4K89-21

KODIAK MANAGEMENT AREA

SALMON RESEARCH OPERATIONAL PLANS FOR 1989

By

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and

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OPERATIONAL PLAN

1989
KODIAK MANAGEMENT AREA
CATCH SAMPLING

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

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INTRODUCTION

The Kodiak Management Area extends from Imuya Bay on the south to Cape Douglas on the north and includes Shelikof Strait and the waters of Kodiak, Afognak, and Shuyak Islands (Figure 1). The area includes over 600 specified salmon streams and lakes. The management area is divided into nine districts and 98 statistical areas. The districts and statistical areas are established to facilitate specific stock management.

Five North Pacific salmon species are harvested in the Kodiak Management Area. Sockeye salmon are economically the most important species followed by pink, chum, coho, and chinook salmon. The 1988 catch was 2,700,000 sockeye, 14,600,000 pink, 1,400,000 chum, 303,000 coho, and 22,400 chinook salmon. The total 1988 harvest was 19,025,400 fish.

The Alaska Department of Fish and Game assumed the responsibility of managing Alaska's salmon resources in 1960. The primary goal has been to manage the resource for maximum sustained yield. Generally achievement of this goal is accomplished by: 1) determining the type and size of the escapement required by system that will produce maximum sustained yield and; 2) determining the techniques required to manage the fishery to obtain the escapement goals. Assignment of catch to river system of origin is a prerequisite to evaluating escapement goals and forecasting stock returns. In 1985 an expanded salmon commercial catch sampling operation was initiated in the Kodiak Management Area for establishing a data base for determining stock contribution levels, evaluating escapement goals, and forecasting. The program has continued since. The current emphasis is on sockeye and chum salmon.

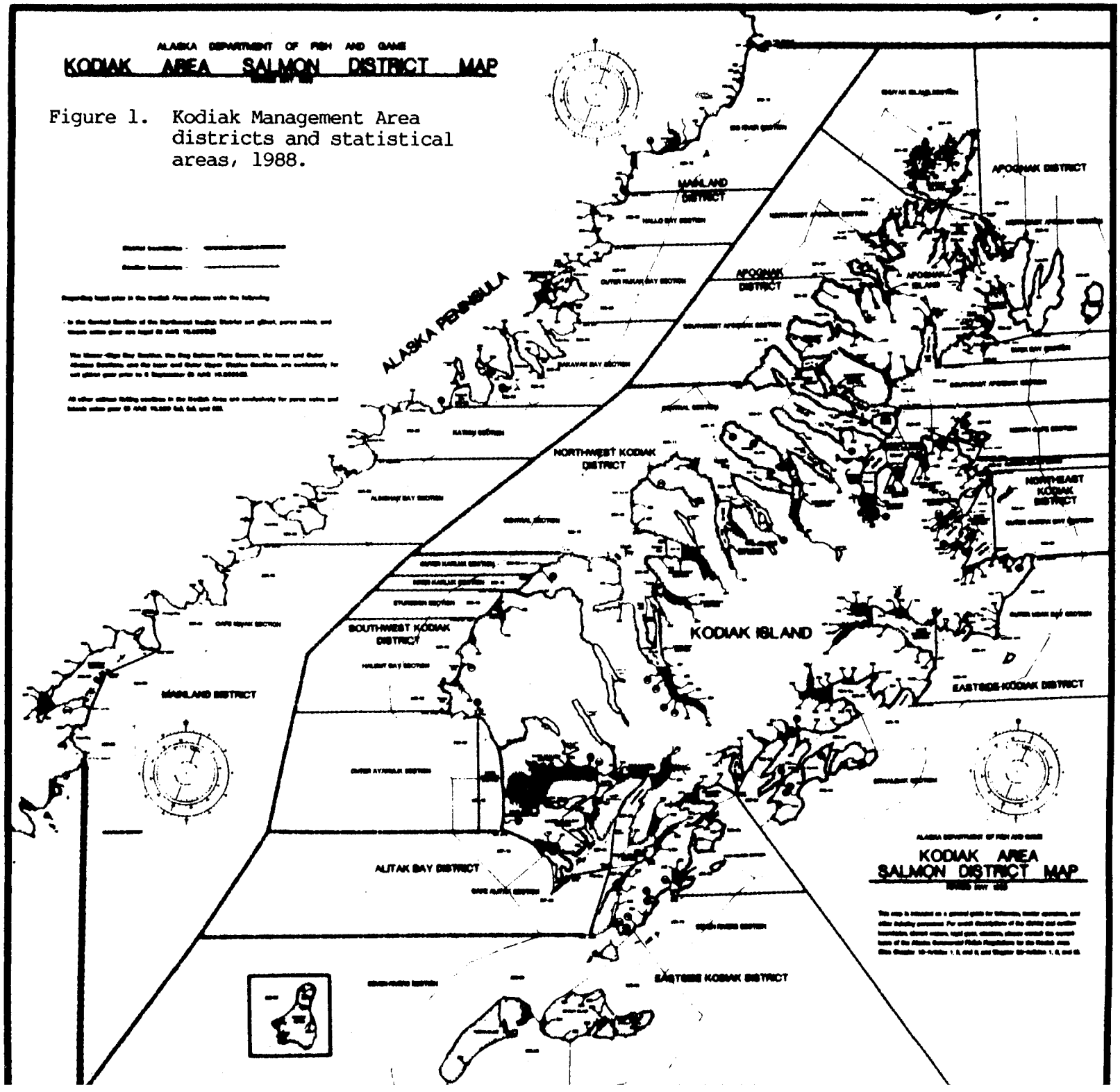


Figure 1. Kodiak Management Area districts and statistical areas, 1988.

OBJECTIVES

Long Term:

Better management of the salmon resources for the Kodiak Management Area through improved forecasting, development of stock-recruitment relationships to assess escapement requirements, and accurate assessment of stock composition levels for mixed stock fisheries.

Short Term:

A. Collect representative age composition data of the sockeye and chum salmon catches from selected fisheries.

B. Collect representative sockeye scales from selected fisheries for future stock separation work.

SUPERVISION

Bruce Barrett will supervise the catch sampling crews at the Port of Kodiak and Lazy Bay.

PERSONNEL

Personnel assignments at Lazy Bay and the Port of Kodiak are defined in Table 1. Available permanent staff will assist in catch sampling at the Port of Kodiak.

Table 1. Salmon catch sampling crew for Kodiak Management Area, 1989.

Location	Name	Title	PCN	Position
Port of Kodiak	Patrick Holmes	FB II	1273	Crew Leader
	Barbara Monkiewicz	FT III	1591	Catch Sampler
Lazy Bay	Charles Swanton	FB I	1413	Crew Leader
	Dave Kaplan	FT III	1760	Catch Sampler

PROCEDURES

Catch Sampling

The sockeye and chum salmon catches will be sampled for age, length, and sex (ALS) by the crew at the Port of Kodiak and at Lazy Bay according to the schedules in Tables 2 and 3. A list of the 1989 statistical weeks is in Table 4.

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

To ensure that sockeye and chum samples are not missed the crews will begin sampling the first day the respective species catches are delivered from the designated sampling areas each statistical week (Tables 2 and 3).
The standard procedures for collecting and recording salmon ALS data are defined in Appendix A and B. The accuracy of the data will be the responsibility of the crew leaders. If there are any questions or problems do not be shy about asking for clarification or help.

Periodically in season the Lazy Bay crew will send their catch sampling AWL originals and corresponding acetates to the Kodiak office for final processing. The Lazy Bay crew leader will notify the Kodiak office by radio that the data are being sent, and will maintain a log book of all out-going samples. All scales collected by the Lazy Bay crew will be pressed and aged at Lazy Bay prior to being mailed to Kodiak.

Table 2. Sockeye salmon catch sampling schedule for the Kodiak Management Area, 1989.

CREW	SAMPLING AREA District/Section	Geographic Area	Statistical Area	STATISTICAL WEEK	SAMPLE Size 1/	Data	FISHERY
Port of Kodiak	N. W. Kodiak/Central	Uganik/Viekoda Bays	253	24-35	600	ALS	Mixed-stock
	Afognak District, 2/ Shuyak Island Section NW Afognak Section SW Afognak Section	Point Banks to Raspberry Cape	251-10 through 70	27-31	600	ALS	Mixed-stock
	Mainland District 2/ Dakavak Section Outer Kukak Bay Section Hallo Bay Section Big River Section	Dakavak Bay to Cape Douglas	262-10 through 55	27-31	600	ALS	Mixed-stock
	N.W. Kodiak/Central	Uyak Bay 3/	254-10,20	24-26	600	Scales	Mixed-stock
Lazy Bay	N.W. Kodiak/Central	Uyak Bay 3/	254-10,20	27-35	600	Scales	Mixed-stock
	Mainland/Cape Igvak	Imuya Bay to Cape Aklek	262-70,80,90,95	24-35	480	Scales	Mixed-stock
	Alitak Bay/Cape Alitak	Cape Alitak	257-10,20	24-35	600	Scales	Mixed-stock
	Alitak Bay/Moser Bay	Moser/Olga Bay	257-40,41	24-28	600	Scales	Mixed-stock
		Moser/Olga Bay	257-40,41	29-35	600	Scales	Terminal
	S.W. Kodiak/ Inner, Outer Ayakulik	Red River	256-10,20	24-35	600	Scales	Terminal
	S.W. Kodiak/ Inner, Outer Karluk	Karluk	255-10,20	24-35	600	Scales	Terminal
	Cape Alitak/ Inner, Outer Upper Station	Upper Olga Bay	257-30	24-28	600	Scales	Terminal

1/ If the required 600-fish sample is impossible to obtain, reduce sample size to 480 fish.

2/ The weekly goal is to obtain a combined sample from the three specified areas of the Afognak District, and a combined sample from the Dakavak Bay to Cape Douglas reach of the Mainland District. When no pure samples are available from these areas, a combined Mainland and Afognak Districts sample should be taken.

3/ To be sampled at Larsen Bay.

Table 3. Chum salmon catch sampling schedule for the Kodiak Management Area, 1989.

CREW	SAMPLING AREA Geographic Area	SAMPLING AREA Statistical Area	STATISTICAL WEEKS 1/	SAMPLE SIZE	SAMPLE DATA
Port of Kodiak	Kiliuda Bay	258-20	32-34	440	Scales
	Zachar Bay 2/	254-30	28-30	440	Scales
Lazy Bay	Sulua/Portage	257-60	32-34	440	Scales
	Kukak Bay 2/	262-25,27	32-36	440	Scales

1/ Samples will be collected only on the weeks when the fishery is terminal and directed specifically for chum salmon.

2/ The M/V Coho may be able to collect the samples on the fishing grounds.

3/ Crews will collect scales only, no lengths or sexes.

Table 4. 1989 statistical weeks.

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

An updated copy of the sampling log (Figure 2) should be sent weekly to the Kodiak office.

Original scale cards and copies of the AWLs should be hand carried to town at the end of the season.

The Lazy Bay crew leader will maintain a daily log of job-related activities. Additionally the crew leader will prepare a report at the end of the season defining problems that occurred over the season, and solutions and suggestions for the following season.

On a time-permitting basis the Lazy Bay crew will assist the weir crews at Upper Station and Akalura in collecting their sockeye escapement samples. At Upper Station the crew will sample 240 sockeye salmon weekly, while at Akalura the crew will sample 480 fish at the peak of the first escapement and again at the peak of the second escapement.

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

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

Figure 2. Lazy Bay catch sampling log, 1989.

AREA SAMPLED	CATCH Week	CATCH Date	SAMPLE DATE	E.O. DATE	SAMPLE SIZE	GEAR TYPE	CREW	SCALES AGED BY	COMMENTS

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.

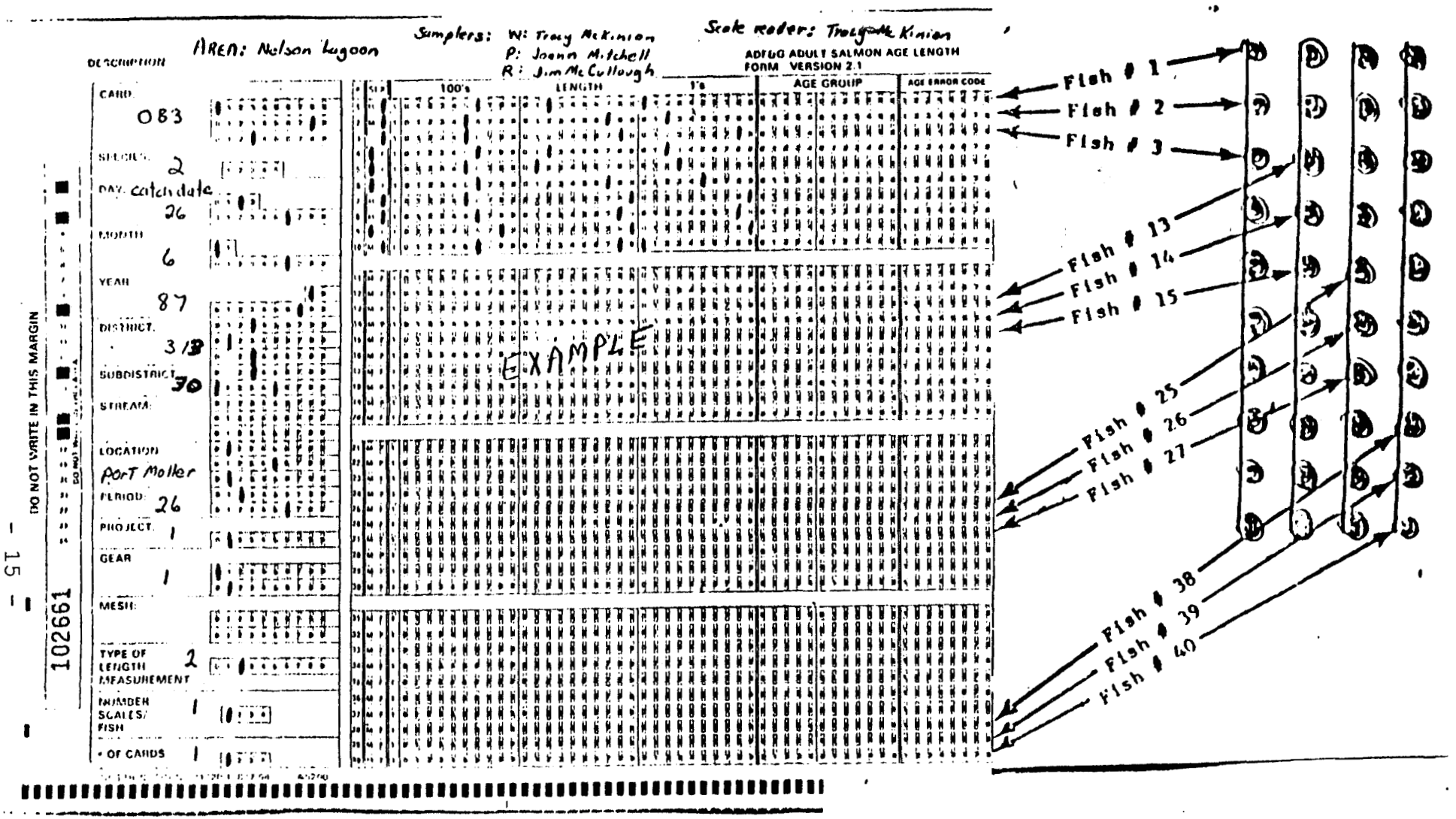
Complete each section of the left side of the mark-sense form using a soft No. 2 pencil and darken the corresponding blocks as shown in the figures. Make every effort to darken the entire block as partially filled blocks are often missed by the optical scanner which reads and records the data from the 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.



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

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:

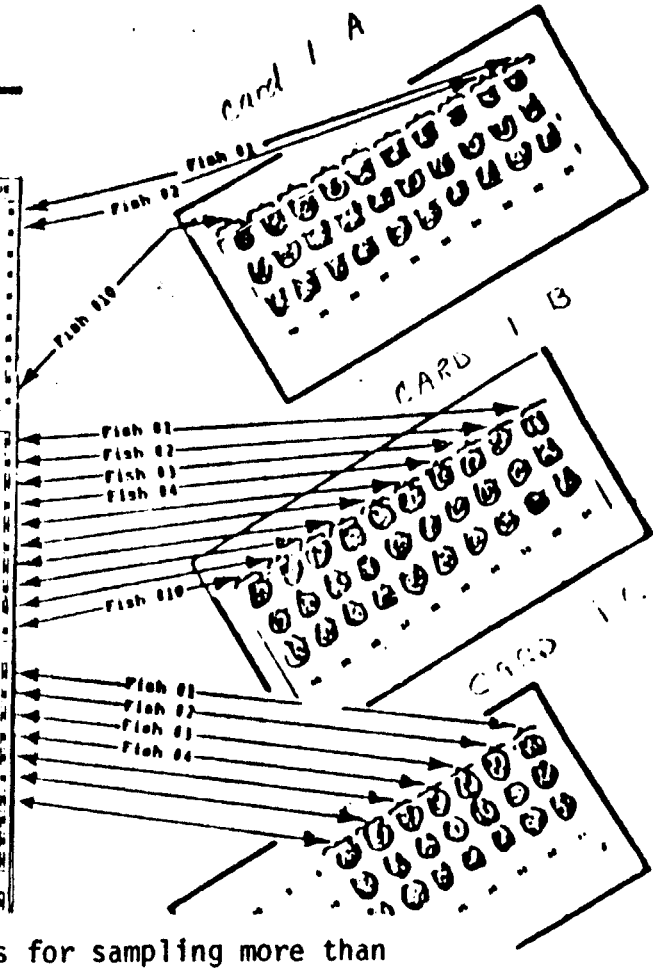
NUMBER SCALES/FISH: 4

OF CARDS: 1

DO NOT WRITE IN THIS MARGIN

103328

	100's	LENGTH	1's	AGE GROUP	AGE ERROR CODE
001 A					
001 B					
001 C					



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

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 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

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 - Larsen Bay
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

scanning 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.

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:

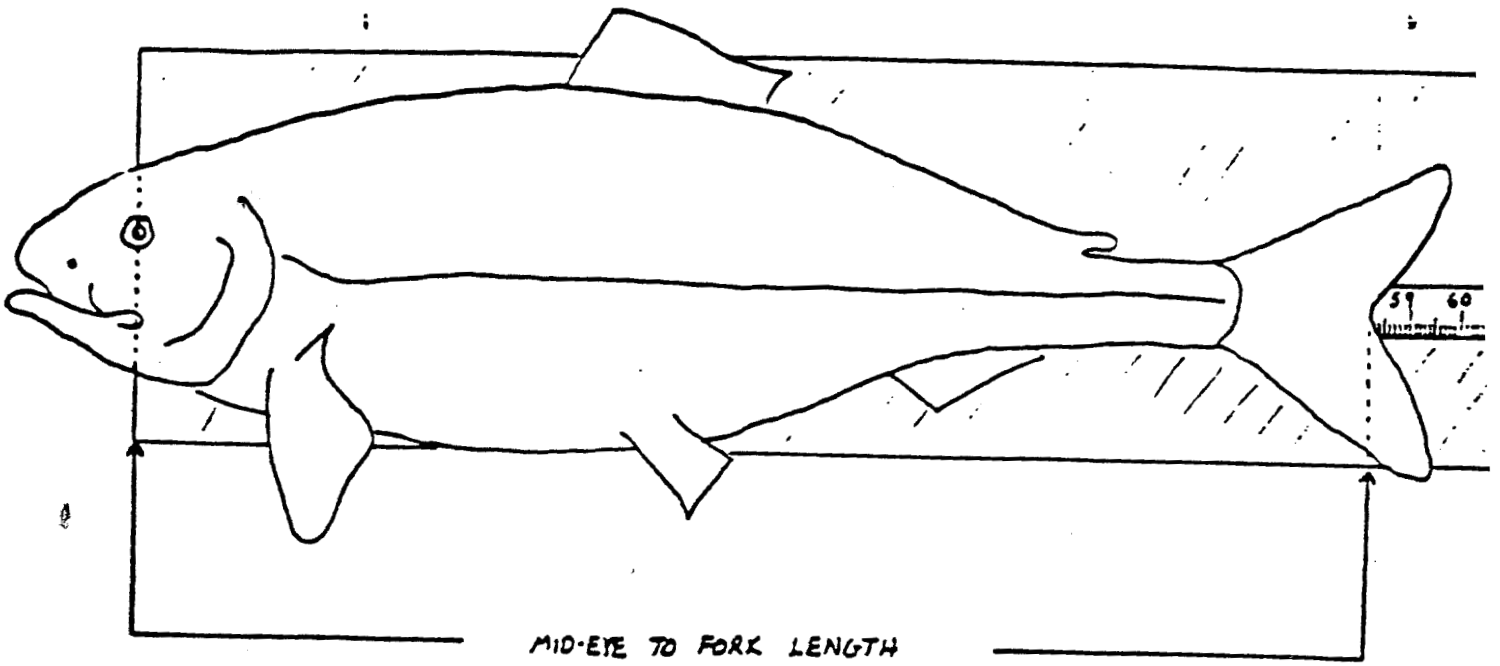
A. GENERAL

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

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 .

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 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:

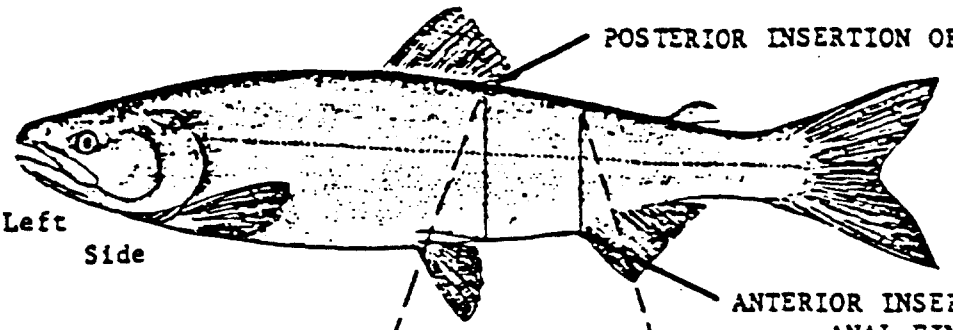
   a. When scales are sampled in wet conditions it is difficult to mount scales in a fashion so as to result in a good scale impression being made. Glue often obscures scale features and scales frequently adhere poorly to the card. In this situation the scales should be remounted.

   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.

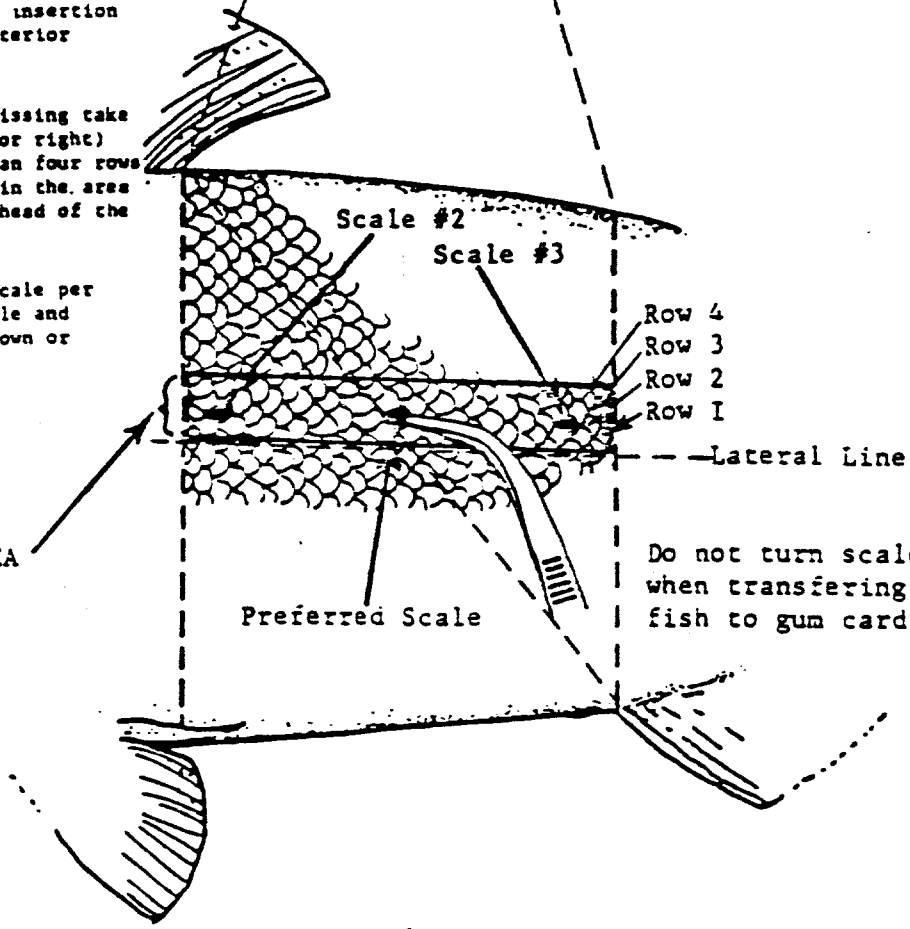
Appendix B.4. Scale sampling procedure showing the preferred scale sampling area on an adult salmon.



Take the preferred scale on the left side of the fish, two rows above the lateral line and on the diagonal from the posterior insertion of the dorsal fin to the anterior insertion of the anal fin.

If the preferred scale is missing take a scale again on the left (or right) side of the fish no more than four rows above the lateral line within the area behind the dorsal fin and ahead of the anal fin.

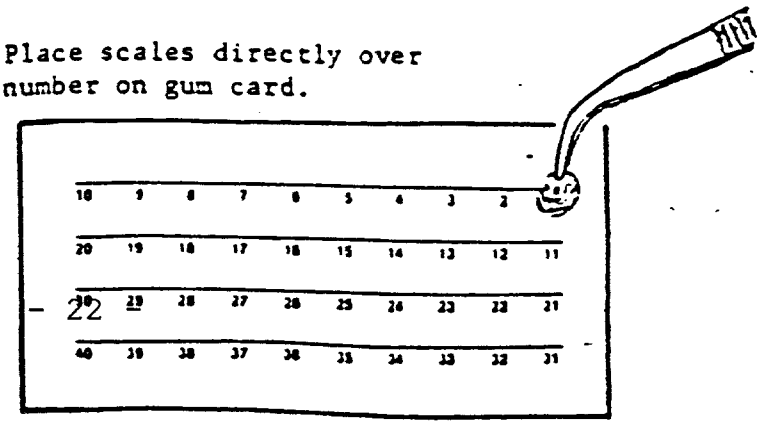
If sampling more than one scale per fish take the preferred scale and scale #2 and scale #3 as shown or the closest scales thereof.



Do not turn scales over when transfering from fish to gum card.

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

Place scales directly over number on gum card.



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.

APPENDIX C

Kodiak Management Plan

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1989 OPERATIONAL PLAN

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. Barbara Monkiewicz 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 data at Karluk River, Red River, Upper Station weirs (Table 1 and Figure 1). The weekly sampling should be performed on the fourth day (Wednesday) 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. But, if necessary, a sample 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.

Table 1. Sockeye salmon escapement sampling schedule, 1989.

Location	Sampling Frequency	Statistical Week Starting	Statistical Week Ending	Sample Size
Karluk weir	weekly	23	40	240
Red River	weekly	23	40	240
Upper Station	weekly	23	40	240
Afognak weir (early)	once	escapement peak		600
Afognak weir (late)	once	escapement peak		600
Little River Lake	once	escapement peak		600
Uganik Lake	once	escapement peak		600
Saltery River	once	escapement peak		600
Buskin Lake	once	escapement peak		600

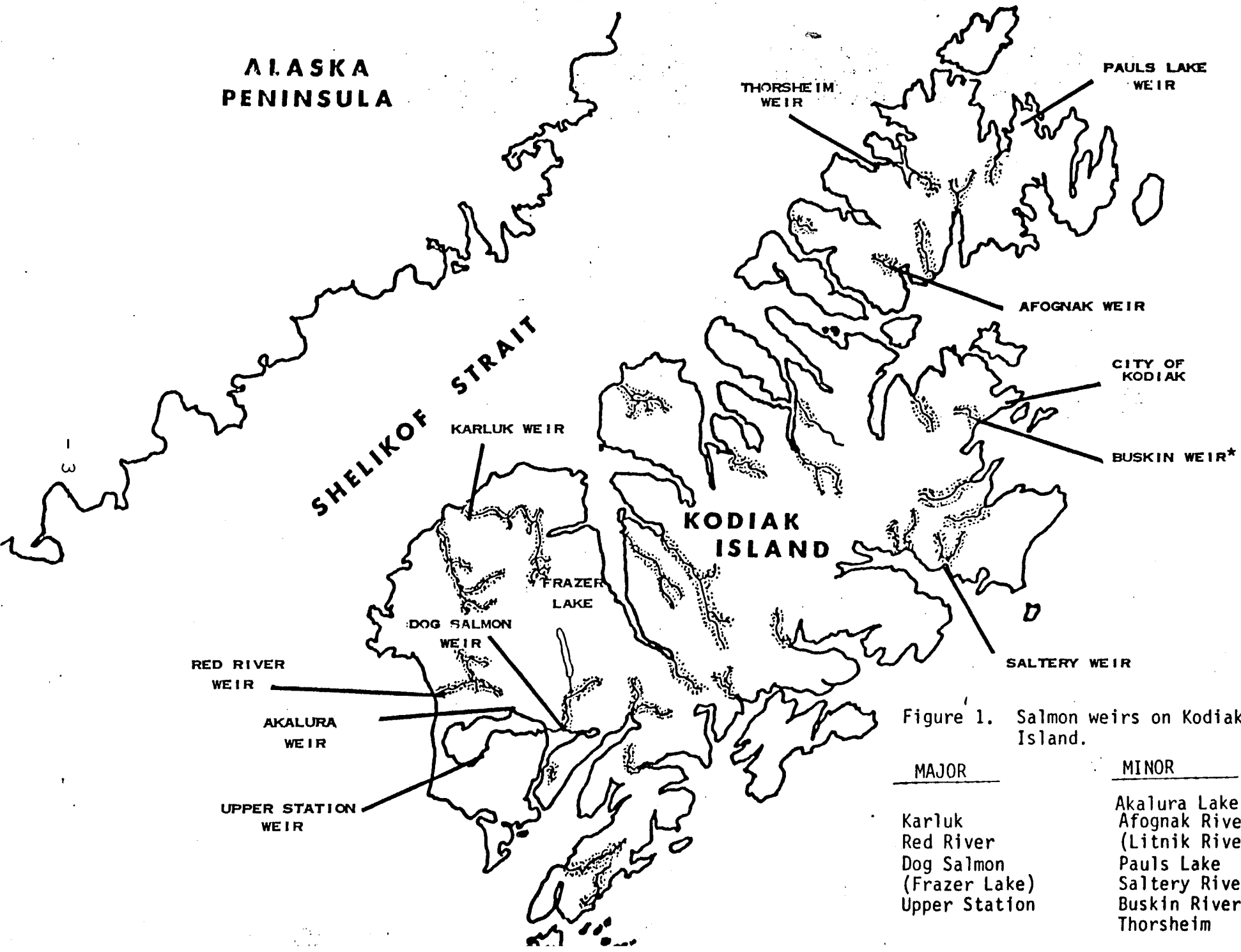


Figure 1. Salmon weirs on Kodiak Island.

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

At Uganik Lake, Little River Lake, and Buskin Lake 600 sockeye salmon will be sampled for ALS data using a beach seine. A sample is to be taken at the escapement peak at each of these locations. Bruce Barrett 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 1989 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. 1989 calendar weeks.

Statistical Week	Calendar Dates	Statistical Week	Calendar Dates
1	01-Jan to 07-Jan	28	09-Jul to 15-Jul
2	08-Jan to 14-Jan	29	16-Jul to 22-Jul
3	15-Jan to 21-Jan	30	23-Jul to 29-Jul
4	22-Jan to 28-Jan	31	30-Jul to 05-Aug
5	29-Jan to 04-Feb	32	06-Aug to 12-Aug
6	05-Feb to 11-Feb	33	13-Aug to 19-Aug
7	12-Feb to 18-Feb	34	20-Aug to 26-Aug
8	19-Feb to 25-Feb	35	27-Aug to 02-Sep
9	26-Feb to 04-Mar	36	03-Sep to 09-Sep
10	05-Mar to 11-Mar	37	10-Sep to 16-Sep
11	12-Mar to 18-Mar	38	17-Sep to 23-Sep
12	19-Mar to 25-Mar	39	24-Sep to 30-Sep
13	26-Mar to 01-Apr	40	01-Oct to 07-Oct
14	02-Apr to 08-Apr	41	08-Oct to 14-Oct
15	09-Apr to 15-Apr	42	15-Oct to 21-Oct
16	16-Apr to 22-Apr	43	22-Oct to 28-Oct
17	23-Apr to 29-Apr	44	29-Oct to 04-Nov
18	30-Apr to 06-May	45	05-Nov to 11-Nov
19	07-May to 13-May	46	12-Nov to 18-Nov
20	14-May to 20-May	47	19-Nov to 25-Nov
21	21-May to 27-May	48	26-Nov to 02-Dec
22	28-May to 03-Jun	49	03-Dec to 09-Dec
23	04-Jun to 10-Jun	50	10-Dec to 16-Dec
24	11-Jun to 17-Jun	51	17-Dec to 23-Dec
25	18-Jun to 24-Jun	52	24-Dec to 30-Dec
26	25-Jun to 01-Jul	53	31-Dec to 31-Dec
27	02-Jul to 08-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) inseason 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 Figure B.1. A completed AWL form and accompanying gum cards for sampling commercial catches of chinook and coho salmon are shown in Figure 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)

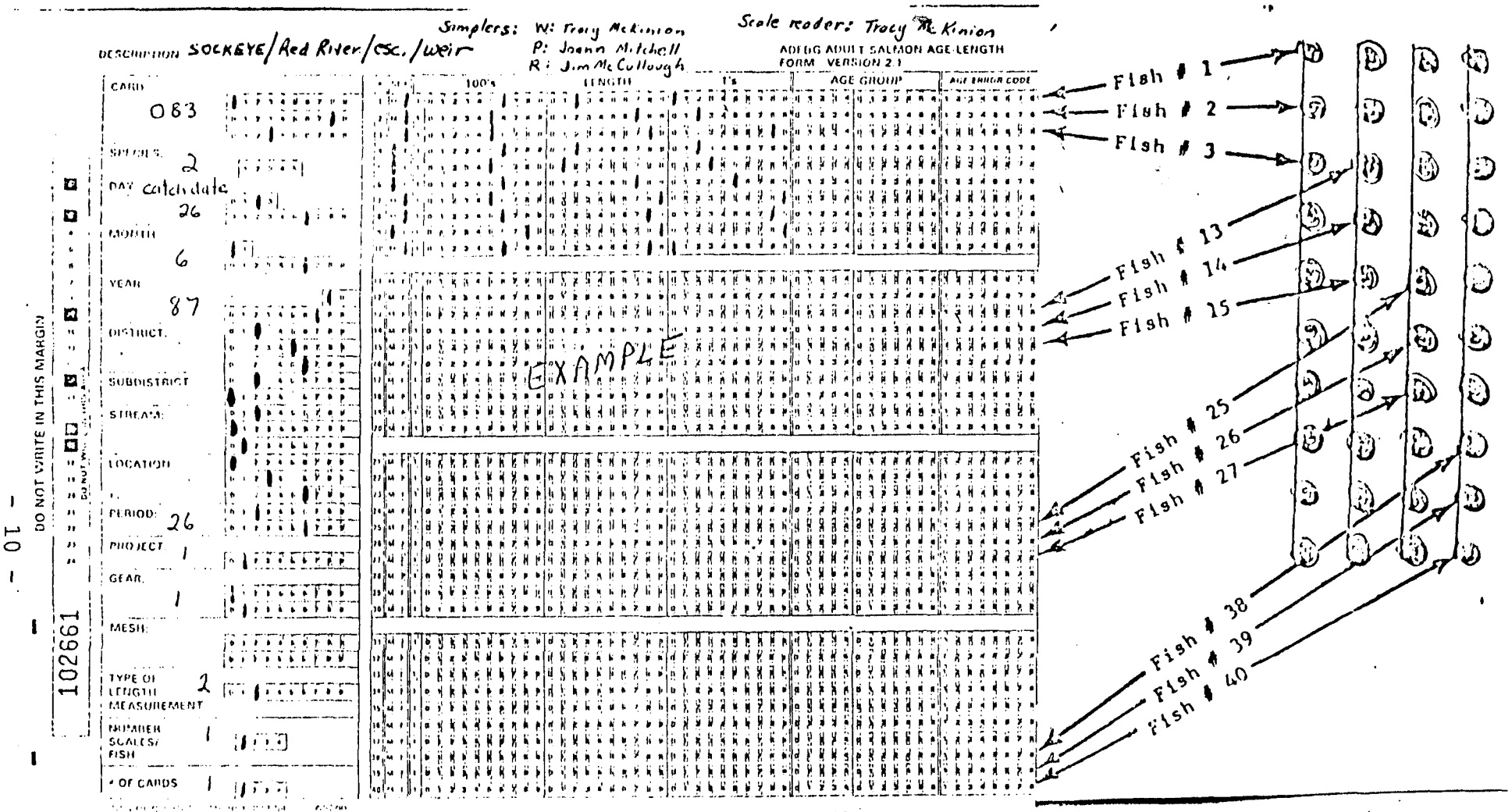


Figure B.1. Example of AWL and gum cards for sampling one scale per fish.

Species: Sockeye Card No: 083

Locality: RED RIVER WEIR - ESCAPEMENT

Stat. Code: 256 - 20 - 201 - ___

Sampling Date: Mo. 6 Day 26 Year 87

Gear: WEIR TRAP

Collector(s): McCullough, Mitchell, McKinion

Remarks: ___

Figure B.2. Example of AWL and scale cards for 2 scales/fish samples.

COHO/SALTERY/ESC./WEIR Comments: Peak of coho run

DESCRIPTION: Samplers: Dinnocenzo, Pearson, Holmes Scale Reader:

ADF&G ADULT SALMON AGE-LENGTH FORM VERSION 2.1

CARD: 001 A&B

SPECIES: Coho

DAY: 25

MONTH: Sept

YEAR:

DISTRICT: 259

SUBDISTRICT: 41

STREAM: 415

LOCATION: Saltery Weir

PERIOD: 38

PROJECT: Escapement

GEAR:

MESH:

TYPE OF LENGTH MEASUREMENT

NUMBER SCALES/ FISH

OF CARDS

DO NOT WRITE IN THIS AREA

103131

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

001 A

001 B

Card 001 A

#1 #1 #10 #11

card 001 B

#21 #21 #31 #31

Species: Coho Card No: 001 B

Locality: Saltery Weir

Stat. Code: 259-41-415-

Sampling Date: Mo. 9 Day 25 Year 86

Gear: Weir Trap

Collector(s): Dinnocenzo, Pearson, Holmes

Remarks: Peak of Run

Samples #21-40 2 scales/fish

Species: Coho Card No: 001 A

Locality: Saltery Weir

Stat. Code: 259-41-415-

Sampling Date: Mo. 9 Day 25 Year 86

Gear: Weir trap

Collector(s): Dinnocenzo, Pearson, Holmes

Remarks: Peak of Run

Samples #1-20 2 scales/fish

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 samples will have only 1 card per AWL form as shown in Figure B.1. Coho and chinook samples will contain up to four cards per AWL form as shown in Figure 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 Figure B.3.

# of cards:
Mark 1 when sampling sockeye and chum salmon (Figure 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 Figure B.2.

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
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

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.

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 Figures B.1-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.

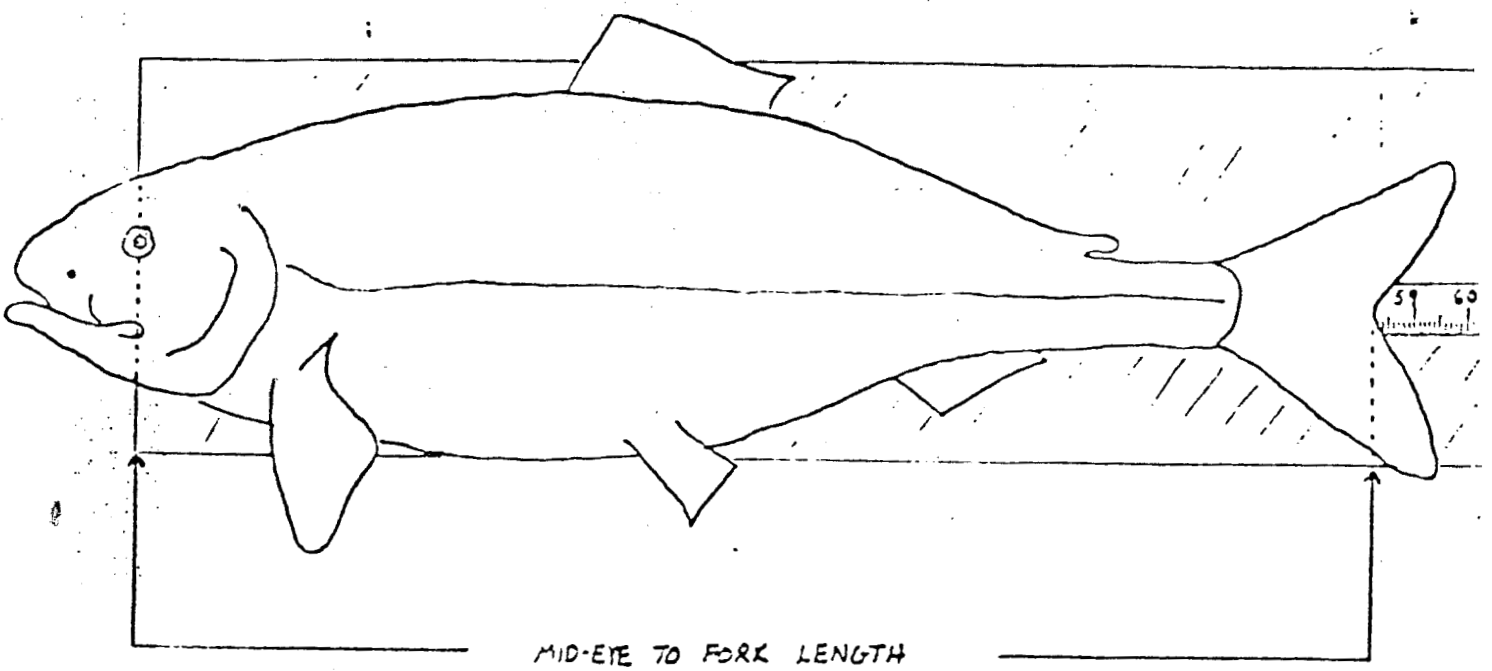
SAMPLING:

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 Figure 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

Figure 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 .

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 Figure 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 Figure 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 2 scales per fish as with chinook and coho salmon sample the "preferred scale" and scale #2 as shown in Figure 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 Figure B.2. Continuing, mount the 2 scales from fish #2 over 2 and 12, etc.

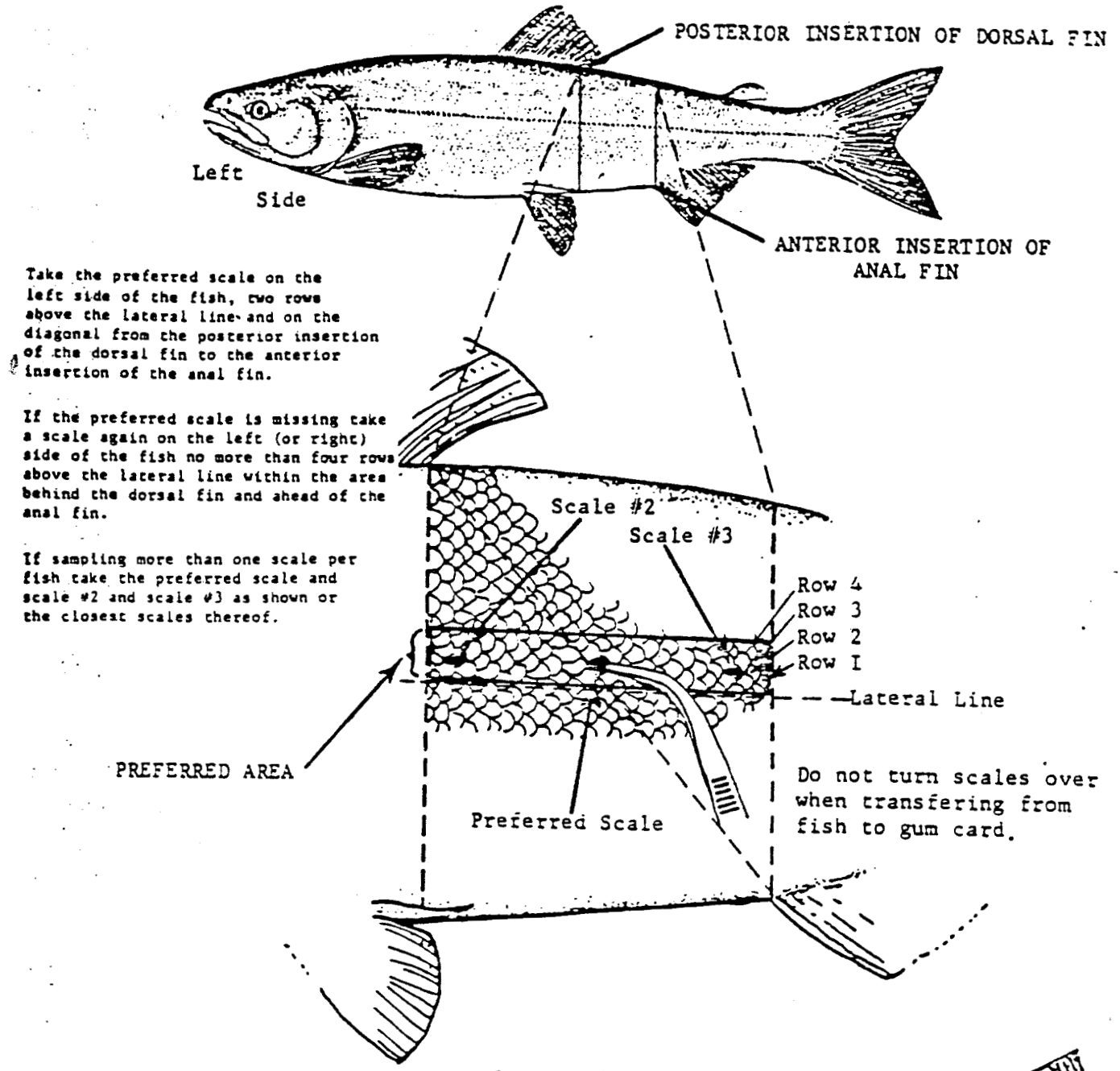
7. Use plastic scale card holders to hold individual scale cards during sampling and cover the completed gum card with wax paper for storage..

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.

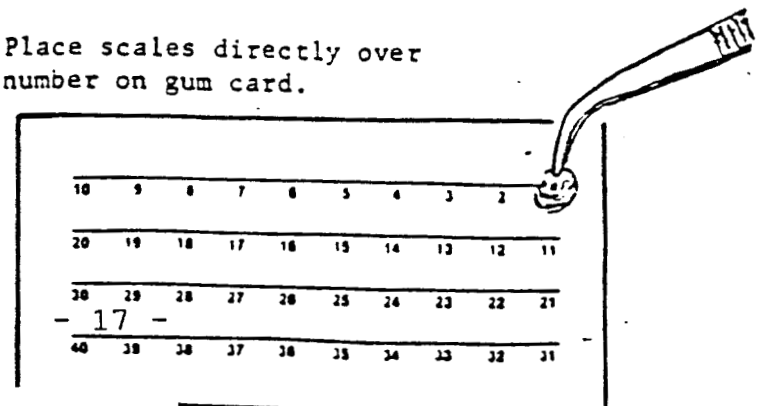
9. Miscellaneous:

   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

Figure 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.



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
Bum 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 before submitting to ARB. 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 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 submitting to the ARB. The optical scanning computer will misread or reject wrinkled sheets.

OPERATIONAL PLAN

ALITAK BAY JUNE SOCKEYE SALMON

TEST FISHERY FOR 1989

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

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INTRODUCTION

In the Alitak Bay District of the Kodiak Management Area there are two early sockeye runs which are the Upper Station Lakes run and the Frazer Lake run. Both occur simultaneously. The Frazer Lake run is usually the dominate run. Both runs contribute to important west side Kodiak salmon fisheries mainly in the Alitak Bay District in June and early July. A reliable inseason estimate of the early run strength to these systems is necessary to maximize their harvest potential and ensure adequate escapement. Currently the primary inseason method for assessing the strength of these runs is a combination of the escapement counts at the Dog Salmon and Upper Station weirs, aerial surveys of escapement build-up on the Dog Salmon River flats, and the 9 June Alitak Bay District commercial catch. The information has not been timely enough to always ensure maximum harvest and optimum escapement. A test fishery and a scale pattern analysis program proposal for upper Moser Bay should provide an accurate in-season measure of the run strength and timing of the Frazer Lake and Upper Station early run stocks.

OBJECTIVES

1. Determine in-season if the combined early sockeye run to Upper Station Lakes and Frazer Lake can be predicted from the test fish catch in upper Moser Bay.

2. In-season estimate the Frazer Lake and Upper Station composition of fish in the test fish catches and pre-15 July Alitak Bay District catches by scale pattern analysis.

PROCEDURES

Test fishing will be conducted daily from 29 May through 7 July on the north side of Chip Cove in upper Moser Bay (Figure 1). A standard 50 fathom, 40 mesh deep, 4.75 inch stretch gill net will be fished at the location for a three hours daily. The daily set will be begin on the flood 1.5 hrs. before high tide and end on the ebb 1.5 hrs. after high tide. The ebb catch and the flood catch will be reported separately on the form shown in Figure 2. Fishing will be discontinued during a set if at any time within the scheduled period more than 200 sockeye salmon are in the net. In addition to the catch associated climatological and fishing conditions will be recorded on the form in Figure 2.

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

All set net caught fish will be sold to the processor at Lazy Bay. The fish ticket receipts will be issued to the State of Alaska, Department of Fish and Game, Division of Commercial Fisheries, Kodiak. Prior to delivering the catch to the processor, the sockeye salmon will be catch sampled for age, length and sex according to the procedures in Appendix A. Within 24 hours of sampling the scales are to be aged.

Linear discriminant analysis using scale measurements will be used to determine rivers origin of the sockeye salmon caught in the test fishery and Alitak District commercial catch. The standards in the stock separation model will be developed from 200 age-2.2 scales from the 1989 early run escapement to Upper Station collected at the weir

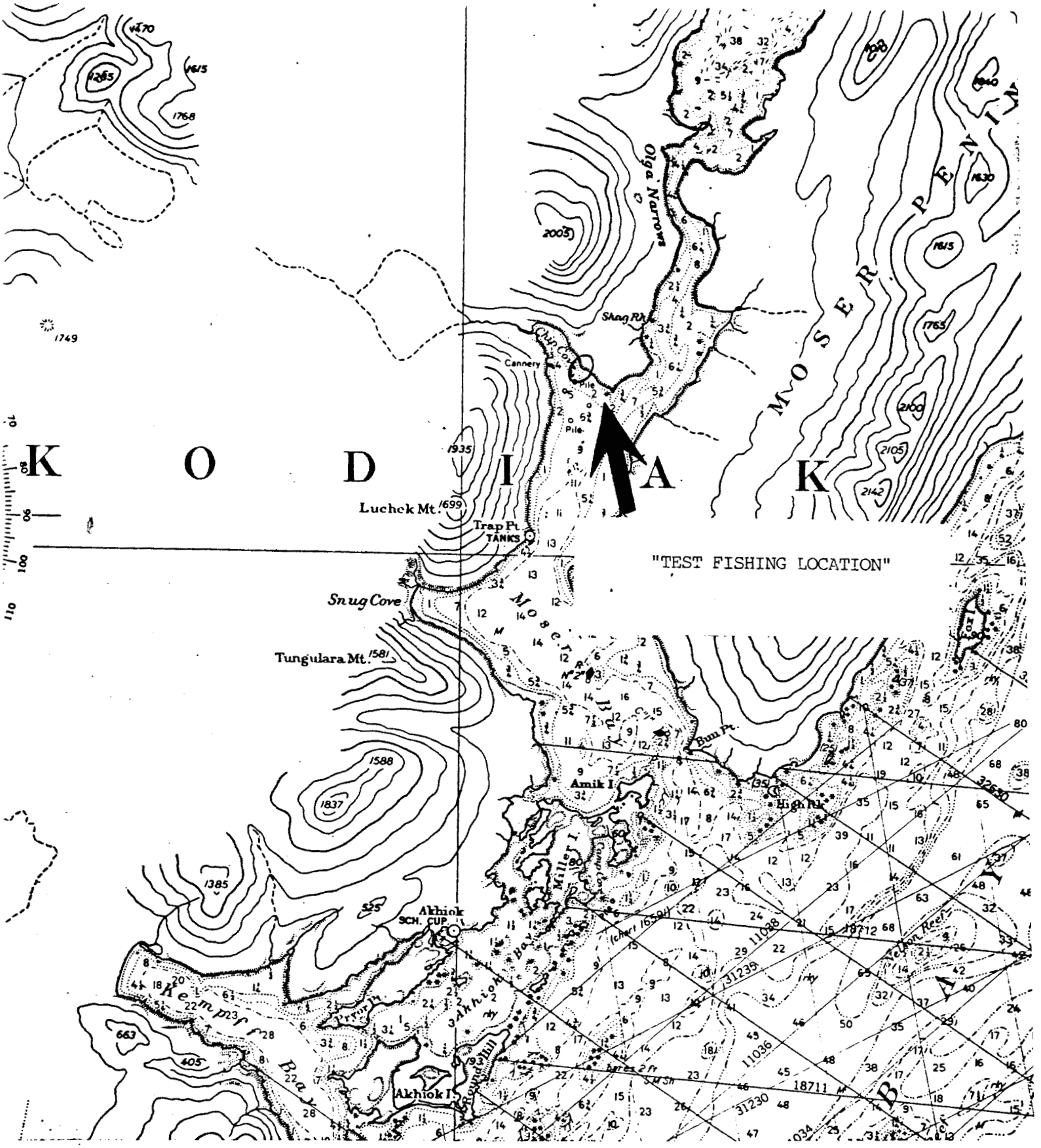

Figure 1. Map of Moser Bay with the general location of the 1988 test fishing location identified.

Figure 2.

SET NET SITE: _____

YEAR: 1989

Date	FISHING TIME 1/			CATCH			WEATHER 2/								Secchi Disk (meter)	REMARKS 3/
	Start	End	Total Min.	Sockeye	Chum	Other	Tide Ht.	Tide Time	Wave Height (Ft.)	Wind Dir.	Wind Vel. (mph.)	Temperature (c) Air	Temperature (c) Water	% Cloud Cover		

1/ Record to the nearest minute and specify a.m. or p.m.

2/ Use standard tide tables with correction factor for Cape Alitak. Record cloud cover to nearest 10%; wave height to nearest foot; wind direction from compass bearing; wind velocity to nearest 5 mph; and temperature to nearest degree.

3/ Note the travel direction for the majority of the fish hitting the net.

there in week 23 (or week 24 if necessary) and 200 age-2.1 scales collected from the Frazer Lake escapement in 1988. Age-2.2 fish model will be used because age -2.2 fish will be the dominate age class in the Frazer Lake and the early Upper Station Lake runs. Age -2.2 fish represent 45% (61,000 fish) of the Upper Station run forecast and 80% (440,000 fish) of the Frazer Lake run forecast. The age-2.2 scale (age-2.1 Frazer 1988) impressions will be projected at 100X onto a digitizing tablet to measure the distances between circuli and record the number of circuli in the first freshwater annulus, the second freshwater annulus, the plus growth, and in the first marine annulus. Once these variables are measured a stock separation model will be constructed that provide a high discrimination level between the Upper Station and Frazer Lake fish. In-season the age-2.2 discriminant model will be applied to successive aggregates of 100 age-2.2 digitized unknowns from each commercial fishery to estimate the Frazer Lake and Upper Station components. All point estimates will be adjusted for misclassification errors using the procedure of Cook and Lord (1978), while 90% confidence intervals around the estimates will be computed using the procedure of Pella and Robertson (1979).

Stock compositions of test and commercial catches other than age-2.2 will be estimated by combining the results from the scale pattern analysis with the age composition of the Upper Station escapement and run forecast and the Frazer Lake run forecast. The underlining assumptions using a ratio estimating procedure to accomplish this are: 1.) the age composition of the catch and escapement (forecast) will be the same; 2.) the exploitation rates of the minor ages will be the same rate estimated for the age-2.2 fish. Stock composition estimates using scale pattern analysis will be made within 24 hours after the collection of each 100 fish age-2.2 test fish catch or commercial fish catch

sample. The latest target date for the first stock composition estimate is 7 June. If a total of 100 or more age-2.2 fish have not been caught in the test fishery by 5 June and provided the age-2.2 discriminant model has been developed, test fishing time will be temporarily extended to obtain a full 100 age-2.2 test fish sample for completion of the first stock composition estimate by 7 June.

REPORTING

Daily, the catch data will be radioed to the Department's Kodiak office via the 3230 frequency. The daily radio report will cover the number of fish caught by species and the total number of minutes fished. Age and stock composition estimates will not be transmitted over the radio unless requested.

Daily test fish catch reports will be posted at the processor at Alitak for public information.

LITERATURECITED

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

Fishery, R. 1936. The use of multiple measurements in taxonomic problems. Annual Eugenics 7:179-188.

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

APPENDIX A

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-SAMPLESusually 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 A.1. A completed AWL form and accompanying gum cards for sampling commercial catches of chinook and coho salmon is shown in Appendix A.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 samples will have only 1 card per AWL form as shown in Appendix A.1. Coho and chinook samples will contain up to four cards per AWL form as shown in Appendix A.2.

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

Day, Month, Year:
Use appropriate digits for the date the fish are 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 A.3.

# of cards:
Mark 1 when sampling sockeye and chum salmon (Appendix A.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 A.2.

It is paramount to keep the mark-sense forms flat, dry, and clean. Fish gurry and water

Table 1. 1989 calendar weeks.

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

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.

GUM CARD(S):

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

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

Locality:
For catch 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 A.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 A.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 A.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 A.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 A.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 <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 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 A.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). 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"!

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.

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
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

Fish Identification Keys

A UNITED STATES DEPARTMENT OF COMMERCE PUBLICATION

NOAA Technical Report NMFS CIRC-356

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

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

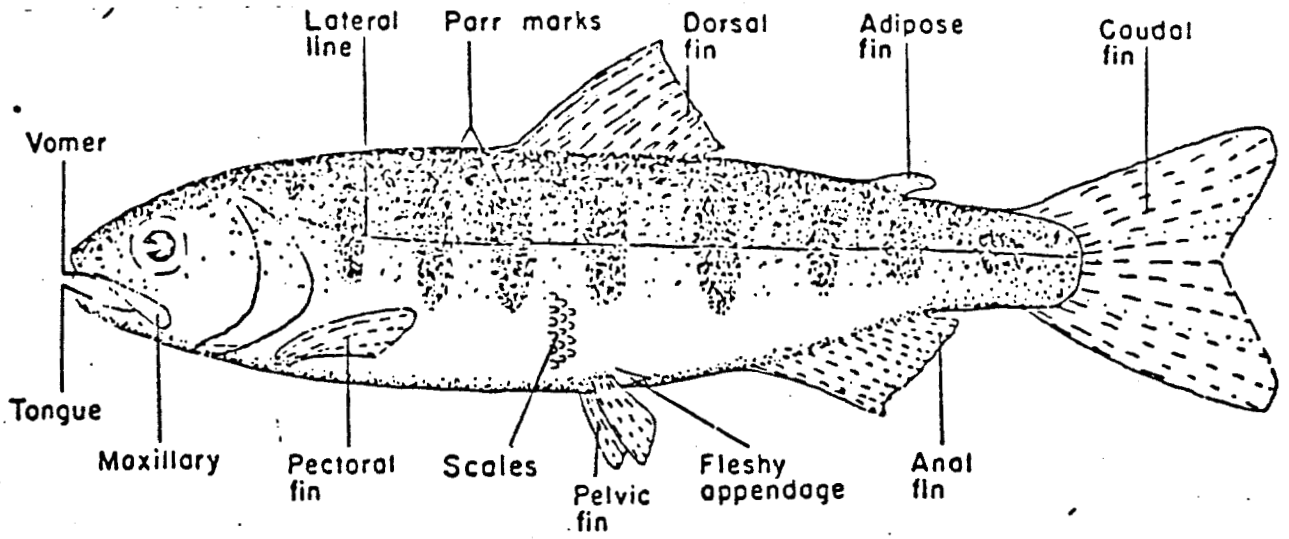


Figure 1.—A hypothetical salmonid showing external characteristics.

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)

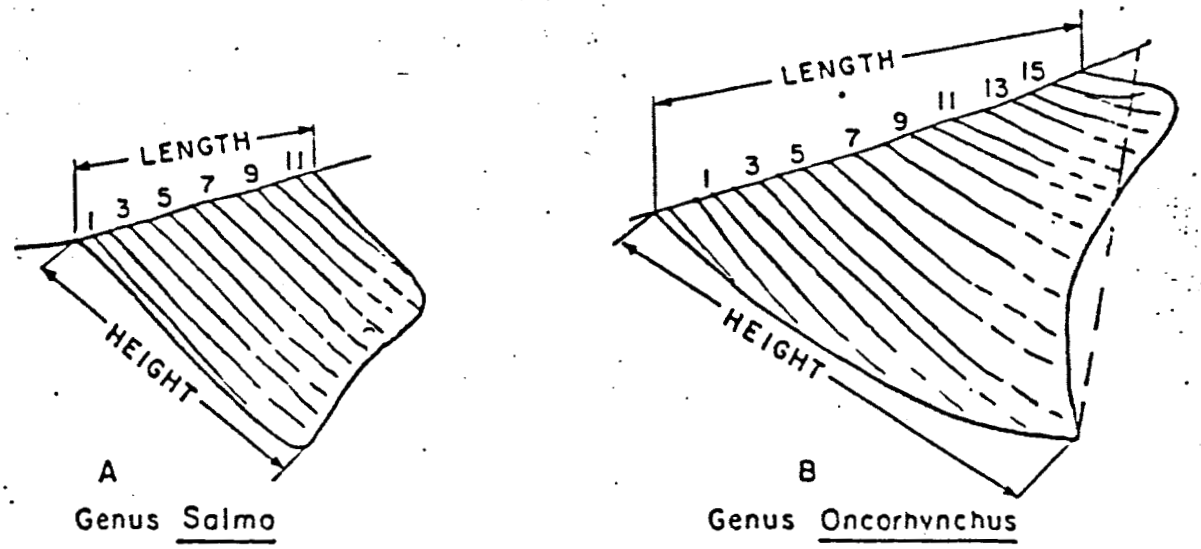


Figure 2.—Anal fins: (A) Trout, genus *Salmo;* (B) Pacific salmon, genus *Oncorhynchus.* The two drawings show differences in structure and fin ray count. (Note that the length of the anal fin is its overall basal length, and its height is that distance from the origin of the fin to the tip of the anterior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

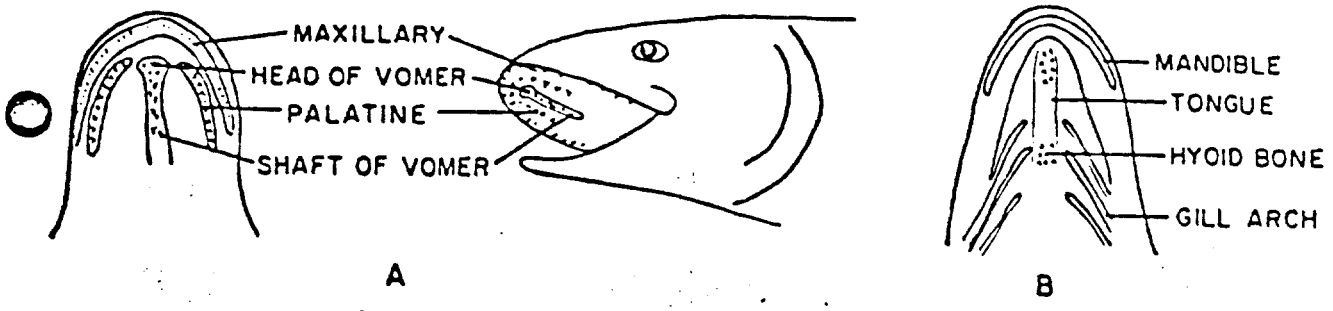
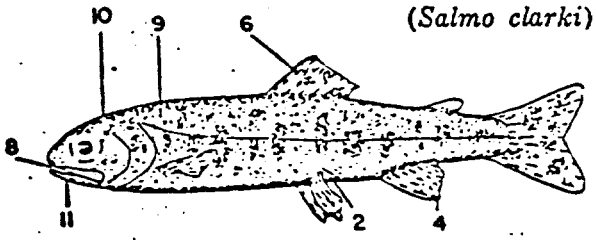


Figure 3.—Location of dentition in (A) the roof and (B) the floor of the mouth of salmonid fishes. (Presence or absence of teeth on the vomer or tongue may be determined by use of the little finger or a blunt instrument. The small hyoid teeth at the base of the tongue are located between the gill arches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

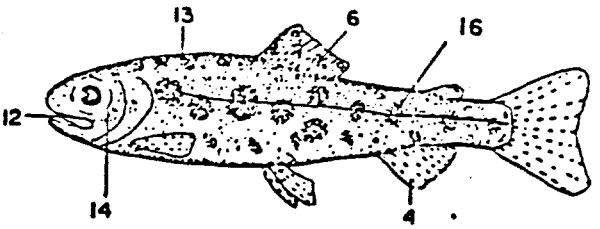
6. (18) Dorsal fin with large dark spots.
Trout
Genus *Salmo*

7. (5) Adipose fin not orange; no row of pale round spots along lateral line.
8. (12) *Small hyoid teeth at base of tongue. (Fig. 3B)
9. (13) Not more than five parr marks on mid-dorsal ahead of dorsal fin.
10. (14) Maxillary reaching past posterior margin of eye.
11. (15) Red or yellowish hyoid mark under lower jaw. Tail usually black spotted.
Cutthroat trout
(*Salmo clarki*)



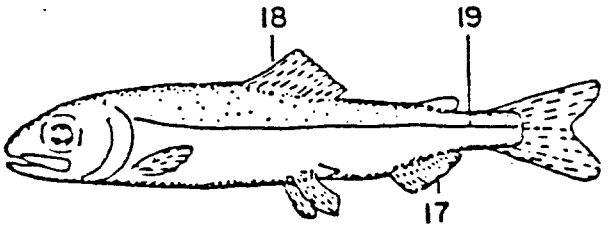
12. (8) *No teeth at base of tongue.
13. (9) Five to 10 parr marks along mid-dorsal ridge ahead of dorsal fin.
14. (10) Maxillary short, not reaching past posterior margin of eye.
15. (11) No hyoid mark under lower jaw. Few or no spots on tail.

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



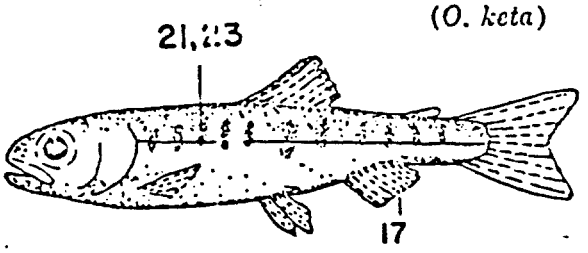
17. (4) Anal fin longer than high, with 13 or more developed rays. (Fig. 2B)
18. (6) Dorsal fin without large dark spots, may be black tipped.
Pacific salmon
Genus *Oncorhynchus*

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



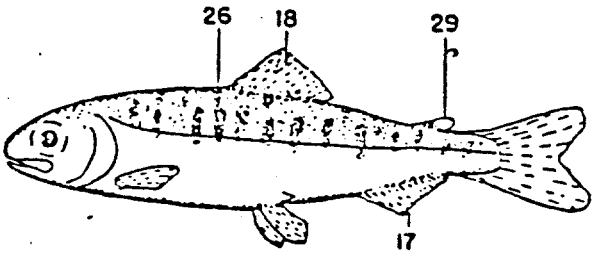
20. (16) Parr marks present as vertical bars or oval spots.
21. (30) Parr marks short, extending little, if any, below lateral line.
22. (25) Gill rakers on first arch, 19 to 26. ** Pyloric caeca, 140 to 186.
23. (26) Parr marks faint. Sides below lateral line iridescent green.
24. (27) Small when migrating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

Chum salmon
(*O. keta*)



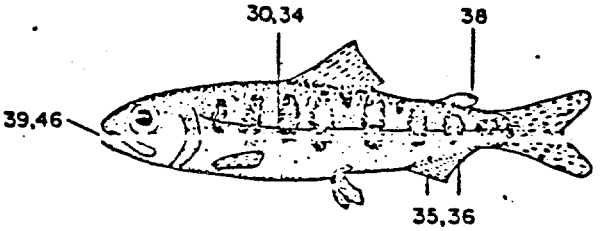
25. (22) Gill rakers on first arch, 30 to 40. **Pyloric caeca 60 to 115.
26. (23) Parr marks usually sharply defined. Sides below lateral line silvery, not iridescent green.
27. (24) Relatively large when migrating from fresh water, approximately 3 to 5 inches (80 to 126 mm) long.
28. (31) Gill rakers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

Sockeye salmon
(*O. nerka*)



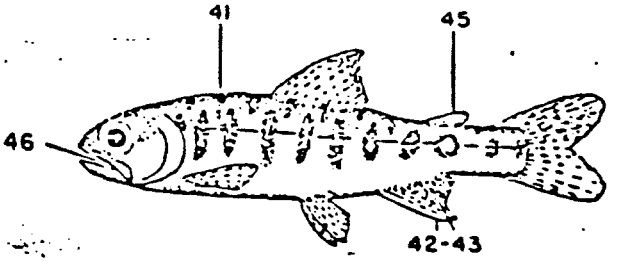
30. (21) Parr marks large, vertical bars centered by lateral line.
31. (28) **Gill rakers short and thick, fewer than 29 on first arch.
32. (29) Adipose fin at least partially pigmented.
33. (40) **Pyloric caeca more than 90.
34. (41) Parr marks broader than interspaces.
35. (42) Anterior rays of anal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

Chinook salmon
(*O. tshawytscha*)



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

Coho salmon
(*O. kisutch*)



47. (1) Adipose fin not present; scales present or lacking.
Not Salmonidae

48. (2) No fleshy appendage at base of pelvic fins.
Smelts
Family Osmeridae

49. (3) Mouth small, not reaching center of eye; teeth weak or absent.

50. (51) Depressed dorsal fin, shorter than head.
Whitefishes
Genus *Coregonus*

51. (50) Depressed dorsal fin, longer than head.
Arctic grayling
(*Thymallus arcticus*)

52. (5) **Teeth on head of vomer only.
Chars
Genus *Salvelinus*
Dolly Varden (*S. malma*)

53. (7) Adipose fin orange; row of distinct pale round spots along lateral line.
Brown trout
(*Salmo trutta*)

ACKNOWLEDGMENTS

We especially thank Dr. Arthur D. Welander, Professor of Fisheries, and Dr. Bruce S. Miller, Research Biologist, College of Fisheries, University of Washington, Seattle, for their valuable suggestions. We also thank Galen H. Maxfield, Fishery Biologist, and Dr. Alan J. Beardsley, Fishery Biologist, both from the NMFS Northwest Fisheries Center, Seattle.

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GPO 9

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 1½ 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

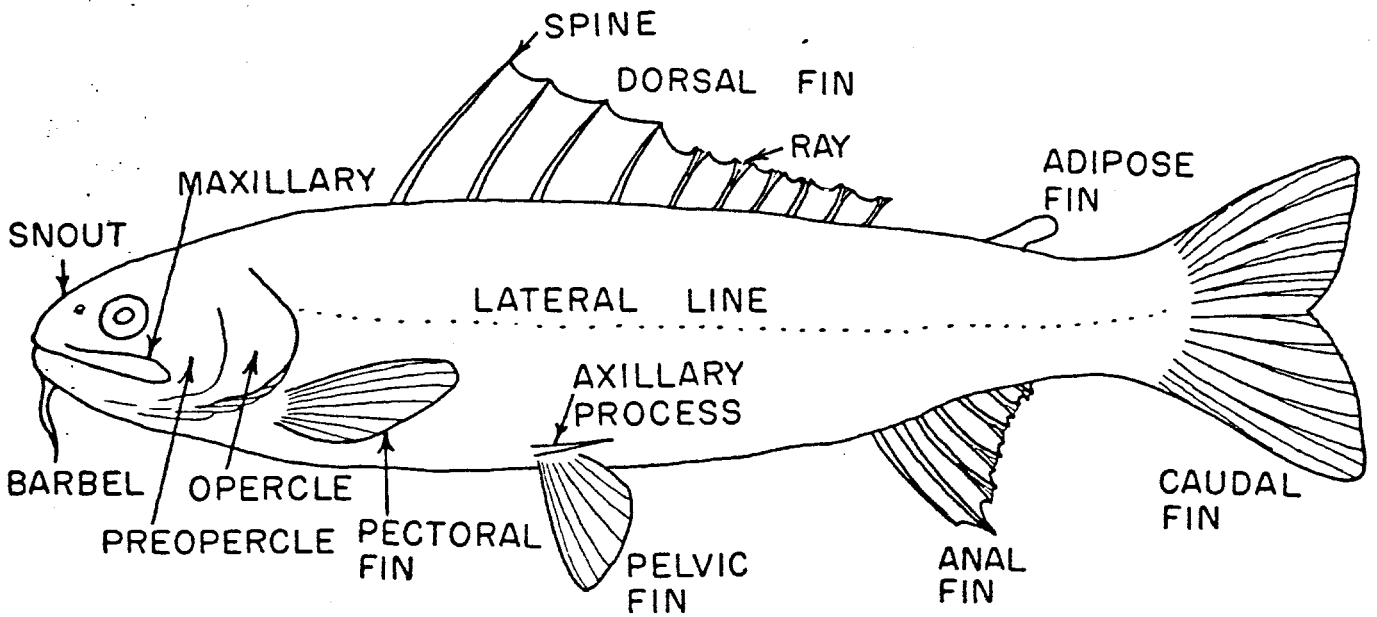

FIGURE 1. A "generalized" fish showing the various structures referred to in the keys.

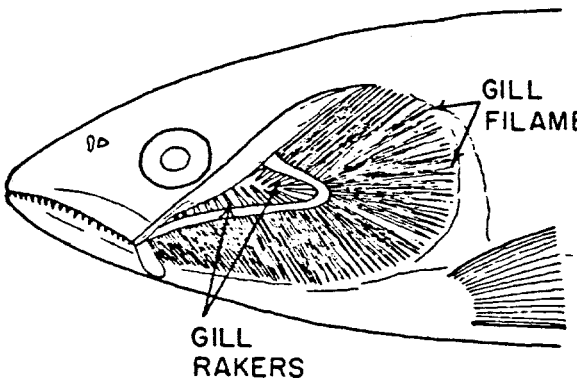

FIGURE 2. Diagram of a gill arch, showing the gill filaments and the gill rakers.

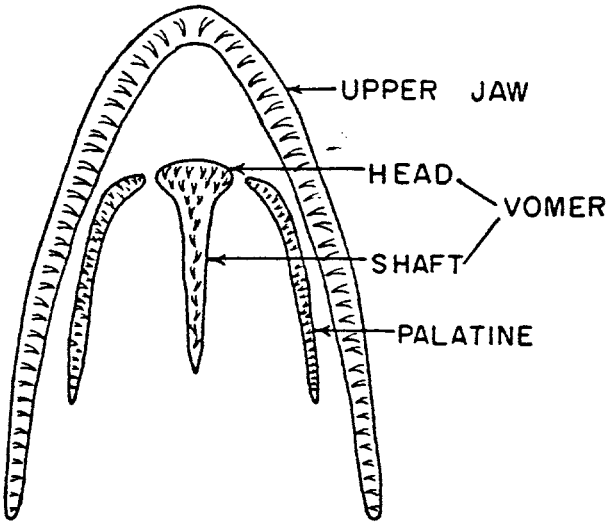

FIGURE 3. Diagram of the roof of the mouth of a fish to show the teeth on the jaws, the head and shaft of the vomer bone, and the palatines.

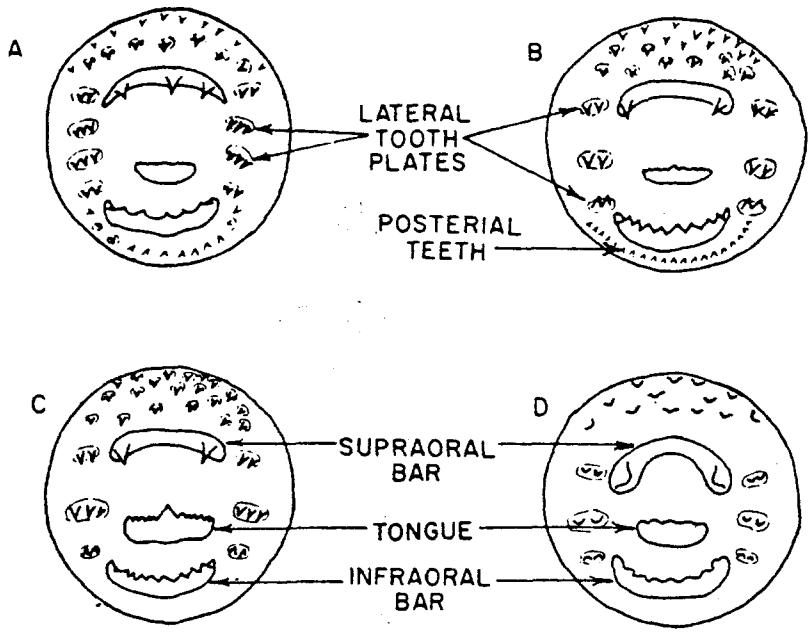

FIGURE 4. Tooth patterns of Alaska lampreys. A. Pacific lamprey, *Entosphenus tridentatus.* B. Arctic lamprey, *Lampetra japonica.* C. River lamprey, *Lampetra ayresi.* D. Western brook lamprey, *Lampetra richardsoni.*

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

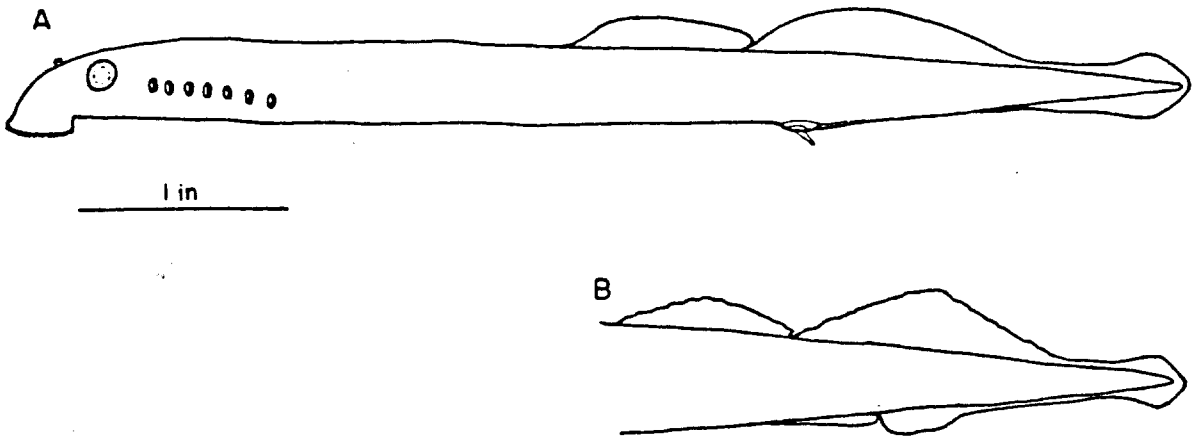

FIGURE 5. Arctic lamprey, *Lampetra japonica*. A. Male. B. Posterior end of female. Note presence of anal fin and lack of urogenital papilla in the female. All four Alaskan lampreys are much alike in general appearance, so only the one species is illustrated.

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.

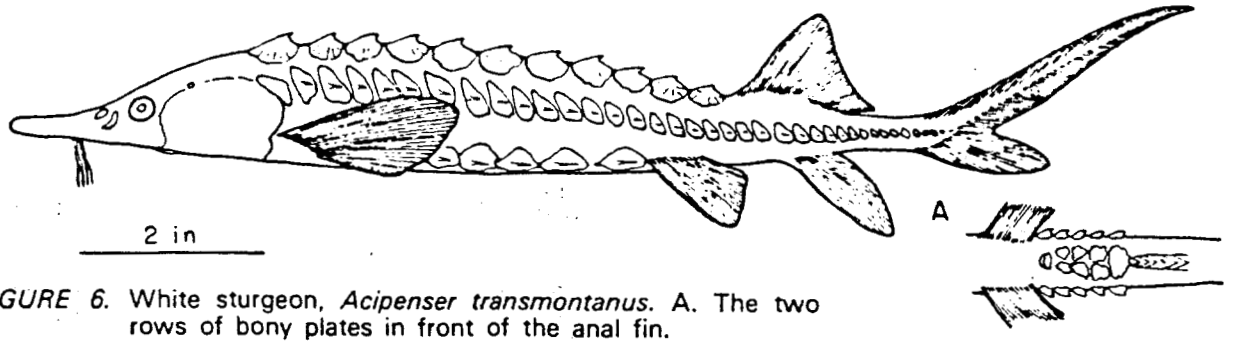

FIGURE 6. White sturgeon, *Acipenser transmontanus.* A. The two rows of bony plates in front of the anal fin.

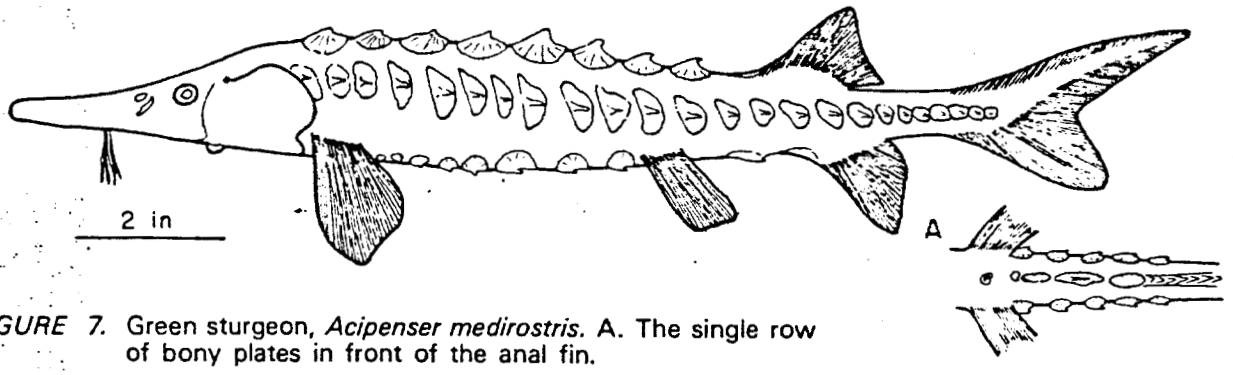

FIGURE 7. Green sturgeon, *Acipenser medirostris.* A. The single row of bony plates in front of the anal fin.

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.

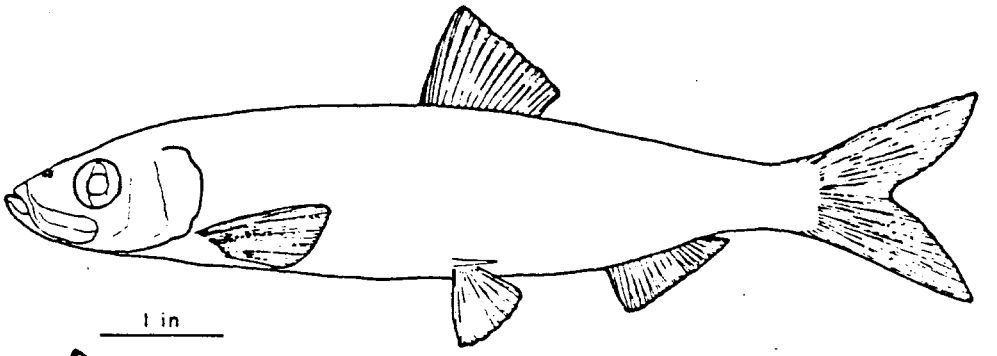

FIGURE 8. Sea herring, *Clupea harengus pallasi.*

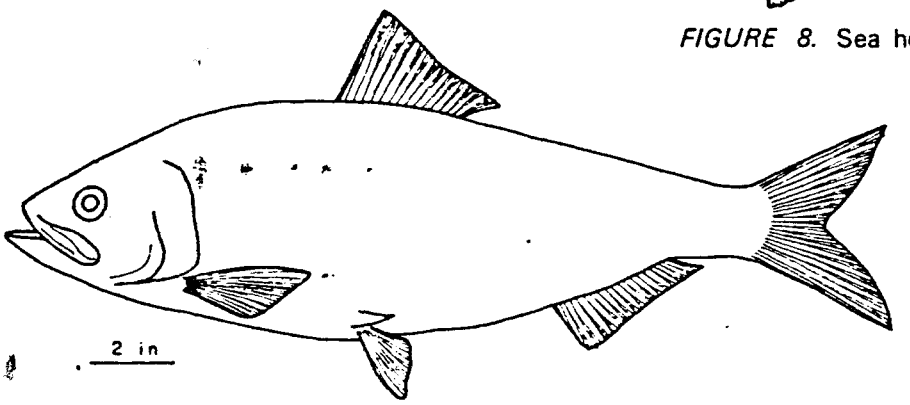

FIGURE 9. American shad, *Alosa sapidissima.*

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.

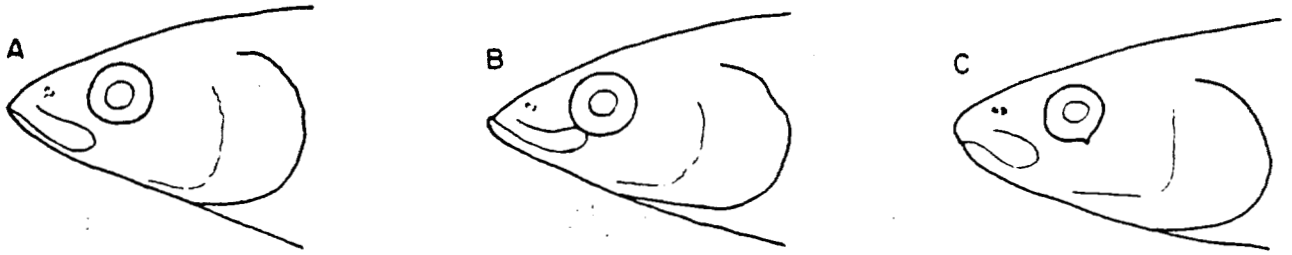

FIGURE 10. Snouts of whitefishes. A. Bering cisco, both jaws equal. B. Least cisco, tip of lower jaw projecting slightly beyond upper jaw. C. Round whitefish, lower jaw shorter than upper and profile of upper lip overhanging.

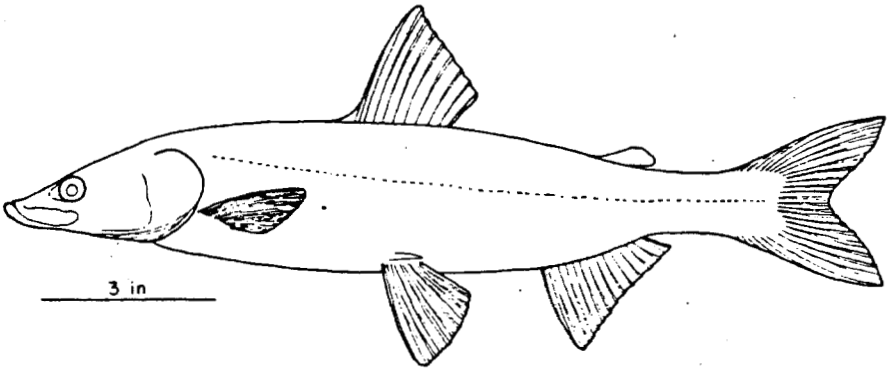

FIGURE 11. Inconnu, *Stenodus leucichthys.* Commonly called "sheefish" in Alaska.

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

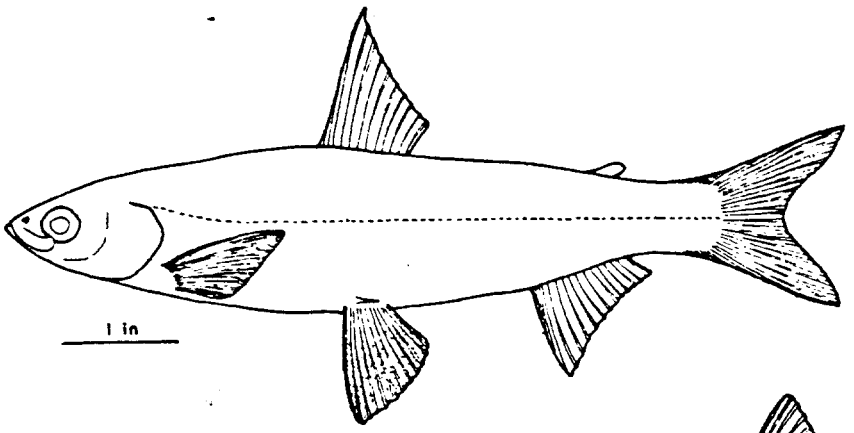

FIGURE 12. Least cisco, *Coregonus sardinella.* Note the dusky pelvic fins.

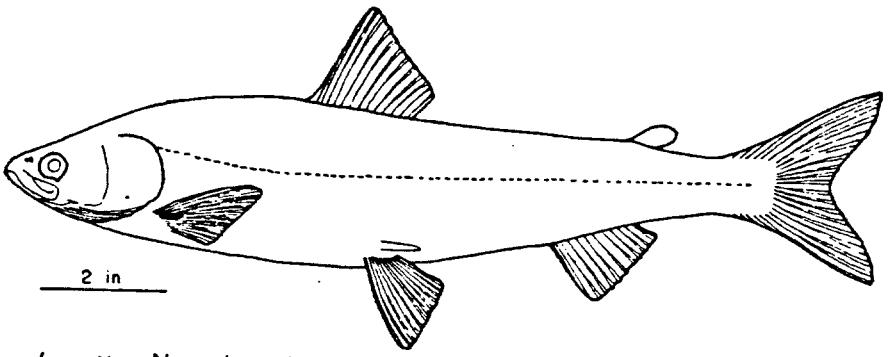

FIGURE 13. Bering cisco, *Coregonus laurettae.* Note the pale pelvic fins. The Arctic cisco, *Coregonus autumnalis,* appears identical with this species but has more gill rakers.

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

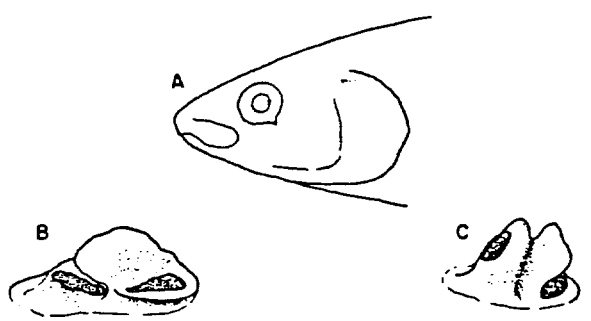

FIGURE 14.

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.)

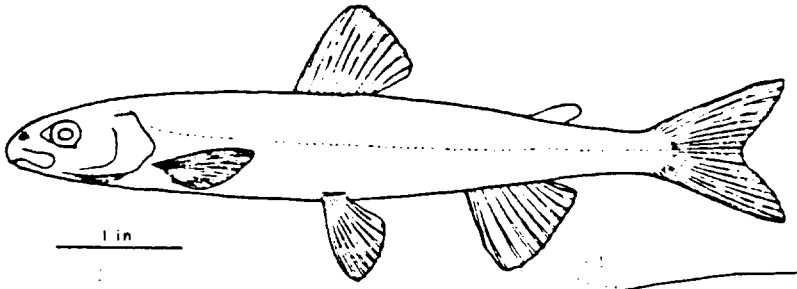

FIGURE 15. Pygmy whitefish, *Prosopium coulteri.*

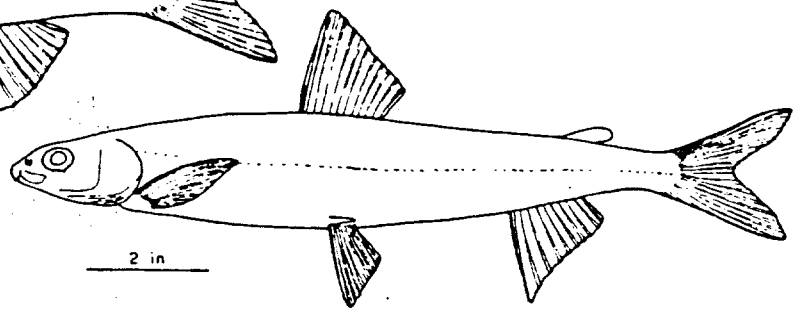

FIGURE 16. Round whitefish, *Prosopium cylindraceum.*

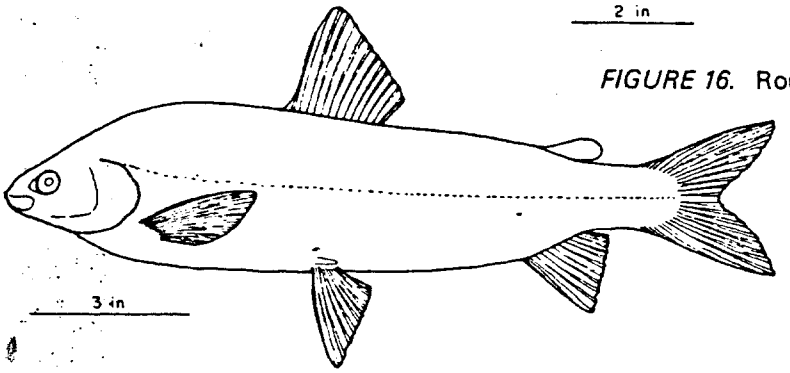

FIGURE 17. Broad whitefish, *Coregonus nasus.*

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.

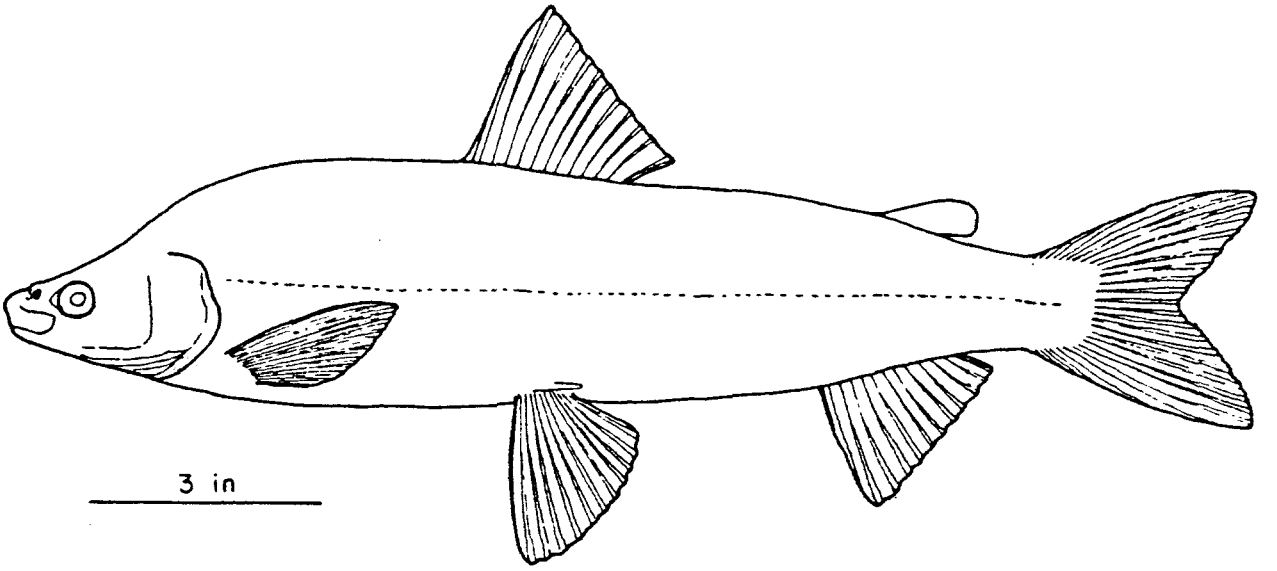

FIGURE 18. Alaska whitefish, *Coregonus nelsoni.* The Humpback and Lake whitefishes closely resemble this species but differ in number of gill rakers.

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.

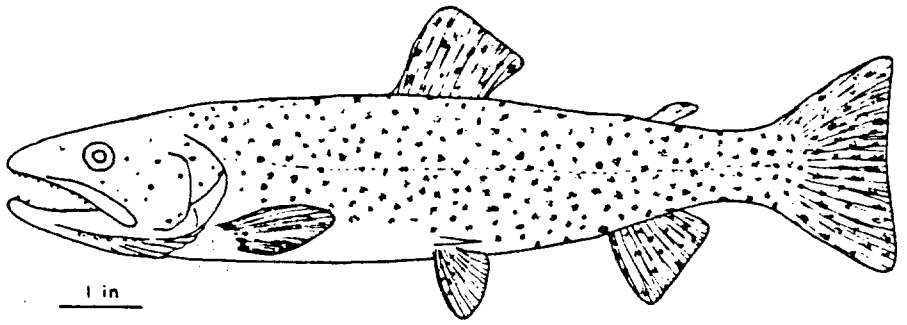

FIGURE 19. Cutthroat trout, *Salmo clarki*. In Alaska, most fresh-water populations are heavily spotted, as shown, but in more southerly populations the spots are generally not so numerous. Spots are missing on freshly sea-run cutthroats.

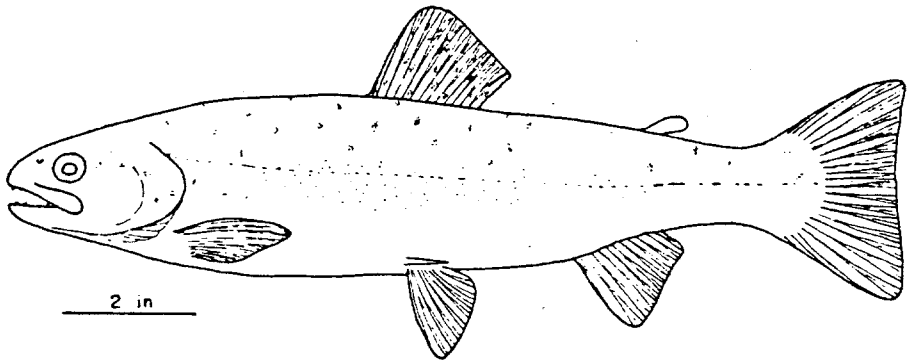

FIGURE 20. Rainbow trout, *Salmo gairdneri*.

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

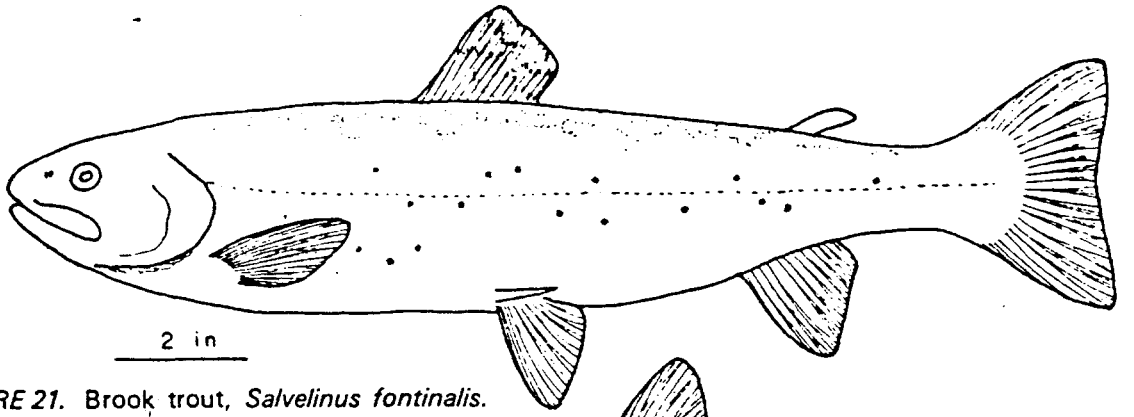

FIGURE 21. Brook trout, *Salvelinus fontinalis.*

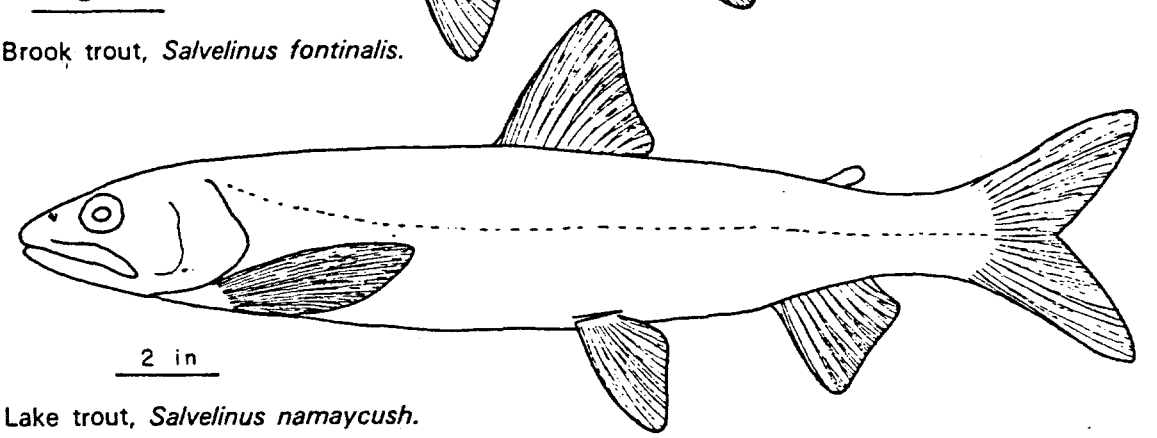

FIGURE 22. Lake trout, *Salvelinus namaycush.*

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

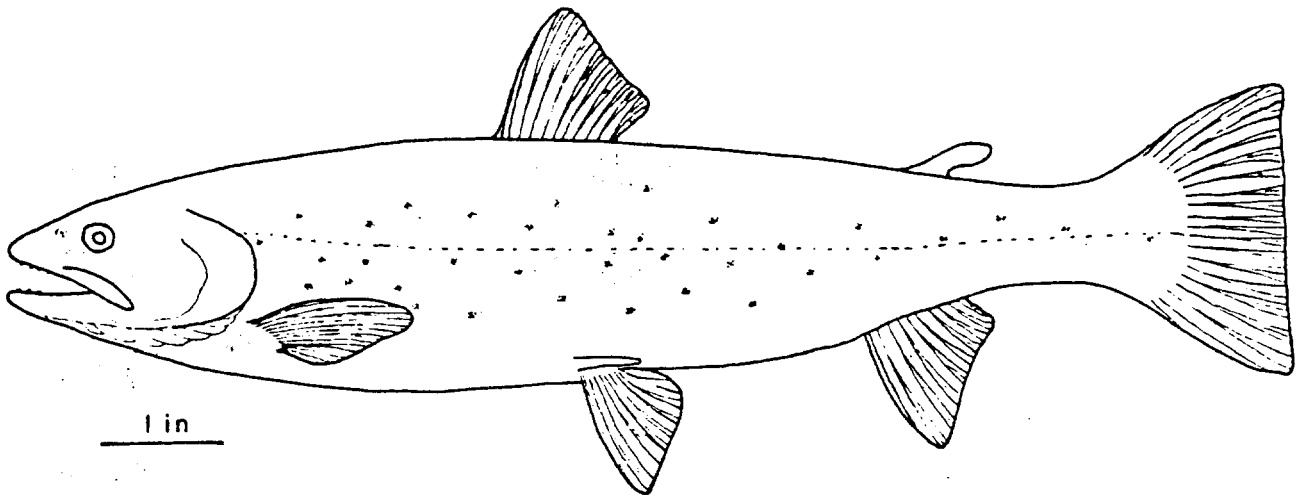

FIGURE 23. Dolly Varden, *Salvelinus malma.* The Arctic charr and Angayukaksurak charr look very much like the Dolly Varden, but the Angayukaksurak charr is black and the Arctic charr has more gill rakers and pyloric caeca.

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

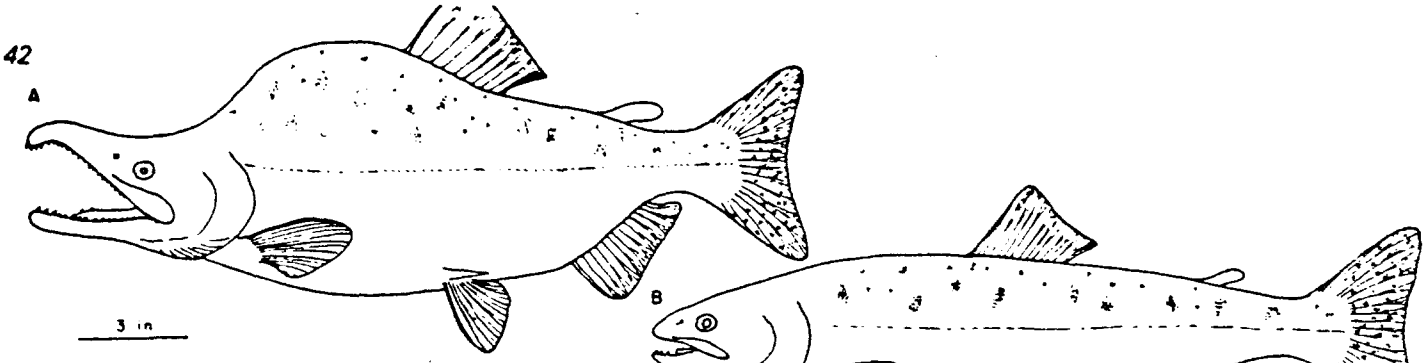

FIGURE 24. Pink salmon, *Oncorhynchus gorbuscha.* A. Breeding male. B. Mature female.

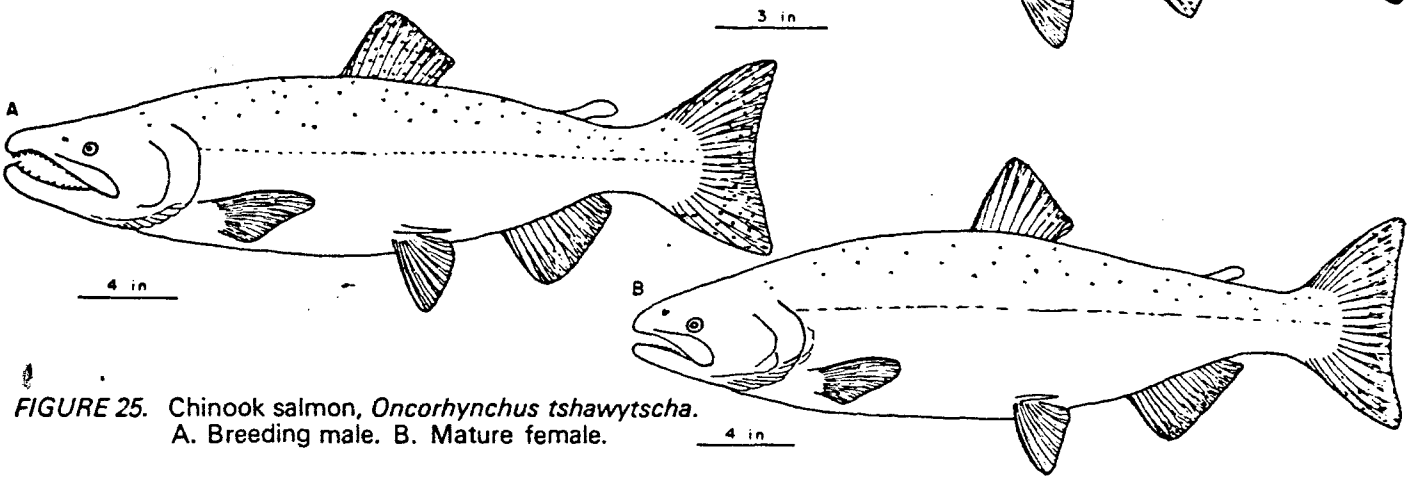

FIGURE 25. Chinook salmon, *Oncorhynchus tshawytscha.* A. Breeding male. B. Mature female.

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.

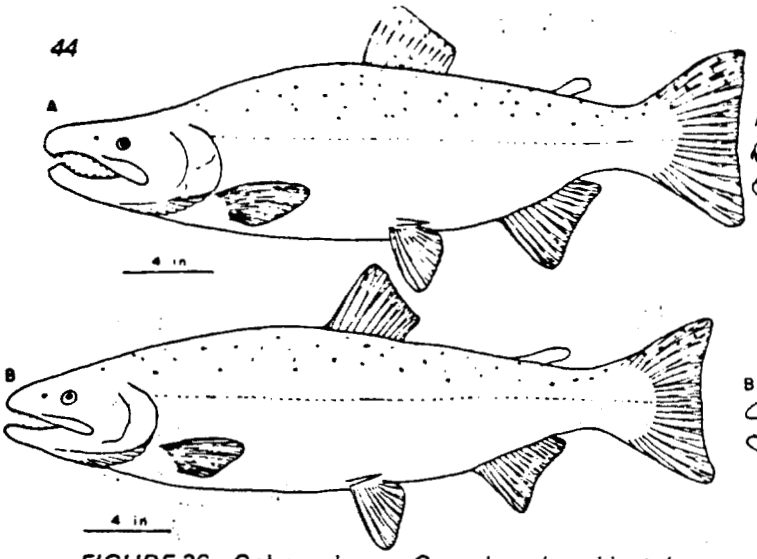

FIGURE 26. Coho salmon, *Oncorhynchus kisutch.* A. Breeding male. B. Mature female.

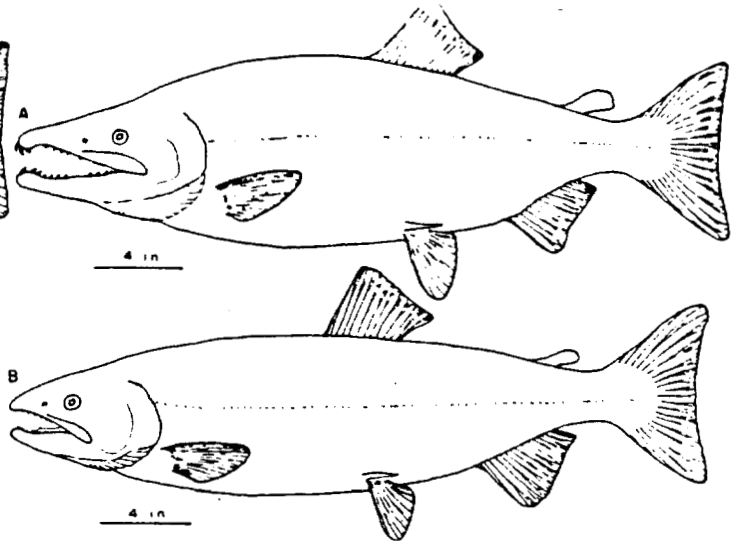

FIGURE 27. Chum salmon, *Oncorhynchus keta.* A. Breeding male. B. Mature female.

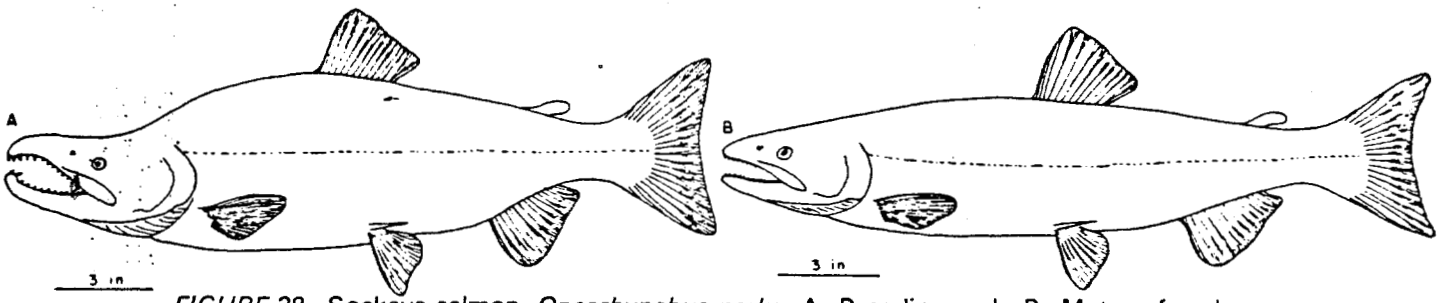

FIGURE 28. Sockeye salmon, *Oncorhynchus nerka.* A. Breeding male. B. Mature female.

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 45-115.

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.

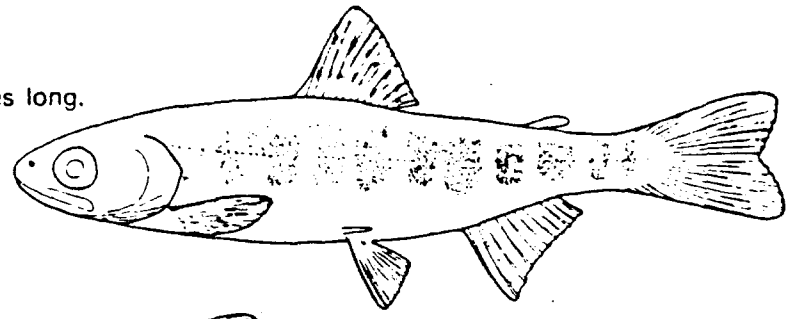

FIGURE 29. Brook trout 3½ inches long.

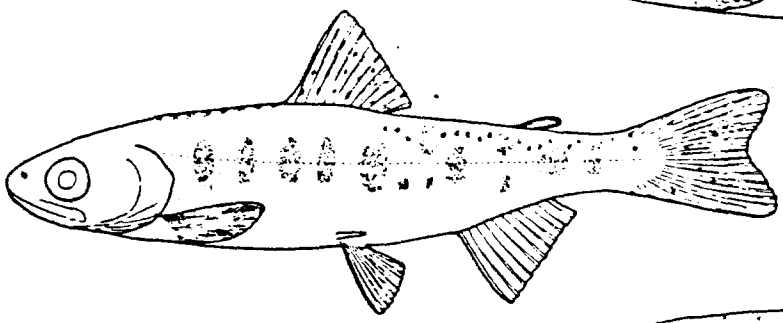

FIGURE 30. Rainbow trout 3½ inches long.

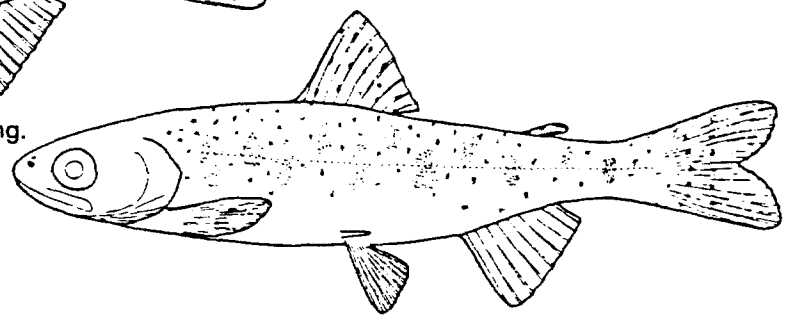

FIGURE 31. Cutthroat trout 3½ inches long.

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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

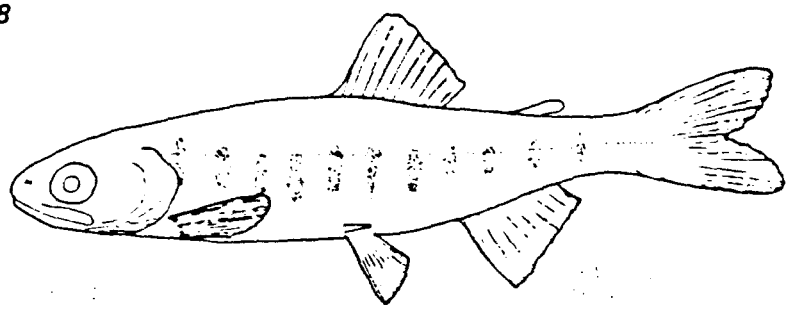

FIGURE 32. Lake trout 5 inches long.

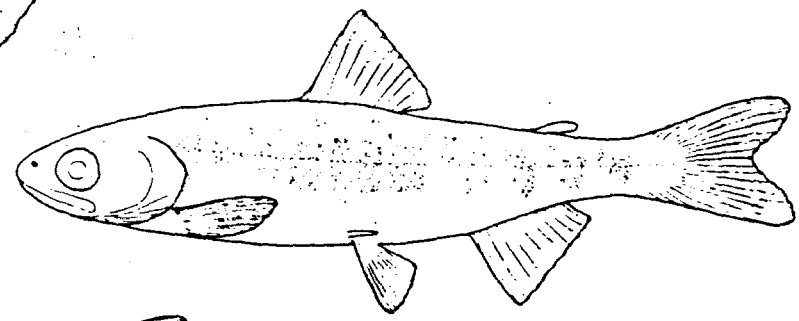

FIGURE 33. Dolly Varden 4 inches long.

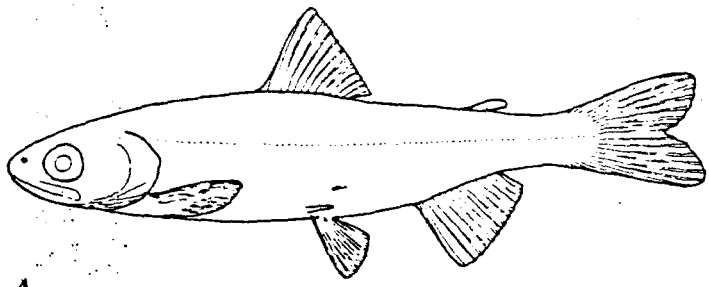

FIGURE 34. Pink salmon 2 inches long.

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

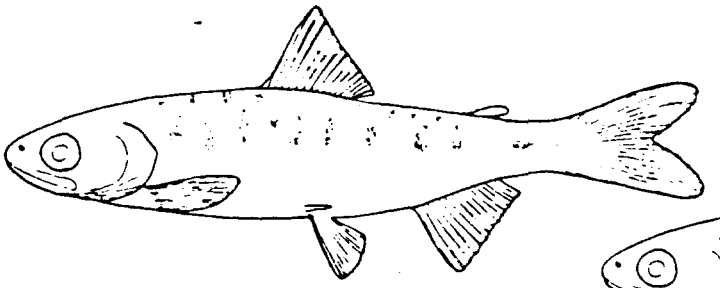

FIGURE 35. Sockeye salmon 3¾ inches long.

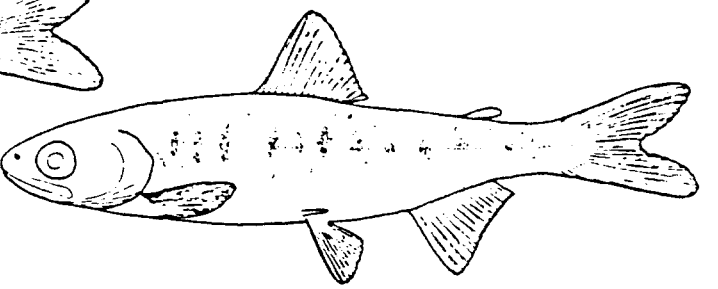

FIGURE 36. Chum salmon 4 inches long.

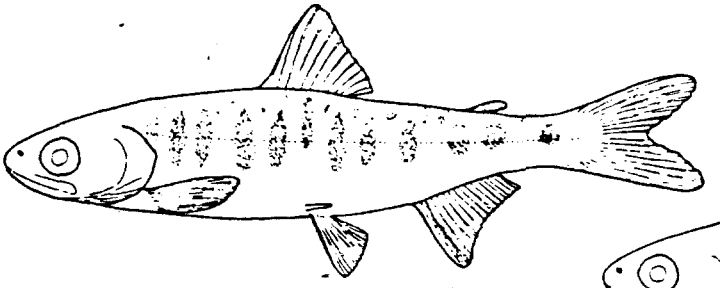

FIGURE 37. Coho salmon 4 inches long.

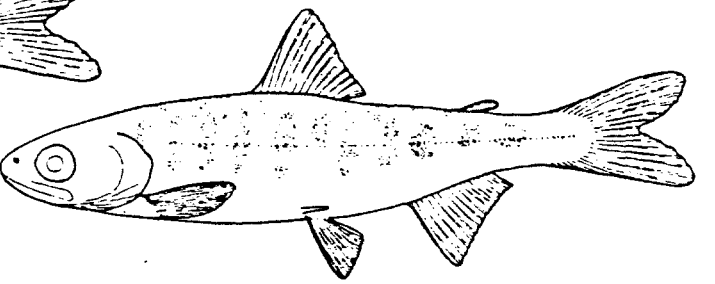

FIGURE 38. Chinook salmon 5 inches long.

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)

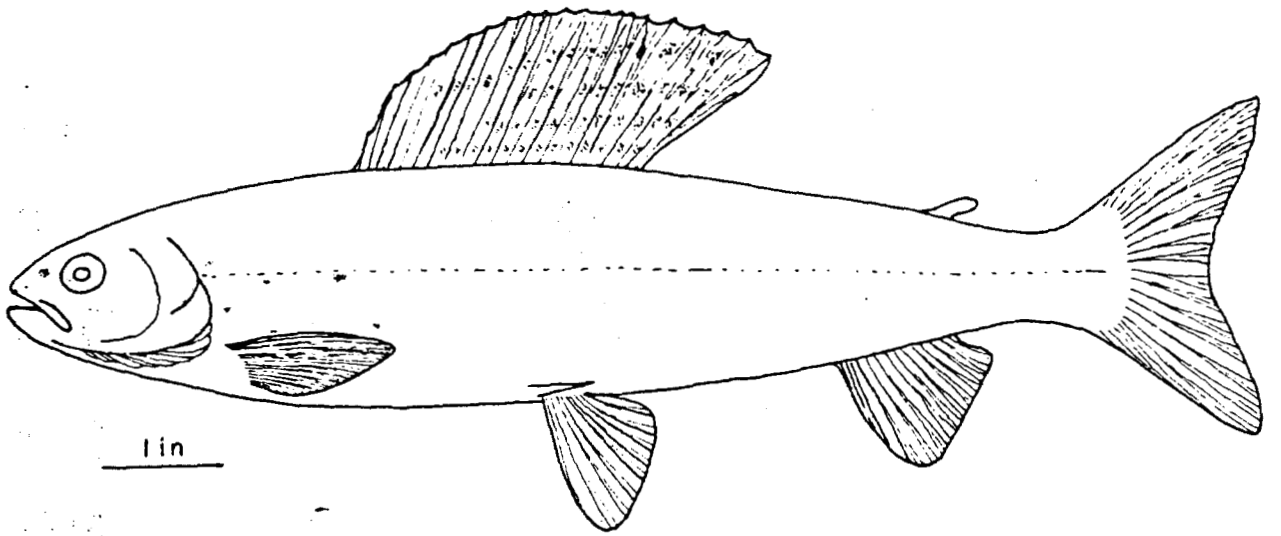

FIGURE 39. Arctic grayling, *Thymallus arcticus.*

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.

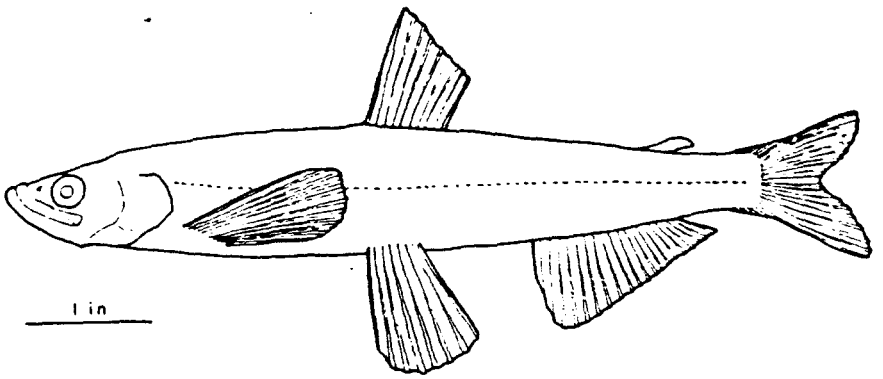

FIGURE 40. Longfin smelt, *Spirinchus thaleichthys.*

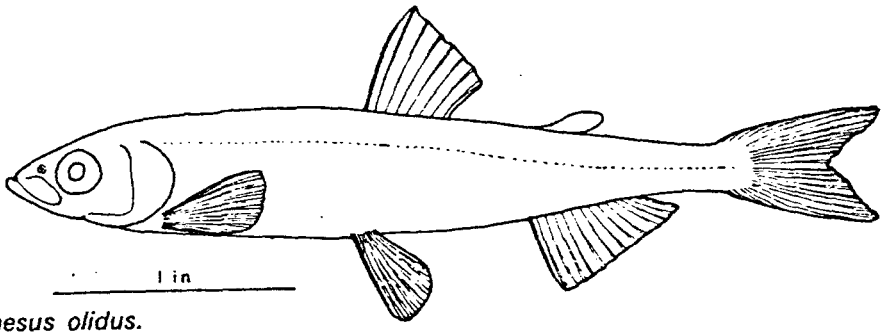

FIGURE 41. Pond smelt, *Hypomesus olidus.*

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.

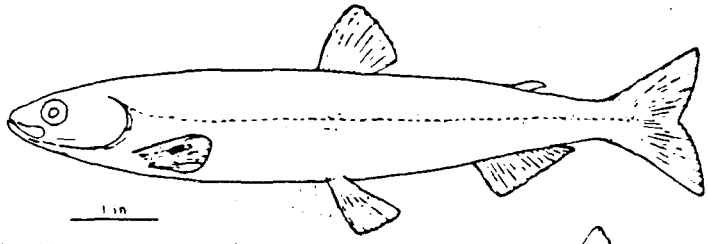

FIGURE 42. Surf smelt, *Hypomesus pretiosus.*

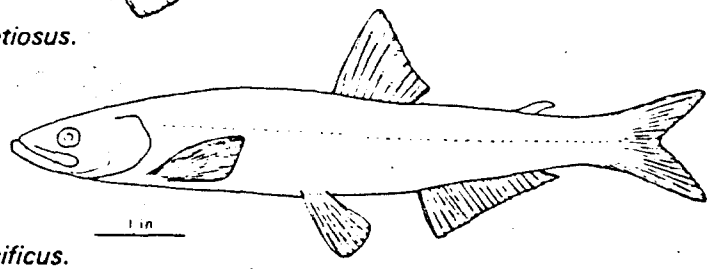

FIGURE 43. Eulachon, *Thaleichthys pacificus.*

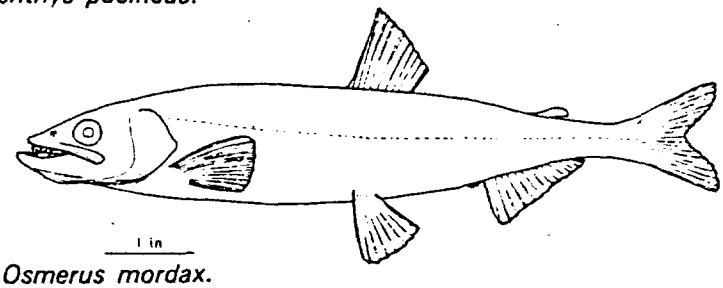

FIGURE 44. Rainbow smelt, *Osmerus mordax.*

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 ahead 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.

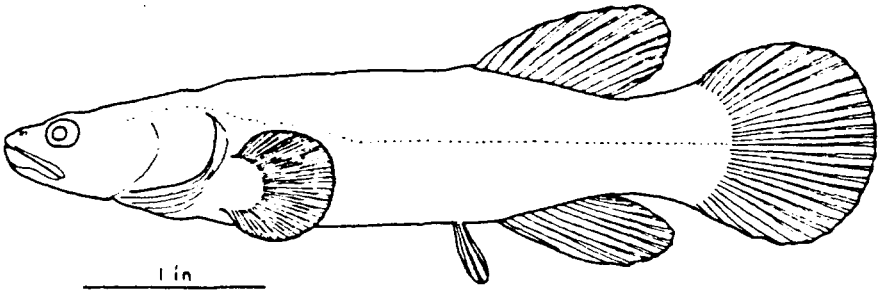

FIGURE 45. Alaska blackfish, *Dallia pectoralis.*

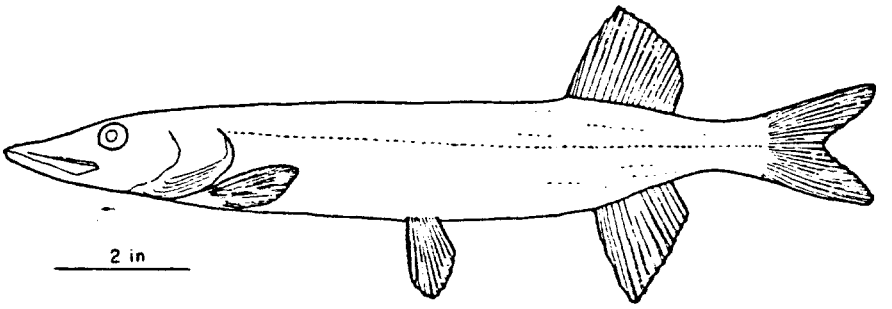

FIGURE 46. Northern pike, *Esox lucius.*

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.

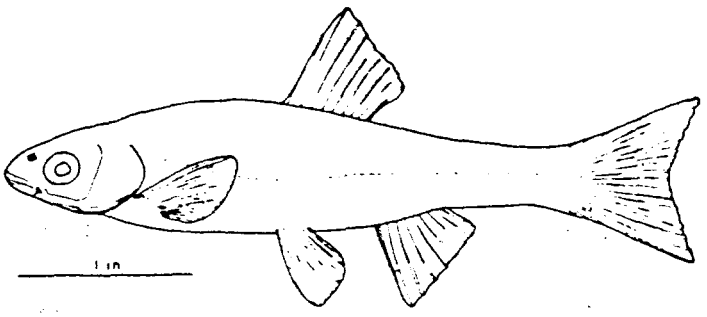

FIGURE 47. Lake chub, *Couesius plumbeus.*

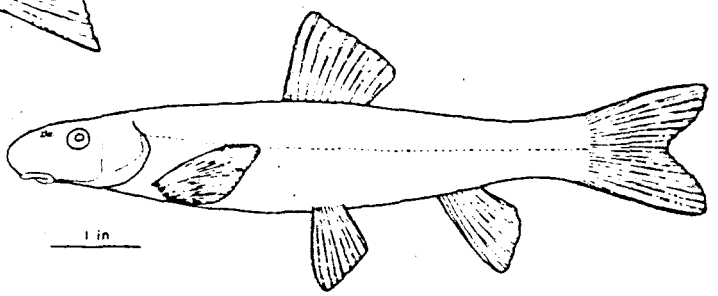

FIGURE 48. Longnose sucker, *Catostomus catostomus.*

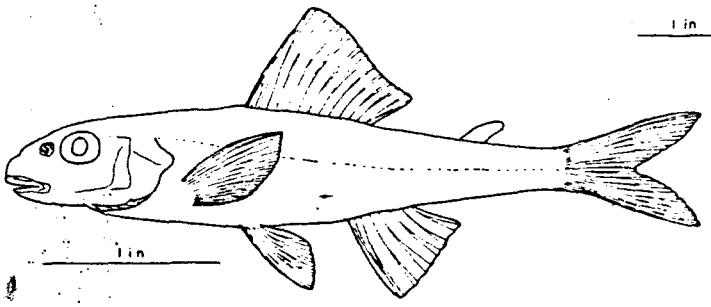

FIGURE 49. Troutperch, *Percopsis omiscomaycus.*

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.

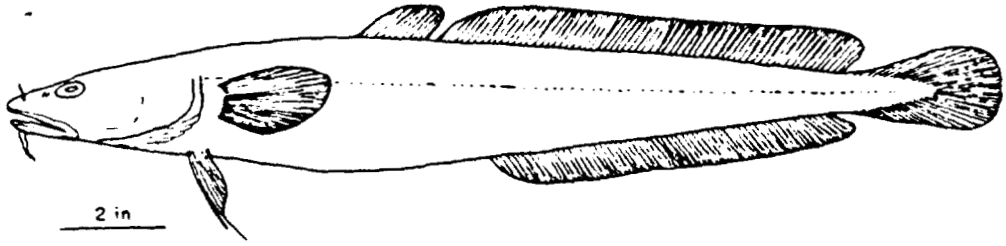

FIGURE 50. Burbot, *Lota lota.*

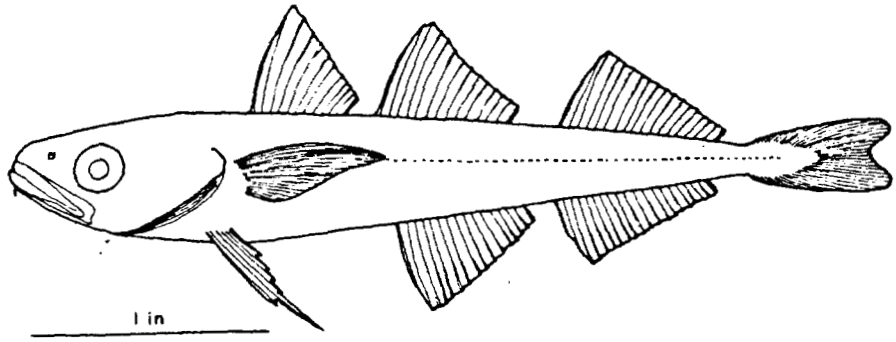

FIGURE 51. Arctic cod, *Boreogadus saida.*

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.

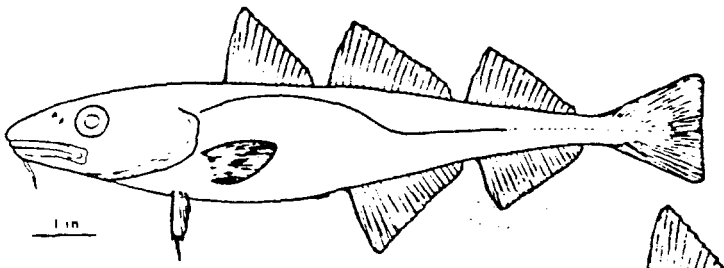

FIGURE 52. Pacific cod, *Gadus macrocephalus.*

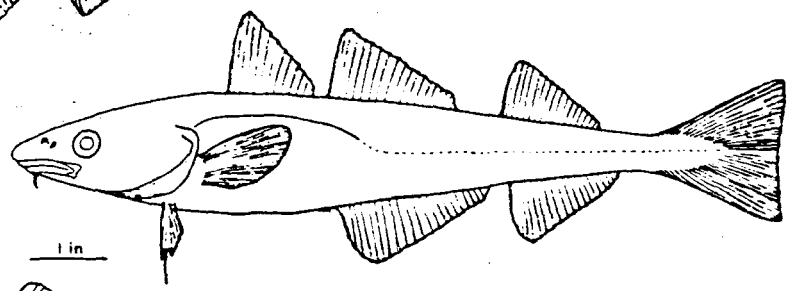

FIGURE 53. Saffron cod, *Eleginus gracilis.*

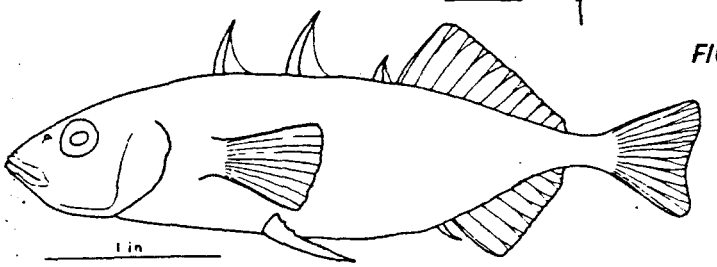

FIGURE 54. Threespine stickleback, *Gasterosteus aculeatus.*

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 fresh-water 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.

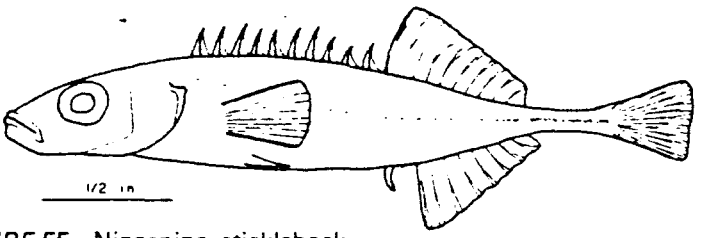

FIGURE 55. Ninespine stickleback, *Pungitius pungitius.*

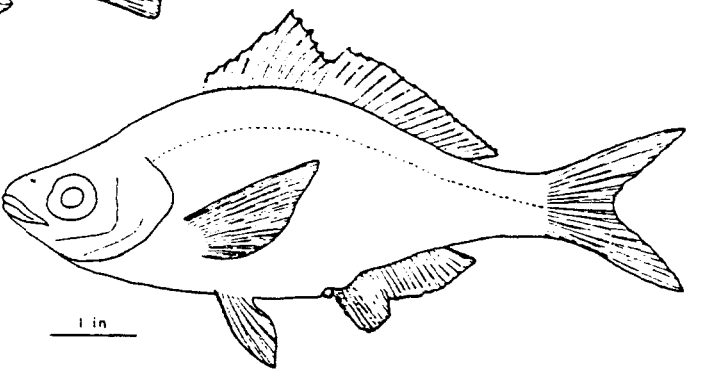

FIGURE 56. Shiner perch, *Cymatogaster aggregata.*

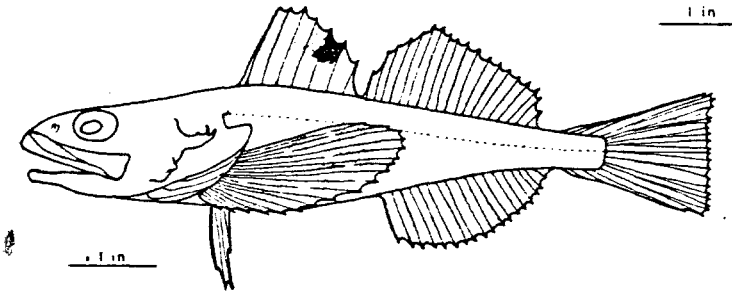

FIGURE 57. Pacific staghorn sculpin, *Leptocottus armatus.*

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.

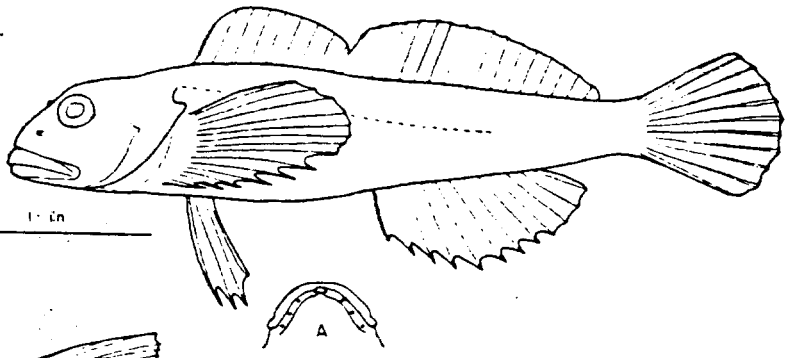

FIGURE 58. Slimy sculpin, *Cottus cognatus.* A. Under side of the head to show the two pores at the tip of the chin.

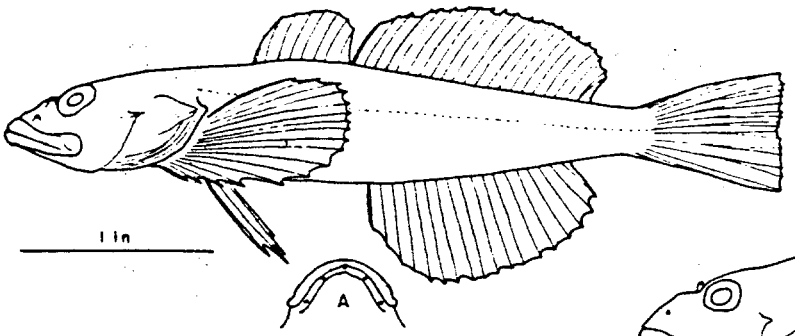

FIGURE 59. Prickly sculpin, *Cottus asper.* A. Under side of the head to show the single pore at the tip of the chin.

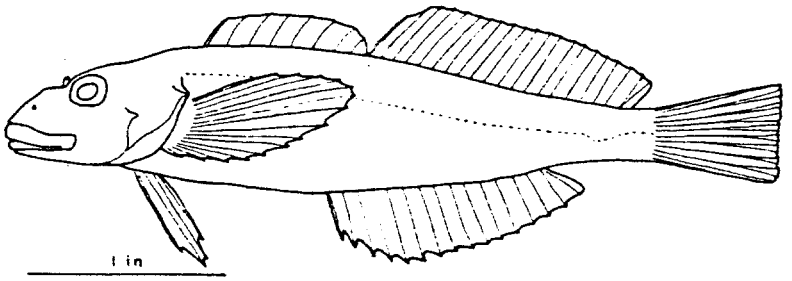

FIGURE 60. Coastrange sculpin, *Cottus aleuticus.*

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

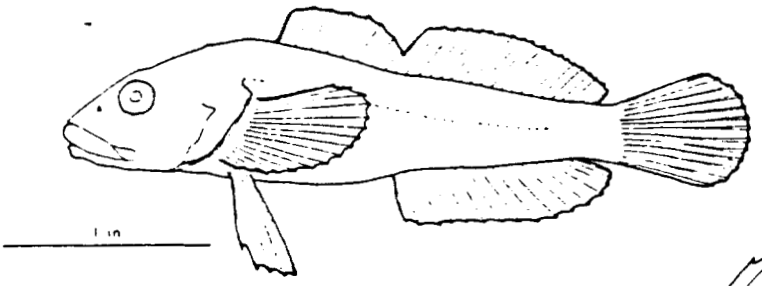

FIGURE 61. Riffle sculpin, *Cottus gulosus.*

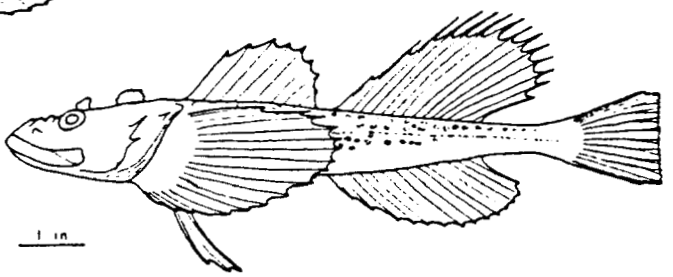

FIGURE 62. Fourhorn sculpin, *Myoxocephalus quadricornis.*

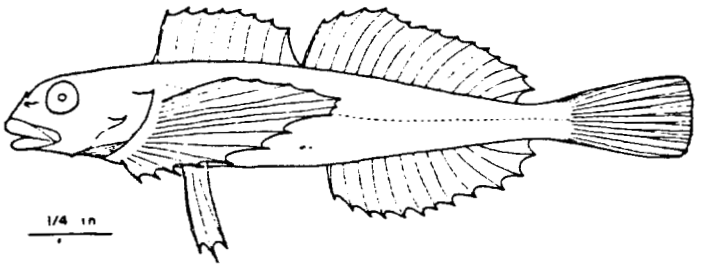

FIGURE 63. Sharpnose sculpin, *Clinocottus acuticeps.*

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.

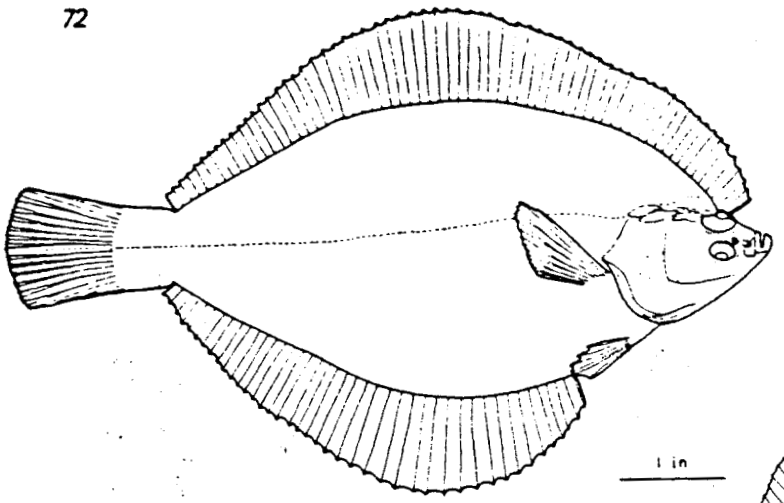

FIGURE 64. Arctic flounder, *Liopsetta glacialis.*

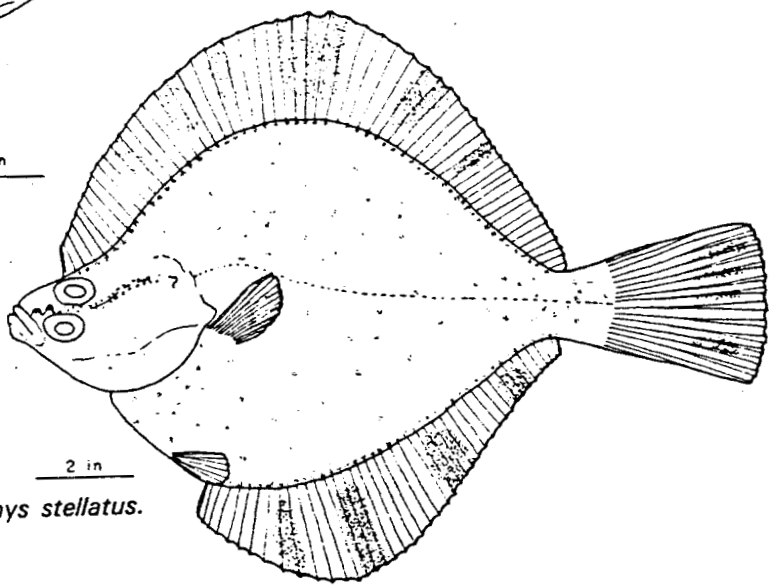

FIGURE 65. Starry flounder, *Platichthys stellatus.*

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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National Marine Fisheries Service, Circulars

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330. EASTROPAC Atlas: Vols. 4, 2. Catalog No. I 49.4:330/(vol.) 11 vols. ($4.75 each). Available from the Superintendent of Documents, Washington, D.C. 20402.

331. Guidelines for the processing of hot-smoked chub. By H. L. Seagran, J. T. Graikoski, and J. A. Emerson. January 1970, iv + 23 pp., 8 figs., 2 tables.

332. Pacific hake. (12 articles by 20 authors.) March 1970, iii + 152 pp., 72 figs., 47 tables.

333. Recommended practices for vessel sanitation and fish handling. By Edgar W. Bowman and Alfred Larsen. March 1970, iv + 27 pp., 6 figs.

335. Progress report of the Bureau of Commercial Fisheries Center for Estuarine and Menhaden Research, Pesticide Field Station, Gulf Breeze, Fla., fiscal year 1969. By the Laboratory staff. August 1970, iii + 33 pp., 29 figs., 12 tables.

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.

338. Bureau of Commercial Fisheries Biological Lab oratory, Auke Bay, Alaska. By Bureau of Com mercial Fisheries. June 1970, 8 pp., 6 figs.

339. Salmon research at Ice Harbor Dam. By Wesle J. Ebel. April 1970, 6 pp., 4 figs.

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

341. Report of the Bureau of Commercial Fisherie Biological Laboratory, Beaufort, N.C., for the 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. August 1970, iii + 39 pp., 28 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 + 38 pp., 31 figs., 11 tables.

Continued on inside back cover.

Draft July 24, 1989

ALASKA DEPARTMENT OF FISH AND GAME

TEST FISHERIES PLAN FOR MONITORING OIL IMPACT IN THE KODIAK SALMON MANAGEMENT AREA

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

INTRODUCTION

On 24 March 1989 the oil tanker EXXON VALDEZ spilled approximately 10,500,000 gallons of crude oil into the waters of Prince William Sound. The oil from the spill first entered the Kodiak Salmon Management Area about 10 days later at Cape Douglas on the Alaska Peninsula and at Big Fort Island located on the east side of Shuyak Island. By 29 May 1989 the oil had impacted the Alaska Peninsula from Cape Douglas to Wide Bay, the west side of the Kodiak Archipelago from Shuyak Island south to Cape Alitak, and the east side of the archipelago from Shuyak Island on the north to Spruce Island on the south.

By Alaska State Statute Title 16 the Department of Fish and Game is charged with managing fishery resources and fisheries which promote conservation, development, and utilization of local resources and the economic stability of the fishing industry. In line with this the Division of Commercial Fisheries will manage the 1989 Kodiak salmon fisheries consistent with traditional fishing patterns, allocations, and biological concerns within the limitations required for oil impact.

Associated with the EXXON VALDEZ oil pollution problem the Departments of Fish and Game (ADF&G) and Environmental Conservation (ADEC) have signed a memorandum of understanding (MOU) for carrying out fisheries management and public protection directives and goals (Appendix A). In concert with the MOU the ADF&G Division of Commercial Fisheries will evaluate oil impact to the salmon fishing grounds of the Kodiak Management Area by test fishing and intertidal surveys. The information collected will be used to make rational and timely decisions on the opening and closing of salmon fisheries.

OBJECTIVE

Determine the potential for oil contamination of gear and catch in the Kodiak Management Area from the 24 March 1989 EXXON VALDEZ spill.

TASK

Provide comprehensive daily monitoring of the nearshore waters including the intertidal areas associated with salmon fisheries in the Kodiak Management Area. This will be accomplished using seven or more EXXON-chartered ADF&G test fishing boats for the nearshore waters and one or more helicopter-supported ADF&G crews to foot survey the intertidal areas.

METHODS

For the purpose of this study the Kodiak Salmon Management Area has been stratified, primiliarly on the basis of fisheries value, into five general areas which are identified below and in Figure 1.

1. Afognak and Shuyak Islands
2. West Side Kodiak
3. East Side Kodiak
4. South Kodiak
5. Kodiak Mainland

The area has been further divided into specific survey reaches, and the coverage of these are the responsibility of specifically assigned ADF&G test fishing boats (Table 1).

The ADF&G test fishing boats will be in the 40-54 ft. length class and will be standard outfitted salmon purse seine vessels. Each will have three or four crew members, a captain with one or more years of salmon fishing experience in the Kodiak Salmon Management Area, and an ADF&G observer. All project ADF&G observers will receive instruction on: 1) identification of intertidal invertebrates, marine plants, and salmon; 3). organoleptic testing for oil contaminated fish; 4). survey procedures for determining oil presence; 5).

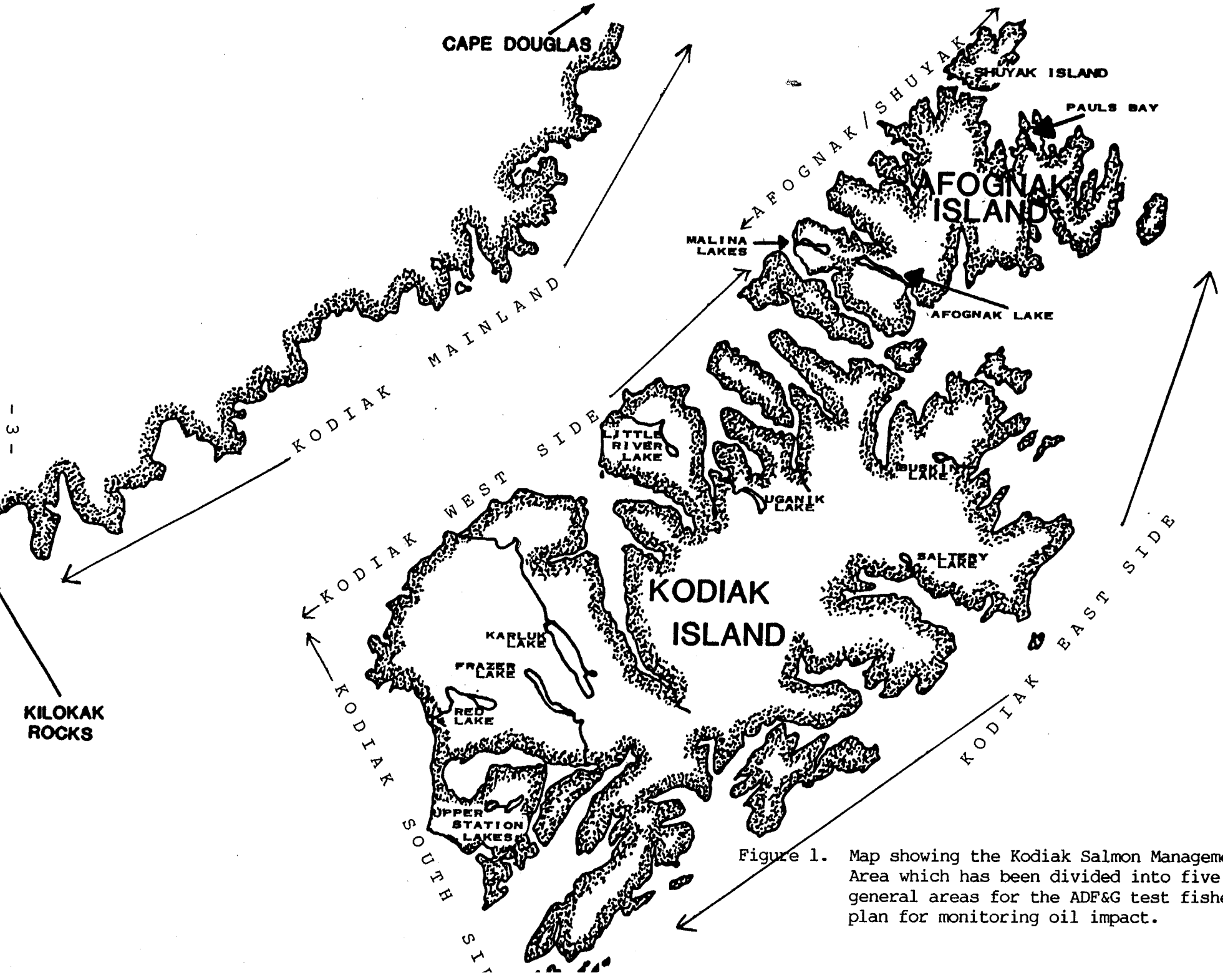

Figure 1. Map showing the Kodiak Salmon Management Area which has been divided into five general areas for the ADF&G test fisheries plan for monitoring oil impact.

06/23/89

Table 1. Locations for salmon test fishery for oil in the Kodiak Management Area, 1989.

GENERAL AREA	SURVEY REACH	VESSEL	SECTION	STATISTICAL AREA	FISHING LOCATION	PRIORITY	OBSERVER
Afognak and Shuyak Islands							
	East Afognak to NE Shuyak	Hail Mary	Perenosa	251 81	NE Shuyak	P	JC
		Hail Mary		82	Delphin Bay	S	JC
		Hail Mary		82	Big Waterfall	P	JC
		Hail Mary		82	Discoverer Bay	S	JC
		Hail Mary		83	Pauls Bay	S	JC
		Hail Mary	NE Afognak	252 10	Tonki Cape	P	JC
		Hail Mary	Izhut Bay	252 30	Saposa Bay	P	JC
		Hail Mary		32	Kitoi Bay	P	JC
		Hail Mary	Duck Bay	252 31	Duck Cape	P	JC
		Hail Mary		31	Duck Bay	S	JC
		Hail Mary	SE Afognak	252 35	Danger Cape	P	JC
	West Afognak to North Shuyak	Summer Gale	Raspberry Strait	251 10	Iron Creek	S	AS
		Summer Gale	SW Afognak	251 10	Pinnacle	P	AS
		Summer Gale		10	Mine	S	AS
		Summer Gale		20	Outer Malina Cape	P	AS
		Summer Gale		20	S. Cape Paramanof	P	AS
		Summer Gale		20	Mid Malina	S	AS
		Summer Gale	NW Afognak	251 30	Thorsheim	S	AS
		Summer Gale		30	Cape Paramanof	P	AS
		Summer Gale		40	N. Ban Island	P	AS
		Summer Gale		40	Black Point	P	AS
		Summer Gale	Shuyak	251 50	Red Fox	S	AS
		Summer Gale		60	W. Shuyak	P	AS
		Summer Gale		60	Big Bay	S	AS
		Summer Gale		70	Inner Shangin	S	AS
West Side Kodiak Island	Raspberry Island to Uganik Bay	Shawnee	Central	253 31	Cape Raspberry	S	DG
		Shawnee		31	Malina Light	P	DG
		Shawnee		31	Seiba Pt. (South Outlet)	S	DG
		Shawnee		31	Cape Uganik	P	DG
		Shawnee		35	Vonnie's Pt.	S	DG
		Shawnee		35	Red's Point	S	DG
		Shawnee		35	Eagle Rock	S	DG
	Uganik Bay to Cape Kuliuk	Keta	Central	253 11	Miners Point	P	PS
		Keta		11	Broken Point	S	PS
		Keta		11	Cape Ugat	S	PS
		Keta		12	South Arm	S	PS
		Keta		13	Rock Point	S	PS
		Keta		13	East Point	P	PS
		Keta		13	Village Islands	S	PS
		Keta		14	West Uganik Pass	S	PS
		Keta		14	Noisy Island	P	PS
		Keta	Terror Bay	253 33	Terror Bay (inner marker)	S	PS
	Cape Kuliuk to Uyak Bay	Restless C	Central	253 11	Two Cone Point	P	JQ
		Restless C	Uyak Bay	254 20	Browns Lagoon	S	JQ
		Restless C		20	Inner Uyak Bay	S	JQ
		Restless C	Zachar Bay	254 30	Zachar Bay	S	JQ
		Restless C	Spiridon Bay	254 40	Hook Point	S	JQ
		Restless C	Central	254 40	Cape Kuliuk	P	JQ
		Restless C		40	Prominent Mound	P	JQ
		Restless C		40	Chief Point	P	JQ
		Restless C		40	Green Banks	S	JQ
	Uyak Bay to Cape Kuliuk	Lisa Gayle		254 10	Bear Island	P	DC
		Lisa Gayle		10	Salmon Creek	S	DC
		Lisa Gayle		10	Rocky Point	P	DC
		Lisa Gayle		20	Amook Island (SW shore)	S	DC
		Lisa Gayle	Inner Karluk	255 10	Pafco Point	P	DC
		Lisa Gayle		10	Karluk	P	DC
		Lisa Gayle	Outer Karluk	255 20	Cape Uyak	P	DC
		Lisa Gayle	Halibut Bay	256 30	Halibut Bay	P	DC
		Lisa Gayle	Sturgeon	256 30	Sturgeon Head	P	DC

-Continued-

Table 1. (page 2 of 2)

GENERAL AREA	SURVEY REACH	VESSEL	SECTION	STATISTICAL AREA	FISHING LOCATION	PRIORITY	OBSERVER
Eastside Kodiak							
	Marmot Bay	Shawnee	North Cape	259 38	Rubber Boot	P	DG
		Shawnee		39	North Cape (Marmot Bay)	P	DG
		Shawnee	Central	259 36	Leto Point	S	DG
		Shawnee		37	Anton Larsen Bay (marker)	S	DG
	Cape Chiniak to Ocean Bay	Gold Nugget	Inner Ugak Bay	259 41	Saltery Cove, east marker	P	EF
		Gold Nugget		41	Saltery Cove, west marker	S	EF
		Gold Nugget		42	Eagle Harbor	P	EF
		Gold Nugget	Sitkalidak	258 10	Inner Right Cape	P	EF
		Gold Nugget		10	Boulder Bay	S	EF
		Gold Nugget		20	Pivot Point	P	EF
		Gold Nugget		20	Santa Flavia	S	EF
		Gold Nugget		30	Port Hoburn	S	EF
		Gold Nugget		30	Tanginak	P	EF
		Gold Nugget		30	Left Cape	S	EF
		Gold Nugget		30	Ghost Rocks	S	EF
		Gold Nugget		40	Ocean Bay	P	EF
		Gold Nugget		40	Cape Barnabas	P	EF
	Old Harbor to Sitkinak Island	El Capitan	Sitkalidak	258 51	Newman Peninsula, outside	P	DH
		El Capitan		51	Newman Peninsula, inside s	S	DH
		El Capitan		51	Rolling Bay, outside set	P	DH
		El Capitan		51	Rolling Bay, lagoon	S	DH
		El Capitan		52	Sikalidak Strait, north	S	DH
		El Capitan		52	Sikalidak Strait, south	S	DH
		El Capitan		52	Barling Bay (south marker)	P	DH
		El Capitan		52	Barling Bay (north marker)	S	DH
		El Capitan	Two-Headed	258 54	Kaiugnak Bay	S	DH
		El Capitan		55	Kiavak Bay	S	DH
		El Capitan		60	Kaguyak	P	DH
		El Capitan	Seven Rivers	258 70	Boot Point	P	DH
		El Capitan		70	Seven Rivers	S	DH
		El Capitan		70	Walters Creek	S	DH
		El Capitan		70	Geeses strm #702	S	DH
		El Capitan		80	Sitkinak Lagoon	S	DH
		El Capitan		90	Russian Harbor	P	DH
South Kodiak							
	Cape Ikolik to Cape Trinity	Miss Olivia	Outer Ayakulik	256 20	Cape Ikolik	P	DH
		Miss Olivia		20	Bumble Bay	S	DH
		Miss Olivia		20	Bear Rocks	P	DH
		Miss Olivia	Inner Ayakulik	256 20	Red River	P	DH
		Miss Olivia	Cape Alitak	257 20	Alitak Beach	P	DH
		Miss Olivia		20	Cape Alitak	P	DH
		Miss Olivia		20	Tanner Head	P	DH
		Miss Olivia	Humpy Deadman	257 50	Fox Island	S	DH
		Miss Olivia		50	Hepburn	S	DH
		Miss Olivia		60	Portage	S	DH
		Miss Olivia		70	Hawk Bluff	P	DH
Kodiak Mainland							
	Cape Douglas to Alinchak Bay	Marci La Rae	Big River	262 10	Cape Douglas	S	EA
		Marci La Rae		15	Kiukpalik	P	EA
		Marci La Rae		15	Village Beach	P	EA
		Marci La Rae	Hallo Bay	262 20	Hallo Bay	P	EA
		Marci La Rae	Outer Kukak	262 25	Outer Kukak	P	EA
		Marci La Rae		30	Kaflia Bay	S	EA
		Marci La Rae	Dakavak	262 35	Gull Cape	P	EA
		Marci La Rae		262 45	Kinak	S	EA
		Marci La Rae		262 50	Takli Island	P	EA
		Marci La Rae	Katmai	262 60	Dakavak	P	EA
		Marci La Rae	Alinchak	262 65	Alinchak	S	EA
		Marci La Rae		262 70	Puale Rocks	P	EA
	Alichak Bay to Kilokak Rocks	Suzanne	Cape Igvak	262 75	Dry Bay	P	JH
		Suzanne		75	Cape Unalishagvak	P	JH
		Suzanne		75	Bird Bluff	P	JH
		Suzanne		80	Portage Bay	S	JH
		Suzanne		80	Cape Igvak	P	JH
		Suzanne		80	Kanatak Lagoon	P	JH
		Suzanne		90	Terrace Island	P	JH
		Suzanne		90	Cape Kayakliut	P	JH
		Suzanne		95	Kilokak Rocks	P	JH
		Suzanne		95	Imuya Bay	S	JH

evidence collection procedures including standard procedures for documenting visual observations.

Each test fishing boat is assigned several primary and secondary fishing locations within their respective survey reach (Table 1). The primary sites are the more common fishing locations, while the secondary sites generally receive more seasonal and infrequent use by the salmon fleet. The test fish boats will survey the primary sites on a two-to-three-day rotation depending on weather and assigned survey reach. The secondary sites will be surveyed on a time available basis. A primary or secondary location will not be fished when oil, other than very light or light sheens, is observed in the water within 1/4 mile of a the location. Oil includes petroleum sheen, mousse, or tar balls. The locations which are oil-free or have very light or light petroleum sheens will be fished using a salmon purse seine for approximately 30 minutes. Regardless of the amount of oil presence at a location a written record of the survey will be recorded using the form "ADF&G TEST FISHERY REPORTING FORM FOR OIL PRESENCE" (Figure 2). The basic information required in the record will include the site location, catch by species, fishing time, survey conditions, weather, oil impact and type, and catch and gear contamination if any. When mousse, sheen, or tar balls are observed within 1/4 mile of a site a chain of custody (COC) sample of the oil and a video will be taken. However when a site is oil free a COC sample or video is not necessary. The standard procedure for collecting a COC sample is covered in Appendix B. If the oil type is free floating mousse or tar balls the COC sample should be collected by a grab sample using a pre-cleaned instrument such as a dipnet or metal strainer. If the product is sheen an absorbent pad should be used which will become part of the sample secured in a factory clean glass jar. For establishing the natural contamination level of the absorbent pad, a section of clean pad from the same case lot should be taken under COC in a separate pre-cleaned glass jar. This should be done at the same time the oil sample is taken.

All fish caught at a set site but not exceeding 35 fish per set should be organoleptically examined for oil contamination. In this study a catch will be considered contaminated if there is any visual evidence of non-naturally occurring oil on a fish or if there is a petroleum smell on any fish in the

Figure 2.

ADF&G Test Fishery Reporting Form for Oil Presence

Boat name: _____

Official number: _____

Captain: _____ ADF&G observer: _____

Date	Location		Time	Weather					Oil		Survey				Catch		Gear Contam.	Comments
	General Area	Latitude Longitude		Wind Dir.	Wind Vel.	Wave Ht.	Tide Stage	Survey Cond.	Impact	Type	Survey Method	Duration of set	Sample Number	Video Number	No. Salmon (code)	Contam. (y/n)		General Comments: description of oil in water, if any wildlife mortalities, etc. record catch in numbers of fish by species

Tide Stage:
- E ebb
- F flood
- S slack

No. Salmon caught (code):
- 1-25 alpha
- 26-50 beta
- 51-75 charlie
- 76-100 echo
- 200 foxtrot
- 300 golf
- more than 300 hotel

Survey Method:
- VIS visual observation
- SPS salmon purse seine
- SG salmon gill net
- HPS herring purse seine
- DN dip net
- OTH other

Impact Classification: (oil coverage of area)
- H heavy 150% or 16 meter band
- M moderate 10-50% or 3-6 meters band
- L Light 1-10% or 1-3 meter band
- VL very light (1% or (1 meter band
- N not detectable

Gear Contamination:
- N not detectable
- HC hand cleanable
- P easily patched
- MP major patching required
- GC grossly contaminated, cannot be patched or cleaned on grounds

Oil Type:
- VL very light sheen (patchy light sheen covering 5-10% of area
- LS light sheen (almost transparent/similar to windrows & not. sheen from processors)
- SS silver sheen (silvery/shimmery appearance
- RS rainbow sheen (sheen reflects colors)
- M mousse (brown oil - 1 mm or thicker layer oil/water emulsion, 30-50% oil:50-70% water)
- TB tar ball (generally black & semi-firm with obvious textured appearance)

Survey Condition:
- P poor
- F fair
- G good
- E excellent

Form date: 2 June 1989

catch. All oil-contaminated catch will be documented by video and a COC sample of the oil. The standard procedure for taking a COC sample of oil on a fish will be to wipe the suspected oil off with a paper towel. (The same paper towel may be used to sample multiple fish from the same catch.) The towel used to sample the oiled fish should immediately be placed in a factory cleaned glass bottle which is then appropriately sealed, labeled, and secured following standard COC procedures covered in Appendix B. At the same time, a clean paper towel from the same roll should be secured under COC in a separate pre-cleaned glass jar.

After each set the seine should be closely examined for oil impact. Any oil on the net must be documented by a COC sample and a video. When there is an insufficient (less than 1/8lb.) amount of oil contaminant on the net to collect a grab sample, a section of the oiled portion should be cut from the seine for the COC sample. Under those circumstances a clean section of the net should should be collected under a separate COC sample. If the net is oiled to where it can not be cleaned or patched with new web on the fishing grounds the net should be considered grossly contaminated. All grossly contaminated nets should be retired from use and returned to the Port of Kodiak for special cleaning or replacement. If a net is oiled but the catch is free of oil the catch should be released. However if there is any oil contaminated fish in the catch the entire catch should be considered adulterated and held on board the boat for disposal.

Each test fishing crew (boat) will set 4-5 passive monitoring stations to test for oil presence. A station will be a 100-200 ft. surface longline with five or more approximately 3-ft. long geotextile oil snares. The monitoring station sites are listed in Table 2 and their monitoring is secondary to test fishing. Generally each station will be checked once every four days. When a station is checked the five or more snares will be individually inspected for oil impact, and the oil impact recorded will be the average for all the snares at the particular station. The data will be reported on the form "ADF&G Passive Monitoring Station Report for Oil Presence (Figure 3)." Oil impact at a station will be documented further by video and a COC sample of the oil. Oiled snares will be replaced with clean snares following each inspection. To prevent

Table 2. Locations for Passive Monitoring Stations for oil in the Kodiak Management Area by geographic reach, 1989.

GEOGRAPHIC REACH	SECTION	STATISTICAL AREA		LOCATION OF MONOTORING STATION	OBSERVER AND VESSEL
Afognak District Shangin Bay to Raspberry Cape	SW Afognak	251	10	Raspberry Straits	AS Summer Gale
	SW Afognak	251	10	Mine, NW tip Raspberry Is	AS Summer Gale
Northwest Kodiak District Raspberry Cape to Cape Kuliuk	Central	253	35	Red's Point	DG Shawnee
			14	Noisy Island	DG Shawnee
			11	Miners Point	DG Shawnee
	North Cape	259	39	North Cape (Marmot Bay)	DG Shawnee
Northwest and Southwest Kodiak Districts Cape Kuliuk to Cape Ikolik	Central	254	40	Chief Point	DC Lisa Gayle
			30	Carlson Pt.	DC Lisa Gayle
			10	Aleution Rock/Wolcott Reef	DC Lisa Gayle
			10	7 mile Beach	DC Lisa Gayle
Southwest Kodiak and Alitak Bay Districts Cape Ikolik to Cape Trinity	Outer Ayakulik	256	20	Old Red River	JC Miss Olivia
		257	10	Low Cape	JC Miss Olivia
		257	20	Cape Alitak/Alitak Beach	JC Miss Olivia
		257	70	Hawk Bluff (between Humpy Cove/Hawk)	JC Miss Olivia
Eastside and Northeast Kodiak Districts Cape Trinity to Cape Chiniak		258	20	Pivot Pt., Kiliuda Bay	GR Gold Nugget
			51	Natalia Peninsula, Newman Bay	GR Gold Nugget
			30	Ghost Rocks, Sitkalidak Str.	GR Gold Nugget
Mainland District	Cape Igvak	262	90	Imuya Bay (station 1)	EA Marci La Rae
Kilokak Rocks to Katmai Bay			80	Cape Igvak (station 2)	EA Marci La Rae
			80	Kanatak (station 3)	EA Marci La Rae
			75	Dry Bay (station 4)	EA Marci La Rae
Mainland District Dakavak Bay to Cape Douglas				To be defined at a later date	

Figure 3.

ADF&G Passive Monitoring Station Report for Oil Presence

Boat name:_____

Official number:_____

Captain:_____ Observer:_____

Location			Description of Gear			Initial Installation		Inspection				Sample No.	Video No.	Comments
Site	Latitude Longitude	Dist. to Shore	Length of Longline	No. Snares	Type	Date	Time	Date	Time	Oil Impact	Oil Type			

Snare Type:

C cork (gillnet float)
P pompoms
O other

Impact classification: (coverage of snare)

H heavy >50%
M moderate 10-50%
L light 1-10%

Oil Type:

LS light sheen (almost transparent/similar to windrows & nat. sheen from processors)
SS silver sheen (silvery/shimmery appearance
RS rainbow sheen (sheen reflects colors)

potential gear conflict problems all passive oil monitoring stations should be removed from the water prior to a scheduled commercial fishing opening and then reset after the closure. However monitoring gear located outside a normal fishing area should be left in place.

Beach surveys will be conducted as required to monitor oil impact on intertidal areas particularly where set netting occurs. A Kodiak-based ADF&G crew will conduct most of the surveys, but the test fish observers will perform surveys as time allows. Transportation will be by an EXXON chartered helicopter or by seine skiff from a test fish boat. Survey data will be recorded on the form "ADF&G COMMERCIAL FISHERIES DIVISION AERIAL AND BEACH SURVEY OIL SPILL REPORT"(Figure 4).

The test fishing boats will not operate in areas open for salmon fishing by emergency order. When a fishing area is open, the ADF&G test fishing vessel(s) assigned to that area will survey the immediate outer area daily until either the fisheries closes or directed otherwise. For the test fishing boats the "immediate area" is defined as all waters within 10-miles of the open fishing area. Additionally intertidal beach surveys for oil impact will be conducted by the helicopter supported crews on all beach areas within 20-miles of the open fishing area. The beach surveys will be conducted daily during the fishery until notified otherwise.

Oil reports received from the public including those received from area fishermen will be recorded on form "ADF&G REPORTING FORM FOR UNCONFIRMED OBSERVATIONS" (Figure 5).

The Kodiak test fishing project will end when ADF&G determines that the EXXON VALDEZ spill does not threaten gear and catch contamination. Due to the present impact to area fishing grounds it is likely that the monitoring will continue for 60 or more days.

Chain-of-custody sampling procedures are in Appendix B.

Figure 4.

ADF&G COMMERCIAL FISHERIES DIVISION
AERIAL AND BEACH SURVEY OIL SPILL REPORT

OBSERVER(S): _____

DATE: _____

District/ Section/ Stat. Area	Specific Location	Time	Intertidal		Nearshore <1-mi.		Survey Method, Distance, & Conditions		SAMPLE NO.	VIDEO NO.	COMMENTS
			Impact	Oil Type	Impact	Oil Type	Intertidal	Nearshore			

IMPACT CLASSIFICATION (Oil Coverage of Area):

- H Heavy >50% or >6 meters band
- M Moderate 10-50% or 3-6 meters band
- L Light 1-10% or 1-3 meters band
- VL Very Light <1% or <1 meter
- N Not Detectable

SURVEY CONDITIONS

- P Poor
- F Fair
- G Good
- E Excellent

SURVEY METHODS

- F Foot
- FW Fixed wing aircraft
- H Helicopter
- B Boat

OIL TYPE:

- VL Very Light Sheen (patchy light sheen covering 5-10% of area)
- LS Light Sheen (almost transparent/similar to windrows & nat. sheen from bio. Processes)
- SS Silver Sheen (silvery/shimmery appearance)
- RS Rainbow Sheen (sheen reflects colors)
- M Mousse (Brown oil/1mm or thicker layer oil/water emulsion (30-50% oil:50-70% water)
- TB Tar Balls (generally black & semi-firm with obvious textured appearance)

Figure 5.

ADFSS Reporting Form for Unconfirmed Observations

OBSERVATION								
Date of Observation	Time of Observation	Location	Description	Person Originating Report	Person Receiving Report	Boat Receiving Report	Date Received	Time Received

APPENDIX A

MEMORANDUM OF UNDERSTANDING

MEMORANDUM OF UNDERSTANDING
1989 COMMERCIAL FISHERY SEASON

Alaska Department of Fish and Game
and
Alaska Department of Environmental Conservation

I. PREAMBLE

On March 24, 1989, the oil tanker EXXON VALDEZ ran aground, spilling more than 10,500,000 gallons of crude oil into the waters of Prince William Sound. The spilled oil has spread and continues to spread from Prince William Sound through the western Gulf of Alaska. The spilled oil has polluted and contaminated and continues to pollute and contaminate state waters and shoreline. The affected waters support productive fisheries which are of immense economic and social value to the State of Alaska and its citizens.

The State of Alaska, through the Department of Fish and Game, is charged with managing fishery resources and fisheries. Management directives and goals include: 1) to protect, maintain, improve, and extend fishery resources; 2) to avoid depletion or waste of fishery resources; 3) to conduct fishing in state waters in an orderly fashion which promotes conservation, development, and utilization of fishery resources; and 4) to preserve the economic stability of the state's fishing industry.

The State of Alaska, through the Department of Environmental Conservation, is charged with protecting the environment and the health, safety, welfare, and economic and social well-being of the public. Public protection directives and goals include: 1) to conserve, improve, and protect natural resources from oil pollution; and 2) to ensure that fish marketed from state waters are pure, safe, wholesome, unadulterated, and free from any taint of oil contamination.

Oil pollution (as defined in AS 46.03.900(19)) in waters or on shorelines in or adjacent to an area where a fishery is conducted poses a risk of adulterating fisheries resources and spreading oil pollution. Oil contamination also poses a risk of disruption of fisheries, including alteration of traditional fishing patterns and Board of Fisheries' adopted fisheries management plans, by causing fouling of fishing gear, by causing loss of fishing time, by causing strains on the ability of industry to supply sufficient amounts of uncontaminated gear to vessels, by causing fishermen who are unable to acquire uncontaminated gear or vessels to forego their livelihoods, and by causing waste of fishery resources that have become adulterated by oil pollution in the water or by contact with oil contaminated gear or vessels.

If oil adulterated fish are introduced into fish processing facilities, it could cause disruption of fisheries and waste of fish product because processing activities would have to be suspended while oil contaminated processing equipment was cleaned, maintained, and inspected. Additional waste and adulteration of fish product could occur if uncontaminated fish were exposed to oil contaminated fish or equipment.

Therefore, in order to carry out the management and public protection directives and goals with which the Department of Fish and Game and the Department of Environmental Conservation are charged, the respective departments agree to conduct the following activities during the 1989 commercial fishing season.

II. ALASKA DEPARTMENT OF FISH AND GAME

The Alaska Department of Fish and Game (ADF&G) will undertake the following activities in areas which have been polluted by oil:

A. ADF&G will conduct, and document the results of, aerial surveys or beach surveys in potential fishing districts, sections, subareas, or other areas as defined by ADF&G (hereinafter "areas") before the initial fishery opening in an area in order to ascertain whether oil pollution is present and to document the character and general location of the oil. ADF&G will provide the Department of Environmental Conservation (DEC) with the results of the surveys.

B. ADF&G will monitor oil contamination in potential fishing areas using oil spill tracking maps provided by DEC and survey information developed by ADF&G.

C. ADF&G will conduct test fisheries before the initial fishery opening in potential fishing areas which have been polluted by oil, even if there is no current discernible presence of oil, and will provide samples of test fishery catches to DEC for evaluation.

1. If requested, ADF&G will assist in providing transportation for DEC inspectors to and from test fishing vessels.
2. Test fishing will be conducted according to the test fishery sampling plans developed in individual fishery management areas.
3. ADF&G may conduct additional test fishing in a previously tested or previously fished area if there is reason to believe that weather or other variables may have resulted in oil or an oil sheen entering the area.

III. ALASKA DEPARTMENT OF ENVIRONMENTAL CONSERVATION

The Alaska Department of Environmental Conservation (DEC) will undertake the following activities:

A. DEC will evaluate commercial fishery catches to ensure that seafood safety and product wholesomeness is maintained. In order to accomplish this, DEC will undertake an intensive inspection program which will have requirements for fishing vessels, tender vessels, buying stations, and processing facilities.

B. DEC will enforce the emergency regulations, 18 AAC 34.500 et seq., which establish emergency requirements for fishing vessels, tender vessels, buying stations, and processing facilities in order to prevent adulteration of product and contamination of equipment by oil. DEC will review the records of tender vessels and processing facilities in order to assure compliance with the regulations.

C. DEC will train state personnel in the technique of organoleptic evaluation of fish for safety and wholesomeness. DEC-trained personnel will evaluate samples of catches from test fisheries provided by ADF&G to determine whether a safe and wholesome product will result from commercial openings in the areas where test fisheries were conducted. DEC will determine the appropriate methods of evaluation of particular samples. DEC will provide the results of organoleptic examination of test fish catches to ADF&G managers within 12 hours after the fish are made available to DEC. DEC will provide the results of laboratory evaluations, if any, of test fish catches to ADF&G managers within 24 hours after the fish are made available to DEC. DEC will provide inspectors for test fishing vessels when ADF&G requires an immediate evaluation of fish catch safety and wholesomeness for fisheries management purposes.

D. DEC will attempt to work with Exxon Shipping Company (Exxon) and encourage Exxon to establish boat cleaning stations and receiving stations for oil adulterated fish and oil contaminated gear. DEC will attempt to work with Exxon to develop recordkeeping procedures and oil contaminated material disposal procedures.

IV. OPENING OF FISHERY AREAS

ADF&G will decide whether to open particular areas for fishing based upon information acquired from the activities described above. The general principles by which ADF&G will make opening determinations are as follows:

A. A fishing area will remain closed if there is an indication of oil in any quantity in the area or the proximity of the area (including beaches), such that there is an appreciable likelihood that gear will be fouled, fish harvest adulterated, or such that the conduct of an orderly fishery could not take place. If weather conditions prohibit ADF&G from evaluating a potential fishing area through surveys or test fishing as set out above, the area will remain closed until the survey or test fishery can be conducted if DEC oil pollution tracking maps, or other reliable information, indicate the presence of oil pollution in the vicinity.

B. A fishing area will remain closed if test fishing has demonstrated that oil contamination of fishing gear or oil adulteration of product is likely to occur.

C. After fishing areas are opened for commercial fishing, if DEC inspection or evaluation of fishing vessels, tender vessels, buying stations, or processing facilities indicates oil adulteration of a harvest, designated representatives of DEC and ADF&G will consult to determine whether a recurring contamination problem has developed. If so, ADF&G will close fishing in the area where the oil contamination occurred.

V. AGENCY STAFF

Each agency will designate key contact people to implement this Memorandum of Understanding (MOU) and to facilitate the decision-making process during the 1989 commercial fishery season. The following are specific agency representatives for all purposes under this MOU:

ADF&G designates:	_____	(NAME)
	_____	(TITLE)
	_____	(PHONE)
DEC designates:	Manny Soares	(NAME)
	Environmental Conservation Manager	(TITLE)
	(907) 563-0318	(PHONE)

Because it may be necessary to make emergency closure decisions, in the event that either designated representative is unavailable, the alternative designated persons are:

ADF&G designates:

Prince William Sound Region:	James Brady & Dennis Haanpaa	(NAME)
	_____	(TITLE)
	_____	(PHONE)
Cook Inlet Region:	Schroeder and Ken Florey	(NAME)
	_____	(TITLE)
	_____	(PHONE)
Westward Region:	Larry Nicholson and Pete Probasco	(NAME)
	_____	(TITLE)
	_____	(PHONE)
DEC Designates:	_____	(NAME)
	_____	(TITLE)
	_____	(PHONE)

Agency staff will, to the maximum extent possible, coordinate and channel all respective efforts through the designated staff member.

6·8·89
Dated

Don W. Collinsworth, Commissioner
Alaska Department of Fish and Game

8 June 1989
Dated

Dennis D. Kelso, Commissioner
Department of Environmental Conservation

APPENDIX B

CHAIN-OF-CUSTODY SAMPLING PROCEDURES

Appendix B

Chain of Custody Procedures

A "chain of custody" is simply a documentation of the general rule that spill site samples should always be either under observation or locked up. Samples taken for documentation of a spill should be labeled according to accepted scientific procedures as they are collected in the field. In addition, the taking of each documentation sample should also be witnessed by a second person. Thereafter, every time that the sample changes hands a record of the transfer should be kept both on a custody label attached to the sample itself and in a comprehensive set of sample records maintained by the party coordinating the documentation efforts. The comprehensive record set should indicate who has custody of every sample at all times.

Factory pre-cleaned bottles have been provided for taking samples of oil at test locations. Accompanying each bottle is a label and a chain of custody form. If the forms and labels are filled in correctly they will satisfy the scientific and legal requirements for sample verification, and also the legal requirements for establishment of a chain of custody. A brief explanation of each of the entries on the form and label follows:

Sample No: Once a sample number is assigned all further references to that sample in field notebooks, laboratory notebooks, and elsewhere should be prefaced by its sample number. Sample numbers should consist of the three initials of the skipper of the test vessel, plus a three digit number beginning with 001. For example, LMS001.

Time: The approximate time that the sample was taken should be recorded.

Date: The date that the sample was taken should be recorded.

Sample Description: The sample description should be brief and concise, such as "mousse in water", "heavy sheen", etc.

Collected By: The signature of the person who actually collected the sample along with his or her address and affiliation, if different than that of the organization charged with collecting the samples, should be recorded.

Witnessed By: The signature of the person who witnesses the actual taking of the sample along with his address and affiliation should be recorded.

Location Taken, lat/long: A brief description of the bay, district or general area, plus lat/long coordinates.

Received From: The initials of the person from whom the sample was received and his or her affiliation should be recorded.

Received By: The initials of the person receiving the sample and his or her affiliation should be recorded.

Date: The date of the sample transfer should be recorded.

Disposition: A brief indication of the condition of the sample disposition, such as intact or not intact, should be recorded by the person receiving the sample.

More complete information on sample condition at disposition should be included in the laboratory notebook of the receiver if the sample was not intact when it arrives. The means by which the sample was transported must also appear in the notebooks of both the sender and the receiver.

TAKING SAMPLES: The ideal sample size is 1/8 pound (2 ounces). If enough oil is present, wooden tongue depressors should be used to place oil in bottles. When this is not feasible, a specially adapted dipnet should be utilized and the oiled web placed in the bottle. The label, (printed on waterproof paper), should be filled out prior to affixing to the bottle, and should be filled in the same manner as the form.

Red evidence tape is provided to be placed around the rim of the closed bottle. The sample bottle should then be placed in the freezer, and recorded as such on the form.

OPERATIONAL PLAN

1989 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).

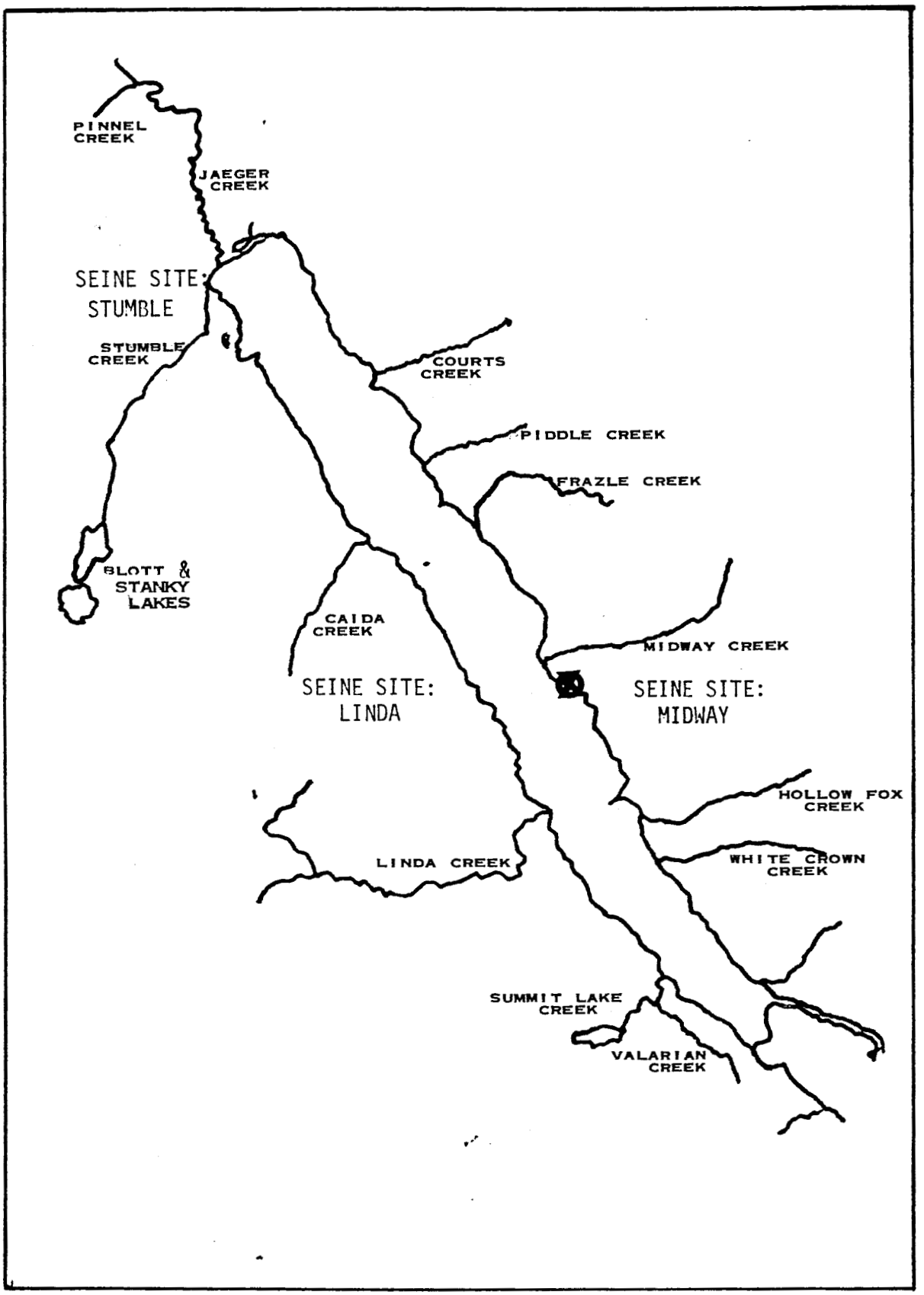


Figure 1. Frazer Lake with inlet streams and littoral seining locations identified.

In initial response to conservative management practices, escapements into Frazer Lake built 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 closer to 140,000 to 200,000. The forecast for the 1989 run is 537,000 sockeye salmon. Most (80%) of these should be age 2.2 from the 1984 parent escapement of 53,524 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, in particular the pink (O. gorbuscha), chum (O. keta) and coho (O. kisutch) salmon escapements 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 Chuck Hastings, and the assistant is Jean White. Chuck will be responsible for making daily work assignments and insuring that operations are conducted safely and according to the standards defined in this manual. Bruce Barrett 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 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).

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.

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

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. 1989 calendar weeks.

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

Figure 3. (page 1 of 5)

FL87-1

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.

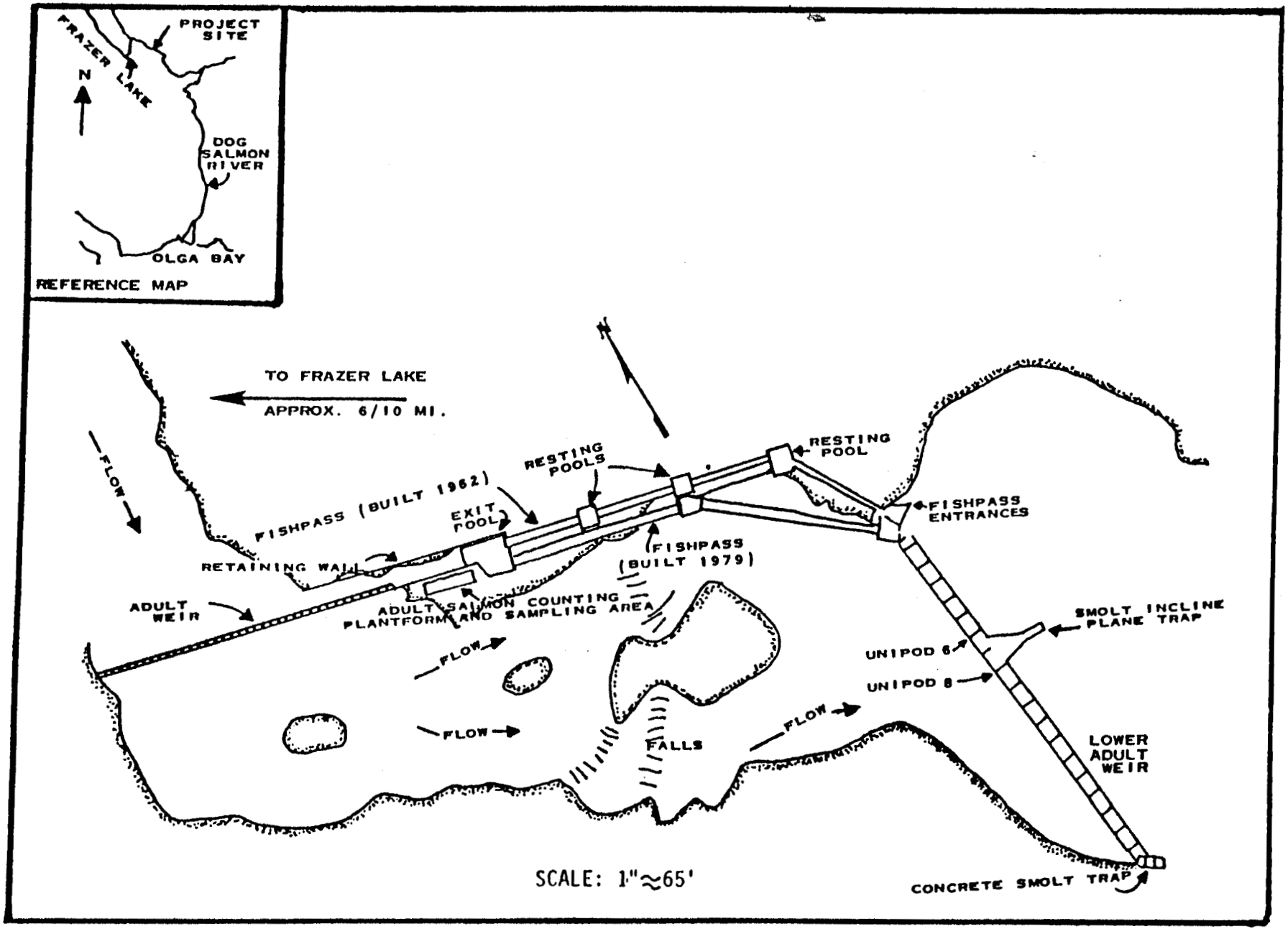


Figure 4. Schematic of the Frazer Lake fishpasses.

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 the a sufficient number of fish the difference will be taken 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-h between noon of one day to noon of the following day and is identified by the calendar date corresponding to the first 12-h 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). Pinnell Creek and Frazer Lake (excluding inlet streams mouths) will be survey 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 the seining will be done 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 each species catch. The length data will be recorded on form FL87-3.

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.

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</u> <u>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. MDULAvoid allowing any detergents or other chemicals from entering the fishpass water supplyMDNM. 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.

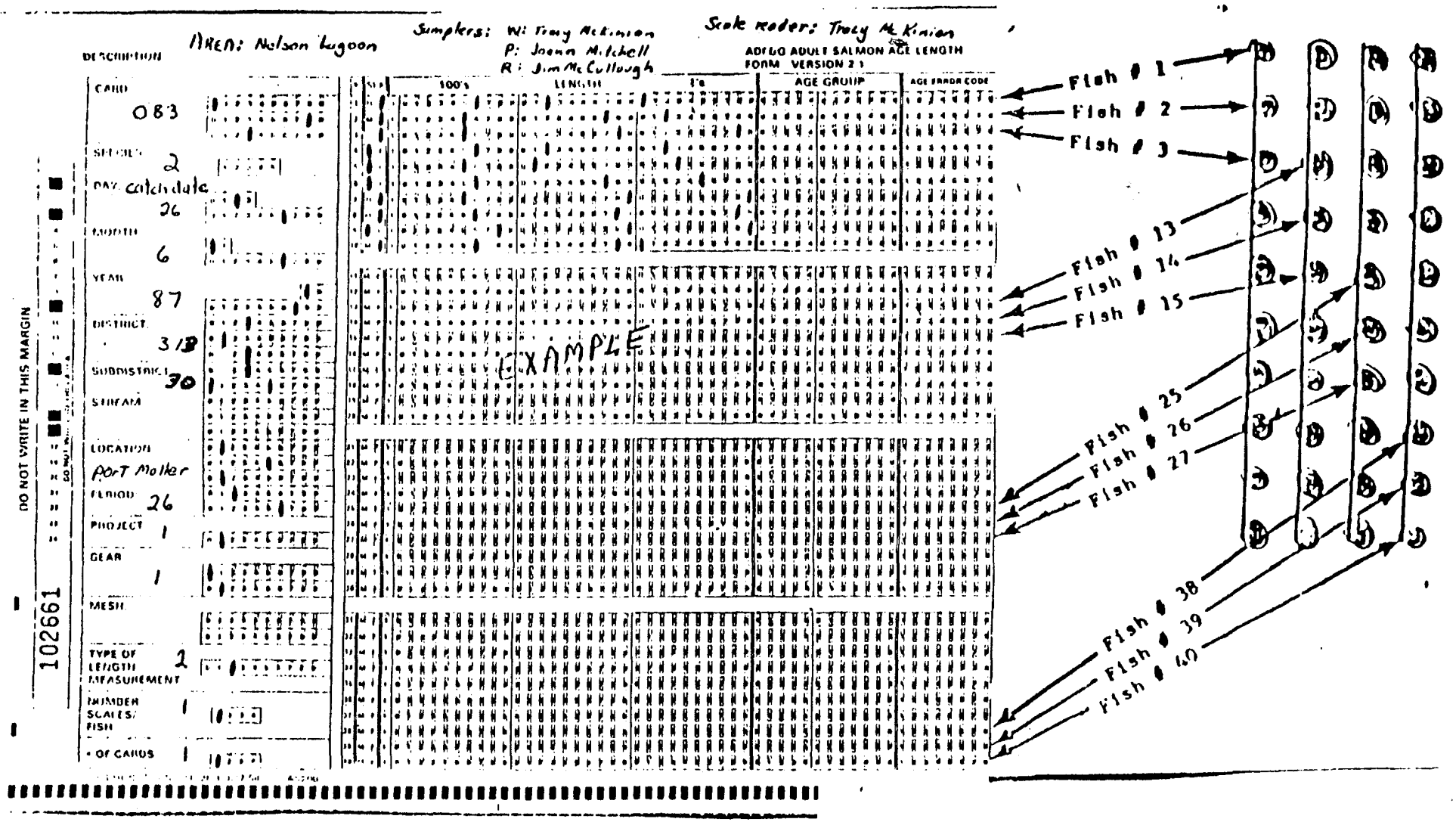
COMPLETING THE FORMS:

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.

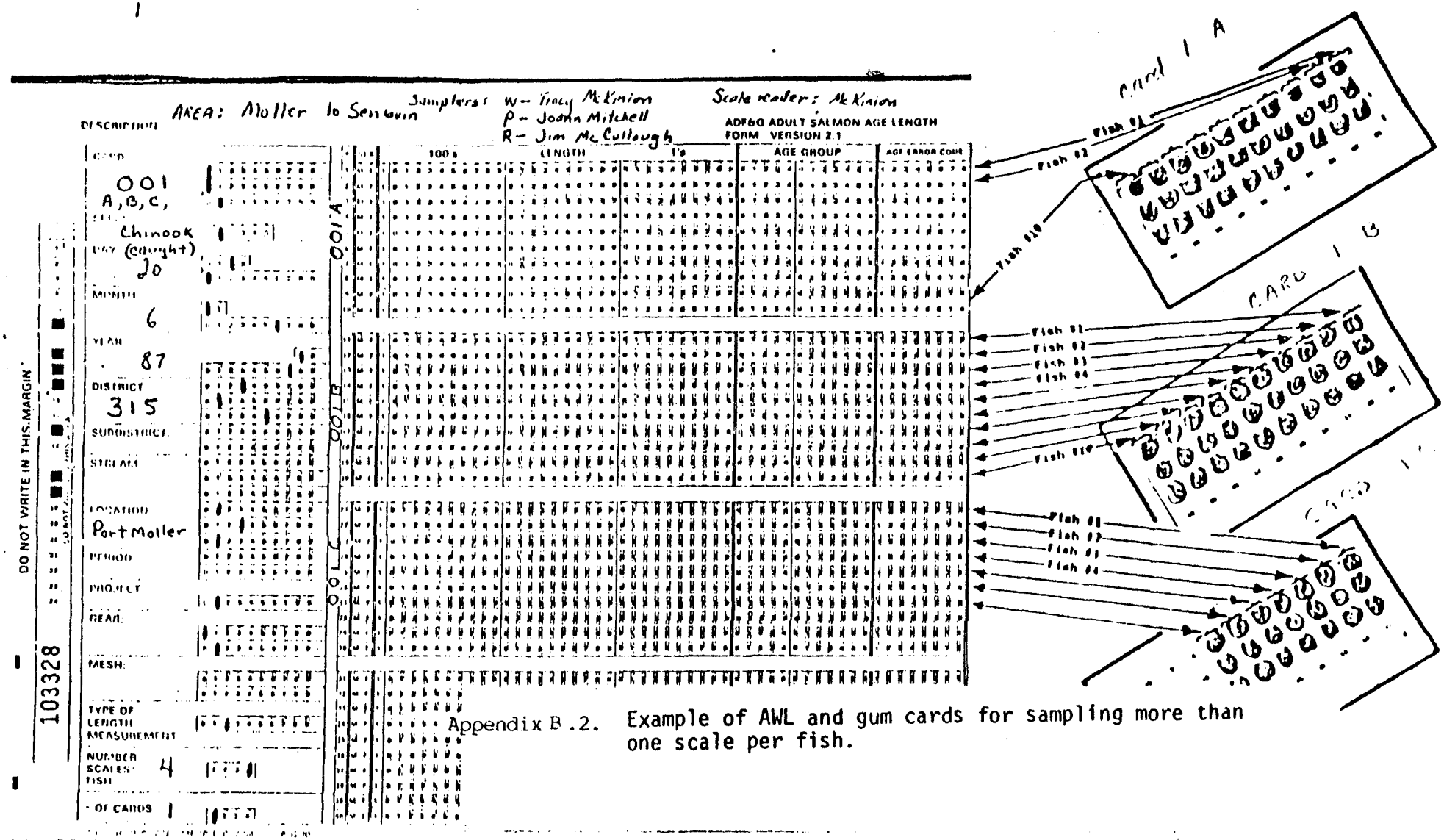
Description:
For catch sampling: Area/Samplers (name and W-R-P)

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



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

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 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.

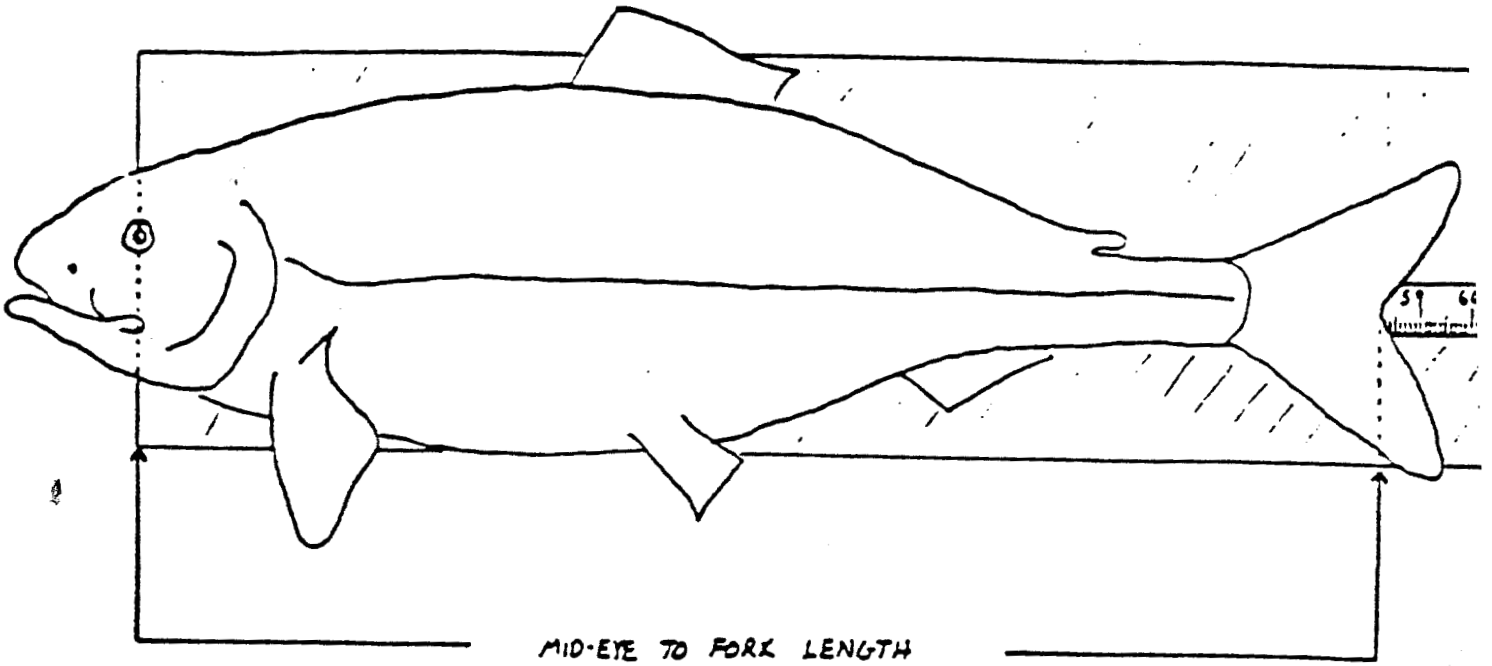
Mesh:
Leave blank unless specifically instructed by supervisor to do otherwise.

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.

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 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:

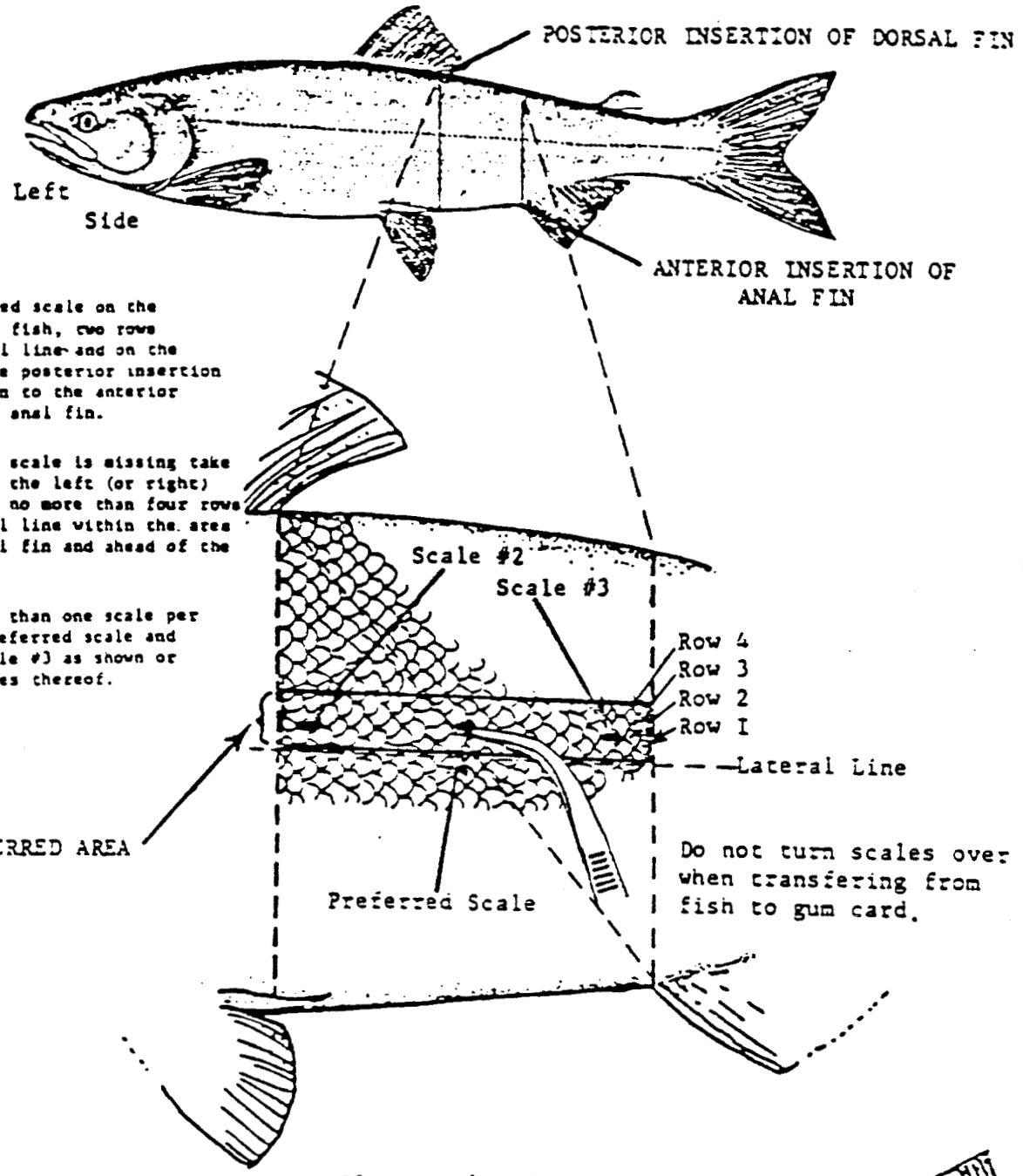
A. GENERAL

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.

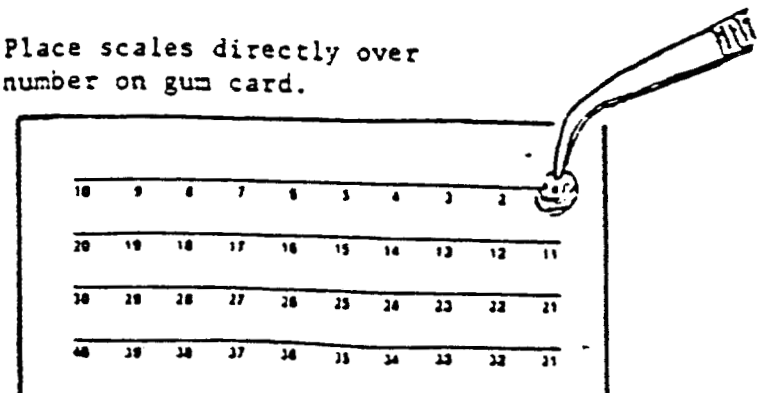
3. Pluck the "preferred scale" from the fish using forceps. Remove all slime, grit, and skin from the scale by moistening and rubbing between fingers. The "preferred scale" is located on the left side of the fish, two rows above the lateral line on the diagonal from the posterior insertion of the dorsal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

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 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-<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 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"!IPO

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
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

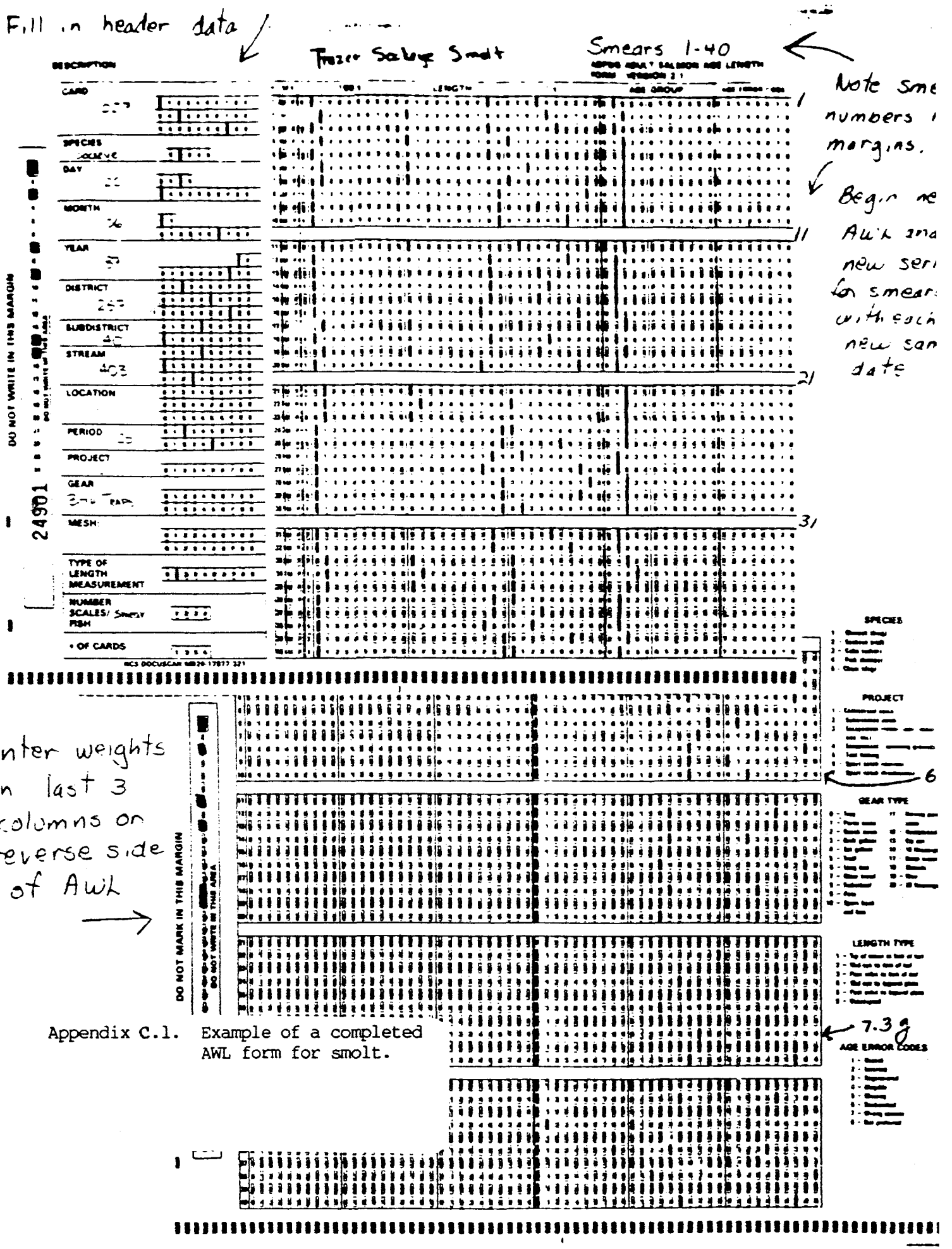
The same size goal per week is 200 sockeye salmon. It essential that the sample is taken randomly. In the event that more than the required sample size is in the smolt trap at the time of sampling the trap is to be stirred to assure randomness. When the smolt are randomly distributed a small dip net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

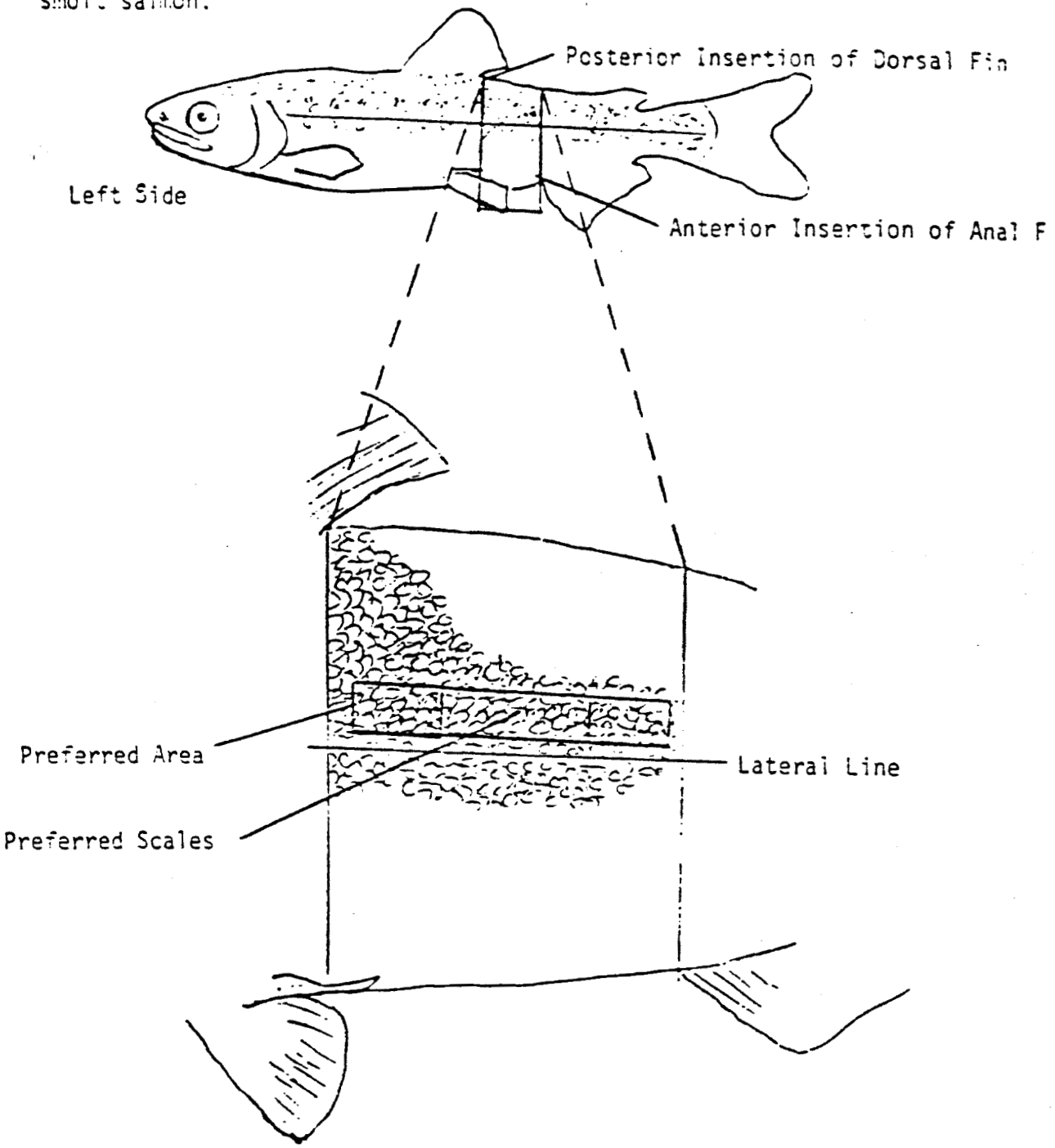
Smolt lengths will be measured to the nearest millimeter, from the tip of the snout to the fork of the tail, Appendix C.4.

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.

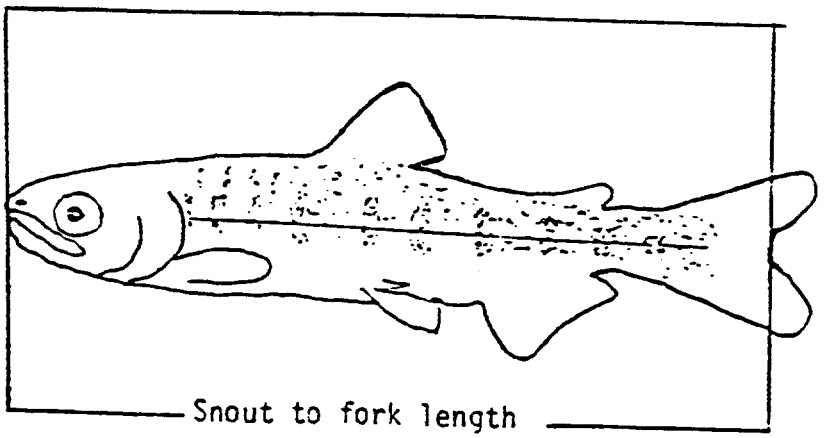
Appendix C.2 Scale sampling procedure showing the preferred scale sampling area on a smolt salmon.



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 1½ 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

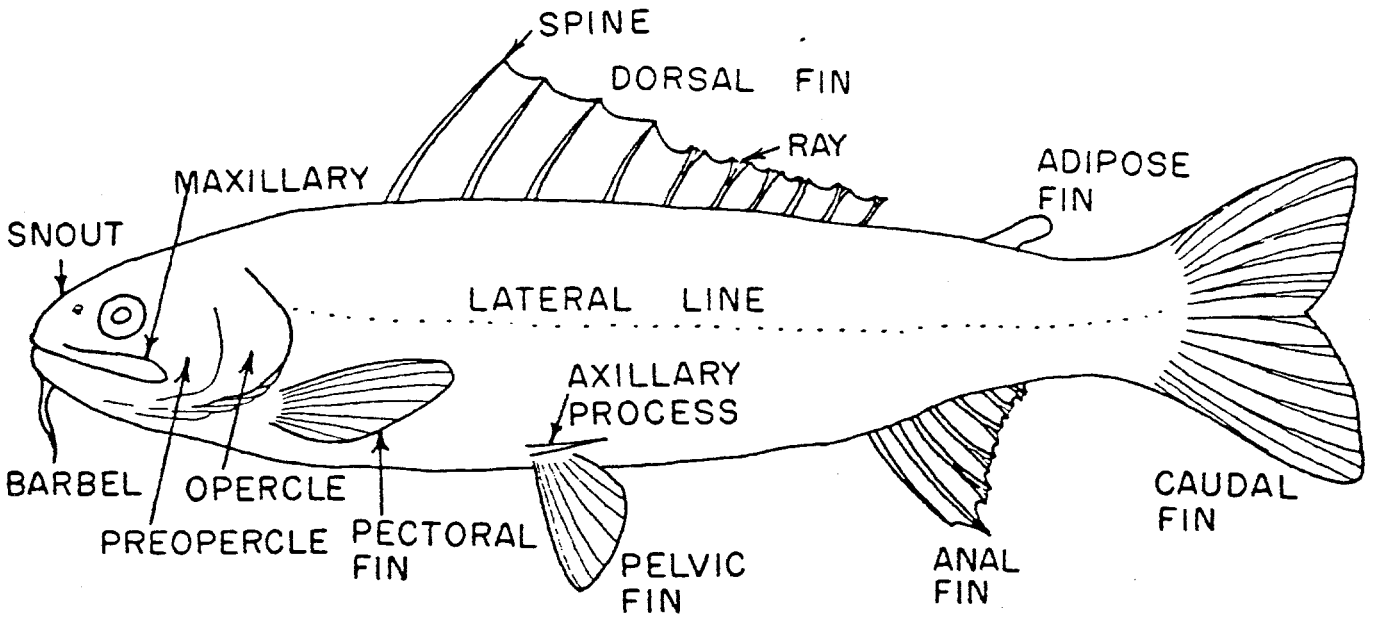


FIGURE 1. A "generalized" fish showing the various structures referred to in the keys.

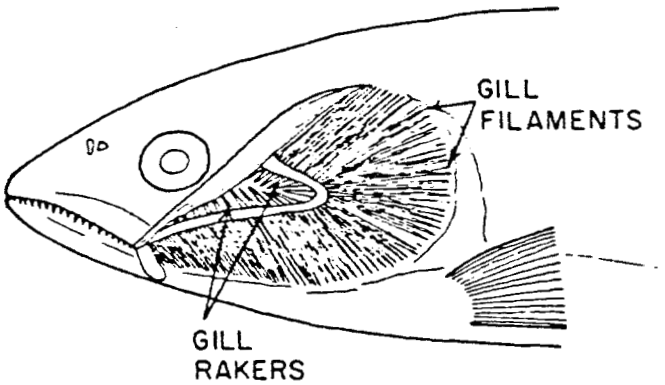


FIGURE 2. Diagram of a gill arch, showing the gill filaments and the gill rakers.

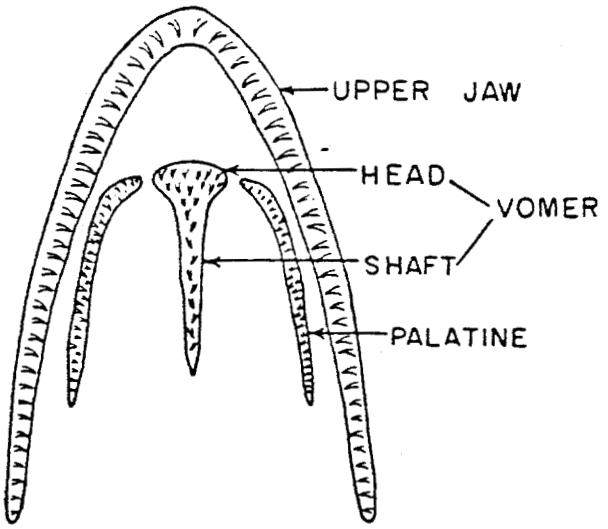


FIGURE 3. Diagram of the roof of the mouth of a fish to show the teeth on the jaws, the head and shaft of the vomer bone, and the palatines.

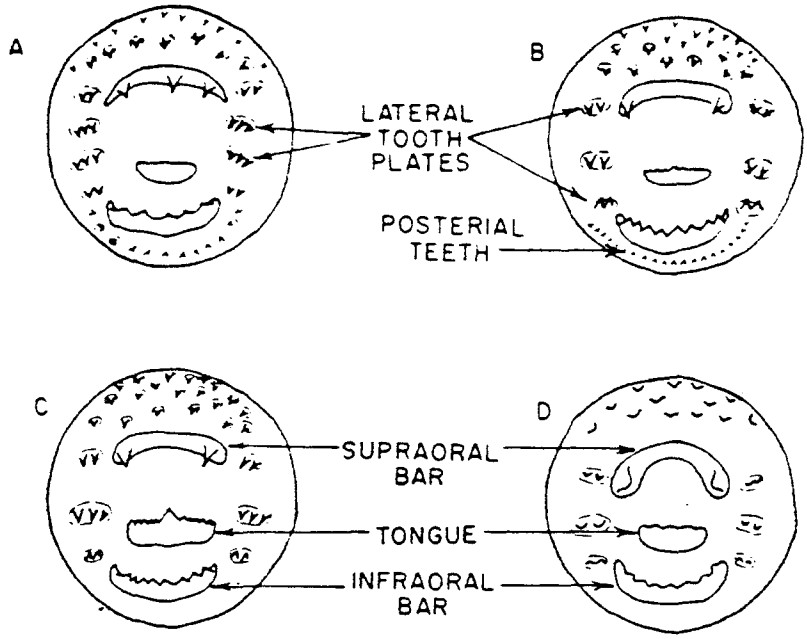


FIGURE 4. Tooth patterns of Alaska lampreys. A. Pacific lamprey, *Entosphenus tridentatus.* B. Arctic lamprey, *Lampetra japonica.* C. River lamprey, *Lampetra ayresi.* D. Western brook lamprey, *Lampetra richardsoni.*

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

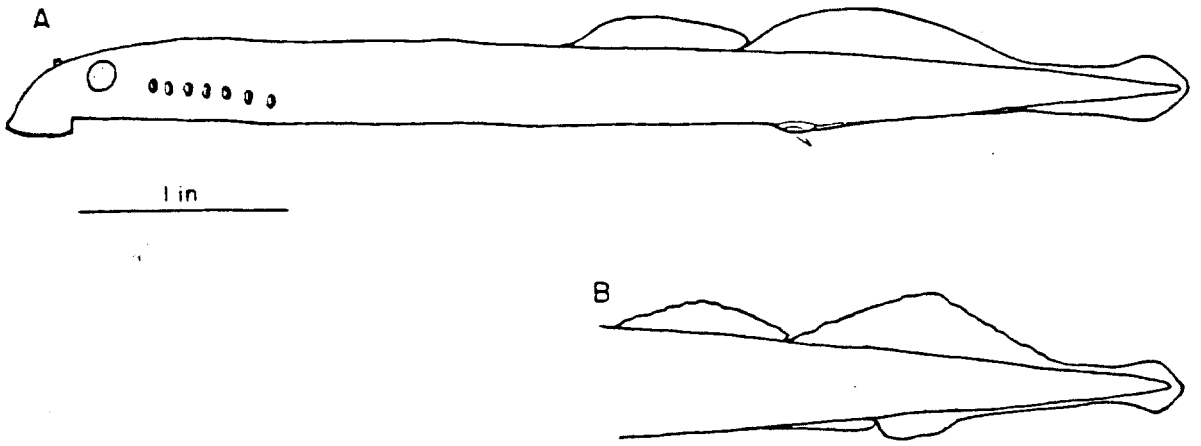


FIGURE 5. Arctic lamprey, *Lampetra japonica*. A. Male. B. Posterior end of female. Note presence of anal fin and lack of urogenital papilla in the female. All four Alaskan lampreys are much alike in general appearance, so only the one species is illustrated.

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.

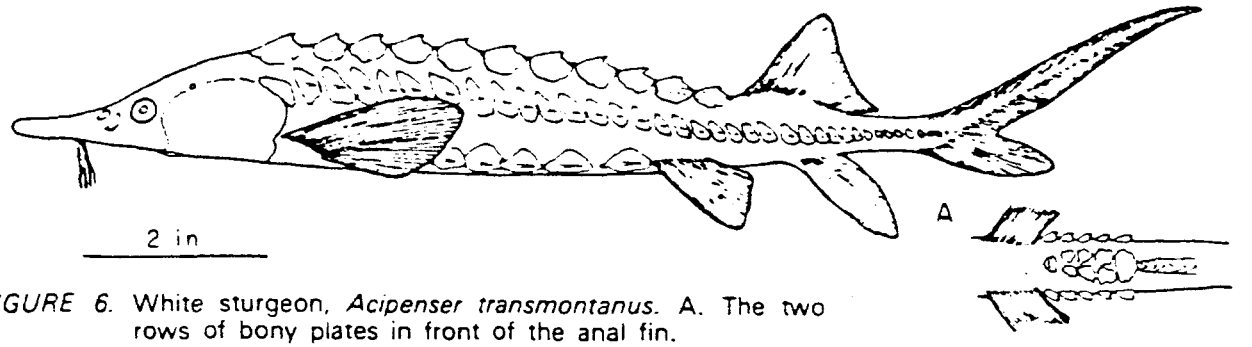


FIGURE 6. White sturgeon, *Acipenser transmontanus.* A. The two rows of bony plates in front of the anal fin.

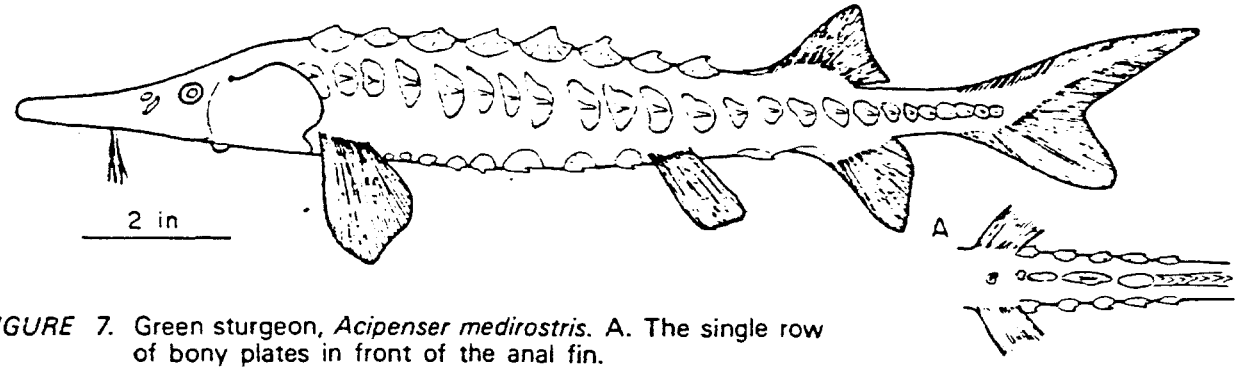


FIGURE 7. Green sturgeon, *Acipenser medirostris.* A. The single row of bony plates in front of the anal fin.

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.

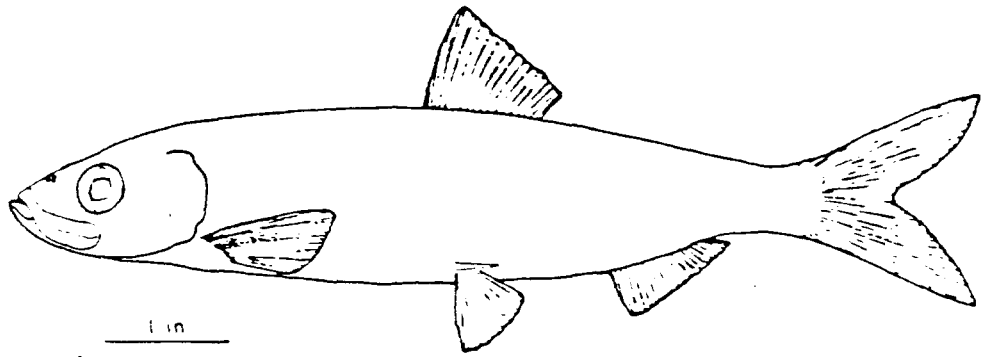


FIGURE 8. Sea herring, *Clupea harengus pallasi.*

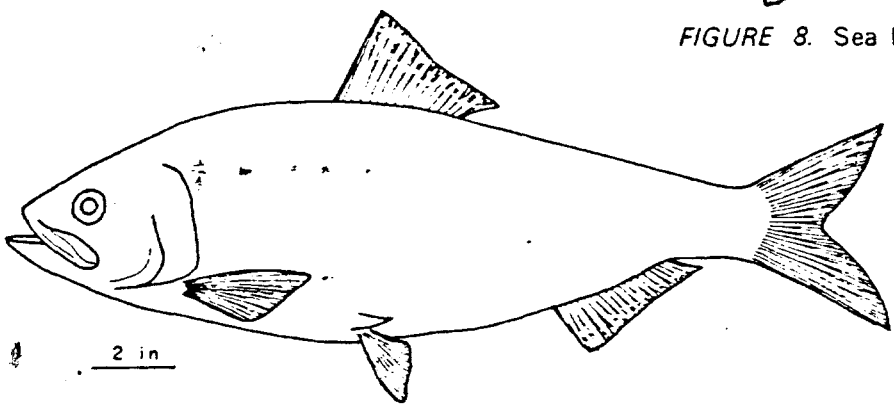


FIGURE 9. American shad, *Alosa sapidissima.*

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.

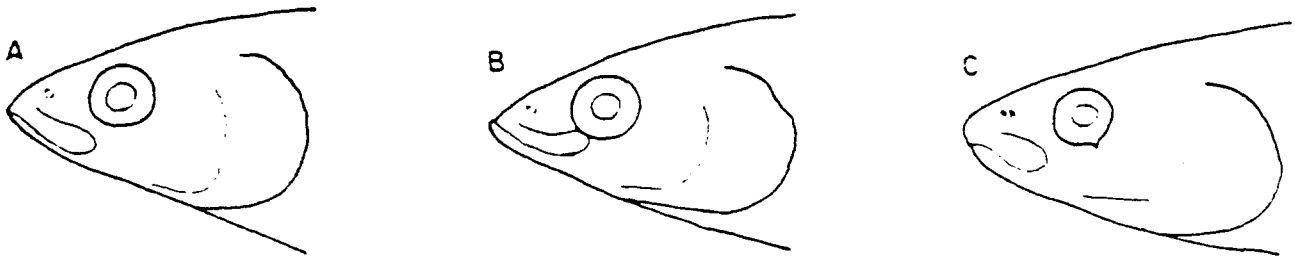


FIGURE 10. Snouts of whitefishes. A. Bering cisco, both jaws equal. B. Least cisco, tip of lower jaw projecting slightly beyond upper jaw. C. Round whitefish, lower jaw shorter than upper and profile of upper lip overhanging.

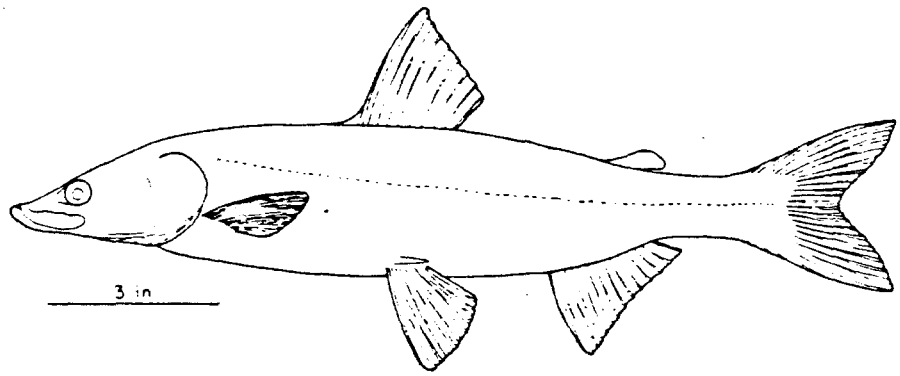


FIGURE 11. Inconnu, *Stenodus leucichthys.* Commonly called "sheefish" in Alaska.

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

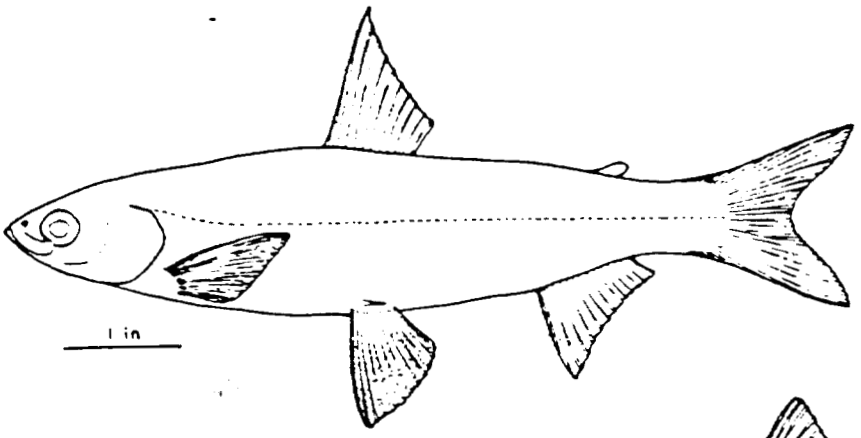


FIGURE 12. Least cisco, *Coregonus sardinella.* Note the dusky pelvic fins.

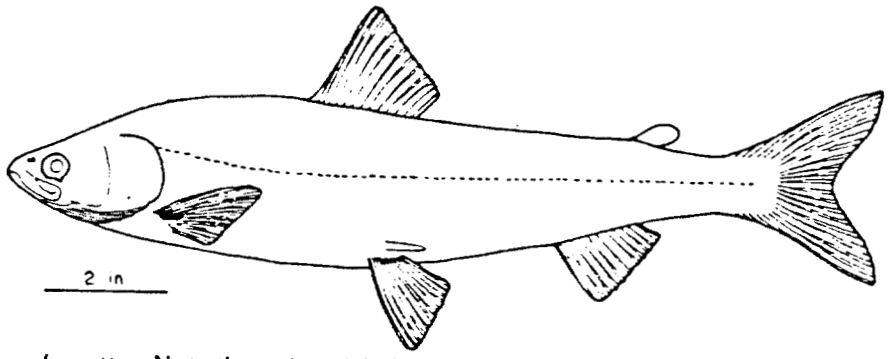


FIGURE 13. Bering cisco, *Coregonus laurettae.* Note the pale pelvic fins. The Arctic cisco, *Coregonus autumnalis,* appears identical with this species but has more gill rakers.

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

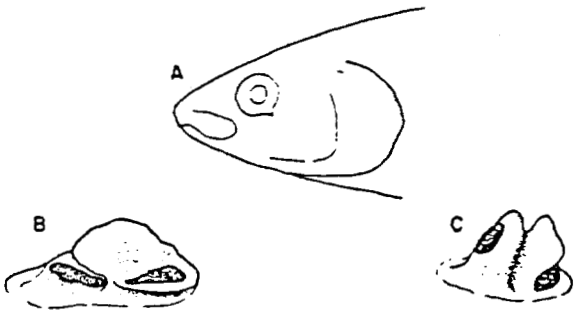


FIGURE 14.

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.)

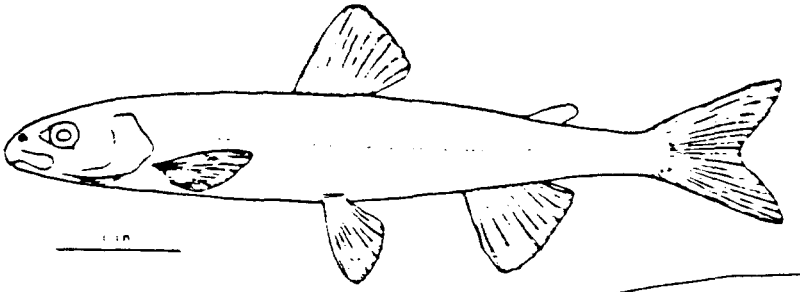


FIGURE 15. Pygmy whitefish, *Prosopium coulteri.*

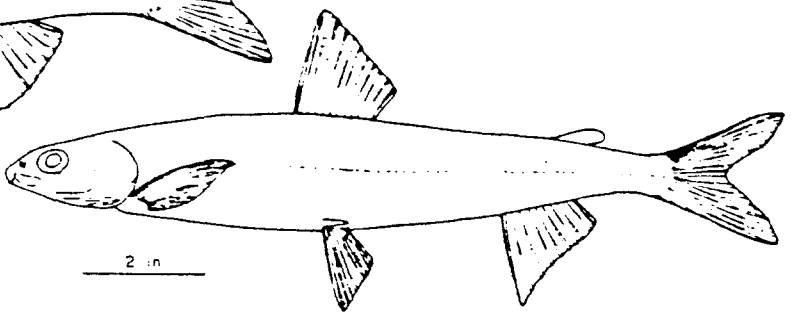


FIGURE 16. Round whitefish, *Prosopium cylindraceum.*

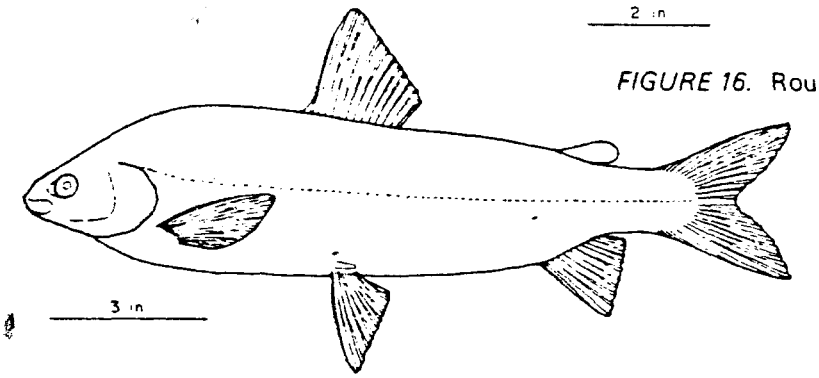


FIGURE 17. Broad whitefish, *Coregonus nasus.*

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.

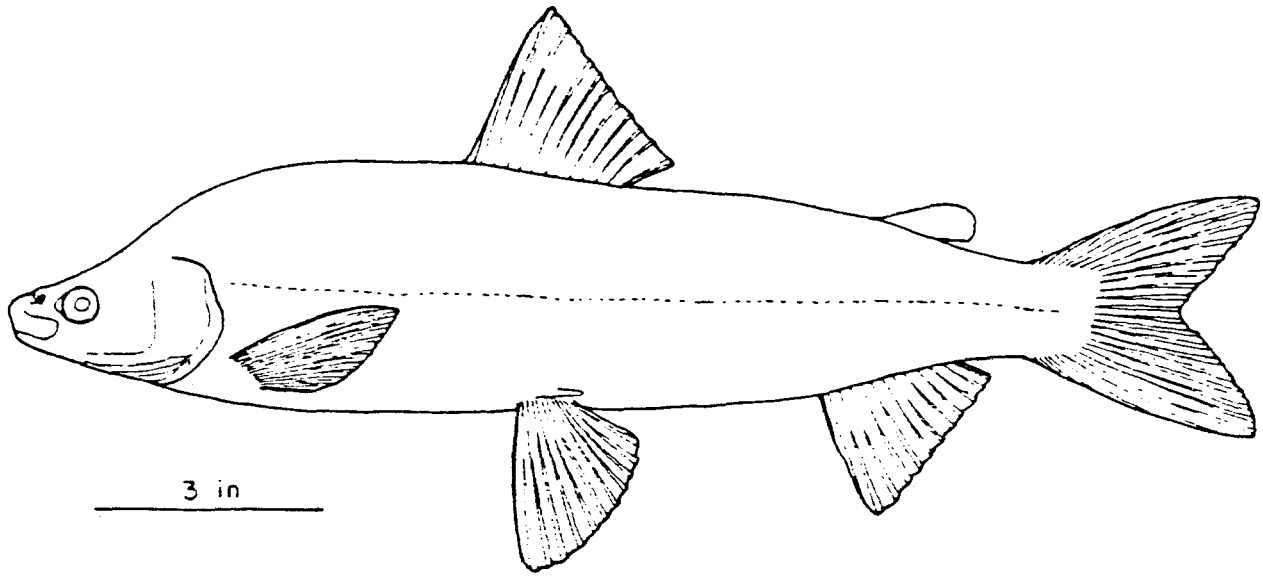


FIGURE 18. Alaska whitefish, *Coregonus nelsoni.* The Humpback and Lake whitefishes closely resemble this species but differ in number of gill rakers.

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.

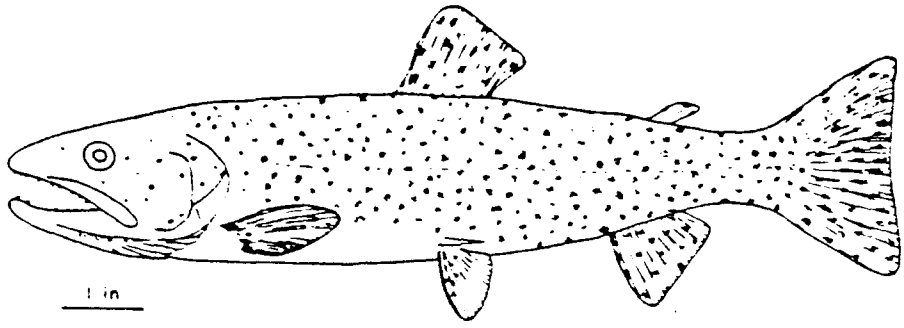


FIGURE 19. Cutthroat trout, *Salmo clarki*. In Alaska, most fresh-water populations are heavily spotted, as shown, but in more southerly populations the spots are generally not so numerous. Spots are missing on freshly sea-run cutthroats.

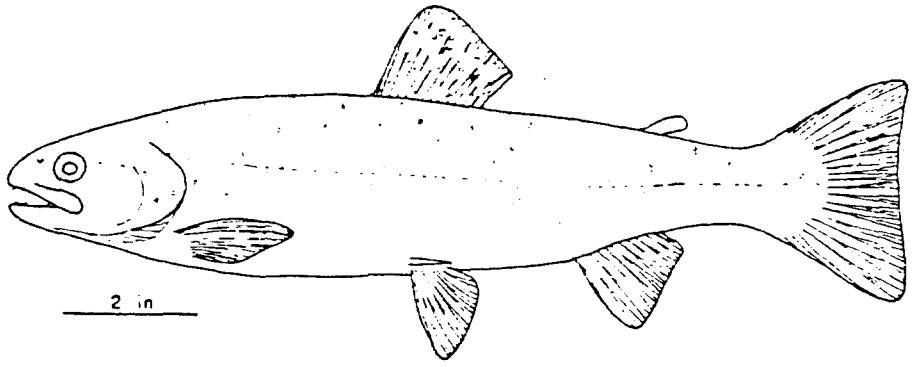


FIGURE 20. Rainbow trout, *Salmo gairdneri*.

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

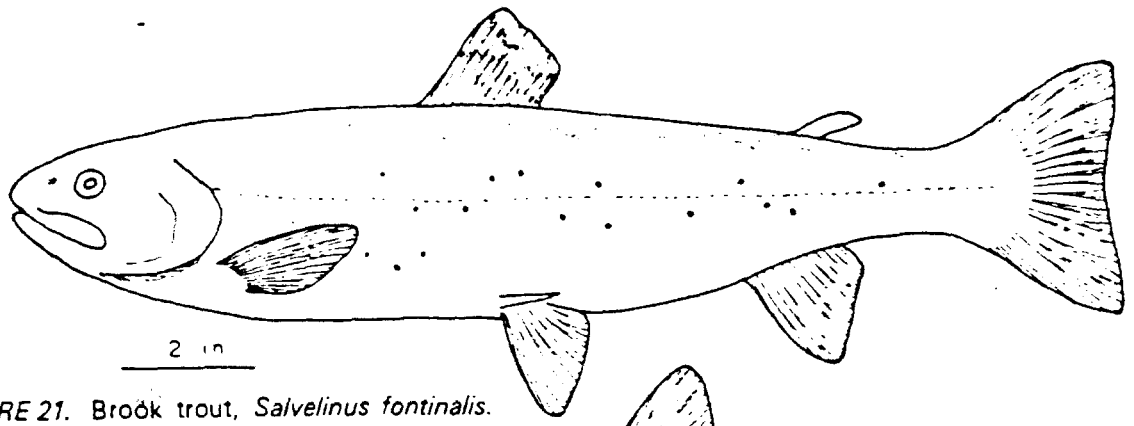


FIGURE 21. Brook trout, *Salvelinus fontinalis.*

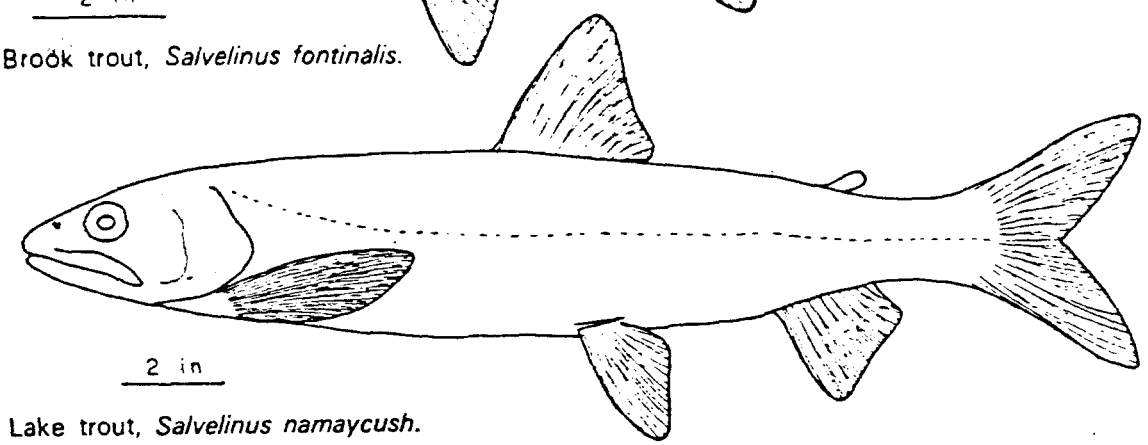


FIGURE 22. Lake trout, *Salvelinus namaycush.*

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

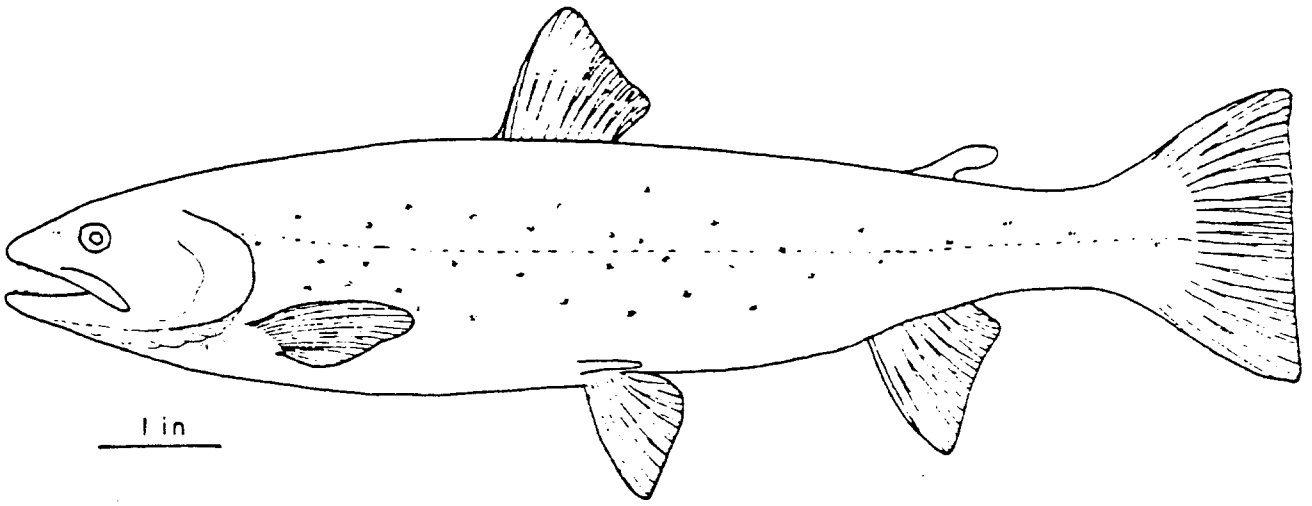


FIGURE 23. Dolly Varden, *Salvelinus malma.* The Arctic charr and Angayukaksurak charr look very much like the Dolly Varden, but the Angayukaksurak charr is black and the Arctic charr has more gill rakers and pyloric caeca.

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

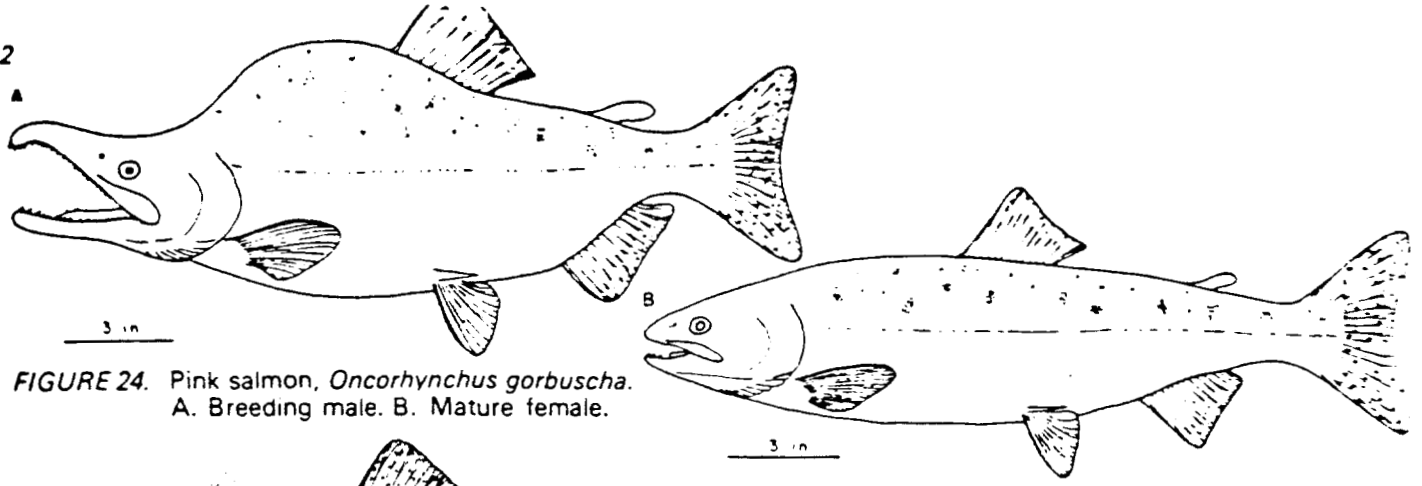


FIGURE 24. Pink salmon, *Oncorhynchus gorbuscha.* A. Breeding male. B. Mature female.

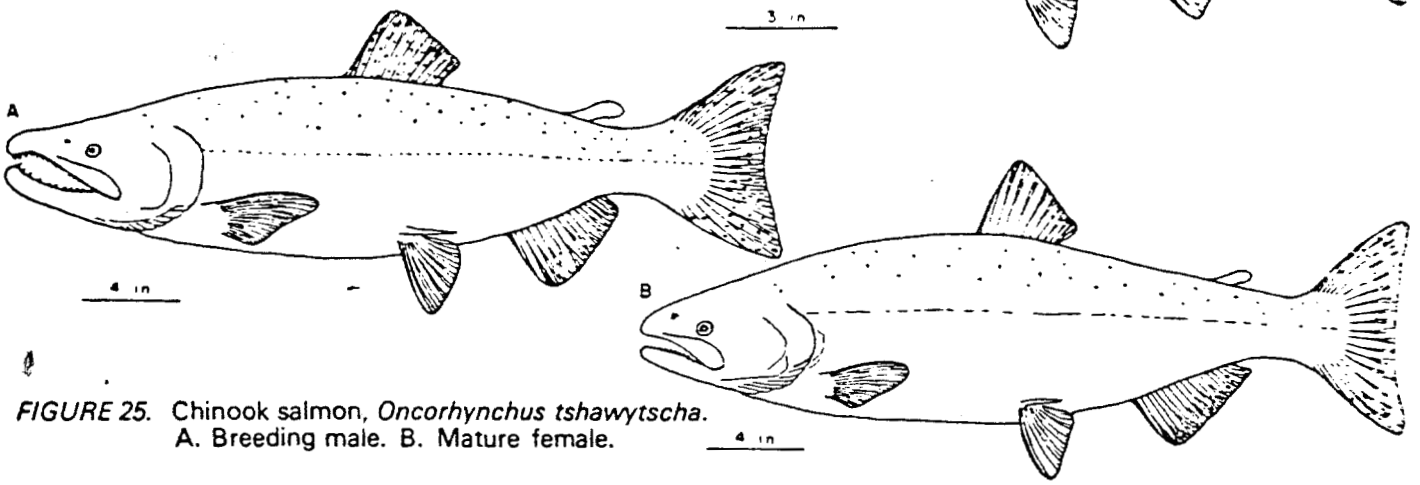


FIGURE 25. Chinook salmon, *Oncorhynchus tshawytscha.* A. Breeding male. B. Mature female.

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.

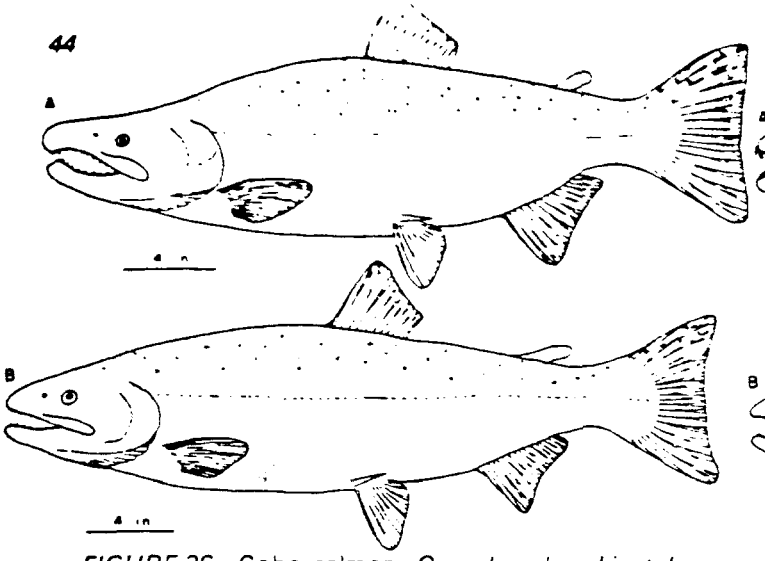


FIGURE 26. Coho salmon, *Oncorhynchus kisutch.* A. Breeding male. B. Mature female.

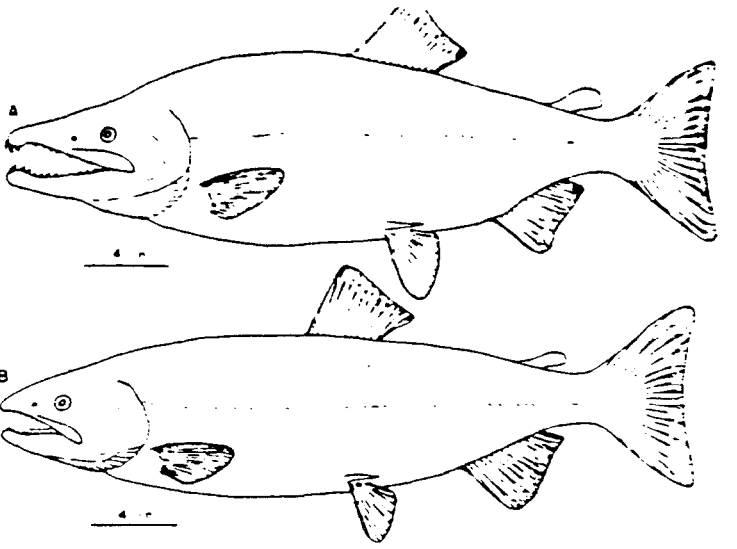


FIGURE 27. Chum salmon, *Oncorhynchus keta.* A. Breeding male. B. Mature female.

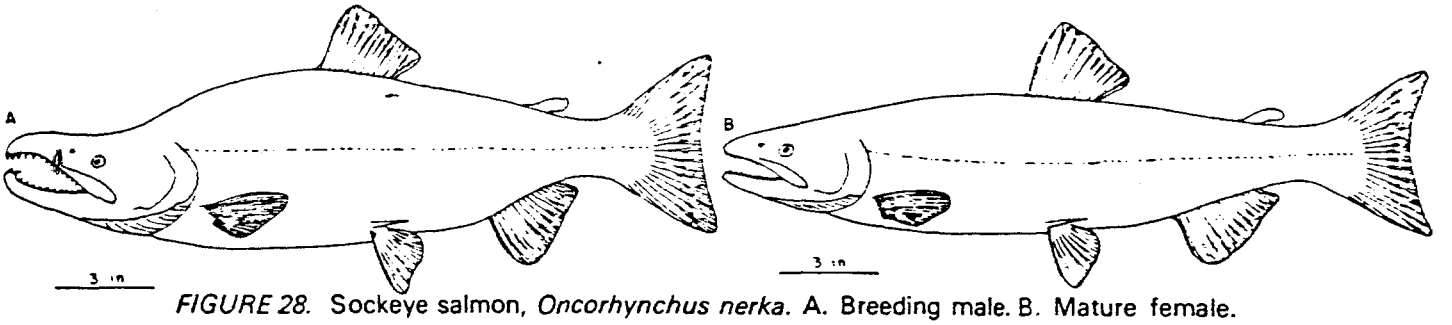


FIGURE 28. Sockeye salmon, *Oncorhynchus nerka.* A. Breeding male. B. Mature female.

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 45-115.

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.

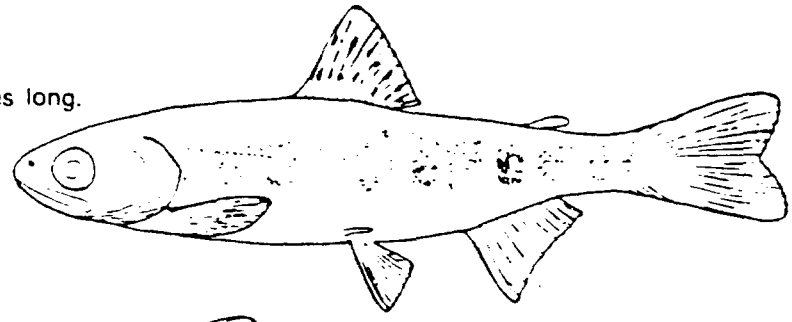


FIGURE 29. Brook trout 3½ inches long.

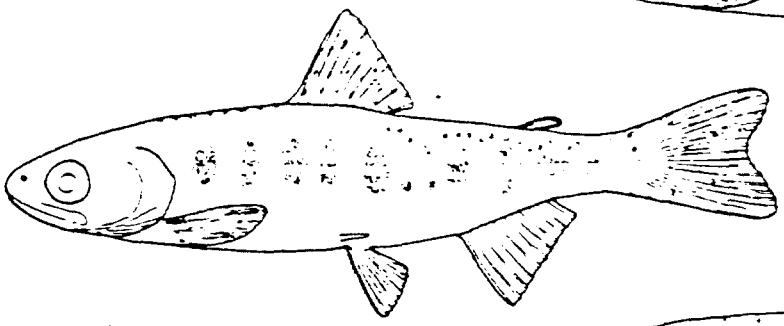


FIGURE 30. Rainbow trout 3½ inches long.

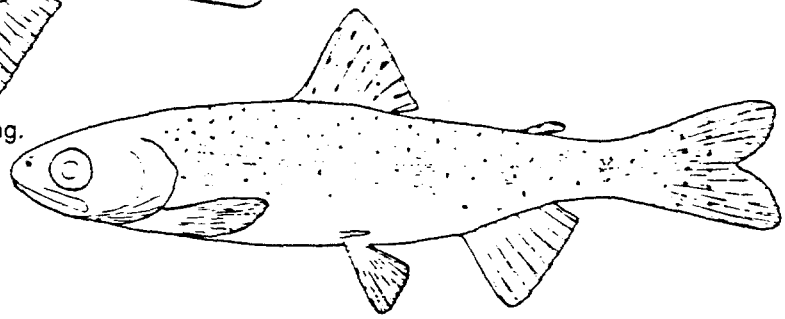


FIGURE 31. Cutthroat trout 3½ inches long.

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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

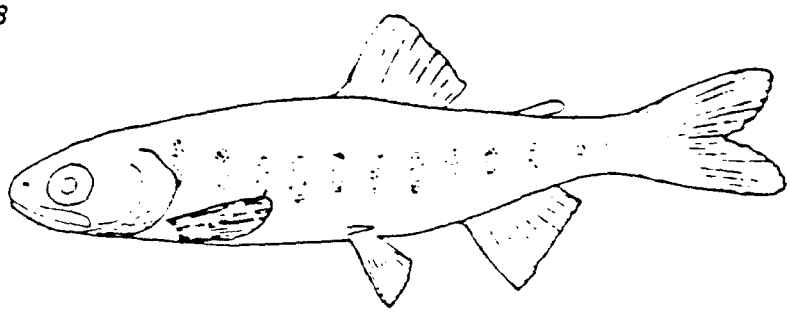

FIGURE 32. Lake trout 5 inches long.

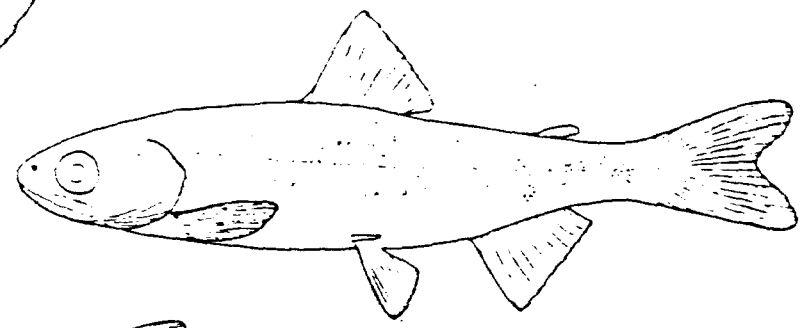

FIGURE 33. Dolly Varden 4 inches long.

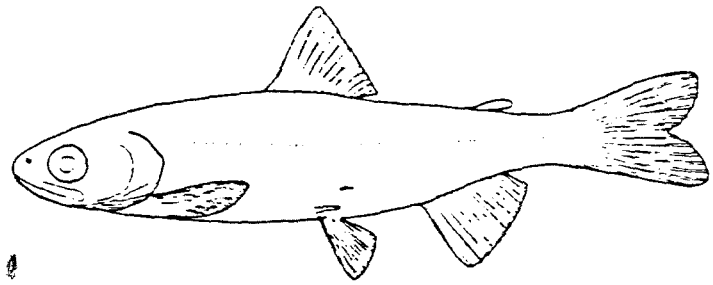

FIGURE 34. Pink salmon 2 inches long.

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

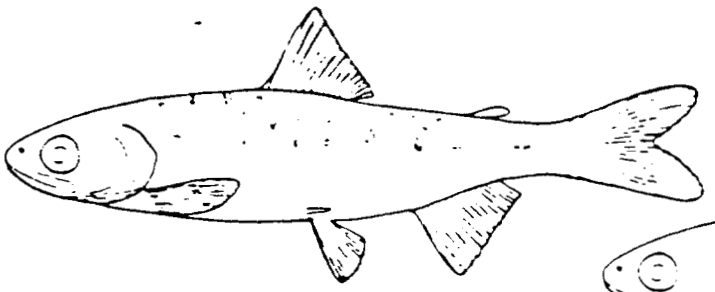

FIGURE 35. Sockeye salmon 3¾ inches long.

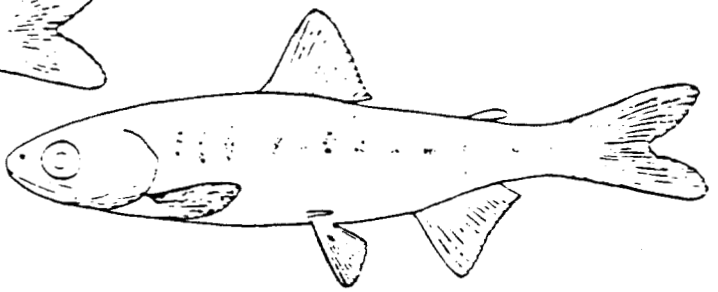

FIGURE 36. Chum salmon 4 inches long.

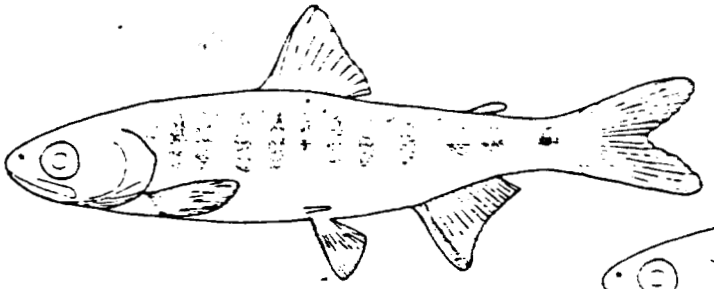

FIGURE 37. Coho salmon 4 inches long.

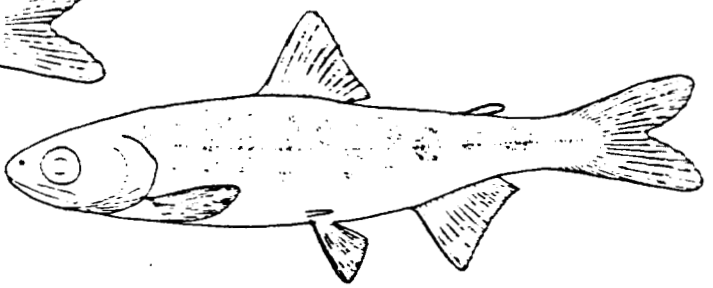

FIGURE 38. Chinook salmon 5 inches long.

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)

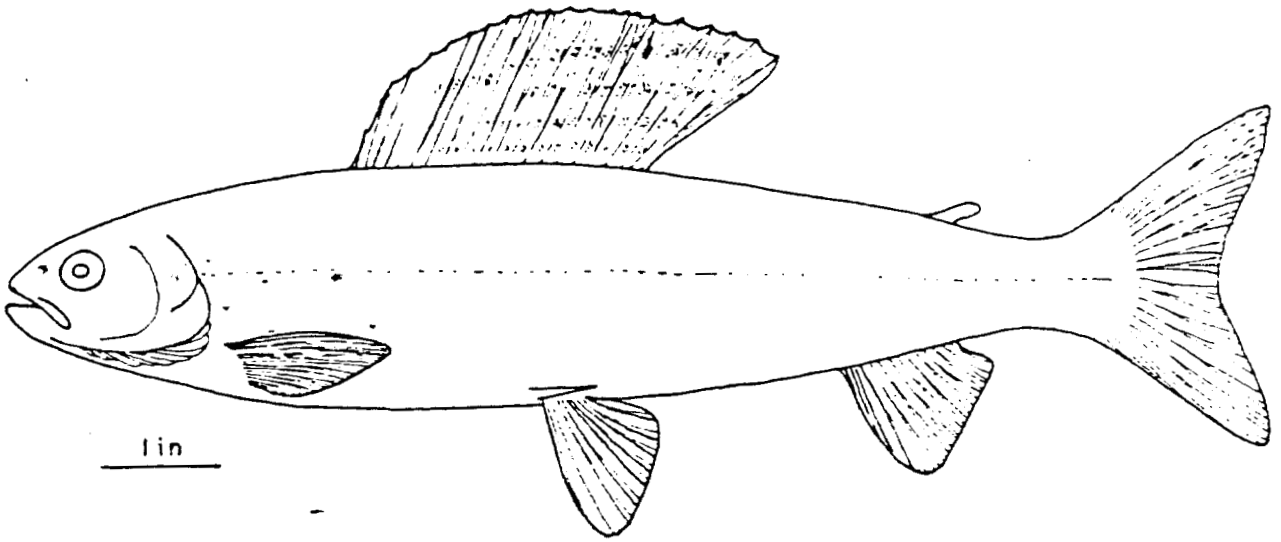

FIGURE 39. Arctic grayling, *Thymallus arcticus.*

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.

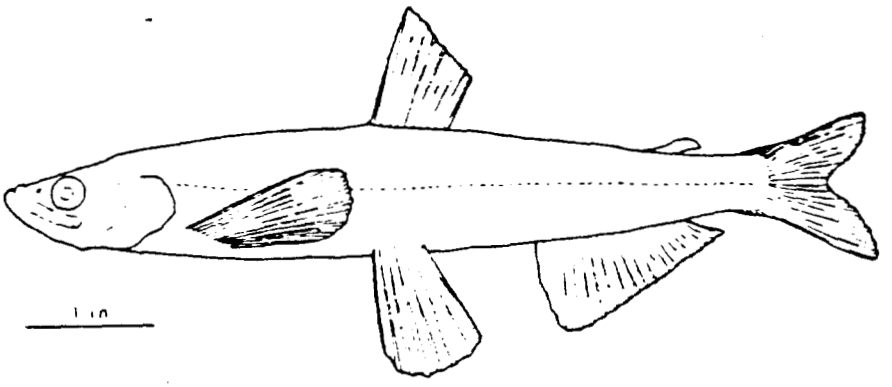

FIGURE 40. Longfin smelt, *Spirinchus thaleichthys.*

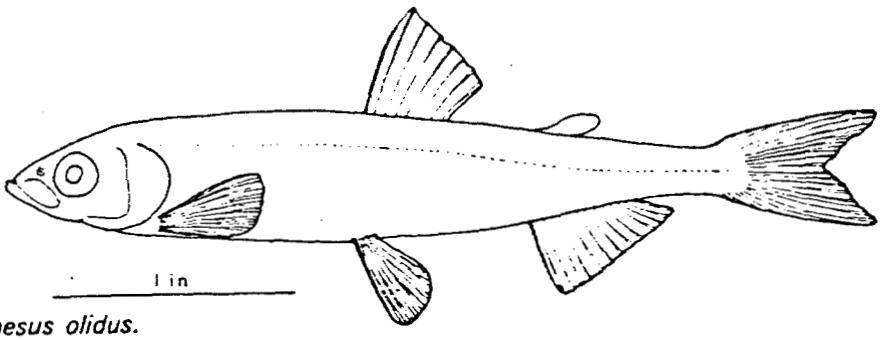

FIGURE 41. Pond smelt, *Hypomesus olidus.*

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.

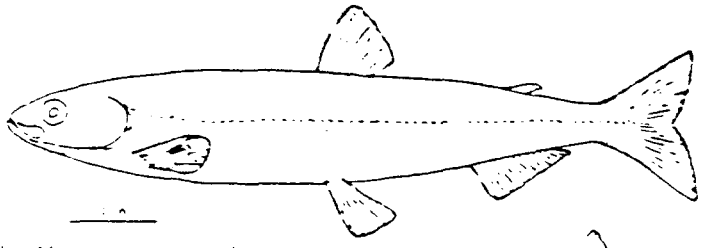

FIGURE 42. Surf smelt, *Hypomesus pretiosus.*

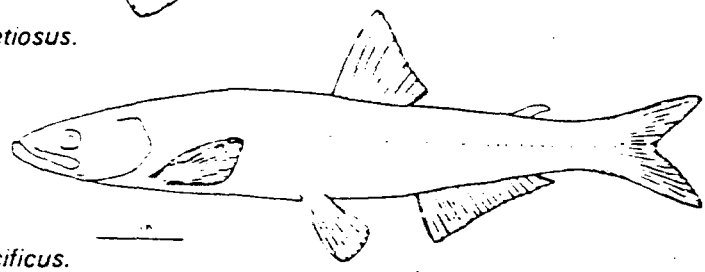

FIGURE 43. Eulachon, *Thaleichthys pacificus.*

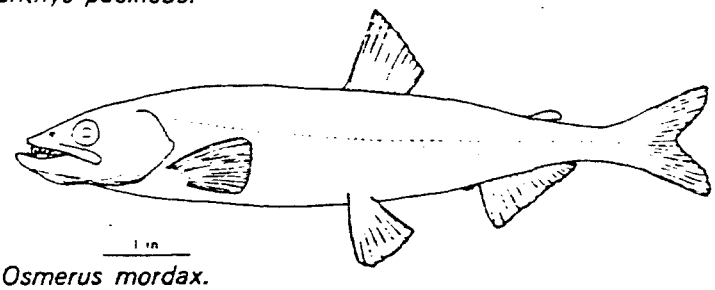

FIGURE 44. Rainbow smelt, *Osmerus mordax.*

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 ahead 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.

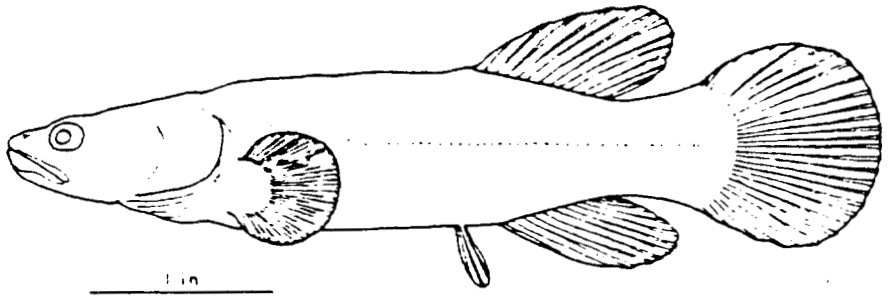

FIGURE 45. Alaska blackfish, *Dallia pectoralis.*

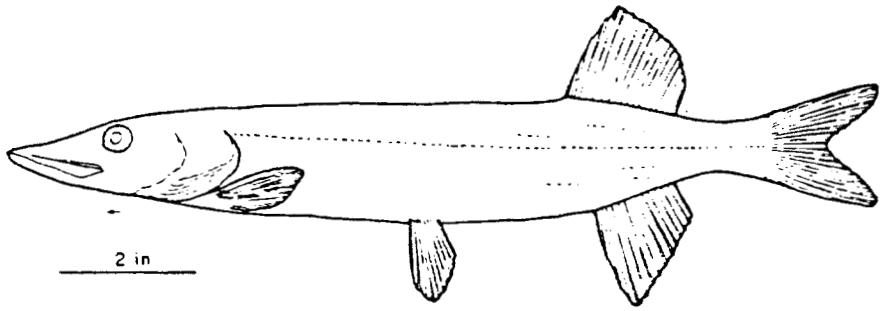

FIGURE 46. Northern pike, *Esox lucius.*

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.

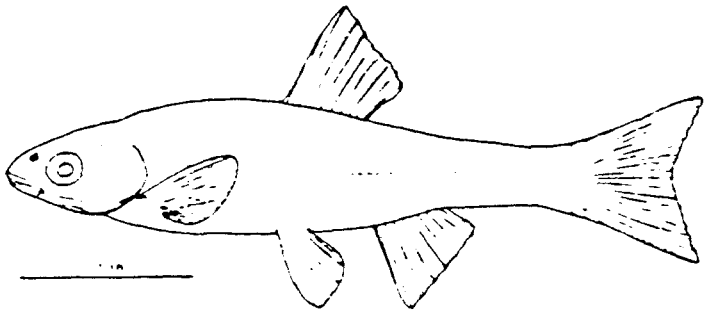

FIGURE 47. Lake chub, *Couesius plumbeus.*

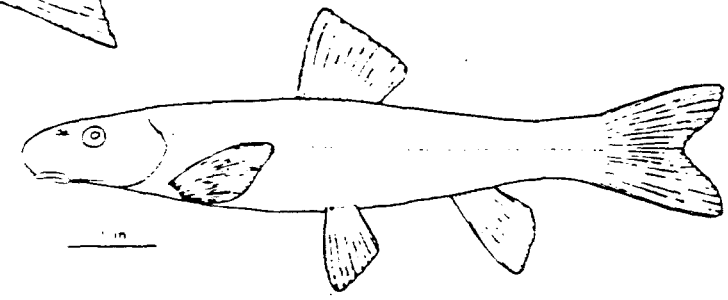

FIGURE 48. Longnose sucker, *Catostomus catostomus.*

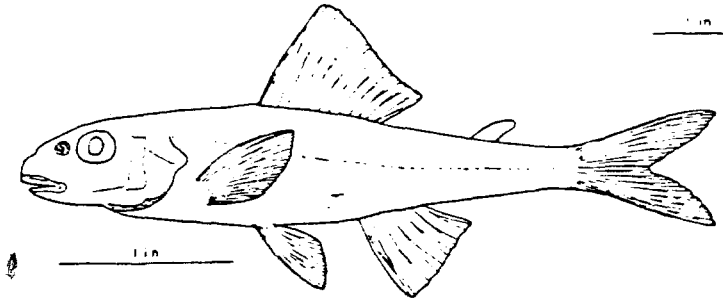

FIGURE 49. Troutperch, *Percopsis omiscomaycus.*

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.

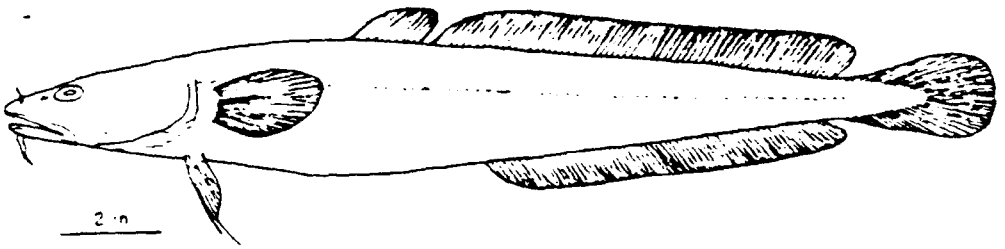

FIGURE 50. Burbot, *Lota lota.*

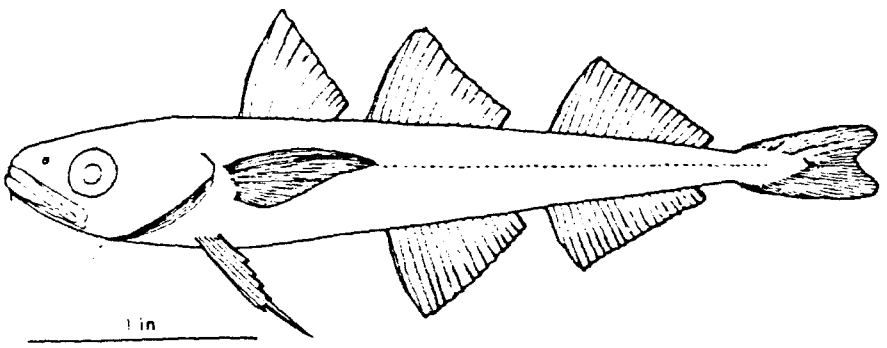

FIGURE 51. Arctic cod, *Boreogadus saida.*

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.

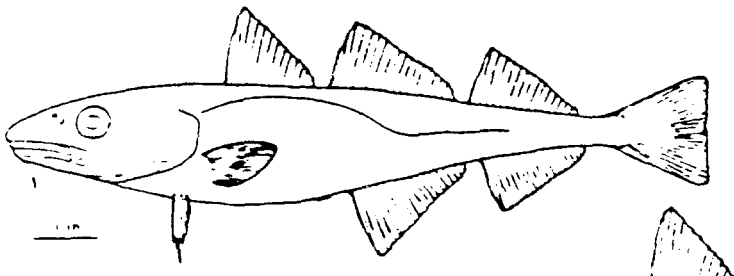

FIGURE 52. Pacific cod, *Gadus macrocephalus.*

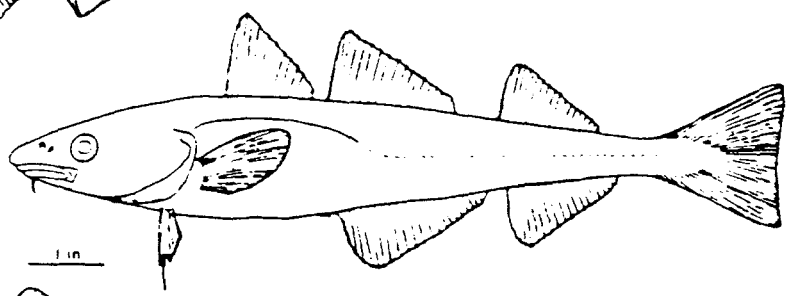

FIGURE 53. Saffron cod, *Eleginus gracilis.*

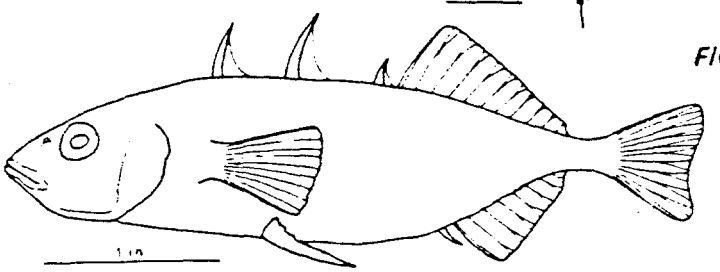

FIGURE 54. Threespine stickleback, *Gasterosteus aculeatus.*

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 fresh-water 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.

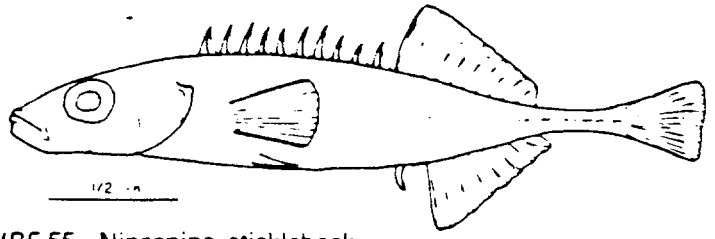

FIGURE 55. Ninespine stickleback, *Pungitius pungitius.*

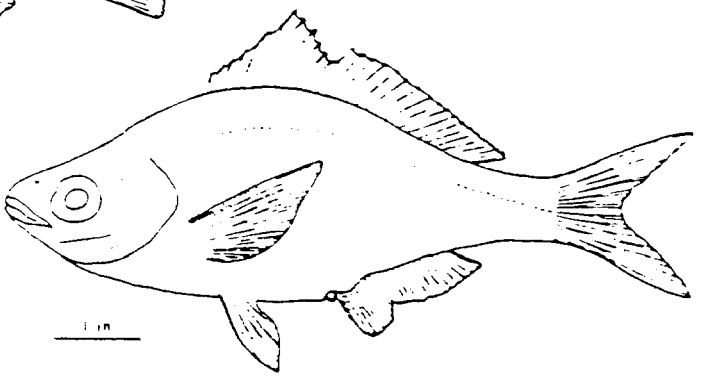

FIGURE 56. Shiner perch, *Cymatogaster aggregata.*

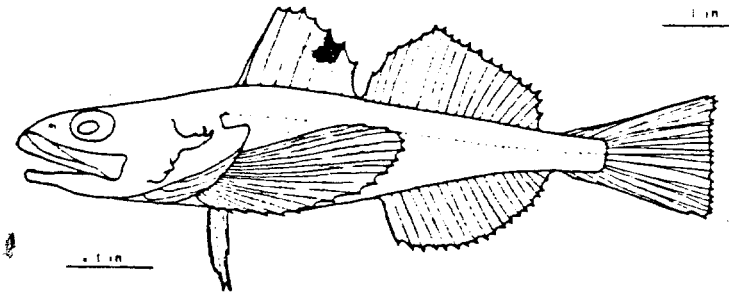

FIGURE 57. Pacific staghorn sculpin, *Leptocottus armatus.*

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.

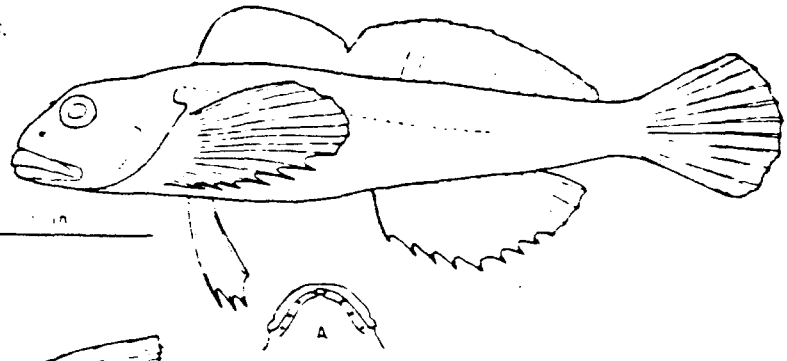

FIGURE 58. Slimy sculpin, *Cottus cognatus*. A. Under side of the head to show the two pores at the tip of the chin.

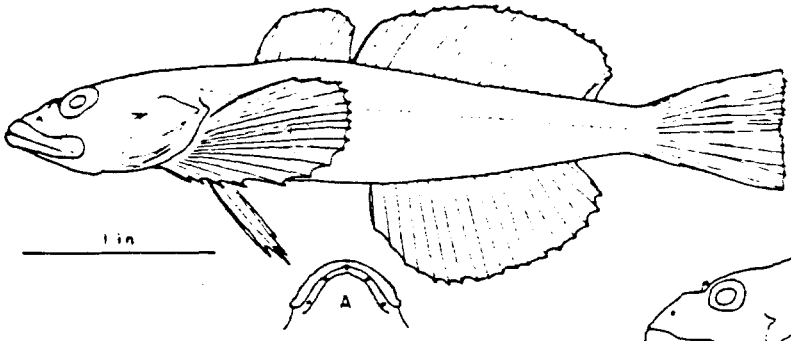

FIGURE 59. Prickly sculpin, *Cottus asper*. A. Under side of the head to show the single pore at the tip of the chin.

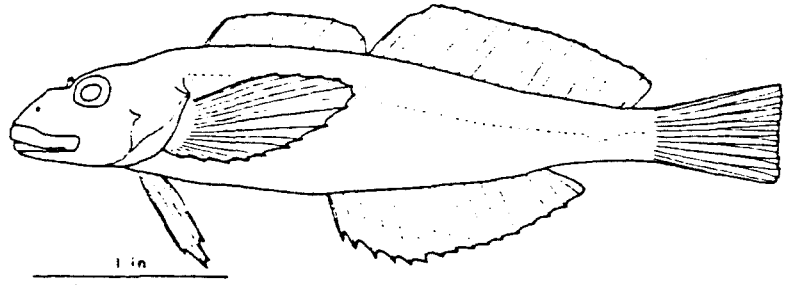

FIGURE 60. Coastrange sculpin, *Cottus aleuticus*.

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

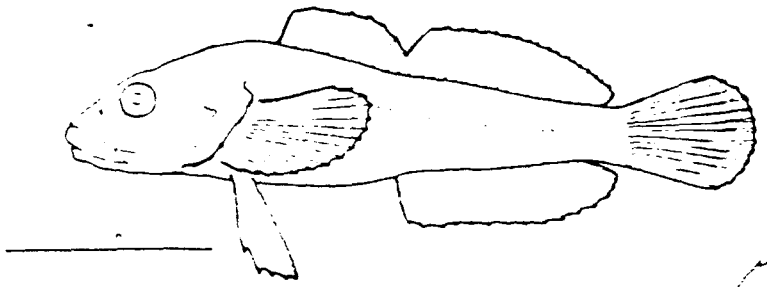

FIGURE 61. Riffle sculpin, *Cottus gulosus.*

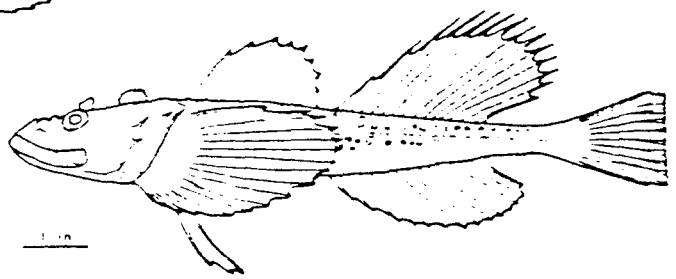

FIGURE 62. Fourhorn sculpin, *Myoxocephalus quadricornis.*

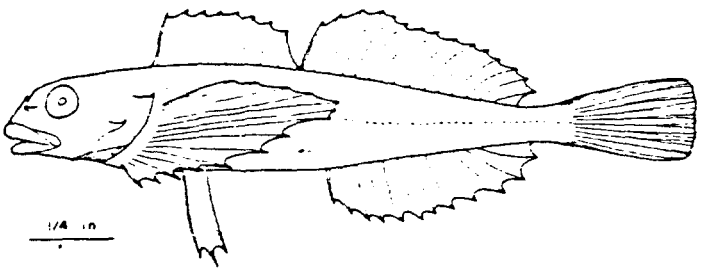

FIGURE 63. Sharpnose sculpin, *Clinocottus acuticeps.*

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.

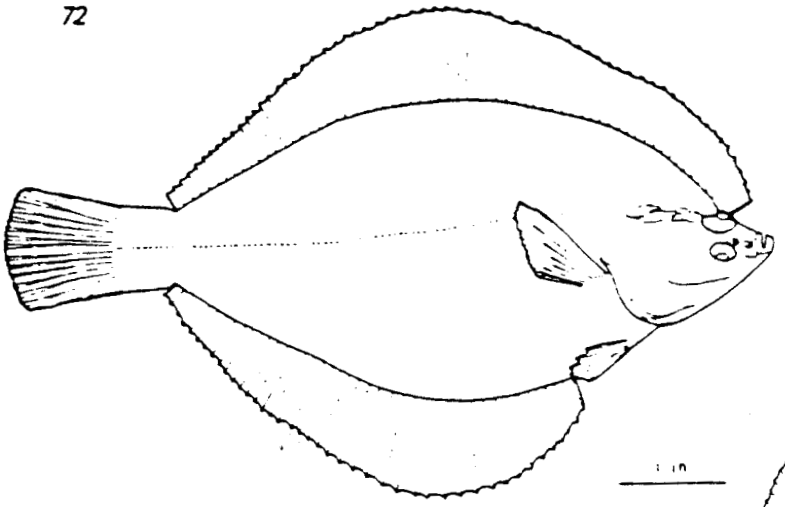

FIGURE 64. Arctic flounder, *Liopsetta glacialis.*

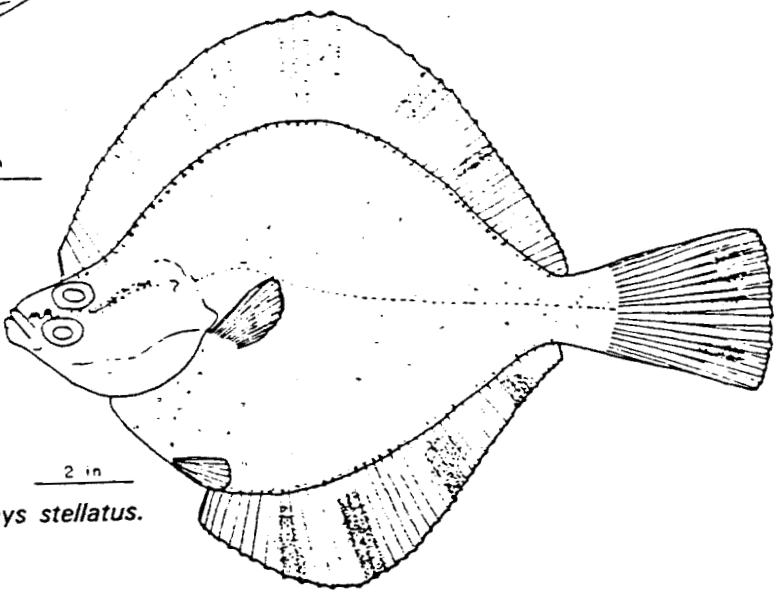

FIGURE 65. Starry flounder, *Platichthys stellatus.*

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

ROBERT J. McCONNELL and GEORGE R. SNYDER

SEATTLE, WA.
January 1972

NOAA TECHNICAL REPORTS

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330. EASTROPAC Atlas: Vols. 4, 2. Catalog No. I 49.4:330/(vol.) 11 vols. ($4.75 each). Available from the Superintendent of Documents, Washington, D.C. 20402.

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332. Pacific hake. (12 articles by 20 authors.) March 1970, iii + 152 pp., 72 figs., 47 tables.

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335. Progress report of the Bureau of Commercial Fisheries Center for Estuarine and Menhaden Research, Pesticide Field Station, Gulf Breeze, Fla., fiscal year 1969. By the Laboratory staff. August 1970, iii + 33 pp., 29 figs., 12 tables.

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

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338. Bureau of Commercial Fisheries Biological La oratory, Auke Bay, Alaska. By Bureau of Co mercial Fisheries. June 1970, 8 pp., 6 figs.

339. Salmon research at Ice Harbor Dam. By Wesl J. Ebel. April 1970, 6 pp., 4 figs.

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

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

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

343. Report of the Bureau of Commercial Fisheri Biological Laboratory, Galveston, Texas, fisc year 1969. By the Laboratory staff. Augu 1970, iii + 39 pp., 28 figs., 9 tables.

344. Bureau of Commercial Fisheries Tropical Atla tic Biological Laboratory progress in resear 1965-69, Miami, Florida. By Ann Weeks. O tober 1970, iv + 65 pp., 53 figs.

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347. Synopsis of biological data on Pacific ocean perc *Sebastodes alutus*. By Richard L. Major an Herbert H. Shippen. December 1970, iii + 3 pp., 31 figs., 11 tables.

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

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ABSTRACT

A key is presented with descriptive illustrations to help in field identification of live, juvenile salmonids in fresh waters of the Pacific Northwest. Other juvenile fish that may be mistakenly identified as salmonids are included.

INTRODUCTION

Species identification of live, anadromous juvenile salmonids is frequently a problem to the field biologist. The purpose of this key is to list and illustrate the external characteristics which will expedite field identification of juvenile salmonids in the Pacific Northwest.

Five species of Pacific salmon (pink, chum, sockeye, chinook, and coho); four species of trout (cutthroat, brown, Dolly Varden, and rainbow or steelhead); and other juvenile and adult fish [1] that may be mistaken for salmon or trout in fresh water are described in this key.

USE OF KEY

The characteristics for identification are listed in a series of alternative statements, some of which are illustrated. To use the key, examine the first statement; if applicable, proceed to the next and continue to successive statements until the species is identified. If a statement is not applicable, pass to the alternative characteristics indicated by numbers in parentheses (numbers on the drawings correspond to numbers of statements in the key). Continue in this manner until the specimen is identified. Some external characteristics are positive separating features (marked with asterisk), whereas others are not. Therefore, two or more statements should be considered before final rejection. If a precise identification cannot be made using the external characteristics —and the fish can be sacrificed, a positive identification can usually be made from internal features (marked with double asterisks). A bibliography of keys that utilize more descriptive internal characteristics is included in this paper.

[1] Especially adult smelt, family Osmeridae.

KEY

1. (47) Adipose fin and scales present. (Fig. 1)
2. (48) Fleshy appendage at base of pelvic fins present.
3. (49) Mouth large, reaching at least to center of eye.

Family Salmonidae

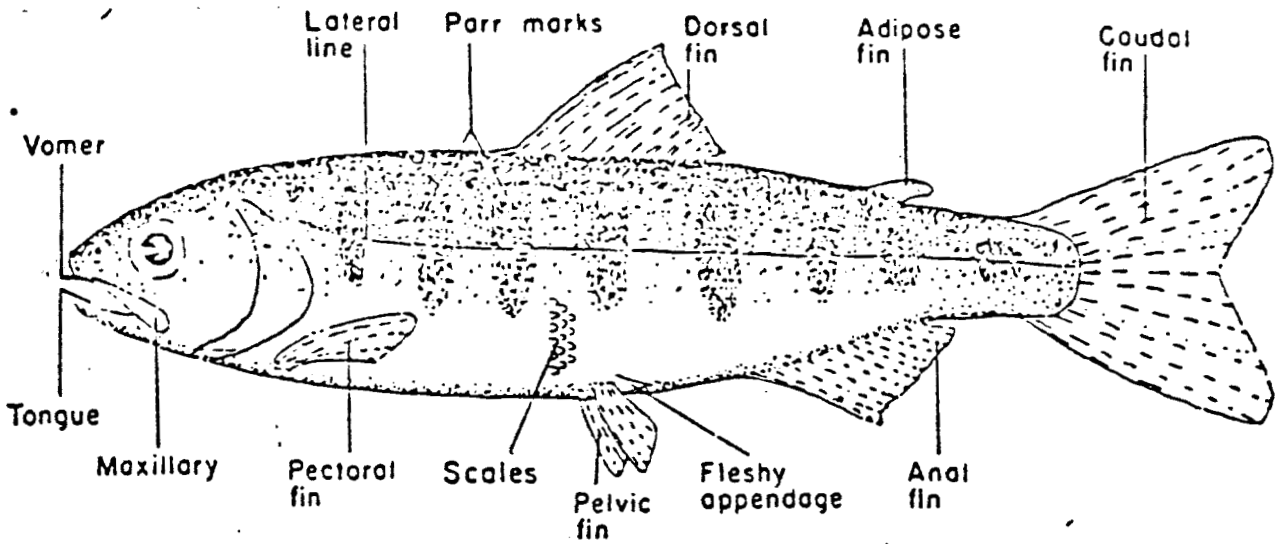


Figure 1.—A hypothetical salmonid showing external characteristics.

4. (17) Anal fin higher than long, with 8 to 12 developed rays (Fig. 2A)
5. (52) *Teeth on head and shaft of vomer. (Fig. 3A)

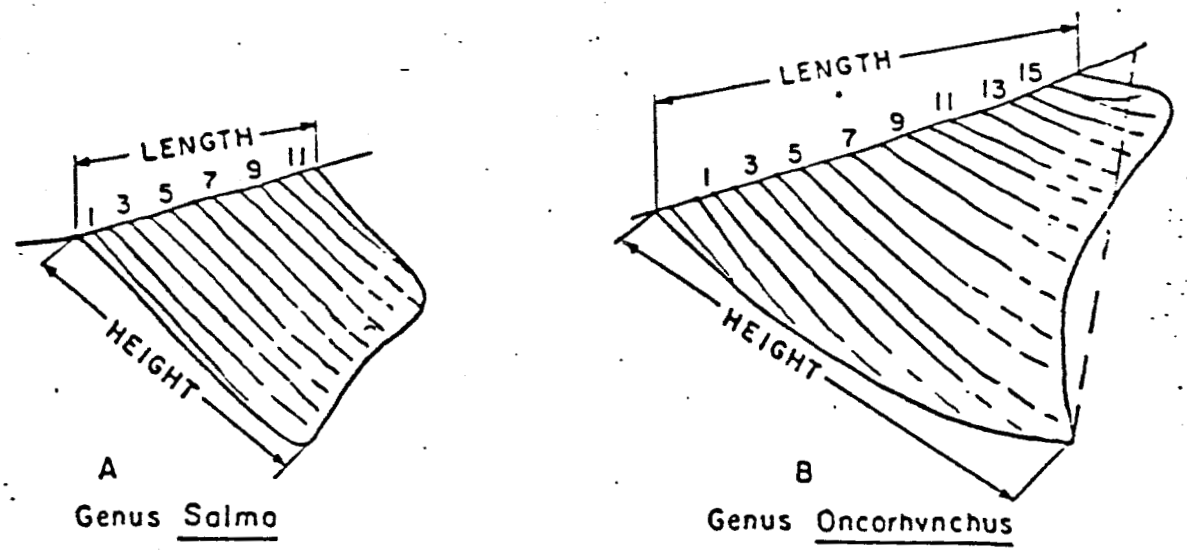


Figure 2.—Anal fins: (A) Trout, genus *Salmo;* (B) Pacific salmon, genus *Oncorhynchus.* The two drawings show differences in structure and fin ray count. (Note that the length of the anal fin is its overall basal length, and its height is that distance from the origin of the fin to the tip of the anterior lobe. In counting fin rays, include only those which originate from the base and terminate at the outer margin of the fin or are half as long as [or greater than] the longest ray.)

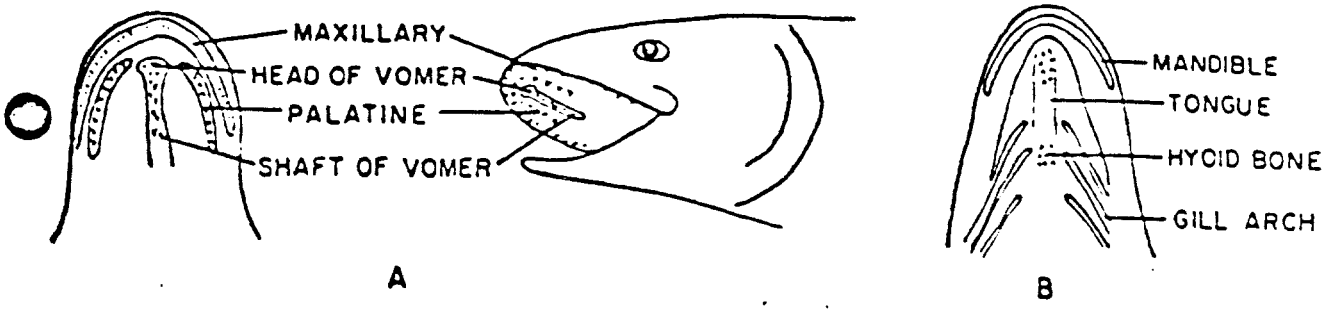


Figure 3.—Location of dentition in (A) the roof and (B) the floor of the mouth of salmonid fishes. (Presence or absence of teeth on the vomer or tongue may be determined by use of the little finger or a blunt instrument. The small hyoid teeth at the base of the tongue are located between the gill arches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

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

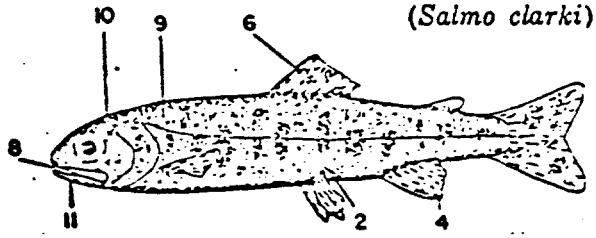
7. (53) Adipose fin not orange; no row of pale round spots along lateral line.

8. (12) *Small hyoid teeth at base of tongue. (Fig. 3B)

9. (13) Not more than five parr marks on mid-dorsal ahead of dorsal fin.

10. (14) Maxillary reaching past posterior margin of eye.

11. (15) Red or yellowish hyoid mark under lower jaw. Tail usually black spotted.
Cutthroat trout
(*Salmo clarki*)



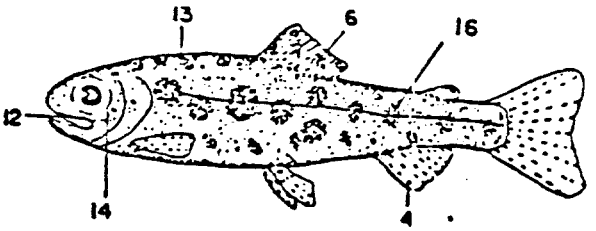
12. (8) *No teeth at base of tongue.

13. (9) Five to 10 parr marks along mid-dorsal ridge ahead of dorsal fin.

14. (10) Maxillary short, not reaching past posterior margin of eye.

15. (11) No hyoid mark under lower jaw. Few or no spots on tail.

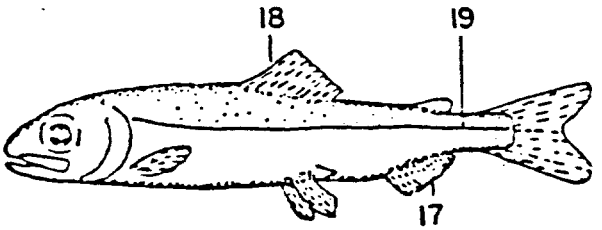
16. (20) Parr marks almost round.
Rainbow or steelhead trout
(*Salmo gairdneri*)



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

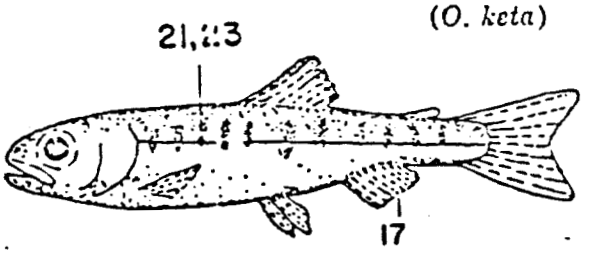
18. (6) Dorsal fin without large dark spots, may be black tipped.
Pacific salmon
Genus *Oncorhynchus*

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



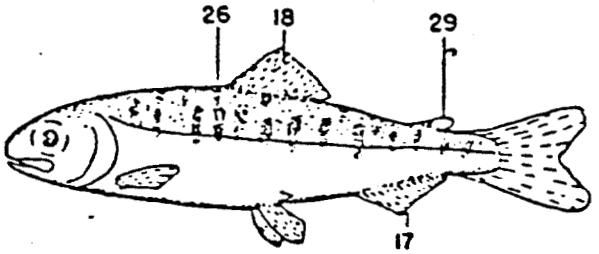
20. (16) Parr marks present as vertical bars or oval spots.
21. (30) Parr marks short, extending little, if any, below lateral line.
22. (25) Gill rakers on first arch, 19 to 26. ** Pyloric caeca, 140 to 186.
23. (26) Parr marks faint. Sides below lateral line iridescent green.
24. (27) Small when migrating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

Chum salmon
(*O. keta*)



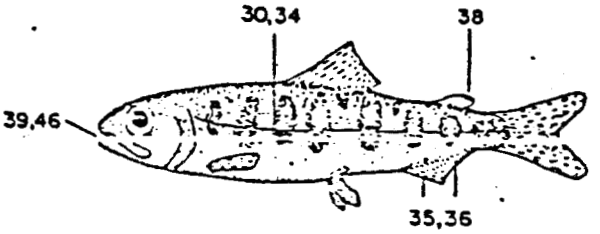
25. (22) Gill rakers on first arch, 30 to 40. **Pyloric caeca 60 to 115.
26. (23) Parr marks usually sharply defined. Sides below lateral line silvery, not iridescent green.
27. (24) Relatively large when migrating from fresh water, approximately 3 to 5 inches (80 to 126 mm) long.
28. (31) Gill rakers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

Sockeye salmon
(*O. nerka*)



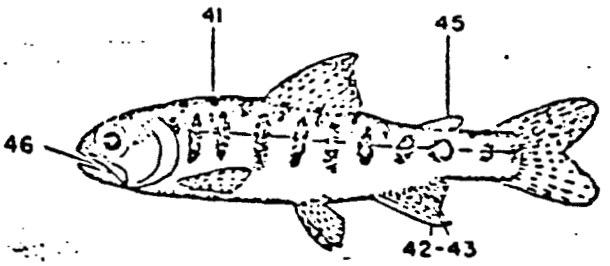
30. (21) Parr marks large, vertical bars centered by lateral line.
31. (28) **Gill rakers short and thick, fewer than 29 on first arch.
32. (29) Adipose fin at least partially pigmented.
33. (40) **Plyloric caeca more than 90.
34. (41) Parr marks broader than interspaces.
35. (42) Anterior rays of anal fin not distinctly longer than rest, not whit edged.
36. (43) Anal fin not pigmented.
37. (44) Black spots, when present, on both lobes of caudal fin.
38. (45) Adipose fin not completely mottled clear area at anterior base of fin.
39. (46) Black gums along base of lower teeth

Chinook salmon
(*O. tshawytscha*)



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

Coho salmon
(*O. kisutch*)



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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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AKALURA LAKE OPERATIONAL PLAN, 1989

Alaska Department of Fish and Game
Division of Commercial Fisheries
211 Mission Road
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INTRODUCTION

Akalura Lake which covers about 1,280 surface acres was historically a major sockeye salmon system that contributed to the Alitak Bay District salmon fisheries (Figure 1). The system was commercially over-exploited from the late 1930's through the 1950's. Prior to the decline there were several years of sockeye escapements of over 100,000 fish. The 1923 - 1947 escapements averaged 70,000 fish. In the 1950's escapements averaged 7,000 fish. Current escapements are averaging about 10,000 fish. The 1988 sockeye escapement was 38,000 fish. Optimum escapement is in the 50,000 fish range. The Akalura sockeye salmon run is insufficient to attain potential returns without restoration measures. Sockeye salmon once a dominant species in the lake have been reduced to a point where competitor and predatory species are are of much greater abundance. Freshwater survival of young-of-the-year sockeye fry rearing in the lake is thought to be so severely depressed by these other species that there is little chance for sockeye salmon to regain dominance without restoration measures. The current recommendation is to fertilize the lake and in the low escapement years to supplement natural fry production.

In 1987 the Division of Commercial Fisheries (C.F.) in cooperation with the Division of Fisheries Rehabilitation, Enhancement and Development (FRED) initiated a pre-rehabilitation study of the Akalura Lake system. Currently the C.F. Division focus has been on monitoring the escapement, smolt migration, and the seasonal abundance of limnetic fish, while the FRED Division focus has been on water quality and seasonal variations in abundance and species composition of the lake's plankton community.

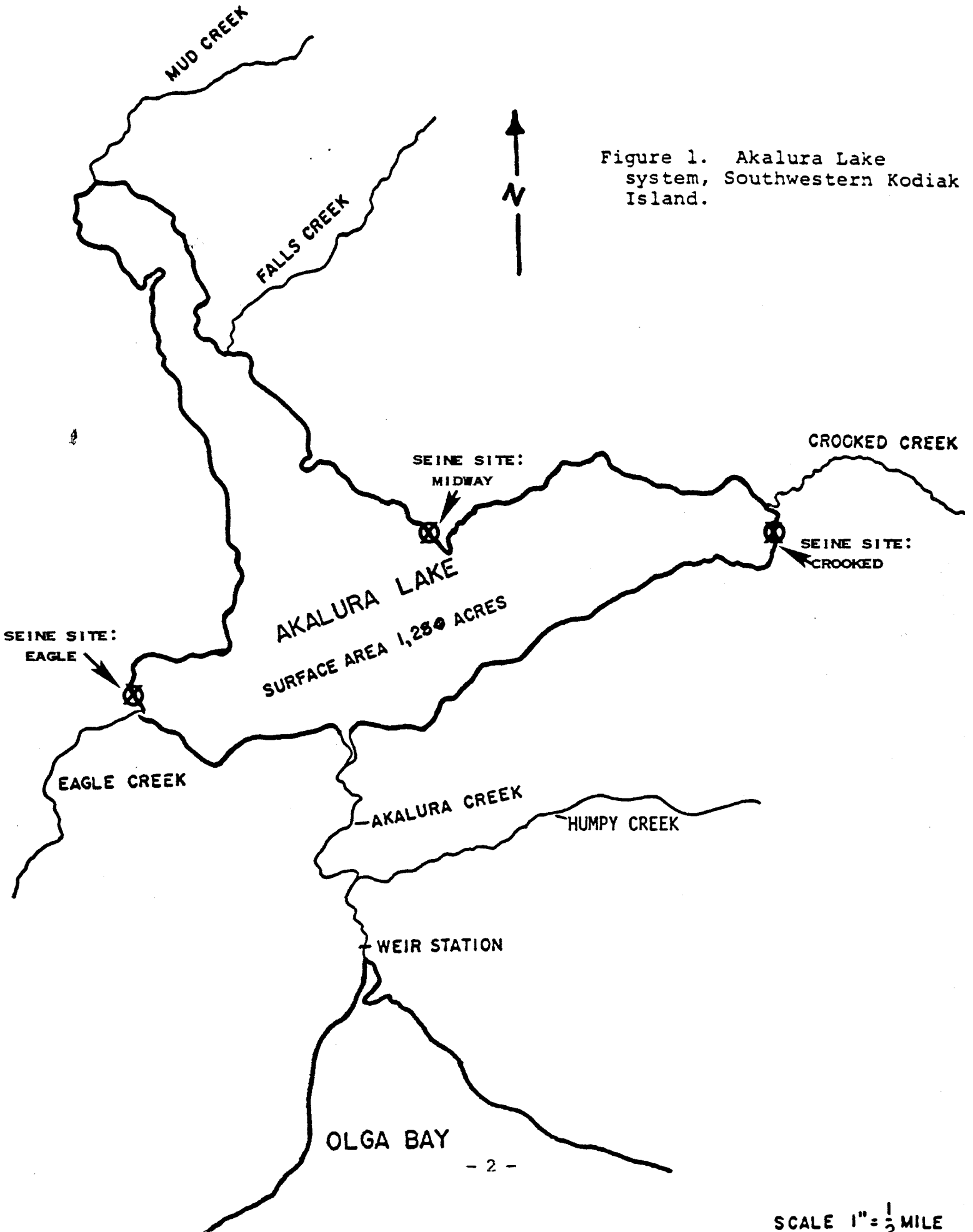

Figure 1. Akalura Lake system, Southwestern Kodiak Island.

OBJECTIVES

1. Enumerate the sockeye salmon escapement into Akalura Lake.

2. Determine the sockeye escapement timing, and estimate the age composition, mean length by age, and sex composition of the escapement

3. Determine sockeye smolt timing, quality and relative abundance.

4. Determine the seasonal abundance of limnetic fish in Akalura Lake.

5. Determine the timing and distribution of the sockeye escapement on the spawning grounds.

SUPERVISION

Jeff Hall, an ADF&G volunteer will be the crew leader and shall be responsible for following the procedures outlined in this manual through his last day of duty on approximately 21 June. An USF&W technician will be transferred to Akalura on or about 21 June to complete the project. Chuck Hastings, the crew leader at the Frazer Lake fishpasses, will be Jeff's field supervisor. In this capacity Chuck will monitor the Akalura operation to insure that project objectives are being met. Bruce Barrett (ADF&G) and Tony Chatto (USF&WS) will administratively oversee the Akalura project.

PROCEDURES

Escapement Enumeration and Sampling

An aluminum weir will be installed across Akalura Creek at a field selected location on or about 22 May. The weir will be maintained and operated, funding permitted, through mid-September. The weir be opened daily as often as necessary to prevent migrational delay. Adult salmon passing through the weir will be individually counted using hand-held tally counters. Weir escapement counts will be recorded on form FL-1(86) (Figure 2).

An escapement sample of approximately 480 sockeye salmon will be taken from the early run and the late run. The sampling is to be done near the peak of each run. The peak of each run can not be predicted with much certainty. However generally the early run peaks in mid June while the late run peaks in late August. Escapement sampling will require two crewmen. Sampling assistance may be obtained from the Frazer Lake crew and or the catch sampling crew at Alitak. Escapement sampling procedures are provided in Appendix A.

Smolt Sampling

An inclined plane trap will be installed and operated on Akalura Creek at a location just upstream of the lagoon from approximately 22 May through 21 June. The trap will be checked multiple times daily to insure that it is operating effectively and smolt mortalities

Figure 2.

AKALURA LAKE 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.

are not occurring. All catches are to be counted by species and released except stickleback which should be destroyed. The catch data will be recorded on form A87-2 (Figure 3). Two 220 sockeye salmon smolt samples will be collected from the inclined plane trap for length, weight, and age determination following the procedures identified in Appendix B. The first 220 smolt sample will be collected before 28 May, while the second 220 sample will be taken about 2 weeks later. Each sample will be taken from a single day's catch if possible. Sampling may extend over into the next couple days if the 220 fish sample size is not met on the first day.

Escapement Surveys

Once every two weeks from 15 July to 15 September, Akalura Lake shoals and Crooked Creek, Falls Creek, and Eagle Creek will be surveyed for sockeye escapement (Figure 1). The shoal areas will be surveyed by a fixed wing aircraft, while the stream escapements will be surveyed on foot. The Frazer crew will assist in the stream and aerial escapement surveys if assistance is requested. The observers will wear polarized glasses and use hand-held tally counters to record live and dead fish by species. The survey counts will be recorded on form FL87-2 (Figure 4).

Beaver dams that pose a migrational barrier to salmon escapement will be removed.

Figure 3.

DAILY CATCH LOG OF DOWNSTREAM MIGRANT FISH

A87-2

Date	Sockeye		Coho		Rainbow		Dolly Varden		Stickleback		Remarks
	Daily	Cum.	Daily	Cum.	Daily	Cum.	Daily	Cum.	Daily	Cum.	

Figure 4.

SOCKEYE SALMON STREAM SURVEY LOG

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.

Limnological Support and Juvenile Fish Rearing in the Littoral Area

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

Three Akalura Lake littoral sites will be sampled with a standard 50 ft. fry seine once every two weeks beginning on 22 May and ending on 15 August (Table 1). The sampling locations are identified in Figure 1. Each site should be permanently marked with a fence post stake and flagging to insure the same location is fished. On the sampling days the seining will be done between approximately 10 am and 2 pm to minimize diurnal variability. The seine catches will be logged on form FL 87-3 (Figure 5). Standard length measurements will be taken from a subsample of each species catch. The length data will be recorded on form FL87-3.

Figure 5.

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.					
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APPENDIX A

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 Figure 1. A completed AWL form and accompanying gum cards for sampling commercial catches of chinook and coho salmon is shown in Figure 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

Table 1. 1989 calendar weeks.

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

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 Figure 1. Coho and chinook samples will contain up to four cards per AWL form as shown in Figure 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 Figure 3.

# of cards:
Mark 1 when sampling sockeye and chum salmon (Figure 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 Figure 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.

GUM CARD(S):

Fill out the gum cards as shown in Figures 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 Figure 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 Figure 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 Figure 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 Figure 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 Figure 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 <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 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.

Figure 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). 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"!

ALASKA PENINSULA 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 Peninsula Research Project Leader, Jim McCullough, 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. Popof Head vs. Mainland, Bear River vs. Nelson Lagoon. 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 and 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.

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
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

APPENDIXB

Procedure for Sampling Salmon Smolt

The same size goal per week is 220 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, Figure 2. The scales will be mounted on a glass slide as illustrated in Figure 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, Figure 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.

APPENDIXC

Presmolt Salmon Key and Anadromous Juvenile Salmonides Key

NOAA TR NMFS CIRC-366

A UNITED STATES DEPARTMENT OF COMMERCE PUBLICATION

NOAA Technical Report NMFS CIRC-366

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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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

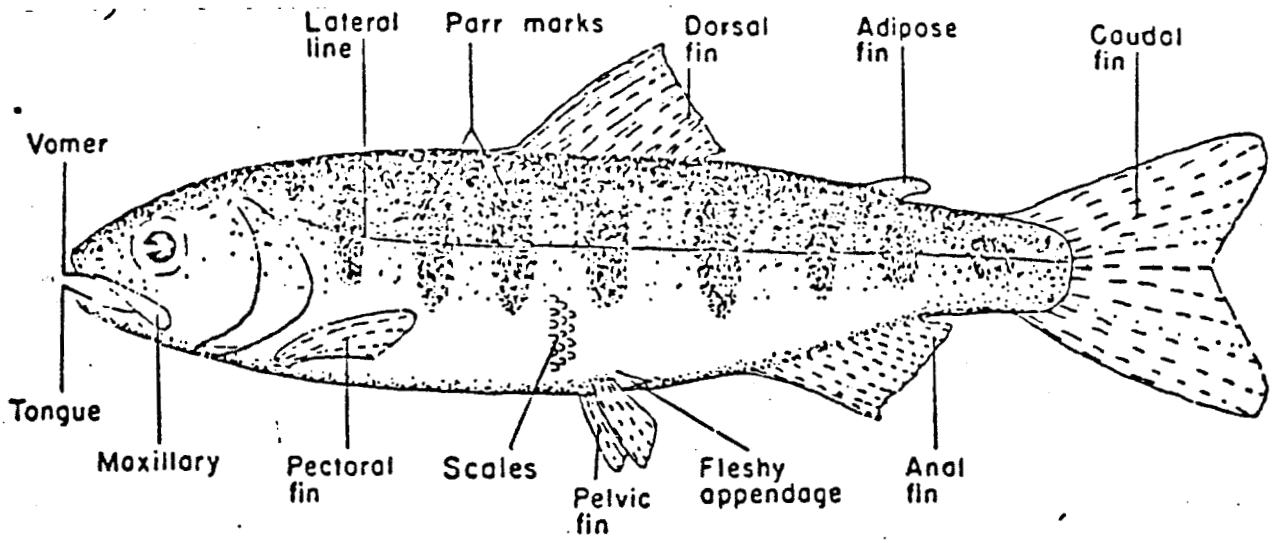


Figure 1.—A hypothetical salmonid showing external characteristics.

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)

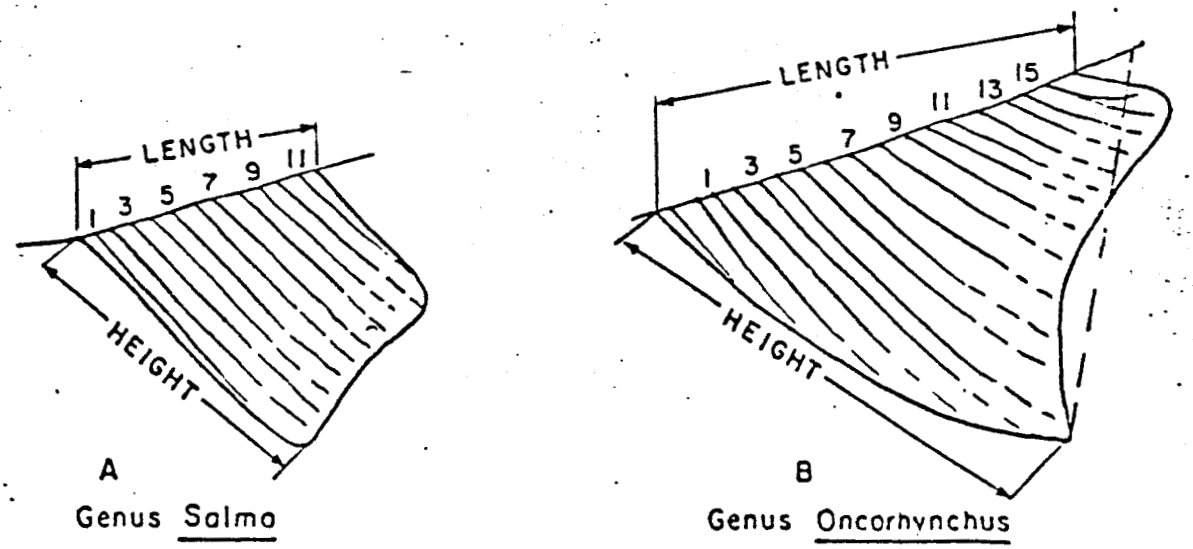


Figure 2.—Anal fins: (A) Trout, genus *Salmo;* (B) Pacific salmon, genus *Oncorhynchus.* The two drawings show differences in structure and fin ray count. (Note that the length of the anal fin is its overall basal length, and its height is that distance from the origin of the fin to the tip of the anterior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

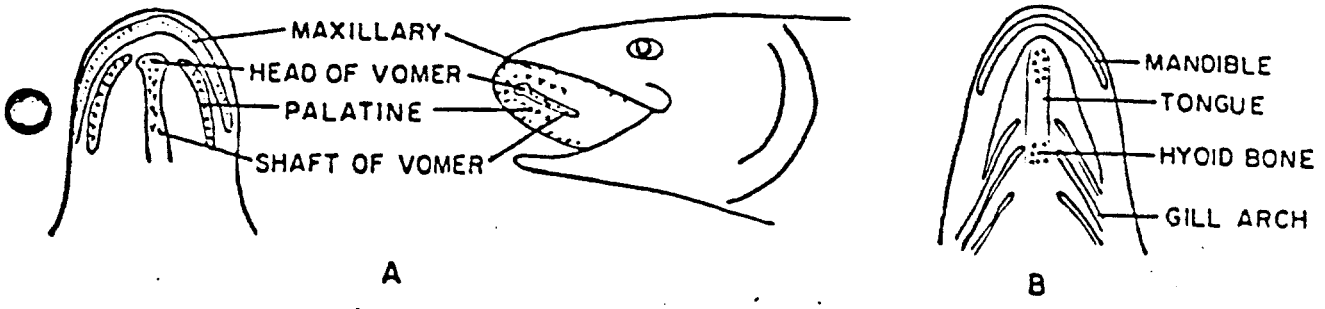


Figure 3.—Location of dentition in (A) the roof and (B) the floor of the mouth of salmonid fishes. (Presence or absence of teeth on the vomer or tongue may be determined by use of the little finger or a blunt instrument. The small hyoid teeth at the base of the tongue are located between the gill arches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

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

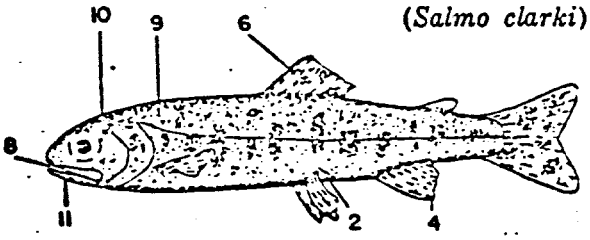
7. (3) Adipose fin not orange; no row of pale round spots along lateral line.

8. (12) *Small hyoid teeth at base of tongue. (Fig. 3B)

9. (13) Not more than five parr marks on mid-dorsal ahead of dorsal fin.

10. (14) Maxillary reaching past posterior margin of eye.

11. (15) Red or yellowish hyoid mark under lower jaw. Tail usually black spotted.
Cutthroat trout
(*Salmo clarki*)



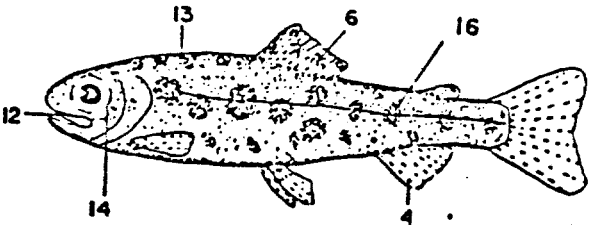
12. (8) *No teeth at base of tongue.

13. (9) Five to 10 parr marks along mid-dorsal ridge ahead of dorsal fin.

14. (10) Maxillary short, not reaching past posterior margin of eye.

15. (11) No hyoid mark under lower jaw. Few or no spots on tail.

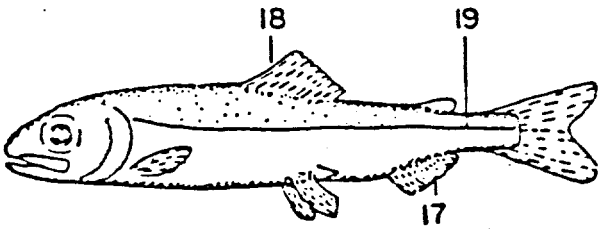
16. (20) Parr marks almost round.
Rainbow or steelhead trout
(*Salmo gairdneri*)



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

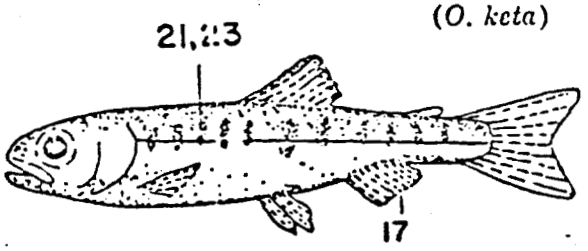
18. (6) Dorsal fin without large dark spots, may be black tipped.
Pacific salmon
Genus *Oncorhynchus*

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



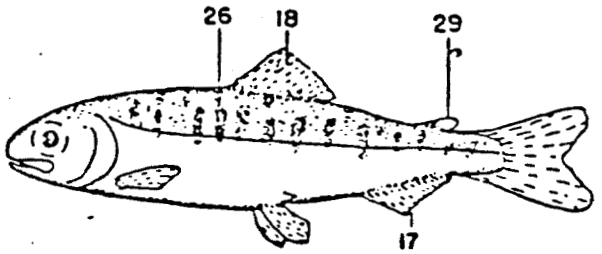
20. (16) Parr marks present as vertical bars or oval spots.
21. (30) Parr marks short, extending little, if any, below lateral line.
22. (25) Gill rakers on first arch, 19 to 26. ** Pyloric caeca, 140 to 186.
23. (26) Parr marks faint. Sides below lateral line iridescent green.
24. (27) Small when migrating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

Chum salmon
(*O. keta*)



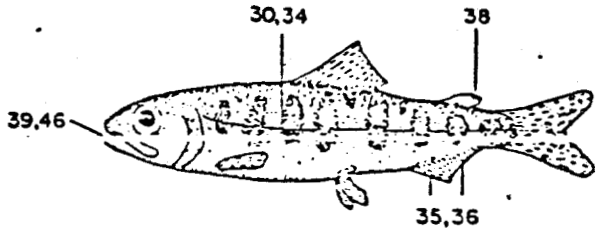
25. (22) Gill rakers on first arch, 30 to 40. **Pyloric caeca 60 to 115.
26. (23) Parr marks usually sharply defined. Sides below lateral line silvery, not iridescent green.
27. (24) Relatively large when migrating from fresh water, approximately 3 to 5 inches (80 to 126 mm) long.
28. (31) Gill rakers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

Sockeye salmon
(*O. nerka*)



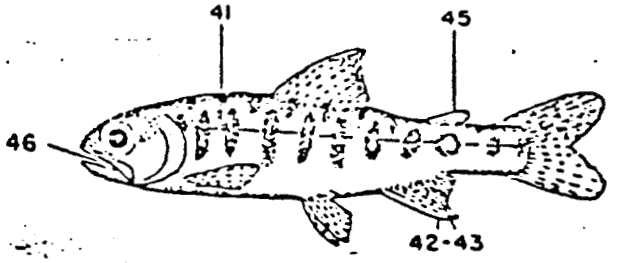
30. (21) Parr marks large, vertical bars centered by lateral line.
31. (28) **Gill rakers short and thick, fewer than 29 on first arch.
32. (29) Adipose fin at least partially pigmented.
33. (40) **Plyloric caeca more than 90.
34. (41) Parr marks broader than interspaces.
35. (42) Anterior rays of anal fin not distinctly longer than rest, not white edged.
36. (43) Anal fin not pigmented.
37. (44) Black spots, when present, on both lobes of caudal fin.
38. (45) Adipose fin not completely mottled, clear area at anterior base of fin.
39. (46) Black gums along base of lower teeth.

Chinook salmon
(*O. tshawytscha*)



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

Coho salmon
(*O. kisutch*)



47. (1) Adipose fin not present; scales present or lacking.
Not Salmonidae

48. (2) No fleshy appendage at base of pelvic fins.
Smelts
Family Osmeridae

49. (3) Mouth small, not reaching center of eye; teeth weak or absent.

50. (51) Depressed dorsal fin, shorter than head.
Whitefishes
Genus *Coregonus*

51. (50) Depressed dorsal fin, longer than head.
Arctic grayling
(*Thymallus arcticus*)

52. (5) **Teeth on head of vomer only.
Chars
Genus *Salvelinus*
Dolly Varden (*S. malma*)

53. (7) Adipose fin orange; row of distinct pale round spots along lateral line.
Brown trout
(*Salmo trutta*)

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Illustrated Keys to the Fresh-water Fishes of Alaska

By JAMES E. MORROW

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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.

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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 1½ 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

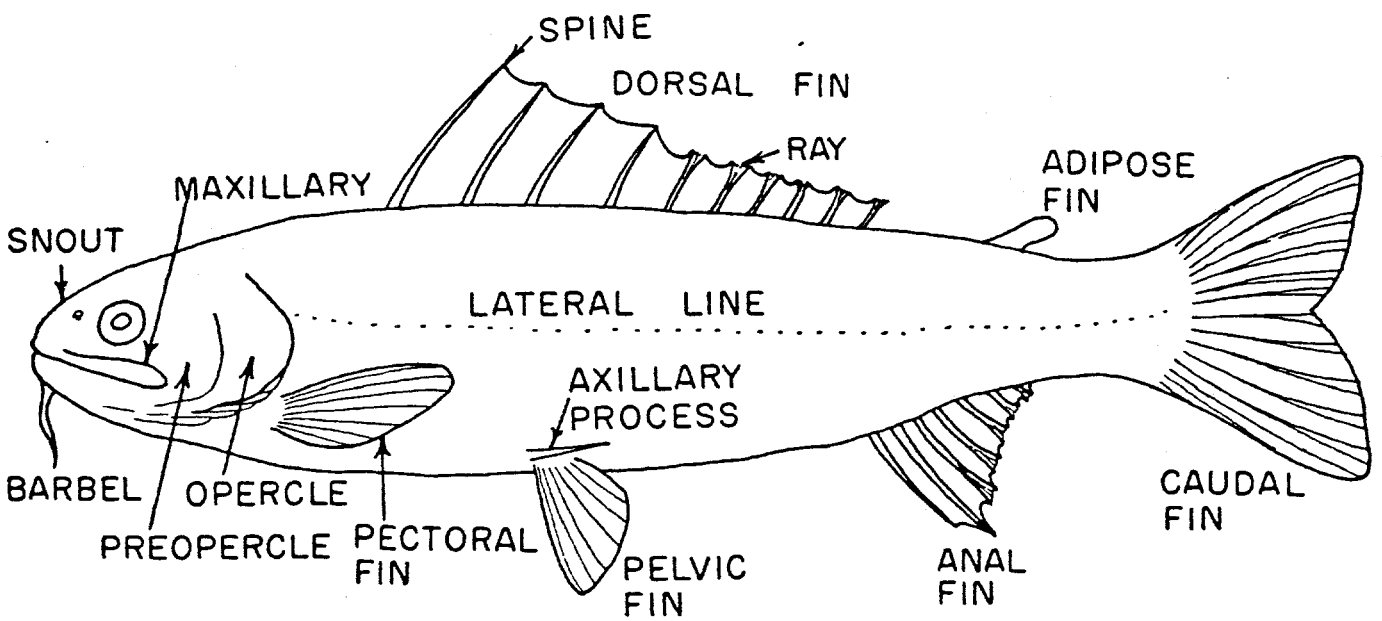

FIGURE 1. A "generalized" fish showing the various structures referred to in the keys.

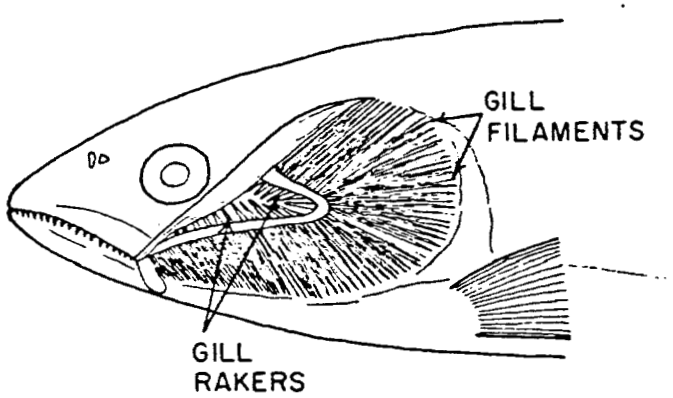

FIGURE 2. Diagram of a gill arch, showing the gill filaments and the gill rakers.

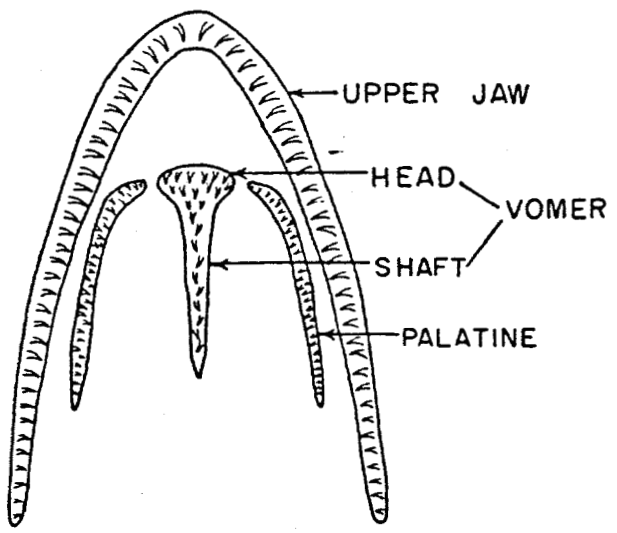

FIGURE 3. Diagram of the roof of the mouth of a fish to show the teeth on the jaws, the head and shaft of the vomer bone, and the palatines.

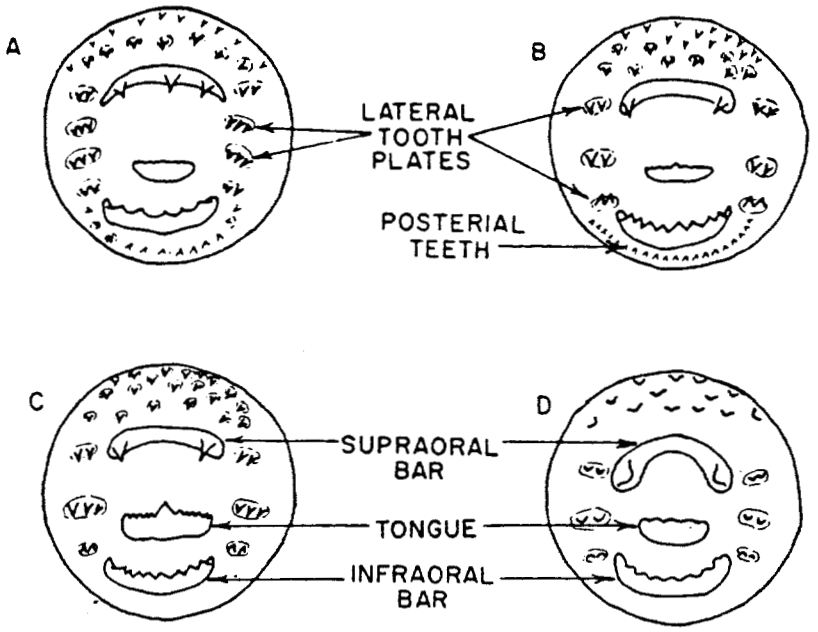

FIGURE 4. Tooth patterns of Alaska lampreys. A. Pacific lamprey, *Entosphenus tridentatus.* B. Arctic lamprey, *Lampetra japonica.* C. River lamprey, *Lampetra ayresi.* D. Western brook lamprey, *Lampetra richardsoni.*

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

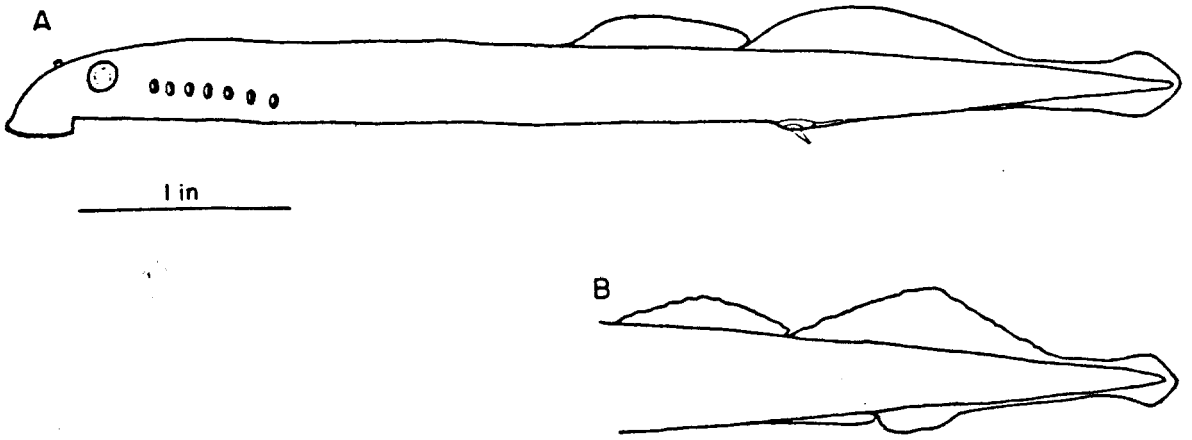

FIGURE 5. Arctic lamprey, *Lampetra japonica.* A. Male. B. Posterior end of female. Note presence of anal fin and lack of urogenital papilla in the female. All four Alaskan lampreys are much alike in general appearance, so only the one species is illustrated.

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.

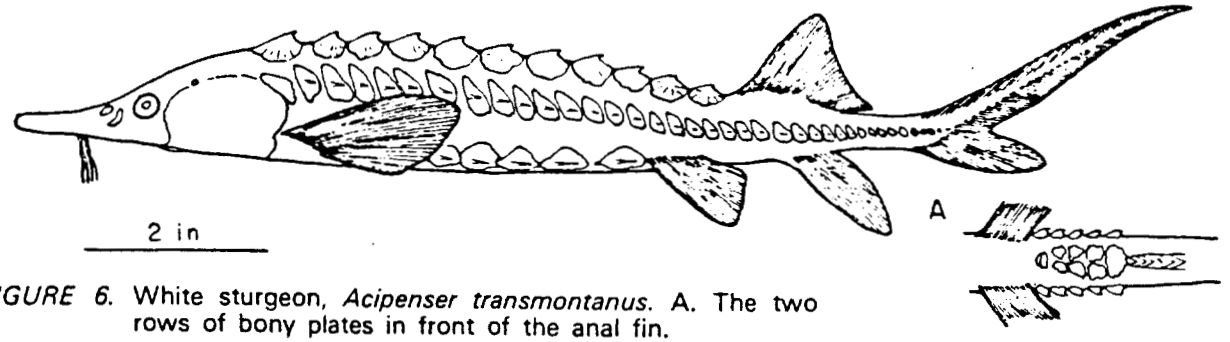

FIGURE 6. White sturgeon, *Acipenser transmontanus.* A. The two rows of bony plates in front of the anal fin.

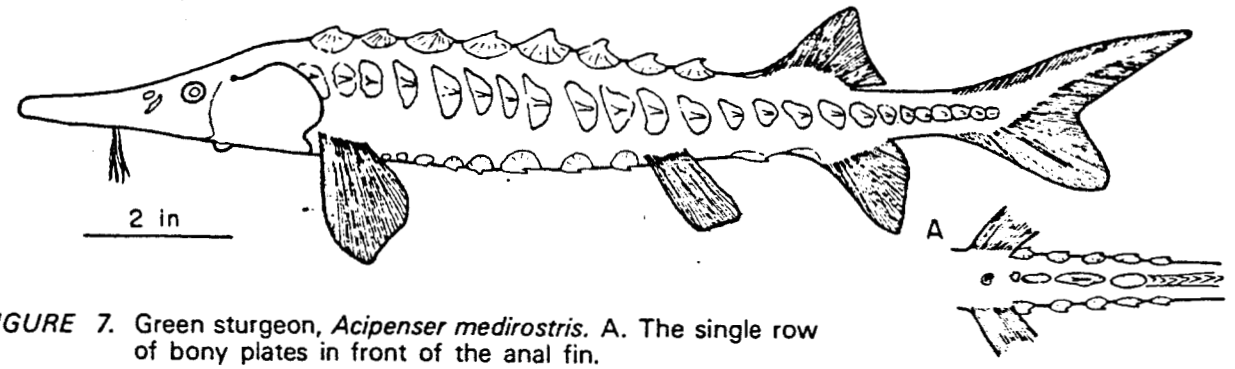

FIGURE 7. Green sturgeon, *Acipenser medirostris.* A. The single row of bony plates in front of the anal fin.

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.

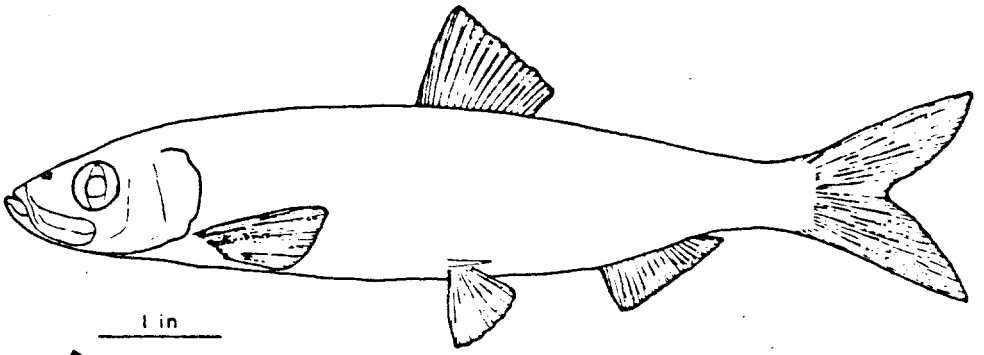

FIGURE 8. Sea herring, *Clupea harengus pallasi.*

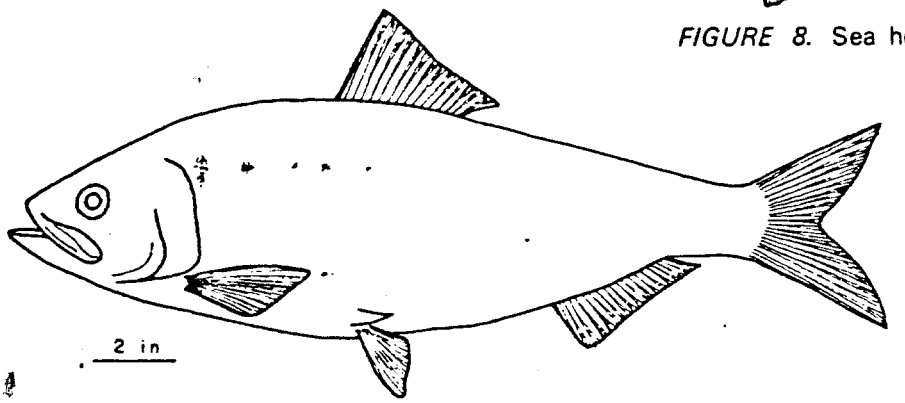

FIGURE 9. American shad, *Alosa sapidissima.*

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.

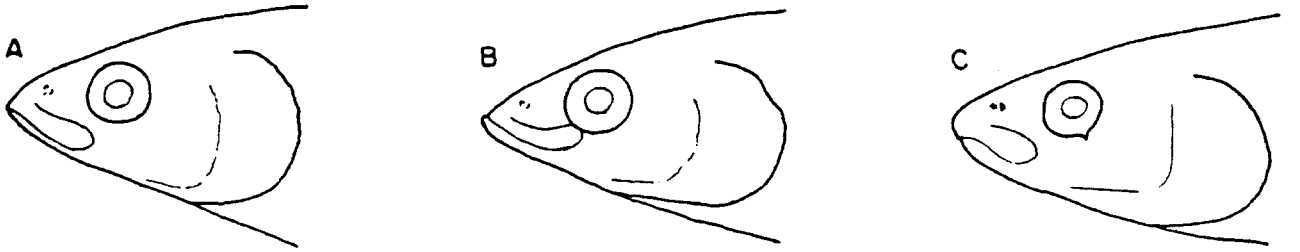

FIGURE 10. Snouts of whitefishes. A. Bering cisco, both jaws equal. B. Least cisco, tip of lower jaw projecting slightly beyond upper jaw. C. Round whitefish, lower jaw shorter than upper and profile of upper lip overhanging.

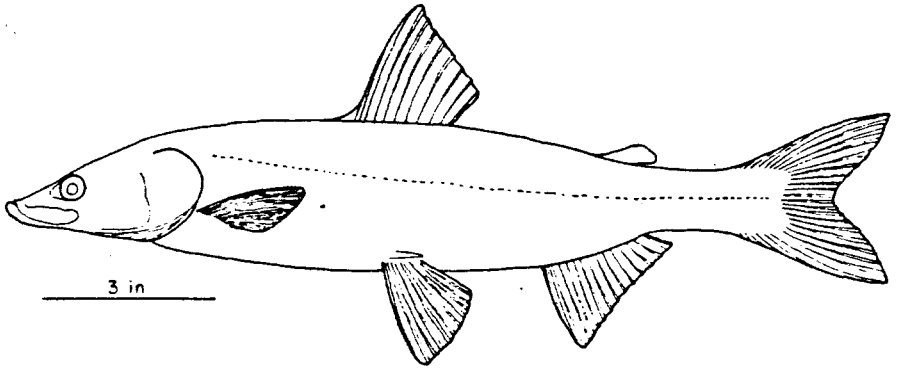

FIGURE 11. Inconnu, *Stenodus leucichthys.* Commonly called "sheefish" in Alaska.

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

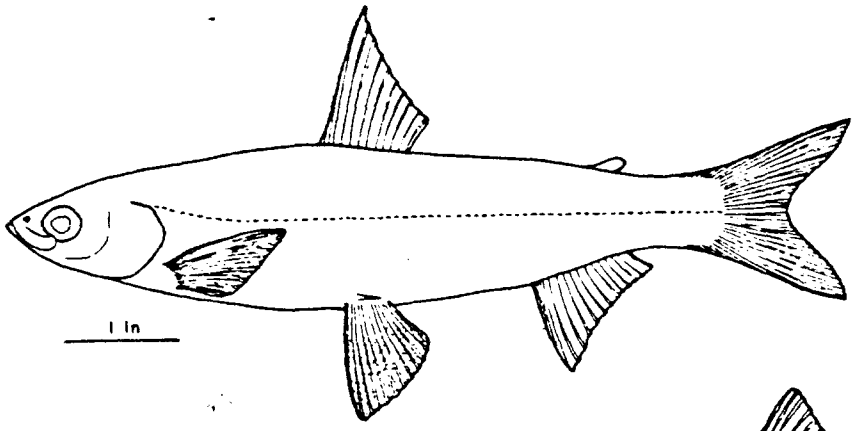

FIGURE 12. Least cisco, *Coregonus sardinella.* Note the dusky pelvic fins.

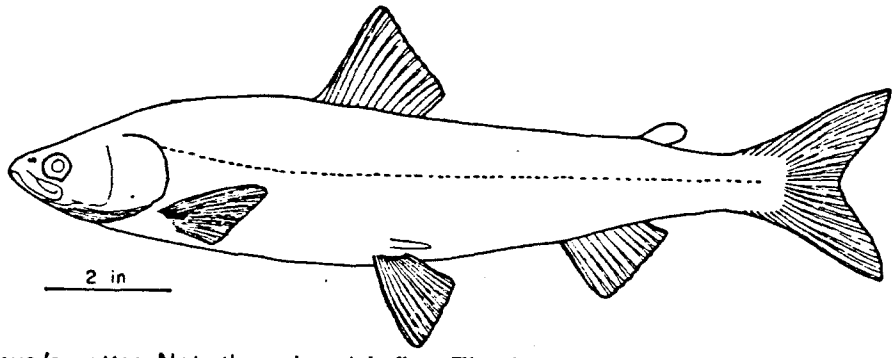

FIGURE 13. Bering cisco, *Coregonus laurettae.* Note the pale pelvic fins. The Arctic cisco, *Coregonus autumnalis,* appears identical with this species but has more gill rakers.

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

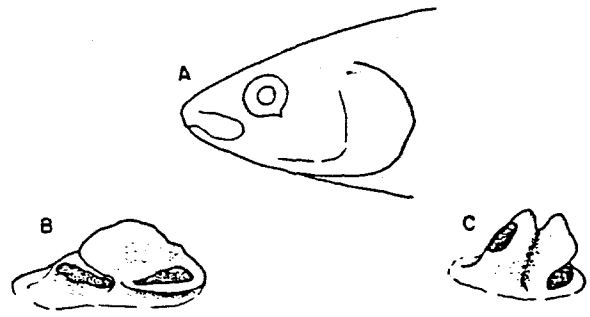

FIGURE 14.

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.)

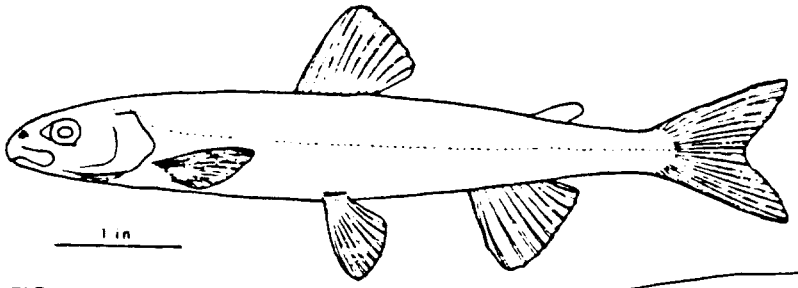

FIGURE 15. Pygmy whitefish, *Prosopium coulteri.*

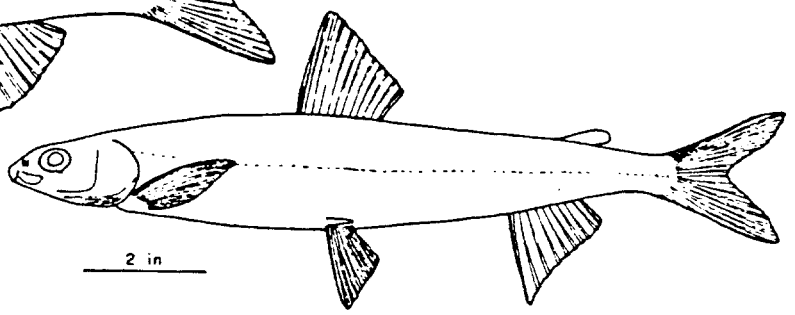

FIGURE 16. Round whitefish, *Prosopium cylindraceum.*

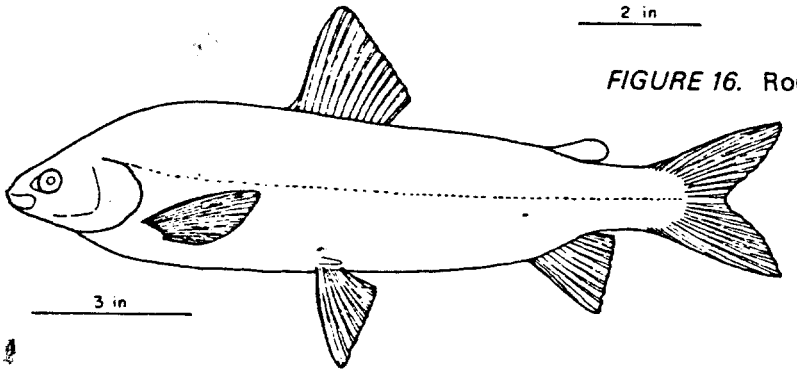

FIGURE 17. Broad whitefish, *Coregonus nasus.*

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.

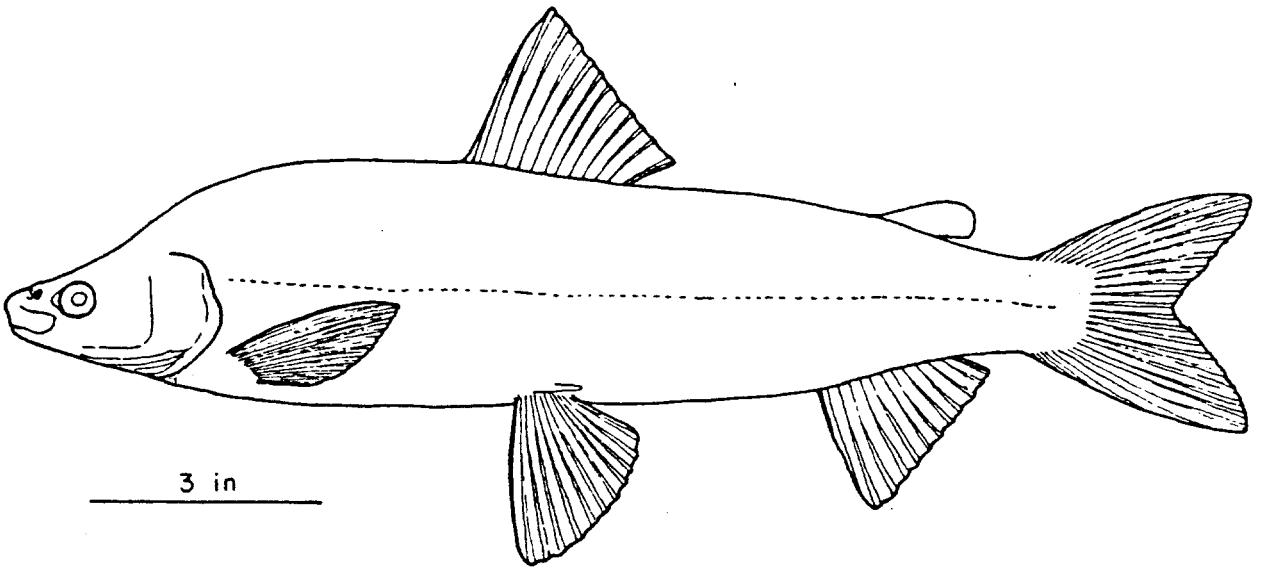

FIGURE 18. Alaska whitefish, *Coregonus nelsoni.* The Humpback and Lake whitefishes closely resemble this species but differ in number of gill rakers.

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.

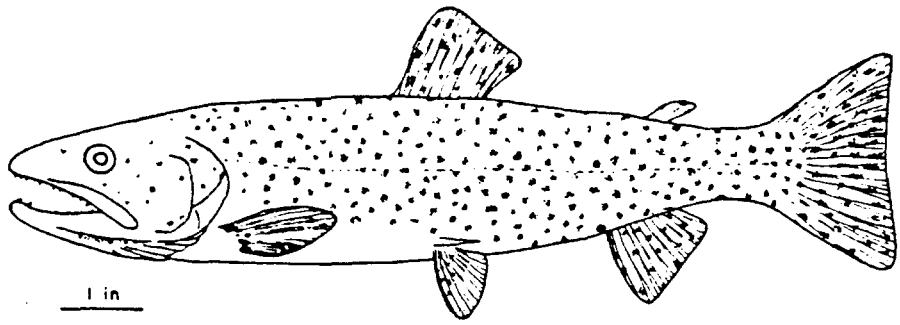

FIGURE 19. Cutthroat trout, *Salmo clarki.* In Alaska, most fresh-water populations are heavily spotted, as shown, but in more southerly populations the spots are generally not so numerous. Spots are missing on freshly sea-run cutthroats.

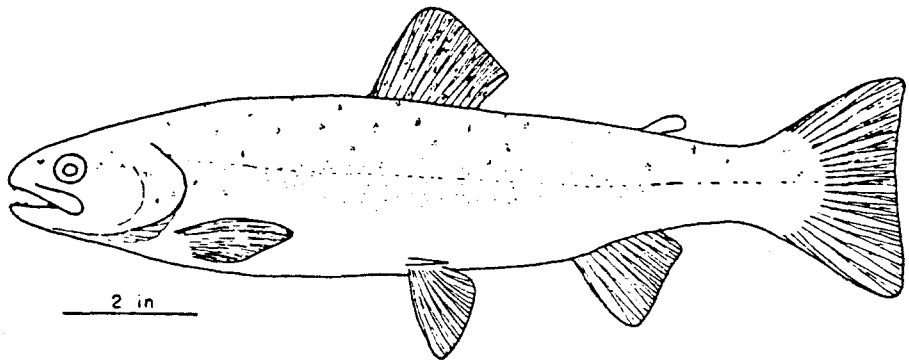

FIGURE 20. Rainbow trout, *Salmo gairdneri.*

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

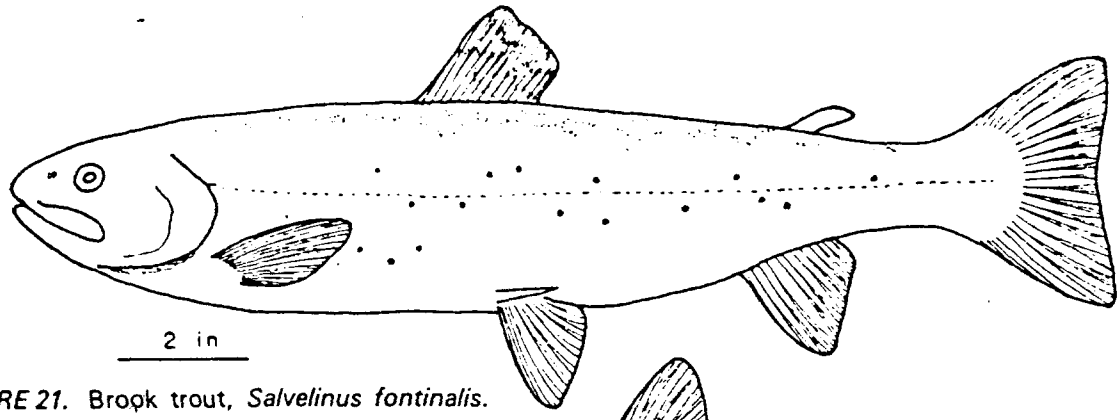

FIGURE 21. Brook trout, *Salvelinus fontinalis.*

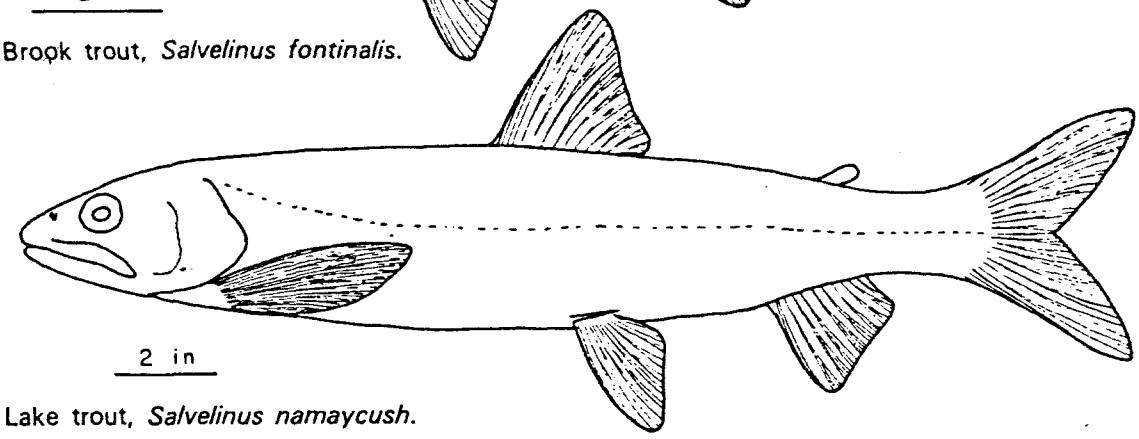

FIGURE 22. Lake trout, *Salvelinus namaycush.*

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

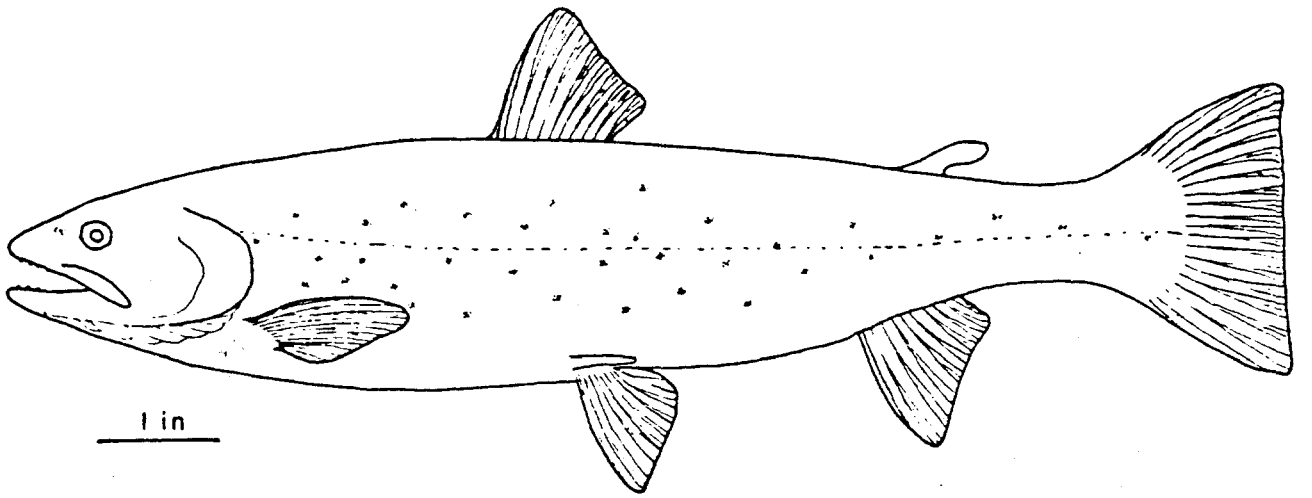

FIGURE 23. Dolly Varden, *Salvelinus malma.* The Arctic charr and Angayukaksurak charr look very much like the Dolly Varden, but the Angayukaksurak charr is black and the Arctic charr has more gill rakers and pyloric caeca.

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

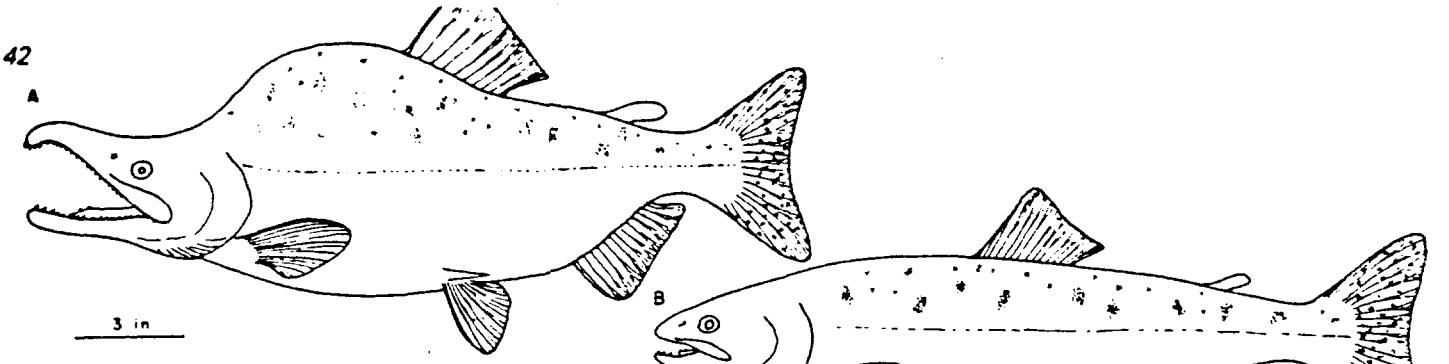

FIGURE 24. Pink salmon, *Oncorhynchus gorbuscha.* A. Breeding male. B. Mature female.

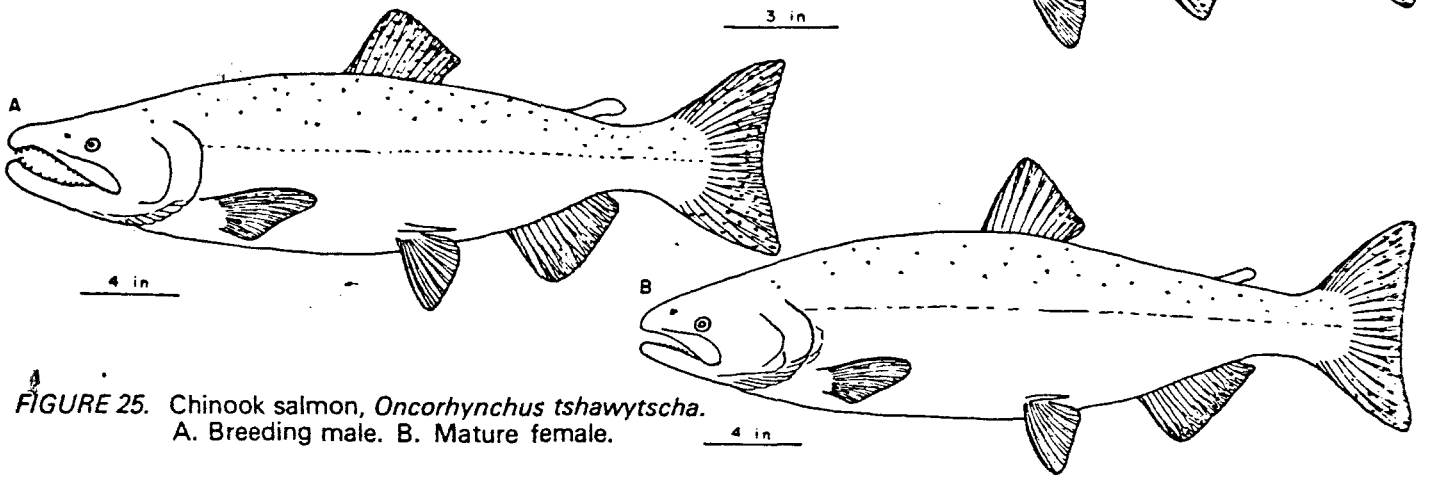

FIGURE 25. Chinook salmon, *Oncorhynchus tshawytscha.* A. Breeding male. B. Mature female.

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.

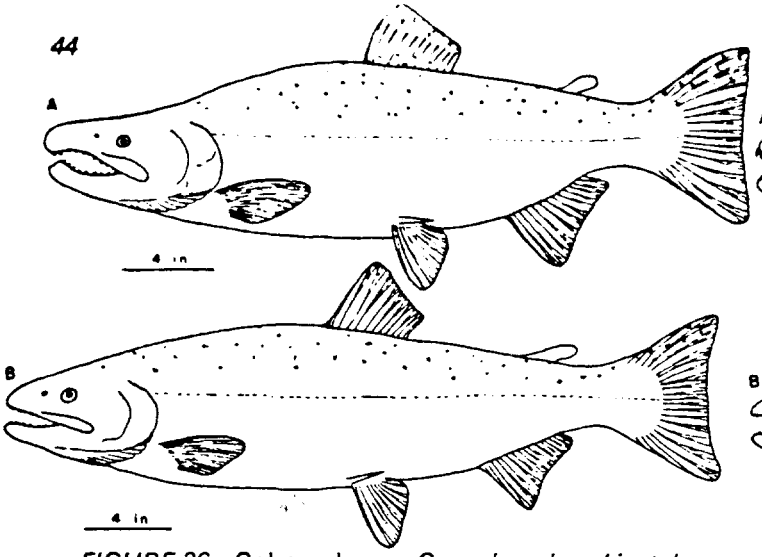

FIGURE 26. Coho salmon, *Oncorhynchus kisutch.* A. Breeding male. B. Mature female.

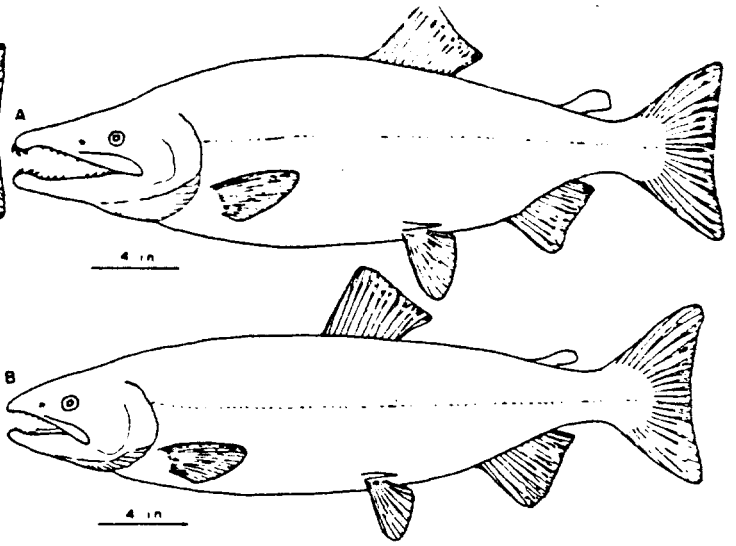

FIGURE 27. Chum salmon, *Oncorhynchus keta.* A. Breeding male. B. Mature female.

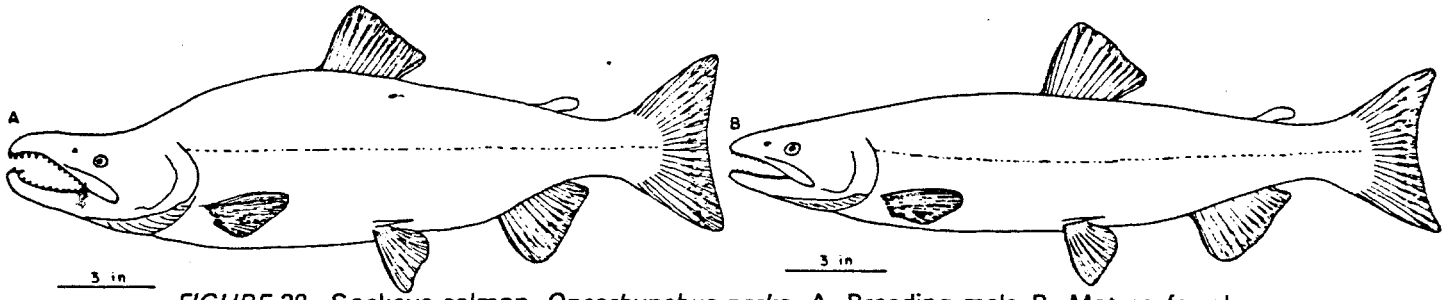

FIGURE 28. Sockeye salmon, *Oncorhynchus nerka.* A. Breeding male. B. Mature female.

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 45-115.

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.

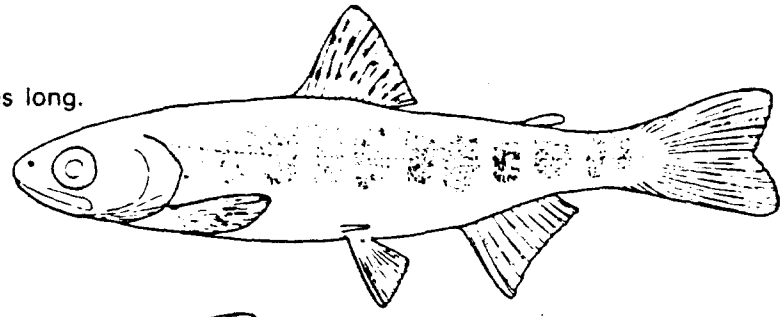

FIGURE 29. Brook trout 3½ inches long.

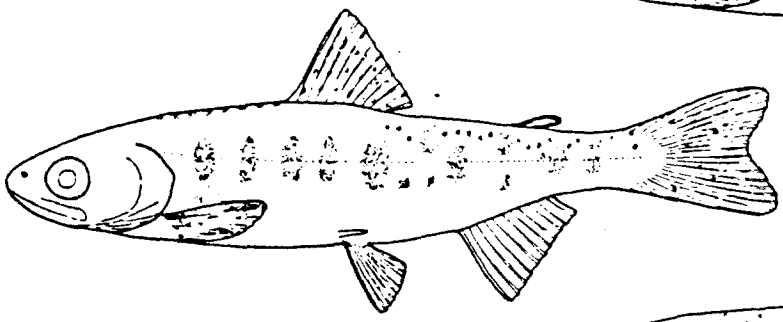

FIGURE 30. Rainbow trout 3½ inches long.

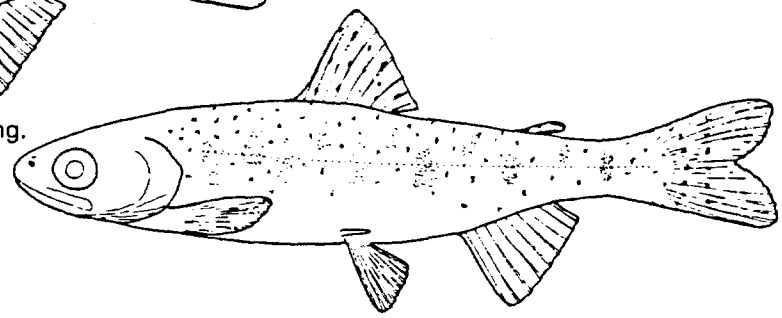

FIGURE 31. Cutthroat trout 3½ inches long.

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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

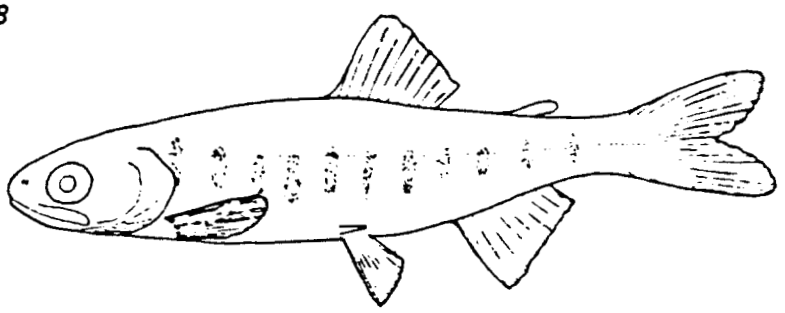

FIGURE 32. Lake trout 5 inches long.

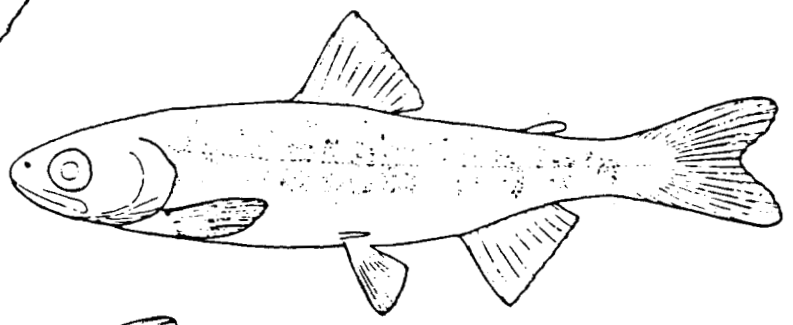

FIGURE 33. Dolly Varden 4 inches long.

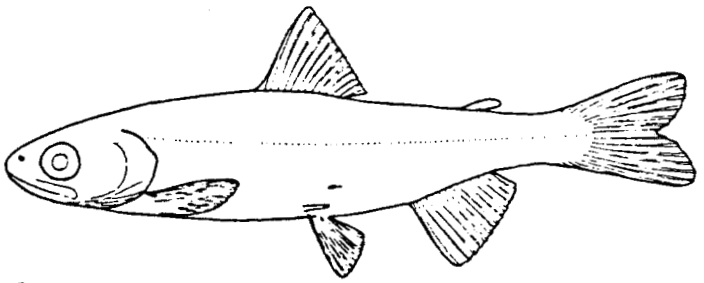

FIGURE 34. Pink salmon 2 inches long.

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

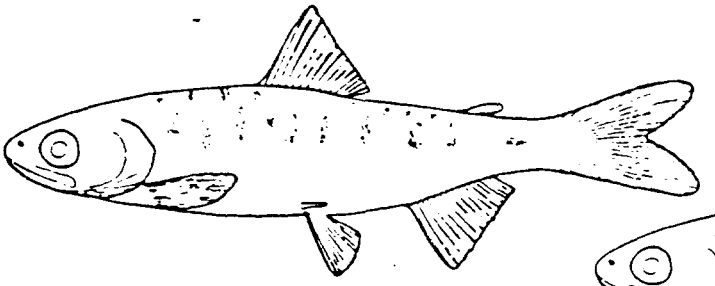

FIGURE 35. Sockeye salmon 3¾ inches long.

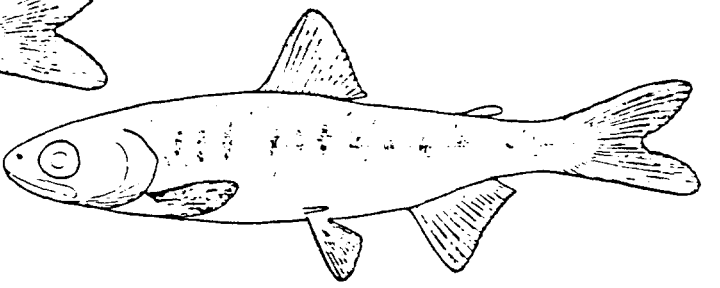

FIGURE 36. Chum salmon 4 inches long.

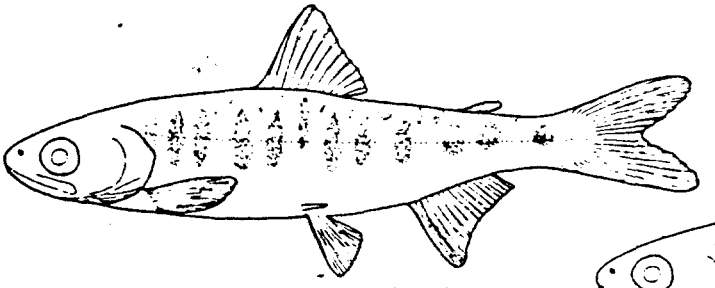

FIGURE 37. Coho salmon 4 inches long.

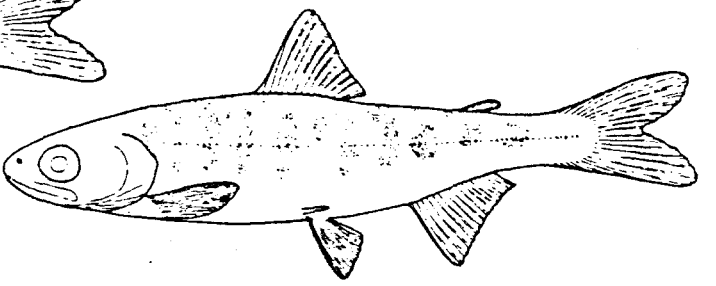

FIGURE 38. Chinook salmon 5 inches long.

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)

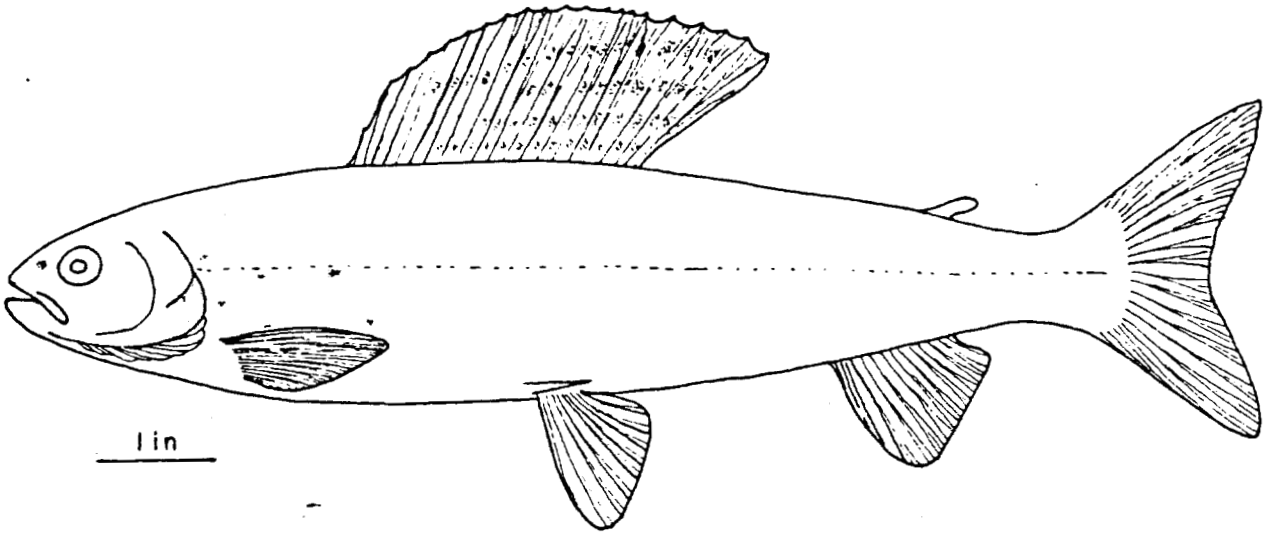

FIGURE 39. Arctic grayling, *Thymallus arcticus.*

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.

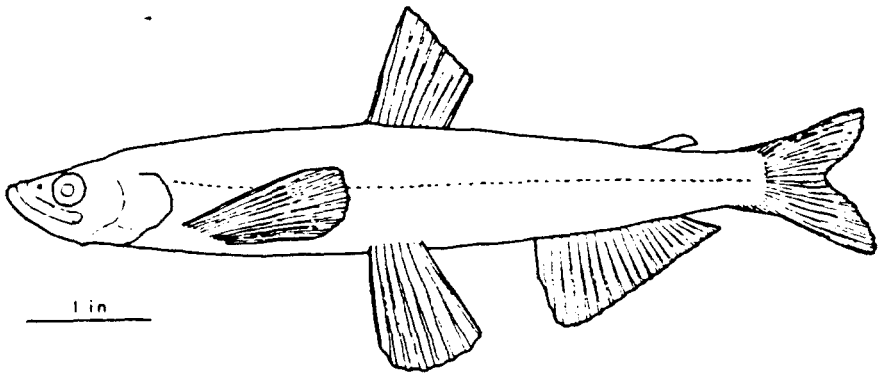

FIGURE 40. Longfin smelt, *Spirinchus thaleichthys.*

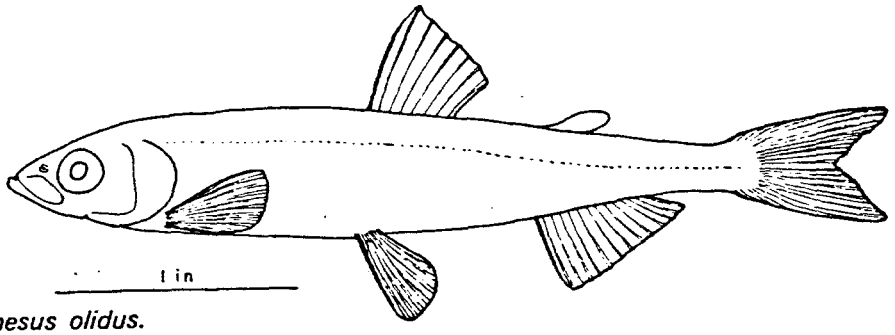

FIGURE 41. Pond smelt, *Hypomesus olidus.*

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.

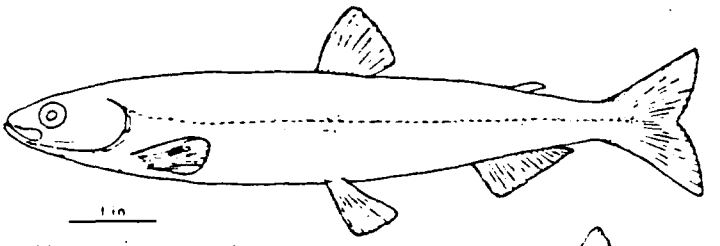

FIGURE 42. Surf smelt, *Hypomesus pretiosus.*

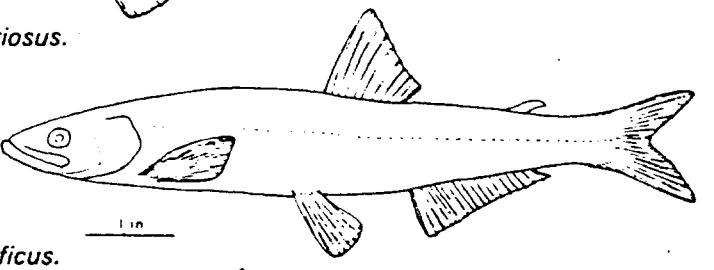

FIGURE 43. Eulachon, *Thaleichthys pacificus.*

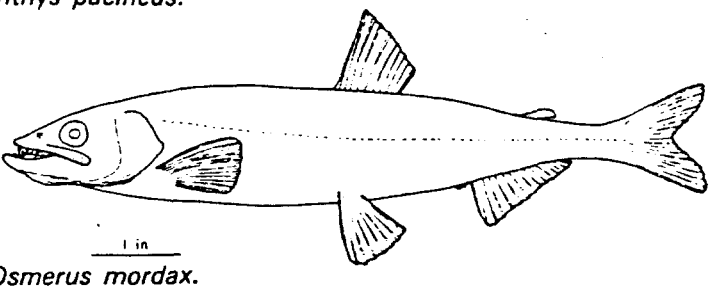

FIGURE 44. Rainbow smelt, *Osmerus mordax.*

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 ahead 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.

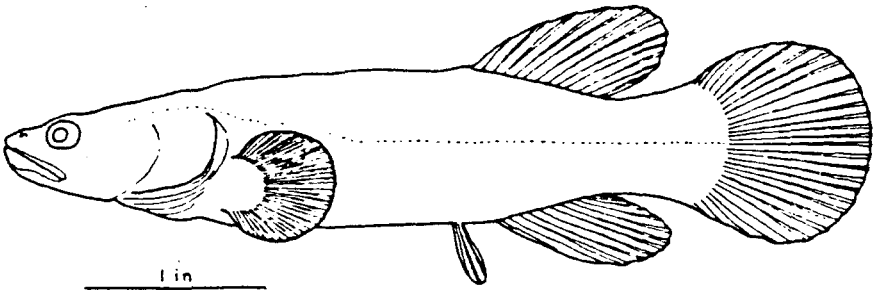

FIGURE 45. Alaska blackfish, *Dallia pectoralis.*

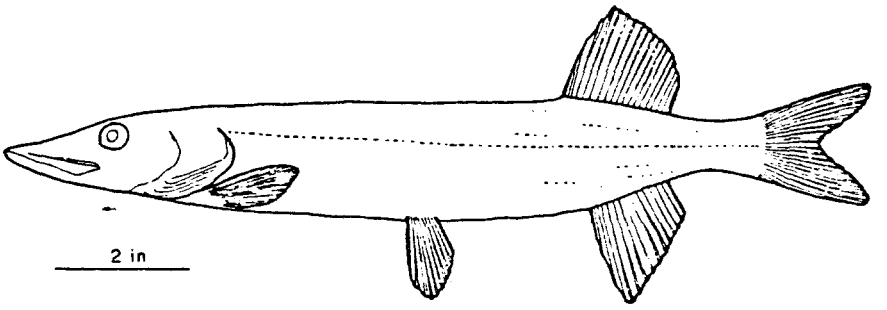

FIGURE 46. Northern pike, *Esox lucius.*

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.

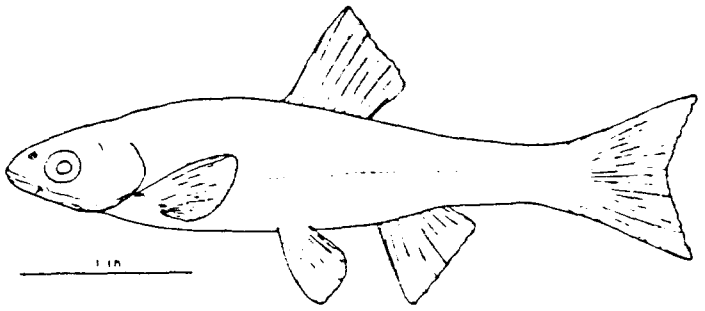

FIGURE 47. Lake chub, *Couesius plumbeus.*

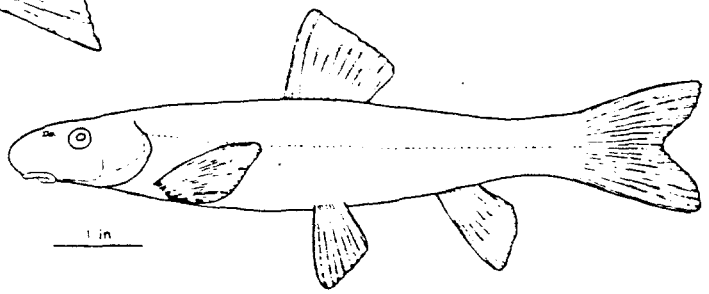

FIGURE 48. Longnose sucker, *Catostomus catostomus.*

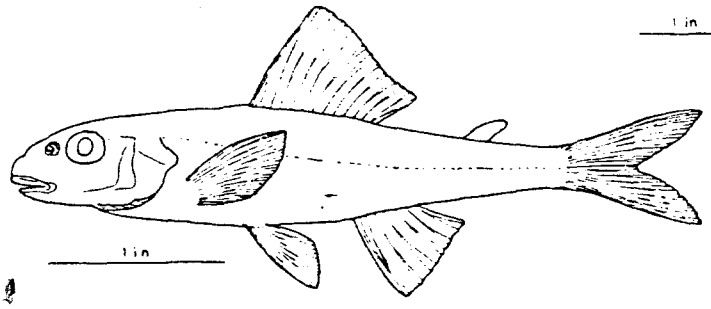

FIGURE 49. Troutperch, *Percopsis omiscomaycus.*

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.

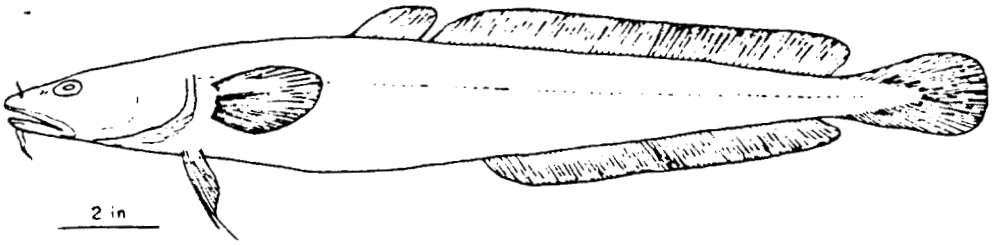

FIGURE 50. Burbot, *Lota lota.*

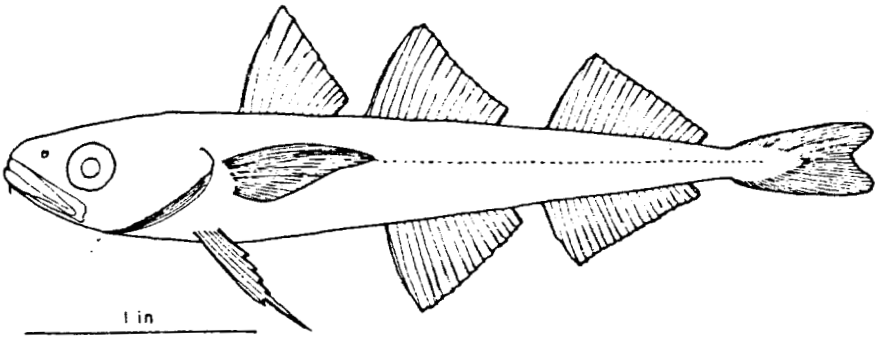

FIGURE 51. Arctic cod, *Boreogadus saida.*

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.

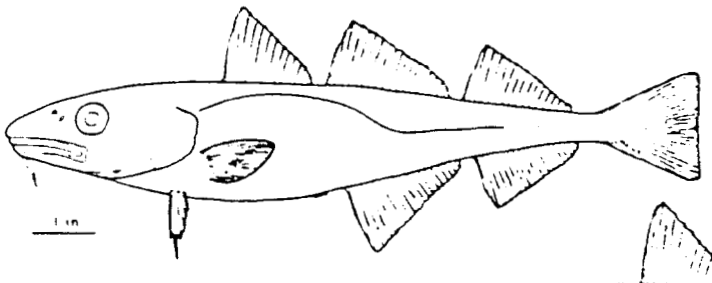

FIGURE 52. Pacific cod, *Gadus macrocephalus.*

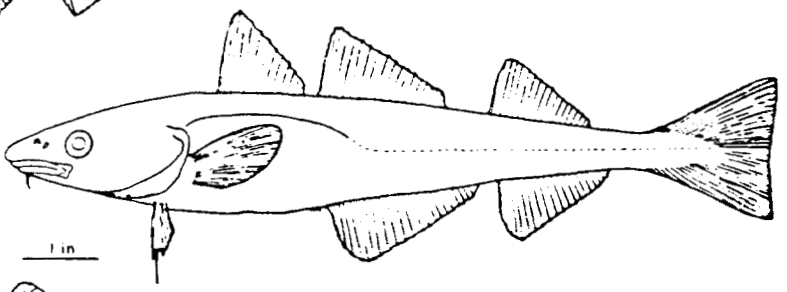

FIGURE 53. Saffron cod, *Eleginus gracilis.*

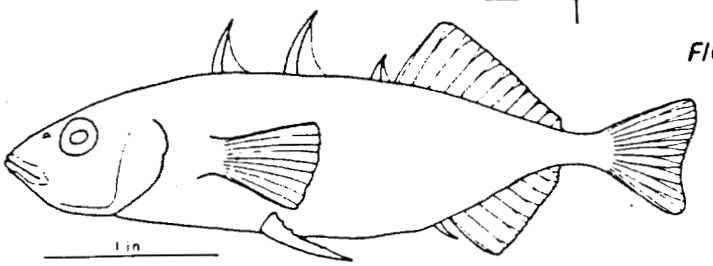

FIGURE 54. Threespine stickleback, *Gasterosteus aculeatus.*

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 fresh-water 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.

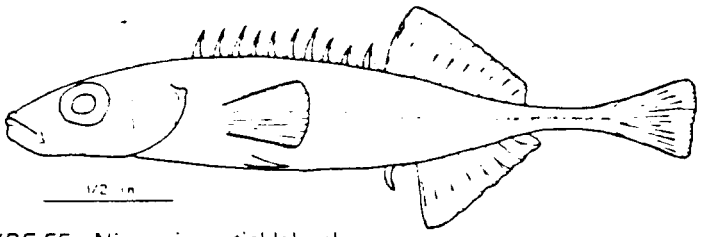

FIGURE 55. Ninespine stickleback, *Pungitius pungitius.*

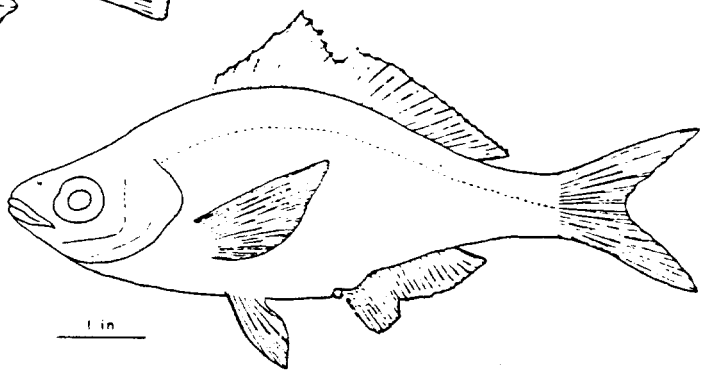

FIGURE 56. Shiner perch, *Cymatogaster aggregata.*

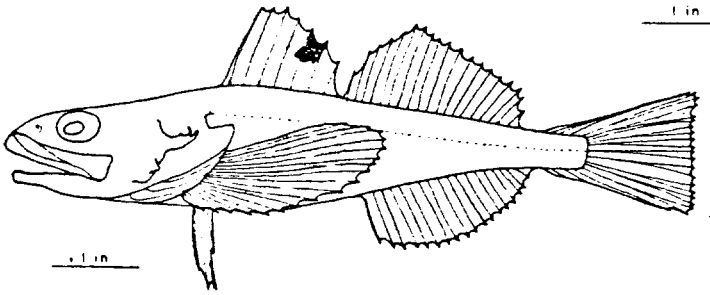

FIGURE 57. Pacific staghorn sculpin, *Leptocottus armatus.*

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.

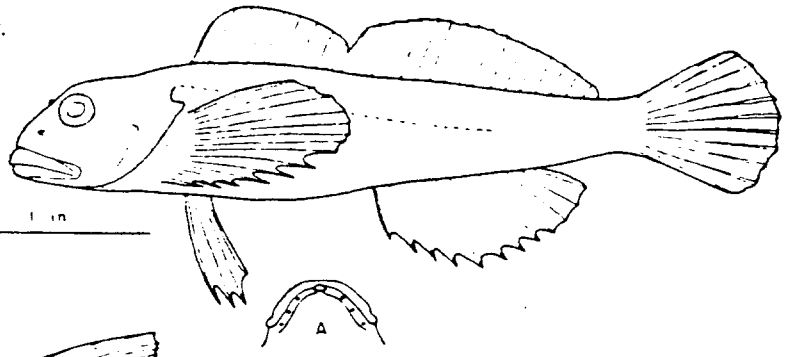

FIGURE 58. Slimy sculpin, *Cottus cognatus.* A. Under side of the head to show the two pores at the tip of the chin.

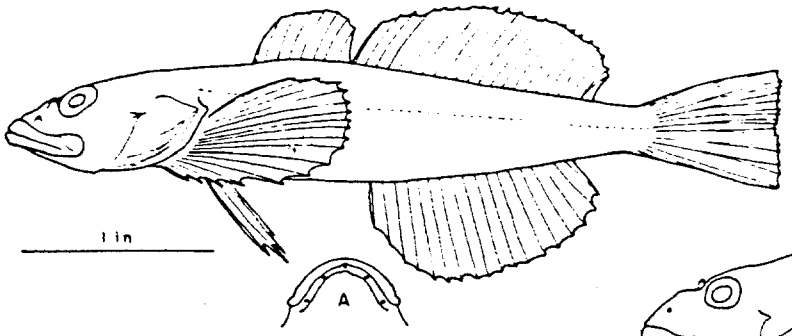

FIGURE 59. Prickly sculpin, *Cottus asper.* A. Under side of the head to show the single pore at the tip of the chin.

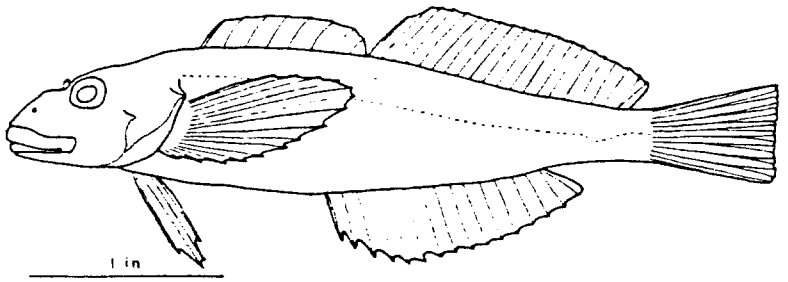

FIGURE 60. Coastrange sculpin, *Cottus aleuticus.*

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

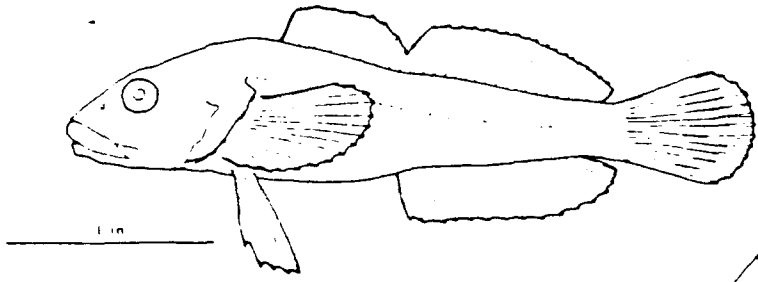

FIGURE 61. Riffle sculpin, *Cottus gulosus.*

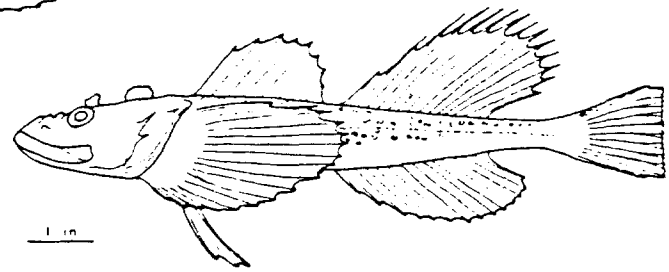

FIGURE 62. Fourhorn sculpin, *Myoxocephalus quadricornis.*

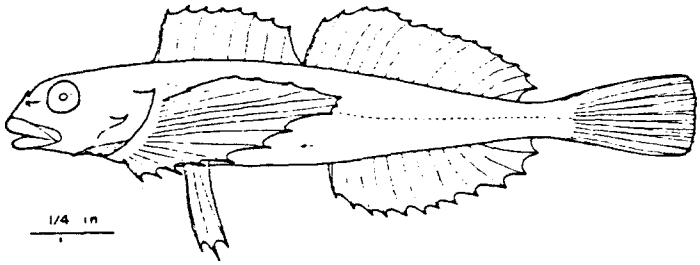

FIGURE 63. Sharpnose sculpin, *Clinocottus acuticeps.*

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.

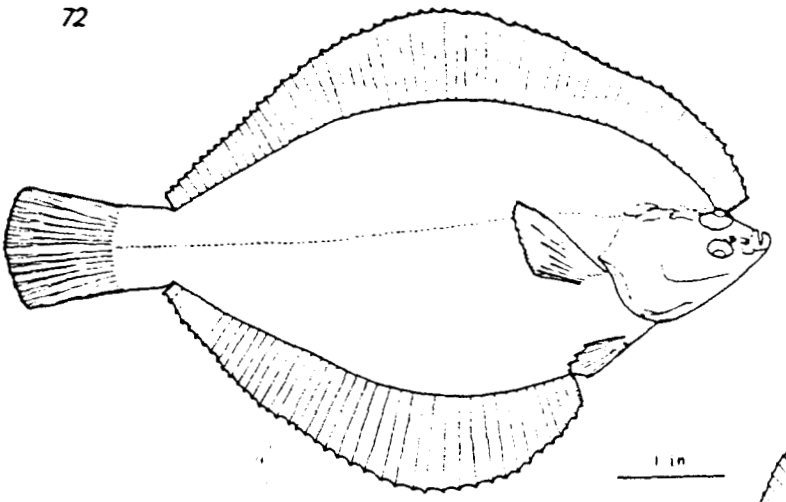

FIGURE 64. Arctic flounder, *Liopsetta glacialis.*

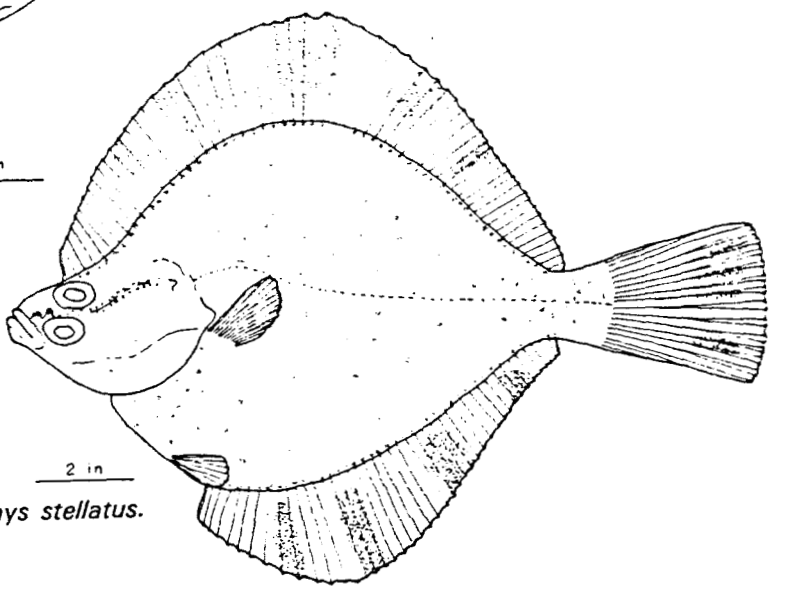

FIGURE 65. Starry flounder, *Platichthys stellatus.*

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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335. Progress report of the Bureau of Commercial Fisheries Center for Estuarine and Menhaden Research, Pesticide Field Station, Gulf Breeze, Fla., fiscal year 1969. By the Laboratory staff. August 1970, iii + 33 pp., 29 figs., 12 tables.

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

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