RESEARCH PROJECT SEGMENT

State: Alaska

Project No.: F-9-4 *Name:* Sport Fish Investigations of Alaska.

Study No.: G-II *Study Title:* Sport Fish Studies.

Job No.: G-II-H *Job Title:* **Anadromous Fish Population Studies-Matanuska Valley and East Side Tributaries of the Susitna River and Tributaries of the Chulitna River.**

Period Covered: July 1, 1971 to June 30, 1972.

ABSTRACT

Boat and foot surveys conducted on Willow, Montana, and Moose creeks indicated minimum escapements of 165, 24, and 40 king salmon, Oncorhynchus tshawytscha, respectively.

A reconnaissance of spawning king salmon populations in Byers, Troublesome, and Chunilna creeks was completed. The largest king salmon count obtained was in Byers Creek where only five king salmon were observed.

Flood conditions caused extensive damage to existing spawning areas in Willow, Montana, and Moose creeks. It is believed that there was an excessive loss of king salmon eggs deposited in the gravel just prior to the flood.

A creel census conducted on Willow Creek, Little Susitna River, and Chunilna Creek resulted in an observed catch of 0, 7, and 12 king salmon, respectively. Punch card returns revealed an additional two king salmon were taken from Chunilna Creek.

Foot surveys of spawning silver salmon, O. kisutch, in established index areas on Wasilla, Cottonwood, Birch, Fish, and Meadow creeks obtained maximum counts of 104, 29, 138, 141, and 9 silver salmon, respectively.

A reconnaissance of spawning silver salmon populations in Byers, Troublesome, and Horseshoe creeks was completed. Approximately 100 silver salmon were observed in Horseshoe Creek and 35 silver salmon were counted in Byers Creek. No silver salmon were located in Troublesome Creek.

RECOMMENDATIONS

1. Retain the present objectives of the study.

2. Delineate king salmon and silver salmon spawning areas in the Little Susitna River.

3. Assist in the determination of the monetary value of recreational salmon fisheries in the Cook Inlet area.

4. Begin evaluation of returning marked king salmon stocked in Willow Creek as smolts in the spring of 1970.

OBJECTIVES

1. To investigate and evaluate population trends of anadromous fish species in the Matanuska Valley and east side tributaries of the Susitna River and tributaries of the Chulitna River.

2. To determine the recreational catch of king salmon, and evaluate angling pressure on anadromous streams in the job area.

3. To determine the monetary value of the recreational fisheries on anadromous fish streams in the job area.

4. To make recommendations for future management, and to direct the course of future studies relating to anadromous fishes within the job area.

TECHNIQUES USED

King salmon spawning populations were enumerated by aerial, boat, and streambank surveys. Silver salmon spawning populations were enumerated by foot surveys within established index areas.

A temporary weir was located in Fish Creek immediately upstream from the Goose Bay-Wasilla Highway culvert. The weir was constructed of wooden frames enclosing heavy wire screen. Salmon were identified by species and enumerated as they passed through a 3' X 3' trap built into the weir fence.

The Upper Cook Inlet king salmon sport harvest was estimated by creel census and from punch card returns. The census was designed to provide daily catch estimates for each stream open to king salmon angling. One or two census clerks, depending on fishing effort, patrolled each stream throughout the day. Anglers were contacted on the stream or at highway

access points. The punch card number and name of each successful angler were recorded. Scales, fork lengths, and sex data were obtained from the catch whenever possible. The effectiveness of the census coverage was determined from returned punch cards.

FINDINGS

History

Prior to 1964, Cook Inlet and its drainages were open to king salmon, Oncorhynchus tshawytscha, fishing. Sport and commercial fishing for king salmon was prohibited during 1964 and 1965 in an attempt to rebuild Cook Inlet king salmon stocks.

In April 1966, a staff proposal to limit sport fishing seasons for king salmon in selected freshwater streams of the Cook Inlet area was approved by the Alaska Board of Fish and Game. A quota of 250 king salmon over 50.8 cm (20 inches) in fork length was established for Upper Cook Inlet with fishing restricted to Deshka River, Lake, Chunilna, and Alexander creeks. In addition, the Board allowed a 500 king salmon harvest from four Kenai Peninsula streams.

In 1969 the area quota on three Kenai Peninsula streams was reduced from 500 to 200 king salmon, and the Kenai River was removed from the quota system. The quota of 250 king salmon for Upper Cook Inlet streams remained the same.

In 1970 the quota for Upper Cook Inlet streams was increased from 250 to 1,000 king salmon. Ship Creek was opened to king salmon fishing. The area quotas for Kenai Peninsula streams remained the same.

In 1971 the Alaska Board of Fish and Game removed all quotas previously set for Kenai Peninsula and Upper Cook Inlet streams. In addition, the Board also approved the opening of Willow Creek and Little Susitna River for the taking of king salmon.

King Salmon Studies

Escapement:

Boat and foot surveys were conducted to estimate spawning king salmon populations in Willow, Montana, and Moose creeks. Aerial and foot surveys were also conducted on Troublesome, Byers, and Chunilna creeks. An aerial survey was attempted in the North Fork of Kashwitna River, but due to dense brush overhanging the streambanks, an accurate count could not be obtained. Surveys were conducted during the peak of spawning which occurred during the latter part of July and the first week in August.

The number of king salmon observed in Willow, Moose, and Montana creeks was the lowest since foot and boat surveys began in 1969 (Table 1).

A total of 165 king salmon was enumerated during a boat survey on Willow Creek. Although water flows were higher than normal, the counting conditions were favorable and it was felt that an accurate count was achieved. Flooding conditions prevented any subsequent surveys on Willow Creek.

In Montana Creek, only 24 king salmon were observed by streambank count from the mouth to the confluence of the North and Middle forks. Surveys conducted in the same areas in 1969 and 1970 indicated that minimum escapement estimates were 150 and 261 salmon, respectively.

TABLE 1 Observed King Salmon Escapements for Willow, Montana, and Moose Creeks, 1969 - 1971.

Year	Willow Creek*	Montana Creek**	Moose Creek**
1969	290	150	No count
1970	640	261	126
1971	165	24	40
1969-1970 Average	465	205	126

*Boat Counts
**Foot Counts

Montana Creek was clear during foot surveys, but due to high stream flows, counting conditions were less than optimum. An additional 20 king salmon were counted by foot surveys in the three forks of Montana Creek.

A total of 40 king salmon were observed in Moose Creek, a tributary to Matanuska River. Counting conditions in 1971 were excellent. In 1970, the first year king salmon were observed in Moose Creek, a total of 126 king salmon were enumerated.

Surveys were conducted for the first time on Byers and Troublesome creeks, located along the new Anchorage-Fairbanks Highway. These streams drain into the Chulitna River and were reported by local residents to have had good king salmon runs ascending them prior to 1971. Only two king salmon were seen in Byers Creek during a foot count which began at the highway crossing and ended at a point approximately 1/2 mile downstream from Byers Lake. An aerial survey was conducted several days later on Byers Creek from its confluence with the Chulitna River upstream to Byers Lake. During this survey only one king salmon was observed. During a streambank count on Troublesome Creek, from the highway crossing upstream to the rapids, a

total of five king salmon were observed.

An aerial survey was conducted on Chunilna Creek, but due to high turbid water, visibility was extremely poor and only five king salmon were seen.

On August 7, heavy rains fell over the area and no further counts could be made on any of the streams. These rains continued for several days and caused extensive flooding in the Matanuska and Susitna Valleys. Water velocities steadily increased in Willow, Montana, and Moose creeks causing extensive damage to surrounding areas as well as to the streams themselves. Streambanks eroded, new channels formed, and tons of silt and gravel were carried downstream.

Since flooding conditions prevailed just after the peak of king salmon spawning, it is assumed that excessive egg loss occurred due to extensive erosion of streambeds. The extent of egg loss in Willow and Montana creeks is unknown, but is believed to be considerable due to high water velocities that occurred during the flood. It is believed that egg loss in Moose Creek approached 100% since the entire streambed was scoured out.

Recovery of king salmon carcasses for length-frequency data was impossible due to flooding conditions that occurred in 1971.

Harvest:

To estimate the king salmon harvest from Willow Creek and Little Susitna River, a creel census was conducted during three consecutive weekends beginning June 12-13.

The first weekend, over 200 vehicles were parked at Willow Creek. Despite the number of people present on the stream, very few were actually fishing. Willow Creek was fairly high and turbid. The second weekend, fewer people were present although stream conditions had improved considerably. Very few people fished. No king salmon were observed taken during both weekends. Since the fishing effort was negligible during the first two weekends, an emergency order was issued to extend the season for one additional weekend. Water conditions were ideal during the third weekend, but fishing effort was very light, and no fish were observed by census takers. Information obtained from the king salmon punch cards returned through February 1, 1972, indicated no king salmon were taken from Willow Creek.

The reason for poor fishing success on Willow Creek was attributed to a late run. Escapement counts also revealed that there was a below average run of king salmon in Willow Creek which also accounted for poor success during the season. Fishing success should have increased on the third weekend, but there was a lack of interest since no king salmon were taken during the previous two weekends.

Fishing effort on Little Susitna River was also low, and an emergency order was issued extending the season one additional weekend. Seven king salmon were censused during the three weekends.

The low catch on Little Susitna River was attributed to a lack of access to the lower section of the river. The Burma Road leads to the lower river, but heavy rains made the road passable only by off road vehicles. The river is accessible at the highway crossing at Houston, but little effort was expended at this access point. Punch card data received through February 1, 1972, also revealed seven king salmon taken in Little Susitna River.

Chunilna Creek was opened to king salmon fishing during the July 3-4, and 10-11 weekends. Chunilna Creek is accessible by riverboat or airplane. An attempt was made by a census taker to check Chunilna Creek during the first weekend, but high water conditions on Talkeetna River prevented travel by boat or plane. Water flows dropped during the week and a census taker was able to travel to the creek. Twelve king salmon were observed caught during the second weekend.

Punch card data received through February 1, 1972, showed that 14 king salmon were taken at Chunilna Creek.

Silver Salmon Studies

Escapement:

Foot surveys were conducted to estimate spawning silver salmon, O. kisutch, populations in established index areas, defined by Redick (1969) on Fish, Meadow, Wasilla, Cottonwood, and Birch creeks. The Wasilla Creek index area was established in 1970 and defined by Redick (1971).

A summary of silver salmon escapement counts in index areas is presented in Table 2.

TABLE 2 Numbers of Silver Salmon in Escapement Index Areas (Foot Counts), Upper Cook Inlet, 1968 - 1971.

Year	Wasilla Creek	Cottonwood Creek	Birch Creek	Fish Creek	Meadow Creek
1968	No count	22	125	35*	54
1969	No count	9	142	852	109
1970	101	5	206	176	49
1971	104	29	138	141**	9
1968 - 1970 Average	101	12	158	354	71

*Count was made after the peak of spawning.
**Because of high water a boat count was necessary.

Wasilla, Cottonwood, and Fish creeks are similar in that they are small creeks and extremely vulnerable to overharvest by sport fishing. Weir counts on Fish Creek have shown the effect sport fisheries can have on salmon migrations in small streams. In Fish Creek in 1969, intense angler activity along the streambanks and in the stream made salmon reluctant to leave the silty, inter-tidal area and enter the creek (Redick, 1970). Due to intense sport fisheries on Wasilla, Cottonwood, and Fish creeks, repeated emergency orders were issued closing these streams to salmon fishing. To allow proper migration of salmon, a new regulation was adopted in 1971 which permitted salmon fishing from Friday midnight through Sunday midnight of each week.

A total of 104 silver salmon were enumerated in the index area on Wasilla Creek. In 1970, the first year an index area was established on Wasilla Creek, a total of 101 silver salmon were counted.

A maximum count of 29 silver salmon was obtained during the Cottonwood Creek survey. This is the largest number of silver salmon counted in the index area since foot counts began in 1968. Several surveys conducted in the upper Cottonwood Creek system revealed an additional 45 silver salmon. This system is difficult to evaluate since there are several large lakes in the system. Silver salmon tend to stay in the lakes until they mature and then move into the small adjoining creeks to spawn.

A total of 138 silver salmon were enumerated in the index area on Birch Creek. Since 1968 the number of silver salmon counted in the index area has been relatively stable with counts ranging from 125 in 1968 to a high of 206 in 1970. In 1971 counting conditions were not optimum as stream flows were considerably higher than in past years.

Only nine silver salmon were counted in the index area on Meadow Creek, which drains a series of lakes and flows into Big Lake. The 1971 count was the lowest since counts began in 1968. Water levels in Meadow Creek were at critically low levels from 1968 to 1970. In 1971 the water level was higher than during the previous three years and it was thought that spawning may have occurred further upstream in the system. During a survey made above the index area only three silver salmon were observed. The index area was checked three times to be sure the run did not occur later than normal.

A count of 141 silver salmon was obtained in the index area on Fish Creek, the outlet of Big Lake. This is the lowest count since the index area was established in 1968. Counting conditions were less than optimum due to extremely high stream flows. The increase was due to the installation of an additional culvert installed at the road crossing. This culvert was installed to lower the water level in Big Lake in order to relieve flooding conditions around the lake shore.

In 1971 the Commercial Fish Division continued operation of the Fish Creek weir. In 1969, this weir allowed index area escapement counts in Fish and Meadow creeks to be evaluated against a numerically known escapement. In 1970, this evaluation was not possible because on August 8, a sudden rise in Fish Creek's flows washed the weir downstream. During August, 1971,

heavy rains caused severe flooding conditions in all streams in the Matanuska and Susitna Valleys. As in 1970 the weir on Fish Creek was again washed downstream on August 8, so index area escapement counts could not be evaluated in 1971.

A total of 583 silver salmon had been counted through the weir before it washed out. Total silver salmon escapement could not be estimated since migration of this species was in progress when the weir washed out.

In 1969 and 1970, escapement through August 8 was 1,071 and 1,040 silver salmon, respectively. If run timing remains relatively constant from year to year, the escapement of 583 silver salmon through August 8, 1971 indicates a substantially reduced run. The fact that a reduced run occurred in Fish Creek was substantiated by the index area count which was the lowest since counts began in 1968.

Byers, Troublesome, and Horseshoe creeks, all crossing the new Anchorage-Fairbanks Highway, were surveyed by foot. No index areas were established on these three streams.

During a foot survey on Troublesome Creek no silver salmon were observed from the highway bridge downstream to Chulitna River. A total of 70 chum salmon, O. keta, were observed spawning in the surveyed area.

Thirty-five silver salmon were counted by foot survey on Byers Creek from the highway bridge downstream to Chulitna River. During this survey approximately 1,100 chum salmon were seen spawning near the confluence of Byers Creek and Chulitna River.

A maximum count of 100 silver salmon was obtained during a foot survey on Horseshoe Creek. A construction camp was located near Horseshoe Creek and workers had been fishing for silver salmon so a fishery does exist on this stream. The stream is small and will require intensive management to maintain escapement.

Since the surveys on Troublesome, Byers, and Horseshoe creeks were designed only to determine the presence of silver salmon in these streams, the counts obtained are not an indication of total spawning silver salmon populations. A more intense survey will be conducted on these streams in 1972 to determine spawning distribution and numbers of silver salmon.

The economic survey of salmon anglers was not conducted during the summer due to a general lack of angling effort in the Willow area. Low fishing effort was attributed to heavy rainfalls and low salmon escapements in popular fishing streams crossing the highway between Willow and Talkeetna.

LITERATURE CITED

Redick, R. Russell. 1969. Inventory and Cataloging of the Sport Fish and Sport Fish Waters in the Cook Inlet Drainage. Alaska Department of Fish and Game. Federal Aid In Fish Restoration, Annual Report of Progress, 1968-1969, Project F-9-1, 10:213-232.

_____. 1970. Inventory, Cataloging, and Population Sampling of the Sport Fish and Sport Fish Waters of the Cook Inlet Drainage. Alaska Department of Fish and Game. Federal Aid In Fish Restoration, Annual Report of Progress, 1969-1970, Project F-9-2, 11:189-210.

_____. 1971. Inventory, Cataloging, and Population Sampling of the Sport Fish and Sport Fish Waters of the Cook Inlet Drainage. Alaska Department of Fish and Game. Federal Aid In Fish Restoration, Annual Report of Progress, 1970-1971, Project F-9-3, 12(G-1):65-94.

Prepared by:

David A. Watsjold
Fishery Biologist

Approved by:

s/Howard E. Metsker
D-J Coordinator

Date: April 30, 1972.

s/Rupert E. Andrews, Director
Division of Sport Fish

Volume 13 Report No. G-II-I

RESEARCH PROJECT SEGMENT

State: Alaska

Project No.: F-9-4 *Name:* Sport Fish Investigations of Alaska.

Study No.: G-II *Study Title:* Sport Fish Studies.

Job No.: G-II-I *Job Title:* **A Study of Steelhead-Cutthroat Trout in Alaska.**

Period Covered: July 1, 1971 to June 30, 1972.

ABSTRACT

This report covers the first year's operation of a project on Petersburg Creek designed to study the life history of the sea-run cutthroat trout, Salmo clarki, and the steelhead trout, S. gairdneri, in a typical Southeast Alaska lake-stream system.

An estimated 806 steelhead migrated upstream past the Petersburg Creek weir between April 22 and June 21, 1971, with the peak of migration occurring in early May. Age composition of the adult steelhead migration was determined from scale samples collected at the weir traps. The steelhead run contained 23 age classes, with 43% of the migration spawning for the second time.

The cutthroat seaward migration began in early May and a total of 202 were enumerated by early August. The in-migration of cutthroat to Petersburg Creek began in late August with a total of 505 passing upstream by the end of October.

Studies of rearing steelhead and cutthroat in the Petersburg Creek system showed that the rearing steelhead were found in many different habitat types, but preferred the swift water areas over a substrate of large stones. Rearing cutthroat were restricted in their distribution to the slough-like areas above and below Petersburg Lake.

RECOMMENDATIONS

1. Construct an adequate weir in 1972 to accurately determine the number of the sea-run cutthroat and steelhead entering and leaving Petersburg Creek.

2. Investigate the migratory habits of Petersburg Creek cutthroat, once they have passed downstream through the weir.

3. Locate the spawning grounds for steelhead and cutthroat in the Petersburg Creek system. Foot surveys during the spawning season on all major tributaries to the Petersburg Creek system should be conducted in 1972.

4. Study the freshwater rearing habitat requirements and food habits, with emphasis on the sea-run cutthroat.

5. Investigate other steelhead populations in Southeast Alaska.

OBJECTIVES

1. To determine the numbers and timing of anadromous cutthroat and steelhead in a selected stream system.

2. To determine the length, weight, sex, and age of anadromous cutthroat and steelhead in a selected stream system.

3. To determine the maturity composition of andromous cutthroat leaving and entering a selected stream system.

4. To determine the food of steelhead smolts and out-migrant cutthroat smolts and adults in a selected system.

5. To determine the distribution of spawning cutthroat and steelhead in a selected stream system.

6. To determine the distribution of rearing cutthroat and steelhead in a selected stream system.

7. To determine the numbers and timing of other salmonids in a selected stream system.

8. To compile an annotated bibliography of selected references on cutthroat and steelhead.

TECHNIQUES USED

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

A weir with upstream and downstream trapping facilities was completed in the upper intertidal area of Petersburg Creek on April 22, 1971. The weir was 165 feet long and 3 feet high. During extreme high tides, an additional 4 vertical feet of screens were added to prevent fish passage. The weir was of a vertical screen panel type using 2.54 cm and/or 1.58 cm hardware cloth to halt fish passage. One downstream trap and two upstream traps were placed at points determined to be most attractive to migrating fish.

All in-migrant steelhead captured at the weir were anesthetized with tricaine methanesulfonate (MS-222), weighed, measured, and marked by punching a hole in the left opercular cover. The fish were then transferred to a freshwater tank to recover. All out-migrant steelhead captured were anesthetized and examined for marks. Those not marked were weighed, measured, and marked with the same mark as used for in-migrants. Scale collections for age determinations were collected from all steelhead.

All out-migrant cutthroat were anesthetized with MS-222, measured, and marked by punching a hole in the upper lobe of the caudal fin. All in-migrant cutthroat were anesthetized, measured, and examined for marks. All in-migrant cutthroat were marked by punching a hole in the lower lobe of the caudal fin.

To estimate the total in-migration of adult steelhead, a marked-to-unmarked ratio of the out-migrants (Petersen estimate) was used to estimate the total number of steelhead that entered Petersburg Creek in 1971.

Every tenth in- and out-migrant cutthroat captured at the weir was killed, measured, weighed, and sexed. Otoliths and scale samples were collected from these fish for age determination. Reproductive maturity and the presence of residual eggs were noted. Stomach contents were examined and classified.

Foot surveys, electroshocking, baited minnow traps, and dip nets were used to determine the distribution of rearing steelhead and cutthroat in the Petersburg Creek system.

The upstream migrations of Dolly Varden and various salmon species were enumerated by removing them from the weir traps with a dip net or by removing a weir screen and counting as they crossed a flash board.

FINDINGS

Steelhead

Numbers and Timing:

An estimated 806 steelhead, Salmo gairdneri, entered Petersburg Creek in 1971. This migration began in late March, peaked in mid-May, and was terminated in late June.

The estimated in-migration of adult steelhead was calculated using Bailey's modification of Petersen's formula (Ricker, 1958) as follows:

$$\hat{N} = \frac{M\ (C + 1)}{R + 1} = \frac{87\ (241)}{26} = 806$$

where

M = 87 marked fish
C = 240 fish sampled
R = 25 marked fish recaptured

The majority of the in-migrant steelhead entered the trap during rising water levels at night. Schools of fish were often observed during the day below the weir, but few steelhead entered the trap during the day. Water temperatures in Petersburg Creek averaged 3°C during the peak of steelhead in-migration with a range of 2° - 6°C.

Many steelhead returned to sea shortly after spawning. The out-migration of spent steelhead started in June, peaked on June 22, and terminated in August (Table 1).

TABLE 1 Steelhead Migration by Month, Petersburg Creek, 1971.

Month	Direction of Migration	
	Upstream	Downstream
April	9	---
May	62	---
June	16	232
July	--	4
August	--	4
Total	87	240

Age-Sex Relationships:

To determine the age-sex relationships of the Petersburg Creek steelhead, scale samples were obtained and sex determined from all steelhead trapped at the weir during the in- and out-migrations. Eighty-seven scales were obtained for in-migrant steelhead and 240 were collected from spent fish on their out-migration. A total of 280 scales from the combined in- and out-migrant fish were readable for total age determinations. No difference in total age was apparent in the two groups and all scales were combined for final analysis.

Twenty-three age classes (ages 2.2 - 4.3S) were present in the Petersburg Creek steelhead population (Table 2). Age classes are presented using the aging method described 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. Initial spawners are those steelhead without an "S" in their total age.

The fish sampled had spent two (27.5%), three (56.8%), and four (15.7%) winters in fresh water. The numbers of winters spent in salt water by the sampled fish were two (34.6%), three (40.1%), four (16.8%), five (6.0%), six (2.1%), and seven (0.4%). The most frequently occurring of the female steelhead were age 3.3, while the most frequently occurring males were age 3.2. The high number of age classes in the population is due to the variable age of smolt migration and to the high occurrence of repeat spawners (43%) in the total run.

TABLE 2 Age Classes, Petersburg Creek Steelhead, 1971.

Age Class	No. SH	No. Females	No. Males	% Total
2.2	18	4	14	6.4
2.2S	13	2	11	4.6
2.2SS	3	2	1	1.1
2.2SSS	2	1	1	0.7
2.3	22	14	8	7.9
2.3S	8	4	4	2.9
2.3SS	7	4	3	2.5
2.3SSS	2	2	-	0.7
2.3SSSS	1	1	-	0.4
2.4	1	1	-	0.4
3.2	44	16	28	15.7
3.2S	33	14	19	11.8
3.2SS	12	7	5	4.3
3.2SSS	2	2	-	0.7

TABLE 2 (Cont.) Age Classes, Petersburg Creek Steelhead, 1971.

Age Class	No. SH	No. Females	No. Males	% Total
3.3	40	27	13	14.3
3.3S	18	13	5	6.4
3.3SS	6	5	1	2.1
3.3SSS	4	4	-	1.4
4.2	34	19	15	12.1
4.2S	5	3	2	1.8
4.2SS	2	-	2	0.7
4.3	1	-	1	0.4
4.3S	2	2	-	0.7
Total	280	148	132	100.0

Frequency of Spawning:

During the Petersburg Creek weir operation in 1971, 57% of the steelhead sampled were spawning for the first time and 43% spawned two or more times. The number of years the sampled steelhead have spawned is presented in Table 3.

TABLE 3 Steelhead Spawning Frequency, Petersburg Creek, 1971.

Sex	Number of Spawning Runs					Total
	One	Two	Three	Four	Five	
Male	78	41	12	1	0	132
Female	82	38	18	9	1	148
Total	160	79	30	10	1	280

Initial Spawners:

Steelhead spawning for the first time were from seven age classes. The mode for initial female spawners was age 3.3, while that for males was 3.2 (Table 4).

TABLE 4 Age Classes of Initial Steelhead Spawners by Sex, Petersburg Creek Weir, 1971.

Age Class	No. SH	No. Females	No. Males	% Total
2.2	18	4	14	11.3
2.3	22	14	8	13.8
2.4	1	1	--	0.6
3.2	44	16	28	27.5
3.3	40	27	13	25.0
4.2	34	19	15	21.3
4.3	1	1	--	0.6
Total	160	82	78	100.1

Repeat Spawners:

The high occurrence of repeat spawners (43%) in the Petersburg Creek steelhead population was not expected. Samples of the Situk River steelhead population at Yakutat in 1970 and 1971 showed that 35% were repeat spawners (McHugh, et al., 1971). It was thought the Situk River population was unique in containing a high number of repeat spawners, but it now appears that Petersburg Creek contains a steelhead run with an even higher percent of repeat spawners.

A breakdown of repeat spawners by sex shows females outnumber males by 1.2:1. Sixteen age classes were represented among the repeat spawners. The mode for both female and male repeat spawners was age 3.2S (Table 5).

Examination of the 66 female repeat spawners revealed 38 (58%) were spawning for the second time, 18 (27%) for the third time, 9 (14%) for the fourth time, and 1 (2%) was spawning for the fifth time. On examination of the 54 male repeat spawners, 41 (76%) were spawning for the second time, 12 (22%) for the third time, and 1 (2%) for the fourth time.

TABLE 5 Age Classes of Steelhead Repeat Spawners by Sex, Petersburg Creek, 1971.

Age Classes	No. SH	No. Females	No. Males	% Total
2.2S	13	2	11	10.8
2.2SS	3	2	1	2.5
2.2SSS	2	1	1	1.7
2.3S	8	4	4	6.7
2.3SS	7	4	3	5.8
2.3SSS	2	2	-	1.7
2.3SSSS	1	1	-	0.8
3.2S	33	14	19	27.5
3.2SS	12	7	5	10.0
3.2SSS	2	2	-	1.7
3.3S	18	13	5	15.0
3.3SS	6	5	1	5.0
3.3SSS	4	4	-	3.3
4.2S	5	3	2	4.2
4.2SS	2	-	2	1.7
4.3S	2	2	-	1.7
Total	120	66	54	100.0

Length-Weight Relationships:

Length-weight data were collected from 280 steelhead trapped at the Petersburg Creek weir in 1971. The average length and weight of females and males for all age groups were almost identical. Examining the average length and weight of initial and repeat spawners, it is apparent that the older repeat spawners are almost all "trophy size" (5.4 kg) fish. Table 6 presents the length-weight relationship of Petersburg Creek steelhead in 1971. The reputation of Petersburg Creek as a trophy steelhead stream rests almost entirely on the large numbers of repeat spawners in the total population.

TABLE 6 Steelhead Length-Weight Relationships, Petersburg Creek, 1971.

	No. in Sample	Length (cm) Range	Length (cm) Avg.	Weight (kg) Range	Weight (kg) Avg.
Initial Spawners	158	60.9 - 102.8	74.6	2.2 - 8.4	4.3
Repeat Spawners	122	68.6 - 102.8	85.3	4.1 - 10.7	6.2

Cutthroat Out-Migration:

The seaward migration of cutthroat, S. clarki, in Petersburg Creek began in early May, peaked in June, and was nearly complete by mid-July. Weir screen panels were of 2.54 cm mesh during this period and only the larger smolts were captured. The majority of the cutthroat trapped were spent adults over 200 mm in length (Table 7). Water temperatures during the out-migration ranged from 3° - 6°C, with the peak of migration occurring at temperatures above 4°C. Petersburg Creek cutthroat migrated at a later date and at lower water temperatures than those observed at Lake Eva, Alaska, where water temperatures averaged 6°C during the peak of out-migration (Armstrong, 1971). Spring, 1971, was unusually late and probably accounted for the late migration timing. Nearly all of the out-migrant cutthroat entered the trap during the hours of darkness on rising stream flows.

The average lengths of out-migrant cutthroat are somewhat biased upward as the smaller initial out-migrants passed through the large mesh weir screens unsampled. Also, total out-migrants trapped is low due to the many hours the weir was inoperative during flood conditions.

TABLE 7 Numbers and Lengths of Out-Migrant Cutthroat by Month, Petersburg Creek Weir, 1971.

Month	No. of Fish	Length (mm) Range	Length (mm) Avg.	% Total
May	36	144 - 360	257	17.8
June	161	166 - 480	217	79.7
July	4	216 - 394	265	2.0
August	1	273	---	0.5
Totals	202	144 - 480	246	100.0

In-Migration:

A total of 505 in-migrant cutthroat were enumerated at the Petersburg Creek weir during 1971. A small number of mature cutthroat passed upstrem in May. These fish were in advanced spawning condition, and their origin is uncertain as the weir is in the intertidal area; it was assumed that no cutthroat were overwintering below the weir site. Small numbers of cutthroat also passed the weir in June and July. These fish did not have the appearance of having spent any

time at sea and are believed to be part of the out-migration that remained in Petersburg Creek below the weir. The sea-run in-migration began in August, peaked in mid- to late-September, and was complete by the end of October (Table 8). This pattern closely parallels that of the in-migration at Lake Eva, Alaska, in 1962-1964 (Armstrong, 1971). Petersburg Creek cutthroat migrated at night, but good numbers also migrated during high water periods during daylight hours. Water temperatures were 12°C at the start of in-migration, averaged 10°C during the peak, and dropped to 4°C at the end.

TABLE 8 Numbers and Lengths of In-Migrant Cutthroat by Month, Petersburg Creek Weir, 1971.

Month	No. of Fish	Length (mm) Range	Avg.	% Total
May	6	255 - 430	342	1.2
June	8	254 - 433	332	1.6
July	7	217 - 430	303	1.4
August	12	178 - 470	293	2.4
September	330	140 - 513	258	65.3
October	142	171 - 440	305	28.1
Total	505	140 - 513	306	100.1

Exact numbers of cutthroat migrating into Petersburg Creek in 1971 were not determined. There were several long periods during the peak of in-migration when the weir was removed due to flood conditions. The number of marked cutthroat recaptured (2.6% of the total in-migration) was too small to be used for a valid analysis using the Petersen formula. As the weir was not a barrier to migration during approximately 50% of the peak of in-migration, the 500 cutthroat trapped may represent approximately 50% of the total 1971 in-migration. It is estimated, therefore, that the total 1971 Petersburg Creek in-migration was 1,000 cutthroat.

Age-Length Relationships:

Twenty-one out-migrant cutthroat otoliths were read for total age. Four age groups were present in the sample with the youngest being age 3. Eighty-one percent of the out-migrant cutthroat showed four and five annuli on their otoliths (Table 9).

TABLE 9 Age-Length Relationships of Out-Migrant Cutthroat, Petersburg Creek Weir, 1971.

Fork Length (mm)	Age (No. of Annuli) 3	4	5	6	Total	% Total
141 - 160	1	-	-	-	1	4.8
161 - 180	-	-	-	-	0	0.0
181 - 200	1	-	-	-	1	4.8
201 - 220	-	1	1	-	2	9.5
221 - 240	-	4	3	-	7	33.3
241 - 260	-	1	1	-	2	9.5
261 - 280	-	-	5	1	6	28.6
281 - 300	-	-	1	-	1	4.8
301 - 320	-	-	-	1	1	4.8
Total	2	6	11	2	21	
% Total	9.5	28.6	52.4	9.5		100.0
Avg. Length (mm)	169	233	253	284		

Age-length data were collected from a random sample of 76 in-migrant cutthroat. These trout ranged from 3 - 8 years, with 73.8% showing four and five annuli on their otoliths (Table 10).

TABLE 10 Age-Length Relationships of In-Migrant Cutthroat, Petersburg Creek Weir, 1971.

Fork Length (mm)	Age (No. of Annuli) 3	4	5	6	7	8	Total	% Total
141 - 160	1	-	-	-	-	-	1	1.3
161 - 180	3	1	-	-	-	-	4	5.3
181 - 200	2	5	-	-	-	-	7	9.2
201 - 220	3	6	-	-	-	-	9	11.8
221 - 240	-	6	2	-	-	-	8	10.5
241 - 260	-	9	1	-	-	-	10	13.2
261 - 280	-	6	4	-	-	-	10	13.2
281 - 300	-	1	2	-	-	-	3	3.9
301 - 320	-	-	6	2	-	1	9	11.8
321 - 340	-	1	3	1	1	-	6	7.9

TABLE 10 (Cont.) Age-Length Relationships of In-Migrant Cutthroat, Petersburg Creek Weir, 1971.

Fork Length (mm)	Age (No. of Annuli) 3	4	5	6	7	8	Total	% Total
341 - 360	-	1	1	-	-	1	3	3.9
361 - 380	-	-	-	3	-	-	3	3.9
381 - 400	-	-	1	-	1	-	2	2.6
401 - 420	-	-	-	-	1	-	1	1.3
Total	9	36	20	6	3	2	76	
% Total	11.8	47.4	26.4	7.9	3.9	2.6		100.0
Avg. Length (mm)	187	242	289	342	365	318		

Reproductive maturity was noted for the cutthroat sampled during the out- and in-migrations. The out-migrant cutthroat were comprised almost entirely of spawned-out mature fish, with only 9% of the sample showing little gonadal development. This is probably biased as the majority of the cutthroat migrating to sea for the first time passed unchecked through the weir screens.

The in-migration was sampled more accurately as weir screens were of smaller mesh (1.6 cm) and captured all age groups in the migration. Fifty-six percent of the in-migrants were not sufficiently mature to spawn in the spring, 1972. This contrasts greatly with studies conducted on Sand Creek, Oregon, where nearly 95% of all in-migrant cutthroat were potential spawners (Sumner, 1962).

It is apparent that Petersburg Creek sea-run cutthroat spawning population is quite small, comprising less than 50% of the estimated 1,000 sea-run population.

Other Migrants

The Dolly Varden, Salvelinus malma, out-migration from Petersburg Lake to salt water was nearly completed when the Petersburg Creek weir became an effective barrier on April 22, 1971. This was confirmed by the large schools of Dolly Varden in Wrangell Narrows and the lower intertidal reaches of Petersburg Creek during weir construction. The few Dolly Varden trapped and released

downstream represented only the remainder of the out-migration. During August and September, it was almost impossible to operate the downstream trap due to the large numbers of dead salmon floating downstream. Table 11 presents the monthly downstream trap counts for the Petersburg Creek weir in 1971.

TABLE 11 Monthly Downstream Trap Counts, Petersburg Creek Weir, 1971.

Month	Fish Species		
	Cutthroat	Dolly Varden	Steelhead
April	---	179	---
May	36	1,465	2*
June	161	27	233
July	4	---	4
August	1	---	3
Total	202	1,671	242

*Steelhead smolts.

The upstream trap was completed on April 22 and the first adult steelhead was captured on April 23. As the steelhead in-migration increased in May, an additional upstream trap was constructed to handle the increasing numbers of fish. Only cutthroat and steelhead were captured during April and May. The Dolly Varden in-migration started in late June together with the first of the sockeye salmon, Oncorhynchus nerka, run. The monthly upstream trap counts for the Petersburg Creek weir are presented in Table 12.

Totals in Table 12 do not represent the entire run for the species listed. Many fish passed the weir uncounted during high water periods, and several thousand pink, O. gorbuscha, and chum, O. keta, salmon spawned in the intertidal area below the weir. The totals given are the actual counts during the 1971 weir operation.

TABLE 12 Number of Upstream Migrants Enumerated at the Petersburg Creek Weir, 1971.

Month	Fish Species*						
	SH	CT	DV	RS	PS	CS	SS
April	9	---	--	--	--	--	---
May	62	6	--	--	--	--	---
June	16	8	3	39	--	--	---
July	--	7	1,240	479	--	10	---
August	--	12	5,849	4,239	27,608	1,265	28
September	--	330	2,825	--	482	1	6
October	--	142	1,726	--	1	7	415
Total	87	505	11,643	4,757	28,091	1,283	449

*SH - Steelhead trout
CT - Cutthroat trout
DV - Dolly Varden
RS - Red salmon
PS - Pink salmon
CS - Chum salmon
SS - Silver salmon

Steelhead-Cutthroat Rearing Requirements

During July an attempt was mde to locate and classify the rearing habitat of steelhead and sea-run cutthroat in the Petersburg Creek system. Two capture methods were tested but only one proved successful.

A backpack electro shocker was tested in Petersburg Creek and one large tributary. Several problems developed and it was apparent that a better capture method would be needed.

Wire mesh minnow traps baited with cured salmon eggs were tested and worked well in all areas sampled. The minnow traps were also much easier to transport from site to site and allowed a greater coverage of the streams.

The Petersburg Creek system contains three major tributaries and numerous lesser tributaries (Figure 1). Rearing steelhead and/or cutthroat were found in all areas sampled.

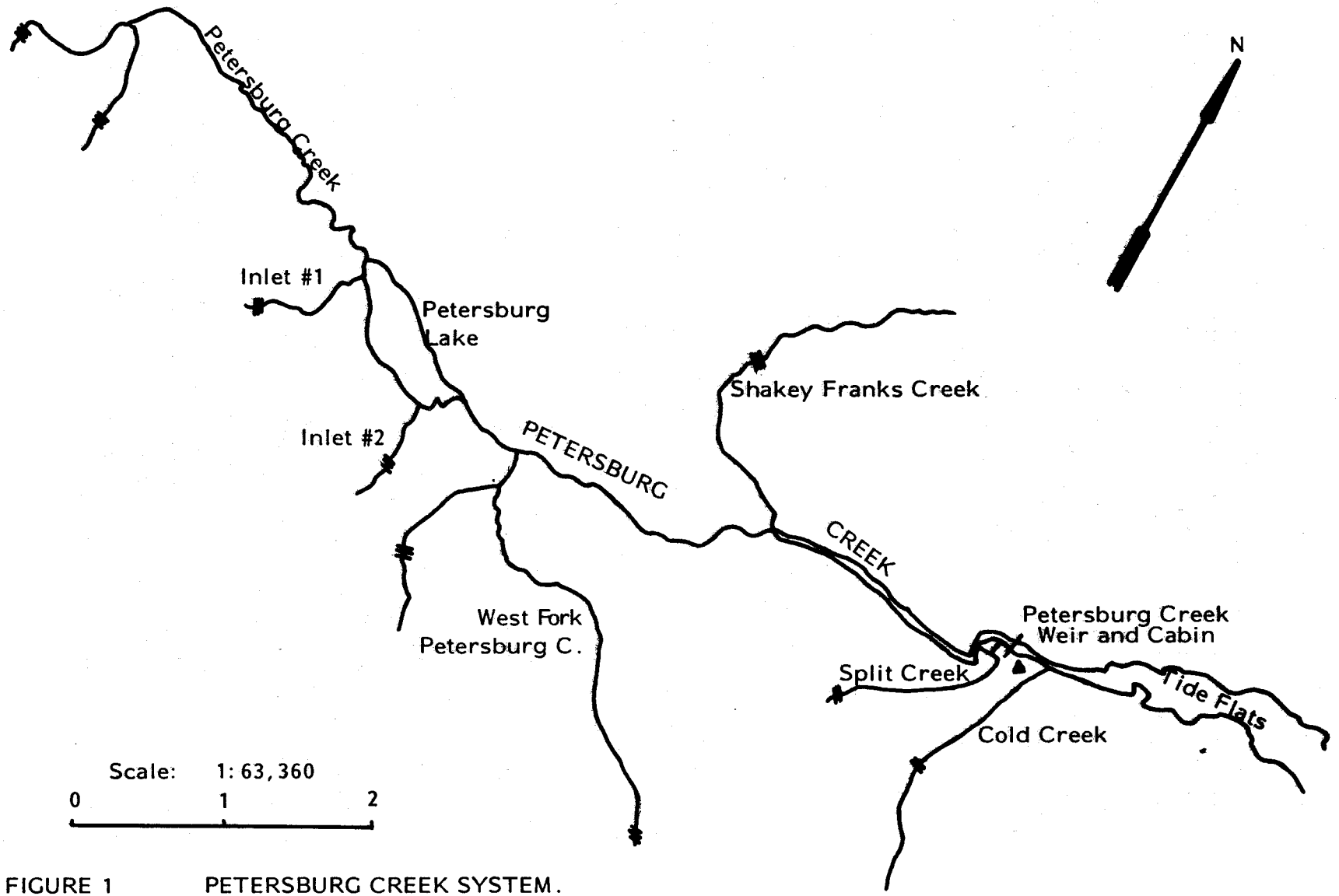

FIGURE 1 PETERSBURG CREEK SYSTEM.

Steelhead Habitat:

Rearing steelhead were found in still and moving water in all areas except Petersburg Lake proper. Steelhead were found in Cold, Split, Shakey Franks, West Fork of Petersburg Creek, and in Petersburg Creek. Rearing steelhead were most abundant in the fast water areas of the tributaries; however, good numbers were also present in the deep pool areas of Petersburg Creek. The most favored rearing habitat type for Petersburg Creek system steelhead is a stream section 15 - 60 cm deep, having moderate to fast flow over a substrate of large stones. Stream areas with overhanging vegetation and/or logs and undercut banks did not seem to be as favored as the more open fast water areas. Rearing steelhead were found throughout several small tributaries from their confluence with Petersburg Creek to the extreme upper limits of possible fish migration.

Cutthroat Habitat:

Rearing cutthroat were found in a more restrictive habitat type than that of steelhead. Rearing cutthroat in the Petersburg Creek system preferred the slough-like areas above and below Petersburg Lake and the shoreline areas of Petersburg Lake. Several beaver ponds along Petersburg Creek and adjacent to the inlet of Petersburg Lake were found to contain rearing cutthroat but not rearing steelhead. Rearing steelhead and cutthroat were found together only in the West Fork of Petersburg Creek. The cutthroat were found in the slow, deep pool areas and the steelhead in the moving water between pools.

Rearing Steelhead-Cutthroat Age-Length Relationships

A total of 120 young steelhead were examined for biological data. A representative sample was taken from each of the various tributaries and habitat types. The steelhead were measured and otoliths were taken for age determination. Four age groups (ages 1 - 4) ranging from 42 - 168 mm, were found rearing in the Petersburg Creek system (Table 13). Young steelhead in the four age groups found in all habitat types. The older steelhead were most abundant in the larger tributaries while the younger fish were concentrated in the smaller tributaries.

A total of 28 rearing cutthroat from all representative habitat types were sampled for age-length relationships. Only three age groups (ages 2 - 4) were present in the fish sampled (Table 14). The sampling gear was apparently either selective to the older age groups of cutthroat, or age 1 cutthroat were not rearing in the area sampled.

TABLE 13 Age-Length Relationships of Rearing Steelhead, Petersburg Creek System, 1971.

Fork Length (mm)	Age (No. of Annuli) 1	2	3	4	Total	% Total
41 - 50	1	-	-	-	1	0.8
51 - 60	5	-	-	-	5	4.2
61 - 70	6	4	-	-	10	8.3
71 - 80	7	7	-	-	14	11.7
81 - 90	1	12	1	-	14	11.7
91 - 100	-	15	-	-	15	12.5
101 - 110	-	9	7	-	16	13.3
111 - 120	-	1	10	-	11	9.2
121 - 130	-	1	14	1	16	13.3
131 - 140	-	-	4	1	5	4.2
141 - 150	-	-	2	8	10	8.3
151 - 160	-	-	-	2	2	1.7
161 - 170	-	-	-	1	1	0.8
Total	20	49	38	13	120	
% Total	16.7	40.8	31.7	10.8		100.0
Avg. Length (mm)	71	90	116	155		

TABLE 14 Age-Length Relationships of Rearing Cutthroat, Petersburg Creek System, 1971.

Fork Length (mm)	Age (No. of Annuli) 2	3	4	Total	% Total
71 - 80	2	-	-	2	7.1
81 - 90	2	-	-	2	7.1
91 - 100	3	2	-	5	17.9
101 - 110	4	-	-	4	14.3
111 - 120	-	1	-	1	3.6
121 - 130	-	4	2	6	21.4
131 - 140	-	1	-	1	3.6
141 - 150	-	4	-	4	14.3
151 - 160	-	2	-	2	7.1
161 - 170	-	-	1	1	3.6
Total	11	14	3	28	
% Total	39.3	50.0	10.7		100.0
Avg. Length (mm)	96	121	136		

LITERATURE CITED

Armstrong, Robert H. 1963. Investigations of Anadromous Dolly Varden Populations in the Lake Eva-Hanus Bay Drainages, Southeastern Alaska. Alaska Department of Fish and Game. Federal Aid In Fish Restoration, Annual Report of Progress, 1962-1963, Project F-5-R-4, 4: 78-122.

_____. 1971. Age, Food and Migration of Sea-Run Cutthroat Trout, Salmo clarki, at Eva Lake, Southeastern Alaska. Transactions of the American Fisheries Society, 100(2): 302-306.

McHugh, Michael J., Darwin E. Jones, and Robert T. Baade. 1971. Inventory and Cataloging of the Sport Fish and Sport Fish Waters in Southeast Alaska. Alaska Department of Fish and Game. Federal Aid In Fish Restoration, Annual Report of Progress, 1970-1971, Project F-9-3, 12(G-I): 1-27.

Narver, David W. and Fred C. Withler. 1971. Age and Size of Steelhead Trout (Salmo gairdneri) in Anglers' Catches from Vancouver Island, British Columbia, Streams. Fisheries Research Board of Canada Circular 91: 1-26.

Ricker, W. E. 1958. Handbook of Computations for Biological Statistics of Fish Populations. Fisheries Research Board of Canada, Bulletin No. 119, p. 84.

Sumner, Francis H. 1962. Migration and Growth of Coastal Cutthroat Trout in Tillamook County, Oregon. Transactions of the American Fisheries Society, 91(1): 77-83.

Prepared by:

Darwin E. Jones
Fishery Biologist

Approved by:

s/Howard E. Metsker
D-J Coordinator

Date: May 1, 1972.

s/Rupert E. Andrews, Director
Division of Sport Fish