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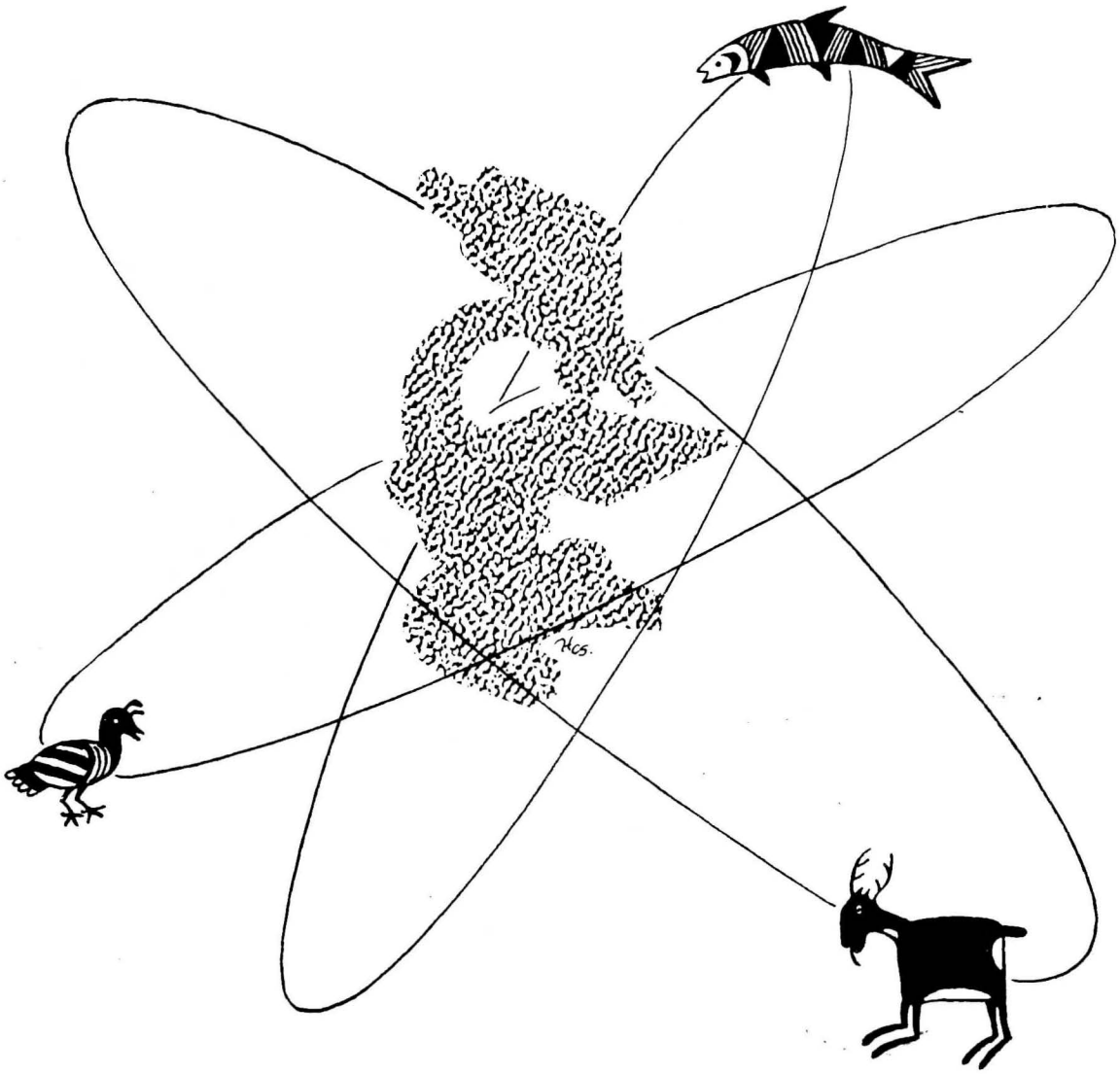

RESEARCH DIVISION

Oregon State Game Commission

Federal Aid Project
F-72-R 2
Coastal Cutthroat

CATCH OF THE 1965 TIDEWATER CUTTHROAT SPORT FISHERY AND NOTES ON THE LIFE HISTORY OF THE COASTAL CUTTHROAT TROUT IN THE SIUSLAW RIVER, OREGON

by

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Abstract

A study conducted during the summer of 1965 provided information on magnitude of the catch and angler effort in the Siuslaw tidewater sport fishery for sea-run coastal cutthroat trout. Hatchery fish comprised 10.2 percent of the 1965 catch which was estimated to have been 6,314 cutthroat. Less than 4 percent of the 1965 release of hatchery trout in the Siuslaw drainage was recovered in the tidewater fishery.

The study will continue in order to determine source of stocks exploited by the fishery and to obtain life history data on wild cutthroat in the drainage.

Introduction

The sea-run coastal cutthroat trout, Salmo clarki clarki Richardson, is highly prized by Oregon sport fishermen. It is sought in tidewater and freshwater as it moves in from the ocean on a spawning migration. Although several well-developed tidewater fisheries for cutthroat exist in Oregon, limited information is available concerning the amount of effort expended in pursuit of the species, size of the catch and source of stocks contributing to the catch.

A study was initiated in 1965 to determine the magnitude of the cutthroat fishery on the Siuslaw River estuary on the central Oregon coast and to determine the contribution of hatchery fish to the catch. The Siuslaw River was selected for study because it has a major tidewater cutthroat fishery, and because a study on the ecology of hatchery cutthroat was already in progress on one of its tributaries.

Angling for cutthroat on the Siuslaw estuary commences in late July and reaches a peak in August and early September. The effort decreases rapidly when salmon enter the estuary in September and the cutthroat move upstream to spawn. A few cutthroat are captured incidentally by salmon anglers in October and November. Essentially all angling is done by boat.

Methods

Sampling area

The area selected for sampling the tidewater fishery extended from Farnum Landing near Mapleton, Oregon, downstream to the mouth of the North Fork of the Siuslaw River, a distance of approximately 15 miles (Figure 1). Cutthroat are captured occasionally in other parts of the estuary but the main fishery is centered in the study area. The estuary was divided into 16 geographic units to facilitate sampling and to determine the areas of heavy angling effort and catch.

Estimation of effort

Previous observations indicated that considerable variation in effort occurred among different days of the week and with the progress of the season. The sampling period from July 15 to October 31 was stratified into two-week sections with weekdays and weekend days plus holidays treated separately in order to evaluate properly variations in catch rate and effort.

Distribution of daily effort was determined by enumerating boat parties angling on the estuary at 2-hour intervals throughout the day. Days on which periodic counts were made were termed "count days". Data from such counts were used to determine periodicity of effort on the typical angling day. The angling day was considered to be from 5:30 A.M. to 8:30 P.M. for purposes of the study. The legal angling day was one hour before sunrise to one hour

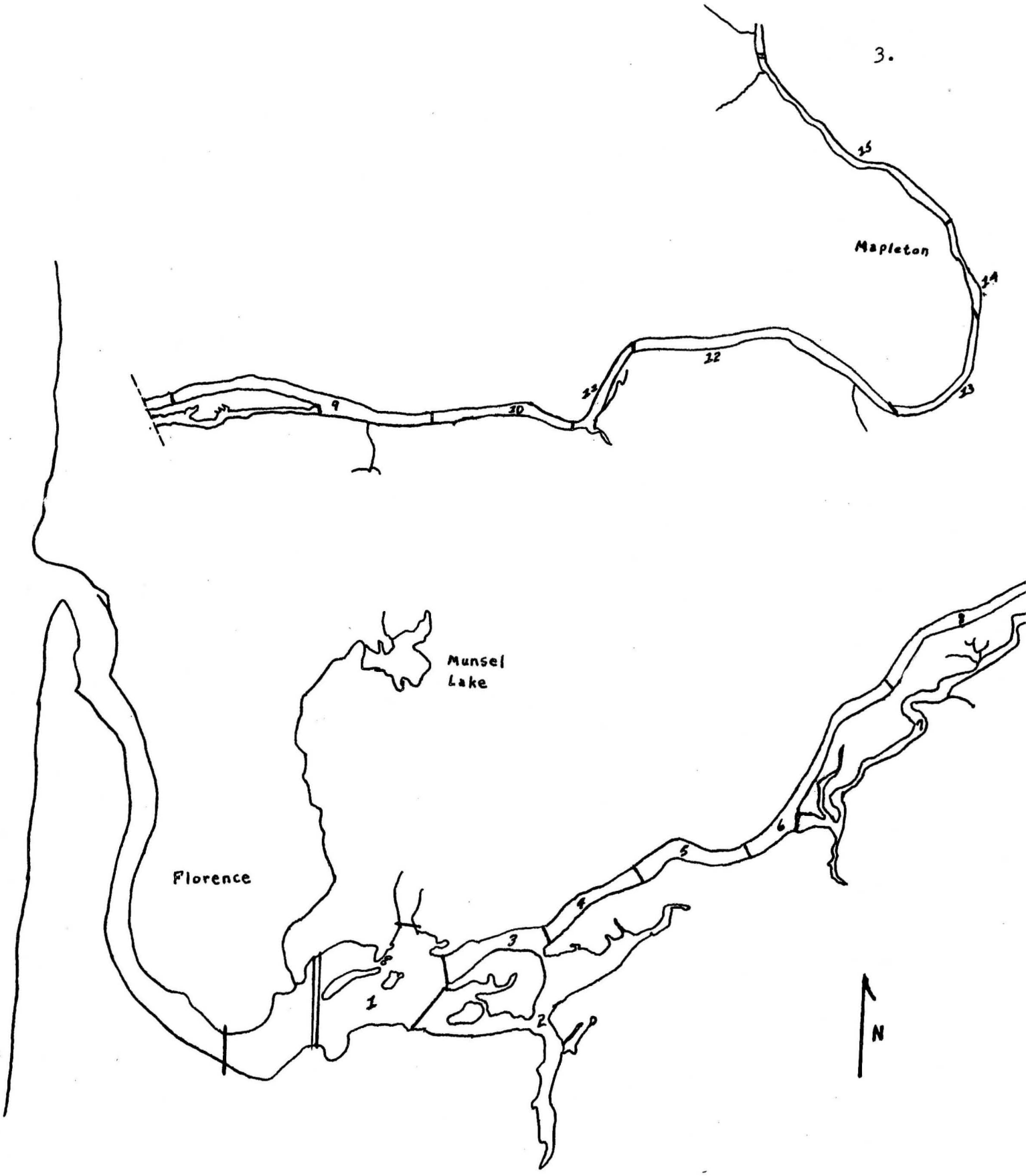

Figure 1. Map of the Siuslaw River estuary showing geographical units used in the 1965 creel census.

after sunset. Pressure counts were made by a census taker as he drove along Highway 36 which runs adjacent to the estuary. As it required approximately 60 minutes to count all boats on the estuary, the count was commenced 30 minutes prior to each even hour and completed 30 minutes after the hour. Thus counts centered on 6, 8, 10, and 12 A.M. and 2, 4, 6, and 8 P.M.

An index to angling pressure on other days was obtained from a single road count taken with the midpoint at 10 A.M. This "index count" was expanded by the proportion of total daily effort for the day. Count days and index days were selected at random within each fortnight and within the weekday and weekend day strata.

As two areas of the estuary were not visible from the highway (areas 7 and 13, Figure 1) aerial counts were also made at 12 noon on each "count day". The proportion of boats missed by the road count was determined by comparing the two counts.

Angler interviews

Cutthroat life history data, estimates of catch per unit of effort, catch composition, and angler origin were obtained by interviewing anglers at the five major boat moorages on the estuary. A census taker was assigned for the day to one moorage selected at random. All five moorages were sampled before returning to the originally-assigned moorage.

Fish were selected at random from the creel for measurements of length and weight. Fork length was recorded to the nearest millimeter and weight to the nearest gram. All body lengths mentioned later in this report are fork lengths. Scale samples were collected from 20 fish selected throughout the size range each sampling day when possible. Scales were extracted from the region between the lateral line and dorsal fin on the left side.

Age composition of the catch was determined by using an age-length frequency key. Scales from five fish within each 5 millimeter length group were read to determine age regardless of the number of fish in the length group. Age composition of the catch sample was then determined by expanding age composition of the five fish from each length group to include all fish in that group. Scales were mounted in sodium silicate-glycerine for viewing through a standard microprojector at a magnification of 80 diameters.

Results

Aerial vs road counts

Simultaneous counts of boats were made on 12 days during the season by plane and auto. Road counts averaged 9.7 percent (4 boats) below the aerial count. The mean weekday road count was 14.8 percent low and the mean weekend count was 8.6 percent low (Appendix A). The difference in percent of error on weekdays and weekend days was related to the number of boats on the estuary. The mean number of boats observed at 12 noon on weekdays was 25.4 and on weekend days was 66.2. Obviously a smaller percentage of the weekend anglers was fishing in the two areas of the estuary that could not be seen from the road. As catch estimates were based on index counts made from the road, the estimates within the weekday and weekend day strata were expanded by the above percentages to obtain final estimates.

Length of angling trip and angler origin

Information was collected on the amount of time the average angler fished the estuary in 1965. Anglers were divided into three groups according to length of fishing trip; one-day anglers (usually local residents who fished only when they heard that fishing was good), "weekend" anglers who fished for several days, and vacationers who brought a house trailer and fished for one or more weeks. The vacationers were out-of-state anglers and Oregon

residents who parked a trailer for the summer and commuted from home whenever fishing was good. Of 1,199 anglers interviewed as to their status during the season, 5 percent were local anglers fishing for the day, 52 percent were "weekend" anglers fishing more than one day and 43 percent were classified as seasonal residents who spent one or more weeks fishing the estuary.

The distance that peopled traveled to fish the estuary was also determined for the period from September 13 to October 11. Of 630 anglers interviewed, 4 percent lived in towns adjacent to the estuary, 89 percent lived 50 to 100 miles away, 4 percent lived within the state but over 100 miles away and 3 percent were from other states, particularly California. The large majority of anglers using the estuary were from the Eugene-Springfield area.

Distribution of daily effort

Angling effort was measured at 2-hour intervals on 16 days during the angling season. Nine weekend days and holidays and 7 weekdays were selected as count days. The legal angling day commenced one hour before sunrise but few fishermen ventured on the estuary before 8 A.M. (Figure 2). Effort on the typical day increased rapidly to a peak around 10 A.M., remained high until after 10 A.M. and then dropped gradually to 8 P.M. The percentage of total daily effort exerted at even hours based on data from 16 days was:

Time:	6	8	10	12	14	16	18	20
Weekdays	0.1	3.9	16.2	9.7	7.7	8.1	3.5	1.5
Weekends	0.4	5.5	12.4	12.0	9.6	6.8	3.1	0.8

The precise estimates of daily effort were obtained on all days from the 10 A.M. count. Standard error expressed as a percent of the mean portion

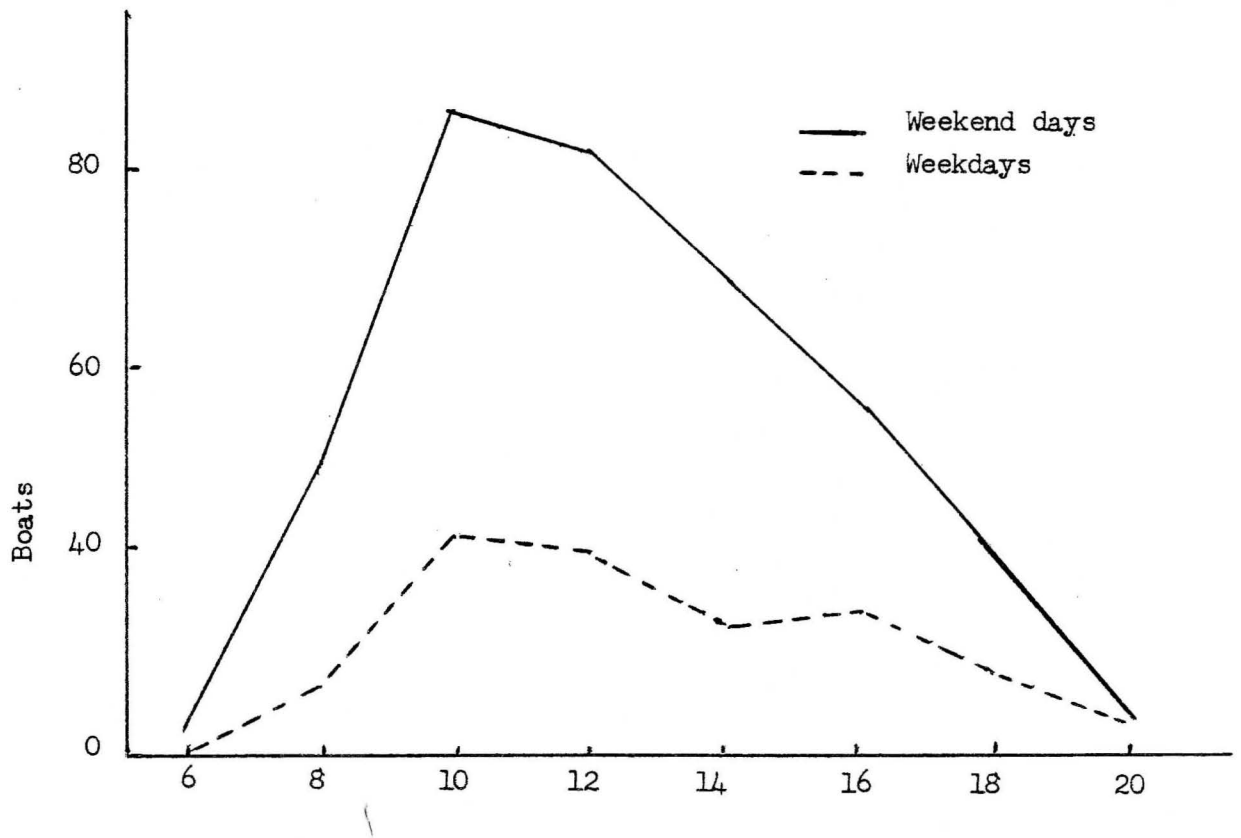

Figure 2. Mean number of boats observed at the even hour on count days on Siuslaw estuary, July to October, 1965.

of daily effort from combined weekday and weekend-day data was:

Time:	8	10	12	14	16	18
Mean	5.0	12.5	11.2	8.7	7.2	4.3
Standard error	21.4	12.9	15.5	20.2	32.5	31.1

Index counts will be made at 10 A.M. in the future to obtain maximum possible accuracy of the catch estimates.

Distribution of effort during the day varied somewhat between weekdays and weekend days, but the big difference between the two strata was in magnitude of angling effort. Of 32,923 boat hours of effort expended in pursuit of all species during the 1965 season, 59 percent occurred on weekends and holidays which represented only 31 percent of the days in the season. The difference was more obvious when mean daily angling effort was compared (Figure 2). Mean angling effort on weekdays was estimated at 180 boat hours, in contrast to an average of 632 boat hours of effort on the typical weekend day.

Similar differences occurred in the percent of the total catch which was captured on weekends and holidays. Total catch of salmon and trout for the season was estimated at 7,518 fish, with 3,692 fish caught on weekends and holidays and 3,827 fish captured on weekdays.

Comparison of catch per boat hour on weekdays and weekends illustrates an important feature of the Siuslaw tidewater fishery. A different type of angler fished the estuary on weekdays than on weekends. The average weekday angler was on vacation or had left work for the day because of reports that fishing was especially good. Before starting to fish in the morning, he usually checked tide and weather conditions, where fish were caught on the previous day and what type of lure was best. If fishing was slow or

conditions were not ideal, he spent the day relaxing ashore and tried again the next morning. Even if fishing was good he frequently stopped at noon for lunch.

The weekend angler had a limited time to fish and spent as much time on the water as possible. He was not as well informed about location of fish and type of successful gear as the weekday angler. Hence, his success per boat-hour of effort was lower. Weekday anglers fished an average of 3.5 hours to catch a fish, whereas the weekend anglers fished 5.3 hours for each fish creeled. In 1965, weekend anglers started fishing earlier in the day, were inclined to forego the noon break and continued fishing in the afternoon. The average weekend angler fished 25 minutes longer than the more leisure weekday angler. Mean length of the boat angling trip was 4.70 hours on weekdays and 5.12 hours on weekends. The shape of the daily effort curves in Figure 2 reflect the differences in habits of weekday and weekend anglers.

Catch estimates

Catch statistics for the tidewater fishery for the 1965 season are presented in Table 1. The statistical procedure used for deriving the catch estimates is described in Appendix B. Estimated catch of sea-run cutthroat during the 1965 season was 6,314 fish. During the period, anglers captured an estimated 179 chinook and 1,026 cohos within the sample area. Total effort in pursuit of all species was estimated at 32,923 boat hours. In July and August, before salmon entered tidewater in concentrations, anglers were seeking cutthroat. As salmon entered the estuary, anglers shifted fishing effort to them. During the transition period in September little change occurred in the type of lure used or method of fishing, so either salmon or cutthroat could be caught on the same gear. Anglers in this category were considered to be spending half of their time seeking cutthroat.

After the middle of September, most anglers were fishing for salmon, and cutthroat were caught only incidentally.

Table 1

Catch statistics of the Siuslaw tidewater fishery July 19 to October 31, 1965 with 95% confidence limits

Total angler trips	Total angler hours	Total boat trips	Total boat hours	Catch				
				Cutthroat	Chinook	Chinook jacks	Coho	Coho jacks
13,324 ±388	73,143 ±2,900	6,443 ±173	32,923 ±717	6,314 ±276	39 ±7	140 ±12	377 ±51	649 ±88

The transition in effort in relation to the cutthroat and salmon catch is illustrated in Figure 3. The cutthroat catch was directly related to angling effort for the species during most of the season. When the first cutthroat was captured on July 29, angling pressure and catch increased rapidly. Thirty-four percent of the seasonal effort for cutthroat and 28 percent of the cutthroat catch occurred during the first half of August. Seventy-eight percent of the seasonal effort and 68 percent of the catch occurred between August 1 and September 15.

Sources of stocks in the catch

The success of a hatchery stocking program is generally measured by the proportion of released fish which are eventually captured by the angler. Hatchery cutthroat released in the Siuslaw River in recent years have been marked with a fin clip. The ratio of marked to unmarked cutthroat in the tidewater catch has been sampled to determine the contribution of the hatchery product to the fishery. Most cutthroat released in the Siuslaw drainage are also subjected to a river fishery prior to recruitment to the tidewater fishery. Data on the proportion of hatchery fish in the river fishery are

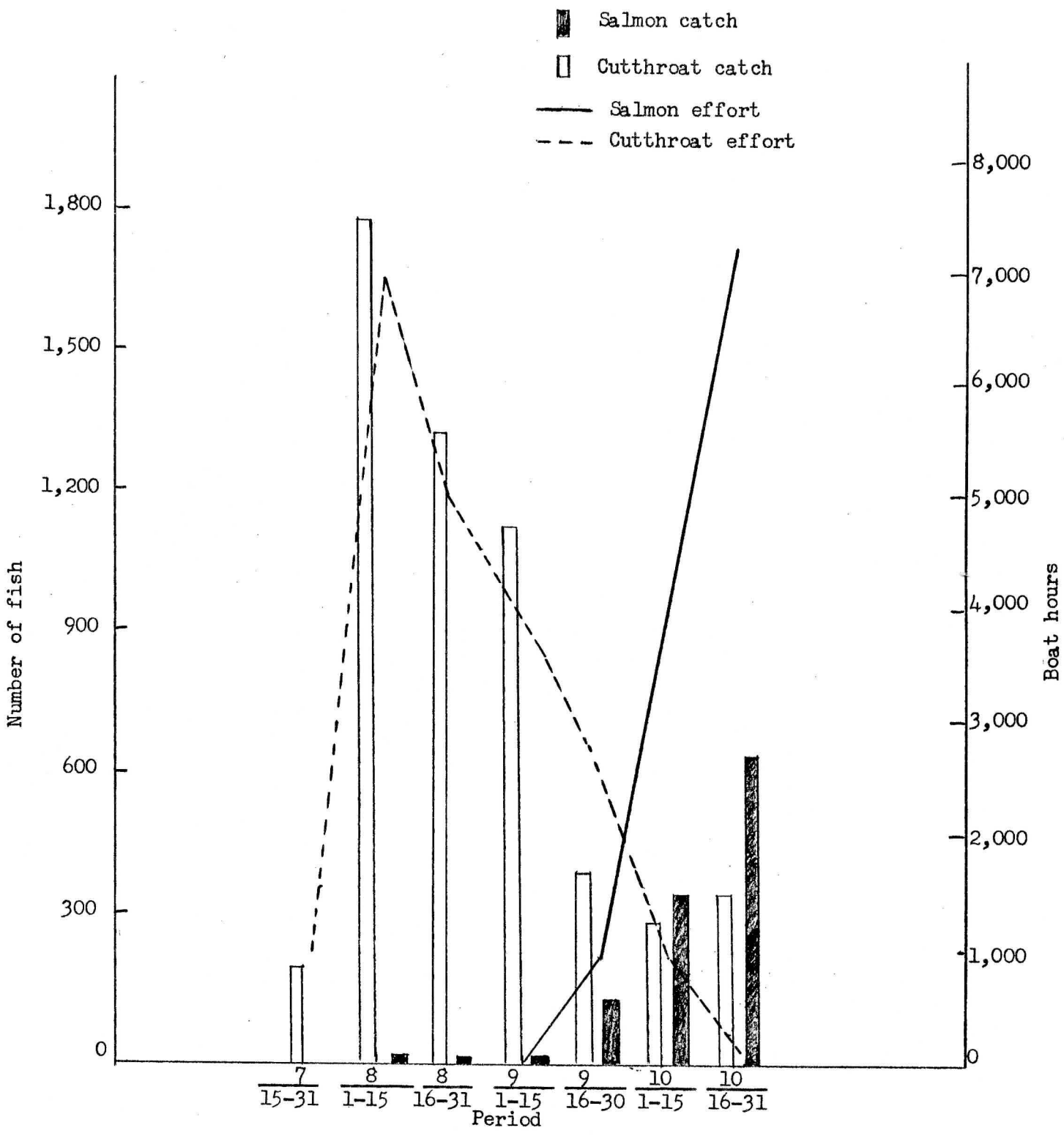

Figure 3. Catch and effort of salmon and cutthroat anglers in the 1965 Siuslaw tidewater fishery by fortnight period.

not available, and accurate estimates of total catch in previous years are not available in either fishery.

Data from annual reports of the Oregon Game Commission (1962, 1963, 1964) indicated the following percentages of marked cutthroat in the Siuslaw tidewater catch samples:

1962	20.8
1963	18.7
1964	6.9

The 1965 catch was estimated to contain 10.2 percent hatchery fish and 9.0 percent marked fish. The reduced proportion of marked fish in the 1964 and 1965 catch was not unexpected as no cutthroat were released in the Siuslaw River in 1964 and only 4,980 fish were released in 1965. In 1962 and 1963, 10,582 and 16,180 cutthroat, respectively were released in the Siuslaw drainage. It is apparent from the percentages of hatchery fish in the catch that the Siuslaw tidewater fishery has been largely sustained in recent years by natural reproduction.

The percentage of marked fish in the 1965 catch given above was less than the percent of hatchery fish in the catch. We noticed while collecting the catch sample that a number of unmarked cutthroat had deformed dorsal fins, suggesting that they were fish of hatchery origin. The dorsal fin had not been used for marking cutthroat in Oregon in recent years.

Scale examination verified the assumption that unmarked hatchery fish were present in the catch. Eight fish of hatchery origin were detected in a random sample of 146 fish selected for age and growth determinations. Expansion of the sample with the age-length frequency key provided an estimate of 19 unmarked hatchery fish in the catch sample and 175 unmarked hatchery fish in the total catch. Scales from these fish had typical characteristics of hatchery growth. Circuli on the freshwater portion of

of the scales were widely and evenly spaced and the scale indicated that the fish had migrated to salt water shortly after depositing the first annulus. The average wild cutthroat examined spent 2 to 3 years in freshwater before moving downstream to the sea. Thus, there were three groups of hatchery fish in the catch; fish with excised fins, tagged fish and unmarked fish detected by scale examination. Unmarked hatchery fish were not included in ratios of hatchery to wild fish in previous years so the proportion of hatchery fish in the catch prior to 1965 might have been higher than indicated above.

Sixty-six marked cutthroat were observed in the 1965 catch sample of 688 fish. Scale examination and liberation records (1965) verified that 55 of the 66 fish were of hatchery origin. Eleven fish with single marks could not be positively identified as hatchery fish and were classified as wild with natural amputations. The group included 7 fish with left maxillary clips, 3 fish with right maxillary and one with a left pectoral clip.

Groups of marked fish identified in the catch are presented in Table 2. The 201 fish with a right pectoral clip were released in 1965 and might have been from either of two groups; 7,000 cutthroat averaging 9 inches in length released in the Alsea River between the town of Alsea and Five Rivers bridge on May 17 and 18, and 4,980 cutthroat of the same size released in the Siuslaw River and tributaries on May 19 and 20. The Siuslaw releases were made in the following places:

Siuslaw River at mouth of Wildcat Creek	1,003 fish
Lake Creek between Swisshome and Deadwood Creek	2,475 fish
Indian Creek at 4-mile bridge	751 fish
Deadwood Creek at West Fork bridge	751 fish

Fish for the Alsea and Siuslaw releases were Alsea stock reared in the Cedar Creek Hatchery of the Oregon Game Commission. If the 201 RP fish in the catch were all from the Siuslaw release, the tidewater fishing recovered 4 percent of the 4,980 fish liberated. The number harvested by the intensive river fishery is not known but might have been significant. The river fishery

will be sampled in 1966 to determine the proportion of each release harvested. The size of hatchery fish in relation to wild smolts suggests that the hatchery product might comprise a major portion of the river catch.

Table 2

Composition of the Siuslaw tidewater catch of cutthroat, July 19 to October 31, 1965, number of fish observed in parentheses

			Hatchery fish									Total
Wild	RP	Tagged	Ad	BV	AdLP	LV	RV	AdLM	AdRP	BP	Unmarked	catch
5,668 (633)	201 (24)	42 (5)	92 (11)	18 (2)	8 (1)	45 (5)	27 (3)	9 (1)	18 (2)	8 (1)	175 (19)	6,134 (688)

Five hundred twenty-five fish with right pectoral clips from the same lot as the Siuslaw release group were marked for future identification with spaghetti tags and liberated in Munsel Creek below the wier (Figure 1) in 1965. Approximately 8 percent of the group were recovered in the tidewater fishery. The return was higher than the Siuslaw release, probably because the tagged group was not angled by the river fishery.

Scale examination indicated that the 92 fish with adipose clips were also from a 1965 release. The only cutthroat with an adipose mark released in 1965 were liberated on March 23 and 24 in the Alsea River between Five Rivers bridge and Alsea, Oregon which is approximately 59 miles via the ocean from the Siuslaw tidewater fishery. The release comprised 7,002 cutthroat measuring 8 inches in mean length. Ninety-two fish from this group represents a recovery of 1.3 percent and indicates that significant straying occurred. Only 9.8 percent of the adipose-marked group were captured in the Alsea tidewater fishery during the same period (Appendix C).

It is not known whether wild cutthroat from the two river systems stray as frequently as suggested by returns of hatchery-reared cutthroat. Further study is needed to determine if the fish stray above tidewater into the river

proper and actually spawn there, or are merely using the estuary as an extension of the marine feeding area until prompted to return to the home stream. Shapovalov and Taft (1954) discussed the difference between "lost" or true straying and temporary wandering prior to returning to the home stream to spawn. The Oregon tidewater cutthroat fishery occurs during the annual period of minimum river flows and high estuarial salinity. In certain years of below-normal rainfall, attraction water might be so low that straying is encouraged (Helle, 1966).

Fish with the BV mark were from a lot of 11,098 fish released in the Siuslaw drainage in 1963, as determined by their scale characteristics, and represented a return of 0.2 percent. Fish with AdLP, AdLM and AdRP clips could not be assigned to a release group but their scales indicated stocking in 1965. Four of the five fish examined with LV clips were released in 1964 and could have come from groups liberated in the Umpqua or Alsea rivers. One fish with an LV mark appeared to have been released as a fingerling in 1962.

Two of the 3 fish examined with an RV mark were assigned to the 1965 release in the Umpqua River. One was released in 1964 in Munsel Lake and migrated downstream. The single fish with both pectoral fins missing was a hatchery fish liberated in 1964 according to the scale pattern, although there is no record of cutthroat released with a BV mark that year.

The unmarked hatchery fish in the catch were released in 1962, 1963 and 1965. They could not be assigned to a release group but might have been from 24,506 unmarked cutthroat stocked in 1965 in coastal lakes having outlets to the ocean not far from the mouth of the Siuslaw River.

The surprising thing about the 1965 catch was the large number of different release groups represented. Obviously the population is a composite of many hatchery releases since 1962 with a preponderance of wild cutthroat.

If the 1965 catch is representative, fish from several river systems contribute to the Siuslaw tidewater catch. All cutthroat released in the area in 1966 will be marked to identify the release site so that movements of hatchery trout can be documented.

Age composition

Age composition of the catch is valuable in assessing condition of the stock in many fisheries. If the fishery is centered on the older age groups with adequate escapement of immature fish and initial spawners, the population is assumed to be in good condition. Cutthroat are available to the Siuslaw tidewater fishery only as they commence their spawning run after spending several months at sea. Protection of wild juvenile cutthroat is essentially complete in Oregon coastal rivers because the angling season commences in late May after most smolts have migrated to the sea. A minimum size limit of 8 inches on trout ensures protection of smolts which have not migrated by that time. Hatchery cutthroat released in coastal streams are usually yearling fish measuring at least 8 inches fork length (204 mm) so that they can support a river fishery prior to migration. The emphasis on cutthroat management in earlier years was to produce a river trout fishery; any return of sea-run fish was considered incidental. Emphasis is now shifting on some streams to a fishery for the sea-run fish.

Age of cutthroat in the 1965 catch sample is recorded in Table 3. The majority of hatchery cutthroat in the catch were of Age Group I (1/1) approaching the end of the second year of life. Most wild fish were of Age Group III (3/1) in the fourth year. Two wild fish in the catch sample were ascribed to be in their seventh year (Age Group VI). No wild fish under two years of age and no hatchery fish older than Age Group IV were found in the catch sample. Sumner (1962) reported that wild fish of Age Group IV were

predominant in Sand Creek spawning runs, comprising 42.01 percent of his sample. Fish of Age Group III comprised 32.72 percent of the Sand Creek runs from 1946 to 1949.

Table 3

Age composition of cutthroat in the 1965

Siuslaw tidewater catch sample

	Sample size	Percent in age group					
		I	II	III	IV	V	VI
Hatchery fish	73	68.5	8.2	8.2	15.1	0.0	0.0
Wild fish	605	0.0	3.8	70.1	24.5	1.3	0.3

Most wild cutthroat in the Siuslaw catch sample of 605 fish spent three years in freshwater prior to migration. Five percent spent two years, 79 percent spent three and 16 percent spent four in the stream before migrating to the sea. The scale pattern indicated that most hatchery fish migrated to salt water shortly after release. Wild and hatchery fish spent a single summer in the ocean before returning to spawn, although one wild fish in the sample spent two summers at sea before returning. After spawning once, most repeat spawners returned rapidly enough to the ocean to show no fresh-water growth on the scales.

Seventy-six percent of the hatchery fish examined and almost 89 percent of the wild fish were on their initial spawning migration (Table 4). The remainder were spawning for the second, third or fourth time. No hatchery fish and only two wild fish in the sample had completed more than two previous spawnings. Scales of repeat spawners revealed that all had spawned each year after reaching maturity, i.e. there were no alternate-year spawners in the sample. Spawning checks were easily detected on the scales because of pronounced scale resorption which was different from the normal annulus.

Table 4

Frequency in percent of repeat spawning of hatchery and wild cutthroat from the 1965 catch sample of the Siuslaw tidewater fishery

Fish origin	Sample size	Number of spawnings			
		1	2	3	4
Hatchery	73	76.1	8.2	15.7	0.0
Wild	605	88.6	9.6	1.5	0.3

As mentioned earlier, hatchery fish comprised only 10.2 percent of the catch. Although the percentage of hatchery fish was small and the fishery was supported mostly by wild fish, this does not indicate by itself that release of hatchery fish could be discontinued with no deleterious effect on the fishery. With no data on escapement to indicate otherwise, it is possible that the hatchery releases mean the difference between adequate and inadequate spawner escapement. If the present spawning runs of wild and hatchery fish were just sufficient to maintain the wild population at present mean levels, and angler catch remained constant, a reduction in number of hatchery fish could decrease spawner escapement and resulting production below the level needed to maintain the fishery. Information to determine whether escapement is adequate is vitally needed where the fishery is presently supported by natural reproduction and is centered on pre-spawning fish.

Length and growth comparisons

Mean fork length of fish in the catch based on a sample of 672 fish was 341.5 millimeters (13.4 inches) with a range of 189 to 475 millimeters. Mean weight was 469 grams (16.6 ounces). The smallest fish examined (189 mm) had marine copepods attached to the base of its ventral fins but there was no evidence of ocean growth on the scales. Wild fish were slightly larger than

hatchery fish in the sample. Mean length of 58 hatchery fish was 335.3 millimeters with a range from 256 to 453 millimeters. Mean weight was 417 grams. Wild fish from a sample of 614 had a mean length of 342.1 millimeters and mean weight of 474 grams.

Length frequency of the catch fluctuated throughout the season with the general trend being towards larger fish as time advanced (Figure 4). Most fish in the catch were in the 301-350 millimeter length group, but the percentage of fish in the group decreased from 60 percent at the start of the season to 27 percent at the end. In the third period (August 15-31) a decrease in mean length of the catch occurred which was attributed to an increased recruitment of young fish during the period.

The increase in percentage of large fish (over 350 mm) as the season progressed resulted from a higher percentage of repeat spawners caught in the latter part of the season and presumably from the increased growth put on by fish remaining longer at sea. Length of wild initial spawners of Age Group III (3/1) captured prior to September 1 was compared with length of fish of the same group captured after September 1 in order to obtain an indication of growth rate during the summer. As will be shown later, estimation of growth during a period of time by comparing different fish is not completely reliable because of wide individual variation in growth rate. Ricker (1958) discusses the hazards of comparing growth using fish which might have different growth rates.

Mean length of 38 wild fish captured an average of 20 days prior to September 1 was 309.6 millimeters. Mean length of 37 fish captured an average of 11 days after September 1 was 327.3 millimeters. Hence, fish in the second group were captured an average of 31 days later and grew 17.6 millimeters larger than fish in the first group. One could assume from the

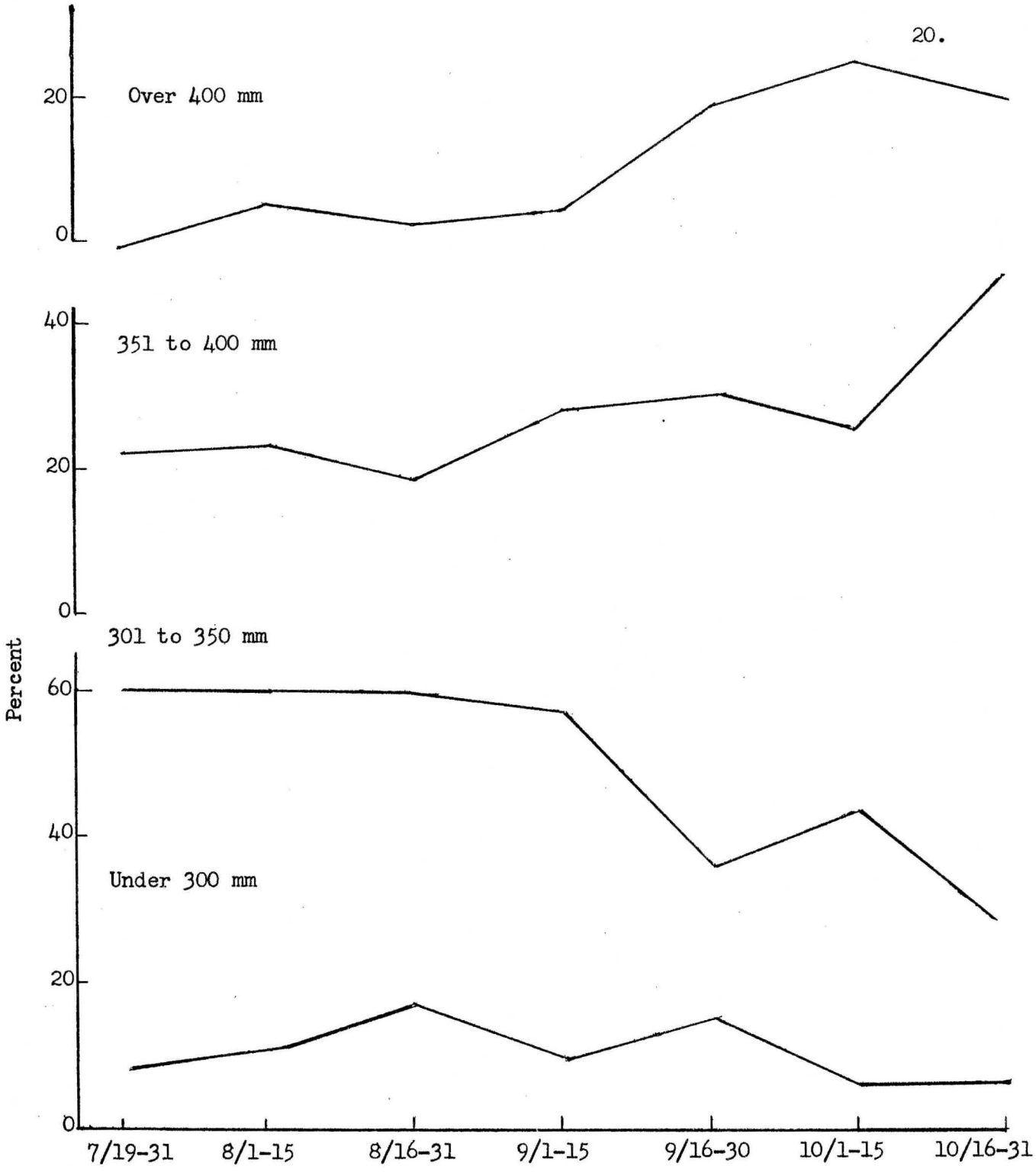

Figure 4. Proportion of the 1965 Siuslaw tidewater catch of fish within four length groups by two-week periods, sample size and mean length shown below.

comparison that mean monthly growth rate approached 18 millimeters during August. Comparison of growth of the above fish since depositing their last annulus, calculated by direct proportion, revealed that the group captured earlier was made up of faster growing fish. The earlier group grew 106 millimeters after their and last annulus was deposited in 31 days less time than it took the second group to grow 119 millimeters. Faster growing fish are usually exploited first in many fisheries because they are recruited to the fishery at a younger age. The difference in mean length of 17.6 millimeters in the first comparison or in mean growth in the last year of life of 13 millimeters does not represent the amount of growth put on by the average fish during a 31-day summer period. These estimates are minimal since growth rates of the two groups were not similar. Limited data on tagged fish suggest that growth rate approached 25 millimeters (1 inch) per month during the summer.

Small sample size and variations in time of release and capture also limit the value of comparisons of growth between wild and hatchery fish. Initial spawners which had spent one summer at sea provided the best comparisons from the 1965 data. Mean length at capture of 101 wild initial spawners was 320.1 millimeters. Back calculation of growth by direct proportion indicates that the fish increased 114 millimeters in mean length after depositing their last annulus. Eleven hatchery fish with adipose clips presumably released March 23-24, 1965 measured 327.5 millimeters in mean length at capture but had grown only 91.0 millimeters since depositing their last (and only) annulus. Mean length at capture of 27 fish with RP clips released on May 19-20, 1965, was 314.7 millimeters. Mean length and weight of the fish at release (n=50) was 228.5 millimeters and 130.2 grams. The 27 RP fish had grown 86.2 millimeters in mean length and 89.9 grams in mean weight.

The data suggest that hatchery fish on their initial spawning run were similar in mean length at capture to wild fish but had grown slightly less than wild fish in the summer of capture. The difference might be due to paucity of data but presumably resulted from wild fish growing at a faster rate during ocean life than their hatchery counterpart. Investigations of growth differences will continue in order to obtain more valid comparisons.

Stream growth

Scales of cutthroat obtained from the tidewater fishery are satisfactory for use in back calculation of growth as minimal scale resorption has occurred by time of capture. Although cutthroat enter tidewater in abundance as early as July on their spawning run, peak movement above tidewater into the spawning areas does not occur until November and December (Sumner, 1962; Lowry, 1965). Unfortunately, the relation of scale-to-body growth of Siuslaw River cutthroat has not been clearly defined since juvenile fish are not available throughout the full size range. Data are being collected to describe the relation for future use. Back calculations of body length, assuming a direct proportional relation of scale to body length, frequently fails to describe adequately actual growth characteristics of individual fish. The scale does not necessarily grow at a constant rate in relation to body growth throughout the life of the fish. Hence, the calculated lengths in Table 5 based on an assumed direct-proportion relation are tentative and need verification when additional data are available. Data from 106 wild fish on their initial spawning run were used in the calculations. Lee's Phenomenon is apparent, with calculated lengths at each year of life smaller for the older fish than for the younger. The reduction is probably a growth characteristic of the population rather than failure of the formula to fit the data; fish reaching smolt size after only two years of stream life

would presumably be the faster growing fish and hence, would be larger at any given age during their stream life than those fish requiring 3 or 4 years to reach smolt size. Calculated lengths agree well with those computed by direct proportion for the Sand Creek cutthroat by Sumner (1962). The Sand Creek fish were smaller at the end of each year of life but one would expect fish to grow slower in a small stream such as Sand Creek in comparison to the Siuslaw River system.

Table 5

Freshwater growth calculated by direct proportion of wild initial spawners captured in the 1965 Siuslaw tidewater fishery in comparison to Sand Creek cutthroat, length in inches in parentheses

Age	Sample size	Calculated length at end of year- 1	2	3	4
2/1	11	83(3.3)	149(5.9)		
3/1	77	78(3.1)	143(5.6)	204(8.0)	
4/1	18	70(2.8)	124(4.9)	188(7.4)	246(9.7)
Total & mean	106	77(3.0)	140(5.5)	201(7.9)	246(9.7)
Sand Creek[1/]					
Calculated lengths:		2.6	4.6	6.5	7.9
Empirical lengths:[2/]		4.2	5.2	6.9	8.3

1/ Sumner, 1962
2/ Downstream migrants

The calculated lengths provide little information on why some fish remain 3 or 4 years in the stream and others migrate to the ocean after 2 years of stream life. Fish remaining 3 years in the stream were only 6 millimeters smaller on the average (143 mm vs 149) at the end of the second year of life than fish spending 2 years in freshwater. Fish remaining 4 years were larger after 3 years in freshwater than fish migrating at 2 years, but the four-year fish spent an additional year before migrating. Size alone is obviously not the only factor involved in determining length of stream life since wide individual variations occur.

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A P P E N D I X

Appendix A

Comparisons of aerial and road counts of boats on Siuslaw estuary at 12 noon on selected days from July to October, 1965

Week days		Weekend days	
Aerial	Road	Aerial	Road
8	6	5	11
35	31	115	100
50	44	107	93
18	18	57	62
17	13	75	69
27	23	43	35
155	135	402	370
14.8%		8.6%	

Appendix B

Calculation of catch estimates for the 1965 Siuslaw tidewater fishery

Steps in obtaining estimates of total catch and effort for the season are listed below:

1. Total daily effort was computed using the standard trapezoidal formula:

$$A_t = h\ 1/2(y_o + y_n) + y_i + y_2 + y_3 + \ldots y_n\text{-}1$$

where

A_t = total daily effort expressed in boat hours,

h = time between counts (2 hours)

y_i = number of boats observed at hour i

2. Total daily effort on a given count day was obtained by expanding the 10:00 o'clock boat count by the mean seasonal ratio (r) of total boat hours (A_t) calculated for the day to the boat hours observed at 10:00 A.M. Values of r for the two strata were as follows:

Weekdays	6.183
Weekends	8.387

The reciprocals of these ratios indicate that on the average day 16 percent of the weekday effort and 12 percent of the weekend day and holiday effort were observed at 10:00 A.M.

3. The proportion of total daily effort accounted for by angler interviews was determined for each index day. Total estimates (T_{yi}) of each variable (y_i) for that day were then obtained by expanding interview data by the proportion.

4. Total seasonal estimates within each stratum were obtained from the formula:

$$T_{y_{strat}} = CN_i\bar{y}_i$$

where C_i = correction factor to account for boats not observed in boat count (C equalled 1.1482 for weekdays and 1.086 for weekends).

N_i = number of days in stratum (74 weekdays and 31 weekend days and holidays).

$\bar{y}_i$ = stratum mean for the variable being considered.

5. Seasonal totals (T_y) were obtained by summing estimates for both strata:

$$T_y = T_{ystrat}$$

6. Sampling variance of the seasonal estimates was obtained by the formula:

$$v(T_y) = C_i \frac{N_i^2}{n_i} \left(\frac{1}{n_{i-1}}\right) \left(y_i^2 - \frac{(y_i)^2}{n_i} \right)$$

where n_i = number of days sampled in stratum

y_i = value of given variable on given day

7. Confidence limits about the estimates were computed in the standard manner:

$$CL = T_y \pm t \frac{v(T_y)}{n_i}$$

Appendix C

Catch statistics for the 1965

Alsea tidewater fishery

The Alsea tidewater fishery was sampled similarly to the described Siuslaw fishery from July 23 to October 15, 1965. The Alsea cutthroat fishery extends from the mouth of Eckman Creek upstream approximately 8 miles to the head of tidewater above the community of Little Switzerland. The fishery was divided into nine geographical sampling units in order to facilitate boat counts and provide even distribution of angler interviews. Boat counts were made by an observer in an automobile traveling along Highway 34 which lies parallel to the estuary, with short trips up the Canal Creek and Little Switzerland roads to cover the entire area. Counts were started 15 minutes before the hour since a single count required 30 minutes to complete. Incomplete and completed anglers were sampled and the catch estimates are based on the assumption that catch per unit of effort for incomplete anglers was similar before and after the interview.

The daily effort curve for the season was based on data collected on seven count days. Index counts were made on 28 days of the 85 days in the sampling period.

Catch and effort estimates with 95 percent confidence limits are as follows:

Total angler trips	Total angler hours	Total boat trips	Total boat hours	Unmarked cutthroat	Marked cutthroat			Total cutthroat
					Ad	RP	LV	
30,935	116,825	13,251	48,290	6,785	686	230	143	7,844
±977	±3,454	±417	±1,434	±328	±43	±35	±37	±334

As mentioned in the text, the fish with adipose clips were released March 23 and 24, 1965 in the Alsea River and represent a return of 9.8 percent.

Fish marked with an RP clip on May 17 and 18 represent a return of 3.3 percent. Fish with the LV mark were from a group of 16,857 fish released May 21 and 22, 1964 and represent 0.8 percent of the release.