4K90-21

KODIAK MANAGEMENT AREA

SALMON RESEARCH OPERATIONAL PLANS FOR 1990

Regional Information Report[1] 4K90-21

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

September 1990

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KODIAK MANAGEMENT AREA
SOCKEYE AND COHO SALMON ESCAPEMENT SAMPLING

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

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OBJECTIVES

1. Determine the age composition, average length by age, and sex composition of selected sockeye escapements within the Kodiak Management Area. Conduct the same for selected coho salmon escapements.

2. Publish the results in a Regional Information Report.

SUPERVISION

The Area Biologist, Larry Malloy, and the Assistant Area Biologist, Dave Prokopowich will supervise escapement sampling at all weir projects except Frazer and Akalura Lakes weirs which are addressed under separate operating plans. Research Biologist Pat Holmes will monitor the weekly escapement sampling schedule addressed in this plan. Patty Roche will monitor incoming scale samples for correct data recording and scale mounting techniques and will routinely notify weir crew leaders and the Area Biologist on the data quality.

PROCEDURES

Sockeye Salmon

Selected systems will be sampled for sockeye age, length, and sex (ALS) data.

Weekly, 240 sockeye salmon will be sampled for ALS (age, length, sex) data at Uganik River, Karluk River, Red River, and Upper Station weirs (Table 1 and Figure 1). The weekly sampling should be performed on the fifth day (Thursday) of each week. If the required sample (240 fish) cannot be obtained on the designated day, sampling may be shifted to another day. The weekly sample should be collected from a single day's escapement; if necessary, it may be collected over a 2-day period. The crew leader will notify Larry Malloy or Dave Prokopowich by radio when each weekly sample is collected. Completed samples will be sent to the Kodiak office as soon as possible after collection.

Completed ALS data from Karluk River weir will be mailed to Kodiak from the Karluk Post Office (return receipt) weekly. Please notify the Kodiak office via radio schedule when ALS data are sent.

A 600-fish sample will be taken from both the early and late sockeye escapements at the Afognak River weir. A single sample of 600 fish will be sampled from the Saltery River weir, at the peak of the escapement (Table 1). The biologist or technician stationed at the weir will notify Pat Holmes if sampling assistance is required.

Three samples of 240 fish will be taken at the Pauls Lake weir during the peak of the escapement. If sampling is not possible at the weir, a single sample of 600 will be taken by beach seine at the mouth of the stream. A single sample of 240 fish will be taken at the Buskin Weir by the Sport Fisheries Division near the peak of the escapement.

Table 1. Sockeye salmon escapement sampling schedule, 1989.

Location	Sampling Frequency	Statistical Week		Sample Size
		Starting	Ending	
Karluk weir	weekly	23	40	240
Red River weir	weekly	23	40	240
Upper Station weir	weekly	23	40	240
Afognak weir (early)	once	24 or 25		600
Afognak weir (late)	once	29		600
Little River Lake	once	24		600
Uganik Lake weir[a]	weekly	23	40	240
Saltery River weir	once	28 or 29		600
Buskin Lake weir[b]	once	24 or 25		240
Pauls Lake weir	weekly	24	26	240
Kaflia Lake	once	28 or 29		600

[a]Sampled by USFWS. A single 600 fish sample will be taken by ADF&G if USFWS is unable to sample at the weir.
[b]Sampled by Sport Fisheries Division.

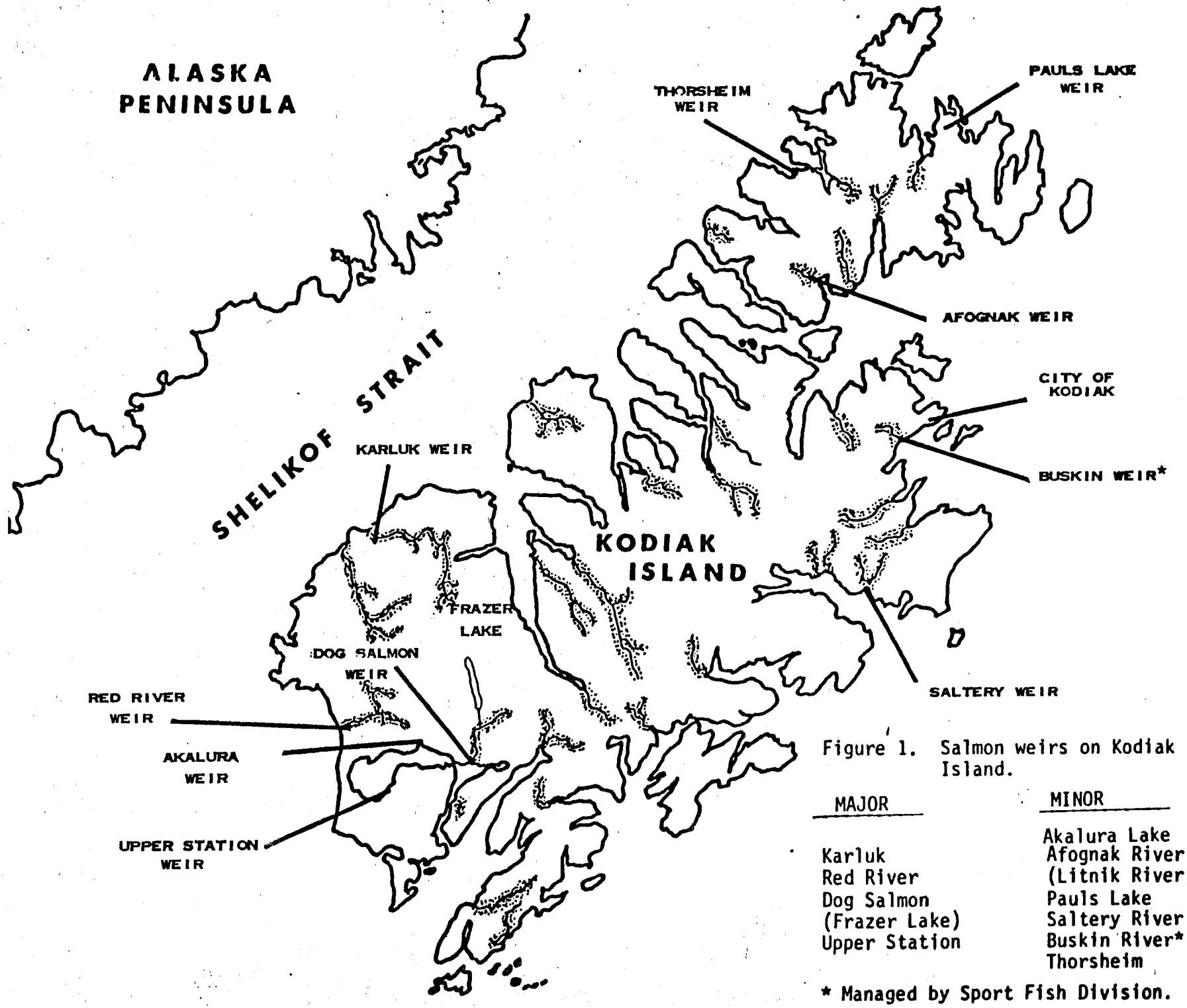


Figure 1. Salmon weirs on Kodiak Island.

MAJOR	MINOR
	Akalura Lake
Karluk	Afognak River
Red River	(Litnik River)
Dog Salmon	Pauls Lake
(Frazer Lake)	Saltery River
Upper Station	Buskin River*
	Thorsheim

* Managed by Sport Fish Division.

At Little River and Kaflia Lakes 600 sockeye salmon will be sampled for ALS data using a beach seine near the escapement peak. Pat Holmes will be responsible for obtaining these samples.

It is essential that all ALS samples be representative of the escapements. Therefore to avoid bias there should be no pre-selection of fish from either a live box or seine for size, sex, condition or any other factor. Collection and recording procedures for ALS sampling are in Appendices A and B.

Sampling schedules in this plan are referenced by statistical week. A list of the 1990 statistical weeks with corresponding calendar days is in Table 2.

Coho Salmon

Coho escapement sampling will occur at Karluk River, Red River, Upper Station Creek, and Saltery River weirs. A total of 280 coho salmon will be sampled at each of these locations during a 10-day period at the peak of escapement. Two scales will be taken from each fish. The weir crews are responsible for collecting samples at Karluk River, Red River, and Upper Station Creek. Pat Holmes will provide sampling assistance at Saltery weir if requested.

It is essential that ALS samples be representative of the escapements; therefore to avoid bias there should be no pre-selection of fish from either a live box or seine for size, sex, condition, or any other factor. Collection and recording procedures for ALS sampling are in Appendices A and B.

DATA REPORTING

Escapement sampling results will be published in a Regional Information Report by Pat Holmes.

Table 2. 1990 statistical weeks.

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

APPENDIX A

Scale Sampling Techniques

KODIAK SCALE SAMPLING TECHNIQUE

The following is an explanation of how salmon scale samples are taken. If you have not taken scales before or if you have any questions ask the Kodiak Research Project Leader, Pat Holmes, to demonstrate the sampling procedure. Scales must be readable to be useful, so follow proper techniques when sampling.

Important Points to Remember

Gum Cards

A scale card is a gum-backed sheet numbered 1 through 40. Samples are placed on the cards with no attempt to separate the fish by their sex.

It is important to keep the gum card dry at all times. If weather does not allow you to do this it is best to suspend sampling until dryer conditions prevail. A wet gum card is useless as the scales will shift and come off and prevent a readable impression from being taken.

A new scale card is started for each day. Even if a card is not filled a new card is still to be started for each day. Also, a different card is to be used for each location, i.e. Red River vs. Cape Alitak. It is important that scale cards and numbers match the corresponding AWL sheet.

Scales

1. Clean the scale by wetting it and rubbing it between your fingers. Make sure no dirt, slime or skin (no silver color) remain on the scale.
2. Mount the scale on the gum card with the ridged side up. The ridged side is the same side that is exposed on the salmon.

3. One scale will be taken from sockeye and chum. Two scales will be taken for coho, and three scales for king salmon.

4. Take the preferred scale if it is available, if not available take a scale but note it is not preferred.

5. Scales should be neat, clean, and orderly.

Age-Weight-Length (AWL) Sampling Form

Age - Scale samples are taken for age.
Weight - Taken to nearest tenth of a kilogram on any adult fish not being returned live to the water.
Length - Taken with the fish laying flat from the mid-eye point to the fork of the tail. Measure to the nearest millimeter.

** Fill in all information on the AWL form.
** Each AWL form should match up with the appropriate scale card.

APPENDIX B

Completion of mark sense A.W.L. forms

Length, Sex, and Scale Sampling Procedure for Sampling:
Using Mark-Sense Forms
(Recommended by Statewide Stock Biology Group, May 1985)

INTRODUCTION

Salmon from the catch are sampled for length, sex, and scales annually by field crews throughout the state. This data base is essential to sound management of the State's salmon resources. This information is drawn upon by management and research biologists for: (1) forecasting run strengths; (2) setting escapement goals; (3) examining the productivity of each system; (4) salmon growth analysis; (5) catch apportionment (based on age composition and/or scale pattern analysis); (6) in-season run estimation; and (7) to gain a better understanding of the biology of each stock.

For clarification purposes a SCALE SAMPLE and SUB-SAMPLE will be defined as follows:

SCALE SAMPLE: A data set collected from a specific sampling location, containing scales and data from a single species, collected during a single year. All data forms and scale cards of a single SAMPLE have the same statistical code. AWL and scale card number in a sample are consecutively and chronologically ordered.

SUB-SAMPLE: Any portion of a scale sample consisting of consecutively numbered AWL's and scale cards. SUB-SAMPLES usually consist of one or more time segments of a sample.

To be useful, data must be recorded on the mark-sense forms neatly and accurately. The following procedures are to be adhered to when sampling for length, sex, and scales using mark-sense AWL forms.

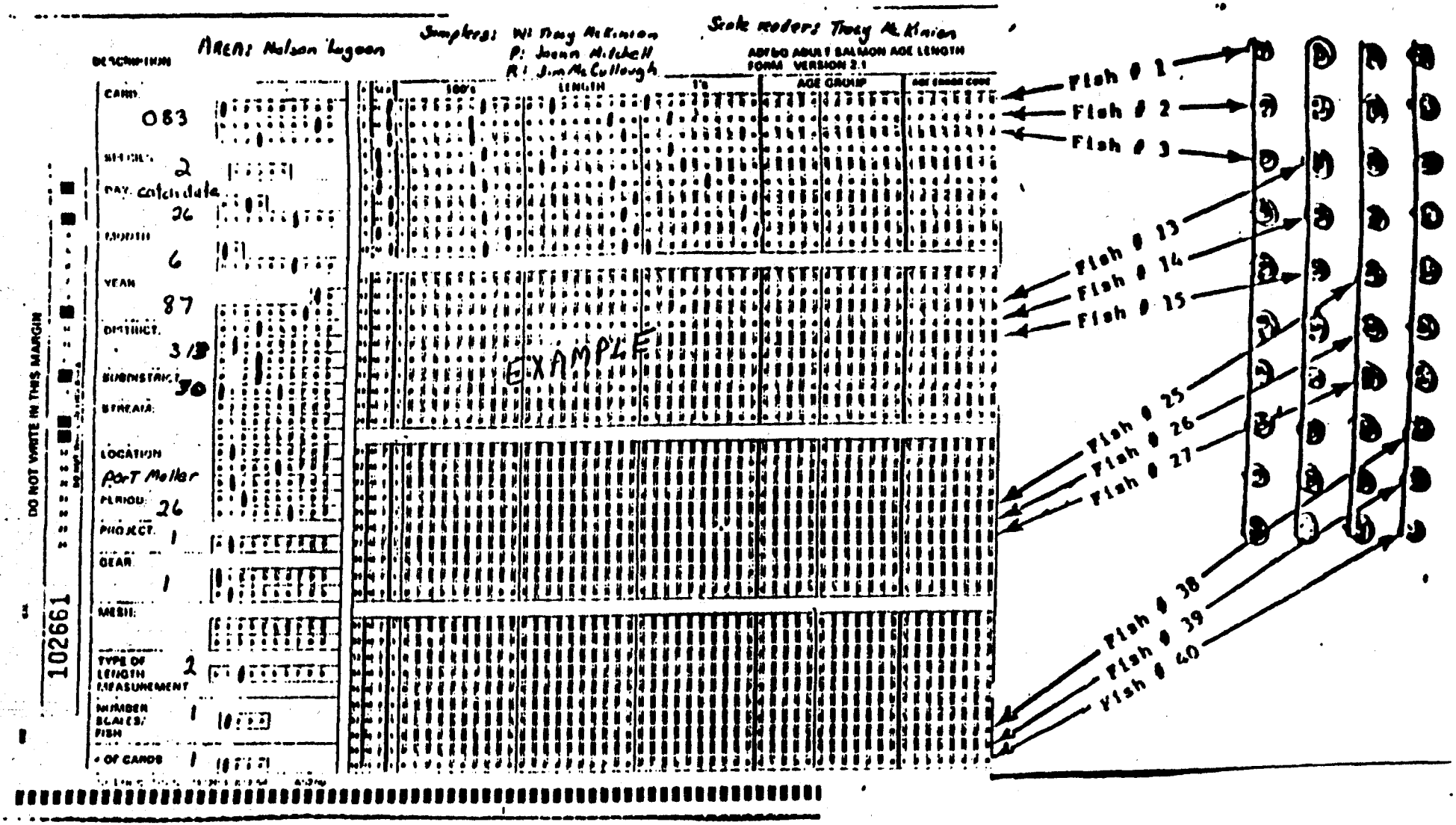
COMPLETING THE FORMS:

A completed mark-sense AWL form and accompanying gum card for sampling commercial catches of sockeye and chum salmon are shown in Appendix B.1. A completed AWL form and accompanying gum cards for sampling commercial catches of chinook and coho salmon are shown in Appendix B.2.

Complete each section of the left side of the mark-sense form using a soft 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 mark-sense AWL forms. Label only one form at a time to avoid "the carbon paper effect" and resulting stray marks.

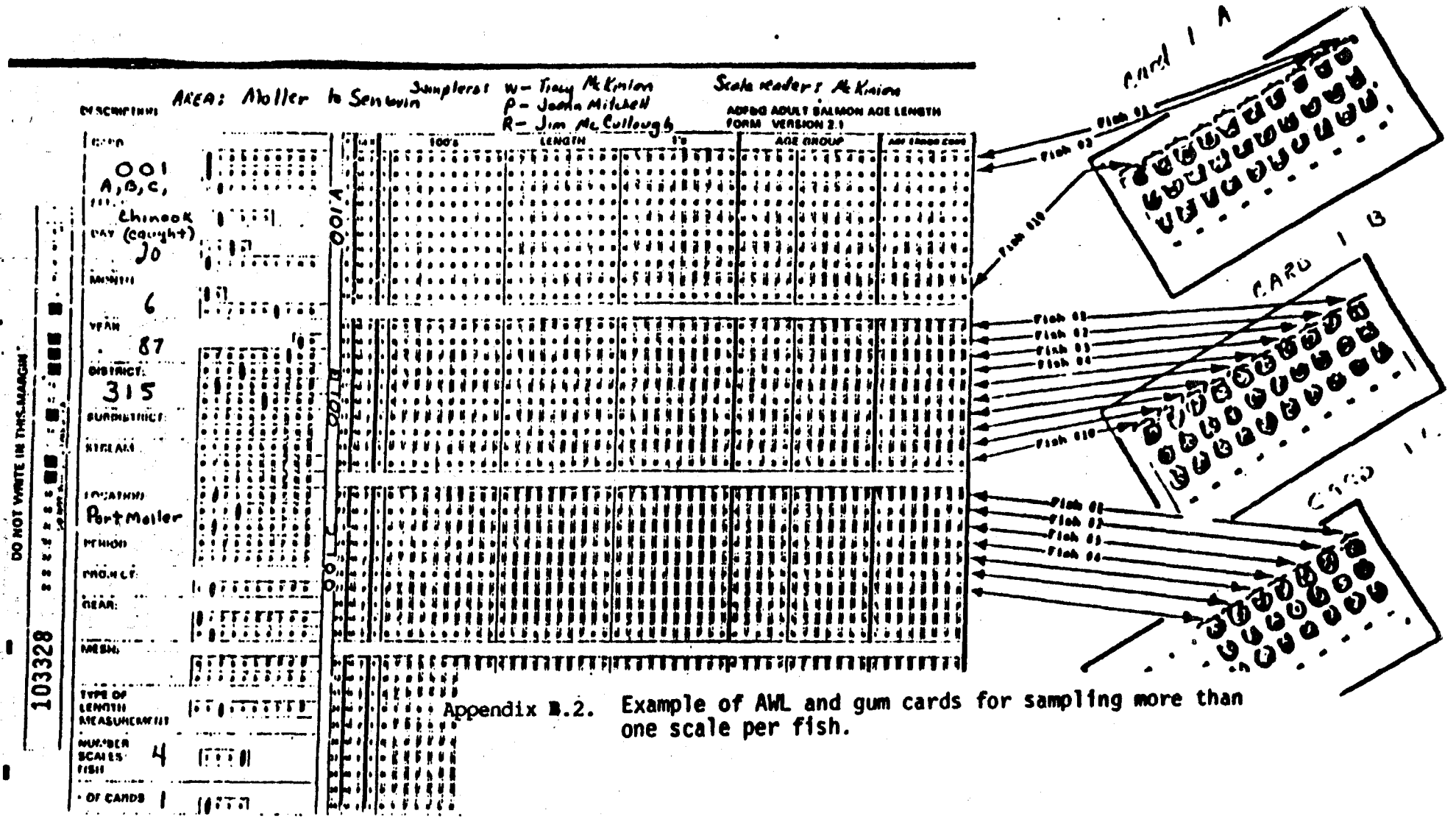
Description:
For escapement sampling: Species/Area/Catch or Escapement/gear type i.e. weir/Samplers (name and W-R-P)

Card:
The AWL forms and corresponding gum card(s) are numbered sequentially by date throughout the season starting with 001. A separate numbering sequence will be used for each species, gear type, district, and geographic location.



Appendix B.1. Example of AWL and gum cards for sampling one scale per fish.

Species: Sockeye Card No: 083
Locality: Nelson Lagoon Catch
Stat. Code: 313-30-
Sampling Date: Mo. 6 Day 26 Year 87
Gear: Purse Seine
Collector(s): McCullough, Mitchell, McKinnon
Remarks:



Appendix B.2. Example of AWL and gum cards for sampling more than one scale per fish.

Species: Chinook Card No 001A
Locality: Moller to Seniavin Catch
Stat. Code: 315-__-__-____-____
Sampling Date: Mo 20 Day 6 Year 87
Gear: purse seine
Collector(s): McKinion, Mitchell, McCullough
Remarks: 3 scales per fish

Species: Chinook Card No 001B
Locality: Moller to Seniavin
Stat. Code: 315-__-__-____-____
Sampling Date: Mo 20 Day 6 Year 87
Gear: purse seine
Collector(s): McKinion, Mitchell, McCullough
Remarks: 3 scales per fish

Species: Chinook Card No 001C
Locality: Moller to Seniavin Catch
Stat. Code 315-__-__-____-____
Sampling Date Mo 20 Day 6 Year 87
Gear purse seine
Collector(s): McKinion, Mitchell, McCullough
Remarks 3 scales per fish

Consult your port supervisor for the current card number. Sockeye and chum samples will have only 1 card per AWL form as shown in Appendix B.1. Coho and chinook samples will contain up to four cards per AWL form as shown in Appendix B.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 caught.

District:
List only one district. Consult project leader for appropriate district, subdistrict, and stream numbers.

Subdistrict:
List a single subdistrict if it is known and all the fish sampled were from that single subdistrict. Leave blank if more than one subdistrict is involved or if the subdistrict is unknown.

Stream:
Leave blank for catch sampling; for escapement sampling consult project leader for appropriate number.

Location:
List the appropriate code as shown on Table B.1.

Period:
List the statistical week in which the fish were caught (Table 4).

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

Gear:
Refer to the reverse side of the AWL form.

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

Type of length measurement:
Use (2) mid-eye to fork-of-tail (unless specifically instructed to do otherwise). Refer to Appendix B.3.

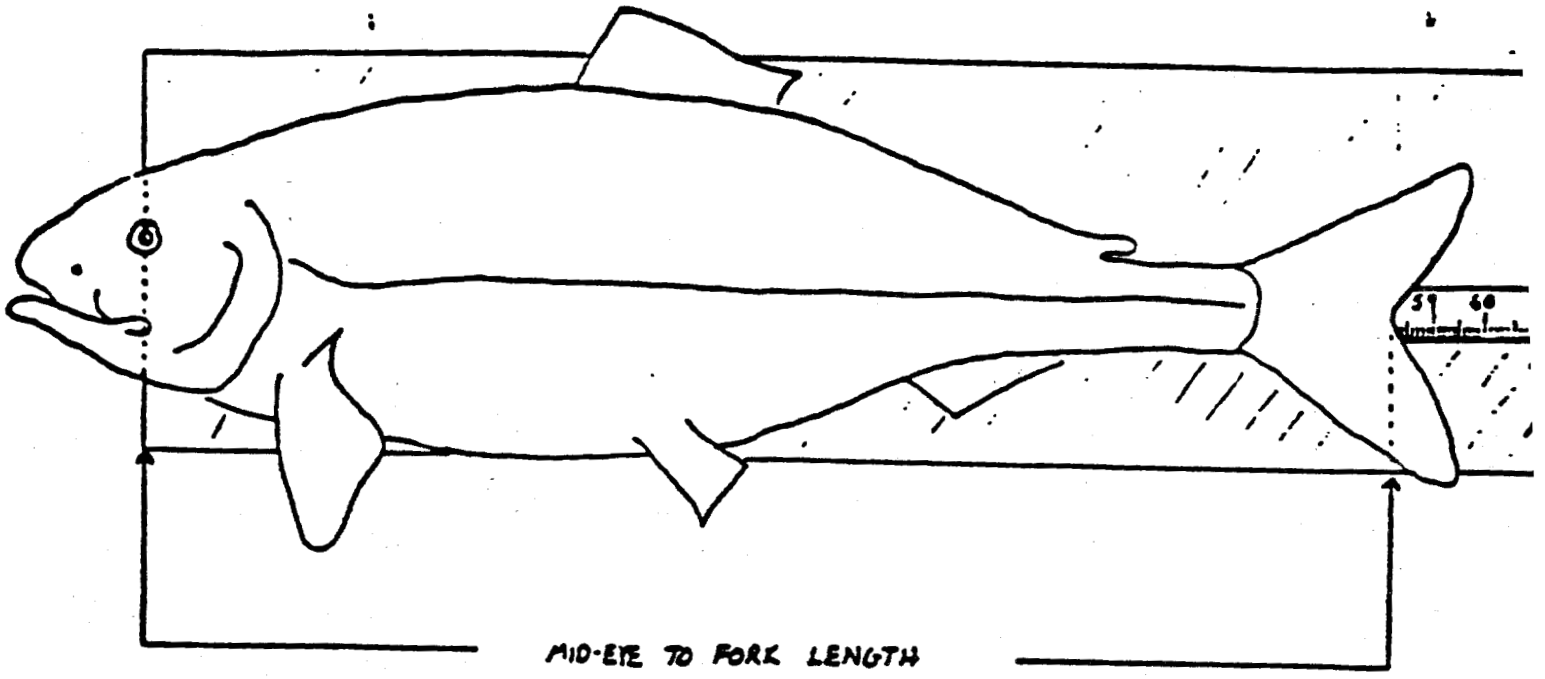
# of cards:
Mark 1 when sampling sockeye, chum, coho, and chinook salmon (Appendix B.1). When sampling chinook and coho salmon write the card numbers (i.e. 001A, 001B, 003B, etc.) perpendicular to the left of the fish # column as shown in Appendix B.2.

It is paramount to keep the mark-sense forms flat, dry, and clean. Fish gurry and water curling will cause data to be misinterpreted by the optical scanning machine. In general, keep the forms neat enough and legible enough to have a stranger be able to make sense out of them.

Table B.1. Assigned port and weir location codes. (Use under location in filling out AWL's for catch and escapement sampling.)

Port Codes
001 - Pelican
002 - Elfin Cove
003 - Sitka
004 - Juneau
005 - Petersburg
006 - Ketchikan
007 - Craig
008 - Port Alexander
009 - Metlakatla
010 - Excursion Inlet
011 - Hoonah
012 - Wrangell
013 - Out of State
014 - Kake
015 - Gedney
016 - Security Bay
017 - Meyers
018 - Pt. Baker
019 - Klawock
020 - Yakutat
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
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 B.3. Measuring fish length.



Because the length and form of the snout of salmon changes as the fish approaches sexual maturity, length measurements are made from the middle of the eye to the fork of the tail. The length is always recorded to the nearest millimeter. The procedure for measuring length (mid-eye to fork) of the salmon is as follows:

1. Place the salmon flat on the board with the head to your left and the dorsal fin away from you.

2. Make sure your eye is directly over the end of the board. Line the eye of the salmon up with the edge of the board and hold the head in place with your left hand. It helps to place a finger in the salmon's eye for reference.

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.

Additional data columns are available on the reverse of the AWL for individual project use. If you as a project leader use them and wish that data to be read by the opscan reader, you will need to transfer the litho code from the front of the form to the reverse.

GUM CARD(S):

Fill out the gum cards as shown in Appendices B.1 and B.2.

Species:
Write out completely (i.e., chinook, sockeye, etc.).

Locality:
For catch sampling and escapement sampling write down area in which fish were caught followed by the word catch or escapement (i.e. Karluk River escapement).

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

Gear:
Write out completely.

Collector(s):
Record the last name or initials of the 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:

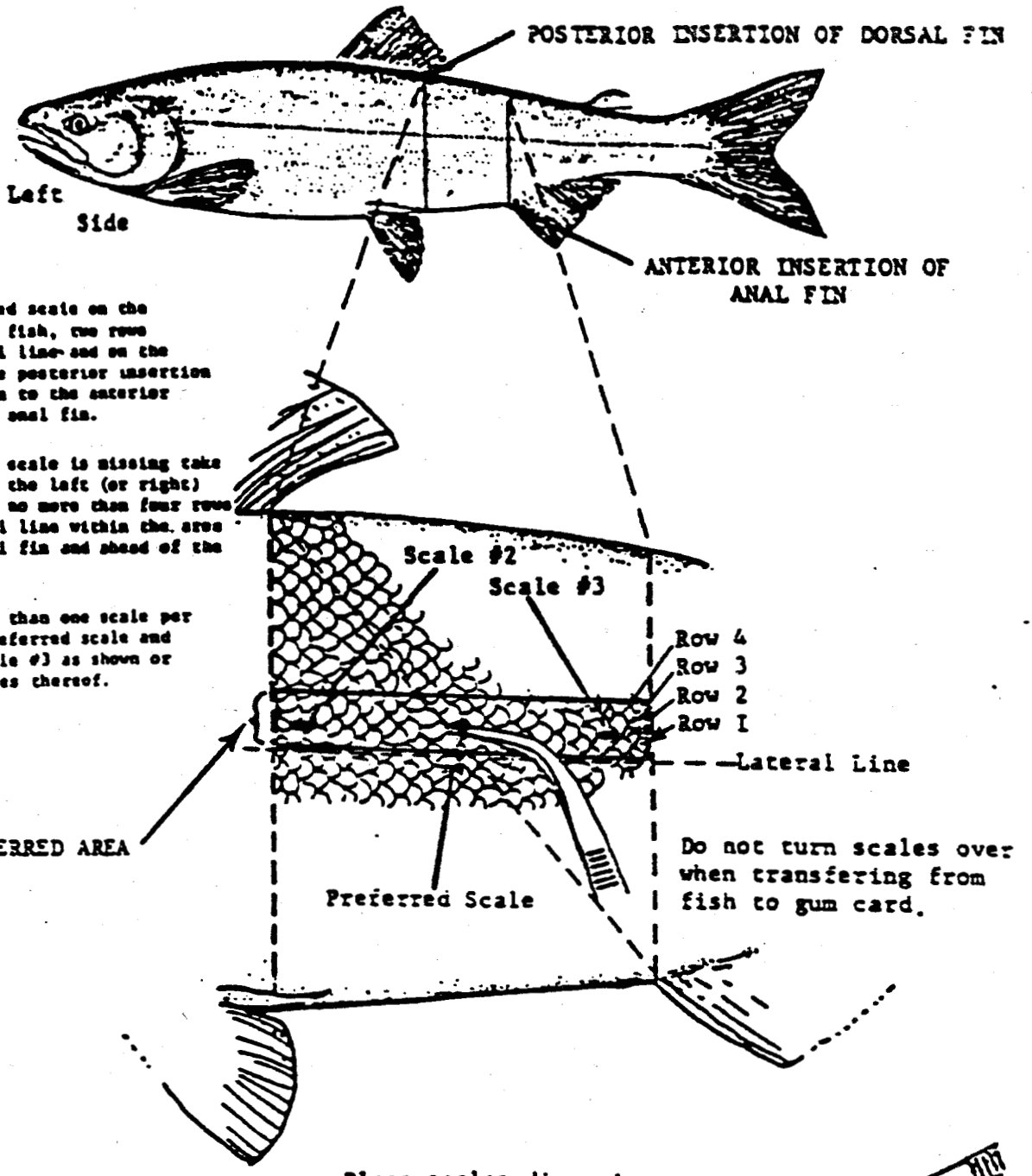
A. GENERAL

1. Sex the fish and darken M or F in the sex columns. If any difficulty was encountered in 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.

2. Measure all species' length in millimeters from the middle of the eye to the fork of the tail, refer to Appendix B.3. Record length by blackening the appropriate column blocks on the AWL form. Column 3 on the AWL form is used for fish over 999 millimeters long (Big Daddy Chinook). Measure all species of salmon to the nearest mm. Check the calipers daily, before use, to ensure the accuracy of the measurements.

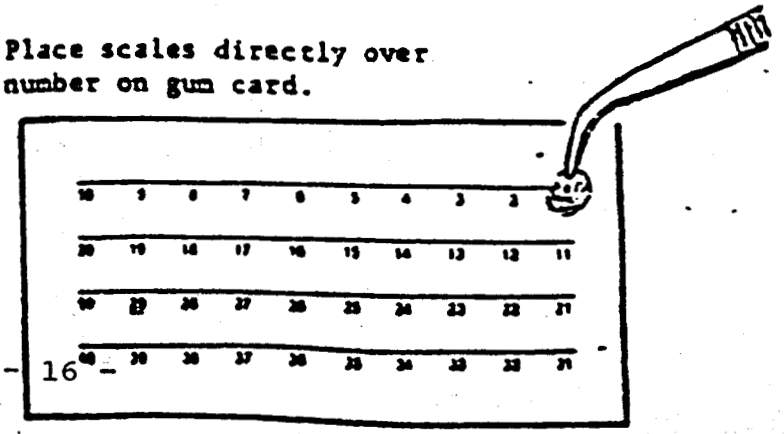
3. Pluck the "preferred scale" from the fish using forceps. Remove all slime, grit, and skin from the scale by moistening and rubbing between fingers. The "preferred scale" is located on the left side of the fish, two rows above the lateral line on the diagonal from the posterior insertion of the dorsal fin to the anterior insertion of the anal fin, refer to Appendix B.4. If the "preferred scale" is missing, select a

Appendix B.4. Scale sampling procedure showing the preferred scale sampling area on an adult salmon.



NOTE: Mount scales with anterior portion of scale oriented toward top of card.

Place scales directly over number on gum card.



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 both sides 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.

4. Clean, moisten and mount scale on gum card directly over number 1 as shown in Appendix B.4. The side of the scale facing up on the gum card is the same as the side facing up when it was adhered to the fish. This outward facing side is referred to as the "sculptured" side of the scale. The ridges on this sculpture side can be felt with a fingernail or forceps. Mount scale with anterior end oriented toward top of gum card.

5. When sampling sockeye and chum salmon repeat steps 1 through 4 for up to 40 fish on each AWL form.

6. When taking multiple scales per fish as with chinook and coho salmon sample the "preferred scale" and scale #2 as shown in Appendix B.4. 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 B.2. Continuing, mount the 2 scales from fish #2 over 2 and 12, etc. If sampling 3 scales, mount the scales over #1, #11, #21, etc.

7. Use plastic scale card holders to hold individual scale cards during sampling and cover the completed gum card with wax paper for storage.

8. When sampling a weired system 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 <u>transfer the data</u> to the mark-sense forms. It is the responsibility of the data collector to transcribe the data before turning it over to the ARB.

9. Miscellaneous:

   a. When scales are sampled in wet conditions it is difficult to mount scales in a fashion so as to result in a good scale impression being made. Glue often obscures scale features and scales frequently adhere poorly to the card. In this situation the scales should be remounted.

   b. For adipose clipped fish record the head tag number on the corresponding row in the first five columns on the reverse side of the AWL.

   c. Look down the form from two angles after the data has been recorded to pick up any glaring mistakes. A common error occurs, for instance, in placing both the 4 and 7 of a 475 mm fish in the 100's column with nothing in the 10's column.

   d. Keep all fish gurry off forms and erase any stray marks on the forms before turning them in to your supervisor.

e. Write in all comments explicitly and completely under remarks, transfer remarks to top margin of AWL.

f. Responsibility for accuracy lies first with the primary data collector(s). The port supervisor will return sloppy or incomplete data to individual collectors. After editing a form, place your initials next to card #, but not in left margin.

10. As soon as possible after completion send the samples and mark-sense forms to the ARB in Kodiak. During scheduled radio calls before and following the sending of data to the ARB, the crew leader will notify the ARB: 1) that the data is being mailed (use a moisture-proof container); 2) what data is being sent; 3) when delivery is expected in Kodiak; and 4) who is transporting the data. It is important that these steps are followed to ensure delivery.

B. SAMPLING SCENARIOS:

1. Differing size crews:

a. One person: Wrestle the fish into the measuring board, wearing a glove on one had. Measure the fish and write the sex and length down on the measuring board to be transferred to the AWL after ten fish have been measured. Next, pluck the preferred scale(s), clean, and mount on the gum card which is taped to the AWL in the clipboard which is sitting on the end of the measuring board. After ten fish have been processed, remove the glove and record the sexes and lengths on the AWL with your clean hand. A slime rag may be helpful.

b. Two persons:

(1) When sampling more than one scale per fish, one person can wrestle the fish and record data while the other plucks and mounts scales. The wrestler needs to wear a glove that he can slip off his writing hand to record the sex and length data on the AWL form.
(2) When sampling one scale per fish, the person plucking the scales also records the data.

c. Three persons: One person wrestles the fish, one plucks and mounts the scales, and the third records the data.

2. Sampling tote to tote:

a. When sampling for 2 or 3 scales per fish (chinook and coho) use two persons.

b. When sampling for 1 scale per fish (sockeye and chum) use three persons, if available.

SCALE SAMPLING CHECKLIST

Clipboard	Pencils (No.2)	Gloves
Gum Cards	Forceps	Measuring board or calipers
AWL's	Wax paper inserts	Sampling Manual
		Plastic scale card holders

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 statistical week for the sampling or catch date. Page numbers should not be repeated; a frequent error is to begin a week's sample with the last page number used the week before. This is particularly important if the data is regularly sent to town; it is easy to forget which 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 marks within each rectangle and completely fill them. After AWLs are edited, place editor's initial next to page number, but not in left margin.

3. Check to make sure error codes are being used correctly, i.e. error code 7 is wrong species, error code 8 is non-preferred. Error code 6 is for the use of the scale reader, it refers to the reabsorption of the scale.

4. 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 margin (not on the left side) or on the reverse of the AWL. If there is not room on the AWL to completely explain the remarks, use a separate piece of paper.

5. 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 card and AWL for the next day.

6. If weights are taken, they may be noted in the right margin of the AWL during sampling, but be sure to transfer the weights to the appropriate columns on the reverse of the AWL before submitting it to the ARB.

7. The data processing program uses the "litho code" on the AWL. (It is located in the lower left margin of the AWL.) It helps if the AWLs are used in the order of this code. It should not be hard to keep them in order 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.

8. If AWLs get wrinkled or splotched they should be copied over before sending in. The optical scanning computer will misread or reject wrinkled sheets.

STUDY PLAN FOR DETERMINING PINK SALMON STREAM LIFE AND CALIBRATING AERIAL PINK SALMON ESCAPEMENT COUNT DATA

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

STUDY PLAN FOR DETERMINING PINK SALMON STREAM LIFE AND CALIBRATING AERIAL PINK SALMON ESCAPEMENT COUNT DATA

Due to the 24 March 1989 Exxon Valdez spill in Prince William Sound commercial salmon fisheries were severely curtailed in the Kodiak Management Area. In 1989 the only openings were special terminal sockeye fisheries in the inner Alitak Bay District and two late fall 6-hour commercial fisheries in the normal closed waters area of the Inner Karluk Section. Because of closed fisheries, about 20 million pink salmon escaped in the Kodiak Management Area which is well in excess of the 4.0 million fish management goal.

The Department of Fish and Game is concerned that the abnormally high 1989 escapement may produce a return in 1991 lower than than would be expected had only 4.0 million fish escaped. In progress are several interrelated studies to determine the impact of the 1989 pink escapement. The study addressed in this document will provide a more precise estimate of the average stream life of pink salmon and quantify the relationship of aerial, foot, and weir pink escapement counts. The results will further refine the 1989 pink escapement estimates.

Objectives:

1. Determine the average stream life of pink salmon.

2. Determine the relationship between aerial, foot, and weir pink salmon escapement counts.

Tasks:

1. Count the daily pink escapement into Barling, East Paramonof, Saltery, and Akalura Creeks and Afognak River using fish-tight weirs.

2. On foot, count the number of live and dead pink salmon upstream of the weir in Barling, East Paramonof, Saltery, and Akalura Creeks and Afognak River once every two to three days. Additionally during each survey remove all the pink carcasses counted so that they are not included in subsequent survey counts of dead fish.

3. Once a week tag, using a specific color code, 150 pink salmon from a daily weir escapement at Barling, East Paramonof, Saltery, and Akalura Creeks and Afognak River. On each escapement survey count the number of live and dead tagged fish by color code.

Supervision:

The Project Leaders are Charles Swanton and Bruce Barrett. Their responsibilities include

data quality control and study design. Any change or deviation from the study plan must be first approved through or initiated by them. The field staff should freely consult with either Swanton or Barrett if a problem arises or clarification is needed. The field crew leaders are responsible for on site safety, daily work assignments, and documentation of field observations or data records.

Single side band radio schedules will be twice daily (8:00am and 8:00pm) for the general purpose of supply requests and field camp monitoring. If weir activities conflict with this schedule the person conducting the radio schedule should contact another field camp so that someone knows that your absence is not an emergency related situation. If an emergency situation arises contact the Kodiak office immediately. Weir operations will be conducted such that safety of personnel and accuracy of the data collected are not compromised. Procedures and operations must adhere to those outlined within this manual.

Procedures:

Weirs:

A fish-tight weir will be operated on Barling, East Paramonof, Saltery, and Akalura Creeks and Afognak River from about 5 July through 15 September. The staff are:

PERSONNEL	POSITION	WEIR LOCATION	DURATION
Scott Marx	Crew Leader	Barling Creek	5 July - 15 September
Mark Larrison	Crew	Barling Creek	5 July - 15 September
Shelly Jones	Crew	Paramanof Creek	5 July - 15 September
Lisa Ranallo	Crew	Akalura Creek	1 July - 15 September
Tom Dinnocenzo	Crew Leader	Saltery Creek	21 June - 15 September
Ed Avery	Crew Leader	Paramanof Creek	5 July - 15 September
Eric Kelly	Crew	Saltery Creek	21 June - 15 September
George Malone	Crew	Saltery Creek	5 July - 15 September
Judy Brant	Crew Leader	Akalura Creek	15 July - 15 September

To ensure that salmon migrations are not delayed weir gates will be opened as often as necessary daily to keep fish numbers from building up behind the weirs. All fish passing through the weir gates will be individually tallied by species using hand held counters. At each weir the daily pink escapement count will be reported on the form in Figure 1. Additionally the number of pink salmon carcasses thrown over the weir will be tallied and recorded on the same form. At the end of each day the completed form will be placed in a slotted lock box which cannot be open in the field. Non-pink salmon weir counts will be reported on the form in Figure 2. Pink salmon escapement counts will kept strictly confidential, but other species counts will be reported via 3230 radio daily. The reason for the secrecy on the pink weir counts is to ensure that foot survey and aerial count data are not biased by weir count data.

Figure 1.

WEIR COUNTS OF THE DAILY PINK SALMON ESCAPEMENT

Weir Site: _____ Crew Leader: _____

Date: _____ (Month, day, yr) (e.g., Wednesday 5/16/90)

Number of Fish Tagged: _____; Tag Color _____; Tagging Time: _____ to _____

Time (Military)	Weir Count		Comments
	Live	Carcasses*	
Daily Total			

* The carcass count is the number of dead pink salmon thrown over the weir, if any. The count includes dead tagged fish; the number of dead tagged fish by color code should be recorded in the "comment" section.

Crew Leader: _____
Signature

Date Signed: _____

Figure 2.

ALASKA DEPARTMENT OF FISH AND GAME
KODIAK MANAGEMENT AREA
WEEKLY SALMON WEIR CAMP REPORT FOR YEAR: 1990

WEIR CAMP — WEEKLY REPORT

NAME:_____ PERSONNEL:_____ NO:_____ FOR WEEK ENDING (SATURDAY)_____

DATE	DAILY TOTAL SALMON ESCAPEMENT					DAILY TOTALS	JACK REDS		STEELHEAD		DOLLYS	GILLNET MARKED		H_2O LEVEL		H_2O TEMP.	WEATHER		
	KINGS	REDS	COHO	PINK	CHUMS		NO.	%	DOWN	UP	UP	REDS	OTHER	UP	DN		CEIL.	VIS.	WIND DIR./ SPEED
SUN D																			
A																			
MON D																			
A																			
TUE D																			
A																			
WED D																			
A																			
THU D'																			
A																			
FRI D																			
A																			
SAT D																			
A																			
TOTAL FOR WK ____																			
ACCUM. THRU WK ____														COMMENTS					
WEIR MORTS. FOR WK														COMMENTS					
TOT. ACCUM.																			
AWL SAMPL. FOR WK												COMMENTS							
TOT. ACCUM.																			

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

Ground Escapement Surveys:

Salmon escapement upstream of the weir will be counted once every two to three days by observers walking the entire stream to at least the upper limit of pink salmon spawning. Included in the survey reach will be all side channels, tributaries, and other habitat that pink salmon may occupy from the weir upstream. The count data will be recorded on the form in Figure 3. All pink salmon carcasses encountered will be counted and then thrown a sufficient distance on the bank to prevent their reintroduction into the counting area. The escapement counts will made when fish visibility is unobstructed by turbidity or other physical factors. This means that survey conditions must be at least "fair" or better. Ground escapement surveys will be terminated after 90% or more of the escapement have spawned and died. This will be considered the point in time when the last live count of fish upstream of the weir is less than 10% of the live peak count. Observers will use hand tally counters and wear polarized glasses when surveying for escapement.

Tagging:

Weekly tagging will begin when the daily weir pink escapement counts start averaging 300 or more fish. Each week a total of 150 pink salmon will be tagged in a single day effort. Each weekly group of 150 fish will bear a color coded FT-3 Floy tag specific to the week tagged. In order of use the weekly color codes are: orange, blue, yellow, pink, and green. Extra effort will be made to minimize tagging stress through careful handing of the fish, proper tag placement, and release of the fish in a low velocity waters where rapid recovery can be expected. Proper fish handling and tagging procedures will be demonstrated in the field. The number of fish tagged and tag color code used during a tagging event will be recorded on the daily pink salmon weir escapement count form (Figure 1). The number of live and dead tagged pink salmon by color code observed on each escapement survey will be recorded using the form in Figure 3.

Aerial Escapement Surveys:

Weather permitting once every five days by fixed wing aircraft, Kevin Brennan or Dave Prokopowich will count the number of live salmon by species upstream of the weirs on Barling, Akalura, East Paramonof, and Saltery Creeks and Afognak River beginning about 15 July and ending about 15 September. The data will be recorded on the form in Figure 4. To ensure unbiased counts neither surveyor will have prior knowledge of the pink salmon weir escapement counts.

Figure 3.

Location: _____

FOOT SURVEY COUNT OF PINK AND CHUM SALMON ESCAPEMENT FROM THE WEIR TO THE UPPER SPAWNING LIMIT

Date (Mo,day,yr)	Time (Military)		Fish[a] Vis.	Pink[b]		Live Tagged Pinks Tag Color				Chum		Comments[c]
	Start	End		Live	Dead	Orange	Blue	Yellow	Pink	Live	Dead	

[a]Excellent (E), good (G), fair (F) or poor (P).
[b]Count includes tagged and non-tagged pink salmon.
[c]List number of tagged dead pink by tag color; observer names, predation levels.

Figure 4.

AERIAL COUNT OF SALMON ESCAPEMENT FROM THE WEIR TO THE UPPER LIMIT OF MIGRATION ON SELECTED SYSTEMS

System	Survey		Observer	Fish[a]	Live Fish Only[b]				Comments
	Date	Time		Vis.	Pink	Chum	Coho	other	

[a]Excellent (E), good (G), fair (F) or poor (P).
[b]The counts are only of live fish by species and do not include **any** fish live or dead downstream of the weir.

STUDY PLAN FOR QUANTIFYING THE AMOUNT OF AVAILABLE PINK SALMON SPAWNING HABITAT IN THE KODIAK AND CHIGNIK MANAGEMENT AREAS, 1990

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

STUDY PLAN FOR QUANTIFYING THE AMOUNT OF AVAILABLE PINK SALMON SPAWNING HABITAT IN THE KODIAK AND CHIGNIK MANAGEMENT AREAS

Due to the 24 March 1989 Exxon Valdez spill in Prince William Sound restricted commercial salmon fisheries occurred in the Kodiak (KMA) and Chignik (CMA) Management Areas. In 1989 the only KMA openings were special terminal sockeye fisheries in the inner Alitak Bay District and two late fall 6-hour commercial fisheries in the normal closed waters area of the Inner Karluk Section. Due to closures, about 20 million pink salmon escaped in the KMA which is well in excess of the 4.0 million fish management goal. Because of fisheries closures in the CMA the 1989 escapement there was 1.4 million fish which is double the management goal of 0.7 million fish. The Department of Fish and Game is concerned that the abnormally high 1989 pink escapements in the KMA and CMA may produce returns in 1991 lower than than would be expected had the pink escapement goals not been exceeded. Studies are in progress to determine the impact if any. The study addressed in this document will quantify the amount of available pink salmon spawning habitat in the KMA and CMA.

Objectives:

1. Estimate the total available pink salmon spawning habitat in the KMA and CMA.

2. Estimate the total available pink salmon spawning habitat sampled under the pre-emergent fry program in the KMA and CMA.

Tasks:

1. Randomly measure the amount of pink spawning habitat in 17 KMA and 6 CMA index streams which was not completed in 1989 (Table 1).

2. Directly measure the amount of pink spawning habitat within the spawning riffles sampled for pre-emergent fry sampling in 33 KMA and 18 CMA index streams (Table 2).

Table 1. List of selected pink salmon spawning streams of the Kodiak and Chignik Management Areas to be surveyed for spawning habitat, 1990.

Stream Name	Stream Number
Kodiak Management Area	
Afognak River	
Uganik River	
Little River	
Zacher River	
Uyak River	
Sturgeon River	
Red River	
Sid Olds River	
American River	
Sheratin Creek	
Kukak Creek	
Missak Creek	
Kinak Creek	
Geographic Creek	
Kakavak Creek	
Big Creek	
Kashvik Creek	
Chignik Management Area	
Yanturia Creek	272-721
Chiginagak	272-903
Chiginagak	272-904
Chiginagak	272-905
Kilokak Creek	272-
Redbluff Creek	272-702

Table 2. Kodiak and Chignik Management Areas pre-emergent salmon streams.

Stream Name	Stream Number
Kodiak Management Area	
Portage Creek	
Paramanof Creek	
Malina Creek	
Afognak River	
Marka Creek	
Danger Creek	
Seal Creek	
Baumans Creek	
Terror River	
Uganik River	
Little River	
Zacher River	
Browns Creek	
Uyak River	
Sturgeion River	
Karluk River	
Red River	
Dog Salmon Creek	
Narrows Creek	
Humpy River	
Deadman Creek	
Seven Rivers	
Kayugnak Creek	
Kiliuda Creek	
Saltery Creek	
Miam Creek	
Hurst Creek	
Sid Olds River	
American River	
Buskin River	
Sheratin Creek	
**Waterfall Creek	
**Pillar Creek	
Chignik Management Area	
Hook Bay	272-302
Cape Kumliun	272-501
N. Fork Kujulik	272-514
Amber Creek	272-702

-Continued-

Table 2. (page 2 of 2)

Stream Name	
Chignik Management Area (continued)	
Yanturia Creek	272-721
Ocean Beach	272-801
Foot Bay Creek	272-802
Chiginagak	272-903
Chiginagak	272-904
Chiginagak	272-905
Agripina River	272-962
Kilokak Creek	272-
Redbluff Creek	273-702
Ivan River	273-722
Spoon Creek	273-823
Portage Creek	273-842
Ivanof River	275-405
Humpback River	725-502

**Non-index streams.

3. Enter the data into an Rbase file and edit the file from the original data records.

Supervision:

The Project Leader is C.O. Swanton. His responsibilities include data quality control and study design. Any change or deviation from the study plan must be first approved through or initiated by him. The field staff are David Kaplan and Terry Geigerich, and they are encouraged to freely consult with C.O. Swanton on any questions or problems. Kaplan and Geigerich are responsible for safety in the field, completing daily work assignments, and documentation of field observations or data records.

All field work will be conducted such that safety of personnel and accuracy of the data collected are not compromised. Further the data collection procedures and operations must be adhered to as covered in this manual.

PROCEDURES:

Operations will begin on 18 July and terminate about 25 August. The KMA and CMA index and pre-emergent pink streams to be surveyed are listed in Table 1 and Table 2 respectively. Maps of the index streams, at 1:250,000 scale with the upper and lower pink salmon spawning limits defined, have already been prepared. For each stream the total length of spawning reach will be divided into 300 meter sections. These will then be sequentially numbered, and using a random number generator five of the sections will be chosen for sampling. For each of these sections there will be 12 transects made perpendicular to the stream bank spaced at 25 meters apart. On each transect, stream width will be measured to the nearest 0.1 meter. The percentage of available spawning habitat will estimated, to the nearest 10 percent, based on the combined criteria of surface water velocity, depth, and substrate size and embeddedness along a one meter wide band extending the length of the transect. The criteria for pink salmon spawning habitat is:

1. Velocity of 0.3 - 0.9 m/sec.
2. Minimum depth of 15.2 cm

3. Predominate substrate size of 0.6 to 13.8 cm.
4. Embeddedness - substrate loose enough to dislodge material without excessive foot pressure.

That portion of a transect having all the sub-components of the spawning habitat criteria is pink salmon spawning habitat. While that portion of a transect which is deficient of one or more habitat criteria sub-components is non-spawning habitat. The results of the transect measurements for width and and spawning habitat will be entered on the form shown in Figure 1.

For areas sampled for pre-emergent pink fry the amount of available spawning habitat will be determined using the spawning habitat criteria as previously defined and the length and width parameters of each riffle. At each riffle, stream width will be measured to the nearest 0.1 meter at one meter intervals from the beginning to the end of the riffle. Additionally at every one meter width interval, the percentage of available spawning habitat will be estimated using the standard spawning habitat criteria. The length of each riffle will be the sum of the number of one meter spaced transects taken. The spawning habitat data measurements will be recorded on the form shown in Figure 2.

Figure 2. PINK SALMON SPAWNING HABITAT EVALUATION FOR PRE-EMERGENT SAMPLING AREAS

Stream Name: _____; Stream # _____; Riffle # _____; Date: _____; Observers: _____ and _____

Trans.[a] #	Width	Habitat[b/c] Spawn.	Non-Spawn.	Trans.[a] #	Width	Habitat[b/c] Spawn.	Non-Spawn.	Trans.[a] #	Width	Habitat[b/c] Spawn.	Non-Spawn.	Trans.[a] #	Width	Habitat[b/c] Spawn.	Non-Spawn.
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			

[a] Distance between transect is 1.0 meter.
[b] Record habitat to nearest 10%.
[c] Spawning habitat: Substrate = 0.60cm-13.75cm (0.25-5.40 inches), Velocity = 0.3-0.9 m/sec, Depth = ≥ 0.15m (≥ 6 inches), and non-embedded substrate.

COMMENTS: _____

Figure 1.

AKA89-3

Stream Name: _____ Date: _____

Stream No.: _____ Survey Crew: _____

Section: _____

Transect[a] #	Width (m)	Habitat[b & c] Spawning	Non-Spawning	COMMENTS[d]
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				

[a]Standard distance between transects is 25m.

[b]Record % spawning habitat to nearest 10%.

[c]Spawning habitat: Substrate = 0.60cm - 13.75cm (0.25 - 5.40 inches), Velocity = 0.3 - 0.9 m/sec, Depth = ≥ 0.15m (≥ 6 inches), and non-embedded substrate.

[d]Comments should include stage of pink spawning activity, sampling problems, and stream temperature where applicable.

1990 OPERATIONAL PLAN

AKALURA, UPPER STATION AND RED LAKES

SOCKEYE SMOLT STUDIES

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

5/10/90 draft

OPERATIONAL PLAN FOR AKALURA, UPPER STATION AND RED LAKES SOCKEYE SMOLT STUDIES 1990

Introduction

In 1989 the commercial sockeye salmon (Oncorhynchus nerka) fisheries were curtailed in most of the Kodiak Management Area due to oil contaminants from the 24 March 1989 Exxon Valdez spill of about 11 million gallons of oil into Prince William Sound. As a consequence several sockeye systems had escapements much greater than the management goal for optimal production. For example the Red Lake system with an escapement goal of 300,000 fish had an escapement in excess of 750,000 fish, and the Akalura system with a desired escapement goal of 50,000 fish had a 110,000 fish escapement. The concern is that the large escapements may damage future returns by a combination of factors including disease, fry starvation, and shifts in the plankton community caused by excessive predation. The project covered here will focus on the response of the sockeye smolt.

Goal:

The overall goal is to quantify the impact, if any, of surplus sockeye escapement to selected systems in the Kodiak Management Area caused by the 1989 EXXON Valdez oil spill. The selected systems include Upper Station Lakes (control), Akalura Lake, and Red Lake. The plan presented here involves an evaluation of the sockeye smolt production from these systems. The specific objectives and tasks for the 1990 smolt program at Akalura, Upper Station, and Red Lakes are:

Objective:

1. Estimate the magnitude of the sockeye smolt run in numbers of fish;

2. Estimate the age composition, and average weight, length, and condition for each of the major age classes of the sockeye smolt run;

3. Determine the timing of the sockeye smolt run.

Tasks:

1. Operate a Canadian fan trap continuously through the sockeye smolt migration;

2. Estimate the daily catch of trap caught fish by species;

3. Sample 220 smolt per week for age, length, and weight from the trap catch;

4. Mark several hundred trap caught sockeye smolt weekly using Bismark Brown Y dye for release upstream of the catch location to determine trap efficiency and allow estimation of total smolt numbers.

Supervision:

The Field Project Leaders are Bruce Barrett and Charles Swanton. The Assistant Project Leader is Gary Todd. The field staff and crew leaders are:

Akalura	1. Ed Avery-Crew Leader 2. Shelly Jones- Crew
Upper Station:	1. Eric. Kelly-Crew Leader 2. Chris Hicks- Crew
Red Lake:	1. Terry Giegerich-Crew Leader 2. Scott Marx- Crew 3. Mark Larrison- Crew

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. Swanton and Barrett will administratively oversee the program which will include ensuring that adequate logistic, equipment, and technical support are provided. Gary Todd will be in the field full time to trouble shoot problems and provide quality control on the data.

Procedures

A Canadian fan trap will used in the outlet stream of Akalura, Red, and Upper Station Lakes to evaluate the sockeye smolt migration. Each trap will be fitted with a live box, anchored at the upstream end using fence posts and polyrope, and equipped with two hand driven winches mounted on a pipe rack set over the lower half of the trap to adjust elevation.

The Akalura smolt trap will be fished in the first stream riffle upstream of the adult salmon weir site which is at the upper limit of intertidal influence. The Upper Station trap will be sited in the outlet stream of Lower Upper Station Lake about 1/2 mile below the lake. The Red Lake trap will be in the outlet creek 1/2 mile below the lake. All traps are to be on location and operational by 15 May 1990. Generally each trap will be sited mid channel and 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 either added or deleted the action should be well documented in the comment section of the daily catch reporting form (Figure 1). This is important because of the likely change in the gear efficiency.

Figure 1.

DAILY SMOLT TRAP CATCH REPORTING FORM

PROJECT LOCATION: _____ DATE: _____

Time (Military)	Sockeye		Coho Fry	Dolly Varden	Stickle-back	other	Comments
	Smolt	Fry					
TOTAL							

Each trap will be checked as often as necessary to maintain the trap efficiency and minimize any fish mortalities. Minimally the traps should be checked every 30 minutes between the hours of sunset and sunrise. During daylight hours normally a check once every four hours is adequate. Although smolt generally outmigrate in the evening hours there is evidence of large smolt movements occurring in hours of mid afternoon coinciding 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 smolts have been overcrowded and killed solely due to crew inattentiveness.

There are two methods for determining the species catch in a trap. The simplest and most common procedure is to individually count the fish by species while emptying the live box with a dipnet. More specifically the catch is transferred by dipnet into a partially water filled 5-gallon plastic bucket, and the fish are individually counted in the process of spilling the contents of the bucket in the stream below the trap. The second method involves a catch-weight sampling procedure where the catch is transferred by dipnet into a small mesh netted basket suspended over the creek from a hanging scale. The aggregate weight of the catch is then recorded and the process is continued until the live box is emptied. However 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 dipnet of fish for a species count by weight. The second method should only be used when there are relatively large number of smolt being caught, and there is not enough time to count all the fish without incurring mortalities. The daily smolt count data will be recorded on the forms in Figures 1 and 2.

Trap efficiency will be estimated weekly by a simple mark and recapture method. This will entail placing about 500 smolt into a holding tank of water containing Bismark Brown Y dye (1 g per 30 l of water for 30 minutes; 1 U.S. gallon= 3.8 liters) which will tint the smolt and make them readily distinguishable from undyed smolt. The dyed fish in the holding tank, which will be oxygenated, will be moved about 0.5 miles upstream by skiff and released evenly across the stream channel. For three days following a release all fish caught in the trap will be checked for the dye mark. If during a three day recovery period the previously defined catch weight sampling procedure is implemented due to more smolt being caught in the trap than can be individually counted, the crew is to sample for both the number of fish caught per sample weight and the number of dyed fish caught per sample weight. Trap efficiency will be determined by the proportion of marked fish recovered. The mark and recapture data will be recorded on the form in Figure 3.

At each location 220 sockeye smolt are to be sampled weekly for age, length, and weight. Specific procedures for collecting and recording the information is in Appendix A and B. Each sample should be taken from a single days catch. If not enough smolt are caught to meet the

WORK SHEET FOR ESTIMATING SMOLT TRAP CATCH USING CATCH-WEIGHT SAMPLING

Figure 2.

Date: _____ Time Period (military): _____ to _____ Project Location: _____

Basket Weight (wet): _____

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.

Totals: _____ + _____ + _____ + _____ = GRAND TOTAL

GRAND TOTAL LESS BASKET WEIGHTS (a): _____

	SAMPLE BIOMASS (Fish plus basket weight)	CATCH Sockeye Smolt	CATCH Other
1.	_____	_____	_____
2.	_____	_____	_____
3.	_____	_____	_____
4.	_____	_____	_____
5.	_____	_____	_____
Sub-total	_____	_____(c)	_____(d)

TOTAL (less basket wts.) _____(b)

ESTIMATED CATCH: _____ Smolt (ac/b); _____ Other (ad/b)

Figure 3.

SOCKEYE SALMON SMOLT SUMMARY REPORT

PROJECT LOCATION: _____

DATE (Day, Month, Year)	TOTAL # SMOLT CAUGHT	TOTAL # SMOLT MORT.	TOTAL # DYED SMOLT RELEASED	TOTAL # SMOLT EXAMINED FOR MARKS	TOTAL # DYED SMOLT RECAPTURED

sample size the balance of the sample should be taken from the next days catch only. 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.

Fish species identification keys are in Appendix c.

Climatological data will be collected at each location daily at approximately 1800 hrs. The information will be recorded on the form in Figure 4 and will include water and air temperatures, stream height, percent cloud cover, and wind direction and velocity.

The smolt traps will be removed at the end of the smolt migration which is expected to be about 21 June.

Figure 4.

CLIMITOGICAL OBSERVATIONS

PROJECT LOCATION: _____

DATE	TIME	TEMP		CLOUD COVER (%)	WIND		STREAM GAUGE (0.1 FT)	COMMENTS
		AIR	WATER		DIRECTION	VEL. (mph)		

APPENDIX A

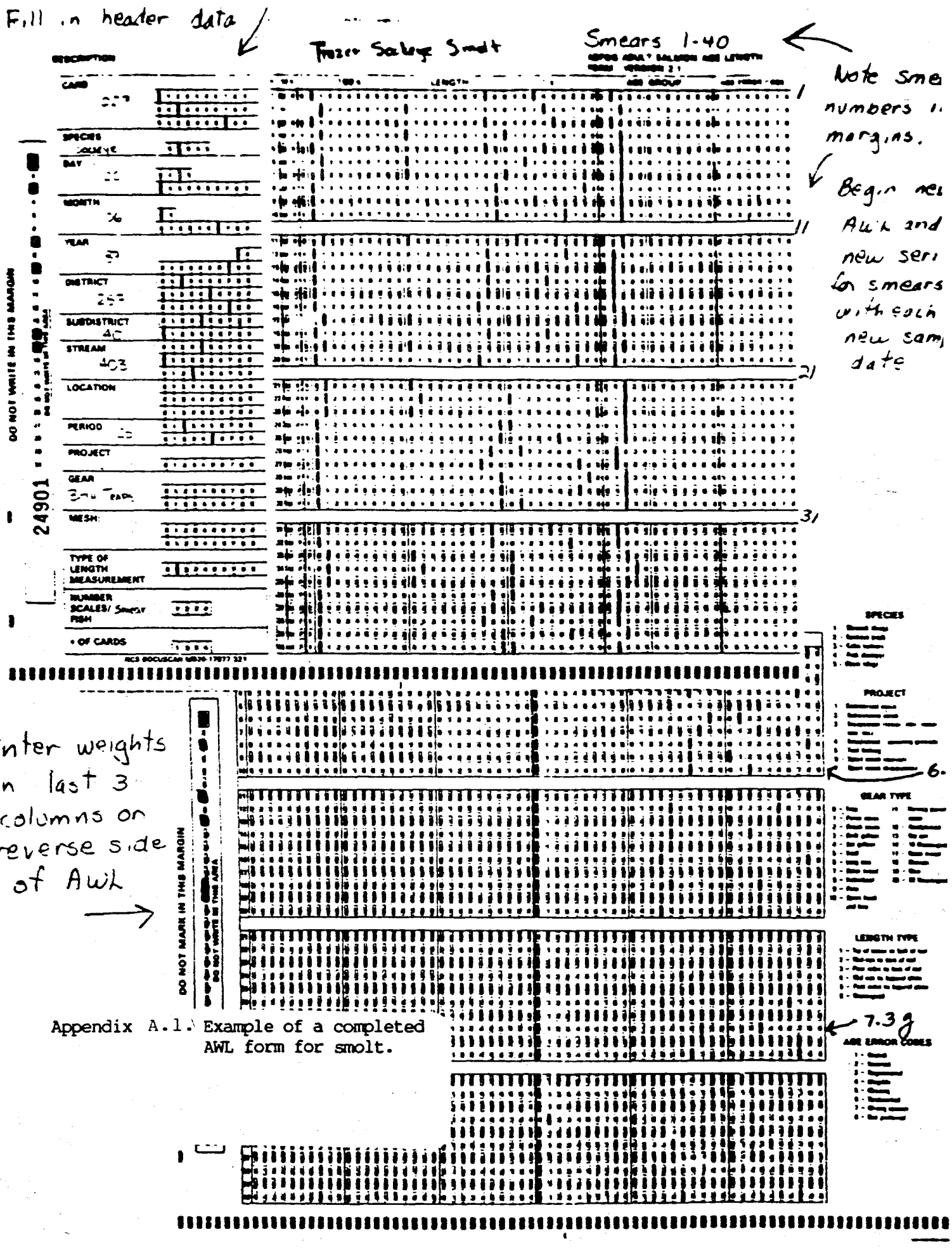
Procedures for Sampling Salmon Smolt

The same size goal per week is 220 sockeye salmon smolt. 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. The use of this chemical will be demonstrated in the field. Age, weight, and length data will be recorded on adult AWL forms (Appendix A.1), as no smolt AWL forms exist. Refer to Appendi B on the standard procedures for recording data on an AWL form. Record at the top of each AWL dorm: personnel collecting the data.

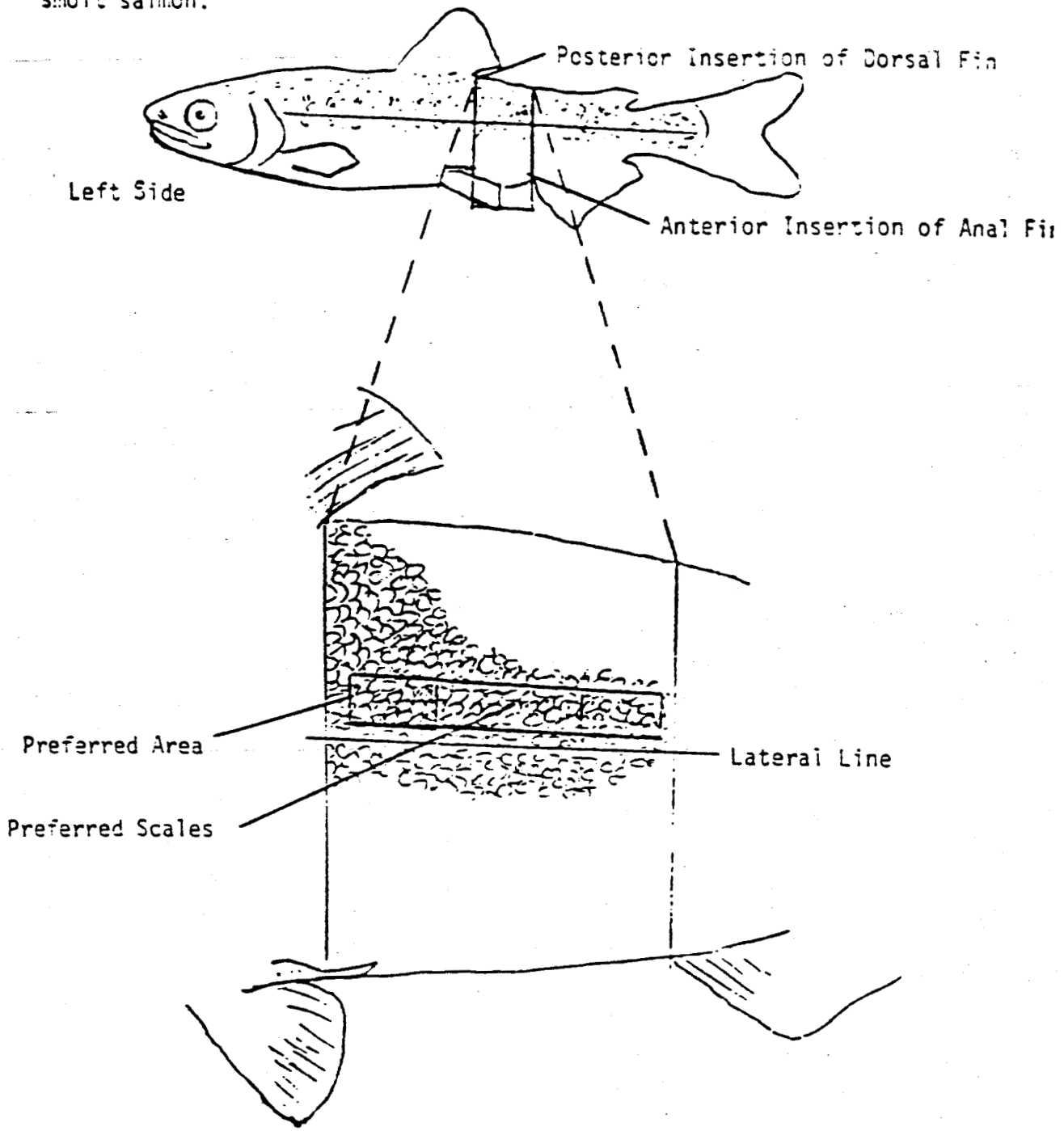
A knife will be used to remove 5-10 scales from the preferred area, Appendix A.2. The scales will be mounted on a glass slide as illustrated in Appendix A.3. The left protion of each slide will be labeled with: sample site, location, date, and specimen number.
Smolt lengths will be measured to the nearest millimeter, from the tip of the snout to the fork of the tail, Appendix A.4.

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 gram.



Appendix A.1. Example of a completed AWL form for smolt.

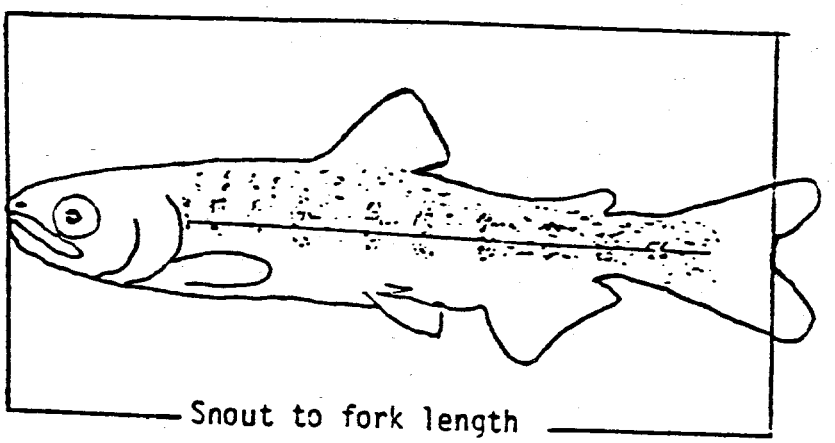
Appendix A.2. Scale sampling procedure showing the preferred scale sampling area on a smolt salmon.



Appendix A.3. Salmon smolt glass slide example.

Location	Bear River				
Collection Date	7/02/86				
Fish Reference Number	#100-104				
Collector	Whelan				
Collector	Perry				
		Number 100	Number 101	Number 102	Number 103	Number 104

Appendix A.4. Measuring smolt length.



APPENDIX B

Procedure for Using AWL Mark-Sense Forms

For Sampling Adult Salmon

Length, Sex, and Scale Sampling Procedure for Sampling:
Using Mark-Sense Forms
(Recommended by Statewide Stock Biology Group, May 1985)

INTRODUCTION

Salmon from the catch are sampled for length, sex, and scales annually by field crews throughout the state. This data base is essential to sound management of the State's salmon resources. This information is drawn upon by management and research biologists for: (1) forecasting run strengths; (2) setting escapement goals; (3) examining the productivity of each system; (4) salmon growth analysis; (5) catch apportionment (based on age composition and/or scale pattern analysis); (6) in-season run estimation; and (7) to gain a better understanding of the biology of each stock.

For clarification purposes a SCALE SAMPLE and SUB-SAMPLE will be defined as follows:

SCALE SAMPLE: A data set collected from a specific sampling location, containing scales and data from a single species, collected during a single year. All data forms and scale cards of a single SAMPLE have the same statistical code. AWL and scale card number in a sample are consecutively and chronologically ordered.

SUB-SAMPLE: Any portion of a scale sample consisting of consecutively numbered AWL's and scale cards. SUB-SAMPLES usually consist of one or more time segments of a sample.

To be useful, data must be recorded on the mark-sense forms neatly and accurately. The following procedures are to be adhered to when sampling for length, sex, and scales using mark-sense AWL forms.

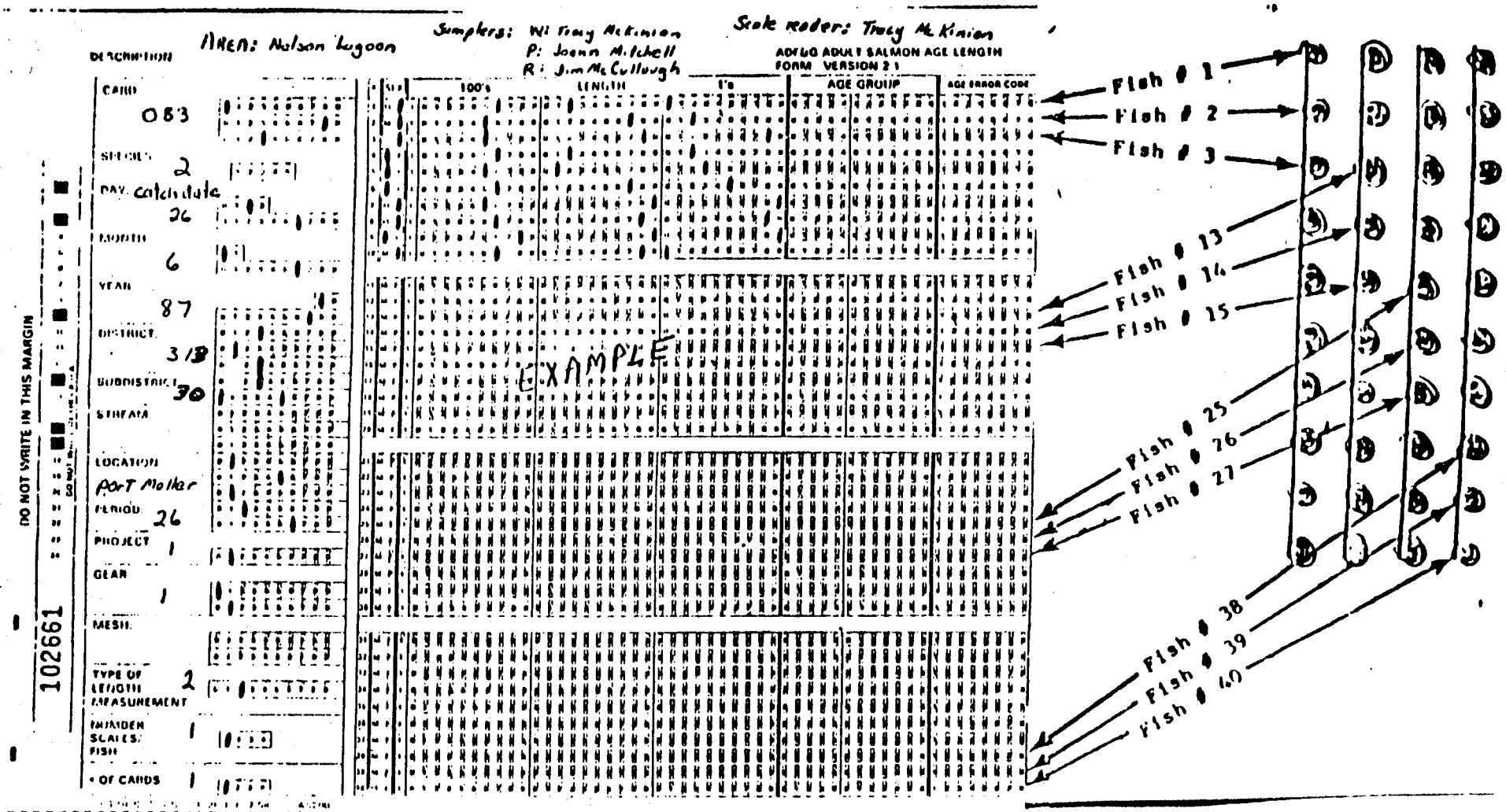
COMPLETING THE FORMS:

A completed mark-sense AWL form and accompanying gum card for sampling commercial catches of sockeye and chum salmon are shown in Appendix B.1. A completed AWL form and accompanying gum cards for sampling commercial catches of chinook and coho salmon is shown in Appendix B.2.

Complete each section of the left side of the mark-sense form using a soft 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 mark-sense AWL forms. Label only one form at a time to avoid "the carbon paper effect" and resulting stray marks.

Description:
For catch sampling: Area/Samplers (name and W-R-P)

Card:
The AWL forms and corresponding gum card(s) are numbered sequentially by date throughout the season starting with 001. A separate numbering sequence will be used



Appendix B.1. Example of AWL and gum cards for sampling one scale per fish.

Species: Sockeye Card No 083
Locality: Nelson Lagoon Catch
Stat. Code: 313-30-
Sampling Date. Mo 6 Day 26 Year 87
Gear: Purse Seine
Collector(s): McCullough, Mitchell, McKinion
Remarks:

AREA: Moller to Seniavin Samplers: W – Tracy McKinion, P – Joann Mitchell, R – Jim McCullough Scale reader: McKinion

ADF&G ADULT SALMON AGE LENGTH FORM VERSION 2.1

DESCRIPTION

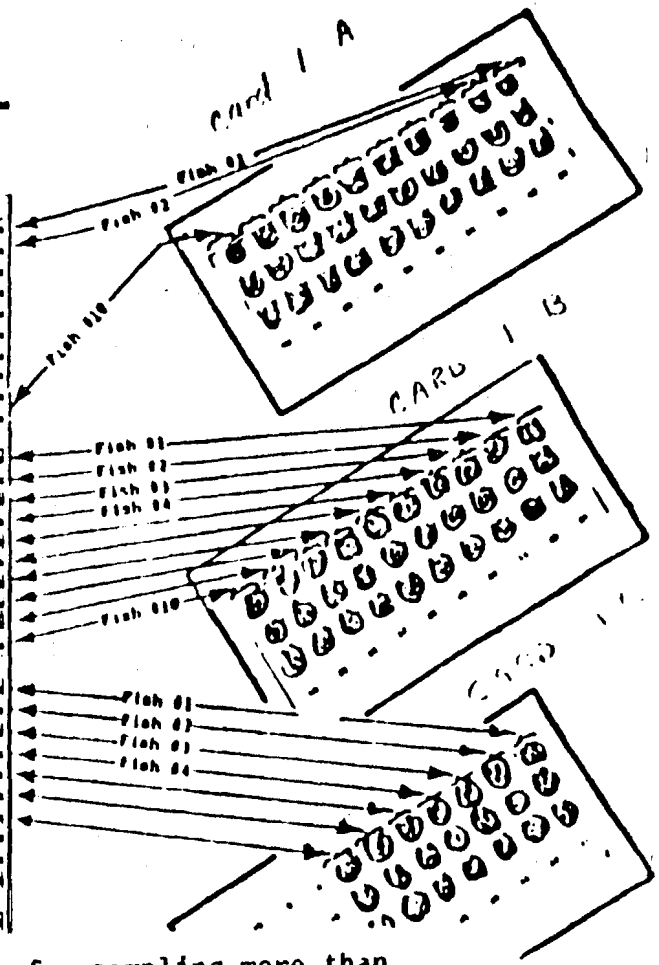
CODE: 001 A,B,C,
SPECIES: Chinook
DAY (caught): 20
MONTH: 6
YEAR: 87
DISTRICT: 315
SUBDISTRICT:
STREAM:
LOCATION: Port Moller
PERIOD:
PROJECT:
GEAR:
PARISH:
TYPE OF LENGTH MEASUREMENT:
NUMBER SCALES/FISH: 4
OF CARDS: 1

DO NOT WRITE IN THIS MARGIN

103328

001A
001B
001C

LENGTH: 100's, 1's AGE GROUP AGE ERROR CODE



Appendix B.2. Example of AWL and gum cards for sampling more than one scale per fish.

Species: Chinook Card No 001A
Locality: Moller to Seniavin Catch
Stat Code 315
Sampling Date Mo 20 Day 6 Year 87
Gear: purse seine
Collector(s): McKinion, Mitchell, McCullough
Remarks: 3 scales per fish

Species Chinook Card No 001B
Locality Moller to Seniavin
Stat Code 315
Sampling Date Mo 20 Day 6 Year 87
Gear purse seine
Collector(s) McKinion, Mitchell, McCullough
Remarks 3 scales per fish

Species Chinook Card No 001C
Locality Moller to Seniavin Catch
Stat Code 315
Sampling Date Mo 20 Day 6 Year 87
Gear purse seine
Collector(s) McKinion, Mitchell, McCullough
Remarks 3 scales per fish

for each species, gear type, district, and geographic location. Consult your port supervisor for the current card number. Sockeye and chum samples will have only 1 card per AWL form as shown in Appendix B.1. Coho and chinook samples will contain up to four cards per AWL form as shown in Appendix B.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 caught.

District:
List only one district. Consult project leader for appropriate district and subdistrict numbers.

Subdistrict:
List a single subdistrict if it is known and all the fish sampled were from that single subdistrict. Leave blank if more than one subdistrict is involved or if the subdistrict is unknown.

Stream:
Leave blank for catch sampling.

Location:
For catch sampling list the appropriate port code.

Period:
List the statistical week in which the fish were caught (Table 1).

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

Gear:
Refer to the reverse side of the AWL form.

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

Type of length measurement:
Use (2) mid-eye to fork-of-tail (unless specifically instructed to do otherwise). Refer to Appendix B.3.

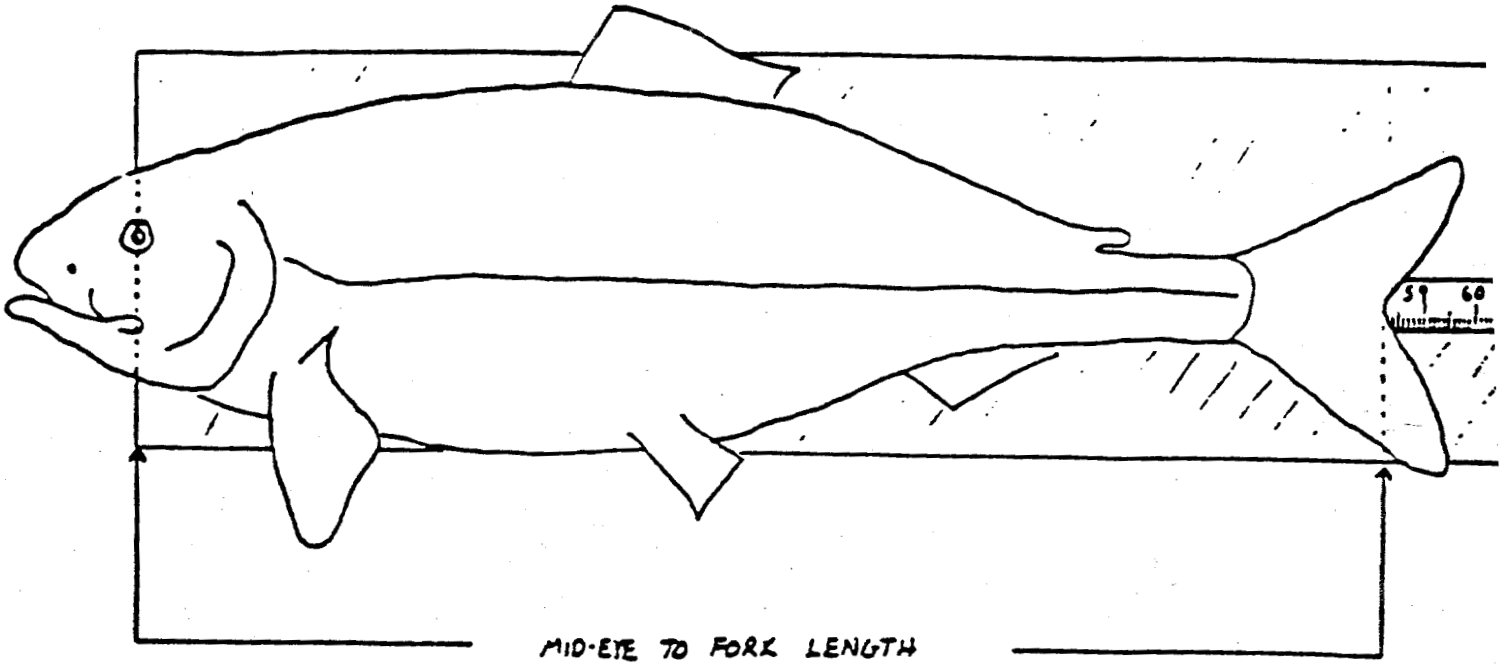
# of cards:
Mark 1 when sampling sockeye and chum salmon (Appendix B.1). Mark 1A, 1B, 1C, or 1D when sampling chinook and coho salmon and write the card numbers perpendicular to the left of the fish # column as shown in Appendix B.2.

It is paramount to keep the mark-sense forms flat, dry, and clean. Fish gurry and water curling will cause data to be misinterpreted by the optical scanning reader machine. In

Table 1. 1990 statistical weeks.

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

Appendix B.3. Measuring fish length.



Because the length and form of the snout of salmon changes as the fish approaches sexual maturity, length measurements are made from the middle of the eye to the fork of the tail. The length is always recorded to the nearest millimeter. The procedure for measuring length (mid-eye to fork) of the salmon is as follows:

1. Place the salmon flat on the board with the head to your left and the dorsal fin away from you.

2. Make sure your eye is directly over the end of the board. Line the eye of the salmon up with the edge of the board and hold the head in place with your left hand. It helps to place a finger in the salmon's eye for reference.

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 .

general, keep the forms neat enough and legible enough to have a stranger be able to make sense out of them.

Additional data columns are available on the reverse of the AWL for individual project use. If you as a project leader use them and wish that data to be read by the opscan reader, you will need to transfer the litho code from the front of the form to the reverse.

GUM CARD(S):

Fill out the gum cards as shown in Appendix B.1-2.

Species:
Write out completely (i.e., chinook, sockeye, etc.).

Locality:
For catch sampling write down area in which fish were caught followed by the word catch (e.e., Herendeen Bay Catch).

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

Gear:
Write out completely.

Collector(s):
Record the last name or initials of the 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:

A. GENERAL

1. Sex the fish and darken M or F in the sex columns. If any difficulty was encountered in 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.

2. Measure all species' length in millimeters from the middle of the eye to the fork of the tail, refer to Appendix B.3. Record length by blackening the appropriate column blocks on the AWL form. Column 3 on the AWL form is used for fish over 999 millimeters long (Big Daddy Chinook). Measure all species of salmon to the nearest mm. Check the calipers daily, before use, to ensure the accuracy of the measurements.

3. Pluck the "preferred scale" from the fish using forceps. Remove all slime, grit, and skin from the scale by moistening and rubbing between fingers. 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, refer to Appendix B.4. 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 both sides 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.

4. Clean, moisten and mount scale on gum card directly over number 1 as shown in Appendix B.4. The side of the scale facing up on the gum card is the same as the side facing up when it was adhered to the fish. This outward facing side is referred to as the "sculptured" side of the scale. The ridges on this sculpture side can be felt with a fingernail or forceps. Mount scale with anterior end oriented toward top of gum card.

5. When sampling sockeye and chum salmon repeat steps 1 through 4 for up to 40 fish on each AWL form.

6. When taking 3 scales per fish as with chinook and coho salmon sample the "preferred scale" and scale #2 and scale #3 as shown in Appendix B.4. Scale #2 is one inch to the left of the "preferred scale," scale #3 is located one inch to the right, and both are 2 rows above the lateral line. Mount the 3 scales from fish #1 over 1, 11, and 21 on the gum card as shown in Appendix B.2. Continuing, mount the 3 scales from fish #2 over 2, 12, and 22, etc.

7. Cover the completed gum card with wax paper.

8. When sampling a weired system you may use the old AWL forms 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 data collector to transcribe the data before turning it over to the port supervisor.

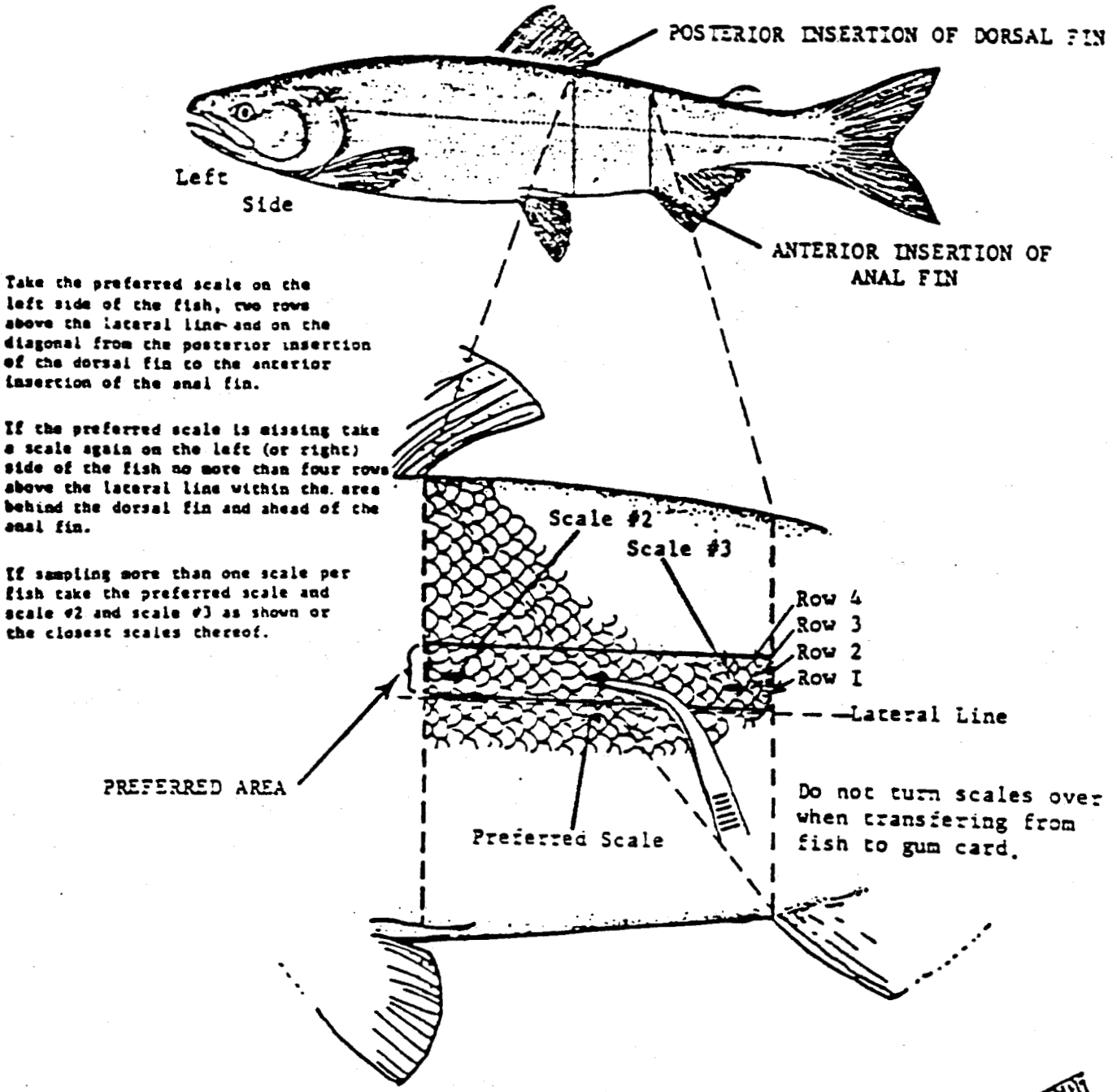
9. Miscellaneous:

   a. When scales are sampled in wet conditions it is difficult to mount scales in a fashion so as to result in a good scale impression being made. Glue often obscures scale features and scales frequently adhere poorly to the card. In this situation the scales should be remounted.

   b. For adipose clipped fish record the head tag number on the corresponding row in the first five columns on the reverse side of the AWL.

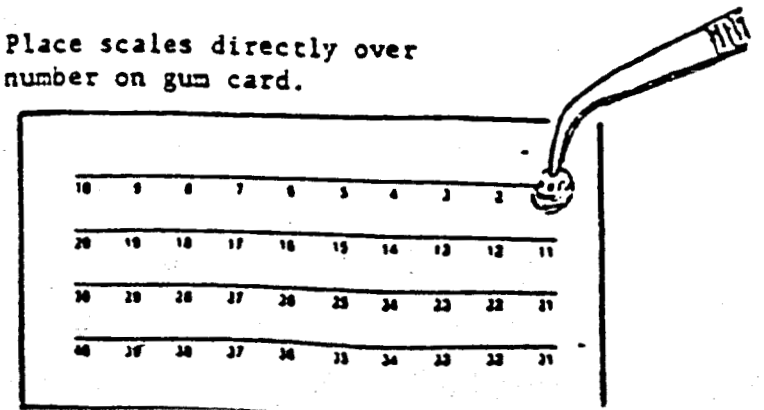
   c. Look down the form from two angles after the data has been recorded to pick up any glaring mistakes. A common error occurs, for instance, in placing both the 4 and 7 of a 475 mm fish in the 100's column with nothing in the 10's column.

Appendix B.4. Scale sampling procedure showing the preferred scale sampling area on an adult salmon.



NOTE: Mount scales with anterior portion of scale oriented toward top of card.

Place scales directly over number on gum card.



d. Keep all fish gurry off forms and erase any stray marks on the forms before turning them in to your supervisor.

e. Write in all comments explicitly and completely under remarks, transfer remarks to top margin of AWL.

f. Responsibility for accuracy lies first with the primary data collector(s). The port supervisor will return sloppy or incomplete data to individual collectors. After editing a form, place your initials next to card #, but not in left margin.

LENGTH, SEX AND SCALE SAMPLING PROCEDURE FOR ESCAPEMENT SAMPLING USING MARK-SENSE FORMS

Salmon from escapement are sampled for length, sex, and scales annually by field crews throughout the state, as are salmon from the catch. The information is used similarly. Data is recorded in a slightly different manner and for this reason a separate instruction section has been prepared this year for escapement sampling.

Appendix B.1 is an example of a mark-sense form filled out for escapement sampling. Data must be recorded on mark-sense forms neatly and accurately. Basically the procedures are the same as for catch sampling, with the following exceptions:

I. Mark Sense Forms

A. Description: For escapement sampling, Area/Samplers (name and W.R.P.). (Note: write out species completely using AFS standards listed on the reverse of the mark-sense form).

B. Subdistrict: Complete for all escapement samples.

C. Stream: Consult the field crew leader.

D. Location: Fill in the appropriate location for escapement sampling. (i.e. Bear River ADF&G camp 055, Nelson River ADF&G camp 056) (Table 2). If a code has not been assigned then leave blank.

II. Gum Cards

A. Locality: Write out the locality followed by the abbreviation "ESC" (e.g. Hugh Smith ESC).

Remember: Even though conditions are not the best when sampling in the field, mark-sense forms should come in neatly written, clean, and flat. Transcribe them if necessary. If gum cards get wet, remount the scales. Responsibility for data lies with the data collector(s) <u>not</u> the port supervisor, or "the people in Kodiak"!

Table 2. Assigned port and weir location codes. (Use under location in filling out AWL's for catch and escapement sampling.)

Port Codes
001 - Pelican
002 - Elfin Cove
003 - Sitka
004 - Juneau
005 - Petersburg
006 - Ketchikan
007 - Craig
008 - Port Alexander
009 - Metlakatla
010 - Excursion Inlet
011 - Hoonah
012 - Wrangell
013 - Out of State
014 - Kake
015 - Gedney
016 - Security Bay
017 - Meyers
018 - Pt. Baker
019 - Klawock
020 - Yakutat
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
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

Presmolt Salmon Key and Anadromous Juvenile Salmonides Key

U.S. DEPARTMENT OF COMMERCE
Frederick B. Dent, Secretary
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
Robert M. White, Administrator
NATIONAL MARINE FISHERIES SERVICE
Robert W. Schoning, Director

NOAA Technical Memorandum NMFS ABFL-2

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

MILTON B. TRAUTMAN

SEATTLE, WA
NOVEMBER 1973

For sale by the Superintendent of Documents, U.S. Government Printing Office
Washington, D.C. 20402

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.

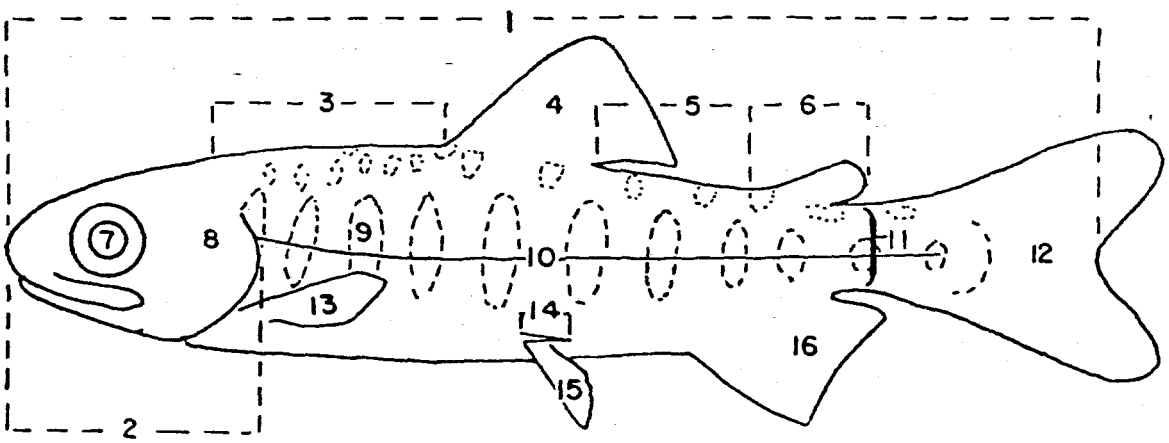


Figure 1.—Juvenile salmon, illustrating parts and methods of measuring: 1) fork length; 2) head length; 3) predorsal ridge; 4) dorsal fin; 5) portion of postdorsal ridge between posterior end of dorsal fin base and origin of adipose fin; 6) adipose fin; 7) pupil of eye; 8) gill cover, beneath which is 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

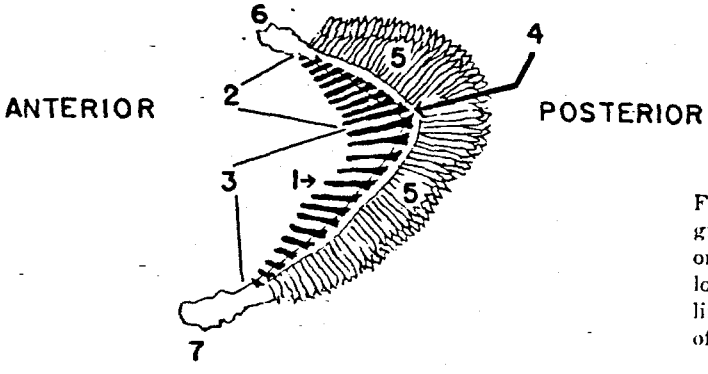


Figure 2.—First gill arch of salmon after removal from left gill chamber: 1) gill raker; 2) gill rakers attached to upper or shorter limb of arch; 3) gill rakers attached to lower or longer limb of arch; 4) angle of arch (junction of the two limbs or bones); 5) gill filaments (lamellae); 6) upper point 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

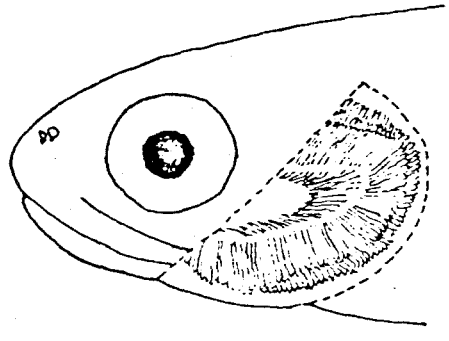


Figure 3.—Head of salmon. Dotted lines indicate that portion of gill cover which has been removed to show first gill arch in place.

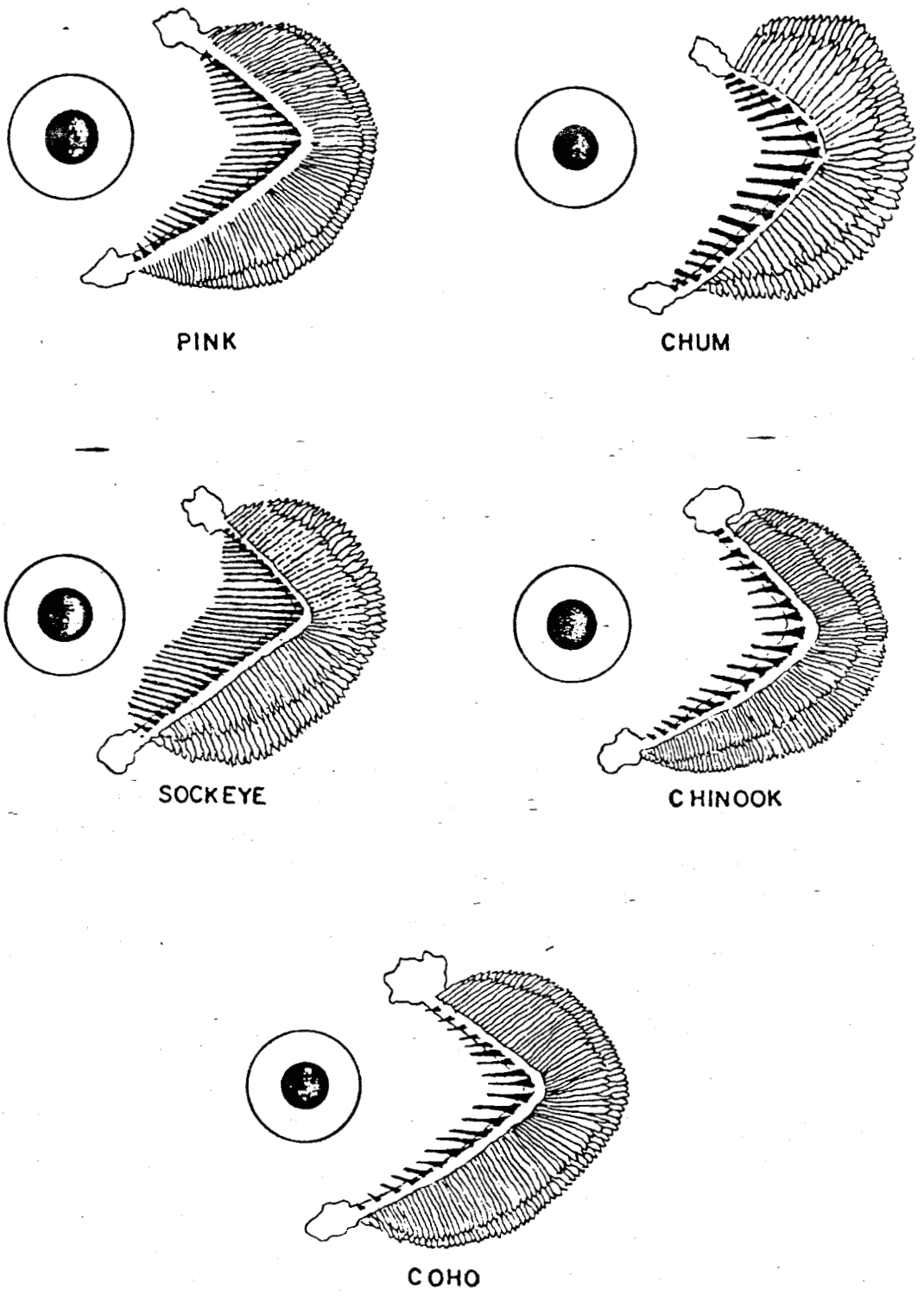


Figure 4. – First gill arch and eye for comparison with longest gill raker length of five species of Pacific salmon.

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.

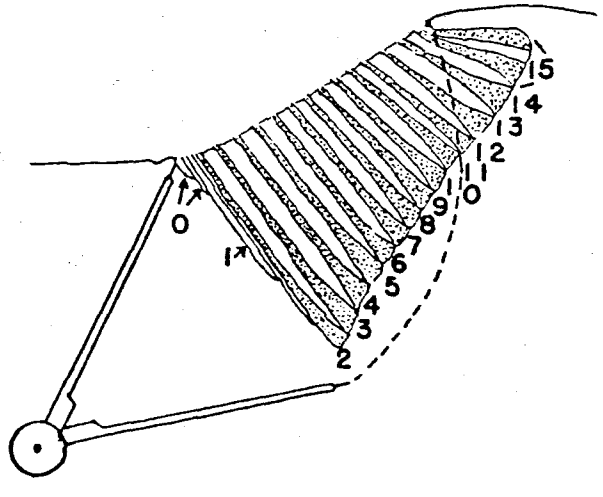


Figure 5.—Anal fin of salmon, illustrating method of measuring length of fin base and of counting rays (rays 2 to 15 are stippled here for emphasis).

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).

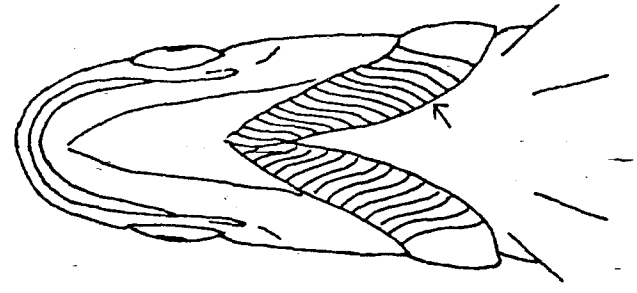


Figure 6.—Ventral surface of head of salmon. Arrow points to one of 14 branchiostegals on left side of head.

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).

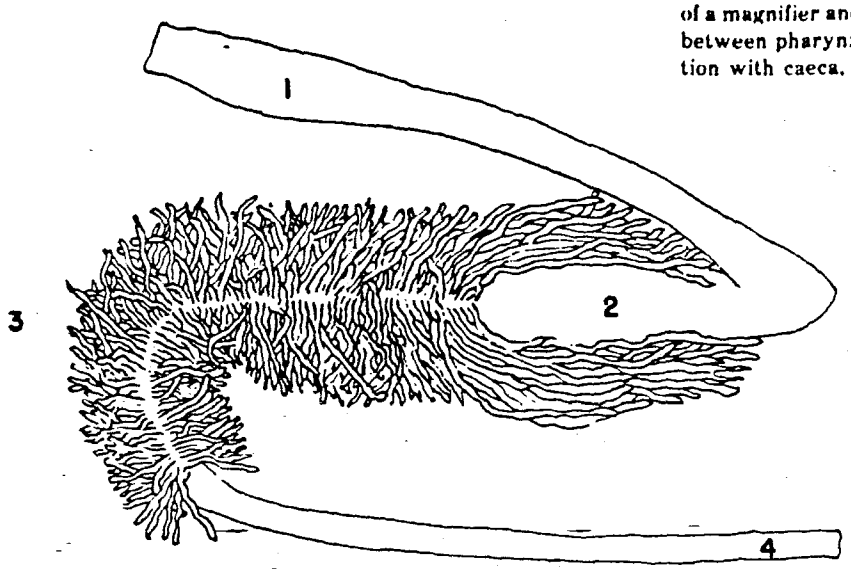


Figure 7.—Major portion of alimentary tract of salmon with pyloric caeca spread apart preparatory to counting with aid of a magnifier and teasing needle: 1) esophagus (part of tract between pharynx and stomach), 2) stomach, 3) pyloric section with caeca, 4) intestine.

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.

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.

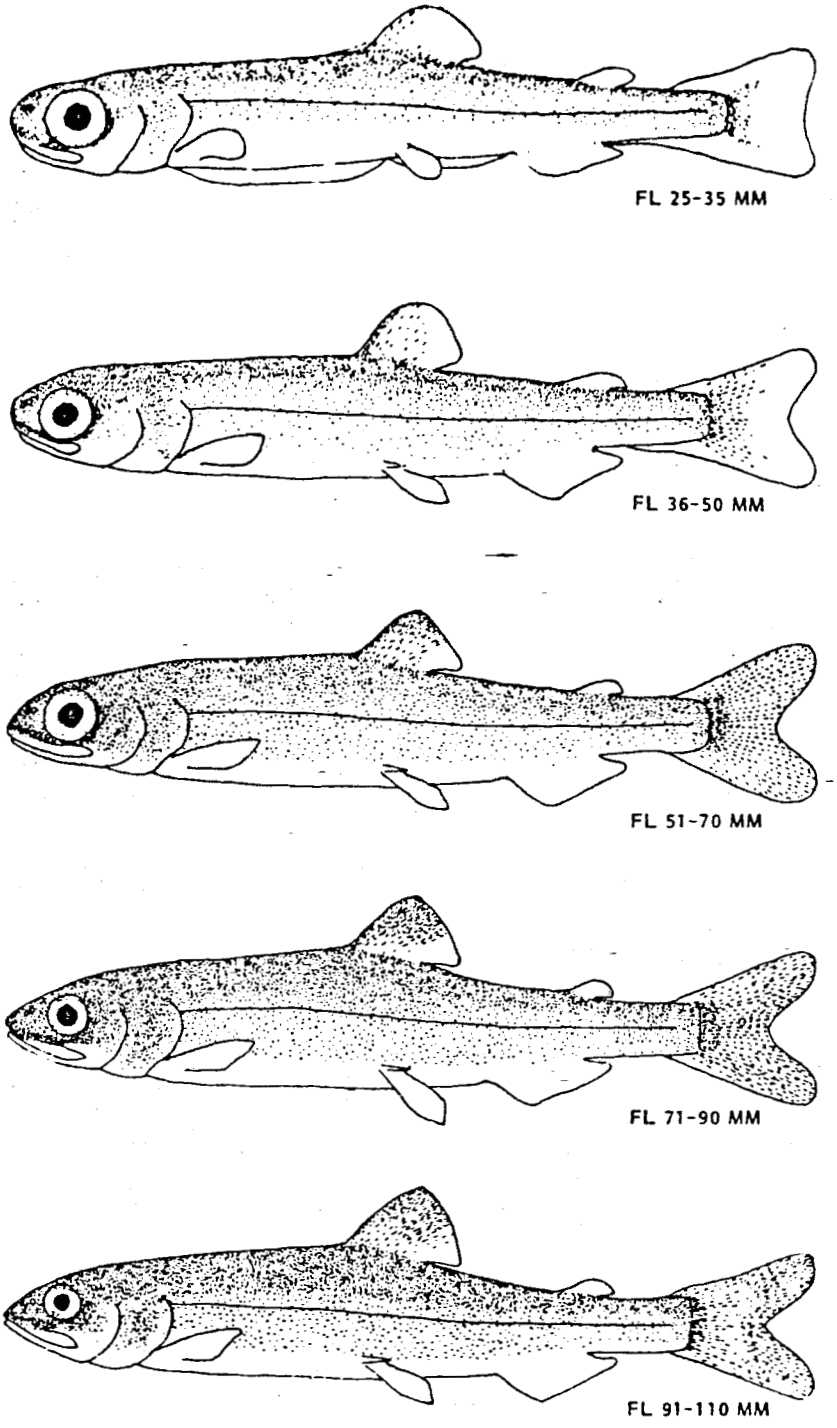


Plate 1.—Pink salmon.

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 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.

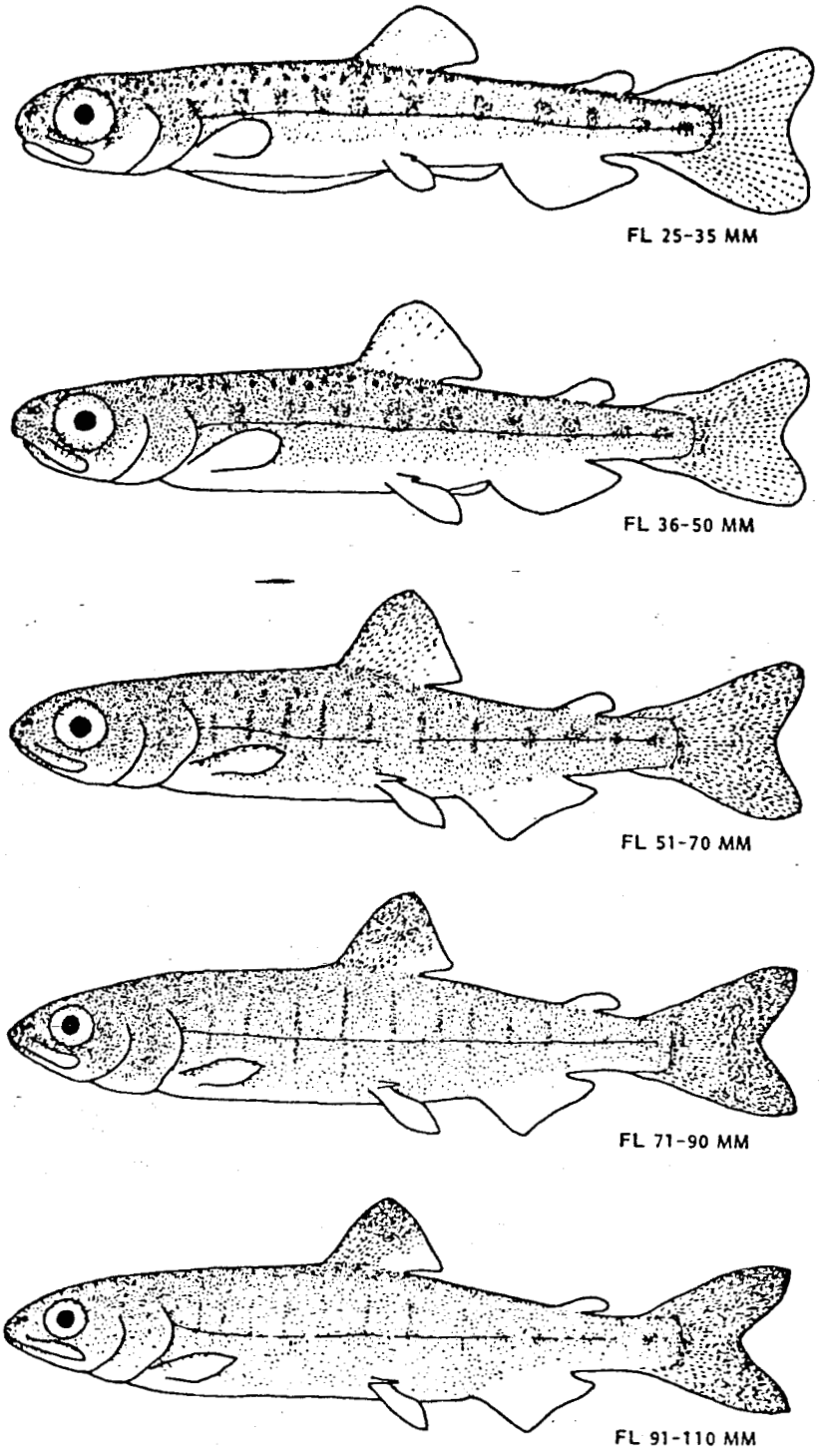


Plate 2.—Chum salmon.

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.

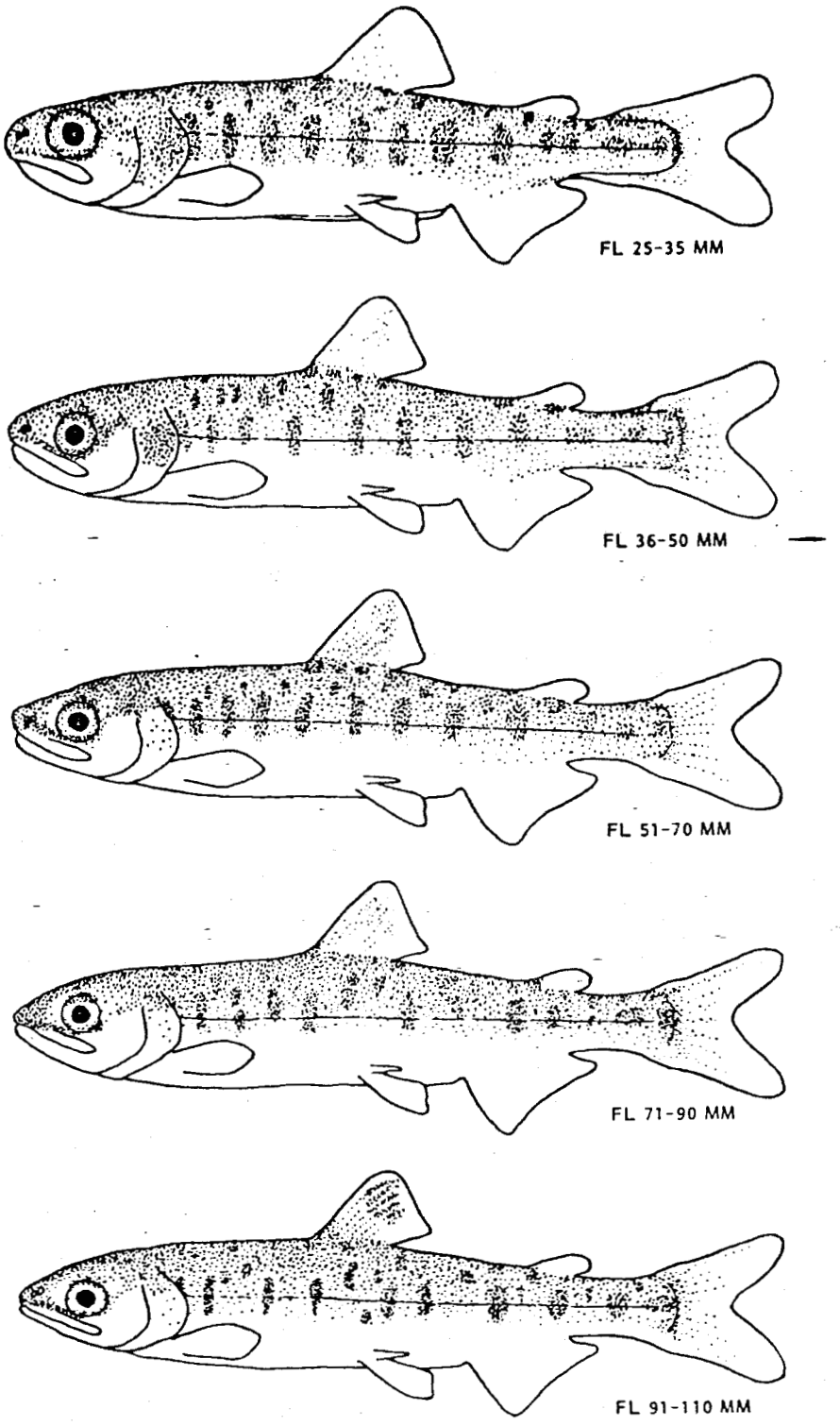


Plate 3.—Sockeye salmon.

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.

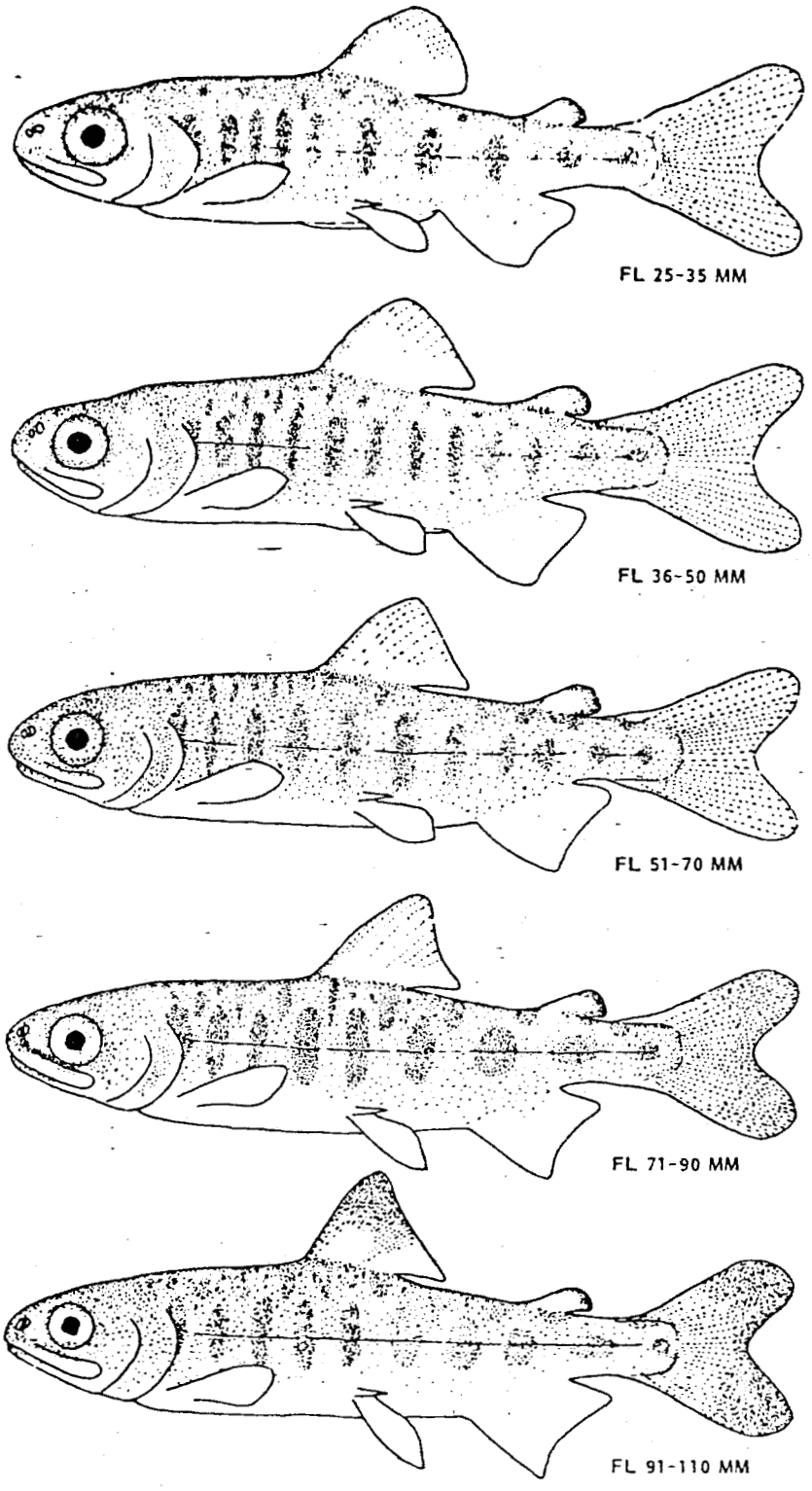


Plate 4.—Chinook salmon.

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-

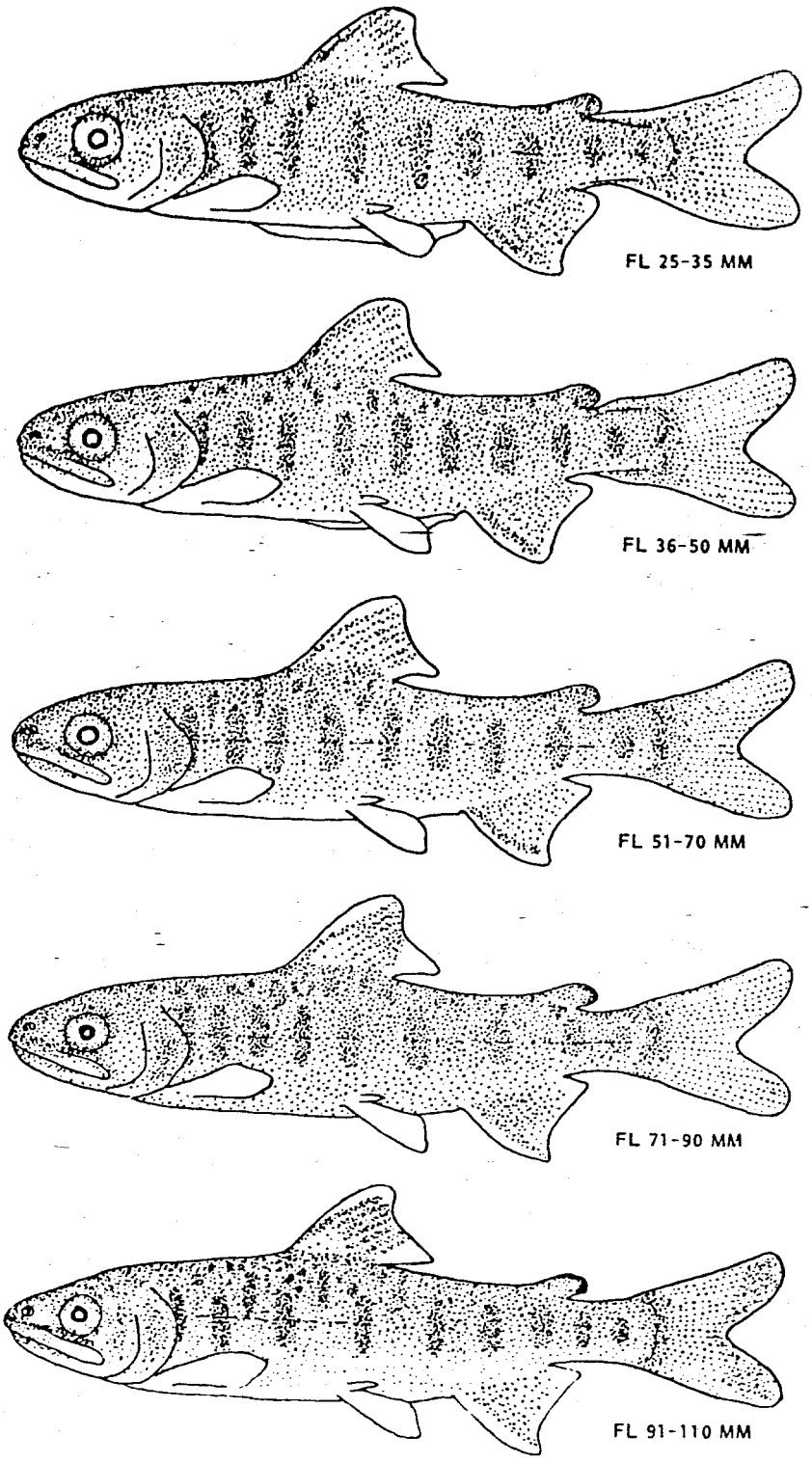


Plate 5.—Coho salmon.

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.

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National Oceanic and Atmospheric Administration
National Marine Fisheries Service

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

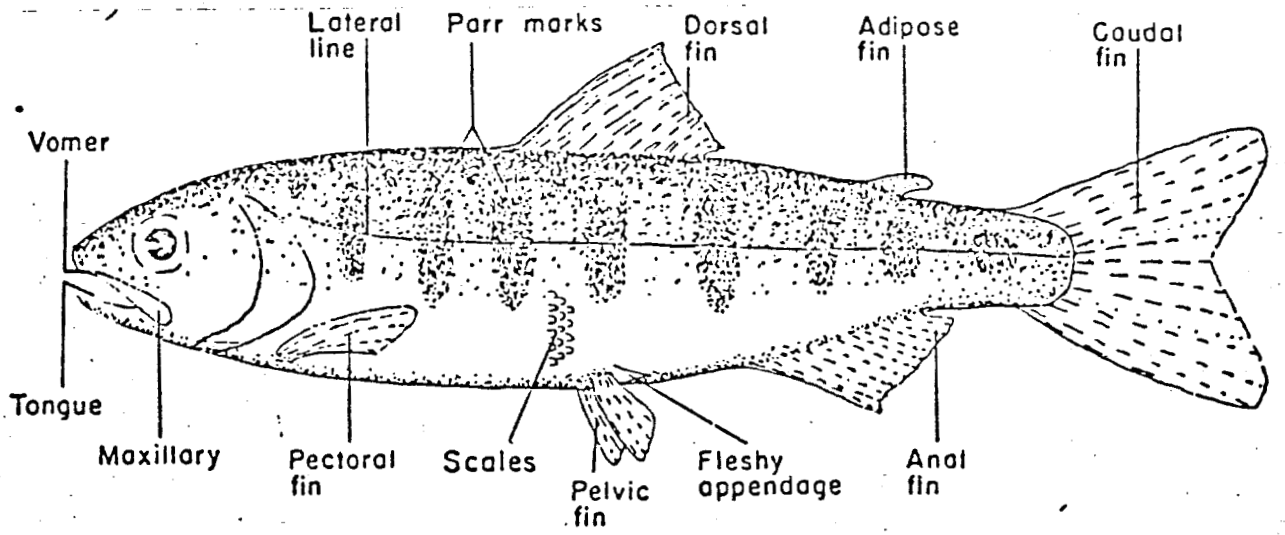
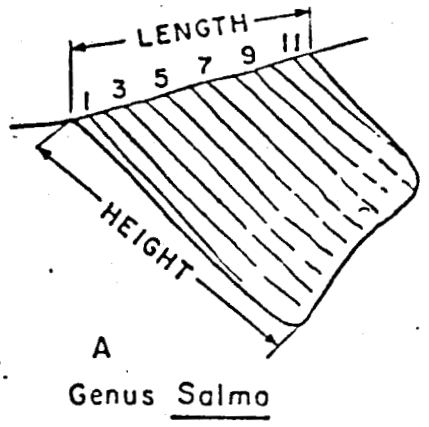


Figure 1.—A hypothetical salmonid showing external characteristics.

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)



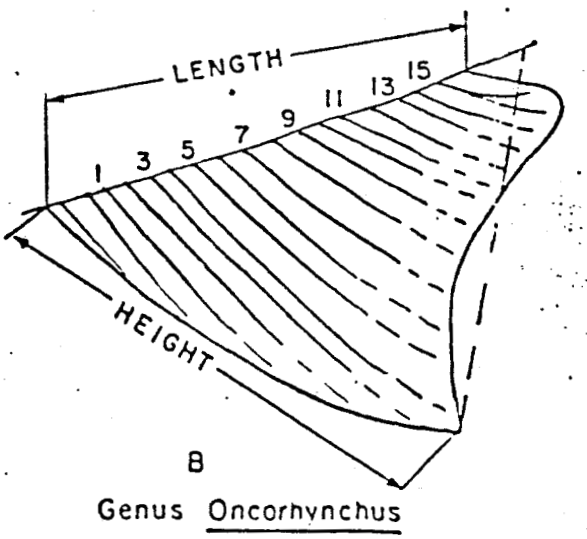


Figure 2.—Anal fins: (A) Trout, genus *Salmo;* (B) Pacific salmon, genus *Oncorhynchus.* The two drawings show differences in structure and fin ray count. (Note that the length of the anal fin is its overall basal length, and its height is that distance from the origin of the fin to the tip of the anterior 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.)

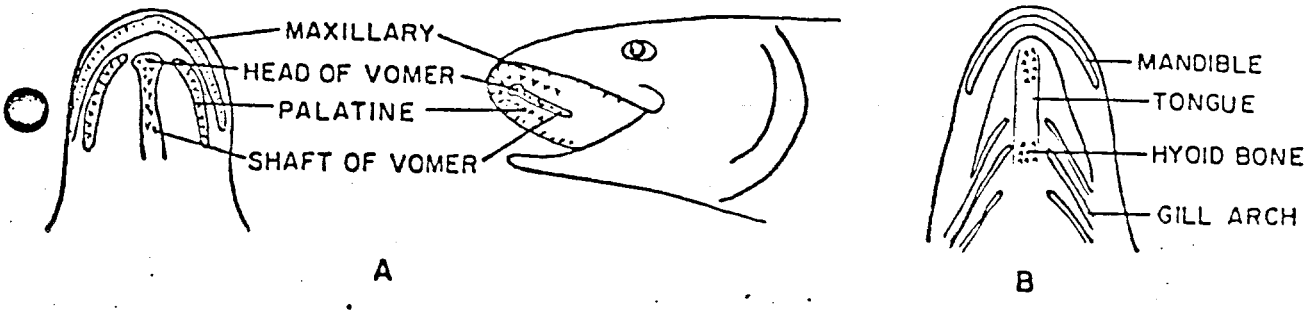


Figure 3.—Location of dentition in (A) the roof and (B) the floor of the mouth of salmonid fishes. (Presence or absence of teeth on the vomer or tongue may be determined by use of the little finger or a blunt instrument. The small hyoid teeth at the base of the tongue are located between the gill arches of the lower jaw and are difficult to find.)

6. (18) Dorsal fin with large dark spots.
Trout
Genus *Salmo*

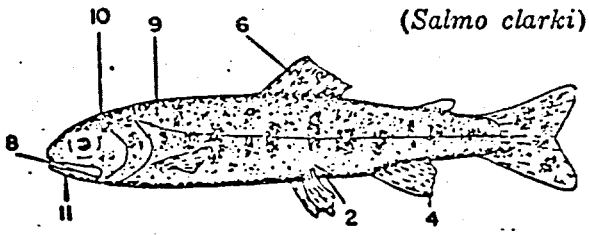
7. (53) Adipose fin not orange; no row of pale round spots along lateral line.

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*)



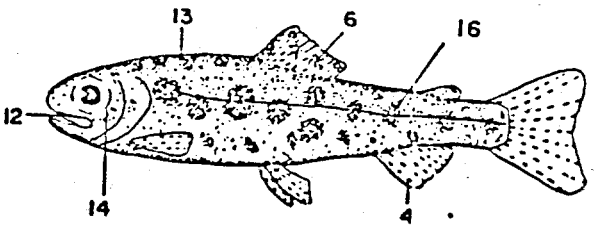
12. (8) *No teeth at base of tongue.

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.

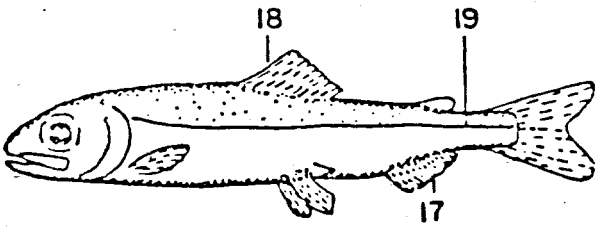
16. (20) Parr marks almost round.
Rainbow or
steelhead trout
(*Salmo gairdneri*)



17. (4) Anal fin longer than high, with 13 or more developed rays. (Fig. 2B)

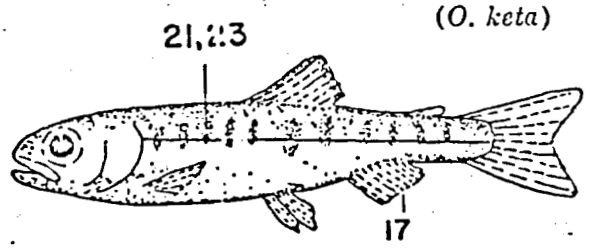
18. (6) Dorsal fin without large dark spots, may be black tipped.
Pacific salmon
Genus *Oncorhynchus*

19. (20) No parr marks. Fry leave fresh water while small—approximately 1.75 inches (45 mm) long.
Pink salmon
(*O. gorbuscha*)



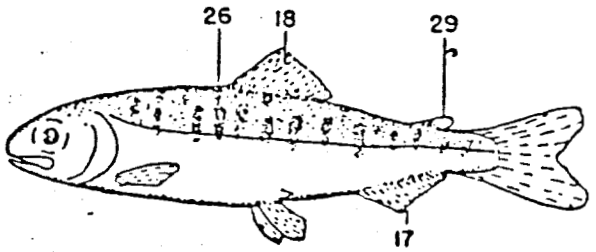
20. (16) Parr marks present as vertical bars or oval spots.
21. (30) Parr marks short, extending little, if any, below lateral line.
22. (25) Gill rakers on first arch, 19 to 26. ** Pyloric caeca, 140 to 186.
23. (26) Parr marks faint. Sides below lateral line iridescent green.
24. (27) Small when migrating from fresh water, approximately 1.5 inches (40 mm) long.

Chum salmon
(*O. keta*)



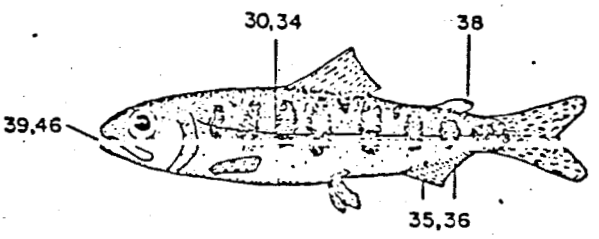
25. (22) Gill rakers on first arch, 30 to 40. **Pyloric caeca 60 to 115.
26. (23) Parr marks usually sharply defined. Sides below lateral line silvery, not iridescent green.
27. (24) Relatively large when migrating from fresh water, approximately 3 to 5 inches (80 to 126 mm) long.
28. (31) Gill rakers long and slender, more than 39 on first arch.
29. (32) Adipose fin clear, not pigmented.

Sockeye salmon
(*O. nerka*)



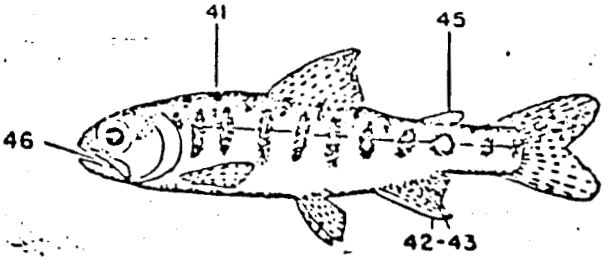
30. (21) Parr marks large, vertical bars centered by lateral line.
31. (28) **Gill rakers short and thick, fewer than 29 on first arch.
32. (29) Adipose fin at least partially pigmented.
33. (40) **Pyloric caeca more than 90.
34. (41) Parr marks broader than interspaces.
35. (42) Anterior rays of anal 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*)

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BIBLIOGRAPHY

Alaska

MEEHAN, W. R., and J. S. VANIA.
1961. An external characteristic to differentiate between king and silver salmon juveniles in Alaska. Alaska Dep. Fish Game, Inf. Leafl. 1. 5 p. (Processed.)

WILIMOVSKY, N. J.
1958. Provisional keys to the fishes of Alaska. U.S. Fish Wildl. Serv., Fish. Res. Lab., Juneau, Alaska. 113 p. (Processed.)

California

SHAPOVALOV, LEO.
1947. Distinctive characters of the species of anadromous trout and salmon found in California. Calif. Fish Game 33: 185-190.

Canada

CARL, G. CLIFFORD, W. A. CLEMENS, and C. C. LINDSEY.
1967. The fresh-water fishes of British Columbia. B. C. Prov. Mus., Dep. Recreation Conserv., Handb. 5. 192 p.

CLEMENS, W. A.
1935. The Pacific salmon in British Columbia waters. B. C., Rep. Comm. Fish. 1934: K103-K105.

CLEMENS, W. A., and G. V. WILBY.
1946. Fishes of the Pacific Coast of Canada. Fish. Res. Board Can., Bull. 68. 368 p.

FOERSTER, R. E., and A. L. PRITCHARD.
1935. The identification of the young of the five species of Pacific salmon, with notes on the fresh-water phase of their life-history. B. C., Rep. Comm. Fish. 1934: K106-K116.

SCOTT, W. B.
1958. A checklist of the freshwater fishes of Canada and Alaska. R. Ont. Mus., Div. Zool. Palaeontol. 30 p.

Montana

WEISEL, G. F.
1957. Fish guide for intermountain Montana. Mont. State Univ. Press, Missoula. 88 p.

Oregon

BOND, CARL E.
1961. Keys to Oregon fresh-water fishes. Oreg. State Univ., Agric. Exp. Stn., Tech. Bull. 58. 42 p.

Pacific Northwest

BURGNER, R. L. (edited by William A. Smoker).
1955. Preliminary key for identification of salmon fry, juveniles, and adults. State of Wash., Dep. Fish. 8 p. (Processed.)

GREGORY, R. W., P. E. FIELDS, R. W. LICHTENHELD, and G. R. SNYDER.
1961. Using anal chromatophores for distinguishing between chinook and silver salmon smolts in the Columbia River. Coll. Fish., Univ. Wash., Seattle, Tech. Rep. to U.S. Army Corps Eng. No. 51. 4 p. (Processed.)

ROUNSEFELL, G. A.
1962. Relationships among North American Salmonidae. U.S. Fish Wildl. Serv., Fish. Bull. 62: 235-270.

SCHULTZ, LEONARD P.
1936. Keys to the fishes of Washing Oregon and closely adjoining regi Univ. Wash., Publ. Biol. 2: 103-22

Washington

CRAWFORD, DONALD R.
1925. Field characters identifying you salmonid fishes in fresh waters of Wa ington. Univ. Wash., Publ. Fish. 1 (2 64-76.

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OPERATIONAL PLAN

1990 Frazer Lake
Sockeye Salmon Studies

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

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INTRODUCTION

Frazer Lake is located on the southern end of Kodiak Island and is the second largest lake on the Kodiak Archipelago (Figure 1). The lake covers 4,200 acres and is 8.6 mi long and 0.8 mi wide. Pinnell Creek is the major lake inlet stream and is located on the northwest end of the lake. The lake outlet stream is Dog Salmon Creek which flows south 8.0 mi into lower Olga Bay. A natural, 30 ft high fish barrier falls occurs on Dog Salmon Creek 0.6 mi below the outlet of Frazer Lake.

Sockeye salmon (Oncorhynchus nerka) were first introduced into Frazer Lake in 1951 through an egg transplant (Russell 1972, Blackett 1979). For the next 20 years (1952 - 1971) a combination of egg, fry and adult transplants were used to develop the population. From 1951 through 1956 egg plants were made from Karluk Lake early run fish; in 1958 and from 1961 through 1969 early run adults from Red Lake were introduced; in 1961, 1966 and from 1968 through 1971 fry from early run Red Lake stock were introduced; and in 1968 eggs from Becharof Lake outlet spawners were transplanted to the system. Although Karluk Lake, Red Lake and Becharof Lake stocks were all introduced into the Frazer Lake, it is not known which stock was the major contributor to the success of the Frazer introduction.

The first adult sockeye return from the transplant occurred in 1956. That same year and through 1962 the adult returns were back-packed over the Dog Salmon Creek falls to the lake. In 1962 an Alaska fishpass was installed at the falls (Ziemer 1962). An additional fishpass was added in 1979 (Blackett 1987).

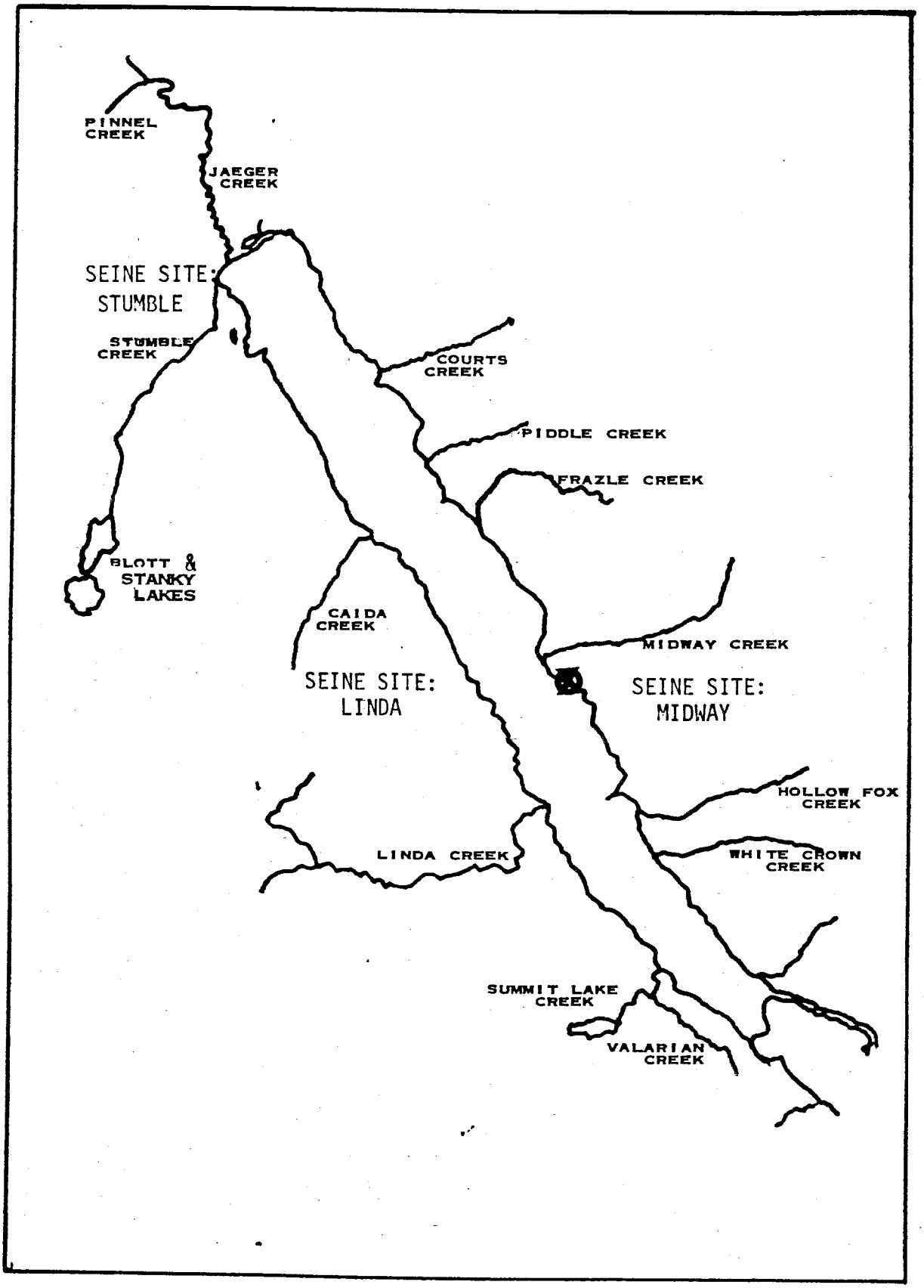


Figure 1. Frazer Lake with inlet streams and littoral seining locations identified.

In initial response to conservative management practices, escapements into Frazer Lake expanded from fewer than 25,000 fish before 1971, to 55,000 - 83,000 fish during 1971-75, to 119,000 - 142,000 fish during 1976-79, and to 378,000 - 430,000 fish during 1980-82. In the last five years escapements have fluctuated from fewer than 41,000 fish (1987) to more than 485,000 fish (1985).

The optimum sockeye salmon escapement for the Frazer Lake system was estimated by Blackett in 1975 at 383,000 adults (Blackett 1979) . His original calculations indicated an almost equal balance between available spawning area (400,000 adults) and rearing (365,000 adults) habitat. Subsequent evaluation indicates that Frazer Lake is rearing limited, and the optimum escapement is between 140,000 and 200,000 fish. The forecast for the 1990 run is 564,000 sockeye salmon. Most of the 1990 return was produced by the 1984 and 1986 broo year escapements which averaged 90,000 fish.

Sockeye salmon escapements have been counted at the Frazer Lake fishpasses since 1956, and smolt have been sampled there since 1965. Additional escapement counting began in 1983 with a weir on Dog Salmon Creek 0.3 mi upstream of lower Olga Bay. This lower escapement enumeration site, located close to the fishery, provides timely in-season run strength information on sockeye salmon and allows monitoring of other salmon species escapements, including pink (O. gorbuscha), chum (O. keta) and coho (O. kisutch) salmon spawning below the Frazer Lake fishpass.

In 1986 the Fisheries Rehabilitation and Enhancement and Development Division transferred the Frazer Lake fishpass operation to the Division of Commercial Fisheries (CF).

OBJECTIVES:

The overall CF goal for the Frazer Lake system is to optimize natural sockeye salmon production and accurately forecast annual runs. The specific objectives of the 1989 field program are to:

1. Provide fish passage into Frazer Lake.
2. Determine escapement timing and magnitude.
3. Estimate age and sex composition, and mean length of the escapement.
4. Determine smolt timing, age composition, weight by age, and relative abundance.
5. Determine the escapement distribution to the various spawning grounds.

SUPERVISION

The Frazer Lake crew leader is Jean White, and the assistant is Tom Rivest. Jean will be responsible for making daily work assignments and insuring that operations are conducted safely and according to the standards defined in this manual. Pat Holmes will oversee the project.

PROCEDURES

Escapement Passage

The old (1962) Frazer Lake fishpass will be operated from approximately 15 June to 21 August. The 15 June starting date is tentative. Actual start-up of the old fishpass will occur on the day following the first sockeye count at the Dog Salmon River weir. The fishpass is not to be opened any earlier than necessary

to minimize smolt passage through the fishpass. The new fishpass (1979) will be ready for use by 15 June. However it will not be operated unless passage rates in the old fishpass exceed approximately 30,000 fish per day.

In association with the fishpasses, the lower adult weir will be checked daily to insure that it is fish-tight for adult salmon. Daily inspection is necessary due to brown bears pushing against the weir and loosening the weir panels. The upper or top weir will be periodically checked to insure that it is operating effectively to prevent fallback of adult fish over the falls. Specific instructions on opening, maintaining and closing the fishpasses are in Appendix A.

The bulkhead at the fishpass entrance will be padded with astroturf to reduce fish mortality associated with jumping activity at the fishpass entrance.

Escapement counts will be made at the exit tank as often as required to prevent fish build-up and migration delay. Generally at least four counts will be made daily. During the peak of the escapement migration it may be necessary to count almost continuously. Fish exiting the top tank will be individually counted by species using hand-held tally counters. The counts will be recorded on Form F1-1(86) (Figure 2).

A standard sampling day for all activities except for smolt will extend from midnight to midnight.

Figure 2.

FRAZER RIVER FISH PASS ESCAPEMENT REPORTING FORM

Year _____

FORM FL-1(86)

Date	Chinook		Sockeye		Pink		Chum		Coho		Mortality 1/		Remarks 2/
	Daily	Cum	Daily	Cum	Daily	Cum	Daily	Cum	Daily	Cum	Smolt	Adult	

1/ Related directly to fishpass; identify specific cause if known under "Remarks".

2/ Include weather and other speicies counts.

Escapement Sampling

Sockeye salmon escapement sampling for age, length, and sex (ALS) data will be conducted weekly through the escapement migration. The sample size per statistical week is 240 fish (Table 1). When possible a weekly sample should be collected from a single day's escapement. If necessary a sample may be taken over two consecutive days but not more than this even if a complete sample is not obtained.

The procedure for collecting and recording sockeye (ALS) data is in Appendix B.

Smolt Sampling

There are two aspects of the smolt sampling program. The first involves measuring the relative abundance of the out-migration and the second is measuring smolt quality. Abundance will be measured by the catches in the concrete trap and an inclined plane trap at the lower adult weir. The concrete trap which is an integral component of the adult weir will be operated continuously from 16 May through 15 July (Figure 3). The trap will be outfitted with approximately 30 feet of smolt panel fitted against the upstream side of the adult weir to increase the fishing area. Visqueen will be placed along the face of the smolt panels to insure adequate flow into the trap. The inclined plane trap will be operated from 16 May through 15 July. It will be positioned between weir unipods 6 and 8 and outfitted with 13-foot of smolt panels (Figure 4).

Table 1. 1990 calendar weeks.

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

Figure 3. (page 1 of 5)

FLB/-1

SOCKEYE SALMON SMOLT CATCHES - FRAZER LAKE FISHPASSES

Date	Inclined Plane Trap		Concrete Trap		Total All Traps		Remarks
	Daily	Cum.	Daily	Cum.	Daily	Cum.	
15-May							
16-May							
17-May							
18-May							
19-May							
20-May							
21-May							
22-May							
23-May							
24-May							
25-May							
26-May							
27-May							
28-May							
29-May							

-Continued-

Figure 3. (page 2 of 5)

SOCKEYE SALMON SMOLT CATCHES - FRAZER LAKE FISHPASSES

FL87-1

Date	Inclined Plane Trap		Concrete Trap		Total All Traps		Remarks
	Daily	Cum.	Daily	Cum.	Daily	Cum.	
30-May							
31-May							
01-Jun							
02-Jun							
03-Jun							
04-Jun							
05-Jun							
06-Jun							
07-Jun							
08-Jun							
09-Jun							
10-Jun							
11-Jun							
12-Jun							
13-Jun							

-Continued-

Figure 3. (page 3 of 5)

SOCKEYE SALMON SMOLT CATCHES - FRAZER LAKE FISHPASSES FL87-1

Date	Inclined Plane Trap		Concrete Trap		Total All Traps		Remarks
	Daily	Cum.	Daily	Cum.	Daily	Cum.	
14-Jun							
15-Jun							
16-Jun							
17-Jun							
18-Jun							
19-Jun							
20-Jun							
21-Jun							
22-Jun							
23-Jun							
24-Jun							
25-Jun							
26-Jun							
27-Jun							
28-Jun							

-Continued-

1/ Identify mortalities by trap. Identify other species catch by trap on reverse side.

Figure 3. (page 4 of 5)

SOCKEYE SALMON SMOLT CATCHES - FRAZER LAKE FISHPASSES FL87-1

Date	Inclined Plane Trap		Concrete Trap		Total All Traps		Remarks
	Daily	Cum.	Daily	Cum.	Daily	Cum.	
29-Jun							
30-Jun							
01-Jul							
02-Jul							
03-Jul							
04-Jul							
05-Jul							
06-Jul							
07-Jul							
08-Jul							
09-Jul							
10-Jul							
11-Jul							
12-Jul							
13-Jul							

-Continued-

Figure 3. (page 5 of 5)

SOCKEYE SALMON SMOLT CATCHES - FRAZER LAKE FISHPASSES FL87-1

Date	Inclined Plane Trap		Concrete Trap		Total All Traps		Remarks
	Daily	Cum.	Daily	Cum.	Daily	Cum.	
14-Jul							
15-Jul							

1/ Identify mortalities by trap. Identify other species catch by trap on reverse side.

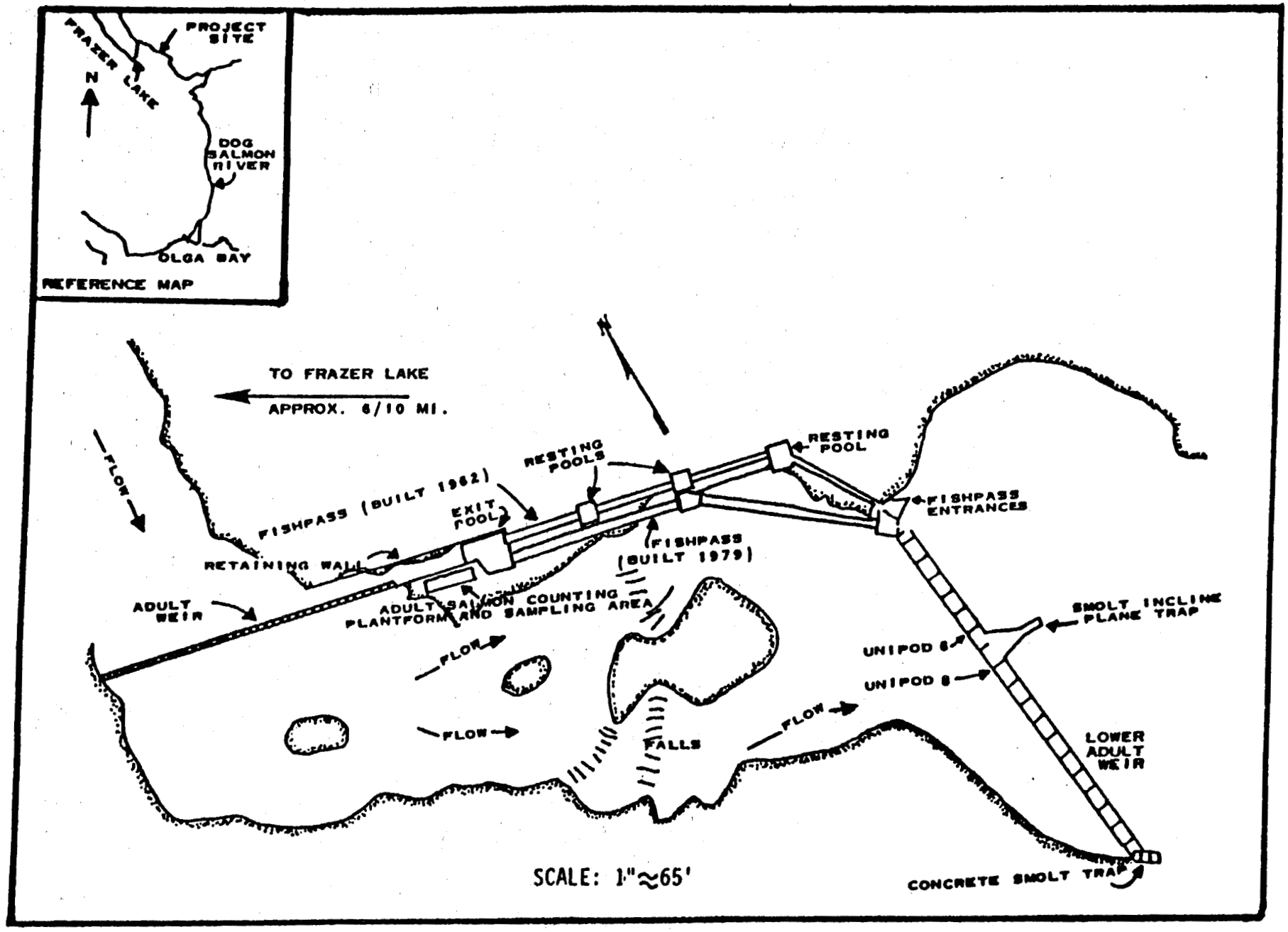


Figure 4. Schematic of the Frazer Lake fishpasses.

The concrete and inclined plane traps will be checked as often as necessary to insure the traps are fishing efficiently and mortalities are not occurring. Minimally there should be three daily checks per trap. Each time a trap is checked the catch will be counted by species and released. All catch data will be recorded on Form FL 87-1 (Figure 3).

Smolt catches are to be sampled weekly age, length and weight. Specific procedures for collecting smolt age, length, and weight data is in Appendix C. A weekly sample will consist of 200 fish. The sample should be taken from a single days catch from the inclined plane trap. If the inclined plane trap does not have sufficient numbers of fish, the difference to complete sampling requirements will be obtained from the concrete trap on the same day. If both traps do not have enough fish to meet the 200 sample size, sampling may extend into the next day but not beyond. A smolt day encompasses the 24-hr between noon of one day to noon of the following day and is identified by the calendar date corresponding to the first 12-hr period.

Species identification keys are in Appendix D.

Escapement Surveys and Beaver Dam Removal

All lake inlet streams (except Pinnell Cr.)and the lake outlet will be surveyed weekly beginning on 15 July and ending on 21 August. Each area will be surveyed to the upper spawning limit. The mouths of the inlet streams will be counted separately from the stream proper. The observers will survey on foot, wear polarized glasses, and use hand-held tally counters to record live and dead fish by species. The survey data will be recorded on form FL 87-2 (Figure 5).

Figure 5.

SOCKEYE SALMON STREAM SURVEY LOG

FL87 -2

Stream Name 1/	Date	Observer	MOUTH			STREAM					Stream Temp (C.)	Remarks
			Survey			Survey		Count				
			Cond.	Meth.	Live Count	Cond.	Meth.	Live	Dead	Total		

1/ For Frazer Lake surveys count the number of live fish on the shoals but exclude fish which are off stream mouth, and under remark designate % of the escapement spawning on the east and west sides of the lake.

Pinnell Creek and Frazer Lake (excluding inlet streams mouths) will be surveyed by the crew leader at least twice from the air between 24 July and 21 August.

Limnological Support and Juvenile Fish Rearing in the Littoral Area

The Frazer Lake crew will assist FRED Division as needed to insure lake limnological data are collected.

Three Frazer Lake littoral sites will be sampled with a standard 50 ft. fry seine once every two weeks beginning on 16 May and ending on 15 August. The fishing locations are marked with metal fence posts and at the sites identified in Figure 1. On the sampling days a single haul will be done at each station between approximately 10 am and 2 pm to minimize diurnal variability. The seine catches will be logged on form FL 87-3 (Figure 6). Standard length measurements will be taken from a subsample of 25 fish for each species caught. The length data will be recorded on form FL87-3.

FIGURE 6. SEINE CATCH LOG (form:Fl 87-3)

Lake:_____ Time:_____ Remarks:
Location:_____ H2O Temp.:_____
Date:_____ Seine Length:_____
Crew:_____

Total Catch

Sockeye:_____ Coho:_____ Dolly V.:_____ Stick.B.:_____ other:_____:____

Length Sample

	Sockeye	Coho	Dolly V.	Sticleback	Rainbow
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					
11.					
12.					
13.					
14.					
15.					
16.					
17.					
18.					
19.					
20.					
21.					
22.					
23.					
24.					
25.					
26.					
27.					
28.					
29.					
30.					

APPENDIX A

Fishpass Maintenance and Operation

Fishpass Maintenance and Operation

Spring maintenance on the fishpass must be completed by the last week of May to insure preseason readiness of the facility.

Spring maintenance will consist of:

1. A thorough inspection of the fishpass for damage or operational defects.

2. Replacement of missing or broken steeppass and tank covers.

3. Cleaning of debris from tanks and steeppass runs.

4. Tight attachment of rubber (tire) bumpers on ends of steeppass in the tanks.

5. Re-grouting steeppasses into tanks and repair of any damage or defects.

6. Cleaning debris from the entrance tanks, installation of plywood wings, and attachment of astroturf mats to prevent injury of jumping fish.

7. Cleaning rocks and streambed materials from the exit tank, channel, stop-log base of the water control weir, and entrance tanks.

8. Other maintenance that is apparent upon inspection. This might include structural support repairs, installation of gabions, new stop-logs, nut tightening on water control diversion at top of falls, etc.

Upon completion of maintenance, the fishpass will be opened by the following procedure:

1. Wood drain plugs are inserted from <u>inside</u> of the tanks into the drain holes. The plugs should fit tightly. Water pressure within the tank acts to hold the plug in place. Two tanks have caps that are screwed on from the outside.

2. Tank covers are placed in position and stop-logs are removed <u>slowly</u> from the exit tank. The bottom stop-log is left in place. If logs are removed rapidly, gravel will wash into the tank.

3. Check the trap for holes that would allow fish to escape uncounted.

4. Install heavy vinyl wire across front of water control weir to prevent salmon from being washed over the falls. Attach this screen so that it <u>does not</u> lift up off the bottom.

The fishpass will normally be operated so that the steeppasses are 2/3 to 3/4 full of water. This volume of water is necessary to maintain velocity attraction at the entrance for optimum sockeye passage. A water level of 1.80 to 1.82 should be maintained on the staff gauge by removing or placing stop logs in the water control diversion at the top of the falls. At this water stage, the old fishpass will be 3/4 to 4/5 full and the new fishpass 2/3 to 3/4 full.

A 9-inch wide vertical slot "door" is kept in place at the entrance during most of the run. Check this door daily during sockeye passage to make sure it is all the way down in the slot. It has a tendency to work up when salmon hit against it. The 9-inch wide opening is necessary to maintain optimum attraction velocity for sockeye. The door can be removed to provide a 12-inch opening (reducing velocity) for less active fish during the latter portion of the migration.

The fishpass will be checked daily for tight covers and unblocked steeppasses. Under no circumstances should any trash, buckets, or other items be put into the exit tank or steeppass. Avoid allowing any detergents or other chemicals from entering the fishpass water supply. Human or bear activity at the entrance will decrease passage of salmon and should be avoided except in the performance of your work. Visitors and casual observers are to be kept off the fishpass and not allowed to interfere with salmon passage.

At the end of the salmon run, usually about August 25, the fishpass will be closed for the year. The procedure in closing will be:

1. Remove the counting trap and screen and store on bank. Place wood blocks under logs and wood frame parts to prevent ground contact and rot.

2. Remove all stop-logs from the water control weir and stack on bank. Replace stop-logs in the exit tank channel. Visqueen as necessary to stop water flow between the logs.

3. Remove all drain caps by unscrewing and plugs by tapping from the outside of the tanks. Drain all tanks completely. Leave the caps and plugs in the tractor shed.

4. Clean dead fish and debris from the tanks.

5. Remove vertical slot door and astroturf from the entrance. Store a A-frame shed.

6. Inspect the fishpass and camp facility for any needed repairs or maintenance work. Describe any work to be performed in the spring and materials that will be needed in the station logbook.

7. Inventory all equipment, materials, and fuel left at Frazer. List items needed for next year's operation.

APPENDIX B

Procedure for Using AWL Mark-Sense Forms

Length, Sex, and Scale Sampling Procedure for Sampling:
Using Mark-Sense Forms
(Recommended by Statewide Stock Biology Group, May 1985)

INTRODUCTION

Salmon from the catch are sampled for length, sex, and scales annually by field crews throughout the state. This data base is essential to sound management of the State's salmon resources. This information is drawn upon by management and research biologists for: (1) forecasting run strengths; (2) setting escapement goals; (3) examining the productivity of each system; (4) salmon growth analysis; (5) catch apportionment (based on age composition and/or scale pattern analysis); (6) in-season run estimation; and (7) to gain a better understanding of the biology of each stock.

For clarification purposes a SCALE SAMPLE and SUB-SAMPLE will be defined as follows:

SCALE SAMPLE: A data set collected from a specific sampling location, containing scales and data from a single species, collected during a single year. All data forms and scale cards of a single SAMPLE have the same statistical code. AWL and scale card number in a sample are consecutively and chronologically ordered.

SUB-SAMPLE: Any portion of a scale sample consisting of consecutively numbered AWL's and scale cards. SUB-SAMPLES usually consist of one or more time segments of a sample.

To be useful, data must be recorded on the mark-sense forms neatly and accurately. The following procedures are to be adhered to when sampling for length, sex, and scales using mark-sense AWL forms.

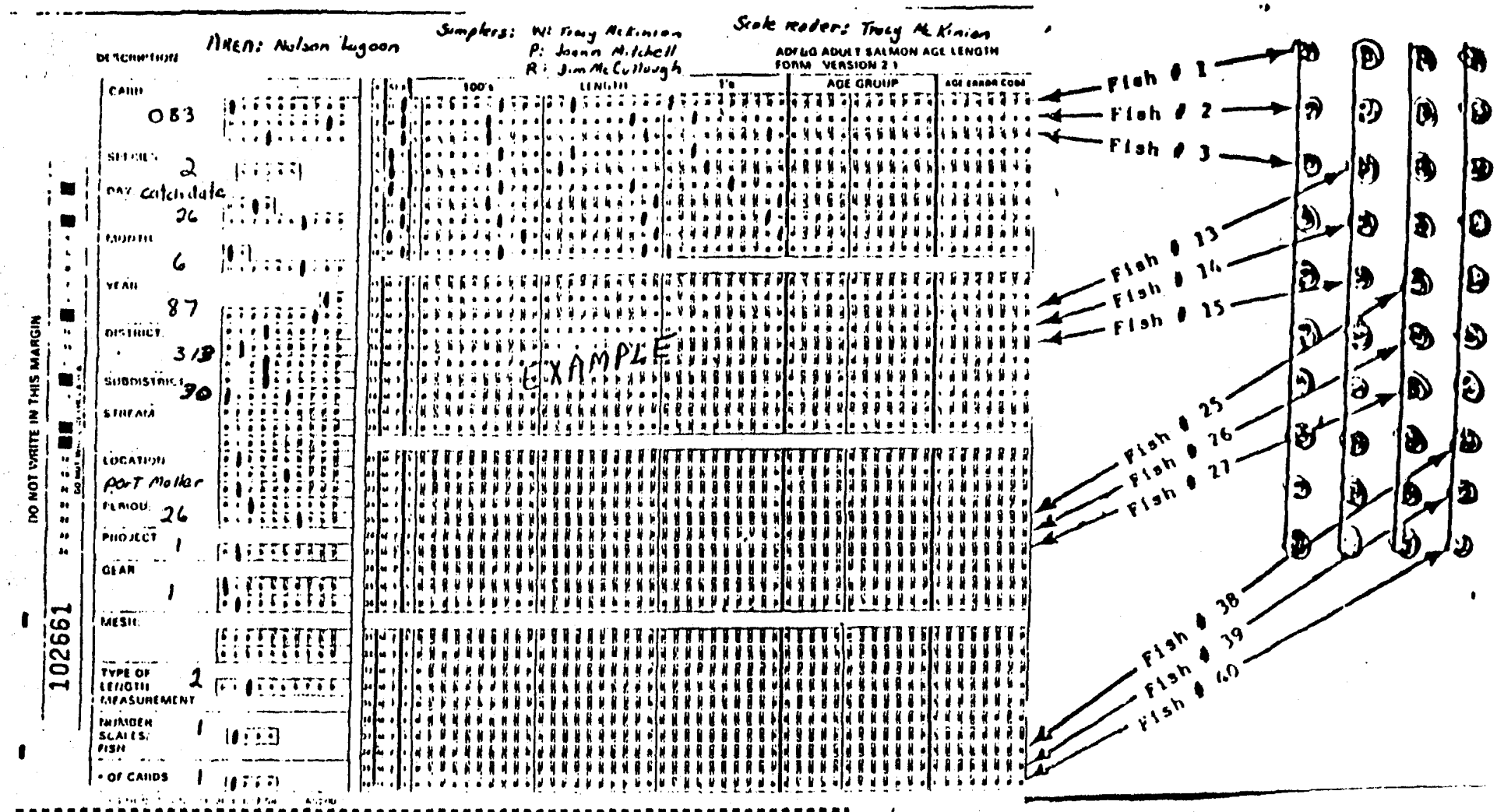
COMPLETING THE FORMS:

A completed mark-sense AWL form and accompanying gum card for sampling commercial catches of sockeye and chum salmon are shown in Appendix B.1. A completed AWL form and accompanying gum cards for sampling commercial catches of chinook and coho salmon is shown in Appendix B.2.

Complete each section of the left side of the mark-sense form using a soft 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 mark-sense AWL forms. Label only one form at a time to avoid "the carbon paper effect" and resulting stray marks.

Description:
For catch sampling: Area/Samplers (name and W-R-P)

Card:
The AWL forms and corresponding gum card(s) are numbered sequentially by date throughout the season starting with 001. A separate numbering sequence will be used for each species, gear type, district, and geographic location. Consult your port supervisor for the current card number. Sockeye and chum



Appendix B.1. Example of AWL and gum cards for sampling one scale per fish.

Species: Sockeye Card No 083
Locality: Nelson Lagoon Catch
Stat. Code: 313-30-
Sampling Date: Mo 6 Day 26 Year 87
Gear: Purse Seine
Collector(s): McCullough, Mitchell, McKinnon
Remarks:

AREA: Moller to Seniavin Samplers: W – Tracy McKinion, P – Joann Mitchell, R – Jim McCullough Scale reader: McKinion

ADF&G ADULT SALMON AGE LENGTH FORM VERSION 2.1

DESCRIPTION

DO NOT WRITE IN THIS MARGIN

103328

CARD: 001 A,B,C,

SPECIES: Chinook

DAY (caught): 20

MONTH: 6

YEAR: 87

DISTRICT: 315

SUBDISTRICT:

STREAM:

LOCATION: Port Moller

PERIOD:

PROJECT:

GEAR:

MESH:

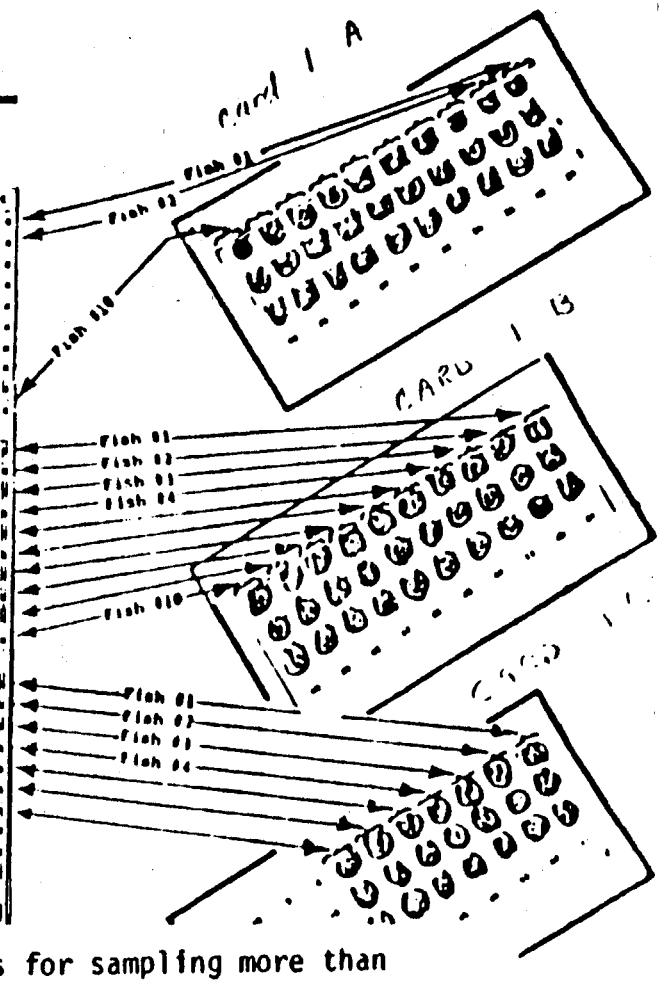
TYPE OF LENGTH MEASUREMENT:

NUMBER SCALES/FISH: 4

OF CARDS: 1

001A 001B 001C

100's | LENGTH | 1's | AGE GROUP | AGE ERROR CODE



Appendix B.2. Example of AWL and gum cards for sampling more than one scale per fish.

Species: Chinook Card No: 001A
Locality: Moller to Seniavin Catch
Stat Code: 315-__-___-___-___
Sampling Date: Mo 20 Day 6 Year 87
Gear: purse seine
Collector(s): McKinion, Mitchell, McCullough
Remarks: 3 scales per fish

Species: Chinook Card No 001B
Locality: Moller to Seniavin
Stat Code: 315-__-___-___-___
Sampling Date: Mo 20 Day 6 Year 87
Gear: purse seine
Collector(s): McKinion, Mitchell, McCullough
Remarks: 3 scales per fish

Species: Chinook Card No 001C
Locality: Moller to Seniavin Catch
Stat Code: 315-__-___-___-___
Sampling Date: Mo 20 Day 6 Year 87
Gear: purse seine
Collector(s): McKinion, Mitchell, McCullough
Remarks: 3 scales per fish

samples will have only 1 card per AWL form as shown in Appendix B.1. Coho and chinook samples will contain up to four cards per AWL form as shown in Appendix B.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 caught.

District:
List only one district. Consult project leader for appropriate district and subdistrict numbers.

Subdistrict:
List a single subdistrict if it is known and all the fish sampled were from that single subdistrict. Leave blank if more than one subdistrict is involved or if the subdistrict is unknown.

Stream:
Leave blank for catch sampling.

Location:
For catch sampling list the appropriate port code.

Period:
List the statistical week in which the fish were caught (Table 1).

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

Gear:
Refer to the reverse side of the AWL form.

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

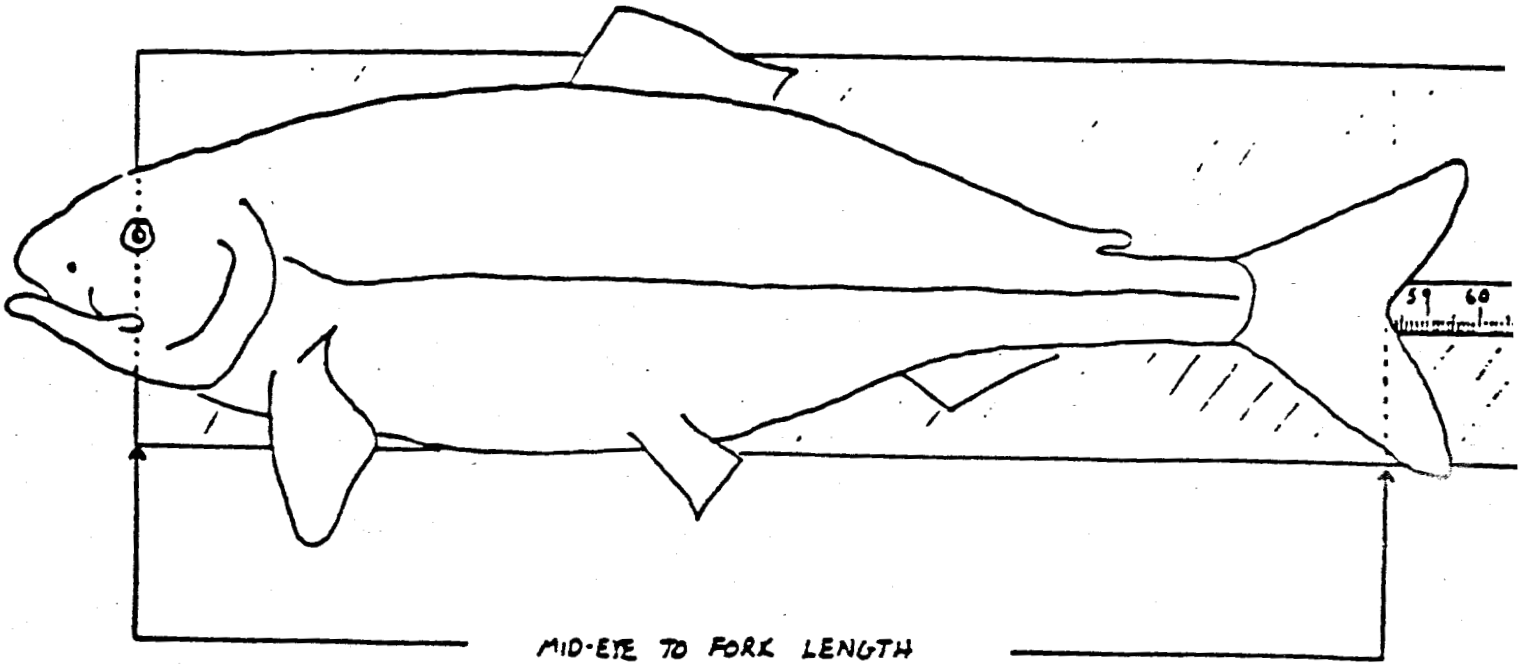
Type of length measurement:
Use (2) mid-eye to fork-of-tail (unless specifically instructed to do otherwise). Refer to Appendix B.3.

# of cards:
Mark 1 when sampling sockeye and chum salmon (Appendix B.1). Mark 1A, 1B, 1C, or 1D when sampling chinook and coho salmon and write the card numbers perpendicular to the left of the fish # column as shown in Appendix B.2.

It is paramount to keep the mark-sense forms flat, dry, and clean. Fish gurry and water curling will cause data to be misinterpreted by the optical scanning reader machine. In general, keep the forms neat enough and legible enough to have a stranger be able to make sense out of them.

Additional data columns are available on the reverse of the AWL for individual project use. If you as a project leader use them and wish that data to be read by the opscan reader, you will need to transfer the litho code from the front of the form to the reverse.

Appendix B.3. Measuring fish length.



Because the length and form of the snout of salmon changes as the fish approaches sexual maturity, length measurements are made from the middle of the eye to the fork of the tail. The length is always recorded to the nearest millimeter. The procedure for measuring length (mid-eye to fork) of the salmon is as follows:

1. Place the salmon flat on the board with the head to your left and the dorsal fin away from you.

2. Make sure your eye is directly over the end of the board. Line the eye of the salmon up with the edge of the board and hold the head in place with your left hand. It helps to place a finger in the salmon's eye for reference.

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 .

GUM CARD(S):

Fill out the gum cards as shown in Appendices B.1 and B.2.

Species:
Write out completely (i.e., chinook, sockeye, etc.).

Locality:
For catch sampling write down area in which fish were caught followed by the word catch (e.e., Herendeen Bay Catch).

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

Gear:
Write out completely.

Collector(s):
Record the last name or initials of the 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:

A. GENERAL

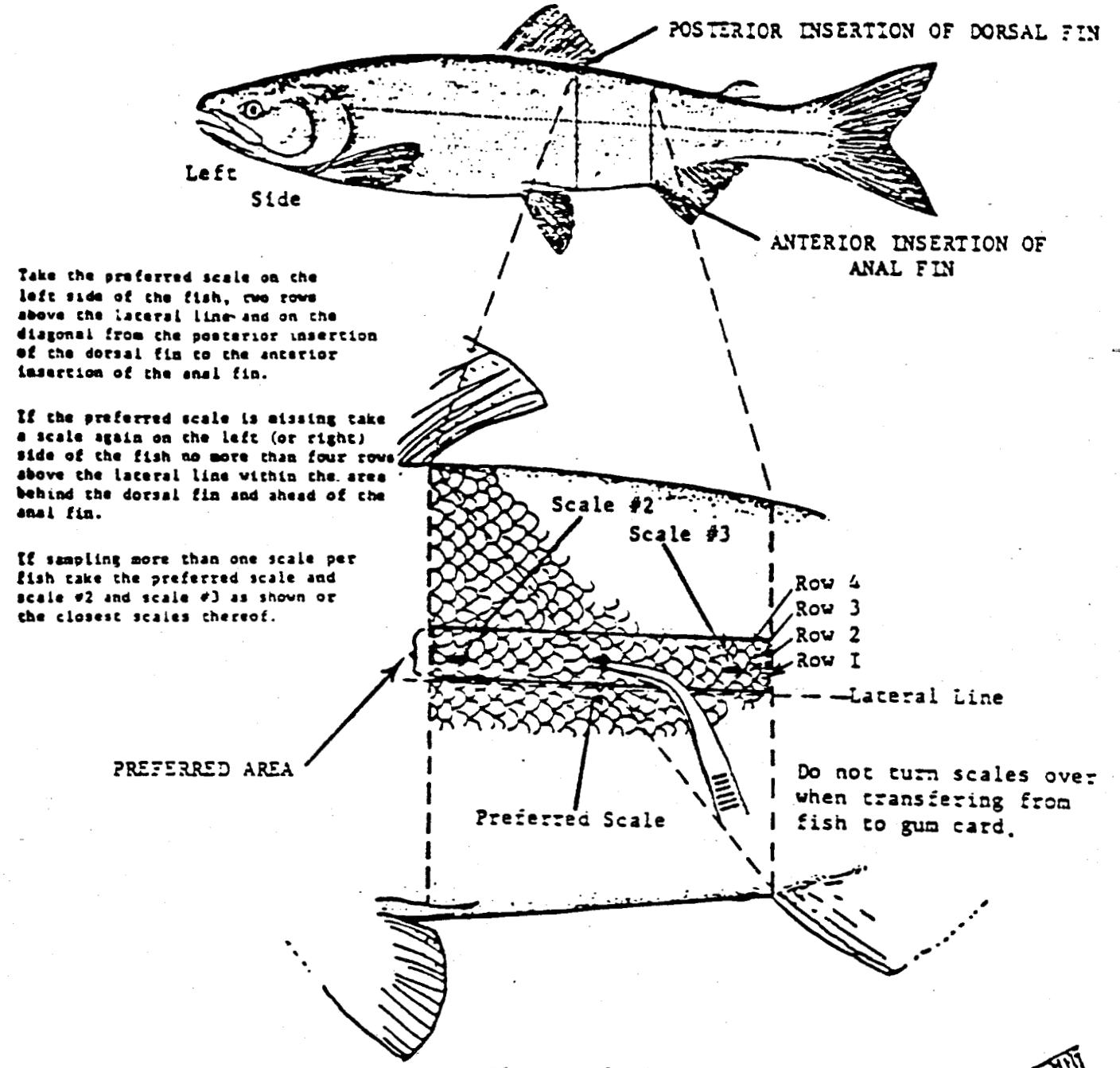
1. Sex the fish and darken M or F in the sex columns. If any difficulty was encountered in this procedure, write "I had trouble sexing these fish" on the top margin of the AWL and ask your supervisor for help as soon as possible before sexing additional fish.

2. Measure all species' length in millimeters from the middle of the eye to the fork of the tail, refer to Appendix B.3. Record length by blackening the appropriate column blocks on the AWL form. Column 3 on the AWL form is used for fish over 999 millimeters long (Big Daddy Chinook). Measure all species of salmon to the nearest mm. Check the calipers daily, before use, to ensure the accuracy of the measurements.

3. Pluck the "preferred scale" from the fish using forceps. Remove all slime, grit, and skin from the scale by moistening and rubbing between fingers. 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, refer to Appendix B.4. 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 both sides 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.

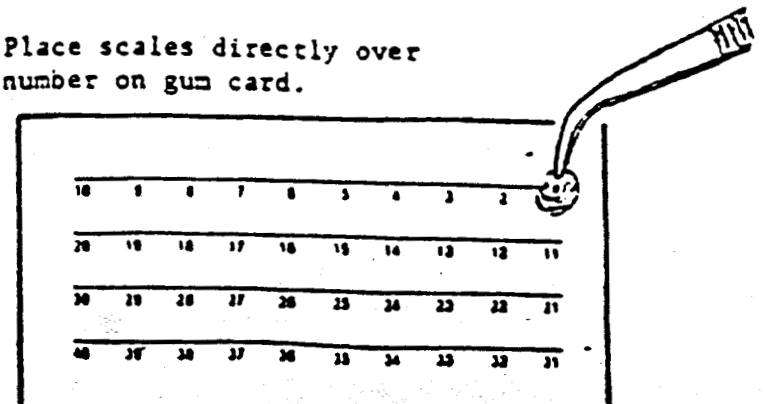
4. Clean, moisten and mount scale on gum card directly over number 1 as shown in Appendix B.4. The side of the scale facing up on the gum card

Appendix B.4. Scale sampling procedure showing the preferred scale sampling area on an adult salmon.



NOTE: Mount scales with anterior portion of scale oriented toward top of card.

Place scales directly over number on gum card.



is the same as the side facing up when it was adhered to the fish. This outward facing side is referred to as the "sculptured" side of the scale. The ridges on this sculpture side can be felt with a fingernail or forceps. Mount scale with anterior end oriented toward top of gum card.

5. When sampling sockeye and chum salmon repeat steps 1 through 4 for up to 40 fish on each AWL form.

6. When taking 3 scales per fish as with chinook and coho salmon sample the "preferred scale" and scale #2 and scale #3 as shown in Appendix B.4. Scale #2 is one inch to the left of the "preferred scale," scale #3 is located one inch to the right, and both are 2 rows above the lateral line. Mount the 3 scales from fish #1 over 1, 11, and 21 on the gum card as shown in Appendix B.2. Continuing, mount the 3 scales from fish #2 over 2, 12, and 22, etc.

7. Cover the completed gum card with wax paper.

8. When sampling a weired system you may use the old AWL forms 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 data collector to transcribe the data before turning it over to the port supervisor.

9. Miscellaneous:

   a. When scales are sampled in wet conditions it is difficult to mount scales in a fashion so as to result in a good scale impression being made. Glue often obscures scale features and scales frequently adhere poorly to the card. In this situation the scales should be remounted.

   b. For adipose clipped fish record the head tag number on the corresponding row in the first five columns on the reverse side of the AWL.

   c. Look down the form from two angles after the data has been recorded to pick up any glaring mistakes. A common error occurs, for instance, in placing both the 4 and 7 of a 475 mm fish in the 100's column with nothing in the 10's column.

   d. Keep all fish gurry off forms and erase any stray marks on the forms before turning them in to your supervisor.

   e. Write in all comments explicitly and completely under remarks, transfer remarks to top margin of AWL.

   f. Responsibility for accuracy lies first with the primary data collector(s). The port supervisor will return sloppy or incomplete data to individual collectors. After editing a form, place your initials next to card #, but not in left margin.

LENGTH, SEX AND SCALE SAMPLING PROCEDURE FOR ESCAPEMENT SAMPLING USING MARK-SENSE FORMS

Salmon from escapement are sampled for length, sex, and scales annually by field crews throughout the state, as are salmon from the catch. The information is used similarly. Data is recorded in a slightly different manner and for this reason a separate instruction section has been prepared this year for escapement sampling.

Appendix B.1 is an example of a mark-sense form filled out for escapement sampling. Data must be recorded on mark-sense forms neatly and accurately. Basically the procedures are the same as for catch sampling, with the following exceptions:

I. Mark Sense Forms

A. Description: For escapement sampling, Area/Samplers (name and W.R.P.). (Note: write out species completely using AFS standards listed on the reverse of the mark-sense form).IP4,8

B. Subdistrict: Complete for all escapement samples.

C. Stream: Consult the field crew leader.

D. Location: Fill in the appropriate location for escapement sampling. (i.e. Bear River ADF&G camp 055, Nelson River ADF&G camp 056). If a code has not been assigned then leave blank.

II. Gum Cards

A. Locality: Write out the locality followed by the abbreviation "ESC" (e.g. Hugh Smith ESC).

Remember: Even though conditions are not the best when sampling in the field, mark-sense forms should come in neatly written, clean, and flat. Transcribe them if necessary. If gum cards get wet, remount the scales. Responsibility for data lies with the data collector(s) <u>not</u> the port supervisor, or "the people in Kodiak"!

Table B.1. Assigned port and weir location codes. (Use under location in filling out AWL's for catch and escapement sampling.)

Port Codes
001 - Pelican
002 - Elfin Cove
003 - Sitka
004 - Juneau
005 - Petersburg
006 - Ketchikan
007 - Craig
008 - Port Alexander
009 - Metlakatla
010 - Excursion Inlet
011 - Hoonah
012 - Wrangell
013 - Out of State
014 - Kake
015 - Gedney
016 - Security Bay
017 - Meyers
018 - Pt. Baker
019 - Klawock
020 - Yakutat
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 Creek
041 - Uganik River
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

Procedure for Sampling Salmon Smolt

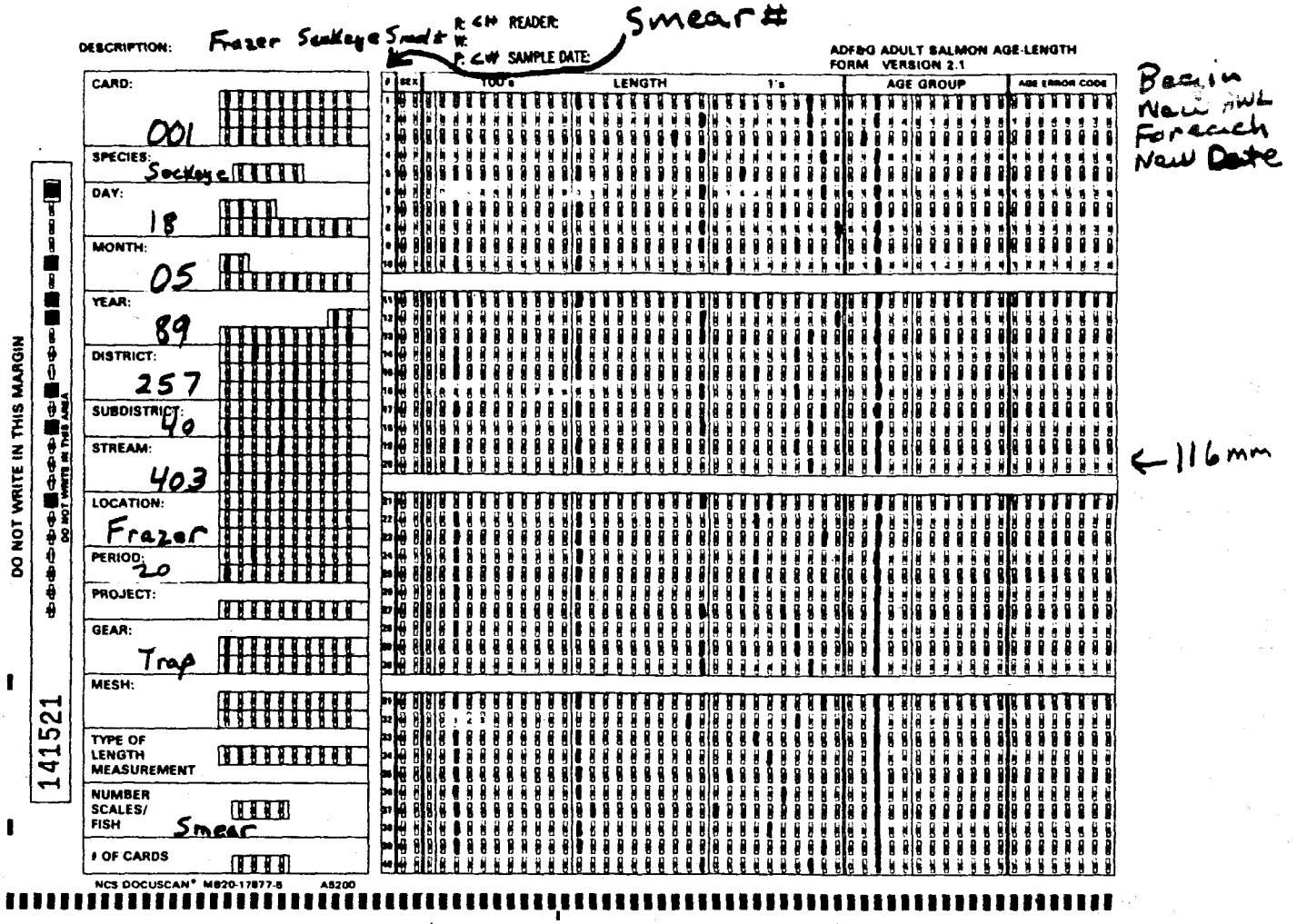
The same size goal per week is 200 sockeye salmon. It essential that the sample is taken randomly. In the event that more than the required sample size is in the smolt trap at the time of sampling the trap is to be stirred to assure randomness. When the smolt are randomly distributed a small dip net will be used to remove a subsample, this procedure will be repeated until the sample goal is met.

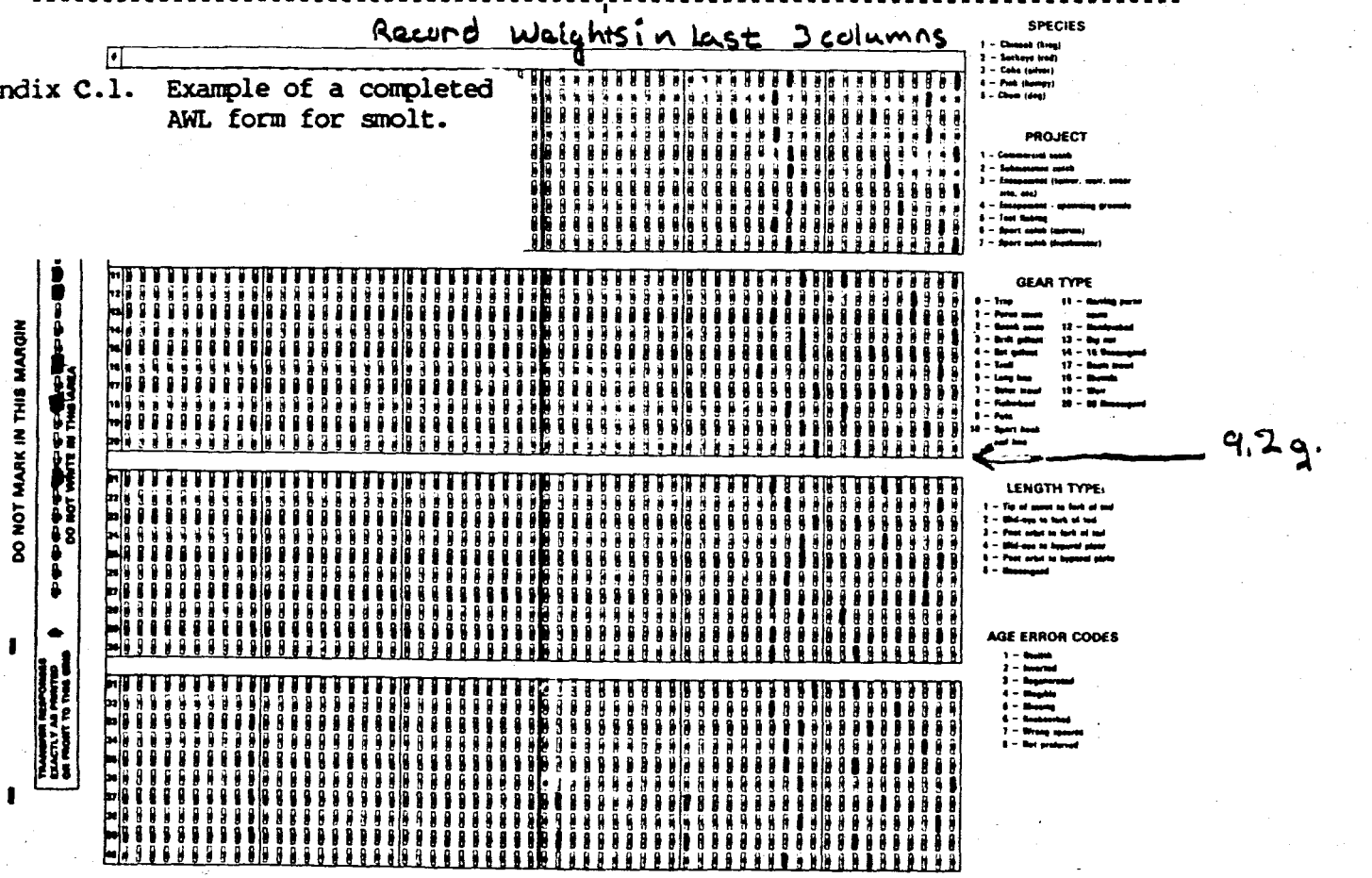
Smolt samples will be kept wet and worked up the day following their capture. Age, weight, and length data will be recorded on adult AWL forms as no smolt AWL forms exist. Refer to Appendix B and C on the standard procedures for recording data on an AWL form. Record at the top of each AWL form: personnel collecting the data, length of time the gear was fished, other species and their numbers captured.

A knife will be used to remove 5-10 scales from the preferred area, Appendix C.2. The scales will be mounted on a glass slide as illustrated in Appendix C.3. The left portion of each slide will be labeled with: sample site, location, date, specimen number, and data collectors.

Smolt lengths will be measured to the nearest millimeter, from the tip of the snout to the fork of the tail, Appendix C.4.

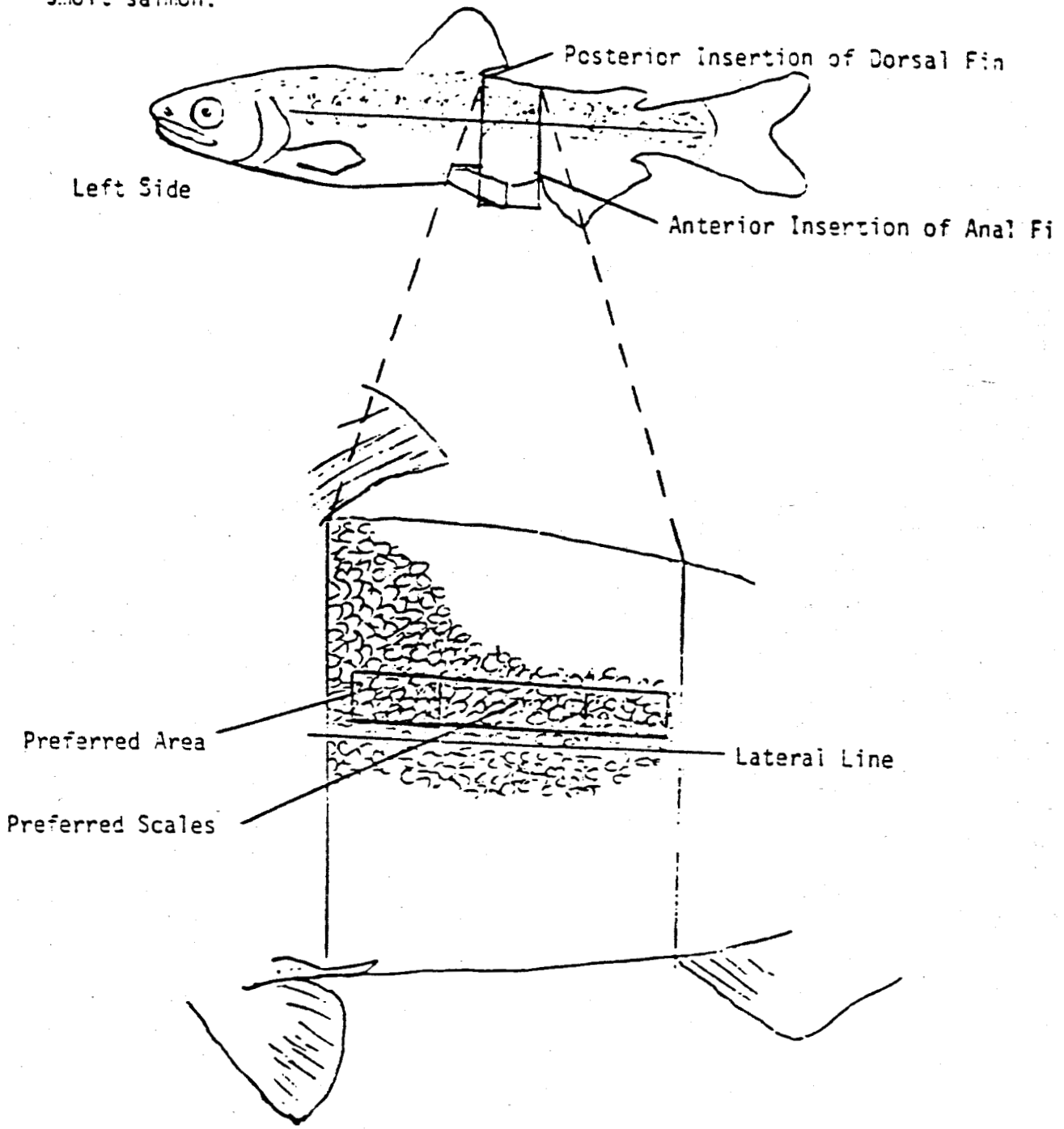
Excess water will be removed from the smolt before weighing by using a paper towel as a blotter. Individual smolt weights will be recorded to the nearest gram.





Appendix C.1. Example of a completed AWL form for smolt.

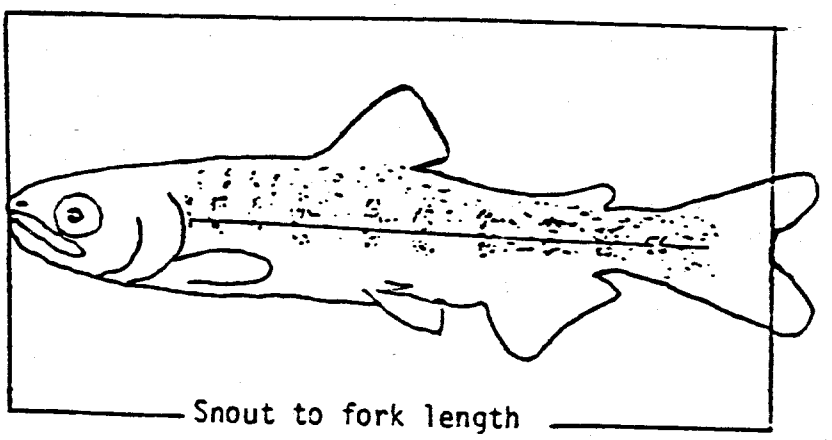
Appendix C.2 Scale sampling procedure showing the preferred scale sampling area on a smolt salmon.



Appendix C.3. Salmon smolt glass slide example.

Location	Bear River				
Collection Date	7/02/86				
Fish Reference Number	#100-104				
Collector	Whelan				
Collector	Perry				
	Number 100	Number 101	Number 102	Number 103	Number 104

Appendix C.4. Measuring smolt length.



APPENDIX D

Fish Identification Keys

Illustrated Keys to the Fresh-water Fishes of Alaska

By JAMES E. MORROW

Published by
Alaska Northwest Publishing Company
Anchorage, Alaska

7

Introduction

This booklet includes all the fishes so far known to inhabit or to occur occasionally in the fresh waters of Alaska. Some of them are strictly fresh-water forms, never found in the sea. Others are normally marine species that sometimes move up the mouths of rivers into brackish or even into fresh water. A fairly large number are anadromous, spending much of their lives in the sea but returning to fresh water to breed, and still others are found mainly in fresh water but may move downstream in the fall and spend the winter in the sea or in brackish water around the river mouths.

The keys in this booklet are designed to provide as simple a means of identification as possible. For each species, a brief discussion of its range has been included, as well as an outline sketch showing the important features of the fish. Many of our fishes have ranges that extend far beyond the borders of the state, but an identification made far outside the geographical areas given here should be regarded with suspicion. If possible, send such fishes to the author for further checking. Every effort has been made to insure accuracy in these keys. If errors are discovered, the author will appreciate learning of them.

Various versions of these keys have been tested, over a period of years, by the author's classes in ichthyology at the University of Alaska. Grateful

appreciation goes to these students for their continued interest and patience. Considerable use has been made of previous works, and a great deal of information on distribution has been gleaned from the altogether excellent book, "Freshwater Fishes of Northwestern Canada and Alaska," by J.D. McPhail and C.C. Lindsey. Anyone wanting detailed information on the life histories and general biology of northern fresh-water fishes is urged to consult that book, although not all of our Alaskan fishes are included in it.

The arrangement of groups and the scientific and common names used follow, with a few exceptions, the 1970 recommendations of the American Fisheries Society's Committee on Names of Fishes.

To the extent possible, technical terms have been avoided. However, sometimes such terms must be used. There are no other simple ways of identifying some structures. Therefore, a glossary of the technical terms employed, and sketches illustrating most of them, have been included.

James E. Morrow, *Professor of Zoology*
University of Alaska, Fairbanks, Alaska 99701

Dr. Morrow took his undergraduate studies at Middlebury College and his Ph.D. at Yale. After obtaining his doctorate, he led four expeditions for Yale's Bingham Oceanographic Laboratory, studying fishes in New Zealand, East Africa, South America and the western Indian Ocean. In 1960 he became Associate Professor of Fisheries at the University of Alaska, Fairbanks. For the past 14 years he has worked with the fishes of Alaska, guiding both undergraduate and graduate students in fish-related studies and, as Professor of Zoology, pursuing his own research on the fishes of the North.

He is the Ichthyological Editor of COPEIA, the journal of the American Society of Ichthyologists and Herpetologists, and is the editor of the BIOLOGICAL PAPERS OF THE UNIVERSITY OF ALASKA.

Glossary

Adipose fin—a small fin-like structure, fleshy and without supporting elements, located on the mid-line of the back between the dorsal fin and the tail. See *Fig. 1.*

Anal fin—an unpaired fin located on the mid-line of the belly, behind the anus. See *Fig. 1.*

Anterior—forward; toward the head.

Axillary process— an enlarged, more or less elongate scale found in the angle between the body and the pelvic fin of some fishes. See *Fig. 1.*

Caudal fin— the tail fin. See *Fig. 1.*

Dorsal— above; toward the back.

Dorsal fin— an unpaired fin located on the mid-line of the back. Sometimes in several parts. See *Fig. 1.*

Gill rakers—bony projections on the anterior side of the gill arches. Gill raker counts are those of the first arch on the left side, and are given either as the total count or as the counts of the upper and lower parts of the arch separately (*i.e.*, 11 – 18). In such a case, a raker at the angle of the arch is counted with the lower part. See *Fig. 2.*

Interorbital or interorbital space— the distance between the eyes, measured in a straight line across the top of the head.

Lateral line— a sense organ that detects (among other things) low frequency vibrations. Appears as a row of pores, generally along the middle of the side of the body. See *Fig. 1.*

Maxillary— the rear-most bone of the upper jaw. See *Fig. 1.*

Opercle— the gill cover. See *Fig. 1.*

Palatines— a pair of bones in the roof of the mouth. Teeth on these bones may be buried in mucus, but may be felt by stroking with a needle. See *Fig. 3.*

Pectoral fin— the "shoulder fin," located just behind the head. Corresponds to the front leg of land animals. See *Fig. 1.*

Pelvic fins— paired fins lying one on either side of the mid-line of the belly. Correspond to the hind limbs of land animals, but may be located

in front of the anal fin (abdominal), more or less below the pectoral fin (thoracic), or on the throat in front of pectoral fin (jugular). See *Fig. 1.*

Posterior – backward; toward the tail.

Preopercle – the "cheek bone" of fishes. The bone lying on the side of the head just in front of the gill cover. See *Fig. 1.*

Pyloric caeca – small, finger-like sacs attached to the intestine just behind the stomach.

Rays – soft, flexible supporting rods in the fins. See *Fig. 1.*

Snout – the distance from the forward end of the upper jaw to the anterior edge of the eye. See *Fig. 1.*

Spines – generally rather strong, stiff, sharp supporting rods in some fins, especially the dorsal and anal fins. See *Fig. 1.*

Ventral – below; toward the belly.

Vomer – a bone in the center of the roof of the mouth, separating the palatines. It may have teeth only on the anterior part (head) or also on the posterior part (shaft) or be toothless. See *Fig. 3.*

How to use the Keys

In general, begin with the "Key to the Families," page 13. Here you will see paired numbered statements (1a, 1b; 2a, 2b; etc.). If your fish agrees with the description in 1a, it is a lamprey. If it does not agree with 1a, go to 1b. If it agrees with 1b, go to the number given at the end of the statement, in this case, 2. Continue to follow the paired descriptions until at last you reach a statement that leads to a name. Thus, to identify a pike, you would go 1a (disagrees, go to 1b); 1b (agrees, go to 2); 2a (agrees, go to 3); 3a (disagrees, go to 3b); 3b (agrees, go to 4); 4a (disagrees, go to 4b); 4b (agrees, go to 5); 5a (disagrees, go to 5b); 5b (agrees, go to 10); 10a (agrees, go to 11); 11a (agrees, your fish is a pike). The key to the families may end up by referring you to a key to the species within the family group. Here you will find a similar key that will lead you to the particular kind of fish you have in hand. All the keys are used in the same way.

These keys have been designed for Alaskan fresh-water fishes only. Attempts to use them in other areas of North America, or for marine fishes in Alaska, will almost certainly lead to wrong identifications.

Key to the Families

		Description	If Description Agrees go to	Page No.
1a.		No jaws, mouth a round sucking disc. A single dorsal median nostril present	Lampreys, Family Petromyzontidae	21
1b.		Mouth with jaws. Nostrils paired, not median	2	
2a.	(1)	Pelvic fins far back, abdominal in position (see "Pelvic fins" in glossary)	3	
2b.		Pelvic fins forward, just behind head or under head, thoracic or jugular in position	13	
3a.	(2)	Five rows of keeled bony shields present along body; four well-developed barbels present under snout in front of mouth	Sturgeons, Family Acipenseridae	25
3b.		No keeled bony shields on body, although flat shields present in one family; no barbels under snout (a single barbel present on tip of lower jaw in some)	4	
4a.	(3)	No lateral line	Herrings and Shads, Family Clupeidae	27
4b.		A lateral line present	5	

		Description	If Description Agrees go to	Page No.
5a.	(4)	An adipose fin present	6	
5b.		No adipose fin	10	
6a.	(5)	Adipose fin well behind base of anal fin. Pectoral fin reaches past base of pelvic fins. Dorsal fin with two spines, anal fin with one spine anteriorly	Troutperch, Family Percopsidae	61
6b.		Adipose fin about over base of anal fin. Pectoral fin does not reach base of pelvic fins. No spines in dorsal or anal fins	7	
7a.	(6)	Pelvic axillary process present	8	
7b.		Pelvic axillary process absent	Smelts, Family Osmeridae	55
8a.	(7)	Dorsal fin long, 18 or more soft rays, its anterior end ahead of posterior tip of pectoral fin	Grayling, Subfamily Thymallinae of the Family Salmonidae	53
8b.		Dorsal fin smaller, 15 or fewer rays, its anterior end behind tip of pectoral fin	9	

		Description	If Description Agrees go to	Page No.
9a.	(8)	Teeth in jaws small and weak, or absent. Scales large, 4-11 rows above lateral line	Whitefishes, Subfamily Coregoninae of the Family Salmonidae	29
9b.		Teeth in jaws well developed. Scales small, difficult to count, 20-27 rows above lateral line	Salmons and Trouts, Subfamily Salmoninae of the Family Salmonidae	37
10a.	(5)	Teeth present in mouth. Front of dorsal fin nearer to base of tail than to tip of snout	11	
10b.		No teeth in jaws. Front of dorsal fin closer to tip of snout than to base of tail	12	
11a.	(10)	Caudal fin forked. Snout long, nearly ½ of head length, flattened like a duck's bill. Pelvic fin with 10 or 11 rays	Pikes, Family Esocidae	59
11b.		Caudal fin rounded. Snout shorter, about ⅓ length of head, not duck-billed. Pelvic fin with 0-3 rays	Alaska blackfish, Family Dalliidae	59
12a.	(10)	Mouth a ventrally placed sucker, lips thick and covered with papillae. Distance from snout tip to anus more than 2½ times distance from anus to base of tail	Suckers, Family Catostomidae	61

		Description	If Description Agrees go to	Page No
12b.		Mouth normal, lips not covered with papillae. Distance from snout to anus about 1 ½ times distance from anus to base of tail	Minnows, Family Cyprinidae	61
13a.	(2)	Both eyes on same side of head	Flounders, Family Pleuronectidae	73
13b.		Eyes in normal position, one on each side of head	14	
14a.	(13)	Several free spines in front of dorsal fin, not connected to each other by membranes. Pelvic fin formed of a single spine	Sticklebacks, Family Gasterosteidae	65
14b.		No free spines in front of dorsal fin. Pelvic fin not reduced to a single spine	15	
15a.	(14)	First dorsal fin made up of spines connected by membrane. No barbel under chin	16	
15b.		No spines in any fins (only soft rays). A barbel present under chin (may be very small)	Codfishes, Family Gadidae	63
16a.	(15)	Body covered with distinct scales. Anal fin with three spines	Surfperches, Family Embiotocidae	67
16b.		Body naked or partly covered with bony tubercles or prickles. No spines in anal fin	Sculpins, Family Cottidae	67

Legend

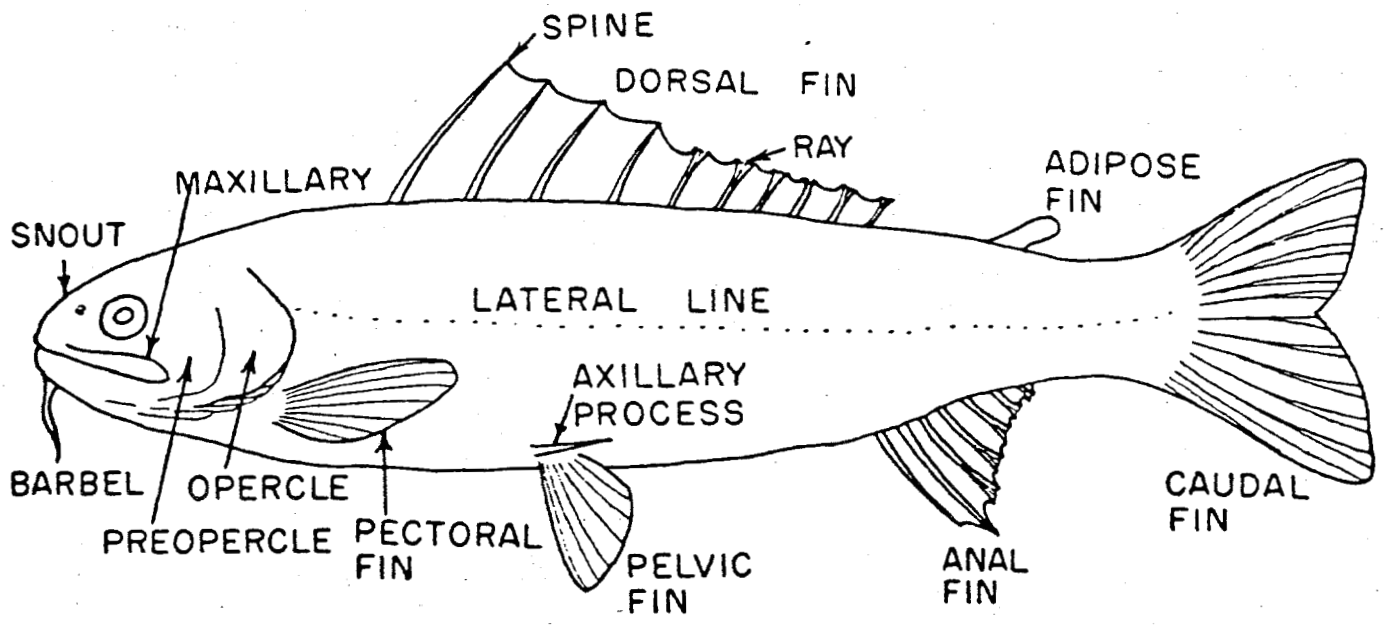


FIGURE 1. A "generalized" fish showing the various structures referred to in the keys.

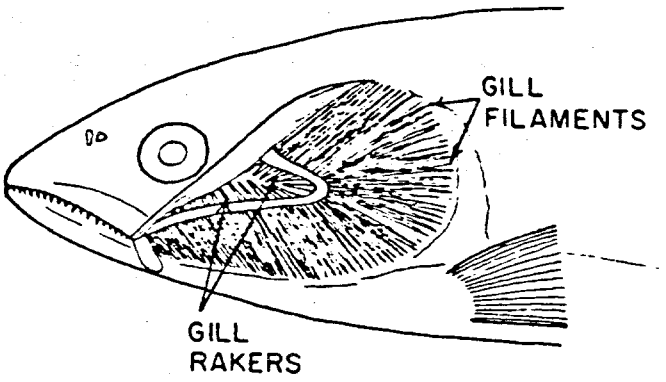


FIGURE 2. Diagram of a gill arch, showing the gill filaments and the gill rakers.

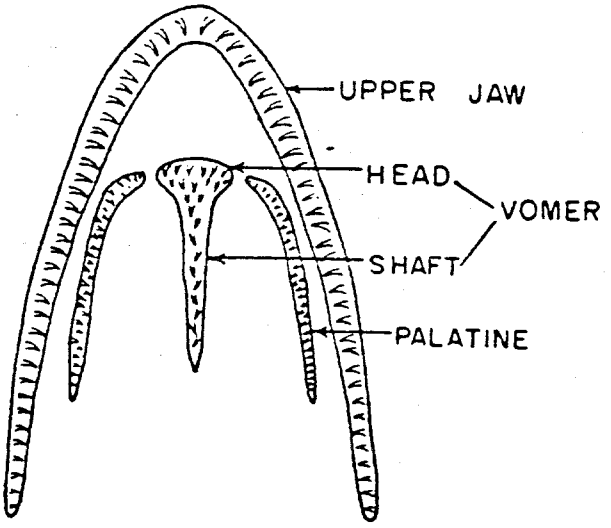


FIGURE 3. Diagram of the roof of the mouth of a fish to show the teeth on the jaws, the head and shaft of the vomer bone, and the palatines.

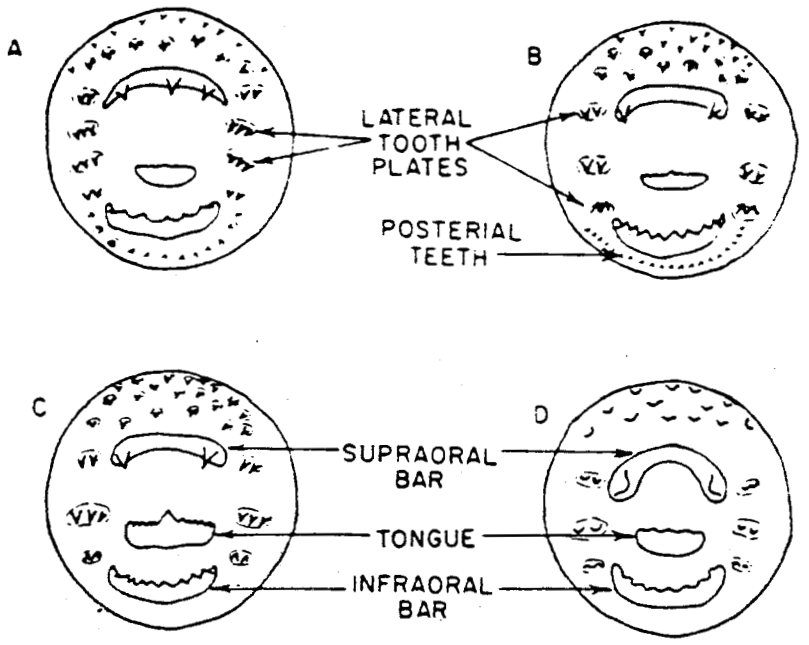


FIGURE 4. Tooth patterns of Alaska lampreys. A. Pacific lamprey, *Entosphenus tridentatus*. B. Arctic lamprey, *Lampetra japonica*. C. River lamprey, *Lampetra ayresi*. D. Western brook lamprey, *Lampetra richardsoni*.

Keys to the Species

LAMPREYS, Family Petromyzontidae

1a.

Supraoral tooth bar with 3 (rarely 2) sharp teeth; infraoral bar with about 5 teeth. Four pairs of lateral tooth plates, the 2 central pairs each with 3 points (*Fig. 4A*).

Pacific lamprey

Entosphenus tridentatus (Gairdner)
Ranges along the coast as far north as the Alaskan Peninsula and the Aleutian Islands. Rare in the Bristol Bay area. Recorded also from St. Lawrence Island and south to southern California. Reaches a length of about 3 feet. Seasonally abundant during spawning runs.

1b.

Supraoral tooth bar with 2 teeth (rarely with a small central third tooth); infraoral bar with 5-10 teeth (usually 7 or 8). Three pairs of lateral tooth plates. (*Fig. 4, B-D*) 2

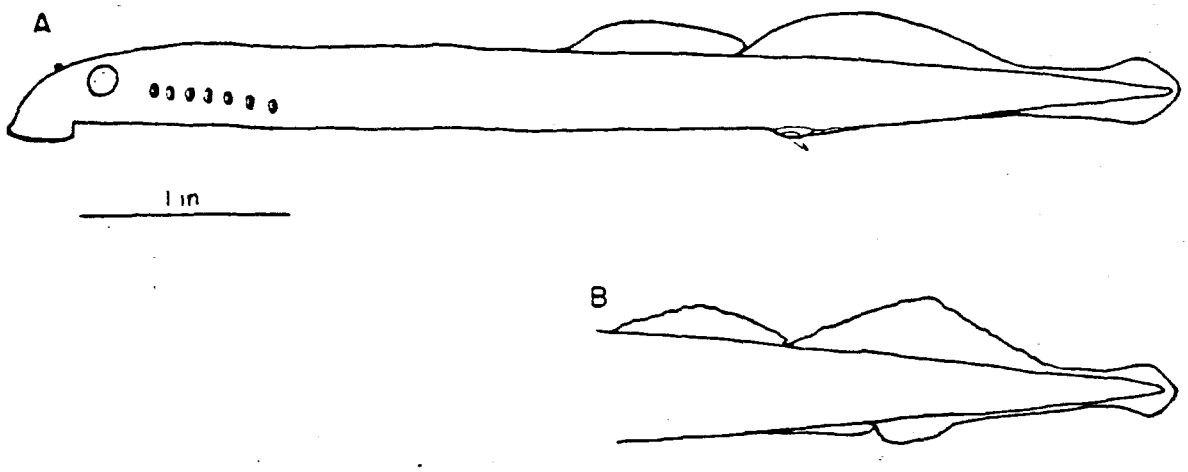


FIGURE 5. Arctic lamprey, *Lampetra japonica.* A. Male. B. Posterior end of female. Note presence of anal fin and lack of urogenital papilla in the female. All four Alaskan lampreys are much alike in general appearance, so only the one species is illustrated.

2a. (1)

A semicircular row of posterial teeth present below infraoral bar (may be hidden by mucus) (*Fig. 4B*); lateral tooth plates all with 2 points.

Arctic lamprey (*Fig. 5*)

Lampetra japonica (Martens)
Distributed in Alaska from the Kenai Peninsula north to the Arctic Ocean. Recorded from St. Lawrence Island, and in the Yukon drainage into Canada. Both fresh-water and anadromous populations are known. Grows to about 2 feet and ½ pound. The non-parasitic, fresh-water form reaches about 7 inches. Locally and seasonally abundant.

2b.

No posterial teeth. Central pair of lateral tooth plates with 2 or 3 points (*Fig. 4, C, D*) 3

3a. (2)

Teeth sharp and strong. Tongue with a large middle tooth. Three (rarely 2) points on central lateral tooth plates (*Fig. 4C*).

River lamprey

Lampetra ayresi (Günther)
Both fresh-water and anadromous populations are known along the coast, from the lower end of the Lynn Canal on southward. Attains length of about 12 inches. Fairly common.

3b.

Teeth blunt. No median tooth on tongue. Two (rarely 3) blunt points on central lateral tooth plates (*Fig. 4D*).

Western brook lamprey

Lampetra richardsoni Vladykov and Follett
The only Alaskan record so far is of two larvae from Lake McDonald, on the Cleveland Peninsula, near Ketchikan. Ranges south to Oregon. Maximum length about 6 inches.

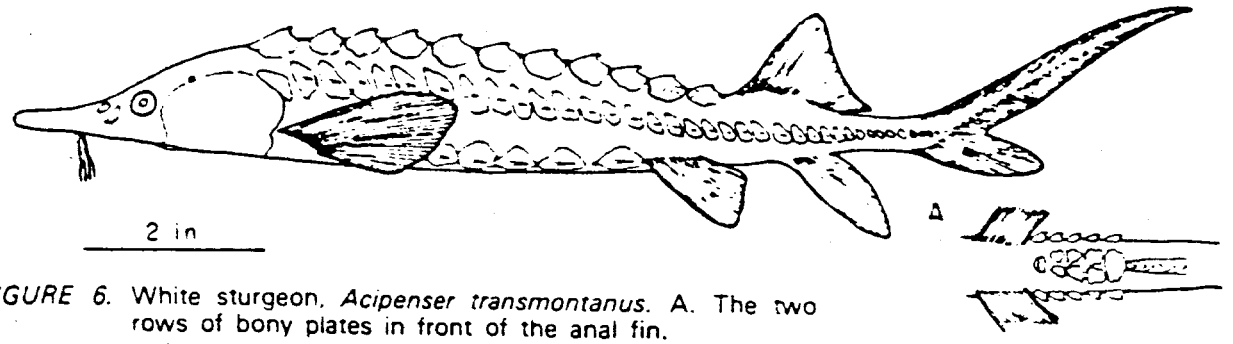


FIGURE 6. White sturgeon, *Acipenser transmontanus*. A. The two rows of bony plates in front of the anal fin.

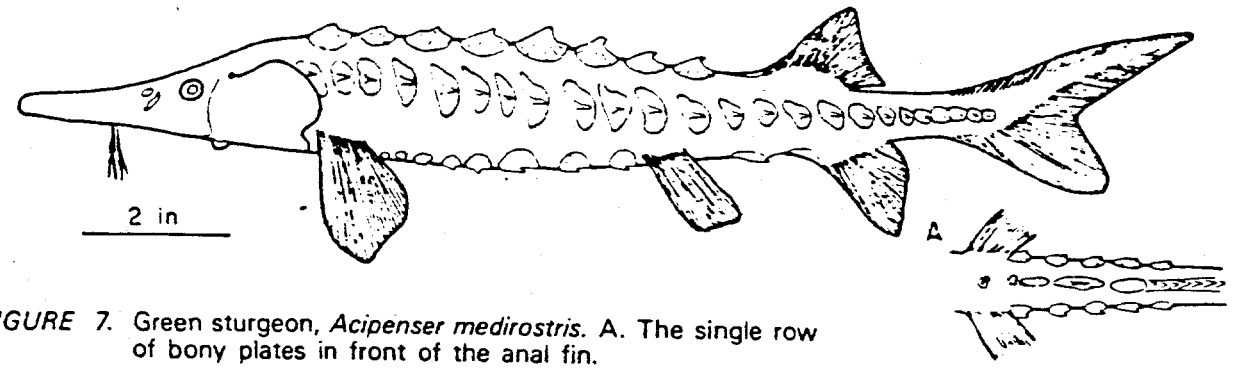


FIGURE 7. Green sturgeon, *Acipenser medirostris*. A. The single row of bony plates in front of the anal fin.

STURGEONS, Family Acipenseridae

Key to the Species

1a. Bony plates between pelvic fins and anal fin in two rows of 4 to 8 plates each (*Fig. 6A*). Dorsal fin rays about 45.

White sturgeon (*Fig. 6*)

Acipenser transmontanus Richardson
Found in Alaska from Southeastern to Cook Inlet, possibly also in Bristol Bay drainages. Anadromous. Ranges south to southern California. Reaches 20 feet and about 1,500 pounds. Not common in Alaska.

1b. Bony plates between pelvic fins and anal fin in a single row of 1 to 4 plates (*Fig. 7A*). Dorsal fin rays about 33.

Green sturgeon (*Fig. 7*)

Acipenser medirostris Ayres
Ranges from Southeastern Alaska to the Aleutian Islands and may also be present in the Bering Sea. Westward to Asia and south to southern California. Anadromous. Length to about 7 feet, weight to 300 pounds. Not common in Alaska.

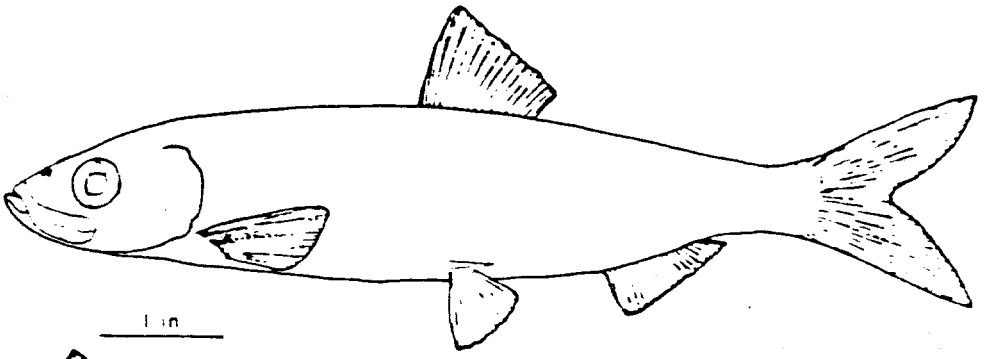


FIGURE 8. Sea herring, *Clupea harengus pallasi.*

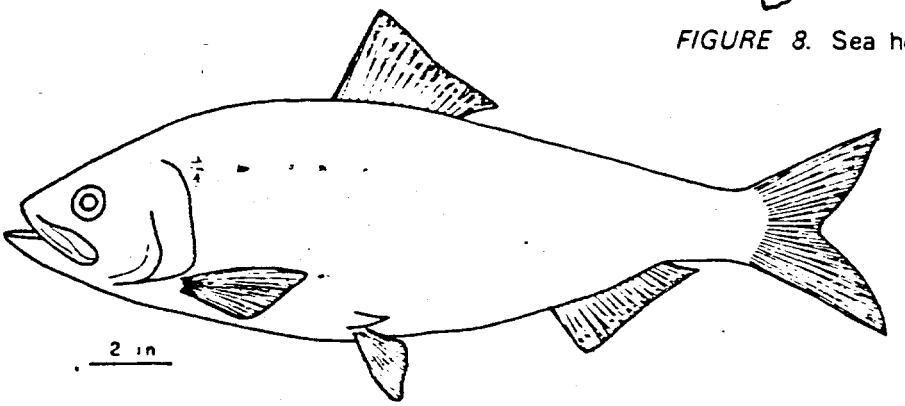


FIGURE 9. American shad, *Alosa sapidissima.*

HERRINGS AND SHADS, Family Clupeidae

Key to the Species

1a.

Distance from front of dorsal fin to tip of snout about equal to distance from front of dorsal fin to base of tail. Teeth present on vomer in roof of mouth (*Fig. 3*)

Sea herring (*Fig. 8*)

Clupea harengus pallasi Valenciennes
Present in the Arctic Ocean and south to California, west to Asia. A marine form that sometimes enters rivers. Achieves 15 inches in length. Seasonally abundant.

1b.

Distance from front of dorsal fin to tip of snout much less than distance from front of dorsal fin to base of tail. No teeth in roof of mouth.

American shad (*Fig. 9*)

Alosa sapidissima Wilson
Introduced into California and Oregon in the late 19th century from the east coast, the shad has spread north to Kodiak Island and Cook Inlet in Alaska and west to Asia. Anadromous. Up to 30 inches long, and 5 to 8 pounds weight. Not common in Alaska.

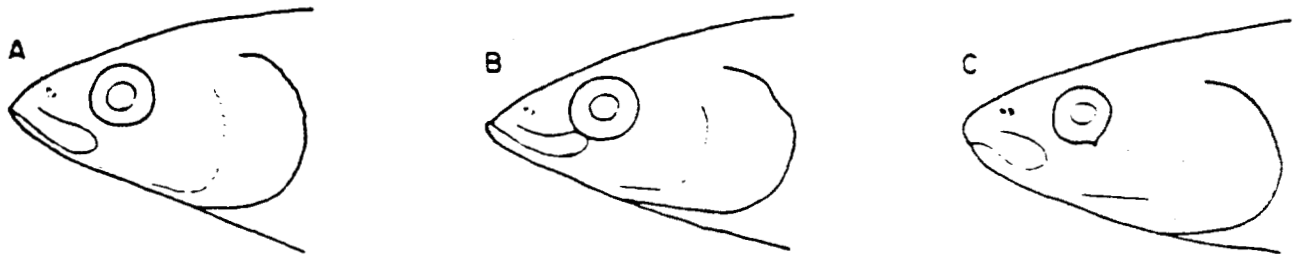


FIGURE 10. Snouts of whitefishes. A. Bering cisco, both jaws equal. B. Least cisco, tip of lower jaw projecting slightly beyond upper jaw. C. Round whitefish, lower jaw shorter than upper and profile of upper lip overhanging.

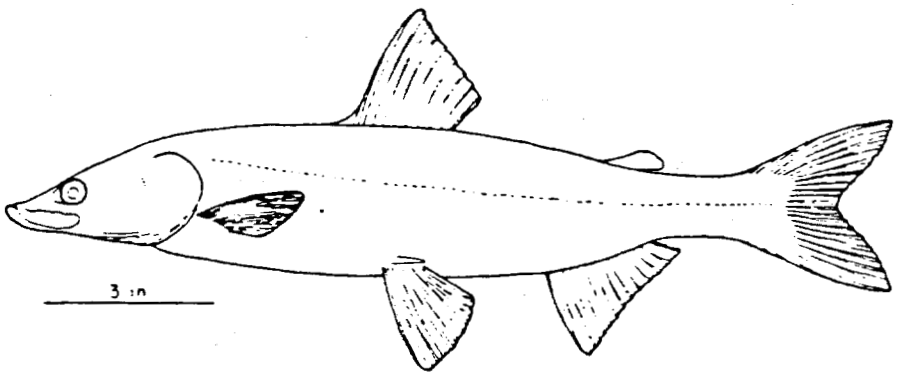


FIGURE 11. Inconnu, *Stenodus leucichthys.* Commonly called "sheefish" in Alaska.

WHITEFISHES, Subfamily Coregoninae of the Family Salmonidae

Key to the Species

1a.

Lower jaw equal to or longer than upper jaw. Profile of upper lip not overhanging lower jaw (*Fig. 10A, B*) 2

1b.

Lower jaw distinctly shorter than upper jaw. Profile of upper lip vertical or overhanging (*Fig. 10C*) 5

2a. (1)

Mouth large, posterior end of maxillary (upper jaw) reaches below posterior margin of pupil of eye. Gill rakers 13-17 on lower limb of first arch.

Inconnu or Sheefish (*Fig. 11*)

Stenodus leucichthys (Güldenstadt)
Found in Alaska from the Kuskokwim River north and east to the Meade River, but absent from some of the streams in between. Quite abundant in the entire Yukon drainage. Another subspecies is in the Mackenzie drainage in Canada. May reach a weight of more than 60 pounds and a length of 5 feet. Seasonally abundant.

2b.

Mouth moderate, upper jaw not reaching posterior edge of pupil. More than 20 gill rakers on lower limb of first arch 3

3a. (2)

Mouth superior, tip of lower jaw generally projects slightly beyond upper jaw (*Fig. 10B*). Pelvic fins black or dusky in adults.

Least cisco (*Fig. 12*)

Coregonus sardinella Valenciennes
Found from Bristol Bay to the Arctic Ocean and more or less generally throughout the Interior. Also recorded from St. Lawrence Island. Reaches a length of nearly 18 inches. Seasonally abundant.

3b.

Mouth terminal, tip of lower jaw not projecting beyond tip of upper jaw (*Fig. 10A*). Pelvic fins always pale 4

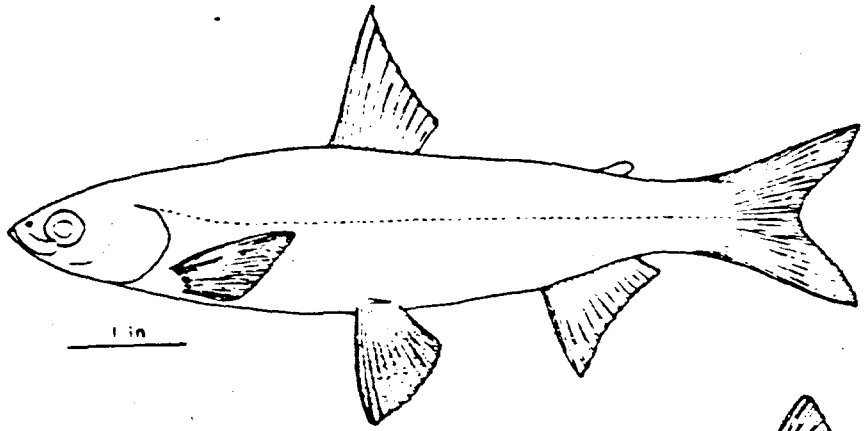


FIGURE 12. Least cisco, *Coregonus sardinella.* Note the dusky pelvic fins.

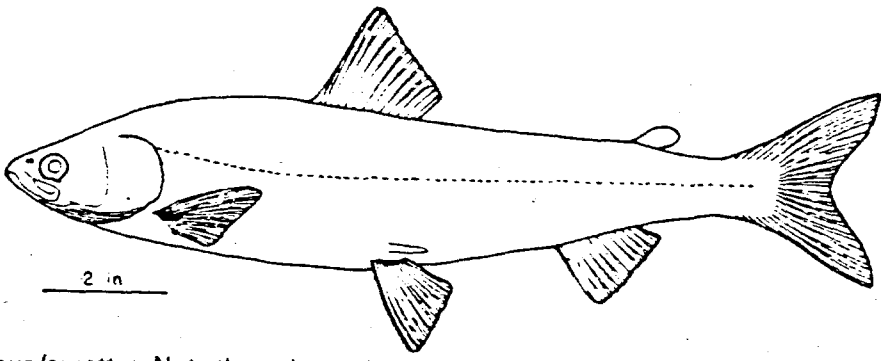


FIGURE 13. Bering cisco, *Coregonus laurettae.* Note the pale pelvic fins. The Arctic cisco, *Coregonus autumnalis,* appears identical with this species but has more gill rakers.

4a. (3)

21-25 gill rakers on lower limb of first arch.

Bering cisco (*Fig. 13*)

Coregonus laurettae Bean
Found from Cook Inlet north and east to the Oliktok River on the Arctic coast. Also well up the Yukon River, at least as far as Rampart, probably widely distributed in the Interior. Length to nearly 16 inches. Seasonally and locally abundant.

4b.

26-31 gill rakers on lower limb of first arch.

Arctic cisco (*Fig. 13*)

Coregonus autumnalis (Pallas)
Known from most of the river systems that empty into the Arctic Ocean. Apparently absent from the Bering Sea and southward. Up to about 2 feet and over 5 pounds. Seasonally abundant.

5a. (1)

Membrane around eye with a distinct notch below posterior edge of pupil (*Fig. 14A*). A single flap between nostrils (*Fig. 14B*) 6

5b.

Membrane around eye without a notch. A double flap between nostrils (*Fig. 14C*) 7

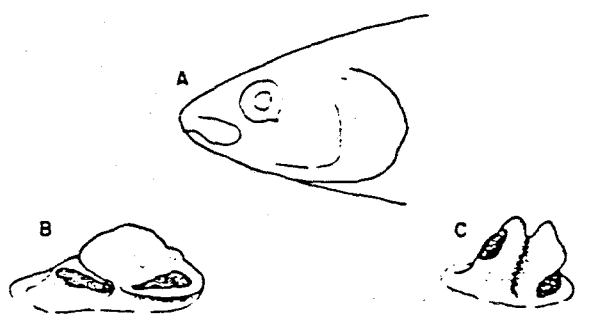


FIGURE 14.

Eyes and nasal flaps of whitefishes. A. Head of the round whitefish, showing the notch in the eye membrane. B. Nostrils of the round whitefish, with a single flap between the anterior and posterior openings. C. Nostrils of the Alaska whitefish, with a double flap between the openings. (NB—One needs a fairly strong magnifying glass to see these flaps clearly.)

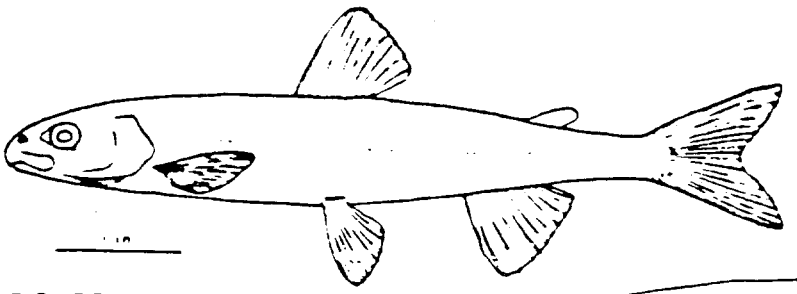


FIGURE 15. Pygmy whitefish, *Prosopium coulteri.*

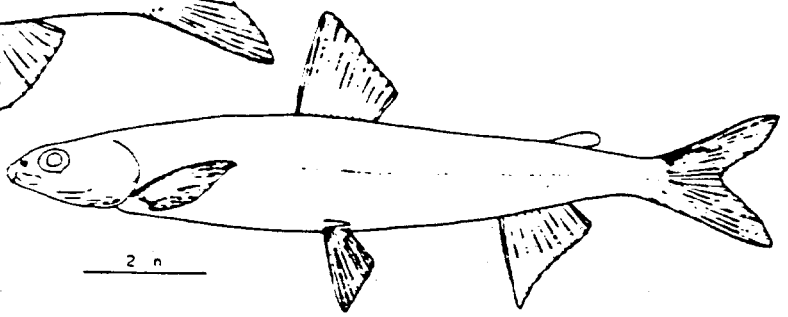


FIGURE 16. Round whitefish, *Prosopium cylindraceum.*

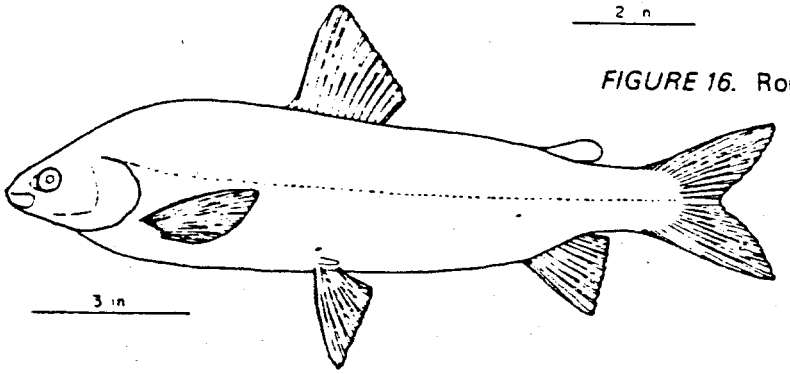


FIGURE 17. Broad whitefish, *Coregonus nasus.*

6a. (5)

Snout blunt as seen from above. Lateral line with less than 70 pored scales. 14-33 pyloric caeca.

Pygmy whitefish (*Fig. 15*)

Prosopium coulteri (Eigenmann and Eigenmann)
In Alaska, found in the Bristol Bay region and in Southcentral Alaska. Also present in Washington, Montana, British Columbia, Yukon Territory and in Lake Superior. Usually less than 6 inches long. Fairly abundant locally.

6b.

Snout rather pointed as seen from above. Lateral line with more than 70 pored scales. Pyloric caeca 50 or more.

Round whitefish (*Fig. 16*)

Prosopium cylindraceum (Pallas)
From the Taku drainage in Southeastern Alaska north to the Noatak and throughout the Interior. The range extends east all across North America and south to the Great Lakes and New England. Westward in Siberia to the Yenisei River. Attains lengths up to 20 inches, weights to nearly 5 pounds. Seasonally and locally abundant.

7a. (5)

Gill rakers short, the longest raker less than 1/5 of interorbital width. Profile of head smoothly convex or only barely concave. Hump behind head absent, or at least not at all prominent.

Broad whitefish (*Fig. 17*)

Coregonus nasus (Pallas)
Found in Bering Sea drainages from the Kuskokwim River north to the Arctic Ocean. Also widely distributed in the Interior. In Siberia, west at least as far as the Pechora River. Reported to reach 35 pounds in Siberia. Largest Alaskan specimens probably less than 10 pounds. Seasonally abundant.

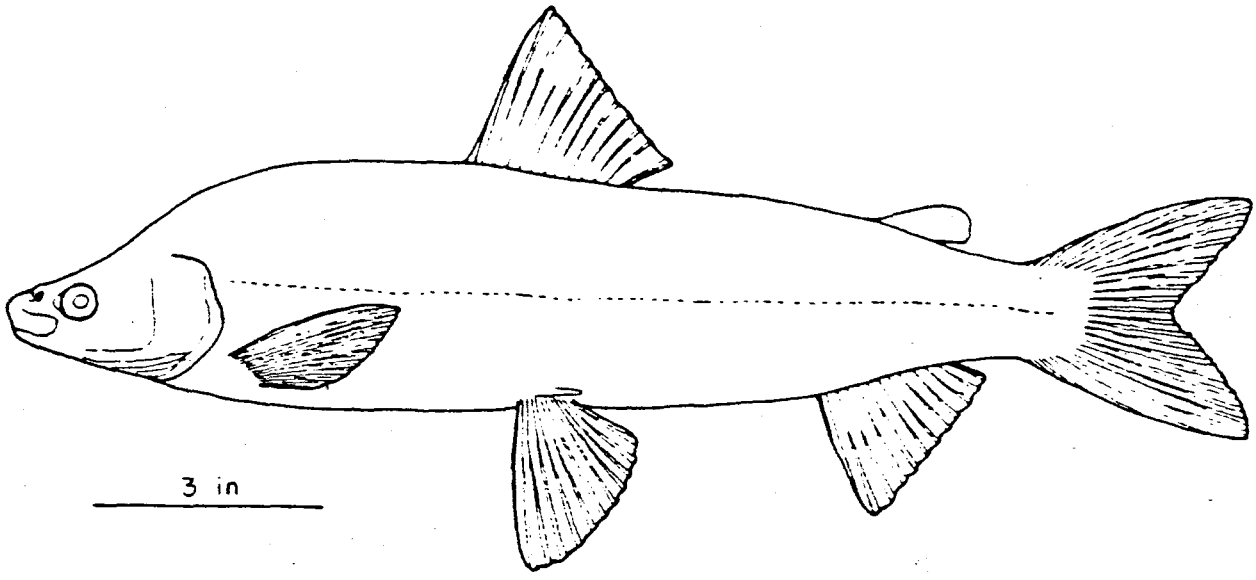


FIGURE 18. Alaska whitefish, *Coregonus nelsoni.* The Humpback and Lake whitefishes closely resemble this species but differ in number of gill rakers.

7b.

Profile of head distinctly concave between snout and nape. A pronounced hump behind head in adults. Longest gill raker longer than 1/5 of interorbital width 8

8a. (7)

Total gill rakers, 19-24, average counts around 21 or 22.

Humpback whitefish (*Fig. 18*)

Coregonus pidschian (Gmelin)
Bering Sea and Arctic Ocean drainages from the Kuskokwim River to the Arctic coast. Generally does not go far inland except in the Kuskokwim. A very similar fish, which may be the same species, ranges west all across Siberia. Average weight probably less than 10 pounds. Seasonally abundant.

8b.

Total gill rakers 23-31 9

9a. (8)

Total gill rakers 23-27, average counts around 24 or 25.

Alaska whitefish (*Fig. 18*)

Coregonus nelsoni Bean
Found chiefly in the Yukon drainage, from the Bering Sea throughout the Interior. Also present in the Kobuk-Selawick area and possibly in the Wulik River. Average weight probably less than 5 pounds. Seasonally abundant.

9b.

Total gill rakers, 24-31, average counts around 26 or more.

Lake whitefish (*Fig. 18*)

Coregonus clupeaformis (Mitchill)
Alaskan records to date are confined to a few locations in the upper Yukon drainage. Ranges eastward across Canada, south to the Great Lakes and the Susquehanna River. Largest specimen known was one of 42 pounds taken in Lake Superior in 1918.

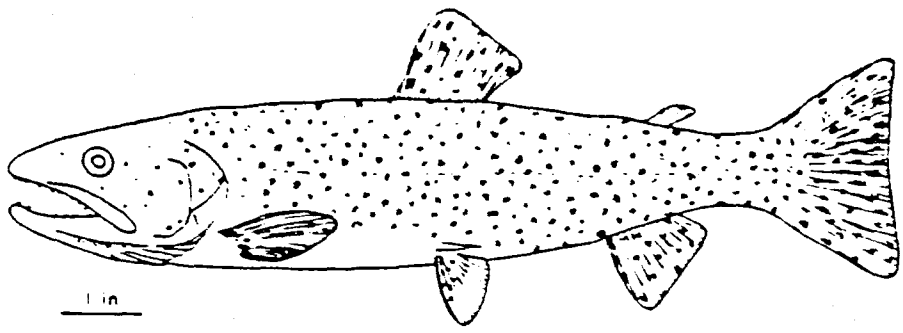


FIGURE 19. Cutthroat trout, *Salmo clarki*. In Alaska, most fresh-water populations are heavily spotted, as shown, but in more southerly populations the spots are generally not so numerous. Spots are missing on freshly sea-run cutthroats.

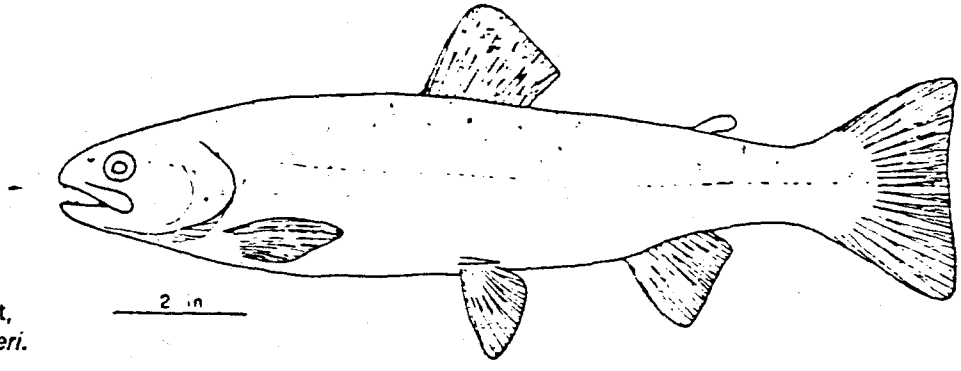


FIGURE 20. Rainbow trout, *Salmo gairdneri*.

SALMONS AND TROUTS, Subfamily Salmoninae of the Family Salmonidae.

Key to the Species (Adults only)

1a.

Anal rays 8-12 2

1b.

Anal rays 13-19 (rarely 12) 8

2a. (1)

Teeth present on both head and shaft of vomer bone in roof of mouth (*Fig. 3*). Spots on body dark brown or black 3

2b.

Teeth on head of vomer, none on shaft. Spots on body pale or red, never brown or black 4

3a. (2)

Small teeth present on floor of mouth behind tongue (hard to see). A red slash under lower jaw (usually pale in sea-run fish and missing in some fresh-water populations). No red band on sides. Upper jaw reaches well behind eye in adults.

Cutthroat trout (*Fig. 19*)

Salmo clarki Richardson
Southeastern Alaska, north to Prince William Sound. Other subspecies range southward as far as Nevada. The record weight is 41 pounds, but most weigh 1 to 4 pounds. Locally abundant.

3b.

No teeth on floor of mouth behind tongue. Generally no red slash under jaws (present in some Bristol Bay populations). A reddish band on sides, most prominent in spawning males but absent on freshly sea-run individuals. Upper jaw reaches little, if any, behind eye in adults.

Rainbow trout (*Fig. 20*)

Salmo gairdneri Richardson
Ranges from Southeastern Alaska north to the drainages of Bristol Bay. Has been introduced into a number of lakes in the

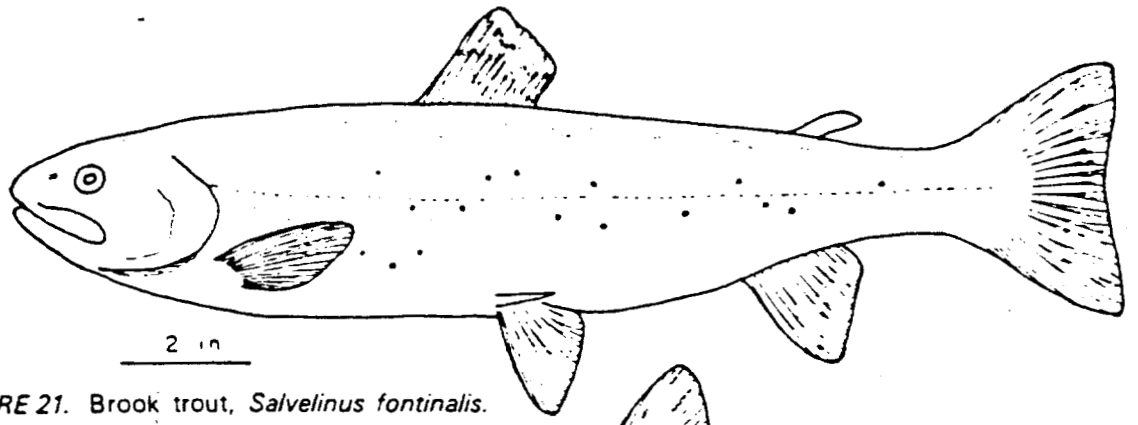


FIGURE 21. Brook trout, *Salvelinus fontinalis.*

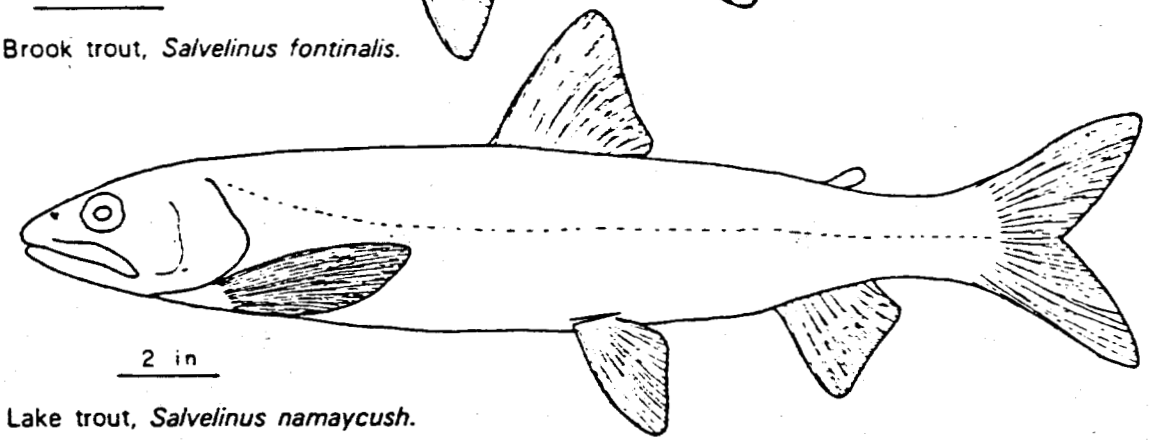


FIGURE 22. Lake trout, *Salvelinus namaycush.*

Interior. Widespread, either naturally or by introduction, in the rest of the U.S. and much of Canada. Largest on record weighed 52.5 pounds. Locally abundant.

4a. (2)

Dark green wavy marks on back and dorsal fin.

Brook trout (*Fig. 21*)

Salvelinus fontinalis (Mitchill)
An eastern species that was introduced into Southeastern Alaska some years ago. Up to 3 feet and 15 pounds, but usually less than 12 inches. Rare in Alaska.

4b.

No dark green marbling on back or dorsal fin 5

5a. (4)

Caudal fin deeply forked. Body color dark green to grayish, with numerous oval or irregular whitish to yellow spots on sides and back. Pyloric caeca 90-200.

Lake trout (*Fig. 22*)

Salvelinus namaycush (Walbaum)
Found in most suitable lakes from the Alaska Peninsula northward. Present in the Copper River drainage, Kobuk River, Noatak River and in many lakes of the Interior and arctic parts of the state. Absent from the lower Yukon drainage. Ranges all across Canada, south to the Great Lakes region and northern New England. Up to 4 feet and 102 pounds, but usually much smaller. Locally abundant.

5b.

Caudal fin only slightly forked. Spots on body round, may be red, pink or yellow in life. Pyloric caeca 13-74 6

6a. (5)

Pyloric caeca 13-35. Stream spawners 7

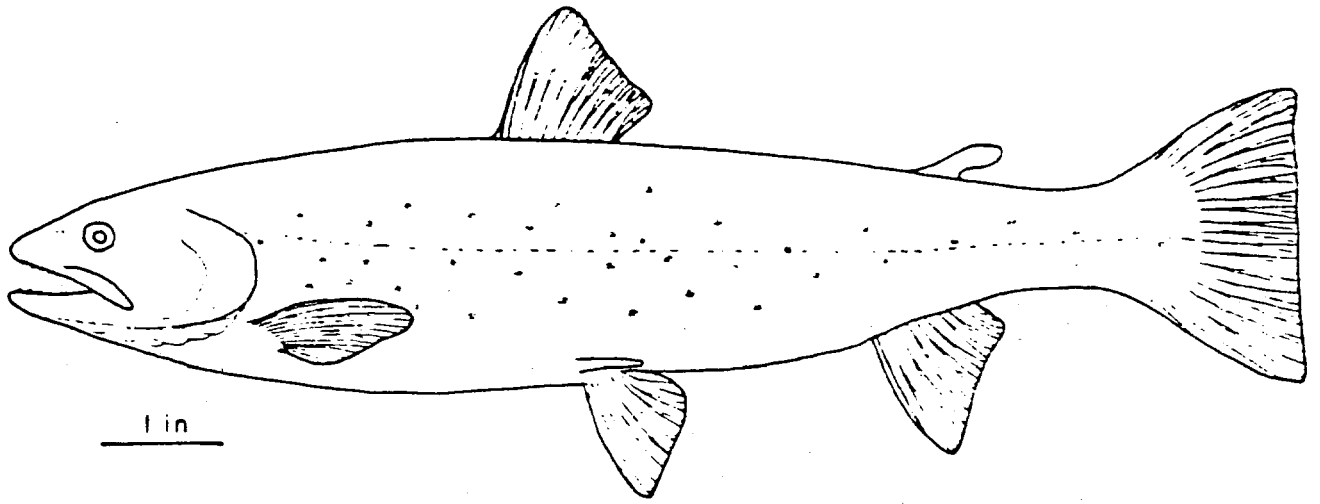


FIGURE 23. Dolly Varden, *Salvelinus malma.* The Arctic charr and Angayukaksurak charr look very much like the Dolly Varden, but the Angayukaksurak charr is black and the Arctic charr has more gill rakers and pyloric caeca.

6b.

Pyloric caeca 30-74. Lake spawners.

Arctic charr (*Fig. 23*)

Salvelinus alpinus (Linnaeus)
Found from Kodiak and the Aleutians to the Arctic coast and at scattered locations in the Interior, such as Wonder Lake in Mount McKinley National Park. Its general distribution is circumpolar, including the British Isles, Iceland, Europe, northern USSR. Size up to about 3 feet and 26 pounds, usually much smaller. Locally and often seasonally abundant.

7a. (6)

Body black with fiery red spots. Pelvic fin rays usually 10.

Angayukaksurak charr (*Fig. 23*)

Salvelinus anaktuvukensis Morrow
Confined to headwaters situations high in the Brooks Range, from Howard Pass to the Aichilik River. This is a very rare species. Maximum length probably less than 1 foot.

7b.

Body not black. Pelvic fin rays usually 9.

Dolly Varden (*Fig. 23*)

Salvelinus malma (Walbaum)
Ranges from Southeastern Alaska to the Arctic coast and in scattered locations in the Interior. The Aleutian Islands mark the boundary between a northern and a southern subspecies. Both anadromous and strictly fresh-water populations are known. Ranges eastward to the Mackenzie system, south to Nevada. The same or a very similar form is also found in northeastern Siberia. Reported to reach a length of over 3 feet and a weight of 40 pounds. Locally and seasonably abundant.

8a. (1)

Distinct black spots present on back and tail.....9

8b.

No distinct black spots on back or tail, although fine speckling may be present..... 12

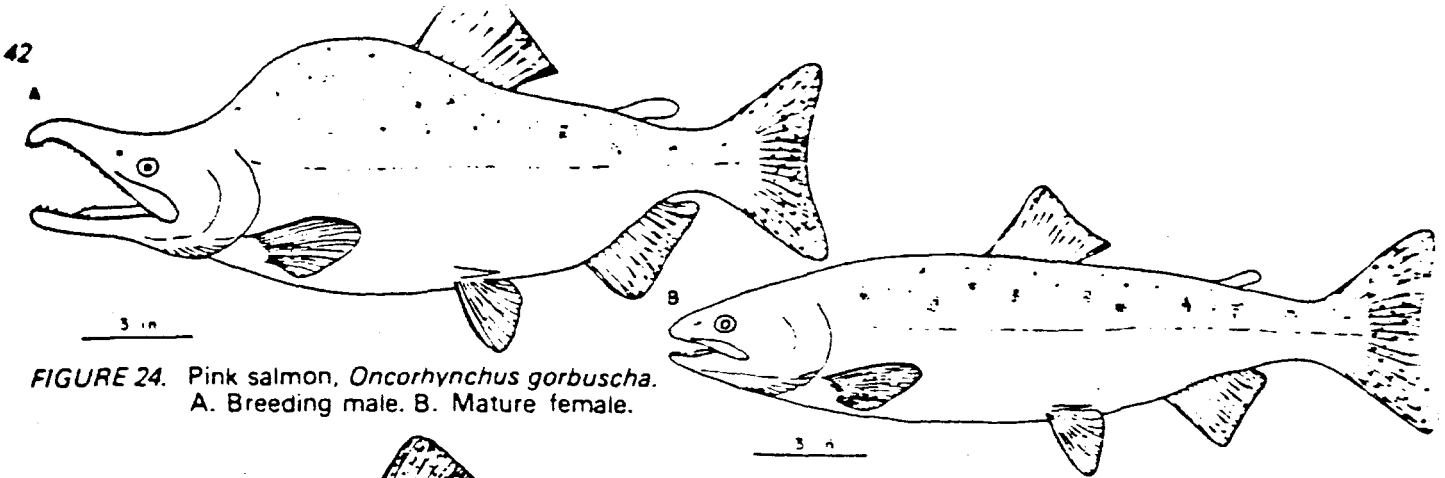


FIGURE 24. Pink salmon, *Oncorhynchus gorbuscha*. A. Breeding male. B. Mature female.

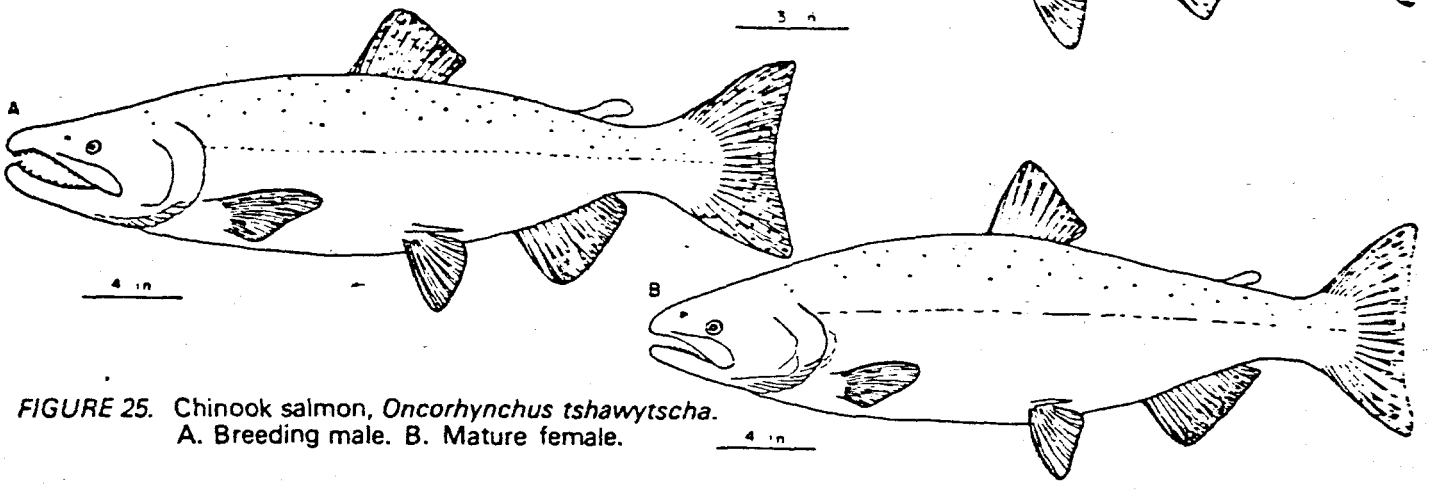


FIGURE 25. Chinook salmon, *Oncorhynchus tshawytscha*. A. Breeding male. B. Mature female.

9a. (8)

Spots large, more or less oval, longest as long as diameter of eye. Scales small, 170 or more in first row above lateral line.

Pink salmon (*Fig. 24*)

Oncorhynchus gorbuscha (Walbaum)
Found from Southeastern to the Arctic in coastal streams. Anadromous. Ranges south to the Sacramento River in California, east to the Mackenzie, west to the Lena River in Siberia. Up to 30 inches and about 14 pounds. Locally and seasonally abundant.

9b.

Spots small and irregular, the largest smaller than eye diameter. Scales larger, 155 or less in first row above lateral line 10

10a. (9)

Gill rakers 30-40.

Sockeye salmon—*See page 45.*

10b.

Gill rakers less than 25 11

11a. (10)

Tail fin with small black spots on both upper and lower lobes. Gum line of lower jaw black. Anal rays 15-17, pyloric caeca 140-185.

Chinook salmon (*Fig. 25*)

Oncorhynchus tshawytscha (Walbaum)
Ranges in Alaska from Southeastern north to Point Hope. Present in most rivers of the Interior. Anadromous. Found also as far south as the Ventura River, California, and as far west as the Anadyr River in Siberia. Heaviest official record is 126 pounds. Another reported at 135 pounds. Seasonally abundant.

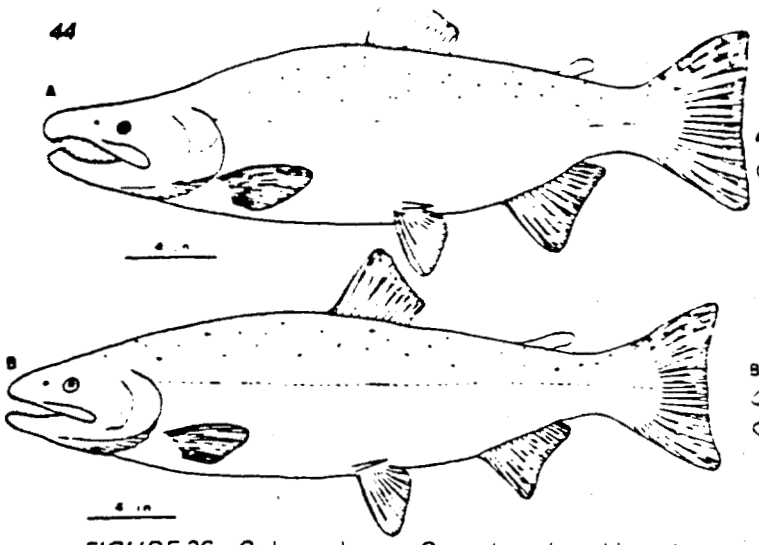


FIGURE 26. Coho salmon, *Oncorhynchus kisutch.* A. Breeding male. B. Mature female.

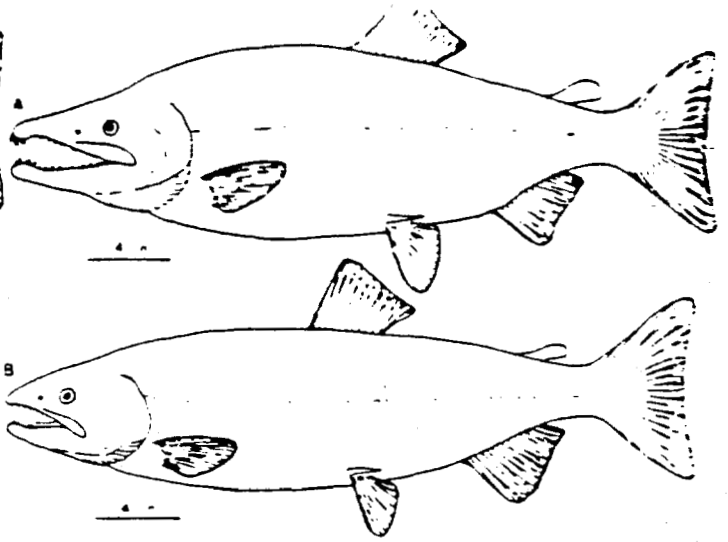


FIGURE 27. Chum salmon, *Oncorhynchus keta.* A. Breeding male. B. Mature female.

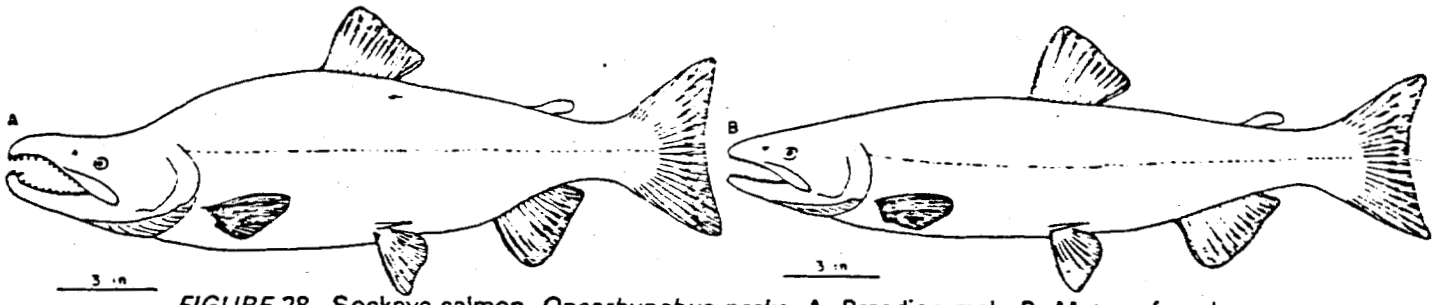


FIGURE 28. Sockeye salmon, *Oncorhynchus nerka.* A. Breeding male. B. Mature female.

11b.

Tail fin either without spots or spotted only on the upper lobe. Anal rays 13-15. Gum line of lower jaw not black.

Coho salmon (*Fig. 26*)

Oncorhynchus kisutch (Walbaum)
Found in coastal streams from Southeastern Alaska north to Point Hope, but rare north of Norton Sound. Also goes well inland in the Yukon and Kuskokwim drainages. Anadromous. Ranges south to Monterey Bay, California, and west as far as the Anadyr River in Siberia. May reach nearly 40 inches and 31 pounds, usually about 10 pounds. Seasonally abundant.

12a. (8)

Gill rakers 18-28, short, stout, smooth and widely spaced. Pyloric caeca 163-249.

Chum salmon (*Fig. 27*)

Oncorhynchus keta (Walbaum)
Ranges in Alaska from Southeastern to the Arctic coast and throughout the Interior. Anadromous. Also found eastward to the Mackenzie and south to the Sacramento River in North America, and in Asia from Korea north and west to the Lena River in Siberia. May attain over 3 feet and 33 pounds. Seasonally abundant.

12b.

Gill rakers 30-40, long, fine, serrated and closely spaced. Pyloric caeca 43-115.

Sockeye salmon (*Fig. 28*)

Oncorhynchus nerka (Walbaum)
This species appears twice in the key because some populations are spotted (cf 8a and 8b), especially in the young. Ranges in Alaska from Southeastern north to Point Hope, but the most northerly major population is on the Seward Peninsula. Found inland in the Yukon as far upstream as the mouth of the Koyukuk, and in the Kuskokwim River. Anadromous. Its total distribution extends south to the Klamath River, California, and west to the Anadyr River in Siberia. Also present in the headwaters of the Peace River in Canada. Reaches a length of nearly 3 feet and weight of 15 pounds. Locally and seasonally abundant.

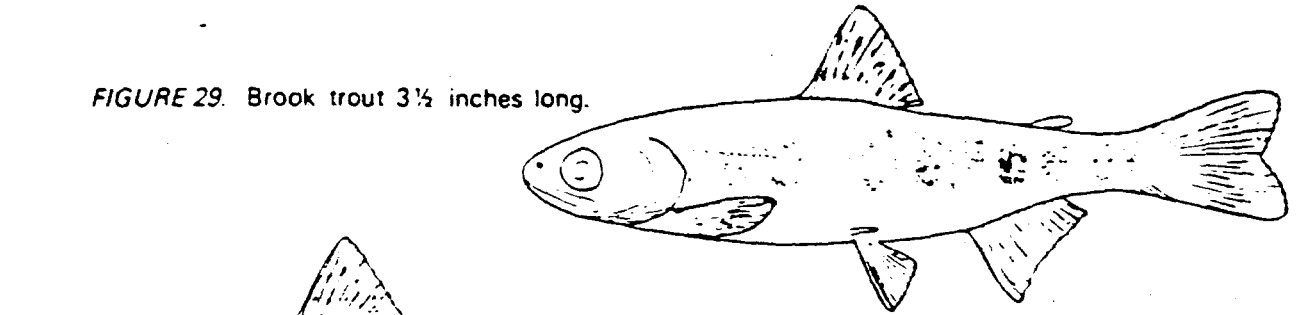


FIGURE 29. Brook trout 3½ inches long.

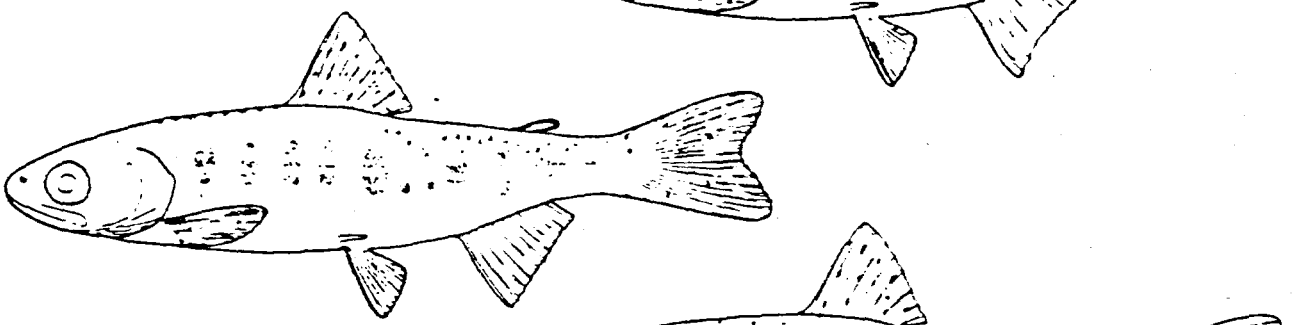


FIGURE 30. Rainbow trout 3½ inches long.

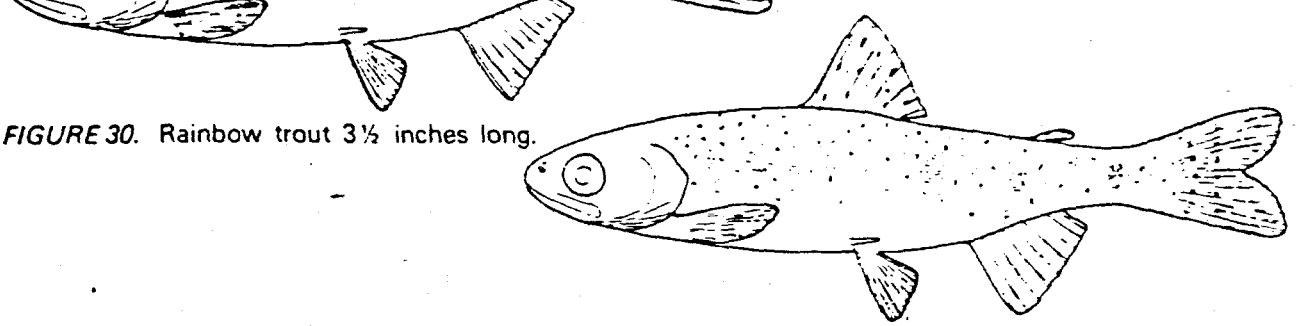


FIGURE 31. Cutthroat trout 3½ inches long.

Key to young salmon and trout less than about 5 inches long

1a.

Anal rays 8-12 2

1b.

Anal rays 13 or more (rarely 12) 6

2a. (1)

Dorsal fin with distinct dark spots, or first dorsal ray is black 3

2b.

Dorsal fin without dark spots, first ray not black (lake trout may have faint dark bars) 5

3a. (2)

Red or yellow spots present along lateral line. Combined width of dark parr marks along lateral line equal to or greater than combined width of light areas between:

Brook trout (*Fig. 29*)

Salvelinus fontinalis (Mitchill)

3b.

No red or yellow spots along lateral line. Width of dark parr marks along lateral line less than width of light areas 4

4a. (3)

Usually 5 to 10 dark marks along middle of back in front of dorsal fin. Black border of adipose fin with only one break or unbroken.

Rainbow trout (*Fig. 30*)

Salmo gairdneri Richardson

4b.

No more than 5 (usually 4 or less) dark marks along back in front of dorsal fin. Black border of adipose fin usually with one or more breaks.

Cutthroat trout (*Fig. 31*)

Salmo clarki Richardson

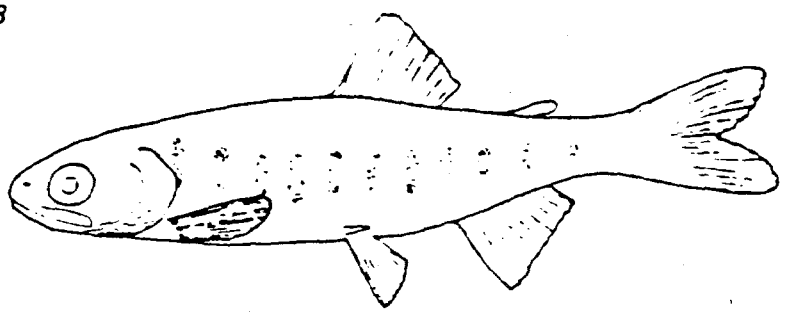


FIGURE 32. Lake trout 5 inches long.

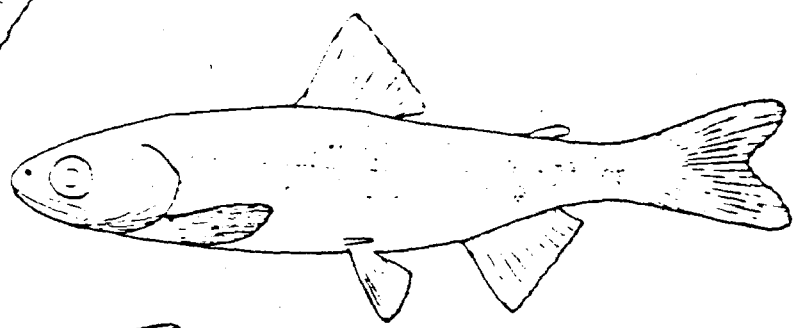


FIGURE 33. Dolly Varden 4 inches long.

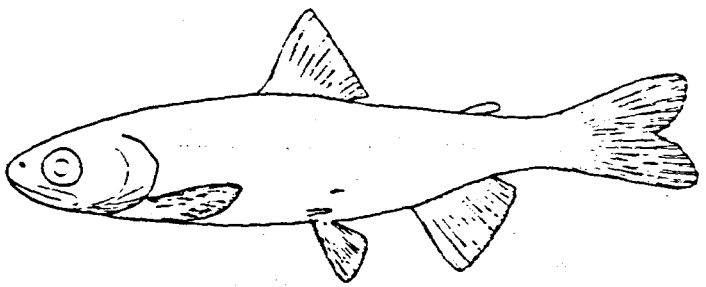


FIGURE 34. Pink salmon 2 inches long.

5a. (2)

Parr marks in form of vertical bars. Width of light areas usually equal to or greater than width of dark areas. Distance from snout to front of dorsal fin about one-half distance from snout to base of tail.

Lake trout (*Fig. 32*)

Salvelinus namaycush (Walbaum)

5b.

Parr marks are irregular blotches. Width of dark areas greater than width of light areas. Distance from snout to front of dorsal fin less than one-half distance from snout to base of tail.

Dolly Varden and Arctic charr (*Fig. 33*)

Salvelinus malma (Walbaum) and ***Salvelinus alpinus*** (Linnaeus)

6a. (1)

No parr marks. Maximum size in fresh water about 2 inches.

Pink salmon (*Fig. 34*)

Oncorhynchus gorbuscha (Walbaum)

6b.

Parr marks present. Maximum size in fresh water up to 5 inches or more 7

7a. (6)

Parr marks short, elliptical or oval, not much longer than vertical diameter of eye, reaching little, if any, below lateral line 8

7b.

Parr marks tall vertical bars, almost bisected by lateral line, highest parr mark much longer than vertical eye diameter 9

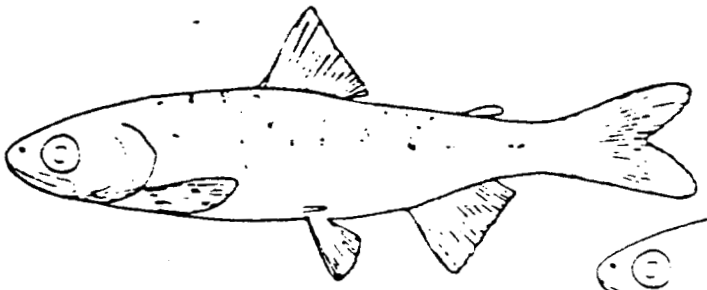


FIGURE 35. Sockeye salmon 3¾ inches long.

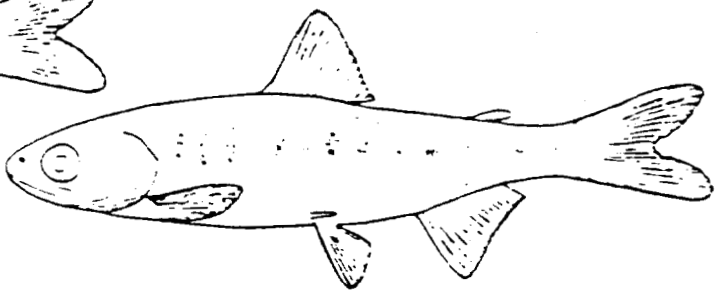


FIGURE 36. Chum salmon 4 inches long.

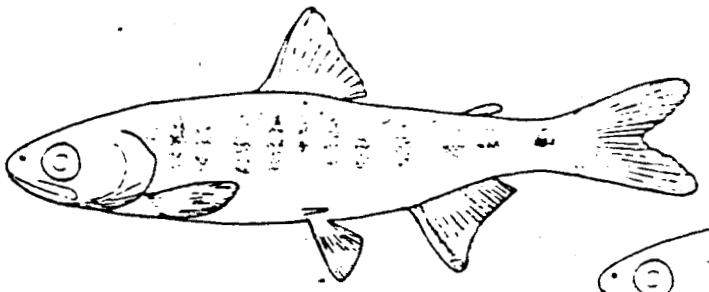


FIGURE 37. Coho salmon 4 inches long.

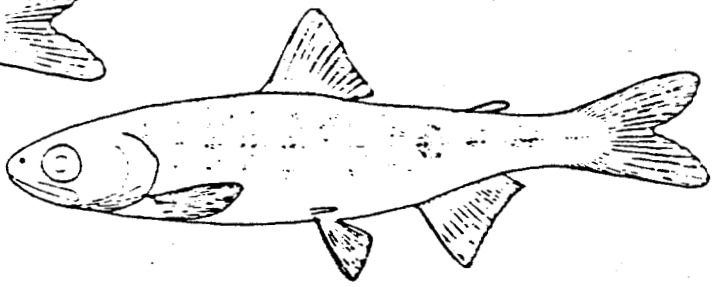


FIGURE 38. Chinook salmon 5 inches long.

8a. (7)

Gill rakers about 11 – 18. A row of definite black spots on back.

Sockeye salmon (*Fig. 35*)

Oncorhynchus nerka (Walbaum)

8b.

Gill rakers about 10 – 14. Black spots on back, if present, irregular in position.

Chum salmon (*Fig. 36*)

Oncorhynchus keta (Walbaum)

9a. (7)

First anal ray elongate, producing a concave outer margin to anal fin. Usually some pigment behind white leading edge of anal fin. Adipose fin uniformly dark.

Coho salmon (*Fig. 37*)

Oncorhynchus kisutch (Walbaum)

9b.

First anal ray not elongate. Anal fin usually without dark pigment behind leading edge. Adipose fin pigmented only around edges.

Chinook salmon (*Fig. 38*)

Oncorhynchus tshawytscha (Walbaum)

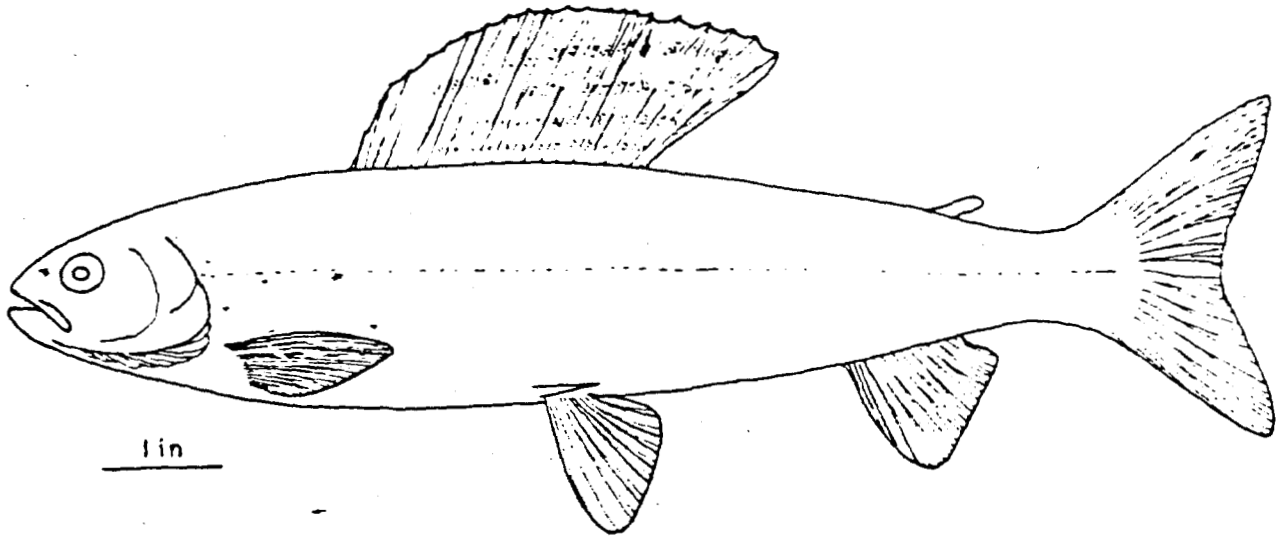


FIGURE 39. Arctic grayling, *Thymallus arcticus.*

GRAYLING, Subfamily Thymallinae of the Family Salmonidae

Key to the Species

Thymallus arcticus (Pallas)

Only one species, the Arctic grayling, (*Fig. 39*), is found in Alaska. Ranges through the northern part of the state from the north side of the Chugach Mountains to the Arctic coast. Known also from the Susitna and Copper rivers and Saint Lawrence Island. Ranges eastward across Canada to the west coast of Hudson's Bay, south to Montana. Widely distributed in Asia as far west as the Ob River and south to Mongolia. Known to reach a weight of 5 pounds, but most are much smaller. Abundant.

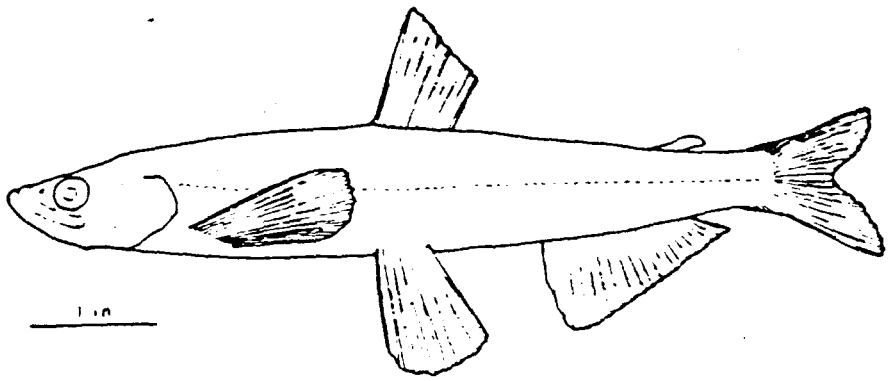


FIGURE 40. Longfin smelt, *Spirinchus thaleichthys.*

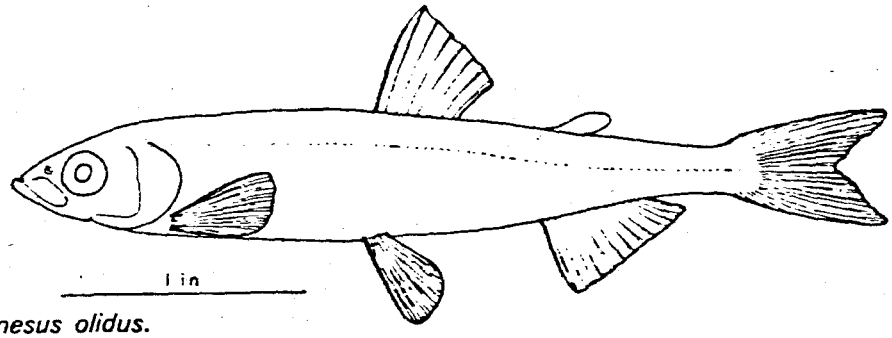


FIGURE 41. Pond smelt, *Hypomesus olidus.*

SMELTS, Family Osmeridae

Key to the Species

1a.

Teeth on vomer bone in roof of mouth, (*see Fig. 3*), small and numerous, not like canine teeth 2

1b.

One or more large canine teeth on each wing of vomer (may be missing in spawning adults of the Eulachon) 4

2a. (1)

Mouth small, upper jaw not reaching behind middle of pupil of eye. Teeth in roof of mouth in two rows on both vomer and palatines 3

2b.

Mouth large, upper jaw reaching at least to middle of pupil of eye. Teeth in single row on vomer and palatines.

Longfin smelt (*Fig. 40*)

Spirinchus thaleichthys (Ayres)
Found along the coast from Southeastern north to the Nushagak River in the Bristol Bay area. Anadromous. The range extends south to San Francisco Bay. Length to 6 inches. Locally and seasonally abundant.

3a. (2)

Pelvic fin bases before or under anterior end of dorsal fin. Lateral line scales 54-62.

Pond smelt (*Fig. 41*)

Hypomesus olidus (Pallas)
Found in Alaska in the Copper River and in Bering Sea drainages as far north as the Kobuk River. Also present in the Mackenzie River in Canada, and in Asia from northern Hokkaido westward to the Alazeya River in Siberia. Usually up to about 6 inches long. May be abundant locally and seasonally.

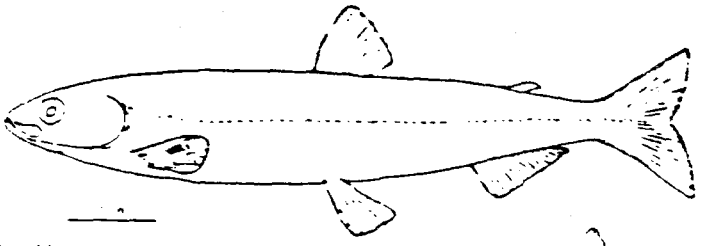


FIGURE 42. Surf smelt, *Hypomesus pretiosus.*

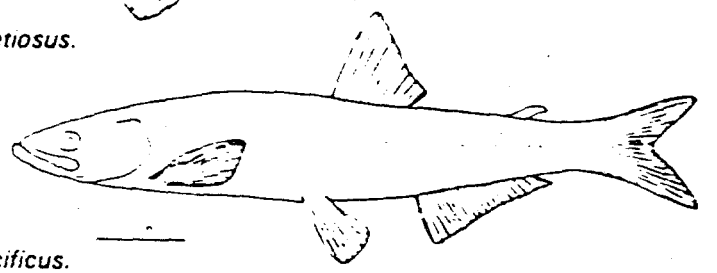


FIGURE 43. Eulachon, *Thaleichthys pacificus.*

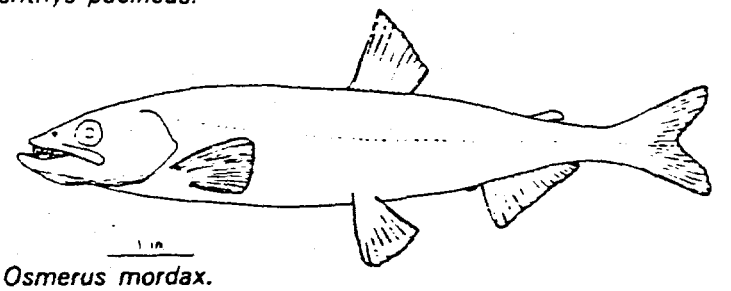


FIGURE 44. Rainbow smelt, *Osmerus mordax.*

3b.

Pelvic fin bases behind anterior end of dorsal fin. Lateral line scales 66-76.

Surf smelt (*Fig. 42*)

Hypomesus pretiosus (Girard)
Found in the sea, sometimes entering fresh water, from Yakutat south. Range extends southward to Long Beach, California. Up to nearly a foot long. Seasonally abundant.

4a. (1)

Anal rays 18-23. Front of dorsal fin behind a vertical through front of pelvic fin base.

Eulachon (*Fig. 43*)

Thaleichthys pacificus (Richardson)
An anadromous fish found in Alaska from Southeastern to Bristol Bay. The range extends south along the coast to Bodega Head in California. Reaches a length of about 12 inches. Seasonally abundant.

4b.

Anal rays 11-16. Front of dorsal fin on or anead of a vertical through pelvic fin base.

Rainbow smelt (*Fig. 44*)

Osmerus mordax (Mitchill)
Coastal regions of Alaska from the southeastern part of the state north to the Arctic coast. Present also on Saint Lawrence Island. Anadromous. The range in North America extends south to Vancouver Island. Westward in Asia to the White Sea. May reach a foot in length. Seasonally abundant.

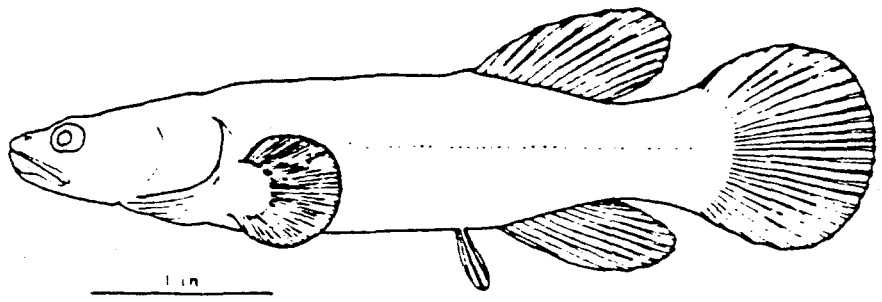


FIGURE 45. Alaska blackfish, *Dallia pectoralis.*

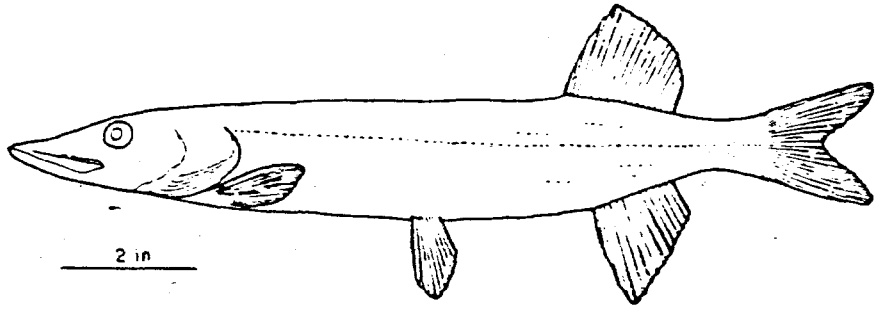


FIGURE 46. Northern pike, *Esox lucius.*

ALASKA BLACKFISH, Family Dalliidae

Dallia pectoralis Bean

There is only one species in this family, the Alaska blackfish, *Dallia pectoralis* Bean (*Fig. 45*). It ranges from the Alaska Peninsula north to the Arctic coast, mainly in coastal areas. Found also in the Kuskokwim River, on Saint Lawrence, Saint Matthew and Nunivak Islands, and in the Yukon drainage as far upstream as Fairbanks. Introduced into Hood Lake, Anchorage, and to Saint Paul Island in the Pribilofs. Ranges westward to the Chukhotsk Peninsula in Siberia. Attains a length of 8 to 10 inches in some areas. Locally abundant.

PIKES, Family Esocidae

Esox lucius Linnaeus

Only the Northern pike, *Esox lucius* Linnaeus, (*Fig. 46*), of this family is found in Alaska. Within the state, it ranges from the Alaska Peninsula streams that drain into Bristol Bay northward to the Arctic coast and throughout the Interior. An isolated population is in the Ahrnklin River and some ponds near Yakutat. The overall range of the species is circumpolar. Reaches at least 4 feet and 50 pounds. Abundant.

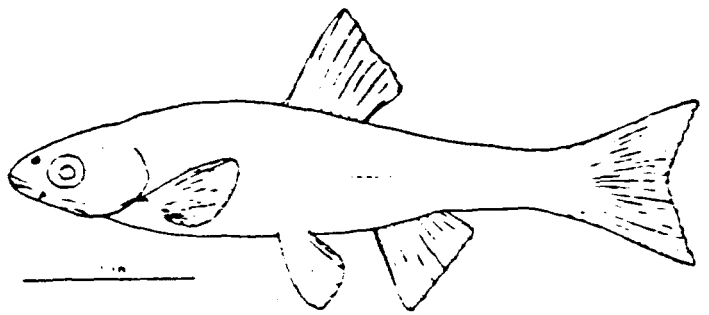


FIGURE 47. Lake chub, *Couesius plumbeus.*

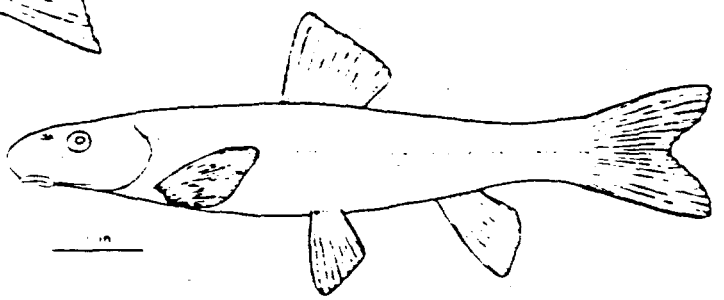


FIGURE 48. Longnose sucker, *Catostomus catostomus.*

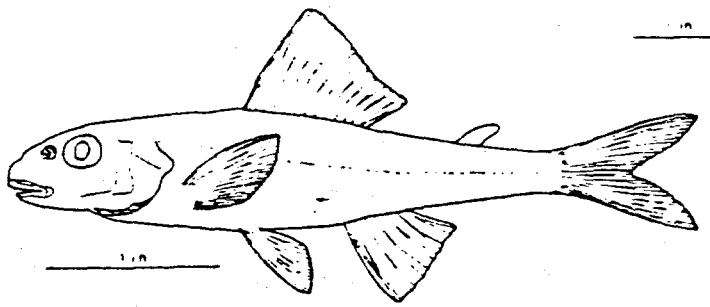


FIGURE 49. Troutperch, *Percopsis omiscomaycus.*

MINNOWS, Family Cyprinidae

Couesius plumbeus (Agassiz)
Although this is one of the largest families of fishes, only one species, the Lake chub, *Couesius plumbeus* (Agassiz), (*Fig. 47*), occurs in Alaska. It is found only in the Yukon River and its tributaries, as far downstream as Nulato. Ranges eastward across Canada to Nova Scotia, south to New England and the Great Lakes in the east, to the upper Fraser and Columbia rivers in the west. Up to 6 inches long, but usually less than 4 inches. Abundant.

SUCKERS, Family Catostomidae

Catostomus catostomus (Forster)
Only one species, the Longnose sucker, *Catostomus catostomus* (Forster), (*Fig. 48*), is found in Alaska, where it occurs throughout the state in drainages emptying into the Arctic Ocean or the Bering Sea. Its entire range extends from the Yana River in Siberia east to the Atlantic coast of North America, south to Maryland. Reaches 2 feet and about 6 pounds. Abundant.

TROUTPERCHES, Family Percopsidae

Percopsis omiscomaycus (Walbaum)
The Troutperch, *Percopsis omiscomaycus* (Walbaum), (*Fig. 49*), the only member of this group present in Alaska, is found within the state only in the Porcupine and Yukon rivers, from about the mouth of the Andreafsky River on upstream. Its range extends generally southeastward across North America to West Virginia and New England. Reaches length of about 4 inches in Alaska, and rather scarce here.

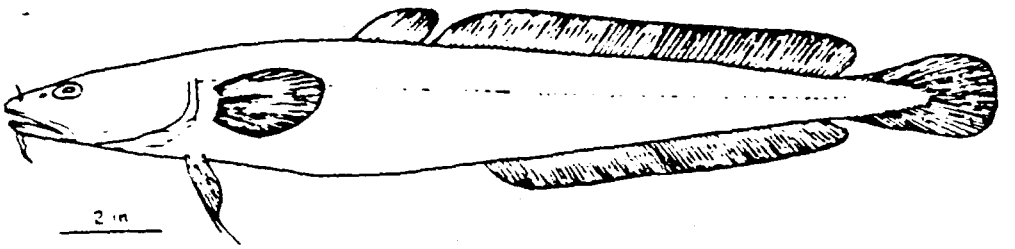


FIGURE 50. Burbot, *Lota lota.*

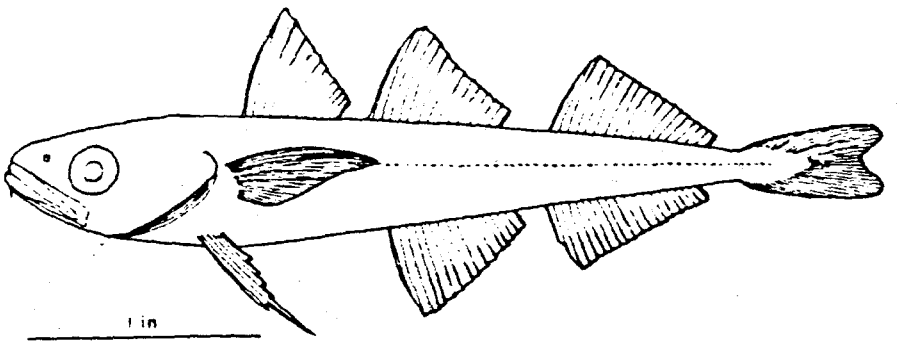


FIGURE 51. Arctic cod, *Boreogadus saida.*

CODFISHES, Family Gadidae

Key to the Species

1a.

Three dorsal fins and two anal fins present 2

1b.

Two dorsal fins and one anal fin present.

Burbot (*Fig. 50*)

Lota lota (Linnaeus)
The only fresh-water codfish, the burbot is present in most Alaskan streams from the Copper River drainage north and west to the Bering Sea and the Arctic Ocean. The entire range of the species is circumpolar, with several subspecies in different parts of the world. Up to 4 feet long and 60 pounds weight. Common.

2a. (1)

Upper jaw longer than lower jaw. Less than 30 gill rakers 3

2b.

Lower jaw equal to or longer than upper jaw. More than 30 gill rakers.

Arctic cod (*Fig. 51*)

Boreogadus saida (Lepechin)
A marine form, known from the Arctic Ocean and Bering Sea, sometimes enters rivers. Circumpolar in its entire range. Reaches about 1 foot maximum length. Locally abundant in the sea, but scarce in fresh water.

3a. (2)

Length of chin barbel equal to at least three-fourths of eye diameter (in young) to longer than eye diameter (in adults). Length of space between 2nd and 3rd dorsal fins less than eye diameter.

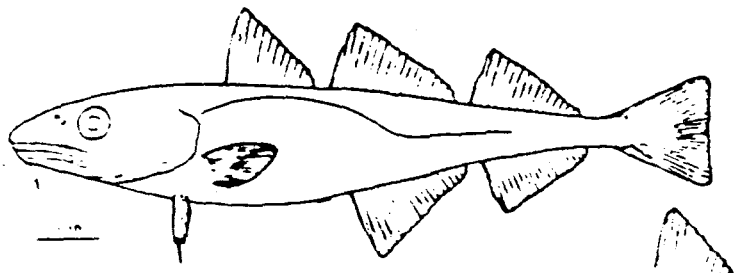


FIGURE 52. Pacific cod, *Gadus macrocephalus.*

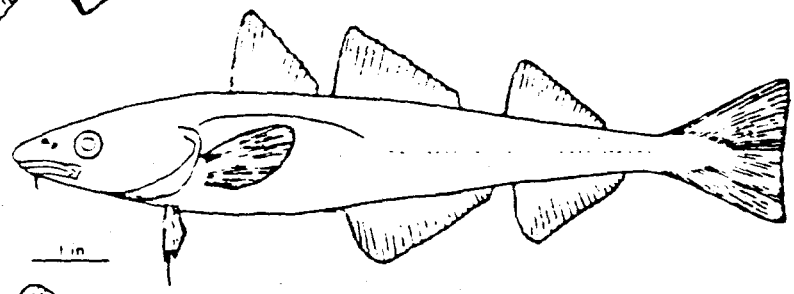


FIGURE 53. Saffron cod, *Eleginus gracilis.*

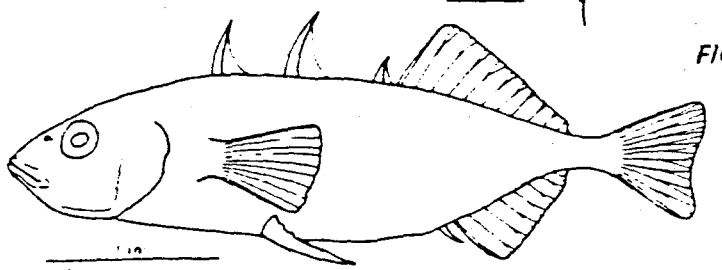


FIGURE 54. Threespine stickleback, *Gasterosteus aculeatus.*

Pacific cod (*Fig. 52*)

Gadus macrocephalus Tilesius
A marine species, sometimes entering rivers, found from the Bering Sea south to Oregon on the North American coast, found also on the Asian side south to the Yellow Sea and Sea of Japan. Reaches a length of about 3 feet. Abundant in the sea, but scarce in fresh water.

3b.

Barbel never longer than one-half eye diameter, usually about equal to or shorter than diameter of pupil. Length of space between 2nd and 3rd dorsal fins equal to or greater than eye diameter.

Saffron cod (*Fig. 53*)

Eleginus gracilis (Tilesius)
A marine form, sometimes enters rivers. Known from the Arctic Ocean and Bering Sea, south to Sitka on the North American side, to the Yellow Sea on the Asian side. Grows to about 2 pounds. Scarce in fresh water.

STICKLEBACKS, Family Gasterosteidae

Key to the Species

1a.

Two to four free spines, not connected by membranes, on mid-line of back in front of dorsal fin.

Threespine stickleback (*Fig. 54*)

Gasterosteus aculeatus Linnaeus
Found in Alaska from Southeastern to the Aleutian Islands, Bristol Bay and Saint Lawrence Island. Also present on the Seward Peninsula. Both marine and freshwater forms are known. In western North America, the range extends south to Baja California. Also known from coastal regions in Asia, Europe and eastern North America. May attain 4 inches. Locally abundant.

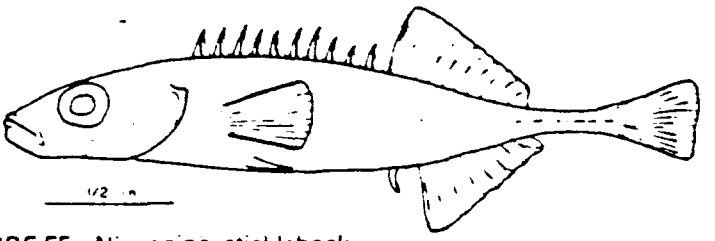


FIGURE 55. Ninespine stickleback, *Pungitius pungitius.*

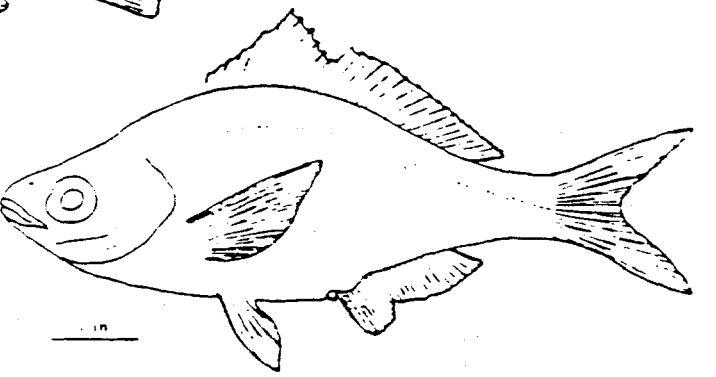


FIGURE 56. Shiner perch, *Cymatogaster aggregata.*

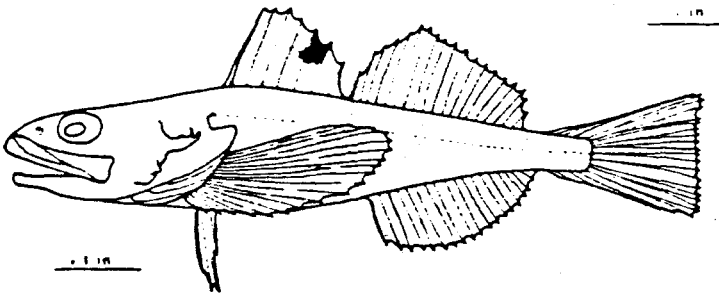


FIGURE 57. Pacific staghorn sculpin, *Leptocottus armatus.*

1b.

Seven to 12 free spines on mid-line of back in front of dorsal fin.

Ninespine stickleback (*Fig. 55*)

Pungitius pungitius (Linnaeus)
Found in Alaska in coastal regions from Cook Inlet north to the Arctic coast. Its general distribution is circumpolar. Reaches 3 to 4 inches length. Locally common.

SURFPERCHES, Family Embiotocidae

Cymatogaster aggregata Gibbons
Of the three members of this family that are found in Alaska, only one, the Shiner perch, *Cymatogaster aggregata* Gibbons, (*Fig. 56*), enters fresh water. It is found in Southeastern Alaska, from about Wrangell on southward. The range continues south to Todos Santos Bay, Baja California. Reaches a length of about 6 inches. Locally abundant.

SCULPINS, Family Cottidae

Key to the Species

1a.

Dorsal fins touching each other or only very slightly separated 2

–

1b.

Dorsal fins well separated 6

2a. (1)

Upper spine on preoperculum moderately long, branched, antler-like, with 3 or 4 spinules.

Pacific staghorn sculpin (*Fig. 57*)

Leptocottus armatus Girard
In Alaska, found from Kodiak to Southeastern, in both marine and fresh waters. Ranges south to San Quintin Bay, Baja California. Up to 18 inches long. Often quite abundant.

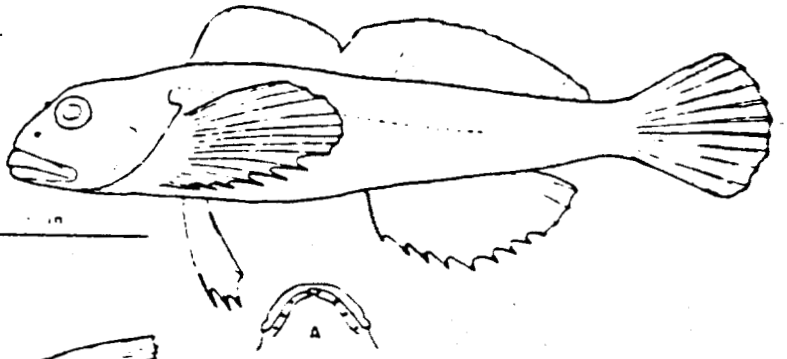


FIGURE 58. Slimy sculpin, *Cottus cognatus*. A. Under side of the head to show the two pores at the tip of the chin.

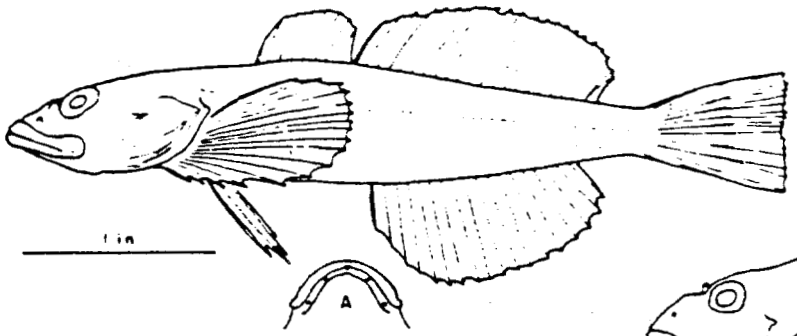


FIGURE 59. Prickly sculpin, *Cottus asper*. A. Under side of the head to show the single pore at the tip of the chin.

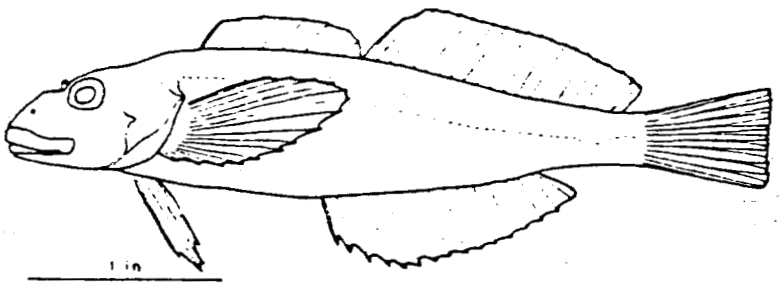


FIGURE 60. Coastrange sculpin, *Cottus aleuticus*.

2b.

Upper preopercular spine short, simple, not branched 3

3a. (2)

Lateral line ends under middle of second dorsal fin, although there may be isolated pores farther behind. Two pores on tip of chin at mid-line (*Fig. 58A*).

Slimy sculpin (*Fig. 58*)

Cottus cognatus Richardson
Found in Alaska from the Copper River drainage north and west to streams emptying into the Bering Sea and Arctic Ocean. Generally present throughout the Interior and also on Saint Lawrence Island. Distributed from eastern Siberia eastward across northern North America to the east coast, south as far as the Great Lakes, with a few isolated populations even farther south. Does not exceed 5 inches in length. Common.

3b.

Lateral line extends to behind anal fin. One pore on tip of chin at mid-line (*Fig. 59A*) 4

4a. (3)

Palatine teeth present, well developed (*Fig. 3*).

Prickly sculpin (*Fig. 59*)

Cottus asper Richardson
The range of this species in Alaska is in the coastal streams from the Kenai Peninsula southward. Outside Alaska, the prickly sculpin is found as far south as the Ventura River, California. Also present in the upper reaches of the Peace River in the Mackenzie system. Usually less than 6 inches long, but may reach a foot. Common.

4b.

Palatine teeth absent or only poorly developed 5

5a. (4)

Pelvic fins long, reaching anus. Anal rays 13-14.

Coastrange sculpin (*Fig. 60*)

Cottus aleuticus Gilbert
Ranges in Alaska from Southeastern north to the Aleutian Islands and Bristol Bay. An isolated population is present in the Kobuk River. It was once reported from the mouth

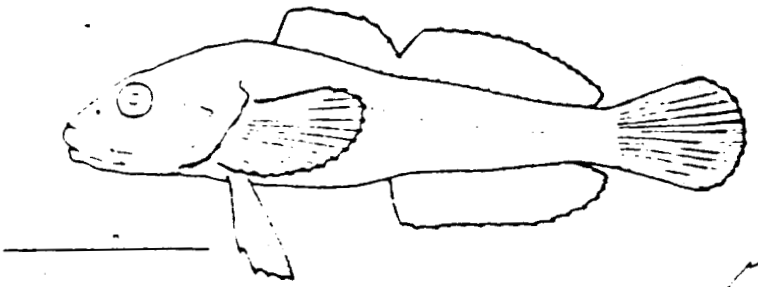


FIGURE 61. Riffle sculpin, *Cottus gulosus.*

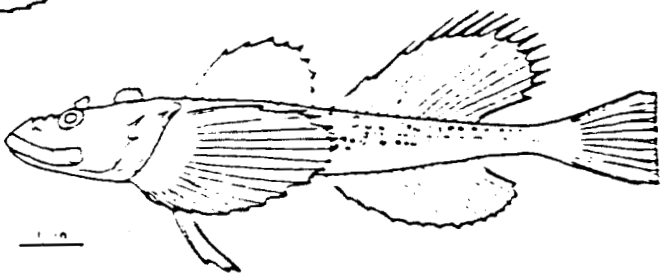


FIGURE 62. Fourhorn sculpin, *Myoxocephalus quadricornis.*

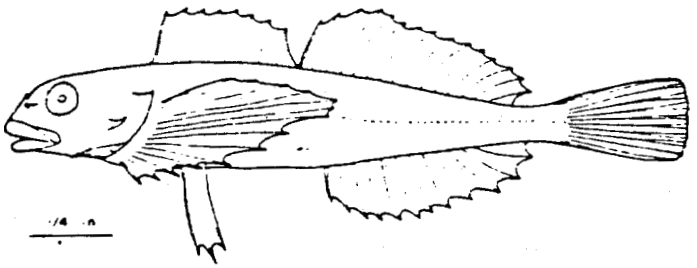


FIGURE 63. Sharpnose sculpin, *Clinocottus acuticeps.*

of the Tanana River, but this was probably a mistake in identification. Ranges southward in coastal streams to San Luis Obispo County, California. Up to about 4 inches. Common.

5b.

Pelvic fins short, not reaching anus. Anal rays 16-18.

Riffle sculpin (*Fig. 61*)

Cottus gulosus (Girard)
This species has been recorded from Alaska only at Loring and the Boca de Quadra. These records are probably based on wrong identifications.

6a. (1)

Two spines on preoperculum. No teeth on palatine bones in roof of mouth.

Fourhorn sculpin (*Fig. 62*)

Myoxocephalus quadricornis (Linnaeus)
A marine form that may range well up into fresh-water streams. In Alaska, found from about Saint Michael northward, and along the Arctic coast. Has been found nearly 100 miles up the Meade River. Also present on Saint Lawrence Island. Virtually circumpolar, with a number of isolated populations in North America, ranges south to the Great Lakes. Up to more than a foot long in the sea, fresh-water populations much smaller. Fairly common locally.

6b.

One spine on preoperculum. Teeth present on palatine bones.

Sharpnose sculpin (*Fig. 63*)

Clinocottus acuticeps (Gilbert)
A normally marine species that sometimes enters fresh water, this form is found from the Aleutian Islands southward. Possibly present also in the Bering Sea, it ranges south as far as the Big Sur River in California. Up to about 2 inches long. Not common.

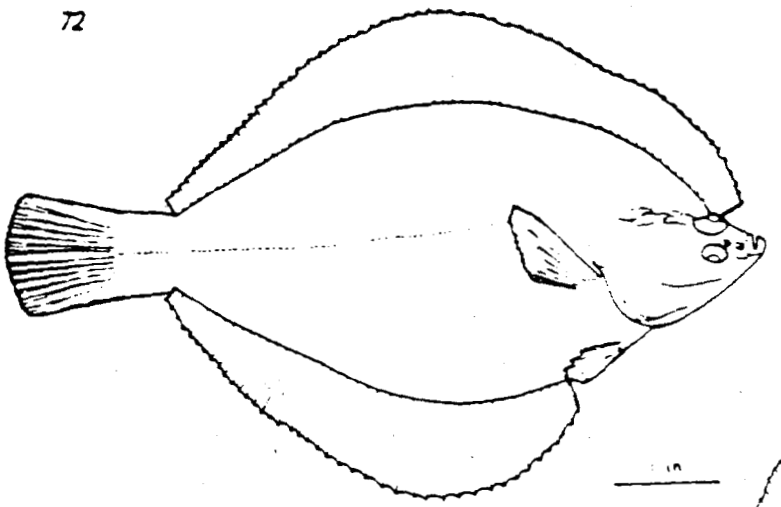


FIGURE 64. Arctic flounder, *Liopsetta glacialis.*

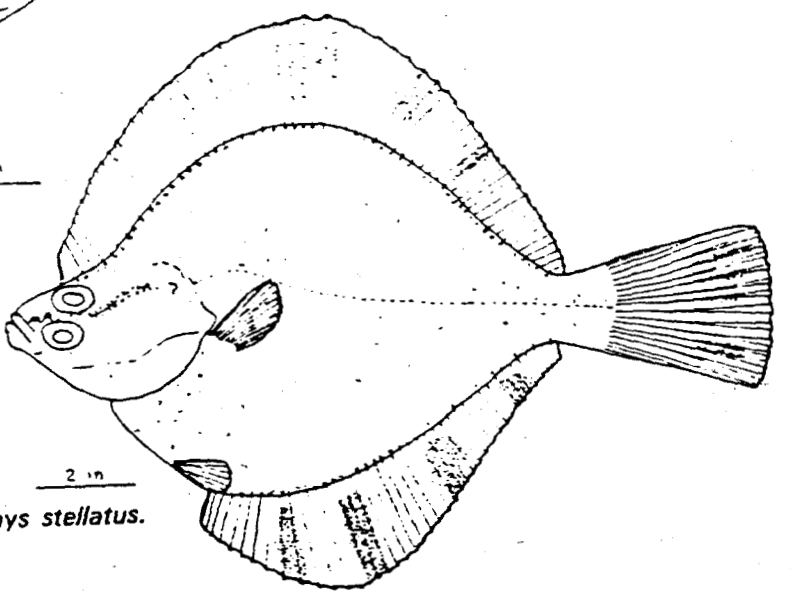


FIGURE 65. Starry flounder, *Platichthys stellatus.*

RIGHTEYE FLOUNDERS, Family Pleuronectidae

Key to the Species

1a. Fins without light and dark bands. Eyed side covered with typical scales, no bony tubercles.

Arctic flounder (*Fig. 64*)

Liopsetta glacialis (Pallas)
Ranges northward from the Alaska Peninsula to the Arctic Ocean. A marine fish that occasionally enters the lower reaches of rivers. Its world range is from the White Sea in Europe eastward to Bathurst Inlet in Canada, south to the Sea of Okhotsk and the Alaskan Peninsula. Probably seldom exceeds a foot in length. Rather scarce in fresh water.

1b. Dorsal and anal fins with alternate light and dark vertical bars. Eyed side with numerous star-shaped tubercles, a row of these along bases of dorsal and anal fins.

Starry flounder (*Fig. 65*)

Platichthys stellatus (Pallas)
Coastal Alaska, from the Arctic on south. A marine form that sometimes enters fresh water. Note that the eye and color may be on either the right or the left side. Ranges from Bathurst Inlet in the Canadian Arctic west to the shores of Siberia, south to Korea and to Santa Barbara County, California. Up to 3 feet long and to 20 pounds weight. Common.

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NOAA Technical Report NMFS CIRC-356

Murray

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service

Key to Field Identification of Anadromous Juvenile Salmonids in the Pacific Northwest

ROBERT J. McCONNELL and GEORGE R. SNYDER

SEATTLE, WA.
January 1972

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336. The northern fur seal. By Ralph C. Baker, Ford Wilke, and C. Howard Baltzo. April 1970, iii + 19 pp., 13 figs.

337. Program of Division of Economic Research, Bureau of Commerecial Fisheries, fiscal year 1969. By Division of Economic Research. April 1970, iii + 29 pp., 12 figs., 7 tables.

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340. Bureau of Commercial Fisheries Technologic Laboratory, Gloucester, Massachusetts. By Bureau of Commercial Fisheries. June 1970, 8 pp 8 figs.

341. Report of the Bureau of Commercial Fisherie Biological Laboratory, Beaufort, N.C., for th fiscal year ending June 30, 1968. By the Lab oratory staff. August 1970, iii + 24 pp., 11 figs. 16 tables.

342. Report of the Bureau of Commercial Fisherie Biological Laboratory, St. Petersburg Beach Florida, fiscal year 1969. By the Laboratory staff August 1970, iii + 22 pp., 20 figs., 8 tables.

343. Report of the Bureau of Commercial Fisherie Biological Laboratory, Galveston, Texas, fisca year 1969. By the Laboratory staff. Augus 1970, iii + 39 pp., 23 figs., 9 tables.

344. Bureau of Commercial Fisheries Tropical Atlantic Biological Laboratory progress in research 1965-69, Miami, Florida. By Ann Weeks. October 1970, iv + 65 pp., 53 figs.

346. Sportsman's guide to handling, smoking, and preserving Great Lakes coho salmon. By Shearon Dudley, J. T. Graikoski, H. L. Seagran, and Paul M. Earl. September 1970, iii + 28 pp., 15 figs.

347. Synopsis of biological data on Pacific ocean perch, *Sebastodes alutus*. By Richard L. Major and Herbert H. Shippen. December 1970, iii + 88 pp., 31 figs., 11 tables.

Continued on inside back cover.

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

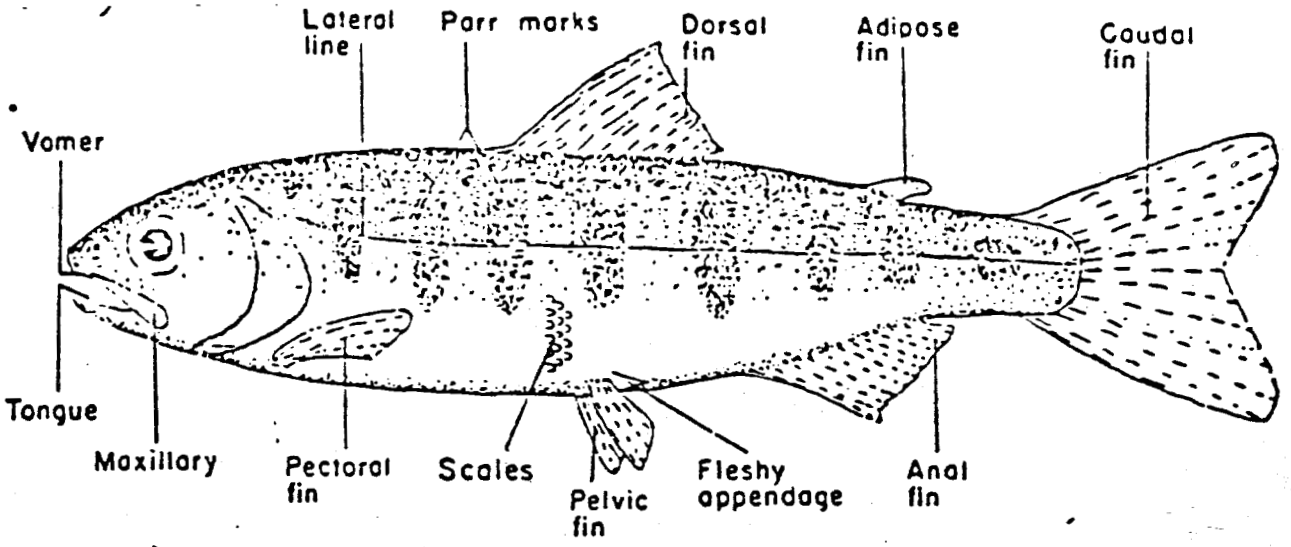


Figure 1.—A hypothetical salmonid showing external characteristics.

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)

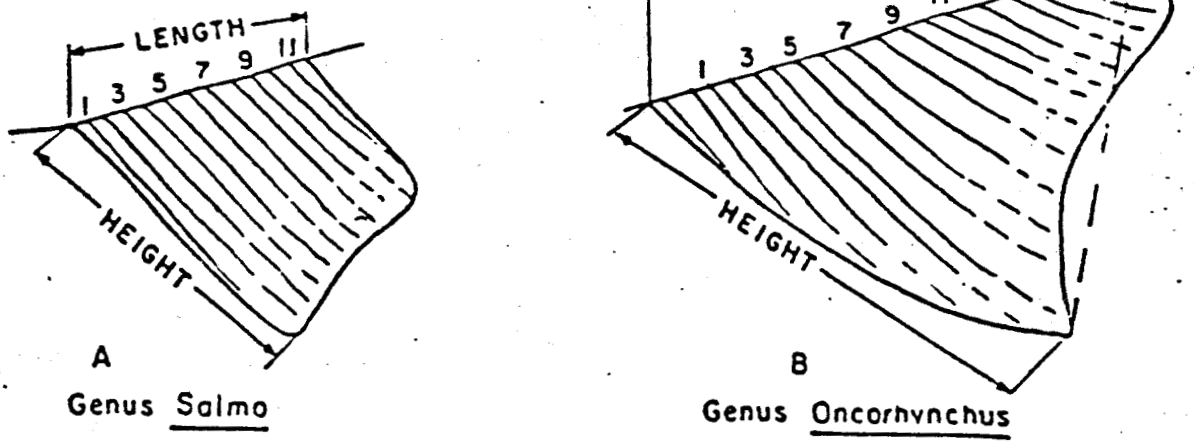


Figure 2.—Anal fins: (A) Trout, genus *Salmo;* (B) Pacific salmon, genus *Oncorhynchus.* The two drawings show differences in structure and fin ray count. (Note that the length of the anal fin is its overall basal length, and its height is that distance from the origin of the fin to the tip of the anterior 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.)

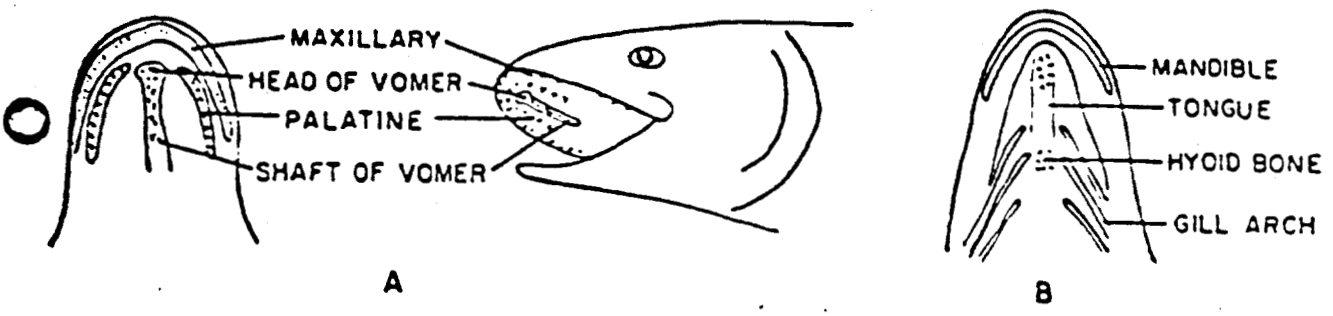
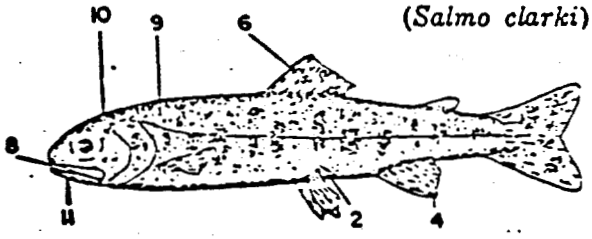


Figure 3.—Location of dentition in (A) the roof and (B) the floor of the mouth of salmonid fishes. (Presence or absence of teeth on the vomer or tongue may be determined by use of the little finger or a blunt instrument. The small hyoid teeth at the base of the tongue are located between the gill arches of the lower jaw and are difficult to find.)

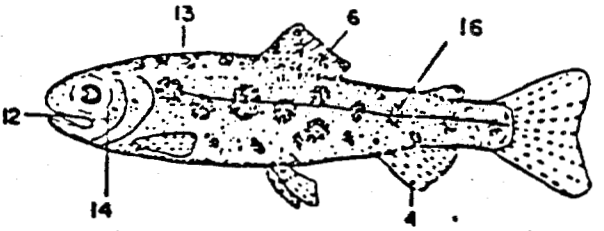
6. (18) Dorsal fin with large dark spots.
Trout
Genus *Salmo*

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*)



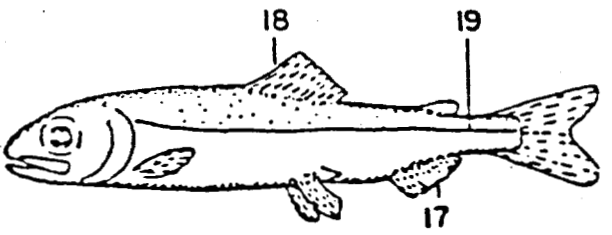
12. (8) *No teeth at base of tongue.
13. (9) Five to 10 parr marks along mid-dorsal ridge ahead of dorsal fin.
14. (10) Maxillary short, not reaching past posterior margin of eye.
15. (11) No hyoid mark under lower jaw. Few or no spots on tail.

16. (20) Parr marks almost round.
Rainbow or
steelhead trout
(*Salmo gairdneri*)



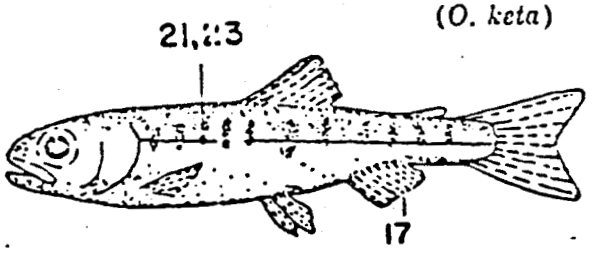
17. (4) Anal fin longer than high, with 13 or more developed rays. (Fig. 2B)
18. (6) Dorsal fin without large dark spots, may be black tipped.
Pacific salmon
Genus *Oncorhynchus*

19. (20) No parr marks. Fry leave fresh water while small—approximately 1.75 inches (45 mm) long.
Pink salmon
(*O. gorbuscha*)



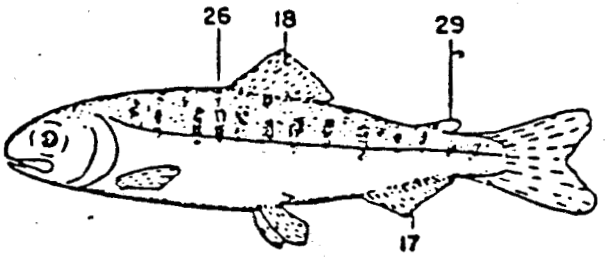
20. (16) Parr marks present as vertical bars or oval spots.
21. (30) Parr marks short, extending little, if any, below lateral line.
22. (25) Gill rakers on first arch, 19 to 26. ** Pyloric caeca, 140 to 186.
23. (26) Parr marks faint. Sides below lateral line iridescent green.
24. (27) Small when migrating from fresh water, approximately 1.5 inches (40 mm) long.

Chum salmon
(*O. keta*)



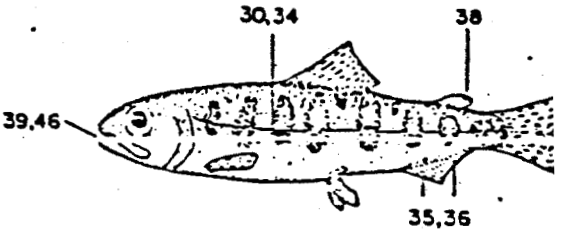
25. (22) Gill rakers on first arch, 30 to 40. **Pyloric caeca 60 to 115.
26. (23) Parr marks usually sharply defined. Sides below lateral line silvery, not iridescent green.
27. (24) Relatively large when migrating from fresh water, approximately 3 to 5 inches (80 to 126 mm) long.
28. (31) Gill rakers long and slender, more than 39 on first arch.
29. (32) Adipose fin clear, not pigmented.

Sockeye salmon
(*O. nerka*)



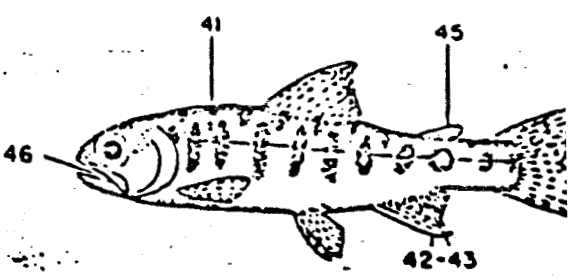
30. (21) Parr marks large, vertical bars c tered by lateral line.
31. (28) **Gill rakers short and thick, fe than 29 on first arch.
32. (29) Adipose fin at least partially mented.
33. (40) **Pyloric caeca more than 90.
34. (41) Parr marks broader than interspa
35. (42) Anterior rays of anal fin not tinctly longer than rest, not wi edged.
36. (43) Anal fin not pigmented.
37. (44) Black spots, when present, on b lobes of caudal fin.
38. (45) Adipose fin not completely mott clear area at anterior base of fin
39. (46) Black gums along base of lower te

Chinook salmo
(*O. tshawytsc*



40. (33) **Pyloric caeca less than 80.
41. (34) Parr marks narrower than int spaces.
42. (35) Anterior rays of anal fin elongat when depressed they extend to b of last ray. (Fig. 2B)
43. (36) Anal fin pigmented between rays, sulting in black banding.
44. (37) Black spots, when present, on up lobe of caudal.
45. (38) Adipose fin completely pigmented.
46. (36) Mouth gray to white.

Coho salm
(*O. kisutc*



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*)

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BIBLIOGRAPHY

Alaska

MEEHAN, W. R., and J. S. VANIA.
1961. An external characteristic to differentiate between king and silver salmon juveniles in Alaska. Alaska Dep. Fish Game, Inf. Leafl. 1. 5 p. (Processed.)

WILIMOVSKY, N. J.
1958. Provisional keys to the fishes of Alaska. U.S. Fish Wildl. Serv., Fish. Res. Lab., Juneau, Alaska. 113 p. (Processed.)

California

SHAPOVALOV, LEO.
1947. Distinctive characters of the species of anadromous trout and salmon found in California. Calif. Fish Game 33: 185-190.

Canada

CARL, G. CLIFFORD, W. A. CLEMENS, and C. C. LINDSEY.
1967. The fresh-water fishes of British Columbia. B. C. Prov. Mus., Dep. Recreation Conserv., Handb. 5. 192 p.

CLEMENS, W. A.
1935. The Pacific salmon in British Columbia waters. B. C., Rep. Comm. Fish. 1934: K103-K105.

CLEMENS, W. A., and G. V. WILBY.
1946. Fishes of the Pacific Coast of Canada. Fish. Res. Board Can., Bull. 68. 368 p.

FOERSTER, R. E., and A. L. PRITCHARD.
1935. The identification of the young of the five species of Pacific salmon, with notes on the fresh-water phase of their life-history. B. C., Rep. Comm. Fish. 1934: K106-K116.

SCOTT, W. B.
1958. A checklist of the freshwater fishes of Canada and Alaska. R. Ont. Mus., Div. Zool. Palaeontol. 30 p.

Montana

WEISEL, G. F.
1957. Fish guide for intermountain Montana. Mont. State Univ. Press, Missoula. 88 p.

Oregon

BOND, CARL E.
1961. Keys to Oregon fresh-water fishes. Oreg. State Univ., Agric. Exp. Stn., Tech. Bull. 58. 42 p.

Pacific Northwest

BURGNER, R. L. (edited by William A. Smoker).
1955. Preliminary key for identification of salmon fry, juveniles, and adults. State of Wash., Dep. Fish. 8 p. (Processed.)

GREGORY, R. W., P. E. FIELDS, R. W. LICHTENHELD, and G. R. SNYDER.
1961. Using anal chromatophores for distinguishing between chinook and silver salmon smolts in the Columbia River. Coll. Fish., Univ. Wash., Seattle, Tech. Rep. to U.S. Army Corps Eng. No. 51. 4 p. (Processed.)

ROUNSEFELL, G. A.
1962. Relationships among North American Salmonidae. U.S. Fish Wildl. Serv., Fish. Bull. 62: 235-270.

SCHULTZ, LEONARD P.
1936. Keys to the fishes of Washing Oregon and closely adjoining regi Univ. Wash., Publ. Biol. 2: 103-22

Washington

CRAWFORD, DONALD R.
1925. Field characters identifying yo salmonid fishes in fresh waters of Wa ington. Univ. Wash., Publ. Fish. 1 (: 64-76.

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