

STATE OF ALASKA

William A. Egan, Governor



Annual Performance Report For

The Study of Cutthroat-
Steelhead in Alaska

by

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RESEARCH PROJECT SEGMENT

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Study No.: AFS-42 Study Title: THE STUDY OF CUTTHROAT-STEEL-HEAD IN ALASKA.

Job No.: AFS-42-2 Job Title: Life History of Steelhead Trout in Southeastern Alaska.

Period Covered: July 1, 1973 to June 30, 1974.

ABSTRACT

This report covers the third year's operation of the project on the Petersburg Creek system, designed to study the life history of the steelhead trout, Salmo gairdneri (Richardson), in a typical southeastern Alaska lake-stream system. An estimated 403 adult steelhead migrated upstream past the Petersburg Creek weir between April 1, 1973, and June 17, 1973, with the peak occurring April 25, 1973. Adult steelhead tagged at the weir spent an average of 26.5 days on the spawning grounds before returning downstream to the sea. Age composition of the adult steelhead was determined from a total of 266 scale samples. The steelhead run was comprised of 22 age classes with 41.7% of the immigrants entering Petersburg Creek in their second, third, fourth, or fifth spawning migration. Adult steelhead ranged in size from 49.5 cm and 1.3 kg to 98.9 cm and 9.2 kg with an overall average of 80.0 cm and 5.9 kg.

The outmigration of steelhead smolts from Petersburg Creek began on May 5, 1973, peaked on June 8, 1973, and was complete by July 22, 1973. A total of 423 smolt were trapped and sampled during this period. Steelhead smolts ranged in age from 2 to 5 years, with 85.4% of the total outmigration falling in the 3 and 4 year age class. A total of 77,753 fish of various species were passed both upstream and downstream during the operation of the Petersburg Creek weir in 1973.

be required to establish and maintain viable steelhead fisheries in selected stream systems.

For southeastern Alaska in general, I recommend that no immediate changes be made in the regulation on steelhead and that selected streams close to population centers be surveyed for their suitability as sites for experimental management of artificially produced steelhead runs.

OBJECTIVES

1. To determine the number of in- and outmigrant steelhead in the Petersburg Creek system.
2. To determine the length, weight, sex, and age of steelhead in the Petersburg Creek system.
3. To determine the number, length, and age of steelhead smolts leaving the Petersburg Creek system.
4. To determine the spawning grounds and distribution of steelhead in the Petersburg Creek system.
5. To determine the length of time spent on the spawning grounds by adult steelhead in the Petersburg Creek system.
6. To compile an annotated bibliography of selected references on steelhead.

TECHNIQUES USED

Background information from prior studies conducted by the Alaska Department of Fish and Game and other agencies was reviewed.

The horse and deck weir incorporating in- and outmigrant traps that was constructed in 1972 was given annual maintenance and was fishing on April 3, 1973. The completed weir was 50 meters long and .61 meters high. An additional .91 meters of height was added to compensate for the higher tides by addition of screens mounted above the weir deck. The weir was of an inclined screen panel type, using 1.60 cm. hardware cloth screen for normal water levels and 2.54 cm. screen during high water levels. Three traps, 3.6 meters by 2.7 meters, were placed near the east bank, as this area has been determined to be the most attractive to migrating fish. The three traps were designed to be used as either in- or outmigrant traps depending upon the direction of the bulk of the migrating fish. A three-meter weir section, located in midstream, was modified to allow boat traffic to pass through the weir. All in- and outmigrant adult steelhead captured at the weir were anesthetized with Tricaine Methanesulfonate (MS 222), sexed, measured, and weighed. All inmigrant adult steelhead were marked by punching a hole in the right opercular cover and a selected sample was tagged with numbered "Floy" internal anchor type tags. Scale samples were also collected from all steelhead for age determinations.

RECOMMENDATIONS

Research

The determination of the number of in- and outmigrant steelhead, their length, weight, sex, and age should be continued for the Petersburg Creek population.

Spawning grounds and spawning requirements of steelhead in the Petersburg system should be mapped and delineated.

Selected immigrant adult steelhead should be tagged to determine the amount of time spent of the spawning grounds and to measure stream mortality rates.

The determination of the number, length, and migration timing of the steelhead smolts leaving the Petersburg Creek system should be continued. This work will give an index of production potential and smolt to adult survival which may be applied to other systems.

Stream systems, other than Petersburg Creek, that contain spring- and/or summer- and fall-run steelhead should be surveyed for potential egg take sites.

Management

In general, the life history study of the steelhead population in Petersburg Creek system indicates that no immediate management changes are needed. Adult steelhead are present in the system for 3 to 3-1/2 months each spring. The weather during this period is normally cold, which tends to limit angling participation in this fishery. A comprehensive creel census for the past two years revealed that anglers harvested 15% of the total adult run annually. At present, there are adequate numbers of adult female spawners to produce fry to completely fill the available rearing areas in the system.

The new Crystal Lake Hatchery now has the capability of rearing steelhead to smolt size in one growing season. It is recommended, that a number (5,000-10,000) of these smolts be marked and released in the Petersburg Creek system. This will allow determination of hatchery smolt survival through the Petersburg Creek weir, and, as they return as adults, over-all survival.

At present, approximately 1,200 wild steelhead smolts migrate to sea annually from Petersburg Creek. These steelhead feed for 2 or 3 years at sea and return to Petersburg Creek as adults. Scale samples, collected during the last three years, indicate that 56%, or approximately 300, steelhead are initial annual spawners. This, then, is approximately a 25% survival rate of smolts to initial spawners.

Petersburg Creek is considered a good steelhead stream on the basis of a total population of 500+ steelhead annually. If hatchery smolts survive at the percentages of wild smolts, only small plants (20,000-30,000) would

The sampled steelhead were then placed in a freshwater tank to recover before being released in the direction of original migration. A small number of adult female steelhead were killed and the ovaries removed for fecundity counts.

All outmigrant steelhead smolts captured at the weir were anesthetized with MS 222, enumerated, and measured. Every 10th smolt was killed, measured, and sexed. Otoliths were collected from these smolts for age determinations. Stomach contents were examined and classified.

Foot surveys and sampling by hook and line were used to determine the location and distribution of spawning steelhead.

The in- and outmigration of Dolly Varden, S. malma, and the enumeration of the various salmon species was achieved by removing the fish from the traps by dip net, or removing a weir screen and tally count as they crossed a "flash board."

FINDINGS

Adult Steelhead--Numbers and Timing

The total run of adult steelhead, Salmo gairdneri, to Petersburg Creek in 1973 was estimated to be 403 fish. Of this total, 71 were harvested from the system by 266 sport anglers.

An actual count of the adult steelhead immigration was impossible due to periodic flooding of Petersburg Creek during the spring of 1973. During these high-water periods, undetermined numbers of adult steelhead passed upstream. To estimate the total immigration of adult steelhead in 1973, a marked-to-unmarked ratio of the outmigrants (Bailey's modification of Peterson's formula: Ricker, 1958) was used. The estimated immigration was computed as follows:

$$N = \frac{M(C+1)}{R+1} = \frac{186(151)}{85} = 330$$

Where M = 186 marked fish

C = 150 fish sampled

R = 84 marked fish recaptured

A total of 71 steelhead were removed from the total run by 266 sport anglers. The addition of these 71 sport caught fish brings the estimated total seasonal run to 403 adult steelhead for 1973.

The immigration of adult steelhead to Petersburg Creek began in February or March, peaked on the 25th of April and was complete by June 17, 1973. Immigration patterns during 1973 closely paralleled those observed in

previous years (Jones, 1971-1972), with fish moving best during the hours of darkness and a rising stream flow level.

The outmigration of spent steelhead started in late April, peaked on June 6 and was complete on July 15, 1973. Outmigrant steelhead seemed reluctant to enter the outmigrant traps and did so only during the hours of darkness when a moderate stream flow level prevailed. Presented in Table 1 are the monthly steelhead migration totals for the Petersburg Creek weir in 1973.

Table 1. Adult Steelhead Trapped by Month, Petersburg Creek weir, 1973.

<u>Month</u>	<u>Direction of Migration</u>	
	<u>Inmigration</u>	<u>Outmigration</u>
April	93	1
May	85	24
June	8	68
July	--	56
Total	186	149

Adult Steelhead Tag Recovery

As adult steelhead passed upstream through the Petersburg Creek weir, a selected sample was tagged with numbered "Floy" internal anchor tags. An effort was made to tag equal numbers of male and female steelhead.

During spawning ground surveys, it was noted that the tagged steelhead began to show up above the weir on the outmigration. These steelhead were trapped, the tag number recorded, and then were released below the weir.

After the last outmigrant adult steelhead had migrated past the weir in July, an analysis was made of stream residency. It was found that the overall average for both males and females was 26.5 days, with a range of 1 - 64 days. A breakdown by sex revealed that male steelhead spend an average of 13 days longer on the spawning grounds than do females (Table 2). This lengthy stream residency by male steelhead is directly reflected in sport angler catches, where male steelhead were caught almost twice as often as females. The short residency by female steelhead is also reflected in their ability to survive for additional spawning migrations.

Table 2. Adult Steelhead Stream Residency in Petersburg Creek, 1973.

<u>Sex</u>	<u>Number</u>	<u>Average # of Days</u>	<u>Range</u>
Females	23	21.5	1-49
Males	14	34.5	4-64
Total	37	26.5	1-64

Adult Steelhead Age-Sex Relationships

To determine the age-sex relationships of the Petersburg Creek steelhead run, scale samples were collected and sex determined from all steelhead trapped at the weir during in- and outmigrations. A total of 266 scales were readable for age determinations.

Twenty-two age classes (ages 2.1s -5.1ss) were found among the Petersburg Creek steelhead population in 1973 (Table 3). This corresponds to 23 age classes in 1971 and 26 age classes in 1972 (Jones, 1972-1973). Age classes are presented using the aging method distributed by Narver, et al. (1971). Repeat spawning steelhead are listed with an "s" after the ocean age. This "s" represents a spawning run and is added to the total to determine the overall total age of repeat spawners. For example, a steelhead with an age of 3.1s is a total of five years of age. This fish spent three winters in fresh water before migrating to sea. It spent one full year at sea and returned to spawn at the end of the second winter at sea. It survived the initial spawning run and has returned on its second run to Petersburg Creek. When sampled, the steelhead was just entering its 6th year of life. Initial steelhead spawners are those fish without an "s" in their total age.

Adult steelhead sampled in 1973 had spent two(11.3%), three(67.3%), four (20.7%), and five(0.7%) winters in fresh water. This corresponds closely with freshwater ages recorded in 1971 and 1972 (Jones 72, 73). The numbers of winters spent in salt water by the sampled steelhead were two (28.2%), three (60.9%), four (7.9%), and five (3.0%). The 1973 run differed from 1971 and 1972 runs in that no steelhead in the 6 and 7 ocean age classes were present. The majority of both sexes were in age classes 3.3 and 3.2, which corresponds exactly with the previous two years findings.

Steelhead Frequency of Spawning

Examination of the steelhead scale samples, obtained during the operation of the Petersburg Creek weir in 1973, revealed that 58.3% of the total run were initial spawning steelhead. It was determined that 41.7% of the

Table 3. Steelhead Trout Age Classes, Petersburg Creek, 1973.

<u>Age Classes</u>	<u>No. SH.</u>	<u>No. of Females</u>	<u>No. of Males</u>	<u>% of Total</u>
2.1s	3	1	2	1.1
2.2s	2	1	1	.8
2.2ss	4	3	1	1.5
2.3	21	13	8	7.9
3.1s	15	9	6	5.7
3.1ss	4	4	0	1.5
3.1sss	2	1	1	.8
3.1ssss	1	1	0	.4
3.2	37	12	25	14.0
3.2s	28	22	6	10.6
3.2ss	10	8	2	3.8
3.2sss	7	6	1	2.6
3.3	75	50	25	28.4
4.1s	7	3	4	2.6
4.1ss	4	2	0	1.5
4.1sss	2	2	0	.8
4.2	12	4	8	4.5
4.2s	17	15	2	6.4
4.2ss	3	3	0	1.1
4.3	10	7	3	3.8
5.1s	1	1	0	.4
5.1ss	1	1	0	.4
Totals	266	169	99	99.9

scales showed one or more spawning migrations. This corresponds almost exactly with findings during 1971 and 1972, when 43.0% and 43.7% of the total run were repeat spawners. The number of years 1973 sampled steelhead spawned is presented in Table 4.

Table 4. Steelhead Trout Spawning Frequency, Petersburg Creek, 1973.

<u>Sex</u>	<u>Number of Years Adult Steelhead Returned to Spawn</u>					<u>Total</u>
	<u>One</u>	<u>Two</u>	<u>Three</u>	<u>Four</u>	<u>Five</u>	
Male	69	21	5	2	0	97
Female	86	52	21	9	1	169
Total	155	73	26	11	1	266

Initial Steelhead Spawners

Steelhead spawning for the first time in 1973 numbered 155 or 58.3% of the fish sampled. These steelhead were from five age classes, with age 2.3 the most numerous for all fish aged (Table 5). Missing from the 1973 run were steelhead in the 2.2 age class. Steelhead in this age class comprised 11.3% of the 1971 run and 7.3% of the 1972 run (Jones, 1972-1973). Apparently, steelhead that would have returned as 2.2 in 1973 remained at sea, and will return as 2.3's in 1974. The sex ratio of initial spawners was 1.2:1, with females only slightly more numerous than males.

Table 5. Age Classes of Initial Steelhead Trout Spawners by Sex - Petersburg Creek Weir, 1973.

<u>Age Classes</u>	<u>No. SH.</u>	<u>No. of Females</u>	<u>No. of Males</u>	<u>% of Total</u>
2.3	21	13	8	13.5
3.2	37	12	25	23.9
3.3	75	50	25	48.4
4.2	12	4	8	7.7
4.3	10	7	3	6.5
Totals	155	86	69	100.0

Repeat Steelhead Spawners

The high percentage (41.7%) of repeat spawners in the 1973 run contained approximately 2% fewer repeat spawners than previous runs. It was feared that the weir might impede the normal outmigration pattern of spawned-out steelhead and cause an unknown mortality. This apparently has not occurred, as the 1973 run contained almost as many repeat spawners as previous years, even though the weir did delay the spent steelheads outmigration somewhat during 1971 and 1972.

Repeat steelhead spawners by sex show females to outnumber males by a ratio of 2.9:1. Seventeen age classes were represented among the repeat spawners with the majority of both females and males falling in the 3.2s and 4.2s age classes (Table 6). Of the 83 repeat spawning females, 52(62.6%) were spawning for the second time, 21(25.3) were spawning for the third time, 6(10.8%) for the fourth time, and 1(1.3%) for the fifth time. Of the 28 repeat spawning males, 21(75.0%) were spawning for the second time, 5(17.8%) were spawning for the third time and 2(7.1%) were spawning for the fourth time.

Steelhead Length - Weight Relationships

Length-weight relationships were collected from 266 steelhead as they passed the Petersburg Creek weir in 1973. Very little difference was found between males and females in overall lengths and weights. The only large differences in size occurred between initial and repeat spawners. The repeat spawners averaged 6.8 kg. (Table 7), which is 1.4 kg. greater than the standard of 5.4 kg. set for a "trophy steelhead" in Alaska. The average length and weight of both initial and repeat spawners was greater in 1973 than it was in either 1971 or 1972 (Jones, 1972-1973).

Steelhead Smolt Outmigration

The seaward outmigration of steelhead smolt through the Petersburg Creek weir began on May 5th, peaked on June 8th, and was complete by July 22, 1973 (Table 8). A total of 423 steelhead smolt were trapped during 1973. This is approximately 1/3 of the 1972 migration, when 1,251 were trapped and passed downstream. The low numbers trapped in 1973 may not have truly reflected the total outmigration, as several hours of fishing time was lost during the peak outmigration period. It was estimated that an additional 400 smolt were missed during the periods of high water. This would bring the estimated total outmigration to 823 smolt for 1973.

The 1973 steelhead smolt outmigration closely paralleled the 1972 outmigration in relation to smolt size and peak migration period. The 1973 smolt averaged 3mm larger overall, a lack of small smolt (less than 100mm) were also noted in the 1972 outmigration (Jones, 1973).

Table 6. Age Classes of Repeat Steelhead Trout Spawners by Sex - Petersburg Creek Weir, 1973.

<u>Age Classes</u>	<u>No. SH.</u>	<u>No. of Females</u>	<u>No. of Males</u>	<u>% of Total</u>
2.1s	3	1	2	2.7
2.2s	2	1	1	1.8
2.2ss	4	3	1	3.6
3.1s	15	9	6	13.5
3.1ss	4	4	0	3.6
3.1sss	2	1	1	1.8
3.1ssss	1	1	0	.9
3.2s	28	22	6	25.2
3.2ss	10	8	2	9.0
3.2sss	7	6	1	6.3
4.1s	7	3	4	6.3
4.1ss	4	2	2	3.6
4.1sss	2	2	0	1.8
4.2s	17	15	2	15.3
4.2ss	3	3	0	2.7
5.1s	1	1	0	.9
5.1ss	1	1	0	.9
Total	117	83	28	99.9

Table 7. Steelhead Trout Length - Weight Relationships, Petersburg Creek, 1973.

	<u>No. in Sample</u>	<u>Length Rg. in Cm.</u>	<u>Average Length</u>	<u>Wt. Rg. in kg.</u>	<u>Average wt. kg.</u>
Initial Spawners	155	49.5-94.0	76.3	1.3-8.7	4.9
Repeat Spawners	111	72.4-98.9	83.1	3.4-9.2	6.8
Total	266	49-98.9	80.0	1.3-9.2	5.9

Table 8. Numbers and Lengths of Outmigrant Steelhead Trout Smolt by Bi-Weekly Periods, Petersburg Creek, 1973.

<u>Bi-Weekly period</u>	<u>No.</u>	<u>Length Range in mm.</u>	<u>Average Length in mm.</u>	<u>Percent of Total</u>
4/30-5/13	6	120-184	164	1.4
5/14-5/27	81	151-238	171	19.1
5/28-6/10	216	135-280	169	51.1
6/11-6/24	91	110-209	168	21.5
6/25-7/8	23	101-201	167	5.4
7/9-7/22	6	112-176	143	1.4
Totals	423	101-280	164	99.9

Steelhead Smolt Age - Length Relationships

Age and length data were collected from a sample of 41 steelhead smolt during outmigration past Petersburg Creek weir, 1973. These smolt ranged in age from two to five years, with 85.4% falling in the 3 and 4 age groups (Table 9).

Table 9. Age - Length Relationships of Steelhead Trout Smolt - Petersburg Creek Weir, 1973.

Fork Length in mm.	Age (Number of Annuli)				Total	Percent of Total
	2	3	4	5		
111-130	1	-	-	-	1	2.4
131-150	2	1	-	-	3	7.3
151-170	2	4	1	-	7	17.1
171-190	-	10	10	1	21	51.2
191-210	-	3	6	-	9	21.9
Totals	5	18	17	1	41	
Percent of Total	12.2	43.9	41.5	2.4		100.0
Average Fork Length in mm.	148	178	187	178		

Other Migrants

The Petersburg Creek weir was complete and fishing on the evening of April 3, 1973. This is 20 days earlier than 1971 and 1972. The Dolly Varden, Salvelinus malma, outmigration from Petersburg Lake to salt water was underway before the weir was fish tight, but it is believed that only small numbers were missed in 1973. Other outmigrant species from Petersburg Creek are presented in Table 10.

After the middle of July, it was almost impossible to operate the downstream traps due to the large numbers of dead salmon floating downstream. Very little downstream movement of any species occurred after mid-July and the traps were converted to trapping upstream fish.

Table 10. Number of Outmigrant Fish by Species and Month, Petersburg Creek Weir, 1973.

<u>Month</u>	<u>Cutthroat</u>	<u>Dolly Varden</u>	<u>Steelhead</u>	<u>Coho</u>
April	36	12,558	1(1)*	(37)*
May	295	9,874	24(168)	(3,323)
June	98	95	68(295)	(176)
July	74	-----	56(8)	(28)
Totals	503	22,527	149(472)	(3,564)

* () indicates smolt

Table 11. Numbers of Immigrant Fish by Species by Month, Petersburg Creek Weir, 1973.

<u>Month</u>	<u>Steelhead</u>	<u>Cutthroat</u>	<u>Dolly Varden</u>	<u>Red</u>	<u>Pink</u>	<u>Chum</u>	<u>Coho</u>
April	93	2	--	-	-	-	-
May	85	12	--	3	-	-	-
June	8	5	5	33	-	-	-
July	-	56	4,530	2,324	10,771	841	-
August	-	85	11,555	27	10,105	1,150	47
September	-	586	3,803	-	55	3	342
October	-	119	4,625	-	-	-	144
Total	186	865	24,518	2,387	20,931	1,994	533

The immigrant traps were complete on April 3, 1973, and the first adult steelhead were trapped on April 13. As no adult steelhead were trapped for the first 10 days of weir operation, it is apparent that the majority of the steelhead run was enumerated in 1973.

Steelhead, cutthroat, Salmo clarki, and the first of the red salmon, Oncorhynchus nerka, were the only immigrants during April and May. The first of the Dolly Varden immigration, together with other salmon species, began in June and reached a peak in August (Table 11). Immigrations of all species slowed in September and were almost complete when the weir was closed on November 1st. Presented in Table 11 are the monthly immigrant trap counts, by species, for the Petersburg Creek weir in 1973.

Totals in Tables 10 and 11 do not represent the entire run for the species listed. Dolly Varden were passing downstream before the weir was fish tight in early April. All species passed both upstream and downstream during periods of extreme high water when the weir screens were removed. Several thousand pink, Oncorhynchus gorbuscha, and chum salmon, Oncorhynchus keta, normally spawn in the inter-tidal area below the weir and are not included in the total counts. The totals presented are the actual counts made during the 1973 weir operation.

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RESEARCH PROJECT SEGMENT

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Cutthroat Trout in
Southeast Alaska.

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ABSTRACT

This report covers the third year's operation of the project on the Petersburg Creek system designed to study the life history of the sea-run cutthroat trout, Salmo clarki (Richardson), in a typical Southeastern Alaska lake-stream system. The out-migration of sea-run cutthroat began in April, peaked in early June, and a total of 501 were tagged and/or marked by late July. The out-migrant cutthroat ranged in length from 131 mm to 469 mm with an average of 258 mm. The out-migrant cutthroat ranged in age from 3 to 10 years with 77.3% occurring in the 4 through 6 year class. The in-migration of sea-run cutthroat to the Petersburg Creek system began in early July, peaked in late September and a total of 865 were enumerated by November 1, 1973. In-migrant cutthroat size and ages were similar to those in the out-migration. Fecundity studies of the in-migrant cutthroat were computed and a total of 169,360 eggs were estimated to have been deposited in Petersburg Creek in the spring of 1974. Sea-run cutthroat tagged at the weir were recovered or observed in 6 streams in the Petersburg area. Tagged cutthroat were recovered as far as 44 miles from Petersburg Creek and spent as much as 158 days at sea, and grew on the average of 36 mm. A total of 77,753 fish of various species were passed both upstream and downstream during the operation of the Petersburg Creek weir in 1973.

RECOMMENDATIONS

Research

The determination of the number of in- and out-migrant cutthroat, their length, weight, sex and age should be continued for the Petersburg Creek population.

The maturity composition of the cutthroat population in the Petersburg Creek System should be determined.

To investigate that portion of the cutthroat population in the Petersburg Creek system that is non-migratory.

Stream systems, other than Petersburg Creek, that contain good runs of sea-run cutthroat should be surveyed for potential egg take sites.

Management

The life history study of the sea-run cutthroat population in Petersburg Creek indicates that some management changes are needed. Adult sea-run cutthroat are available to the angler in the stream or in the intertidal area for approximately 8 months each year. This long exposure to fishing pressure causes higher exploitation of the stocks. Fishing pressure in Petersburg Creek has been slowly increasing and this trend is expected to continue. Comprehensive Creel Census programs throughout the period of 1966 to 1973 indicate that anglers harvest between 300-400 sea-run cutthroat annually. At present, the annual migrations number approximately 1,200 adults. These cutthroat appear to be of mixed stocks. Tagging studies have shown that a large number of cutthroat, originating in other stream systems in the area, use the Petersburg Creek-Lake complex as an overwintering area. The exploitation of these mixed races compounds management of this species.

Fecundity studies of in-migrants have shown that less than half of the overwintering populations are mature spawners. Average egg counts indicate that fecundity is approximately 800 eggs for the average female cutthroat. This low fecundity and numbers of females may be a limiting factor in cutthroat populations in the system.

For Southeast Alaska, I recommend that the daily bag limit be reduced to 6 cutthroat daily with a possession limit of 10 on sea-run cutthroat. And I further recommend that an egg take site be investigated for procural of eggs to establish a brood stock at the Crystal Lake Hatchery.

OBJECTIVES

1. To determine the number of in- and out-migrant anadromous cutthroat in the Petersburg Creek system.
2. To determine the length, weight, sex and age of anadromous cutthroat in the Petersburg Creek system.
3. To determine the maturity composition of the anadromous in- and out-migrant cutthroat in the Petersburg Creek system.
4. To determine the age of cutthroat smolts in the Petersburg Creek system.
5. To determine the spawning grounds and distribution of anadromous cutthroat in the Petersburg Creek system.
6. To determine the migration patterns of the anadromous cutthroat after they have migrated out of the Petersburg Creek system.
7. To compile an annotated bibliography of selected references on cutthroat.

TECHNIQUES USED

Background information from prior studies conducted by the Alaska Department of Fish and Game and other agencies was reviewed.

The horse and deck weir incorporated in- and out-migrant traps that was constructed in 1972 was given annual maintenance and was fishing on April 3, 1973. The completed weir was 50 meters long and .91 meters high. An additional .91 meters of height was added to compensate for the higher high tides by addition of screens mounted above the weir deck. The weir was of an inclined screen panel type using 1.60 cm hardware cloth screens for normal water levels and 2.54 cm screens during high water levels. Three traps 3.6 meters by 2.7 meters were placed near the east bank as this area has been determined to be the most attractive to migrating fish. The three traps were designed to be used as either in- or out-migrant traps depending upon the direction of the bulk of the migrating fish. A three meter weir section, located in mid-stream, was modified to allow boat traffic to pass through the weir.

As the out-migrant cutthroat entered the traps, they were anesthetized with Tricaine Methanesulfonate (MS 222). They were measured, those over 200 mm and not already fin clipped and/or tagged, were fin clipped left ventral and tagged with numbered "Floy" internal anchor type tags. Cutthroat under 200 mm were only given a left ventral fin clip. All cutthroat were then placed in a freshwater recovery tub and were observed until all were active before release below the weir.

As the in-migrant cutthroat entered the traps, they were handled using the same procedure as were the out-migrants. All in-migrant cutthroat were measured and examined for fin clips and tags.

Every 10th in- and out-migrant cutthroat captured at the weir was sampled, measured, weighed and sexed. The condition of the gonads were examined to determine maturity.

Foot surveys, hook and line, and angler contacts were used to determine the distribution of tagged cutthroat in streams other than Petersburg Creek.

The in- and out-migration of Dolly Varden, S. malma, and the enumeration of the various salmon species were counted past the weir by removing them from the traps by dip net or removing a weir screen and tally counting as they crossed a flash board.

FINDINGS

Cutthroat Trout Out-migration

The sea-ward migration of cutthroat trout, S. clarki, from Petersburg Creek began on April 4, 1973, peaked on June 1, and was complete on July 22, 1973. A total of 501 fish was passed during this period (Fig. 1). The 1973 out-migration began almost 1 month earlier than in 1971 and 1972, however the peak movement was during the same time period for all three years (Jones, 72, 73). Water temperatures during the out-migration ranged from 2° C to 13° C with peak of migration occurring at temperatures above 7° C. Nearly all of the out-migrant cutthroat entered the traps during the hours of darkness on moderate stream flows. Movement virtually stopped on extreme high or low stream flows.

Presented in Table 1 are the length frequencies of out-migrant cutthroat by five day periods. Small numbers of large cutthroat migrate first followed by average size fish during the peak of out-migration in late May and early June. The small cutthroat comprised the last of the out-migration in late June and July. This closely parallels the migration pattern established in 1972 (Jones, 73). Cutthroat smolt (fish less than 200 mm in length) had two peak periods of out-migration. One peak of movement occurred from mid-May to early June and another from early July to late July. This differed from 1972 when the peak out-migration of cutthroat smolt occurred in mid-July (Jones, 73).

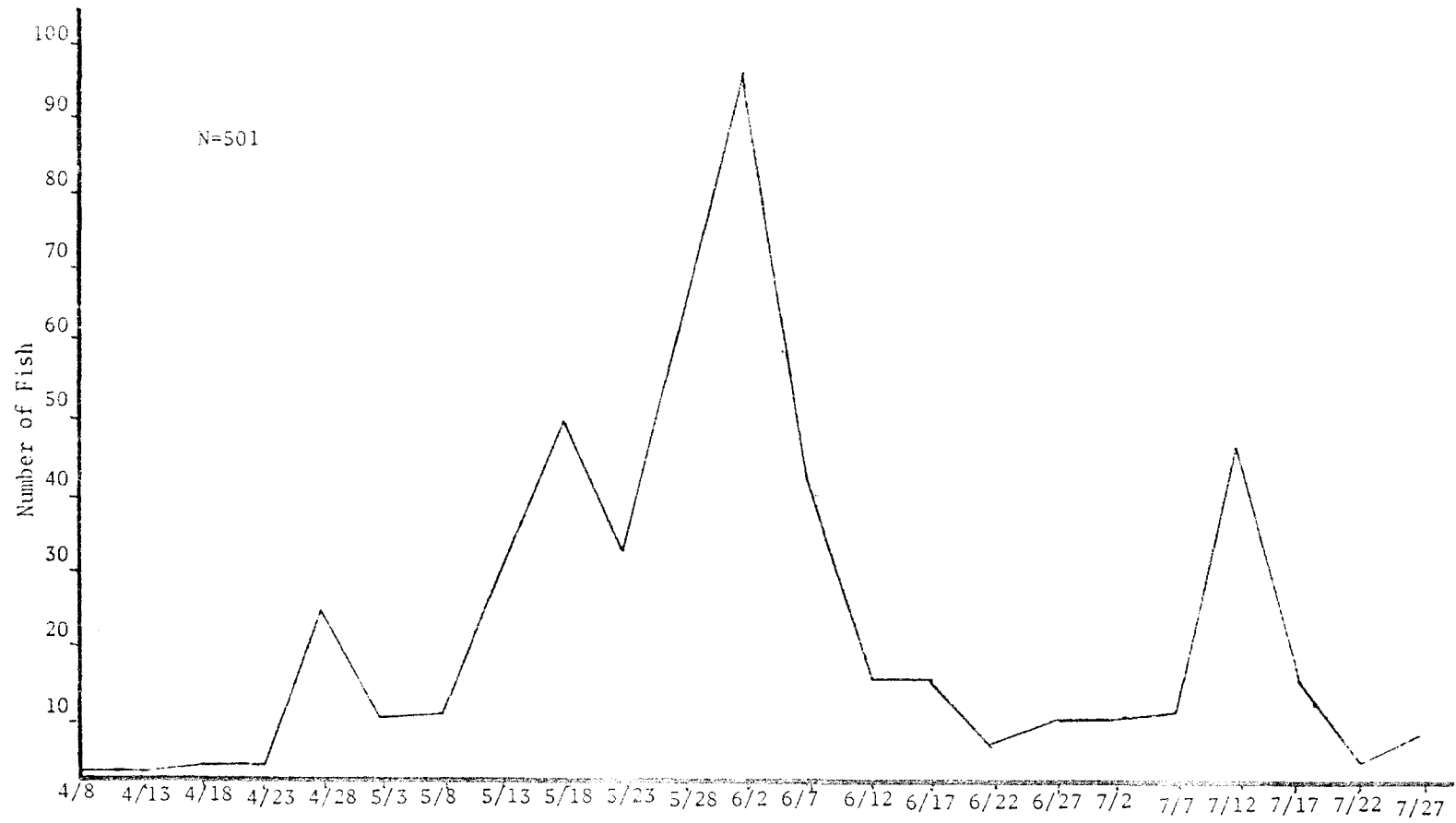


Figure 1. Out-migrant Cutthroat Trout by Five Day Periods. Petersburg Creek Weir, 1973.

Table 1. Length Frequencies of Out-migrant Cutthroat by Five Day Periods Petersburg Creek Weir, 1973.

<u>Five Day Period</u>	<u>No.</u>	<u>Length Range in mm</u>	<u>Average Length</u>	<u>Cutthroat Less than 200 mm</u>
4/4-4/8	1	-	403.0	-
4/9-4/13	1	-	457.0	-
4/14-4/18	2	410-425	417.5	-
4/19-4/23	2	385-389	387.0	-
4/24-4/28	24	195-440	360.8	1
4/29-5/3	10	247-422	342.2	-
5/4-5/8	11	278-400	320.7	-
5/9-5/13	29	179-411	287.3	3
5/14-5/18	50	173-330	222.8	14
5/19-5/23	33	131-345	229.7	11
5/24-5/28	63	184-460	259.9	3
5/29-6/2	95	160-365	271.4	10
6/3-6/7	42	184-375	232.9	4
6/8-6/12	15	191-440	292.8	3
6/13-6/17	15	154-390	237.0	5
6/18-6/22	6	233-342	284.0	-
6/23-6/27	10	133-356	230.2	3
6/28-7/2	10	143-379	216.6	7
7/3-7/7	11	185-400	298.5	1
7/8-7/12	46	131-350	208.0	21
7/13-7/17	15	132-190	162.0	5
7/18-7/22	3	142-164	151.3	3
7/23-7/27	7	147-245	187.2	5
Totals	501	131-460	258.0	99

Age-Length Relationships of Out-migrant Cutthroat Trout

Ages of the out-migrant cutthroat were determined from a sample of 75 fish captured throughout the spring. Aging was accomplished by counting the number of annuli on their otoliths. The 1973 cutthroat out-migration contained trout in eight age groups with ages ranging from three to ten with 77.3% of the fish occurring in the four through six age class (Table 2). Out-migrants in age class nine and ten were recorded for the first time in 1973. Fifty-one percent of the out-migrant cutthroat sampled were between 191 and 290 mm in fork length.

Table 2. Age-Length Relationships of Out-migrant Cutthroat Petersburg Creek Weir, 1973.

Fork Length in mm	Age (Number of Annuli)								Total	% of Total	
	3	4	5	6	7	8	9	10			
131-150	1								1	1.3	
151-170	1								1	1.3	
171-190		2	1						3	4.0	
191-210	1	3	3	1					8	10.7	
211-230		1	5	3					9	12.0	
231-250		1	3	3					7	9.3	
251-270		1	1	2					4	5.3	
271-290				8	2				10	13.3	
291-310				1	1	1			3	4.0	
311-330				2	3	2			7	9.3	
331-350				2	6				8	10.7	
351-370								1	1	2.7	
371-390					3	2	1			6	8.0
391-410							3			3	4.0
411-430						1				1	1.3
431-450								2		2	2.7
Totals	3	8	26	24	6	4	3	1	75		
% of Total	4.0	10.7	34.6	32.0	8.0	5.3	4.0	1.3		99.9	
Ave. Fork Length	167	210	258	296	353	395	413	360			

Cutthroat Trout In-migration

In-migrant cutthroat were recorded at the Petersburg Creek weir during the first week of operation in April and continued throughout the remainder of the season. The early in-migrants were mature fish headed upstream to the spawning grounds above the weir. This early spring in-migration occurred in 1972 and the origin of these fish is still unknown as none of them were previously marked at the weir. The in-migration of sea-run cutthroat to Petersburg Creek began on July 7, 1973, peaked on September 25, 1973, and was complete on October 30, 1973, (Figure 2) with an estimated 865 cutthroat passing the weir during this period.

The in-migrant cutthroat entered the traps at night on moderate to rising stream flows. Very little movement occurred during extreme high or low water levels. Stream water temperatures were 13° C at the start of in-migration, averaged 8° C during the peak and dropped to 2° C at the end of migration.

Presented in Table 3 are the length frequencies of in-migrant cutthroat by five day periods. The early in-migrants were small fish followed by average size fish during the peak of in-migration and again dropping to small cutthroat during the last ten days of October. In-migrant cutthroat under 200 mm in fork length were captured throughout the in-migration period. Small numbers of these small cutthroat did not appear to be sea-run and were most likely rearing cutthroat moving to new feeding or wintering areas. The majority of the sub 200 mm cutthroat were bright sea-run fish that apparently had been to sea for the first time. As none of these fish were fin clipped, it appears that they originated in other streams in the area and were returning to the Petersburg Creek system for the winter. In-migrant cutthroat fork lengths ranged from 135 mm to 471 mm (Table 3). The average fork length of 865 measured in-migrants was 245.3 mm.

In-migrant Cutthroat Age-Length Relationships

Age-length data were collected from a random sample of 81 in-migrant cutthroat as they passed the Petersburg Creek weir in 1973. These cutthroat ranged in age from three to eight years of age with 60% showing four, five or six annuli on their otoliths (Table 4). The 1973 in-migration was like the 1972 in-migration in most age groups with the 1973 migration containing a few more cutthroat in the six year age class. Average lengths of the 1973 sampled cutthroat closely paralleled lengths for cutthroat sampled in 1972 with the 1973 sample being slightly smaller for all age classes (Jones, 73).

Sea-Run Cutthroat Fecundity

Degree of sexual maturity was noted for the cutthroat sampled at the weir. It was found that 54.1% of the in-migrants were not maturing and

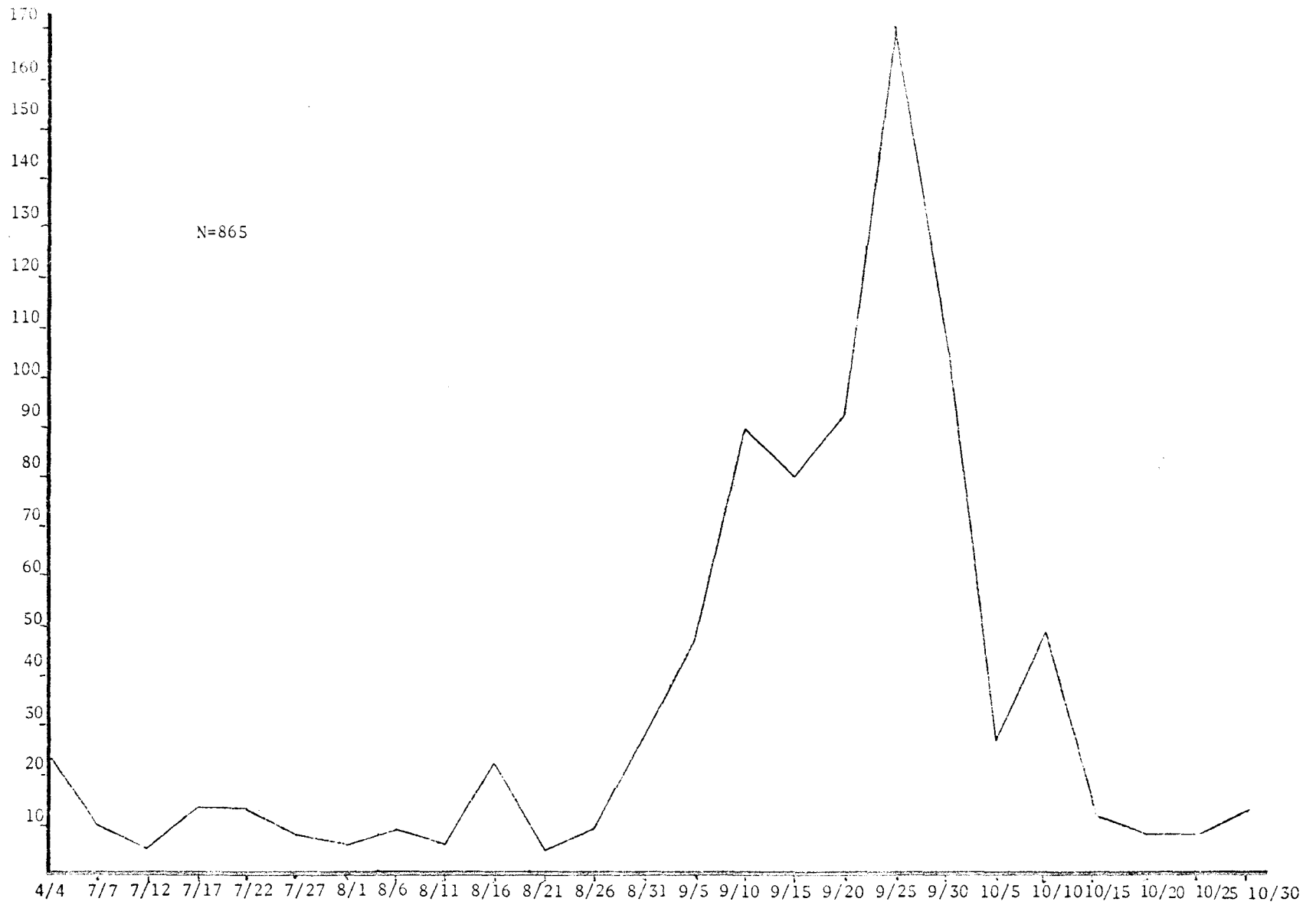


Figure 2. In-migrant Cutthroat Trout by Five Day Periods. Petersburg Creek Weir, 1973.

would not spawn in the spring of 1974. This closely parallels findings in 1971 and 1972 when 56.0% and 53.0% of the in-migration were noted as being immature (Jones, 72-73).

A small number of female cutthroat were sampled for fecundity studies. As the total number of eggs per female was small, total counts were made. Egg counts ranged from a low of 500 for a 370 mm female cutthroat to a high of 1,100 for a 440 mm cutthroat. From this, it appears that Southeast Alaskan cutthroat have a lower fecundity for comparable length fish than is found on the Oregon coast (Cramer, 1940).

The estimated total in-migration of sea-run cutthroat to Petersburg Creek for 1973 was calculated to be 856 fish, with an overall sex ratio of 1.5:1 females to males. The run contained an estimated 232 maturing females. With an average of 730 eggs per female, the estimated possible egg deposition for the 1973 run is 169,360 eggs.

Table 3. Length Frequencies of In-migrant Cutthroat by Five Day Periods Petersburg Creek Weir, 1973.

<u>Five Day Period</u>	<u>No.</u>	<u>Length Range in mm</u>	<u>Average Length</u>	<u>Cutthroat Less Than 200 mm</u>
4/4-7/2*	25	138-385	246.8	10
7/3-7/7	10	136-255	174.3	8
7/8-7/12	5	131-266	174.2	4
7/13-7/17	14	141-320	176.4	10
7/18-7/22	13	135-280	181.5	12
7/25-7/27	8	145-326	215.3	4
7/28-8/1	6	150-385	249.9	2
8/2-8/6	9	153-409	239.3	5
8/7-8/11	6	195-373	275.6	1
8/12-8/16	22	170-379	274.3	1
8/17-8/21	5	185-400	266.2	1
8/22-8/26	9	185-377	241.8	4
8/27-8/31	28	186-455	273.3	5
9/1-9/5	47	165-442	284.3	8

Table 3. (cont.) Length Frequencies of In-migrant Cutthroat by Five Day Periods Petersburg Creek Weir, 1973.

Five Day Period	No.	Length Range in mm	Average Length	Cutthroat Less Than 200 mm
9/6-9/10	90	168-430	274.2	13
9/11-9/15	80	161-430	259.4	16
9/16-9/20	93	160-395	253.2	13
9/21-9/25	171	158-471	265.7	21
9/26-9/30	105	183-432	267.8	10
10/1-10/5	27	196-403	261.8	2
10/6-10/10	50	192-405	266.1	4
10/11-10/15	12	190-360	247.7	3
10/16-10/20	8	186-295	265.6	1
10/21-10/25	9	175-294	247.2	2
10/26-10/30	13	183-308	251.1	2
Totals	865	135-471	245.3	162

*4/4-7/2/73 This time period was consolidated due to limited number of in-migrant fish.

Table 4. Age-Length Relationships of In-migrant Cutthroat. Petersburg Creek Weir, 1973.

Fork Length in mm	Age (Number of Annuli)							Total	% of Total	
	3	4	5	6	7	8	9			10
131-150	2								2	2.5
151-170	1	1	1						3	3.7
171-190	1	2	1						4	4.9
191-210	2	5	2						9	11.1
211-230	1	3	2	1					7	8.6
231-250		4	2	1					7	8.6

Table 4. (cont.) Age-Length Relationships of In-migrant Cutthroat.
Petersburg Creek Weir, 1973.

Fork Length in mm	Age (Number of Annuli)							Total	% of Total	
	3	4	5	6	7	8	9			10
251-270		3	2	3					8	9.9
271-290		2	4	1					7	8.6
291-310			1	5					6	7.4
311-330			1	6	1				8	9.9
331-350			1	1	1	1			4	4.9
351-370			1	2	3				6	7.4
371-390				2	4				6	7.4
391-410							1		1	1.2
411-430					2				2	2.5
431-450							1		1	1.2
Totals	7	20	18	22	11	3			81	99.8
% of Total	8.6	24.7	22.2	27.2	13.6	3.7				
Average Fork Length	177	224	256	307	341	396				

In-migrant Cutthroat Trout Tag Recoveries

The in-migration of tagged and/or marked cutthroat to Petersburg Creek followed closely the timing for unmarked cutthroat. A total of 65 (22.2%) cutthroat bearing a tag were recovered from a total 292 tagged on the out-migration in 1973 (Table 5). In addition, 16 (16%) cutthroat smolt, marked on their out-migration were recovered from a total of 99 marked. Also recovered during the 1973 cutthroat in-migration were 27 cutthroat tagged on their out-migration in 1972. These cutthroat were not noted in the 1972 fall in-migration nor in the 1973 spring out-migration which leads to the theory that a portion of the cutthroat population from Petersburg Creek spent the winter of 72-73 in some other system and were returning to the Creek after an absence of over 1 year. This also leads to the assumption that sea-run cutthroat do not necessarily make overwintering migrations to a specific system but are random in

their selection of overwintering areas. The capture of a tagged cutthroat in the upper area of Blind Slough in late October 1973 lends evidence to the above assumption as very little migration occurred in Petersburg Creek after mid-October 1973.

Cutthroat tagged in 1973 spent from 7-158 days at sea. Cutthroat tagged in May averaged 114 days at sea while cutthroat tagged in June spent an average of 85 days at sea. Average growth increments were also highest for the cutthroat that migrated to sea in May. These cutthroat grew an average of 48.7 mm which is almost 14 mm more growth than that recorded in 1972 (Jones, 1973). In 1972 it was found that a correlation existed between percent of return and length of time spent at sea, i.e., the greatest percent recovery was from cutthroat spending the least time at sea. In 1973 there didn't appear to be a correlation in percent recovery and length of time at sea. Those cutthroat spending the greatest time at sea (114 day average) returned at nearly the same rate as did those spending an average of only 85 days at sea. Overall, the 1973 recovery rate (22.2%) was only slightly less than the 26.6 recovery rate noted in 1972.

Table 5. Days at Sea and Growth Increment for Tagged Cutthroat Trout Recaptured at the Petersburg Creek Weir, 1973.

Monthly Period	No. Tagged	No. Recovered*	% Recovery	Days at Sea Range	Ave.	Growth Range	Increment Ave.
4/1-4/30	24	3	12.5	68-112	96	4-29 mm	13 mm
5/1-5/31	189	43	22.7	7-158	114	3-145	48.7
6/1-6/30	66	18	27.2	31-127	85	10-56	34.0
7/1-7/31	13	1	7.6	---	74	---	47.0
Totals	293	65	22.2	7-158	92	3-145	35.7

* Represents cutthroat captured throughout the in-migration period and in Petersburg Creek below the weir.

Cutthroat Tag Recoveries--Other Streams

Six streams in the Petersburg area were found to contain cutthroat tagged at the Petersburg Creek weir in 1973. This information was obtained from tags turned in by sport anglers and by recovery efforts on the part of the weir crew.

The 1973 tag recoveries came from most of the streams containing tagged cutthroat in 1972 plus recoveries from 2 new systems. These new streams were "Three Mile Creek" and Portage Bay Creek (Table 6).

As shown in Figure 3, tagged cutthroat had migrated in all directions after leaving Petersburg Creek. There appears to be a pattern to their movements away from Petersburg Creek. They seem to follow the shore line of either Mitkof Island or Kupreanof Island. No recoveries have as yet been made in streams on the south side of Sumner Strait or across Fredrick Sound on the mainland. The number of days between tagging and recovery ranged from 15 for a cutthroat caught in Blind Slough in June to 145 days for a cutthroat caught in Blind Slough in October.

Table 6. Tagged Cutthroat Recoveries from Streams other than Petersburg Creek.

Stream Number	Stream	Date Recovered	Miles from Petersburg Creek Weir	No. Recovered	No. of Days After Tagging
1	"Three Mile Cr."	7/10/73	5	1	40
	"Three Mile Cr."	8/10/73	5	1	74
	"Three Mile Cr."	9/2/73	5	1	95
2	"Blind Slough"	6/12/73	17	1	15
	"Blind Slough"	6/12/73	17	1	16
	"Blind Slough"	10/21/73	17	1	145
3	"Twelve Mile Cr."	7/15/73	18	1	70
4	Portage Bay Cr.	8/28/73	34	1	*
5	Castle River	9/2/73	34	1	*
6	Duncan Salt Cr.	7/9/73	44	1	76

* Fin Clipped fish

Other Migrants

The Petersburg Creek weir was complete and fishing on the evening of April 3, 1973. This is 20 days earlier than 1971 and 1972. The Dolly Varden, *Salvelinus malma*, out-migration from Petersburg Lake to salt water was underway before the weir was fish tight, but it is believed that only small numbers were missed in 1973. Other out-migrant species from Petersburg Creek are presented in Table 7.

Table 7. Numbers of Out-migrant Fish by Species and Month. Petersburg Creek Weir, 1973.

Month	Fish Species			
	Cutthroat	Dolly Varden	Steelhead	Coho
April	36	12,558	1 (1)*	(37)*
May	295	9,874	24 (168)	(3,323)
June	98	95	68 (295)	(176)
July	74	---	56 (8)	(28)
Totals	503	22,527	149 (472)	(3,564)

* () indicates smolt

After the middle of July it was difficult to operate the downstream traps due to the large numbers of dead salmon floating downstream. Very little downstream movement of any species occurs after mid-July and the traps were converted to upstream traps.

The in-migrant traps were complete on April 13, 1973, and the first adult steelhead were trapped on the 13th. As no adult steelhead were trapped for the first ten days of weir operation, it is apparent that the majority of the steelhead run was enumerated in 1973.

Steelhead, cutthroat and the first of the red salmon were the only in-migrants during April and May. The first of the Dolly Varden in-migration together with the other salmon species began in June and reached a peak in August (Table 8). In-migration of all species slowed in September and was almost complete when the weir was closed on the 1st of November. Presented in Table 8 are the monthly in-migrant trap counts by species for the Petersburg Creek weir in 1973.

Table 8. Numbers of In-migrant Fish by Species by Month.
Petersburg Creek Weir, 1973.

Month	Fish Species						
	Steelhead	Cutthroat	Dolly Varden	Red	Pink	Chum	Coho
April	93	2	----	---	---	---	---
May	85	12	----	3	---	---	---
June	8	5	5	33	---	---	---
July	---	56	4,530	2,324	10,771	841	---
August	---	85	11,555	27	10,105	11,150	47
September	---	586	3,803	---	55	3	342
October	---	119	4,625	---	---	---	144
Totals	186	865	24,518	2,387	20,931	11,994	533

Totals in Tables 7 and 8 do not represent the entire run for the species listed. Dolly Varden were passing downstream before the weir was fish tight in early April. All species passed in both directions during periods of extreme high water when the weir screens were removed. Several thousand pink and chum salmon normally spawn in the inter-tidal area below the weir and are not included in the total counts. The totals presented are the actual counts made during the 1973 weir operation.

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