STATE OF ALASKA

William A. Egan, Governor

Annual Progress Report for

Inventory and Cataloging of Kenai Peninsula, Cook Inlet, and Prince William Sound Drainages and Fish Stocks.

by

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RESEARCH PROJECT SEGMENT

State: Alaska

Project No.: F-9-5 Name: Sport Fish Investigations of Alaska

Study No.: G-I Study Title: Inventory and Cataloging

Job No.: G-I-C Job Title: Inventory and Cataloging of Kenai Peninsula, Cook Inlet, and Prince William Sound Drainages and Fish Stocks.

Period Covered: July 1, 1972 through June 30, 1973.

ABSTRACT

Various aspects of the Arctic grayling's, Thymallus arcticus, life history were studied at Crescent Lake. Data regarding population characteristics, seasonal distribution and spawning are presented. The adult population was estimated to be 1,547 at conclusion of spawning. Age IV fish were dominant in the spawning population. Juveniles exhibited a preference for lotic habitat, whereas adults preferred the lentic environment. Harvest, fishing effort and angler distribution are discussed.

A partial creel census was conducted at Kachemak Bay from July 3 through August 7 to determine the species composition of the catch, and fishing distribution. A total of 1,211 anglers with 1,125 fish were interviewed. Pacific halibut, Hippoglossus stenolepis, accounted for 43.6% of the boat catch. Flounders, Pleuronectidae, constituted 64.0% of the shore harvest. Catch rates for boat and shore fisheries were 0.15 and 0.62 fish per hour, respectively.

Surveys performed on two lakes are discussed.

Salmonoid plants were evaluated in 14 managed lakes. Growth and relative survival rates, as defined by net sampling, are compared for coho salmon, Oncorhynchus kisutch, and rainbow trout, Salmo gairdneri.

RECOMMENDATIONS

1. Close the Crescent Lake drainage to fishing from April 15 through June 30 and reduce the daily bag and possession limits to two grayling.

2. Continue surveillance of Crescent Lake grayling to determine catch, effort and population trends.

3. Determine population characteristics of Bench Lake grayling prior to completion of a U. S. Forest Service trail.

4. Initiate lake surveys on the west side of Cook Inlet, with emphasis on the West Forelands Area.

OBJECTIVES

1. To determine the environmental characteristics of the existing or potential recreational fishery waters of the job area and to obtain estimates of existing and/or potential angler use and sport fish harvest.

2. To evaluate application of fishery restoration measures and availability of sport fish egg sources.

3. To assist as required in the investigation of public access status to the area's fishing waters and to make specific recommendations for segregati of public fishing access sites.

4. To evaluate multiple water-use development projects (public and private) and their effects on the area's streams and lakes for the proper protection of sport fish resources.

5. To investigate, evaluate, and develop plans for the enhancement of anadromous and resident fish stocks.

6. To provide recommendations for the management of sport fish resources in these waters and direct the course of future studies.

TECHNIQUES USED

Monofilament and multifilament gillnets (125 X 6-foot) having five mesh sizes ranging from 1/2 to 2-inch bar measure were used to collect fish specimens. Nets were set for approximately 24 hours in each lake. A 50-foot seine with 1/4-inch bar measure mesh was employed to capture grayling from Crescent Cree

A floy tag applicator utilizing yellow FD-67 internal anchor tags was used to tag grayling. All fish were anesthetized with MS-222 prior to being tagged. Numbered tags were inserted in the left-side musculature immediately below the

dorsal fin. The T-bar of the tag was positioned beyond the interneural bones of the dorsal fin. The adipose fin was excised from each tagged grayling to evaluate tag loss.

Harvest of adult grayling was determined by census taker billeted at Crescent Creek throughout most of the spawning period. Random angler counts and interviews with 154 completed fishermen provided catch and effort estimates. Sport-caught grayling were examined, whenever possible, for sex, fork length, tags and fin clips.

Adult harvest, after June 25, was determined by expansion of voluntary tag returns. The tagged-to-untagged ratio was established by gillnet sampling in Crescent Lake.

Ages were determined by examining scales with a microprojector and/or a binocular scope. Lengths were recorded to the nearest millimeter and weights to the nearest 0.01 pound. All lengths are expressed as fork measurement unless otherwise stated.

The Kachemak Bay creel census was active two weekdays per week. Sampling varied randomly throughout the week and extended from 1:00 to 8:00 p.m. daily. Shore fishermen were enumerated twice each day; once between 1:00 and 3:00 p.m. and again between 5:00 and 8:00 p.m. on a random hourly basis. Statistics obtained from completed anglers included numbers of fish or shellfish by species, number of hours fished, number of anglers in party and fishing location.

Standard techniques[1] were employed during lake surveys. A P-100 Ross depth finder was used to record depths.

FINDINGS

Crescent Lake Studies

Arctic grayling, Thymallus arcticus, were introduced into Crescent Lake in 1952; a self-sustaining population developed rapidly from the original plant of 240 sub-adults. Fly-in fishermen quickly realized that the lake supported an abundant grayling population that achieved exceptional size. Adult grayling were lightly exploited, however, because they resided in the relatively inaccessible lentic environment throughout most of the year. Hazardous spring ice normally precluded aircraft access while the adults were in Crescent Creek spawning areas. Juveniles formerly comprised the bulk of the Crescent Lake harvest because they were readily available in the outlet area throughout the ice-free period of the year.

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1. Lake and Stream Survey Manual. Alaska Department of Fish and Game, Division of Sport Fish, Typewritten, 36 pp., 1970.

Fishing pressure and reproductive potential of the stock existed in harmony until a foot trail was constructed to the lake outlet in 1970. The U.S. Forest Service trail substantially increased utilization of the summer fishery, and more importantly, permitted exploitation of spawning fish. The increased popularity of the fishery, with accompanying apprehension that its stability might be jeopardized, provided the catalyst for this investigation.

Crescent Lake is located at an altitude of 1,454 feet in a curved mountainous valley. The six-mile-long lake covers approximately 1,400 acres, and occupies two basins that are connected by an island-studded constriction. Maximum depths in the northwest basin, constriction, and northeast basin are approximatel 123, 20 and 300 feet, respectively (Plafker, 1955). The normally clear water receives silt-laden snow runoff into the northeastern basin during July and August. Secchi disc readings during August of 14 feet in the eastern basin and 24 feet in the northwestern basin illustrate the influence of the turbid runoff. Summer surface temperatures of the northeastern basin average $4^{o}F$ colder than those of the northwest basin. A maximum surface temperature of $62^{o}F$ was recorded from the western basin in mid-August.

The Crescent Lake watershed comprises approximately 22 square miles. The Lake drains to the west by Crescent Creek and Quartz Creek into Kenai Lake, a difference in altitude of about 1,000 feet. Crescent Creek discharge patterns, at the lake outlet, are characterized by the following mean flow rates: May 82 cfs; June 143 cfs; July 88 cfs; August 68 cfs; and September 70 cfs (U. S. Geological Survey, 1960, 1960a, 1961, 1962). The water of Crescent Creek has an average pH of 7.2 (6.9-7.6), bicarbonate ($-HCO_3$) of 43 ppm (27-49 ppm), dissolved solids of 55 ppm (50-65 ppm) and a $CaCO_3$ hardness of 47 ppm (42-54 ppm).

Grayling and coast-range sculpin, Cottus aleuticus, are the only fishes residing in Crescent Lake.

Harvest and Effort

A creel census, extending from May 26 through June 9, 1972, sampled nearly the entire fishing effort and catch of spawning grayling. An estimated 210 anglers harvested 209 spawning and 20 juvenile grayling from the outlet area prior to an emergency fishing closure on June 10. After fishing resumed on June 26, 34 additional adults were estimated to have been harvested from the lake.

An average catch of one adult grayling per fisherman in 1972 was considerably less than a 1971 catch rate of 1.55 fish per angler. The 1971 census, which was only active 6 days and included few completed fishermen trips, revealed 119 anglers had harvested 174 grayling. Daily fishermen counts in 1971 and

1972 averaged 20 and 14 anglers, respectively. A maximum count of 53 anglers in 1971 was also higher than a peak count of 34 fishermen in 1972.

The length of the observed adult catch in 1972 ranged from 300 to 474 mm with a mean length of 373.3 mm. The adult male to female ratio was 1.6:1. Juveniles averaged 278 mm.

Fishing effort was greatest along a 200-yard portion of Crescent Creek immediately below the lake. No fishing effort was observed further than 400 yards downstream from the lake. Excellent adult catches were also recorded by shore anglers fishing the lake near the outlet. Artificial lures, including spoons, spinners and flies, were used by the majority of the anglers. Snagging was a common angling practice in Crescent Creek.

A partial census provided information on the status of the 1972 summer fishery which extended from June 26 until closed by emergency order on August 1. Five visits at weekly intervals during this period (all weekdays) revealed that 28 incomplete anglers harvested 30 juvenile and 3 adult grayling. These catch and effort observations were alarmingly low for a fishery that had formerly enjoyed a quality reputation. Sporadic monitoring of the summer fishery between 1962 and 1970 consistently revealed catch rates approaching the 10-fish-daily bag limit.

Population Estimate

In 1972, 747 spawning grayling were tagged, finclipped and released in Crescent Creek between March 31 and June 13. Tagging was initiated shortly after spawning began, and continued until only a few spawners remained in the creek. All fish were captured by seine within 200 yards of the lake.

The spawning population was subsequently sampled by gillnet after the fish returned to the lake. Nets were fished overnight at various locations on four occasions between June 14 and August 23. A total of 368.5 gillnet hours at 16 littoral sampling stations yielded 0.44 adults per net hour. Of the 162 adults captured, 72 had been tagged during the spawning period. No evidence of tag loss was noted. The pattern of recapture suggested that tagged fish were uniformly distributed among the untagged. The length distribution and average size of the net sample compared favorably with data from Crescent Creek spawning grounds. A preponderance of females in the net catches, however, differed sharply from the sex composition of the creek sample (Table 1).

The adult population in Crescent Lake after June 13 was estimated by Bailey's modification of Petersen's direct proportion method (Ricker, 1958). The estimate presupposes that 54 tagged fish were removed by anglers during the tagging operation. The population estimate was calculated as $\hat{N} = M(C+1)/R+1$, where

M is the number of fish tagged, C the total catch at recapture, R the number of tagged fish recaptured, and $\hat{N}$ the population estimate. A symmetrical confidence interval about $\hat{N}$ was calculated by setting 95% CI as: R-1.75 (R) and R+2.33 (R

The adult population was estimated to be 1,547 (1,298 - 1,822) at the conclusion of spawning. Net mortality (162), and the sport catch (34) after June 13, further reduced the population to 1,351 (range 1,102 - 1,626). Conversely, the adult population was 1,756 (range 1,507 - 2,031), at the onset of spawning.

Table 1 Length Summary by Sex of Grayling Collected from Crescent Creek and Crescent Lake, 1972.

Location	No. of Fish		Length Range (mm)		Mean Length (mm)	
Creek	371	374	290-489	302-492	366	391
Lake	38	83	304-469	316-465	367	392

Spawning

Adult grayling began to congregate at the outlet of Crescent Lake about March 26, 1972. Arrival of spawning fish was characterized by erratic wandering between the lake and Crescent Creek. Spawning actually began a few days after the fish entered the outlet.

Nearly all spawning was confined to the first 200 yards of Crescent Creek where the stream averaged 45 feet (20-60 feet) in width. Mid-stream depths in the spawning area ranged from 1/2 to 2-1/2 feet. A few fish also utilized a spawning site located about 370 yards downstream from the lake. Water temperatures during spawning ranged from 38°-42°F.

Survey of three major tributaries of Crescent Lake failed to reveal spawning fish or rearing fry. Tributary water temperatures were consistently colder (4°-10°F) than outlet temperatures throughout the summer.

Spawning terminated in the outlet about June 10, concomitant with the break-up of Crescent Lake ice. The exact duration of spawning was difficult to assess because a few adults remained in the stream several days after completion of spawning. Less than 40 adults were present after June 14.

Observations in 1971 revealed numerous spawners in Crescent Creek between June 10 and June 20. The beginning and conclusion of spawning, however, was not determined.

The 1972 spawning population was examined for sex, size and age compositions. A sample of 747 adults, collected between March 31 and June 13, consisted of equal numbers of males and females. Random sub-sampling of tagged fish revealed that males remained longer on the spawning beds than females. This tendency resulted in a predominance of males on the spawning ground during most of the spawning period. A 2.4:1 ratio of males to females was observed during peak spawning activities. Females, however, out-numbered males during the latter stage of spawning (Table 2).

Table 2 Male-Female Ratio of Spawning Crescent Lake Grayling, 1972.

Date	Fish Marked		Ratio	Fish Recaptured		Ratio	Total Fish Captured		Ratio
5/31	127	121	1.0:1				127	121	1.0:1
6/ 1	56	43	1.3:1	65	36	1.8:1	121	79	1.5:1
6/ 2	35	29	1.2:1	49	20	2.5:1	84	49	1.7:1
6/ 6	62	53	1.2:1	99	13	7.6:1	161	66	2.4:1
6/ 7	52	52	1.0:1	99	21	4.7:1	151	73	2.1:1
6/ 8	33	51	0.6:1	86	28	3.1:1	119	79	1.5:1
6/12	1	7	0.1:1	13	5	2.6:1	14	12	1.2:1
6/13	7	15	0.5:1	12	7	1.7:1	19	22	0.9:1
6/14				5	9	0.6:1	5	9	0.6:1

A sample of 108 adults collected between June 10 and June 20, 1971 suggested a male-to-female ratio of 0.5:1. These data may not reflect the population's true sex composition because the fish were probably collected late in the spawning period.

Fifty-six gillnet-caught adults, all tagged, were examined internally to verify external sex determinations of the spawning ground. Two of these fish (3.6%) had been incorrectly sexed.

Length distributions of the 1971 and 1972 spawning populations were remarkably similar. During both years adult males had smaller mean lengths than females, and were better represented among the small length classes than among fish of larger size. A striking feature of the size distribution as shown in Figure 1, is the preponderance of females over 400 mm in length. Mean lengths of males in 1971 and 1972 were 391 and 366 mm, respectively. Females averaged 403 mm in 1971 and 391 mm in 1972.

Fork and total length relationships were recorded from 282 grayling ranging from 247 to 480 mm fork length. A factor of 1.075 converts all length classes within this interval to total length.

Age analysis of the 1972 sport harvest indicated that grayling less than 290 mm were immature and fish longer than 340 mm were mature. Some males spawn at age III whereas most females mature at age IV. Grayling of age group IV were most abundant on the spawning ground. All fish age IV or older were sexually mature. Net sampling in Crescent Lake suggests that adult grayling spawn every year.

Age and Growth

The age-length distribution of Crescent Lake grayling was based on adults (age III-V) from the 1971 and 1972 spawning populations, and on sub-adults (age I-II) collected from Crescent Creek between July 31 and August 5, 1965-1968 (Table 3). These data, although not directly comparable because of differing sampling dates, are useful for describing the population's general growth pattern. Fish older than age V were omitted because of uncertainty in aging techniques.

Mean lengths of the five age groups indicated that the greatest growth occurred during the first year. The mean lengths of age groups I through V were 173.7, 253.9, 323.5, 366.5 and 416.5 mm, respectively. Yearly growth increments during the first, second, third, fourth and fifth years were 173.7, 80.2, 69.6, 43.0 and 50.0 mm, respectively.

Comparison of age data by sex revealed that male growth was slightly superior to female through age IV. Mean lengths of males and females older than age IV were nearly similar (Table 4). These data suggest that the low representation of males in the larger length classes (Figure 1) resulted from differential mortality rather than differing growth rates. Selective harvest during the spawning period may contribute to the scarcity of males in the older age groups. A large portion of the spring catch occurs in Crescent Creek, where males predominated on the spawning grounds.

Age and growth have been determined for Alaskan grayling from such areas as the Tangle Lakes (Roguski and Winslow, 1969), the Chena River and Mineral

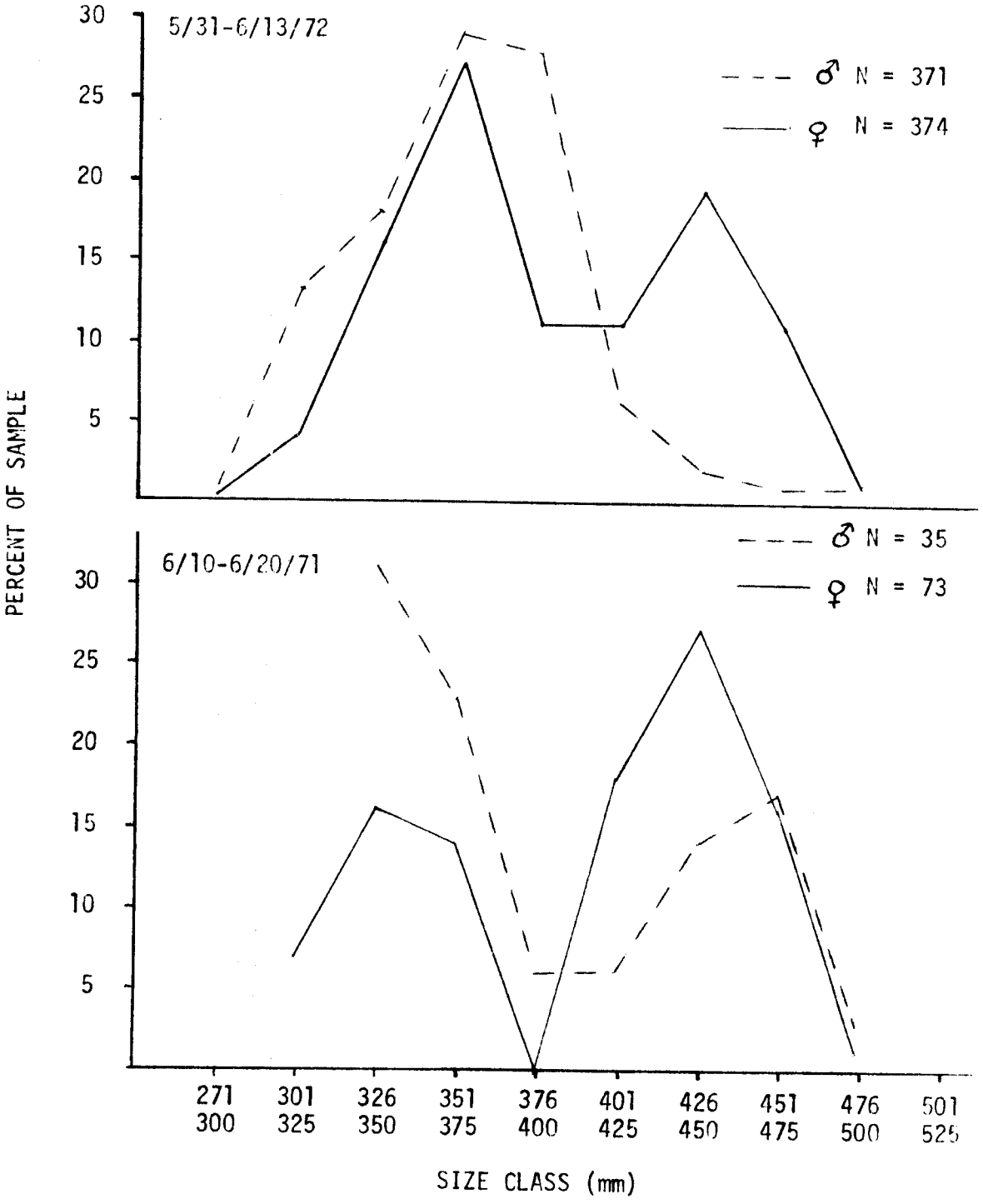

FIGURE 1. Length Distributions of Adult Crescent Lake Crayling, 1971 and 1972.

TABLE 3 Age-Length Composition of Crescent Lake Grayling, 1965-1972.

Length Group (mm)	Age Class					
	I*	II*	III**	IV**	V**	Total
126-150	9					9
151-175	37					37
176-200	45					45
201-225	2	8				10
226-250		22				22
251-275		30				30
276-300		9	10	1		20
301-325		1	19			20
326-350			21	15		36
351-375			3	43	1	47
376-400				23	1	24
401-425				2	14	16
426-450					6	6
Total	93	70	53	84	22	322
Mean Length	173.7	253.9	323.5	366.5	416.5	

* Samples taken July 31 to August 5, 1965-68.
** Samples taken June, 1971-72.

TABLE 4 Comparison of Age-Length Data by Sex for Crescent Lake Grayling, 1965 - 1972.

	I		II		III		IV		V or older	
Mean Length (mm)	189.8	174.2	258.5	253.3	329.6	320.3	374.5	361.5	439.0	444.1
No. of Fish	7	6	30	28	26	23	40	42	22	73

TABLE 5 Age-Length Comparison for Grayling from Various Alaskan Waters.

	Crescent Lake		Ugashik Lake Outlet		Wood River Lake System		Tangle Lakes		Chena River		Mineral Lake	
Age	Mean Length	Sample Size	Mean Length	Sample Size	Mean Length	Sample Size	Mean Length	Sample Size	Mean Length	Sample Size	Mean Length	Sample Size
I	174	93	--	--	--	--	127	3	90	11	--	--
II	254	70	--	--	--	--	200	41	152	53	162	2
III	324	53	313	3	290	7	256	37	202	11	192	11
IV	367	84	363	25	332	7	305	26	231	88	226	32
V	417	22	408	30	386	32	347	10	264	16	269	11

lakes (Tack, 1971), numerous interior Alaskan waters (Reed, 1964), and Ugashik Lake and the Wood River System (Siedelman, 1971). Growth of Crescent Lake grayling is substantially greater than interior Alaska stocks, and nearly identical to the trophy grayling of Ugashik Lake (Table 5).

Examination of 121 spawning fish in 1971 revealed that 46.1% exceeded 457 mm (18 inches) and 4.3% were longer than 508 mm (20 inches) total length. Of the 747 adults sampled during the 1972 spawning period, 18.5% and 1.6% exceeded 457 and 508 mm, total length, respectively. The preponderance of large fish in 1971 may have been caused, in part, by sampling error. As previously noted, the sample consisted largely of females collected late in the spawning period.

Distribution

Adult grayling occupy Crescent Creek during the spawning period which normally extends from late May until late June. Adults, after completion of spawning, return to the lake where they reside throughout the remainder of the year. Many spawners linger near the outlet for several days before dispersing into the lake. Gillnet sampling indicated a summer distribution characterized by an abundance of fish in the constriction and northwest basin, and relatively few fish in the northeast basin.

Juvenile grayling move into Crescent Creek with spawning adults but for the most part remain segregated from adult fish. During the 1972 spawning period, most juveniles occupied that portion of the stream which overlapped the lower end of the spawning beds, and extended downstream to the confluence of an intermittent glacial tributary (370 yards from the lake). Examination of juvenile stomachs revealed that grayling ova comprised the bulk of their diet during the spawning period.

As summer progressed, a few juveniles selected habitats within the spawning area but none were observed downstream from the glacial tributary. The general morphology of Crescent Creek below the glacier tributary appeared suited to grayling; however, increased turbidity and lower water temperatures may influence utilization of the area.

Temperatures of the glacial tributary ranged from 42°-46°F between July 11 and August 23, and then gradually dropped to 37°F on September 27, 1972. Silt-laden water, 12°-14°F colder than the receiving water, lowered the temperature of Crescent Creek 1°-6°F during the summer. The tributary cleared during late September and stopped flowing in winter.

Crescent Creek juveniles were enumerated periodically throughout the summer by visual observation. Although surveys were subject to normal visual error they suggested that fewer than 400 fish were present during late June. As

the summer continued subsequent enumeration indicated declining numbers of grayling. On September 27, the stream's population had dwindled to about 50 fish.

Juvenile abundance in 1972 was markedly lower than in previous years. In 1963, Lawler (1964) reported that about 400 juveniles were easily captured by barbless hooks during a 5-day transplant program. Engel (1969) readily seined 1,216 juveniles from a single location during 3 days in 1968. Sporadic surveillance of the summer fishery in 1969 and 1970 revealed an abundance of grayling in Crescent Creek.

Although juveniles were to have been examined for age and growth in 1972, no fish were sampled because of their scarcity. Prior collections have repeatedly shown that summer populations are composed primarily of age groups I and II (Table 6).

Gillnet sampling to develop the adult population estimate revealed minor summer utilization of Crescent Lake by juveniles. Sampling which caught 162 adults from an estimated population of 1,547 produced only 12 juveniles. All juveniles were captured in the northwest basin on August 23.

Grayling fry were present in Crescent Creek from mid-June until fall. Fry were also observed along the shore of the northwest basin.

Management Implications

It is apparent from this study and prior observations that Crescent Lake supports two distinct grayling fisheries - one occurring during the spring on spawners of notable size, and the other during the summer and fall on juveniles. Both fisheries exploit a respective segment of the population at the lake outlet.

Before a management plan can be formulated for either fishery, a defined goal or goals must be established. Such a plan might endeavor to maintain a population level which would produce the highest sustainable yield, or it might be aimed at maximum harvest of large fish. The exceptional growth characteristics of the stock would readily accommodate a quality (trophy) fishing program.

Population estimates indicate that there is sufficient brood stock to perpetuate a self-sustaining population. Whether this spawning level is higher or lower than prior years cannot be determined from the facts at hand. Recent studies suggest that adults may be vulnerable to overharvest because they utilize a single very confined spawning area that is readily accessible to anglers.

Exploitation of spawners, if restricted to Crescent Creek, would be expected to result in a higher male catch because of their greater longevity on the spawning beds. The yield of mature females would presumably increase, however, if pre-spawning fish were harvested from the lake.

TABLE 6 Age Composition of Crescent Creek Grayling During July and Augus 1962-1968.

	Age Class				
Year	I Percent	II Percent	III Percent	IV Percent	Sample Size
1962	55.5	43.7	0.8	----	119
1965	12.3	59.2	26.5	2.0	49
1966	2.1	72.4	23.4	2.1	47
1967	82.0	10.3	5.1	2.6	39
1968	98.2	1.8	----	----	55
1962-68 Average	51.5	38.8	8.7	1.0	309

TABLE 7 Species Composition of the Kachemak Bay Sport Harvest, 1972.

Shore Fishery			Boat Fishery				
Species	No. of Fish	%	Species	No. of Fish	%	Species	No. of Fish
Flounder	392	64.0	Halibut	223	43.6	Ronquil	11
Dolly V.	102	16.6	Pink S.	84	16.4	Greenling	11
Pink S.	47	7.7	Dolly V.	47	9.2	Tom Cod	7
Pricklebacks	42	6.9	Sculpin	43	8.4	Coho S.	5
Sculpin	15	2.4	Rockfish	40	7.8	Chinook S.	2
Coho Salmon	15	2.4	Flounder	38	7.4	Chum S.	1
Total	613				Total 512		

After returning to the lake, many post-spawners linger near the outlet for several weeks before dispersing. Although these fish are available to shore fishermen, effort and harvest have been negligible to date.

The study provided substantial evidence that adult grayling remain ecologically segregated from juveniles throughout most of the ice-free period of the year. Transition from lotic to lentic environments occurs at about age III.

Juvenile preference for a specific stream niche deserves special management consideration because of possible overharvest. The 1972 investigation revealed that nearly all juveniles reside in the initial 370 yards of Crescent Creek during most of the summer. These data further indicated that the juvenile population was greatly diminished, probably as a result of excessive fishing. If recovery is to occur, fishing pressure will have to be reduced. Furthermore, after recovery, existing regulations must be modified if the population is to remain at a healthy level.

Kachemak Bay Creel Census

Kachemak Bay is a large, clear body of water located on the east side of Cook Inlet near the southern tip of the Kenai Peninsula. The northern shore of the bay is generally uniform with a gradually sloping beachline, while the southern shore is irregular, often steep, with numerous indentations. The town of Homer is situated on the north shore of Kachemak Bay near the base of a 4-1/2 mile long spit. A small boat basin, located at the outer end of the spit, provided all-weather moorage facilities. Recreational use of the bay has increased substantially since 1967, due to improved highway connections with Anchorage and neighboring communities.

A partial creel census was conducted from July 3 through August 7 to obtain basic data on various aspects of the growing sport fishery. The census was designed to determine fishing patterns, catch distributions, species composition and catch rates. A total of 1,211 anglers with 1,125 fish were interviewed. Boat fishermen accounted for 74.6% of the contracts while anglers fishing from piers of shore areas of the spit comprised the remainder. Shore anglers averaged 3.2 hours per trip whereas boat fishermen averaged 3.7 hours. The average boat contained 4.2 anglers. The mean rate of success for shore and boat fishermen was 0.62 and 0.15 fish per hour, respectively.

Eighteen counts during the census enumerated 627 shore fishermen. Counts 1:00-3:00 P.M. averaged 33.9 anglers, whereas those 5:00-8:00 P.M. averaged 36.6 fishermen. Minimum and maximum counts were 12 and 72 anglers, respectively.

Catch compositions of the two fisheries differed markedly. Flounders, primarily yellowfin sole, Limanda aspera, and starry flounders, Platichthys stellatus,

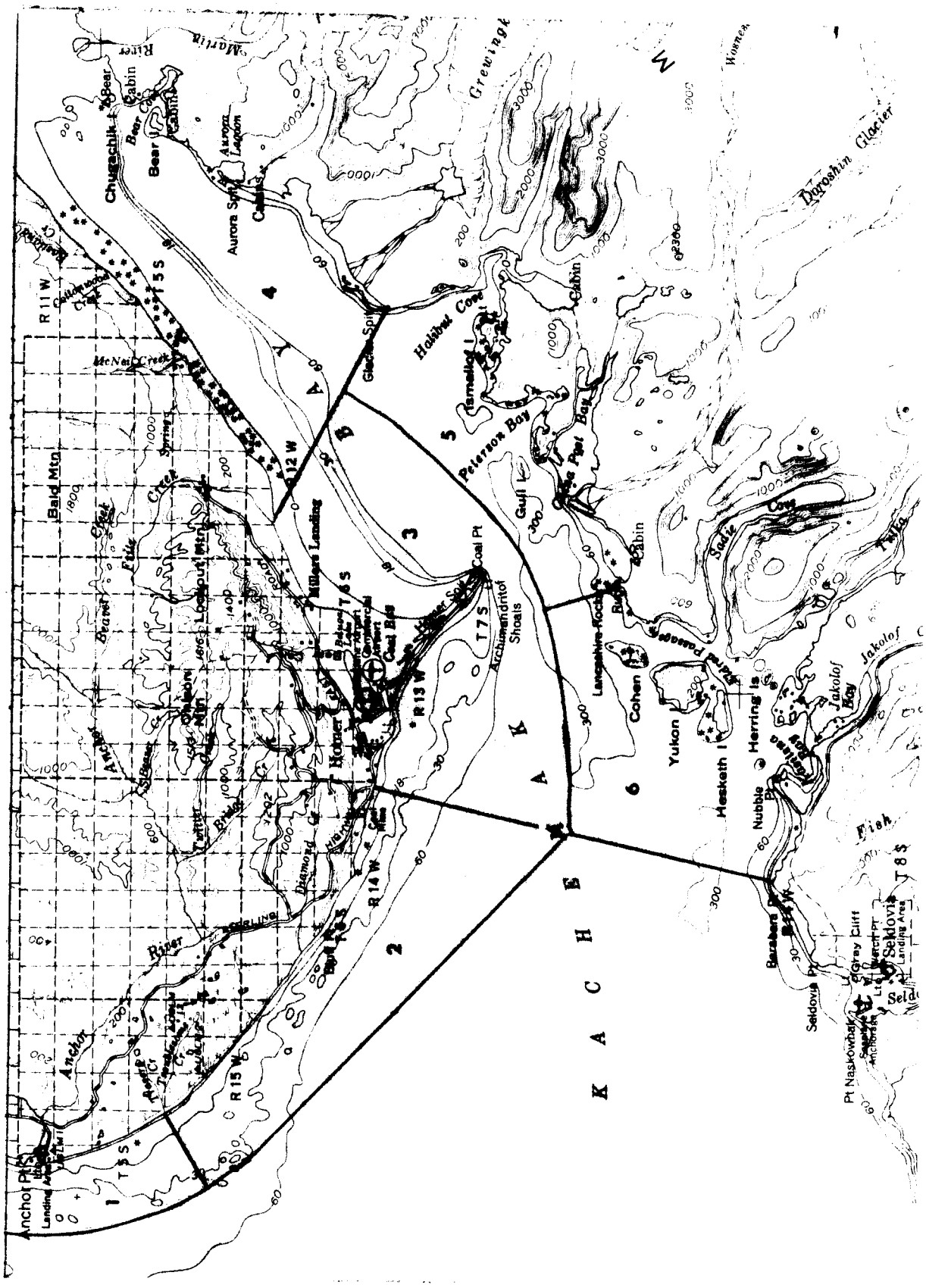

Figure 2 Kachemak Bay Fishing Zones.

and Dolly Varden, Salvelinus malma, comprised 80.6% of the shore harvest whereas Pacific halibut, Hippoglossus stenolepis, and pink salmon, Oncorhynchus gorbuscha, accounted for 60% of the boat catch. Table 7 shows the species composition of the harvests.

Considerable interest in shellfish was evident during the census. A total of 107 fishermen with 79 nets or traps were observed fishing from the Homer pier. The recorded harvest was 139 dungeness crabs, Cancer magister, and 694 shrimp, Pandalus spp, and Pandalopsis dispar, during 294 trap-hours. Boat fishermen caught 82 King, Paralithodes camtschatica, 62 tanner, Chionecetes bairdi, and 8 dungeness crabs. Shrimp, although evident in the catch, were not enumerated during boat interviews.

Division of Kachemak Bay into six zones (Figure 2) revealed noteworthy differences in distribution of catch and fishing effort. Fish availability and weather appeared to be major factors influencing fishing patterns. Eighty-one percent of the effort was recorded in Zones 2 and 6 (Table 8). During early July the bulk of the effort occurred in Zone 2 where pacific halibut dominated the catch. Inspection of charter boat log books also revealed that the area received substantial effort in June. Zone 2 was the only area where rockfish, Sebastodes, were harvested. Fishing effort increased in Zone 6 concomitant with the arrival of pink salmon in mid-July. The majority of pink salmon were harvested from Tutka Bay Lagoon. Zone 6 was also frequented by many boats during inclement weather because the area affords protection from the wind. Catch rates were nearly similar in all zones receiving fishing effort.

Lake Survey

Basic surveys were performed on Big Troika and Narrow Troika lakes, located in the Chugach National Forest near Seward (T2N, R1E, Sec. 19-30). Both waters are situated at an elevation of 887 feet, and are accessible by a 2-1/2 mile trail from Mile 12.5 on the Seward Highway. The two lakes are connected by an intermittent subterranean stream that drains Big Troika Lake. No additional inlets or outlets are present.

Big Troika Lake has an estimated 17 surface acres and a maximum observed depth of 25 feet. Narrow Troika Lake covers 5 acres and has a maximum depth of 14 feet. Gillnet sampling and visual observation indicate both lakes are barren of fish.

Lake Stocking Evaluations

Hatchery-reared salmonoids are being used in increasing numbers to supplement native game fish populations on the Kenai Peninsula. Fall gillnet sampling has been employed to evaluate these introductions. Sampling continued in 1972 in a further attempt to determine proper initial and supplementary stocking rates, including size and species of fish.

Table 8 Distribution of Catch, Effort* and C.P.U.E. by Areas for Kachemak Bay Boat Fishery, 1972

Zone 1		Zone 2		Zone 3		Zone 4		Zone 5		Zone 6	
Species	No. Fish	Species	No. Fish	Species	No. Fish	Species	No. Fish	Species	No. Fish	Species	No. Fish
No Fish		Halibut	122	Halibut	43	No Fish		D. Varden	23	Pink S.	89
		Rockfish	36	D. Varden	5			Halibut	4	Halibut	51
		Flounder	13	Flounder	3			Flounder	4	Sculpin	22
		Sculpin	12	Coho S.	3			Pink S.	2	Flounder	16
		Greenling	8	Sculpin	3			Chinook	1	Ronquil	6
		Tom Cod	6	Pink S.	2					Chinook	1
		Ronquil	5							Chum	1
Number Boats	4		76		28	No Effort			27		71
Number Anglers	7		350		86				90		357
Angler Hours	23		1345		374				208		1304
Fish Per Hour	-		0.13		0.16				0.16		0.14
Percent Effort **	0.7		41.3		11.5				6.4		40.1

* Anglers fishing more than one zone were not included in summary.

** Based on man-hours.

TABLE 9 Coho Salmon Stocking Rates in Kenai Peninsula Lakes.

Lake	Date Stocked	Origin	Fish/ (lb.)	Fish/ Acre	Total Stocked
Upper Jean	9/9/69	Seward	144	250	11,500
Scout	9/9/69	Seward	144	300	28,500
	8/3/72	Seward	445	250	23,800
Centennial	9/9/69	Seward	144	220	7,900
	6/28/71	Seward	391	217	7,800
	8/3/72	Seward Kodiak	317	200	7,200
Sunken I.	6/28/71	Seward	391	200	28,000
Rock	6/28/71	Seward	391	450	4,000

Coho Salmon

Growth and relative survival rates were evaluated in five lakes stocked with coho salmon, O. kisutch. Centennial, Upper Jean and Scout lakes were planted during the fall of 1969. In addition, Centennial Lake received supplementary plants in 1971 and 1972, and Scout Lake a second plant in 1972. Sunken Island and Rock lakes were stocked during June, 1971. Stocking rates, size of planted fish and dates of introduction are presented in Table 9. Threespine sticklebacks, Gasterosteus aculeatus, are present in all waters except Rock Lake. Scout Lake contains a few rainbow trout, Salmo gairdneri, and Upper Jean and Sunken Island lakes, small sockeye salmon, O. nerka, populations.

Comparison of the various plants reveals considerable variation in size and relative abundance (Table 10). Stocking densities between 200 and 300 fish per surface acre produced mean sizes ranging from 167-230 mm at age I+, 197-257 mm at age II+ and 268-283 mm at age III+. Excellent catches from Sunken Island Lake suggest that early summer plants may have better survival than fall plants. Failure of the Rock Lake plant is attributed to insufficient dissolved oxygen Winter oxygen levels ranging from 3.8 ppm to less than 1 ppm have been recorded from Rock Lake.

The percentage of sexually mature salmon in the various net catches are presented in Table 11. Among age group III+, 20.7 to 42.1% of the fish were mature. Faster growing individuals, primarily males, showed a trend toward earlier maturity.

Insects and sticklebacks were the principal food groups and consumed during the fall by age I and older salmon. Leeches (hirudinea), snails (gastropoda), clams (pelecypoda), cladocera and amphipods were also encountered in some fish.

Rainbow Trout

Rainbow trout growth and survival rates were evaluated by examination of gillnet-caught fish from nine lakes. Four lakes, including Sport, Arc, Cabin and Fetus lakes, support only rainbow trout whereas the others contain mixed species. Sticklebacks are present in all mixed species waters except Jerome Lake. Stocking histories and results of the sampling are shown in Table 12.

Sampling in 1972 provided the first opportunity to evaluate spring-planted rainbow trout of Ennis, Montana, origin. Mid-summer or fall stocking has been the normal practice on the Kenai Peninsula. Relative abundance, as defined by gillnet sampling, indicated that survival of spring plants (0.2 and 0.17 fish/hour) in Arc and Sport lakes was lower than previously recorded for fall plants (0.29 to 0.55 fish/hour). However, the trout averaged more than 25 mm longer than previous fall plants of the same age.

Table 10 Length, Weights and Catch Per Gillnet Hour of Coho Salmon in Five Kenai Peninsula Lakes.

Lake	Date Stocked	Year Sampled*	No Fish	Age	Length (mm) Range	Mean	Weight (lbs.)	Catch/ Hour
Upper Jean	9/9/69	1970	43	I+	150-262	179.3	0.17	0.56
		1971	46	II+	170-460	256.9	0.54	1.00
			19	III+	204-466	283.3	0.75	0.44
Scout	9/9/69	1970	103	I+	142-234	167.5	0.12	1.78
		1971	112	II+	162-288	217.0	0.28	1.39
		1972	42	III+	237-366	279.3	0.64	0.62
Centennial	8/3/72	1972	169	0+	97-115	104.8	0.03	2.50
	9/9/69	1970	75	I+	143-294	230.4	0.39	1.27
		1971	85	II+	163-274	197.1	0.19	1.23
		1972	29	III+	243-320	267.8	0.49	0.66
	6/28/71	1971	44	0+	103-123	113.2	0.04	0.63
		1972	33	I+	125-251	226.4	0.31	0.75
Sunken I.	8/3/72	1972	34	0+	96-125	103.6	0.03	0.77
	6/28/71	1971	73	0+	100-150	114.0	0.05	1.22
		1972	223	I+	120-250	196.5	0.19	2.95
Rock	6/28/71	1971	19	0+	135-162	145.9	0.08	0.19
		1972	No Fish					

* Sampled during September or October of the year indicated.

TABLE 11 Size and Percentage of Sexually Mature Coho Salmon in Kenai Peninsula Lakes.

Lake	Age	Sample Size	No. Mature ♂	No. Mature ♀	Mean Length (mm) Mature	Mean Length (mm) Immature	% Mature
Upper Jean	III+	19	4	4	334.9	245.7	42.1
Scout	0+	169	0	0	-----	104.8	----
	III+	42	10	1	280.1	276.0	26.2
Centennial	0+	34	0	0	-----	103.6	----
	I+	33	0	0	-----	220.4	----
	III+	29	6	0	281.2	258.4	20.7
Sunken I.	I+	223	5	0	232.4	195.6	2.2

Table 12 Population Characteristics of Kenai Peninsula Lakes Stocked with Rainbow Trout, 1972.

	Catch Data						Stocking History			
Lake	Species*	No. of Fish	Length Range (mm)	Mean	Mean Weight (lbs)	Catch/ Hour	Date Stocked	** Strain	Per (lb.)	Per Acre
Sport	RT	10	216-322	279.6	0.63	0.17	6/11/71	E	114	410
	RT	9	412-470	442.3	2.41	0.16	8/27/68	W	210	400
Arc	RT	73	94-116	104.8	0.03	1.74	8/3/72	W	449	315
	RT	1	314	---	0.88	0.02	6/11/71	E	114	315
	RT	2	386-398	392.0	1.71	0.05	9/5/69	W	132	200
	RT	1	422	---	1.81	0.02	8/27/68	W	210	315
Cabin	RT	17	286-320	301.8	0.75	0.35	9/11/70	W	165	450
	RT	14	276-325	295.5	0.71	0.29	6/4/71	E	114	270
Fetus	RT	37	266-314	295.3	0.70	0.79	6/28/71	O	2,984	600
Hump	RT	16	160-371	307.7	0.92	0.37	6/4/71	E	114	500
Island	RT	16	295-388	339.8	1.33	0.20	6/11/71	E	119	200
	RT	5	410-555	476.4	3.70	0.06	9/5-8/69	W	132	390
	PS	33	204-440	265.6	0.54	0.40	6/68	B	70	64
Jerome	RT	7	92-104	98.3	0.03	0.17	8/3/72	W	449	225
	RT	10	196-336	286.7	0.81	0.24	6/11/71	E	158	225
	RT	5	375-460	415.0	2.20	0.12	Unknown	-	---	---
	DV	43	183-406	249.8	0.52	1.02	Wild	-	---	---
	SS	1	187	---	0.18	0.02	Wild	-	---	---
Musik	RT	1	341	---	1.20	0.04	6/11/71	E	326	500
Stickleback	RT	0	---	---	---	---	6/11/71	E	326	500

* RT = rainbow trout, RS = sockeye salmon, DV = Dolly Varden, SS = coho salmon.

** W = Winthrop, Washington E = Ennis, Montana O = Oregon
B = Bear Lake, Seward, Alaska.

A 1970 fall plant and a 1971 spring plant in Cabin Lake allows comparison of growth and relative survival in a common environment. Mean lengths of the two plants differed by only 6 mm during the fall of 1972. Gillnet catch rates suggest a slightly greater survival of spring planted trout if differences in stocking densities are considered.

Fetus Lake, located at an elevation of 1,250 feet, was stocked in June 1971 with fry at a density of 600 trout per surface acre. Although the lake is ice-covered longer than other study waters, growth compared favorably to that of spring-planted fingerlings. A catch of 0.79 fish per net hour was the highest recorded for a 1971 plant.

Hump, Stickleback and Musik lakes were planted in June 1971 with fingerlings. Threespine sticklebacks are indigenous to each lake. Plants averaging 326 per pound in Musik Lake and interconnected Stickleback Lake yielded one rainbow trout to fall gillnet sampling. A plant in Hump Lake, averaging 114 per pound, produced a catch of 0.37 trout per net hour.

Island Lake, which contains sticklebacks and introduced sockeye salmon, was initially planted in September 1969 with 132 to the pound trout, at a density of 390 per acre. During October 1970, the trout averaged 258.6 mm in length and were caught at a rate of 0.07 fish per net hour. A second plant, averaging 117 per pound, was introduced in June 1971 at a density of 200 fish per surface acre. These fish, in October 1972, averaged 339.8 mm in length and were captured at a rate of 0.20 fish per net hour. The 1972 gillnet catch also included 33 sockeye salmon (0.40 salmon per net hour) from a 1968 plant of age II smolts. Lengths of sockeye salmon ranged from 204-440 mm with a mean of 265.6 mm. Thirty-three percent, eight males and three females, were sexually mature.

Dolly Varden reinfestation of Jerome Lake has substantially reduced rainbow trout production since chemical rehabilitation in 1968. Sampling in 1969, 1970 and 1971 produced declining trout catch rates of 2.43, 0.96 and 0.23 fish per net hour, respectively. Dolly Varden catch rates during the same year were 0.02, 0.26 and 0.55 fish per hour. In 1972, the Dolly Varden catch rate rose to 1.02 fish per net hour while the rainbow trout catch rate was 0.36 fish per hour for fish age I and older.

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