A REPORT OF

FISHERIES INVESTIGATIONS IN OREGON COASTAL STREAMS SOUTH OF THE COLUMBIA RIVER AND EXCLUSIVE OF THE UMPQUA RIVER

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by the

OREGON STATE GAME COMMISSION

January, 1947

Foreward

This report is a summarization of investigational work that has been completed since 1941 by the Oregon State Game Commission on the coastal streams south of the Columbia river, exclusive of the Umpqua and its tributaries. The Umpqua river system was covered in another report prepared jointly by biologists of the Fish Commission of Oregon and the Oregon State Game Commission and titled, "The Umpqua River Study".

The report following herewith is divided into two parts: Part I, Rogue River system, and Part II, Coastal Streams Other Than the Rogue and Umpqua. Thorough studies of the Rogue have been made and the results are incorporated herein. No intensive studies have been made by the Oregon State Game Commission on any coastal streams other than the Rogue and Umpqua. Therefore the information contained in Part II of this report is somewhat general and preliminary in nature. Further studies of all coastal streams are necessary before intelligent stocking and management plans can be initiated. It is hoped however that the facts presented here will help in an understanding of the problems involved and serve to make known the critically low levels of runs of anadromous fishes in the coastal streams. The Game Commission is much concerned over the continuing decline of coastal fisheries and today is expending a high proportion of its fisheries research funds in an effort first, to find the causes, and second, to eliminate these in so far as is possible.

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ROGUE RIVER SYSTEM

Summary

1. The counting of upstream adults over Gold Ray Dam has continued uninterrupted since April 22, 1942. The annual chinook count was 43,429 in 1942, 38,052 in 1943, 31,940 in 1944, 33,718 in 1945 and 30,065 in 1946. The annual silver count was 4,608 in 1942, 3,290 in 1943, 3,230 in 1944, 1,907 in 1945 and 3,760 in 1946. The annual steelhead count was 22,359 in 1942, 19,623 in 1943, 19,478 in 1944, and 15,989 in 1945.

2. From two years of collecting seaward migrants it has been found that the peak of chinook and silver salmon seaward migrations in the upper river section occurs during the months of June and July, and of steelhead trout during the period of May through October.

3. Of the seaward migrants trapped in 1945 at Gold Ray Dam, chinooks averaged 3.03 inches in length and ranged from 1.53 to 4.8 inches. Silvers averaged 4.3 inches long with a range of 1.73 to 5.51 inches. Steelhead averaged 3.54 inches in length with a range of 1.57 to 8.19 inches.

4. Seaward migration studies indicate that irrigation ditches must be tightly screened from May 1 to August 15. Screening control must be emphasized for the period from June 1 to August 1 on the ditches taking water from the main Rogue and the period from May 1 to July 15

on ditches taking water from tributaries.

5. Weights, lengths, sex and scale samples were collected from 844 angler-caught chinook salmon at the mouth of the Rogue. Females averaged 19 pounds 12 ounces in weight and 32.2 inches in length, while the males averaged 19 pounds 7 ounces in weight and 32 inches in length.

6. The sex ratios of chinook salmon caught near the mouth of the Rogue ran 1 male to 1.3 females.

7. Much effort has been directed to a study of fishery protection problems in relation to dams proposed for construction in the Rogue Basin.

8. Any impassable dam built across the main Rogue channel below the mouth of Big Butte Creek would probably spell the doom of this fishery.

9. Areas available to migratory fish for spawning have been surveyed in square yards with the exception of the Applegate and Illinois drainages. The stream beds so far surveyed contain over 846,000 square yards of available gravel which should accommodate spawning populations in excess of 500,000 migratory steelhead and salmon.

10. In 1940, sports fishing contributed approximately $1,684,000 to the economy of the Rogue Basin. With a return of four per cent the fishing resource can be capitalized at $42,100,000.

11. Summer run steelhead which are the fish that are most economically valuable to the basin should receive more protection by further restrictions on seasons, bag limits and areas fished.

12. New fish ladders are needed on the south side of Savage Rapids dam, the Wimer and Fielder Creek Dams on Evans Creek, the Newberryman and Laurel Hill Dams on the Applegate, and the Lovelace Dam on Slate Creek.

13. The intakes of the pumps at Savage Rapids Dam should be screened or by-passes should be provided from the high ditches so that fish pumped into them can be returned to the main Rogue.

14. Fishing pressure must be watched closely on the Rogue. During the year 1945, between 16,000 and 19,000 salmon were caught by sportsmen in the lower twelve miles of the river alone. In the fall of 1946, between 25,000 and 30,000 steelhead were taken by sportsmen in that section of the river from Savage Rapids Dam to Galice.

Introduction

This report summarizes the investigations completed from April 30, 1943 to January 1, 1947.

The actual survey work of the Rogue River Investigations is near completion. However, there still remains two years of upstream counting to be carried on at Gold Ray Dam. Much information is still needed which will be invaluable in analyzing the affects of dam construction on fishery of the Rogue River. Completion of the survey to determine the quantities of gravel available for spawning, conducting tagging operations to learn the distribution of adult upstream runs in the basin and accurate correlated water temperature studies are only a few of the fishery-dam relationship surveys that can be undertaken. Scale studies, spawning distribution surveys, natural and artificial propagation comparisons, and a quantitative study of the different factors that are a drain on the fishery resource are other phases of the work that should be continued to adequately set up a management plan for the Rogue River.

The work was carried on at a much reduced rate during the war period because of the lack of manpower.

Personnel

In April, 1943, H. R. Newcomb was working in the area as resident biologist and was assisted by Mr. Norbert L. Sieg. Cole M. Rivers joined the unit in June of that year after returning from college. Mr. Sieg left for the armed services in August and was followed by

Mr. Newcomb in September of that year. Mr. Rivers remained and has carried on the studies to date.

Harvey E. Cassman is employed to count fish at Gold Ray Dam. Counting with him for periods of employment have been Bert Peck, William Wilson and Homer Brown. John E. Barraclough was hired in July, 1945, and has counted with Mr. Cassman to date.

Acknowledgements

The sportsmen of the area have been very cooperative in working with and helping the unit. With the shortage of help their assistance has been very much appreciated.

All of the persons mentioned in the previous report of April, 1943, have been of much aid during the period of this report. Special mention must also go to Reed S. Neilson of the Fish and Wildlife Service, Nick Andrieff of Gold Beach, Officers Gardner, Stansill, Madarus and Neil of the Oregon State Police, William J. McLean of Kerby, Harold Witherwox, Robert Fox, Glenn Woolridge, and other Rogue River guides.

COUNTING OF UPSTREAM ADULTS AT GOLD RAY DAM

A counting station was built at Gold Ray Dam in 1942. The counting of all species of upstream adults has been continuous and uninterrupted since April 22 of that year.

Two counters have been employed to count the migratory runs of chinook salmon, silver salmon, steelhead trout and suckers that pass over the dam by means of the fish ladder. The station has not been

unmanned since the date of installation. The counters have been responsible for counting these fish as accurately as possible from daylight to dusk every day. The gate of the counting rack is closed at night while the station is unattended because movements at night are negligible. During high water the fish are not allowed to pass the station because of difficult passage through the headgates of the ladder. These have been the only occasions in which free passage has not been allowed.

Temperature studies have been made in relation to fish movements. It was found that migrations stopped altogether when water temperatures dropped below 41° F. When the water remains below 41° F. over a long enough period of time, it is believed that large numbers of silvers and steelhead (the only fish passing the station at that season of the year) spawn below Gold Ray Dam. If higher water temperatures prevailed, they would probably pass over the dam to spawn in the areas above. This naturally does not make the year to year trends of these two species present a very true picture. The winter of 1945-46 is an excellent example of cold water holding steelhead and silvers below Gold Ray Dam.

Chinooks are usually counted from the first week in April to the first week in November with the peak occurring about June 15. (Figure 1). The silver salmon first appear at the station about the first week in October. This migration continues until the first week in February with a peak occurring any time during the months of November, December or January, depending upon water temperatures (Figure 2).

Steelhead passage is continuous the year around. Two distinct

runs are present, summer and winter runs. It is impossible to distinguish by visual counting where the summer run ends and the winter runs begin, but it is possible to segregate and keep a separate tally when the end of the winter run overlaps the beginning of the summer run. This usually occurs during the three week period at the end of April and the first of May. These fish are tallied separately with the bright steelhead representing the new summer run compared with the dark fish of the winter run. Therefore, the seasonal count on steelhead extends from March or April of one year through to May or June of the following year. The peak of the summer run occurs in July and October while the months of February, March and April are the peak periods for the winter run, depending upon water temperatures (Figure 3).

It is known there is a coastal cutthroat run that passes the station sometime during the summer, probably June. The unit has been trying to devise a method to catch this separate count but has met with no success. The cutthroat escapement over the dam has been included with the steelhead count.

Many suckers (Catostomus rimiculus) pass the station that evidently make an inter-sectional migration from one part of the river to another.

The annual counts of these species over Gold Ray Dam are given in Table 1.

Table 1. Total Annual Counts Over Gold Ray Dam

	1942	1943	1944	1945	1946
Chinook salmon	43,429	38,052	31,940	33,718	30,065
*	15.6 per cent Jacks	11.0 per cent Jacks	13.1 per cent Jacks	17.6 per cent Jacks	16.5 per cent Jacks
Silver salmon	4,608	3,290	3,230	1,907	3,760
*	4.7 per cent Jacks	6.1 per cent Jacks	10.4 per cent Jacks	4.4 per cent Jacks	5.5 per cent Jacks
Steelhead trout	22,359	19,623	19,478	15,989	Incomplete
Suckers	5,189	12,075	4,731	5,735	499

* The count of Jacks are included with the totals.

SAMPLING OF SEAWARD MIGRANTS

In 1945 studies of seaward migrations were conducted at Gold Ray Dam. A specially designed trap was installed in the fish ladder and operated from March 1, 1945 to February 28, 1946. It was in operation over that period 24 hours per day. Each specimen trapped was identified as to species and measured to the nearest millimeter. Flood waters took out the entire trap December 28, 1945. Due to the lumber shortage and re-occurring high waters during the following three weeks, the new trap was not installed again until January 19. This was the only gap left in the year.

During the collections, 1,688 Chinook salmon, 211 Silver salmon,

and 550 Steelhead were collected and checked. The average length of the Chinooks trapped was 3.03 inches and they ranged from 1.53 to 4.8 inches. The Silvers averaged 4.3 inches and ranged from 1.73 to 5.51 inches in length. The steelhead averaged 3.54 inches and ranged from 1.57 to 8.19 inches.

Figures 4 through 12B present in graphic form the information obtained from these studies. The periods of downstream migration of the three main species are shown in Figures 4, 5 and 6. The peak of chinook seaward migration reached Gold Ray between June 15 and July 15, and that of the silvers and steelhead between June 15 and July 1. Figures 7, 8 and 9 illustrate the length-frequency distribution of the above seaward migrants, length-frequency being the relationship between size and numbers. The majority of the chinooks fell within the 3 to 3½ inch class, the silvers in the 4 to 5 inch class, and the steelhead in the 2 to 3 inch class. Figures 10A through 12B show the length-frequency histograms of the three species of seaward migrants by two week periods.

No cutthroats were trapped in the course of the study, but many suckers, both immature and adults, were taken. Eight large-mouth bass (Aplites salmoides) ranging from 1.26 to 3.62 inches in length were taken from June through September. Two black crappies (Pomoxis sparoides) were taken in May, and three blue-gills (Helioperca incisor), one adult and two immature, were trapped in September.

STUDIES OF FISHERY AT MOUTH OF ROGUE RIVER

A checking station was set up at Gold Beach to obtain factual data concerning angler-caught fish at the mouth of the Rogue. The

writer spent three days per week checking all chinook salmon brought into Nick Andrieff's custom cannery. Weights, lengths, sex and adequate scale samples were recorded and collected from 775 chinooks and 69 Silvers. All fish checked were caught by sportsmen in the lower 12 miles of the river. The studies were run from March 27 to June 5 in 1945 and from June 6 to October 30 in 1946.

Tables 2 and 3 give the breakdown of some of the information gathered at the mouth.

Table 2. Angler-caught Salmon from Mouth of Rogue River

844 Samples

		Mean	Maximum	Minimum
Spring Run Chinooks	(N = 566)			
	Weight	19 lbs. 13 oz.	41 lbs. 0 oz.	2 lbs. 0 oz.
	Length	81.6 cm.	104 cm.	37 cm.
Males				
	Weight	19 lbs. 7 oz.	41 lbs. 0 oz.	2 lbs. 0 oz.
	Length	80.1 cm.	104 cm.	37 cm.
Females				
	Weight	19 lbs. 12 oz.	36 lbs. 10 oz.	9 lbs. 1 oz.
	Length	81.8 cm.	95 cm.	63 cm.
Sex ratio - - 1 to 1.3 of males to females				
Fall Run Chinooks				
	Weight	18 lbs. 6 oz.	43 lbs. 2 oz.	2 lbs. 9 oz.
	Length	78.45 cm.	111 cm.	41 cm.
Males				
	Weight	17 lbs. 11 oz.	43 lbs. 2 oz.	2 lbs. 9 oz.
	Length	71.07 cm.	111 cm.	41 cm.
Females				
	Weight	19 lbs. 10 oz.	31 lbs. 2 oz.	5 lbs. 12 oz.
	Length	83.73 cm.	100 cm.	59 cm.
Sex ratio - - 1 to 1.07 of males to females				
Silver Salmon				
	Weight	11 lbs. 1 oz.	14 lbs. 15 oz.	1 lbs. 6 oz.
	Length	72.0 cm.	81 cm.	64 cm.
Males				
	Weight	10 lbs. 15 oz.	14 lbs. 13 oz.	1 lbs. 6 oz.
	Length	71.2 cm.	81 cm.	35 cm.
Females				
	Weight	11 lbs. 2 oz.	14 lbs. 15 oz.	7 lbs. 14 oz.
	Length	72.7 cm.	78 cm.	64 cm.
Sex ratio - - 1 to 1.23 of males to females (2.54 cm. = 1 inch)				

Table 3. Percentage of Weight Lost by Cleaning Chinooks for Canning

20 Samples

In Per Cent

		Maximum	Minimum	Average
Males	(N-10)	21.11	18.3	19.76
Females	(N-10)	24.3	21.0	22.6
				21.18

Figure 13 graphically illustrates the relationship between length and numbers as found in 595 adult chinook salmon taken by anglers at the mouth of the Rogue in 1945. The majority of these fish were from 30 to 35 inches in length.

GENERAL OBSERVATIONS

During the fall and winter of 1943 and the spring of 1944 the entire watershed was surveyed to determine the uppermost reaches accessible to migrations of the Rogue species. Other studies were conducted to find out the dates of spawning and areas most intensely used by the individual species.

Chinooks start entering the Rogue about the last week in February or the first week in March. They continue entering the river apparently through to the end of August with the peak about May 1. The first of the run, including the peak, makes a rapid migration up through the watershed with a peak reached at Gold Ray Dam about June 15. In the river above Gold Ray Dam they lie in deep holes until spawning

time. Later runs, apparently still in the spring run category, stop over in the area from Robertson Bridge to Gold Ray.

An attempt was made to learn the peak of spawning activity on specific study riffles. Sample riffles were chosen in the Rogue from Robertson Bridge to the mouth of Big Butte Creek. These riffles were visited two or three times a week, and the chinooks present on the gravel were counted and recorded. Of course, it is realized the dates derived may not apply to every year because of different weather conditions and the resulting differences in water temperatures, but these dates were found to be the approximate peaks of chinook spawning in the fall of 1943. Table 4 gives the results of the study.

Table 4. Peaks of Chinook Spawning on Designated Riffles

Riffle	Location	Peak Date
Rogue Elk	Rogue Elk Egg-Taking Station	September 15
Hardy Riffle	Below Gold Ray	October 8
Greens Creek Riffle	Above Grants Pass	October 10
Wharton Riffle	10 miles below Grants Pass	October 19
Dunn Riffle	Above Hellgate	November 1

Spring run chinooks use the upper river area above Grants Pass with the greater concentration occurring in the main channel of the Rogue. The greatest concentration of spawning spring chinooks (in numbers) appears to be immediately below Shady Cove near the Roger's

Ranch.

Fall run chinooks utilize the river from Grants Pass to the coast. Chinooks which were definitely fall fish have been observed spawning in the area between Mule Creek Canyon and Black Bar Ranch during the last two weeks of October.

In the North Fork of the Rogue a few jack salmon are able to reach the Copco Power Plant near Prospect, but apparently no adults are able to reach that high. The upper reach of adults appears to be just above the mouth of the South Fork. In the South Fork itself they are able to reach a cascade at the upper end of a box canyon located five or six miles above the mouth, and a goodly portion of this stream is utilized.

Big Butte Creek is undoubtedly the most important tributary to the chinooks for spawning. Nearly all of the available gravel is utilized from the mouth of the falls located below the town of Butte Falls.

The only other tributaries in the watershed that are used to any extent by chinooks are the lower reaches of the Applegate River from its mouth to the mouth of Williams Creek, and the Illinois River from its mouth to the Illinois Falls. A few, but not many, pass over the Illinois Falls and use the river available above there for spawning. It is believed all those found in the Illinois are fall run fish.

Steelhead apparently enter the mouth of the river in early summer with the first of the chinooks, although, they are probably very few in number. Other activities of the steelhead at the mouth are unknown, except that they are caught by anglers in August and September. The

summer run peaks reach Gold Ray Dam July 15 and November 1. The winter run peaks reach Gold Ray during the months of January, February and March. It is believed that the summer run spend the better part of the summer and fall in the river; some laying over in the lower section and others moving up to lay over in the upper section of the river. The latter group would account for the peak being reached about November 1 at Gold Ray. Warm water caused by irrigation undoubtedly is the main contributing factor for this broken trend in migration and the concentrations of those laying over in the lower river during summer.

The peak of steelhead spawning at the Butte Falls egg-taking station at the mouth of Big Butte Creek is between March 15 and April 15, depending upon water temperatures.

During the spring of 1944 a series of angling tests were run below Grants Pass to obtain additional spawning information. A place was located where many steelhead could be caught and carefully landed. Each was then tested for spawning development and released. The tests continued through the months of February, March and April at regular intervals. Out of 128 fish tested, 36 were caught in ripe condition, the peak of ripe fish being reached on March 14.

There have been very few places in the watershed where steelhead have not been observed using all accessible waters available to migratory fish. All of the tributaries listed in Table 5 are heavily used as well as a large number of smaller tributaries entering the Rogue, and those entering these larger tributaries already mentioned.

Little is known about silver salmon activities in the Rogue River.

However, we do know from samples of yearling fish checked in creel census that nearly all of the major tributaries entering the Rogue below and including Big Butte Creek are utilized to some degree. They enter the mouth about September 1 with a peak about September 20. A rapid migration is made up through the watershed. By far the majority of them use that section of the basin from Savage Rapids Dam to the coast. The intensities of migrations in the lower river are unknown. They reach their peak of spawning at the mouth of Big Butte about December 15. In the Illinois River a sizable run passes the Illinois Falls about the first of December and many are noticed using the East Fork and Deer and Sucker Creeks each year.

It is known that there exists a migratory cutthroat run in the Rogue. They are taken by anglers and have been checked frequently during creel census.

There is a definite need for tagging of adult migratory fish at the mouth of the Rogue. If and when such work is initiated and followed up with a detailed survey, we may have at our disposal concrete information on the utilization, distribution and ranges of all the migratory species in the watershed.

Ranges of Migration

There are many limiting factors to fish migration in the Rogue. Many barriers have been found which are impassable in some water stages but passable in others. This naturally makes for fluctuations in the numbers of fish that reach given areas from year to year. Table 5 lists the uppermost reaches of the basin accessible to migratory fish.

Only those barriers that are impassable during normal water flows are included.

Table 5. Upper Limits of Fish Migration in Rogue River and Tributaries

Stream	Uppermost Reach
North Fork Rogue River	to Mills Creek Falls; only accessible to a few jack salmon and steelhead because of bad cascade just above mouth of South Fork
South Fork Rogue River	to head of box canyon located five miles above mouth.
Big Butte Creek	to falls located below town of Butte Falls
Elk Creek	to mouth of Elkhorn Creek; maybe a few steelhead go higher
Trail Creek	to upper reaches of both East and West Forks
Little Butte Creek	to the upper reaches of the South Fork, but usually on the North Fork it is impassable beyond the Medford Irrigation Company Dam located five miles above town of Lake Creek.
Bear Creek	to the upper tributaries above Ashland
Evans Creek	to the Fielder Creek Dam above the town of Rogue River, but when passable, to the Wimer Dam located above the town of Wimer.
Applegate River	to the Laurel Hill Ditch Company's dam above the mouth of Williams Creek, but when passable the headwaters are accessible
Slate Creek	to the Lovelace Dam located between Wonder and Wilderville, but passable during high water.

Table 5. (Continued)

Stream	Uppermost Reach
Williams Creek	to Laurel Hill Ditch Company's dam located 100 yards up from mouth, but when passable it is believed they are able to reach most of the East and West Forks
Thompson Creek	to a point four miles up from mouth where there exists a natural cascade barrier, but all downstream migrants are lost in irrigation ditches during downstream movements.
Little Applegate River	to dam about two and one-half miles up from mouth, but passable during high water.
Carberry Creek	to a log dam about 3 miles up from mouth
Illinois River	not determined
Briggs Creek	
Deer Creek	to headwaters. Some barriers present but nearly all passable at normal winter water flows
East Fork Illinois	undetermined
Sucker Creek	most of stream passable in normal water, but a few low dams with sloping flash boards makes passage difficult
West Fork Illinois	not determined

DAMS PROPOSED IN RELATION TO FISHERY PROTECTION PROBLEMS

Water resource surveys made over the last six years by the U. S. Bureau of Reclamation and the U. S. Army Engineers for the building of a series of dams on the Rogue River watershed has initiated critical fisheries maintenance studies. Every effort has been made to find out the potentialities of the watershed and what effect dams proposed for

construction might have on the basin's fish runs.

The report, "The Fisheries Resources of the Rogue River Basin Oregon in Relation to General Water Development Plans", was published April 30, 1945, by the Oregon State Game Commission. It might be said that nearly all of the information gathered by this survey to date is pertinent to the fishery maintenance problem in relation to dams.

According to available information, the U. S. Bureau of Reclamation and the U. S. Army Engineers have made investigations and have considered 51 possible sites in the basin. Some are planned for irrigation storage alone while others are planned for multiple purpose projects for irrigation, flood control and power. Table 6 lists the number of sites possible on the individual sections of the watershed.

Table 6. Proposed Dam Sites for Rogue River Basin

Stream	Number of Sites
Main Rogue River	25
Illinois River	10
Applegate River	4
Slate Creek	1
Graves Creek	1
Jump-off Joe Creek	1
Evans Creek	3
Bear Creek	2
Little Butte Creek	2
Big Butte Creek	1
South Fork Rogue River	1
	51

Any dam that might be built in the channel of the main Rogue River below the mouth of Big Butte Creek would either seriously affect or

destroy the resource depending upon its location. It would also entail great sums of money to introduce and operate the salvage program necessary to replace the losses that would be brought about by such a blockade. The higher the site might be on the river or on any of the tributaries, the more chance there would be to successfully operate a salvage program. These points were strongly stressed in the Game Commission's report of April 30, 1945.

Some tributary projects, if built, would be more serious than others if proper control of water temperature, minimum flow regulation and other factors were not given serious consideration and attention. Because of present extensive irrigation, it is felt that if dams were built on the Applegate River, Jump-off Joe and Graves Creeks, fisheries conditions could be improved. However, this would only be possible in the event seasonal fluctuations and volumes of water were properly released to the stream below.

Special Studies in Relation to Dam Construction

This section is written to present several special subjects of the study made for specific phases of the dam investigation.

Spawning Bed Survey

All of the available spawning gravel is being quantitatively surveyed in square yards over that part of the watershed accessible to migratory fish. The purpose of the survey is to determine the potential numbers of fish the watershed, or parts of such, can support.

Preliminary studies were made to ascertain the composition of the gravel used by chinooks, silvers and steelhead, and also to determine the water conditions of velocity and depth these fish preferred. It was learned that chinooks utilized the greatest range of size in gravel composition, and that steelhead were the most selective in the type they preferred. Therefore, two grades or types of gravel were devised and throughout the survey they were kept in separate tally. Steelhead were observed to use only the Grade I type gravel, namely, that made up of rocks ranging from approximately one-half to three inches in diameter. Chinooks and silvers were observed to prefer this type also, but they were capable and very often did use the Grade II gravel which is made up of rocks ranging from three to five inches in diameter. The gravel included in the survey is being selected according to the facts found in this preliminary survey. However, it is realized that this spawning area survey has been run too conservatively in estimating the gravel quantities found. The water characteristics in velocity and depth were set too rigidly to include the total amounts of gravel the migratory fish will actually use. No gravel has been included that did not have at least one foot-per-second velocity and not more than three feet in depth of water running over it. Since this rule was set, it has been found that the fish will use a greater range in both velocity and depth. When the watershed has been completely surveyed, a correction factor will be worked out to gain more accurate figures of the amounts of gravel available.

Chinooks spawning and emergence of the young from the gravel is nearly over by the time the silvers and steelhead start spawning, so it

is assumed all of the available gravel is ready for use the second time for that season. The Rogue and its tributaries have 846,562 square yards of spawning gravel. (See Table 7) By using the figure of 40 square feet of gravel per spawning pair of adult fish[3] and assuming that the sex ratio is equal, this part of the Rogue Basin is capable of supporting 380,900 spawning chinooks and in addition the same number of silvers and steelhead. In other words the Rogue Basin can support a total of 761,800 steelhead and salmon.

Table 7. Available Spawning Gravel in Rogue River and its Tributaries with the Exception of the Applegate and Illinois Rivers

Location (From previous station on river to given station) T - Tributary	Spawning Gravel in Square Yards			Accumulative Total-- (Amount available in watershed above given point)
	Grade I	Grade II	Total	
Hwy Crossing 62 to--				
Copco Power Plant	00	0	0	
T- South Fork Rogue	3,883	5,825	9,708	
Mouth Big Butte Creek	16,168	39,122	55,280	64,988
T- Big Butte Creek	3,804	5,706	9,510	
Rogue Elk	6,910	6,875	13,785	
T- Elk Creek	8,900	2,967	11,867	
Lewis Creek Dam site	8,910	10,800	19,710	119,858
T- Trail Creek	860	3,439	4,299	
Diversion Dam site	49,853	16,937	66,790	190,947
Dodge Bridge	29,760	29,549	59,299	
T- Little Butte Creek	15,311	17,458	32,769	
Bybee Brdige	10,265	38,640	48,905	
T- Bear Creek	12,142	9,892	22,034	
Gold Ray Dam	2,455	3,275	5,630	359,684
Mouth Evans Creek	17,231	27,530	44,761	
T- Evans Creek	7,605	4,232	11,837	
T- Applegate River	180,000	60,000	240,000	(continued)

(3) "An Investigation of Fish Salvage Problems in Relation to Shasta Dam", by H. A. Hanson, O. R. Smith and P. R. Needham, Bureau of Fisheries, 1940, page 31.

Table 7. (Continued)

Location (From previous station on river to given station) T - Tributary	Spawning Gravel in Square Yards			Accumulative Total-- (Amount available in watershed above given point)
	Grade I	Grade II	Total	
Mouth of Applegate	13,550	17,305	30,855	
T- Jump-off Joe Cr.	4,760	2,210	6,970	
Mouth of Grave Creek	7,206	16,828	24,034	
T- Grave Creek	10,095	9,580	19,675	
Agness	8,081	9,994	18,075	
T- Illinois River	30,000	30,000	60,000	
T- Lobster Creek	4,231	6,500	10,731	
Canfield Riffle (Head of tidewater)	13,975	5,990	19,965	846,562

The counts at Gold Ray can be used in comparing the gravel now used with the area's potential utilization. In 1944, 54,648 steelhead and salmon were counted at the station at Gold Ray Dam. The area above Gold Ray is capable of supporting approximately 162,000 steelhead and salmon and therefore, is only supporting about 33 per cent of its potentiality.

Minimum Flow Recommendations(4)

Upon request of the Bureau of Reclamation a minimum flow survey was conducted to recommend volumes of water necessary to maintain fish life in some of the tributaries on which dam constructions are planned. A report, "Minimum Stream Flows for Fish Life in Rogue River and Tributaries," was submitted by Reed S. Neilson and Cole M. Rivers. No recommendations were given for the main Rogue channel because it was felt decreed water rights below proposed sites would give adequate protection for fish life. The 1,000 c.f.s. capacity at Copco Power Plant at Gold

Ray would have to be guaranteed. However, for the tributaries, minimum flow figures were given to protect migratory fish in certain stages of their life cycles. Their annual fresh water activity was divided into two periods. Water requirements for September 1 to February 28, on Period "A", were felt necessary to protect the migratory fish during their stages of spawning, incubation, emergence, rearing and downstream migration. Period "B", extending from March 1 to August 31, was set at 50 per cent of the requirement for Period "A" because it was felt with these flows the migratory fish would be adequately protected during their movements to the spawning areas. Table 8 gives the recommended minimum flow figures as they were given for the tributaries concerned.

As mentioned before if the tributary dam projects were built on the Applegate River, Jump-off Joe and Graves Creeks, it is felt fisheries would not be seriously injured, but probably improved if suitable minimum flow requirements were observed. Even the sites on the Illinois River with the exception of the Kerby and Sucker Creek sites, might be included with this group. However, it is felt it would be impossible to get by without some loss to the resource in the other tributaries under consideration even though water flows were respected.

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(4) Much credit for this work mustgo to Reed S. Neilson of the Fish and Wildlife Service.

Table 8. Recommended Minimum Flows for Rogue River and Tributaries in c.f.s.

Name of Stream	Dam	Period "A"	Period "B"
Bear Creek	Ashland	10	5
Little Butte Creek	Lake Creek	30	15
Evans Creek	Upper and Lower	30	15
East Fork Evans	Meadows	10	5
Illinois River	Kerby	100	50
West Fork	Lone Mountain	40	20
Althouse Creek	Althouse	15	8
Sucker Creek	Grayback	20	10
Deer Creek	Deer Creek	20	10
Applegate River	Ruch	80	40
	McKee Bridge	60	30
	French Gulch	60	30
	Squaw Creek	60	30
Slate Creek	Slate Creek	10	5
Jump-off Joe Creek	Winona	10	5
Graves Creek	Pease Bridge	20	10

ECONOMIC VALUE OF FISHERIES TO ROGUE RIVER BASIN

A survey was run throughout the Rogue Basin to get an idea of the economic value of the fisheries resource. The survey was conducted to determine how much money was spent in the area for sports fishing only. Resorts, boats, boat rentals, guides, tourist camps, auto courts, hotels, canneries, cold storage plants and tackle stores were all personally contacted to find the amount of money spent by sportsmen in pursuit of the Rogue fishes. It was found that the income from the fishery resource to the Rogue River Basin in 1940, a typical pre-war year, was approximately $1,684,000.00; and if this

income represents a return of four per cent, then the resource may be capitalized at $42,100,000.00.

RECOMMENDATIONS

Season and Bag Limits

The season and bag limits for the Rogue Basin have been substantually reduced during the past three years, but it is felt further restrictions should gradually be imposed in the future to help off-set the increase in fishing pressure. Fishing pressure and intensity will undoubtedly continue to increase in the near future as the demand increases. The people of the basin have just begun to capitalize on the sports fishing resources. The starting of a steelhead derby held in Josephine County in 1945 is only one example of the efforts being made to further advertise and get the tourist sportsmen to come to the Rogue country and fish for steelhead and salmon. Resort owners and guide executives are beginning to spend their winter periods traveling all over the country to advertise the famous Rogue fishing.

With 71 licensed guides that are now operating in the Rogue waters and accompanied by additional numbers that will enter the field as the demand increases, it is not hard to see that numbers of fish taken each season could easily destroy the resource. During the year of 1945, between 16,000 and 19,000 salmon were caught by sportsmen in the lower twelve miles of the river alone. In the fall of 1946, between 25,000 and 30,000 steelhead were taken by sportsmen in that section of the river from Savage Rapids Dam to Galice. Neither can the large numbers of privately-owned

boats and local shore fishermen be entirely ignored in this respect. If it is desirous to maintain the Rogue at a substantial level of angling, fishing intensity should by one means or another be greatly reduced, and close control on seasonal size and bag limits will become increasingly necessary.

With regulations concerning the chinook and silver salmon it is not a difficult problem to control seasons and bag limits. The chinooks are most heavily fished for near the mouth of the river from Gold Beach to Agness, and the situation can easily be controlled if adequate law enforcement protection is maintained. About the only pressure for silver salmon is present at the mouth, also.

With the steelhead the problem is not so simple. The most heavily fished section of the river for this fish is in the Grants Pass area (from Savage Rapids to Galice). The summer run is of more value to the basin's economic welfare in that it is the most heavily pursued by the local and tourist sportsmen. This is the run that is rapidly decreasing through heavy fishing traffic or through combinations of other inimical factors, and it definitely needs more protection. A much greater run of winter fish enters the area about the time the season should be closed to protect the summer run. The problem, therefore, is that the sportsmen must be deprived of sharing the winter fish if the season is closed early enough to protect the most valuable of the two runs.

From the standpoint of conserving the summer run, the upper river section is the area that is most seriously affected by the late closing date of January 15. There is not too much drag on this run in the lower

section of the river below Galice. Nearly all of the steelhead caught above Grants Pass between January 1 and 15 are summer run fish which are either sexually mature, ready to spawn, or are spawning.

If the sportsmen are to be allowed to pursue this large winter run safely from the standpoint of conservation, the river should be divided into two or possibly three sections, each with a different closing date. Everything should be closed above Grants Pass or Savage Rapids Dam December 15. That section of the river from Grants Pass to the Curry County line should be closed no later than January 1, and the remaining section of the river in Curry County and also the Illinois River up to the Illinois Falls or Deer Creek should be closed no later than February 28. If the sportsmen of the basin would forget their "personal" sections of the river and think of the basin as a whole, this type of regulation would not be difficult to put over. As it is now, however, the sportsmen of the upper river become quite alarmed at the mere mention of such a change. It is felt that if they cannot be sold on the regulation first, then the program cannot be a total success.

With the bag limits it is felt a program should be set to periodically introduce further restrictions in a manner that will be directly proportional to the increase in fishing traffic. A census program could be conducted to determine the trend of fishing intensity and a correction system could be made to apply to the regulations according to the comparisons found.

Screening

One of the biggest problems on the Rogue is the unscreened

irrigation ditches. This has been emphasized many times in previous reports. The present screening program is rapidly reducing the fish losses to irrigation. It is reported that the Game Commission crews will have 94 per cent of the Rogue Basin screened by irrigation season, 1947.

The downstream studies have given us concrete evidence that can be applied to the screening activities in the Rogue watershed. The facts found deem it imperative that all irrigation ditches be tightly screened from May 1 to August 15 with special emphasis being placed on the period from June 1 to August 1 in the ditches taking water from the main river and the period from May 1 to July 15 in those taking water from the tributaries.

It has been mentioned many times in previous reports that something be done to screen the pumping sump at the Savage Rapids Dam located six miles above Grants Pass. It is the writer's opinion that there is no more serious screening problem in the watershed than this unscreened sump. It takes more fish from the main river channel than the combined losses of nearly all of the present unscreened ditches in the area. Poisoning of the high ditches at different times of the year and the fish taken as a result have definitely proven this point. It has been estimated that 100,000 to 400,000 downstream migrants are lost each year by this unscreened pump intake. This estimate is most certainly on the conservative side. Less than 15 per cent of the fish pumped up through to the high ditches are killed by the pumping operations.

If nothing can be done with the intake of the pump because of various obstacles to overcome, it is then suggested that the high ditches themselves be screened so that the fish pumped into them and are not killed

can be returned to the river. An ideal site for a rotary screen on the south high ditch is at the intersection of Greens Creek, located about 3/4 of a mile below the head of the ditch. Greens Creek could easily be used as a by-pass stream by which fish could be returned to the river. On the north high ditch the fish loss is not as serious, but a screen could be placed at the intersection of Jones Creek near Grants Pass. If there is not enough water for a by-pass arrangement, surely enough water can be spared to open the by-pass for a number of hours twice a week to allow the accumulated fish to pass back out into the river.

Physical Improvements

Construction and repair work that is much needed on barriers on the Rogue watershed are as follows:

1. The south side ladder at Savage Rapids Dam needs construction.
2. The Laurel Hill Dam on the Applegate River near the mouth of Williams Creek needs a ladder.
3. Two dams, the Fielder Creek and Wimer Dams, located on Evans Creek need new ladders.
4. The Newberryman Dam on the Applegate above McKee Bridge needs a better ladder.
5. The Lovelace Dam on Slate Creek could use a better ladder.
6. The mouth of Thompson Creek, tributary to the Applegate River, should be racked off to prevent fish from entering and using this stream for spawning. No escapement of downstream migrants is possible with the present water

development program.

7. The pump intake at Savage Rapids Dam should be screened or a suitable by-pass built from the ditches so that fish passing up through the pumps may be returned to the main Rogue below the dam.

Part II

COASTAL STREAMS OTHER THAN THE ROGUE AND UMPQUA

Summary

1. Extreme water fluctuations in many coastal streams cause heavy losses in young fish populations.

2. The food productivity of coastal streams is not as high as those of eastern Oregon and may be correlated with the low content of dissolved mineral salts.

3. The cutthroat trout populations are on the decline in all coastal streams with the exception of the Necanicum and Siuslaw rivers.

4. Steelhead seem to be holding their own and even increasing in most of the streams south of Tillamook Bay but are continuing to decline north of that area.

5. Silver salmon have been greatly reduced in all coastal streams but are making a come-back in the Necanicum, Dee, and Siuslaw rivers.

6. The spring chinook has all but been exterminated in the coastal streams south of the Columbia.

7. The main downstream migration of young steelhead and cutthroat trout fingerlings and silver salmon fingerlings takes place during May in north coast streams.

8. The present early opening in coastal streams is detrimental to fish conservation but the 8" minimum size limit and closure of tide water to trout fishing until June 15 will aid in remedying the situation.

9. The 1946 legal limit for trout in Tillamook bay streams was entirely out of line with the actual catch inasmuch as the number of fish taken

per angler ranged from a low 0.58 fish per man to a high of only 4.65 fish per man. A lower limit would allow a more equitable distribution of the fish.

10. Cutthroat trout may remain in fresh water past the fourth year before migrating to the ocean.

11. The 1942 steelhead studies in Tillamook county disclosed that the angler took smaller and younger fish as well as a larger proportion of females than did the commercial netters.

12. Logging operations and over-fishing are the principal causes for the decline in coastal stream fishing.

13. Barriers such as log jams, dams, waterfalls, and sand bars are important limiting factors in coastal streams.

14. Logging wastes constitute the main pollution problem in coastal waters.

15. Salvage of stranded fish is not a practical operation except in a few isolated cases.

16. Sport fishing on the coastal streams is responsible for a capital investment of over $10,000,000, an annual income of over $1,681,000.00, and the employment of over 1,400 persons.

17. Angling pressure on coastal streams has increased more than 55 per cent since 1940.

Introduction

A reconnaissance survey of most of the coastal streams was made in the summer of 1941. The primary purpose of the survey was to obtain basic information upon which proper fish stocking policies could be formulated. Plans to continue the surveys in 1942 were interrupted by the war, and they were not resumed until the summer of 1946. This past year much additional data on the status of the sport fishery in the coastal streams have been acquired. The emphasis of the field studies was on fish population studies, needed stream improvements, and an economic survey to determine the amount of investment and return from sport fishing in coastal waters.

In the winter and spring of 1942 studies concerning the steelhead fishery were conducted in the Tillamook Bay area, and were discontinued at that time because of the war. In 1946 two biologists were assigned to a study of the cutthroat trout including its life history and migratory habits. Sand Creek, Tillamook county, was selected as the "pilot" stream on which this study is being conducted. Coal and Clear creeks, tributaries of the Kilchis river, have also been used as study streams. The cutthroat studies will also afford an opportunity to study other anadromous species such as steelhead and salmon, and much valuable information will be obtained relative to their conservation.

Personnel

The personnel of the 1941 survey included the leader, Francis H. Sumner, and three assistants, Henry E. Mastin, Francis Schneider, and

Gale S. Wellorn. The 1946 survey was led by William E. Pitney, assisted by Richard J. Hallock, James C. Negley Jr., and Jim D. Rearden.

Mr. Sumner conducted the steelhead studies in Tillamook county in 1942; and he, assisted by Mr. Mastin, is conducting the cutthroat studies at the present time.

Mr. Pitney and Mr. Sumner were largely responsible for the preparation of Part II of this report. Many others have helped including Dr. H. S. Davis, Technical Consultant, and R. C. Holloway, Chief Biologist. Mr. C. A. Lockwood, Assistant State Game Supervisor, was in charge of the program in 1942, and at the present time the work is under the supervision of Dr. Paul R. Needham, Director of Fisheries.

Acknowledgments

We wish to express our appreciation for special assistance afforded by employees of the Fish Commission of Oregon, the U. S. Fish and Wildlife Service, and the Game Division of the Oregon State Police. Thanks are due the United States Forest Service and Western Oregon Forest Protective Associations for maps and location and condition of roads and trails; the officials of the several counties for office space in their courthouses and for maps and other aids; several members of the Oregon State College faculty for technical assistance; and the many sportsmen and residents of the areas for much information they willingly gave to supplement the scientific studies carried out by the biological staff.

PHYSIOGRAPHY AND GEOLOGY

The Oregon coastal streams south of the Columbia River arise in the Coast Range and Siskiyou Mountains, except for the Umpqua and Rogue Rivers which have their headwaters in the Cascades. In Oregon the Coast Range extends from the Columbia River on the north to the Coquille River, 240 miles south. The Siskiyou Mountains occupy the remaining 70 miles from the Coquille River to the California line, extending eastward to merge with the Cascades. The Coast Range is about 30 to 50 miles wide from west to east. Its highest peak is a little over 4,000 feet above sea level, which is also about the maximum elevation of the Siskiyou Mountains in the area drained by the coastal streams.

The geological formations encountered along the coastal section differ considerably and influence the configuration of the mountains as well as the characteristics of the streams. The Coast Range was formed by the folding of sedimentary rock strata. Those folds, whose axis points north and south, were tilted upward at their southern end, thus, from north to south progressively older strata are exposed. In Columbia, Clatsop, Tillamook, and northern Lincoln Counties there is much surface basalt, the remains of geologically recent lava flows and intrusions. Sandstones and shales are also exposed where the basalt has weathered away.

Since basaltic rocks are relatively resistant to wear, the mountains in the northern section are more rugged than those of the central sector, from the Yaquina to the Coquille River, where sandstone predominates. The Siskiyou Mountains are composed principally of metamorphic and granitic rocks formed by a massive intrusion of molten lava from below. These are

still harder than basalt, and thus give the region a more rugged terrain than that of the northern Coast Range.

Basalt and metamorphic rocks form good spawning gravel for trout and salmon, while sandstone breaks down to its component grains which are washed away in freshets. Thus, many good spawning riffles are found in Curry County streams where the hardest rock is located, but almost none in the main Siuslaw River whose bed is formed largely of massive sandstones. However, in several streams of the central coast sector, good spawning gravel has been formed of basalt derived from local lava intrusions.

ENVIRONMENTAL CONDITIONS

Many natural factors are found in the wild habitat that have a great bearing on the life of the fish. There must be food to eat, oxygen to breathe, gravel deposits for spawning, a balance of certain mineral salts to promote proper growth and well-being, temperatures within the range of tolerance, cover for protection from enemies, and many others. These factors are classified into physical, chemical, and biological categories.

Physical Factors

The principal physical factors are those of stream bottom types and spawning areas, pools and riffles, cover, water fluctuations, and water temperatures. The complete absence or lack of balance of any one of these factors can seriously affect all of the life within the water.

Bottom Material Types: These may be classified as silt, sand, gravel, rubble, boulders, and bed rock according to the size or texture

of the component parts. All are found in varying abundance in the coastal streams, but seldom is any one observed alone. Most stream beds are made up of a mixture of two or more different kinds. Each type has its own potential as far as the food producing capacity is concerned, but the main consideration is the presence or absence of gravel deposits suitable for spawning.

A study of available spawning areas in 1946 disclosed that in the Coast Range the best gravel deposits are usually in the tributaries, whereas in the Siskiyou Mountains both the main rivers and their feeder streams have an abundance of spawning grounds.

Soil erosion and the resultant silting of the stream beds has caused some loss of the use of gravel deposits for spawning purposes. This situation can be clearly seen in the Coquille River. The middle and lower reaches of that stream, with the exception of the South Fork, have a scarcity of gravel. Especially is this true along the East Fork and the tributaries of the main river below the town of Myrtle Point. Young salmon and trout were not as abundant in these waters as in those of other areas.

Pools and Riffles: Good trout streams usually have an area ratio of about 50-50 between pools and riffles, and in most of the coastal waters approximately this condition prevails. There are, however, more streams having a higher percentage of pools than those in which riffles predominate. Pool sizes and types are also important factors to trout and salmon, and generally in this respect the coastal streams are very good. Only nine per cent of all streams studied fell below the optimum standards of

~~of~~ width, depth, and usefulness to fishlife.

Cover: The lack of cover for the protection of fish can in no sense be considered a limiting factor in the majority of coastal waters. Less than ten per cent of the streams checked fall below a standard that is considered good, and more than three-fifths of the total number are excellent. Cover usually includes boulders, over-hanging banks, deep pools, logs, vegetation, etc., where the fish can take refuge and hide.

Water Fluctuation: One of the worst conditions existing on some streams is that of great water fluctuation. Due to extensive logging operations and forest fires, most of the watershed cover has been removed from some areas and consequently the ground has lost much of its water holding capacity. The results are obvious. During the wet winter months great quantities of water pour from the slopes into the stream channels and the resultant torrents scour the beds and cut the banks. Then during the summer season many creeks become low or dry, stranding fish which managed to survive the floods. It is only normal for a stream to have some fluctuation, but on the coast the fluctuations are so extreme in many cases that much damage is done. Along the middle section of the Chetco River great quantities of drift were found deposited more than 60 feet above the late summer water level. It was reported that this flood had carried away countless thousands of salmon eggs to be left dead on the farms along the lower valley.

Water Temperature: This is one of the most important factors that limit the distribution of fish, especially trout and salmon. In their original, virgin condition all of the coastal waters had temperature

ranges well within the tolerance of trout, but as a result of the man-caused changes, some of the stream temperatures now approach the maximum in which these fish can exist. On the whole, however, the situation is better than might be expected. Of 210 temperature readings taken in coastal streams from the middle of June to early September, 1946, none exceeded the maximum range for trout or salmon. Readings obtained varied from 50 to 74 degrees Fahrenheit with an overall average of 59.4 degrees. This compares very closely with the work in 1941 which began a little earlier in the season and stopped about the same time of year. The maximum temperature recorded that year was 76 degrees Fahrenheit, and the average was 60.6 degrees. In most cases the averages for the tributary streams are lower than those of the rivers, and are certainly below the temperatures found in the lower sections of the larger systems. All of the readings of 70 degrees and above in 1946 were obtained from those lower sections. In general, therefore, it may be stated that critical water temperatures are not an important contributing factor in the present status of the coastal fisheries.

Chemical Factors

Chemicals found dissolved in water play a very important part in the life of fish. Water is their atmosphere, and, with few exceptions, everything that comes to them must pass through that medium. The chemical factors of most concern are the hydrogen ion concentration or pH, the amounts of dissolved oxygen and carbon dioxide, and the quantities of other minerals that occur in solution.

Hydrogen Ion Concentration: The acid or alkaline properties of water are measured through the hydrogen ion concentration. Pure water has a pH value of 7.0, whereas water on the acid side has a value less than that and alkaline water has a higher pH. It is common knowledge that the coastal waters are "soft", or lacking in alkaline properties. Of 118 samples tested during the 1941 survey a range of 6.2 to 7.9 was found, with an average pH of 7.07. Likewise, for 50 samples analyzed in 1946, the range was 6.5 to 8.0 with an average of 7.03. It can be seen that none of the coastal streams are strongly alkaline while many are slightly on the acidic side, and the overall average is close to that of distilled water.

Dissolved Oxygen and Carbon Dioxide: While the quantities of these substances are very important, it is seldom that they are deficient in running waters, unless pollution or some other disturbing factor is present. There is no reason to believe that great concern should be given to these factors under the conditions now prevailing in coastal streams. All sources of pollution should be closely checked and eliminated to prevent any such possibilities, however; and with the ever present quantities of logging and lumbering wastes a critical situation could arise in some areas.

Dissolved Carbonates and Bicarbonates: Determination of the amounts of these salts is really a measure of the buffer capacity of the waters. Experience has shown a consistent correlation between high buffer capacity and biological productivity. The coastal waters are uniformly low in this value, and because of the softness indicate the lack of soluble mineral substances in the soil. During 1941, 118 samples were

checked and a range of 10 to 60 parts per million parts of water was established, while the overall average was 23.3 ppm.

Biological Factors

Among the biological factors influencing fish life are shelter and shade, aquatic vegetation, fish food organisms, types and abundance of predators, and parasites and diseases.

Shelter and Shade: The watershed cover has a very definite bearing on many other factors influencing stream life and furnishes shade to the stream which is an important factor in regulating water temperatures. At one time or another much of the shade was removed throughout the Coast Range. Now, however; except for the areas recently logged or burned, there is good shelter along most of the streams. The outstanding exceptions are those areas in the Tillamook Burn that have been ravaged by several fires.

Aquatic Vegetation: Plants occurring in the water fulfill many important functions: perhaps the most important being that of acting as a haven for aquatic organisms which serve as food to the fish, and providing cover for the smaller fish themselves. Fresh water algae, usually Chlorophyceae (green algae), is the most abundant type of vegetation found in coastal streams, but aquatic mosses are also commonly seen, as well as some of the higher plants.

Fish Food Organisms: The supply of aquatic insects and other bottom dwelling forms which constitute the major portion of the trout's diet, is not considered to constitute any problem in coastal waters. One or more

types were found to be abundant or very common at about 95 per cent of all stations and stream sections checked in both 1941 and 1946. The region is not as productive as the waters in the eastern part of the state, however, and this may be correlated with the buffer capacity as demonstrated by the amounts of mineral salts in solution. No quantitative counts of organisms were made, but relative abundance of the forms were determined by searching the bottoms of pools and riffles. In both years caddis fly larvae were found in the greatest abundance. May fly nymphs occur quite commonly, while true fly larvae and stonefly nymphs are somewhat less abundant. The total of all other food organisms nearly equals the numbers of may fly young, and were represented by small crayfish, snails and worms.

Predators: The element of predation must be considered in any management program, but it is a difficult factor to properly evaluate without intensive study. Many different types of potential predators are found along the coastal region of Oregon, but to point out any one type or group of animals and estimate the extent of the damage they cause is impossible at the present time. It is not believed that birds or mammals ordinarily cause any great losses to the fish populations in the streams of that region. Predacious forms undoubtedly kill some young of the anadromous species as they migrate downstream towards salt water. One factor that undoubtedly serves a valuable purpose for the protection of game fish is the universal distribution of several species of trash fish which carry a large share of the predation losses. The more important of these are bullheads, minnows, and sticklebacks.

Parasites and Diseases: Many parasites and diseases are found in fish in wild waters, but rarely reach epidemic proportions. A number are known to exist in the coastal streams but none offer a serious problem, and only where fish are crowded together under unnatural conditions is disease an important consideration.

FISH AND FISH POPULATION STUDIES

Species of Fresh Water Fish Found in Coastal Waters

Many different species of fish belonging to at least 13 families are known to occur in the fresh water streams and lakes along the Oregon coast. Most of these forms are native to the area, but a number of exotics have also been introduced with varying degrees of success. Some of the species live entirely in fresh water; others range back and forth; while still a third group, including salmon and steelhead, spend most of their life in saltwater, residing in fresh water during their youth and returning to it again to spawn.

The following is a list of fish which have been introduced into or are native to the coastal streams.

Family Petromyzonidae	
Pacific Lamprey	Entosphenus tridentatus (Gairdner)
Brook Lamprey	Lampetra planeri (Bloch)
Family Acipenseridae	
Green Sturgeon	Acipenser acutirostris Ayres
White Sturgeon	Acipenser transmontanus Richardson
Family Gasterosteidae	
Three-spined Stickleback	Gasterosteus aculeatus Linnaeus
Northern Stickleback	Pungitius pungitius Linnaeus

Family Osmeridae		
	Columbia River Smelt or Eulachon	Thaleichthys pacificus (Richardson)
	Freshwater Smelt	Hypomesus olidus (Pallas)
Family Salmonidae		
	Chinook Salmon	Oncorhynchus tshawytscha (Walbaum)
	Silver Salmon	Oncorhynchus kisutch (Walbaum)
	Chum Salmon	Oncorhynchus keta (Walbaum)
(1)	Sockeye Salmon	Oncorhynchus nerka (Walbaum)
(1)	Pink Salmon	Oncorhynchus gorbuscha (Walbaum)
	Steelhead or Rainbow Trout	Salmo gairdneri Richardson
	Coastal Cutthroat Trout	Salmo clarki clarki Richardson
(2)	Montana Blackspotted Trout	Salmo clarki lewisi Girard
(3)	Brown Trout	Salmo trutta Linnaeus
(4)	Eastern Brook Trout	Salvelinus fontinalis (Mitchill)
Family Thymallidae		
(2)	Montana Grayling	Thymallus montanus Milner (or T. americanus
Family Ameiuridae		
	Bullhead Catfish	Ameiurus nebulosus (LeSueur)
	Black Catfish	Ameiurus melas (Rafinesque)
	Yellow Catfish	Ameiurus natalis (LeSueur)
Family Percidae		
	Yellow Perch	Perca flavescens (Mitchill)
Family Cantrapchidae		
	Large-mouth Black Bass	Huro salmoides (Lacepede)
	Small-mouth Black Bass	Micropterus dolomieu Lacepede
	Black Crappie	Pomoxis nigro-maculatus (LeSueur)
	White Crappie	Pomoxis annularis Rafinesque
	Bluegill Sunfish	Lepomis macrochirus Rafinesque
	Pumpkinseed Sunfish	Lepomis gibbosus (Linnaeus)
	Warmouth Bass	Chaenobryttus gulosus (Cuvier)
Family Moronidae		
	Striped Bass	Roccus saxatilis (Walbaum)
Family Clupeidae		
	Shad	Alosa sapidissima (Wilson)
Family Cyprinidae		
	Carp	Cyprinus carpio Linnaeus
	Goldfish	Carrassius auratus (Linnaeus)
	Squawfish	Ptychocheilus oregonensis (Richardson)

species not native, but introduced into coastal waters

Squawfish	Ptychocheilus umpquae Snyder
Long-nosed Dace	Rhinichthys cataractae (Valenciennes)
Black-sided Dace	Rhinichthys osculus (Girard)
Red-sided Shiner or Bream	Richardsonius balteatus (Richardson)

Family Catostomidae

Coarse-scaled Sucker	Catostumus macrocheilus Girard
Fine-scaled Sucker	Catostumus syncheilus Jubbs & Schultz

Family Cottidae

Prickly Bullhead	Cottus asper Richardson
Bullhead	Cottus gulosus (Girard)
Bullhead	Cottus aleuticus Gilbert
Bullhead	Cottus rhotheus (Rosa Smith)

(1) Only an occasional straggler in Oregon south of the Columbia River.
(2) Stocked in times past but present status unknown.
(3) Reported to have become established in Forth-of-July Creek on Upper Winchuck River.
(4) Established in Matson Creek on East Fork of the Millicoma River.

Fish Population Trends

Population trends of the coastal fishery were determined by extensive interviews with long-time residents of that region. Persons with first hand information were sought out. These included sportsmen, commercial fishermen, resort owners, tackle dealers, lumbermen and farmers in the various localities.

Questions asked concerned the trend of abundance of the different species over as long a period of time as could be recalled, and any changes in the over-all picture within recent years. Causes for the decrease or increase in numbers of the fish were also considered, as well as corrective measures to overcome the present limiting factors. Results of these interrogations varied considerably, but most answers concerning any one species in one body of water were very similar, and the opinions expressed were used as the findings of the study.

The cutthroat trout has suffered heavy decreases in all of the coastal streams. In recent years there appears to be some slight recovery in the Necanicum and Siuslaw Rivers, however, and this can be correlated with the regrowth of the watershed cover in the upper reaches of those drainages.

Although the steelhead trout is also present in much smaller numbers than formerly, this species is beginning to recover or at least hold its own in most streams south of the Tillamook Bay area. It is still on the decline north of that point, and in the Tenmile Lakes system and Coos Bay streams. Predation by yellow perch and striped bass respectively is the factor believed responsible for continuing decline in the last two mentioned localities.

Silver salmon have been greatly reduced in all of the coastal streams. The consensus of opinion indicates that this species is now starting a comeback in the Necanicum, Dee (Devils Lake), and Siuslaw Rivers, as well as maintaining a stable population in Salmon River and Elk Creek. A large run was experienced in most of the streams of the north and central coastal sectors during the 1945 season, but this is believed to have been caused by a heavy cycle rather than any general increases.

The spring chinook salmon is usually a fish of the longer river systems, and was not found originally in great abundance in most of the shorter coastal streams. The species has been nearly exterminated in these areas however, and unless it is afforded all possible protection may become extinct in Oregon waters other than the Columbia, Umpqua, and Rogue Rivers. The fall chinook has fared better, but is also rapidly decreasing in all coastal streams. Like the silver salmon, this fish appeared in somewhat

greater numbers in 1945, but again the cause is attributed to a heavy cycle.

Chum salmon, although not considered a sports fish, were also reported to be on a decline in most of the streams studied.

Fish Counts and Catches

Fish Trap Counts: Coal and Clear Creeks, tributaries to the Kilchis River in Tillamook County, were the sites of downstream fish trapping operations during part of the spring and summer of 1946. Both streams enter the Kilchis from the south, Coal Creek at a point about 2.5 miles above Tillamook Bay and Clear Creek approximately 3.7 miles farther upstream. The Coal Creek trap was installed on April 5 and the one on Clear Creek on April 28, and both were removed August 30. Installation in each case was within 100 yards of the stream mouth. Water volumes at the trapping sites varied from 17.5 to 1.3 cubic feet per second in Coal Creek and from 40 to 3.8 cubic feet in Clear Creek.

Both traps were constructed of hardware-cloth cubes with wooden bracing to provide rigidity. These were set into frames driven into the creek bed and could be lifted out to be emptied. Fences were extended from the traps diagonally upstream and part way across the channels. So that more fish could be taken, both of these were lengthened within a month after installation. The Coal Creek trap took chum and silver salmon fry as it was constructed of six-mesh hardware-cloth, but as the Clear Creek trap was made of material with two meshes to the inch only larger fish were caught.

It will be noted from the catch records (Tables 9 and 10) that the

Clear Creek trap took comparatively few fish despite that streams greater size. The explanation for this poverty is probably to be found in both excessive angling and logging. It was reported that angling was very heavy prior to the closure of these tributaries in 1938, and that limit catches of fish more than 12 inches in length were common in the early and middle 1930's. The fires of 1933 and 1935 apparently did not affect that stream as only the extreme upper end of one fork is in the burnt area, and that was attributed to the 1939 fire. Lately there has been considerable logging along the creek, with the resultant formation of several log and slash jams. These jams probably do not greatly hinder the downstream migration of fingerling silver salmon and trout, but adult salmon and steelhead are impeded on their upstream migrations.

The Cool Creek area was logged many years ago and at the present time a good second growth has clothed the watershed. The stream itself is too small to attract the average angler, and the landowner controlling the approaches to the upper creek did not encourage fishing even before its closure by law.

Trap returns show that chum salmon move downstream as recently hatched fry with its yolk sac barely absorbed. The same is true of the silver salmon fry taken, but it is not believed that these move directly to salt water as the young chum are presumed to do. Most adult silvers show on their scales one year of freshwater growth before entering the ocean. Nevertheless, it is evident that by far the greater proportion of the silver salmon hatch moves out of the small tributaries shortly after emerging from the gravel. Such a migration is essential if the

streams are not to be overcrowded. The first trout fry of the season were observed in a small tributary of Coal Creek, about one mile above the trapsite, on the 19th of May, although none were noted at the trap itself until early June. There was no evidence that these fish migrate downstream at that stage.

Salmon fry taken in the traps were usually sampled once each week to determine average length measurements. When insufficient numbers entered the traps, samples of the stream population were taken by seining. It was noted that the growth of Coal Creek fry was slightly ahead of those in Clear Creek, but somewhat higher temperatures in the former body of water serve to explain that difference.

The data collected clearly demonstrates that the main downstream migration of steelhead and cutthroat trout fingerlings and silver salmon fry and fingerlings takes place during May, with perhaps some slight shifting of the peak from year to year because of climatic variations. It is believed that some of the immature steelhead had previously been in brackish or salt water for a short period and then moved upstream, presumably to feed on salmon fry. These were taken as they returned to tidewater. Also a few cutthroat showed "sea colors" and perhaps had been upstream to spawn, or it is possible that these were a spring run that were to stay in freshwater until after their next fall spawning, and had entered the traps while moving around in the creeks.

Cottids also occurred in the traps in greatest numbers during May, but their main period of movement extended through June. Brook lamprey were observed spawning in Coal Creek from the middle of May through

Table 9

COAL CREEK TRAP - 1946

PERIOD	CHUM	1946 HATCH SILVERS	TROUT	SILVERS	FINGERLINGS STEELHEAD	CUTTHROAT	OTHERS
4/6-4/12	16,172	65		4			7
13-19	34,928	2,058			1		3
20-26	73,224	4,891					7
4/27-5/3	45,793	7,924		2	2		9
4-10	4,001	3,438		183	125	34	18
11-17	16	40		193	200	60	9
18-24	3	2,608		55	108	45	16
25-31	1	338		22	28	64	17
6/1-6/7		13		2	22	16	23
8-14		1		2	3	5	10
15-21		13			1		5
22-28		16					14
6/29-7/5		13					2
6-12		19	1				3
13-19		5	1				9
20-26		8					14
7/27-8/2							7
3-9		1				1	8
10-16		1					5
17-23							7
24-30		1					10
TOTALS	174,137	21,453	2	463	490	225	202

Table 10

CLEAR CREEK TRAP - 1946

PERIOD	SILVERS	STEELHEAD	CUTTHROAT	OTHERS
4/29-5/3	6	1		10
4-10	21	8	1	11
11-17	56	13	16	12
18-24	21	2	11	22
25-31	1	1	2	18
6/1-6/7	1	1	10	9
8-14	1	1	1	11
15-21		2		15
22-28	1	7	2	11
6/29-7/5			1	4
6-12	1	3	1	5
13-19		2	1	2
20-26	1	2	1	3
7/27-8/2	3	1	1	3
3-9	3	1		3
10-16	1	2		9
17-23	1	2		11
24-30	3	1		2
TOTALS	121	50	48	161

mid-June. The Pacific lamprey larvae taken in that stream were probably on their way to salt water, while the adults in Clear Creek had come up to spawn. The crayfish were caught as they presumably moved around the streams.

The counts of downstream migrants bear a striking relationship to the angler's early season catches. A great many sub-legal fish are hooked during that period and many are killed when released. The legal fish include many of the quasi-migrants from salt water. Steelheads taken at that time would provide better sport if permitted to mature and be caught during the winter season. It seems obvious that the present early opening is detrimental to fish conservation and that it is clearly advisable to delay the date. The new regulations calling for an 8" minimum size limit and the closure of tide water to trout fishing until June 15 should remedy the situation to some extent, but a later opening date would be more effective in saving larger numbers of small, pre-seaward migrant fish.

Sand Creek Studies: A two-way fish weir was constructed on Sand Creek in Tillamook County in the fall of 1946 for the purpose of studying upstream and downstream migrations, particularly those of cutthroat trout. These studies are to be on a year around basis and were started on October 20, 1946.

At the time of this writing, few trout have been taken, the largest count being on the second day of operations, so the peak of the fall run may have passed prior to that time. Another possibility is that the main concentrations of cutthroat in tidewater have been awaiting a freshet and will move up when the water level rises. On November 18, however, heavy

rains caused a sharp rise of the stream level and for a period of four hours water was passing over the top of the weir. On the basis of partial counts it was estimated that 41 trout, as well as 364 salmon (mostly chum), passed over the top of the trap. These, with the 53 trout and 303 salmon counted through the trap, would make a total upstream migration by November 30 of 94 cutthroat and 667 salmon.

Most of the trout are sexually green as they pass the site. Only one female appeared to be approaching ripeness and three males seemed ready to spawn. Two of the latter were taken late in November. The cutthroat ratio was one male to 2.7 females, 27 per cent of the 53 fish taken being males.

Five commercial set-nets operated in tidewater of Sand Creek, and available records on four of these showed 669 salmon taken. It can be assumed from that that the commercial fishery removed about 836 fish or 56 per cent of the entire run from October 20 to November 30. The sports take of salmon is unknown.

Talbe 11

SAND CREEK WEIR COUNTS

PERIOD	SILVERS	CHUM	CUTTHROAT
10/20 - 10/26	4		21
10/27 - 11/2	3	2	20
11/3 - 11/9		1	3
11/10 - 11/16		195	3
11/17 - 11/23	1	69	5
11/24 - 11/30	1	27	1
TOTALS	9	294	53