STATE OF ALASKA

Jay S. Hammond, Governor

Annual Performance Report for

ANCHOR RIVER STEELHEAD STUDY

by

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ALASKA DEPARTMENT OF FISH AND GAME
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By: Joe Wallis and D. Thomas Balland

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RESEARCH PROJECT SEGMENT

State: Alaska Name: Sport Fish Investigations of Alaska

Project No.: AFS-48 Project Title: ANADROMOUS FISH STUDIES

Segment No.: AFS-48-1 Segment Title: Anchor River Steelhead Study

Cooperators: Joe Wallis and D. Thomas Balland

Period Covered: July 1, 1980 to June 30, 1981

ABSTRACT

An inclined-plane downstream migrant trap was operated in Anchor River from June 7 through September 10, 1980 to capture juvenile steelhead trout, Salmo gairdneri (Richardson), migrating downstream. The trap was effective in capturing coho, Oncorhynchus kisutch (Walbaum), and chinook salmon, Oncorhynchus tshawytscha (Walbaum), but not effective in capturing steelhead trout. Additional juveniles of all species were captured throughout the watershed by electrofishing.

Fifty adult steelhead were tagged with Floy anchor tags, tags were recovered at random in the creel census, and anglers voluntarily returned other tags. On the basis of this tag and recovery program, the 1980 steelhead run was estimated to be 2,388 fish.

Nine adult steelhead were tagged with radio tags in an attempt to monitor instream movements. Limited success in the program showed comparatively little movement of the tagged fish.

A creel census was conducted and an estimated 15,157 angler days of effort were spent during the summer-fall fishery from July 1 through November 15. During this period, it was estimated that anglers harvested 847 steelhead, or 35.5 percent of the run; anglers kept 57.5 percent of the steelhead they caught.

The adult run was comprised of 17 separate age classes. First-spawning fish were of seven age classes with the majority of both males and females of Age Class 3.2. Ten separate age classes were represented in a sample of repeat spawners with 3.2s1 the most common with 20 of 38 individuals. Repeat spawners comprised 19.7 percent of the fish sampled.

It was estimated that 15 to 20 percent of the escapement from the 1978 steelhead run in Anchor River survived to return again in 1980.

Analysis of scales from both juveniles and adults provided an estimate of sizes of steelhead smolts in Anchor River. It was estimated that smolts ranged from 127 to 204 mm (5.0 to 8.0 inches) with a mean of 172 mm (6.8 inches).

BACKGROUND

A vicinity map showing location of the study area is presented in Figure 1, and a list of species of fish is presented in Table 1.

In the Cook Inlet area, steelhead trout occur in only a few streams of the Lower Kenai Peninsula, Anchor River, Ninilchik River, Stariski Creek, Deep Creek and a limited population in Crooked Creek, a Kasilof River tributary. We have very limited information regarding numbers of fish in these streams, but the total numbers are comparatively small.

The popularity and demand for steelhead fishing in the southcentral Alaska region is growing rapidly. The intensity of angling effort has increased dramatically on these few small streams during the last several years.

The Anchor River, southernmost steelhead stream on the Kenai Peninsula, appears to have the largest run and is the site of the most intense fishery. From 15,000 to 20,000 man-days of angling effort are spent on Anchor River in the summer-fall fishery during the period steelhead are caught. Dolly Varden, coho salmon and steelhead are all caught during this period and it is not feasible to assign fishing effort to any one species. Total harvest of steelhead has ranged from about 600 to 1,500 from Anchor River during the past 4 years. This has accounted for about 26 to 40% of the total combined harvest of steelhead in the state.

Steelhead stocks in all streams on the Kenai Peninsula are similar to those termed "summer-run" throughout the Pacific Northwest. Adults enter the stream throughout the summer and fall, spend the winter in freshwater, then spawn the following spring and migrate back to sea.

Some aspects of Anchor River steelhead life history and population characteristics have been investigated periodically since the mid-1950's, but the studies have been intermittent and of limited scope. Total run size, adult migration and spawning characteristics, areas and timing of juvenile rearing and migration, and the potential supplemental production are a few important aspects which have not been studied adequately.

The stocks of steelhead are entirely naturally produced at present and it is doubted that they can sustain future pressures without harm to the stocks, unless additional restrictions are imposed on the harvest or supplemental measures are undertaken.

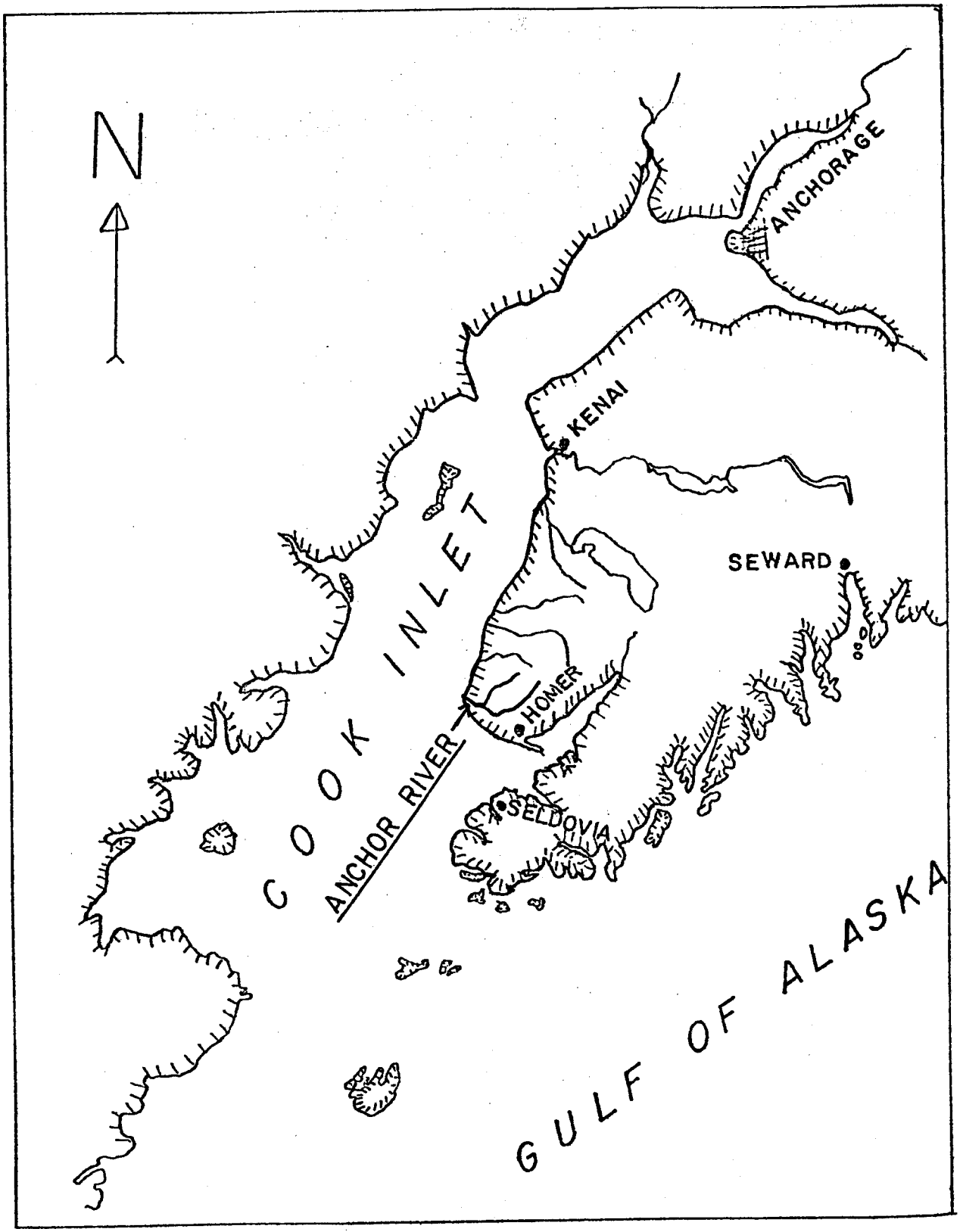


Figure 1. Vicinity map showing location of the study area.

Table 1. List of Common Names, Scientific Names and Abbreviations.

Common Name	Scientific Name & Author	Abbreviation
Chinook salmon	Oncorhynchus tscawytscha (Walbaum)	KS
Coho salmon	Oncorhynchus kisutch (Walbaum)	SS
Dolly Varden	Salvelinus malma (Walbaum)	DV
Rainbow trout	Salmo gairdneri Richardson	RT
Steelhead trout	Salmo gairdneri Richardson	SH

The Department's goal is to provide continued recreational angling for steelhead on these streams. The concern is the lack of biological information upon which to base management programs, formulate regulatory guidelines, and evaluate need and potential for supplemental enhancement of these stocks.

This study was initiated to provide information for the Department to use in refining its management program, and to provide direction to future enhancement of steelhead stocks.

RECOMMENDATIONS

1. The present objectives of this study should be retained and the study should be continued.

2. As soon as feasible, the scope of the study should be expanded to include definition of characteristics of the steelhead populations in other Lower Kenai Peninsula streams.

OBJECTIVES

1. To determine size of steelhead stocks.

2. To determine instream behavior and intrasystem movement and migration.

3. To determine angler utilization and effects of current harvest levels.

4. To determine the need for supplementing steelhead stocks.

TECHNIQUES USED

An inclined-plane downstream migrant trap was constructed using a modified design of one described by Clay (1961). It was installed in Anchor River on June 7 and operated until September 10 with only brief periods of interruption for maintenance and a few brief periods during high water. It was located on the South Fork of Anchor River immediately upstream from the junction of the North and South Forks.

Juveniles were collected at various locations in the watershed by electroshocking with a Coffelt Electronics Company Model BP-2 backpack shocker. Adult steelhead were captured with both beach seine and hook and line and tagged with serially numbered Floy anchor tags. Tags were recovered during the creel census and by voluntary returns. Tagged to untagged ratios were used to make a population estimate of steelhead, based upon Schaeffer's formula as outlined by Ricker (1975).

To obtain fish for inserting radio tags, adult steelhead were captured by hook and line and by drifting a small section of gill net through sections of the river.

Radio tags were inserted into adult steelhead and movements were monitored with tracking receivers in an attempt to determine instream migration characteristics of adult steelhead. This was a cooperative project with the U.S. Fish and Wildlife Service who provided the tags, receivers and technical assistance. Tags and receivers were of Smith Root manufacture operating on a frequency of 40 MHz.

A creel census was conducted during the period July 1 - November 15, 1981. The method employed was a modification of that described by Neuhold and Lu (1957). For sampling purposes, Anchor River was separated into two sections: Area 1 included the area from the junction of the North and South Forks downstream to saltwater; and Area 2 included the area from the Forks upstream to the bridge on the Homer end of the North Fork Road. Each sampling day was broken into three randomly selected time periods of 2.5 hours each; two periods were spent in Area 1 and one period in Area 2.

Estimates of effort in Area 1 were based upon two randomly selected instantaneous angler counts. Each weekend day and holiday and three weekdays each week were sampled. Due to changing day length the fishing day ranged from 18 to 12 hours as follows: July 1 to August 15, 18 hours; August 16 to September 15, 16 hours; September 16 to October 15, 14 hours; October 16 to November 15, 12 hours. During interviews the following information was obtained: hours fished; number and species of fish caught; numbers and species of fish kept; and selected biological data and scale samples from a sample of the fish harvested.

It was not possible to make instantaneous angler counts in Area 2. Estimates of effort were based upon the relationship of vehicle counts in Area 2 to vehicle counts in Area 1; this proportion was applied to estimated angler effort in Area 1 to estimate effort in Area 2. Interview information and biological data were obtained in a manner similar to that in Area 1.

Scales were mounted on gummed tape and pressed on acetate sheets, then were examined on a microfiche viewer. Scale images were printed on a viewer/printer. Circuli counts in the freshwater portion of scales were made along a 20° ventral line using the technique described by Clutter and Whitesel (1956) for sockeye salmon.

FINDINGS

Water temperatures were recorded at the inclined plane trap throughout most of the summer and the daily maximum and minimum temperatures are listed in Table 2.

Table 2. Water Temperatures Recorded at the Inclined Plane Trap on Anchor River in 1980, °C.

Day of Month	June		July		August	
	Min.	Max.	Min.	Max.	Min.	Max.
1	...	...	8	...	11	14
2	...	...	11	13	11	15
3	...	...	7	9	8	12
4	...	...	7	9	11	14
5	...	...	10	14	12	15
6	...	...	10	13	11	13
7	...	...	10	13	...	...
8	...	...	11	14	11	13
9	7	...	10	12	10	12
10	...	8	10	14	11	14
11	7	9	10	10	10	11
12	8	8	10	10	11	12
13	7	10	...	...	9	13
14	8	10	...	...	9	12
15	8	9	11	...	...	...
16	8	10	10	13	9	13
17	7	11	10	10	...	...
18	9	12	10	11	9	11
19	8	12	10	10	8	11
20	8	11	12	14	9	11
21	8	9	12	14	...	...
22	8	11	13	16	...	...
23	9	13	12	17	...	...
24	10	12	12	17	...	...
25	8	11	13	15	10	12
26	8	10	13	15	...	...
27	...	...	14	16	...	...
28	...	...	10	13	...	...
29	8	9	11	16	...	...
30	8	9	10	10	...	...
31	...	...	9	11	...	...

Juvenile Data

Juvenile rainbow/steelhead captured in the inclined plane trap are listed in Table 3 by weekly intervals and size. Very few smolts were captured in the trap, and most of the fish were Age I and Age II parr. A few young-of-the-year parr were captured beginning in late July and continuing through August.

Various places throughout the drainage were sampled by electrofishing in an attempt to determine distribution of rearing juveniles. Specific sampling site locations are described in Table 4 and are noted on a map on the Anchor River drainage in Figure 2.

Numbers of juveniles of different species collected at the different sites are listed in Table 5. All of the rainbow/steelhead captured were Age I and Age II parr with the exception of a few young-of-the-year captured in Two Moose Creek in September. Greatest numbers of juveniles were collected in the smaller tributary streams. This may have been due in part to the electrofishing technique being more effective in small streams, however, observations indicated that juveniles were more abundant in the small streams.

Adult Data

During the period August 27 to November 11, 50 steelhead were tagged with serially numbered Floy tags and released. A summary of the pertinent tagging and recovery data is presented in Table 6.

Tags recovered from steelhead trout during the random creel census interviews were used to establish tagged to untagged ratios for a population estimate. The total steelhead run into Anchor River during the fall of 1980 was estimated to be 2,388 fish.

One steelhead which had been tagged on September 13, 1979, was caught by an angler on April 12, 1980, and the tag returned by mail. No report was given on its exact location or the degree of sexual maturation.

Three tagged fish were recovered away from Anchor River. One fish tagged on August 27 was caught in Stariski Creek 4 days later. Two fish were recovered in the subsistence fishery on the beach south of Anchor Point on September 12; one had been tagged on September 3 and the other on September 11. All three had been captured, tagged and released in the intertidal area of Anchor River. It is not known if the tagging procedure was responsible for these fish leaving Anchor River, or if they were destined for other streams and were intercepted while they were "nosing" into Anchor River.

A total of nine adult steelhead were tagged by insertion of a radio tag, in an attempt to monitor instream migration of adult steelhead. Pertinent data on tagging and subsequent tracking of these fish are presented in Table 7. Ejection of tags was a serious problem and even though some radio signals were picked up over a period of several weeks, it is felt that only

Table 3. Numbers of Rainbow/Steelhead Trout Captured in Inclined Plane Trap in Anchor River in 1980, by Weekly Period and Length Interval.

Length (mm)	Week Ending 6/22	6/29	7/6	7/13	7/20	7/27	8/3	8/10	8/17	8/24	8/31	Total
25-29									2	0	0	2
30-34							3	1	1	1	0	6
35-39						1	0	0	0	0	0	1
40-44							1	0	1	0	0	2
...												...
...												...
80-84					1							1
85-89									2		1	3
90-94								1			3	4
95-99									2		3	5
100-104							1					1
105-109								1				1
110-114								1				1
115-119					1		1	1				3
120-124												0
125-129								1				1
...												...
...												...
165-169			1				1					2
170-174					1							1
175-179												0
180-184												0
185-189	1											1
Total	1	0	1	0	3	1	7	6	8	1	7	35

Table 4. Location of Juvenile Sampling Stations in Anchor River System, 1980.

Station Number	Locations
1	So. Fk. Anchor River; 25 yards upstream from smolt trap (SE 1/4 Sec 4 T5S R15W).
2	So. Fk. Anchor River; Mile 158 Sterling Highway (NW 1/4 Sec 10 T5S R15W).
3	So. Fk. Anchor River; Mile 159.3 Sterling Highway (NW 1/4 Sec 11 T5S R15W).
4	Two Moose Creek; tributary to Anchor River; Mile 159.7 Sterling Highway (SE 1/4 Sec 11 T5S R15W).
5	Unnamed tributary to Anchor River; Mile 160.5 Sterling Highway (SW 1/4 Sec 12 T5S R15W).
6	So. Fk. Anchor River; Mile 160.5 Sterling Highway (Blackwater Bend) (NW 1/4 Sec 13 T5S R15W).
7	So. Fk. Anchor River; Mile 161.5 Sterling Highway Anchor River wayside (SE 1/4 Sec 15 T5S R15W).
8	So. Fk. Anchor River; Mile 162.7 Sterling Highway NW 1/4 Sec 19 T5S R14W).
9	So. Fk. Anchor River; Mile 163 Sterling Highway; Glanville residence (NW 1/4 Sec 29 T5S R14W).
10	So. Fk Anchor River; Mile 164.1 Sterling Highway; at start of Old North Fork trail (SE 1/4 Sec 29 T5S R14W).
11	Ruby Creek; tributary to Anchor River; Mile 0 North Fork Loop Road (SE 1/4 Sec 29 T5S R14W).
12	Unnamed tributary to Anchor River; Mile 1.0 North Fork Loop Road (SW 1/4 Sec 28 T5S R14W).
13	So. Fk. Anchor River; Mile 1.2 North Fork Loop Road (NW 1/4 Sec 27 T5S R14W).
14	Twitter Creek; tributary to Anchor River (NE 1/4 Sec 27 T5S R14W).
15	Unnamed tributary to Anchor River, and waters of main river at Engebretsons (NE 1/4 Sec 27 T5S R14W).

Table 4 (cont.) Location of Juvenile Sampling Stations in Anchor River System, 1980.

Station Number	Location
16	No. Fk. Anchor River; bridge of Hoot Owl Range (SE 1/4 Sec 36 T4S R14W).
17	No. Fk. Anchor River; bridge of Russian Village Road (NW 1/4 Sec 27 T4S R14W).
18	No. Fk. Anchor River; 1/2 mile upstream of Mumey residence (NE 1/4 Sec. 28 T4S R14W).
19	No. Fk. Anchor River; bridge at Chakok East Subdivision (SW 1/4 Sec 29 T4S R14W).
20	Chakok River; approximately 1 1/2 - 1 3/4 mile upstream of junction with No. Fk. Anchor River (NE 1/4 Sec 20 T4S R14W).
21	So. Fk. Anchor River and tributaries; float trips from Beaver Creek to No Fk. Loop Road bridge.

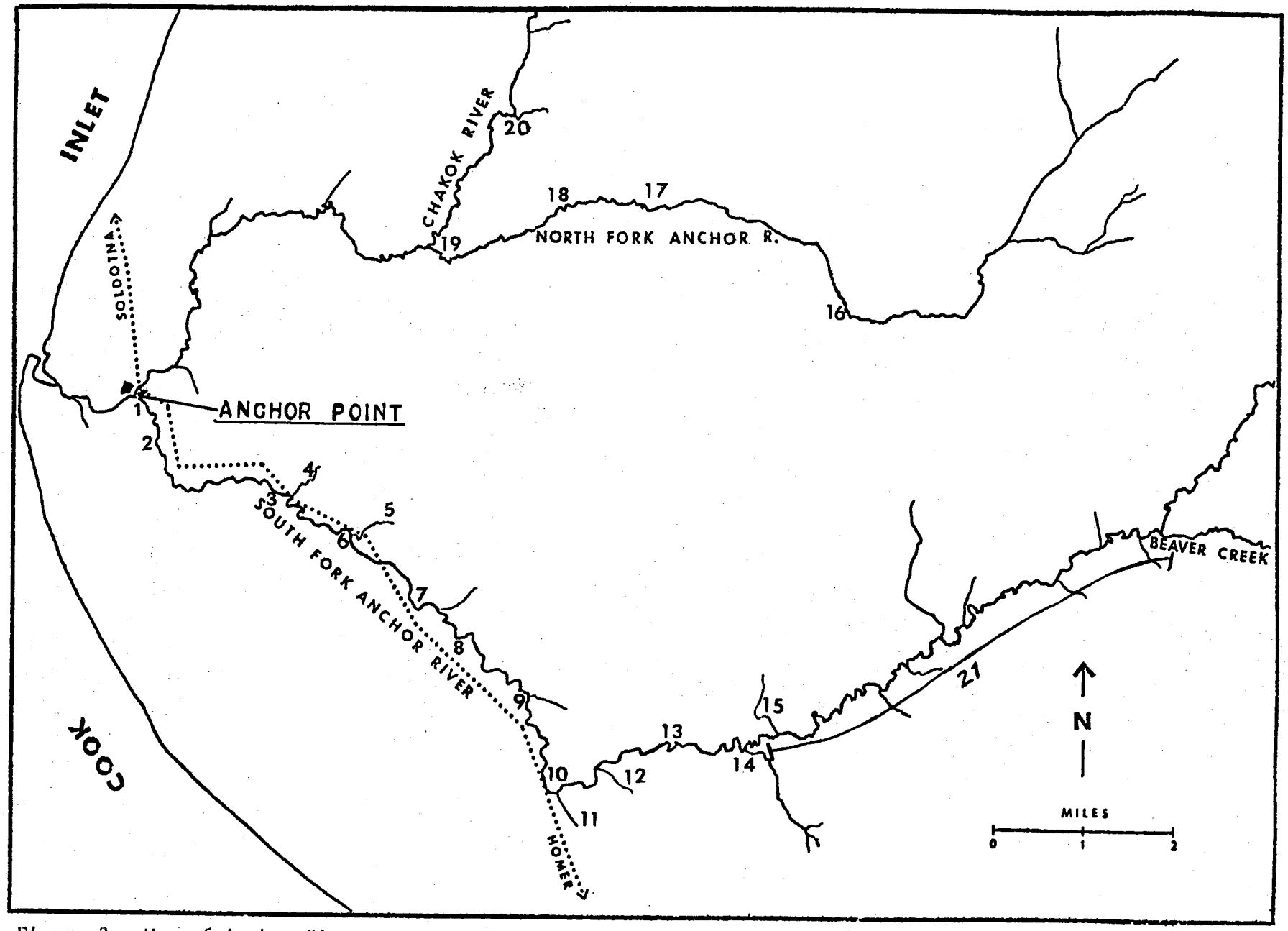


FIgure 2. Map of Anchor RIver system showing sampling locations.

Table 5. Numbers of Juvenile Salmonids Collected in Anchor River System by Electro-Fishing, 1980.

Station No.	Date	RT/SH	SS	KS	DV
1	8/09/80	0	1	0	0
2	8/20/80	0	16	0	1
3	7/10/80	1	0	0	0
	8/20/80	0	5	0	0
4	7/16/80	Numerous small salmonids noted, but not captured.			
	8/20/80	15	5	2	22
	9/25/80	3	0	4	22
5	7/10/80	2	4	0	2
	8/20/80	1	9	0	7
6	7/10/80	2	0	0	3
7	7/10/80	2	0	3	1
8	7/10/80	0	0	1	2
9	7/10/80	0	3	0	0
10	7/16/80	Three small salmonids noted, but not captured.			
11	8/09/80	0	1	0	2
	8/14/80	0	15	0	6
12	8/14/80	1	6		19
13	7/16/80	0	0	0	0
14	7/16/80	Few small salmonids noted, but not captured.			
15	8/14/80	1	15	0	19
16	7/23/80	1	0	0	4
17	7/23/80	4	0	0	11
18	7/23/80	9	0	0	6
19	7/23/80	5	2	0	2

Table 5. (Cont.) Numbers of Juvenile Salmonids Collected in Anchor River System by Electro Fishing, 1980.

Station No.	Date	RT/SH	SS	KS	DV
20	7/23/80	0	0	0	0
	8/28/80	3	1	0	0
21	7/25/80	1	27	1	35

Table 6. Summary of Tagging and Recovery Data for Adult Anchor River Steelhead, 1980.

	Week Ending												
	8/31	9/7	9/14	9/21	9/28	10/5	10/12	10/19	10/26	11/2	11/9	11/15	Total
Number of fish tagged	1	6	26	8	0	3	1	1	0	1	0	3	50
Number of tags recovered	1	2	8	2		0	1	0	0	0	0	0	14
Number of tagged fish caught and released	0	0	1	1		0	0	0	0	0	0	0	2
Number of tagged fish recovered out of Anchor River	1	1	1	0		0	0	0	0	0	0	0	3
Known harvest of tagged fish	1	2	7	1		0	1	0	0	0	0	0	12
Days from tagging to capture													
Mean	...	14	11	26			...						
Range	4	9-18	1-36	1-50			1						

Table 7. Pertinent Tagging Data for Adult Steelhead from Anchor River Which Were Tagged with Radio Tags, and Results of Tracking, 1980.

Fish No.	Size-Sex	Peterson Disc Tag No.	Radio Frequency	Date Released	Location of Release	Tracking Results
1	720 mm Male	A-051	40.639	10/8/80	Behind cabin	10/9-Downstream 1/4 mi. above slough. 10/16-1/14/81-Strong signal in slough; suspected out of fish.
2	745 mm Female	A-052	40.610	10/8/80	Forks	10/12-Caught by angler above forks; radio returned.
3	645 mm Female	A-053	40.600	Held overnight; ejected radio; retagged with Floy tag.		
4	685 mm Female	A-053	40.600	Held overnight; ejected radio; retagged with Floy tag.		
5	660 mm Female	A-098	40.651	10/16/80	Forks	10/17 - 50 yds, below bridge. 10/18 - Cottonwood Hole. 10/20 - Signal missing.
6	795 mm Female	A-097	40.620	10/16/80	Behind cabin	10/17 - Cottonwood Hole 10/18-11/10 - 1/2 mi. above Forks 12/2-12/29 - 50 yds. below bridge 1/14/81 - Signal missing
7	750 mm Male	A-096	40.600	10/16/80	Behind cabin	10/17-18 - Behind cabin 10/20-21 - In Intertidal area 10/23 - Signal missing
8	745 mm Male	A-095	400.610	10/16/80	Behind cabin	10/17-1/14-81 - Signal behind cabin; signal weak by 12/29
9	760 mm Female	A-054	400.630	10/29/80	Behind cabin	10/29-11/6 - Behind cabin 11/10-12/11 - Downstream 1/4 mi., above slough 12/29 - Signal missing

about four of these remained in the fish more than a few days. Signals from four radios ceased after having been tracked for a few days to over 2 months. Their fate is unknown, but the fish could have been caught by anglers, left the river, or the radio ceased to transmit. In the limited tracking that was possible, adults were found to move very little. However, the tagging program was conducted during the latest portion of the run and fish which enter the river earliest may tend to move more.

A creel census of the summer-fall fishery was started on July 1 and terminated on November 15. A total of 3,634 anglers were interviewed and completed anglers fished an average of 2.5 hours per day. Total angling effort during this period amounted to 15,157 man-days.

It was estimated that anglers harvested 847 steelhead from Anchor River; they are listed in Table 8 by area and weekly period. Information obtained during interviews showed that anglers kept 57.5% of the steelhead they caught.

The first steelhead appeared in creel census sampling on August 23, but a few fish had been observed outside the census periods about 1 week earlier. In 1978, the first steelhead appeared in the creel census during the week of August 6 and, in 1979, during the week of August 5. The first steelhead are usually caught in or immediately above the intertidal area of the river and appear to coincide closely with their first entry into the river. The harvest builds to a peak in mid-to-late September; the harvest by weekly period during the past 3 years is illustrated in Figure 3. The comparatively low harvest after about mid-October in 1980 was due largely to extreme flood and high water conditions in Anchor River which persisted until freeze-up.

A summary of creel census data since 1954 from the summer-fall fishery in Anchor River is presented in Table 9, with available population estimates and estimates of harvest of steelhead.

During the period August 18 to September 22, 1980 an area in Cook Inlet south of the Anchor Point light was open to set net fishing for subsistence users. There were two 48-hour fishing periods per week and a census was conducted to determine the harvest of steelhead in that fishery; it was estimated that 190 steelhead were harvested (Wallis, 1980). Steelhead harvested in that fishery were probably a mixed stock destined for other Kenai Peninsula streams as well as to Anchor River. Biological data and scales were collected to determine if a separation of the harvest into streams of different origin was feasible. With existing data such a separation was not possible.

Scales were collected from steelhead during the tagging operations, creel census interviews and subsistence fishery interviews. Total age determinations could be made from 26 fish tagged, 167 examined in the creel census, and 80 fish examined from the subsistence fishery. Summaries of the age and sex composition and lengths of fish in the three samples are presented in Tables 10, 11 and 12.

Table 8. Estimated Sport Fish Harvest of Steelhead from Anchor River by Weekly Intervals and Area, July 1 - November 15, 1980.

Week Ending	Area 1	Area 2	Total
7/6	12[1/]	0	12
7/13	0	0	0
7/20	0	0	0
7/27	0	0	0
8/3	0	0	0
8/10	0	0	0
8/17	0	0	0
8/24	36	0	36
8/31	72	0	72
9/7	145	0	145
9/14	149	0	149
9/21	120	19	139
9/28	43	5	48
10/5	79	9	88
10/12	59	17	76
10/19	44	12	56
10/26	0	0	0
11/2	8	0	8
11/9	4	6	10
11/15	3	5	8
Total	774	73	847

[1/] Kelts

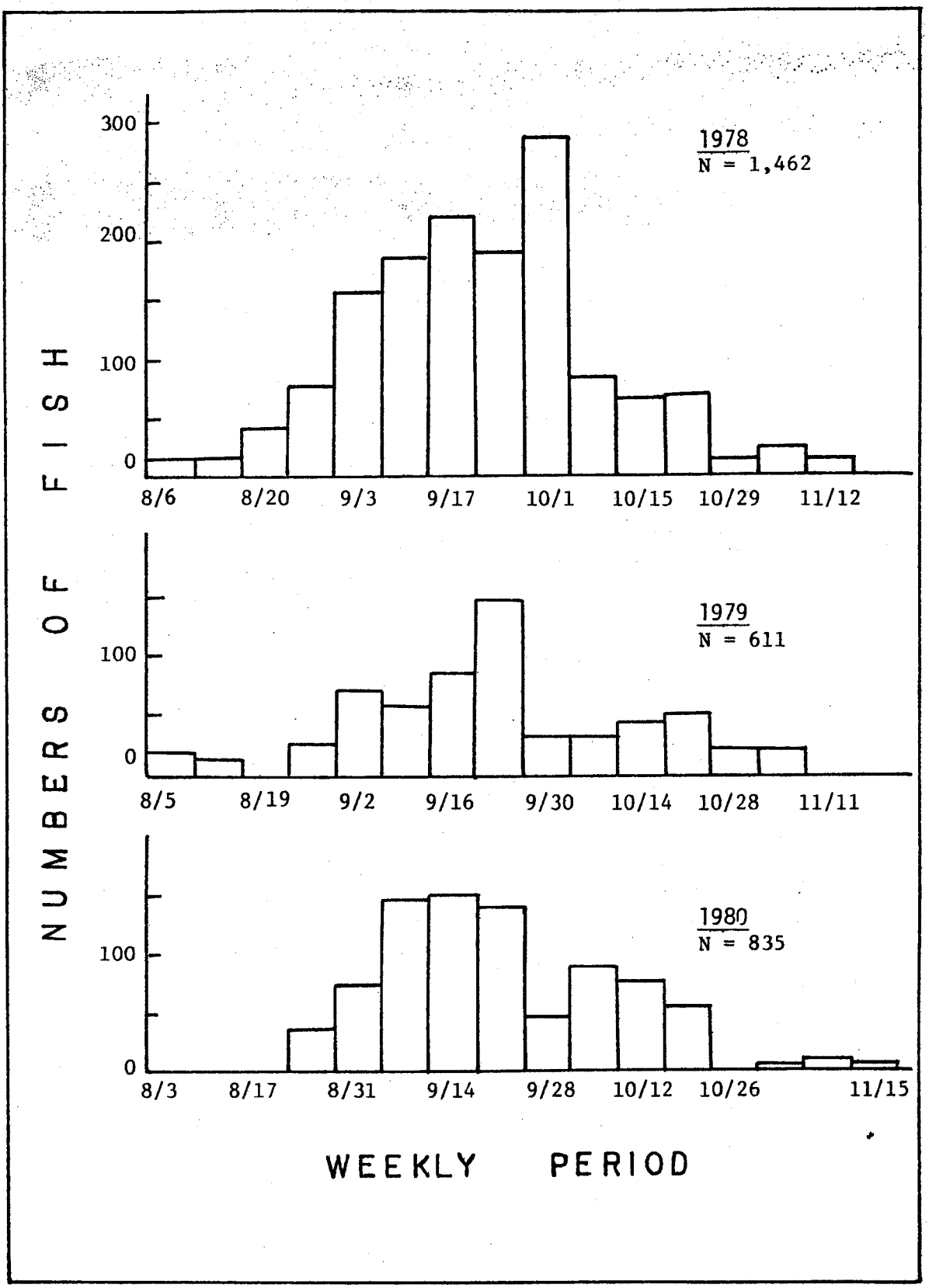


Figure 3. Bar graph illustrating harvest of steelhead trout from Anchor River, by weekly period, 1978-1980.

Table 9. Summary of Angler Effort, and Estimates of Harvest and Total Populations of Steelhead on Anchor River.

Year	Period Covered in Census	Effort Man-Days	Steelhead Estimates Harvest	Total Runs	Source of Data
1954	5/29/-10/23	3,000	247	511	
1957	5/1-10/15	5,800	50	600	
1960	5/7-10/2	5,300*	400	...	Dunn (1960)
1968	7/6-10/19	3,045	102	...	McHenry (1968)
1977	5/28-6/19	10,978	NC**	...	ADF&G (Unpubl. data)
	Bal. of Year	20,573	1,072	...	Mills (1978)
	Total	31,515			
1978	5/27-6/19	23,748	NC**	...	ADF&G (Unpubl. Data)
	7/15-11/12	20,906	1,462	4,162	Wallis & Hammarstrom (1979)
	Total	44,654			
1979	4/13-4/30	3,500	100	...	Wallis & Hammarstrom (1980)
	5/26-6/18	17,715	75	...	ADF&G (Unpubl. Data)
	7/14-11/4	18,267	611	...	Wallis & Hammarstrom (1980)
	Total	39,482	786		
1980	5/24-6/16	10,109	15	...	ADF&G (Unpubl. Data)
	7/1-11/15	15,157	847	2,388	
	Total	25,266			

* Effort incomplete - covers period 5/7-7/14 only.

** NC - Not covered in census.

Table 10. Summary of Age Composition and Lengths of Anchor River Steelhead Tagged in 1980.

Age Class	Number	Length (mm) Mean	Length (mm) Range
First-time spawners			
Males			
2.2	1	...	735
3.1	1	...	590
3.2	4	704	620-765
4.1	1	...	555
Total	7		
Females			
2.2	1	...	690
3.1	1	...	570
3.2	10	678	660-710
4.2	2	702	685-720
Total	14		
Repeat Spawners			
Males			
3.1s	1	...	655
3.1s1	1	...	680
Total	2		
Females			
3.2s1	2	805	780-830
4.1s	1	...	675
Total	3		

Table 11. Summary of Age Composition and Lengths of Anchor River Steelhead Trout; Data from Scales Collected in Creel Census, Fall, 1980.

Age Class	Number	Length (mm) Mean	Length (mm) Range
First-time spawners			
Males			
2.1	1	...	585
2.2	7	691	640-750
3.1	12	581	555-610
3.2	35	689	610-760
3.3	1	...	700
4.2	3	712	635-790
Total	59		
Females			
2.2	15	700	650-780
3.1	6	574	560-610
3.2	52	689	610-790
4.2	2	698	665-730
Total	75		
Repeat spawners			
Males			
2.1s1	3	718	710-725
2.2s1	1	...	780
3.1s	1	...	655
3.1s1	2	738	705-770
3.2s	1	...	700
3.2s1	2	780	775-785
3.2s1s1	1	...	880
4.1s1s	1	...	740
Total	12		
Females			
2.2s1	1	...	695
3.2s1	16	783	725-860
4.1s	1	...	675
4.2s1	3	768	730-800
Total	21		

Table 12. Summary of Age Composition and Lengths of Steelhead Trout Caught in the Anchor Point Subsistence Fishery, 1980.

Age Class	Number	Length (mm) Mean	Length (mm) Range
First-time spawners			
Males			
2.1	2	575	530-620
2.2	4	735	725-765
3.1	9	592	530-615
3.2	15	735	680-810
4.2	1	...	725
Total	31		
Females			
2.2	4	676	655-740
3.2	34	698	640-790
4.2	1	...	695
Total	39		
Repeat spawners			
Males			
3.1s	1	...	715
3.1s1	3	753	675-810
Total	4		
Females			
2.2s1	1	...	810
3.1s	1	...	640
3.1s1	1	...	730
3.2s1	2	782	760-805
4.1s1	1	...	735
Total	6		

In both 1978 and 1979, the majority of the males on their first spawning run were fish which had spent only one winter in the ocean. However, in 1980, 77% of the first spawning males were 2-ocean fish. In all years the majority of first spawning females have been 2-ocean fish.

Thirty-eight of the 193 fish (19.7% of the sample), for which total age determinations could be interpreted, had spawned previously. Six of the fish were returning to spawn in their second consecutive year and all others had 1-ocean annulus following a spawning check. Two of the individual fish had spawned twice previously and had returned to spawn a third time. The percentage of repeat spawners is comparable to those reported earlier: Allin (1954) - 26%; Dunn (1960) - 3.5%; Redick (1968) -24.3%; McHenry (1969) - 16.2%; Wallis and Hammarstrom (1979) - 17.7%; Wallis and Hammarstrom (1980) - 17.5%.

The combination of population data from the 1978 and 1980 adult runs permits an estimate of numbers of fish of the 1978 run which survived to return again in the 1980 run.

It was estimated that the 1978 run in Anchor River was 4,132 fish. An estimated 1,462 fish were caught in the fall of 1978, and 100 were caught in the spring of 1979 prior to spawning. No census was conducted to estimate the numbers of kelts harvested during the chinook salmon fishery in 1979, but it is guessed that about 50-75 were taken. This would leave about 2,500 fish from the 1978 adult run which remained to return to sea.

In 1980, 32 of the 193 steelhead for which total age determinations could be made had spawned in the spring of 1979. This percentage, 16.6%, applied to the estimate of 2,388 fish in 1980, gives an estimate of 396 fish which had spawned in 1979, or 15.8% of the approximate number which could have returned to sea.

A very small percentage of fish spawn a third time, therefore the above data were corrected to reflect the survival of only first-time spawners of the 1978 run up to their second spawning run. This resulted in an estimate of 19.2% survival. While these data are subjected to much error, they are adequate to suggest a post-spawning survival rate of 15 to 20%.

Scale Analysis

Juvenile scales were examined to establish background data for use in interpreting certain aspects of adult scales. Photographic examples of different age juvenile scales are shown in Figure 4.

Scale A is from a fish which had emerged from the gravel 1 to 2 months earlier; the narrower spacing of the last circulus being deposited on the margin is thought to be the beginning of formation of the first freshwater annulus. Scale B shows no evidence of an annulus, but is from a fish which had spent one winter residing in the stream. Some adult scales exhibit patterns which suggest an annulus was not formed during the first winter of freshwater residency, but we have no quantative data at present to estimate the proportion or significance of this. Scale C is from a typical Age I

A. Young-of-the-year; 38mm; collected 9/25/80; 48X magnification.

B. Age I parr; no first annulus; 61mm; collected 7/10/80; 48X magnification.

C. Age I parr; annulus at arrow; 68mm; collected 7/16/80; 48X magnification.

D. Age II parr; annuli at arrows; 95mm; collected 7/23/80; 29X magnification.

E. Age II smolt; 163mm; collected 8/1/80; showing extensive freshwater growth after second annulus; 29X magnification.

F. Age III smolt; 185mm; collected 6/21/80; showing very little freshwater growth after third annulus; 29X magnification.

Figure 4. Examples of scales from juvenile steelhead trout collected in Anchor River.

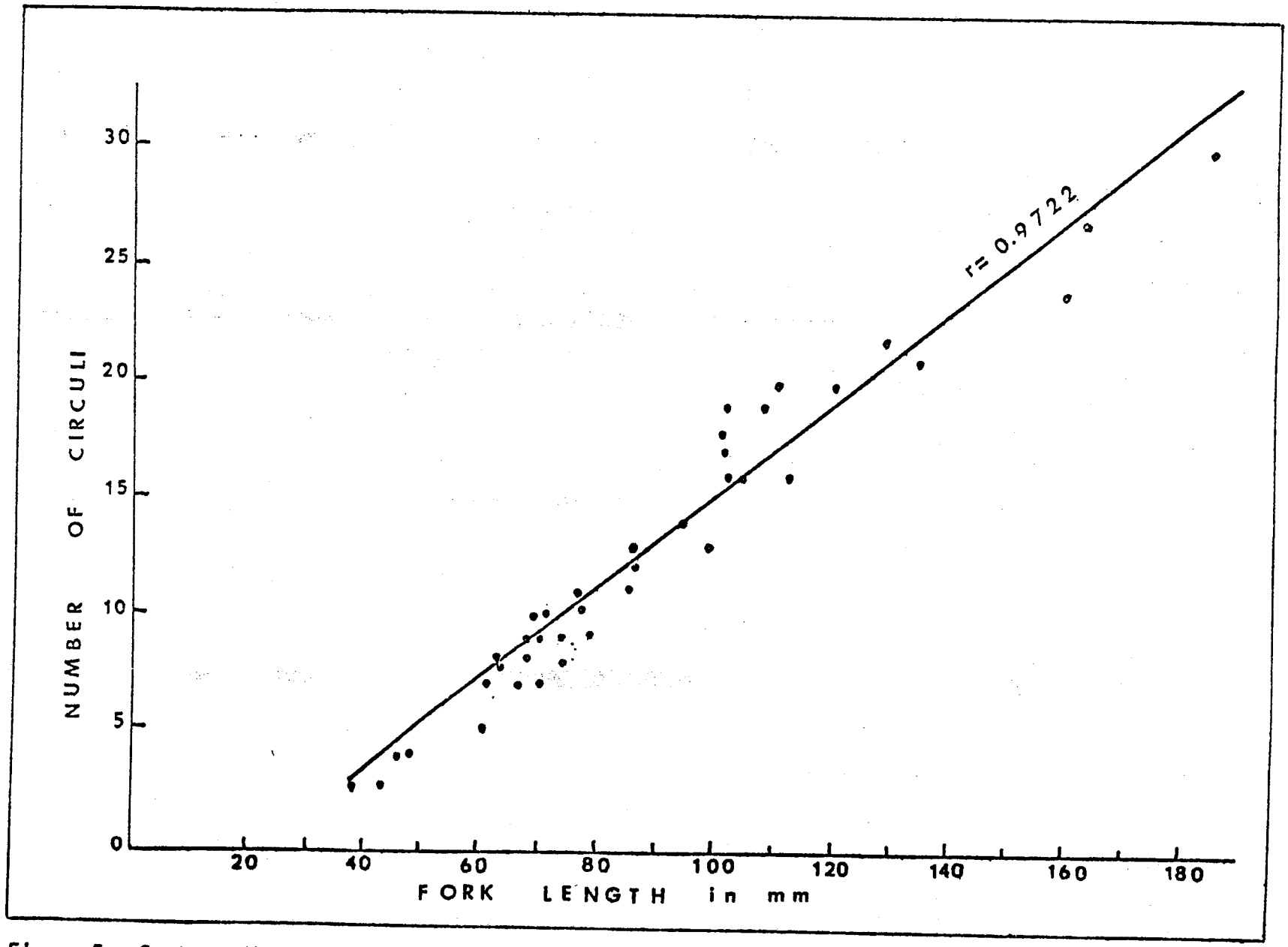
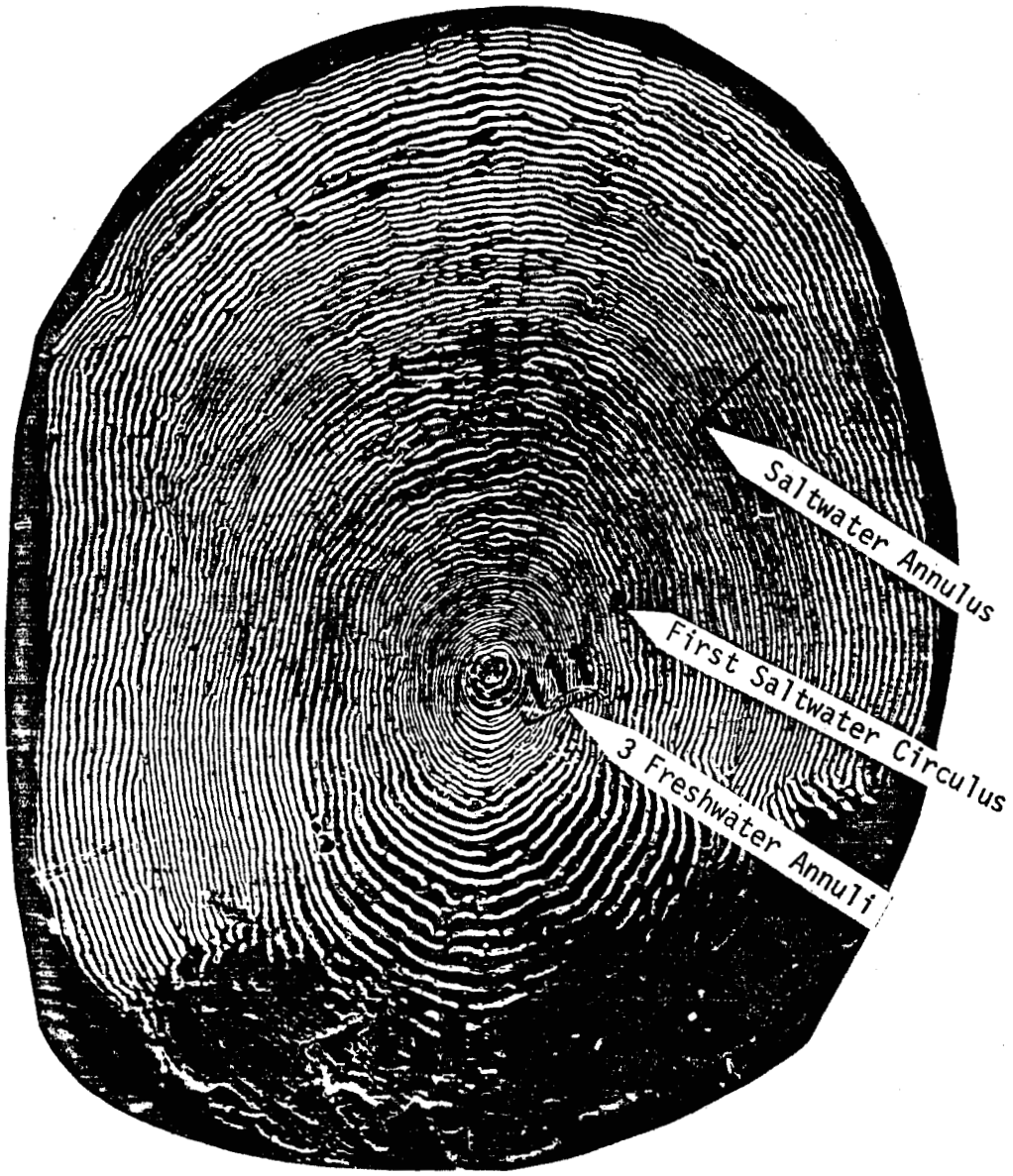


Figure 5. Scatter diagram showing relationship between lengths of juvenile steelhead trout and numbers of freshwater circuli, in Anchor River.



575 mm Female
Caught 9/2/80
Age Class 3.1

Figure 6. Scale from a typical 1-ocean steelhead in Anchor River.

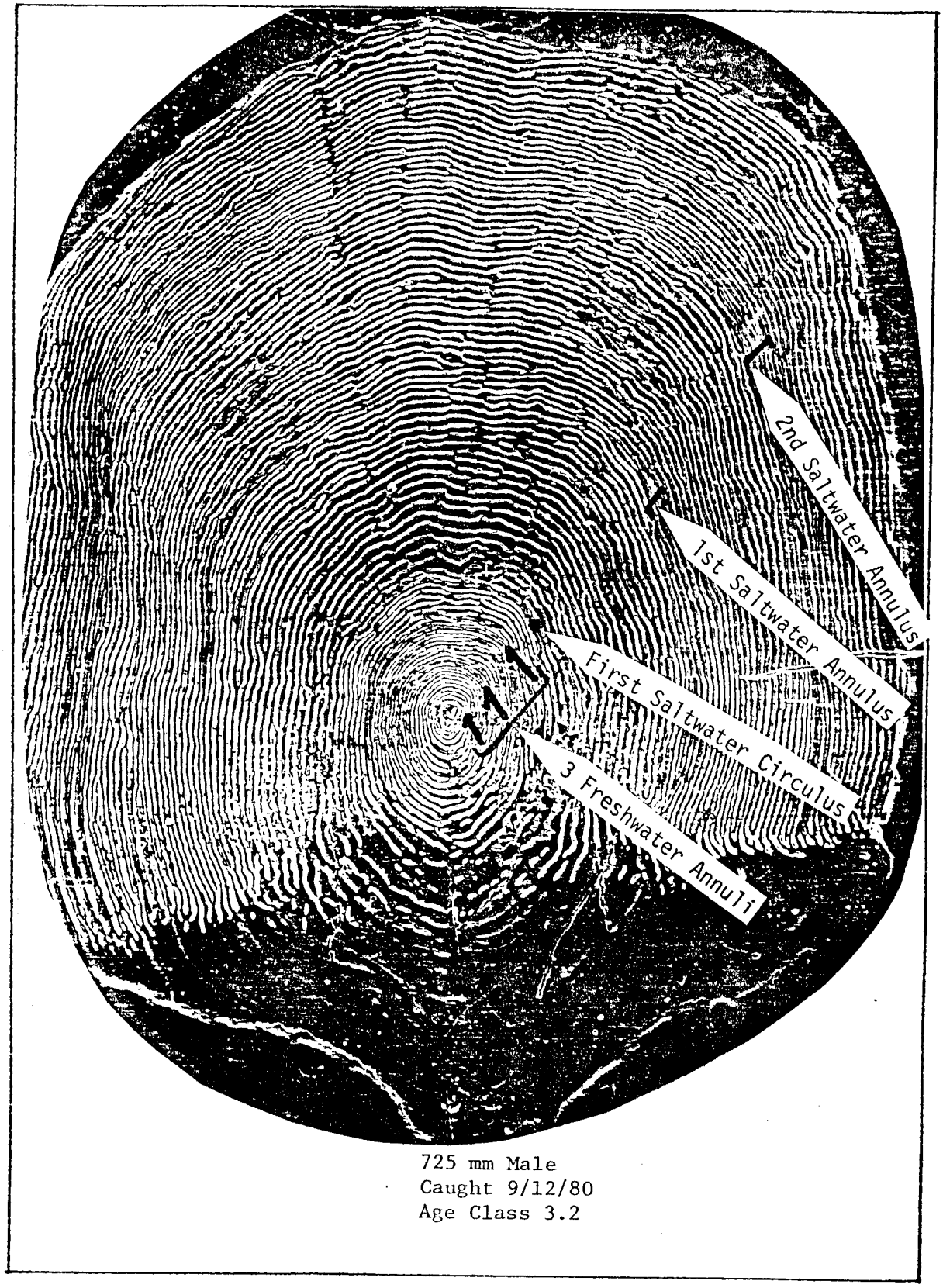


Figure 7. Scale from a typical 2-ocean steelhead in Anchor River.

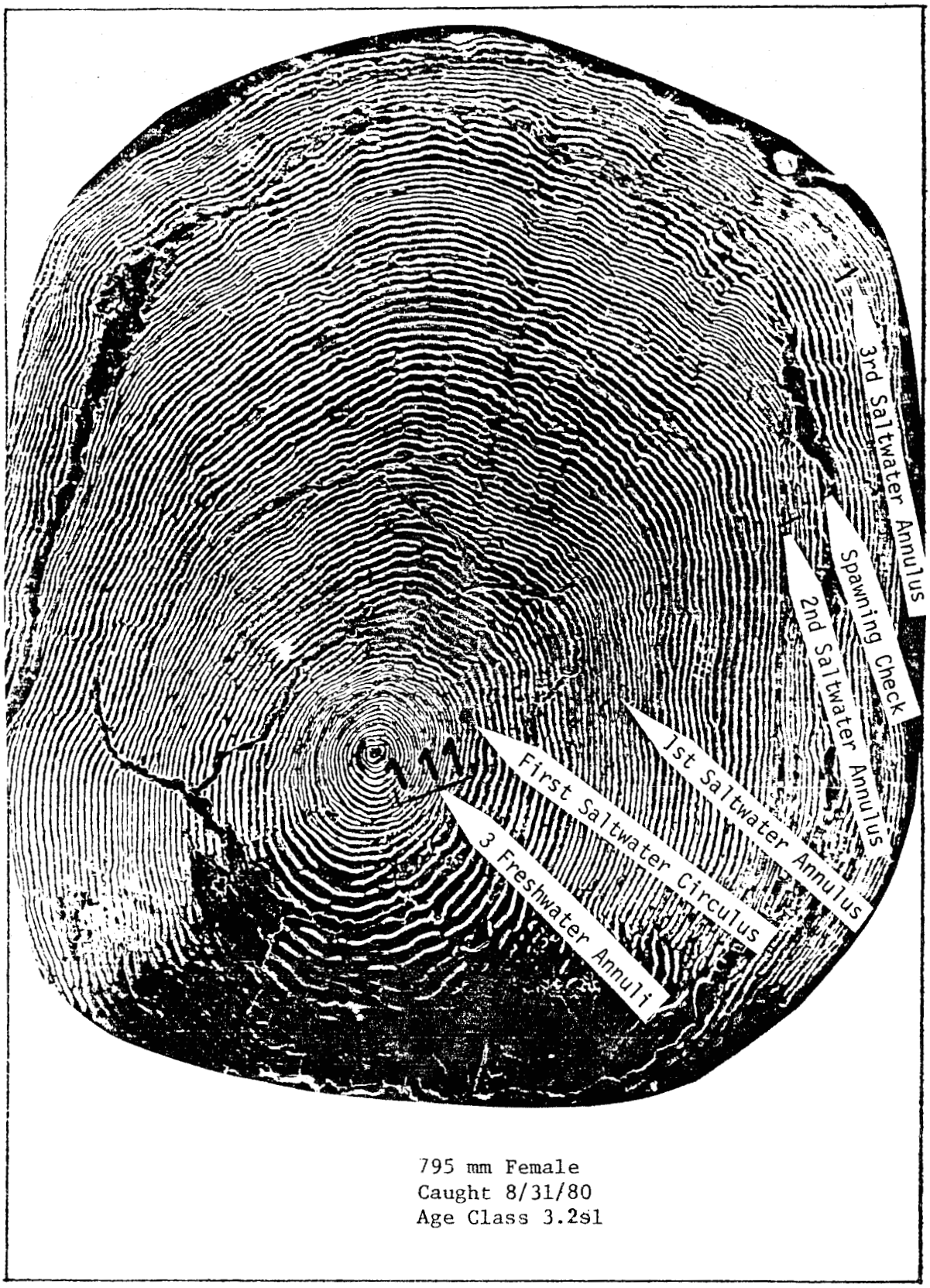


Figure 8. Scale from a typical repeat spawning steelhead in Anchor River.

Table 13. Frequencies of Total Number of Freshwater Circuli and Number of Freshwater circuli Formed after the Last Freshwater Annulus on Scales from Adult Steelhead in Anchor River.

Total number of freshwater circuli		Number of freshwater circuli after last freshwater circuli	
Number of Circuli	Number of Fish	Number of Circuli	Number of Fish
20	1		
21	0	0	2
22	4	1	6
23	4	2	22
24	10	3	11
25	9	4	12
26	12	5	34
27	14	6	25
28	22	7	17
29	27	8	14
30	13	9	12
31	7	10	5
32	13	11	0
33	7	12	0
34	6	13	0
35	2	14	1
36	2		
37	1	Total	161
38	4	Mean	5
39	1	Standard Deviation	2.5
40	1		
41	1		
Total	161		
Mean	29		
Standard Deviation	3.8		

parr, and Scale D represents a typical Age II parr. Scales E and F demonstrate patterns that are commonly represented on adult scales.

The number of circuli was related to length of juvenile steelhead; this relationship is exhibited in Figure 5. Numbers of circuli in the freshwater portion of adult scales were counted and the relationship of number of circuli to length was applied to these data to provide an estimate of length of the fish at formation of their last freshwater circulus.

The frequency of freshwater circuli counts is presented in Table 13. Both the mean and modal count was 29 freshwater circuli with a narrow standard deviation. In the relationship shown in Figure 5, 29 freshwater circuli represent a length of 172 mm (6.8 inches); the population encompassed by ±2 Standard Deviations would range from 127 to 204 mm (5.0 and 8.0 inches).

Examples of typical scales from the three most common life history patterns in Anchor River are shown in Figures 6, 7 and 8. The first ocean annulus usually consists of several closely spaced circuli, preceded and followed by more widely spaced circuli; this is demonstrated by the scale from a 1-ocean female in Figure 6. The apparent first ocean annulus on the scale in Figure 7 is a little more definite than in the previous example, but its precise location is subject to interpretation. The second ocean annulus is usually more pronounced than the first, as illustrated in Figure 7. Most of the repeat spawners in Anchor River exhibit 1-ocean annulus following a spawning "check" as illustrated in Figure 8, however, a small percentage do exhibit spawning checks in consecutive years.

Discussion

The inclined-plane trap was not effective in capturing steelhead smolts, although it was effective in capturing both coho and chinook salmon smolts.

Past studies by Allin (1957) and McHenry (1969) indicated that the peak migration of steelhead smolts occurs from late June to mid-July. The trap was in operation throughout this period, and it is felt the failure to trap smolts was due to trap inefficiency. It is suspected that the approach velocity in the trap was not sufficient to force the smolt over the weir crest.

Size of the few smolts captured and the calculated size based upon scale analysis agree with size of smolts reported in earlier studies. Allin (1957) reported steelhead smolts ranging from 165 to 230 mm with the mode 180 to 200 mm. McHenry (1969) reported observations of smolts ranging from 150 to 200 mm. Data presented in the current study suggest a modal length of 172 mm with most of the fish in the range of 150 to 200 mm.

Observations from previous years suggest that steelhead in Anchor River spawn during the month of May. Using temperature data from 1980, it is calculated that fry would emerge from the gravel about mid-July from eggs deposited in early May, and in late July to early August from eggs deposited in late May. This is in agreement with the first appearance of young-of-the-year in the inclined-plane trap.

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