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SOCKEYE SALMON (*Oncorhynchus nerka*) STUDIES IN COPPER RIVER-PRINCE WILLIAM SOUND, 1980

By:
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September 1983

ALASKA DEPARTMENT OF FISH AND GAME
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Don W. Collinsworth
Commissioner

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SOCKEYE SALMON *(ONCORHYNCHUS NERKA)* STUDIES IN COPPER RIVER-PRINCE WILLIAM SOUND, 1980[1]

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ABSTRACT

Sockeye salmon *(Oncorhynchus nerka)* catalog and inventory studies were continued by the Alaska Department of Fish and Game in the Copper River-Prince William Sound, Alaska area from 1 July 1980 through 30 June 1981. The 1980 Copper River sockeye salmon commercial catch was 18,451 fish, the lowest since 1892. The Prince William Sound catch of 211,742 sockeye salmon was above average. Age class composition of the severely limited Copper River commercial harvest was similar to prior years with 5-year fish or age class 1.3 predominating and age classes 1.2 and 2.3 (4 and 6 year-olds) accounting for the majority of the remaining catch. Lengths by age class were similar to prior years. Prediction of the total Copper River sockeye salmon harvest from early period catches was not accurate as a result of closure of the commercial fishery. Third year operation of side scanning sonar counters provided an in-season escapement estimate and was instrumental in the management of the Copper River sockeye fisheries. Weirs were operated at Long Lake and Fish Creek in the continuing program for establishing improved aerial index estimates of spawning populations. Eshamy and Coghill weirs were operated again in Prince William Sound. Further work has been done in providing an anadromous fish stream catalog for the Copper River and Prince William Sound drainages. There was a slight increase in the number of dip net permits but a decrease in fishwheel permits issued in 1980, as well as a 6% decrease in the sockeye subsistence take compared to 1979. The Gulkana River sockeye salmon stream side incubation system, initially installed in 1973 and expanded in 1974 to 5 units, in 1979 to 10 units, and in 1980 to 20 units, was loaded with 6,228,906 green eggs.

An experimental design testing the effects of loading density, layering and substrate on fry development, size, and survival was incorporated into the 1980 incubation system operation. Results of the experiment will be presented in a separate paper.

INTRODUCTION

The Copper River, Alaska salmon studies began in 1967. Inclusion of the Prince William Sound sockeye salmon populations within the scope of the project began in 1974. The primary intent was to combine all data collection associated with sockeye salmon *(Oncorhynchus nerka)* in the management area under one project and to incorporate the data into a stream catalog being prepared for sockeye salmon of the Copper River-Prince William Sound area. Catalog and inventory studies have been conducted annually be the Division of Commercial Fisheries of the Alaska Department of Fish and Game (ADF&G) with funding by the National Marine Fisheries Service (NMFS) and the State of Alaska. Federal funding since 1 July 1967 has been allocated under the authorization of the Anadromous Fish Conservation Act (P.L. 89-304, as amended). This report deals with the period from 1 July 1980 through 30 June 1981.

The Copper River and its extensive delta form a complex spawning system utilized by sockeye salmon, and to a lesser degree, chinook *(O. tshawytscha)* and coho *(O. kisutch)*, plus a few pink salmon *(O. gorbuscha)* and chum salmon *(O. keta)*. These waters are glacial, or are reached by migration through glacial streams. Inherent in dealing with glacial systems are problems in location and enumeration of salmon along their migration route and on the spawning grounds. Prince William Sound sockeye populations are widely scattered with few large stocks.

Figure 1 shows the Copper River delta complex, the entire upper Copper River system, Bering River, as well as the commercial fishery zone, sonar site, and the subsistence fishing zone. The Prince William Sound area with field camp sites and major sockeye areas is shown in Figure 2.

Goals of the Copper River-Prince William Sound Sockeye Salmon Catalog and Inventory Project are to provide rapid assessment of escapement levels during the commercial fishing season and a sound base from which escapement goals and total run predictions can be formulated. During the report period attempts were made to accomplish the following objectives:

1) monitor the commercial harvest of sockeye and chinook salmon,

2) evaluate sonar salmon counting in the Copper River,

3) monitor sockeye and chinook salmon escapement,

4) develop improved aerial index estimates of spawning grounds,

5) monitor the subsistence harvest of sockeye and chinook salmon, and

6) continue evaluation of stream side gravel incubation systems in interior Alaska.

Rapid in-season management response to small or large runs in the Copper River was not possible until the 1978 installation of a side scanning sonar salmon counter. In early 1980 two units were installed at the outlet of Miles Lake (Million Dollar Bridge site) approximately 53 km upstream from the fishery zone.

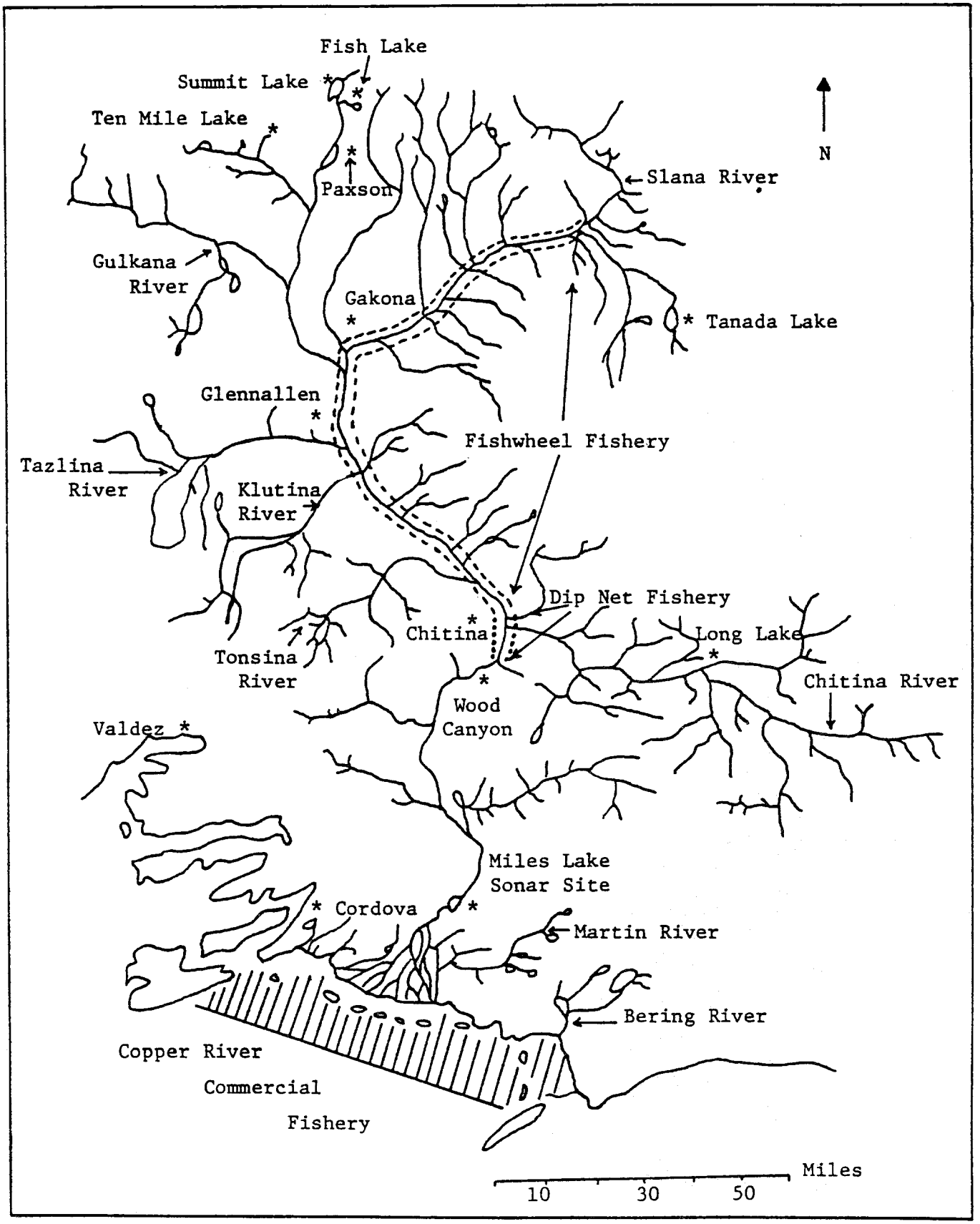

Figure 1. Copper River drainage.

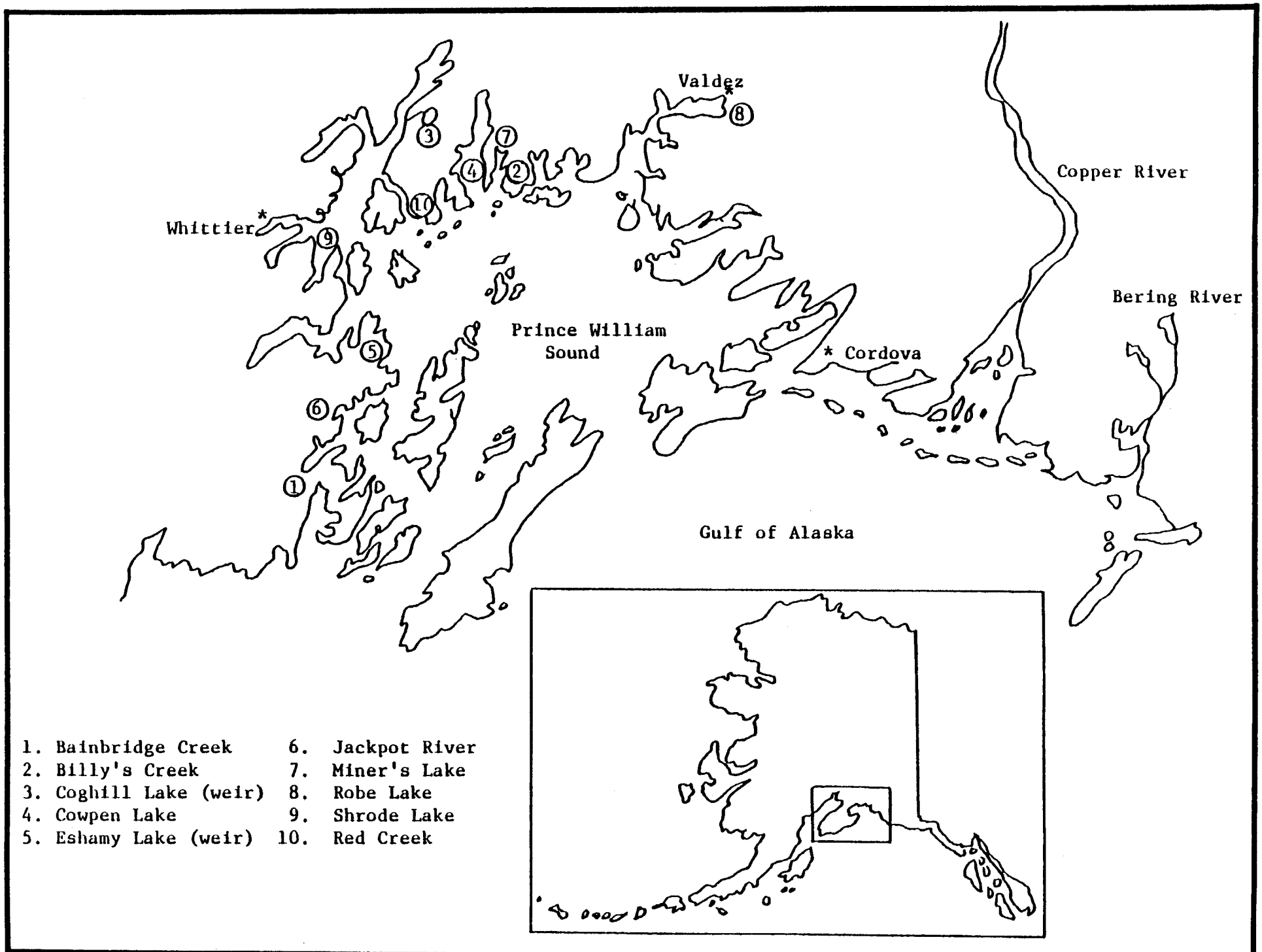

Figure 2. Prince William Sound major sockeye salmon spawning grounds and field camp locations, 1980.

They provided an in-season escapement estimate which was utilized by management personnel to insure an adequate escapement of sockeye salmon into the Copper River system while allowing for maximum harvest by the various user groups.

No weirs were employed on the Copper River Delta during 1980. Weirs were utilized at the outlets of Eshamy and Coghill Lakes in Prince William Sound and at Long Lake and Fish Creek in the upper Copper River. Lakes are a major concern since beach or tributary spawning populations are difficult to assess from the air, resulting in factional counts and unreliable timing information into the lakes. Total enumeration of adult sockeye salmon within a system provides more complete information, which in turn is useful in understanding rearing productivity of the lakes.

In addition to the weirs, surveys of the salmon populations on spawning grounds were conducted in the Copper-Bering River area and in Prince William Sound, where water conditions allowed, to provide an index of abundance, while physical data of the spawning and rearing areas were recorded for use in a stream catalog.

In the Copper River, an upriver subsistence fishery harvests a considerable number of sockeye and chinook salmon each year. These fish are caught along a 176 km stretch of the main Copper River above Wood Canyon. Because the harvest is a part of the upriver escapement it is monitored through the evaluation of subsistence permit data and observations made while the fishery is in progress.

Evaluation of artificial stream side incubators for use in interior Alaska was initiated in 1973 when one incubator unit was installed in a spring located between Paxson and Summit Lakes on the upper Gulkana River. In 1974 an additional four units were installed in a more suitable location. In 1975 the original unit was moved to the location of the newer units, placing five units linearly arranged at one location. In 1979, five more units were added for a total of 10, and these were loaded with 3.56 million eggs. In 1980, ten more units were added for a total pf 20, and 17 of those were loaded with 6.23 million eggs. Sockeye salmon stocks indigenous to local springs were used for obtaining the gametes.

COMMERCIAL CATCH ANALYSIS AND SAMPLING

Methods

Commercial catch sampling methods have remained essentially the same with random sampling of catches at the processing plants in Cordova. Age, length, weight, and sex characteristics of the salmon harvested were collected each period of the fishery to provide a basis for comparison through time.

Results

The 1980 Copper River and Prince William Sound catch monitoring and sampling are shown below.

Commercial Catch Monitoring:

The Copper River and Bering River districts remained closed during the 1980 season except for a closely managed quota chinook salmon catch of 8,434 fish out of a possible quota of 10,000 (Table 1). The 1980 chinook salmon catch was 39% of the last 10 year average. The Copper River commercial sockeye salmon catch of 18,451 occurred primarily after 21 July when fishing on late Copper River Delta spawning stocks was allowed and was 3% of the last 10 year average. The 1980 sockeye salmon catch was the lowest on record since 1892.

The Copper River District was reopened by emergency order on 11 August for the coho salmon fishery. The coho salmon catch was 212,477 fish, 156% of the last 10 year average.

This is the second consecutive year the Copper River commercial sockeye salmon fishery was closed for extensive periods because of poor returns. The low 1980 sockeye salmon run is due in part to the low numbers of parent year (1975) stock. The 1975 sockeye salmon catch was 51.5% less than the average sockeye salmon catch of 552,604 fish since statehood. Prediction of the total commercial catch and resultant error of prediction by week were not calculated for the 1980 commercial sockeye salmon season because the extended closures of the 1980 commercial fishery were inconsistent with annual catch and effort patterns.

Commercial Catch Sampling:

A total of 234 sockeye salmon were sampled to collect age and length statistics from the Copper River commercial catches. Age analysis of the limited Copper River commercial salmon catch showed 1.3[1] predominated in the catch at 60.7% (Appendix Table 1). The 1.2 and 2.3 age classes accounted for most of the remaining catch with 27.3% and 4.7%, respectively. There were no large overall differences in age class when analyzed by sex (Appendix Table 2).

The sockeye salmon harvest in Prince William Sound occurs primarily in two major areas, Eshamy and Coghill districts. Eshamy and Coghill lakes sockeye salmon stocks are sufficiently large to require individual management techniques. Eshamy sockeye salmon are subjected to purse seine, drift and set gill net fishing, and Coghill sockeye salmon are subjected to purse seine and drift gill net fishing. The Eshamy sockeye salmon run is a late season run and the Coghill run is early summer stock.

Total catch of sockeye salmon for the Prince William Sound fishing season was 211,742, which is 43.6% greater than the 1979 catch (preliminary data). The Eshamy District was opened to fishing for the first time in 4 years. Incidental catches of sockeye salmon occur in most of the Prince William Sound fishing

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[1] European Formula - Number of freshwater annuli - decimal - number of salt water annuli. For example, age class 1.3 would represent a fish in its 5th year of life with one winter in freshwater and three ocean winters.

Table 1. Copper River commercial catch fishery information, 1980.

Week ending	Week	Closures	No. Sockeye	No. Chinook	No. Coho	No. Boats	Sockeye/ boat	Parent year (1975) sockeye catch
5/24	21	Open[1]	92	1,933	0	93	1.0	77,303
5/31	22	Open[1]	162	3,125	0	151	1.1	59,726
6/7	23	Open[1]	474	2,738	0	153	3.1	52,757
6/14	24	Open[1]	81	605	0	94	0.9	64,874
6/21	25	Closed	0	0	0	0	0.0	32,223
6/28	26	Closed	0	0	0	0	0.0	16,945
7/05	27	Closed	0	0	0	0	0.0	11,949
7/12	28	Closed	0	0	0	0	0.0	6,392
7/19	29	Closed	0	0	0	0	0.0	2,991
7/26	30	Open	12,587	21	422	240	52.4	3,823
8/02	31	Open	2,931	0	2,036	--	0.0	Closed
8/90	32	Open	1,654	1	6,515	--	30.9	Closed
8/16	33	Open	346	11	24,460	--	4.4	Closed
8/23	34	Open	121	0	34,730	--	1.9	Closed
8/30	35	Open	3	0	41,793	--	0.5	6
9/6	36	Open	0	0	34,800	--	0.1	0
9/13	37	Open	0	0	18,300	--	0.0	0
9/20	38	Open	0	0	16,978	--	0.0	0
9/27	39	Open	0	0	7,684	--	0.0	0
Total			18,451	8,434	212,477			335,687

[1] Chinook salmon gear only, mesh size 8¼" or larger, no sockeye salmon gear fished.

districts; however, reporting of those catches is often inaccurate as to species and location.

Discussion

Weekly catch and effort data provide a baseline for comparison between years and have been used in the past to predict the total catch. However, this prediction is dependent upon consistent catch and effort patterns. Closure of the 1980 Copper River commercial sockeye salmon fishery precluded accurate prediction of the total catch based on early weeks' catches. It currently appears that commercial catch data and sonar count escapement data may be readily used to replace or augment the catch prediction system used since 1974 when fishing effort is not consistent or lacking. Additional years of sonar data and refinement of the catch statistics data base is expected to improve this procedure.

Commercial sockeye salmon catch sampling provided a weekly as well as annual measure of variation by age, weight, length, and sex ratios indicating any changes in age class contributions and potential effects of net selectivity on the fishery. Dominance of the 1.3 age class in the Copper River and Bering River fisheries show only minor variaitons in length and sex measurements between years, indicating a relatively stable age composition of these sockeye salmon stocks.

ESCAPEMENT ANALYSIS

Sonar Enumeration

Details of the 1980 side scanning sonar system application on the Copper River are presented below.

Methods:

Due to the multi-channeled nature of the Copper River Delta, the Miles Lake area is the closest (approximately 53 river km) suitable escapement assessment site to the fishery zone. Consequently the sonar counting site was established at the outlet of Miles Lake, immediately downstream from the "Million Dollar Bridge" near the end of the Copper River Highway.

Operation of the Miles Lake sonar site began on 18 May and continued until 9 August. The south bank was continuously monitored by sonar, while the north bank sonar operated intermittently as water level and ice load permitted.

Due to fluctuation of the Copper River by as much as several feet vertically per day and 15 ft or more during the counting season, frequent adjustment of the sonar substrate was required.

Accuracy of the side scanning sonar counter varies with the swimming speed of the salmon. Comparative counts were made every 6 hours for a total of 4 hours per day between the sonar count and the visual interpretation of the oscilloscope trace of the sonar beam. These comparative counts were used to determine system accuracy and total daily counts were adjusted accordingly. In addition, 3.75

minutes per hour of the raw amplified echoes received by the transducer were recorded each day. Thus an additional record and potential check of accuracy could be re-examined at any time by playing the tapes back through an oscilloscope, permitting visual observation of the receiver output.

Results:

The total estimated sonar counts of chinook and sockeye salmon in 1980 was 283,856 salmon. During May and early June, 5,880 chinook salmon were counted on the south bank and 1,438 counted on the north bank for a minimum estimated escapement of 7,318 chinook salmon (Table 2). Chinook salmon counts were based on subjective interpretation of echo strength, pulse width, echo location (sectors 7-12), and repitition. Caution should be used in applying population estimates to the chinook salmon portion of the escapement data. After 6 June, segregation of chinook salmon on the counter was not attempted, because chinook salmon escapement seemed to be decreasing. The 1980 chinook salmon escapement estimate was 36.6% less than the 1979 estimate. This may be in part due to a higher water level in 1980, which forced the artificial substrate farther into shore, perhaps away from the preferred chinook salmon migration corridor.

The 1980 south bank sonar count of sockeye salmon was 235,491 and the north bank sockeye salmon count was 41,047, for a total sockeye salmon escapement of 276,538 (Table 2 and Figure 3). This is a 14.2% greater total sockeye escapement than observed in 1979 and is 10.6% greater than the desired minimum escapement of 250,000 sockeye salmon. It is assumed that the majority (85%) of the salmon passed on the south bank because of river configuration and the influence of Childs Glacier on the north bank.

Salmon distribution along the south bank counting substrate changed over time. Because 21 May and 3 June, 38.5% of the salmon were counted in the first sector (1.5 m) of the artificial substrate. Icebergs interrupted normal sonar operations on 4 and 5 June. On 6 June use of the artificial substrate was discontinued and the permanent substrate was employed for the remainder of the season. (Miles Lake permanent substrate consists of 26.5 m of iron rail imbedded in concrete extending from the low water line to the high water line.) On 6 June 48.3% of the salmon were counted in the first sector (1.1 m) of the permanent substrate. Between 7 June and 20 June, 84.8% of the salmon were counted in the first sector (Figure 4). The majority of salmon continued to pass across the first sector for the remainder of the counting period (20 June - 9 August).

Data indicates that the increased percentage of salmon passage close to shore over time was the result of increased river level and associated increased water velocity and chinook run timing. Chinook salmon escapement in the Copper River occurs primarily in late May and early June. Decreased percentage of counts in the offshore sectors over time may reflect passage of the chinook salmon run.

Weir Counts

Details of the 1980 weir operations on the Copper River and in Prince William Sound are given below.

Table 2. Copper River sonar counts, Miles Lake site, 1980.

Date	North Bank[1] Sockeye	North Bank[1] Chinook	South Bank Sockeye	South Bank Chinook	TOTAL Daily sockeye	TOTAL Cum.	TOTAL Daily chinook	TOTAL Cum.
May 18	23	4	195	34	218	218	38	38
19	18	3	149	26	167	385	29	67
20	24	4	197	35	221	606	39	106
21	9	2	79	14	88	694	16	122
22	42	7	349	62	391	1,085	69	191
23	64	11	530	93	594	1,679	104	295
24	53	9	441	78	494	2,173	87	382
25	76	14	637	112	713	2,886	126	508
26	113	25	944	208	1,057	3,943	233	741
27	227	33	1,888	277	2,115	6,058	310	1,051
28	181	44	1,512	366	1,693	7,751	410	1,461
29	116	10	964	84	1,080	8,831	94	1,555
30	204	51	1,699	422	1,903	10,734	473	2,028
31	388	42	3,232	351	3,620	14,354	393	2,421
June 1	1,112	172	4,145	641	5,257	19,611	813	3,234
2	1,833	172	5,228	492	2,061	26,672	664	3,898
3	2,299	461	5,138	1,030	7,437	34,109	1,491	5,389
4	2,129	263	6,867	849	8,996	43,105	1,112	6,501
5	1,313	75	8,433	481	9,746	52,851	556	7,057
6	746	36	4,661	225	5,407	58,258	261	7,318
7	289		1,804		2,093	60,351		
8	186	1,438	1,163	5,880	1,349	61,700	7,318	7,318
9	489		3,054		3,543	65,243		
10	1,007		6,294		7,301	72,544		
11	1,660		10,372		12,032	84,576		
12	1,598		9,986		11,584	96,160		
13	1,048		6,552		7,600	103,760		
14	781		4,880		5,661	109,421		
15	1,008		6,300		7,308	116,729		
16	780		4,875		5,655	122,384		
17	992		6,197		7,189	129,573		
18	930		5,811		6,741	136,314		
19	330		2,061		2,391	138,705		
20	496		3,101		3,597	142,302		
21	571		3,571		4,142	146,444		
22	545		3,409		3,954	150,398		
23	537		3,359		3,896	154,294		
24	686		4,531		5,217	159,511		
25	704		4,400		5,104	164,615		
26	496		3,099		3,595	168,210		
27	472		2,949		3,421	171,631		
28	596		3,728		4,324	175,955		
29	530		3,315		3,845	179,800		
30	478		2,987		3,465	183,265		
July 1	491		3,068		3,559	186,824		
2	464		2,901		3,365	190,189		

-Continued-

Table 2. Copper River sonar counts, Miles Lake site, 1980 (continued).

Date	North Bank[1] Sockeye	North Bank[1] Chinook	South Bank Sockeye	South Bank Chinook	TOTAL Daily sockeye	TOTAL Cum.	TOTAL Daily chinook	TOTAL Cum.
July 3	566		3,538		4,104	194,293		
4	405		2,529		2,934	197,227		
5	397		2,482		2,879	200,106		
6	417		2,608		3,025	203,131		
7	454		2,837		3,291	206,422		
8	413		2,582		2,995	209,417		
9	389		2,428		2,817	212,234		
10	502		3,140		3,642	215,876		
11	795		4,968		5,763	221,639		
12	660		4,128		4,788	226,427		
13	238		1,487		1,725	228,152		
14	232		1,447		1,679	229,831		
15	240		1,503		1,743	231,574		
16	347		2,168		2,515	234,089		
17	472		2,947		3,419	237,508		
18	811		5,067		5,878	243,386		
19	774		4,839		5,613	248,999		
20	698		4,362		5,060	254,059		
21	528		3,298		3,826	257,885		
22	438		2,735		3,173	261,058		
23	296		1,847		2,143	263,201		
24	187		1,166		1,353	264,554		
25	224		1,399		1,623	266,177		
26	173		1,083		1,256	267,433		
27	165		1,033		1,198	268,631		
28	96		602		698	269,329		
29	55		345		400	269,729		
30	65		405		470	270,199		
31	49		304		353	270,552		
Aug. 1	114		711		825	271,377		
2	143		891		1,034	272,411		
3	105		659		764	273,175		
4	98		610		708	273,883		
5	105		653		758	274,641		
6	121		756		877	275,518		
7	85		530		615	276,133		
8	23		143		166	276,299		
9	33		206		239	276,538		
Total	41,047	1,438	235,491	5,880	276,538	276,538	7,318	7,318

[1] North bank counts interpolated from May 18 through May 31, from June 6 through June 23 and from June 29 through August 9. A 40 foot substrate was used from June 1 through June 5 and on June 24 and part of June 25. A 20 foot substrate was used on part of June 25 and on June 26 through June 28.

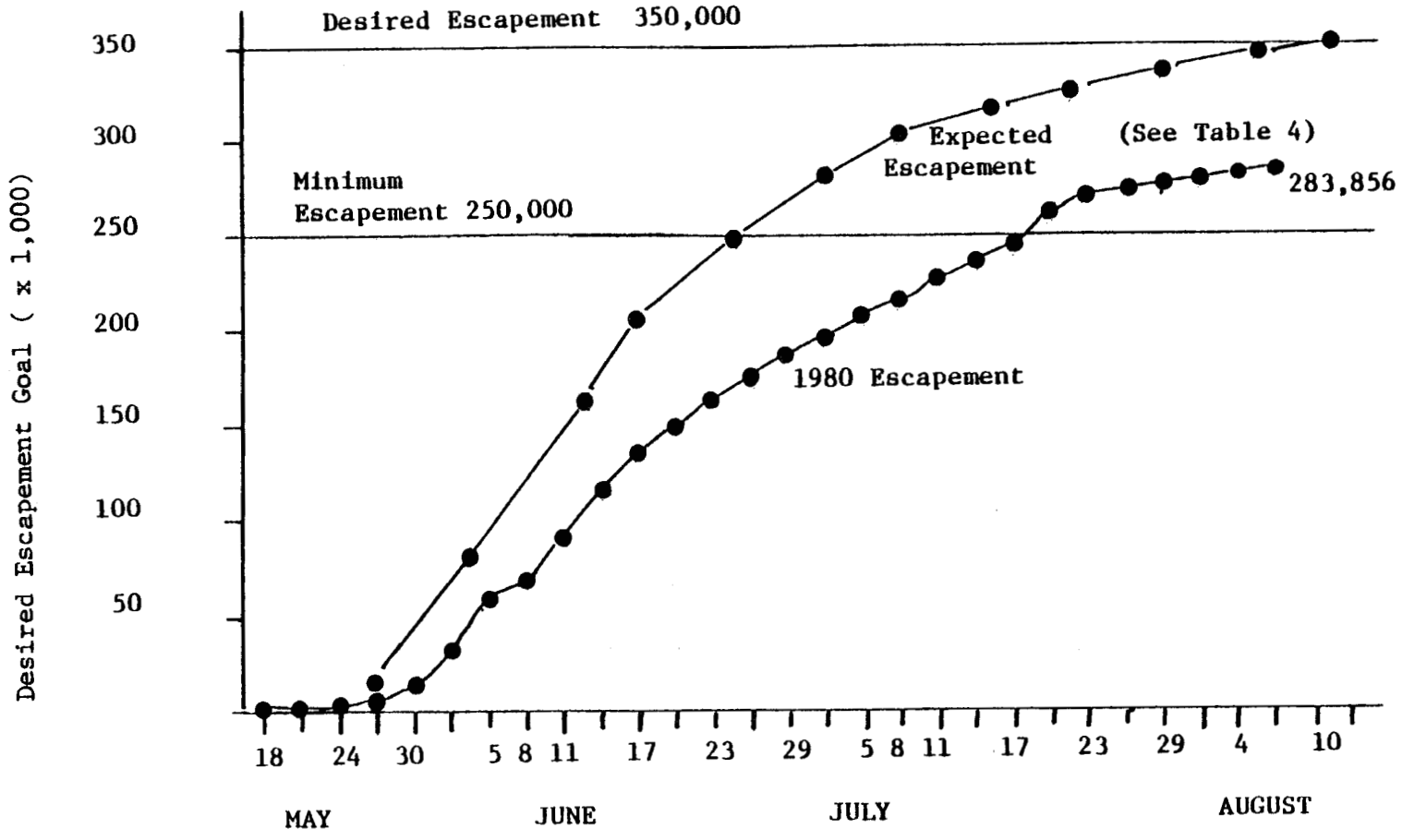

Figure 3. Estimated Copper River salmon sonar counts, 1980.

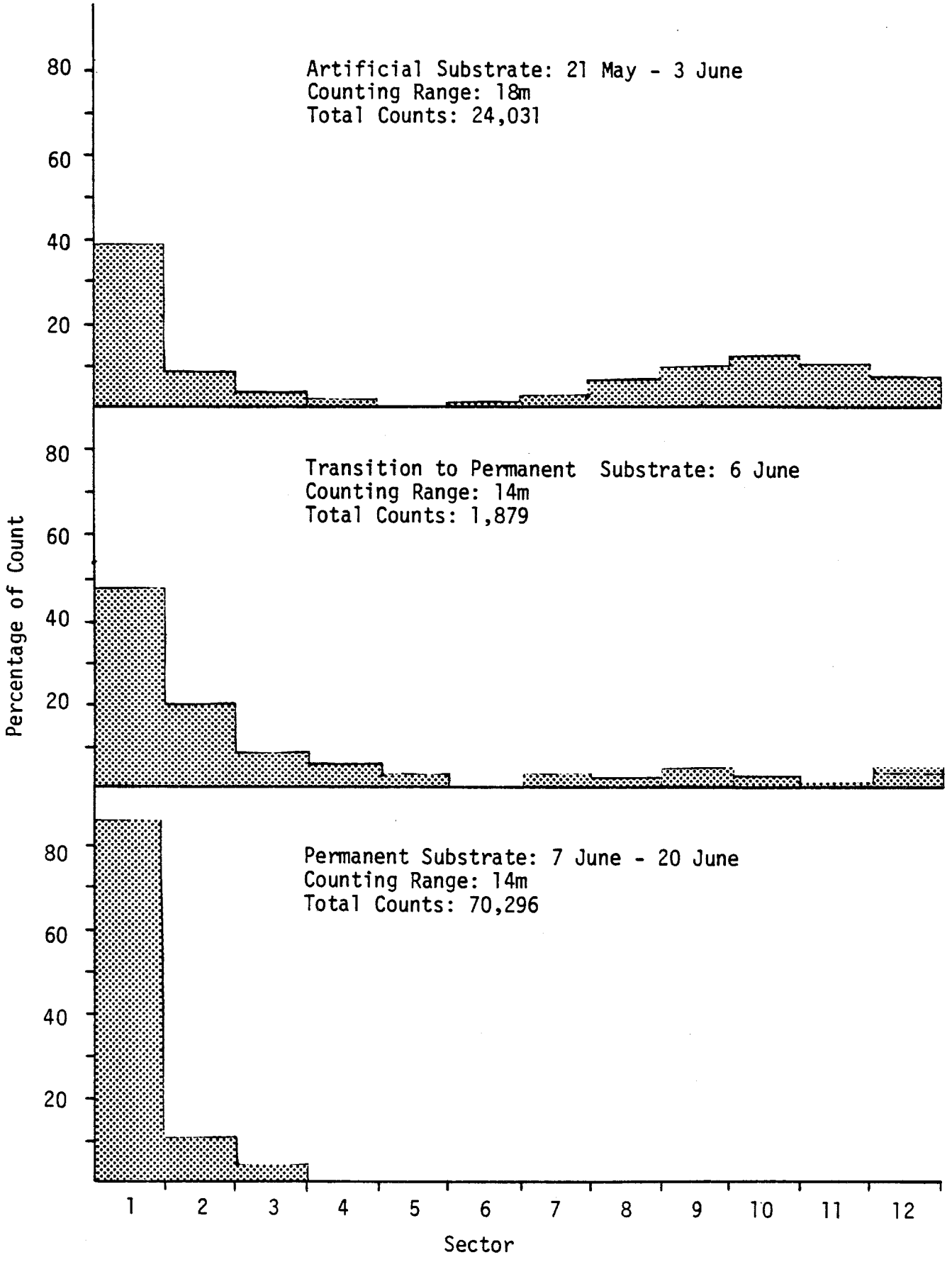

Figure 4. Comparison of sector count percentages for artificial and permanent substrates, south bank, Miles Lake sonar site, 1980.

Methods:

In 1980 weirs were operated on Fish Creek and Eshamy, Long and Coghill Lakes. They consisted of 1.5-2.0 m steel fence or wooden "A" frames supporting either wire mesh or wooden or conduit pickets spaced to prohibit passage of all but the smallest adult sockeye salmon. A counting section, consisting of 1.3 cm conduit evenly spaced through a wood frame, was installed in all weirs where fish passage was most likely to occur. Fish passage and enumeration was accomplished by removing lengths of conduit from this section and counting fish that passed through. Weirs were checked frequently to prevent any delay in fish movement.

Aerial surveys were conducted whenever possible during and after weir operations with actual fish movements and numbers in lake systems, then compared with aerial survey data. Lakes picked for weirs had historically significant spawning populations that were difficult to assess from the air.

Results:

The 1980 weir operation results are presented by lake system.

Long Lake. Long Lake drains westward into the Lakina River, a tributary of the Chitina River, approximately 257 km above the mouth of the Copper River (Figure 1). It is a narrow lake, 5.3 km long by 0.4 km wide. The lake outlet is approximately 3 m wide by 0.6 m deep. Fish species known to be present, other than anadromous sockeye salmon, are grayling *(Thymallus arcticus)*, anadromous coho salmon, longnose suckers *(Catostomus catostomus)*, Dolly Varden *(Salvelinus malma)*, burbot *(Lota lota)*, sculpins (Cottidae), residual sockeye[1], and kokanee[2]. Spawning occurs primarily at a spring-fed shoal area three-fourths of the distance up the north side from the lake outlet. Sockeye salmon reach the lake near the first of August each year and continue migrating into the lake until late September. Peak spawning occurs in December and January with some live adults observed in the spring area as late as early April.

A total of 38,500 sockeye salmon was enumerated at the weir. Although peak spawning is believed to occur after November, ice conditions and poor lighting make aerial surveys impractical. On 30 October, observations from the air accounted for 2,650 (or 6.0%) of the 38,500 sockeye salmon in the lake, indicating an aerial accountability well below the numbers of salmon known to be present in the lake.

Fish Lake. Upper Fish Lake drains 6.2 km westward, through Fish Creek, into the Gulkana River approximately 440 km from the mouth of the Copper River (Figure 1). The lake is elongate, being 3 km long and 0.7 km wide at the widest portion. Maximum lake depth is 5.5 m. The outlet stream is approximately 4.6 m wide and

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[1] Residual sockeye are migratory type sockeye salmon spawners but turn a mottled green. They are sometimes referred to as dwarf sockeye.

[2] Kokanee are non-migratory sockeye salmon maturing in 3-6 years with both sexes represent are are viable reproducing populations. The mature adults assume the coloration of migratory sockeye.

0.3 m deep. The only fish species reported taken from the lake are anadromous sockeye salmon and grayling. Spawning occurs entirely on the lake substrate and during clear conditions can be observed from the air. Sockeye salmon arrive at the lake in mid-July and stragglers continue arriving through mid-August. Spawning commences in early August and continues into mid-September.

A weir was placed in Fish Creek above the Alyeska pipeline right-of-way. Daily weir counts commenced on 23 June and were terminated on 6 August. A total of 11,063 adult sockeye salmon was enumerated (Appendix Table 3). Aerial observations on 21 July accounted for only 3,175 sockeye salmon.

Eshamy Lake. Eshamy Lake lies in a dog-leg configuration approximately 9.2 km long and ranging from 0.4 km to 0.9 km in width (Figure 2). The maximum recorded depth is 75.6 m. Eshamy River drains Eshamy Lake eastward for 0.4 km into Eshamy Lagoon in Prince William Sound. Spawning primarily takes place along the beaches. One inlet stream has been used for spawning but apparently never to any significant extent. Other fish species known to inhabit the lake include coho salmon, Dolly Varden, and cutthroat trout *(Salmo clarki)*.

The weir was installed on 22 June and operated through 1 September with the first sockeye counted through on 25 June. A total of 44,263 sockeye salmon was enumerated during the weir operation, well above the average escapement.

Coghill Lake. Coghill Lake is approximately 8.3 km long and 2.6 km wide, draining westward by way of Coghill River for 2.6 km into College Fiord in Prince William Sound (Figure 2). Coghill River is also the primary water source of the lake, originating at Dartmouth Glacier 8.8 km northeast of the lake. Most sockeye salmon spawning is believed to occur in the lake with limited spawning in inlet streams. Pink, chum, and coho salmon, plus Dolly Varden and stickleback (Gasterosteidae) occur in the Coghill system with the sockeye salmon.

Effects of the glacial melt at times make the lake and river waters silty, reducing visibility below a desirable level. A weir was first installed in 1974 to help eliminate some of the problems in obtaining reliable escapement estimates that plagued weir-tower counts in prior years.

The weir was installed on 7 June and removed on 22 July. Salmon were first observed on 7 June. A total of 142,253 sockeye salmon was enumerated into Coghill Lake in 1980. The escapement in 1980 was significantly higher than the 10-year (1970-79) average of 17,408 sockeye salmon.

Other Spawning Ground Escapement Surveys

Surveys of escapement to the spawning grounds of the Copper River-Prince William Sound areas are conducted using a variety of equipment. Fixed-wing aircraft, boats, all-terrain vehicles, and highway vehicles are used in addition to foot surveys for access to or conduct of the various spawning surveys. Nearly all spawning areas were surveyed several times with the intent of acquiring a peak count for each spawning area. Distribution and timing data are acquired as part of the survey procedure. A few spawning areas are not reached each year because of time and budgetary limitations.

Most upriver spawning areas surveyed had near average escapements in 1980. Appendix Table 4 lists the peak spawner counts for sockeye, chinook, and coho salmon from the Copper and Bering rivers in 1980. Sockeye and chinook salmon numbers were considerably above average for many of the Copper River spawning areas.

Appendix Table 5 shows peak counts for sockeye, pink, and chum salmon for Prince William Sound sockeye salmon systems. Prince William Sound sockeye, chum, and pink salmon escapements in 1980 were far above average. The sockeye salmon escapement at Eshamy was the largest since 1969 and the escapement at Coghill was the largest on record.

Aerial Survey Index:

During the course of surveying salmon populations in the Copper River area, certain key spawning areas are readily surveyed. Many of these areas have been surveyed for the majority of the past 20 years. In order to establish a reasonable index of escapement to both the Copper River Delta and the upper Copper River, streams that have been surveyed consistently and provide reasonable countability were selected for an aerial escapement index. Seven areas on the Copper River Delta and 20 areas in the upper Copper River area were selected as the index standards. Several areas were not surveyed for all of the past 20 years; however, due to their importance were included and missing years' data interpolated. Unless indicated otherwise, all counts are aerial survey counts. Table 3 shows the aerial index figures and totals for the period 1968 through 1980.

Stream Catalog:

Collection of descriptive data for streams and lakes utilized by sockeye salmon in the Copper River drainage and Prince William Sound was continued in order to prepare a catalog of information for each area. Physical data for each area, survey methods and routes, historical count data, and other pertinent material will be included in the final catalog.

Similar data for other species of fish was collected incidental to the collection of sockeye salmon data, with a minimum of additional effort. Chinook salmon data was collected from the commercial fishery. Due to the relative importance of the Copper River system as a source of commercial, subsistence, and sport fish, information gathered on the system may be useful in future evaluations.

Discussion

The extremely poor return of sockeye salmon in 1980 made the season of sonar operations particularly valuable in that direct application of the data was made within a few days of installation. Justification for the fishing period closures during the 1980 season was based extensively on the Miles Lake sonar site counts as well as historical catches by week and species (sockeye and chinook) plus the subsistence catches at Chitina. All available data were considered to insure that the sonar counts indicating poor run strength could be relied upon. Calculations were made establishing average weekly desired escapement, as well as total season desired and minimum escapement figures, so that sonar counts could be related to an existing data base. Table 4 shows the basis for weekly escapement figures and the sonar count figures acquired during the 1980 field season from

Table 3. Copper River aerial survey index of sockeye salmon spawning escapements, 1968-1980.

System	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
Eyak Lake	1360	21000[1]	28742[1]	5800	12275	6000	4625	17500	8500	11000	16250	21000	22500
McKinley Lake	0	500	5000	1700	600	1800	2000	8000	6000	15000	17500	25000	27500
39 Mile Creek	2000	3000	5997	8270	14910	5511	2400	2500	3500	4500	6500	17500	18000
Lake Tokun	3500	700	19764	23000	1850	8000	1468	1200	8500	5500	6600	6500	17000
Little Martin Lake	0	400	0	3000	3000	1500	1500	2000	8000	1550	3500	2000	6500
Martin Lake	1000	1500	600	3400	6500	2000	1500	460	4000	6087	10500	12000	17650
Martin River Slough	3500	4000	4450	5000	5000	1990	5000	400	2500	3100	6300	4200	10000
Copper River Delta Subtotal	11360	31100	64553	51270	44135	26801	18493	32060	41000	46737	67150	88200	119150
Salmon Creek	275*	0	0	275*	0	200	400	0P	300	275*	50	450	1500
Tonsina Lake	200	1100	500	500	250	300	200	250	900	432*	4	775	650
Mahlo Creek	2200	750	5000	12400	1525	4500	500	314G	600	5200	300	450	1000
St. Anne Creek	3200	4300	18300	25100	1900	7400	2100	449G	1700	7000	1150	730	5000
Mendeltna Creek	1350	6805G	4700	870	1950	1200	332	325	900	3900	725	350	1125
Keg Creek	810*	1400	810*	810*	0	1435	190	256	125	725	1050	1300	2325
Dickey Lake	210	150	183	170	73	2500	10	25	0	650	75	13	250
Swede Lake	0	5	2	9	400	350	15	6	10	750	80	155	400
Paxson Lake Outlet	700	2578*	3500	3400	2700	4300	1000	550	2100	3800	2500	1900	3800
Inlet to Mud Creek	7000	3200	8850	7900	5818	10500	14300	2100	4200	6000	2700	5400	8200
Mud Creek and Lake	750	600	1500	600	850	500	300	400	1100	650	150	460	740
Mud Cr.-Summit Lake	2075	2500	4000	3250	1675	5700	2700	1200	1900	5900	800	2600	3075
Fish Lake	4000	400	13000	700P	4500	6300	800	2800	900	8000	2650	1700	3175
Bad Crossing #1 & #2	5	4050	1650	6	0	9275	650	5	16	8400	600	650	75
Fish Creek	115	300	1000	900	650	2200	450	200	250	6900	1300	350	900
Mentasta Lake	500	2000	3800	2295	800	2700	700	450	600	3500	3600	2500	3200
Suslota Lake	550	800	4000	4550	4830	3400	400	0	100	300	1200	1000	1700
Tanada Lake	175	6	1100	4093	930	10	3100	700	6100	9100	2625	5175	13700
Long Lake	3000	5000	2000	2000	3000	150	750	1100	2450	877	1425	3100	2650
Tana River	404*	404*	50	404*	180	1425	520	60	25	404*	504	465	2130
Upper Copper River Subtotal	27115	36348	73945	70232	32031	64345	29417	11190	24276	72763	23448	29523	55595
TOTAL	38475	67448	138498	121502	76166	91146	47910	43250	65276	119500	90638	117723	174745

[1] From sonar counter. * = interpolated. P = poor survey conditions G = ground survey

$\frac{642,009}{13}$ = 49,385 = Average index Copper River Delta systems. $\frac{550,228}{13}$ = 42,325 = Average index Upper Copper River systems.

Table 4. Expected upriver escapement by week based upon percent of average weekly sockeye salmon catch from the Copper River District to produce 350,000 desired escapement and 250,000 minimum escapement.

Week	Average Catch	Years	Percent	Cumulative Percent	Expected Average Escapement	Cumulative Expected Average Escapement	Minimum Expected Sonar Escapement (Cumulative)	Average Expected Sonar Escapement (Cumulative)	1980 Cumulative Sonar counts allowing 8 days delay for migration to sonar site
20	32,602	(9)	4.7	4.7	16,440	16,440			712
21	102,868	(15)	14.8	19.5	51,790	68,230	11,750	16,440	7,109
22	144,653	(16)	20.9	40.4	73,140	141,370	48,750	68,230	39,498
23	132,503	(18)	19.1	59.5	66,840	208,210	101,000	141,370	79,862
24	76,753	(18)	11.1	70.6	38,840	247,050	148,650	208,210	136,891
25	61,650	(18)	8.9	79.5	31,140	278,190	176,400	247,050	166,829
26	48,838	(17)	7.0	86.5	24,490	302,680	198,650	278,190	194,142
27	33,387	(18)	4.8	91.3	16,790	319,470	216,150	302,680	216,735
28	27,032	(18)	3.9	95.2	13,640	333,110	228.150	319.470	238,892
29	16,415	(18)	2.4	97.6	8,390	341,500	237,900	333,110	268,376[2]
30	10,429	(18)	1.5	99.1	5,240	346,740	243,900	341,500	277,047
31	4,660	(17)	0.7	99.8	2,440	349,180	247,650	346,740	281,959
32	1,476	(17)	0.2	100.0	690	349,870	249,400	349,180	283,856
33	298	(13)	0.04		130	350,000	249,900	349,870	
Average	693,564				350,000[1]	350,000[1]	250,000[1]	350,000[1]	283,856[3]

[1] Escapement upriver.

[2] From this time until the end of the sockeye salmon run, Copper River Delta stocks predominate. 80,000 - 90,000 additional spawners required for Copper River Delta spawning areas.

[3] Actual escapement requires subtraction of subsistence and sport fishery take.

which it can be seen that the sonar-derived escapement estimates indicated a weak run in 1980.

The comparative aerial survey and weir escapement data obtained for Long Lake and Fish Creek were useful in determining timing characteristics of individual spawning populations.

Escapement into the Upper Copper River system was above the minimum goal but below the desired escapement; however, the overall distribution of spawners between the various spawning streams was very good with a few excellent spawning stock escapements. Most of the areas exhibited a reasonable escapement. The upriver aerial index figure of 55,595 sockeye salmon was 46.9% above the 1979 escapement and 30.7% above the 14-year average of 38,547. The index figure appears to have been unduly influenced by a few spawning areas where survey timing and technique improvement have occurred. Although the 1980 escapement was below desired levels it has the capacity, with good winter conditions, to produce an average sockeye return. Considering all factors an acceptable minimum escapement level was achieved for the upper Copper River and an excellent escapement was achieved for the Copper River Delta. It is of particular importance that the sockeye salmon escapement was well distributed.

Escapement into Prince William Sound General District sockeye salmon spawning areas was variable with the two major areas exhibiting excellent escapements. Escapement into Coghill River was 66.1% greater in 1980 than in 1979 and 75.8% greater than the last 10-year average. Escapement into Eshamy Lake was 72.5% greater in 1980 than in 1979 and 75.3% greater than the last 10-year average.

The data collected from the various weir sites has provided the ability to interpret with some confidence the escapement into these spawning units from aerial estimates, which will be useful for the management of the various fisheries involved. Total escapement estimates with corresponding age and growth information can also be utilized in determining productivity of spawning and rearing areas.

SUBSISTENCE FISHERY

Methods

Subsistence permits, available to all state of Alaska residents, were issued by seasonal personnel at Glenallen and Chitina. Permit allocations are determined by the applicant's gross family income and whether the applicant is an individual or has dependents. Records were kept and tabulated on numbers of permits issued and returned, catch by species, gear type, and date during the fishing season. Upon completion of the fishing season, data were coded, keypunched, and subjected to simple computer tabulation and analysis.

Results

A total of 3,203 permits was issued in 1980 (Table 5). The 1979 issue of permits was 3,200, while the previous 10-year average was 3,619. Fishwheel permits numbered 399 while the dip net permits in 1980 numbered 2,804 (Table 5), a slight

Table 5. Copper River subsistence fishery, 1980[1].

Area	Number Permits Issued	Type of Gear	Catch			
			Sockeye	Chinook	Coho	Other[2]
Upper Copper River	2,804	Dip Net	12,287	1,767	578	29
Upper Copper River	399	Fishwheel	9,150	489	61	96
Total	3,203		21,437	2,256	639	125

[1] Compiled from reports received through 9 January 1981.

[2] Includes pink salmon, whitefish, steelhead, cutthroat, Dolly Varden, lamprey, lingcod, and grayling.

reduction in the number of fishwheel permits from previous years. Returns through 9 January 1981 were 2,151 or approximately 67% of those issued. The rate of return is the same as the 10-year average return of 67.8%.

Catch per unit of effort for sockeye salmon was 7.6 fish per dip net permit and 46.4 fish per fishwheel permit returned. Total reported subsistence catch of sockeye salmon was 21,437 (Table 5), the majority of which (57.3%) was taken by dip net users. The 1980 reported sockeye catch was 6% less than the 1979 reported catch and 18.9% less than the 10-year catch average. The 1980 reported chinook salmon subsistence catch was 2,256, a decrease of 10.3% from the 1979 reported catch but 20% greater than the 10-year average catch. The 1980 reported coho salmon subsistence catch was 639, a decrease of 15.0% from the 1979 reported subsistence catch, but 37.7% greater than the 10-year average catch.

Residents of the Copper River Basin who primarily use fishwheels held 8% of the permits but caught 29% of the total catch. Dip nets were the choice of gear for 97% of the non-local residents, a percentage similar to past years.

Type "A" permits were issued to low income, local, traditional fishwheel users, and as a group they held 1% of the permits and caught 9% of the total catch. Type "B" permits were issued to local users from the Copper River Basin, and they held 7% of the permits while catching 9% of the fish. Type "D" permits were issued to non-Copper Basin permit holders, and they held 92% of the permits while catching 70% of the fish. Type "C" permits were to be issued to non-local, low income, traditional users, but in 1980 no Type "C" permits were issued. Type "A" permit holders were 82% successful while Type "B" and "D" had 84% and 68% success rates. Subsistence catches are fairly well correlated with aerial index levels ($r = 0.90$) as can be seen in Figure 5.

Discussion

A definite relationship between the aerial survey index levels and subsistence catch can be shown, thus strengthening the hypothesis that monitoring the subsistence catch provides an important index of escapement level. The impact and potential for growth of the subsistence fishery is sufficiently large that catch data is essential for long-term management of this fishery. Increases in state population, coupled with an increase in use of the more efficient fishwheel, can soon put additional pressures on this fishery producing an ever more important obstacle to attainment of escapement goals.

GULKANA STREAM SIDE INCUBATORS

During the 1980-81 fiscal year, major funding for the incubation project was appropriated from the legislature through the ADF&G, Fisheries Rehabilitation Enhancement, and Development (FRED) Division. The project will continue under the auspices of the FRED Division and future reporting will be through that division's annual reports for the project.

In 1980 the total number of incubation units was doubled to 20. However, only 17 units were loaded because of insufficient numbers of available spawners by mid-

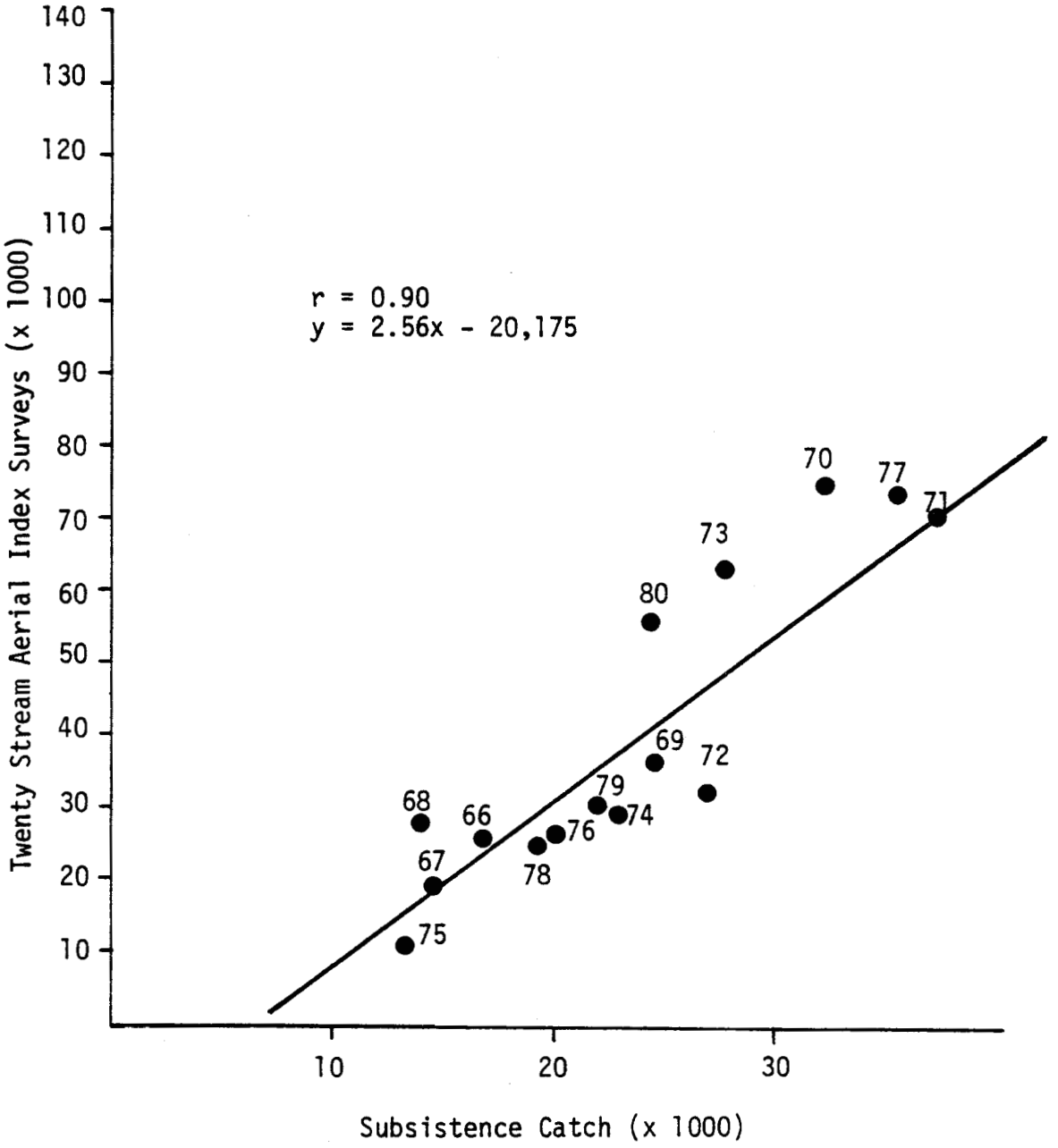

Figure 5. Relationship of upper Copper River sockeye salmon twenty stream aerial index surveys to subsistence catch of sockeye salmon, 1966-1980.

October. This problem should be overcome in 1981 by initiating the egg take slightly earlier (10 September). The estimated total number of eggs loaded into the 17 units in 1980 was 6,228,906. As in 1979, experiments were conducted on egg loading density and substrate type (plastic intalox saddles and gravel).

CONCLUSIONS AND RECOMMENDATIONS

Copper River-Prince William Sound sockeye salmon studies have provided a great volume of data relating to the dynamics and characteristics of the salmon populations of the Copper River drainages and Prince William Sound.

The Copper River sockeye salmon long run duration and narrow fishery zone allows a relatively ideal management procedure. The present alternation of relatively short opened and closed fishing periods during the 9 weeks of significant fishery protect individual spawning stocks in that total capture of an individual stock is highly unlikely during a single fishing period. Fish from an individual stock may have maximum passage through the fishery during open or closed periods, thus producing catches ranging from 40% to 70% of the overall run. Prince William Sound sockeye salmon populations are managed in conjunction with the pink and chum salmon fishery, with the exception of Eshamy and Coghill where nearly immediate weir counts allow rapid assessment of escapement. Stream mouth and bay closures protect most of the remaining Prince William Sound sockeye salmon populations. Significant modifications to the present management procedures do not appear warranted.

Accurate prediction of the total Copper River sockeye salmon harvest from early period catch per unit of effort data was not possible in 1980 becuase of the closure of the commercial fishery. However, this kind of prediction effort, in conjunction with the in-season sonar escapement estimate, should allow a more rapid in-season management response to small or large runs in the Copper River.

The ability to regulate the harvest taken by the Copper River commercial and subsistence fisheries, based on assessment of the in-season sonar escapement estimate, will benefit both the catch and escapement segments of the run in terms of reaching optimum levels of spawner seeding while retaining a maximum allowable catch.

Commercial catch sampling as presently conducted provides an adequate measure of the characteristics of the fishery and its effect on the salmon run and indicates relatively stable sockeye salmon stocks.

Direct application of the sonar enumeration data in 1980 to management concerns was again made within a few days of installation because of the unusually poor expected salmon run. All other potential sources of data to assist the management decision process were also utilized. Major restrictions of the commercial and subsistence fisheries were required in response to the low escapement level. The escapement, however, was considered potentially adequate if given good survival conditions. Clearly a lower and much less equitable escapement would have been attained had the sonar data not been available; thus, the effectiveness of the equipment when operating properly has again been demonstrated. As in 1979, only a small portion of the total escapement in 1980 (14%) traveled along the north

bank. Childs Glacier abuts the river just below the sonar operation area on the north bank and it is assumed that glacier activity contributes to lessening the percentage of fish traveling near that shore.

Continuing emphasis was placed on estimating escapement into major spawning systems of the Copper River and Prince William Sound through aerial and weir counts. Total or partial weirs were established to provide counts of actual escapement into individual spawning systems and for relating these counts to aerial surveys.

Relating aerial survey estimates of escapement to weir counts on selected spawning areas for the most part provided an understanding as to what portion of a spawning population is actually visible from the air. Several years of reliable estimates and aerial survey counts can make it possible to calculate a reasonable estimate of the magnitude of escapement each system has had in the past, or what it has presently. This information, coupled with age samples, can also be helpful in determining productivity of a system, as well as providing a more rational escapement index.

Age, length, and sex ratio information for the escapement to the delta, upper Copper River, and Prince William Sound provides a basis for comparison with commercial catch data and a measure of the effects of the commercial fishery in terms of selection and other factors. Length by age and sex for the Copper River commercial catch has remained relatively stable with no significant change in size of fish on the spawning grounds noted in comparison with past seasons.

Future ground sampling of the various spawning areas, while providing an abundance of data relating to individual populations, can be relegated to a low priority for most upriver spawning areas because of the multiple years of sampling already accomplished. Delta spawning areas require additional survey work to establish baseline characteristics which are presently limited for many spawning units. The importance of several spawning areas in glacial lakes and streams throughout the Copper River drainage should be assessed in order to provide baseline data and also allow inclusion in the spawning ground catalog. A number of Prince William Sound sockeye salmon populations also require more adequate assessment of magnitude, timing, and other escapement characteristics.

Collection of aerial and ground survey spawning area data should be continued for inclusion into a working stream and lake catalog as a reference for those areas not routinely surveyed and as a central repository for individual spawning unit data, as well as a post-season check on the sonar counter escapement estimate.

Limited data collection has been conducted in conjunction with the sockeye salmon work upon chinook, coho, chum, and pink salmon and other fish species. These data provide a baseline of information for future reference as well as documenting the spawning locations and other pertinent information. Chinook salmon are important in the Copper River commercial fishery and occur concurrently with the sockeye salmon and are for the most part managed with the sockeye salmon. In 1980, due to a poor sockeye salmon return the chinook salmon were managed separately. Sport and subsistence catches of chinook salmon are also significant; thus, the escapement estimates and other data collected are important for the management of this species. Documentation of coho, chum, and pink salmon and other fish species

distribution is secondary, but constitutes significant data where little knowledge now exists.

Monitoring of the subsistence fishery, which through the use of fishwheels and dip nets takes a significant portion of the escapement from the upper Copper River, provides minimum catch figures for sockeye as well as chinook and coho salmon. The catch by subsistence means has increased significantly since 1969. This increased catch has caused the monitoring to become extremely important. Also, analysis by type of permit with reported catch, plus past creel census, has shown an increase in the sport aspect of subsistence fishing. Continued evaluation of this fishery is necessary because of the potentially high harvest that can be taken from the escapement. The direct relationship between subsistence catch and upper Copper River escapement may prove useful in future management schemes.

During the 1980 fiscal year, major funding for the stream side gravel incubation project was appropriated from the legislature. The total number of incubation units was doubled to 20. An impressive survival rate of green sockeye salmon eggs to fry continued to be observed in 1980. Incubator evaluation will be continued through the ADF&G, FRED Division, to insure that fry survival data is continuous, that major adult returns become a reality, and that evaluation of rearing sites is completed so that expansion of this program may be conducted in logical sequence.

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(1980 Field Season)

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APPENDICES

Appendix Table 1. Copper River sockeye salmon catch by age class contribution, by sex and week, 1980.

Week		1.1		0.2		0.3		1.2		2.2		1.3		2.3		1.4		Sample Size Catch
		M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	
21	%	0	0	0	0	0	0	4.0	0	2.0	0	54.0	34.0	4.0	2.0	0	0	50
	No.	0	0	0	0	0	0	4	0	2	0	50	30	4	2	0	0	92
22		No samples collected																
23	%	0	0	0	0	0	0	10.5	5.3	5.3	0	47.4	26.3	5.3	0	0	0	19
	No.	0	0	0	0	0	0	50	25	25	0	224	125	25	0	0	0	474
24		No samples collected																
25		Closed																
26		Closed																
27		Closed																
28		Closed																
29		Closed																
30	%	0.8	0	0.8	0.8	0	1.5	17.3	18.8	3.8	2.3	14.3	34.6	3.8	0.8	0.8	0	133
	No.	94	0	94	94	0	189	2179	2368	473	284	1798	4353	473	94	94	0	12,587
31-39		No samples collected																
Totals	%	0.5	0	0.5	0.5	0	1.0	13.3	13.3	3.4	1.5	27.1	33.5	3.9	1.0	0.5	0	202
	No.	66	0	66	66	0	132	1749	1749	447	197	3564	4406	513	132	66	0	13,153[1]
Sexes Combined	%	0.5		1.0		1.0		26.6		4.9		60.6		4.9		0.5		202
	No.	66		132		132		3499		648		7971		639		66		13,153

[1] Total commercial catch was 18,451.

Appendix Table 2. Mean length[1] by age class, week and sex of Copper River sockeye salmon commercial catch, 1980.

Week		1.1		0.2		0.3		1.2		2.2		1.3		2.3		1.4		Catch Sample Size
		M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	
21	$\bar{x}$	0	0	0	0	0	0	532	0	552	0	572	555	544	522	0	0	92
	No.	0	0	0	0	0	0	(2)	0	(1)	0	(27)	(17)	(2)	(1)	0	0	(50)
22		No samples collected																
23	$\bar{x}$	0	0	0	0	0	0	552	478	524	0	598	584	545	0	0	0	474
	No.	0	0	0	0	0	0	(2)	(1)	(1)	0	(9)	(5)	(1)	0	0	0	(19)
24		No samples collected																
25		Closed																
26		Closed																
27		Closed																
28		Closed																
29		Closed																
30	$\bar{x}$	300	0	534	528	0	574	543	527	550	554	603	587	603	611	598	0	12,587
	No.	(1)	0	(1)	(1)	0	(2)	(23)	(25)	(5)	(3)	(19)	(46)	(5)	(1)	(1)	0	(133)
31-39		No samples collected																
Total mean		300	0	534	528	0	574	543	525	547	554	587	579	581	567	598	0	13,153[1]
Sample No.		(1)	0	(1)	(1)	0	(2)	(27)	(26)	(7)	(3)	(55)	(68)	(8)	(2)	(1)	0	(202)

[1] Lengths are mid-eye to fork-of-tail in millimeters.
[2] Total commercial catch was 18,451.

Appendix Table 3. Sockeye salmon counts, Fish Creek weir, 1980.

Date	Number of Sockeye Salmon	Cumulative Count
June 23		Weir installed
June 23-July 7	0	0
July 8	1	1
9	4,445	4,446
10	3,000[1]	7,446
	100	7,546
July 11-19	0	7,546
20	415	7,961
21	2,211	10,172
23	1	10,173
24	181	10,354
25	45	10,399
26	36	10,435
28	276	10,711
30	51	10,762
31	85	10,847
August		
1	4	10,851
3	83	10,934
5	94	11,028
6	35	11,063

Total counted through weir = 8,063

Total of counted and estimated = 11,063

[1] Estimated - were not counted but escaped upstream through a hole in the weir.

Appendix Table 4. Copper River and Bering River sockeye, chinook, and coho salmon escapement, 1980.

Location	Glacial	Date	Method	Sockeye	Chinook	Coho
Bremner River						
Peninsula Lake		8/15	A	1,475		
Salmon Creek		8/15	A	1,500		
Steam Boat Lake		9/3	A	300		
Unnamed Creek		9/3	A	0		
Tiekel River Lake		9/3	A	150		
Tonsina River						
Lower Tonsina Creek		9/3		425		
Little Tonsina River		8/10	A	0	70	
Tonsina Lake		10/30	A	650		
Bernard Creek				No Survey		
Grayling Creek		8/10	A	0	66	
Klutina River						
Manker Creek		8/10	A	0	35	
Mahlo Creek		7/22	A	1,000		
Unnamed Lake		9/3	A	1,000		
1884 Lake		9/3	A	50		
Hallet Slough		9/3		200		
Curtis Creek				No Survey		
St. Anne Creek		7/22	A	5,000	0	
Tazlina River						
Mendeltna Creek		9/3	A	1,125	3	
Kiana Creek		7/22	A	0	247	
Tazlina Lake				No Survey		
Gulkana River						
Mouth to West Fork				No Survey		
West Fork		7/21	A	95	26	
Moose Creek				No Survey		
Keg Creek		7/21	A	2,325	2	
Victor Creek		7/21	A	3,275		
West Fork to Middle Fork		7/21	A	1,500	497	
Middle Fork		7/21		0	127	
Dickey Lake		7/21	A	250		
Swede Lake		7/21	A	400		
Hungry Hollow		10/16	A	150[1]		
Tenmile Lake		10/16	A	100		
East Fork to Paxson Lake		8/11	A	3,800	35	
Paxson Lake		8/11	A	0		
Paxson Lake Inlet		9/2	A	1,100		
Inlet to Mud Creek		8/11	A	8,200		
Mud Creek		8/11	A	725		
Mud Lake		8/11	A	15		
Mud Creek to Summit Lake		8/11	A	3,075[2]		
Fish Lake		7/21	A	3,175		
" "			(Weir	11,063)		
Summit Lake		7/21	A	0		

-Continued-

Appendix Table 4. Copper River and Bering River sockeye, chinook, and coho salmon escapement, 1980 (continued).

Location	Glacial	Date	Method	Sockeye	Chinook	Coho
Gunn Creek		7/21	A	325		
Gakona River						
Spring Creek				No Survey		
Chistochina River						
East Fork		7/21	A		575	
Eagle Creek		7/21	A	75	18	
Mankomen Lake		7/21	A	0		
Slana River						
Mentasta Lake		7/21	A	3,200		
Fish Creek		7/21	A	900		
Bad Crossing #1		7/21	A	55		
Bad Crossing #2		7/21	A	20		
Bone Creek				No Survey		
Slana Sloughs		7/21	A	100		
Suslota Lake		7/21	A	1,700		
Indian River		7/21	A		24	
Ahtell Creek		7/21	A		0	
Tanada Creek						
Tanada Lake		9/2	A	4,200		
Tanada Lake Outlet		9/2	A	9,500		
Copper Creek						
Copper Lake		9/2	A	35		
Tebay River		8/15	A	0	5	
Chokosna River		8/15	A	350		
Lakina River						
Long Lake		10/30	A	2,650		
" "			(Weir	38,500)		
Clear Creek (Chitina River)				No Survey		
Tana River						
Tana Clear Channels		8/15	A	1,560		
Tana Lake Inlet		8/15	A	500		
West Fork Clear Channels		8/15	A	70		
Swan Lake (Copper River)		8/15	A	350		

-Continued-

Appendix Table 4. Copper River and Bering River sockeye, chinook, and coho salmon escapement, 1980 (continued).

Location	Date	Method	Sockeye	Chinook Date	Coho
Eyak River					
Eyak Lake	9/10	A	22,500	9/18	6,000
Hatchery Creek	7/9	A	800		--
Power Creek	8/29	A	4,500		--
Ibek Creek	7/25	A	35	9/10	12,110
Alganik Slough					
McKinley Lake	7/15	A	27,500	9/18	2,500
Salmon Creek	7/25	A	5,000	9/18	2,000
Salmon Creek Springs	8/4	A	3,500	9/10	2,500
Pete Dahl Slough					
Miles 26 & 27 Creeks	7/15	A	7,500		--
Copper River Delta					
Mile 39	8/4	A	18,000	9/18	7,100
Goat Mountain Creek	7/25	A	150	9/18	800
Martin River					
Tokun Lake	9/10	A	17,000	9/18	2,000
Tokun River	8/15	A	6,800	9/18	2,200
Tokun Springs	8/15	A	2,000		--
Little Martin Lake	9/10	A	6,500	9/18	1,500
Little Martin Outlet	8/29	A	1,500		--
Martin River	7/25	A	3,500	9/18	12,855
Martin Lake	6/24	A	17,650	9/18	4,500
Martin Feeders	7/15	A	8,500		--
Martin Outlet	6/30	A	15,000	9/10	2,100
Pothole Lake	9/10	A	8,000		--
Pothole Outlet	6/30	A	4,500		
Ragged Point Lake	9/10	A	13,000		
Ragged Point Outlet	8/29	A	5,000	9/10	100
Martin River Slough	6/30	A	10,000	9/18	22,000

[1] All produced by incubation system.

[2] Majority produced by incubation system.

A = Aerial counts

Appendix Table 5. Sockeye salmon estimated spawning escapement from selected systems in Prince William Sound[1].

System	Stream No.	Date 7/2	7/14	7/16	7/22	8/5	8/14	8/20	8/22	9/4	Total[2]
Robe Lake	137				993[3]						993
Billy's Hole	218	0			0	0					0[4]
Red Lake	300	300	900		500	100					900
Shrode Lake	476		75			350	250	1200			1200
Jackpot	608			0	2600				3500	2000	3500
Bainbridge	630				350						350
Total											6943

[1] All counts are aerial survey estimates unless indicated otherwise.

[2] Peak count used.

[3] Ground count by Division of Sport Fish personnel.

[4] Ground observations by USFS personnel confirms insignificant escapement.

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