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CHARACTERISTICS OF THE FALL-RUN STEELHEAD TROUT (SALMO GAIRDNERI GAIRDNERI) OF THE KLAMATH RIVER SYSTEM WITH EMPHASIS ON THE HALF-POUNDER[1]

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Creel census data for the 1958, 1962, 1967, and 1968 Klamath River runs were analyzed to determine growth, age composition, sex ratios, maturity, migrations, food, feeding habits and length-weight relationship of fall-run steelhead, particularly half-pounders, (defined here as steelhead 250-349 mm FL). These were in the l/l, 2/1, and 3/l age categories and were on their first upstream migration after only a few months in the ocean. Most half-pounders are immature, but probably return as mature steelhead after a second season in the ocean. Half-pounders, in contrast to mature steelhead, feed extensively on their first upstream migration. The sex ratio of all Klamath River fall-run steelbead is about 1:1. Condition factors increase in saltwater and decrease in fresh. Scale formation begins at about 30 mm.

INTRODUCTION

Fall-run steelhead trout of the Klamath River system provide an important sport fishery during August, September, and October. This fishery accounts for about five times the effort expended for the late-run (winter) steelhead (Fish and Wildlife Service, 1960). The early fall-run fishery is primar ly for small steelecad commonly called "half-pounders" and is the most important of its type on the West Coast. Half-pounders are limited to the Klamath, Eel, and Rogue rivers, and to a lesser extent to a few other rivers in northern California and southern Oregon.

In this study, steelhead 250-349 mm (9.8-13.8 inches) FL are defined as half-pounders.

The purpose of this study was to determine the growth characteristics, age composition, sex ratios, maturity, migration characteristics, and food and feeding habits of Klamath River fall-run steelhead, particularly the half-pounder.

STUDY AREA

The Klamath River basin is in south central Oregon and northwestern California (Figure 1). In California, the basin includes portions of Modoc, Siskiyou, Trinity, Humboldt and Del Norte counties. In Oregon, it comprises portions of Lake, Klamath, Josephine, and Jackson counties. The area of the basin is approximately 10 million acres.

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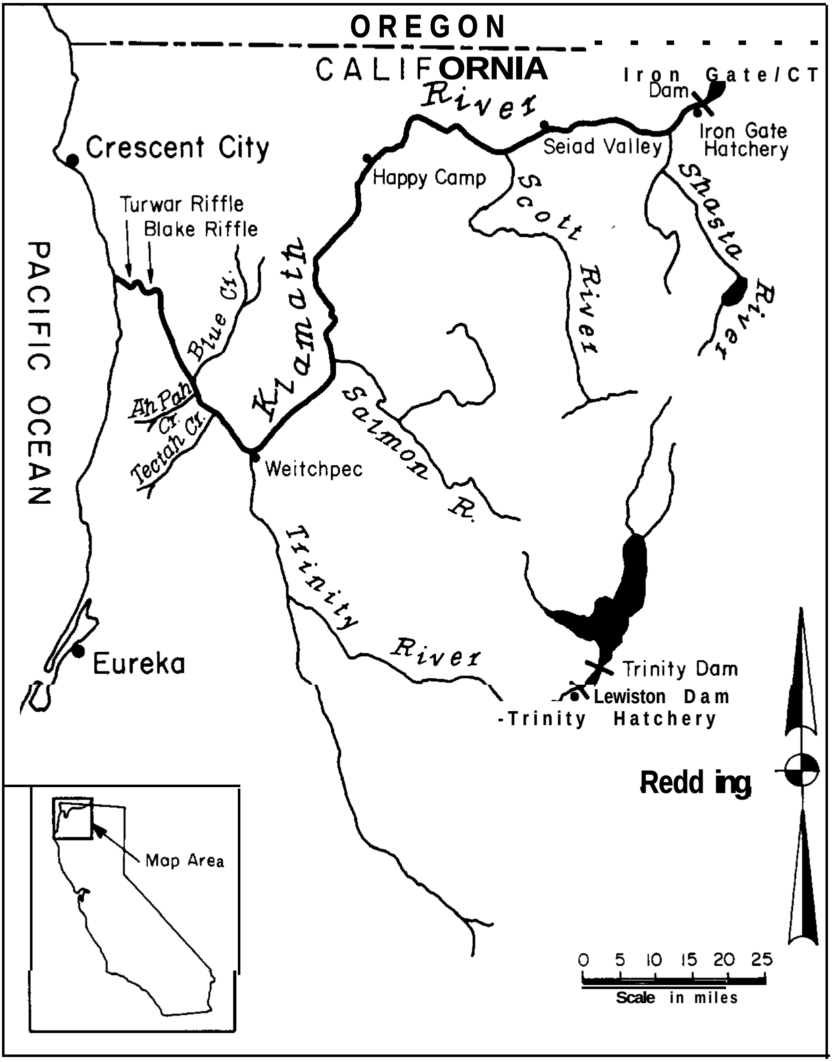

FIGURE 1. Klamath River drainage.

The main river within the basin is the Klamath, the second largest river in California, exceeded in size only by the Sacramento. The Klamath originates at Lake Ewana, near Klamath Falls, Oregon. From Lake Ewana it flows southwest for 263 miles to its mouth, 32 miles south of the Oregon-California boundary.

Iron Gate Reservoir is 190 miles upstream from the mouth, at which point the upstream migration of anadromous fish is blocked.

The largest tributary of the Klamath is the Trinity River. Two recently constructed reservoirs, Lewiston and Trinity, block the migration of anadromous fish into its upper reaches. Other major tributaries are the Shasta, Scott, and Salmon rivers. Approximately 200 minor tributary streams complete the drainage system.

METHODS AND MATERIALS

Data from 618 returning fall-run steelhead were collected by creel census and hook and line in 1967 and 1968. Samples from 232 steelhead collected by creel census and hook and line in 1962 and 58 steelhead caught in fyke nets near Ah Pah Creek in 1958 were given to the authors. During 1967-68 additional data were collected from steelhead that had migrated to Iron Gate Hatchery on the upper Klamath River. In 1967 and 1968, juvenile steelhead were sampled by electrofishing from Blue and Tectah creeks, small tributaries of the lower Klamath. Data collected included some or all of the following: length and weight measurements, scale samples, gonad samples, and stomach samples.

All scales were read on a commercial scale reader using a magnification of 80X. Scales were read at least three times. If a fair degree of confidence concerning the age of a fish could not be established at the third reading, it was eliminated from the data. Three qualified persons read specified groups of scales to confirm our interpretations. General agreement was attained.

The principal criteria used to define annuli in the study were cutting or crossing-over of circuli, incompleteness of circuli, and narrowing of distance between circuli (Figures 2 and 3). One year's growth as represented on a scale was considered to be the time from the formation of the last circulus of an annulus to the formation of the last circulus of the succeeding annulus.

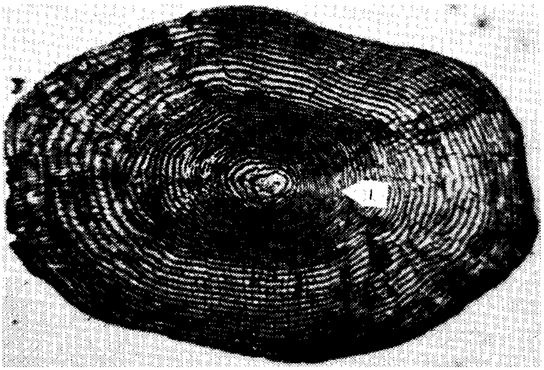

FIGURE 2. Scale of a 1/1 Klamath River half-pounder. Note the large amount of stream growth in the year of entrance to the ocean.

Ocean growth on steelhead scales was distinguished from stream growth by the increased spacing between the circuli. It was sometimes difficult to distinguish ocean growth from river growth, especially on the scales of larger steelhead.

In this study we used the method of aging steelhead devised by Shapovalov and Taft (1954). Briefly, this indicates years spent in the stream and ocean and, when applicable, the spawning history of the fish. The number of years spent in the stream appears on the left-hand side of a diagonal line and the number of years in the ocean on the right-hand side of the line. For example, steelhead with an indicated age of 2/1 have spent 2 years in the stream, and 1 year in the ocean.

The majority of the steelhead sampled were captured during the fall months, well before they had completed their current year's growth. For the study, the year of capture is considered a full year's growth. For example, a 2/l fish has been given an age of 3 years, even though its third year represents only a few months in the ocean,

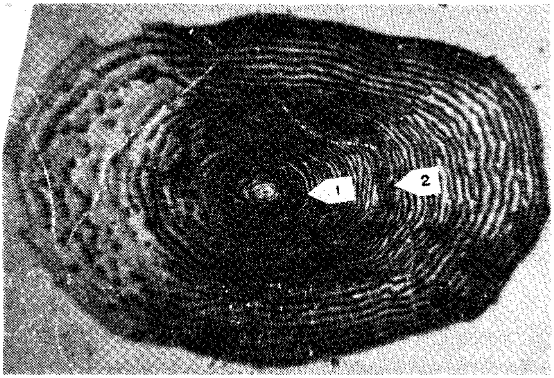

FIGURE 3. Scale of a 2/1 Klamath River half-pounder. Note the small amount of growth achieved during the first year of life.

The year of life in which steelhead smolts enter the sea usually includes both stream and ocean growth. For purposes of clarity and convenience, and because the greatest amount of growth is achieved in the ocean, a year of mixed stream and ocean growth has been indicated as ocean growth.

All readable scales were measured so that lengths at annuli and other positions of importance could be back-calculated.

All readable scales were examined to determine if spawning checks were present at annuli. In this study, an area of moderate to heavy lateral and anterior resorption is considered a spawning check. Small amounts of lateral resorption may appear at almost any annulus of the steelhead scale, but we believe that such resorption does not indicate a spawning-maturation check.

Stomach and gonad samples were analyzed by standard techniques. Temperature and flow data were obtained from the U. S. Geological Survey, Eureka, California. A computer program was used in the length-weight regression analysis (Swingle, 1964). The scale radius-length regression analysis was also computerized.

GROWTH CHARACTERISTICS

The relationship between fork length and weight of 532 Klamath River steelhead of several age categories was calculated for fish divided into 10 mm groups and for individual fish (Figure 4). The formula used was $W = aL^b$ or $\log W = \log a + b (\log L)$, where log

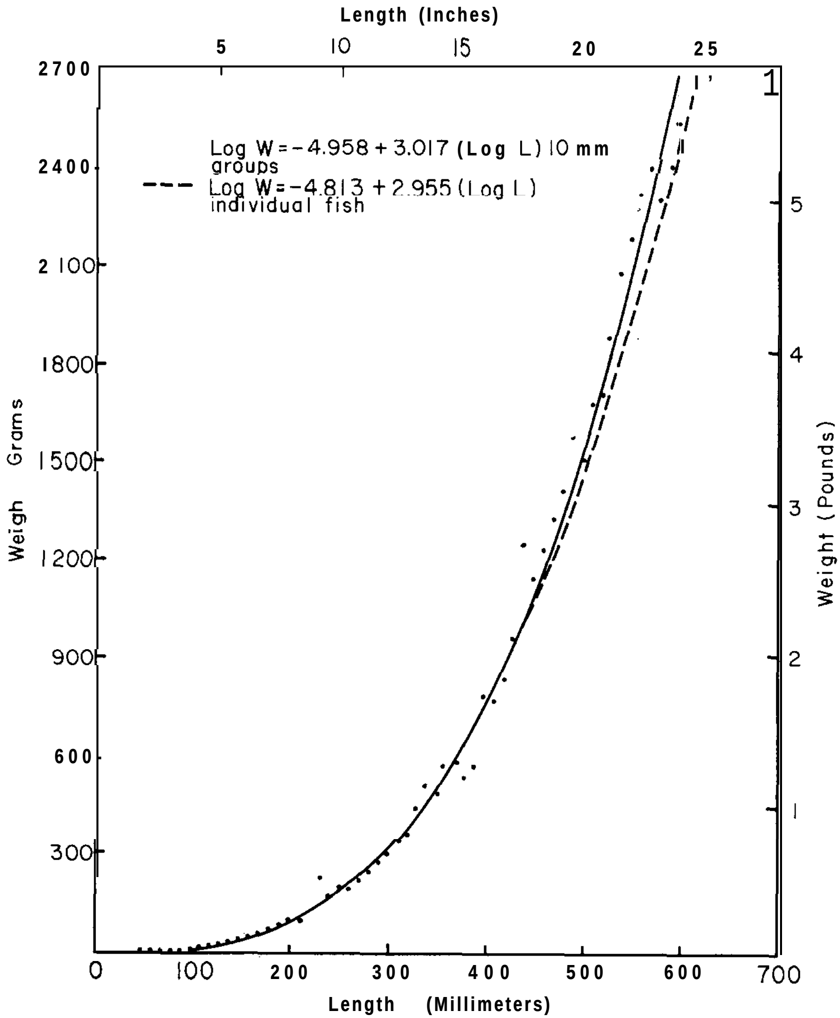

FIGURE 4. Relationship between fork length and weight of 532 Klamath River steelhead. The dots represent the average weights for the mid-points of 10 mm length intervals.

a = -4.958 and b = 3.017 for the fish divided into 10 mm length groups. For individual fish, it was log a = -4.813 and b = 2.955.

A scale radius-length regression analysis performed on 712 fall-run steelhead gave an intercept of 30.1 mm assuming a linear relationship. Snyder (1925), in a study of the Eel River half-pounder, inferred that scales first appear when the fish is about 30 mm long. Sumner (pers. comm.) earlier used a 38 mm intercept for back-calculating lengths of steelhead, but he is currently using a 35 mm intercept in a study by the Oregon Game Commission of Rogue River summer steelhead.

Lengths by age category were determined for Klamath River stream steelhead (Table 1). The differences in size of Klamath River stream steelhead within the same age category may be accounted for by different growth rates and the prolonged spawning season of steelhead which leads to different hatching and emerging times.

TABLE 1. Means and Ranges of Fork Lengths of Klamath River Stream Steelhead Collected in 1962, 1967, and 1968 Before Completion of Their Current Year's Growth

Age category	Mean fork length (mm)	Range of fork lengths (mm)
1/0	79 (57)*	52-115
2/0	150 (79)	108-195
3/0	218 (7)	175-274

* Sample size in parentheses.

Lengths by age category were determined for Klamath River ocean steelhead (Table 2). The values are similar to those found by Snyder (1925) for 18 Klamath River steelhead. The means and ranges of fork lengths for males and females showed no appreciable differences.

TABLE 2. Length Measurements by Age Category. Means and Ranges of Fork Lengths (mm) of Klamath River Ocean Steelhead From the 1958, 1962, 1967, and 1968 Runs. Measurements Taken Before Completion of Current Year's Growth

Age category	Year sampled: 1958	1962	1967	1968	Total
1/1	279 (3)* / 279	285 (43) / 252-340	287 (2) / 275-298	293 (26) / 260-370	287 (74) / 252-370
1/2	436 (8) / 368-559	458 (7) / 417-553	486 (15) / 448-517	---	466 (30) / 368-559
1/3	---	542 (1) / 542	585 (1) / 585	---	564 (2) / 542-585
2/1	338 (28) / 267-406	312 (92) / 263-420	360 (34) / 308-429	328 (48) / 285-409	327 (202) / 263-429
2/2	533 (3) / 508-559	427 (4) / 405-453	521 (37) / 455-584	517 (8) / 456-586	514 (52) / 405-586
3/1	381 (6) / 356-406	357 (6) / 289-451	404 (14) / 332-468	329 (3) / 285-354	382 (29) / 285-468
3/2	---	---	524 (2) / 521-526	---	524 (2) / 521-526

* Mean / Range. Sample size in parentheses.

Means and ranges of length were determined for Klamath River steelhead sampled at Iron Gate Hatchery during the winter of 1967-68. A comparison of the lengths of steelhead sampled at the hatchery with the lengths of other Klamath River steelhead of comparable ages indicated that they did not differ markedly.

Means and ranges in length at previous ages were back-calculated for Klamath River ocean steelhead (Table 3). We found that lengths at annuli for steelhead from the 1962 run were generally less than those for steelhead from the 1958, 1967, and 1968 runs. Discrepancies between lengths of stream steelhead (Table 1) and corresponding back-calculated lengths of ocean steelhead (Table 3) can best be explained by the fact that the stream fish had not completed their year's growth when collected. The lengths of several 2/0 fish collected at or near

TABLE 3. Back Calculated Lengths by Age Category. Back Calculated Means and Ranges of Fork lengths (mm) at Annuli for Klamath River Steelhead From the 1958, 1962, 1967, and 1968 Runs Combined

Age category	Annulus				
		2	3		5
1/1	118 (74) 90-165	287 (74)* 252-370			
1/2	139 (30) 100-185	329 (30) 250-395	466 (30)* 368-559		
1/3	120 (2) 110-130	315 (2) 310-320	490 (2) 470-520	564 (2)* 542-585	
2/1	92 (202) 60-145	169 (202) 105-280	327 (202)* 263-429		
2/2	104 (52) 60-145	192 (52) 132-290	383 (52) 300-460	514 (52)* 405-586	
3/1	93 (29) 65-140	168 (29) 105-230	242 (29) 155-320	382 (29)* 285-468	
3/2	98 (2) SO-115	163 (2) 135-190	265 (2) 220-310	435 (2) 420-450	524 (2)* 521-526

* Length at time of capture (and before annulus formation). Others are back-calculations giving lengths at time of annulus formation.

annulus formation (mid-January) were in close agreement with back-calculated lengths of 2/1 and 2/2 steelhead.

A size group frequency distribution was determined for Klamath River fall-run steelhead (Table 4). Half-pounders (250-349 mm size category) consisted only of 1/1, 2/1, and 3/1 individuals. Some fish of these ages were found within larger size categories also. These age groups migrated upstream in the same year that they entered the ocean. Thus the small-sized Klamath River steelhead, commonly called

" half -pounders ' ', are fish which had been in the ocean only a very short period of time and had achieved little ocean growth before beginning their first upstream migration.

TABLE 4. Size-Group Frequency Distribution of Klamath River Steelhead From the 1958, 1962, 1967, and 1968 Runs

Age category	Size group (mm fork length)		
	250-349 (half-pounder)	350-449	≥450
1/1	71	2	
1/2	--	10	no
1/3	--	--	2
2/1	152	50	--
2/2	--	3	49
3/1	8	18	3
3/2	--	■■	2

AGE COMPOSITION

Most of our data were collected by creel census during the fall of the year so the age composition of steelhead runs occurring later cannot be inferred. The majority of the steelhead studied were in the 2/1 category. Fish in the 1/1 category were moderately numerous in 1962 and 1968, but were almost lacking in 1967. Notable were the large numbers of 2/2 steelhead in 1967 and lack of 1/2 fish in 1968 (Table 2).

Shapovalov and Taft (1954), Maher and Larkin (1954), and others reported that the age composition of steelhead runs within a given drainage varies from year to year. Although the age composition of Klamath River steelhead no doubt varies from year to year, the differences observed in the 1967 and 1968 runs are atypical. It was apparent from conversations with long-time Klamath River fishermen that the 1967 run lacked normal numbers of half-pounders and that the 1968 run contained very few larger, older fish. This is interesting since the 2/1 half-pounders of 1967 and 2/2 stcelhead of 1968 were both of the 1965 year class.

The winter of 1964-65 in northern California was a time of exceptionally high water and heavy flooding. The effects of high water on steelhead production for the year are not known. It is possible that reduced food supplies and abnormal temperature patterns affected the survival of steelhead of the 1965 year class.

MIGRATION AND MOVEMENT

The size of Klamath River steelhead at the time of entrance to the ocean was calculated at between 187 and 210 mm for l-year-old smolts, 199 and 215 mm for 2-year-old smolts, and 247 and 280 mm for 3-year old smolts (Table 5 and Figure 5). Riikula (Oregon Game Commission, pers. comm.) states that the average length of Rogue River steelhead at entrance to the sea was between 191 and 241 mm.

Examination of Klamath River steelhead scales revealed that l/l fish do not migrate as rapidly to the ocean after formation of their first annulus as do 2/l steelhead after formation of their second annulus.

TABLE 5. Calculated Means and Ranges of Fork length at Entrance to the Ocean of Klamath River Steelhead From the 1958, 1962, 1967, and 1968 Runs

Age category	Fork length (mm)	
	Mean	Range
1/1	187 (74)*	140-265
1/2	200 (30)	140-265
1/3	210 (2)	210
2/1	199 (202)	130-280
2/2	215 (52)	150-290
3/1	247 (29)	175-320
3/2	280 (2)	250-310

* Sample size in parentheses.

This conclusion is based on the observation that more stream growth is usually present in the year of seaward migration on 1/1 scales than on 2/1 scales (Figures 2 and 3). It is interesting that 3/1 Klamath River steelhead scales show little, if any, stream growth after formation of their third annulus and, therefore, enter the ocean earlier than do 2/1 fish.

Neave (1949)) Maher and Larkin (1954)) Shapovalov and Taft (1954)) and Chapman (1958)) found that the majority of steelhead smolts enter the ocean during March through May. The majority of Klamath steelhead enter the ocean in mid-April or early May and many return in September. This indicates an ocean growth rate for 2/1's of 130 mm for 4 months, or about 30 mm per month.

The length of 1/1 steelhead at their first stream annulus is greater than the lengths of 2/1 and 3/1 fish at the same annulus (Figure 5). Apparently, 1/1 fish have a greater stream growth rate than 2/1 fish and are able to achieve smolt size in their second year, but are smaller upon entering the ocean than are the 2- and 3-year-old smolts. In addition they go to sea later in the year than the 2/1 and 3/1 fish, but return at about the same time and have not achieved as much ocean growth. They, therefore, are of smaller size than 2/1 and 3/1 fish.

There is little difference between the lengths of 1/1, 2/1, and 3/1 steelhead and the back-calculated lengths of adult steelhead of similar freshwater life histories. This was true of the 1965 year class sampled in consecutive years (Table 6). Thus, we feel the Klamath River half-pounder returns the following year as a large mature steelhead.

We were not able to ascertain why half-pounders spend only a few months in the ocean before beginning their first upstream migration. Studies by Maher and Larkin (1954) and Sumner (1945) show that steelhead from the Chilliwack River and Tillamook County streams, with few exceptions, spend 2 years at sea before commencing their first upstream migration. Whitt and Pratt (1955) report that most Clearwater River steelhead spend 1 year in the ocean before beginning their first upstream migration. A great proportion of Waddell Creek steelhead return to the river after having spent 1 year at sea (Shapovalov and Taft, 1954. Hallock, Van Woert, and Shaporalov (1961) found that most Sacramento River steelhead spend 1 or 2 years in salt water.

IIalf-pounders were caught primarily in the early part of the 1967 fall run, while larger steelhead were taken later in the run. In 1968,

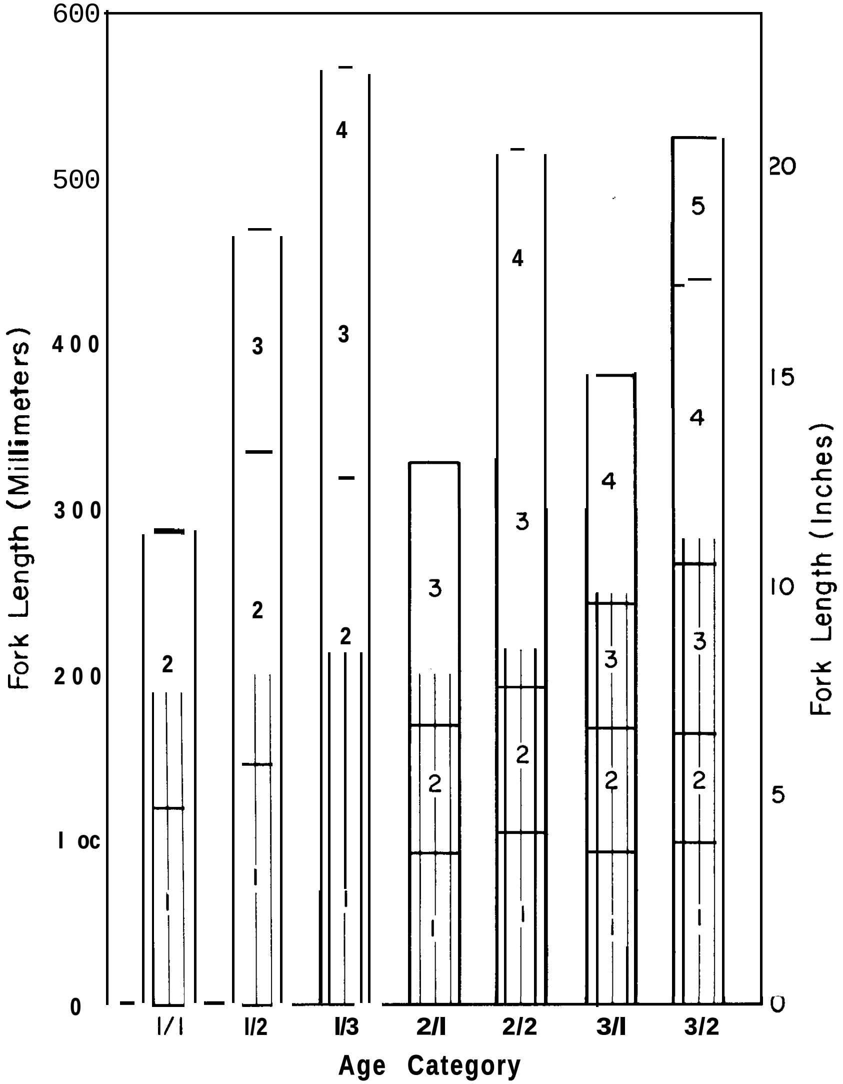

FIGURE 5. Mean fork lengths at annuli for Klamath River steelhead from the 1958, 1962, 1967, and 1968 runs combined. The striped areas of the bars represent stream growth and the clear areas ocean growth.

essent i.ally all half-pounders at Blake Rifle were caught by early September. Bailey (1952) computed the mean fork lengths for steelhead caught at Blake and Turwar riffles for 7 days between August 26 and October 10, 1951. His data show that the mean lengths of the fish caught increased as the season progressed.

Although no catch-per-unit effort data were obtained during the study, it was observed that the best angling at Blake Riffle, occurred

TABLE 6. Means and Ranges of Fork Lengths (mm) at Annuli for the 1965 Year Class of 2/I and 2/2 Klamath River Steelhead Sampled in 1967 and 1968, Respectively

Age category	Annulus 1	2	3	4
2/1	94 (34)* / 70-125	194 (34) / 140-280	360† (34) / 308-429	
2/2	100 (8) / 80-115	194 (8) / 150-260	390 (8) / 340-450	517† (8) / 456-586

* Mean / Range — Sample size in parentheses.
† Length at capture, measurements taken before completion of current year's growth.

between September 1-10 in 1967 and August 21-25 in 1968. U. S. Geological Survey temperature and flow records of the lower Klamath River for 1967 and 1968 were examined for relationships between temperature and flow and times of steelhead movement, specifically September 1-10, 1967 and August 21-25, 1968. An average drop of 3 F in the daily maximum and minimum temperatures did occur during the 1968 period. A similar correlation was not obvious in 1967. No correlation was apparent between water discharge and fall-run steelhead movement in the lower Klamath. Water temperatures in the lower Klamath generally range in the low 70's for the period of mid-August to mid-September. A few days of cloudy weather inland can result in a few degrees drop in temperature on the lower river, possibly enough to stimulate fish movement. The average late summer, early fall discharge in the lower Klamath ranges from 2,200 cfs to 4,400 cfs, but fluctuates little until the rainy season begins, usually mid-October. Discharge, therefore, probably is not as important a factor as temperature in stimulating fall-run steelhead movement on the lower Klamath. This is not the case for small streams. In Waddell Creek, a small central California coastal stream, Shapovalov and Taft (1954) point out the importance of stream flow in stimulating upstream migration.

The migration patterns of fall-run steelhead, particularly half-pounders, after entrance into the river are largely unknown.

Persons associated with the Klamath River fishery state that most half-pounders do not migrate above Seiad Valley, 130 miles from the mouth of the river. Riley and Estey (California Department of Fish and Game, pers. comm.) have not observed large numbers of half-pounders at Iron Gate and Trinity River hatcheries. Lanse (pers. comm.), from observations and interpretation of data collected during creel surveys on the upper Klamath in 1967 and 1968, believes that half-pounders do not occur in great numbers above Happy Camp. The Salmon River has a sizeable half-pounder run. People living in the Scott River area reported that the half-pounder run is not large in that tributary.

CONDITION

Average condition factors of Klamath River steelhead were calculated for the 1962, 1967, and 1968 runs (Table 7). The lower condition factors of steelhead from the upper Klamath and Trinity rivers are not surprising since upstream migration is demanding and draws upon the energy reserves of the fish. Many of the scales examined showed small amounts of marginal resorption at annuli. According to Chapman (1958), this indicates the fish were losing or just maintaining their weight.

TABLE 7. Average Condition Factors of Klamath River Steelhead From the 1962, 1967, and 1968 Runs

Age category	Location		
	Lower Klamath †	Upper Klamath ‡	Trinity River
1/1	1.16 (23)*	1.14 (8)	1.01 (25)
1/2	1.31 (17)	1.14 (5)	1.26 (1)
2/1	1.21 (90)	1.15 (10)	1.01 (39)
2/2	1.28 (32)		0.98 (1)
3/1	1.28 (12)	1.07 (2)	1.10 (1)

* Sample size in parentheses.
† Mouth of Klamath to Weitchpec.
‡ Weitchpec to Iron Gate Reservoir. Includes a few fish sampled at Iron Gate Dam.

Condition factor: $K = \frac{1{,}000 \text{ weight (g)}}{\text{length (mm)}^3}$

Trinity River 1/1 and 2/1 steelhead have lower average condition factors than the same age categories of steelhead taken from the upper Klamath. Many of the Trinity River samples were obtained later in the year than were samples from the upper Klamath Further investigation may show, however, that the difference in condition factors is an indication of a difference in productivity between the two rivers.

The average condition factor of 55 1/0 juvenile steelhead taken from the lower Klamath River was 1.35. For 79 2/0 juvenile steelhead taken from all sections of the river the average condition factor was 1.29.

SEX RATIO

The sex ratios for steelhead captured on the lower Klamath were as follows : total all years, 120 males to 129 females, 21 undetermined; 1962, 32 males to 35 females, 1 undetermined; 1967, 60 males to 60 females, 9 undetermined; 1968, 28 males to 34 females, 11 undetermined. Many of the fish for which sex could not be determined showed little or no gonad development. We believe that many of these mere immature males. Data were insufficient to allow meaningful determination of sex ratios by age category.

MATURITY

In this study, steelhead with gonads weighing 1 g or less were considered immature. We felt this was below the gonad weight which divides mature and immature steelhead. We prepared a gonad weight frequency distribution for Klamath River steelhead (Table 8). Half-

TABLE 8. Gonad Weight Frequency Distribution of Klamath River Steelhead From the 1962, 1967, and 1968 Runs

Age category	Year sampled*	Weight of gonads in grams				
		1.0	1.1-10.0	10.1-25.0	25.1-50.0	51.0-75.0
1/1	1962	13/23†	---	---	---	---
	1967-68	8/13	---	---	---	---
1/2	1962	2/0	1/0	0/1	---	---
	1967-68	2/1	1/3	3/4	1/2	---
2/1	1962	34/46	0/1	---	---	---
	1967-68	6/39	2/1		1/0	---
2/2	1962	2/1	0/1	---	---	---
	1967-68	4/0	5/2	7/3	2/6	2/1
3/1	1962	1/2	---	---	---	---
	1967-68	3/1	2/4	1/1	---	---
3/2	1962	0/0	---	---	---	---
	1967-68	---	---	0/1	0/1	---

* The 1962 samples were weighed as fresh material in the field; those of 1967 and 1968 were weighed as preserved material in the laboratory after blotting to remove excess preservative.
† Male/female.

pounders accounted for the majority of the 1/1 and 2/1 fish and only three half-pounders possessed gonads weighing more than 1 g. Everest (1970) examined gonads from 80 half-pounders netted on the lower Rogue River for stage of maturity. Only three of 37 Rogue River males examined (8%) were maturing and these averaged slightly more than 15 inches (380mm) FL. No females were maturing. Everest defines a "half-pounder" as a fish which has spent 1, 2, or 3 years rearing in freshwater and less than one year at sea before making its first upstream migration, and states that such fish are less than 16 inches in length. Data from a small sample from the Klamath River indicated that half-pounder gonads collected in late fall and early winter months had not increased significantly in size.

The percentage of Klamath River half-pounders on a spawning migration needs further investigation.

Our data indicate that the majority of Klamath River fall-run steelhead reach sexual maturity at age four or older, although considerable variation exists. Many of the steelhead scales from older age categories (1/2, 2/2, 3/2) collected in the winter of 1967 at Iron Gate Hatchery showed the beginnings of heavy resorption during their current year's growth. However, none of the 1/1 and 2/1 fish collected from the Klamath River or the hatchery showed evidence of heavy resorption on any part of their scales. Only two of the 2/2 steelhead scales showed evidence of heavy lateral and anterior resorption at the third (2/1) annulus indicating they had spawned. None of the scales of 1/2 fish showed resorption at the 1/1 annulus.

Size as well as age apparently influences time of maturation. Many of the 1/2 steelhead studied possessed gonads weighing more than 1 g (Table 8). They had achieved considerable size after spending 2 years in the ocean. In our study all 2/1 steelhead larger than half-pounder size also possessed gonads weighing more than 1 g.

Our data indicate that there were two second spawners in the steelhead sampled. Shapovalov and Taft (1954)) Chapman (1958), Whitt and Pratt (1955)) Maher and Larkin (1954)) and Hallock, Van Woert, and Shapovalov (1961), reported 82.8%, 83--88%, 98%, 95%, and 83% were first time spawners in their respective steelhead runs.

FOOD AND FEEDING HABITS

Regarding the feeding habits of steelhead, Snyder (1933) states: "On entering the streams their stomachs are usually empty, and they seem to remain so while they are in the estuaries. A little farther upstream their appetites appear to return, and their behavior is governed accordingly. "

Snyder's statement describes well our findings concerning the feeding habits of Klamath River steelhead. Stomach samples, when not empty, from the lower Klamath contained relatively small amounts of food material (Table 9). None of the stomachs were full, as was the case for many of the fish stomachs sampled from the upper Klamath.

TABLE 9. Percentage of Klamath River Steelhead From the 1962, 1967, and 1968 Runs With Food Materials in Their Stomachs

Size group fork length (mm)	Area: Lower Klamath*	Upper Klamath +	Trinity River	Total
250-349 (half-pounders)	49 (139) ‡	83 (65)	88 (75)	67 (279)
350-449	35 (51)	55 (10)	87 (8)	44 (69)
>450	27 (81)	33 (3)	0 (1)	27 (85)
Totals	40 (271)	77 (78)	87 (84)	55 (433)

* Mouth of Klamath to Weitchpec.
+ Weitchpec to Iron Gate Reservoir.
‡ Sample size in parentheses.

It is interesting that half-pounders feed more than do larger steelhead. Sixty-seven percent of the fish under 350 mm had food in their stomachs compared to only 44% for those fish 350-449 mm and 27% for those fish over 449 mm. A higher percentage of large steelhead, in contrast to half-pounders, are ripe or ripening and on a spawning migration. Lanse (pers. comm.) states that the stomachs of ripe Klamath River steelhead frequently are empty.

We determined the numbers of Klamath River steelhead from the 1967 and 1968 runs containing specified food material in their stomachs. Trichoptera larvae were consumed by more fish than were other food materials (Table 10). Shapovalov and Taft (1954) found Trichoptera larvae to be the most important food item of Waddell Creek stream steelhead. Cowichan River steelhead (255 to 510 mm long) also had a higher incidence of Trichoptera larvae in their stomachs than other food items (Shapovalov and Taft, 1954, citing Idyll, 1942). This probably does not indicate food preference but rather food availability. It appeared that many of the fish had simply " scooped up " a mass of food materials often mixed with small stones, sticks, bird feathers, or other miscellaneous material.

TABLE 10. Numbers of Klamath River Steelhead From the 1967 and 1968 Runs Containing Specified Food Materials in Their Stomachs

Food material	Stage*	Size group (mm)			
		250-349 (half-pounder)	350-449	≥450	Total
Diptera	I	13	0	1	14
Lepidoptera	I	6	1	0	7
Hymenoptera	M	1	0	0	1
Ephemeroptera	I	17	3	4	24
Odonata	I	4	0	0	4
Plecoptera	I	17	3	1	21
Hemiptera	M	2	0	0	2
Coleoptera	M	1	0	0	1
Trichoptera	I	30	3	1	34
Gastropoda	..	4	1	1	6
Pelecypoda	-	1	0	0	1
Annelida	..	2	0	0	2
Crustacea	--	0	0	1	1
Fish	_	1	1	1	3
Salmon eggs	--	11	4	10	25

* I, immature; M. mature.

SUMMARY

1) For purposes of this study the half-pounder is defined as a steelhead 250-349 mm FL. The majority of those aged were in the 2/l category, all the remainder were either l/l or 3/l.

2) Half-pounder steelhead are limited to rivers of northern California and southern Oregon, principally the Klamath, Eel and Rogue. The fishery for half-pounders on the Klamath River is the most important of its type on the West Coast.

3) Biological data from over 900 Klamath River stream and returning (ocean) steelhead were obtained during 1958, 1962, 1967, and 1968 by creel census, hook and line, and electrofishing.

4) Scales were used for age determination ; all scales were measured so the size of the fish at annulus formation and entry into the ocean could be calculated.

5) Stomach and gonad samples were analyzed by standard techniques.

6) Length-weight relationships are presented for fish divided into 10 mm length groups and for individual fish.

7) The calculated fish length at the time of scale formation is 30.1 mm.

8) Mean lengths by age category of ocean steelhead were similar to those found in a previous Klamath River steelhead study and were similar to those from fish sampled at Iron Gate Hatchery.

9) The back-calculated sizes at time of entrance to the ocean for ocean steelhead were as follows : l-year-olds, 187-210 mm; 2-year-olds, 199-215 mm; and 3-year-olds, 247-280 mm. Older smolts apparently migrate to the sea earlier in the year than the younger ones.

10) Based on back-calculations, steelhead from the 1962 run grew more slowly than those from other runs sampled.

11) Actual lengths of several 2/O steelhead taken near the time of annulus formation were in close agreement with the back-calculated lengths of 2/l and 2/2 fish at the time of their second annulus formation.

12) There were no good correlations between water temperature or flow, and peak runs of Klamath River steelhead.

13) The distribution of half-pounders in the Klamath River extends from the mouth upstream to about Seiad Valley. The Salmon River has a sizeable half-pounder run.

14) Condition factor of Klamath River steelhead decreases with time in freshwater.

15) The sex ratio of Klamath River steelhead is approximately one-to-one.

16) The Klamath River half-pounder is small because it remains only a short time in the ocean before makings its first upstream migration. Gonad examinations indicate that it enters freshwater on a non-spawning run, excepting perhaps for a small percentage of males. It returns to the ocean and later makes a second upstream migration as a larger mature steelhead. Most Klamath River steelhead reach sexual maturity at age four.

17) Stomach analyses indicate half-pounder steelhead feed extensively while large maturing steelhead do not. Trichoptera larvae were the most common food item noted in stomach samples.

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