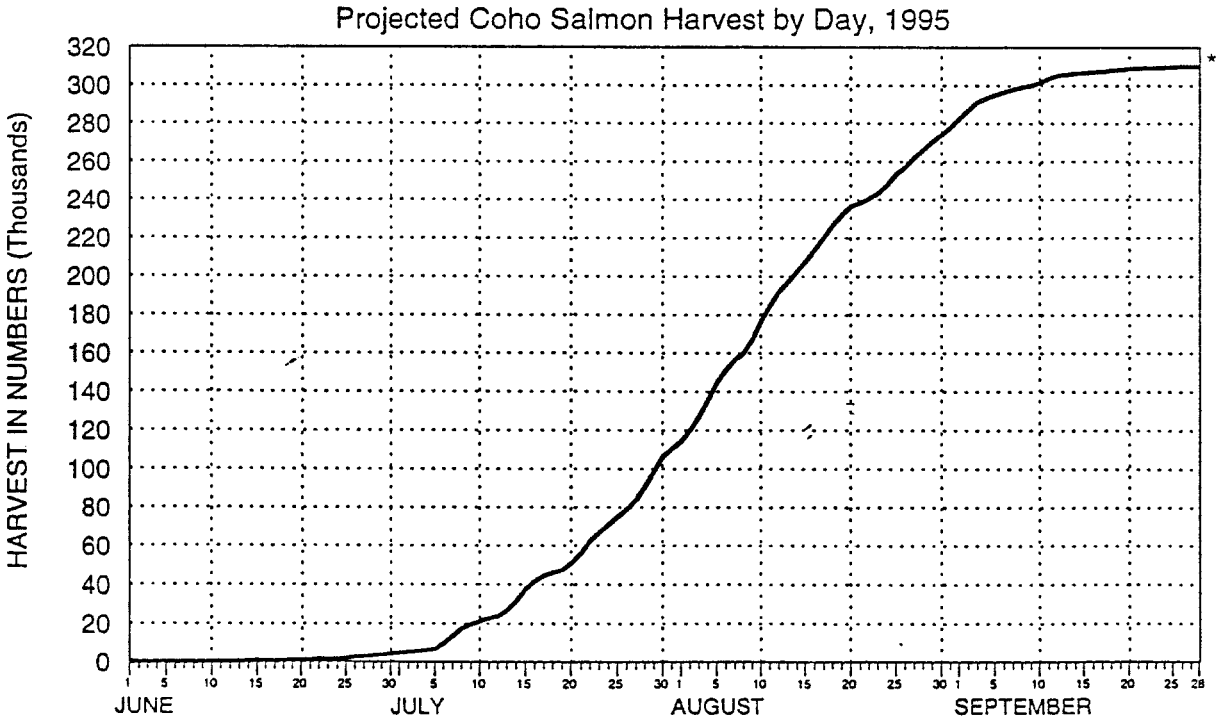




Appendix A.2. Projected sockeye and pink salmon harvest curves for the Kodiak Management Area, 1995.

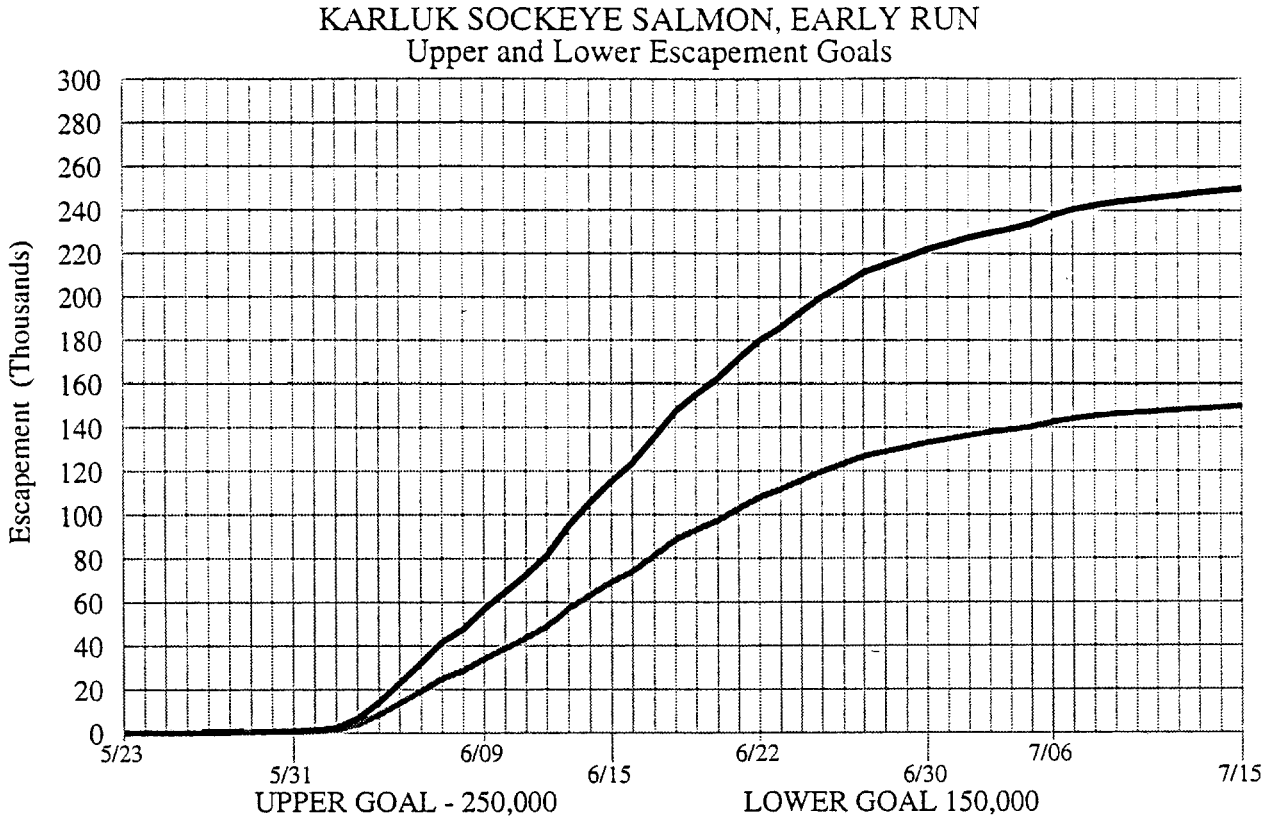


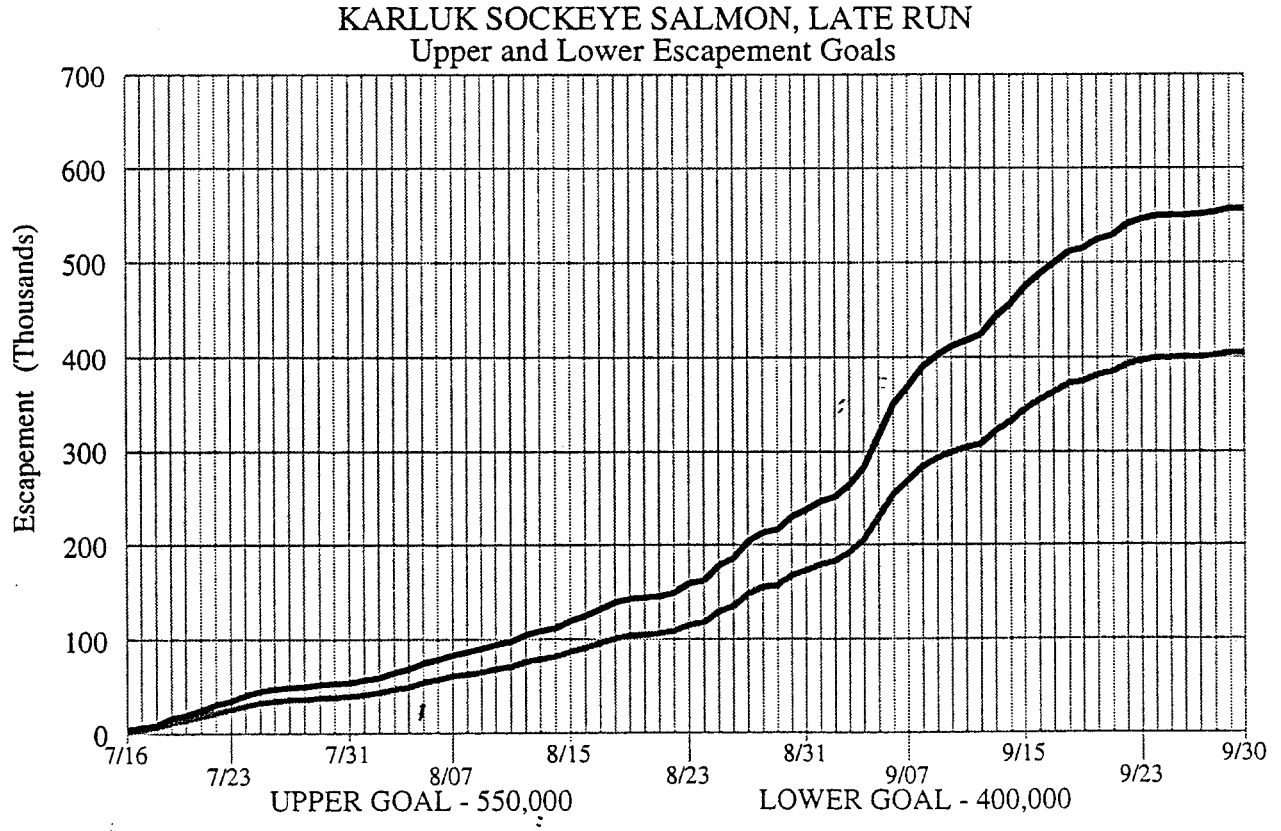
* 1995 CHUM SALMON PROJECTED HARVEST TOTAL = 800,000



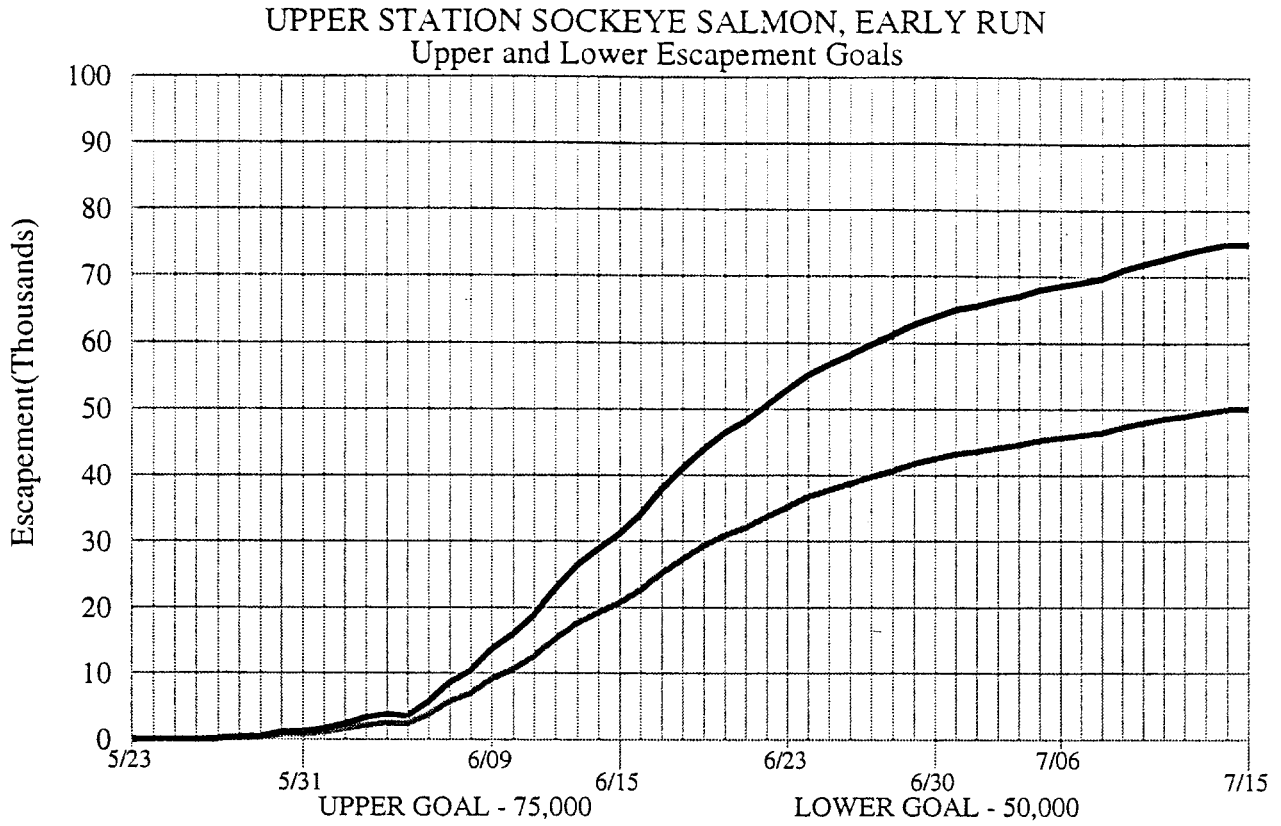
* 1995 COHO SALMON PROJECTED HARVEST TOTAL = 310,000

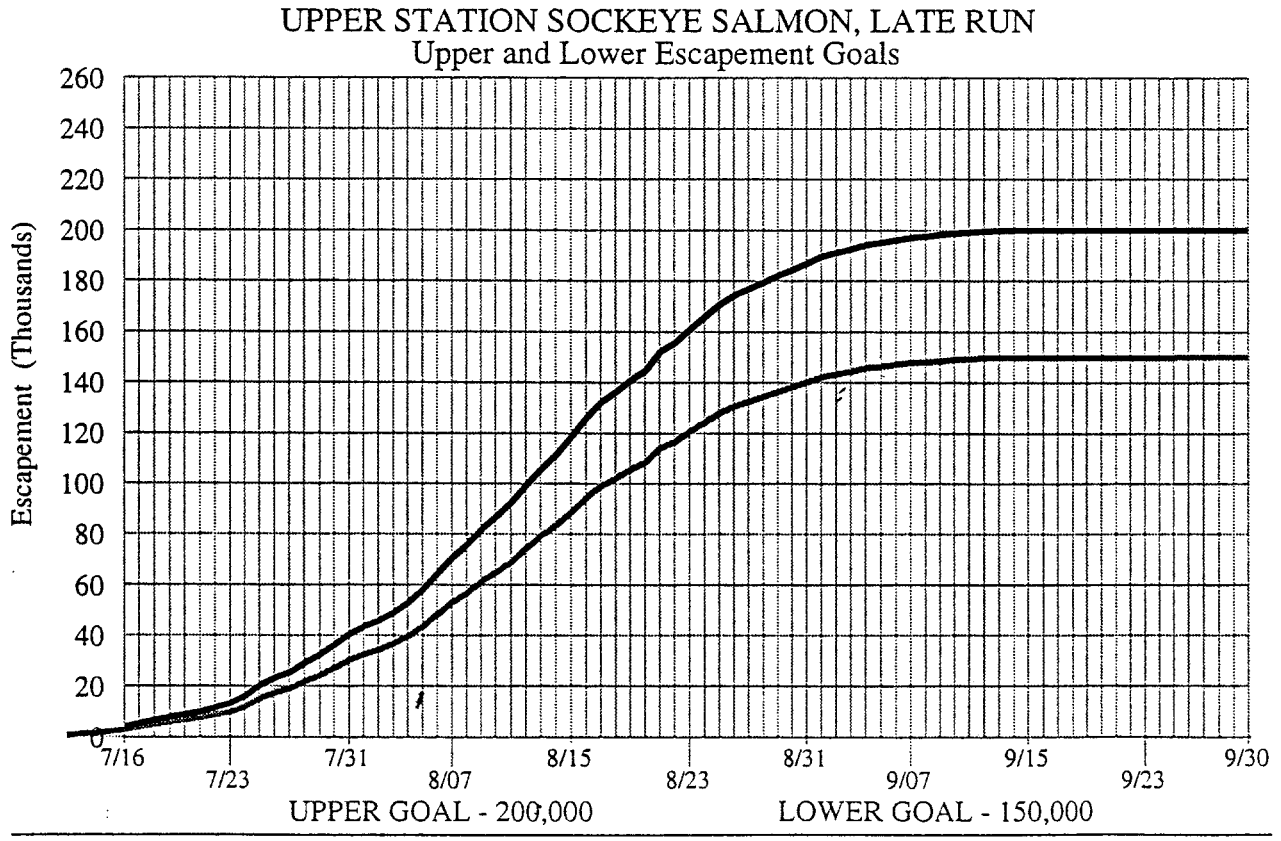
Appendix A.3. Projected chum and coho salmon harvest curves for the Kodiak Management Area, 1995.



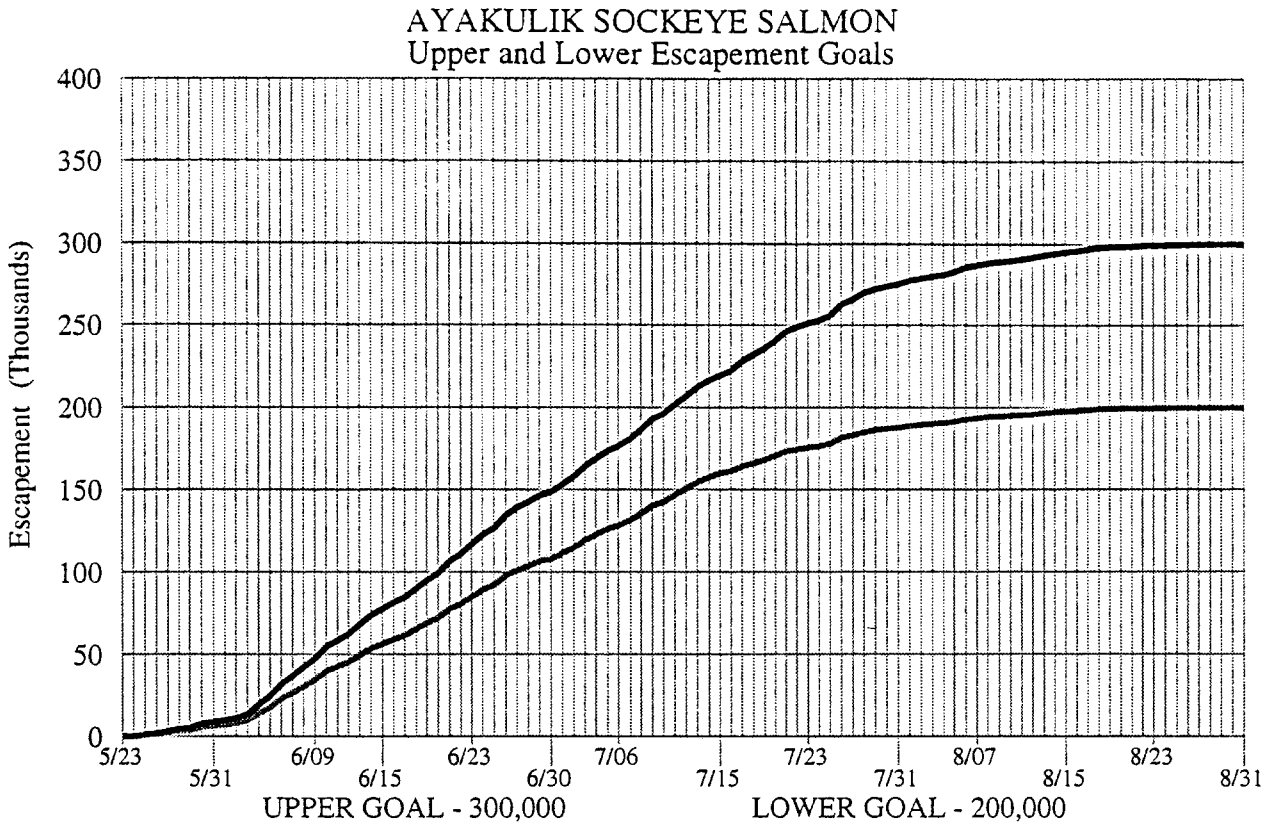


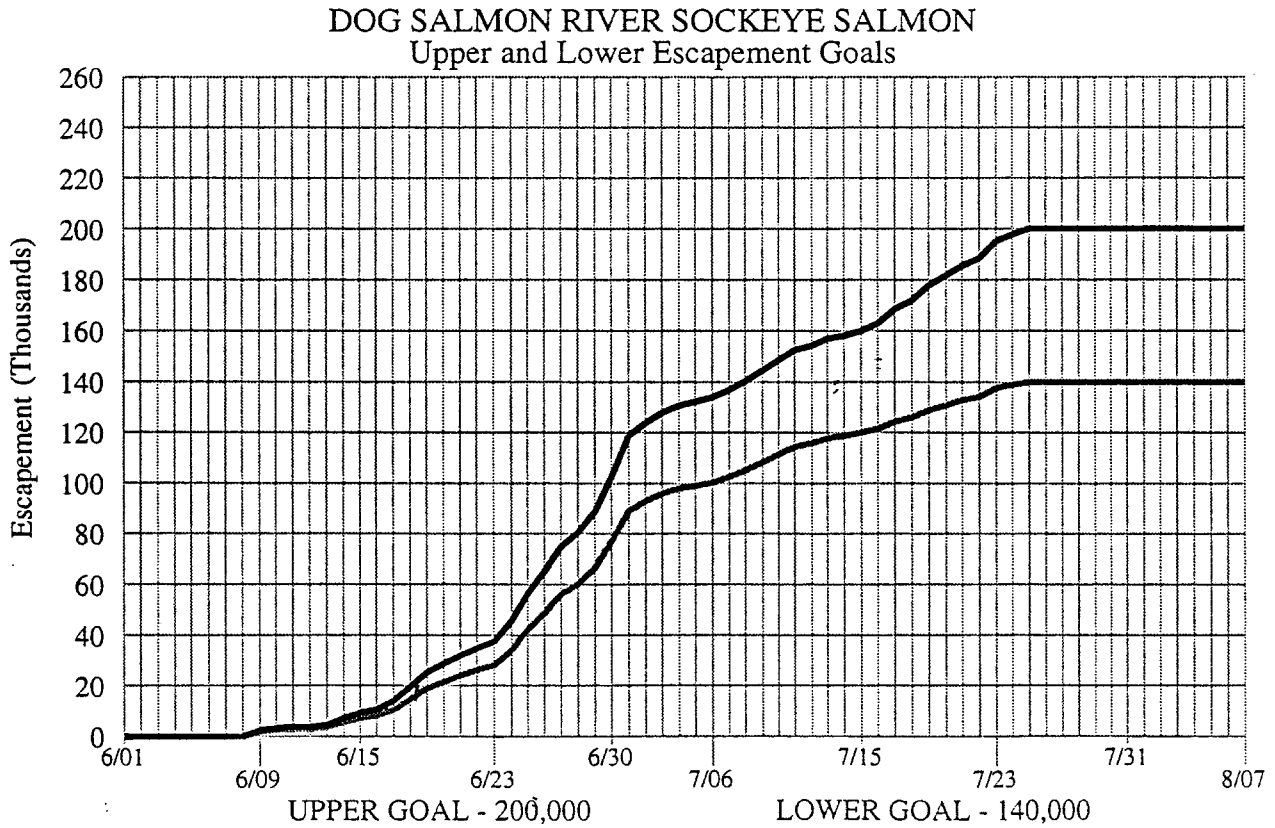
Appendix B1. Upper and lower escapement goal curves for the early and late run's of Karluk sockeye salmon in the Kodiak Management Area, 1995.



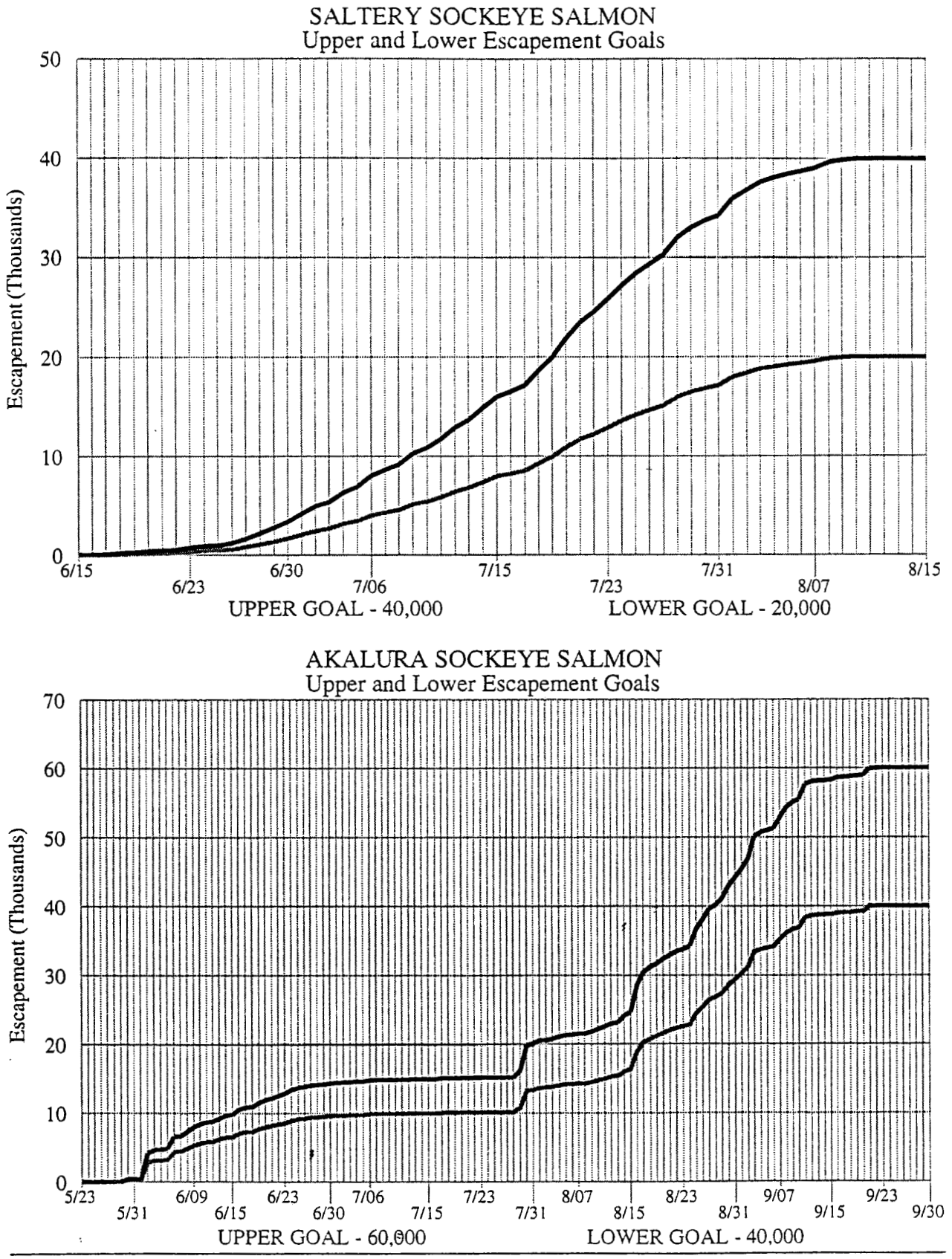


Appendix B.2. Upper and lower escapement curves for the early and late run's of Upper Station sockeye salmon in the Kodiak Management Area, 1995.

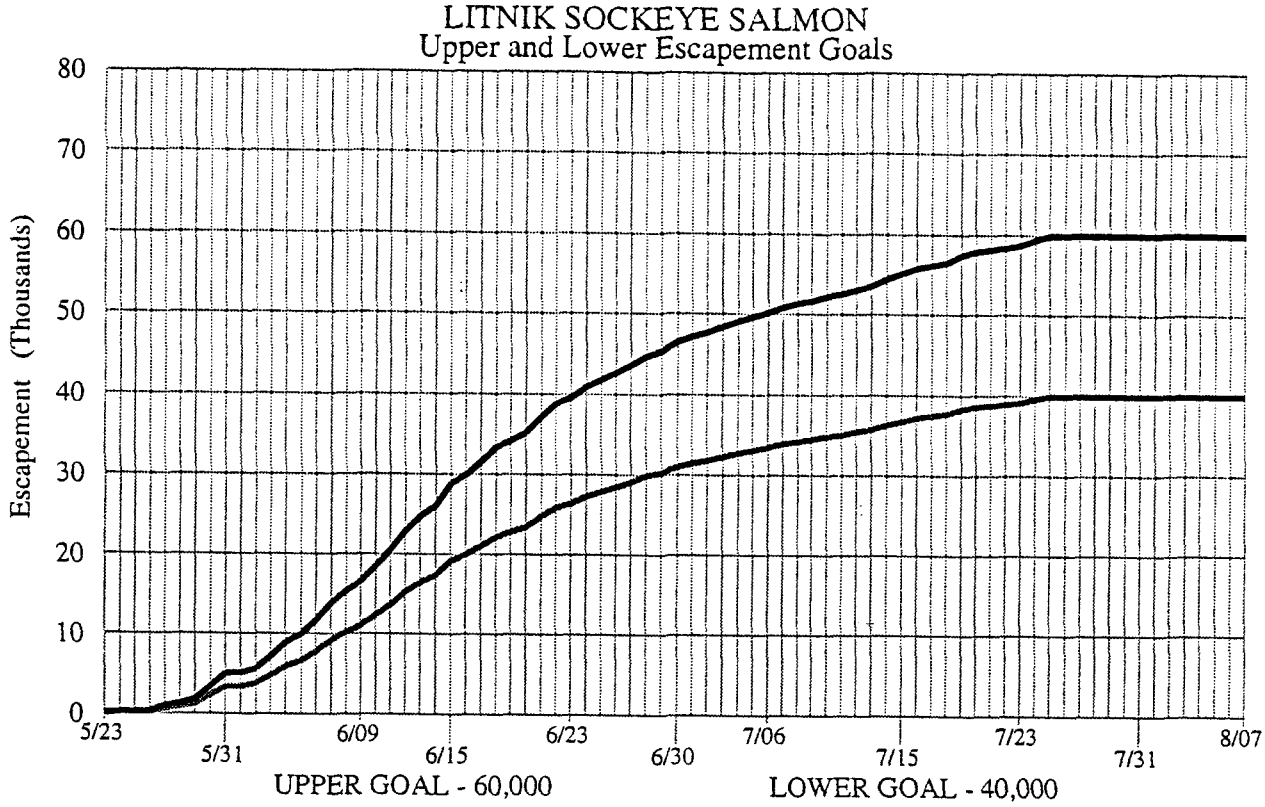


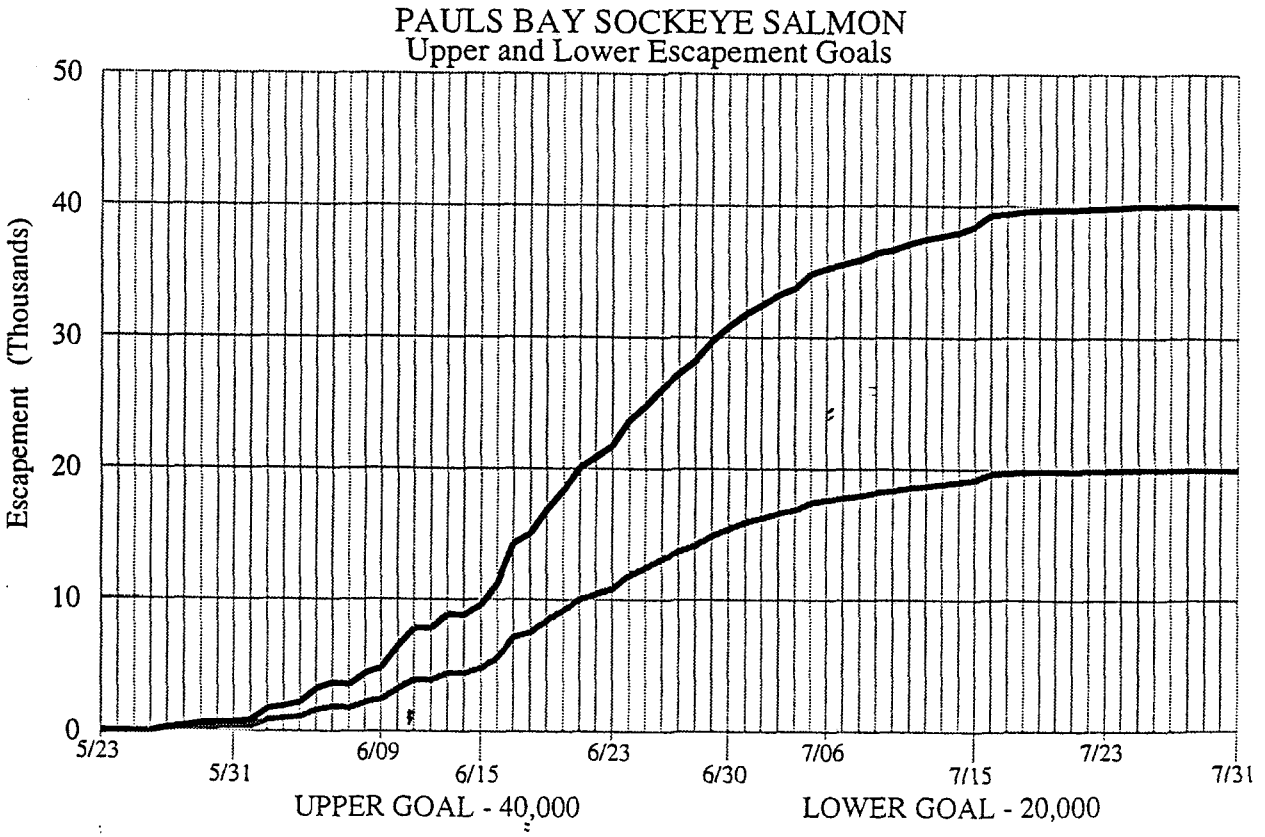


Appendix B3. Upper and lower escapement curves for the Ayakulik and Dog Salmon Rivers sockeye salmon in the Kodiak Management Area, 1995.



Appendix B.4. Upper and lower escapement curves for the Saltery and Akalura Rivers sockeye salmon in the Kodiak Management Area, 1995.





Appendix B.5. Upper and lower escapement curves for the Litnik and Pauls Bay sockeye salmon in the Kodiak Management Area, 1995.

APPENDIX B

Kodiak Management Area Salmon Escapement Sampling Operational Plan, 1995

KODIAK MANAGEMENT AREA SALMON ESCAPEMENT SAMPLING

OPERATIONAL PLAN, 1995

Alaska Department of Fish and Game
Commercial Fisheries Management and Development Division
211 Mission Road
Kodiak, Alaska 99615

MAY 1995

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INTRODUCTION

Annually, sockeye salmon escapements are sampled for age, length, and sex from major and minor systems by field personnel within the Kodiak Management Area (KMA). Management and research biologists rely on this data for forecasting, escapement goal evaluation, catch apportionment, and run timing estimation. As the demand on our salmon resource increases, so does the intrinsic value of this data.

Stock identification projects using scale pattern analysis as well as age marker analysis have been conducted within the Afognak, NW Kodiak , SW Kodiak, Alitak Bay, and Mainland Districts. The foundation for these projects are the scale samples that are collected. It is imperative that scales collected be of the highest quality possible. In recent years, an attempt was made to use average weights as a possible method of stock separation by area. Fish ticket weights were used as individual fish weights by system were not available. In order to evaluate length-weight relationships by system throughout the KMA area, weights will be taken along with ALS at seven locations during 1995.

GOAL

Provide improved management of the Kodiak Management Area salmon runs by optimizing escapement requirements thereby insuring maximum harvest opportunities.

OBJECTIVES

1. Construct accurate brood tables (spawner-recruitment relationships).
2. Develop accurate run forecasts.
3. Evaluate escapement goals and accurately define run timing.
4. Provide samples suitable for scale pattern analysis as required for addressing mixed stock fishery issues.
5. Evaluate length-weight relationships at Afognak, Spiridon, Karluk, Ayakulik, Upper Station, Frazer, and Saltery Rivers.

TASKS

1. Collect representative age, length, and sex data from all major and selected minor sockeye salmon systems within the KMA.

2. Collect a mixed assortment of weight data from selected sockeye salmon systems within the KMA.

SUPERVISION

Regional Finfish Research Supervisor, Charles Swanton will supervise escapement sampling at Frazer Fishpass and Akalura weir. All other KMA escapement crews will be directly supervised by Kodiak Management Area staff. Regional Salmon Research Biologist, Patricia Nelson will monitor weekly escapement sampling and review incoming data for quality, quantity, and timeliness. A log book will be maintained tracking weekly samples, and weir crew leader's will be notified periodically regarding data quality.

PROCEDURES

Weekly sockeye salmon escapement sampling for age, length, weight, and sex (ALWS), will be conducted at Karluk River, Upper Station, Ayakulik River, and Frazer Lake (Figure 1). Samples will be collected using a live box trap (Figure 2) according to the schedules in Table 1. If the required number of fish are not taken within a single day, obtain the balance of the sample on the following day.

Minor systems will be sampled with reduced intensity following the sampling schedule in Table 1. Litnik (Afognak) weir personnel will collect two 480 fish ALS samples from both early and late sockeye run components. Additionally, 200 individual fish weights (100 male and 100 female) will be collected from the early and late run components. Two 480 fish ALS samples from both early and late sockeye run components will be collected at Akalura weir. A single 480 fish sample will be collected at the Saltery weir during the peak escapement and 200 individual fish weights will be measured (100 male and 100 female). Sport Fisheries Division (S.F.D.) personnel will sample the Buskin River sockeye escapement with a goal of 140 fish every two

weeks. for six weeks (sample size specified by S.F.D. biometrician). S.F.D. will similarly sample the Buskin River sockeye subsistence harvest. Development section personnel will collect ALS data from Malina Lake, Little Kitoi, and Pauls Bay following the sampling schedule presented in Table 1. Additionally, samples for ALWS will be collected at the Telrod Cove Terminal Harvest Area with a targeted sample size of 240 ALS and 30 weight samples (15 males and 15 females) per week.

It is essential that all ALS data be representative of the true escapement, therefore avoid bias by NOT pre-selecting fish based upon size, sex, condition or any other factor. Sampling and recording procedures are presented in Appendix A. **Weight samples on the other hand should not be random**. It is important that we obtain the greatest variety of lengths available at each system. Therefore, try to sample the smallest and largest fish during the sampling period as well as a wide variety of lengths between the largest and smallest fish. Weights are to be measured using a Chatillon spring scale to 25 lbs. Weigh fish to the nearest 0.25 lb and record weight on the back of the AWL form (right side). Check calibration of scale before use and periodically during the season using a 3 lb can of coffee. Remember that we are evaluating weight at length so take care to ensure that each weight corresponds to the appropriate length. Specific procedures for collecting and recording weight data are described in Appendix A.

DATA REPORTING

Crew leaders will notify Dave Prokopowich, Kevin Brennan, or Dennis Gretsch via SSB radio upon completion of weekly sampling. Karluk weir will mail completed ALS data to Kodiak (return receipt from the Karluk village post office), and notify the office of the mailing date (via radio). All other field camp personnel will send completed samples back to town on return grocery flights. These packages should be clearly labeled to include: system, sample dates, and Attn.: Patti Nelson. The pilot should be notified to call Fish and Game at 486-1855 for package pick up.

Table 1. Sockeye salmon escapement sampling schedule, 1995.

Location	Sampling Frequency	Date Starting	Date Ending	ALS Sample Size	Weight Sample Size
Akalura weir (early)	once	May 15	Jul 15	480	N/A
Akalura weir (late)	once	Jul 16	Sep 15	480	N/A
Ayakulik weir	weekly	May 30	Sep 30	240	30
Buskin Lake weir[a]	biweekly	Jun 01	Aug 01	140	N/A
Buskin Subsistence Harvest[a]	biweekly	Jun 01	Aug 01	140	N/A
Frazer Fishpass	weekly	Jun 15	Aug 30	240	30
Karluk weir	weekly	May 30	Sep 30	240	30
Litnik (Afognak) weir (early)	once	Jun 07	Jun 15	480	200
Litnik (Afognak) weir (late)	once	Jul 14	Jul 20	480	200
Malina Lake weir[b]	intermittently	Jun 01	Aug 15	600	N/A
Little Kitoi[b]	intermittently	Jun 01	Aug 15	600	N/A
Pauls Bay[b]	biweekly	Jun 06	Jul 03	200	N/A
Saltery River weir	once	Jul 07	Jul 20	480	200
Upper Station	weekly	Jun 06	Sep 30	240	30
Telrod Cove[b]	weekly	Aug 01	Sept 15	240	30

[a] Sampled by Sport Fish Division (sample size determined by S.F. Biometrician).
[b] Sampled by Development Section personnel.

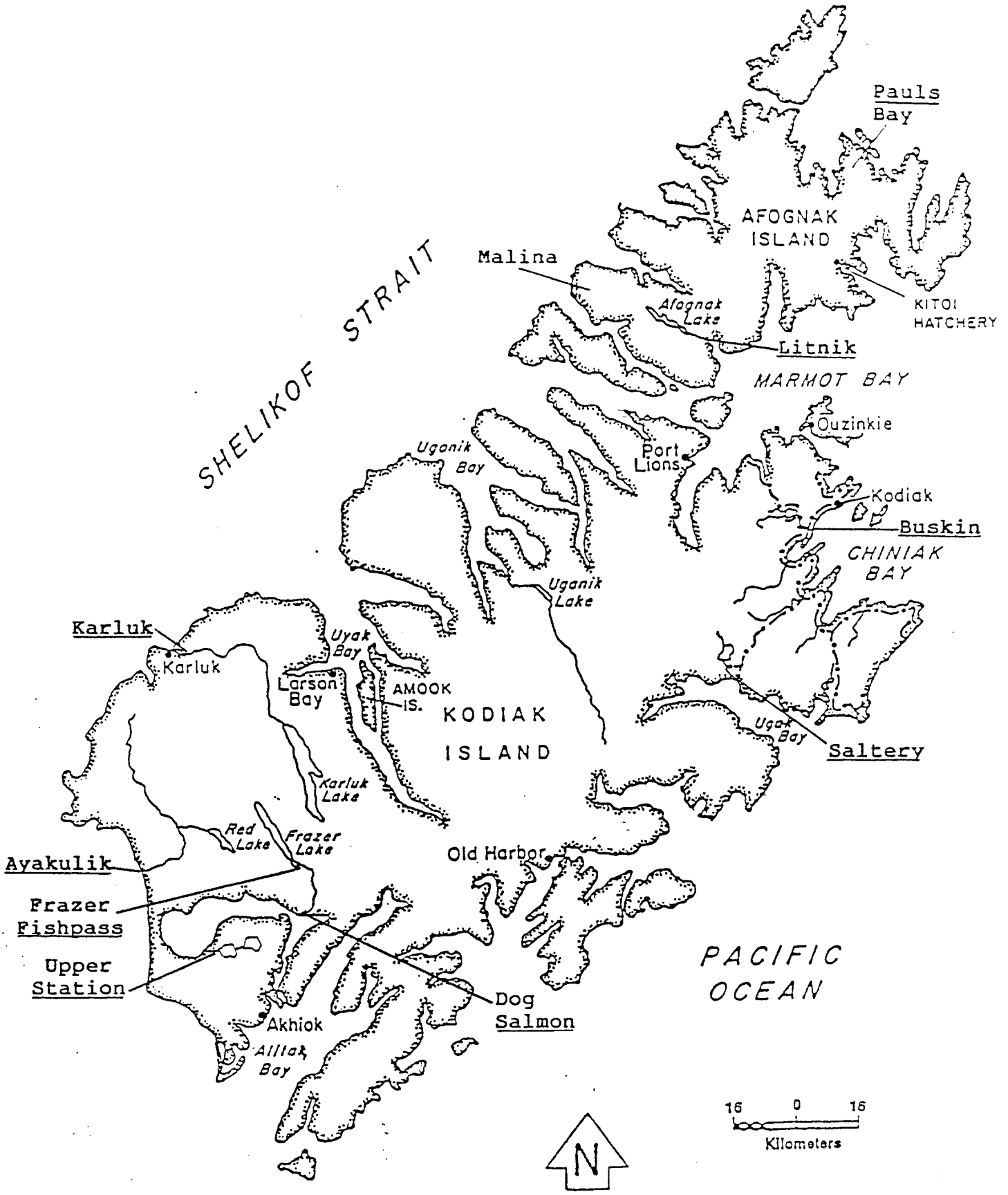

Figure 1. Location of salmon weirs in the Kodiak Management Area.

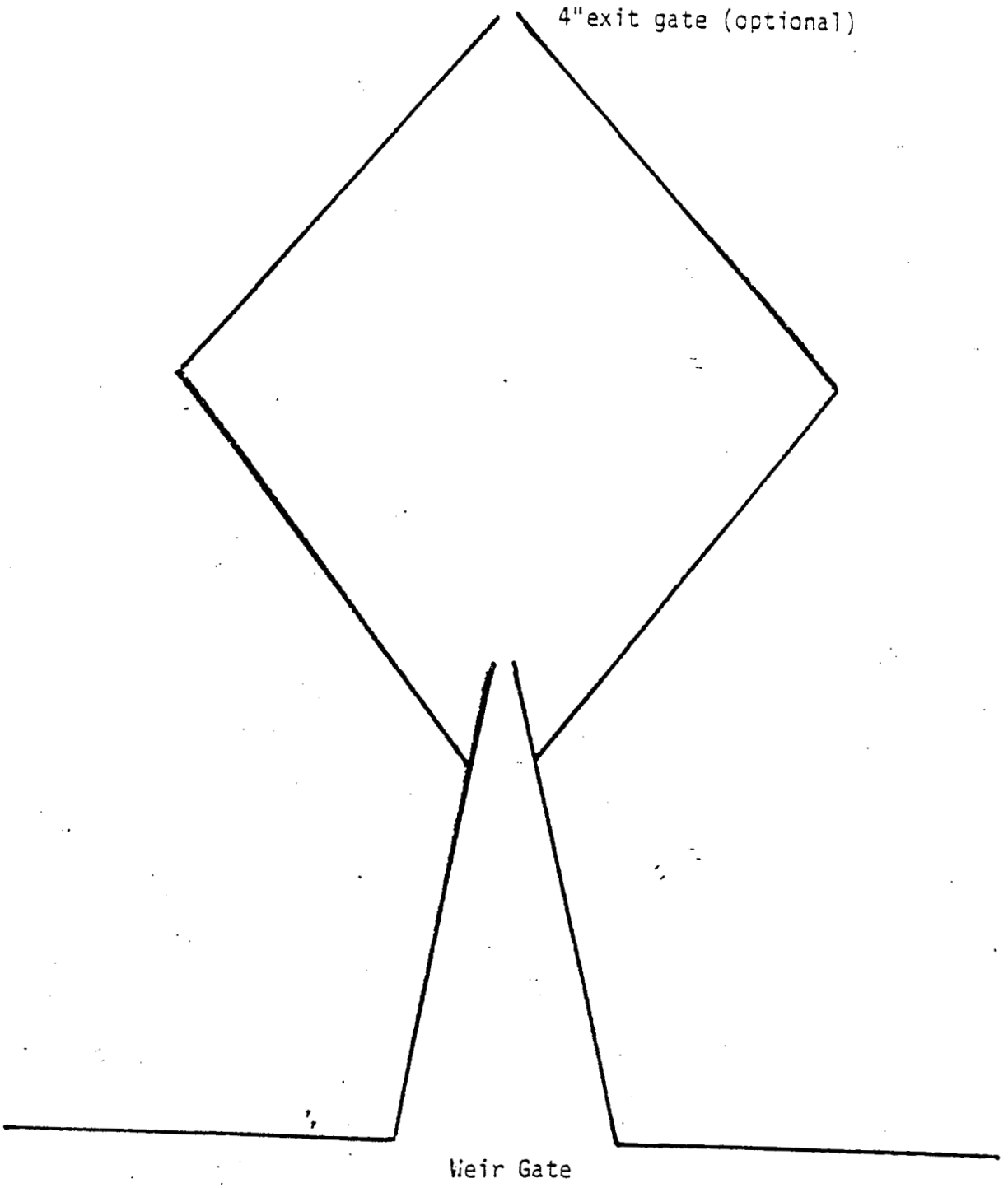

Figure 2. The "Scott" six panel salmon trap.

APPENDIX A

Procedure for Sampling Adult Salmon for age, length, weight, and sex

Annually, salmon escapements and catches are sampled for age (scales), length, and sex (ALS) by field crews throughout the state. This database is essential for sound management of the State's salmon resources.

To be useful, data must be recorded on the mark-sense (AWL) forms neatly and accurately. Scale samples must be collected and mounted properly to ensure accurate age determination. The following procedures are to be adhered to when sampling for age, length, weight, and sex.

COMPLETING THE AWL FORMS:

A completed AWL form and accompanying gum card for sampling sockeye and chum salmon are shown in Appendix A.1-2.

Complete each section on the left side of the AWL form using a No. 2 pencil and darken the corresponding blocks as shown in the figures. Make every effort to darken the entire block as partially filled blocks are often missed by the optical scanner which reads and records the data from the AWL forms. Label only one form at a time to avoid a "carbon paper effect" resulting in stray marks.

Description:
Record the following: species/area/catch or escapement/gear type (seine, weir, etc.)/samplers

Card:
The AWL forms and corresponding gummed card(s) are numbered sequentially by date throughout the season starting with 001. A separate numbering sequence will be used for each species, district, and geographic location. Consult your port supervisor for the current card number. Sockeye scale samples will have only 1 gum card per AWL form as shown in Appendix A.1.

Species:
Refer to the reverse side of the AWL form for the correct digit.

Day, Month, Year:
Use appropriate digits for the date the fish are sampled; for catch sampling, use the date the fish were caught.

District:
List only one district. Consult area statistical map or project leader for appropriate district.

Subdistrict (Section):
List a single subdistrict if it is known and if all the potential samples were caught in that section. If more than one section is involved, list each section but do not darken the corresponding blocks. Leave blank if the section is unknown.

Stream:
Leave blank for catch sampling; escapement sampling consult area statistical map for appropriate stream number.

Location:
List the appropriate code as shown on Appendix A.3.

Period:
List the period in which the fish were caught (Appendix A.4.).

Project and Gear:
Refer to the reverse side of the AWL form for the correct code.

Mesh:
Leave blank unless specifically instructed by supervisor to do otherwise.

Type of length measurement:
Use (2) mid-eye to fork-of-tail. Refer to Appendix A.5.

# of cards:
Mark 1 (each AWL form in individually numbered).

Keep the litho codes in numerical order throughout the season and keep the AWL forms flat, dry, and clean. Fish gurry and water curling will cause data to be misinterpreted by the optical scanning machine. It is the crew leaders responsibility to make sure that all forms are carefully edited before returning them to your supervisor.

GUMMED CARDS:

Fill out the gum cards as shown in Appendices A.1

Species:
Write out completely (sockeye) and fill in appropriate number (2).

Locality:
For catch and escapement sampling, write down the area in which fish were caught, followed by catch or escapement (e.g. Karluk River escapement; Uganik Bay catch).

Stat. code and Sampling date:
Transfer the appropriate digits from the AWL form.

Gear:
Write out completely.

Collector(s):
Record the last names of person(s) sampling.

Remarks:
Record any pertinent information such as number of scales per fish sampled. vessel/tender name, etc. Transfer this same information to the top margin of the AWL.

SAMPLING PROCEDURE:

A. GENERAL

1. Place the fish on its right side to sample the left side.

2. Determine sex of the fish and darken M or F in the sex columns. If any difficulty is encountered with this procedure, write "I had trouble sexing these fish" on the top margin of the AWL and ask your supervisor for help as soon as possible before sexing additional fish.

3. Measure fish length in millimeters from the mid-eye to fork-of-tail (Appendix A.5). Record length by blackening the appropriate column blocks on the AWL form. Column 3 on the AWL form is used for fish with a length greater than 999 millimeters (Chinook). Measure all species of salmon to the nearest mm. Check the calipers periodically to ensure measurement accuracy. **When escapement sampling, take care to ensure that each length corresponds to the appropriate scale mounted on the gummed card as length at age is evaluated for each sample.**

4. Remove the "preferred scale" from the fish by grasping its exposed posterior edge with forceps and pulling free. Remove all slime, grit, and skin from the scale. The "preferred scale" is located on the left side of the fish, two rows above the lateral line on the diagonal from the posterior insertion of the dorsal fin to the anterior insertion of the anal fin (Appendix A.6.). If the "preferred scale" is missing, select a scale within the preferred area on either the left or right side of the fish. If no scales are present in the "preferred area" on either side of the fish, sample a scale as close to the preferred area as possible and darken the 8 under "age error code" on the AWL form. Do not select a scale located on the lateral line.

5. It is important to take care that scales adhere to the card, rough side up. Therefore, without turning the forceps over, clean, moisten, and mount the scale on the gummed card with your thumb or forefinger. Exert just enough pressure to spread and smooth the scales directly over the number as shown in Appendix A.6. The ridges on the sculptured side can be felt with a fingernail or forceps. Mount scale with anterior end oriented toward top of gum card. All scales should be correctly oriented on the card in the same direction (Appendix A.7.).

6. Once the length and sex have been recorded, and the scale has been collected, slide the fish into the weighing sack provided, hang it from the scale and record the weight in pounds on

the back side of the AWL form (to the nearest 0.25 lbs). If weights are recorded on the back of an AWL form, transfer the litho code to the appropriate column. A completed back side of an AWL form is illustrated in Appendix A.2. **Keep in mind that not all fish will be weighed. The minimum sample size is 15 males and 15 females per week. If the process goes smoothly and you can collect more weights (25 per sex), this would be greatly appreciated.**

7. Repeat steps 1 through 4 for up to 40 fish on each AWL form.

8. When sampling at weirs you may use write in rain books to record the data. Keep the mark-sense forms in camp where they will be clean, dry, and flat. After sampling is done for the day transfer the data to the mark-sense forms. **Each length, sex, scale and weight must correspond to a single fish! It is the responsibility of the crew leader to be sure the data has been transcribed correctly and the AWL forms filled out completely.** Log books containing length, weight, and sex data should be returned to Patti Nelson at the end of the season.

SCALE SAMPLING CHECKLIST

OPERATIONAL PLAN	PENCILS (NO. 2)
GUM CARDS	FORCEPS
AWL FORMS	PLASTIC CARD HOLDERS
CALIPERS	CLIPBOARD
SPRING SCALE	WEIGHING SACK

SOME REMINDERS

1. For greater efficiency in scale reading and digitizing, mount scales with anterior end toward top of scale card.

2. AWLs should be carefully edited. Re-check header information on AWLs; make sure all available information is filled in. Take extra care to use the correct period code for the sampling or catch date. AWL numbers should not be repeated; a frequent error is to begin a week's sample with the last AWL number used the week before. This is particularly important if the data is regularly sent to town; it is easy to forget which AWL numbers were used. Crew leaders should take time to ensure that the boxes are being blackened correctly, if the boxes are sloppily marked the optical scanner records the information incorrectly or misses it entirely. Keep pencil marks within each block, filling it completely.

3. Transfer important comments from scale cards to AWLs. After pressing scales, the cards are seldom referred to again, and important remarks can be lost. Write comments in the top right margin. If there is not room on the AWL to completely explain the remarks, use a separate piece of paper.

4. Never put data from different dates on one AWL or one scale card. Even if only one scale is collected that day, begin a new AWL and gum card the next day.

5. If weights are taken, they may be noted in the right margin of the AWL during sampling, but **be sure to transfer the weights and litho code to the appropriate columns on the reverse of the AWL before submitting it to your supervisor**.

6. The data processing program uses the "litho code" on the AWL. (It is located in the lower left margin of the AWL.) Try to keep the litho codes in numerical order. This should not be hard to do if they are arranged that way before page numbering. Those who sample different areas throughout the season can arrange the litho codes in order before each sample is taken.

7. If AWLs get wrinkled or splotched they should be transcribed onto a new AWL prior to sending in. The optical scanning computer will misread or reject wrinkled sheets. Do not use paperclips on AWL forms.

8. Be careful when collecting and mounting scales in wet conditions (rain, high humidity, etc.) Glue often obscures scale features and scales frequently adhere poorly to wet card. Protect the cards, keep them dry to avoid having to remount the scales on a new card.

9. Scan the AWL form for mistakes. A common error occurs, for instance, in placing both the 4 and 7 of a 475mm fish in the 100's column with nothing in the 10's column.

10. Record all comments explicitly on the gum card under remarks and transfer remarks to the top margin of the AWL form.

11. Responsibility for accuracy lies first with the primary data collector(s). The port supervisor will return sloppy or incomplete data to individual collectors for correction.

Gum Card front side

16 scales collected
Gum Card back side

Species: SOCKEYE Card No: 014
Locality: FRAZER ESC.
Stat. Code: 257-40-403-___
Sampling Date: Mo. 06 Day 07 Year 95
Gear: WEIR / TRAP
Collector(s): D. Pitcher, S. Peschier
Remarks: _____

10	9	8	7	6	5	4	3	2	1
20	19	18	17	16	15	14	13	12	11
30	29	28	27	26	25	24	23	22	21
40	39	38	37	36	35	34	33	32	31

AWL FRONT SIDE:

DESCRIPTION: SOCKEYE / FRAZER / ESC samplers: Pitcher Peschier

ADF&G ADULT SALMON AGE-LENGTH FORM VERSION 2.1

litho code 260498

DO NOT WRITE IN THIS MARGIN DO NOT WRITE IN THIS AREA

CARD: 014
SPECIES: 2
DAY: 07
MONTH: 06
YEAR: 95
DISTRICT: 257
SUBDISTRICT: 40
STREAM: 403
LOCATION: 038
PERIOD: 24
PROJECT: 3
GEAR: 19
MESH:
TYPE OF LENGTH MEASUREMENT 2
NUMBER SCALES/ FISH 1
OF CARDS 1

#	SEX	100's LENGTH	1's LENGTH	AGE GROUP	AGE ERROR CODE
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
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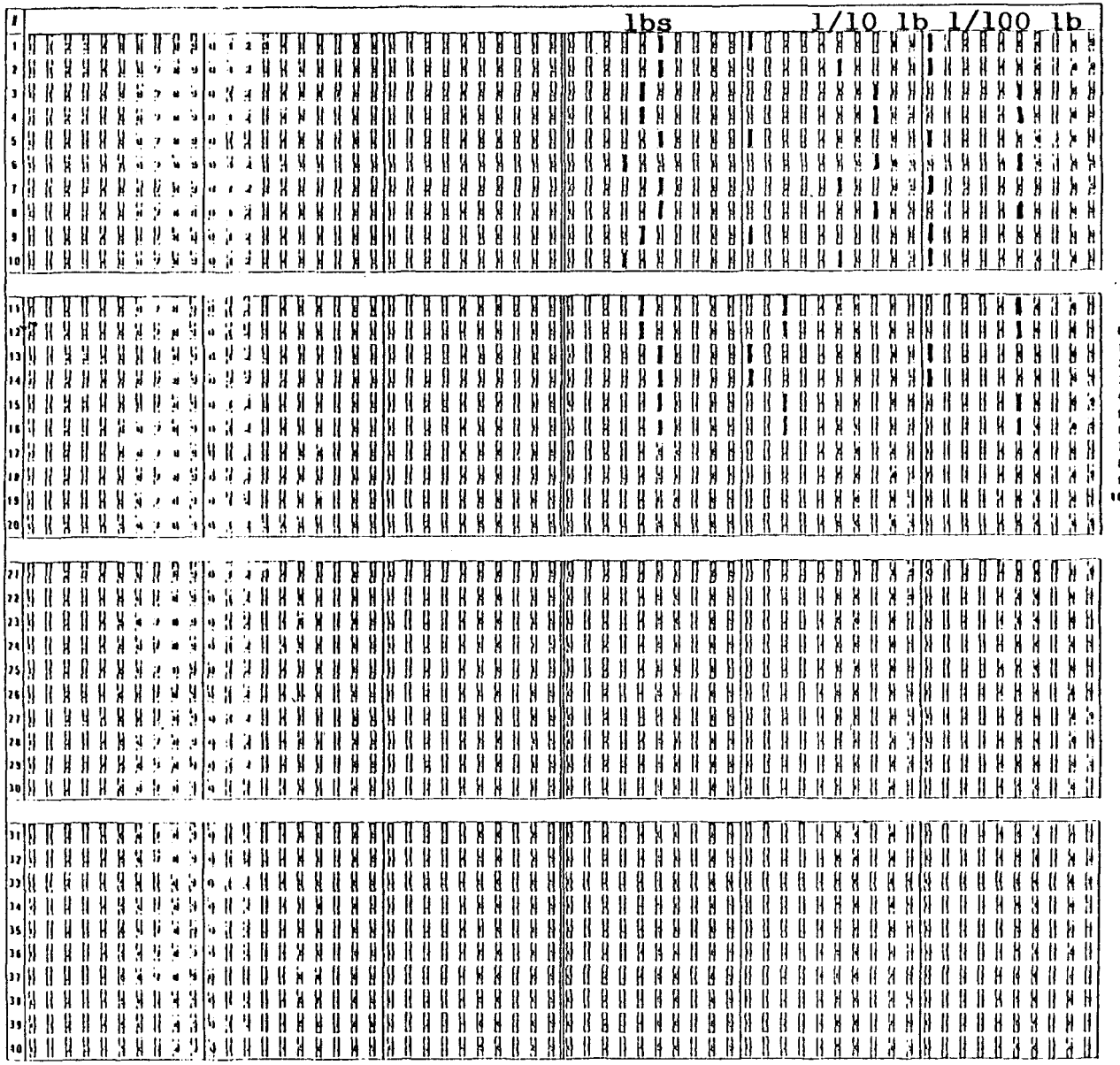
40					

NCS DOCUSCAN M020-17877 161514 A4200

Appendix A.1. Completed AWL (front side) and associated gum card 16 fish sampled.

AWL BACK SIDE: 16 fish sampled, 16 weights measured



CODES:

SPECIES

1 - Chinook (king)
2 - Sockeye (red)
3 - Coho (silver)
4 - Pink (humpy)
5 - Chum (dog)

PROJECT

1 - Commercial catch
2 - Subsistence catch
3 - Escapement (tower, weir, sonar site, etc)
4 - Escapement - spawning grounds
5 - Test fishing
6 - Sport catch (marine)
7 - Sport catch (freshwater)

GEAR TYPE

0 - Trap
1 - Purse seine
2 - Beach seine
3 - Drift gillnet
4 - Set gillnet
5 - Troll
6 - Long line
7 - Otter trawl
8 - Fishwheel
9 - Pots
10 - Sport hook and line
11 - Handling purse seine
12 - Handpicked
13 - Dip net
14 - 14 Unassigned
17 - Beam trawl
18 - Shovels
19 - Weir
20 - 99 Unassigned

LENGTH TYPE

1 - Tip of snout to fork of tail
2 - Mid eye to fork of tail
3 - Post orbit to fork of tail
4 - Mid eye to hypural plate
5 - Post orbit to hypural plate
6 - Unassigned

AGE ERROR CODES

1 - Otolith
2 - Inverted
3 - Regenerated
4 - Illegible
5 - Missing
6 - Reabsorbed
7 - Wrong species
8 - Not processed

Appendix A.2. Back side of AWL with 16 weights recorded and litho code transferred.

Appendix A.3. Assigned port and weir location codes.

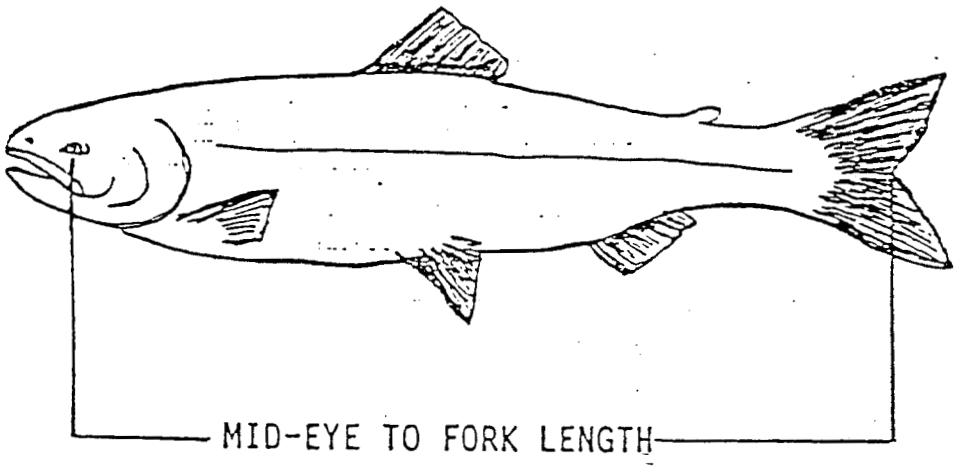
Port and Location Codes

030 - Lazy Bay
031 - Port of Kodiak
032 - Pauls Lake
033 - Thorshiem
034 - Afognak River
035 - Karluk River
036 - Red River
037 - Upper Station
038 - Frazer Lake
039 - Dog Salmon
040 - Akalura River
041 - Uganik River
042 - Malina Creek
150 - King Cove
151 - Port Moller
052 - Dutch Harbor
053 - Akutan
054 - Sand Point
055 - Bear River, ADF&G Camp
056 - Nelson River, ADF&G Camp
057 - Canoe Bay

Appendix A.4. Periods and corresponding calendar dates. 1995.

Period	Calendar Dates	Period	Calendar Dates
1	01-Jan to 03-Jan	28	05-Jul to 11-Jul
2	04-Jan to 10-Jan	29	12-Jul to 18-Jul
3	11-Jan to 17-Jan	30	19-Jul to 25-Jul
4	18-Jan to 24-Jan	31	26-Jul to 01-Aug
5	25-Jan to 31-Jan	32	02-Aug to 08-Aug
6	01-Feb to 07-Feb	33	09-Aug to 15-Aug
7	08-Feb to 14-Feb	34	16-Aug to 22-Aug
8	15-Feb to 21-Feb	35	23-Aug to 29-Aug
9	22-Feb to 28-Feb	36	30-Aug to 05-Sep
10	01-Mar to 07-Mar	37	06-Sep to 12-Sep
11	08-Mar to 14-Mar	38	13-Sep to 19-Sep
12	15-Mar to 21-Mar	39	20-Sep to 26-Sep
13	22-Mar to 28-Mar	40	27-Sep to 03-Oct
14	29-Mar to 04-Apr	41	04-Oct to 10-Oct
15	05-Apr to 11-Apr	42	11-Oct to 17-Oct
16	12-Apr to 18-Apr	43	18-Oct to 24-Oct
17	19-Apr to 25-Apr	44	25-Oct to 31-Oct
18	26-Apr to 02-May	45	01-Nov to 07-Nov
19	03-May to 09-May	46	08-Nov to 14-nov
20	10-May to 16-May	47	15-Nov to 21-Nov
21	17-may to 23-May	48	22-Nov to 28-Nov
22	24-May to 30-May	49	29-Nov to 05-Dec
23	31-may to 06-Jun	50	06-Dec to 12-Dec
24	07-Jun to 13-Jun	51	13-Dec to 19-Dec
25	14-Jun to 20-Jun	52	20-Dec to 26-Dec
26	21-Jun to 27-Jun	53	27-Dec to 31-Dec
27	28-Jun to 04-Jul		

Appendix A.5 Measuring fish length, mid-eye to fork of tail.



Mid-eye to fork lengths are taken because the length and shape of a salmon's snout changes as it approaches sexual maturity. The procedure for measuring by this method follows:

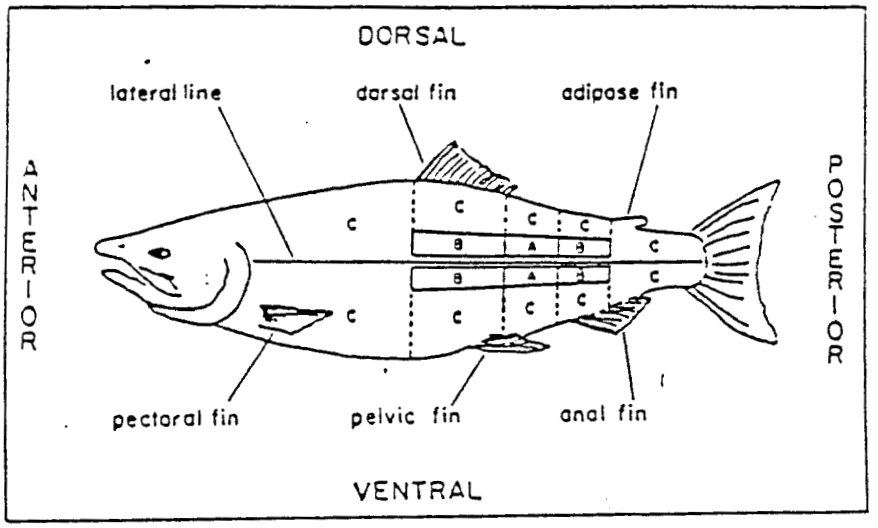
1) Place the salmon flat on its right side, with its head to your left and the dorsal fin away from you.

2) The eye should be on the line projecting from the end of the meter stick. Hold the head in place with your right hand. Sometimes you can control the fish better by placing your thumb in the fish's mouth.

3) Flatten and spread the tail against the board with your right hand.

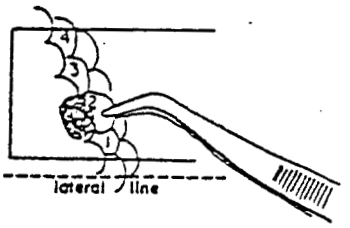
4) Read the mid-eye to fork length tó the nearest millimeter.

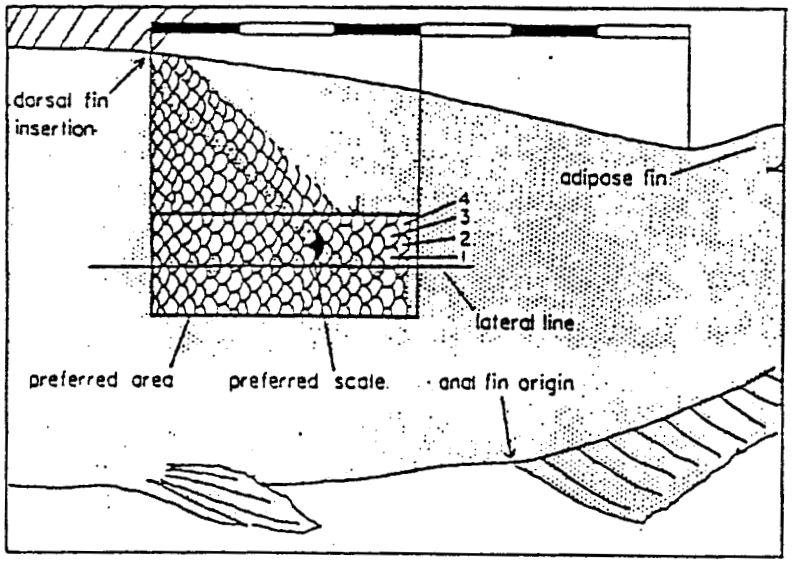
Appendix A.6. Removal and mounting of the preferred scale.



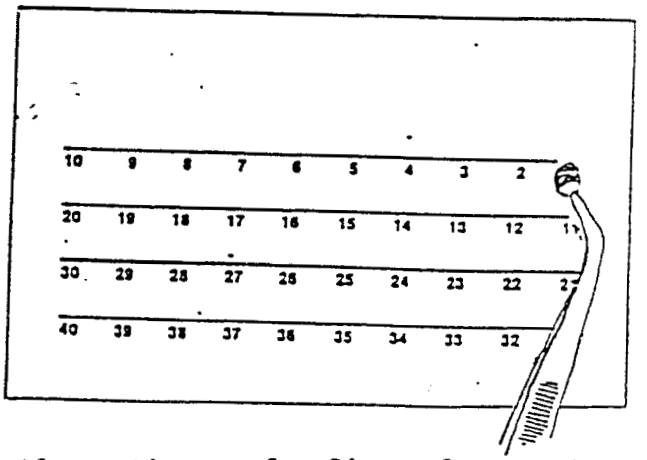
INPFC rated areas for scale removal.
Area A is the preferred area. B is the second choice if there are no scales in area A.
C designates non preferred areas. If scales on on the left side of the fish are not good, try the right side.

DO NOT TURN SCALE OVER



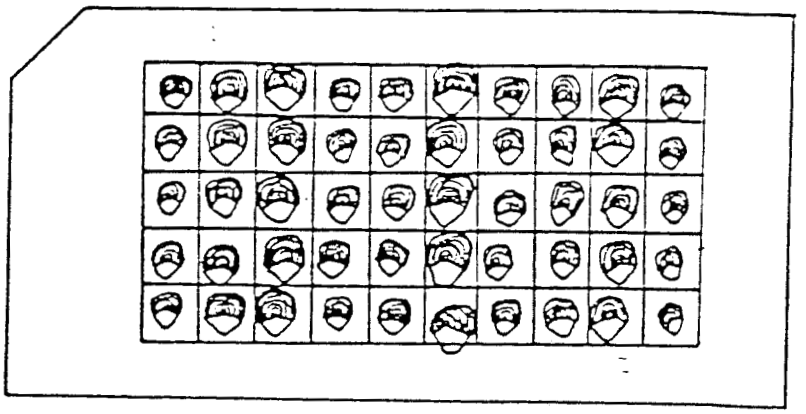


The preferred scale in this diagram is solid black. It is located 2 rows up from the lateral line, on a diagonal from the insertion (posterior) of the dorsal fin "back" towards the origin of the anal fin.

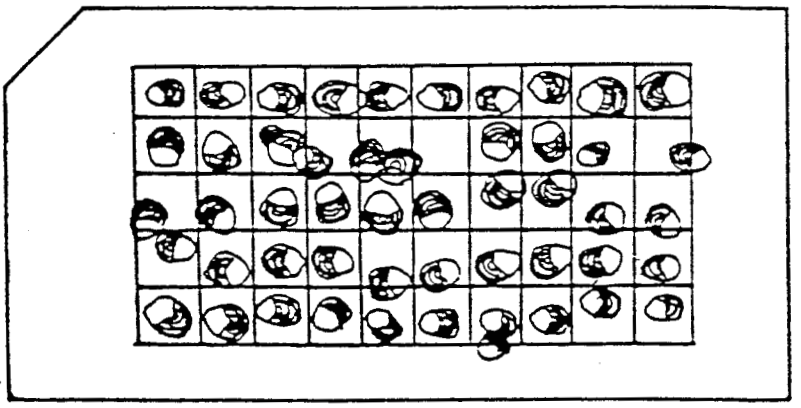


Place the scale directly over the number on the gummed card with the anterior portion (arche of the scale pointed toward the top of the card.

Appendix A.7. Scale orientation on the gummed card.



The scales are all correctly oriented on the card in the same direction, with the anterior portion of the scale pointed toward the top of the card.



The scales are incorrectly oriented in different directions. This increases the time spent to age samples.

APPENDIX B

Kodiak Area Commercial Salmon Fishery
Harvest Strategy, 1995

APPENDIX C

Annual Report Format

MEMORANDUM STATE OF ALASKA

TO: Distribution DATE: July 14, 1994

FILE: memorpt.94

FROM: Steve Hoanold SUBJECT: Project Reports: format/example

Attached is an updated version of the required format for Annual Project Reports plus a copy of a report written by management personnel. This format is general and modification will be needed for individual projects. The example report is not specifically written to follow the current format, as it was drafted several years ago. Each crew leader will be responsible for drafting a report for each project worked during the season. Crew members should also participate in the writing of the report. I recommend that crew leaders delegate specific sections of the report, based on each crew members experience on the projects. I would like a draft of the report to review prior to the end of the field season, preferably, early enough to provide feedback to allow revision.

The initial draft of the report can be handwritten and later, after final revision, will be typed by clerical staff. I encourage each crew leader to work on these reports in-season while activity is ongoing. I realize how busy the field season is, however, data summary is much easier while it is fresh. The necessary time required for revision will be scheduled when things slow down and field personnel are in town.

If any clarification and or assistance is needed to write the reports, please let the appropriate staff know. I would be more than happy to help out anytime.

I will look forward to seeing your reports. Keep in mind that these reports are important documents which provide significant information for future implementation of our projects.

cc: All Development staff

CREW LEADER ANNUAL REPORTS

I. INTRODUCTION

Description of Project Location

Include general and specific location characteristics (stream width, depth, flow, tidal influence, etc.) and effect on project.

History of Project

Brief history of program.

Purpose of Project

Objectives

Purpose of Report

II. METHODS AND MATERIALS

Precisely describe all components of your work that produced the results reported:

Employees

List employees on site and for what periods, as well as job classes, previous time spent on the job, etc.

Weir/traps

Type of weirs and traps and installation, dates of installation and trapping, maintenance schedule; enumeration techniques, how sampled, when, how estimates were made, adult, smolt and other sampling techniques, etc.

Monitoring

Regulatory duties such as setting or moving markers or monitoring the fishery, etc.

Fish Pass Maintenance

Seasonal maintenance schedule - removing and installing doors, type of repairs, performance before and after, fish usage, etc.

Other Duties and Misc.

Physical data, safety, bear avoidance or activity, sport and subsistence fishing activity, etc.

Generally, following the operational plan procedures section will assist with this section. Also, maps, photographs and diagrams are useful for this section.

III. RESULTS

Base your results on the objectives and what was accomplished: be specific as to #'s, dates, etc. Generate specifics here as far as data collected, etc. Address each category listed in the Methods section. For example, smolt enumeration, timing, number sampled, mortality, adult escapements and timing by species, adult sampling numbers, spawning surveys, fish pass usage, etc. Simple tables and graphs should be constructed to summarize significant data.

IV. DISCUSSION AND RECOMMENDATIONS

Elaborate on results, techniques, significant findings, problems, etc.; be thorough - things you would want to know if you did not have any involvement in the project, but may in the future.

Recommend changes, modifications, etc. This should include all aspects of the project. Items that may be addressed:

improvement of weir/trap installation, maintenance and operation, changes or improvement of sampling techniques, camp and support improvements. Necessary or optional equipment/gear lists would be helpful in this section.

DIVIDER

MALINA LAKE SMOLT AND ADULT ENUMERATION PROJECT OPERATIONAL PLAN, 1995

by

S. G. Honnold

and

Steve Schrof

Alaska Department of Fish and Game
Commercial Fisheries Management and Development Division
211 Mission Road
Kodiak, Alaska 99615

June 1995

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INTRODUCTION

Adult sockeye escapement from Upper and Lower Malina lakes, located on the southwest side of Afognak Island, have averaged ~5,000 since 1968. Potential escapement to the system is 20,000, thus the lakes have not produced near optimum levels in recent years. Rehabilitation efforts, at Malina lakes, includes fertilization and sockeye fry stocking to increase productivity, thus increasing sockeye fry recruitment, smolt production, and adult returns. The new Malina Lake project will collect adult escapement and smolt migration data to assist the rehabilitation efforts.

Goal

The goal of this project is to evaluate the condition of sockeye smolt emigrating from Malina lakes and to enumerate total adult sockeye escapement.

Objectives

1. Sample the age composition, and the average weight, length, and condition of the sockeye smolt migration from Upper and Lower Malina lakes.

2. Conduct a total escapement count of the adult sockeye run.

3. Estimate the age composition and average length of the sockeye escapement.

4. Monitor sockeye buildup off the mouth of Malina Creek to determine egg take timing.

5. Monitor lower river sockeye escapement into Malina Creek.

6. Estimate the juvenile sockeye abundance and sample for condition in both Lower and Upper Malina lakes.

7. Summarize project activities and data collected.

Tasks

1. Erect a weatherport and set up field camp.
   Target Date: May 31st

2. Install and operate an Incline-plane smolt trap to sample the sockeye smolt outmigration.
   Target date: May 31 until the end of the smolt migration.

3. Enumerate the daily trap catch of fish by species.

4. Sample ~210 sockeye smolt per week, during a 3-4 day period (as required), for approximately three weeks, for age, length, and weight data.

5. Collect physical data daily.

6. Install an adult weir.
   Target date: May 31 or June 1

7. Enumerate salmonids passing through the weir on a daily basis.

8. Sample 600 adult sockeye for age and length data. Sampling should occur throughout the adult escapement period.

9. Beach seine approximately 50 adult sockeye in the saltwater lagoon and floy tag the fish to estimate the amount of time it takes the fish to travel from the lagoon to the weir.

   Target dates: Tag once in mid-June and once in early July

10. Conduct weekly foot surveys of lower river to estimate sockeye buildup.

11. Conduct weekly stream surveys during the peak sockeye escapement to determine spawner distribution.
    Target Date: July 26 - August 10

12. Close camp, inventory and store equipment.
    Target Date: August 15

13. Conduct hydroacoustics and townet survey in Lower and Upper Malina lakes.
    Target Date: October 1

14. Write Project Summary Report.
    Target Date: September 15

SUPERVISION

Project Biologists: Steve Honnold, Steve Schrof
Pete Cleary (hydroacoustics)

Field Staff: Mary Bingham - crew leader
Mike Mahoney - crew

Responsibilities

Crew leader will schedule daily tasks and oversee field operations. Crew member will assist crew leader in all assigned tasks and field operation. Crew leader will be responsible for implementation of ADF&G safety SOP. The Department field safety policy will be reviewed by the crew leader and crew prior to field assignment and the Employee Safety SOP Verification will be signed. The project biologists will oversee the project, providing logistical and technical support.

PROCEDURES

Trap Monitoring and Maintenance

The smolt trap will be placed in the same location in the lower river as in 1993, if high water and velocity make trap set up dangerous, establish the smolt trap in the 1994 location. The velocity through the trap will be sufficient to minimize fish avoidance. The trap should be kept free of debris to maintain trap efficiency and minimize smolt mortality. This will require frequent monitoring and maintenance. This is an important aspect of this project and should not be taken lightly. Keep in mind the significance of smolt survival to the overall adult return. Significant mortality can occur in a short period of time if a crew is not keeping "on top" of trap monitoring and maintenance. Also, migration patterns may change with significant weather changes (i.e. rain may trigger a large outmigration) so becoming too routine in trap monitoring is not advised. The trap should be checked approximately every hour from sunset to sunrise and every four hours during daylight hours. The trap will only be fished long enough to collect 240 - 300 samples per week. The trap should be modified or wings pulled during non-trapping periods to allow smolt passage. The back panel of the catch box can be removed to allow the trap to stay in without capturing fish.

Trap Catch and Species Enumeration

Everything caught in the smolt trap will be enumerated. Please refer to the attached identification keys to alleviate any problems with species identification (Appendix A). Contract Project biologist if any questions regarding identification occur. Use a dip net to remove and release the fish as they are counted. Handle sockeye smolt gently as they are very sensitive to any stress and mortality can occur with the loss of just a few scales. A tally wacker should be used to count the sockeye smolt to assure an accurate count. Once the required sample is collected, the trap will be opened or wings removed to allow smolt passage. In the event an extremely large outmigration occurs in a relatively short time period and time will not permit counting individual smolt without mortalities, collect enough smolt for a daily sample and then pull the wings so that the trap is not fishing. This will prevent unnecessary mortality. Enter all data on the Daily Smolt Trap Catch Reporting Form (Figure 1) each time the trap is checked. Also, record any mortality on the form each day. Summarize daily trapping data on the Sockeye Smolt Summary Form (Figure 2).

Age, Weight and Length Sampling

At Malina, sample 70 - 100 sockeye smolt per day, for three days, per week, for age, length, and weight. Each sample will be taken from a single day's catch. Do not mix samples between days. If less than 70 fish are caught in a day, the sample size for that day will be the number of fish caught on that day. Since smolt primarily migrate at night, a single sampling day will be the 24 hour period from noon to noon and will be identified by the calendar date corresponding to the first noon. The total number of smolt sampled during the migration should be approximately 600.

It is essential that the daily sample be taken randomly. In the event that more than the required sample size is in the smolt trap at the time of sampling, the trap is to be stirred to assure randomness. When the smolt are randomly distributed, a small dip net will be used to remove a subsample, this procedure will be repeated until the sample goal is met.

Smolt samples will be kept alive and worked the day of capture. MS222 will be used to anesthetize the fish. Latex gloves should be worn to prevent direct exposure to MS222 (Appendix B). The use of this chemical will be demonstrated in the field. Age, weight, and length data will be recorded on adult AWL forms (Appendix C.1), as no smolt AWL forms exist. Refer to Appendix C on the standard procedures for recording data on an AWL form. Record at the top of each AWL form: personnel collecting the data.

A knife or scalpel will be used to remove 5-10 scales from the preferred area, Appendix C.3. The scales will be mounted on a glass slide as illustrated in Appendix C.4. The left portion of each slide will be labeled with: AWL number, sample, location, date, and fish number. Smolt lengths will be measured to the nearest millimeter, from the tip of the snout to the fork of the tail.

Excess water will be removed from the smolt before weighing by using a paper towel as a blotter. Individual smolt weights will be recorded to the nearest 0.1 gram.

All data (slides, forms) will be forwarded to the area office and reviewed on a frequent basis (weekly or earliest available plane to town). Be sure to duplicate the data forms in case originals are misplaced in transit. **Please be conscientious in the quality control of <u>all</u> data prior to sending into Kodiak. Take the time to thoroughly review slides and forms to see they are filled out properly. This is especially important for the computer AWL forms.** These are some common mistakes which should be avoided:

1) Scales mounted poorly - avoid too many scales in a smear and avoid slime or debris when mounting; also keep smears far enough apart to avoid mistaking one fish for another.

2) Numbering AWL form improperly - for example, if 70 smolt are sampled in one day (day 1), the AWL numbers should be (001 (fish 1-40; 8 slides), 002 (1-30; 6 slides), do not continue from 40 to 41-70. The next day will start with AWL 003 (fish 1-40) and so on.

3) Numbering when two smolt smears or adult scales <u>per fish</u> are required - these should be number 001 A, B not 01-002.

4) "# of cards" mislabeled - use one even if there are two scale cards or slides.

5) Damage AWL form (computer - Mark sense) - do not bend, fold, tape, staple, paper clip, etc. these forms. The computer will not read them correctly, otherwise.

Physical Data

Physical data will be collected at the smolt site at approximately 1100 and 2300 hours. Information will be recorded on the Daily Physical Observation form and will include: water and air temperatures, stream height, percent cloud cover, wind direction and velocity, and precipitation (Figure 3).

Weir and Installation

The Malina weir will be installed by approximately May 31st. Wooden tripods with attached 4x4 stringers will be placed across Malina creek, and aluminum conduit panels will be placed on the upstream side of the tripods. Plastic coated fencing will be placed at the base of the panels and weighed with sandbags to seal the weir.

Escapement Counts and Weir Maintenance

When sufficient fish build up behind the weir, a gate will be opened and fish will be counted. A tally wacker will be used to assure accurate counts. Daily and cumulative counts will be recorded on the Malina Weir Counts form (Figure 4). All carcasses and debris will be removed from the weir in a timely manner. The weir should be checked a minimum of twice a day to assure it is fish tight. Any modifications or work done on the weir should be noted.

Age and Length Sampling

When sufficient numbers of adult sockeye are available, samples will be collected for scale and length data, as required, to acquire 480 total for the season. Sampling should be distributed throughout the escapement period to approximate run strength. Please refer to **Appendix A** of "Kodiak Management Area Salmon Escapement Sampling Operational Plan, 1995" (Appendix D) for procedures.

Adult Tagging

When an increase in the number of adult sockeye begin to build up in the lagoon at the mouth of Malina creek, a beach seine will be walked around the fish to collect a sample of ~ 50 adult sockeye. If there is not a 50 fish sample size, then a smaller sample size down to 30 fish will be sufficient. Once the fish have been captured, each fish will be held down while another person will insert a spaghetti tag with the use of a hollow ended needle just below and towards

the posterior end of the dorsal fin (instructions on proper procedure for tagging will be sent with the tagging equipment). The needle with the tag trailing is inserted into one side of the fish and pulled out the opposite side. The needle is set aside with the spaghetti tag hanging from the fish. The two ends of the tag are tied together and the fish is released. The date and number of fish tagged should be recorded. There will be two tagging dates, one on June 15th and one on July 12th. Tagged fish will be enumerated, and date recorded as they appear at the weir. The number of tagged fish that are passed through the weir can be recorded in the "comments section" of the Malina Weir Counts form (Figure 4).

Stream Surveys

When sockeye pass through the weir and begin entering their spawning grounds, foot surveys will be conducted weekly to determine spawner distribution. Foot surveys of tributaries will require that both crew members hike upstream to the point where sockeye have not been observed. At this point each crew member will make independent counts, while traveling downstream, of live and dead sockeye. Record survey results on Malina Survey Count form (Figure 5).

Also, when camp is opened, a foot survey will be conducted of the lower river to saltwater to determine sockeye run strength. Consequently, periodic (7-10 days) survey will be continued to monitor the run. This information will be relayed to the appropriate commercial fisheries managers at their request.

Camp Inventory and Close Up

Malina lakes camp will be inventoried for all gear prior to camp close up. Items of high value will be returned to Kodiak and stored in the ADF&G warehouse in appropriate lockers. Record all items and indicate there location. A list will be made of equipment needed for the 1995 field season. The weatherport platform and out buildings will be secured prior to leaving field sites.

Hydroacoustics/townetting

Separate hydroacoustic surveys will be conducted in Upper and Lower Malina lakes to determine the significance of Lower Malina Lake as a sockeye rearing habitat. Juvenile sockeye will be collected by townetting and processed for age, weight and length data. Species composition and catch per-unit-effort data will be collected at each lake.

OTHER REQUIREMENTS

Safety and Radio Schedule

Each employee will receive CPR/First Aid Certification as required by the Department SOP, prior to assignment to the Malina Project. In addition, each employee will review the required sections

of the ADF&G SOP and sign the Employee Safety SOP Verification form. Specific SOP's to review include Safety Policy/Standards, Building Safety, Field Camp Safety, Aircraft Safety/Passenger, Emergency/Survival Equipment Required in Aircraft, Boating Safety, Vehicle Safety, Laboratory Safety, Small Tool Handling, and Firearm/Bear Safety. There is additional information in the office safety files to supplement the SOP and is also available for review.

Project crew leaders will be responsible for providing the necessary equipment and information to field technicians. **Each employee is responsible for receiving his/her own safety training.**

Field camps will be contacted by office personnel by SSB radio. The Development Section, CFM&D Division, radio schedule will be from 8:45 to 9:00 A.M. Monday through Friday and 7:30 to 7:45 P.M. Sunday through Thursday. Commercial Fish Management Section has a daily schedule at 8:00 AM and 8:00 PM, and can relay information if the need arises (Appendix E). The frequency for Fish and Game contact is 3230. **ALL FIELD PERSONNEL WILL BE AWARE OF EMERGENCY CONTACT PROCEDURE POSTED ON EACH RADIO AND AT WHICH LONGITUDE AND LATITUDE COORDINATES THEIR CAMP IS LOCATED. CREW LEADERS ARE RESPONSIBLE FOR OBTAINING THE LONGITUDE AND LATITUDE OF THE FIELD CAMPS LOCATION.**

Air Charters

All air charters will be set up through Kodiak staff. Appropriate information in regard to charters will be relayed through daily radio contact. It is important to contact office personnel when any data, equipment or other freight will be "back hauled" to Kodiak.

Reporting

Crew leaders will be responsible for reporting all of the job activities and compiling biological data. Be sure to use pencil rather than a pen for data entry. Data forms and a field log will be completed daily. Use "rite in the rain" field log books in the field and transfer data onto rite in the rain data forms after field work is completed. Data will be reported to Kodiak staff via SSB radio as previously mentioned. Completed data forms will be sent to Kodiak weekly. Make sure that data that is sent to Kodiak is properly packaged and labelled.

A report of project activities will be sent to town weekly or on soonest available plane . A one page weekly report is sufficient (Appendix F). In addition to weekly reporting, crew leaders will be responsible for writing a report summarizing Malina Project activities for the season. Please follow the enclosed format when writing this document (Appendix G). Specific information on hardware installation and removal, and system operation should be included.

Inventory

Upon completion of the project, crew leaders will complete a thorough inventory of all project equipment. The final location of each inventoried item will be noted (i.e. at Malina, warehouse bin, etc.).

Video/Photo Documentation

Crew leaders will be responsible for photo documenting project activities. Specific aspects such as trap installations, weir construction, and other detailed tasks are important to photograph. When possible, State cameras and film will be used. If, however, State cameras are not available, film will be provided for use with personal cameras. The use of personal cameras is suggested in this case but not required.

Performance Appraisal

Crew leaders will be responsible for evaluation of each crew members performance during the Malina Project operations. A Performance Evaluation will be written for each crew member at the end of the project. These evaluations will be written on the State of Alaska Performance Evaluation form (Appendix H). Beginning in 1994, the individuals that write these project evaluations will be referred to in the final evaluation written by the Project Biologist. Crew leaders should keep crew members appraised of their performance during the project.

Timesheets

All timesheets are to be in the Kodiak office by the 15th and 30th of each month. When the employee is working in the field and receives hazard pay, the timesheet "Comments" column is to have the location of the field camp. If there was overtime worked, the employee must state a choice each pay period whether to be paid for the overtime hours worked or accrue compensatory leave (comp time). The comp time should be put on the timesheet as overtime, and at the top of the timesheet write the following: "I wish to receive compensatory leave in lieu of overtime." Comp time is calculated each pay period by multiplying the number of hours of eligible overtime by 1.5. If the employee has comp time at the end of the field season, they are to use the comp time before being put on seasonal leave without pay. Employees cannot collect unemployment while on comp time. Crew leaders should plan work activities to be completed in a 7.5 hour day. All overtime worked will be pre-authorized by the Project Biologist.

Figure 1. Daily smolt trap catch reporting form.

DAILY SMOLT TRAP CATCH REPORTING FORM

PROJECT LOCATION: _____ DATE: _____

TIME (Military)	SOCKEYE		COHO FRY	DOLLY VARDEN	STICKLE-BACK	OTHER	COMMENTS
	SMOLT	FRY					
TOTAL							

Figure 2. Sockeye smolt summary form.

SOCKEYE SMOLT SUMMARY FORM

Location: _____ **Year:** _____

DATE	SMOLT		MORTALITY [a]		AWL SAMPLE		COMMENTS
	DAILY	CUMULATIVE	DAILY	CUMULATIVE	DAILY	CUMULATIVE	

[a] Included in daily and cumulative counts.

Figure 3. Daily physical observation form.

DAILY PHYSICAL OBSERVATIONS

Project:_____ Location: _____

DATE	TIME	TEMPERATURE				GUAGE	WEATHER
		AIR		WATER			
		MIN	MAX	MIN	MAX		

Figure 4. Malina weir counts forms.

MALINA WEIR COUNTS

YEAR _____ PAGE _____

DATE	NUMBER OF FISH					COMMENTS
	SOCKEYE	CUM	PINK	COHO	OTHER	

Figure 5. Malina survey counts forms.

MALINA SURVEY COUNTS

YEAR _____ AREA _____ PAGE _____

DATE	SECTION NO.	NUMBER OF FISH			COMMENTS
		PINK	COHO	OTHER	

APPENDIX

A Guide to the Collection and Identification of Presmolt Pacific Salmon in Alaska with an Illustrated Key

MILTON B. TRAUTMAN[1]

ABSTRACT

This field and laboratory key contains recommendations for types of equipment needed, instructions for preserving and labeling specimens, and descriptions of the characters used in identifying five species of Pacific salmon. The key is illustrated with six line figures: 1) juvenile salmon, 2) the first gill arch, 3) head with gill arch in situ, 4) first gill arch and eye for comparison with longest rakers, 5) method of counting anal fin rays, and 6) ventral surface of head showing branchiostegals. Five plates of stippled line drawings of five lengths (25 to 110 mm fork length) for each of the five species of Pacific salmon, an annotated opposable key, and a glossary are also included.

INTRODUCTION

As adults, the five species[2] of Pacific salmon of the genus *Oncorhynchus* inhabiting western North American waters are easily identified, but as subadults or as smolts in silvery coloration, they are less easily recognized. As juveniles less than 125 mm (5 inches) in fork length (FL), they may be quite difficult to identify. In addition, characters by which presmolt juveniles can be distinguished may vary with geographic area.

Several keys for identification of juvenile salmon have been published, most of which utilize the number, length, and shape of the gill rakers on the first gill arch; number of pyloric caeca and branchiostegals; and absence of parr marks, or if present, their size and shape (Foerster and Pritchard, 1935; Schultz, 1936; Haig-Brown, 1947; Clemens and Wilby, 1961; McPhail and Lindsey, 1970; Wilimovsky[3]). In addition to the above characters, the key in this paper emphasizes and illustrates the distribution of those chromatophores (usually melanophores) which are reliable enough to aid in the specific identification of juveniles.

This key describes the characters typical of presmolt juveniles of the five species of Pacific salmon in Alaska. The common names recommended by the American Fisheries Society (Bailey et al., 1970, p. 17) are used, despite the fact that other names appear to be in more general use. These other names are inserted in parentheses after their respective species. Trouts, Atlantic salmon (*Salmo salar*), and some other salmonoids are included in the key because of their resemblance to Pacific salmon.

Before presenting the key, it appears advisable to describe the equipment and methods I recommend for preserving specimens, labeling specimens, and counting, measuring, and removing parts of specimens, so that those not acquainted with my procedures may more accurately and quickly identify their material.

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[1] Professor Emeritus of Zoology, Ohio State University, Columbus, OH 43210. The author was employed in Alaska by the National Marine Fisheries Service Auke Bay Fisheries Laboratory during the summers of 1959 and 1961. The specimens were obtained and most of the drawings made at that time.

[2] A sixth species, *O. masou* (Brevoort), inhabits the streams of eastern Asia from the Okhotsk Sea to Formosa.

[3] N. J. Wilimovsky, 1958. Provisional keys to the fishes of Alaska. On file Natl. Mar. Fish. Serv., Auke Bay Fish. Lab., Auke Bay, AK 99821.

RECOMMENDED EQUIPMENT

Magnifiers: Magnification in the range of 4 to 30 will prove helpful in identification of juvenile salmon. A binocular microscope having such a range is the most satisfactory, but any type of magnifier of more than 4 power and less than 30 may be used provided it is not necessary to use one's hand to hold it—usually both hands are needed to manipulate a specimen. In the field, a binocular unit containing lenses inserted in a frame or headstrap or a jeweler's eye magnifier (especially if one wears glasses) may be used.

Forceps: Four or five inches long with straight or curved tips—for lifting fins, holding back gill covers, etc.

Scalpel: A sharp blade an inch or two long—for removing gill arches, opening body cavities, etc.

Teasing needle: A needle inserted in a wooden or metal handle—for separating closely set gill rakers, etc.

Dividers: For measuring and comparing various body parts; dividers in which one or both legs can be "broken" are the most satisfactory.

Scissors: About 6 inches long with the blades or cutting surface of about 1 inch.

Ruler: Graduated in millimeters to measure fish lengths and parts; one which includes inches also desirable.

PRESERVING SPECIMENS

The careful preserving of specimens cannot be too strongly emphasized. Much time is lost in attempting to identify improperly preserved fishes; it is only when properly preserved that they may be rapidly and correctly identified. Frequently, juvenile salmon that have died in nets become soft, bleached, and torn. For the sake of accuracy it is better not to attempt to identify such material.

To preserve juveniles, upon capture place them in a solution of 1 part Formalin to 9 parts water. If live fishes are placed in too strong a Formalin solution, they may die with their mouths widely agape or the chromatophores may close so tightly as to be difficult to detect. If placed in too weak a Formalin solution, the fishes become bleached and soft and may decompose. If fishes are to be preserved for more than a year (or permanently), leave them in the Formalin solution at least 1 wk and if possible no longer than 4 mo. When fish are removed from the Formalin solution, soak them in water for 24 to 48 hr; then place them in a solution containing 70% ethyl alcohol and 30% water or 35% isopropyl alcohol and 65% water.

Do not crowd or pack fishes in a container, especially if they are alive or only recently dead. Fresh fishes, if packed too tightly, will become permanently deformed upon hardening in Formalin, will be bleached where their bodies come in close contact, or will decompose. A container is too crowded if the fishes will not readily move as the container is slowly rotated or shaken. When sufficient room is allowed, identification will be facilitated because the fishes will harden without discoloring; bodies and fins will not be deformed, twisted, or broken; and the chromatophores will remain nearly or fully open.

LABELING SPECIMENS

Labeling specimens fully and properly is of great importance; unlabeled or mislabeled specimens are of little or no value. Put the label with the specimens at the time the fishes are preserved. Label paper should remain firm when wet and should not become pulpy. Write clearly with pencil or permanent ink, recording the following data.

Field Number

Use your own or a department number. A satisfactory method is to use the first initial of your surname or your full surname, the last two digits of the year, and your collection number. Thus, if Joe Brown in 1962 preserves his fifth collection, he writes B-62-5 or Brown-62-5; if for the Department of Salmon Investigations he writes, SI-62-5. When a departmental symbol is used, it often is desirable for the collector to add his initials or name to the label.

Name of Water Body and Locality

Use names on standard maps. Whenever possible, avoid temporary or local names, such

Brown's fishing camp. An example of a brief but adequate recording is: Alaska, Naknek River System, Katmai National Monument, Brooks Lake.

Date

Include the month, day, and year and, if pertinent, the hour.

The following additional information may be needed at times.

Method of Capture

Describe type of gear and size if significant, i.e., seine (2 cm mesh), fry net (1 cm mesh), trawl (1 cm bag), etc.

Temperature

Measure temperature of air and/or water. If water is ice-covered, what percent?

Other Water Conditions

If a *stream:* estimate its average width and maximum depth; if tidal and brackish, to what extent; degree of turbidity and source—glacial silt, plankton, etc.; degree of gradient—low, moderate, or high; percentage of stream in pools, with or without current; percentage of stream in riffles, whether flow is sluggish, moderate, or swift; dominant bottom types—sand, gravel, boulders, bedrock, muck, silt, etc.; aquatic vegetation—submerged, emergent, or both (name dominant species or genera if known). If a *lake or bay:* state whether fresh, brackish, or saline; if tidal, state to what extent; estimate size and possible depth; give degree of turbidity, type of bottom, and amount and kinds of aquatic vegetation.

Remarks

Describe anything that may aid in identification of the fishes, such as peculiar markings, habits, or habitats.

CHARACTERS USED IN IDENTIFYING SPECIES

A juvenile salmon is shown in Figure 1 to assist in recognizing and defining the characters and the counts and measurements used when keying out a specimen.

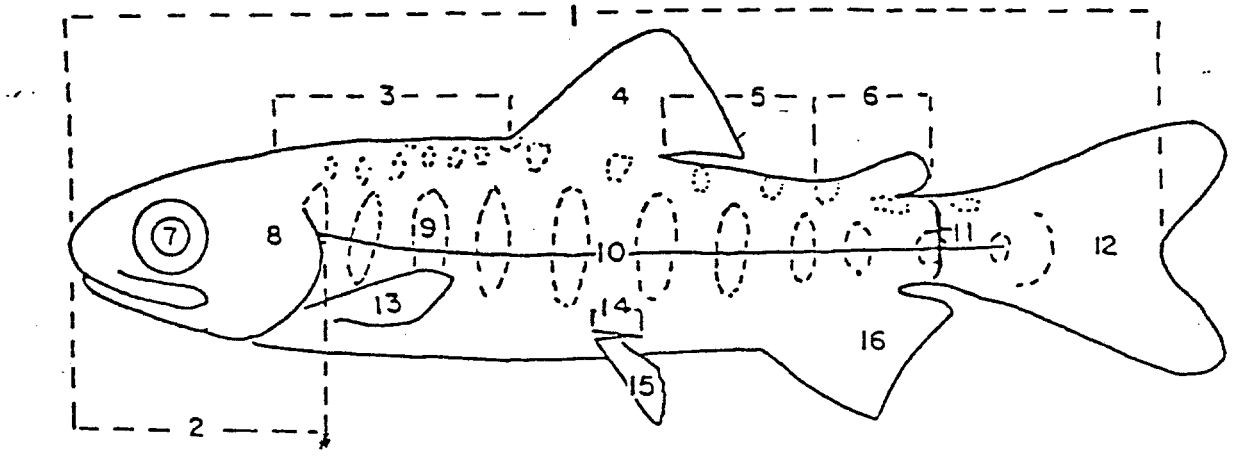

Figure 1.—Juvenile salmon, illustrating parts and methods of measuring: 1) fork length; 2) head length; 3) predorsal ridge; 4) dorsal fin; 5) portion of postdorsal ridge between posterior end of dorsal fin base and origin of adipose fin; 6) adipose fin; 7) pupil of eye; 8) gill cover, beneath which is gill chamber containing gill arches; 9) a parr mark; 10) lateral line; 11) caudal peduncle; 12) caudal fin or tail; 13) pectoral fin; 14) axillary process or scale; 15) pelvic fin; 16) anal fin.

First Gill Arch

Beneath each gill cover are four fully formed gill arches; the first gill arch on either side is the part used for specific identification. A gill arch (Fig. 2) consists primarily of a bony central arch to which the gill rakers are attached anteriorly, the gill filaments (lamellae) posteriorly. The gill rakers prevent solid substances such as food from being carried out through the branchial clefts and protect the delicate gill filaments. The numbers of gill rakers vary somewhat among individuals of each species of salmon, but the difference in average number between some species is sufficiently great to enable one to use them as specific characters.

The rakers on the gill arch may be counted as a unit, or the upper and lower limbs may be counted separately. The two limbs are joined

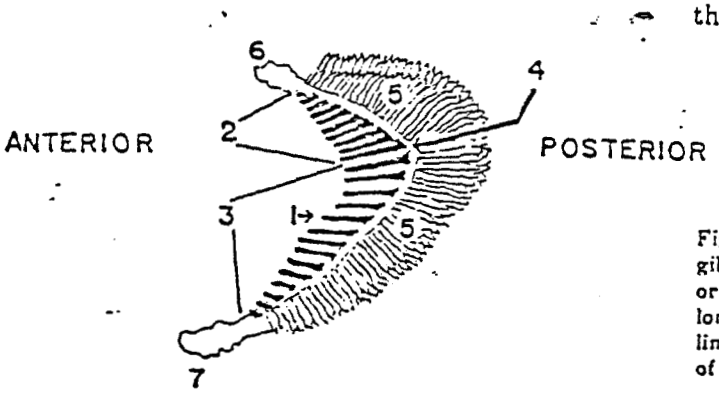

Figure 2.—First gill arch of salmon after removal from left gill chamber: 1) gill raker; 2) gill rakers attached to upper or shorter limb of arch; 3) gill rakers attached to lower or longer limb of arch; 4) angle of arch (junction of the two limbs or bones); 5) gill filaments (lamellae); 6) upper point of arch attachment; 7) lower point of arch attachment.

at an angle, the upper being the shorter. When a raker is situated astride the angle, it is included in the lower limb count. When all of the rakers on the arch are counted as a unit, a single number is given; otherwise, both limbs are recorded separately (the upper limb first), and then added, thus 12 + 20 = 32.

The gill rakers nearest the angle of the arch are the longest; the rakers become progressively shorter as they approach the attachment ends of each arch. The rakers near the ends are often rudimentary and can be counted only under magnification.

It may be difficult to count all of the rakers accurately while the first gill arch is in place, in which case it will be necessary to remove the arch. To do this, turn back or cut away gill cover as shown in Figure 3. Lift the first gill arch upward. With a sharp scalpel, cut between the dorsal ends of the first and second arches, making a deep incision parallel with them; then cut the remainder of the attachment away. Next cut the ventral attachment in the same manner; and when both ends are free, remove the arch. Great care must be taken so that all rudimentary rakers may be removed and counted. After finishing the examination of the arch, reinsert it in the gill chamber for possible future examination.

Gill Raker and Eye Comparison

The longest rakers are compared with the length of the eye (Fig. 4). With dividers, obtain the measurement of the length of the longest raker; then place one point of the dividers at the anterior edge of the eye, the other extending

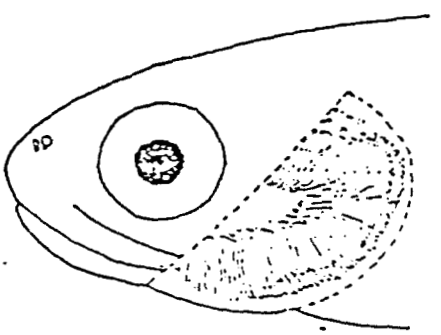

Figure 3.—Head of salmon. Dotted lines indicate that portion of gill cover which has been removed to show first gill arch in place.

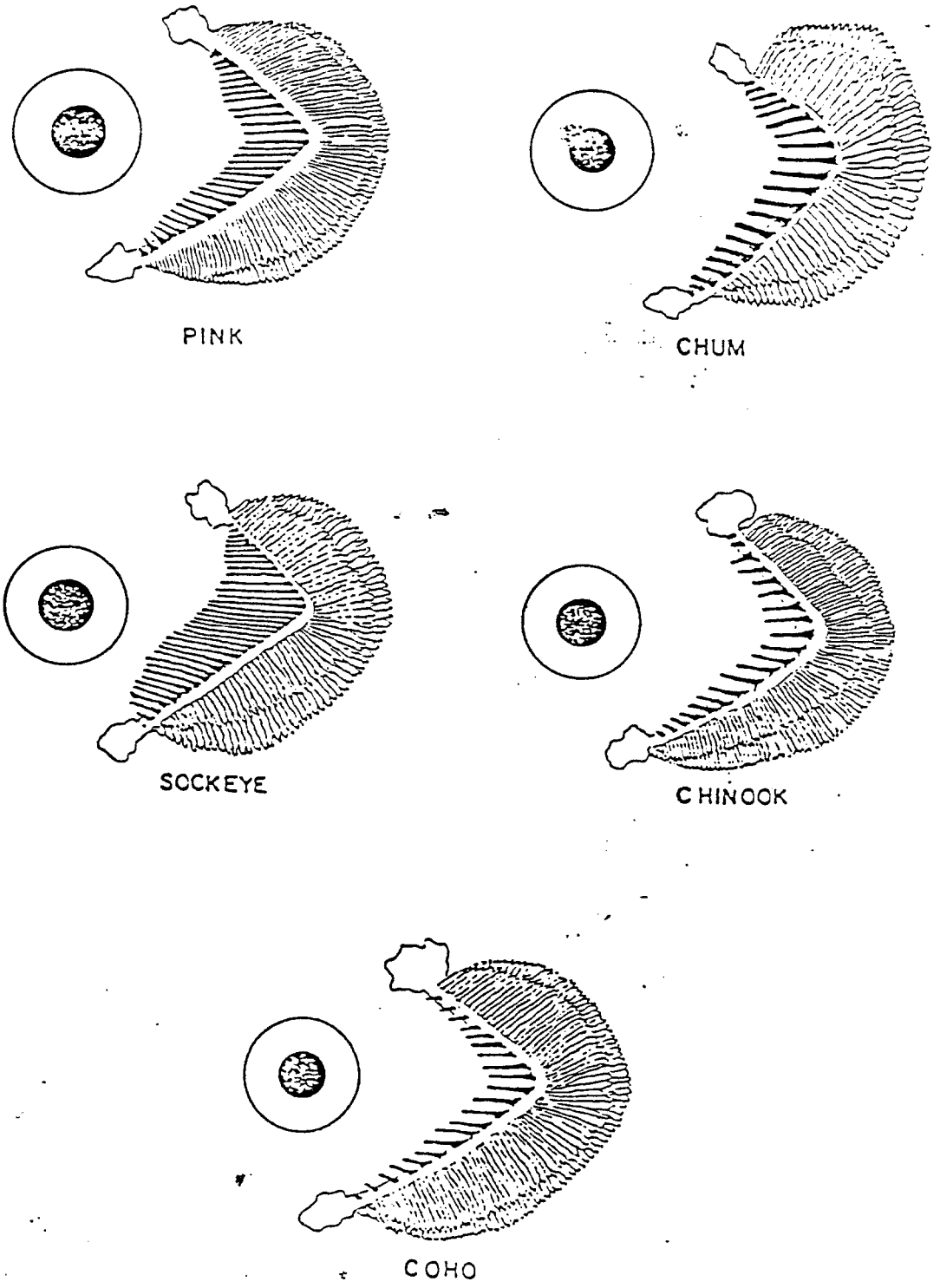

Figure 4.—First gill arch and eye for comparison with longest gill raker length of five species of Pacific salmon.

toward the opposite edge. Because the raker is shorter than the eye length in juvenile salmon, it is simplest to note where the raker reaches in relation to the pupil. Like many body part ratios, the gill raker-eye size ratios change as the juvenile salmon increases in length. For example, in specimens about 40 mm FL, the longest raker may be contained about 3 times the eye length, but in 140 mm specimens of the same species, the raker may be contained only about 2 times. This and other proportional changes must be considered.

Anal Fin Measurement and Count

To compare the length of the fin base with the longest ray, measure the anal fin base with dividers; then project the posterior leg of the dividers forward to the opposite tip of the longest ray as shown in Figure 5 by dotted line.

In counting the number of rays (Fig. 5), do not count those anteriormost ones which are less than half the length of the longest rays, such as those marked "0." Count all rays, such as No. 1, that are half (or more than half) the length of the longest ray, taking great care to observe the last ray—No. 15 in Figure 5. The last ray is usually split to its base and appears superficially as two rays, but it is in reality only one and should be counted as such.

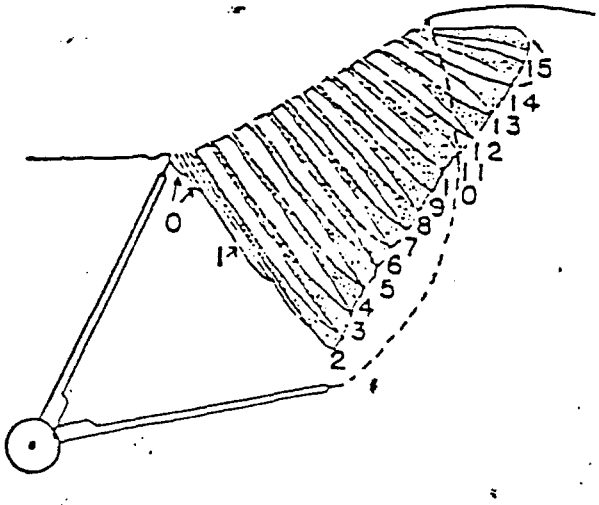

Figure 5.—Anal fin of salmon, illustrating method of measuring length of fin base and of counting rays (rays 2 to 15 are stippled here for emphasis).

Branchiostegal Count

All branchiostegals (Fig. 6), including the smallest, anteriormost ones are counted. Usually this may be accomplished satisfactorily only under magnification, and with juveniles longer than 40 mm FL. The branchiostegal count is used primarily as an additional character in specimens otherwise difficult to identify, and is especially valuable in separating the chinook salmon (usually 15 or 16) from the coho salmon (usually 13 or 14).

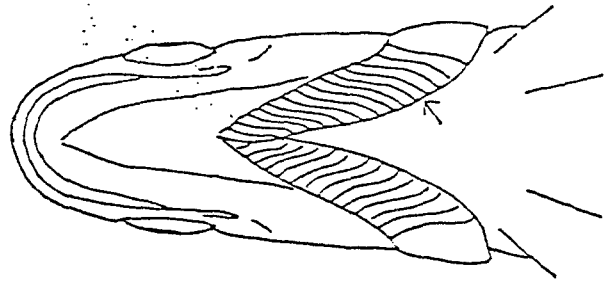

Figure 6.—Ventral surface of head of salmon. Arrow points to one of 14 branchiostegals on left side of head.

Pyloric Caeca Count*

With a scalpel, widely open the abdominal cavity. Sever the esophagus as far forward as possible; then cut off the intestine near the posterior end of the stomach. The stomach and caeca can now be removed as a unit (Fig. 7). Use magnification and teasing needle as aids in counting. Counts of pyloric caeca are useful chiefly as an additional character for questionable specimens, especially in separating the chinook salmon (more than 100 caeca) from the coho salmon (fewer than 90).

Color Pattern Variations

Juvenile salmon from certain waters or at certain stages of development may have their parr marks or other markings masked by a bluish-

*In the key, I have used pyloric caeca counts of my own, plus published accounts of others and especially the more recent ones, such as Clemens and Wilby (1961) and McPhail and Lindsey (1970).

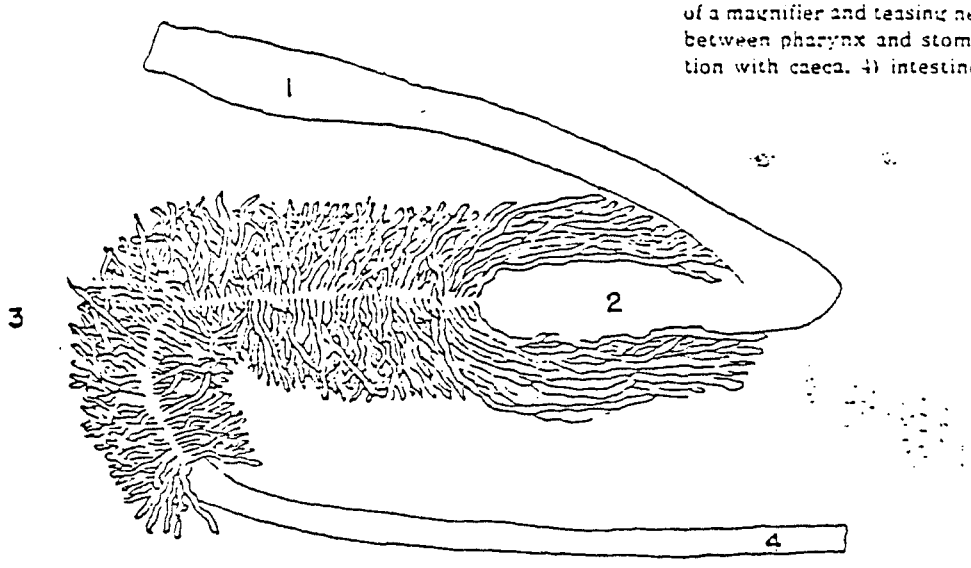

Figure 7.—Major portion of alimentary tract of salmon with pyloric caeca spread apart preparatory to counting with aid of a magnifier and teasing needle: 1) esophagus (part of tract between pharynx and stomach), 2) stomach, 3) pyloric section with caeca, 4) intestine.

or greenish-silvery sheen, especially when they are alive. To identify these fish, it may be necessary to preserve them first in Formalin to intensify their markings.

Juveniles of one species from certain waters, such as habitually turbid ones, may have their melanophores restricted in size or distribution, thereby resembling superficially another species. As an example, coho salmon normally have the adipose and anal fins densely speckled with rather large melanophores. But in some specimens, the melanophores may be reduced in size or distribution, so that coho salmon superficially resemble chinook salmon. Conversely, juvenile chinook salmon may have the melanophores unusually numerous and well developed, thereby resembling coho salmon. To avoid error in identification, compare the size and number of melanophores on the fins with those on the body; if few and small on the body, they should be few and small on the fins.

Color variations also occur regionally. An example is the predorsal stripe in chinook salmon, which in fish from some waters is normally a solid dark bar in specimens less than 80 mm FL; in chinook salmon in other waters the stripe may be reduced to a series of oblong blotches.

The length when individuals attain smolt coloration varies greatly, both regionally and in specimens from the same locality; some fish of the same species may lose parr and other presmolt markings when only half as large as other fish.

HOW TO USE KEY

Because of the variations in morphology and coloring, it is advisable to use the key in conjunction with the figures and plates and to check a large combination of characters.

In using the key, first make certain your specimen is a Pacific salmon by examining the characters under the two opposable groups labeled "1." Next, note the absence or presence of parr marks (see sections *"Combination of"* under opposable groups 2). If no parr marks are present and your specimen has not entered the silvery smolt stage, it is probably a pink salmon, but to make sure, compare it with the identifying characters between opposable groups 2. If parr marks are present, note the absence or presence of melanophores on adipose and anal fins (see groups 3). If melanophores are absent, see sections *"Combination of"* under groups 4; if present, see *"Combination of"* sections under groups 5. Decide which *"Combination of"* most closely fits your specimen, then verify it by comparing the descriptions of the identifying characters for the opposable groups.

KEY TO PRESMOLT JUVENILE SALMON

Salmonoid fishes having fewer than 20 rays in the dorsal fin (excludes grayling); strong teeth on jaws and tongue (excludes ciscoes and whitefishes); many pyloric caeca (excludes smelts, family Osmeridae); an axillary process or scaly appendage above pelvic fin (Fig. 1, No. 14); an adipose fin; cycloid scales; upper jaw formed by both premaxillary and maxillary ..... 1.

1a Base of anal fin *shorter* than longest ray (Fig. 5). Anal rays usually 9 to 12 (rarely 8 or 13). Gill rakers normally fewer than 20 on first gill arch (Fig. 3). Dorsal fin of larger juveniles of some species with several blackish spots.
CHAR, TROUTS, ATLANTIC SALMON ..... Not in this key.

1b Base of anal fin *longer* than longest ray (Fig. 5). Anal rays usually 13 to 17 (rarely 12, 18, or 19). Gill rakers normally 20 to 40 on first gill arch (rarely 19). Dorsal fin of larger juveniles lack blackish spots but tip of fin may be blackish.
PACIFIC SALMON—genus *Oncorhynchus* ..... 2.

2a *Combination of: No* parr marks on sides and *no* prominent specklings on back of presmolt juveniles. Usually no melanophores on anal and adipose fins; if melanophores present, they are few and very small, and if on adipose, are restricted to its posterior, free edge.
PINK (HUMPBACK) SALMON—*O. gorbuscha* ..... Plate 1.

General development—Similar to chum salmon in that yolk sac may not disappear until juvenile is more than 34 mm FL, after which development toward smolt shape and coloration is rapid. When less than 50 mm FL, this species is similar to chum salmon in being more terete than the sockeye, chinook, and coho salmon; body depth immediately before dorsal fin usually more than 1.5 times head length.

Parr marks—Only species of salmon lacking parr marks in the presmolt juvenile.

Coloration of body—*Preserved material*—In juveniles less than 40 mm FL, back is dark to lateral line and ventral half of body light when bicolored; dorsal third of body is darkest, sides lighter, ventral third lightest (usually milky-white or silvery) when tricolored. Few or no melanophores on lower sides and belly. In juveniles more than 40 mm FL, bicolored or tricolored condition is normally not evident, the dark back lightening gradually downward to the very light belly. *Living specimens*—Dorsal half of body bright bluish or greenish with much silvery reflection; ventral half milky or silvery-white.

Fins—Anal and dorsal fins averaging smaller than in chum salmon; these fins in this species and in chum salmon distinctly smaller than in sockeye, chinook, or coho salmon. In specimens less than 40 mm FL the longest anal ray, when measured into head length, extends from tip of snout to about center of eye; in larger presmolt juveniles, this measurement extends from tip of snout to anterior half of eye. Anal rays usually 14 to 16 (extremes 13 to 17). *Dorsal fin* has few specklings and only a slight tendency toward a dark anterior edge in juveniles less than 50 mm FL; over 50 mm, blackish anterior edge becomes pronounced and tip of fin dusky. *Caudal fin* has speckling confined to basal half in juveniles less than 50 mm; with increasing length of juveniles, specklings appear along rays, and in large presmolt juveniles lobes tend to become blackish.

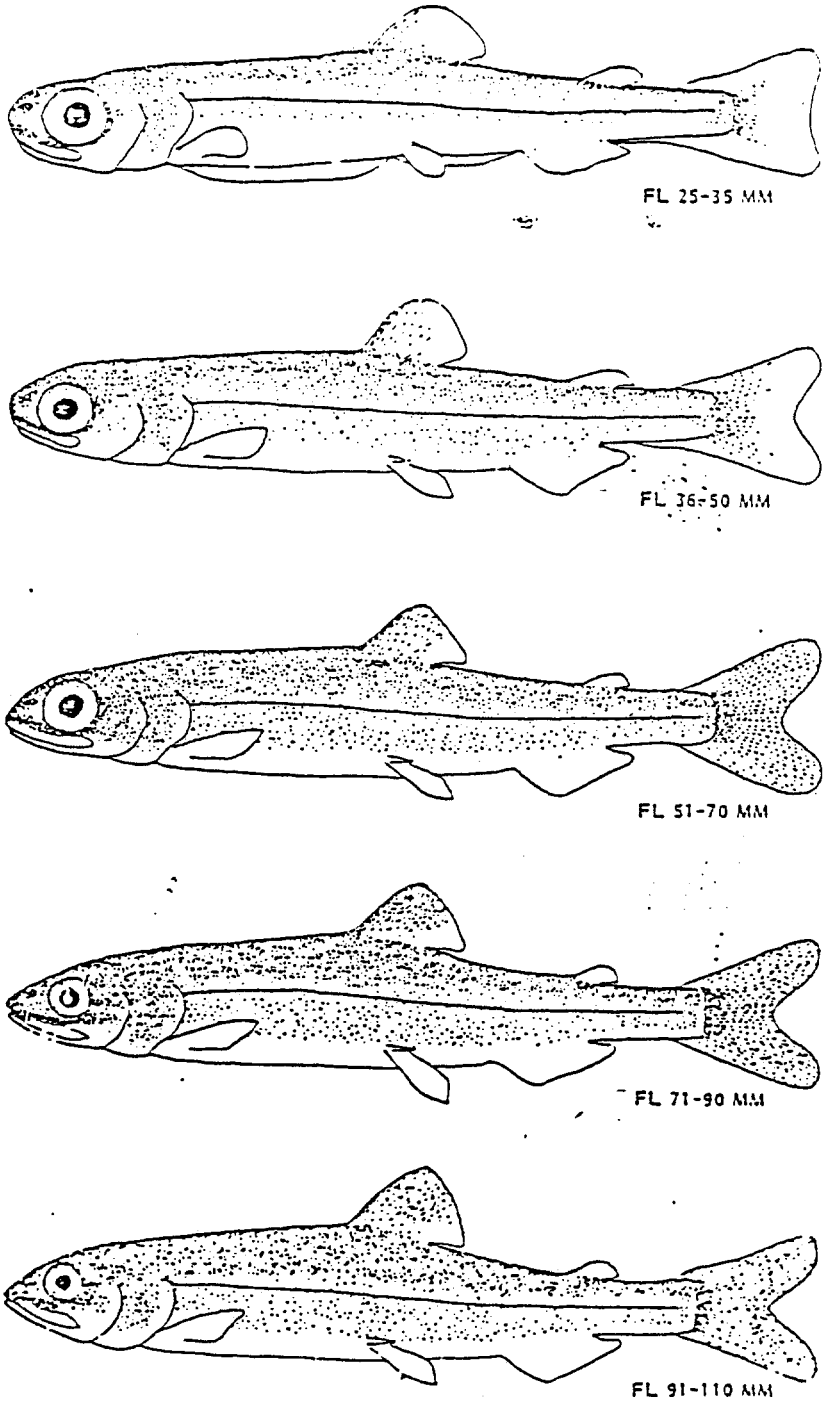

Plate 1.—Pink salmon.

Gill rakers (see Fig. 4)—Eleven to fourteen on upper limb, 14 to 19 on lower, total usually ranging between 27 and 33 (extremes 25 and 35); rakers slender and rather long; most similar in size and number to sockeye salmon but shorter and usually fewer (normally less than 31).

Pyloric caeca—Usually 130 to 195 (extremes 95 to 224); slender and rather long; differ sufficiently in numbers from coho and sockeye salmon, which have fewer than 100, to be a distinct aid in specific identification.

Branchiostegal rays—Usually 11 to 14 (rarely 10 or 15); average number less than in other species, almost invariably less than in chinook salmon, which usually has 15 to 18 (rarely 14).

Scales in lateral line—More than 170, more than in any other of the Pacific salmon; lateral line scale counts may be obtained under magnification in specimens longer than 60 mm FL.

Habits—Shortest life span of any species, between 18 mo and 2 yr. Only a comparatively small proportion of adults make extended migration in fresh water. Majority spawn in fresh waters within a short distance of brackish water or in intertidal waters. Many young enter brackish or salt waters within a few hours or days after emerging from redds, and comparatively few are found in fresh water when more than 45 mm FL.

Combination of: Both parr marks on sides and dark spottings on back usually obvious in living, presmolt juveniles and always in preserved specimens under magnification (may be faint in fishes from turbid waters); parr marks become faint and disappear as juvenile assumes smolt coloration ..... 3.

2b

No melanophores normally present on adipose and anal fins of presmolt juveniles, or if present, few and quite small. Parr marks occupy a larger area above lateral line than below it, and in some specimens anterior parr marks may be almost entirely above the lateral line.

3a

CHUM AND SOCKEYE SALMON ..... 4.

Melanophores normally obvious on adipose fin in living specimens and always in preserved specimens under magnification (may be indistinct in juveniles from silty waters). Anteriormost parr marks appear to occupy as large (or almost as large) an area below lateral line as above it; these parr marks are usually large, long, and wide.

3b

CHINOOK AND COHO SALMON ..... 5.

Combination of: Gill rakers 19 to 26 (average 23), notably fewer and much shorter than in sockeye salmon, which have more than 28. Normally *no* melanophores on adipose and anal fins. Anterior squarish (quadrate) parr marks situated almost or entirely above lateral line in specimens less than 50 mm FL; in presmolt juveniles more than 50 mm FL, anterior parr marks tend to be long and very narrow and sometimes may extend well below lateral line.

4a

CHUM (DOG) SALMON—*O. keta* ..... Plate 2.

General development—Similar to pink salmon in that yolk sac may not disappear until juvenile is more than 34 mm FL, after which development toward smolt shape is rapid. Also similar to pink salmon in being more terete (when less than 50 mm FL) than the sockeye, chinook, and coho salmon; body depth immediately before dorsal fin usually 1.5 to 1.8 times head length.

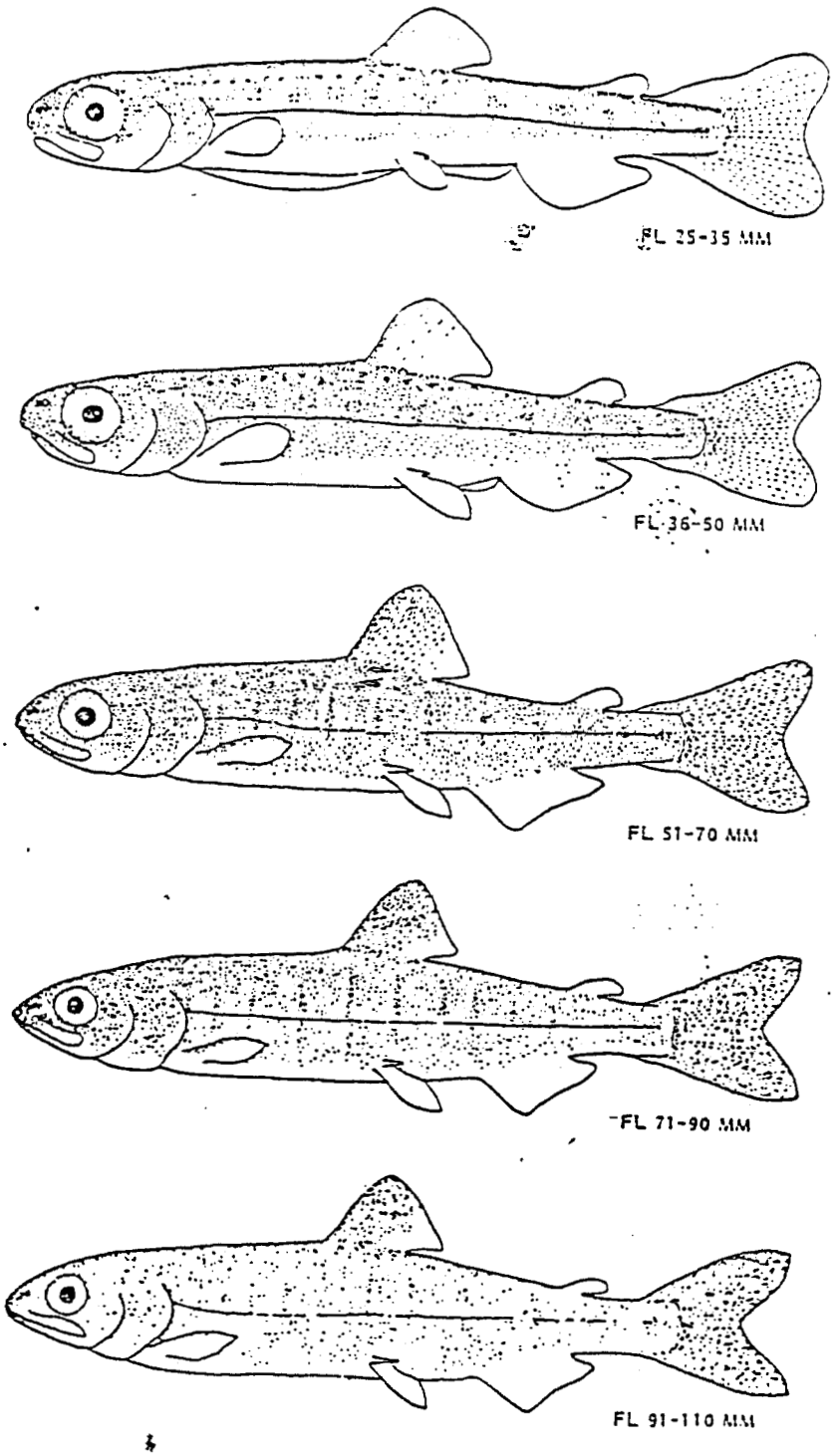

Plate 2.—Chum salmon.

Parr marks—Anterior parr marks in specimens less than 50 mm FL are more squarish (quadrate) and do not extend quite so far below lateral line as in sockeye salmon; in presmolt juveniles more than 50 mm FL, parr marks tend to become longer and more narrow than in sockeye salmon, and some tend to extend well below lateral line.

Coloration of body—*Preserved material*—Dorsal ridge stripe usually present, sometimes a series of blotches in juveniles less than 50 mm FL, becoming faint or disappearing in presmolt juveniles more than 50 mm FL; a prominent irregular row of spots and blotchings between dorsal ridge and upper edge of parr marks, these usually most distinct in specimens between 34 and 50 mm, often fading or disappearing in larger juveniles. *Living specimens*—Markings may be obscured by greenish or bluish overcast of dorsal half of body and whitish or silverish sheen of ventral half.

Fins—Anal and dorsal fins small, averaging slightly larger in size than those of pink salmon and averaging considerably smaller in height and area than those of sockeye salmon. Length of longest anal ray, when measured from snout to eye, reaches to, or almost to, center of eye; in sockeye salmon this measurement usually extends well beyond center of eye. Anal rays usually 13 or 14 (extremes 13 to 17). *Dorsal fin* has few or no distinct spottings in specimens less than 50 mm FL; in larger presmolt juveniles a dusky spot develops on tip. *Caudal fin* has faint spots largely confined to basal half in juveniles less than 50 mm FL; in larger juveniles lobes become blackish.

Gill rakers (see Fig. 4)—Seven to twelve on upper limb, 12 to 19 on lower, total usually ranging between 20 and 26 (extremes 19 to 30); rakers blunt and short, in sharp contrast to thinner, longer, and more numerous rakers of sockeye salmon, which has 30 to 39.

Pyloric caeca—Usually 160 to 185 (extremes 140 to 249); differ sufficiently in numbers from sockeye and coho salmon, which usually have fewer than 100, to be an aid in specific identification.

Branchiostegal rays—Usually 13 or 14 (extremes 12 to 16); of value primarily in separating this species from chinook salmon, which generally has more than 15.

Scales in lateral line—Between 125 and 155; of value chiefly in separating this species from pink salmon.

Habits—Life span usually 3 to 5 yr, for majority, 4 yr, some less than 3 yr. Jacks may occur. Majority spawn in fresh waters only a comparatively short distance from brackish water or in intertidal waters. Many young enter brackish or salt waters very shortly after emerging from redd, and few juveniles are found in fresh waters when more than 45 mm FL.

Combination of: Gill rakers 30 to 39 (average 36); notably more numerous, longer, and more slender than in chum salmon, which have fewer than 27. Normally *no* melanophores on adipose and anal fins. Anterior parr marks more rectangular than squarish in outline in specimens less than 45 mm FL and sometimes extend as much as a third to a half below lateral line; these oblong parr marks tend to shorten in presmolt juveniles more than 50 mm FL and to be mostly above lateral line.

4b

SOCKEYE (RED) SALMON—*O. nerka*. . . . . Plate 3.

General development—Yolk sac usually disappears, except for trace, before juveniles reach 30 mm FL. Body deeper and species more slab-sided in all presmolt lengths than in chum and pink salmons—body depth immediately before dorsal fin usually less than 1.5 times head length.

Parr marks—See "*Combination of*" above.

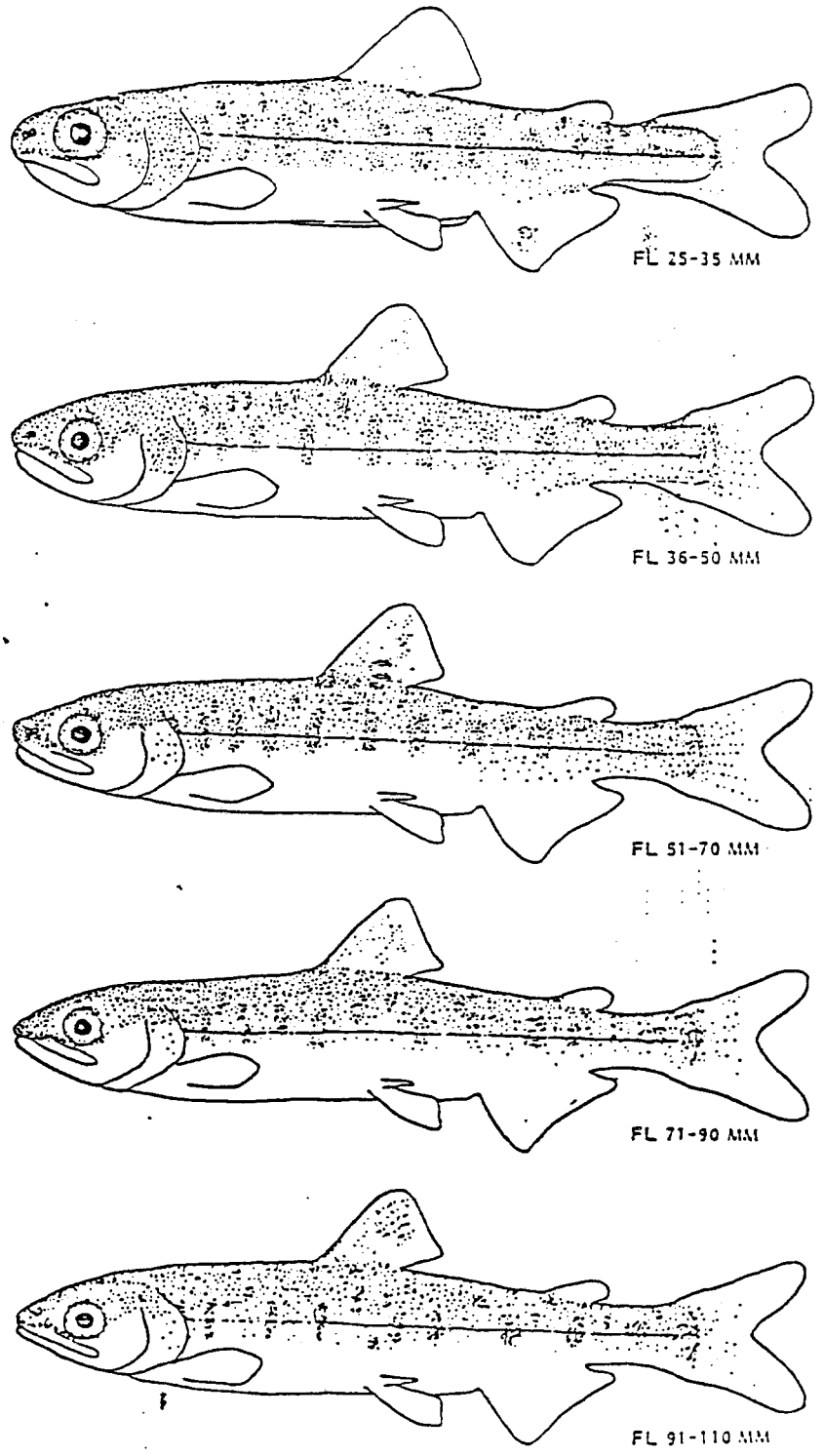

Plate 3.—Sockeye salmon.

Coloration of body—*Preserved material*—Dorsal ridge usually contains a series of more or less distinct spots in specimens less than 35 mm FL, becoming more confluent in fishes between 40 and 55 mm FL and sometimes merging into a dusky bar; in presmolt juveniles over 60 mm FL, spots or bars may disappear, after which a series of roundish spots become apparent on both sides of, and adjacent to, dorsal ridge, especially that portion behind dorsal fin; in addition to these spots, in fishes more than 35 mm FL, another longitudinal row of spots develops between dorsal ridge and upper halves of parr marks. *Living specimens*—Markings may be obscured by greenish or bluish overcast of dorsal half of body and whitish or silverish sheen of ventral half.

Fins—Anal and dorsal fins average larger in height and area than in chum and pink salmon. Length of longest anal ray, when measured from snout to eye, reaches usually from snout to beyond center of eye. Anal rays usually 14 to 16 (extremes 13 to 16). *Dorsal fin* normally has few or no distinct specklings in specimens less than 60 mm FL; a rather faint dorsal spot develops in larger presmolt juveniles in upper portion of fin, the fin being bordered on its free edges with whitish (see lowest figure, Plate 3). *Caudal fin* has few specklings on basal half, the lobes having few or no melanophores, even in rather large juveniles.

Gill rakers (see Fig. 4)—Twelve to sixteen on upper limb, 18 to 23 on lower, total usually ranging between 32 and 37 (extremes 30 to 39); rakers long and slender, averaging longer than in any other species, in sharp contrast to fewer, blunter rakers of chum salmon, which has 19 to 30.

Pyloric caeca—Usually 65 to 95 (extremes 45 to 115); usually considerably fewer than in pink, chum, and chinook salmon, and averaging more than in coho salmon.

Branchiostegal rays—Usually 13 to 15 (extremes 11 to 16); of value chiefly in separating this species from chinook salmon, which average more.

Scales in lateral line—Between 125 and 140; of value chiefly in separating this species from pink salmon, which has a higher number.

Habits—Life span usually 4 or 5 yr, some only 3. Jacks may occur. Majority of individuals highly migratory. Adults usually spawn in streams tributary to lakes; a small minority spawn in streams without a lake, in lake outlets, or on lake beaches. After rising from redd, young move downstream rather rapidly to a lake, remaining usually 1, sometimes 2, and rarely 3 yr in fresh water before entering brackish or salt water.

Combination of: Melanophores on adipose fin usually most numerous on posterior half and generally forming a dark border (see Plate 4); anterior half of adipose with few melanophores or none. Anal fin with few melanophores or none, but when
5a melanophores are present, often quite large. Tip of dorsal fin and lobes of caudal fin darker in larger presmolt juveniles.

CHINOOK (KING) SALMON—*O. tshawytscha*. . . . . Plate 4.

General development—Yolk sac usually disappears or is reduced to a trace before juveniles reach 32 mm FL. Body deeper and species more slab-sided in all presmolt lengths than in chum and pink salmon; body depth immediately before dorsal fin usually less than 1.5 times head length (range 1.1 to 1.5).

Parr marks—Almost invariably rectangular and long vertically; marks usually situated equidistant on each side of lateral line; dark parr marks and other markings contrast sharply with lighter background of body in some living and most preserved specimens.

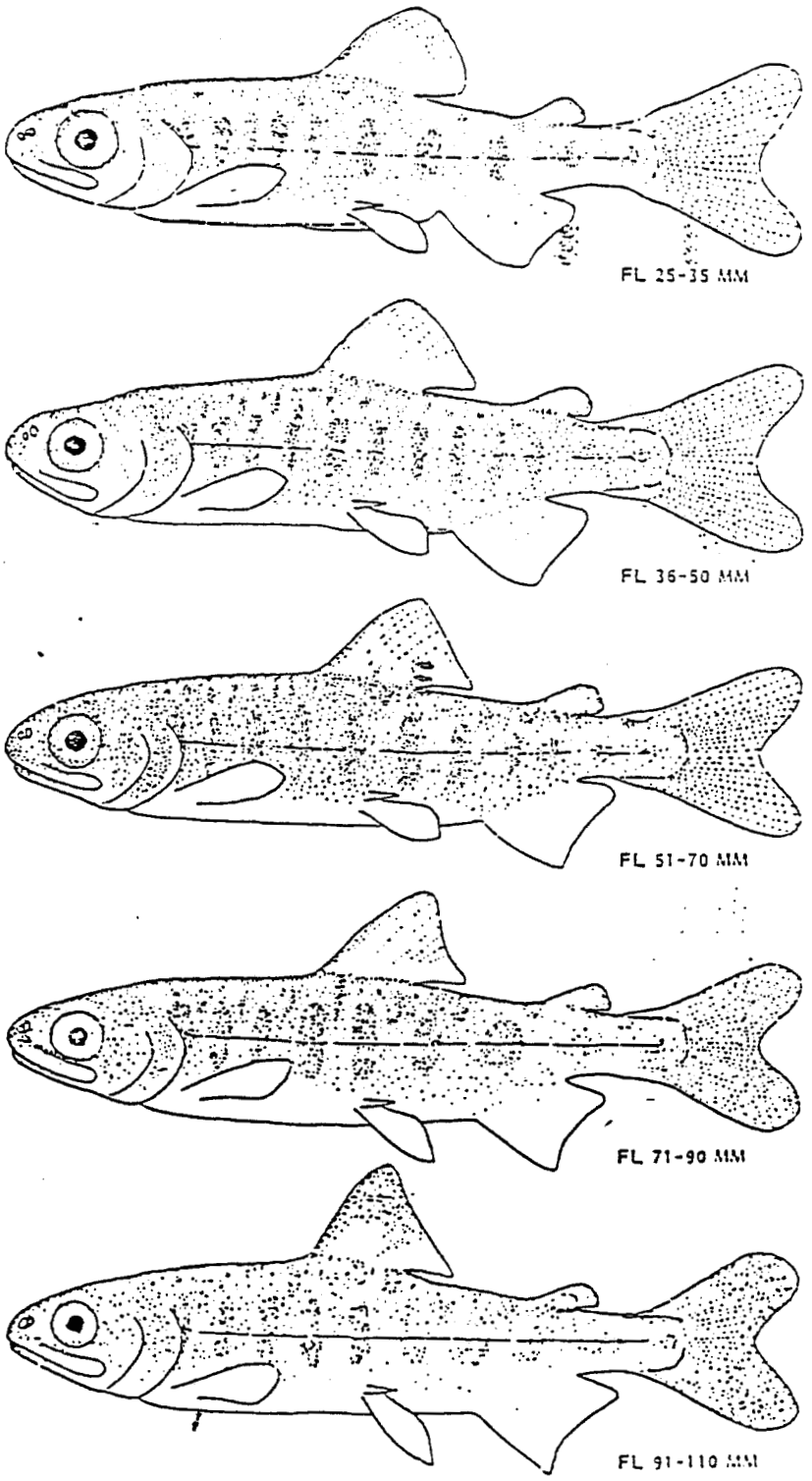

Plate 4.—Chinook salmon.

Coloration of body—*Preserved material*—Background color of body generally much lighter than body color of coho salmon, usually contrasting sharply with dark dorsal stripe or spotting, parr marks, and prominent dorsal spottings; blackish band astride dorsal ridge usually bold and unbroken in specimens less than 80 mm FL and especially on ridge before dorsal fin; in larger juveniles dorsal band often breaks up into series of spots, disappearing in larger presmolts as other spottings on dorsal half of body become more numerous and distinct; spottings between dorsal ridge and parr marks absent in fishes less than 35 mm FL, developing rapidly thereafter into many large and small spots and increasing in numbers as juveniles approach smolt stage. *Living specimens*—Parr marks and other markings may be obscured by bluish-silvery color of dorsal half of body and silvery sheen of ventral half.

Fins—Anal and dorsal fins averaging considerably larger in area than those of the chum and pink salmon and slightly larger than in the sockeye salmon; length of longest anal rays, when measured into head length, reaching from snout tip to beyond posterior edge of pupil and sometimes beyond posterior edge of eye; distal edge of anal slightly falcate in specimens more than 40 mm FL but averaging less falcate than does the free edge of the anal of the coho salmon. Anal rays 15 to 19, averaging higher in number than in any other species. *Dorsal fin* in young less than 60 mm FL usually has few or no distinct spottings, a blackish spot developing in the upper portion of the fin as the juveniles approach the smolt stage (see Plate 4). *Caudal fin* has comparatively few melanophores rather generally distributed in the smaller individuals, the lobes darkening as the fishes approach the presmolt stage.

Gill rakers (see Fig. 4)—Seven to twelve on upper limb, 10 to 16 on lower, total usually ranging between 20 and 25 (extremes 19 to 28); rakers short and similar in size and number to chum and coho salmon.

Pyloric caeca—Usually 140 to 185 (extremes 90 to 240); of value in separating this species from coho salmon, which normally has fewer than 85.

Branchiostegal rays—Usually 16 to 18 (extremes 13 to 19); average number greater than in any other species.

Scales in lateral line—Between 132 and 152; usually of most value in separating this species from pink salmon.

Habits—Life span 2 to 8 yr, usually 4 to 6. Jacks may occur. A portion of the juveniles enter salt water during first year of life; remainder stay in fresh waters more than 1 yr but rarely 2 yr. Juveniles of presmolt stage found in fresh waters when as long as 150 mm FL.

Combination of: Melanophores usually numerous and rather evenly distributed on adipose fin; occasionally in larger juveniles, posterior or free edge may be darker than remainder, thereby resembling somewhat melanophore distribution on adipose of chinook salmon. Anal fin in specimens larger than 30 mm FL more falcate and anterior tip more pronounced than in other species, including chinook salmon; in all except smallest specimens, anterior or leading edge of anal fin is whitish, with a dark bar parallel and posterior to it; remaining, posterior portion of fin usually abundantly speckled with melanophores except for distal and posterior edges (see Plate 5).

COHO (SILVER) SALMON—*O. kisutch*. . . . . Pla

General development—Yolk sac usually disappears, except for a trace, before juveniles reach 32 mm FL. Body deeper and species more slab-sided in all pre-

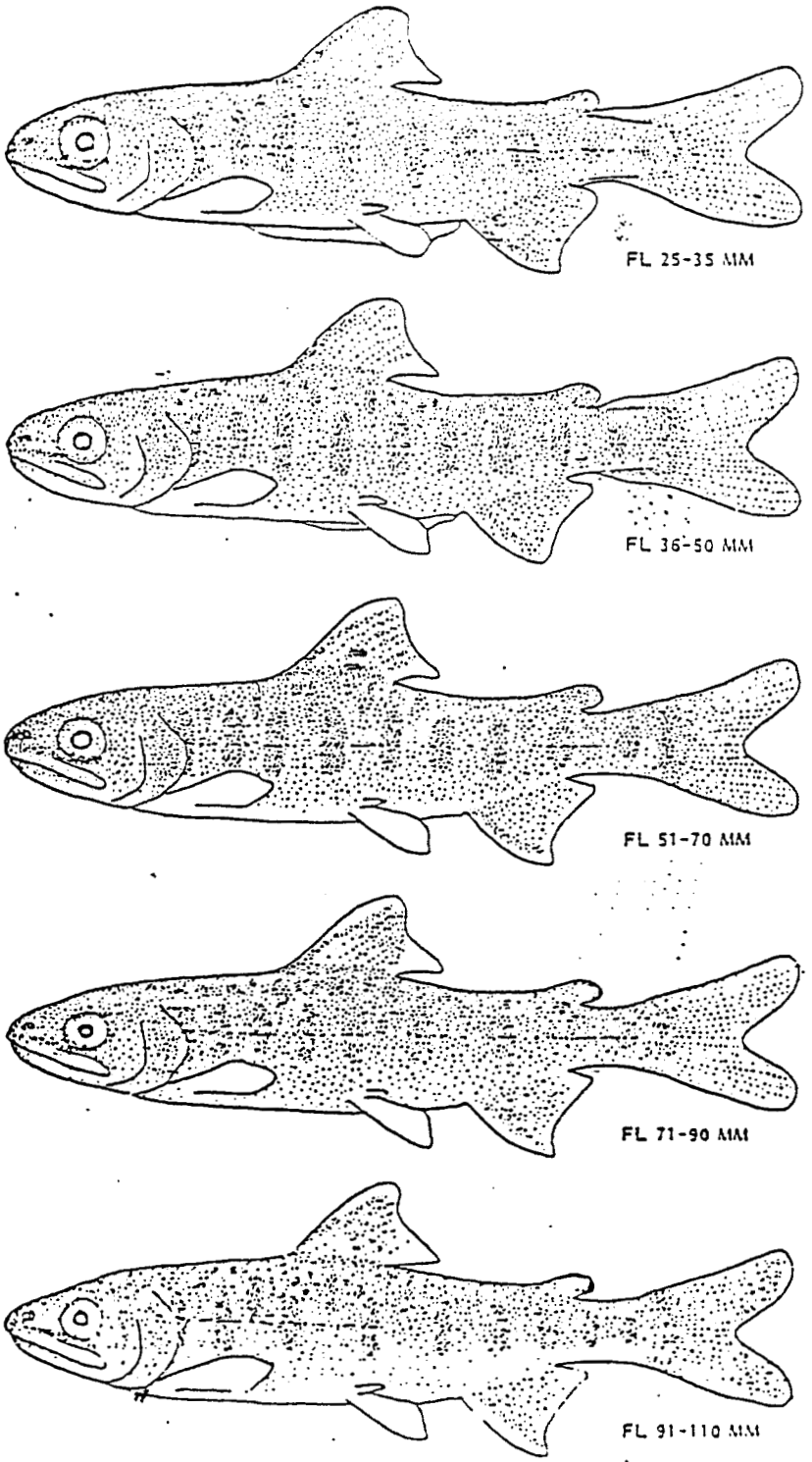

Plate 5.—Coho salmon.

smolt lengths than in chum and pink salmon; body depth immediately before dorsal fin usually less than 1.5 times head length (range 0.9 to 1.5).

Parr marks—Anterior parr marks always large and long vertically, their upper and lower ends more rounded than rectangular-shaped parr marks of chinook salmon; marks usually situated equidistant on each side of lateral line; usually less contrast between color of parr marks and body than in chinook salmon.

Coloration of body—*Preserved material*—In all but smallest specimens, contrast between all body marks and background color of body is not as pronounced as in other species; dark bar along dorsal ridge usually distinct and unbroken in juveniles less than 50 mm FL, breaking up into spots or disappearing in larger specimens; back spottings on both sides of dorsal ridge usually prominent in all except smallest specimens; spots between parr marks often elongate and extending downward between them, sometimes to lateral line (see bottom figure, Plate 5); spots on dorsal half of body often increase in number and/or decrease in size as individuals approach smolt stage. *Living specimens*—Parr marks and other body markings may be obscured by dark coloration of body or by bluish sheen.

Fins—Anal and adipose fins described under "*Combination of*" (this section). Anal rays usually 13 or 14 (extremes 13 to 16). *Dorsal fin* has comparatively few melanophores scattered over it in smallest specimens; in those more than 32 mm FL the number of melanophores increases, especially on or adjacent to anterior or leading edge; this results in a dark bar along the anterior edge behind which melanophores are rather evenly distributed; as fishes approach presmolt stage, a white anterior (or leading) edge and a whitish tip develops, followed by a dark parallel bar (see bottom figure, Plate 5). *Caudal fin* has rather even distribution of melanophores along rays in all except smallest young, this increasing in color intensity and number as fish increases in size.

Gill rakers (see Fig. 4)—Eight to thirteen on upper limb, 9 to 14 on lower, total number usually ranging between 19 and 27 (extremes 18 to 27); rakers short and rather similar in size and number to chum and chinook salmon.

Pyloric caeca—Usually 50 to 85 (extremes 45 to 114); of value in separating this species from chinook, pink, and chum salmon, which normally have more than 100.

Branchiostegal rays—Usually 13 or 14 (extremes 12 to 15); average number less than in chinook salmon, which normally has 15 or more.

Scales in lateral line—Between 120 and 140 (average 128); usually averaging fewer than in any other species.

Habits—Life span 2 to 4 yr. Jacks may occur. Majority appear to spend 1 or 2 yr in fresh waters, a few 3 yr. Some juveniles in presmolt stage are found in fresh waters when 150 mm FL.

GLOSSARY

Adipose fin A fleshy, finlike, rayless structure situated on dorsal ridge between dorsal and caudal fins (Fig. 1, No. 6).

Anal fin The fin situated medially and immediately behind vent between posterior end of abdomen and anterior end of caudal peduncle (Fig. 1, No. 16).

Axillary process or scale An accessory enlarged scale attached to upper or anterior base of pelvic fin (Fig. 1, No. 14).

Gill opening Opening between opercle or gill cover and side of head.

Branchiostegals or branchiostegal rays Elongated bones arranged fanwise within branchiostegal membranes, situated on ventral edge of gill covers (Fig. 6).

Caudal fin Terminal or tail fin of fishes (Fig. 1, No. 12).

Caudal peduncle That region of body between base of posterior ray of anal fin and base of caudal fin (Fig. 1, No. 11).

Chromatophores Color cells which under control of sympathetic nervous system can be altered in shape, producing color changes.

Cycloid scales Smooth-edged scales of soft-rayed fishes having an evenly curved posterior border devoid of minute spines.

Dorsal fin In salmons, a single fin composed of rays situated dorsally on body approximately halfway between head and tail (Fig. 1, No. 4).

Dorsal ridge Apex or dorsal junction of left and right sides of body; dorsal and adipose fins are situated on this ridge (Fig. 1, No. 3-6).

Dorsal stripe A band on dorsal ridge which is lighter or darker than adjacent areas.

Falcate Curved like a sickle; a fin is falcate when its distal edge is concave, having middle rays shorter than anterior and usually posterior rays.

Filaments See *gill filaments*.

Fork length Distance in a straight line from anteriormost part of tip of upper jaw or snout of juvenile salmons to apex of angle produced by two lobes of caudal fin (Fig. 1, No. 1).

Gill arch Branchial skeleton which contains gill rakers and gill filaments, or lamellae (Fig. 2).

Gill cover, opercle, or operculum Large, very flat, thin bones on each side of head which cover gills (see Fig. 3, which has the major portion of the gill cover removed).

Gill filaments (lamellae) Pleated folds of skin, richly supplied with blood vessels, attached to posterior edge of gill arch (Fig. 2, No. 5).

Gill rakers Projections on anterior edge of first gill arch (Fig. 2, No. 1).

Head length Distance in a straight line from anteriormost part of upper jaw or snout to posterior margin of opercle (Fig. 1, No. 2).

Hypural Complex of expanded and fused bones of last few vertebrae which support caudal fins in certain fishes.

Jack Precocious male salmon which spawn after spending a year or two less in the ocean than the majority of individuals; they are notably smaller than average size of spawning males of their species.

Juvenile As used here, a salmon between 25 and 110 mm FL which has not entered smolt stage.

Lamellae See *gill filaments*.

Lateral line A line formed by a series of sensory tubes and pores extending along sides from head to tail (Fig. 1, No. 10).

Lateral line scale count A count of pored scales from first scale on body behind head posteriorly to above hypural.

Melanophores Chromatophores with dark or black pigment.

Parr marks Squarish or oblong blotches or pigmented areas along sides of presmolt salmonids (Fig. 1, No. 9).

Pectoral fins Anterior or uppermost of paired fins of fishes, one on each side of breast immediately behind head (Fig. 1, No. 13).

Pelvic fins A ventral pair of fins, abdominal in salmonids (Fig. 1, No. 15).

Postdorsal ridge That portion of dorsal ridge behind dorsal fin (Fig. 1, No. 5).

Predorsal ridge That portion of dorsal ridge before dorsal fin (Fig. 1, No. 3).

Presmolt A juvenile salmon with parr marks; in pink salmon, which lack parr marks, demarcation between a presmolt and smolt is slight, differing chiefly in latter's more adult shape.

Pupil of eye Opening in iris of eye by which light reaches retina. It is circular in fishes (Fig. 1, No. 7).

Pyloric caeca Fingerlike diverticula, usually glandular, which open into alimentary canal

of most fishes at junction of stomach and intestine in region of pylorus (Fig. 7, No. 3).

Rakers See *gill rakers*.

Redd Excavation or nest made by a spawning salmon.

Rudimentary Very small and poorly formed, pertaining here chiefly to smallest gill rakers and anal rays (Fig. 5, "0").

Slab-sided When depth of body, measured before dorsal fin, is considerably greater than width of body.

Smolt As used here, a young salmon which has lost its parr marks. Pink and chum salmon fry usually go to the ocean within a few days of emerging from the streambed and usually do not undergo a visible change in morphology or color in fresh water.

Subadult An individual similar to an adult and approaching adulthood in age and size but still incapable of breeding.

Tercte Nearly cylindrical in cross section and tapering toward the front and rear.

ACKNOWLEDGMENTS

Publications such as this are possible only because of aid given by many individuals. I wish to acknowledge the aid and encouragement given me by Robert J. Ellis, George Y. Harry, Jr., Wilbur L. Hartman, William R. Heard, David T. Hoopes, Theodore R. Merrell, Jr., Jay C. Quast, and William A. Smoker, and to the many field men, students, and others who have tested the key.

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Key to Field Identification of Anadromous Juvenile Salmonids in the Pacific Northwest

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ABSTRACT

A key is presented with descriptive illustrations to help in field identification of live, juvenile salmonids in fresh waters of the Pacific Northwest. Other juvenile fish that may be mistakenly identified as salmonids are included.

INTRODUCTION

Species identification of live, anadromous juvenile salmonids is frequently a problem to the field biologist. The purpose of this key is to list and illustrate the external characteristics which will expedite field identification of juvenile salmonids in the Pacific Northwest.

Five species of Pacific salmon (pink, chum, sockeye, chinook, and coho); four species of trout (cutthroat, brown, Dolly Varden, and rainbow or steelhead); and other juvenile and adult fish [1] that may be mistaken for salmon or trout in fresh water are described in this key.

USE OF KEY

The characteristics for identification are listed in a series of alternative statements, some of which are illustrated. To use the key, examine the first statement; if applicable, proceed to the next and continue to successive statements until the species is identified. If a statement is not applicable, pass to the alternative characteristics indicated by numbers in parentheses (numbers on the drawings correspond to numbers of statements in the key). Continue in this manner until the specimen is identified. Some external characteristics are positive separating features (marked with asterisk), whereas others are not. Therefore, two or more statements should be considered before final rejection. If a precise identification cannot be made using the external characteristics —and the fish can be sacrificed, a positive identification can usually be made from internal features (marked with double asterisks). A bibliography of keys that utilize more descriptive internal characteristics is included in this paper.

[1] Especially adult smelt, family Osmeridae.

KEY

1. (47) Adipose fin and scales present. (Fig. 1)
2. (48) Fleshy appendage at base of pelvic fins present.
3. (49) Mouth large, reaching at least to center of eye.

Family Salmonidae

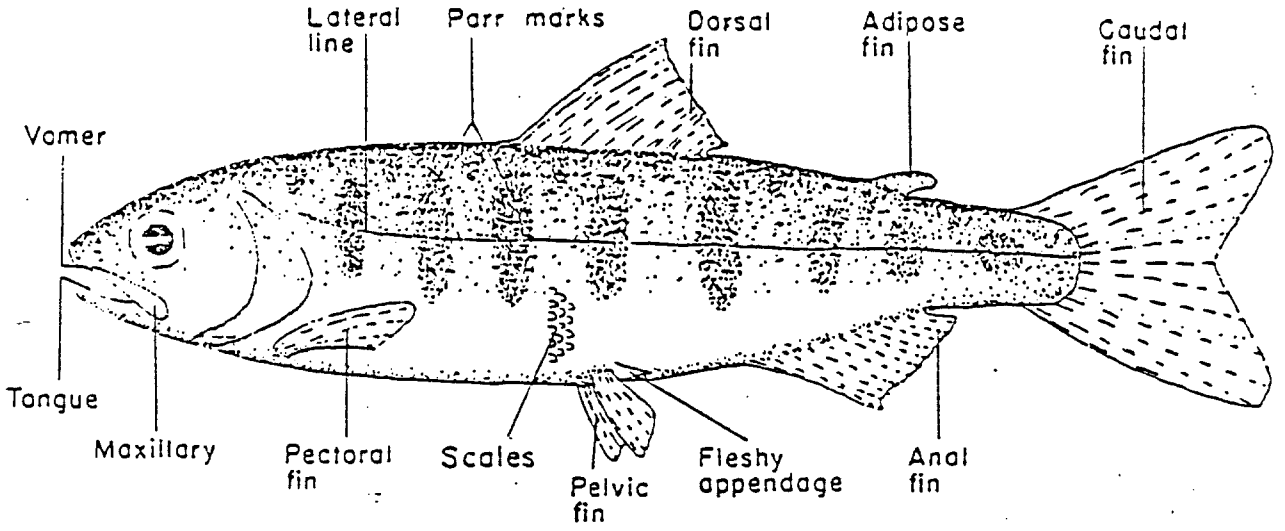


Figure 1.—A hypothetical salmonid showing external characteristics.

4. (17) Anal fin higher than long, with 8 to 12 developed rays (Fig. 2A)
5. (52) *Teeth on head and shaft of vomer. (Fig. 3A)

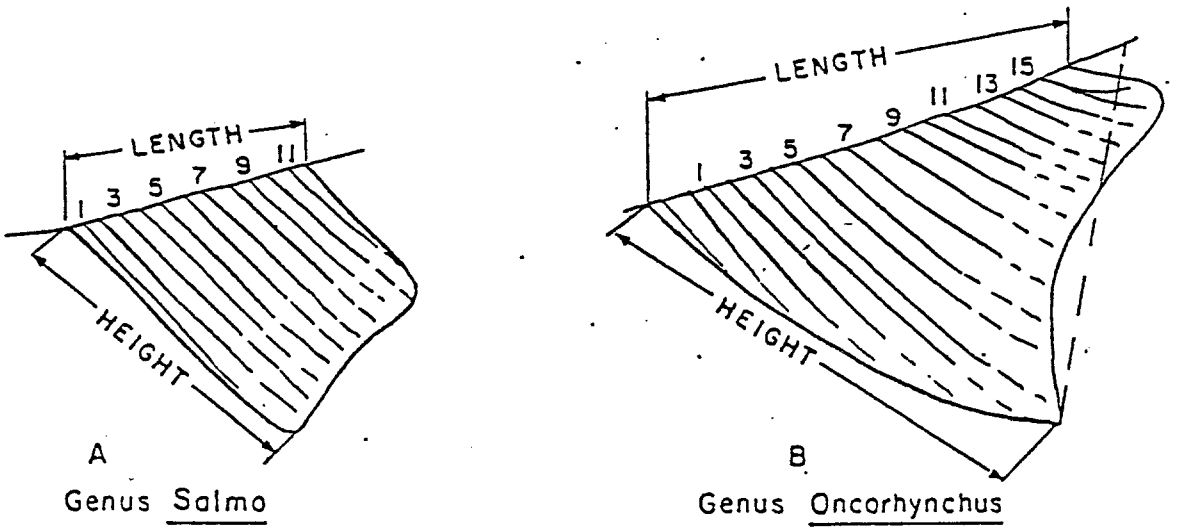


Figure 2.—Anal fins: (A) Trout, genus *Salmo;* (B) Pacific salmon, genus *Oncorhynchus.* The two drawings show differences in structure and fin ray count. (Note that the length of the anal fin is its overall basal length, and its height is that distance from the origin of the fin to the tip of the anterior lobe. In counting fin rays, include only those which originate from the base and terminate at the outer margin of the fin or are half as long as [or greater than] the longest ray.)

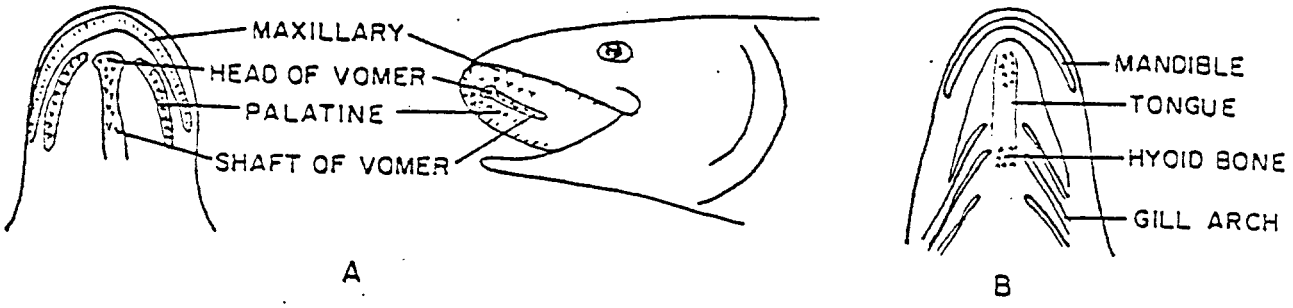
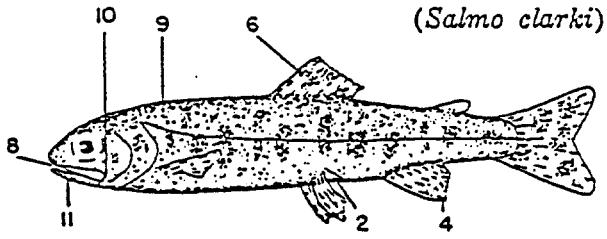


Figure 3.—Location of dentition in (A) the roof and (B) the floor of the mouth of salmonid fishes. (Presence or absence of teeth on the vomer or tongue may be determined by use of the little finger or a blunt instrument. The small hyoid teeth at the base of the tongue are located between the gill arches of the lower jaw and are difficult to find.)

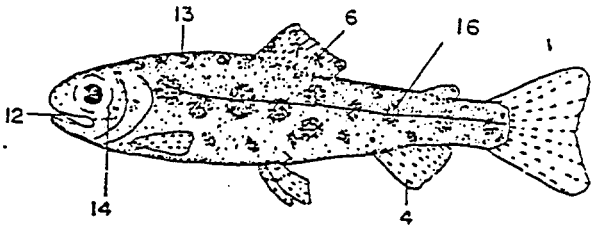
6. (18) Dorsal fin with large dark spots.
Trout
Genus *Salmo*

7. (53) Adipose fin not orange; no row of pale round spots along lateral line.
8. (12) *Small hyoid teeth at base of tongue. (Fig. 3B)
9. (13) Not more than five parr marks on mid-dorsal ahead of dorsal fin.
10. (14) Maxillary reaching past posterior margin of eye.
11. (15) Red or yellowish hyoid mark under lower jaw. Tail usually black spotted.
Cutthroat trout
(*Salmo clarki*)



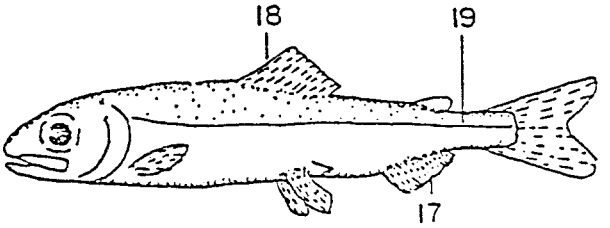
12. (8) *No teeth at base of tongue.
13. (9) Five to 10 parr marks along mid-dorsal ridge ahead of dorsal fin.
14. (10) Maxillary short, not reaching past posterior margin of eye.
15. (11) No hyoid mark under lower jaw. Few or no spots on tail.

16. (20) Parr marks almost round.
Rainbow or
steelhead trout
(*Salmo gairdneri*)



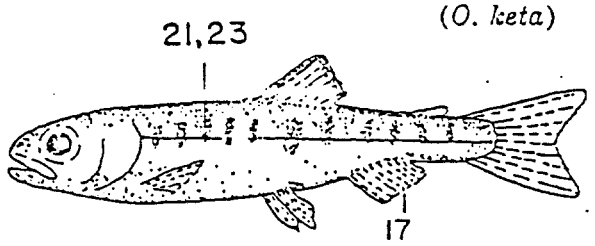
17. (4) Anal fin longer than high, with 13 or more developed rays. (Fig. 2B)
18. (6) Dorsal fin without large dark spots, may be black tipped.
Pacific salmon
Genus *Oncorhynchus*

19. (20) No parr marks. Fry leave fresh water while small—approximately 1.75 inches (45 mm) long.
Pink salmon
(*O. gorbuscha*)



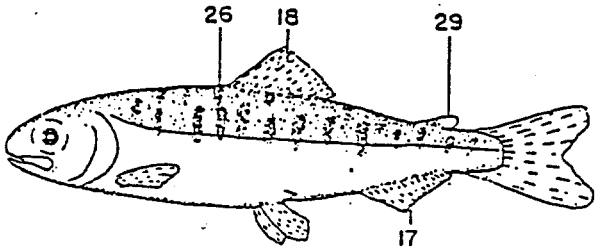
20. (16) Parr marks present as vertical bars or oval spots.
21. (30) Parr marks short, extending little, if any, below lateral line.
22. (25) Gill rakers on first arch, 19 to 26. ** Pyloric caeca, 140 to 186.
23. (26) Parr marks faint. Sides below lateral line iridescent green.
24. (27) Small when migrating from fresh water, approximately 1.5 inches (40 mm) long.

Chum salmon
(*O. keta*)



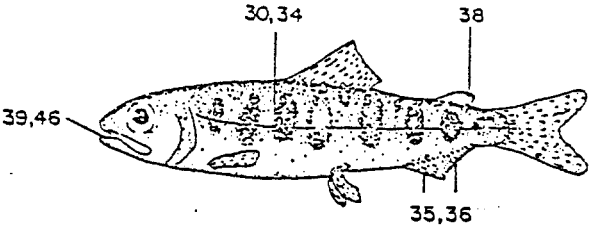
25. (22) Gill rakers on first arch, 30 to 40. **Pyloric caeca 60 to 115.
26. (23) Parr marks usually sharply defined. Sides below lateral line silvery, not iridescent green.
27. (24) Relatively large when migrating from fresh water, approximately 3 to 5 inches (80 to 126 mm) long.
28. (31) Gill rakers long and slender, more than 29 on first arch.
29. (32) Adipose fin clear, not pigmented.

Sockeye salmon
(*O. nerka*)



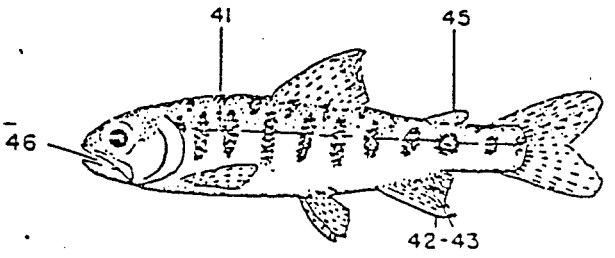
30. (21) Parr marks large, vertical bars centered by lateral line.
31. (28) **Gill rakers short and thick, fewer than 29 on first arch.
32. (29) Adipose fin at least partially pigmented.
33. (40) **Plyloric caeca more than 90.
34. (41) Parr marks broader than interspaces.
35. (42) Anterior rays of anal fin not distinctly longer than rest, not white edged.
36. (43) Anal fin not pigmented.
37. (44) Black spots, when present, on both lobes of caudal fin.
38. (45) Adipose fin not completely mottled, clear area at anterior base of fin.
39. (46) Black gums along base of lower teeth.

Chinook salmon
(*O. tshawytscha*)



40. (33) **Plyloric caeca less than 80.
41. (34) Parr marks narrower than interspaces.
42. (35) Anterior rays of anal fin elongated; when depressed they extend to base of last ray. (Fig. 2B)
43. (36) Anal fin pigmented between rays, resulting in black banding.
44. (37) Black spots, when present, on upper lobe of caudal.
45. (38) Adipose fin completely pigmented.
46. (36) Mouth gray to white.

Coho salmon
(*O. kisutch*)



47. (1) Adipose fin not present; scales present or lacking.
Not Salmonidae

48. (2) No fleshy appendage at base of pelvic fins.
Smelts
Family Osmeridae

49. (3) Mouth small, not reaching center of eye; teeth weak or absent.

50. (51) Depressed dorsal fin, shorter than head.
Whitefishes
Genus *Coregonus*

51. (50) Depressed dorsal fin, longer than head.
Arctic grayling
(*Thymallus arcticus*)

52. (5) **Teeth on head of vomer only.
Chars
Genus *Salvelinus*
Dolly Varden (*S. malma*)

53. (7) Adipose fin orange; row of distinct pale round spots along lateral line.
Brown trout
(*Salmo trutta*)

ACKNOWLEDGMENTS

We especially thank Dr. Arthur D. Welander, Professor of Fisheries, and Dr. Bruce S. Miller, Research Biologist, College of Fisheries, University of Washington, Seattle, for their valuable suggestions. We also thank Galen H. Maxfield, Fishery Biologist, and Dr. Alan J. Beardsley, Fishery Biologist, both from the NMFS Northwest Fisheries Center, Seattle.

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Appendix B. Material Safety Data Sheet (MS222).

aterial Safety Data Sheet ...
v. be used to comply with
Hazard Communication Standard,
910.1200 Standard must be
nsulted for specific requirements.

U.S. Department of Labor
Occupational Safety and Health Administration
(Non-Mandatory Form)
Form Approved
OMB No. 1218-0072

ENTITY (As Used on Label and List)	Note: Blank spaces are not permitted. If any item is not applicable, or no information is available, the space must be marked to indicate that
INQUEL	

ection I

anufacturer's Name	Emergency Telephone Number
urgent Chemical Laboratories, Inc.	(206)885-3777
ress (Number, Street, City, State, and ZIP Code)	Telephone Number for Information
2 152nd Avenue N.E.	(206)885-3777
Redmond, WA 98052	Date Prepared 3-4-92
	Signature of Preparer (optional)

ection II — Hazardous Ingredients/Identity Information

Hazardous Components (Specific Chemical Identity, Common Name(s))	OSHA PEL	ACGIH TLV	Other Limits Recommended	% (optional)
nzoic acid,3-Amino,Ethyl Ester, Methanesulfonate	NA	NA	NA	

N-MUS LD50:180mg/kg
N-FRG LD50:250 mg/kg

May be harmful by inhalation, ingestion, or skin absorption.
May cause irritation.

RTECS #DG2455000 CAS# 886-86-2

Section III — Physical/Chemical Characteristics

Boiling Point	NA	Specific Gravity (H_2O = 1)	NA
Vapor Pressure (mm Hg)	NA	Melting Point	148°C
Vapor Density (AIR = 1)	NA	Evaporation Rate (Butyl Acetate = 1)	NA

Solubility in Water
1 g/0.8 mls at 20°C

Appearance and Odor
White powder with slight to no odor.

Section IV — Fire and Explosion Hazard Data

Flash Point (Method Used)	Flammable Limits	LEL	UEL
NA	NA		

Extinguishing Media
Water spray, Carbon Dioxide, Dry Chemical, Alcohol or Polymer Foam

Sp l Fire Fighting Procedures
self-contained breathing apparatus and protective clothing to prevent contact with skin and eyes.

Unusual Fire and Explosion Hazards
Emits toxic fumes under fire conditions-nitrogen oxides, sulfer oxides, carbon monoxide, carbon dioxide.

TRICAIN METHANESULFONATE
(MS 222, Prefuran)

MS222 is used as an anesthetic for fish. It is generally a safe chemical and there are not special precautions called for on the Material Safety Data Sheet, however, common sense should be used when handling any chemical. Avoid breathing dusts and, of course, ingestion. If skin irritation occurs, use rubber gloves.

HEALTH HAZARDS:

Avoid inhaling MS222 or getting into the eyes. Treated fish destined for food must be held in fresh water above 10° C for 21 days before consumption. There is no other information available at this time on health hazards.

FIRST AID:

EYE CONTACT:
Flush eyes with water.

SKIN CONTACT:
Flush with water.

INGESTION:
No information available at this time.

INHALATION:
No information available at this time.

SYMPTOMS OF OVEREXPOSURE:

Not known at this time.

Appendix C. AWL forms and standard procedures for recording data.

The sample size is 70 sockeye salmon smolt per day, five days a week. If daily sampling objectives are being met, sampling will not occur on Wednesday and Sunday. It is essential that the sample be taken randomly. In the event that more than the required sample size is in the smolt trap at the time of sampling, the trap is to be stirred to assure randomness. When the smolt are randomly distributed, a small dip net will be used to remove a subsample. This procedure will be repeated until the sample size goal is met.

AWL Forms

Smolt length and weight will be recorded on AWL forms (Appendix D.1). Using a No. 2 pencil, complete each section of the left side of the AWL and darken the corresponding blocks:

Description: Include species (sockeye smolt), location, year, and samplers.

Card: The AWL forms and corresponding slides are numbered sequentially by date throughout the season starting with # 001. A new, consecutively numbered, card is used each day even if the previous card is not completed. There may be a minimum of one fish and a maximum of 40 fish (8 slides) per AWL.

Species: Refer to the reverse side of the AWL form to obtain species; sockeye = 2.

Day, Month, Year: Use the appropriate digits for the date the fish are sampled.

District, Subdistrict, Stream, Location: Consult project leader for the appropriate codes.

Period: List the period in which the fish were sampled using Appendix D.2.

Project: Refer to the reverse side of the AWL form to obtain code; code 4 will be used as default since a specific smolt code does not exist.

Gear: Refer to the reverse side of the AWL form to obtain code; 00 = trap.

Mesh: Leave blank.

Type of Length Measurement: Refer to the reverse side of the AWL form to obtain code; 1 = Tip-of-snout to fork-of-tail.

Number of Scales: Mark 1 (refers to 1 smear/fish)

# of Cards: Mark 1 (each AWL form is individually numbered)
Keep the litho codes in numerical order throughout the season and be sure to transfer the litho code from the front left side to the backside of the AWL form. These forms will be optically scanned and stray marks may be misinterpreted. It is the crew leaders responsibility to make sure that all forms are carefully edited before returning them to your supervisor.

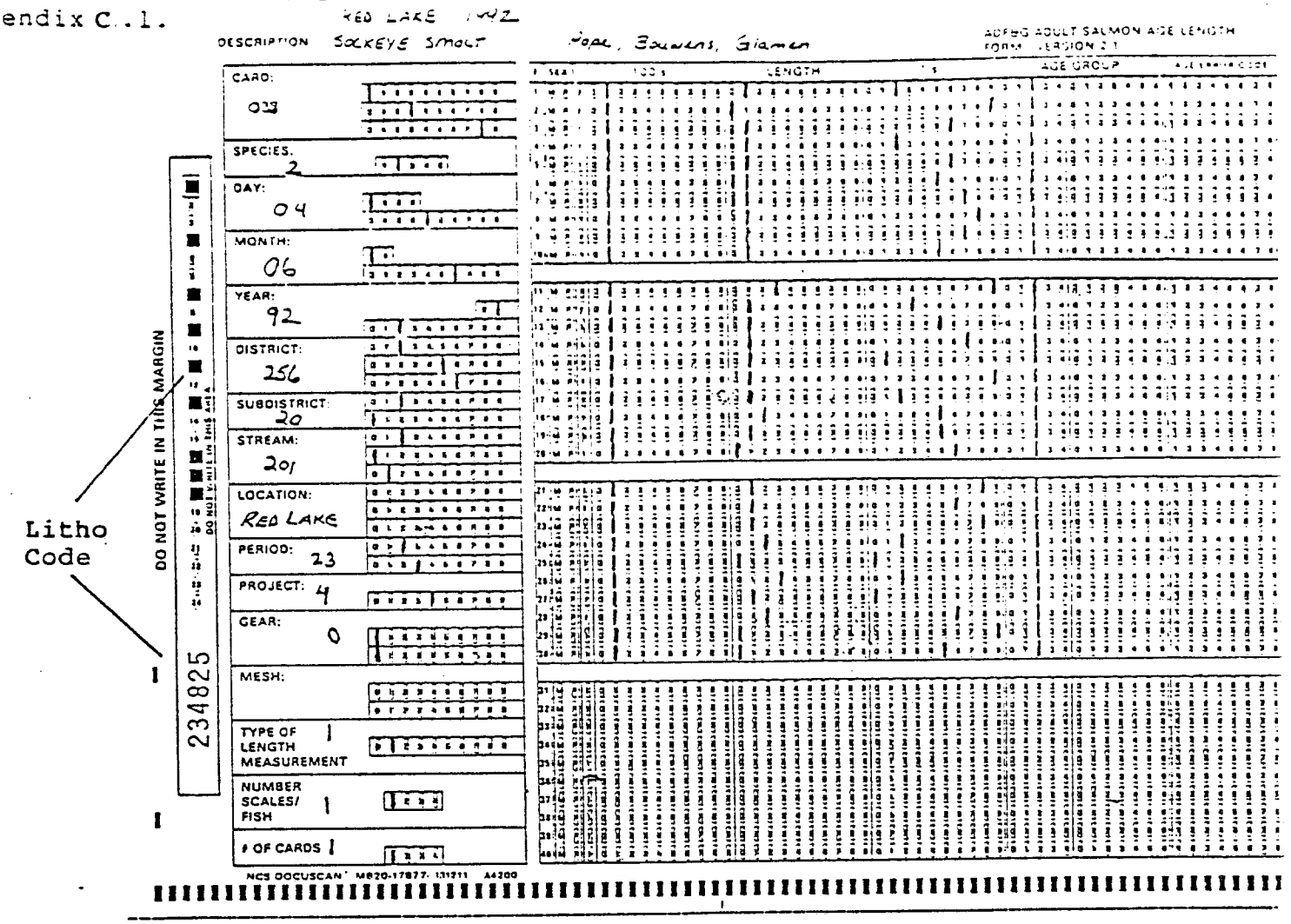
Sampling procedure

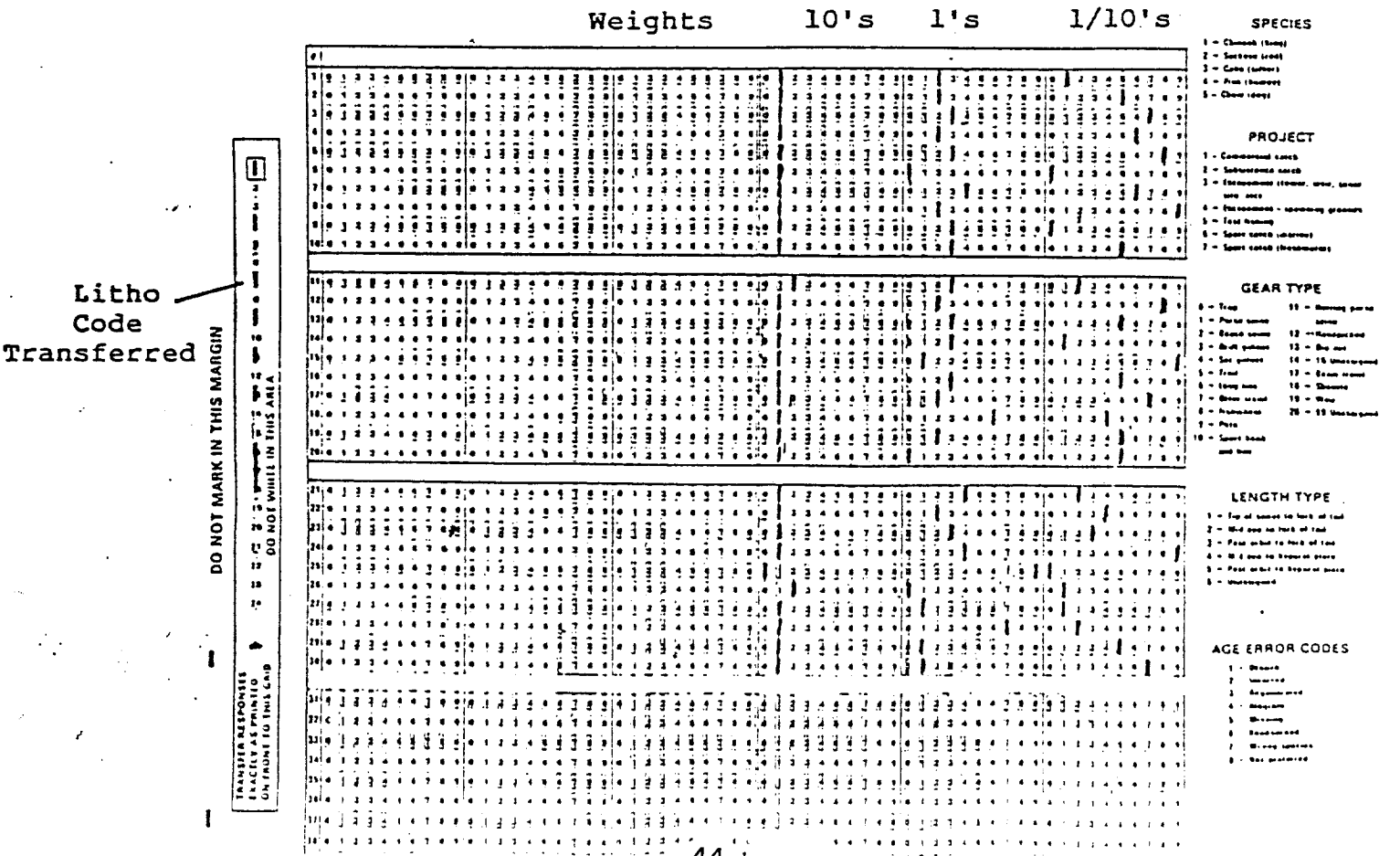
Smolt will be kept alive and sampled the day of capture. MS222 will be used to anesthetize the fish. The use of this chemical will be demonstrated in the field. A flattened probe will be used to remove 5-10 scales from the preferred area, consult Appendix D.3. The scales will be mounted on a glass slide as illustrated in Appendix D.4. The left portion of each slide will be labeled: location, date, AWL # (card #), and fish numbers (1-5, 6-10, 11-15, etc.). When the slides are completed, return them to the box in order, and label the box as shown in Appendix D.4. Smolt lengths will be measured in millimeters from the tip of the snout to the fork of the tail, Appendix D.5. Record each length by darkening the appropriate column blocks on the AWL form.

Excess water will be removed from the smolt before weighing by using a paper towel blotter. Individual smolt weights will be recorded to the nearest 0.1 gram on the backside (right side) of the AWL form (Appendix D.1).

Take care to ensure length and weight data corresponds to the appropriate scale smear as this information is used to calculate condition factor at age. When sampling for age, length, and weight, rite-in-rain books may be used to record data. After sampling is done, transfer the data carefully to the AWL forms. **It is the responsibility of the crew leader to make sure the data has been transferred correctly and the AWL form is filled out completely.**

Appendix C.1.

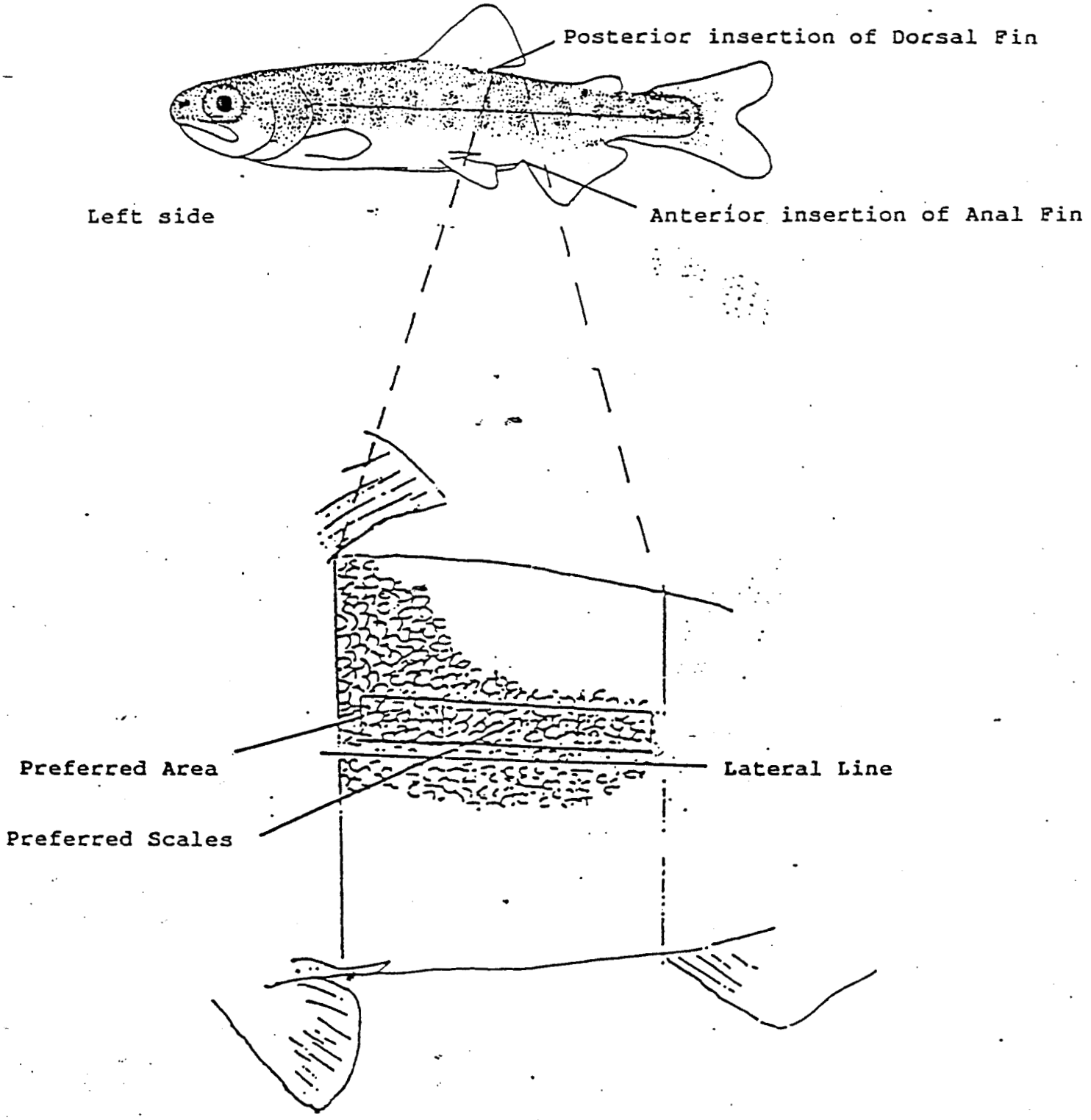

RED LAKE 1992
DESCRIPTION SOCKEYE SMOLT
Pope, Bowers, Glamen
ADF&G ADULT SALMON AGE LENGTH
CARD: 033
SPECIES: 2
DAY: 04
MONTH: 06
YEAR: 92
DISTRICT: 256
SUBDISTRICT: 20
STREAM: 201
LOCATION: RED LAKE
PERIOD: 23
PROJECT: 4
GEAR: 0
MESH:
TYPE OF LENGTH MEASUREMENT 1
NUMBER SCALES/ FISH 1
OF CARDS 1
234825
DO NOT WRITE IN THIS MARGIN
Litho Code
LENGTH
AGE GROUP
NCS DOCUSCAN M820-17877-131211 A4200


Weights 10's 1's 1/10's
SPECIES
PROJECT
GEAR TYPE
LENGTH TYPE
AGE ERROR CODES
DO NOT MARK IN THIS MARGIN
DO NOT WRITE IN THIS AREA
TRANSFER RESPONSES EXACTLY AS PRINTED ON FRONT TO THIS CARD
Litho Code Transferred

Appendix C2. Period codes and corresponding dates.

Period	Dates	Period	Dates
1	01-Jan to 03-Jan	28	05-July to 11-July
2	04-Jan to 10-Jan	29	12-July to 18-July
3	11-Jan to 17-Jan	30	19-July to 25-July
4	18-Jan to 24-Jan	31	26-July to 01-Aug
5	25-Jan to 31-Jan	32	02-Aug to 08-Aug
6	01-Feb to 07-Feb	33	09-Aug to 15-Aug
7	08-Feb to 14-Feb	34	16-Aug to 22-Aug
8	15-Feb to 21-Feb	35	23-Aug to 29-Aug
9	22-Feb to 28-Feb	36	30-Aug to 05-Sep
10	01-Mar to 07-Mar	37	06-Sep to 12-Sep
11	08-Mar to 14-Mar	38	13-Sep to 19-Sep
12	15-Mar to 21-Mar	39	20-Sep to 26-Sep
13	22-Mar to 28-Mar	40	27-Sep to 03-Oct
14	29-Mar to 04-Apr	41	04-Oct to 10-Oct
15	05-Apr to 11-Apr	42	11-Oct to 17-Oct
16	12-Apr to 18-Apr	43	18-Oct to 24-Oct
17	19-Apr to 25-Apr	44	25-Oct to 31-Oct
18	26-Apr to 02-May	45	01-Nov to 07-Nov
19	03-May to 09-May	46	08-Nov to 14-Nov
20	10-May to 16-May	47	15-Nov to 21-Nov
21	17-May to 23-May	48	22-Nov to 28-Nov
22	24-May to 30-May	49	29-Nov to 05-Dec
23	31-May to 06-June	50	06-Dec to 12-Dec
24	07-June to 13-June	51	13-Dec to 19-Dec
25	14-June to 20-June	52	20-Dec to 26-Dec
26	21-June to 27-June	53	27-Dec to 31-Dec
27	28-June to 04-July		

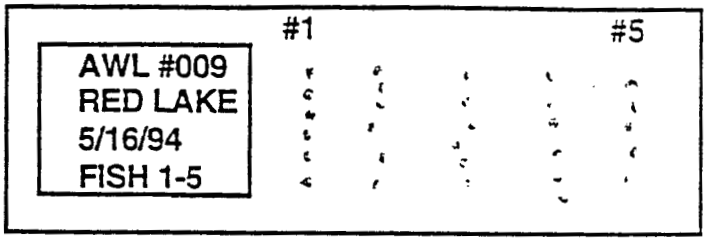
Appendix C.3. Scale sampling procedure showing the preferred area on a smolt salmon.

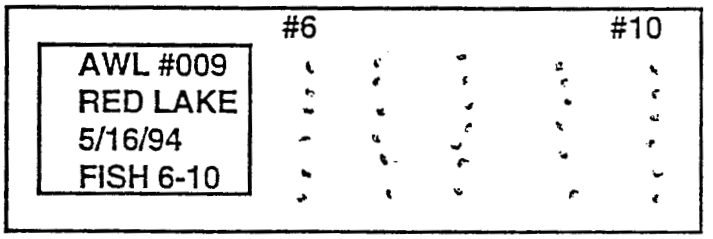


Appendix C.4 Salmon smolt glass slide example.

The following information should be legibly written on the slide label:

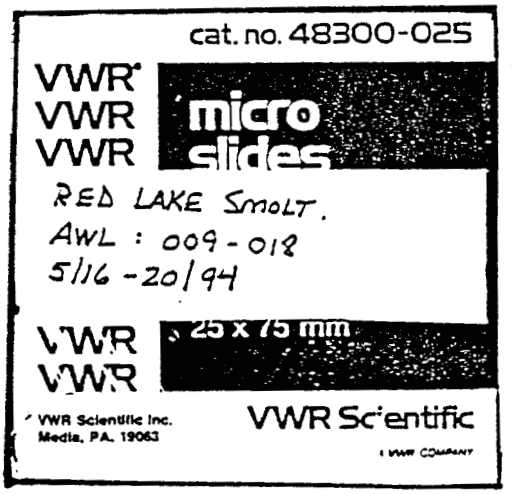
1. AWL #
2. Location
3. date (mo/day/yr)
4. Fish # (1-5, 6-10,...35-40)





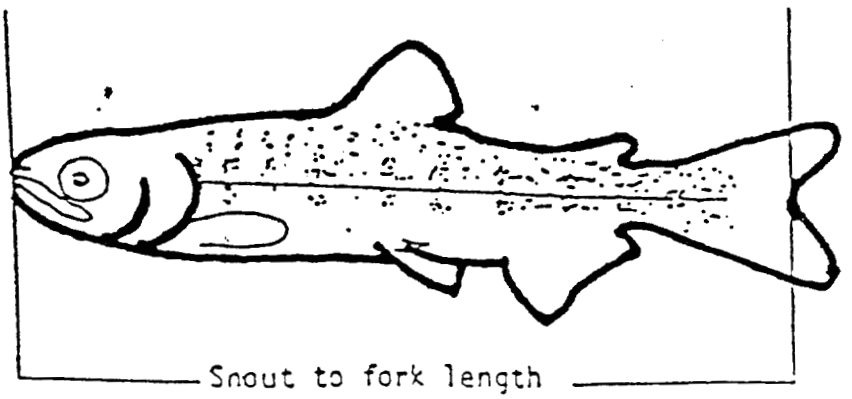
When the slides are completed, return them to the box in order by AWL #, date, and fish #. Label the slide box on top with the following information:

LOCATION (RED LAKE)
AWL NUMBERS (AWL # 009 - 018)
BEGINNING AND ENDING DATES (5/16 - 20/94)



Appendix C.5

MEASURING SMOLT LENGTH



Appendix D.

KODIAK MANAGEMENT AREA SALMON ESCAPEMENT SAMPLING

OPERATIONAL PLAN, 1995

Alaska Department of Fish and Game
Commercial Fisheries Management and Development Division
211 Mission Road
Kodiak, Alaska 99615

MAY 1995

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INTRODUCTION

Annually, sockeye salmon escapements are sampled for age, length, and sex from major and minor systems by field personnel within the Kodiak Management Area (KMA). Management and research biologists rely on this data for forecasting, escapement goal evaluation, catch apportionment, and run timing estimation. As the demand on our salmon resource increases, so does the intrinsic value of this data.

Stock identification projects using scale pattern analysis as well as age marker analysis have been conducted within the Afognak, NW Kodiak , SW Kodiak, Alitak Bay, and Mainland Districts. The foundation for these projects are the scale samples that are collected. It is imperative that scales collected be of the highest quality possible. In recent years, an attempt was made to use average weights as a possible method of stock separation by area. Fish ticket weights were used as individual fish weights by system were not available. In order to evaluate length-weight relationships by system throughout the KMA area, weights will be taken along with ALS at seven locations during 1995.

GOAL

Provide improved management of the Kodiak Management Area salmon runs by optimizing escapement requirements thereby insuring maximum harvest opportunities.

OBJECTIVES

1. Construct accurate brood tables (spawner-recruitment relationships).
2. Develop accurate run forecasts.
3. Evaluate escapement goals and accurately define run timing.
4. Provide samples suitable for scale pattern analysis as required for addressing mixed stock fishery issues.
5. Evaluate length-weight relationships at Afognak, Spiridon, Karluk, Ayakulik, Upper Station, Frazer, and Saltery Rivers.

TASKS

1. Collect representative age, length, and sex data from all major and selected minor sockeye salmon systems within the KMA.

2. Collect a mixed assortment of weight data from selected sockeye salmon systems within the KMA.

SUPERVISION

Regional Finfish Research Supervisor, Charles Swanton will supervise escapement sampling at Frazer Fishpass and Akalura weir. All other KMA escapement crews will be directly supervised by Kodiak Management Area staff. Regional Salmon Research Biologist, Patricia Nelson will monitor weekly escapement sampling and review incoming data for quality, quantity, and timeliness. A log book will be maintained tracking weekly samples, and weir crew leader's will be notified periodically regarding data quality.

PROCEDURES

Weekly sockeye salmon escapement sampling for age, length, weight, and sex (ALWS), will be conducted at Karluk River, Upper Station, Ayakulik River, and Frazer Lake (Figure 1). Samples will be collected using a live box trap (Figure 2) according to the schedules in Table 1. If the required number of fish are not taken within a single day, obtain the balance of the sample on the following day.

Minor systems will be sampled with reduced intensity following the sampling schedule in Table 1. Litnik (Afognak) weir personnel will collect two 480 fish ALS samples from both early and late sockeye run components. Additionally, 200 individual fish weights (100 male and 100 female) will be collected from the early and late run components. Two 480 fish ALS samples from both early and late sockeye run components will be collected at Akalura weir. A single 480 fish sample will be collected at the Saltery weir during the peak escapement and 200 individual fish weights will be measured (100 male and 100 female). Sport Fisheries Division (S.F.D.) personnel will sample the Buskin River sockeye escapement with a goal of 140 fish every two

weeks, for six weeks (sample size specified by S.F.D. biometrician). S.F.D. will similarly sample the Buskin River sockeye subsistence harvest. Development section personnel will collect ALS data from Malina Lake, Little Kitoi, and Pauls Bay following the sampling schedule presented in Table 1. Additionally, samples for ALWS will be collected at the Telrod Cove Terminal Harvest Area with a targeted sample size of 240 ALS and 30 weight samples (15 males and 15 females) per week.

It is essential that all ALS data be representative of the true escapement, therefore avoid bias by NOT pre-selecting fish based upon size, sex, condition or any other factor. Sampling and recording procedures are presented in Appendix A. **Weight samples on the other hand should not be random**. It is important that we obtain the greatest variety of lengths available at each system. Therefore, try to sample the smallest and largest fish during the sampling period as well as a wide variety of lengths between the largest and smallest fish. Weights are to be measured using a Chatillon spring scale to 25 lbs. Weigh fish to the nearest 0.25 lb and record weight on the back of the AWL form (right side). Check calibration of scale before use and periodically during the season using a 3 lb can of coffee. Remember that we are evaluating weight at length so take care to ensure that each weight corresponds to the appropriate length. Specific procedures for collecting and recording weight data are described in Appendix A.

DATA REPORTING

Crew leaders will notify Dave Prokopowich, Kevin Brennan, or Dennis Gretsch via SSB radio upon completion of weekly sampling. Karluk weir will mail completed ALS data to Kodiak (return receipt from the Karluk village post office), and notify the office of the mailing date (via radio). All other field camp personnel will send completed samples back to town on return grocery flights. These packages should be clearly labeled to include: system, sample dates, and Attn.: Patti Nelson. The pilot should be notified to call Fish and Game at 486-1855 for package pick up.

Table 1. Sockeye salmon escapement sampling schedule, 1995.

Location	Sampling Frequency	Date Starting	Date Ending	ALS Sample Size	Weight Sample Size
Akalura weir (early)	once	May 15	Jul 15	480	N/A
Akalura weir (late)	once	Jul 16	Sep 15	480	N/A
Ayakulik weir	weekly	May 30	Sep 30	240	30
Buskin Lake weir[a]	biweekly	Jun 01	Aug 01	140	N/A
Buskin Subsistence Harvest[a]	biweekly	Jun 01	Aug 01	140	N/A
Frazer Fishpass	weekly	Jun 15	Aug 30	240	30
Karluk weir	weekly	May 30	Sep 30	240	30
Litnik (Afognak) weir (early)	once	Jun 07	Jun 15	480	200
Litnik (Afognak) weir (late)	once	Jul 14	Jul 20	480	200
Malina Lake weir[b]	intermittently	Jun 01	Aug 15	600	N/A
Little Kitoi[b]	intermittently	Jun 01	Aug 15	600	N/A
Pauls Bay[b]	biweekly	Jun 06	Jul 03	200	N/A
Saltery River weir	once	Jul 07	Jul 20	480	200
Upper Station	weekly	Jun 06	Sep 30	240	30
Telrod Cove[b]	weekly	Aug 01	Sept 15	240	30

[a] Sampled by Sport Fish Division (sample size determined by S.F. Biometrician).
[b] Sampled by Development Section personnel.

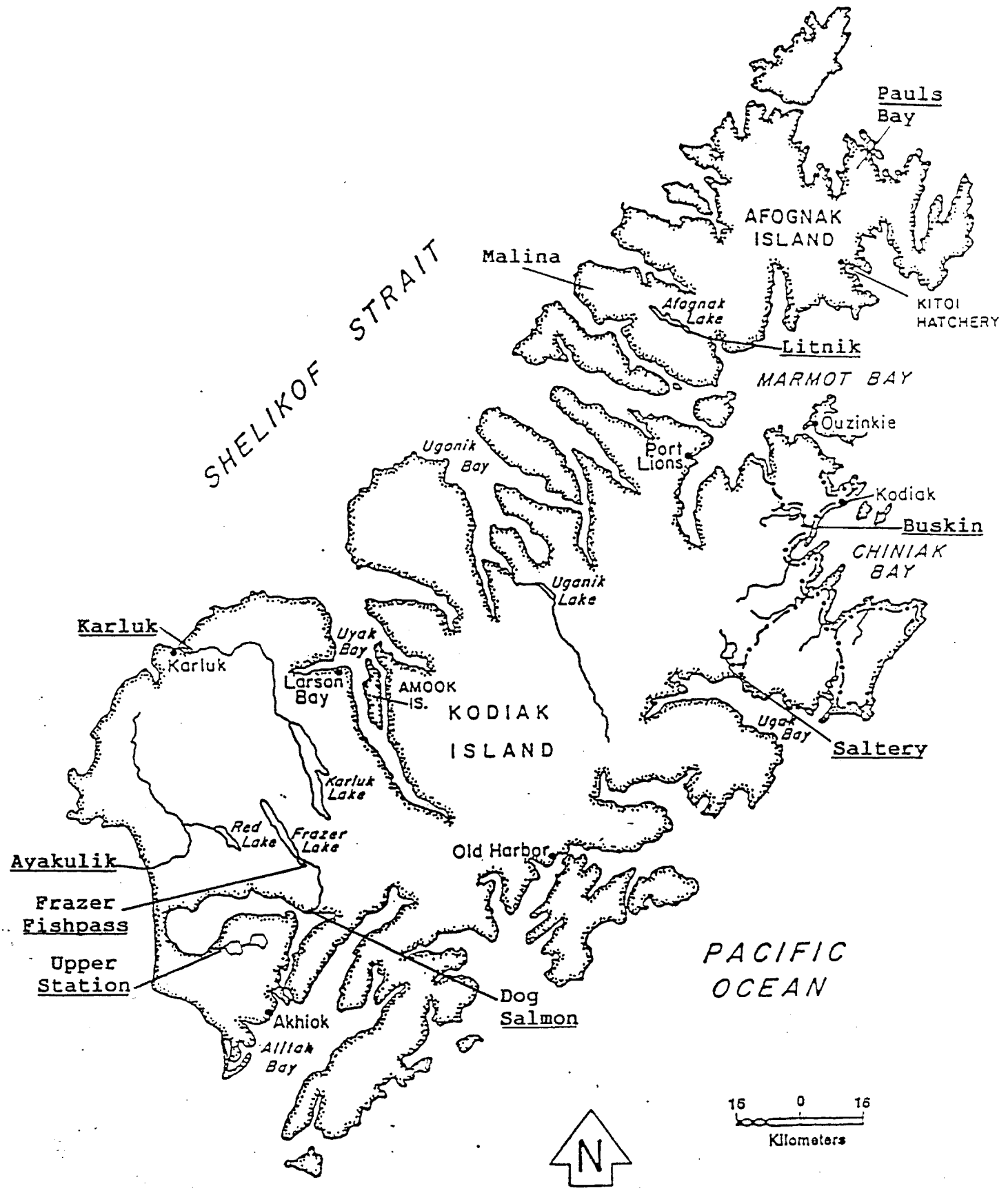


Figure 1. Location of salmon weirs in the Kodiak Management Area.

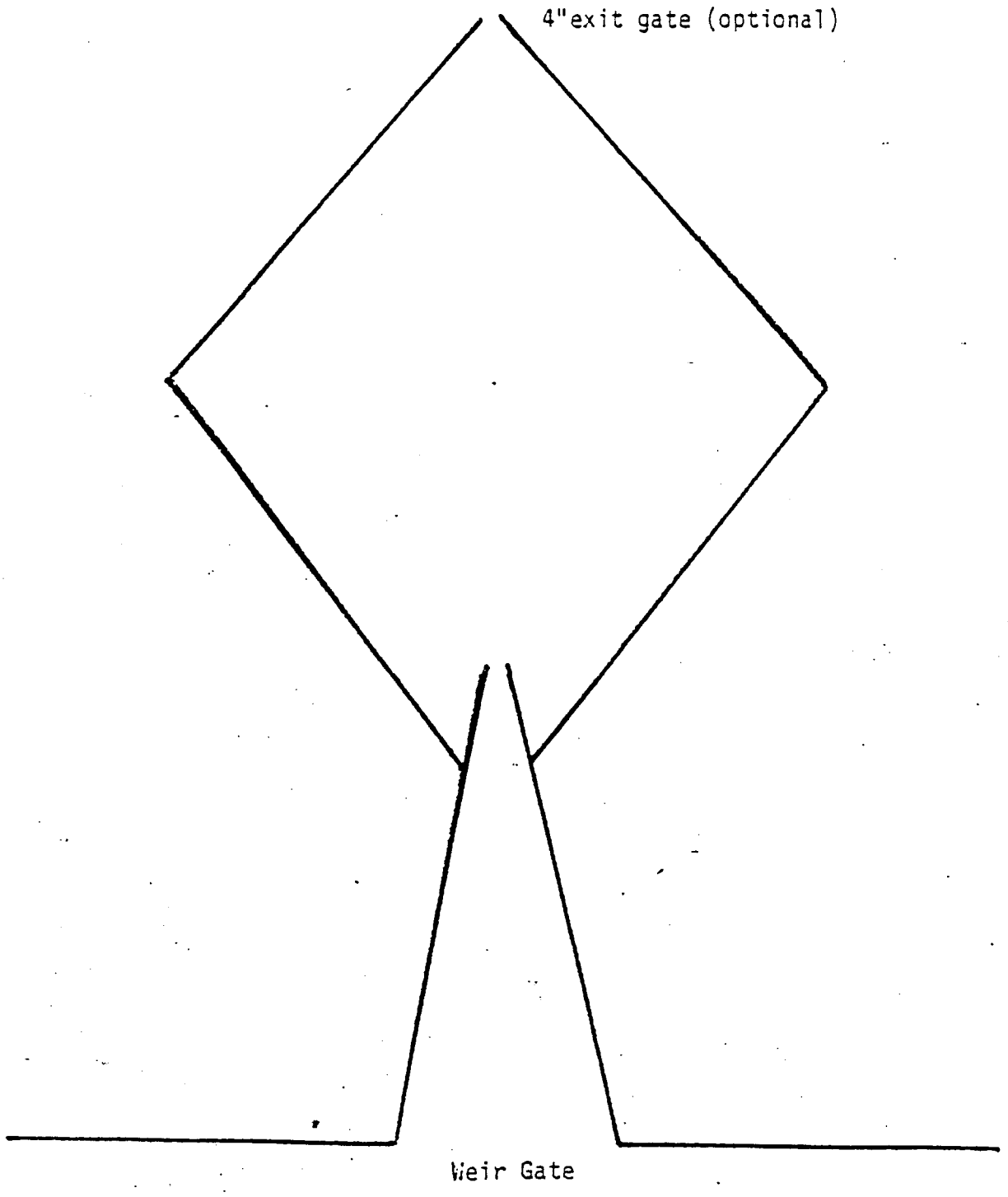


Figure 2. The "Scott" six panel salmon trap.

APPENDIX A

Procedure for Sampling Adult Salmon
for age, length, weight, and sex

Annually, salmon escapements and catches are sampled for age (scales), length, and sex (ALS) by field crews throughout the state. This database is essential for sound management of the State's salmon resources.

To be useful, data must be recorded on the mark-sense (AWL) forms neatly and accurately. Scale samples must be collected and mounted properly to ensure accurate age determination. The following procedures are to be adhered to when sampling for age, length, weight, and sex.

COMPLETING THE AWL FORMS:

A completed AWL form and accompanying gum card for sampling sockeye and chum salmon are shown in Appendix A.1-2.

Complete each section on the left side of the AWL form using a No. 2 pencil and darken the corresponding blocks as shown in the figures. Make every effort to darken the entire block as partially filled blocks are often missed by the optical scanner which reads and records the data from the AWL forms. Label only one form at a time to avoid a "carbon paper effect" resulting in stray marks.

Description:
Record the following: species/area/catch or escapement/gear type (seine, weir, etc.)/samplers

Card:
The AWL forms and corresponding gummed card(s) are numbered sequentially by date throughout the season starting with 001. A separate numbering sequence will be used for each species, district, and geographic location. Consult your port supervisor for the current card number. Sockeye scale samples will have only 1 gum card per AWL form as shown in Appendix A.1.

Species:
Refer to the reverse side of the AWL form for the correct digit.

Day, Month, Year:
Use appropriate digits for the date the fish are sampled; for catch sampling, use the date the fish were caught.

District:
List only one district. Consult area statistical map or project leader for appropriate district.

Subdistrict (Section):
List a single subdistrict if it is known and if all the potential samples were caught in that section. If more than one section is involved, list each section but do not darken the corresponding blocks. Leave blank if the section is unknown.

Stream:
Leave blank for catch sampling; escapement sampling consult area statistical map for appropriate stream number.

Location:
List the appropriate code as shown on Appendix A.3.

Period:
List the period in which the fish were caught (Appendix A.4.).

Project and Gear:
Refer to the reverse side of the AWL form for the correct code.

Mesh:
Leave blank unless specifically instructed by supervisor to do otherwise.

Type of length measurement:
Use (2) mid-eye to fork-of-tail. Refer to Appendix A.5.

# of cards:
Mark 1 (each AWL form in individually numbered).

Keep the litho codes in numerical order throughout the season and keep the AWL forms flat, dry, and clean. Fish gurry and water curling will cause data to be misinterpreted by the optical scanning machine. It is the crew leaders responsibility to make sure that all forms are carefully edited before returning them to your supervisor.

GUMMED CARDS:

Fill out the gum cards as shown in Appendices A.1

Species:
Write out completely (sockeye) and fill in appropriate number (2).

Locality:
For catch and escapement sampling, write down the area in which fish were caught, followed by catch or escapement (e.g. Karluk River escapement; Uganik Bay catch).

Stat. code and Sampling date:
Transfer the appropriate digits from the AWL form.

Gear:
Write out completely.

Collector(s):
Record the last names of person(s) sampling.

Remarks:
Record any pertinent information such as number of scales per fish sampled, vessel/tender name, etc. Transfer this same information to the top margin of the AWL.

SAMPLING PROCEDURE:

A. GENERAL

1. Place the fish on its right side to sample the left side.

2. Determine sex of the fish and darken M or F in the sex columns. If any difficulty is encountered with this procedure, write "I had trouble sexing these fish" on the top margin of the AWL and ask your supervisor for help as soon as possible before sexing additional fish.

3. Measure fish length in millimeters from the mid-eye to fork-of-tail (Appendix A.5). Record length by blackening the appropriate column blocks on the AWL form. Column 3 on the AWL form is used for fish with a length greater than 999 millimeters (Chinook). Measure all species of salmon to the nearest mm. Check the calipers periodically to ensure measurement accuracy. **When escapement sampling, take care to ensure that each length corresponds to the appropriate scale mounted on the gummed card as length at age is evaluated for each sample.**

4. Remove the "preferred scale" from the fish by grasping its exposed posterior edge with forceps and pulling free. Remove all slime, grit, and skin from the scale. The "preferred scale" is located on the left side of the fish, two rows above the lateral line on the diagonal from the posterior insertion of the dorsal fin to the anterior insertion of the anal fin (Appendix A.6.). If the "preferred scale" is missing, select a scale within the preferred area on either the left or right side of the fish. If no scales are present in the "preferred area" on either side of the fish, sample a scale as close to the preferred area as possible and darken the 8 under "age error code" on the AWL form. Do not select a scale located on the lateral line.

5. It is important to take care that scales adhere to the card, rough side up. Therefore, without turning the forceps over, clean, moisten, and mount the scale on the gummed card with your thumb or forefinger. Exert just enough pressure to spread and smooth the scales directly over the number as shown in Appendix A.6. The ridges on the sculptured side can be felt with a fingernail or forceps. Mount scale with anterior end oriented toward top of gum card. All scales should be correctly oriented on the card in the same direction (Appendix A.7.).

6. Once the length and sex have been recorded, and the scale has been collected, slide the fish into the weighing sack provided, hang it from the scale and record the weight in pounds on

the back side of the AWL form (to the nearest 0.25 lbs). If weights are recorded on the back of an AWL form, transfer the litho code to the appropriate column. A completed back side of an AWL form is illustrated in Appendix A.2. **Keep in mind that not all fish will be weighed. The minimum sample size is 15 males and 15 females per week. If the process goes smoothly and you can collect more weights (25 per sex), this would be greatly appreciated.**

7. Repeat steps 1 through 4 for up to 40 fish on each AWL form.

8. When sampling at weirs you may use write in rain books to record the data. Keep the mark-sense forms in camp where they will be clean, dry, and flat. After sampling is done for the day transfer the data to the mark-sense forms. **Each length, sex, scale and weight must correspond to a single fish! It is the responsibility of the crew leader to be sure the data has been transcribed correctly and the AWL forms filled out completely.** Log books containing length, weight, and sex data should be returned to Patti Nelson at the end of the season.

SCALE SAMPLING CHECKLIST

OPERATIONAL PLAN	PENCILS (NO. 2)
GUM CARDS	FORCEPS
AWL FORMS	PLASTIC CARD HOLDERS
CALIPERS	CLIPBOARD
SPRING SCALE	WEIGHING SACK

SOME REMINDERS

1. For greater efficiency in scale reading and digitizing, mount scales with anterior end toward top of scale card.

2. AWLs should be carefully edited. Re-check header information on AWLs; make sure all available information is filled in. Take extra care to use the correct period code for the sampling or catch date. AWL numbers should not be repeated; a frequent error is to begin a week's sample with the last AWL number used the week before. This is particularly important if the data is regularly sent to town; it is easy to forget which AWL numbers were used. Crew leaders should take time to ensure that the boxes are being blackened correctly, if the boxes are sloppily marked the optical scanner records the information incorrectly or misses it entirely. Keep pencil marks within each block, filling it completely.

3. Transfer important comments from scale cards to AWLs. After pressing scales, the cards are seldom referred to again, and important remarks can be lost. Write comments in the top right margin. If there is not room on the AWL to completely explain the remarks, use a separate piece of paper.

4. Never put data from different dates on one AWL or one scale card. Even if only one scale is collected that day, begin a new AWL and gum card the next day.

5. If weights are taken, they may be noted in the right margin of the AWL during sampling, but **be sure to transfer the weights and litho code to the appropriate columns on the reverse of the AWL before submitting it to your supervisor**.

6. The data processing program uses the "litho code" on the AWL. (It is located in the lower left margin of the AWL.) Try to keep the litho codes in numerical order. This should not be hard to do if they are arranged that way before page numbering. Those who sample different areas throughout the season can arrange the litho codes in order before each sample is taken.

7. If AWLs get wrinkled or splotched they should be transcribed onto a new AWL prior to sending in. The optical scanning computer will misread or reject wrinkled sheets. Do not use paperclips on AWL forms.

8. Be careful when collecting and mounting scales in wet conditions (rain, high humidity, etc.) Glue often obscures scale features and scales frequently adhere poorly to wet card. Protect the cards, keep them dry to avoid having to remount the scales on a new card.

9. Scan the AWL form for mistakes. A common error occurs, for instance, in placing both the 4 and 7 of a 475mm fish in the 100's column with nothing in the 10's column.

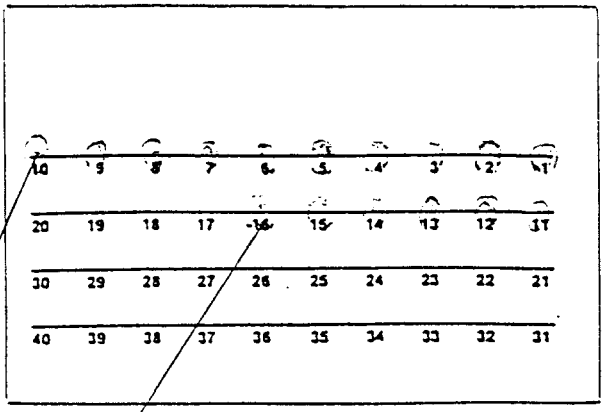
10. Record all comments explicitly on the gum card under remarks and transfer remarks to the top margin of the AWL form.

11. Responsibility for accuracy lies first with the primary data collector(s). The port supervisor will return sloppy or incomplete data to individual collectors for correction.

Gum Card front side

16 scales collected
Gum Card back side

Species: SOCKEYE Card No: 014
Locality: FRAZER ESC.
Stat. Code: 257-40-403-___
Sampling Date: Mo. 06 Day 07 Year 95
Gear: WEIR / TRAP
Collector(s): D. Pitcher, S. Peschier
Remarks: _____



AWL FRONT SIDE:

samplers: Pitcher Peschier

DESCRIPTION: SOCKEYE / FRAZER / ESC

ADF&G ADULT SALMON AGE-LENGTH FORM VERSION 2.1

litho code

DO NOT WRITE IN THIS MARGIN

260498

DO NOT WRITE IN THIS AREA

CARD: 014
SPECIES: 2
DAY: 07
MONTH: 06
YEAR: 95
DISTRICT: 257
SUBDISTRICT: 40
STREAM: 403
LOCATION: 038
PERIOD: 24
PROJECT: 3
GEAR: 19
MESH:
TYPE OF LENGTH MEASUREMENT: 2
NUMBER SCALES/ FISH: 1
OF CARDS: 1

#	SEX	LENGTH 100's	LENGTH 1's	AGE GROUP	AGE ERROR CODE
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
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40					

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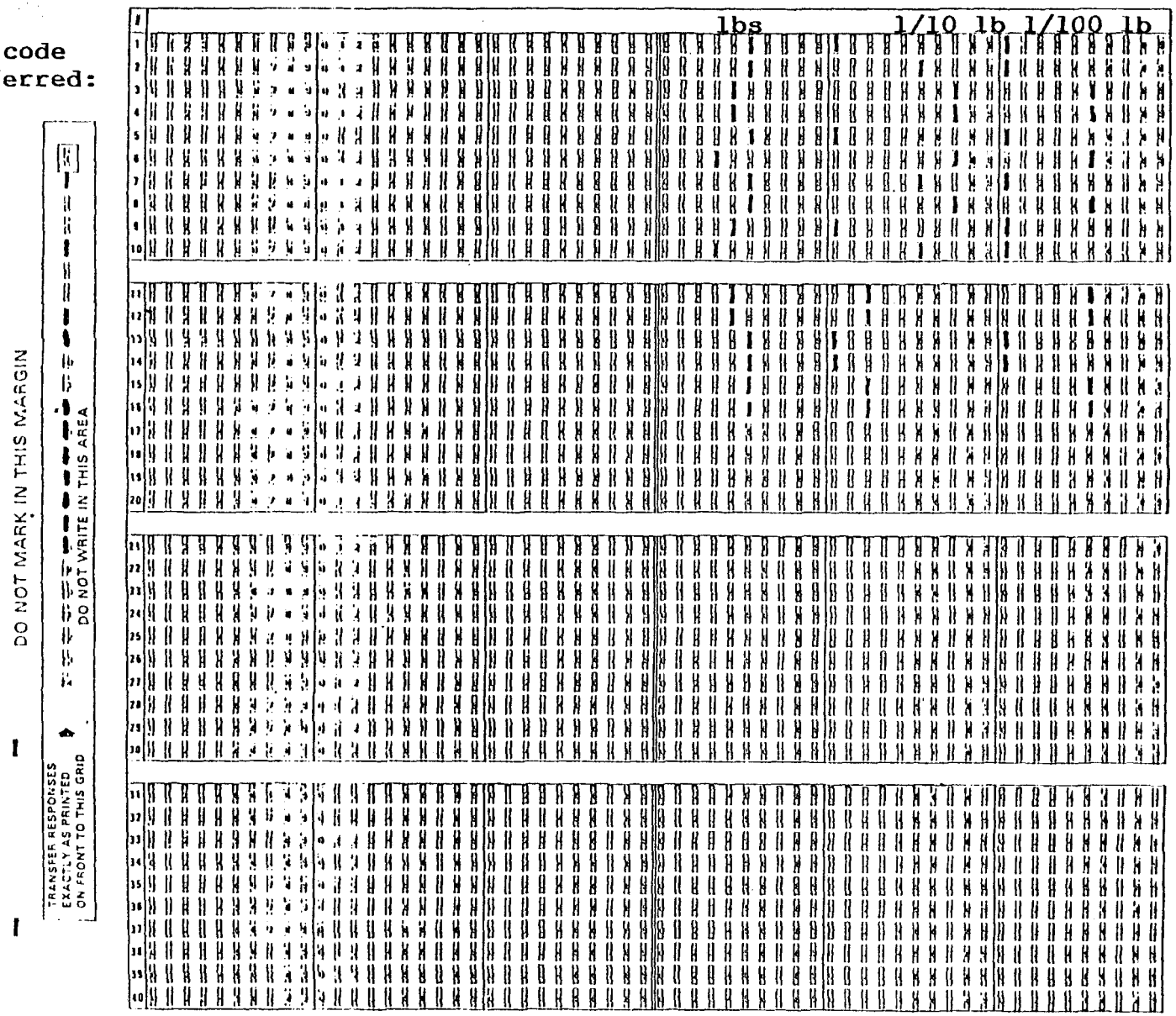
Appendix A.1. Completed AWL (front side) and associated gum card with 16 fish sampled.

AWL BACK SIDE: 16 fish sampled, 16 weights measured

litho code transferred:



CODES:

SPECIES
1 - Chinook (king)
2 - Sockeye (red)
3 - Coho (silver)
4 - Pink (humpy)
5 - Chum (dog)

PROJECT
1 - Commercial catch
2 - Subsistence catch
3 - Escapement (tower, weir, aerial etc. etc)
4 - Escapement - spawning grounds
5 - Test fishing
6 - Sport catch (marine)
7 - Sport catch (freshwater)

GEAR TYPE
0 - Troll
1 - Purse seine
2 - Beach seine
3 - Drift gillnet
4 - Set gillnet
5 - Troll
6 - Long line
7 - Otter trawl
8 - Fishwheel
9 - Pots
10 - Sport hook and line
11 - Herring purse seine
12 - Handpicked
13 - Dip net
14 - 14 Unassigned
17 - Beam trawl
18 - Shovels
19 - Weir
20 - 29 Unassigned

LENGTH TYPE
1 - Tip of snout to fork of tail
2 - Mid eye to fork of tail
3 - Post orbit to fork of tail
4 - Mid eye to hypural plate
5 - Post orbit to hypural plate
6 - Unassigned

AGE ERROR CODES
1 - Otolith
2 - Inverted
3 - Regenerated
4 - Illegible
5 - Missing
6 - Reabsorbed
7 - Wrong section
8 - Not processed

ndix A.2. Back side of AWL with 16 weights recorded and litho code transferred.

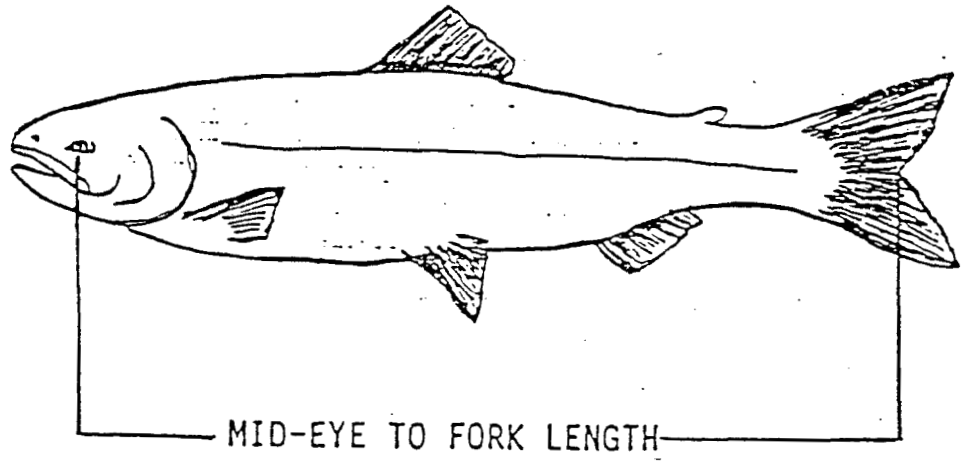
Appendix A.3. Assigned port and weir location codes.

Port and Location Codes
030 - Lazy Bay
031 - Port of Kodiak
032 - Pauls Lake
033 - Thorshiem
034 - Afognak River
035 - Karluk River
036 - Red River
037 - Upper Station
038 - Frazer Lake
039 - Dog Salmon
040 - Akalura River
041 - Uganik River
042 - Malina Creek
150 - King Cove
151 - Port Moller
052 - Dutch Harbor
053 - Akutan
054 - Sand Point
055 - Bear River, ADF&G Camp
056 - Nelson River, ADF&G Camp
057 - Canoe Bay

Appendix A.4. Periods and corresponding calendar dates, 1995.

Period	Calendar Dates	Period	Calendar Dates
1	01-Jan to 03-Jan	28	05-Jul to 11-Jul
2	04-Jan to 10-Jan	29	12-Jul to 18-Jul
3	11-Jan to 17-Jan	30	19-Jul to 25-Jul
4	18-Jan to 24-Jan	31	26-Jul to 01-Aug
5	25-Jan to 31-Jan	32	02-Aug to 08-Aug
6	01-Feb to 07-Feb	33	09-Aug to 15-Aug
7	08-Feb to 14-Feb	34	16-Aug to 22-Aug
8	15-Feb to 21-Feb	35	23-Aug to 29-Aug
9	22-Feb to 28-Feb	36	30-Aug to 05-Sep
10	01-Mar to 07-Mar	37	06-Sep to 12-Sep
11	08-Mar to 14-Mar	38	13-Sep to 19-Sep
12	15-Mar to 21-Mar	39	20-Sep to 26-Sep
13	22-Mar to 28-Mar	40	27-Sep to 03-Oct
14	29-Mar to 04-Apr	41	04-Oct to 10-Oct
15	05-Apr to 11-Apr	42	11-Oct to 17-Oct
16	12-Apr to 18-Apr	43	18-Oct to 24-Oct
17	19-Apr to 25-Apr	44	25-Oct to 31-Oct
18	26-Apr to 02-May	45	01-Nov to 07-Nov
19	03-May to 09-May	46	08-Nov to 14-nov
20	10-May to 16-May	47	15-Nov to 21-Nov
21	17-may to 23-May	48	22-Nov to 28-Nov
22	24-May to 30-May	49	29-Nov to 05-Dec
23	31-may to 06-Jun	50	06-Dec to 12-Dec
24	07-Jun to 13-Jun	51	13-Dec to 19-Dec
25	14-Jun to 20-Jun	52	20-Dec to 26-Dec
26	21-Jun to 27-Jun	53	27-Dec to 31-Dec
27	28-Jun to 04-Jul		

Appendix A.5 Measuring fish length, mid-eye to fork of tail.



Mid-eye to fork lengths are taken because the length and shape of a salmon's snout changes as it approaches sexual maturity. The procedure for measuring by this method follows:

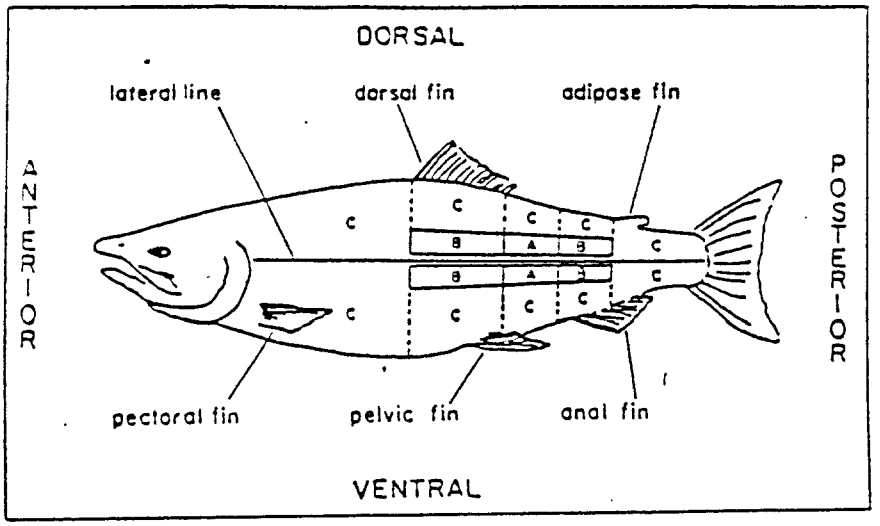
1) Place the salmon flat on its right side, with its head to your left and the dorsal fin away from you.

2) The eye should be on the line projecting from the end of the meter stick. Hold the head in place with your right hand. Sometimes you can control the fish better by placing your thumb in the fish's mouth.

3) Flatten and spread the tail against the board with your right hand.

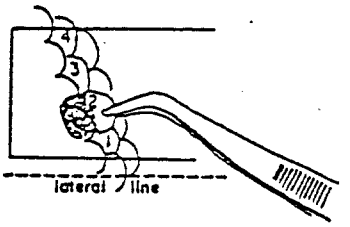
4) Read the mid-eye to fork length to the nearest millimeter.

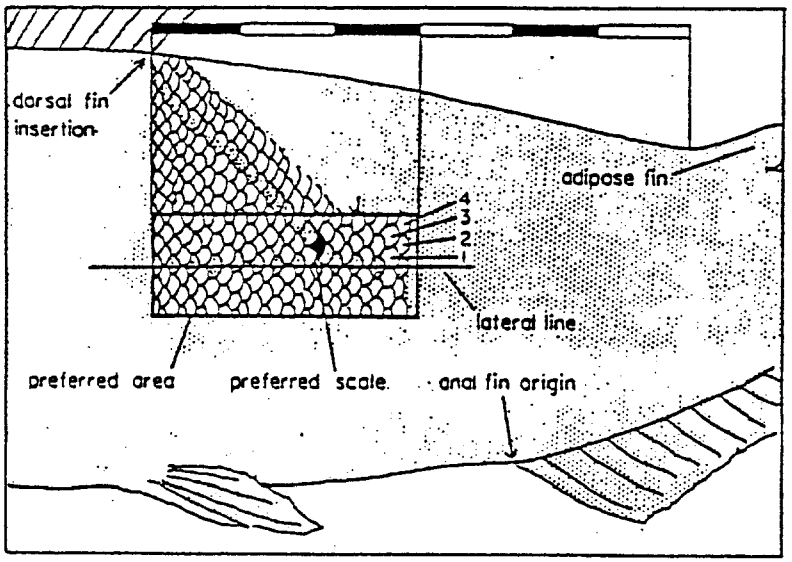
Appendix A.6. Removal and mounting of the preferred scale.



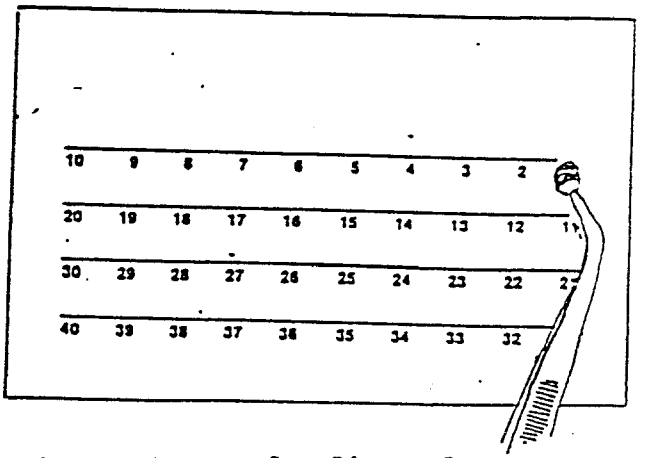
INPFC rated areas for scale removal.
Area A is the preferred area. B is the second choice if there are no scales in area A.
C designates non preferred areas. If scales on on the left side of the fish are not good, try the right side.

DO NOT TURN SCALE OVER



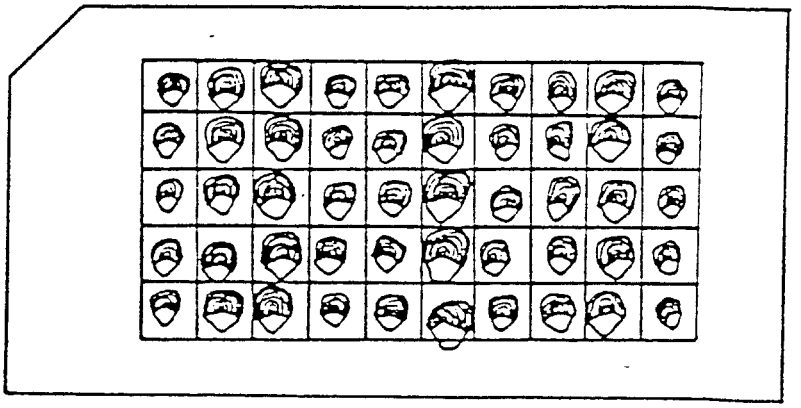


The preferred scale in this diagram is solid black. It is located 2 rows up from the lateral line, on a diagonal from the insertion (posterior) of the dorsal fin "back" towards the origin of the anal fin.

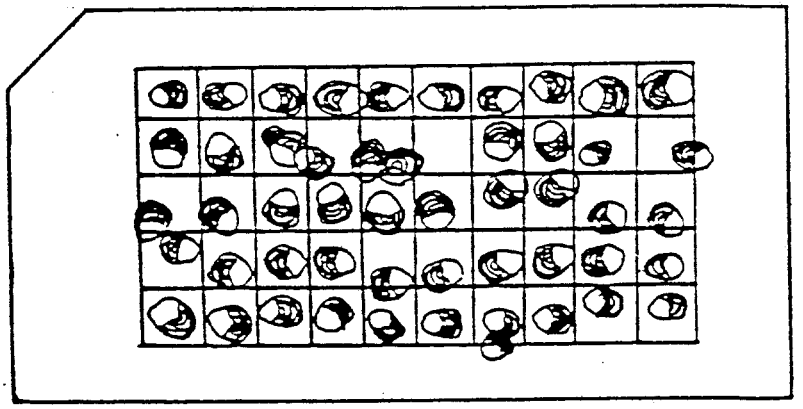


Place the scale directly over the number on the gummed card with the anterior portion (arche of the scale pointed toward the top of the card.

Appendix A.7. Scale orientation on the gummed card.



The scales are all correctly oriented on the card in the same direction, with the anterior portion of the scale pointed toward the top of the card.



The scales are incorrectly oriented in different directions. This increases the time spent to age samples.

Appendix E. Radio Communications schedule.

COMMERCIAL FISHERIES MANAGEMENT & DEVELOPMENT
Regional Radio Schedule - 3230

EXISTING

0001 - 0645	OPEN STANDBY
0645 - 0700	DILLINGHAM
0700 - 0715	KING SALMON
0715 - 0740	CHIGNIK - PENINSULA
0740 - 0800	BETHEL - AYK
0800 - 0830	KODIAK
0830 - 0845	FRED DILLINGHAM
0845 - 0900	GAME/SPORT FISH/KING SALMON
0900 - 0930	HOMER
0930 - 1000	CORDOVA
1000 - 1020	CHIGNIK - PENINSULA
1020 - 1530	OPEN STANDBY
1530 - 1600	CHIGNIK - PENINSULA
1600 - 1630	HOMER
1630 - 1700	CORDOVA
1700 - 1730	BETHEL - AYK
1730 - 1845	OPEN STANDBY
1845 - 1900	CHIGNIK - PENINSULA
1900 - 1930	KING SALMON
1930 - 1950	DILLINGHAM
1950 - 2000	FRED DILLINGHAM
2000 - 2045	KODIAK
2030 - 2400	OPEN STANDBY

PROPOSED

0001 - 0730	OPEN
0730 - 0815	BETHEL/AYK
0815 - 0900	KODIAK
0900 - 0925	PENINSULA
0925 - 0930	CHIGNIK
0930 - 1000	CORDOVA
1000 - 1030	HOMER/SOLDOTNA
1030 - 1600	OPEN
1600 - 1630	HOMER/SOLDOTNA
1630 - 1700	CORDOVA
1700 - 1730	BETHEL/AYK
1730 - 1930	OPEN
1930 - 2000	PENINSULA/CHIGNIK
2000 - 2045	KODIAK
2045 - 2400	OPEN

Appendix F. Weekly report example.

Date: 6/3/91

To: Lonnie White
Area Biologist - FRED

Weeks: 21, 22, and 23

From: Steve Schrof
Fish Culturist I - FRED

Subject: Spiridon Lake Sockeye Smolt Project

Activities:

Week 21:

Materials for tent platform arrived on 5/23. Began building platform on 5/24, completed and moved tent onto platform 5/26. Tent platform is built approximately 150 ft. from the lakeshore, paralleling the outlet stream.

Sockeye smolt movement is minimal at this point. Smolt count from 5/23 to 5/25 is 102 fish passed. Daily counts have ranged from 8 to 49 smolts passed. The holding pen for sockeye smolts is stressful. Strong water flow through the pen creates too much stress on the smolts. The pen needs to be enclosed on all sides to reduce flow speed. Due to low temps. and low numbers of fish, adequate oxygen levels should not be a concern.

Worked gillnet for adult Dolly Vardens on 5/24 and 5/25. Catches for adult Dollies were 10 and 7, respectively. The gillnet was set on the west creek. CPUE was 20.5 hrs, and 23.5 hrs.

Week 22:

Smolt counts still slow from 5/26 - 5/30, total fish passed 32. Rain and lots of wet weather raised water levels

in the greatest numbers to date on 5/31 and 6/1. Total numbers for the two days: 5/31 - 501 ; 6/1 - 118. We are still seeing a high percentage of mortalities in the holding box before sampling.

Set the gillnet on the south creek shoreline, 5/29 and 5/30. Catches for adult Dolly Vardens, 9 and 10, respectively. CPUE 16.0 hrs. and 23.5 hrs. Length, weight, and otolith sampler taken.

Made beach seine sets for juvenile Dolly Varden on south creek (2 sets), outlet creek (1 set), west creek (1 set), and east creek (1 set) sites on 5/29. We did not capture any juvenile Dollies, some miscellaneous numbers of sculpins and sticklebacks. We surveyed east and west creeks for any sign of juveniles up in there respective systems. We saw no sign of juveniles walking either system.

Week 23:

Smolt counts slowing down again. Counts on 6/2 were 6 smolts, and 6/3 were 6 smolts.

Attempted to work on lake 6/3, beach seining and setting the gillnet. High winds from the southeast created white capping and unstable conditions on the lake.

Significant Events:

Lochaye smolt counts started out slow but a rise in water level triggered smolt to migrate down-stream on 5/31 and 6/1.

Juvenile Dolly Varden are not being apprehended using the beach seine. Scouting along the lakeshore,

Significant Events cont.

visual sightings of juveniles.

Anticipated Activities:

Due to minimal smolt movement, we will be concentrating on beach seining, and setting the gillnet for the collection of Dolly Varden.

Continue to sample sockeye smolts migrating downstream.

Appendix G. Annual report format.

MEMORANDUM STATE OF ALASKA

TO: Distribution DATE: July 14, 1994

FILE: memorpt.94

FROM: Steve Honnold SUBJECT: Project Reports: format/example

Attached is an updated version of the required format for Annual Project Reports plus a copy of a report written by management personnel. This format is general and modification will be needed for individual projects. The example report is not specifically written to follow the current format, as it was drafted several years ago. Each crew leader will be responsible for drafting a report for each project worked during the season. Crew members should also participate in the writing of the report. I recommend that crew leaders delegate specific sections of the report, based on each crew members experience on the projects. I would like a draft of the report to review prior to the end of the field season, preferably, early enough to provide feedback to allow revision.

The initial draft of the report can be handwritten and later, after final revision, will be typed by clerical staff. I encourage each crew leader to work on these reports in-season while activity is ongoing. I realize how busy the field season is, however, data summary is much easier while it is fresh. The necessary time required for revision will be scheduled when things slow down and field personnel are in town.

If any clarification and or assistance is needed to write the reports, please let the appropriate staff know. I would be more than happy to help out anytime.

I will look forward to seeing your reports. Keep in mind that these reports are important documents which provide significant information for future implementation of our projects.

cc: All Development staff

CREW LEADER ANNUAL REPORTS

I. INTRODUCTION

Description of Project Location

Include general and specific location characteristics (stream width, depth, flow, tidal influence, etc.) and effect on project.

History of Project

Brief history of program.

Purpose of Project

Objectives

Purpose of Report

II. METHODS AND MATERIALS

Precisely describe all components of your work that produced the results reported:

Employees

List employees on site and for what periods, as well as job classes, previous time spent on the job, etc.

Weir/traps

Type of weirs and traps and installation, dates of installation and trapping, maintenance schedule; enumeration techniques, how sampled, when, how estimates were made, adult, smolt and other sampling techniques, etc.

Monitoring

Regulatory duties such as setting or moving markers or monitoring the fishery, etc.

Fish Pass Maintenance

Seasonal maintenance schedule - removing and installing doors, type of repairs, performance before and after, fish usage, etc.

Other Duties and Misc.

Physical data, safety, bear avoidance or activity, sport and subsistence fishing activity, etc.

Generally, following the operational plan procedures section will assist with this section. Also, maps, photographs and diagrams are useful for this section.

III. RESULTS

Base your results on the objectives and what was accomplished: be specific as to #'s, dates, etc. Generate specifics here as far as data collected, etc. Address each category listed in the Methods section. For example, smolt enumeration, timing, number sampled, mortality, adult escapements and timing by species, adult sampling numbers, spawning surveys, fish pass usage, etc. Simple tables and graphs should be constructed to summarize significant data.

IV. DISCUSSION AND RECOMMENDATIONS

Elaborate on results, techniques, significant findings, problems, etc.; be thorough - things you would want to know if you did not have any involvement in the project, but may in the future.

Recommend changes, modifications, etc. This should include all aspects of the project. Items that may be addressed:

improvement of weir/trap installation, maintenance and operation, changes or improvement of sampling techniques, camp and support improvements. Necessary or optional equipment/gear lists would be helpful in this section.

Appendix H.

STATE OF ALASKA
PERFORMANCE EVALUATION WORKSHEET

NAME	SOCIAL SECURITY NO.	DEPARTMENT	DIVISION

PCN	JOB CLASSIFICATION TITLE	REPORT COVERAGE FROM	REPORT COVERAGE TO

REASON FOR REPORT

☐ ANNUAL ☐ RESIGNATION ☐ COMPLETION OF PROBATION
☐ OTHER (SPECIFY) _____

POSITION DESCRIPTION REVIEWED BY RATER

YES ☐ NO ☐ If no, explain:

SPECIFIC RATING AREAS

	* U	A	O
PERFORMANCE	☐	☐	☐

(As shown by: quantity, quality, accuracy, and completeness of work; knowledge of job fundamentals; judgment shown on the job; willingness and ability to carry out new assignments; independence of performance; attitude towards job.)

WORK HABITS	☐	☐	☐

(As shown by: attendance; punctuality; appearance and grooming; safety.)

INTERPERSONAL RELATIONSHIPS	☐	☐	☐

(As shown by: consideration of public and co-workers; acceptance of supervision.)

SUPERVISORY (for Supervisory Employees Only)	☐	☐	☐

(As shown by: training and directing subordinates; evaluating subordinates; planning and organizing work, including delegation; problem solving and decision-making ability; affirmative action achievement; cost effectiveness; and, Labor Contract Administration).

* U = Unacceptable, A = Acceptable
O = Outstanding

NARRATIVE SECTION

Overall Effectiveness on the Job U 1☐ Acceptable 2☐ 3☐ 4☐ O 5☐

(Overall Effectiveness **MUST** be explained. Other performance consideration, such as strong points and areas needing improvement, should be included.)

Rater's Recommended Action: _____
(See Instructions on back)

Rating was discussed with employee ☐ Yes ☐ No If no, explain: _____

Signature of Rater _____ Title _____ Date _____

Employee: ☐ Concur with Rating ☐ Disagree (Employee comments on back)

Signature _____ Date _____

REVIEWED AND APPROVED BY:
Division
Signature: _____ Title _____ Date _____
Department
Signature: _____ Title _____ Date _____

(02-252WC (REV 8-82)

DIVIDER

KODIAK ISLAND AND SOUTHWEST ALASKA LAKE ASSESSMENT/LIMNOLOGY PROJECT OPERATIONAL PLAN, 1995

by

Steven G. Honnold

and

Steve Schrof

Alaska Department of Fish and Game
Commercial Fisheries Management and Development Division
211 Mission Road
Kodiak, Alaska 99615

June 1995

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INTRODUCTION

The Lake Assessment Project for Kodiak Island and Southwest Alaska includes limnology field sampling, lab processing, and analysis of lake trophic-level dynamics for 19 Kodiak and 8 Southwest Alaska lakes. These samples provide data with which lake productivity and sockeye smolt production can be assessed. Using this information, appropriate rehabilitation or enhancement strategies can then be applied to each salmon system.

Goal

The goal of this project is to determine the productivity status of Kodiak Island and Southwest Alaska lakes as related to development and restoration of sockeye salmon stocks.

Objectives

1. Provide samples for water quality, nutrient and chlorophyll a analysis.
2. Estimate density, biomass, size and species composition of the macrozooplankton community.
3. Estimate the compensation depth (EZD) for algal photosynthesis.
4. Determine the temperature and dissolved oxygen regime.

Tasks

1. Collect three carboys of lake water at 1 m, 2 m and mid-hypolimnion at each standard limnology sampling station from lakes being fertilized and/or stocked lakes.
2. Collect a zooplankton sample by vertical towing at each station in each lake.
3. Collect upward directed light readings at each standard limnology (original) station.
4. Measure dissolved oxygen and temperatures from the lake surface to the lake bottom at each standard limnology (original) station.
5. Collect secchi disk reading at each standard limnology (original) station.

SUPERVISION

Project Biologists: Steve Honnold, Steve Schrof,
Pete Cleary (Kitoi Lakes)

Field Staff:

Kodiak: Rob Markle (Kitoi Lakes)
Steve Schrof, P.J. Purdy, Mary Bingham

Southwest Alaska: Wade Wilson

The field staff is responsible for scheduling air charters for sampling and completing field sampling on schedule. Field staff are responsible for reviewing the Department's safety SOP, with emphasis on aircraft safety, and signing the Employee Safety SOP Verification form.

The project biologists are responsible for project oversight, including logistics and technical support as well as data quality control.

PROCEDURES

Water Sampling

At each limnology sampling station (Appendices A and B), water samples will be collected at 1 m, 2 m and at mid-hypolimnion (~75% of lake depth). Lakes that are not currently being fertilized or considered candidates for fertilization will not have water samples collected for analysis (Kodiak Island). Set up Van Dorn sampler and lower to sampling depth. Attach messenger to rope and release; wait for Van Dorn bottle to close, will be able to feel bottle closing; if not give a couple quick jerks to rope. Pull up the sampler and rinse clean (see lab processing section for cleaning procedure) carboy with portion of sample and discard. **Discard any samples that contain sediment and take another sample.** Pour sample into rinsed carboy labeled with name of lake, station and depth. Repeat process (without rinsing) until carboy is 2/3

to 3/4 full for 1 m and "deep" sample and 1/2 full for 2 m sample. Record sampling depths, stations, and other appropriate comments on Detailed Lake Survey (DLS) form (Appendix C). See the Field Sampling Equipment List (Appendix D) for the necessary collection gear.

Zooplankton Sampling

At each sampling station, vertical tows will be conducted to collect zooplankton. One tow will be conducted at each sample site. In 1994, additional stations were set in larger lakes or lakes with more than one basin to assess spatial variance in zooplankton density and biomass. Prepare a clearly marked morphometric map showing station locations, and forward to the Kodiak office, as well as the Limnology Lab.

To conduct tows, rinse zooplankton net and collection basin with distilled or filtered water before use. Slowly lower zooplankton net to sampling depth. Pull the net up vertically at 0.5 m/sec., stopping at the lake surface pulling the rim of the net just out of the water. Rinse the net by immersing several times in the lake to just above the collection basin without submerging the rim (wide end) of the net. Remove the collection basin from the net and pour the contents into a 125 ml polybottle **containing 12.5 ml (10% of volume) of buffered formalin**. Rinse the remaining tow contents off of the collection basin screen, without immersing, and continue to pour the sample into polybottle. If contents remain on the screen, use a washbottle containing filtered water to rinse off. Make sure the bottles are labeled with lake, station, date, time, depth, etc.

Phytoplankton Sampling

Phytoplankton samples will be collected four times per season **only at lakes being fertilized or being considered for fertilization (Appendix A)**. Samples will only be collected at the original limnology station and at the two meter depth.

Light Measurement and Secchi Disc Depth

Light levels will be measured at each standard limnology station, using an electronic photometer. Light readings will be recorded, beginning just above the lake surface (incidence), then just below the surface (subsurface), at 0.5 m intervals to 5 m, and at every meter, thereafter, until the light level is 1% of subsurface reading. Record only "up" measurements. Record data on the DLS form. **Please calculate the actual foot candle readings (this can be done in the office if it is preferred).** Repeat at each station.

Temperature and Dissolved Oxygen Measurement

Water temperature and dissolved oxygen (DO) will be measured at each standard limnology station, each sampling period. A YSI meter will be used as well as a handheld thermometer, to verify surface temperature. Prior to use, the YSI meter will be red lined and zeroed. Also, the DO's will be calibrated to the surface water temperature. This will be done by taking a surface water temperature and then adjusting the DO reading at the surface, based on the chart on the rear of the meter. This calibration will be repeated at each lake at each sampling date. This calibration can also be accomplished in the lab prior to sampling by using a HACH Kit. If this method is used, double check using the preceding method in the field.

At each limnology station, take DO and temperature readings from the surface to the bottom at 1 m intervals. During isothermic periods (spring and fall), readings can be taken at 5 - 10 m intervals. Record data on DLS form.

Secchi Disk (SD) transparency will be recorded at each station. Lower the SD until it disappears from view and record the depth on the DLS form. Pull SD up until it reappears and record the depth on the DLS form. Repeat at each station.

Note: It is best to measure light level and SD depth on the shaded or lee side of the boat or plane.

Metals

Processing water samples for metals has been discontinued.

Water Sample Processing

Water samples collected in the field will be processed in the Kodiak, Kitoi Hatchery or Russell Creek Hatchery labs.

Lab Set Up/Cleaning

Wash glass and poly filtration gear (filter towers, flasks) and graduated cylinders with phosphate free soap and rinse the first four times with tap water and then rinse four times with filtered water (do not need to wash waste water flasks). Wash carboys with phosphate free soap and rinse three times with filtered water. (If using the same carboys at the same lake and the same depth, then just rinse two times with tap water and two times with filtered water.) Wash nutrient poly plastic bottles with phosphate free soap and rinse with tap water four times, then rinse with filtered water two times. For equipment needed to process samples in the lab, refer to Appendix E. Label poly bottles and cover filter apparatus with tin foil until ready to process samples. Prepare all reagents and necessary equipment; set up vacuum pump with filter; **pump should be set at 15psi**. Reagent preparation is outlined in **Limnology Field and Laboratory Manual.**

Processing should be done as soon as possible after field sampling. Do not let carboys of water build up in refrigerator for more than three days. Process each carboy one at a time. Prepare polybottles and graduated cylinders by rinsing with a small portion of water sample. Using a rinsed graduated cylinder, measure for the following subsamples:

Unfiltered refrigerated: 500 ml into 500 ml polybottle; seal and refrigerate.
Unfiltered frozen: 200 ml into 250 ml polybottle; seal and freeze.

Phytoplankton: 100 ml into 125 ml polybottle; add 2 ml of Lugols acetate; seal and leave at room temperature. **Collect 2 m phytoplankton samples, only at lakes being fertilized or considered for fertilization, four times a year (Appendices A and B).**

Particulates: Using sterile forceps, place sterile Whatman GF/F filter(s) on the filter apparatus(es) and draw 50 ml of filtered water through filters. Using a wash bottle with filtered water, rinse tower and discard water from flask. Measure 1000 ml (1 Liter) of sample into graduated cylinder for each of the four particulate samples (CHLA,N,P,C). For 2m carboy, CHLA particulated only. Pour portion of sample from graduated cylinder(s) into filter tower(s) and turn on vacuum pump; as sample filters, add more from g. cylinder until all 1000 ml is filtered; let all samples filter through completely except the filter for chlorophyll a; as the last 50 ml of this sample is filtered add 5 ml of MgCO3 solution and 5 ml of filtered water to the filter; turn off pump when all towers are empty. Remove particulate nutrient filters from filter apparatus and place in appropriate, labelled petri slides; store frozen.

Unfiltered frozen: Save approximately 450 ml of filtrate from filtrate flask and after rinsing 500 ml bottle with small portion of filtrate, pour into bottle and seal; store frozen.

After samples have been processed, they will be shipped to Soldotna lab in sealed cooler. Samples should be **shipped via ERA airlines within five days after field sampling**. Include zooplankton samples but keep separate from other samples (ziplock) and seal bottles with electricians tape. Avoid shipping samples on Friday and be sure to call lab personnel to **inform of arrival time**. Ship original DLS forms to Lab and make a copy for our files.

Supply Ordering

P.J. Purdy will be responsible for seeing that all field sampling and lab processing equipment and supplies are in working order and/or stocked. Supplies will be ordered directly from the appropriate vendors. Check with a biologist before placing an order. Likewise, equipment will

be repaired or maintained through the appropriate company. The Soldotna Limnology Lab will only supply labels and bottles. Refer to Appendix F for important limnology reminders.

Miscellaneous

Zooplankton bottles (125 ml) can not be used for water samples if they have contained formalin (for preserving). Glassware that has been used for mixing reagents and formalin should not be used to measure water samples.

APPENDIX

Appendix A. Kodiak limnology sampling, 1995.

Lake Fertilization (3)	Station #	Sampling Depths (M) Zoop.	Deep H_2O	Chla	Phyto	Comments
Portage	1	15	15	1 & 2	2	
	2	14	-	-	-	
Laura	1	35	35	1 & 2	2	
	2	35	-	-	-	
Afognak	1	17	13	1 & 2	2	
	2	11	11	1 & 2	2	
	3	22	-	-	-	
	4	23	-	-	-	
Malina (lower)	1	10	10	1 & 2	2	
(upper)	2	27	27	1 & 2	2	
(upper)	3	29	-	-	-	
Little Waterfall Bay	1	15	15	1 & 2	2	
	2	12	-	-	-	
Stocking (4)						
Jennifer (upper)	1	26	-	-	-	Water samples will
(lower)	2	26	-	-	-	not be collected
Crescent	1	26	-	-	-	Water samples will
	2	21	-	-	-	not be collected
Hidden	1	40	40	1 & 2	-	
	2	23	-	-	-	
Spiridon	1	50	50	1 & 2	-	
	2	50	50	1 & 2	-	
	3	50	-	-	-	
	4	50	-	-	-	
Post Fertilization (6)						
Karluk (Main)	3	50	-	-	-	Water samples will
(O'Malley)	4	50	-	-	-	not be collected
Frazer	1	24	24	1 & 2	-	
(oil control)	3	50	50	1 & 2	-	
	2	50	-	-	-	
	3	50	-	-	-	
	4	50	-	-	-	
Oil (4)						
Red	1	38	38	1 & 2	-	
	2	38	38	1 & 2	-	
	3	37	-	-	-	
	4	37	-	-	-	
Akalura	1	16	16	1 & 2	-	
	2	14	14	1 & 2	-	
	3	12	-	-	-	
Development (6)						
McDonalds (Sorg)	1	17	-	-	-	Water samples will not be collected
Ruth	1	15	-	-	-	" "
	2	8	-	-	-	
Little Kitoi	1	19	18	1 & 2	2	
	2	15	15	1 & 2	2	
Saltry	1	33	-	-	-	Water samples will
	2	28	-	-	-	not be collected
Pillar	1	TBD	-	-	-	Water samples will not be collected
Upper Station	1	50	-	-	-	Not sampled in 1994
	2	24	-	-	-	

TBD = To be determined

Appendix B. Alaska Peninsula limnology sampling, 1995.

Lake Fertilization	Station #	Sampling Depths (M)		Comments
		Zoo.	Deep Water	
Bear	1	50	50	
	2			
Charlie Hansen	1	13	13	
Morzhovoi	1	2.5	--	Water samples
Orzinski	1	15	--	not collected
Sandy	1	6	6	
Sapsuk	1	50	50	
	2			
Thin Point	1	2	--	Water samples
Wildman	1	12	--	not collected

Appendix C. (page 1 of 2) DETAILED LAKE SURVEY
Field Form

CFMD Division
Limnology Section

Lake identification (note name, drainage, bay or fjord receiving drainage)_____

_____ Sample station designation

and depth_____(m). Weather & lake surface conditions_____

_____

Date_____Name(s) of sampling personnel_____

PHYSICAL & CHEMICAL PARAMETERS:

Depth (m)	Temperature (°C)	Dissolved Oxygen (mg/l)	% Oxygen Saturation	Solar Illuminence (Foot Candles) Up	Down	% Incident Light Leve Up	Dow
Incidence							
Surface							
0.5							
1.0							
1.5							
2.0							
2.5							
3.0							
3.5							
4.0							
4.5							
5.0							
6.0							
7.0							
8.0							
9.0							
10.0							
11.0							
12.0							
13.0							
14.0							
15.0							
16.0							
17.0							
18.0							
19.0							
20.0							
		"					

mments: Sampling Time: Surface: Deep Water H_2O Seechi Disk

Air Temp: Plankton

Meter: Light Meter: Water Temp: Bottom

(over)

Water samples collected for lab analyses 2 Depths samples were taken (m) and (m) Samples filtered in lab yes or field

Comments

Secchi disc: Depth(s) disc disappeared/reappeared / (m) Mean disc reading

BIOLOGICAL PARAMETERS:

Phytoplankton: ^{14}C conducted Dosimetry badges worn (initial of sampling personnel) .

Vial Number	Depth (m)	Bottle	pH	Time Set	Time Pulled
		Light			
		Light			
		Dark			
		Kill			
		Light			
		Light			
		Dark			
		Kill			
		Light			
		Light			
		Dark			
		Kill			

^{14}C samples filtered in lab or field .

Periphyton: Site designation and/or location of colonization plates

Incubation time (3 wk) (6 wk). Was one plate contents preserve . Was other plate filtered for Chl a in lab or field . Comments

Zooplankton: Number of tows taken 2 Tow depth (m) Tow angle (vertical or specify angle) Net size 20 cm x 147 u

Each tow preserved separately. yes Comments: Preserved with 10% buffered formalin by volume.

Benthic invertebrates: Site designation and/or location of Hester-Dendy samplers

Incubation time Comments

Additional Information or Comments:

Appendix D. Field sampling equipment list.

Equipment	Task
Van dorn bottle	Water samples
Rope marked in Meters	"
Messenger	"
Carboys 3 per original station	"
20-cm x 153-um mesh Plankton net	Zooplankton samples
Rope marked in meters	"
2 125 ml polybottles (Per station) with **12.5 ml of 100% buffered formalin in each bottle.**	Zooplankton samples
D.O./temperature meter (cord marked in meters)	Temp/DO readings
Photometer (cord marked in 1/2 meters) Secchi disk	Light level readings Turbidity reading
Clip board/rite in rain paper	Data entry
Anchors (1 per station), chain lead, rope and buoy.	Station set up

Appendix E. Lab processing equipment list.

Equipment		Task
Polybottles (labeled)		
per Carboy 1 M sample:	(2) 500 ml	500 ml unfilt. refrig. 500 ml filtrate frozen
	(2) 125 ml	1-phytoplankton 1-metals
	(1) 250 ml	200 ml unfilt. frozen
per Carboy 2 m sample:	(1) 125 ml	1-phytoplankton
per Carboy deep sample:		
	(2) 500 ml	500 ml unfilt. refrig. 500 ml filtrate frozen
	(1) 250 ml	200 ml unfilt. frozen
Whatman GF/F filters/petri slides		
per Carboy 1 m and deep sample:		
	(4) 4.25-cm	Particulate filtering (CHLA, N, P,C)
per Carboy 2 m sample:	(1)	Particulate CHLA
Graduated cylinders		Sample measurement
Filter apparatus:	filter tower (4) filtrate flask (1) vacuum pump vacuum hose vacuum filter Waste water flask	Particulate filtering filtr. frozen samples
Wash bottle with **filtered** water		Rinsing filter apparatus btw stations
Phosphate free detergent		Washing bottles, carboys, glassware
Filtered water		Rinsing bottles, carboys, glassware after washing
Sterile forceps		Handling filters
Lugols acetate		Phytoplankton preservation
Magnesium Carbonate		Chlorophyll preservation
Tin foil/cellophane		Covering filter apparatus after disinfection

Appendix F. Important limnology reminders.

Sampling

1. **Record the meters used** for sampling on DLS form.
2. Take a **hand held thermometer temperature** at the surface to compare to YSI meter.
3. **Complete all labels and all parts of DLS form.**
4. **Don't forget to calibrate DO meter.**
5. Have other lakes that are due for sampling, in the location of target lakes, in mind as "backup" in case weather is a problem. **Surface winds of greater than 15 mph usually means sampling will have to be aborted.** Do not try to push the weather limitation to collect a sample. Quality is desired, not quantity.
6. Use 100% formalin at **10% volume of polybottle (12.5 ml)** to preserve zooplankton tows.
7. Calculate light reading - should be **in foot candles on DLS form.**
8. It is important to be **consistant in sampling** with regards to station locations and sampling procedures. Make sure to **note any change in station location** and **attempt to relocate station** prior to sampling. Also, **zooplankton** and **deep water** sampling should be taken at **same depths each time sampled.**
9. It is a good idea to have a **station "set up" along** at each time of sampling in case bouy is missing or anchor is consistently moving.

Lab

1. Prior to working in the lab be sure that ADF&G lab safety SOP has been reviewed and Employee Safety SOP Vertification is signed.
2. When in doubt, **rinse liberally with filtered H_20** (DI) - all bottles, filter equipment and glassware.
3. **Do not use bottles previously used for zooplankton** or that are known to **have contained formalin** for any samples other than zooplankton.

-Continued-

4. **Complete all labels**.
5. Be considerate of other lab personnel when using chemicals; **mix and pour chemicals under "hood"**. Be careful when using chemicals.
6. Keep Chl. A filter tower in same location on manifold.

Shipping

1. **Double check labels and DLS forms; make copy of DLS forms**.
2. Make sure zooplankton bottles are **sealed with electrical tape. Keep separate** from other samples.
3. **Keep phytoplankton separate** from other samples. Ziplocks will work to isolate.

4. Make sure that samples being shipped are charged to the appropriate account (KRAA, ADF&G, or Clean Lakes).
5. Remove all old labels from cooler or box used to ship; use shipping label and seal with strapping tape. If cooler isn't full, pack it so nothing can move - this will minimize spilling or damage.
6. At airline, make sure they **know the importance of the samples**. Ask them to put the **appropriate labels** on the coolers, i.e. chill, freeze, etc.
7. Always **call to verify that the flight has left** Kodiak. Also, call Soldotna and **inform them of arrival time**. Finally, **call Soldotna to verify that they received the samples**.

DIVIDER

HIDDEN LAKE SOCKEYE ENHANCEMENT PROJECT
OPERATIONAL PLAN, 1995

By

Steve Honnold
and
Steve Schrof

Alaska Department of Fish and Game
Commercial Fisheries Management and Development Division
211 Mission Road
Kodiak, Alaska 99615

June 1995

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INTRODUCTION

In July 1992, the U.S. Fish and Wildlife Service (Service) prepared an environmental assessment (EA) on a proposal by Alaska Department of Fish and Game (ADF&G) to introduce sockeye salmon into Hidden Lake on Afognak Island in the Kodiak National Wildlife Refuge. This EA was prepared in cooperation with ADF&G under the current Service mandates and guidelines for management of refuge resources. The ADF&G strategy for this project was to use the freshwater environment of Hidden Lake, originally barren of salmon, for stocking and subsequent rearing of juvenile sockeye that will migrate to the ocean and return as adults. The objective of the project is to enhance the common property fishery in the Kodiak area (White 1992).

Goal

The goal of this project is to evaluate the condition of sockeye salmon smolt outmigrating from Hidden Lake, determine the number of sockeye adults produced and monitor the commercial fishery. In addition, comply with the monitoring requirements of the EA in agreement with the Kodiak National Wildlife Refuge.

Objectives

1. Evaluate the overall condition of sockeye salmon smolt outmigrating from Hidden Lake.

2. Determine age composition and average size of sockeye smolt outmigrating.

3. Estimate timing and run strength of adult sockeye to facilitate a commercial fishery.

4. Estimate the size of the sockeye, pink and coho salmon run to Hidden Creek.

5. Determine the age composition of the sockeye run in the terminal harvest area and the escapement into Hidden Creek.

6. Conduct brown bear activity surveys in the Hidden Creek basin throughout the sockeye and pink salmon escapement period.

7. Determine Dolly Varden catch per unit effort and size frequency in Hidden Lake.

Tasks

1. Collect physical data daily.

2. Note the overall condition of smolt outmigrating.

3. Collect 70 smolt per day, three days a week (total of 210/week), for scales, lengths, and weights from May 24th to mid-June; enumerate smolt with right ventral (RV) fin clips.

4. Construct and maintain an adult barrier weir.

5. Monitor the salmon build up and vessel activity during fishery openings.

6. Sample 120 adult sockeye/week for age and length in the commercial fishery in Foul Bay.

7. Collect an additional 240 scales (80 scales/week) and lengths from adult sockeye at the weir located at Hidden Creek throughout the run.

8. Observe and record the number of adult sockeye with (RV) fin clips in the commerical catch and fish passed through the weir.

9. Conduct weekly foot surveys to estimate and determine the distribution of pink and coho salmon in Hidden Creek.

10. Determine juvenile coho salmon relative abundance in lower Hidden Creek.

11. Collect adult Dolly Varden from Hidden Lake for CPUE once in June and August.

12. Record brown activity in the creek basin throughout the salmon escapement period.

SUPERVISION

Project Biologists: Steve Honnold, Steve Schrof

The biologists will be responsible for logistical, technical, and equipment support.

Field Staff: Greg Watchers - crew leader
Helen Nute - crew

The crew leader will schedule daily tasks and oversee field operations and safety. In addition, the crew leader will be responsible for assuring that the Department's Safety SOP is followed.

PROCEDURES

Physical Data

Physical data will be collected at the smolt site at 1100 and 2300 hours. Once the smolt portion is complete, physical data should be collected daily at the barrier weir site. Information will be recorded on the Daily Physical Observation form (Figure 1) and will include: water and air temperatures, stream height, percent cloud cover, wind direction and velocity, and precipitation.

Sockeye Salmon Smolt Outmigrant Condition

A fyke net will be fished to assess the mortality or injury to sockeye smolt as a result of migration over the barrier falls at Hidden creek. The trap will be fished below the falls from late May until the end of the run (~June 20). Sockeye smolt captured in the fyke net will be assessed for injury and mortality as a result of migration over the barrier falls. Observations of excessive scale loss, lacerations, and/or mortality will be noted on the Daily Smolt Trap Catch Reporting Form (Figure 2).

Trap Monitoring and Maintenance

The location of the smolt or fyke trap will be in a point, mid channel where the velocity is sufficient to minimize fish avoidance. The trap should be kept free of debris to maintain trap efficiency and minimize smolt mortality. This will require frequent monitoring and maintenance. The trap should be checked every hour between sunset and sunrise and every four hours during daylight hours. This is an important aspect of the project and should not be taken lightly. Significant mortality can occur in a short period of time if the crew is not keeping "on top" of trap monitoring. Migration patterns may change with significant weather changes, so becoming too routine in trap monitoring is not advised. The smolt day begins at 12:00 noon and continues for 24 hours until 12:00 noon the following day.

Trap Catch and Species Enumeration

Everything caught in the smolt trap will be enumerated. Please refer to identification keys if questions arise regarding species identification (Appendix A). Feel free to contact the Project

Biologist if any questions regarding identification occur. Use a dip net to remove and release the fish as they are counted. Handle sockeye smolt gently as they are very sensitive to any stress and mortality can occur with the loss of just a few scales. A tally whacker should be used to count sockeye smolt to assure an accurate count. In the event an extremely large outmigration occurs in a relatively short time period, and time will not permit counting individual smolt without mortality, collect enough smolt for a daily sample and then pull the wings so that the trap is not fishing. This will prevent unnecessary mortality. This method should only occur when there are relatively large number of smolt being caught, and there is not enough time to count all the fish without incurring mortalities. Enter all data on the Daily Smolt Trap Catch Reporting Form (Figure 2) each time the trap is checked. Also, record any mortality on the form each day. Summarize daily trapping data on Sockeye Smolt Summary Form (Figure 3).

Age, Weight, and Length Sampling

A sample of 70 - 100 sockeye smolt per day, for three days per week for the length of the migration are to be sampled for age, weight, and length. Each sample will be taken from a single day's catch; do not mix samples between days. If less than 70 fish are caught in a day, the sample size for that day will be number of fish caught on that day. Since smolt primarily migrate at night, a single sampling day will be the 24 hour period from noon to noon and will be identified by the calendar date corresponding to the first noon.

It is essential that the sample be taken randomly. In the event that more than the required sample size is in the smolt trap at the time of sampling, the trap is to be stirred to assure randomness. When the smolt are randomly distributed, a small dip net will be used to remove a subsample, this procedure will be repeated until the sample goal is met.

Smolt samples will be kept alive and worked the day of capture. MS222 will be used to anesthetize the fish. Latex gloves should be worn to prevent direct exposure to MS222 (Appendix B). The use of this chemical will be demonstrated in the field. Age, weight, and length data will be recorded on adult AWL forms (Appendix C) as no smolt AWL forms exist. Refer to Appendix C.1 on the standard procedures for recording data on an AWL form. Record at the top of each AWL form: personnel collecting the data.

A knife or scalpel will be used to remove 5-10 scales from the preferred area Appendix C.3. The scales will be mounted on a glass slide as illustrated in Appendix C.4. The left portion of each slide will be labeled with: sample AWL number, location, date, and fish number. Smolt lengths will be measured to the nearest millimeter, from the tip of the snout to the fork of the tail.

Excess water will be removed from the smolt before weighing by using a paper towel as a blotter. Individual smolt weights will be recorded to the nearest 0.1 gram.

At each system, when mortality occurs during sampling, save 5-10 smolt and preserve in 15% buffered formulin in a polybottle. Label the bottle with system, date and preservative. Trap mortality can also be used for the sample.

During AWL sampling, all smolt will be examined for right ventral fin clips. The number of fish examined and number of clips found will be recorded.

All data (slides, forms) will be forwarded to the area office and reviewed on a frequent basis (weekly or earliest available plane to town). Be sure to duplicate the data forms in case originals are misplaced in transit. **Please be conscientious in the quality control of <u>all</u> data prior to sending into Kodiak. Take the time to thoroughly review slides and forms to see they are filled out properly. This is especially important for the computer AWL forms.** These are some common mistakes which should be avoided:

1) Scales mounted poorly - avoid too many scales in a smear and avoid slime or debris when mounting; also, keep smears far enough apart ot avoid mistaking one fish for another.

2) Numbering AWL forms improperly - for example, if 70 smolt are sampled in one day (day 1), the AWL numbers should be 001 (fish 1-40; 8 slides), 002 (1-30; 6 slides), do not continue from 40 to 41-70. The next day will start with AWL 003 (fish 1-40) and so on.

3) Numbering when two smears per fish is required - these should be numbered 001 A, B not 001-002.

4) "# of cards" mislabeled - use one even if there are two scale cards or slides.

5) Damage AWL form (computer - Mark sense) - do not bend, fold, tape, staple, paper clip, etc. these forms. The computer will not read them correctly, otherwise.

Fishery Monitoring and Sampling

From June 9 to August 1, the commercial salmon fishery will be monitored in Foul Bay. Once the camp is established, a barrier weir will be installed and maintained across Hidden Creek to prevent adult sockeye salmon from escaping into Hidden Creek. To minimize potential human/bear contact, seven to ten percent of the sockeye run into Foul Bay should be allowed to escape into Hidden Creek. The forecast for returning sockeye is 21,000 fish, for an escapement into Hidden Creek of 1500 to 2000 fish. Adjustments to the escapement will be made according to the estimated run strength. The barrier weir will be monitored in such a manner to avoid mortality to fish and wildlife. Pink salmon will be passed through the weir to spawn in Hidden Creek. The weir will be kept clear of debris daily. Daily surveys will be conducted in the Foul Bay to assess sockeye salmon run strength with information relayed to the Commercial Fishery

Managers at 0800 and 2000 hour radio schedules. The crew leader will be responsible for coordinating the opening of the fishery under direction of Commercial Fishery Managers (June 09 fishery opens at 1200 for 33 hours). During the fishery, vessel names, fishing location, and estimated catch by species will be logged.

The adult sockeye salmon run will be examined for age and length data with a goal of sampling ~840 fish from 09 June through the end of the run. The weekly goal will be 120 fish in the commercial fishery. In addition, approximately 80 scales and lengths per week (240 total) will be collected from adult sockeye at the weir in Hidden Creek. During sampling, sockeye salmon will be examined for right ventral fin clips. Record the date and number of clips observed. Refer to the Kodiak Area Commercial Salmon Fishery Harvest Strategy, 1995 for additional information.

Pink and Coho Escapement Surveys and Juvenile Coho Sampling

Pink and coho salmon escapement surveys will be conducted on Hidden Creek weekly. These foot surveys should begin at the barrier falls and end at the intertidal zone. Fish distribution will be recorded by dividing the stream into four sections as described in the introduction; live and dead fish will be enumerated in each section.

Sampling with minnow traps for rearing coho salmon will occur in June, July, and August. Two baited minnow traps will be set, each, in three permanent sample locations in the stream located in the last pool, meadow, and waterfall sections. The minnow traps should be fished for ~ 24 hours. Fish captured in the minnow traps will be identified, enumerated, and then released.

Indigenous Fish Population Sampling

A variable mesh gillnet (33 m x 2.7 m) will be used to sample Dolly Varden char in Hidden Lake. The net will be set from a permanent sampling point (fence post) on the southwest shore of the lake. Sampling is to be conducted for two 24 hour periods on approximately 30 June and 30 August. The gillnet should be set ~ 30 m from the shoreline by aircraft, extending (by taxing of the plane) from the fence post on shore to the opposite end of the net. Once extended, an anchor will be dropped from the plane. All adult Dolly Varden caught will be sampled for weight (0.1 gram) and length (mm) (Figure 4). All Dolly Varden will be eviscerated to examine stomach contents for sockeye fry predation.

All fish captured were measured (mid eye to fork of tail) for length and weighed to the nearest 0.1 grams. Scale samples were collected from any sockeye pre-smolt captured.

Brown Bear Monitoring

Brown bear activity in the Hidden Creek drainage will be monitored throughout the field season. The sampling objective is to spend 50 hours each month observing brown bears feeding on salmon in Hidden Creek. The study area includes the stream bed, a previously established trail, and the area between the trail and creek. The observer should spend 1-5 hour intervals at varying times of the day at various designated locations of the stream watching for bears.

Any bear sign found is to be noted and then obliterated. Track width of the front paws will be measured and recorded. Any scat found examined for content. Any bears observed should be noted for activity, physical characteristics, and photographed.

Observation points for viewing bears were selected in 1993. Permanent observation points were established in the Last Pool and Waterfall sections of Hidden Creek will be used again. In 1994, a third permanent observation point was established in the meadow section of the creek, this site has a 100 m view upstream and a 100 m view downstream. These observation points will be used again in 1995 for brown bear monitoring.

Safety and Radio Schedule

Each employee will receive CPR/First Aid Certification as required by the Department SOP, prior to assignment to the Spiridon Project. In addition, each employee will review the required sections of the ADF&G SOP and sign the Employee Safety SOP Verification form. Specific SOP's to review include Safety Policy/Standards, Building Safety, Field Camp Safety, Aircraft Safety/Passenger, Emergency/Survival Equipment Required in Aircraft, Boating Safety, Vehicle Safety, Laboratory Safety, Small Tool Handling, and Firearm/Bear Safety. There is additional information in the office safety files to supplement the SOP and is also available for review.

Project crew leaders will be responsible for providing the necessary equipment and information to field technicians. **Each employee is responsible for receiving his/her own safety training.**

Field camps will be contacted by office personnel by SSB radio. The Development Section, CFM&D Division, morning radio schedule will be from 0845 - 0900 hours Monday through Friday and the evening 2100 - 2115 hours Sunday through Thursday. During smolt season the "morning" schedule will be 1300 - 1315 hours. If contact is necessary at other times information can be relayed vie the Commercial Fish Management Section schedule at 0800 and 2000 hours. (Appendix D). The frequency for Fish and Game contact is 3230. **ALL FIELD PERSONNEL WILL BE AWARE OF EMERGENCY CONTACT PROCEDURE POSTED ON EACH RADIO AND AT WHICH LONGITUDE AND LATITUDE COORDINATES THEIR CAMP IS LOCATED.**

Air Charters

All air charters will be set up through Kodiak staff. Appropriate information in regard to charters will be relayed through daily radio contact. It is important to contact office personnel when any data, equipment or other freight will be "back hauled" to Kodiak.

Reporting

Crew leaders will be responsible for reporting all of the job activities and compiling biological data. Be sure to use pencil rather than a pen for data entry. Data forms and a field log will be completed daily. Use "rite in the rain" field log books in the field and transfer data onto rite in the rain data forms after field work is completed. Data will be reported to Kodiak staff via SSB radio as previously mentioned. Completed data forms will be sent to Kodiak weekly. Make sure that data that is sent to Kodiak is properly packaged and labelled.

A report of project activities will be sent to town weekly or on soonest available plane . A one page weekly report is sufficient (Appendix E). In addition to weekly reporting, crew leaders will be responsible for writing a report summarizing project activities for the season. Please follow the enclosed format when writing this document (Appendix F). Specific information on weir installation and removal, operation, and fishery monitoring should be included.

Inventory

Upon completion of the project, crew leaders will complete a thorough inventory of all project equipment. The final location of each inventoried item will be noted (i.e. at Hidden, warehouse bin, etc.).

Video/Photo Documentation

Crew leaders will be responsible for photo documenting project activities. Specific aspects such as trap installations, weir construction, and other detailed tasks are important to photograph. When possible, State cameras and film will be used. If, however, State cameras are not available, film will be provided for use with personal cameras. The use of personal cameras is suggested in this case but not required.

Performance Appraisal

Crew leaders will be responsible for evaluation of each crew members performance during the Spiridon Project operations. A Performance Evaluation will be written for each crew member at the end of the project. These evaluations will be written on the State of Alaska Performance Evaluation form (Appendix G). The individuals that write these project evaluations will be referred to in the final evaluation written by the Project Biologist. Crew leaders should keep crew members appraised of their performance during the project.

Timesheets

All timesheets are to be in the Kodiak office by the 15th and 30th of each month. When the employee is working in the field and receives hazard pay, the timesheet "Comments" column is to have the location of the field camp. If there was overtime worked, the employee must state a choice each pay period whether to be paid for the overtime hours worked or accrue compensatory leave (comp time). The comp time should be put on the timesheet as overtime, and at the top of the timesheet write the following: "I wish to receive compensatory leave in lieu of overtime." Comp time is calculated each pay period by multiplying the number of hours of eligible overtime by 1.5. If the employee has comp time at the end of the field season, they are to use the comp time before being put on seasonal leave without pay. Employees cannot collect unemployment while on comp time. Crew leaders should plan work activities to be completed in a 7.5 hour day. **All overtime worked will be pre-authorized by the Project Biologist.**

Figure 1. Daily physical observation form.

DAILY PHYSICAL OBSERVATIONS

Project: _____ **Location:** _____

DATE	TIME	TEMPERATURE				GAUGE	WEATHER
		AIR		WATER			
		MIN	MAX	MIN	MAX		

Figure 2. Daily smolt trap catch reporting form.

DAILY SMOLT TRAP CATCH REPORTING FORM

PROJECT LOCATION: _____ DATE: _____

TIME (Military)	SOCKEYE		COHO FRY	DOLLY VARDEN	STICKLE-BACK	OTHER	COMMENTS
	SMOLT	FRY					
TOTAL							

Figure 3. Sockeye smolt summary form.

SOCKEYE SMOLT SUMMARY FORM

Location: _____ **Year:** _____

DATE	SMOLT		MORTALITY [a]		AWL SAMPLE		COMMENTS
	DAILY	CUMULATIVE	DAILY	CUMULATIVE	DAILY	CUMULATIVE	

[a] Included in daily and cumulative counts.

Figure 4. Dolly Varden gillnet survey form.

Personnel:
Data collected on:

Gillnet set (date/time):
Gillnet pulled (date/time):

Fish Number	Length (mm)	Weight (g)	Fish Number	Length (mm)	Weight (g)
1			34		
2			35		
3			36		
4			37		
5			38		
6			39		
7			40		
8			41		
9			42		
10			43		
11			44		
12			45		
13			46		
14			47		
15			48		
16			49		
17			50		
18			51		
19			52		
20			53		
21			54		
22			55		
23			56		
24			57		
25			58		
26			59		
27			60		
28			61		
29			62		
30			63		
31			64		
32			65		
33			66		
Average:					

APPENDIX

A Guide to the Collection and Identification of Presmolt Pacific Salmon in Alaska with an Illustrated Key

MILTON B. TRAUTMAN[1]

ABSTRACT

This field and laboratory key contains recommendations for types of equipment needed, instructions for preserving and labeling specimens, and descriptions of the characters used in identifying five species of Pacific salmon. The key is illustrated with six line figures: 1) juvenile salmon, 2) the first gill arch, 3) head with gill arch in situ, 4) first gill arch and eye for comparison with longest rakers, 5) method of counting anal fin rays, and 6) ventral surface of head showing branchiostegals. Five plates of stippled line drawings of five lengths (25 to 110 mm fork length) for each of the five species of Pacific salmon, an annotated opposable key, and a glossary are also included.

INTRODUCTION

As adults, the five species[2] of Pacific salmon of the genus *Oncorhynchus* inhabiting western North American waters are easily identified, but as subadults or as smolts in silvery coloration, they are less easily recognized. As juveniles less than 125 mm (5 inches) in fork length (FL), they may be quite difficult to identify. In addition, characters by which presmolt juveniles can be distinguished may vary with geographic area.

Several keys for identification of juvenile salmon have been published, most of which utilize the number, length, and shape of the gill rakers on the first gill arch; number of pyloric caeca and branchiostegals; and absence of parr marks, or if present, their size and shape (Foerster and Pritchard, 1935; Schultz, 1936; Haig-Brown, 1947; Clemens and Wilby, 1961; McPhail and Lindsey, 1970; Wilimovsky[3]). In addition to the above characters, the key in this paper emphasizes and illustrates the distribution of those chromatophores (usually melanophores) which are reliable enough to aid in the specific identification of juveniles.

This key describes the characters typical of presmolt juveniles of the five species of Pacific salmon in Alaska. The common names recommended by the American Fisheries Society (Bailey et al., 1970, p. 17) are used, despite the fact that other names appear to be in more general use. These other names are inserted in parentheses after their respective species. Trouts, Atlantic salmon (*Salmo salar*), and some other salmonoids are included in the key because of their resemblance to Pacific salmon.

Before presenting the key, it appears advisable to describe the equipment and methods I recommend for preserving specimens, labeling specimens, and counting, measuring, and removing parts of specimens, so that those not acquainted with my procedures may more accurately and quickly identify their material.

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[1] Professor Emeritus of Zoology, Ohio State University, Columbus, OH 43210. The author was employed in Alaska by the National Marine Fisheries Service Auke Bay Fisheries Laboratory during the summers of 1959 and 1961. The specimens were obtained and most of the drawings made at that time.

[2] A sixth species, *O. masou* (Brevoort), inhabits the streams of eastern Asia from the Okhotsk Sea to Formosa.

[3] N. J. Wilimovsky, 1958. Provisional keys to the fishes of Alaska. On file Natl. Mar. Fish. Serv., Auke Bay Fish. Lab., Auke Bay, AK 99821.

RECOMMENDED EQUIPMENT

Magnifiers: Magnification in the range of 4 to 30 will prove helpful in identification of juvenile salmon. A binocular microscope having such a range is the most satisfactory, but any type of magnifier of more than 4 power and less than 30 may be used provided it is not necessary to use one's hand to hold it—usually both hands are needed to manipulate a specimen. In the field, a binocular unit containing lenses inserted in a frame or headstrap or a jeweler's eye magnifier (especially if one wears glasses) may be used.

Forceps: Four or five inches long with straight or curved tips—for lifting fins, holding back gill covers, etc.

Scalpel: A sharp blade an inch or two long—for removing gill arches, opening body cavities, etc.

Teasing needle: A needle inserted in a wooden or metal handle—for separating closely set gill rakers, etc.

Dividers: For measuring and comparing various body parts; dividers in which one or both legs can be "broken" are the most satisfactory.

Scissors: About 6 inches long with the blades or cutting surface of about 1 inch.

Ruler: Graduated in millimeters to measure fish lengths and parts; one which includes inches also desirable.

PRESERVING SPECIMENS

The careful preserving of specimens cannot be too strongly emphasized. Much time is lost in attempting to identify improperly preserved fishes; it is only when properly preserved that they may be rapidly and correctly identified. Frequently, juvenile salmon that have died in nets become soft, bleached, and torn. For the sake of accuracy it is better not to attempt to identify such material.

To preserve juveniles, upon capture place them in a solution of 1 part Formalin to 9 parts water. If live fishes are placed in too strong a Formalin solution, they may die with their mouths widely agape or the chromatophores may close so tightly as to be difficult to detect. If placed in too weak a Formalin solution, the fishes become bleached and soft and may decompose. If fishes are to be preserved for more than a year (or permanently), leave them in the Formalin solution at least 1 wk and if possible no longer than 4 mo. When fish are removed from the Formalin solution, soak them in water for 24 to 48 hr; then place them in a solution containing 70% ethyl alcohol and 30% water or 35% isopropyl alcohol and 65% water.

Do not crowd or pack fishes in a container, especially if they are alive or only recently dead. Fresh fishes, if packed too tightly, will become permanently deformed upon hardening in Formalin, will be bleached where their bodies come in close contact, or will decompose. A container is too crowded if the fishes will not readily move as the container is slowly rotated or shaken. When sufficient room is allowed, identification will be facilitated because the fishes will harden without discoloring; bodies and fins will not be deformed, twisted, or broken; and the chromatophores will remain nearly or fully open.

LABELING SPECIMENS

Labeling specimens fully and properly is of great importance; unlabeled or mislabeled specimens are of little or no value. Put the label with the specimens at the time the fishes are preserved. Label paper should remain firm when wet and should not become pulpy. Write clearly with pencil or permanent ink, recording the following data.

Field Number

Use your own or a department number. A satisfactory method is to use the first initial of your surname or your full surname, the last two digits of the year, and your collection number. Thus, if Joe Brown in 1962 preserves his fifth collection, he writes B-62-5 or Brown-62-5; if for the Department of Salmon Investigations he writes, SI-62-5. When a departmental symbol is used, it often is desirable for the collector to add his initials or name to the label.

Name of Water Body and Locality

Use names on standard maps. Whenever possible, avoid temporary or local names, such as

Brown's fishing camp. An example of a brief but adequate recording is: Alaska, Naknek River System, Katmai National Monument, Brooks Lake.

Date

Include the month, day, and year and, if pertinent, the hour.

The following additional information may be needed at times.

Method of Capture

Describe type of gear and size if significant, i.e., seine (2 cm mesh), fry net (1 cm mesh), trawl (1 cm bag), etc.

Temperature

Measure temperature of air and/or water. If water is ice-covered, what percent?

Other Water Conditions

If a *stream:* estimate its average width and maximum depth; if tidal and brackish, to what extent; degree of turbidity and source—glacial silt, plankton, etc.; degree of gradient—low, moderate, or high; percentage of stream in pools, with or without current; percentage of stream in riffles, whether flow is sluggish, moderate, or swift; dominant bottom types—sand, gravel, boulders, bedrock, muck, silt, etc.; aquatic vegetation—submerged, emergent, or both (name dominant species or genera if known). If a *lake or bay:* state whether fresh, brackish, or saline; if tidal, state to what extent; estimate size and possible depth; give degree of turbidity, type of bottom, and amount and kinds of aquatic vegetation.

Remarks

Describe anything that may aid in identification of the fishes, such as peculiar markings, habits, or habitats.

CHARACTERS USED IN IDENTIFYING SPECIES

A juvenile salmon is shown in Figure 1 to assist in recognizing and defining the characters and the counts and measurements used when keying out a specimen.

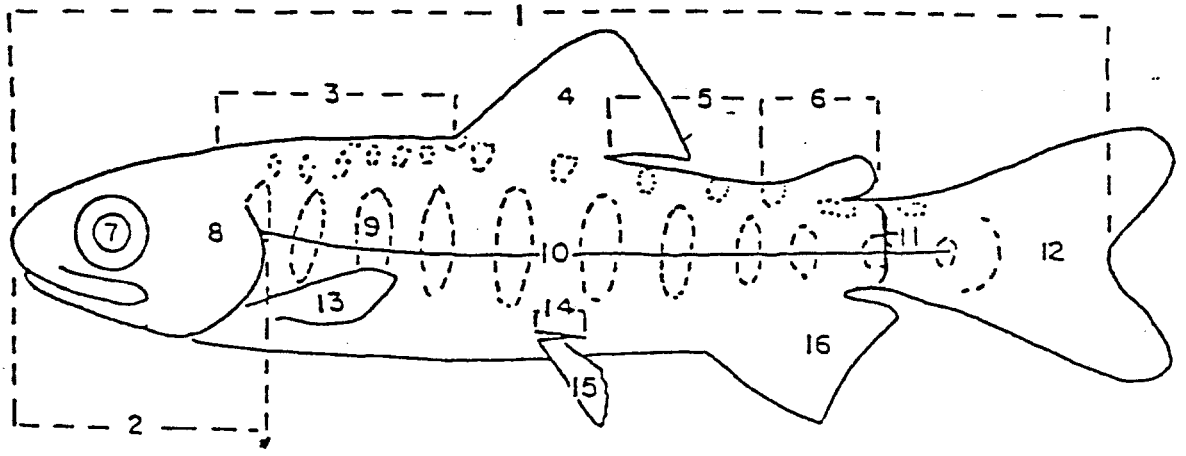

Figure 1.—Juvenile salmon, illustrating parts and methods of measuring: 1, body length; 2, head length; 3, predorsal ridge; 4, dorsal fin; 5, portion of postdorsal ridge between posterior end of dorsal fin base and origin of adipose fin; 6, adipose fin; 7, pupil of eye; 8, gill cover, beneath which is gill chamber containing gill arches; 9, a parr mark; 10, lateral line; 11, caudal peduncle; 12, caudal fin or tail; 13, pectoral fin; 14, axillary process or scale; 15, pelvic fin; 16, anal fin.

First Gill Arch

Beneath each gill cover are four fully formed gill arches; the first gill arch on either side is the part used for specific identification. A gill arch (Fig. 2) consists primarily of a bony central arch to which the gill rakers are attached anteriorly, the gill filaments (lamellae) posteriorly. The gill rakers prevent solid substances such as food from being carried out through the branchial clefts and protect the delicate gill filaments. The numbers of gill rakers vary somewhat among individuals of each species of salmon, but the difference in average number between some species is sufficiently great to enable one to use them as specific characters.

The rakers on the gill arch may be counted as a unit, or the upper and lower limbs may be counted separately. The two limbs are joined

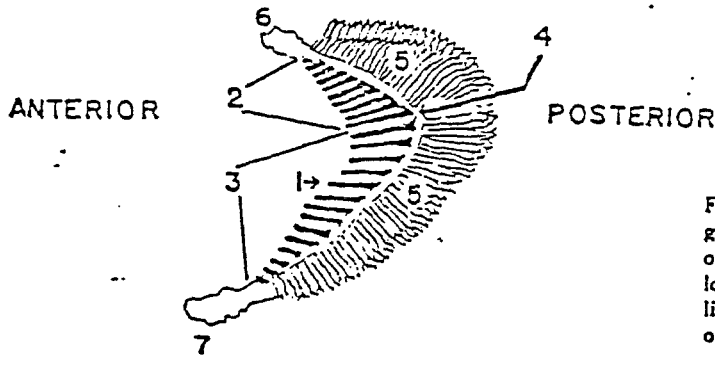

Figure 2.—First gill arch of salmon after removal from left gill chamber: 1) gill rakers; 2) gill rakers attached to upper or shorter limb of arch; 3) gill rakers attached to lower or longer limb of arch; 4) angle of arch (junction of the two limbs or bones); 5) gill filaments (lamellae); 6) upper point of arch attachment; 7) lower point of arch attachment.

at an angle, the upper being the shorter. When a raker is situated astride the angle, it is included in the lower limb count. When all of the rakers on the arch are counted as a unit, a single number is given; otherwise, both limbs are recorded separately (the upper limb first), and then added, thus 12 + 20 = 32.

The gill rakers nearest the angle of the arch are the longest; the rakers become progressively shorter as they approach the attachment ends of each arch. The rakers near the ends are often rudimentary and can be counted only under magnification.

It may be difficult to count all of the rakers accurately while the first gill arch is in place, in which case it will be necessary to remove the arch. To do this, turn back or cut away gill cover as shown in Figure 3. Lift the first gill arch upward. With a sharp scalpel, cut between the dorsal ends of the first and second arches, making a deep incision parallel with them; then cut the remainder of the attachment away. Next cut the ventral attachment in the same manner; and when both ends are free, remove the arch. Great care must be taken so that all rudimentary rakers may be removed and counted. After finishing the examination of the arch, reinsert it in the gill chamber for possible future examination.

Gill Raker and Eye Comparison

The longest rakers are compared with the length of the eye (Fig. 4). With dividers, obtain the measurement of the length of the longest raker; then place one point of the dividers at the anterior edge of the eye, the other extending

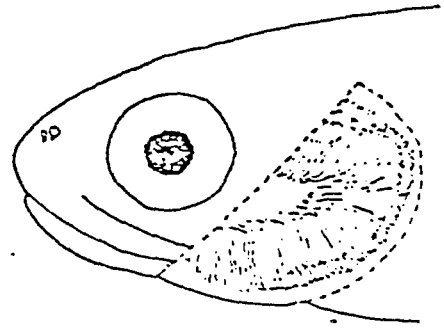

Figure 3.—Head of salmon. Dotted lines indicate that portion of gill cover which has been removed to show first gill arch in place.

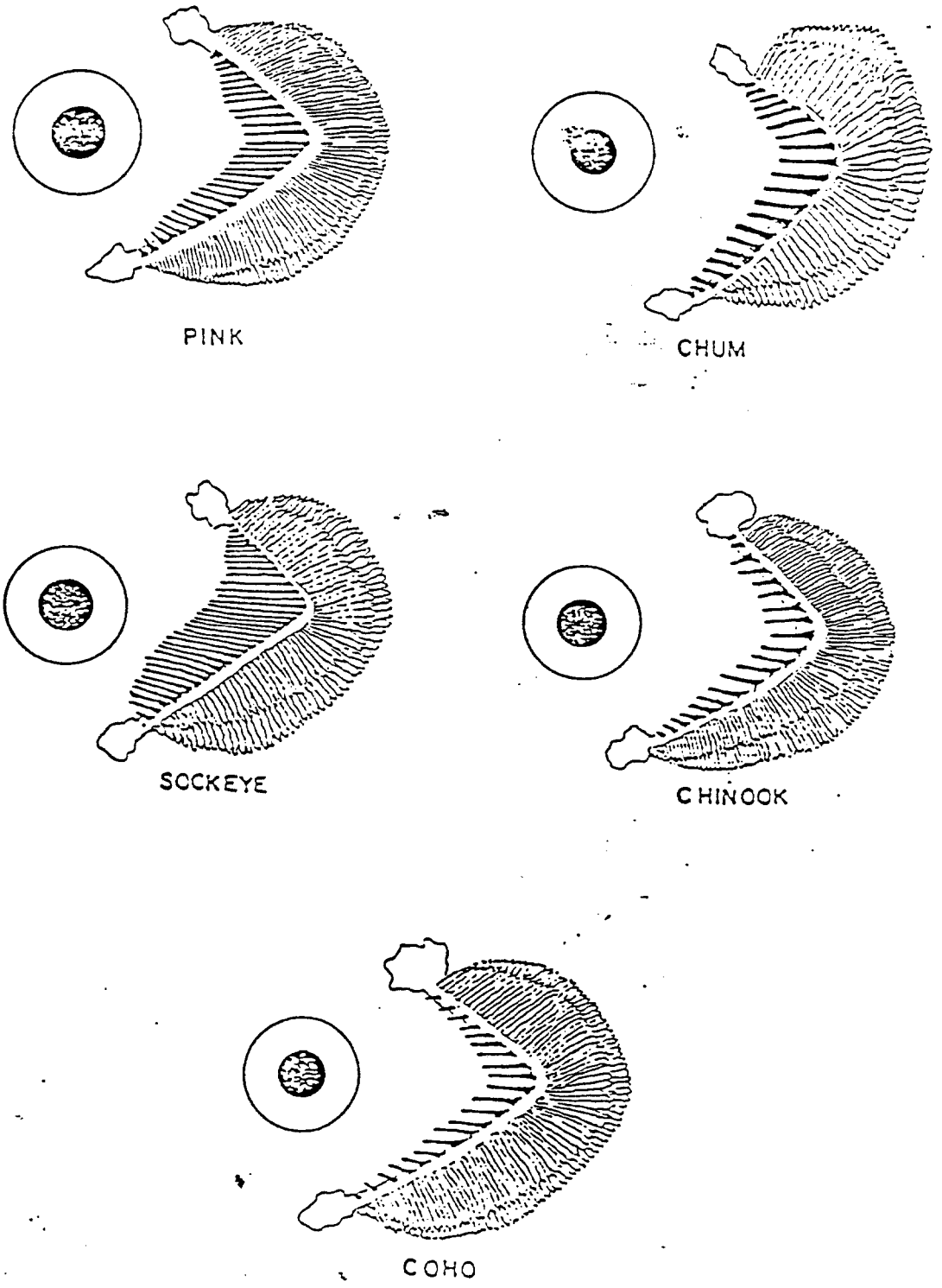

Figure 4.—First gill arch and eye for comparison with longest gill raker length of five species of Pacific salmon.

toward the opposite edge. Because the raker is shorter than the eye length in juvenile salmon, it is simplest to note where the raker reaches in relation to the pupil. Like many body part ratios, the gill raker-eye size ratios change as the juvenile salmon increases in length. For example, in specimens about 40 mm FL, the longest raker may be contained about 3 times the eye length, but in 140 mm specimens of the same species, the raker may be contained only about 2 times. This and other proportional changes must be considered.

Anal Fin Measurement and Count

To compare the length of the fin base with the longest ray, measure the anal fin base with dividers; then project the posterior leg of the dividers forward to the opposite tip of the longest ray as shown in Figure 5 by dotted line.

In counting the number of rays (Fig. 5), do not count those anteriormost ones which are less than half the length of the longest rays, such as those marked "0." Count all rays, such as No. 1, that are half (or more than half) the length of the longest ray, taking great care to observe the last ray—No. 15 in Figure 5. The last ray is usually split to its base and appears superficially as two rays, but it is in reality only one and should be counted as such.

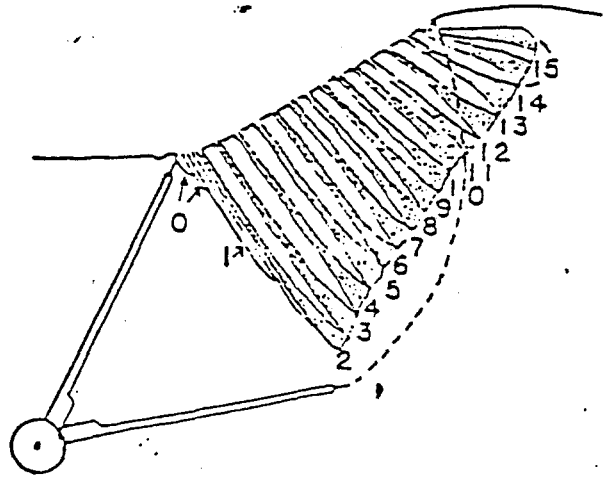

Figure 5.—Anal fin of salmon, illustrating method of measuring length of fin base and of counting rays (rays 2 to 15 are stippled here for emphasis).

Branchiostegal Count

All branchiostegals (Fig. 6), including the smallest, anteriormost ones are counted. Usually this may be accomplished satisfactorily only under magnification, and with juveniles longer than 40 mm FL. The branchiostegal count is used primarily as an additional character in specimens otherwise difficult to identify, and is especially valuable in separating the chinook salmon (usually 15 or 16) from the coho salmon (usually 13 or 14).

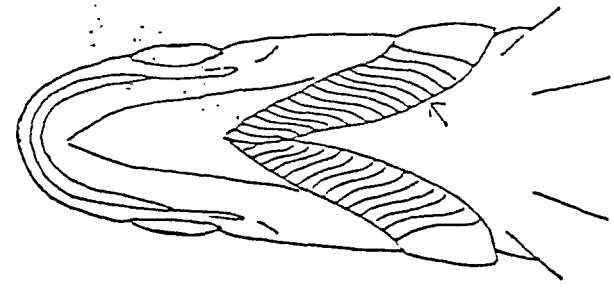

Figure 6.—Ventral surface of head of salmon. Arrow points to one of 14 branchiostegals on left side of head.

Pyloric Caeca Count*

With a scalpel, widely open the abdominal cavity. Sever the esophagus as far forward as possible; then cut off the intestine near the posterior end of the stomach. The stomach and caeca can now be removed as a unit (Fig. 7). Use magnification and teasing needle as aids in counting. Counts of pyloric caeca are useful chiefly as an additional character for questionable specimens, especially in separating the chinook salmon (more than 100 caeca) from the coho salmon (fewer than 90).

Color Pattern Variations

Juvenile salmon from certain waters or at certain stages of development may have their parr marks or other markings masked by a bluish-

*In the key, I have used pyloric caeca counts of my own, plus published accounts of others and especially the more recent ones, such as Clemens and Wilby (1961) and McPhail and Lindsey (1970).

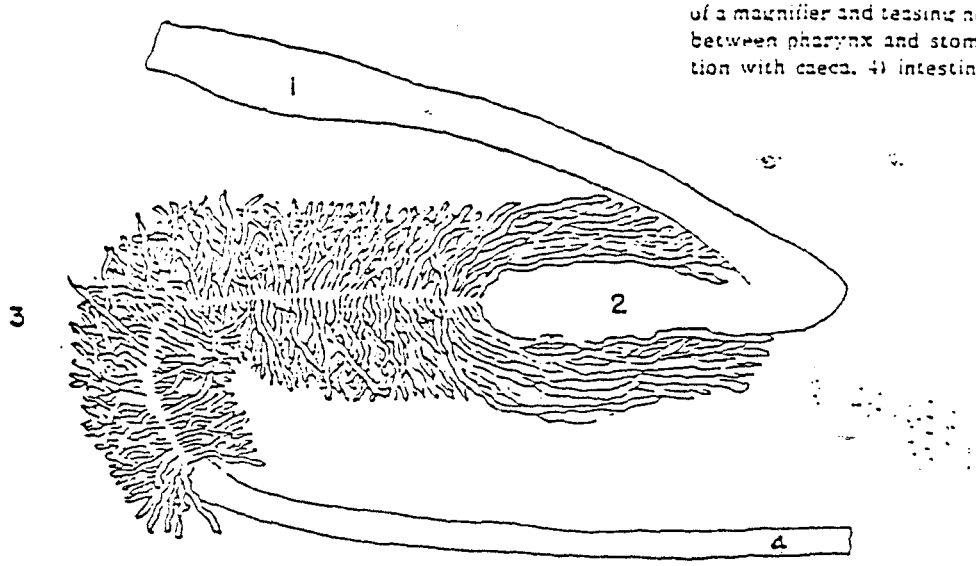

Figure 7.—Major portion of alimentary tract of salmon with pyloric caeca spread apart preparatory to counting with aid of a magnifier and teasing needle: 1) esophagus (part of tract between pharynx and stomach), 2) stomach, 3) pyloric section with caeca, 4) intestine.

or greenish-silvery sheen, especially when they are alive. To identify these fish, it may be necessary to preserve them first in Formalin to intensify their markings.

Juveniles of one species from certain waters, such as habitually turbid ones, may have their melanophores restricted in size or distribution, thereby resembling superficially another species. As an example, coho salmon normally have the adipose and anal fins densely speckled with rather large melanophores. But in some specimens, the melanophores may be reduced in size or distribution, so that coho salmon superficially resemble chinook salmon. Conversely, juvenile chinook salmon may have the melanophores unusually numerous and well developed, thereby resembling coho salmon. To avoid error in identification, compare the size and number of melanophores on the fins with those on the body; if few and small on the body, they should be few and small on the fins.

Color variations also occur regionally. An example is the predorsal stripe in chinook salmon, which in fish from some waters is normally a solid dark bar in specimens less than 80 mm FL; in chinook salmon in other waters the stripe may be reduced to a series of oblong blotches.

The length when individuals attain smolt coloration varies greatly, both regionally and in specimens from the same locality; some fish of the same species may lose parr and other presmolt markings when only half as large as other fish.

HOW TO USE KEY

Because of the variations in morphology and coloring, it is advisable to use the key in conjunction with the figures and plates and to check a large combination of characters.

In using the key, first make certain your specimen is a Pacific salmon by examining the characters under the two opposable groups labeled "1." Next, note the absence or presence of parr marks (see sections *"Combination of"* under opposable groups 2). If no parr marks are present and your specimen has not entered the silvery smolt stage, it is probably a pink salmon, but to make sure, compare it with the identifying characters between opposable groups 2. If parr marks are present, note the absence or presence of melanophores on adipose and anal fins (see groups 3). If melanophores are absent, see sections *"Combination of"* under groups 4; if present, see *"Combination of"* sections under groups 5. Decide which *"Combination of"* most closely fits your specimen, then verify it by comparing the descriptions of the identifying characters for the opposable groups.

KEY TO PRESMOLT JUVENILE SALMON

Salmonoid fishes having fewer than 20 rays in the dorsal fin (excludes grayling); strong teeth on jaws and tongue (excludes ciscoes and whitefishes); many pyloric caeca (excludes smelts, family Osmeridae); an axillary process or scaly appendage above pelvic fin (Fig. 1, No. 14); an adipose fin; cycloid scales; upper jaw formed by both premaxillary and maxillary ..... 1.

1a Base of anal fin *shorter* than longest ray (Fig. 5). Anal rays usually 9 to 12 (rarely 8 or 13). Gill rakers normally fewer than 20 on first gill arch (Fig. 3). Dorsal fin of larger juveniles of some species with several blackish spots.
CHAR, TROUTS, ATLANTIC SALMON ..... Not in this key.

1b Base of anal fin *longer* than longest ray (Fig. 5). Anal rays usually 13 to 17 (rarely 12, 18, or 19). Gill rakers normally 20 to 40 on first gill arch (rarely 19). Dorsal fin of larger juveniles lack blackish spots but tip of fin may be blackish.
PACIFIC SALMON—genus *Oncorhynchus* ..... 2.

2a *Combination of: No* parr marks on sides and *no* prominent specklings on back of presmolt juveniles. Usually no melanophores on anal and adipose fins; if melanophores present, they are few and very small, and if on adipose, are restricted to its posterior, free edge.
PINK (HUMPBACK) SALMON—*O. gorbuscha* ..... Plate 1.

General development—Similar to chum salmon in that yolk sac may not disappear until juvenile is more than 34 mm FL, after which development toward smolt shape and coloration is rapid. When less than 50 mm FL, this species is similar to chum salmon in being more terete than the sockeye, chinook, and coho salmon; body depth immediately before dorsal fin usually more than 1.5 times head length.

Parr marks—Only species of salmon lacking parr marks in the presmolt juvenile.

Coloration of body—*Preserved material*—In juveniles less than 40 mm FL, back is dark to lateral line and ventral half of body light when bicolored; dorsal third of body is darkest, sides lighter, ventral third lightest (usually milky-white or silvery) when tricolored. Few or no melanophores on lower sides and belly. In juveniles more than 40 mm FL, bicolored or tricolored condition is normally not evident, the dark back lightening gradually downward to the very light belly. *Living specimens*—Dorsal half of body bright bluish or greenish with much silvery reflection; ventral half milky or silvery-white.

Fins—Anal and dorsal fins averaging smaller than in chum salmon; these fins in this species and in chum salmon distinctly smaller than in sockeye, chinook, or coho salmon. In specimens less than 40 mm FL the longest anal ray, when measured into head length, extends from tip of snout to about center of eye; in larger presmolt juveniles, this measurement extends from tip of snout to anterior half of eye. Anal rays usually 14 to 16 (extremes 13 to 17). *Dorsal fin* has few specklings and only a slight tendency toward a dark anterior edge in juveniles less than 50 mm FL; over 50 mm, blackish anterior edge becomes pronounced and tip of fin dusky. *Caudal fin* has speckling confined to basal half in juveniles less than 50 mm; with increasing length of juveniles, specklings appear along rays, and in large presmolt juveniles lobes tend to become blackish.

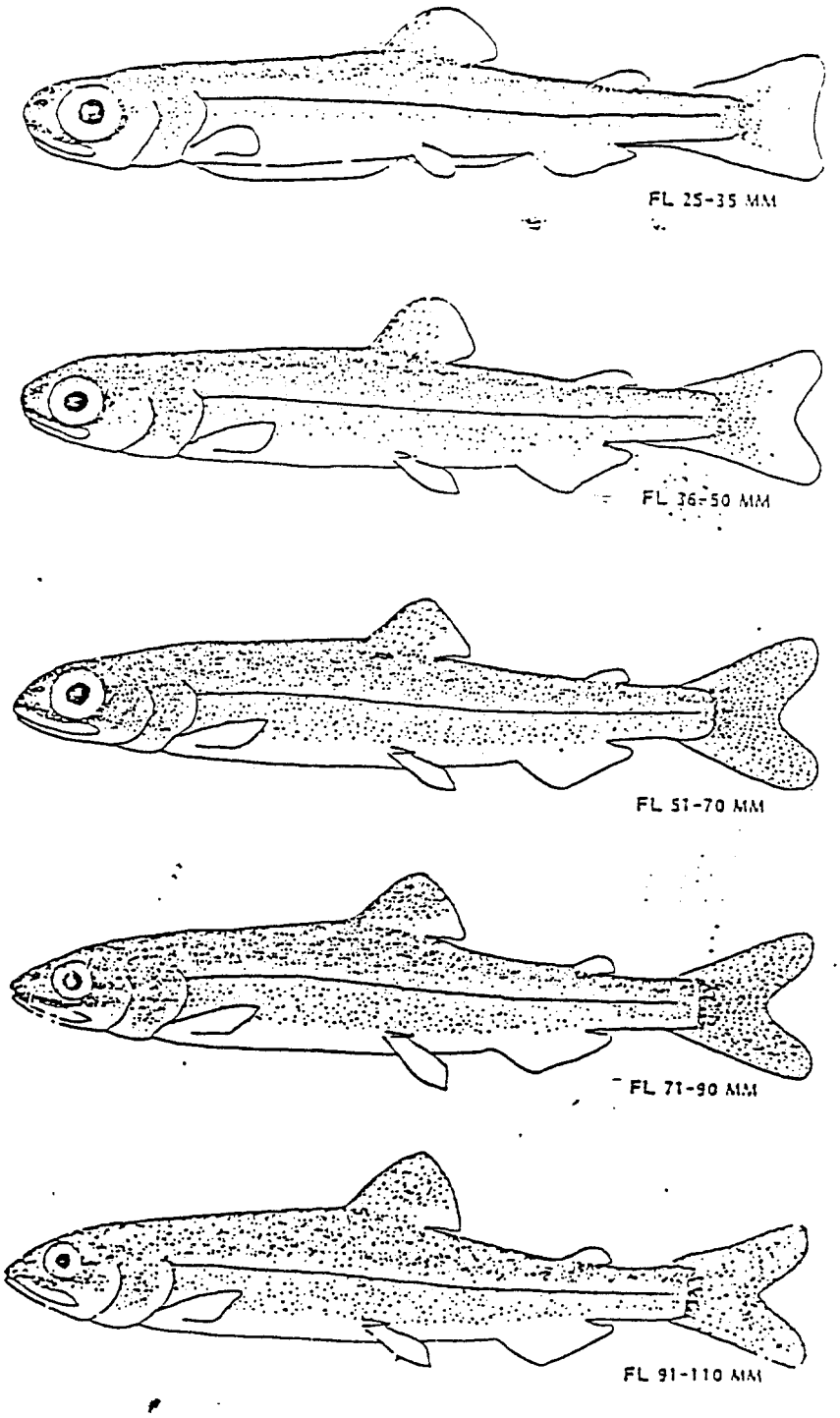

Plate 1.—Pink salmon.

Gill rakers (see Fig. 4)—Eleven to fourteen on upper limb, 14 to 19 on lower, total usually ranging between 27 and 33 (extremes 25 and 35); rakers slender and rather long; most similar in size and number to sockeye salmon but shorter and usually fewer (normally less than 31).

Pyloric caeca—Usually 130 to 195 (extremes 95 to 224); slender and rather long; differ sufficiently in numbers from coho and sockeye salmon, which have fewer than 100, to be a distinct aid in specific identification.

Branchiostegal rays—Usually 11 to 14 (rarely 10 or 15); average number less than in other species, almost invariably less than in chinook salmon, which usually has 15 to 18 (rarely 14).

Scales in lateral line—More than 170, more than in any other of the Pacific salmon; lateral line scale counts may be obtained under magnification in specimens longer than 60 mm FL.

Habits—Shortest life span of any species, between 18 mo and 2 yr. Only a comparatively small proportion of adults make extended migration in fresh water. Majority spawn in fresh waters within a short distance of brackish water or in intertidal waters. Many young enter brackish or salt waters within a few hours or days after emerging from redds, and comparatively few are found in fresh water when more than 45 mm FL.

Combination of: Both parr marks on sides and dark spottings on back usually obvious in living, presmolt juveniles and always in preserved specimens under magnification (may be faint in fishes from turbid waters); parr marks become faint and disappear as juvenile assumes smolt coloration ..... 3.

2b

No melanophores normally present on adipose and anal fins of presmolt juveniles, or if present, few and quite small. Parr marks occupy a larger area above lateral line than below it, and in some specimens anterior parr marks may be almost entirely above the lateral line.

3a

CHUM AND SOCKEYE SALMON ..... 4.

Melanophores normally obvious on adipose fin in living specimens and always in preserved specimens under magnification (may be indistinct in juveniles from silty waters). Anteriormost parr marks appear to occupy as large (or almost as large) an area below lateral line as above it; these parr marks are usually large, long, and wide.

3b

CHINOOK AND COHO SALMON ..... 5.

Combination of: Gill rakers 19 to 26 (average 23), notably fewer and much shorter than in sockeye salmon, which have more than 28. Normally *no* melanophores on adipose and anal fins. Anterior squarish (quadrate) parr marks situated almost or entirely above lateral line in specimens less than 50 mm FL; in presmolt juveniles more than 50 mm FL, anterior parr marks tend to be long and very narrow and sometimes may extend well below lateral line.

4a

CHUM (DOG) SALMON—*O. keta* ..... Plate 2.

General development—Similar to pink salmon in that yolk sac may not disappear until juvenile is more than 34 mm FL, after which development toward smolt shape is rapid. Also similar to pink salmon in being more terete (when less than 50 mm FL) than the sockeye, chinook, and coho salmon; body depth immediately before dorsal fin usually 1.5 to 1.8 times head length.

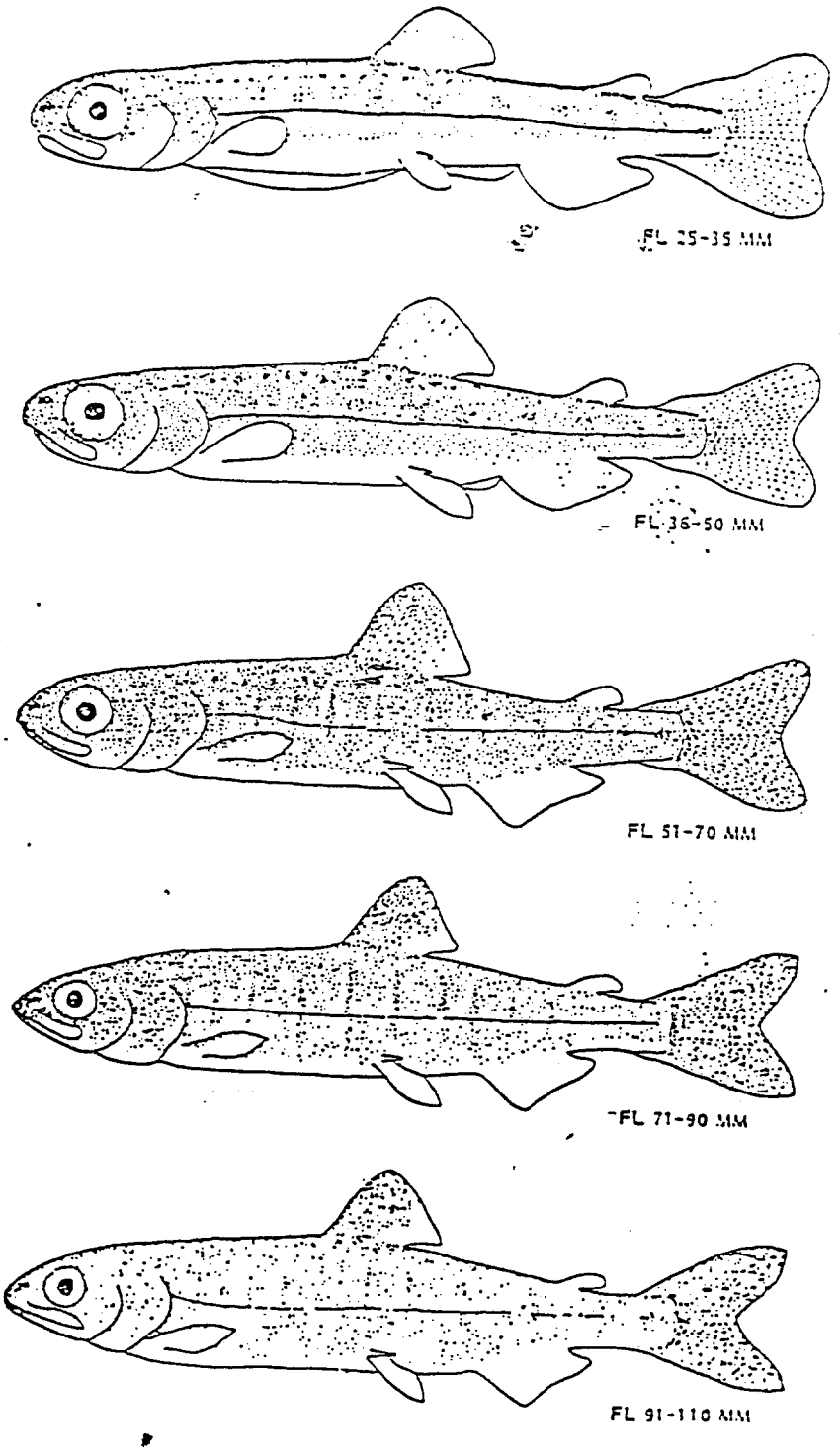

Plate 2.—Chum salmon.

Parr marks—Anterior parr marks in specimens less than 50 mm FL are more squarish (quadrate) and do not extend quite so far below lateral line as in sockeye salmon; in presmolt juveniles more than 50 mm FL, parr marks tend to become longer and more narrow than in sockeye salmon, and some tend to extend well below lateral line.

Coloration of body—*Preserved material*—Dorsal ridge stripe usually present, sometimes a series of blotches in juveniles less than 50 mm FL, becoming faint or disappearing in presmolt juveniles more than 50 mm FL; a prominent irregular row of spots and blotchings between dorsal ridge and upper edge of parr marks, these usually most distinct in specimens between 34 and 50 mm, often fading or disappearing in larger juveniles. *Living specimens*—Markings may be obscured by greenish or bluish overcast of dorsal half of body and whitish or silverish sheen of ventral half.

Fins—Anal and dorsal fins small, averaging slightly larger in size than those of pink salmon and averaging considerably smaller in height and area than those of sockeye salmon. Length of longest anal ray, when measured from snout to eye, reaches to, or almost to, center of eye; in sockeye salmon this measurement usually extends well beyond center of eye. Anal rays usually 13 or 14 (extremes 13 to 17). *Dorsal fin* has few or no distinct spottings in specimens less than 50 mm FL; in larger presmolt juveniles a dusky spot develops on tip. *Caudal fin* has faint spots largely confined to basal half in juveniles less than 50 mm FL; in larger juveniles lobes become blackish.

Gill rakers (see Fig. 4)—Seven to twelve on upper limb, 12 to 19 on lower, total usually ranging between 20 and 26 (extremes 19 to 30); rakers blunt and short, in sharp contrast to thinner, longer, and more numerous rakers of sockeye salmon, which has 30 to 39.

Pyloric caeca—Usually 160 to 185 (extremes 140 to 249); differ sufficiently in numbers from sockeye and coho salmon, which usually have fewer than 100, to be an aid in specific identification.

Branchiostegal rays—Usually 13 or 14 (extremes 12 to 16); of value primarily in separating this species from chinook salmon, which generally has more than 15.

Scales in lateral line—Between 125 and 155; of value chiefly in separating this species from pink salmon.

Habits—Life span usually 3 to 5 yr, for majority, 4 yr, some less than 3 yr. Jacks may occur. Majority spawn in fresh waters only a comparatively short distance from brackish water or in intertidal waters. Many young enter brackish or salt waters very shortly after emerging from redd, and few juveniles are found in fresh waters when more than 45 mm FL.

Combination of: Gill rakers 30 to 39 (average 36); notably more numerous, longer, and more slender than in chum salmon, which have fewer than 27. Normally *no* melanophores on adipose and anal fins. Anterior parr marks more rectangular
4b than squarish in outline in specimens less than 45 mm FL and sometimes extend as much as a third to a half below lateral line; these oblong parr marks tend to shorten in presmolt juveniles more than 50 mm FL and to be mostly above lateral line.

SOCKEYE (RED) SALMON—*O. nerka*. . . . . Plate 3.

General development—Yolk sac usually disappears, except for trace, before juveniles reach 30 mm FL. Body deeper and species more slab-sided in all presmolt lengths than in chum and pink salmons—body depth immediately before dorsal fin usually less than 1.5 times head length.

Parr marks—See "*Combination of*" above.

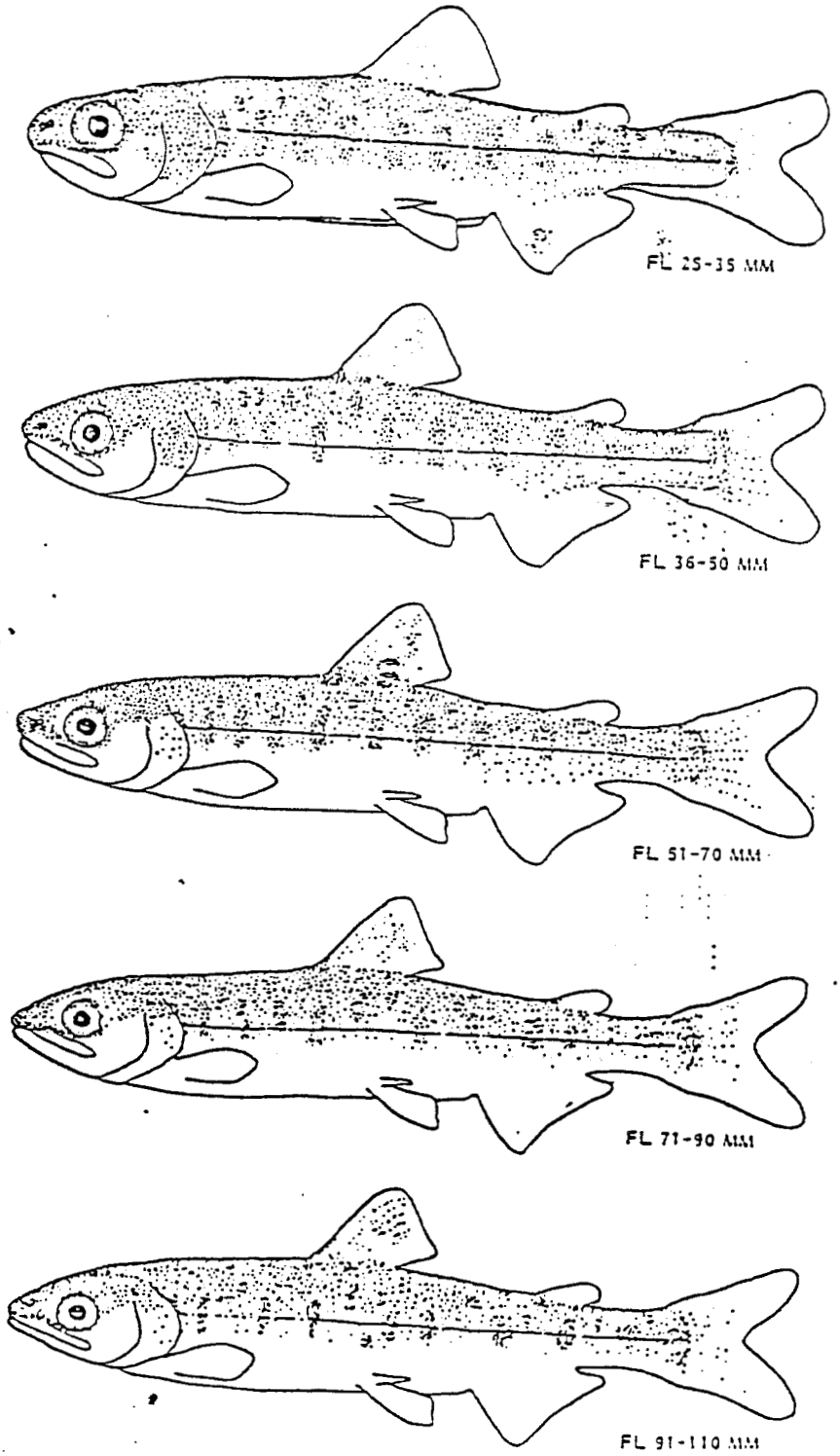

Plate 3.—Sockeye salmon.

Coloration of body—*Preserved material*—Dorsal ridge usually contains a series of more or less distinct spots in specimens less than 35 mm FL, becoming more confluent in fishes between 40 and 55 mm FL and sometimes merging into a dusky bar; in presmolt juveniles over 60 mm FL, spots or bars may disappear after which a series of roundish spots become apparent on both sides of, and adjacent to, dorsal ridge, especially that portion behind dorsal fin; in addition to these spots, in fishes more than 35 mm FL, another longitudinal row of spots develops between dorsal ridge and upper halves of parr marks. *Living specimens*—Markings may be obscured by greenish or bluish overcast of dorsal half of body and whitish or silverish sheen of ventral half.

Fins—Anal and dorsal fins average larger in height and area than in chum and pink salmon. Length of longest anal ray, when measured from snout to eye, reaches usually from snout to beyond center of eye. Anal rays usually 14 to 16 (extremes 13 to 16). *Dorsal fin* normally has few or no distinct specklings in specimens less than 60 mm FL; a rather faint dorsal spot develops in larger presmolt juveniles in upper portion of fin, the fin being bordered on its free edges with whitish (see lowest figure, Plate 3). *Caudal fin* has few specklings on basal half, the lobes having few or no melanophores, even in rather large juveniles.

Gill rakers (see Fig. 4)—Twelve to sixteen on upper limb, 18 to 23 on lower, total usually ranging between 32 and 37 (extremes 30 to 39); rakers long and slender, averaging longer than in any other species, in sharp contrast to fewer, blunter rakers of chum salmon, which has 19 to 30.

Pyloric caeca—Usually 65 to 95 (extremes 45 to 115); usually considerably fewer than in pink, chum, and chinook salmon, and averaging more than in coho salmon.

Branchiostegal rays—Usually 13 to 15 (extremes 11 to 16); of value chiefly in separating this species from chinook salmon, which average more.

Scales in lateral line—Between 125 and 140; of value chiefly in separating this species from pink salmon, which has a higher number.

Habits—Life span usually 4 or 5 yr, some only 3. Jacks may occur. Majority of individuals highly migratory. Adults usually spawn in streams tributary to lakes; a small minority spawn in streams without a lake, in lake outlets, or on lake beaches. After rising from redd, young move downstream rather rapidly to a lake, remaining usually 1, sometimes 2, and rarely 3 yr in fresh water before entering brackish or salt water.

Combination of: Melanophores on adipose fin usually most numerous on posterior half and generally forming a dark border (see Plate 4); anterior half of adipose with few melanophores or none. Anal fin with few melanophores or none, but when
5a melanophores are present, often quite large. Tip of dorsal fin and lobes of caudal fin darker in larger presmolt juveniles.

CHINOOK (KING) SALMON—*O. tshawytscha*. . . . . Plate 4.

General development—Yolk sac usually disappears or is reduced to a trace before juveniles reach 32 mm FL. Body deeper and species more slab-sided in all presmolt lengths than in chum and pink salmon; body depth immediately before dorsal fin usually less than 1.5 times head length (range 1.1 to 1.5).

Parr marks—Almost invariably rectangular and long vertically; marks usually situated equidistant on each side of lateral line; dark parr marks and other markings contrast sharply with lighter background of body in some living and most preserved specimens.

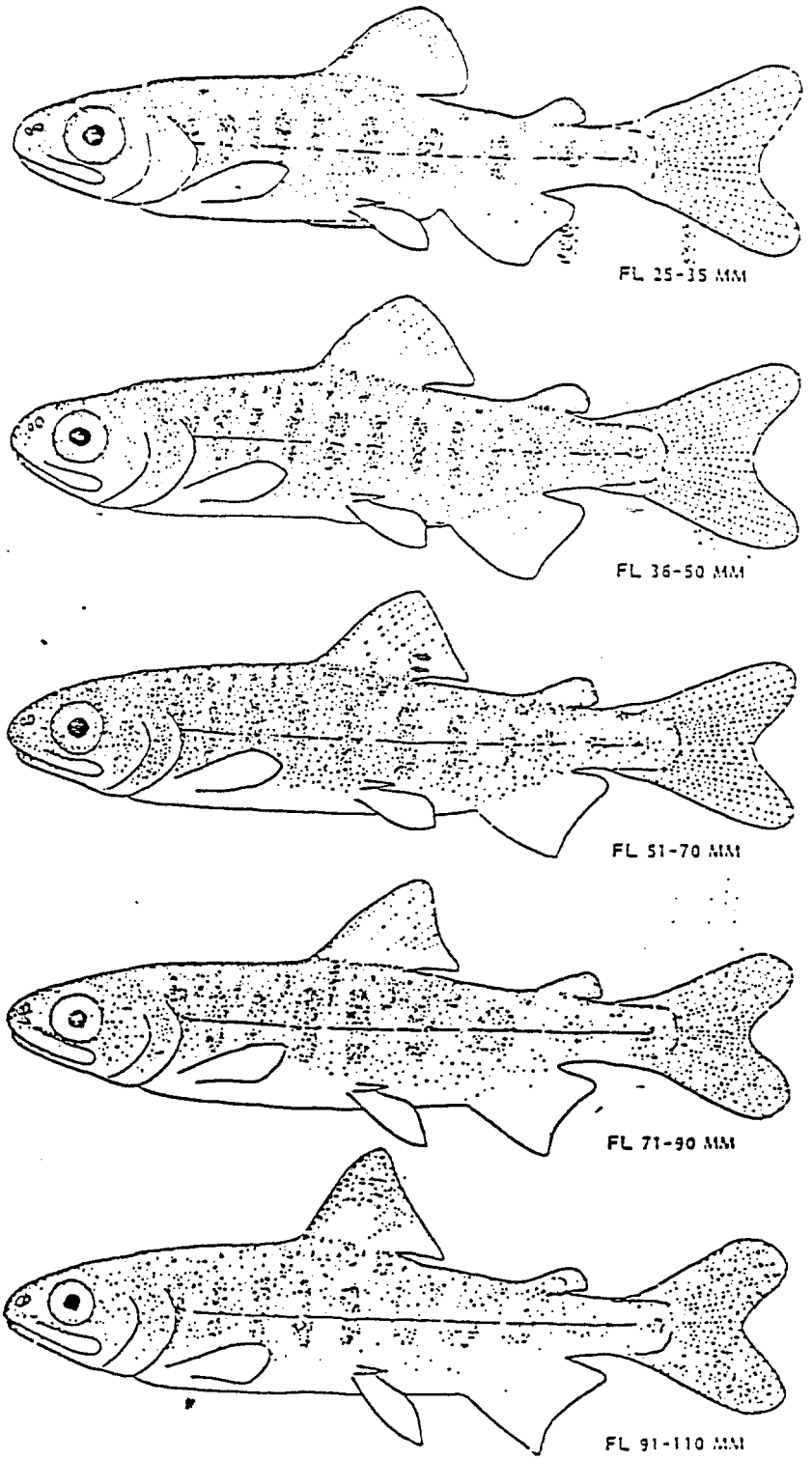

Plate 4.—Chinook salmon.

Coloration of body—*Preserved material*—Background color of body generally much lighter than body color of coho salmon, usually contrasting sharply with dark dorsal stripe or spotting, parr marks, and prominent dorsal spottings; blackish band astride dorsal ridge usually bold and unbroken in specimens less than 80 mm FL and especially on ridge before dorsal fin; in larger juveniles dorsal band often breaks up into series of spots, disappearing in larger presmolts as other spottings on dorsal half of body become more numerous and distinct; spottings between dorsal ridge and parr marks absent in fishes less than 35 mm FL, developing rapidly thereafter into many large and small spots and increasing in numbers as juveniles approach smolt stage. *Living specimens*—Parr marks and other markings may be obscured by bluish-silvery color of dorsal half of body and silvery sheen of ventral half.

Fins—Anal and dorsal fins averaging considerably larger in area than those of the chum and pink salmon and slightly larger than in the sockeye salmon; length of longest anal rays, when measured into head length, reaching from snout tip to beyond posterior edge of pupil and sometimes beyond posterior edge of eye; distal edge of anal slightly falcate in specimens more than 40 mm FL but averaging less falcate than does the free edge of the anal of the coho salmon. Anal rays 15 to 19, averaging higher in number than in any other species. *Dorsal fin* in young less than 60 mm FL usually has few or no distinct spottings, a blackish spot developing in the upper portion of the fin as the juveniles approach the smolt stage (see Plate 4). *Caudal fin* has comparatively few melanophores rather generally distributed in the smaller individuals, the lobes darkening as the fishes approach the presmolt stage.

Gill rakers (see Fig. 4)—Seven to twelve on upper limb, 10 to 16 on lower, total usually ranging between 20 and 23 (extremes 19 to 28); rakers short and similar in size and number to chum and coho salmon.

Pyloric caeca—Usually 140 to 185 (extremes 90 to 240); of value in separating this species from coho salmon, which normally has fewer than 85.

Branchiostegal rays—Usually 16 to 18 (extremes 13 to 19); average number greater than in any other species.

Scales in lateral line—Between 132 and 152; usually of most value in separating this species from pink salmon.

Habits—Life span 2 to 8 yr, usually 4 to 6. Jacks may occur. A portion of the juveniles enter salt water during first year of life; remainder stay in fresh waters more than 1 yr but rarely 2 yr. Juveniles of presmolt stage found in fresh waters when as long as 150 mm FL.

Combination of: Melanophores usually numerous and rather evenly distributed on adipose fin; occasionally in larger juveniles, posterior or free edge may be darker than remainder, thereby resembling somewhat melanophore distribution on adipose of chinook salmon. Anal fin in specimens larger than 30 mm FL more falcate and anterior tip more pronounced than in other species, including chinook salmon; in all except smallest specimens, anterior or leading edge of anal fin is whitish, with a dark bar parallel and posterior to it; remaining, posterior portion of fin usually abundantly speckled with melanophores except for distal and posterior edges (see Plate 5).

COHO (SILVER) SALMON—*O. kisutch*. . . . . Plate 5.

General development—Yolk sac usually disappears, except for a trace, before juveniles reach 32 mm FL. Body deeper and species more slab-sided in all pre-

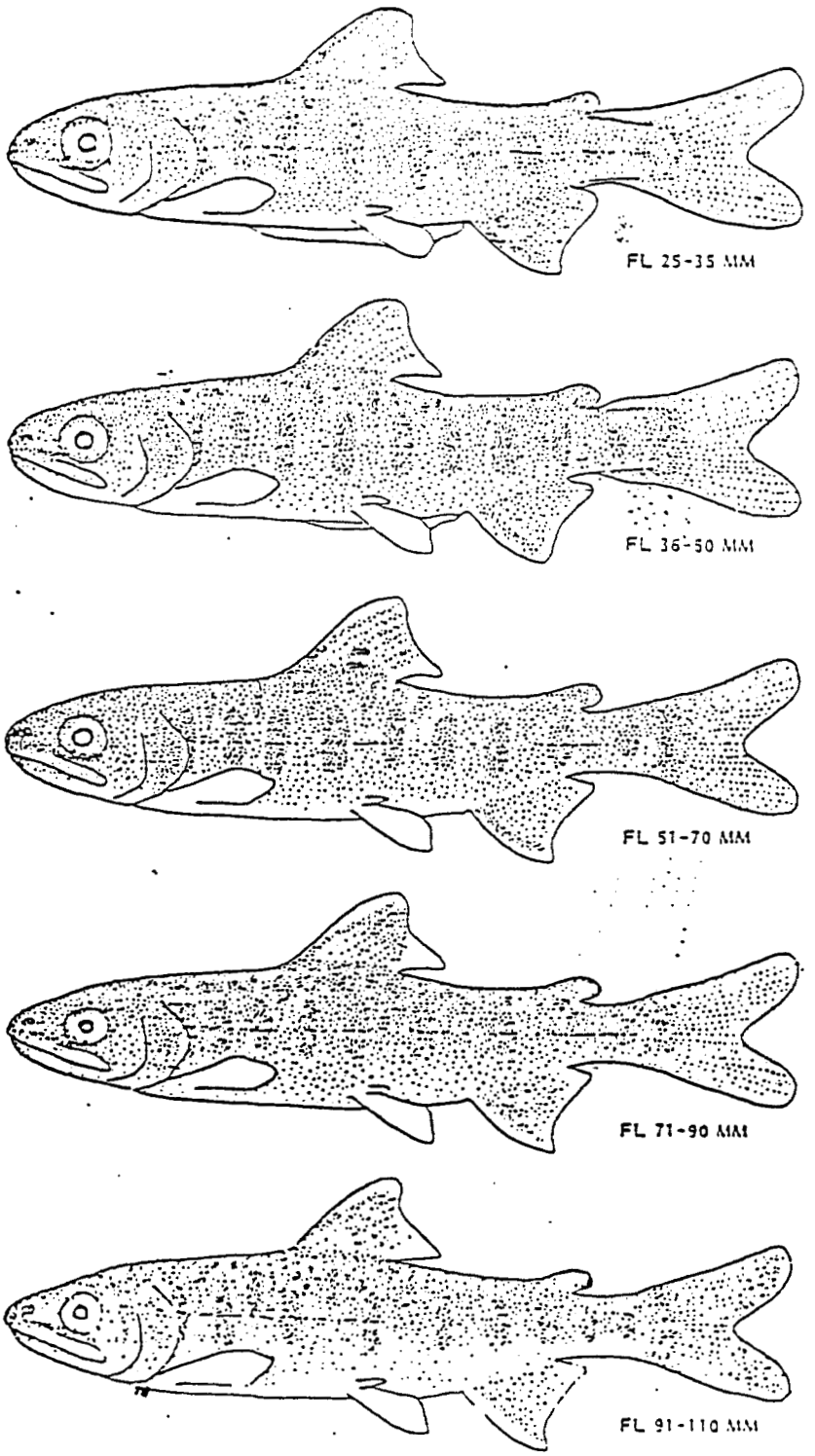

Plate 5.—Coho salmon.

smolt lengths than in chum and pink salmon; body depth immediately before dorsal fin usually less than 1.5 times head length (range 0.0 to 1.5).

Parr marks—Anterior parr marks always large and long vertically, their upper and lower ends more rounded than rectangular-shaped parr marks of chinook salmon; marks usually situated equidistant on each side of lateral line; usually less contrast between color of parr marks and body than in chinook salmon.

Coloration of body—*Preserved material*—In all but smallest specimens, contrast between all body marks and background color of body is not as pronounced as in other species; dark bar along dorsal ridge usually distinct and unbroken in juveniles less than 50 mm FL, breaking up into spots or disappearing in larger specimens; back spottings on both sides of dorsal ridge usually prominent in all except smallest specimens; spots between parr marks often elongate and extending downward between them, sometimes to lateral line (see bottom figure, Plate 5); spots on dorsal half of body often increase in number and/or decrease in size as individuals approach smolt stage. *Living specimens*—Parr marks and other body markings may be obscured by dark coloration of body or by bluish sheen.

Fins—Anal and adipose fins described under "*Combination of*" (this section). Anal rays usually 13 or 14 (extremes 13 to 16). *Dorsal fin* has comparatively few melanophores scattered over it in smallest specimens; in those more than 32 mm FL the number of melanophores increases, especially on or adjacent to anterior or leading edge; this results in a dark bar along the anterior edge behind which melanophores are rather evenly distributed; as fishes approach presmolt stage, a white anterior (or leading) edge and a whitish tip develops, followed by a dark parallel bar (see bottom figure, Plate 5). *Caudal fin* has rather even distribution of melanophores along rays in all except smallest young, this increasing in color intensity and number as fish increases in size.

Gill rakers (see Fig. 4)—Eight to thirteen on upper limb, 9 to 14 on lower, total number usually ranging between 19 and 27 (extremes 18 to 27); rakers short and rather similar in size and number to chum and chinook salmon.

Pyloric caeca—Usually 50 to 85 (extremes 45 to 114); of value in separating this species from chinook, pink, and chum salmon, which normally have more than 100.

Branchiostegal rays—Usually 13 or 14 (extremes 12 to 15); average number less than in chinook salmon, which normally has 15 or more.

Scales in lateral line—Between 120 and 140 (average 128); usually averaging fewer than in any other species.

Habits—Life span 2 to 4 yr. Jacks may occur. Majority appear to spend 1 or 2 yr in fresh waters, a few 3 yr. Some juveniles in presmolt stage are found in fresh waters when 150 mm FL.

GLOSSARY

Adipose fin A fleshy, finlike, rayless structure situated on dorsal ridge between dorsal and caudal fins (Fig. 1, No. 6).

Anal fin The fin situated medially and immediately behind vent between posterior end of abdomen and anterior end of caudal peduncle (Fig. 1, No. 16).

Axillary process or scale An accessory enlarged scale attached to upper or anterior base of pelvic fin (Fig. 1, No. 14).

Gill opening Opening between opercle or gill cover and side of head.

Branchiostegals or branchiostegal rays Elongated bones arranged fanwise within branchiostegal membranes, situated on ventral edge of gill covers (Fig. 6).

Caudal fin Terminal or tail fin of fishes (Fig. 1, No. 12).

Caudal peduncle That region of body between base of posterior ray of anal fin and base of caudal fin (Fig. 1, No. 11).

Chromatophores Color cells which under control of sympathetic nervous system can be altered in shape, producing color changes.

Cycloid scales Smooth-edged scales of soft-rayed fishes having an evenly curved posterior border devoid of minute spines.

Dorsal fin In salmons, a single fin composed of rays situated dorsally on body approximately halfway between head and tail (Fig. 1, No. 4).

Dorsal ridge Apex or dorsal junction of left and right sides of body; dorsal and adipose fins are situated on this ridge (Fig. 1, No. 3-6).

Dorsal stripe A band on dorsal ridge which is lighter or darker than adjacent areas.

Falcate Curved like a sickle; a fin is falcate when its distal edge is concave, having middle rays shorter than anterior and usually posterior rays.

Filaments See *gill filaments.*

Fork length Distance in a straight line from anteriormost part of tip of upper jaw or snout of juvenile salmons to apex of angle produced by two lobes of caudal fin (Fig. 1, No. 1).

Gill arch Branchial skeleton which contains gill rakers and gill filaments, or lamellae (Fig. 2).

Gill cover, opercle, or operculum Large, very flat, thin bones on each side of head which cover gills (see Fig. 3, which has the major portion of the gill cover removed).

Gill filaments (lamellae) Pleated folds of skin, richly supplied with blood vessels, attached to posterior edge of gill arch (Fig. 2, No. 5).

Gill rakers Projections on anterior edge of first gill arch (Fig. 2, No. 1).

Head length Distance in a straight line from anteriormost part of upper jaw or snout to posterior margin of opercle (Fig. 1, No. 2).

Hypural Complex of expanded and fused bone of last few vertebrae which support caudal fins in certain fishes.

Jack Precocious male salmon which spawn after spending a year or two less in the ocean than the majority of individuals; they are notably smaller than average size of spawning males of their species.

Juvenile As used here, a salmon between 25 and 110 mm FL which has not entered smolt stage.

Lamellae See *gill filaments.*

Lateral line A line formed by a series of sensory tubes and pores extending along sides from head to tail (Fig. 1, No. 10).

Lateral line scale count A count of pored scales from first scale on body behind head posteriorly to above hypural.

Melanophores Chromatophores with dark or black pigment.

Parr marks Squarish or oblong blotches or pigmented areas along sides of presmolt salmonids (Fig. 1, No. 9).

Pectoral fins Anterior or uppermost of paired fins of fishes, one on each side of breast immediately behind head (Fig. 1, No. 13).

Pelvic fins A ventral pair of fins, abdominal in salmonids (Fig. 1, No. 15).

Postdorsal ridge That portion of dorsal ridge behind dorsal fin (Fig. 1, No. 5).

Predorsal ridge That portion of dorsal ridge before dorsal fin (Fig. 1, No. 3).

Presmolt A juvenile salmon with parr marks; in pink salmon, which lack parr marks, demarcation between a presmolt and smolt is slight, differing chiefly in latter's more adult shape.

Pupil of eye Opening in iris of eye by which light reaches retina. It is circular in fishes (Fig. 1, No. 7).

Pyloric caeca Fingerlike diverticula, usually glandular, which open into alimentary canal

of most fishes at junction of stomach and intestine in region of pylorus (Fig. 7, No. 3).

Rakers See *gill rakers*.

Redd Excavation or nest made by a spawning salmon.

Rudimentary Very small and poorly formed, pertaining here chiefly to smallest gill rakers and anal rays (Fig. 5, "0").

Slab-sided When depth of body, measured before dorsal fin, is considerably greater than width of body.

Smolt As used here, a young salmon which has lost its parr marks. Pink and chum salmon fry usually go to the ocean within a few days of emerging from the streambed and usually do not undergo a visible change in morphology or color in fresh water.

Subadult An individual similar to an adult and approaching adulthood in age and size but still incapable of breeding.

Tercte Nearly cylindrical in cross section and tapering toward the front and rear.

ACKNOWLEDGMENTS

Publications such as this are possible only because of aid given by many individuals. I wish to acknowledge the aid and encouragement given me by Robert J. Ellis, George Y. Harry, Jr., Wilbur L. Hartman, William R. Heard, David T. Hoopes, Theodore R. Merrell, Jr., Jay C. Quast, and William A. Smoker, and to the many field men, students, and others who have tested the key.

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U.S. GOVERNMENT PRINTING OFFICE 1971-[illegible]/13 REGION 13

Key to Field Identification of Anadromous Juvenile Salmonids in the Pacific Northwest

By

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ABSTRACT

A key is presented with descriptive illustrations to help in field identification of live, juvenile salmonids in fresh waters of the Pacific Northwest. Other juvenile fish that may be mistakenly identified as salmonids are included.

INTRODUCTION

Species identification of live, anadromous juvenile salmonids is frequently a problem to the field biologist. The purpose of this key is to list and illustrate the external characteristics which will expedite field identification of juvenile salmonids in the Pacific Northwest.

Five species of Pacific salmon (pink, chum, sockeye, chinook, and coho); four species of trout (cutthroat, brown, Dolly Varden, and rainbow or steelhead); and other juvenile and adult fish [1] that may be mistaken for salmon or trout in fresh water are described in this key.

USE OF KEY

The characteristics for identification are listed in a series of alternative statements, some of which are illustrated. To use the key, examine the first statement; if applicable, proceed to the next and continue to successive statements until the species is identified. If a statement is not applicable, pass to the alternative characteristics indicated by numbers in parentheses (numbers on the drawings correspond to numbers of statements in the key). Continue in this manner until the specimen is identified. Some external characteristics are positive separating features (marked with asterisk), whereas others are not. Therefore, two or more statements should be considered before final rejection. If a precise identification cannot be made using the external characteristics —and the fish can be sacrificed, a positive identification can usually be made from internal features (marked with double asterisks). A bibliography of keys that utilize more descriptive internal characteristics is included in this paper.

[1] Especially adult smelt, family Osmeridae.

KEY

1. (47) Adipose fin and scales present. (Fig. 1)
2. (48) Fleshy appendage at base of pelvic fins present.
3. (49) Mouth large, reaching at least to center of eye.

Family Salmonidae

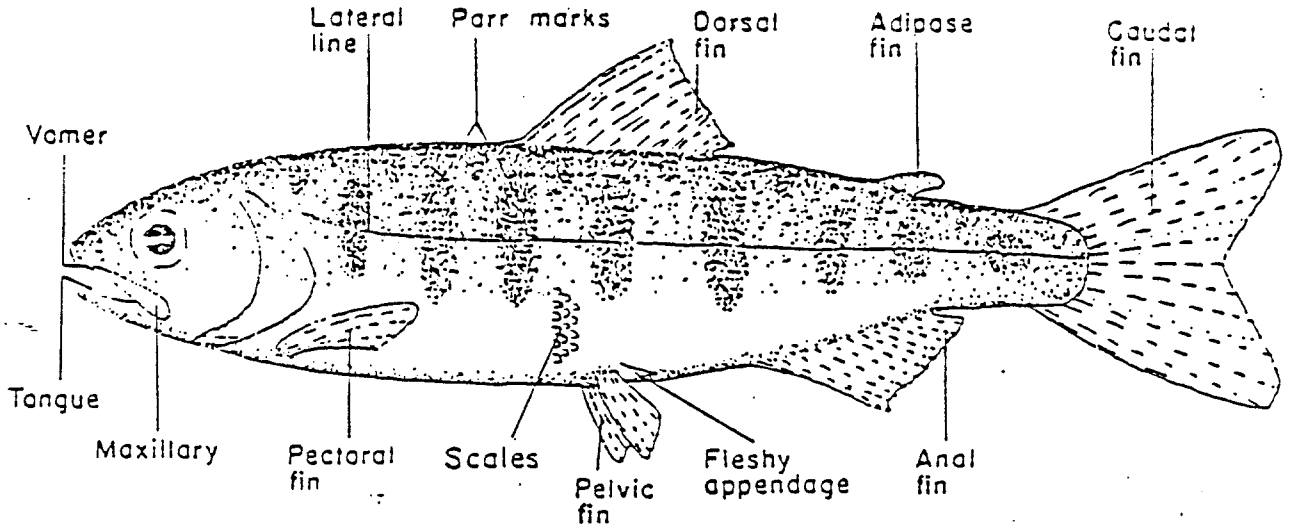


Figure 1.—A hypothetical salmonid showing external characteristics.

4. (17) Anal fin higher than long, with 8 to 12 developed rays (Fig. 2A)
5. (52) *Teeth on head and shaft of vomer. (Fig. 3A)

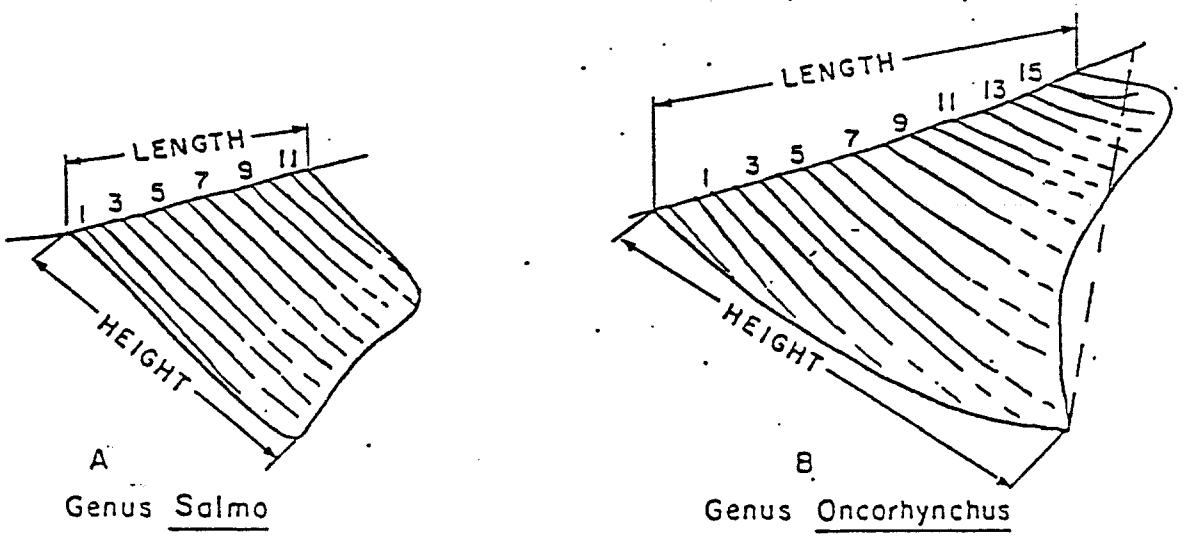


Figure 2.—Anal fins: (A) Trout, genus *Salmo;* (B) Pacific salmon, genus *Oncorhynchus.* The two drawings show differences in structure and fin ray count. (Note that the length of the anal fin is its overall basal length, and its height is that distance from the origin of the fin to the tip of the anterior lobe. In counting fin rays, include only those which originate from the base and terminate at the outer margin of the fin or are half as long as [or greater than] the longest ray.)

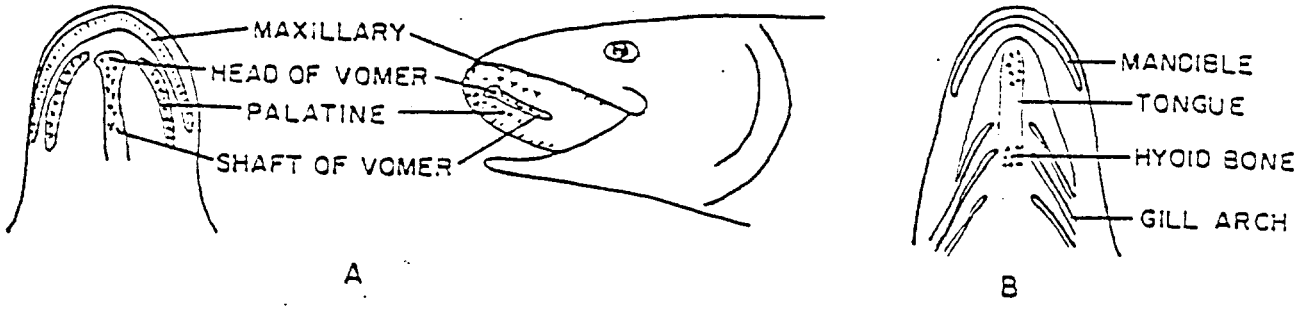
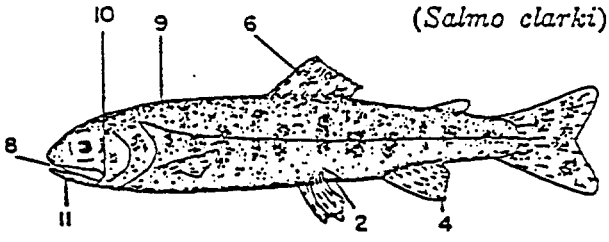


Figure 3.—Location of dentition in (A) the roof and (B) the floor of the mouth of salmonid fishes. (Presence or absence of teeth on the vomer or tongue may be determined by use of the little finger or a blunt instrument. The small hyoid teeth at the base of the tongue are located between the gill arches of the lower jaw and are difficult to find.)

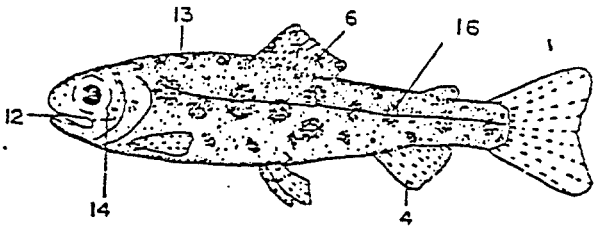
6. (18) Dorsal fin with large dark spots.
Trout
Genus *Salmo*

7. (53) Adipose fin not orange; no row of pale round spots along lateral line.
8. (12) *Small hyoid teeth at base of tongue. (Fig. 3B)
9. (13) Not more than five parr marks on mid-dorsal ahead of dorsal fin.
10. (14) Maxillary reaching past posterior margin of eye.
11. (15) Red or yellowish hyoid mark under lower jaw. Tail usually black spotted.
Cutthroat trout
(*Salmo clarki*)



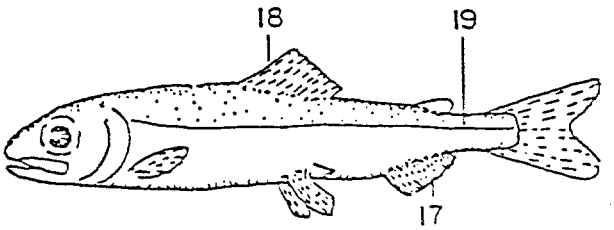
12. (8) *No teeth at base of tongue.
13. (9) Five to 10 parr marks along mid-dorsal ridge ahead of dorsal fin.
14. (10) Maxillary short, not reaching past posterior margin of eye.
15. (11) No hyoid mark under lower jaw. Few or no spots on tail.

16. (20) Parr marks almost round.
Rainbow or steelhead trout
(*Salmo gairdneri*)



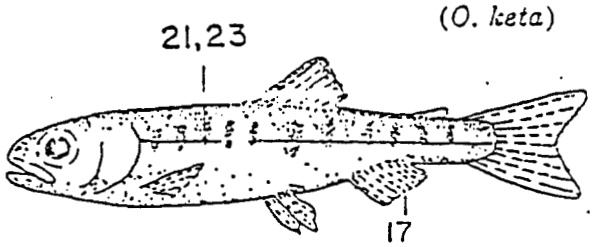
17. (4) Anal fin longer than high, with 13 or more developed rays. (Fig. 2B)
18. (6) Dorsal fin without large dark spots, may be black tipped.
Pacific salmon
Genus *Oncorhynchus*

19. (20) No parr marks. Fry leave fresh water while small—approximately 1.75 inches (45 mm) long.
Pink salmon
(*O. gorbuscha*)



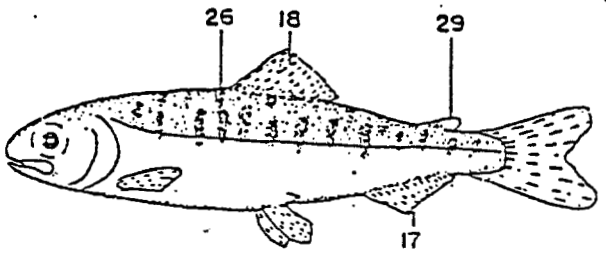
20. (16) Parr marks present as vertical bars or oval spots.
21. (30) Parr marks short, extending little, if any, below lateral line.
22. (25) Gill rakers on first arch, 19 to 26. ** Pyloric caeca, 140 to 186.
23. (26) Parr marks faint. Sides below lateral line iridescent green.
24. (27) Small when migrating from fresh water, approximately 1.5 inches (40 mm) long.

Chum salmon
(*O. keta*)



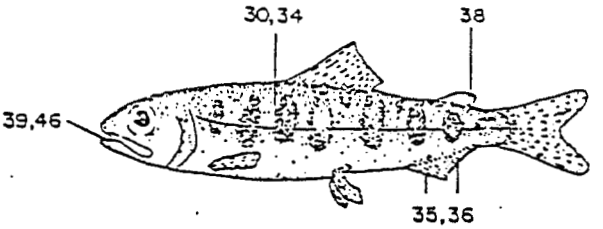
25. (22) Gill rakers on first arch, 30 to 40. **Pyloric caeca 60 to 115.
26. (23) Parr marks usually sharply defined. Sides below lateral line silvery, not iridescent green.
27. (24) Relatively large when migrating from fresh water, approximately 3 to 5 inches (80 to 126 mm) long.
28. (31) Gill rakers long and slender, more than 29 on first arch.
29. (32) Adipose fin clear, not pigmented.

Sockeye salmon
(*O. nerka*)



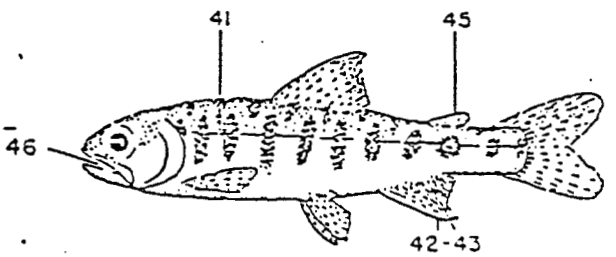
30. (21) Parr marks large, vertical bars centered by lateral line.
31. (28) **Gill rakers short and thick, fewer than 29 on first arch.
32. (29) Adipose fin at least partially pigmented.
33. (40) **Plyloric caeca more than 90.
34. (41) Parr marks broader than interspaces.
35. (42) Anterior rays of anal fin not distinctly longer than rest, not white edged.
36. (43) Anal fin not pigmented.
37. (44) Black spots, when present, on both lobes of caudal fin.
38. (45) Adipose fin not completely mottled, clear area at anterior base of fin.
39. (46) Black gums along base of lower teeth.

Chinook salmon
(*O. tshawytscha*)



40. (33) **Plyloric caeca less than 80.
41. (34) Parr marks narrower than interspaces.
42. (35) Anterior rays of anal fin elongated; when depressed they extend to base of last ray. (Fig. 2B)
43. (36) Anal fin pigmented between rays, resulting in black banding.
44. (37) Black spots, when present, on upper lobe of caudal.
45. (38) Adipose fin completely pigmented.
46. (36) Mouth gray to white.

Coho salmon
(*O. kisutch*)



47. (1) Adipose fin not present; scales present or lacking.
Not Salmonidae

48. (2) No fleshy appendage at base of pelvic fins.
Smelts
Family Osmeridae

49. (3) Mouth small, not reaching center of eye; teeth weak or absent.

50. (51) Depressed dorsal fin, shorter than head.
Whitefishes
Genus *Coregonus*

51. (50) Depressed dorsal fin, longer than head.
Arctic grayling
(*Thymallus arcticus*)

52. (5) **Teeth on head of vomer only.
Chars
Genus *Salvelinus*
Dolly Varden (*S. malma*)

53. (7) Adipose fin orange; row of distinct pale round spots along lateral line.
Brown trout
(*Salmo trutta*)

ACKNOWLEDGMENTS

We especially thank Dr. Arthur D. Welander, Professor of Fisheries, and Dr. Bruce S. Miller, Research Biologist, College of Fisheries, University of Washington, Seattle, for their valuable suggestions. We also thank Galen H. Maxfield, Fishery Biologist, and Dr. Alan J. Beardsley, Fishery Biologist, both from the NMFS Northwest Fisheries Center, Seattle.

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Appendix B. Material Safety Data Sheet (MS222).

aterial Safety Data Sheet ...
v be used to comply with
Hazard Communication Standard,
910.1200 Standard must be
nsulted for specific requirements.

U.S. Department of Labor
Occupational Safety and Health Administration
(Non-Mandatory Form)
Form Approved
OMB No. 1218-0072

ENTITY (As Used on Label and List)
INQUEL

Note: Blank spaces are not permitted. If any item is not applicable, or no information is available, the space must be marked to indicate that.

ection I

anufacturer's Name
rgent Chemical Laboratories, Inc.

Emergency Telephone Number
(206)885-3777

ddress (Number, Street, City, State, and ZIP Code)
8702 152nd Avenue N.E.
Redmond, WA 98052

Telephone Number for Information
(206)885-3777

Date Prepared
3-4-92

Signature of Preparer (optional)

ection II — Hazardous Ingredients/Identity Information

Hazardous Components (Specific Chemical Identity, Common Name(s))	OSHA PEL	ACGIH TLV	Other Limits Recommended	% (optional)
nzoic acid,3-Amino,Ethyl Ester, Methanesulfonate	NA	NA	NA	

N-MUS LD50:180mg/kg
N-FRG LD50:250 mg/kg

May be harmful by inhalation, ingestion, or skin absorption.
May cause irritation.

RTECS #DG2455000 CAS# 886-86-2

Section III — Physical/Chemical Characteristics

Boiling Point	NA	Specific Gravity (H_2O = 1)	NA
Vapor Pressure (mm Hg)	NA	Melting Point	148°C
Vapor Density (AIR = 1)	NA	Evaporation Rate (Butyl Acetate = 1)	NA

Solubility in Water
1 g/0.8 mls at 20°C

Appearance and Odor
White powder with slight to no odor.

Section IV — Fire and Explosion Hazard Data

Flash Point (Method Used)	Flammable Limits	LEL	UEL
NA	NA		

Extinguishing Media
Water spray, Carbon Dioxide, Dry Chemical, Alcohol or Polymer Foam

Special Fire Fighting Procedures
self-contained breathing apparatus and protective clothing to prevent contact with skin and eyes.

Unusual Fire and Explosion Hazards
Emits toxic fumes under fire conditions-nitrogen oxides, sulfer oxides, carbon monoxide, carbon dioxide.

TRICAIN METHANESULFONATE
(MS 222, Prefuran)

MS222 is used as an anesthetic for fish. It is generally a safe chemical and there are not special precautions called for on the Material Safety Data Sheet, however, common sense should be used when handling any chemical. Avoid breathing dusts and, of course, ingestion. If skin irritation occurs, use rubber gloves.

HEALTH HAZARDS:

Avoid inhaling MS222 or getting into the eyes. Treated fish destined for food must be held in fresh water above 10° C for 21 days before consumption. There is no other information available at this time on health hazards.

FIRST AID:

EYE CONTACT:
Flush eyes with water.

SKIN CONTACT:
Flush with water.

INGESTION:
No information available at this time.

INHALATION:
No information available at this time.

SYMPTOMS OF OVEREXPOSURE:

Not known at this time.

The sample size is 70 sockeye salmon smolt per day, five days a week. If daily sampling objectives are being met, sampling will not occur on Wednesday and Sunday. It is essential that the sample be taken randomly. In the event that more than the required sample size is in the smolt trap at the time of sampling, the trap is to be stirred to assure randomness. When the smolt are randomly distributed, a small dip net will be used to remove a subsample. This procedure will be repeated until the sample size goal is met.

AWL Forms

Smolt length and weight will be recorded on AWL forms (Appendix D.1). Using a No. 2 pencil, complete each section of the left side of the AWL and darken the corresponding blocks:

Description: Include species (sockeye smolt), location, year, and samplers.

Card: The AWL forms and corresponding slides are numbered sequentially by date throughout the season starting with # 001. A new, consecutively numbered, card is used each day even if the previous card is not completed. There may be a minimum of one fish and a maximum of 40 fish (8 slides) per AWL.

Species: Refer to the reverse side of the AWL form to obtain species; sockeye = 2.

Day, Month, Year: Use the appropriate digits for the date the fish are sampled.

District, Subdistrict, Stream, Location: Consult project leader for the appropriate codes.

Period: List the period in which the fish were sampled using Appendix D.2.

Project: Refer to the reverse side of the AWL form to obtain code; code 4 will be used as default since a specific smolt code does not exist.

Gear: Refer to the reverse side of the AWL form to obtain code; 00 = trap.

Mesh: Leave blank.

Type of Length Measurement: Refer to the reverse side of the AWL form to obtain code; 1 = Tip-of-snout to fork-of-tail.

Number of Scales: Mark 1 (refers to 1 smear/fish)

# of Cards: Mark 1 (each AWL form is individually numbered)
Keep the litho codes in numerical order throughout the season and be sure to transfer the litho code from the front left side to the backside of the AWL form. These forms will be optically scanned and stray marks may be misinterpreted. It is the crew leaders responsibility.to make sure that all forms are carefully edited before returning them to your supervisor.

Sampling procedure

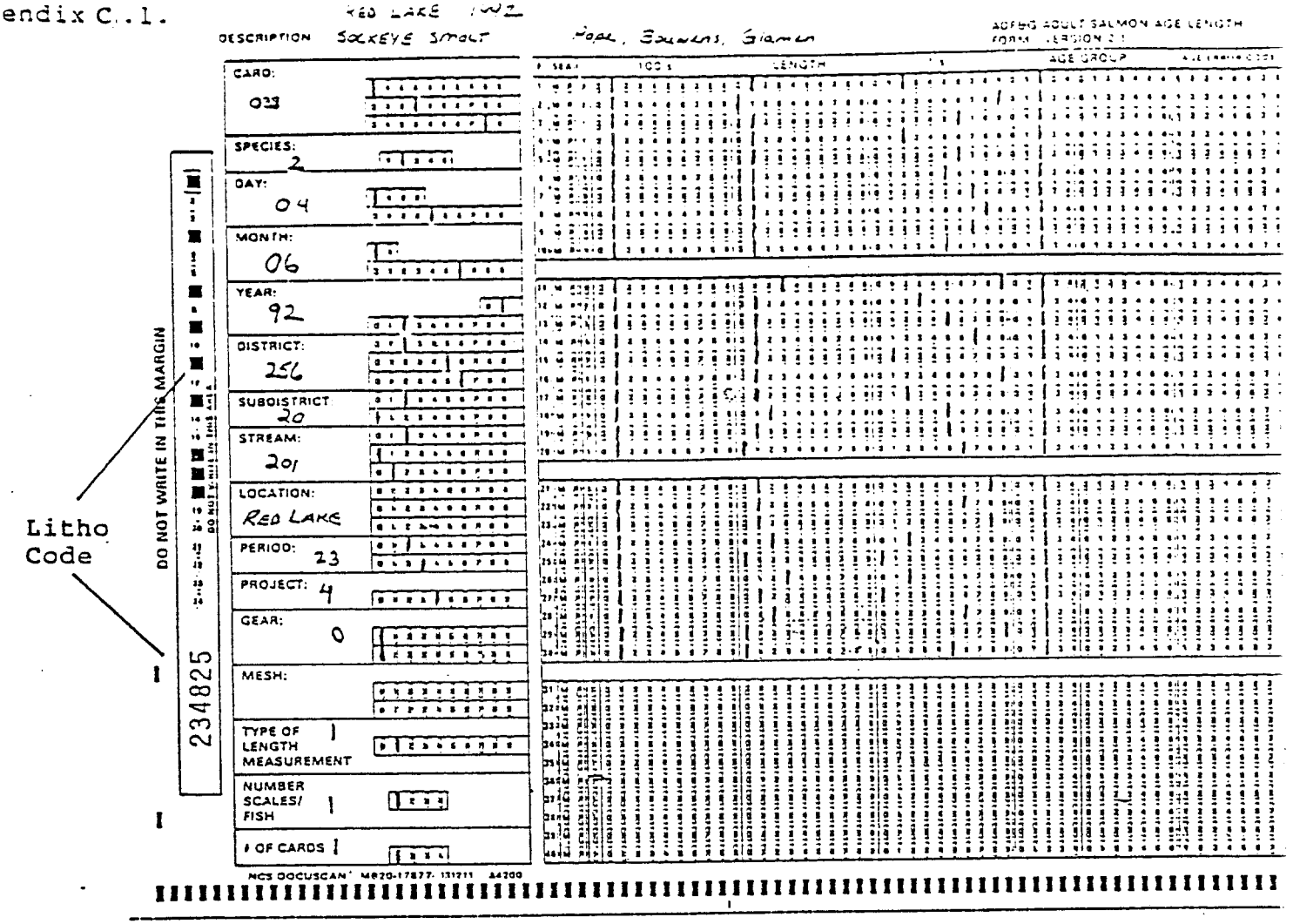
Smolt will be kept alive and sampled the day of capture. MS222 will be used to anesthetize the fish. The use of this chemical will be demonstrated in the field. A flattened probe will be used to remove 5-10 scales from the preferred area, consult Appendix D.3. The scales will be mounted on a glass slide as illustrated in Appendix D.4. The left portion of each slide will be labeled: location, date, AWL # (card #), and fish numbers (1-5, 6-10, 11-15, etc.). When the slides are completed, return them to the box in order, and label the box as shown in Appendix D.4. Smolt lengths will be measured in millimeters from the tip of the snout to the fork of the tail, Appendix D.5. Record each length by darkening the appropriate column blocks on the AWL form.

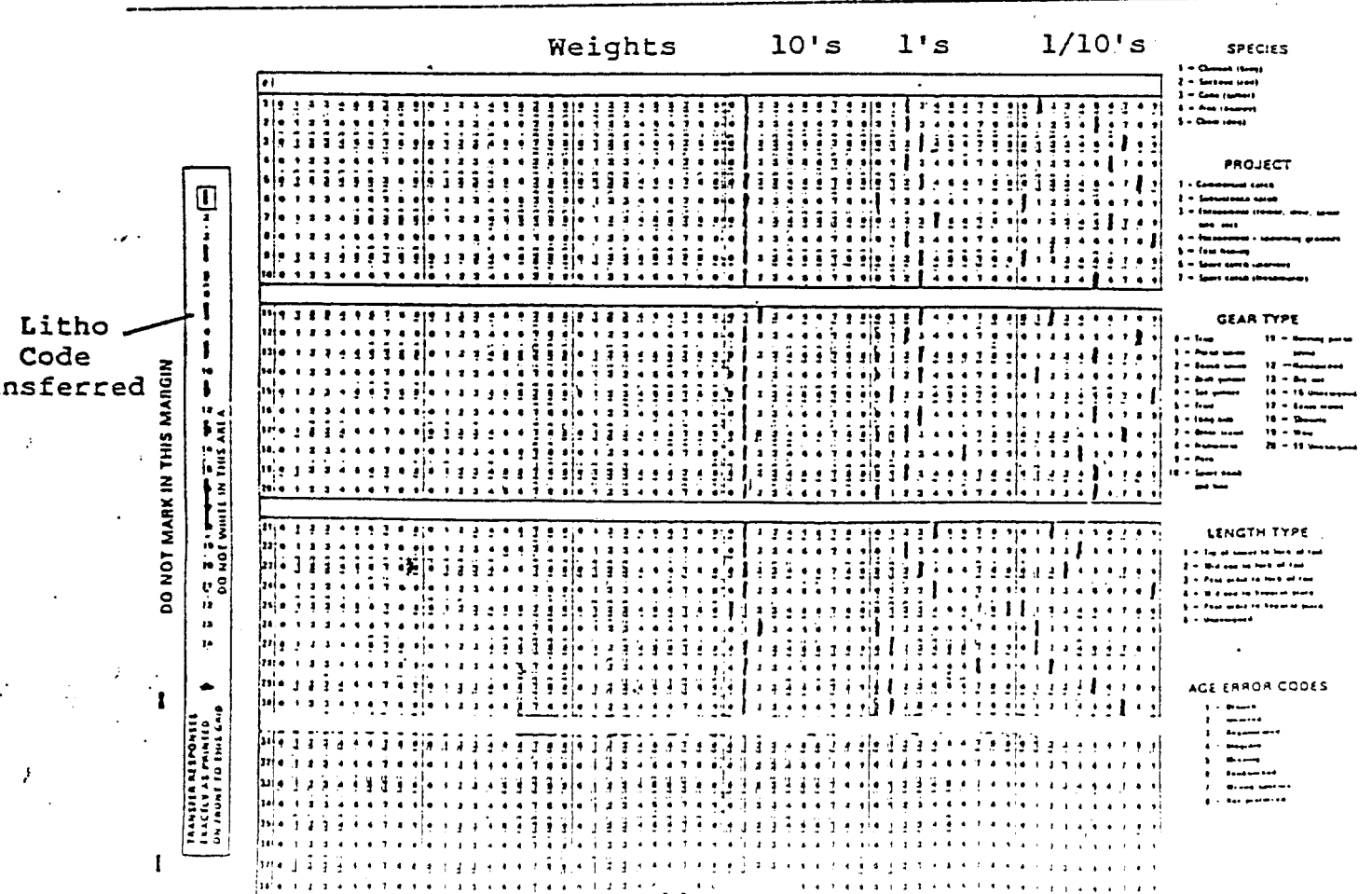
Excess water will be removed from the smolt before weighing by using a paper towel blotter. Individual smolt weights will be recorded to the nearest 0.1 gram on the backside (right side) of the AWL form (Appendix D.1).

Take care to ensure length and weight data corresponds to the appropriate scale smear as this information is used to calculate condition factor at age. When sampling for age, length, and weight, rite-in-rain books may be used to record data. After sampling is done, transfer the data carefully to the AWL forms. **It is the responsibility of the crew leader to make sure the data has been transferred correctly and the AWL form is filled out completely.**

Appendix C. (page 3 of 6)

Appendix C.1.





RED LAKE 1992

DESCRIPTION SOCKEYE SMOLT Pope, Bouwens, Glamen

ADF&G ADULT SALMON AGE LENGTH FORM VERSION 2.1

CARD:	033
SPECIES:	2
DAY:	04
MONTH:	06
YEAR:	92
DISTRICT:	256
SUBDISTRICT:	20
STREAM:	201
LOCATION:	RED LAKE
PERIOD:	23
PROJECT:	4
GEAR:	0
MESH:	
TYPE OF LENGTH MEASUREMENT	1
NUMBER SCALES/ FISH	1
# OF CARDS	1

SEX 100's LENGTH 1's AGE GROUP AGE ERROR CODE

DO NOT WRITE IN THIS MARGIN

234825

Litho Code

NCS DOCUSCAN M820-17877-131211 A4200

Weights 10's 1's 1/10's

SPECIES

PROJECT

GEAR TYPE

LENGTH TYPE

AGE ERROR CODES

DO NOT MARK IN THIS MARGIN

DO NOT WRITE IN THIS AREA

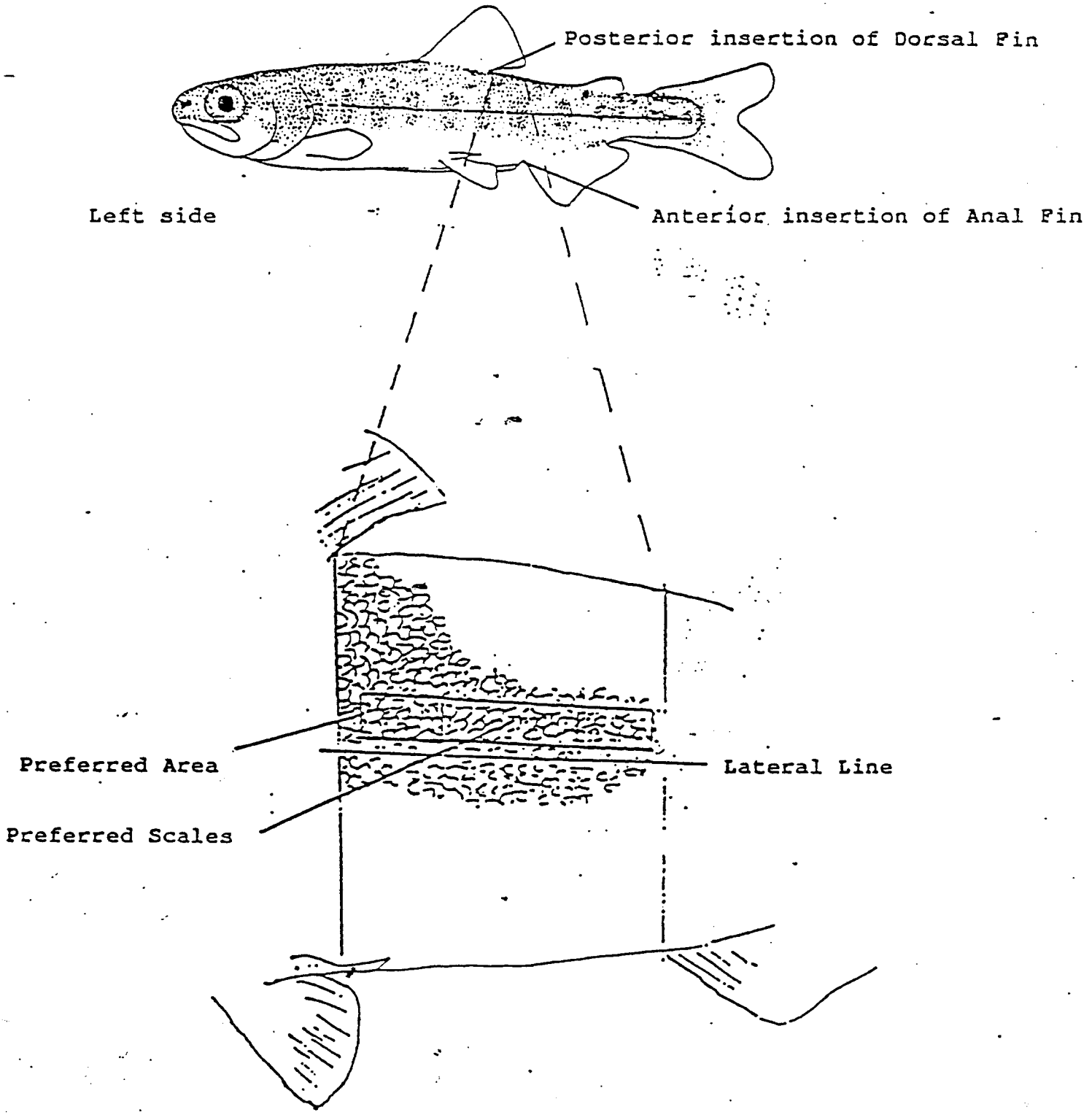
TRANSFER RESPONSES EXACTLY AS PRINTED ON FRONT TO THIS GRID

Litho Code Transferred

Appendix C2. Period codes and corresponding dates.

Period	Dates	Period	Dates
1	01-Jan to 03-Jan	28	05-July to 11-July
2	04-Jan to 10-Jan	29	12-July to 18-July
3	11-Jan to 17-Jan	30	19-July to 25-July
4	18-Jan to 24-Jan	31	26-July to 01-Aug
5	25-Jan to 31-Jan	32	02-Aug to 08-Aug
6	01-Feb to 07-Feb	33	09-Aug to 15-Aug
7	08-Feb to 14-Feb	34	16-Aug to 22-Aug
8	15-Feb to 21-Feb	35	23-Aug to 29-Aug
9	22-Feb to 28-Feb	36	30-Aug to 05-Sep
10	01-Mar to 07-Mar	37	06-Sep to 12-Sep
11	08-Mar to 14-Mar	38	13-Sep to 19-Sep
12	15-Mar to 21-Mar	39	20-Sep to 26-Sep
13	22-Mar to 28-Mar	40	27-Sep to 03-Oct
14	29-Mar to 04-Apr	41	04-Oct to 10-Oct
15	05-Apr to 11-Apr	42	11-Oct to 17-Oct
16	12-Apr to 18-Apr	43	18-Oct to 24-Oct
17	19-Apr to 25-Apr	44	25-Oct to 31-Oct
18	26-Apr to 02-May	45	01-Nov to 07-Nov
19	03-May to 09-May	46	08-Nov to 14-Nov
20	10-May to 16-May	47	15-Nov to 21-Nov
21	17-May to 23-May	48	22-Nov to 28-Nov
22	24-May to 30-May	49	29-Nov to 05-Dec
23	31-May to 06-June	50	06-Dec to 12-Dec
24	07-June to 13-June	51	13-Dec to 19-Dec
25	14-June to 20-June	52	20-Dec to 26-Dec
26	21-June to 27-June	53	27-Dec to 31-Dec
27	28-June to 04-July		

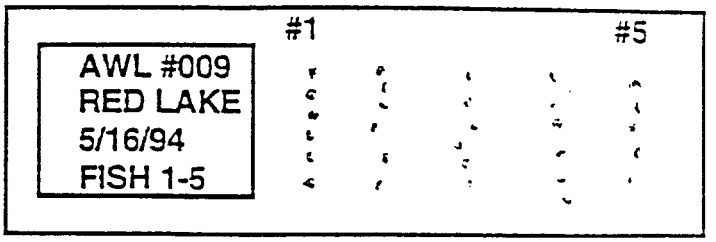
Appendix C.3. Scale sampling procedure showing the preferred area on a smolt salmon.

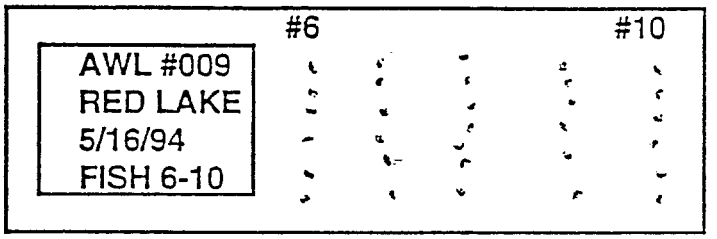


Appendix c.4 Salmon smolt glass slide example.

The following information should be legibly written on the slide label:

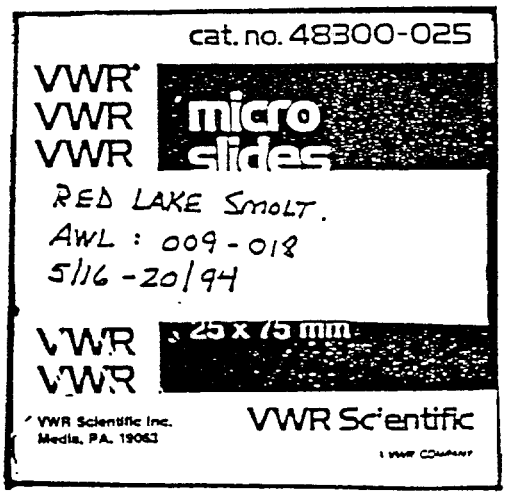
1. AWL #
2. Location
3. date (mo/day/yr)
4. Fish # (1-5, 6-10,...35-40)





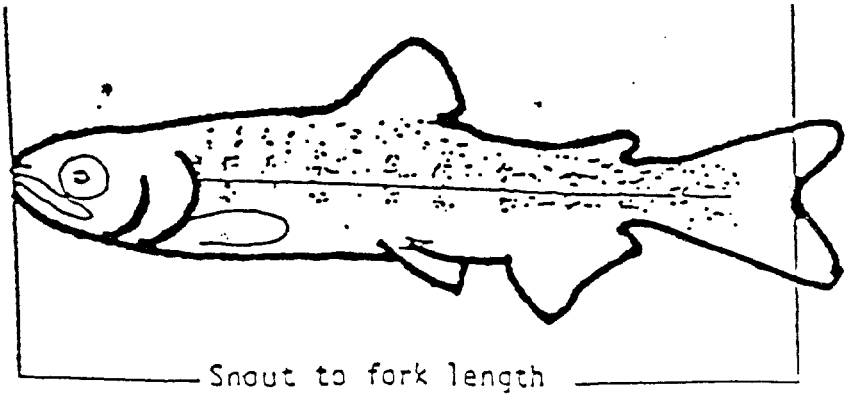
When the slides are completed, return them to the box in order by AWL #, date, and fish #. Label the slide box on top with the following information:

LOCATION (RED LAKE)
AWL NUMBERS (AWL # 009 - 018)
BEGINNING AND ENDING DATES (5/16 - 20/94)



Appendix C.5

MEASURING SMOLT LENGTH



Appendix D. Radio Communications schedule.

COMMERCIAL FISHERIES MANAGEMENT & DEVELOPMENT
Regional Radio Schedule - 3230

EXISTING

0001 - 0645	OPEN STANDBY
0645 - 0700	DILLINGHAM
0700 - 0715	KING SALMON
0715 - 0740	CHIGNIK - PENINSULA
0740 - 0800	BETHEL - AYK
0800 - 0830	KODIAK
0830 - 0845	FRED DILLINGHAM
0845 - 0900	GAME/SPORT FISH/KING SALMON
0900 - 0930	HOMER
0930 - 1000	CORDOVA
1000 - 1020	CHIGNIK - PENINSULA
1020 - 1530	OPEN STANDBY
1530 - 1600	CHIGNIK - PENINSULA
1600 - 1630	HOMER
1630 - 1700	CORDOVA
1700 - 1730	BETHEL - AYK
1730 - 1845	OPEN STANDBY
1845 - 1900	CHIGNIK - PENINSULA
1900 - 1930	KING SALMON
1930 - 1950	DILLINGHAM
1950 - 2000	FRED DILLINGHAM
2000 - 2045	KODIAK
2030 - 2400	OPEN STANDBY

PROPOSED

0001 - 0730	OPEN
0730 - 0815	BETHEL/AYK
0815 - 0900	KODIAK
0900 - 0925	PENINSULA
0925 - 0930	CHIGNIK
0930 - 1000	CORDOVA
1000 - 1030	HOMER/SOLDOTNA
1030 - 1600	OPEN
1600 - 1630	HOMER/SOLDOTNA
1630 - 1700	CORDOVA
1700 - 1730	BETHEL/AYK
1730 - 1930	OPEN
1930 - 2000	PENINSULA/CHIGNIK
2000 - 2045	KODIAK
2045 - 2400	OPEN

Appendix E. Weekly report example.

Date: 6/3/91

To: Lonnie White
Area Biologist - FRED

Weeks: 21, 22, and 23

From: Steve Schrof
Fish Culturist I - FRED

Subject: Spiridon Lake Sockeye Smolt Project

Activities:

Week 21:

Materials for tent platform arrived on 5/23. Began building platform on 5/24, completed and moved tent onto platform 5/26. Tent platform is built approximately 150 ft. from the lakeshore, paralleling the outlet stream.

Sockeye smolt movement is minimal at this point. Smolt count from 5/23 to 5/25 is 102 fish passed. Daily counts have ranged from 8 to 49 smolts passed. The holding pen for sockeye smolts is stressful. Strong water flow through the pen creates too much stress on the smolts. The pen needs to be enclosed on all sides to reduce flow speed. Due to low temps. and low numbers of fish, adequate oxygen levels should not be a concern.

Worked gillnet for adult Dolly Vardens on 5/24 and 5/25. Catches for adult Dollies were 10 and 7, respectively. The gillnet was set on the west creek. CPUE was 20.5 hrs. and 23.5 hrs.

Week 22:

Smolt counts still slow from 5/26 - 5/30, total fish passed 32. Rain and lots of wet weather raised water level

in the greatest numbers to date on 5/31 and 6/1. Total numbers for the two days: 5/31 - 501; 6/1 - 118. We are still seeing a high percentage of mortalities in the holding box before sampling.

Set the gillnet on the south creek shoreline, 5/29 and 5/30. Catches for adult Dolly Vardens, 9 and 10, respectively. CPUE 16.0 hrs. and 23.5 hrs. Length, weight, and otolith samples taken.

Made beach seine sets for juvenile Dolly Varden on south creek (2 sets), outlet creek (1 set), west creek (1 set), and east creek (1 set) sites on 5/29. We did not capture any juvenile Dollies, some miscellaneous numbers of sculpins and sticklebacks. We surveyed east and west creeks for any sign of juveniles up in there respective systems. We saw no sign of juveniles walking either system.

Week 23:

Smolt counts slowing down again. Counts on 6/2 were 6 smolts, and 6/3 were 6 smolts.

Attempted to work on lake 6/3, beach seining and setting the gillnet. High winds from the southeast created white capping and unstable conditions on the lake.

Significant Events:

Lochaye smolt counts started out slow but a rise in water level triggered smolt to migrate down-stream on 5/31 and 6/1.

Juvenile Dolly Varden are not being apprehended using the beach seine. Scouting along the lakeshore,

Significant Events cont.

visual sightings of juveniles.

Anticipated Activities:

Due to minimal smolt movement, we will be concentrating on beach seining, and setting the gillnet for the collection of Dolly Varden.

Continue to sample sockeye smolts migrating downstream.

Appendix F. Annual report format.

MEMORANDUM STATE OF ALASKA

TO: Distribution DATE: July 14, 1994

FILE: memorpt.94

FROM: Steve Honnold SUBJECT: Project Reports: format/example

Attached is an updated version of the required format for Annual Project Reports plus a copy of a report written by management personnel. This format is general and modification will be needed for individual projects. The example report is not specifically written to follow the current format, as it was drafted several years ago. Each crew leader will be responsible for drafting a report for each project worked during the season. Crew members should also participate in the writing of the report. I recommend that crew leaders delegate specific sections of the report, based on each crew members experience on the projects. I would like a draft of the report to review prior to the end of the field season, preferably, early enough to provide feedback to allow revision.

The initial draft of the report can be handwritten and later, after final revision, will be typed by clerical staff. I encourage each crew leader to work on these reports in-season while activity is ongoing. I realize how busy the field season is, however, data summary is much easier while it is fresh. The necessary time required for revision will be scheduled when things slow down and field personnel are in town.

If any clarification and or assistance is needed to write the reports, please let the appropriate staff know. I would be more than happy to help out anytime.

I will look forward to seeing your reports. Keep in mind that these reports are important documents which provide significant information for future implementation of our projects.

cc: All Development staff

CREW LEADER ANNUAL REPORTS

I. INTRODUCTION

Description of Project Location

Include general and specific location characteristics (stream width, depth, flow, tidal influence, etc.) and effect on project.

History of Project

Brief history of program.

Purpose of Project

Objectives

Purpose of Report

II. METHODS AND MATERIALS

Precisely describe all components of your work that produced the results reported:

Employees

List employees on site and for what periods, as well as job classes, previous time spent on the job, etc.

Weir/traps

Type of weirs and traps and installation, dates of installation and trapping, maintenance schedule; enumeration techniques, how sampled, when, how estimates were made, adult, smolt and other sampling techniques, etc.

Monitoring

Regulatory duties such as setting or moving markers or monitoring the fishery, etc.

Fish Pass Maintenance

Seasonal maintenance schedule - removing and installing doors, type of repairs, performance before and after, fish usage, etc.

Other Duties and Misc.

Physical data, safety, bear avoidance or activity, sport and subsistence fishing activity, etc.

Generally, following the operational plan procedures section will assist with this section. Also, maps, photographs and diagrams are useful for this section.

III. RESULTS

Base your results on the objectives and what was accomplished: be specific as to #'s, dates, etc. Generate specifics here as far as data collected, etc. Address each category listed in the Methods section. For example, smolt enumeration, timing, number sampled, mortality, adult escapements and timing by species, adult sampling numbers, spawning surveys, fish pass usage, etc. Simple tables and graphs should be constructed to summarize significant data.

IV. DISCUSSION AND RECOMMENDATIONS

Elaborate on results, techniques, significant findings, problems, etc.; be thorough - things you would want to know if you did not have any involvement in the project, but may in the future.

Recommend changes, modifications, etc. This should include all aspects of the project. Items that may be addressed:

improvement of weir/trap installation, maintenance and operation, changes or improvement of sampling techniques, camp and support improvements. Necessary or optional equipment/gear lists would be helpful in this section.

Appendix G.

STATE OF ALASKA
PERFORMANCE EVALUATION WORKSHEET

NAME	SOCIAL SECURITY NO.	DEPARTMENT	DIVISION

PCN	JOB CLASSIFICATION TITLE	REPORT COVERAGE FROM	REPORT COVERAGE TO

REASON FOR REPORT

☐ ANNUAL ☐ RESIGNATION ☐ COMPLETION OF PROBATION
☐ OTHER (SPECIFY) _____

POSITION DESCRIPTION REVIEWED BY RATER

YES ☐ NO ☐ If no, explain:

SPECIFIC RATING AREAS

	* U	A	O
PERFORMANCE	☐	☐	☐

(As shown by: quantity, quality, accuracy, and completeness of work; knowledge of job fundamentals; judgment shown on the job; willingness and ability to carry out new assignments; independence of performance; attitude towards job.)

WORK HABITS	☐	☐	☐

(As shown by: attendance; punctuality; appearance and grooming; safety.)

INTERPERSONAL RELATIONSHIPS	☐	☐	☐

(As shown by: consideration of public and co-workers; acceptance of supervision.)

SUPERVISORY (for Supervisory Employees Only)	☐	☐	☐

(As shown by: training and directing subordinates; evaluating subordinates; planning and organizing work, including delegation; problem solving and decision-making ability; affirmative action achievement; cost effectiveness; and, Labor Contract Administration).

* U = Unacceptable, A = Acceptable
O = Outstanding

NARRATIVE SECTION

Overall Effectiveness on the Job U 1☐ Acceptable 2☐ 3☐ 4☐ O 5☐

(Overall Effectiveness **MUST** be explained. Other performance consideration, such as strong points and areas needing improvement, should be included.)

Rater's Recommended Action: _____
(See Instructions on back)

Rating was discussed with employee ☐ Yes ☐ No If no, explain: _____

Signature of Rater _____ Title _____ Date _____

Employee: ☐ Concur with Rating ☐ Disagree (Employee comments on back)

Signature _____ Date _____

REVIEWED AND APPROVED BY:
Division
Signature: _____ Title _____ Date _____
Department
Signature: _____ Title _____ Date _____

DIVIDER

JUVENILE ASSESSMENT PROJECT
OPERATIONAL PLAN, 1995

by

Steven G. Honnold,
Peter M. Cleary
and
Steve Schrof

Alaska Department of Fish and Game
Commercial Fishery Management and Development Division
211 Mission Road
Kodiak, Alaska 99615

June 1995

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INTRODUCTION

The Alaska Department of Fish and Game (ADF&G), Commercial Fisheries Management and Development Division, Fisheries Development Section, in cooperation with Kodiak Regional Aquaculture Association (KRAA), is currently rehabilitating or enhancing sockeye salmon *Oncorhynchus nerka* in various locations on Kodiak Island. Rehabilitation/enhancement strategies include improving the nutrient base, thus increasing zooplankton production, by lake fertilization or increasing egg to fry survival by sockeye fry stocking. ADF&G - KRAA activity on Kodiak Island often involves a combination of these strategies. The analysis of juvenile sockeye salmon abundance and growth data is important for evaluating rehabilitation and enhancement projects.

Goal

The goal of this project is to evaluate the relative abundance of juvenile sockeye salmon rearing in Karluk, Spiridon, Frazer (smolt outmigrants and rearing fall fry), Afognak, Malina, Hidden and Crescent Lakes (rearing fall fry) and to assess their age and growth (condition).

Objective

1. Estimate the relative abundance of the sockeye smolt migration from Karluk, Frazer, and Spiridon Lakes.

2. Determine the age composition, and the average weight, length, and condition for sockeye smolt outmigrating during the peak 3 week movement (Karluk, Afognak, Crescent).

3. Estimate the relative abundance, age and mean size of rearing fall fry (sockeye) in Karluk, Frazer, Afognak, Malina, Crescent, Hidden and Spiridon Lakes.

Tasks

1. Conduct hydroacoustic surveys at Karluk, Frazer, and Spiridon Lakes in late April, early May, prior to the sockeye smolt migration and repeat each survey in mid to late June, after smolt have migrated.

2. Townet to determine sockeye and stickleback catch-per-unit-effort (CPUE), species composition; and stickleback length frequency at Karluk and Frazer Lakes.

3. Operate a fyke net or smolt trap during the peak sockeye smolt outmigration at Karluk, Afognak, and Crescent Lakes.
   Target dates: May 22 - June 16 (Afognak)
   May 25 - June 16 (Karluk)
   June 5 - June 16 (Crescent)

4. Enumerate the daily catch of fish by species at each system during the sampling period.

5. Sample 70 - 100 smolt per day, for three days per week (210 total), for age, length, and weight data at Karluk and Afognak Lakes; one 200 fish sample at Crescent Lake.

6. Collect physical data daily at each site.

7. Conduct hydroacoustic surveys and townetting for species composition and CPUE data in the fall at Karluk, Frazer, Afognak, Malina, Crescent Lakes; hydroacoustics only at Hidden, and Spiridon Lakes.

8. Sample all sockeye pre-smolt collected by townetting for age, weight and length; 200 sticklebacks will be sampled for length at Karluk and Frazer Lakes.

9. AWL data from smolt and pre-smolt will be summarized into table form by 01 November.

SUPERVISION

Project Biologists:	Smolt AWL	- Steve Schrof
	Spring surveys	- Steve Honnold
	Fall surveys and pre-smolt AWL	- Pete Cleary

Responsibilities: Planning, logistics, technical support, and quality control.

Field Staff:	Smolt AWL	- Steve Schrof Management and Sport fish crews
	Spring surveys	- Pete Cleary, Tim Sands
	Fall surveys	- Pete Cleary, Wes Ghormley, Steve Honnold

PROCEDURES

Hydroacoustic Surveys

After arriving at the lake, the raft will be assembled (on lakes that do not have boat) and light sensitive flashers are set at the end of each transect. The boat will then prepared for the survey. This consists of setting up all the hydroacoustic equipment. This includes a Biosonics model 171 tape interface a model 105 echo sounder, a model 117 chart recorder, a Sony digital audio tape and an ossciiscope. A flow meter is used to maintain correct transect speed (1.5 m\s). All the gear with a tarp. After the equipment is set up and the boat will be prepared for the survey

calibrations will be completed (see Appendix A for survey preparations.) The survey will start when it is dark enough to see the flashers. When the flashers are observed on the opposite shore, the transducer will be placed in the water and the depth determined by turning the sounder on. If it is deep enough to begin the survey the boat will be positioned away from the shore and the transect started; otherwise, the boat will be moved to shore slowly to a depth of ~5 meters, then the boat will be pointed away from the shore and the transect started; the flasher on the opposite shore will be visible and the boat speed at 1.5 meters /second. Lake, date, transect number, direction, depth range and paper speed will be recorded on the chart recorder paper. As depth range changes new ranges will be recorded on the paper. The distance from shore will be periodically given by the skiff operator and depths from the chart paper and osscilloscope will be relayed to the skiff operator. The transect will end when the depth reaches 2-5 meters. This process will be repeated at each transect until the survey is completed.

Townetting for CPUE, Species Composition, AWL, and Length Frequencies

A 2m/2m/7.5 meter monofilament tow net with a 6.5 meter opening and 19.5 meter tow lines used used on the large lakes. Another net approximately the same size with heavy fabric will be utilized in shallow lakes where the risk of hitting the bottom is much greater. These nets will be used in order to capture targets observed during the hydroacoustic surveys. The net will be towed at varying depths depending on the location of the targets in the water column and the depth of the lake. In general it is best to tow well above the bottom to avoid damage to the net. Catch, time, depth and duration of the tow will be recorded. Pre-smolt sockeye salmon will be preserved in 10% buffered formalin and sampled for length, weight and scale samples after returning to Kodiak. Approximately 100 stickebacks per basin or lake (Karluk, Frazer, Afognak and Malina Lakes) will also be preserved to obtain length frequencies. Pre-smolt scales will be aged in Kodiak with age, length and weight data recorded on mark sense forms.

Trap Monitoring and Maintenance

The location of the smolt trap or fyke net will be in a point, mid channel where the velocity is sufficient to minimize fish avoidance. The trap should be kept free of debris to maintain trap efficiency and minimize smolt mortality. This will require frequent monitoring and maintenance. The trap should be checked every 30-60 minutes between sunset and sunrise and every four hours during daylight hours. Significant mortality can occur in a short period of time if a crew is not keeping "on top" of trap monitoring and maintenance. Also, migration patterns may change with significant weather changes (i.e. rain may trigger a large outmigration) so becoming too routine in trap monitoring is not advised. The smolt day begins at 12:00 noon and continues for 24 hours until 12:00 noon the following day.

Trap Catch and Species Enumeration

Everything caught in the smolt trap will be enumerated. Please refer to identification keys if questions arise regarding species identification (Appendix B). Feel free to contact the Project biologist if any questions regarding identification occur. Use a dip net to remove and release the

fish as they are counted. Handle sockeye smolt gently as they are very sensitive to any stress and mortality can occur with the loss of just a few scales. A tally whacker should be used to count the sockeye smolt to assure an accurate count. In the event an extremely large outmigration occurs in a relatively short time period, and time will not permit counting individual smolt without mortalities, collect enough smolt for a daily sample and then pull the wings so that the trap is not fishing. This will prevent unnecessary mortality. This method should only occur when there are relatively large number of smolt being caught, and there is not enough time to count all the fish without incurring mortalities. Enter all data on the Daily Catch Reporting Form (Figure 1) each time the trap is checked. Also, record any mortality on the form each day. Summarize daily trapping data on Sockeye Salmon Summary Report Form (Figure 2).

Age, Weight and Length Sampling

At each system, 70 - 100 sockeye smolt per day, three days per week (240/weekly minimum target number) are to be sampled for age, length, and weight. Each sample will be taken from a single day's catch. Do not mix samples between days. If less than 70 fish are caught in a day, the sample size for that day will be the number of fish caught on that day. Since smolt primarily migrate at night, a single sampling day will be the 24 hour period from noon to noon and will be identified by the calendar date corresponding to the first noon.

It is essential that the sample be taken randomly. In the event that more than the required sample size is in the smolt trap at the time of sampling, the trap is to be stirred to assure randomness. When the smolt are randomly distributed, a small dip net will be used to remove a subsample, this procedure will be repeated until the sample goal is met.

Smolt samples will be kept alive and worked the day of capture. MS222 will be used to anesthetize the fish. Latex gloves should be worn to prevent direct exposure to MS222 (Appendix C). The use of this chemical will be demonstrated in the field. Age, weight, and length data will be recorded on adult AWL forms (Appendix D.1) as no smolt AWL forms exist. Refer to Appendix D on the standard procedures for recording data on an AWL form. Record at the top of each AWL form: personnel collecting the data.

A knife or scalpel will be used to remove 5-10 scales from the preferred area (Appendix D.3). The scales will be mounted on a glass slide as illustrated in Appendix D.4. The left portion of each slide will be labeled with: sample AWL number, location, date, and fish number. Smolt lengths will be measured to the nearest millimeter, from the tip of the snout to the fork of the tail.

Excess water will be removed from the smolt before weighing by using a paper towel as a blotter. Individual smolt weights will be recorded to the nearest 0.1 gram. Length and weight information can be recorded on the AWL Work Form (Figure ?) when sampling.

All data (slides, forms) will be forwarded to the area office and reviewed on a frequent basis (weekly or earliest available plane to town). Be sure to duplicate the data forms in case originals are misplaced in transit. **Please be conscientious in the quality control of <u>all</u> data prior to**

sending into Kodiak. Take the time to thoroughly review slides and forms to see they are filled out properly. This is especially important for the computer AWL forms. These are some common mistakes which should be avoided:

1) Scales mounted poorly - avoid too many scales in a smear and avoid slime or debris when mounting; also, keep smears far enough apart to avoid mistaking one fish for another.

2) Numbering AWL forms improperly - for example, if 70 smolt are sampled in one day (day 1), the AWL numbers should be 001 (fish 1-40; 8 slides), 002 (1-30; 6 slides), do not continue from 40 to 41-70. The next day will start with AWL 003 (fish 1-40) and so on.

3) Numbering when two smears per fish is required - these should be numbered 001 A, B not 001-002.

4) "# of cards" mislabeled - use one even if there are two scale cards or slides.

5) Damage AWL form (computer - Mark sense) - do not bend, fold, tape, staple, paper clip, etc. these forms. The computer will not read them correctly, otherwise.

Physical Data

Physical data will be collected at the smolt site at 1100 and 2300 hours. Information will be recorded on the Daily Physical Observation form (Figure 3) and will include: water and air temperatures, stream height, percent cloud cover, wind direction and velocity, and precipitation.

Figure 1. Daily smolt trap catch reporting form.

DAILY SMOLT TRAP CATCH REPORTING FORM

PROJECT LOCATION: _____ DATE: _____

TIME (Military)	SOCKEYE		COHO FRY	DOLLY VARDEN	STICKLE-BACK	OTHER	COMMENTS
	SMOLT	FRY					
TOTAL							

Figure 2. Sockeye smolt summary form.

SOCKEYE SMOLT SUMMARY FORM

Location: _____ **Year:** _____

DATE	SMOLT		MORTALITY [a]		AWL SAMPLE		COMMENTS
	DAILY	CUMULATIVE	DAILY	CUMULATIVE	DAILY	CUMULATIVE	

[a] Included in daily and cumulative counts.

Figure 3. Daily physical observation form.

DAILY PHYSICAL OBSERVATIONS

Project:_____ **Location:** _____

DATE	TIME	TEMPERATURE				GAUGE	WEATHER
		AIR		WATER			
		MIN	MAX	MIN	MAX		

APPENDIX

Appendix A. Summary of hydroacoustic survey preparations.

---

1. Review equipment list, make sure batteries are fully charged and all equipment has been tested, bring more gas than you need, bring snacks and water.

2. Set up with tarped frame in afternoon of survey date.

   - Make sure that your sitting position under the tarp will not be a problem later in the survey. Try not to face backwards so driver is not blinded by your headlamp.
   - easy access
   - secure with duck tape or string, etc.
   - paper for recorder
   - hook up 105, 171, dat recorder, and transducer recorder, oscilloscope, and place volt meter in workable location
   - transducer should be secured with board, (side mounted) at one meter depth, so that no movement is allowed during survey
   - power to all units should be left disconnected until survey
     * Transducer will be made inoperable if power is turned on when it is out of water. Also, cables are fragile and vertical surface is sensitive to shock or abrasion so protect with padding.

3. Flashers to mark transects - good for three days.(depending on temperature)

4. Survey start up.

   - set up log book
   - transducer in H_2O, if not then transmitter off
   - hook up batteries-one for 105, 171, 115, dat recorder
   - turn on 105, 171, dat recorder on pause Cal EXT
     - pings on EXT calibrator on -20
     - record 1 minute
     - measure voltage detected #1, #2 while recording
     - record a blank for 10 seconds (105 off)
     - review on oscilloscope to see normal voltage signal 5 P/S
     - pings on 5 P/S
     - calibrater -20
     - record 1-2 minutes
     - review on oscilloscope to see "normal bell shaped" signal
     - record on blank
     - playback all calibrations prior to survey to assure their quality (see playback)
   - take calibration readings and record on log book
   - record counter begin and end in log book for each calibration
   - record counter#'s in log book and clock time (in minutes and seconds) from stop watch at each calibration; also log settings to use for transects

5. Transects

   105 settings:
   - 5 P/S pings

-Continued-

- calibrater to off
- put transducer and fin in water, verify depth of transducer and turn transmitter on.
- when ready to begin first transect, turn on chart recorder and record range, threshold, and paper speed in log book and on chart paper
- simultaneously mark chart recorder and start dat recorder recording
- label chart with transect #, direction, and range
- record counter #'s and time at beginning and end of each transect
- give "driver" periodic depth checks from echogram and oscilloscope
- monitor oscilloscope for signal and depth (will give instant depth while chart recorder is delayed)
- make turn and stop dat recording, mark and stop chart recorder
  * If transducer hits bottom, could permanently damage it.
- record a blank with 105 off (10 seconds)
- record counter #'s in log book
- repeat for each transect

6. End Survey - Calibrations

   - repeat for Caltone EXT and Caltone 5 P/S as described earlier

7. Playback

   - #2 playback pin connector to AC #1 out
   - #2 scope sync in (remove 105 scope sync in)
   - scope to channel #2
   - 105 off, 171 on

A Guide to the Collection and Identification of Presmolt Pacific Salmon in Alaska with an Illustrated Key

MILTON B. TRAUTMAN[1]

ABSTRACT

This field and laboratory key contains recommendations for types of equipment needed, instructions for preserving and labeling specimens, and descriptions of the characters used in identifying five species of Pacific salmon. The key is illustrated with six line figures: 1) juvenile salmon, 2) the first gill arch, 3) head with gill arch in situ, 4) first gill arch and eye for comparison with longest rakers, 5) method of counting anal fin rays, and 6) ventral surface of head showing branchiostegals. Five plates of stippled line drawings of five lengths (25 to 110 mm fork length) for each of the five species of Pacific salmon, an annotated opposable key, and a glossary are also included.

INTRODUCTION

As adults, the five species[2] of Pacific salmon of the genus *Oncorhynchus* inhabiting western North American waters are easily identified, but as subadults or as smolts in silvery coloration, they are less easily recognized. As juveniles less than 125 mm (5 inches) in fork length (FL), they may be quite difficult to identify. In addition, characters by which presmolt juveniles can be distinguished may vary with geographic area.

Several keys for identification of juvenile salmon have been published, most of which utilize the number, length, and shape of the gill rakers on the first gill arch; number of pyloric caeca and branchiostegals; and absence of parr marks, or if present, their size and shape (Foerster and Pritchard, 1935; Schultz, 1936; Haig-Brown, 1947; Clemens and Wilby, 1961; McPhail and Lindsey, 1970; Wilimovsky[3]). In addition to the above characters, the key in this paper emphasizes and illustrates the distribution of those chromatophores (usually melanophores) which are reliable enough to aid in the specific identification of juveniles.

This key describes the characters typical of presmolt juveniles of the five species of Pacific salmon in Alaska. The common names recommended by the American Fisheries Society (Bailey et al., 1970, p. 17) are used, despite the fact that other names appear to be in more general use. These other names are inserted in parentheses after their respective species. Trouts, Atlantic salmon (*Salmo salar*), and some other salmonoids are included in the key because of their resemblance to Pacific salmon.

Before presenting the key, it appears advisable to describe the equipment and methods I recommend for preserving specimens, labeling specimens, and counting, measuring, and removing parts of specimens, so that those not acquainted with my procedures may more accurately and quickly identify their material.

---

[1] Professor Emeritus of Zoology, Ohio State University, Columbus, OH 43210. The author was employed in Alaska by the National Marine Fisheries Service Auke Bay Fisheries Laboratory during the summers of 1958 and 1961. The specimens were obtained and most of the drawings made at that time.

[2] A sixth species, *O. masou* (Brevoort), inhabits the streams of eastern Asia from the Okhotsk Sea to Formosa.

[3] N. J. Wilimovsky, 1958. Provisional keys to the fishes of Alaska. On file Natl. Mar. Fish. Serv., Auke Bay Fish. Lab., Auke Bay, AK 99821.

RECOMMENDED EQUIPMENT

Magnifiers: Magnification in the range of 4 to 30 will prove helpful in identification of juvenile salmon. A binocular microscope having such a range is the most satisfactory, but any type of magnifier of more than 4 power and less than 30 may be used provided it is not necessary to use one's hand to hold it—usually both hands are needed to manipulate a specimen. In the field, a binocular unit containing lenses inserted in a frame or headstrap or a jeweler's eye magnifier (especially if one wears glasses) may be used.

Forceps: Four or five inches long with straight or curved tips—for lifting fins, holding back gill covers, etc.

Scalpel: A sharp blade an inch or two long—for removing gill arches, opening body cavities, etc.

Teasing needle: A needle inserted in a wooden or metal handle—for separating closely set gill rakers, etc.

Dividers: For measuring and comparing various body parts; dividers in which one or both legs can be "broken" are the most satisfactory.

Scissors: About 6 inches long with the blades or cutting surface of about 1 inch.

Ruler: Graduated in millimeters to measure fish lengths and parts; one which includes inches also desirable.

PRESERVING SPECIMENS

The careful preserving of specimens cannot be too strongly emphasized. Much time is lost in attempting to identify improperly preserved fishes; it is only when properly preserved that they may be rapidly and correctly identified. Frequently, juvenile salmon that have died in nets become soft, bleached, and torn. For the sake of accuracy it is better not to attempt to identify such material.

To preserve juveniles, upon capture place them in a solution of 1 part Formalin to 9 parts water. If live fishes are placed in too strong a Formalin solution, they may die with their mouths widely agape or the chromatophores may close so tightly as to be difficult to detect. If placed in too weak a Formalin solution, the fishes become bleached and soft and may decompose. If fishes are to be preserved for more than a year (or permanently), leave them in the Formalin solution at least 1 wk and if possible no longer than 4 mo. When fish are removed from the Formalin solution, soak them in water for 24 to 48 hr; then place them in a solution containing 70% ethyl alcohol and 30% water or 35% isopropyl alcohol and 65% water.

Do not crowd or pack fishes in a container, especially if they are alive or only recently dead. Fresh fishes, if packed too tightly, will become permanently deformed upon hardening in Formalin, will be bleached where their bodies come in close contact, or will decompose. A container is too crowded if the fishes will not readily move as the container is slowly rotated or shaken. When sufficient room is allowed, identification will be facilitated because the fishes will harden without discoloring; bodies and fins will not be deformed, twisted, or broken; and the chromatophores will remain nearly or fully open.

LABELING SPECIMENS

Labeling specimens fully and properly is of great importance; unlabeled or mislabeled specimens are of little or no value. Put the label with the specimens at the time the fishes are preserved. Label paper should remain firm when wet and should not become pulpy. Write clearly with pencil or permanent ink, recording the following data.

Field Number

Use your own or a department number. A satisfactory method is to use the first initial of your surname or your full surname, the last two digits of the year, and your collection number. Thus, if Joe Brown in 1962 preserves his fifth collection, he writes B-62-5 or Brown-62-5; if for the Department of Salmon Investigations he writes, SI-62-5. When a departmental symbol is used, it often is desirable for the collector to add his initials or name to the label.

Name of Water Body and Locality

Use names on standard maps. Whenever possible, avoid temporary or local names, such

Brown's fishing camp. An example of a brief but adequate recording is: Alaska, Naknek River System, Katmai National Monument, Brooks Lake.

Date

Include the month, day, and year and, if pertinent, the hour.

The following additional information may be needed at times.

Method of Capture

Describe type of gear and size if significant, i.e., seine (2 cm mesh), fry net (1 cm mesh), trawl (1 cm bag), etc.

Temperature

Measure temperature of air and/or water. If water is ice-covered, what percent?

Other Water Conditions

If a *stream:* estimate its average width and maximum depth; if tidal and brackish, to what extent; degree of turbidity and source—glacial silt, plankton, etc.; degree of gradient—low, moderate, or high; percentage of stream in pools, with or without current; percentage of stream in riffles, whether flow is sluggish, moderate, or swift; dominant bottom types—sand, gravel, boulders, bedrock, muck, silt, etc.; aquatic vegetation—submerged, emergent, or both (name dominant species or genera if known). If a *lake or bay:* state whether fresh, brackish, or saline; if tidal, state to what extent; estimate size and possible depth; give degree of turbidity, type of bottom, and amount and kinds of aquatic vegetation.

Remarks

Describe anything that may aid in identification of the fishes, such as peculiar markings, habits, or habitats.

CHARACTERS USED IN IDENTIFYING SPECIES

A juvenile salmon is shown in Figure 1 to assist in recognizing and defining the characters and the counts and measurements used when keying out a specimen.

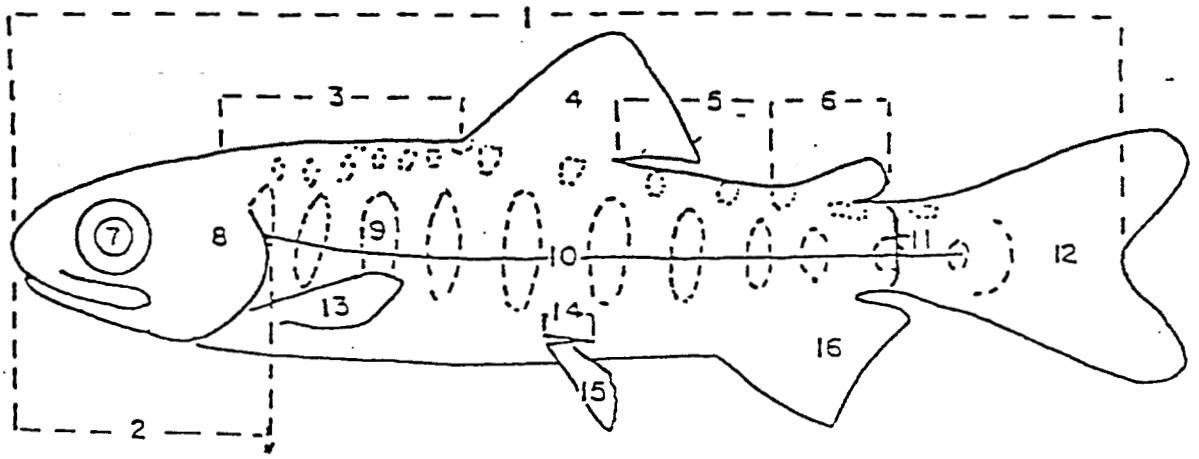
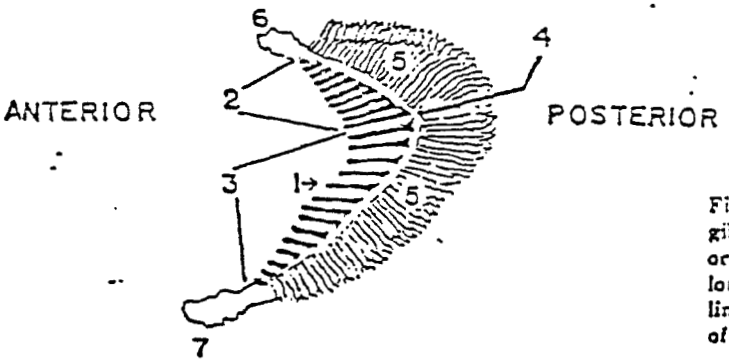


Figure 1.—Juvenile salmon, illustrating parts and methods of measuring: 1) fork length; 2) head length; 3) predorsal ridge; 4) dorsal fin; 5) portion of postdorsal ridge between posterior end of dorsal fin base and origin of adipose fin; 6) adipose fin; 7) pupil of eye; 8) gill cover, beneath which is gill chamber containing gill arches; 9) a parr mark; 10) lateral line; 11) caudal peduncle; 12) caudal fin or tail; 13) pectoral fin; 14) axillary process or scale; 15) pelvic fin; 16) anal fin.

First Gill Arch

Beneath each gill cover are four fully formed gill arches: the first gill arch on either side is the part used for specific identification. A gill arch (Fig. 2) consists primarily of a bony central arch to which the gill rakers are attached anteriorly, the gill filaments (lamellae) posteriorly. The gill rakers prevent solid substances such as food from being carried out through the branchial clefts and protect the delicate gill filaments. The numbers of gill rakers vary somewhat among individuals of each species of salmon, but the difference in average number between some species is sufficiently great to enable one to use them as specific characters.

The rakers on the gill arch may be counted as a unit, or the upper and lower limbs may be counted separately. The two limbs are joined



at an angle, the upper being the shorter. When a raker is situated astride the angle, it is included in the lower limb count. When all of the rakers on the arch are counted as a unit, a single number is given: otherwise, both limbs are recorded separately (the upper limb first), and then added, thus $12 + 20 = 32$.

The gill rakers nearest the angle of the arch are the longest: the rakers become progressively shorter as they approach the attachment ends of each arch. The rakers near the ends are often rudimentary and can be counted only under magnification.

It may be difficult to count all of the rakers accurately while the first gill arch is in place, in which case it will be necessary to remove the arch. To do this, turn back or cut away gill cover as shown in Figure 3. Lift the first gill arch upward. With a sharp scalpel, cut between the dorsal ends of the first and second arches, making a deep incision parallel with them; then cut the remainder of the attachment away. Next cut the ventral attachment in the same manner; and when both ends are free, remove the arch. Great care must be taken so that all rudimentary rakers may be removed and counted. After finishing the examination of the arch, reinsert it in the gill chamber for possible future examination.

Gill Raker and Eye Comparison

The longest rakers are compared with the length of the eye (Fig. 4). With dividers, obtain the measurement of the length of the longest raker; then place one point of the dividers at the anterior edge of the eye, the other extending

Figure 2.—First gill arch of salmon after removal from left gill chamber: 1) gill raker; 2) gill rakers attached to upper or shorter limb of arch; 3) gill rakers attached to lower or longer limb of arch; 4) angle of arch (junction of the two limbs or bones); 5) gill filaments (lamellae); 6) upper point of arch attachment; 7) lower point of arch attachment.

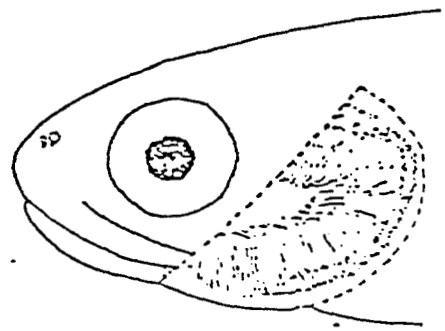


Figure 3.—Head of salmon. Dotted lines indicate that portion of gill cover which has been removed to show first gill arch in place.

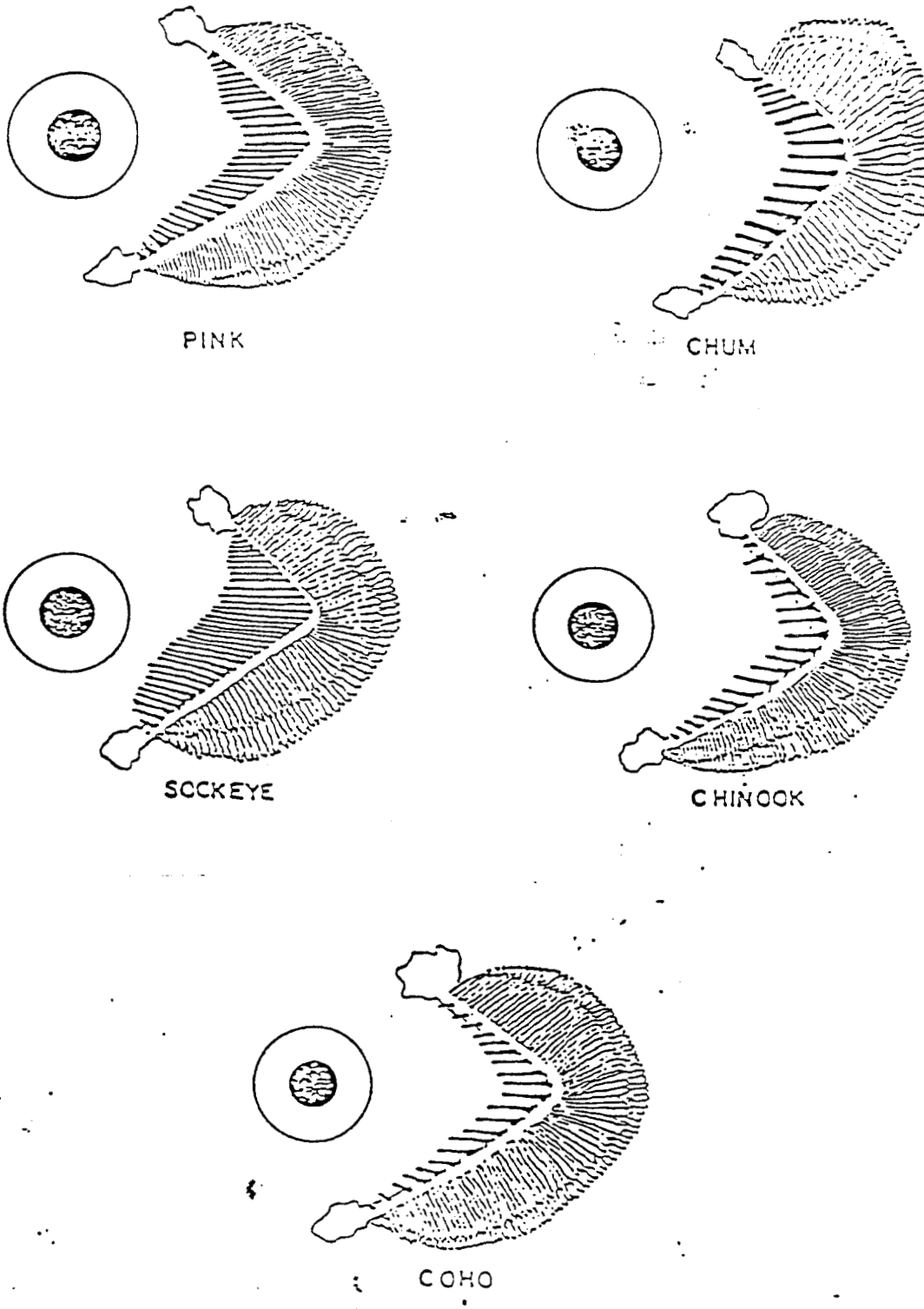


Figure 1.—First gill arch and eye for comparison with longest gill raker length of five species of Pacific salmon.

toward the opposite edge. Because the raker is shorter than the eye length in juvenile salmon, it is simplest to note where the raker reaches in relation to the pupil. Like many body part ratios, the gill raker-eye size ratios change as the juvenile salmon increases in length. For example, in specimens about 40 mm FL, the longest raker may be contained about 3 times the eye length, but in 140 mm specimens of the same species, the raker may be contained only about 2 times. This and other proportional changes must be considered.

Anal Fin Measurement and Count

To compare the length of the fin base with the longest ray, measure the anal fin base with dividers; then project the posterior leg of the dividers forward to the opposite tip of the longest ray as shown in Figure 5 by dotted line.

In counting the number of rays (Fig. 5), do not count those anteriormost ones which are less than half the length of the longest rays, such as those marked "0." Count all rays, such as No. 1, that are half (or more than half) the length of the longest ray, taking great care to observe the last ray—No. 15 in Figure 5. The last ray is usually split to its base and appears superficially as two rays, but it is in reality only one and should be counted as such.

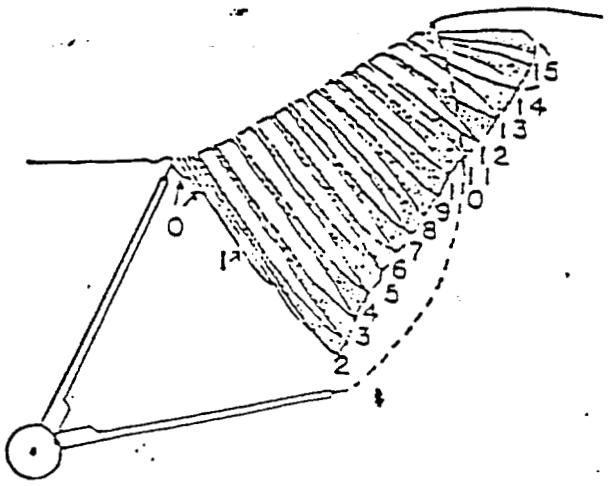


Figure 5.—Anal fin of salmon, illustrating method of measuring length of fin base and of counting rays (rays 2 to 15 are stippled here for emphasis).

Branchiostegal Count

All branchiostegals (Fig. 6), including the smallest, anteriormost ones are counted. Usually this may be accomplished satisfactorily only under magnification, and with juveniles longer than 40 mm FL. The branchiostegal count is used primarily as an additional character in specimens otherwise difficult to identify, and is especially valuable in separating the chinook salmon (usually 15 or 16) from the coho salmon (usually 13 or 14).

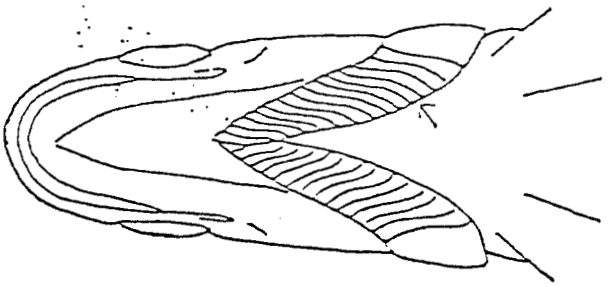


Figure 6.—Ventral surface of head of salmon. Arrow points to one of 14 branchiostegals on left side of head.

Pyloric Caeca Count*

With a scalpel, widely open the abdominal cavity. Sever the esophagus as far forward as possible; then cut off the intestine near the posterior end of the stomach. The stomach and caeca can now be removed as a unit (Fig. 7). Use magnification and teasing needle as aids in counting. Counts of pyloric caeca are useful chiefly as an additional character for questionable specimens, especially in separating the chinook salmon (more than 100 caeca) from the coho salmon (fewer than 90).

Color Pattern Variations

Juvenile salmon from certain waters or at certain stages of development may have their parr marks or other markings masked by a bluish-

*In the key, I have used pyloric caeca counts of my own, plus published accounts of others and especially the more recent ones, such as Clemens and Wilby (1961) and McPhail and Lindsey (1970).

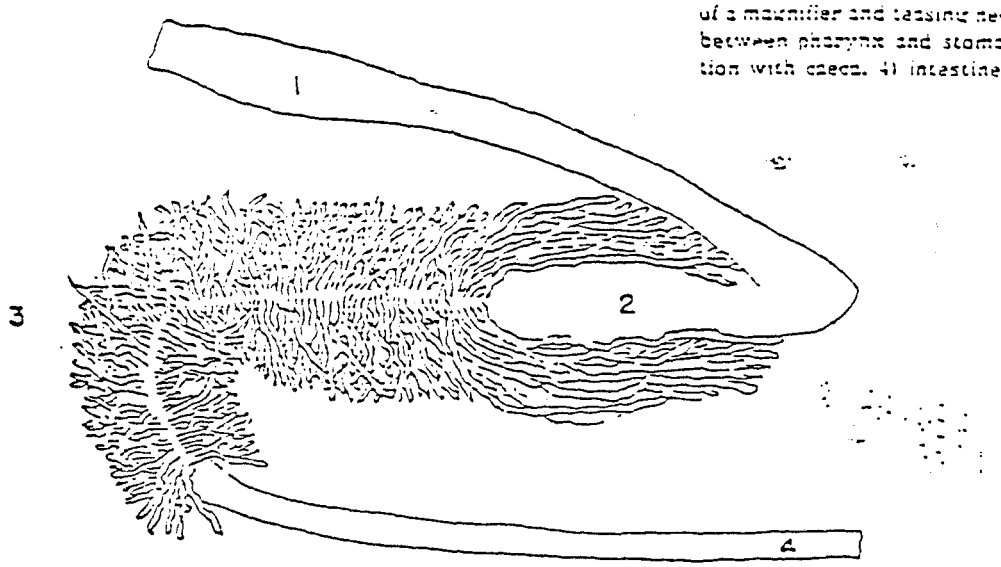


Figure 7.—Major portion of alimentary tract of salmon with pyloric caeca spread apart preparatory to counting with aid of a magnifier and teasing needle: 1) esophagus (part of tract between pharynx and stomach), 2) stomach, 3) pyloric section with caeca, 4) intestine.

or greenish-silvery sheen, especially when they are alive. To identify these fish, it may be necessary to preserve them first in Formalin to intensify their markings.

Juveniles of one species from certain waters, such as habitually turbid ones, may have their melanophores restricted in size or distribution, thereby resembling superficially another species. As an example, coho salmon normally have the adipose and anal fins densely speckled with rather large melanophores. But in some specimens, the melanophores may be reduced in size or distribution, so that coho salmon superficially resemble chinook salmon. Conversely, juvenile chinook salmon may have the melanophores unusually numerous and well developed, thereby resembling coho salmon. To avoid error in identification, compare the size and number of melanophores on the fins with those on the body; if few and small on the body, they should be few and small on the fins.

Color variations also occur regionally. An example is the predorsal stripe in chinook salmon, which in fish from some waters is normally a solid dark bar in specimens less than 80 mm FL; in chinook salmon in other waters the stripe may be reduced to a series of oblong blotches.

The length when individuals attain smolt coloration varies greatly, both regionally and in specimens from the same locality; some fish of the same species may lose parr and other presmolt markings when only half as large as other fish.

HOW TO USE KEY

Because of the variations in morphology and coloring, it is advisable to use the key in conjunction with the figures and plates and to check a large combination of characters.

In using the key, first make certain your specimen is a Pacific salmon by examining the characters under the two opposable groups labeled "1." Next, note the absence or presence of parr marks (see sections *"Combination of"* under opposable groups 2). If no parr marks are present and your specimen has not entered the silvery smolt stage, it is probably a pink salmon, but to make sure, compare it with the identifying characters between opposable groups 2. If parr marks are present, note the absence or presence of melanophores on adipose and anal fins (see groups 3). If melanophores are absent, see sections *"Combination of"* under groups 4; if present, see *"Combination of"* sections under groups 5. Decide which *"Combination of"* most closely fits your specimen, then verify it by comparing the descriptions of the identifying characters for the opposable groups.

KEY TO PRESMOLT JUVENILE SALMON

Salmonoid fishes having fewer than 20 rays in the dorsal fin (excludes graylings); strong teeth on jaws and tongue (excludes ciscoes and whitefishes); many pyloric caeca (excludes smelts, family Osmeridae); an axillary process or scaly appendage above pelvic fin (Fig. 1, No. 14); an adipose fin; cycloid scales; upper jaw formed by both premaxillary and maxillary ..... 1.

1a Base of anal fin *shorter* than longest ray (Fig. 5). Anal rays usually 9 to 12 (rarely 8 or 13). Gill rakers normally fewer than 20 on first gill arch (Fig. 3). Dorsal fin of larger juveniles of some species with several blackish spots.
CHAR, TROUTS, ATLANTIC SALMON ..... Not in this key.

1b Base of anal fin *longer* than longest ray (Fig. 5). Anal rays usually 13 to 17 (rarely 12, 18, or 19). Gill rakers normally 20 to 40 on first gill arch (rarely 19). Dorsal fin of larger juveniles lack blackish spots but tip of fin may be blackish.
PACIFIC SALMON—genus *Oncorhynchus* ..... 2.

2a *Combination of: No* parr marks on sides and *no* prominent specklings on back of presmolt juveniles. Usually no melanophores on anal and adipose fins; if melanophores present, they are few and very small, and if on adipose, are restricted to its posterior, free edge.
PINK (HUMPBACK) SALMON—*O. gorbuscha* ..... Plate 1.

General development—Similar to chum salmon in that yolk sac may not disappear until juvenile is more than 34 mm FL, after which development toward smolt shape and coloration is rapid. When less than 50 mm FL, this species is similar to chum salmon in being more terete than the sockeye, chinook, and coho salmon; body depth immediately before dorsal fin usually more than 1.5 times head length.

Parr marks—Only species of salmon lacking parr marks in the presmolt juvenile.

Coloration of body—*Preserved material*—In juveniles less than 40 mm FL, back is dark to lateral line and ventral half of body light when bicolored; dorsal third of body is darkest, sides lighter, ventral third lightest (usually milky-white or silvery) when tricolored. Few or no melanophores on lower sides and belly. In juveniles more than 40 mm FL, bicolored or tricolored condition is normally not evident, the dark back lightening gradually downward to the very light belly. *Living specimens*—Dorsal half of body bright bluish or greenish with much silvery reflection; ventral half milky or silvery-white.

Fins—Anal and dorsal fins averaging smaller than in chum salmon; these fins in this species and in chum salmon distinctly smaller than in sockeye, chinook, or coho salmon. In specimens less than 40 mm FL the longest anal ray, when measured into head length, extends from tip of snout to about center of eye; in larger presmolt juveniles, this measurement extends from tip of snout to anterior half of eye. Anal rays usually 14 to 16 (extremes 13 to 17). *Dorsal fin* has few specklings and only a slight tendency toward a dark anterior edge in juveniles less than 50 mm FL; over 50 mm, blackish anterior edge becomes pronounced and tip of fin dusky. *Caudal fin* has speckling confined to basal half in juveniles less than 50 mm; with increasing length of juveniles, specklings appear along rays, and in large presmolt juveniles lobes tend to become blackish.

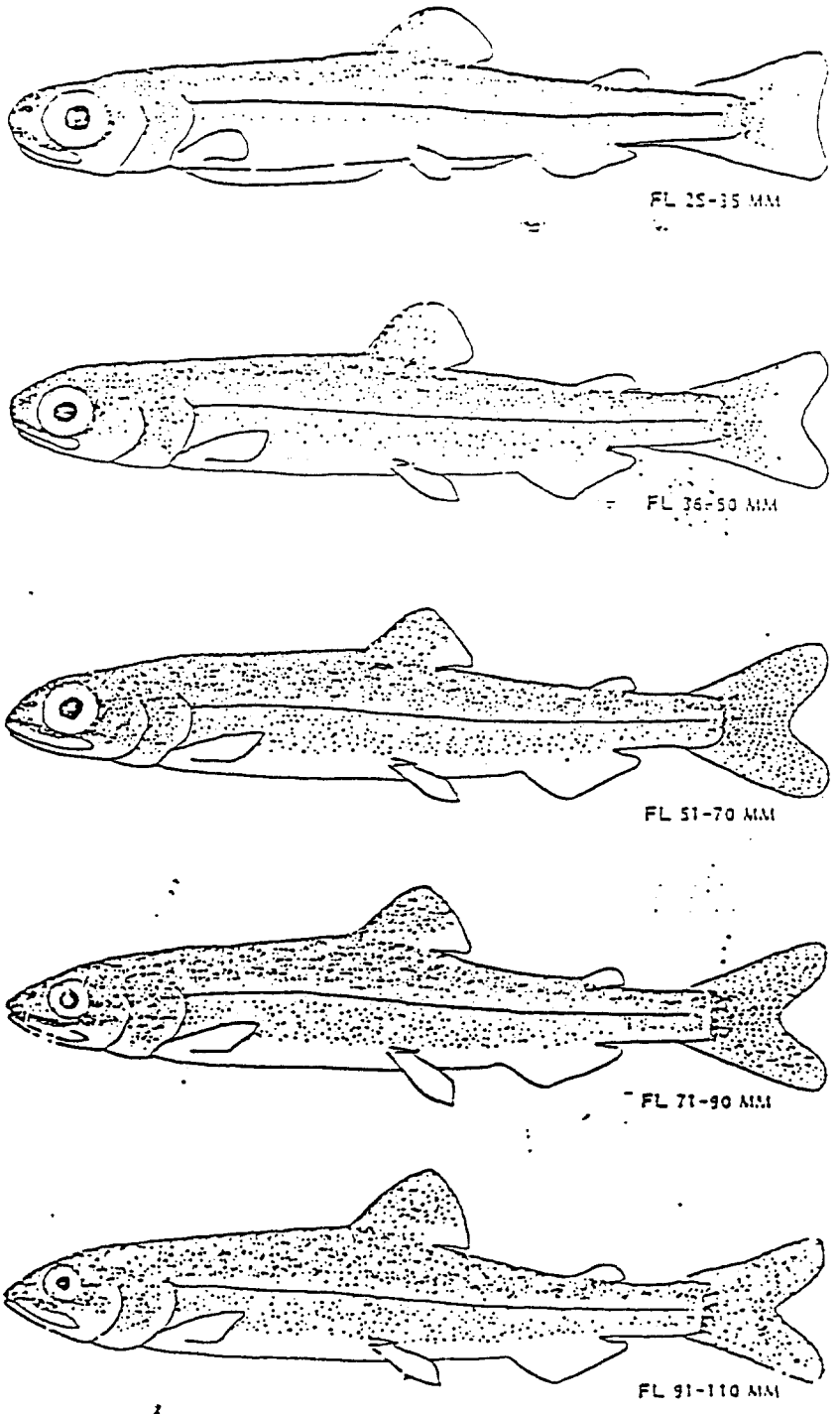


Plate 1.—Pink salmon.

Gill rakers (see Fig. 4)—Eleven to fourteen on upper limb, 14 to 19 on lower, total usually ranging between 27 and 33 (extremes 25 and 35); rakers slender and rather long; most similar in size and number to sockeye salmon but shorter and usually fewer (normally less than 31).

Pyloric caeca—Usually 130 to 195 (extremes 95 to 224); slender and rather long; differ sufficiently in numbers from coho and sockeye salmon, which have fewer than 100, to be a distinct aid in specific identification.

Branchiostegal rays—Usually 11 to 14 (rarely 10 or 15); average number less than in other species, almost invariably less than in chinook salmon, which usually has 15 to 18 (rarely 14).

Scales in lateral line—More than 170, more than in any other of the Pacific salmon; lateral line scale counts may be obtained under magnification in specimens longer than 60 mm FL.

Habits—Shortest life span of any species, between 18 mo and 2 yr. Only a comparatively small proportion of adults make extended migration in fresh water. Majority spawn in fresh waters within a short distance of brackish water or in intertidal waters. Many young enter brackish or salt waters within a few hours or days after emerging from redds, and comparatively few are found in fresh water when more than 45 mm FL.

2b *Combination of:* Both parr marks on sides and dark spottings on back usually obvious in living, presmolt juveniles and always in preserved specimens under magnification (may be faint in fishes from turbid waters); parr marks become faint and disappear as juvenile assumes smolt coloration ..... 3.

3a *No* melanophores normally present on adipose and anal fins of presmolt juveniles, or if present, few and quite small. Parr marks occupy a larger area above lateral line than below it, and in some specimens anterior parr marks may be almost entirely above the lateral line.
CHUM AND SOCKEYE SALMON ..... 4.

3b Melanophores normally obvious on adipose fin in living specimens and always in preserved specimens under magnification (may be indistinct in juveniles from silty waters). Anteriormost parr marks appear to occupy as large (or almost as large) an area below lateral line as above it; these parr marks are usually large, long, and wide.
CHINOOK AND COHO SALMON ..... 5.

4a *Combination of:* Gill rakers 19 to 26 (average 23), notably fewer and much shorter than in sockeye salmon, which have more than 28. Normally *no* melanophores on adipose and anal fins. Anterior squarish (quadrate) parr marks situated almost or entirely above lateral line in specimens less than 50 mm FL; in presmolt juveniles more than 50 mm FL, anterior parr marks tend to be long and very narrow and sometimes may extend well below lateral line.
CHUM (DOG) SALMON—*O. keta* ..... Plate 2.

General development—Similar to pink salmon in that yolk sac may not disappear until juvenile is more than 34 mm FL, after which development toward smolt shape is rapid. Also similar to pink salmon in being more terete (when less than 50 mm FL) than the sockeye, chinook, and coho salmon; body depth immediately before dorsal fin usually 1.5 to 1.8 times head length.

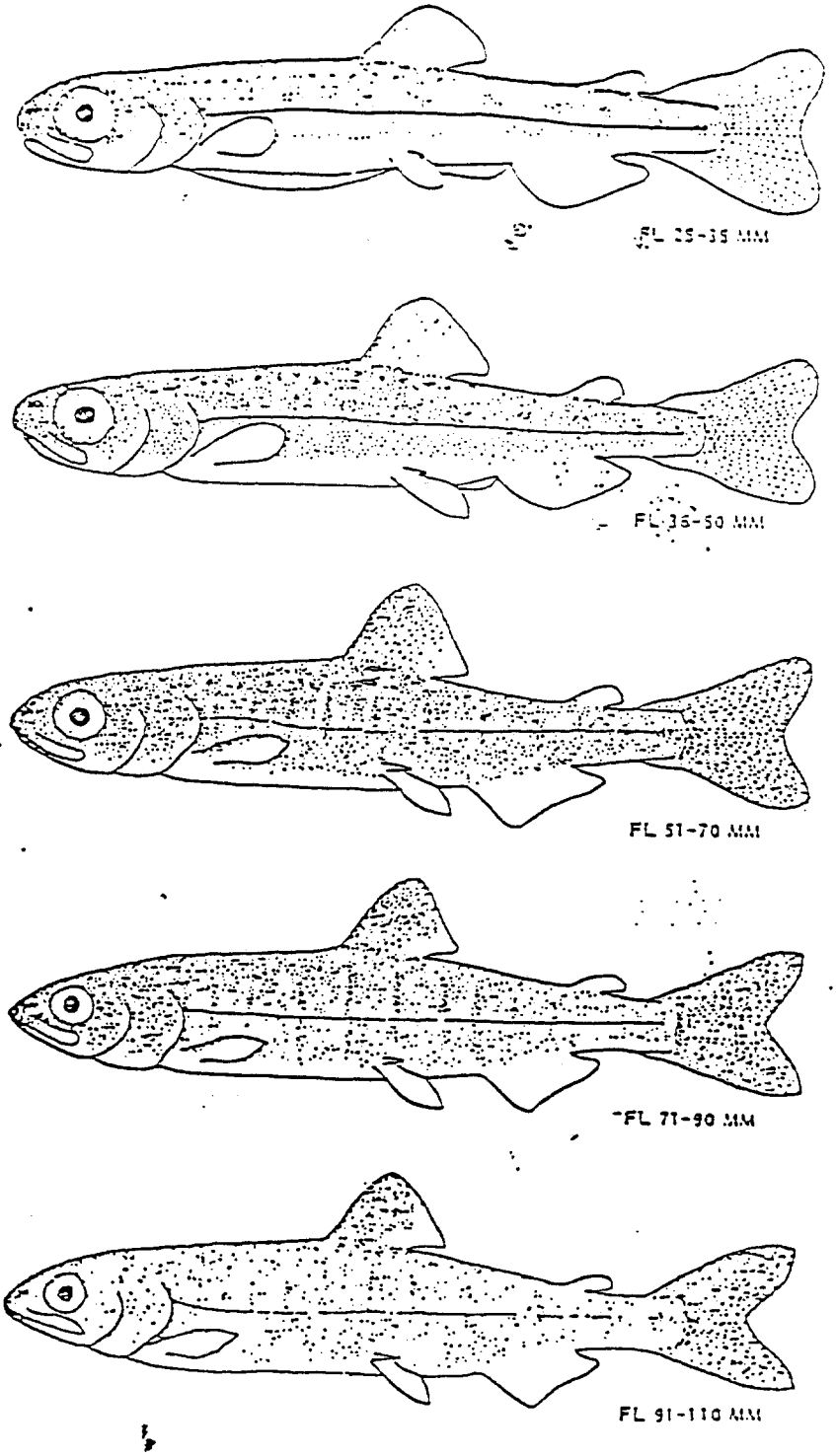


Plate 2.—Chum salmon.

Parr marks—Anterior parr marks in specimens less than 50 mm FL are more squarish (quadrate) and do not extend quite so far below lateral line as in sockeye salmon; in presmolt juveniles more than 50 mm FL, parr marks tend to become longer and more narrow than in sockeye salmon, and some tend to extend well below lateral line.

Coloration of body—*Preserved material*—Dorsal ridge stripe usually present, sometimes a series of blotches in juveniles less than 50 mm FL, becoming faint or disappearing in presmolt juveniles more than 50 mm FL; a prominent irregular row of spots and blotchings between dorsal ridge and upper edge of parr marks, these usually most distinct in specimens between 34 and 50 mm, often fading or disappearing in larger juveniles. *Living specimens*—Markings may be obscured by greenish or bluish overcast of dorsal half of body and whitish or silverish sheen of ventral half.

Fins—Anal and dorsal fins small, averaging slightly larger in size than those of pink salmon and averaging considerably smaller in height and area than those of sockeye salmon. Length of longest anal ray, when measured from snout to eye, reaches to, or almost to, center of eye; in sockeye salmon this measurement usually extends well beyond center of eye. Anal rays usually 13 or 14 (extremes 13 to 17). *Dorsal fin* has few or no distinct spottings in specimens less than 50 mm FL; in larger presmolt juveniles a dusky spot develops on tip. *Caudal fin* has faint spots largely confined to basal half in juveniles less than 50 mm FL; in larger juveniles lobes become blackish.

Gill rakers (see Fig. 4)—Seven to twelve on upper limb, 12 to 19 on lower, total usually ranging between 20 and 26 (extremes 19 to 30); rakers blunt and short, in sharp contrast to thinner, longer, and more numerous rakers of sockeye salmon, which has 30 to 39.

Pyloric caeca—Usually 160 to 185 (extremes 140 to 249); differ sufficiently in numbers from sockeye and coho salmon, which usually have fewer than 100, to be an aid in specific identification.

Branchiostegal rays—Usually 13 or 14 (extremes 12 to 16); of value primarily in separating this species from chinook salmon, which generally has more than 15.

Scales in lateral line—Between 125 and 155; of value chiefly in separating this species from pink salmon.

Habits—Life span usually 3 to 5 yr, for majority, 4 yr, some less than 3 yr. Jacks may occur. Majority spawn in fresh waters only a comparatively short distance from brackish water or in intertidal waters. Many young enter brackish or salt waters very shortly after emerging from redd, and few juveniles are found in fresh waters when more than 45 mm FL.

Combination of: Gill rakers 30 to 39 (average 36); notably more numerous, longer, and more slender than in chum salmon, which have fewer than 27. Normally *no* melanophores on adipose and anal fins. Anterior parr marks more rectangular than squarish in outline in specimens less than 45 mm FL and sometimes extend as much as a third to a half below lateral line; these oblong parr marks tend to shorten in presmolt juveniles more than 50 mm FL and to be mostly above lateral line.

4b

SOCKEYE (RED) SALMON—*O. nerka*. . . . . Plate 3

General development—Yolk sac usually disappears, except for trace, before juveniles reach 30 mm FL. Body deeper and species more slab-sided in all presmolt lengths than in chum and pink salmons—body depth immediately before dorsal fin usually less than 1.5 times head length.

Parr marks—See "*Combination of*" above.

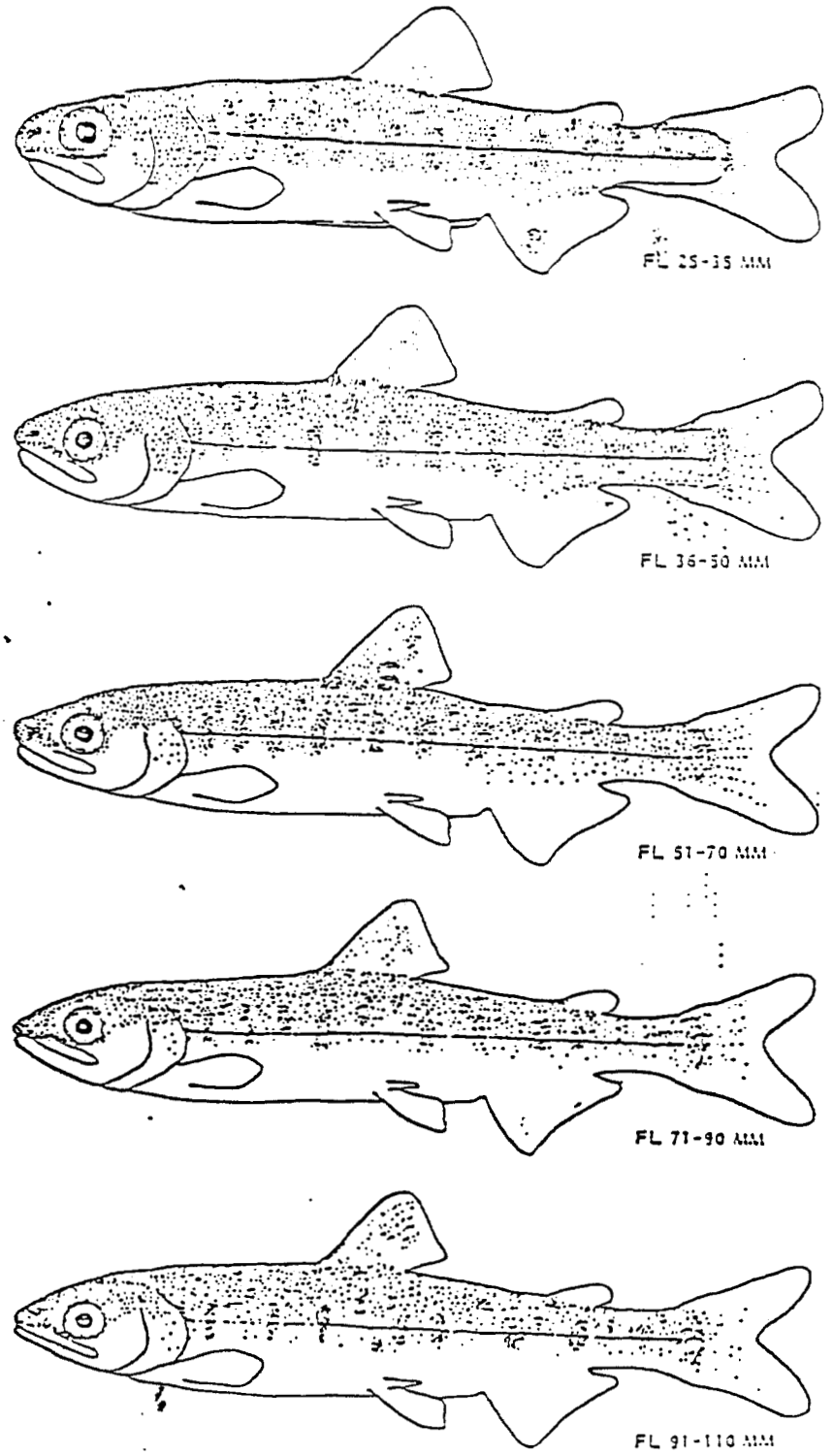


Plate 3.—Sockeye salmon.

Coloration of body—*Preserved material*—Dorsal ridge usually contains a series of more or less distinct spots in specimens less than 35 mm FL, becoming more confluent in fishes between 40 and 55 mm FL and sometimes merging into a dusky bar in presmolt juveniles over 60 mm FL, spots or bars may disappear, after which a series of roundish spots become apparent on both sides of, and adjacent to, dorsal ridge, especially that portion behind dorsal fin; in addition to these spots, in fishes more than 35 mm FL, another longitudinal row of spots develops between dorsal ridge and upper halves of parr marks. *Living specimens*—Markings may be obscured by greenish or bluish overcast of dorsal half of body and whitish or silverish sheen of ventral half.

Fins—Anal and dorsal fins average larger in height and area than in chum and pink salmon. Length of longest anal ray, when measured from snout to eye, reaches usually from snout to beyond center of eye. Anal rays usually 14 to 16 (extremes 13 to 16). *Dorsal fin* normally has few or no distinct specklings in specimens less than 60 mm FL; a rather faint dorsal spot develops in larger presmolt juveniles in upper portion of fin, the fin being bordered on its free edges with whitish (see lowest figure, Plate 3). *Caudal fin* has few specklings on basal half, the lobes having few or no melanophores, even in rather large juveniles.

Gill rakers (see Fig. 4)—Twelve to sixteen on upper limb, 18 to 23 on lower, total usually ranging between 32 and 37 (extremes 30 to 39); rakers long and slender, averaging longer than in any other species, in sharp contrast to fewer, blunter rakers of chum salmon, which has 19 to 30.

Pyloric caeca—Usually 65 to 95 (extremes 45 to 115); usually considerably fewer than in pink, chum, and chinook salmon, and averaging more than in coho salmon.

Branchiostegal rays—Usually 13 to 15 (extremes 11 to 16); of value chiefly in separating this species from chinook salmon, which average more.

Scales in lateral line—Between 125 and 140; of value chiefly in separating this species from pink salmon, which has a higher number.

Habits—Life span usually 4 or 5 yr, some only 3. Jacks may occur. Majority of individuals highly migratory. Adults usually spawn in streams tributary to lakes; a small minority spawn in streams without a lake, in lake outlets, or on lake beaches. After rising from redd, young move downstream rather rapidly to a lake, remaining usually 1, sometimes 2, and rarely 3 yr in fresh water before entering brackish or salt water.

Combination of: Melanophores on adipose fin usually most numerous on posterior half and generally forming a dark border (see Plate 4); anterior half of adipose with few melanophores or none. Anal fin with few melanophores or none, but when
5a melanophores are present, often quite large. Tip of dorsal fin and lobes of caudal fin darker in larger presmolt juveniles.

CHINOOK (KING) SALMON—*O. tshawytscha*. . . . . Plate 4.

General development—Yolk sac usually disappears or is reduced to a trace before juveniles reach 32 mm FL. Body deeper and species more slabsided in all presmolt lengths than in chum and pink salmon; body depth immediately before dorsal fin usually less than 1.5 times head length (range 1.1 to 1.5).

Parr marks—Almost invariably rectangular and long vertically; marks usually situated equidistant on each side of lateral line; dark parr marks and other markings contrast sharply with lighter background of body in some living and most preserved specimens.

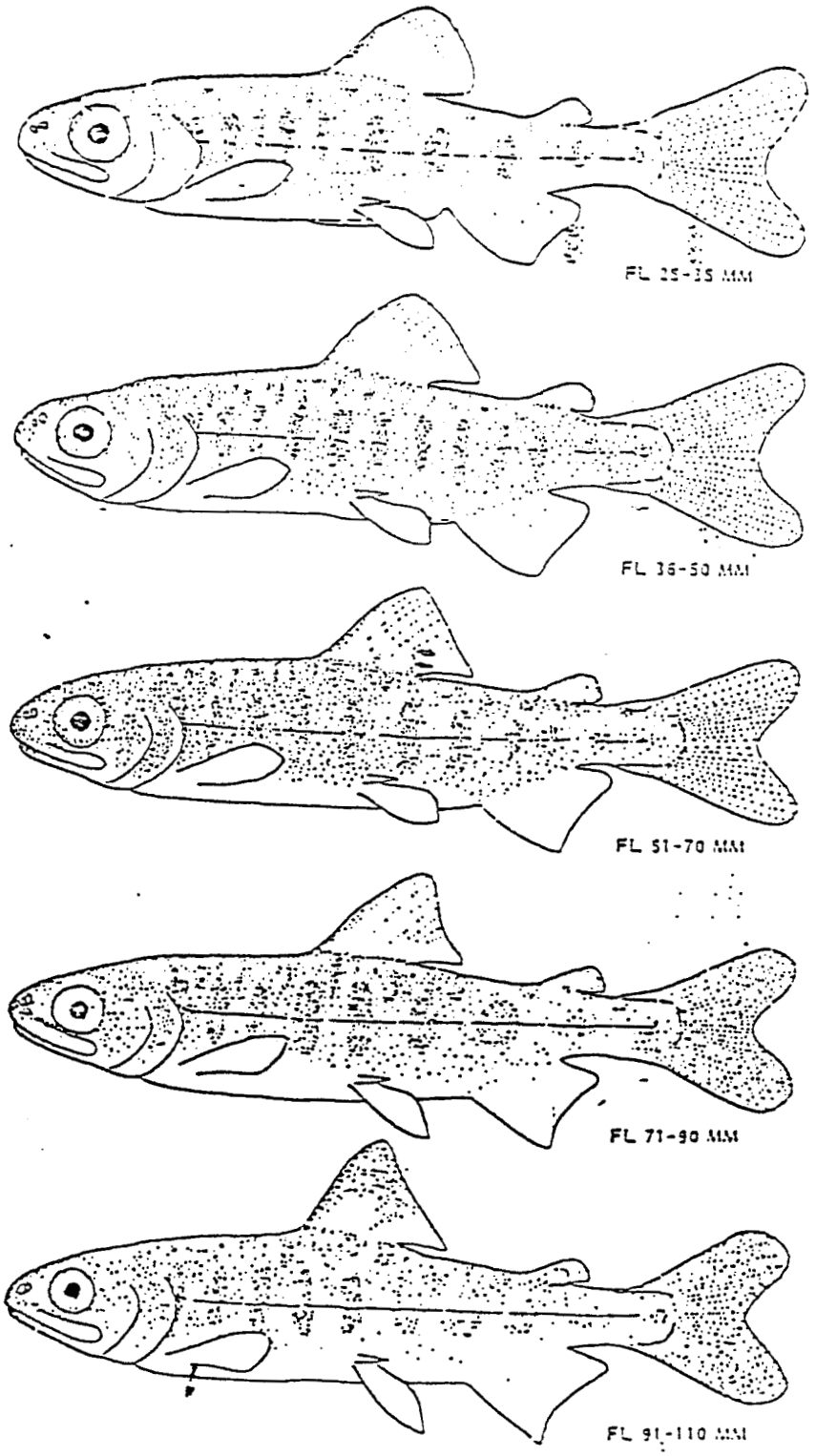


Plate 4.—Chinook salmon.

Coloration of body—*Preserved material*—Background color of body generally much lighter than body color of coho salmon, usually contrasting sharply with dark dorsal stripe or spotting, parr marks, and prominent dorsal spottings; blackish band astride dorsal ridge usually bold and unbroken in specimens less than 80 mm FL and especially on ridge before dorsal fin; in larger juveniles dorsal band often breaks up into series of spots, disappearing in larger presmolts as other spottings on dorsal half of body become more numerous and distinct; spottings between dorsal ridge and parr marks absent in fishes less than 35 mm FL, developing rapidly thereafter into many large and small spots and increasing in numbers as juveniles approach smolt stage. *Living specimens*—Parr marks and other markings may be obscured by bluish-silvery color of dorsal half of body and silvery sheen of ventral half.

Fins—Anal and dorsal fins averaging considerably larger in area than those of the chum and pink salmon and slightly larger than in the sockeye salmon; length of longest anal rays, when measured into head length, reaching from snout tip to beyond posterior edge of pupil and sometimes beyond posterior edge of eye; distal edge of anal slightly falcate in specimens more than 40 mm FL but averaging less falcate than does the free edge of the anal of the coho salmon. Anal rays 15 to 19, averaging higher in number than in any other species. *Dorsal fin* in young less than 60 mm FL usually has few or no distinct spottings, a blackish spot developing in the upper portion of the fin as the juveniles approach the smolt stage (see Plate 4). *Caudal fin* has comparatively few melanophores rather generally distributed in the smaller individuals, the lobes darkening as the fishes approach the presmolt stage.

Gill rakers (see Fig. 4)—Seven to twelve on upper limb, 10 to 16 on lower, total usually ranging between 20 and 25 (extremes 19 to 28); rakers short and similar in size and number to chum and coho salmon.

Pyloric caeca—Usually 140 to 185 (extremes 90 to 240); of value in separating this species from coho salmon, which normally has fewer than 85.

Branchiostegal rays—Usually 16 to 18 (extremes 13 to 19); average number greater than in any other species.

Scales in lateral line—Between 132 and 152; usually of most value in separating this species from pink salmon.

Habits—Life span 2 to 8 yr, usually 4 to 6. Jacks may occur. A portion of the juveniles enter salt water during first year of life; remainder stay in fresh waters more than 1 yr but rarely 2 yr. Juveniles of presmolt stage found in fresh waters when as long as 150 mm FL.

Combination of: Melanophores usually numerous and rather evenly distributed on adipose fin; occasionally in larger juveniles, posterior or free edge may be darker than remainder, thereby resembling somewhat melanophore distribution on adipose of chinook salmon. Anal fin in specimens larger than 30 mm FL more falcate and anterior tip more pronounced than in other species, including chinook salmon; in all except smallest specimens, anterior or leading edge of anal fin is whitish, with a dark bar parallel and posterior to it; remaining, posterior portion of fin usually abundantly speckled with melanophores except for distal and posterior edges (see Plate 5).

COHO (SILVER) SALMON—*O. kisutch*.

General development—Yolk sac usually disappears, except for a trace, before juveniles reach 32 mm FL. Body deeper and species more slab-sided in all pre-

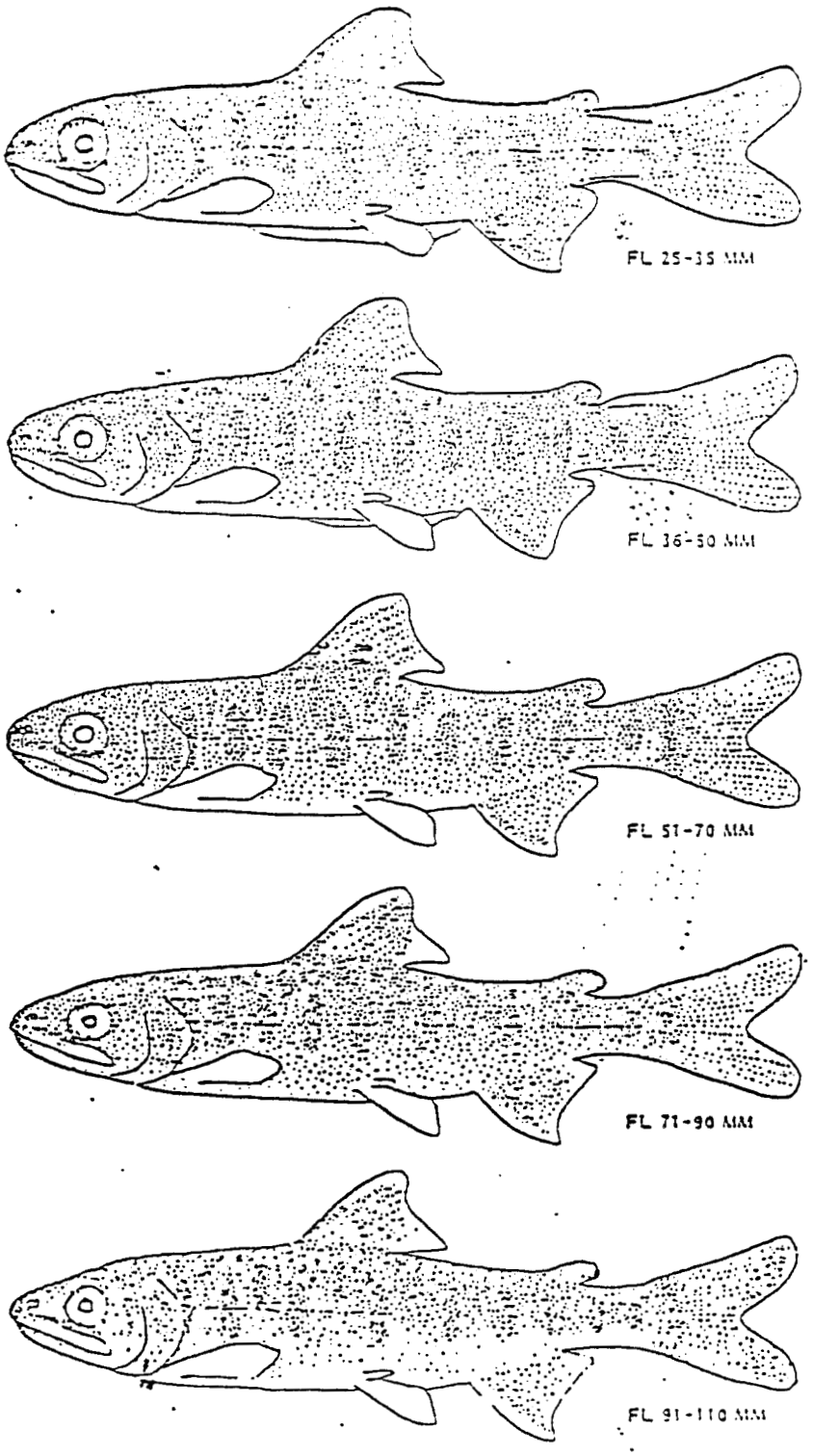


Plate 5.—Coho salmon.

smolt lengths than in chum and pink salmon; body depth immediately before dorsal fin usually less than 1.3 times head length (range 0.9 to 1.5).

Parr marks—Anterior parr marks always large and long vertically, their upper and lower ends more rounded than rectangular-shaped parr marks of chinook salmon; marks usually situated equidistant on each side of lateral line; usually less contrast between color of parr marks and body than in chinook salmon.

Coloration of body—*Preserved material*—In all but smallest specimens, contrast between all body marks and background color of body is not as pronounced as in other species; dark bar along dorsal ridge usually distinct and unbroken in juveniles less than 50 mm FL, breaking up into spots or disappearing in larger specimens; back spottings on both sides of dorsal ridge usually prominent in all except smallest specimens; spots between parr marks often elongate and extending downward between them, sometimes to lateral line (see bottom figure, Plate 5); spots on dorsal half of body often increase in number and/or decrease in size as individuals approach smolt stage. *Living specimens*—Parr marks and other body markings may be obscured by dark coloration of body or by bluish sheen.

Fins—Anal and adipose fins described under "*Combination of*" (this section). Anal rays usually 13 or 14 (extremes 13 to 16). *Dorsal fin* has comparatively few melanophores scattered over it in smallest specimens; in those more than 32 mm FL the number of melanophores increases, especially on or adjacent to anterior or leading edge; this results in a dark bar along the anterior edge behind which melanophores are rather evenly distributed; as fishes approach presmolt stage, a white anterior (or leading) edge and a whitish tip develops, followed by a dark parallel bar (see bottom figure, Plate 5). *Caudal fin* has rather even distribution of melanophores along rays in all except smallest young, this increasing in color intensity and number as fish increases in size.

Gill rakers (see Fig. 4)—Eight to thirteen on upper limb, 9 to 14 on lower, total number usually ranging between 19 and 27 (extremes 18 to 27); rakers short and rather similar in size and number to chum and chinook salmon.

Pyloric caeca—Usually 50 to 85 (extremes 45 to 114); of value in separating this species from chinook, pink, and chum salmon, which normally have more than 100.

Branchiostegal rays—Usually 13 or 14 (extremes 12 to 15); average number less than in chinook salmon, which normally has 15 or more.

Scales in lateral line—Between 120 and 140 (average 128); usually averaging fewer than in any other species.

Habits—Life span 2 to 4 yr. Jacks may occur. Majority appear to spend 1 or 2 yr in fresh waters, a few 3 yr. Some juveniles in presmolt stage are found in fresh waters when 150 mm FL.

GLOSSARY

Adipose fin A fleshy, finlike, rayless structure situated on dorsal ridge between dorsal and caudal fins (Fig. 1, No. 6).

Anal fin The fin situated medially and immediately behind vent between posterior end of abdomen and anterior end of caudal peduncle (Fig. 1, No. 16).

Axillary process or scale An accessory enlarged scale attached to upper or anterior base of pelvic fin (Fig. 1, No. 14).

Gill opening Opening between opercle or gill cover and side of head.

Branchiostegals or branchiostegal rays Elongated bones arranged fanwise within branchiostegal membranes, situated on ventral edge of gill covers (Fig. 6).

Caudal fin Terminal or tail fin of fishes (Fig. 1, No. 12).

Caudal peduncle That region of body between base of posterior ray of anal fin and base of caudal fin (Fig. 1, No. 11).

Chromatophores Color cells which under control of sympathetic nervous system can be altered in shape, producing color changes.

Cycloid scales Smooth-edged scales of soft-rayed fishes having an evenly curved posterior border devoid of minute spines.

Dorsal fin In salmons, a single fin composed of rays situated dorsally on body approximately halfway between head and tail (Fig. 1, No. 4).

Dorsal ridge Apex or dorsal junction of left and right sides of body; dorsal and adipose fins are situated on this ridge (Fig. 1, No. 3-6).

Dorsal stripe A band on dorsal ridge which is lighter or darker than adjacent areas.

Falcate Curved like a sickle; a fin is falcate when its distal edge is concave, having middle rays shorter than anterior and usually posterior rays.

Filaments See *gill filaments*.

Fork length Distance in a straight line from anteriormost part of tip of upper jaw or snout of juvenile salmons to apex of angle produced by two lobes of caudal fin (Fig. 1, No. 1).

Gill arch Branchial skeleton which contains gill rakers and gill filaments, or lamellae (Fig. 2).

Gill cover, opercle, or operculum Large, very flat, thin bones on each side of head which cover gills (see Fig. 3, which has the major portion of the gill cover removed).

Gill filaments (lamellae) Pleated folds of skin, richly supplied with blood vessels, attached to posterior edge of gill arch (Fig. 2, No. 5).

Gill rakers Projections on anterior edge of first gill arch (Fig. 2, No. 1).

Head length Distance in a straight line from anteriormost part of upper jaw or snout to posterior margin of opercle (Fig. 1, No. 2).

Hypural Complex of expanded and fused bones of last few vertebrae which support caudal fins in certain fishes.

Jack Precocious male salmon which spawn after spending a year or two less in the ocean than the majority of individuals; they are notably smaller than average size of spawning males of their species.

Juvenile As used here, a salmon between 25 and 110 mm FL which has not entered smolt stage.

Lamellae See *gill filaments*.

Lateral line A line formed by a series of sensory tubes and pores extending along sides from head to tail (Fig. 1, No. 10).

Lateral line scale count A count of pored scales from first scale on body behind head posteriorly to above hypural.

Melanophores Chromatophores with dark or black pigment.

Parr marks Squarish or oblong blotches or pigmented areas along sides of presmolt salmonids (Fig. 1, No. 9).

Pectoral fins Anterior or uppermost of paired fins of fishes, one on each side of breast immediately behind head (Fig. 1, No. 13).

Pelvic fins A ventral pair of fins, abdominal in salmonids (Fig. 1, No. 15).

Postdorsal ridge That portion of dorsal ridge behind dorsal fin (Fig. 1, No. 5).

Predorsal ridge That portion of dorsal ridge before dorsal fin (Fig. 1, No. 3).

Presmolt A juvenile salmon with parr marks; in pink salmon, which lack parr marks, demarcation between a presmolt and smolt is slight, differing chiefly in latter's more adult shape.

Pupil of eye Opening in iris of eye by which light reaches retina. It is circular in fishes (Fig. 1, No. 7).

Pyloric caeca Fingerlike diverticula, usually glandular, which open into alimentary canal

of most fishes at junction of stomach and intestine in region of pylorus (Fig. 7, No. 3).

Rakers See *gill rakers*.

Redd Excavation or nest made by a spawning salmon.

Rudimentary Very small and poorly formed, pertaining here chiefly to smallest gill rakers and anal rays (Fig. 5, "0").

Slab-sided When depth of body, measured before dorsal fin, is considerably greater than width of body.

Smolt As used here, a young salmon which has lost its parr marks. Pink and chum salmon fry usually go to the ocean within a few days of emerging from the streambed and usually do not undergo a visible change in morphology or color in fresh water.

Subadult An individual similar to an adult and approaching adulthood in age and size but still incapable of breeding.

Terete Nearly cylindrical in cross section and tapering toward the front and rear.

ACKNOWLEDGMENTS

Publications such as this are possible only because of aid given by many individuals. I wish to acknowledge the aid and encouragement given me by Robert J. Ellis, George Y. Harry, Jr., Wilbur L. Hartman, William R. Heard, David T. Hoopes, Theodore R. Merrell, Jr., Jay C. Quast, and William A. Smoker, and to the many field men, students, and others who have tested the key.

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Key to Field Identification of Anadromous Juvenile Salmonids in the Pacific Northwest

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ABSTRACT

A key is presented with descriptive illustrations to help in field identification of live, juvenile salmonids in fresh waters of the Pacific Northwest. Other juvenile fish that may be mistakenly identified as salmonids are included.

INTRODUCTION

Species identification of live, anadromous juvenile salmonids is frequently a problem to the field biologist. The purpose of this key is to list and illustrate the external characteristics which will expedite field identification of juvenile salmonids in the Pacific Northwest.

Five species of Pacific salmon (pink, chum, sockeye, chinook, and coho); four species of trout (cutthroat, brown, Dolly Varden, and rainbow or steelhead); and other juvenile and adult fish [1] that may be mistaken for salmon or trout in fresh water are described in this key.

USE OF KEY

The characteristics for identification are listed in a series of alternative statements, some of which are illustrated. To use the key, examine the first statement; if applicable, proceed to the next and continue to successive statements until the species is identified. If a statement is not applicable, pass to the alternative characteristics indicated by numbers in parentheses (numbers on the drawings correspond to numbers of statements in the key). Continue in this manner until the specimen is identified. Some external characteristics are positive separating features (marked with asterisk), whereas others are not. Therefore, two or more statements should be considered before final rejection. If a precise identification cannot be made using the external characteristics—and the fish can be sacrificed, a positive identification can usually be made from internal features (marked with double asterisks). A bibliography of keys that utilize more descriptive internal characteristics is included in this paper.

KEY

1. (47) Adipose fin and scales present. (Fig. 1)
2. (48) Fleshy appendage at base of pelvic fins present.
3. (49) Mouth large, reaching at least to center of eye.

Family Salmonidae

[1] Especially adult smelt, family Osmeridae.

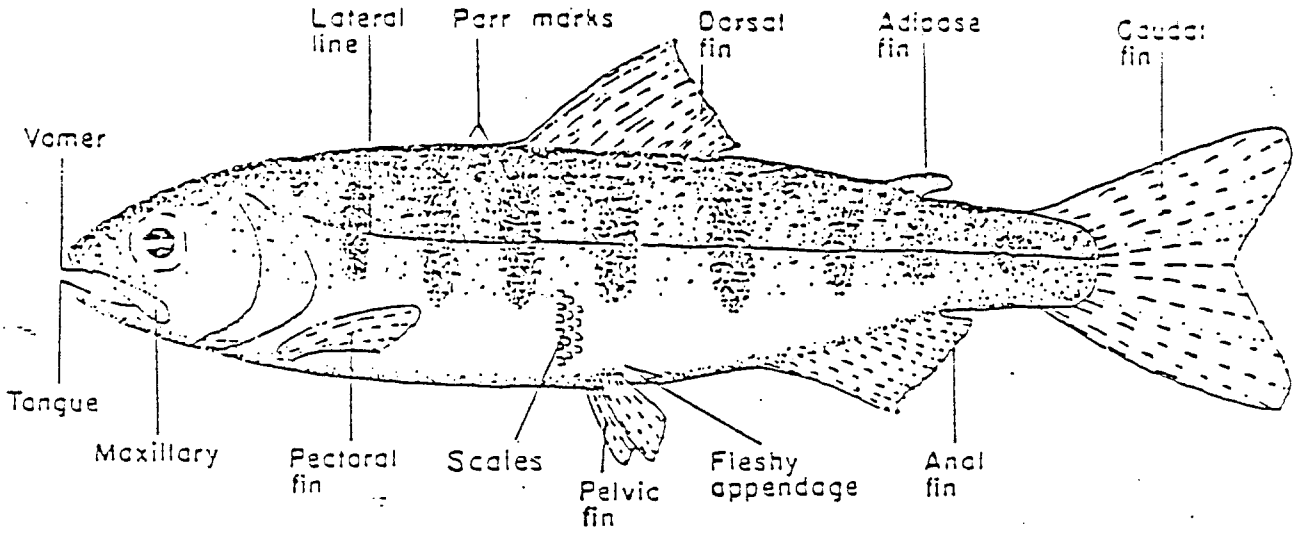


Figure 1.—A hypothetical salmonid showing external characteristics.

4. (17) Anal fin higher than long, with 8 to 12 developed rays (Fig. 2A).
5. (52) *Teeth on head and shaft of vomer. (Fig. 3A)

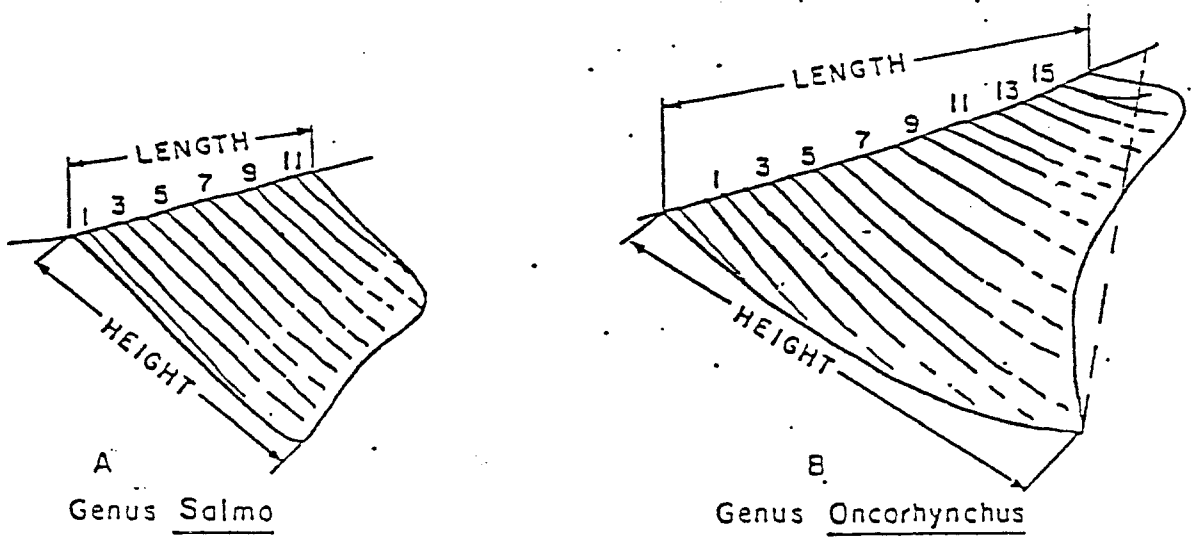


Figure 2.—Anal fins: (A) Trout, genus *Salmo;* (B) Pacific salmon, genus *Oncorhynchus.* The two drawings show differences in structure and fin ray count. (Note that the length of the anal fin is its overall basal length, and its height is that distance from the origin of the fin to the tip of the anterior lobe. In counting fin rays, include only those which originate from the base and terminate at the outer margin of the fin or are half as long as [or greater than] the longest ray.)

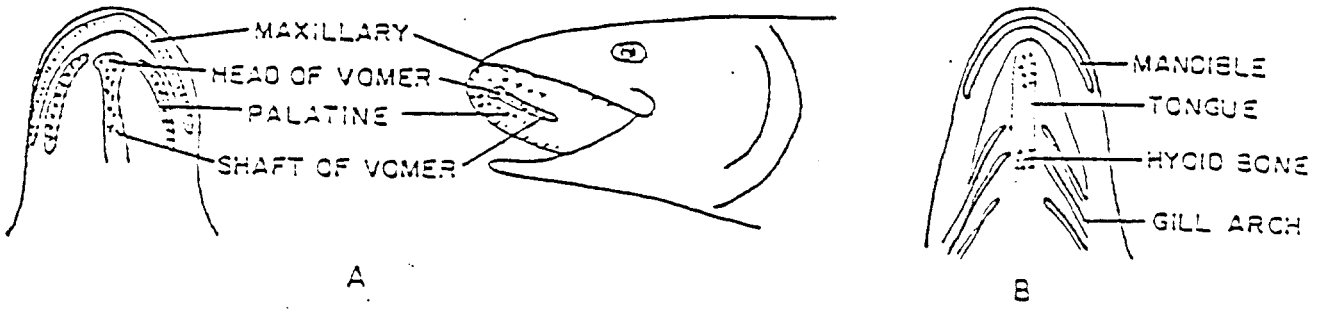
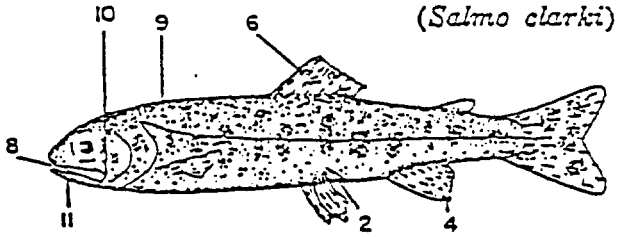


Figure 3.—Location of dentition in (A) the roof and (B) the floor of the mouth of salmonid fishes. (Presence or absence of teeth on the vomer or tongue may be determined by use of the little finger or a blunt instrument. The small hyoid teeth at the base of the tongue are located between the gill arches of the lower jaw and are difficult to find.)

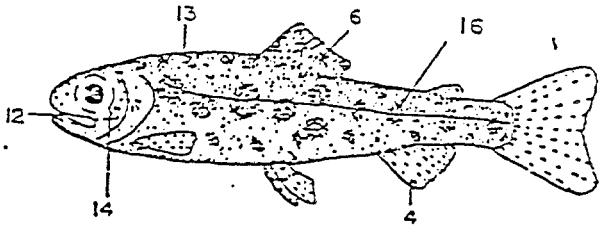
6. (18) Dorsal fin with large dark spots.
Trout
Genus *Salmo*

7. (53) Adipose fin not orange; no row of pale round spots along lateral line.
8. (12) *Small hyoid teeth at base of tongue. (Fig. 3B)
9. (13) Not more than five parr marks on mid-dorsal ahead of dorsal fin.
10. (14) Maxillary reaching past posterior margin of eye.
11. (15) Red or yellowish hyoid mark under lower jaw. Tail usually black spotted.
Cutthroat trout
(*Salmo clarki*)



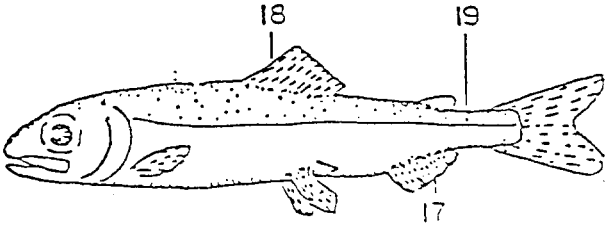
12. (8) *No teeth at base of tongue.
13. (9) Five to 10 parr marks along mid-dorsal ridge ahead of dorsal fin.
14. (10) Maxillary short, not reaching past posterior margin of eye.
15. (11) No hyoid mark under lower jaw. Few or no spots on tail.

16. (20) Parr marks almost round.
Rainbow or steelhead trout
(*Salmo gairdneri*)



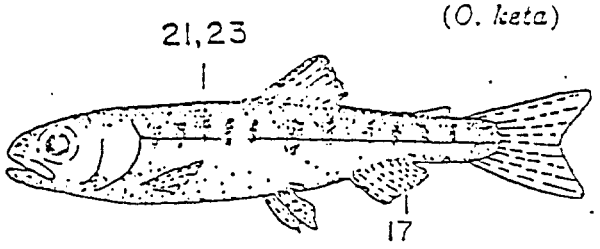
17. (4) Anal fin longer than high, with 13 or more developed rays. (Fig. 2B)
18. (6) Dorsal fin without large dark spots, may be black tipped.
Pacific salmon
Genus *Oncorhynchus*

19. (20) No parr marks. Fry leave fresh water while small—approximately 1.75 inches (45 mm) long.
Pink salmon
(*O. gorbuscha*)



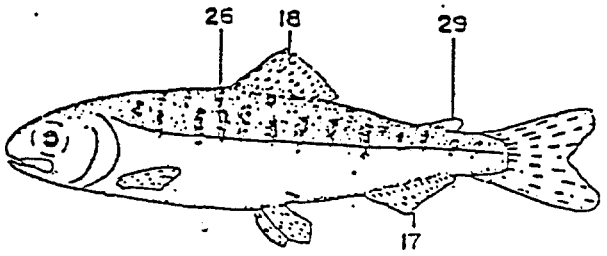
20. (16) Parr marks present as vertical bars or oval spots.
21. (20) Parr marks short, extending little, if any, below lateral line.
22. (25) Gill rakers on first arch, 19 to 26. ** Pyloric caeca, 140 to 186.
23. (26) Parr marks faint. Sides below lateral line iridescent green.
24. (27) Small when migrating from fresh water, approximately 1.5 inches (40 mm) long.

Chum salmon
(*O. keta*)



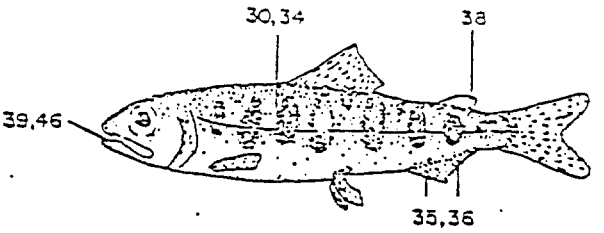
25. (22) Gill rakers on first arch, 30 to 40. **Pyloric caeca 60 to 115.
26. (23) Parr marks usually sharply defined. Sides below lateral line silvery, not iridescent green.
27. (24) Relatively large when migrating from fresh water, approximately 3 to 5 inches (80 to 126 mm) long.
28. (31) Gill rakers long and slender, more than 29 on first arch.
29. (32) Adipose fin clear, not pigmented.

Sockeye salmon
(*O. nerka*)



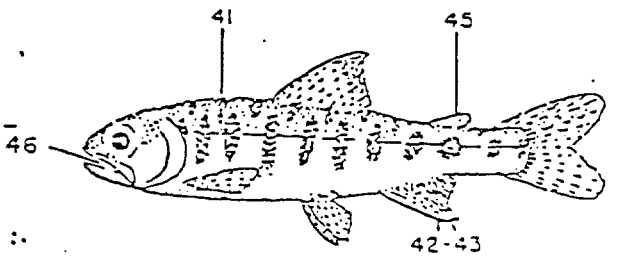
30. (21) Parr marks large, vertical bars centered by lateral line.
31. (28) **Gill rakers short and thick, fewer than 29 on first arch.
32. (29) Adipose fin at least partially pigmented.
33. (40) **Pyloric caeca more than 90.
34. (41) Parr marks broader than interspaces.
35. (42) Anterior rays of anal fin not distinctly longer than rest, not white edged.
36. (43) Anal fin not pigmented.
37. (44) Black spots, when present, on both lobes of caudal fin.
38. (45) Adipose fin not completely mottled, clear area at anterior base of fin.
39. (46) Black gums along base of lower teeth.

Chinook salmon
(*O. tshawytscha*)



40. (33) **Pyloric caeca less than 80.
41. (34) Parr marks narrower than interspaces.
42. (35) Anterior rays of anal fin elongated; when depressed they extend to base of last ray. (Fig. 2B)
43. (36) Anal fin pigmented between rays, resulting in black banding.
44. (37) Black spots, when present, on upper lobe of caudal.
45. (38) Adipose fin completely pigmented.
46. (36) Mouth gray to white.

Coho salmon
(*O. kisutch*)



47. (1) Adipose fin not present; scales present or lacking.
Not Salmonidae

48. (2) No fleshy appendage at base of pelvic fins.
Smelts
Family Osmeridae

49. (3) Mouth small, not reaching center of eye; teeth weak or absent.

50. (51) Depressed dorsal fin, shorter than head.
Whitefishes
Genus *Coregonus*

51. (50) Depressed dorsal fin, longer than head.
Arctic grayling
(*Thymallus arcticus*)

52. (5) **Teeth on head of vomer only.
Chars
Genus *Salvelinus*
Dolly Varden (*S. malma*)

53. (7) Adipose fin orange; row of distinct pale round spots along lateral line.
Brown trout
(*Salmo trutta*)

ACKNOWLEDGMENTS

We especially thank Dr. Arthur D. Welander, Professor of Fisheries, and Dr. Bruce S. Miller, Research Biologist, College of Fisheries, University of Washington, Seattle, for their valuable suggestions. We also thank Galen H. Maxfield, Fishery Biologist, and Dr. Alan J. Beardsley, Fishery Biologist, both from the NMFS Northwest Fisheries Center, Seattle.

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Appendix C. Material Safety Data Sheet (MS222).

terial Safety Data Sheet ...
be used to comply with
Hazard Communication Standard,
1910.1200 Standard must be
sulted for specific requirements.

U.S. Department of Labor
Occupational Safety and Health Administration
(Non-Mandatory Form)
Form Approved
OMB No. 1218-0072

ENTITY (As Used on Label and List)	Note: Blank spaces are not permitted. If any item is not applicable, or no information is available, the space must be marked to indicate that.
NQUEL	

ction I

Manufacturer's Name	Emergency Telephone Number
gent Chemical Laboratories, Inc.	(206)885-3777
ress (Number, Street, City, State, and ZIP Code)	Telephone Number for Information
02 152nd Avenue N.E.	(206)885-3777
dmond, WA 98052	Date Prepared 3-4-92
	Signature of Preparer (optional)

ction II — Hazardous Ingredients/Identity Information

Hazardous Components (Specific Chemical Identity, Common Name(s))	OSHA PEL	ACGIH TLV	Other Limits Recommended	% (optional)
oic acid,3-Amino,Ethyl Ester, Methanesulfonate	NA	NA	NA	

MUS LD50:180mg/kg
FRG LD50:250 mg/kg

y be harmful by inhalation, ingestion, or skin absorption.
y cause irritation.

FCS #DG2455000 CAS# 886-86-2

ction III — Physical/Chemical Characteristics

ng Point	NA	Specific Gravity (H_2O = 1)	NA
por Pressure (mm Hg)	NA	Melting Point	148°C
por Density (AIR = 1)	NA	Evaporation Rate (Butyl Acetate = 1)	NA

lubility in Water
1 g/0.8 mls at 20°C

pearance and Odor
White powder with slight to no odor.

ction IV — Fire and Explosion Hazard Data

ash Point (Method Used)	Flammable Limits	LEL	UEL
A.	NA		

tinguishing Media
ater spray, Carbon Dioxide, Dry Chemical, Alcohol or Polymer Foam

l Fire Fighting Procedures
self-contained breathing apparatus and protective clothing to prevent contact
ith skin and eyes.

ual Fire and Explosion Hazards
ites toxic fumes under fire conditions-nitrogen oxides, sulfer oxides, carbon
onoxide, carbon dioxide.

TRICAIN METHANESULFONATE
(MS 222, Prefuran)

MS222 is used as an anesthetic for fish. It is generally a safe chemical and there are not special precautions called for on the Material Safety Data Sheet, however, common sense should be used when handling any chemical. Avoid breathing dusts and, of course, ingestion. If skin irritation occurs, use rubber gloves.

HEALTH HAZARDS:

Avoid inhaling MS222 or getting into the eyes. Treated fish destined for food must be held in fresh water above 10° C for 21 days before consumption. There is no other information available at this time on health hazards.

FIRST AID:

EYE CONTACT:
Flush eyes with water.

SKIN CONTACT:
Flush with water.

INGESTION:
No information available at this time.

INHALATION:
No information available at this time.

SYMPTOMS OF OVEREXPOSURE:

Not known at this time.

Appendix D. AWL forms and standard procedures for recording data.

The sample size is 70 sockeye salmon smolt per day, five days a week. If daily sampling objectives are being met, sampling will not occur on Wednesday and Sunday. It is essential that the sample be taken randomly. In the event that more than the required sample size is in the smolt trap at the time of sampling, the trap is to be stirred to assure randomness. When the smolt are randomly distributed, a small dip net will be used to remove a subsample. This procedure will be repeated until the sample size goal is met.

AWL Forms

Smolt length and weight will be recorded on AWL forms (Appendix D.1). Using a No. 2 pencil, complete each section of the left side of the AWL and darken the corresponding blocks:

Description: Include species (sockeye smolt), location, year, and samplers.

Card: The AWL forms and corresponding slides are numbered sequentially by date throughout the season starting with # 001. A new, consecutively numbered, card is used each day even if the previous card is not completed. There may be a minimum of one fish and a maximum of 40 fish (8 slides) per AWL.

Species: Refer to the reverse side of the AWL form to obtain species; sockeye = 2.

Day, Month, Year: Use the appropriate digits for the date the fish are sampled.

District, Subdistrict, Stream, Location: Consult project leader for the appropriate codes.

Period: List the period in which the fish were sampled using Appendix D.2.

Project: Refer to the reverse side of the AWL form to obtain code; code 4 will be used as default since a specific smolt code does not exist.

Gear: Refer to the reverse side of the AWL form to obtain code; 00 = trap.

Mesh: Leave blank.

Type of Length Measurement: Refer to the reverse side of the AWL form to obtain code; 1 = Tip-of-snout to fork-of-tail.

Number of Scales: Mark 1 (refers to 1 smear/fish)

# of Cards: Mark 1 (each AWL form is individually numbered)
Keep the litho codes in numerical order throughout the season and be sure to transfer the litho code from the front left side to the backside of the AWL form. These forms will be optically scanned and stray marks may be misinterpreted. It is the crew leaders responsibility to make sure that all forms are carefully edited before returning them to your supervisor.

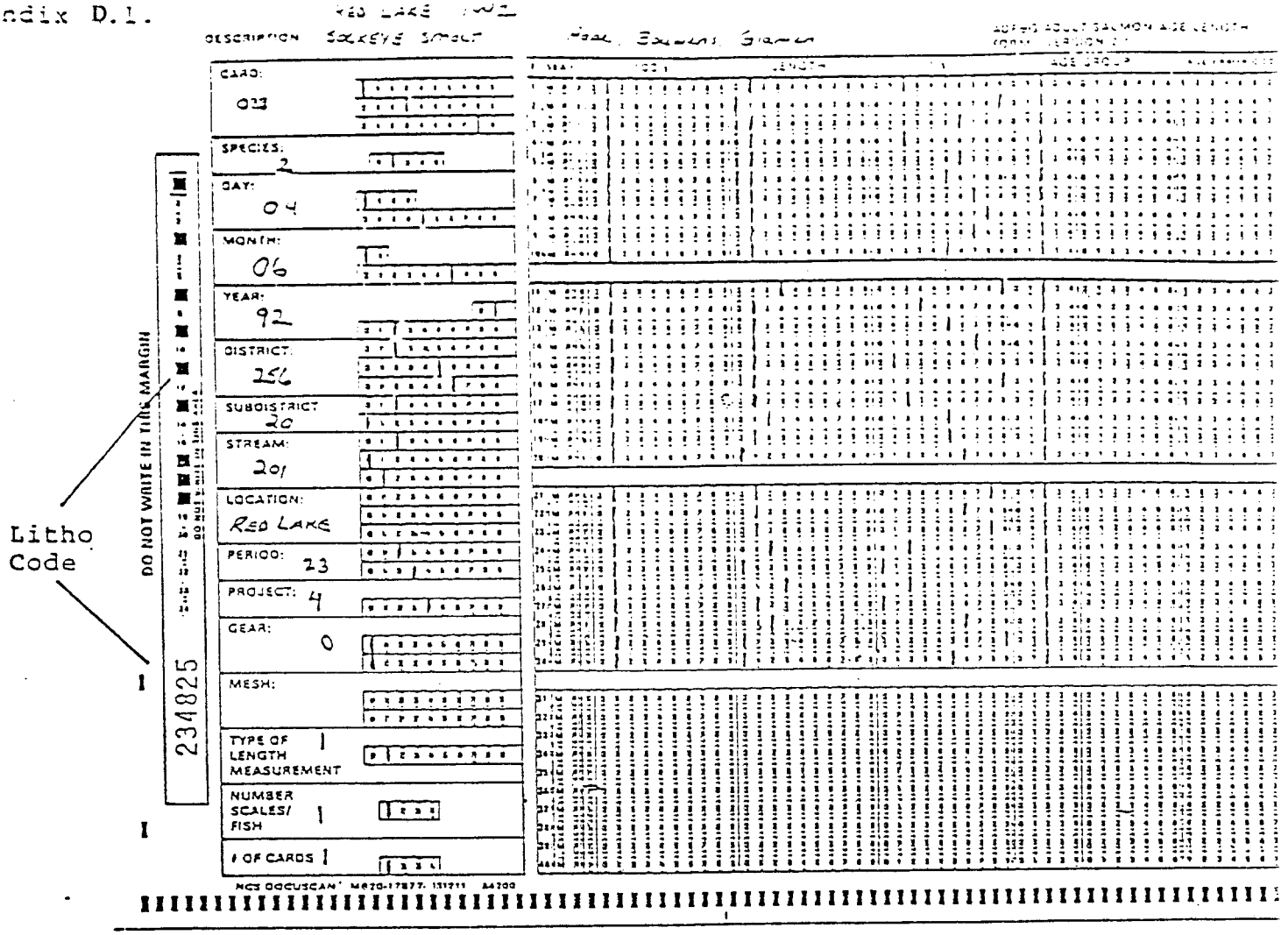
Sampling procedure

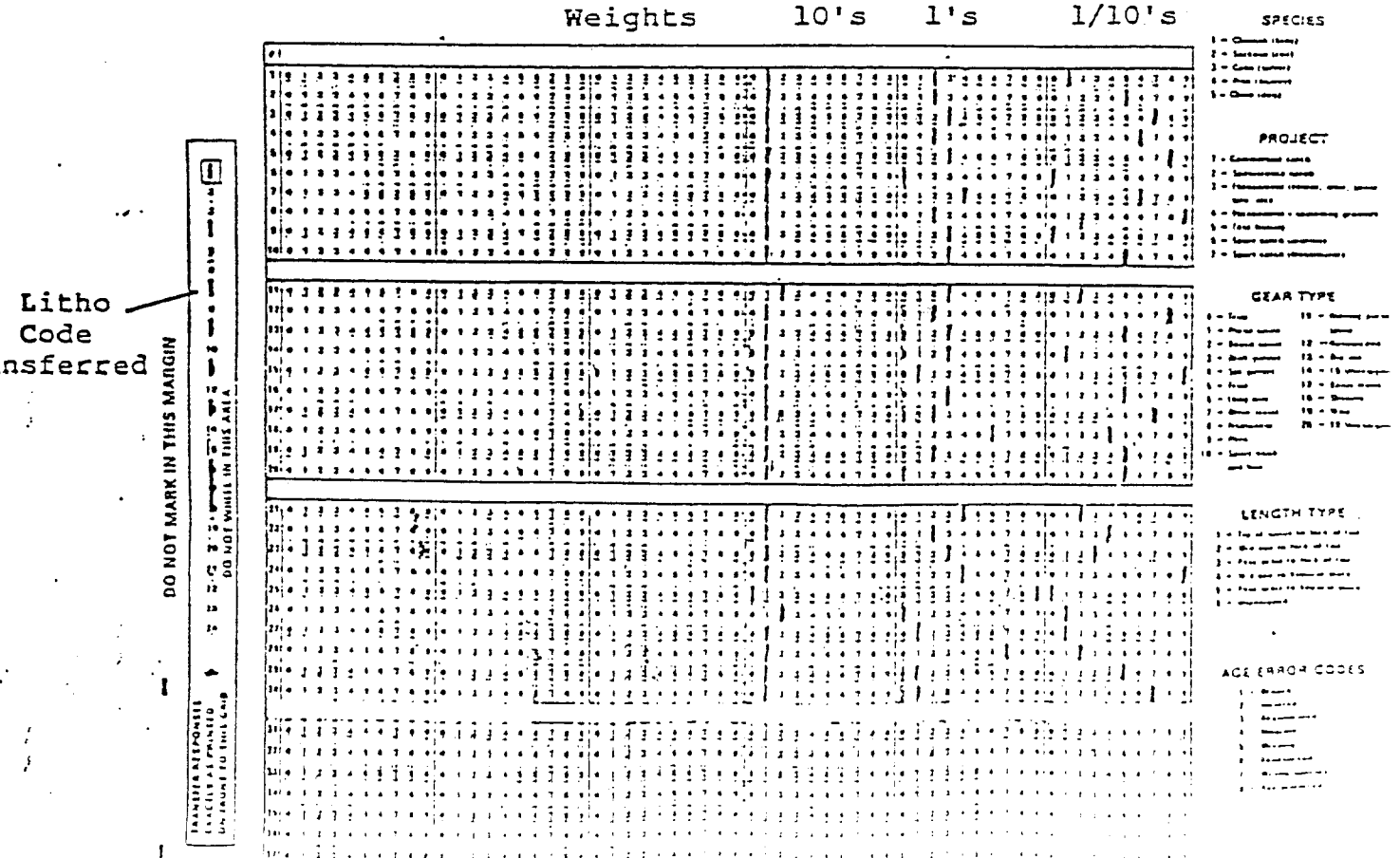
Smolt will be kept alive and sampled the day of capture. MS222 will be used to anesthetize the fish. The use of this chemical will be demonstrated in the field. A flattened probe will be used to remove 5-10 scales from the preferred area, consult Appendix D.3. The scales will be mounted on a glass slide as illustrated in Appendix D.4. The left portion of each slide will be labeled: location, date, AWL # (card #), and fish numbers (1-5, 6-10, 11-15, etc.). When the slides are completed, return them to the box in order, and label the box as shown in Appendix D.4. Smolt lengths will be measured in millimeters from the tip of the snout to the fork of the tail, Appendix D.5. Record each length by darkening the appropriate column blocks on the AWL form.

Excess water will be removed from the smolt before weighing by using a paper towel blotter. Individual smolt weights will be recorded to the nearest 0.1 gram on the backside (right side) of the AWL form (Appendix D.1).

Take care to ensure length and weight data corresponds to the appropriate scale smear as this information is used to calculate condition factor at age. When sampling for age, length, and weight, rite-in-rain books may be used to record data. After sampling is done, transfer the data carefully to the AWL forms. **It is the responsibility of the crew leader to make sure the data has been transferred correctly and the AWL form is filled out completely.**

Appendix D.1.

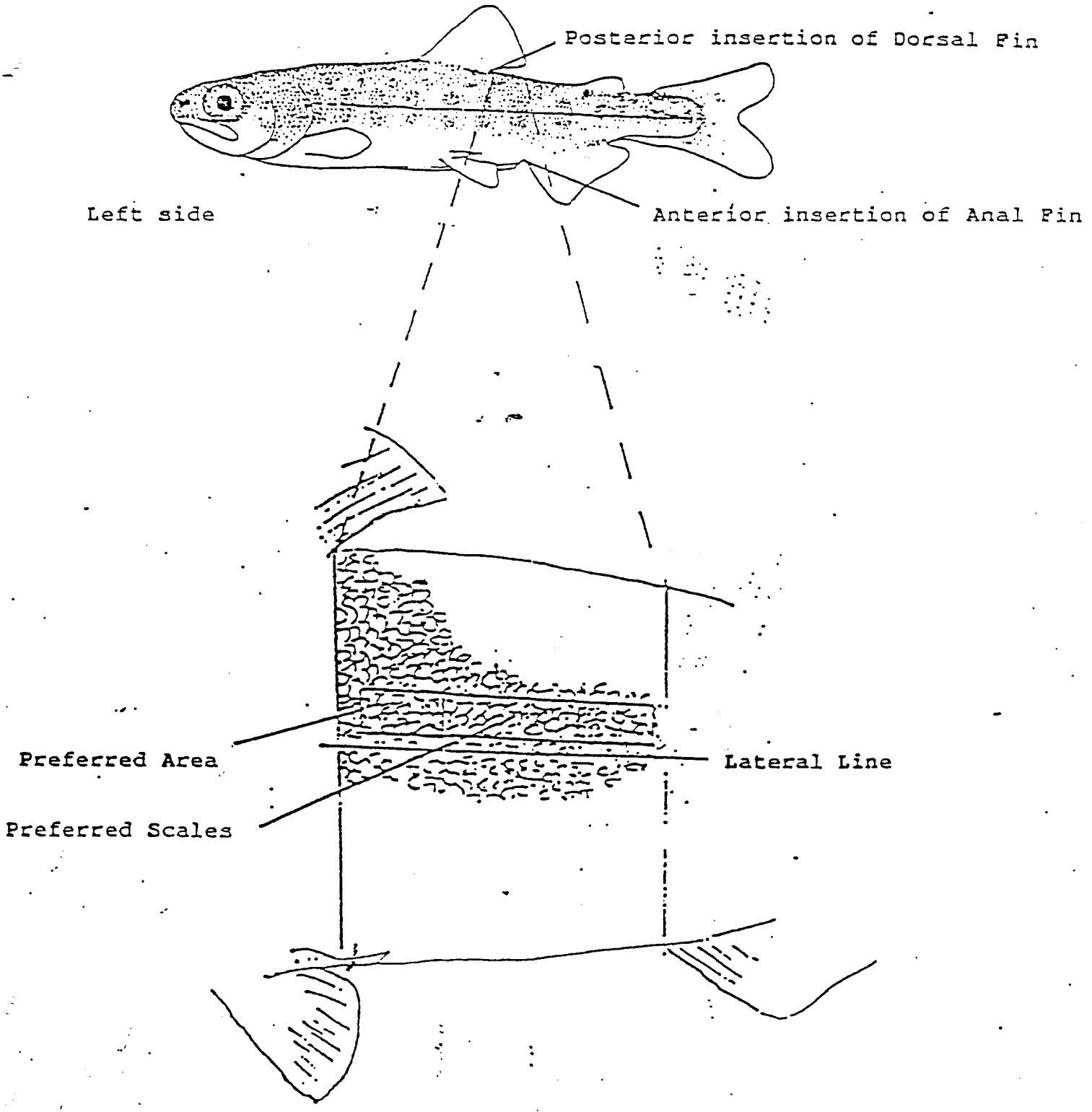

RED LAKE
DESCRIPTION SOCKEYE SMOLT
CARD: 013
SPECIES: 2
DAY: 04
MONTH: 06
YEAR: 92
DISTRICT: 256
SUBDISTRICT: 20
STREAM: 201
LOCATION: RED LAKE
PERIOD: 23
PROJECT: 4
GEAR: 0
MESH:
TYPE OF LENGTH MEASUREMENT 1
NUMBER SCALES/ FISH 1
OF CARDS 1
234825
DO NOT WRITE IN THIS MARGIN
Litho Code


Weights 10's 1's 1/10's
SPECIES
PROJECT
GEAR TYPE
LENGTH TYPE
AGE ERROR CODES
DO NOT MARK IN THIS MARGIN
Litho Code Transferred

Appendix D2. Period codes and corresponding dates.

Period	Dates	Period	Dates
1	01-Jan to 03-Jan	28	05-July to 11-July
2	04-Jan to 10-Jan	29	12-July to 18-July
3	11-Jan to 17-Jan	30	19-July to 25-July
4	18-Jan to 24-Jan	31	26-July to 01-Aug
5	25-Jan to 31-Jan	32	02-Aug to 08-Aug
6	01-Feb to 07-Feb	33	09-Aug to 15-Aug
7	08-Feb to 14-Feb	34	16-Aug to 22-Aug
8	15-Feb to 21-Feb	35	23-Aug to 29-Aug
9	22-Feb to 28-Feb	36	30-Aug to 05-Sep
10	01-Mar to 07-Mar	37	06-Sep to 12-Sep
11	08-Mar to 14-Mar	38	13-Sep to 19-Sep
12	15-Mar to 21-Mar	39	20-Sep to 26-Sep
13	22-Mar to 28-Mar	40	27-Sep to 03-Oct
14	29-Mar to 04-Apr	41	04-Oct to 10-Oct
15	05-Apr to 11-Apr	42	11-Oct to 17-Oct
16	12-Apr to 18-Apr	43	18-Oct to 24-Oct
17	19-Apr to 25-Apr	44	25-Oct to 31-Oct
18	26-Apr to 02-May	45	01-Nov to 07-Nov
19	03-May to 09-May	46	08-Nov to 14-Nov
20	10-May to 16-May	47	15-Nov to 21-Nov
21	17-May to 23-May	48	22-Nov to 28-Nov
22	24-May to 30-May	49	29-Nov to 05-Dec
23	31-May to 06-June	50	06-Dec to 12-Dec
24	07-June to 13-June	51	13-Dec to 19-Dec
25	14-June to 20-June	52	20-Dec to 26-Dec
26	21-June to 27-June	53	27-Dec to 31-Dec
27	28-June to 04-July		

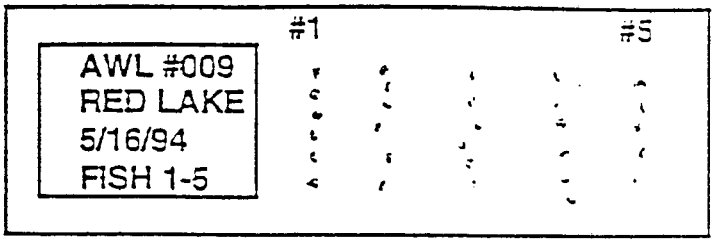
Appendix D.3. Scale sampling procedure showing the preferred area on a smolt salmon.

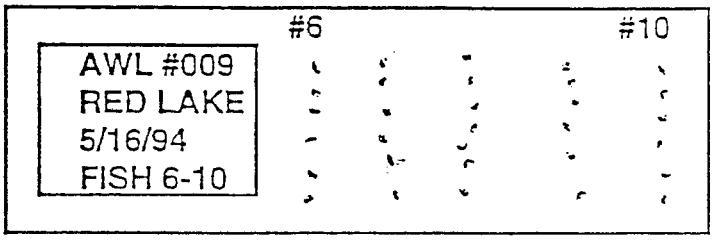


Appendix D.4 Salmon smolt glass slide example.

The following information should be legibly written on the slide label:

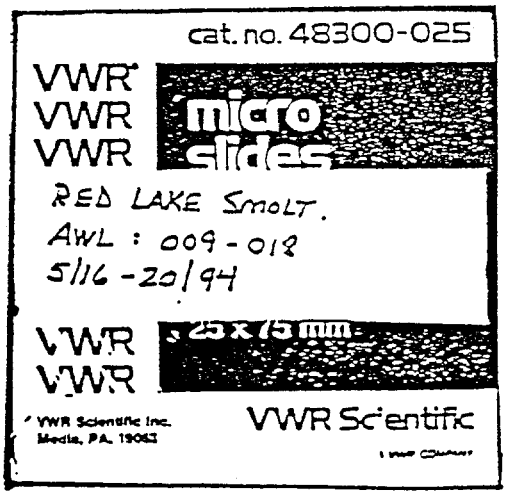
1. AWL #
2. Location
3. date (mo/day/yr)
4. Fish # (1-5, 6-10,...35-40)





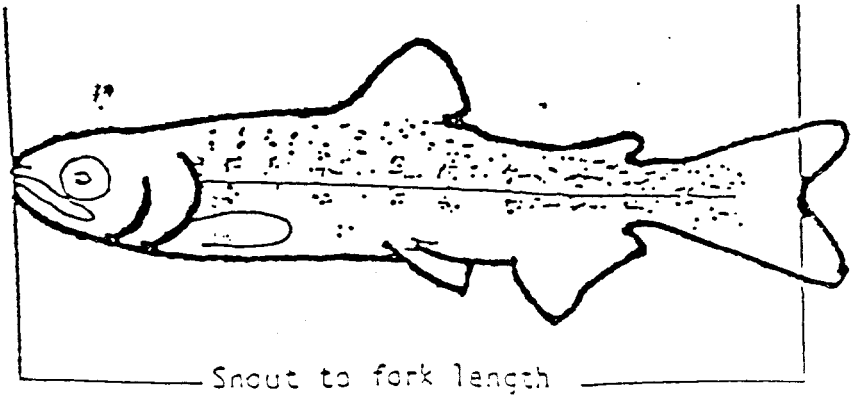
When the slides are completed, return them to the box in order by AWL #, date, and fish #. Label the slide box on top with the following information:

LOCATION (RED LAKE)
AWL NUMBERS (AWL # 009 - 018)
BEGINNING AND ENDING DATES (5/16 - 20/94)



Appendix D.5

MEASURING SMOLT LENGTH



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