

State of California
The Resources Agency
DEPARTMENT OF FISH AND GAME

FINAL REPORT
HYDROACOUSTIC COUNTING OF SALMON AND STEELHEAD TROUT RUNS
KLAMATH RIVER TRIBUTARIES
PROJECT (2.25)

by

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Inland Fisheries

1990

FINAL REPORT
FOR
PROJECT (2.25)

HYDROACOUSTIC COUNTING OF SALMON AND STEELHEAD TROUT RUNS IN
SELECTED KLAMATH RIVER TRIBUTARIES

A. Abstract:

Hydroacoustic (sonar) equipment was used to enumerate the anadromous fish spawning runs on the Salmon River. The equipment was operated from September 3 through November 3, 1988. We were unable to determine the size of the runs based on preliminary analyses of the echograms because: (i) fish milling in the ensonified zone made interpretation of the echograms impossible; and (ii) the weir operated to trap upstream migrating fall chinook salmon to estimate spawning escapement did not provide accurate information on the species composition of the runs. These are relatively minor problems that should be fairly easy to overcome. Information was collected on the diurnal pattern of fish movement.

B. Introduction:

A major objective of the California Department of Fish and Game's Klamath River Project is to determine the natural spawning escapement of anadromous salmonids in the Klamath River basin, excluding the Trinity River basin. To accomplish this objective, the project operates four fish-counting facilities. At two of these facilities, Bogus Creek and the Shasta River, we get essentially complete counts of the fall chinook salmon runs (except for about 0.5 miles of Bogus Creek below the weir). The other two, located on the Scott and Salmon rivers, are temporary weirs, and we do not obtain complete counts. Estimates of total fall chinook escapement to these two rivers are based on mark and recapture statistical methods and carcass counts.

With recently developed techniques in hydroacoustic (sonar) monitoring of fishery resources, we believe we now have the potential for getting complete and accurate counts of all chinook salmon entering these rivers to spawn.

In most years, late-fall and winter storms wash out the facilities at all four of our sites before we have obtained figures for the later-migrating coho salmon and steelhead stocks. By using hydroacoustic techniques, we believe it possible to also get these counts.

In addition to obtaining more complete and accurate counts, using sonar techniques may eventually allow us to reduce our spawning stock efforts on these streams.

C. Description of Study Area:

The Klamath River system drains approximately 12,000 sq. mi. of northwestern California and southern Oregon. It is the second most important fall chinook salmon producer in California. Major salmon and steelhead spawning tributaries are the Trinity River, Salmon River, Scott River, Shasta River and Bogus Creek. Natural reproduction is augmented by two hatcheries, Iron Gate Hatchery at the foot of Iron Gate Dam on the Klamath River, and Trinity River Hatchery at the base of Lewiston Dam on the Trinity River. Salmon rearing ponds are operated by local organizations on several smaller tributaries that historically had spawning runs of chinook salmon. Since 1978, the numbers of fall chinook salmon returning to the Klamath River system have ranged from a low of about 53,800 adults in 1984 to a high of about 236,700 in 1986.

The Salmon River, a major salmon and steelhead spawning tributary to the Klamath River, drains an area of approximately 750 square miles and is totally contained within the Klamath National Forest in western Siskiyou County, California. It is 91.9 miles long including the north and south forks, and enters the Klamath River at river mile 66.0. The California Department of Fish and Game has operated a fish marking and counting weir on the Salmon River since 1984 to estimate fall chinook spawning escapement.

D. Methods and Materials:

A site on the Salmon River conducive to hydroacoustic enumeration of upstream migrating salmonids was selected approximately one mile upstream of the Klamath River Project's temporary weir in the Oak Bottom area. A second, partial weir and the hydroacoustic equipment was installed and operated to verify the hydroacoustic counts and to collect biological data on fish passing the weir. The hydroacoustic gear consisted of a Biosonic 105 Dual-Beam Echosounder, 115 Portable Chart Recorder, Elliptical Dual-Beam Transducer, and a Hitachi Oscilloscope V-209.

Study site selection, installation and operation of the hydroacoustic equipment, interpretation of the data, and training of Department personnel in the use, maintenance and operation of the equipment was contracted out to Biosonics, Inc. of Seattle WA., who were conducting studies on hydroaco-

ustic (sonar) enumeration of salmon runs in the lower Klamath River near the mouth.

E. Results and Discussion:

The hydroacoustic fish enumerating station on the Salmon River operated from September 3 through November 3, 1988. To date, we have made preliminary analyses of the echograms recorded from September 3 through October 14.

The echograms for the period October 15 through November 3 recorded a lot of milling behavior by fish entering the sampling field, thus making it difficult or impossible to interpret the traces.

Complete echogram counts of passing fish were made for only 17 of 42 sampling days during the period September 3 through October 14. Incomplete counts on remaining days generally resulted from the paper jamming in the chart recorder or from fish milling in the ensonified zone, making interpretation of the recording impossible. The 17 days with complete and legible recordings were used to expand counts for the 25 days of partial data during this period by determining the percentage each half-hour increment made of total daily counts. This percentage was used to calculate the number of counts for each missing half-hour period. Daily counts were combined by standard week, and compared to the counts made at the fish counting/marketing weir, upstream (Table 1). Based on visual examination, there does not appear to be any relationship between the number of fish tallied on the echogram and the numbers of fish passing the counting/marketing weir. This lack of correlation was probably due to the following reasons: (i) significant numbers of steelhead that passed the sonar counting site were observed to be holding in a large pool between the two weirs, and never passed through the counting/marketing weir.

As a result, these fish were recorded at the sonar site, but not counted at the counting/marketing weir; and (ii) smaller fish, such as half-pounder steelhead, American shad, and possibly suckers were counted at the sonar, but were not collected in the upstream trap. Because the species composition of fish migrating past the sonar site was apparently different than the species composition taken in the trap, we cannot use the trapping data to determine species composition at the sonar.

While we have not been able to use the sonar results to estimate the number of fish migrating up the Salmon River in 1988, the data do reflect a diurnal pattern of migration (Figure 1). Very few fish passed the sonar site between the hours of 10:00 a.m. and 4:00 p.m.

TABLE 1. WEEKLY FISH AND ECHOGRAM COUNTS
SALMON RIVER, 1988

WEEK ENDING	WEIR COUNTS			OTHER FISH	TOTAL FISH	SONAR COUNTS
	ADULTS	GRILSE	TOTAL			
SEPT 9	22	7	29	57	86	333
SEPT 16	53	25	78	21	99	334
SEPT 23	79	16	95	15	110	623
SEPT 30	125	22	147	26	173	285
OCT 7	146	28	174	73	247	1520
OCT 14	77	8	85	18	103	1513
TOTAL	502	106	608	210	818	4608

F. Summary and Conclusions:

This was the first year of a proposed two-year study to determine the feasibility of using hydroacoustic methods for enumerating the anadromous fish runs in the Salmon River. Based on preliminary analysis of the data, we were unable to accomplish this task for the following reasons: (i) fish milling in the ensonified zone made it impossible to interpret the marks on the chart recorder; and (ii) the trap at the upstream counting/marking weir did not provide an accurate representation of the species composition to apply to the sonar counts.

At this time, we feel these problems can be overcome. By relocating the sonar weir, we believe the problem of fish milling in the ensonified zone can be virtually eliminated. At the same time, repositioning the weir can be done so as to eliminate the opportunity for fish to linger between the two weirs. Once the method has been verified by the counting and marking weir and the subsequent Petersen estimate based on marked carcass recoveries, need for the second counting/marking weir would be reduced to providing data on species and size composition, and as a means for recovering marked and tagged fish.

Design changes in the trap can be easily made to provide a more representative catch composition. In addition, more sophisticated transducers and recorders are available that would give us more information about directional movement and size of the fish thus aiding interpretation of the echograms.

G. Summary of Expenditures:

Contract	\$17,537
Overhead	<u>3,963</u>
Total	\$21,500

H. Supplemental Data:

Supplemental data are contained in Appendix A submitted as separate volume.

Prepared by: Jack A. Hanson

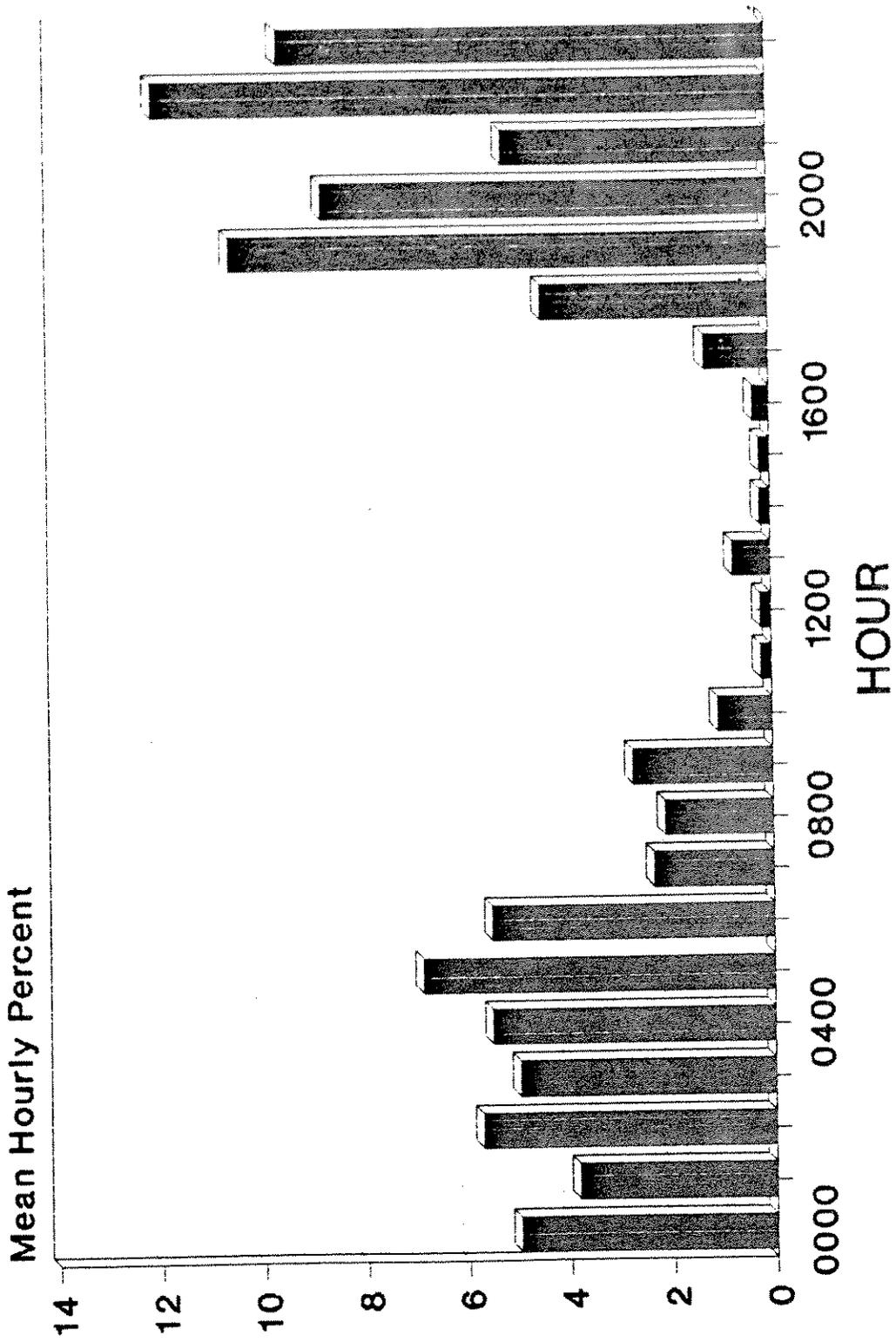
Jack A. Hanson

Date: 3/6/90

¹ Includes expenditures of \$15,734 incurred from October 1, 1987 through September 31, 1988.

ECHOGRAM COUNTS

Salmon River, Fall 1988



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APPENDIX A

by

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Klamath River Project, Inland Fisheries Division

Inland Fisheries

1990

Salmon River Echogram Counts for Julian Week 35

Time	3-Sep	4-Sep	5-Sep	6-Sep	7-Sep	8-Sep	9-Sep	
0:00	0	0	Note 2	3	Note 2	Note 2	Note 2	9
0:30	0	0	Note 2	2	Note 2	Note 2	Note 2	10
1:00	0	0	Note 2	3	Note 2	Note 2	Note 2	11
1:30	1	0	Note 2	3	Note 2	Note 2	Note 2	12
2:00	1	0	Note 2	2	Note 2	Note 2	Note 2	13
2:30	0	0	Note 2	12	Note 2	Note 2	Note 2	14
3:00	1	0	Note 2	1	Note 2	Note 2	Note 2	15
3:30	1	0	Note 2	1	Note 2	Note 2	Note 2	16
4:00	1	0	Note 2	3	Note 2	Note 2	Note 2	17
4:30	1	0	Note 2	0	Note 2	Note 2	Note 2	18
5:00	0	5	Note 2	2	Note 2	Note 2	Note 2	19
5:30	0	0	Note 2	0	Note 2	Note 2	Note 2	20
6:00	0	0	Note 2	0	Note 2	Note 2	Note 2	21
6:30	0	2	Note 2	Note 2	Note 2	Note 2	Note 2	22
7:00	0	0	Note 2	23				
7:30	0	0	Note 2	0	Note 2	Note 2	Note 2	24
8:00	0	0	Note 2	0	Note 2	Note 2	Note 2	25
8:30	0	0	Note 2	1	Note 2	Note 2	Note 2	26
9:00	0	1	Note 2	27				
9:30	0	0	Note 2	2	Note 2	Note 2	Note 2	28
10:00	0	0	Note 2	0	Note 2	Note 2	Note 2	29
10:30	0	0	3	0	Note 2	Note 2	Note 2	30
11:00	0	1	3	0	Note 2	Note 2	Note 2	31
11:30	1	0	2	1	Note 2	Note 2	Note 2	32
12:00	0	0	6	1	Note 2	Note 2	Note 2	33
12:30	0	0	6	0	Note 2	Note 2	Note 2	34
13:00	0	0	4	0	Note 2	Note 2	Note 2	35
13:30	0	2	5	2	Note 2	Note 2	Note 2	36
14:00	0	0	1	0	Note 2	Note 2	Note 2	37
14:30	0	Note 1	Note 1	0	Note 2	Note 2	0	38
15:00	0	Note 1	0	1	Note 2	Note 2	0	39
15:30	0	Note 1	1	2	Note 2	Note 2	0	40
16:00	0	0	0	1	Note 2	Note 2	1	41
16:30	0	0	0	0	Note 2	Note 2	0	42
17:00	0	0	0	1	Note 2	Note 2	1	43
17:30	0	0	0	3	Note 2	Note 2	1	44
18:00	0	0	1	1	Note 2	Note 2	0	45
18:30	1	0	0	5	Note 2	Note 2	0	46
19:00	1	1	0	8	Note 2	Note 2	0	47
19:30	1	0	4	2	Note 2	Note 2	0	48
20:00	1	Note 2	1	0	Note 2	Note 2	0	49
Time	0	Note 2	1	1	Note 2	Note 2	0	50
21:00	0	Note 2	2	1	Note 2	Note 2	0	51
21:30	0	Note 2	10	Note 2	Note 2	Note 2	1	52
22:00	0	Note 2	7	Note 2	Note 2	Note 2	2	53
22:30	0	Note 2	1	Note 2	Note 2	Note 2	1	54
23:00	0	Note 2	2	Note 2	Note 2	Note 2	0	55
23:30	0	Note 2	2	Note 2	Note 2	Note 2	3	56

TOTALS 11 12 62 65 0 0 10

36.47 45.77 31.40 0 0 46.93

19 117 75 38 34 19

Salmon River Echogram Counts for Julian Week 37

Time	10-Sep	11-Sep	12-Sep	13-Sep	14-Sep	15-Sep	16-Sep
0:00	0	1	0	0	5	1	9
0:30	1	0	0	0	1	0	9
1:00	0	0	0	1	5	1	10
1:30	0	0	0	0	2	3	5
2:00	0	0	0	0	3	1	18
2:30	0	1	0	0	3	2	11
3:00	1	1	0	0	3	0	9
3:30	1	0	0	0	3	2	9
4:00	0	1	0	1	0	3	4
4:30	1	0	0	1	5	1	33
5:00	7	0	0	0	2	3	2
5:30	5	1	0	0	0	4	1
6:00	5	0	0	1	0	1	0
6:30	3	0	0	1	0	1	0
7:00	0	0	0	1	0	0	0
7:30	1	0	0	0	0	0	0
8:00	1	0	0	1	0	0	1
8:30	1	0	0	0	0	0	0
9:00	0	0	0	0	0	1	1
9:30	0	0	0	0	0	0	0
10:00	2	0	0	0	0	0	Note 2
10:30	0	0	0	0	0	0	Note 2
11:00	0	0	0	0	0	0	0
11:30	0	0	0	0	0	0	0
12:00	0	0	0	0	0	0	0
12:30	1	0	0	0	0	0	1
13:00	0	0	0	0	0	0	0
13:30	0	0	0	0	0	0	0
14:00	0	0	0	0	0	0	1
14:30	0	0	0	0	0	0	0
15:00	0	0	0	0	0	0	0
15:30	0	0	0	0	0	0	Note 2
16:00	0	0	0	0	0	0	Note 2
16:30	0	0	0	0	1	0	Note 2
17:00	0	0	0	0	0	0	Note 2
17:30	1	0	0	0	0	1	Note 2
18:00	0	0	0	0	0	2	Note 2
18:30	0	0	0	0	0	1	Note 2
19:00	1	0	0	0	0	0	1
19:30	0	0	0	1	0	1	1
20:00	0	0	0	1	2	2	4
20:30	0	0	0	2	9	0	1
21:00	2	0	0	1	0	1	3
21:30	1	0	0	1	2	1	1
22:00	1	0	1	4	0	2	0
22:30	2	1	0	3	2	7	3
23:00	0	0	0	2	0	18	0
23:30	1	0	0	5	1	9	5

TOTALS

39 6 1 27 49 69 143

729
151

Salmon River Echogram Counts for Julian Week 38

Time	AK	AM	AO	20-Sep	21-Sep	22-Sep	23-Sep	
	17-Sep	18-Sep	19-Sep					
0:00	8	Note 2	5	5	4	1	2	9
0:30	5	Note 2	5	10	4	0	0	10
1:00	4	Note 2	1	8	3	1	0	11
1:30	0	Note 2	6	1	2	0	1	12
2:00	1	Note 2	6	10	4	1	0	13
2:30	0	Note 2	3	14	5	0	1	14
3:00	1	Note 2	4	8	7	0	1	15
3:30	2	Note 2	10	5	6	3	1	16
4:00	0	Note 2	5	9	3	1	0	17
4:30	2	Note 2	4	6	3	0	1	18
5:00	1	Note 2	5	12	5	1	0	19
5:30	1	Note 2	3	8	2	2	0	20
6:00	2	Note 2	2	14	0	7	0	21
6:30	3	Note 2	0	10	0	0	0	22
7:00	1	Note 2	0	10	0	0	1	23
7:30	0	Note 2	1	5	0	0	0	24
8:00	0	Note 2	0	4	0	0	0	25
8:30	1	Note 2	0	1	0	0	0	26
9:00	0	Note 2	0	6	0	0	0	27
9:30	0	Note 2	1	0	0	0	0	28
10:00	0	Note 2	0	0	0	0	0	29
10:30	0	Note 2	0	0	0	0	0	30
11:00	0	Note 2	0	0	0	0	0	31
11:30	0	Note 2	0	0	0	0	0	32
12:00	0	Note 2	0	0	0	0	0	33
12:30	0	Note 2	0	0	0	0	0	34
13:00	0	Note 2	0	0	0	0	0	35
13:30	0	Note 2	0	0	0	0	0	36
14:00	Note 2	Note 2	Note 2	0	0	0	0	37
14:30	Note 2	Note 2	Note 2	0	0	0	0	38
15:00	Note 2	Note 2	0	0	0	0	0	39
15:30	Note 2	0	0	0	0	0	0	40
16:00	Note 2	0	0	0	0	0	0	41
16:30	Note 2	0	0	0	0	0	0	42
17:00	Note 2	0	0	0	0	0	0	43
17:30	Note 2	0	1	0	0	0	0	44
18:00	Note 2	0	1	0	0	0	0	45
18:30	Note 2	0	0	0	0	0	0	46
19:00	Note 2	2	0	16	0	0	1	47
19:30	Note 2	4	0	1	0	1	2	48
20:00	Note 2	9	1	2	2	0	0	49
20:30	Note 2	25	0	1	1	1	1	50
21:00	Note 2	16	0	1	0	0	0	51
21:30	Note 2	9	18	0	1	0	2	52
22:00	Note 2	6	8	2	3	0	1	53
22:30	Note 2	9	1	3	7	0	2	54
23:00	Note 2	3	4	10	1	0	0	55
23:30	Note 2	7	4	4	1	0	0	56
TOTALS	32	90	99	186	64	19	17	532
	5329	0.97	0.21					69
	69	130	99					

Salmon River Echogram Counts for Julian Week 39

Time	AP	M	N	O	P	Q	30-Sep	
	24-Sep	25-Sep	26-Sep	27-Sep	28-Sep	29-Sep		
0:00	1	0	0	1	0	1	0	1
0:30	1	3	2	1	0	1	0	10
1:00	0	1	0	0	0	0	1	11
1:30	0	3	0	0	0	1	0	12
2:00	0	2	0	1	0	0	1	13
2:30	1	4	0	0	0	0	2	14
3:00	1	2	0	0	0	0	2	15
3:30	0	0	0	0	0	0	5	16
4:00	1	1	0	0	0	1	2	17
4:30	0	3	0	2	2	0	1	18
5:00	2	3	1	1	2	1	1	19
5:30	0	2	0	0	1	1	0	20
6:00	0	1	0	1	1	0	0	21
6:30	1	0	2	0	1	0	0	22
7:00	0	0	0	0	0	1	0	23
7:30	2	0	0	0	0	0	0	24
8:00	0	0	0	1	0	0	3	25
8:30	1	0	0	5	0	2	2	26
9:00	0	0	0	17	0	0	6	27
9:30	0	0	0	0	1	0	0	28
10:00	0	0	0	3	1	0	0	29
10:30	0	0	1	1	0	0	0	30
11:00	0	0	0	0	0	0	0	31
11:30	0	0	0	0	0	0	1	32
12:00	0	0	0	0	0	0	0	33
12:30	1	0	0	0	0	0	0	34
13:00	0	0	0	2	1	0	0	35
13:30	0	3	0	1	0	0	0	36
14:00	Note 2	0	0	0	2	0	0	37
14:30	Note 2	0	0	0	0	0	Note 2	38
15:00	Note 2	0	0	0	0	0	0	39
15:30	Note 2	0	0	0	0	0	0	40
16:00	Note 2	0	0	0	0	0	0	41
16:30	Note 2	1	0	0	0	0	0	42
17:00	1	1	0	0	3	0	0	43
17:30	1	1	0	0	0	0	0	44
18:00	1	0	1	0	0	0	0	45
18:30	0	1	3	2	5	6	0	46
19:00	1	16	2	0	4	2	1	47
19:30	2	16	1	0	6	8	6	48
20:00	2	2	0	2	3	7	1	49
20:30	0	0	0	3	1	2	2	50
21:00	1	1	0	0	1	2	0	51
21:30	1	1	0	0	0	2	1	52
22:00	1	1	0	0	0	2	4	53
22:30	0	0	0	0	0	0	7	54
23:00	0	0	4	0	0	0	2	55
23:30	0	0	2	0	0	0	4	56
TOTALS	23	69	19	44	35	40	55	58

0.74
23

55

Salmon River Echogram Counts for Julian Week 40

Time	AU		AW		AY		BA		bc		BE	
	1-Oct	2-Oct	3-Oct	4-Oct	5-Oct	6-Oct	7-Oct	8-Oct	9-Oct	10-Oct	11-Oct	12-Oct
0:00	3	3	Note 3	Note 3	Note 2	23	Note 3					7
0:30	0	2	Note 3	Note 3	Note 2	17	Note 3					10
1:00	0	1	Note 3	Note 3	Note 2	28	Note 3					11
1:30	2	0	Note 3	3	Note 2	15	Note 3					12
2:00	1	1	15	3	Note 2	7	Note 3					13
2:30	0	4	10	2	Note 2	10	Note 3					14
3:00	1	1	1	1	Note 2	8	Note 3					15
3:30	0	2	1	1	Note 2	31	Note 3					16
4:00	3	1	0	1	Note 2	9	Note 3					17
4:30	2	1	0	1	Note 2	9					13	18
5:00	1	2	1	0	Note 2	45	Note 3					19
5:30	0	3	3	0	Note 2	17	Note 3					20
6:00	1	3	5	0	Note 2	36	Note 3					21
6:30	2	6	2	0	Note 2	9	Note 3					22
7:00	0	2	0	1	Note 2	5					1	23
7:30	3	1	1	3	Note 2	2					0	24
8:00	2	2	1	0	Note 2	4					1	25
8:30	2	2	0	0	Note 2	3					0	26
9:00	1	3	1	1	Note 2	6					0	27
9:30	0	2	2	0	Note 2	2					7	28
10:00	0	1	3	1	Note 2	0					4	29
10:30	2	2	5	1	Note 2	0					7	30
11:00	1	1	1	0	Note 2	1					1	31
11:30	0	0	2	0	Note 2	3					0	32
12:00	1	0	0	0	Note 2	1					0	33
12:30	0	1	0	5	Note 2	0					0	34
13:00	0	2	0	0	Note 2	2					1	35
13:30	0	0	2	0	Note 2	1					2	36
14:00	0	2	0	0	Note 2	0					0	37
14:30	0	0	0	0	Note 2	0					0	38
15:00	0	1	0	Note 2	Note 2	0					0	39
15:30	2	2	0	0	Note 2	0					0	40
16:00	0	2	Note 2	0	Note 2	1					0	41
16:30	1	0	0	1	Note 2	0					0	42
17:00	0	1	0	Note 2	Note 2	0					2	43
17:30	5	1	Note 3	Note 2	3	0					0	44
18:00	4	0	Note 3	Note 2	1	0					7	45
18:30	16	1	Note 3	Note 2	0	6	Note 2					46
19:00	7	0	Note 3	Note 2	0	Note 3	Note 2					47
19:30	12	7	Note 3	Note 2	21	9	Note 2					48
20:00	23	Note 3	Note 3	Note 2	21	8	Note 2					49
20:30	15	13	Note 3	Note 2	9	14					1	50
21:00	12	Note 3	Note 3	Note 2	10	8					19	51
21:30	23	Note 3	Note 3	Note 2	6	17	Note 3					52
22:00	29	Note 3	Note 3	Note 2	6	Note 3					5	53
22:30	41	Note 3	Note 3	Note 2	3	Note 3					22	54
23:00	24	Note 3	Note 3	Note 2	6	Note 3	Note 3					55
23:30	9	Note 3	Note 3	Note 2	2	Note 3	Note 3					56
TOTALS	251	79	56	25	88	357	102	54				
		32.45	62.27	39.67	47.89	26.96	64.33					
		1.7	1.3	3.2	16.9	4.87	2.86					

Salmon River Echogram Counts for Julian Week 41

Time	B6	B1	BK	BM	B0	B2	B5	
	8-Oct	9-Oct	10-Oct	11-Oct	12-Oct	13-Oct	14-Oct	
0:00	Note 3	Note 3	0	3	9	8	Note 3	9
0:30	Note 3	Note 3	4	Note 3	Note 3	Note 3	Note 3	10
1:00	Note 3	Note 3	7	Note 3	Note 3	13	Note 3	11
1:30	Note 3	Note 3	0	3	Note 3	Note 3	13	12
2:00	Note 3	Note 3	3	1	12	Note 3	10	13
2:30	Note 3	Note 3	6	25	11	Note 3	2	14
3:00	Note 3	Note 3	3	Note 3	10	Note 3	1	15
3:30	Note 3	Note 3	12	0	5	Note 3	0	16
4:00	Note 3	Note 3	10	2	2	Note 3	1	17
4:30	Note 3	Note 3	6	2	4	Note 3	4	18
5:00	Note 3	Note 3	Note 3	6	2	Note 3	0	19
5:30	Note 3	27	0	5	4	Note 3	5	20
6:00	Note 3	Note 3	0	4	2	0	6	21
6:30	Note 3	15	0	3	1	Note 2	3	22
7:00	Note 3	1	3	4	3	Note 2	8	23
7:30	11	7	1	2	2	Note 2	3	24
8:00	3	7	0	9	Note 2	Note 2	0	25
8:30	3	19	0	5	1	1	1	26
9:00	1	3	0	3	5	0	0	27
9:30	1	2	0	0	5	5	3	28
10:00	0	0	0	0	2	0	2	29
10:30	4	0	2	0	14	0	0	30
11:00	3	0	0	0	0	1	0	31
11:30	0	7	1	0	0	1	0	32
12:00	0	1	0	0	1	0	0	33
12:30	0	0	1	0	0	1	0	34
13:00	0	0	3	1	1	1	1	35
13:30	0	0	0	0	1	0	1	36
14:00	1	0	0	3	1	0	1	37
14:30	2	1	3	4	0	0	0	38
15:00	3	1	1	0	1	0	0	39
15:30	7	3	2	4	2	0	0	40
16:00	4	8	6	0	0	0	0	41
16:30	11	9	9	5	1	0	0	42
17:00	8	9	1	4	7	1	6	43
17:30	4	3	14	7	10	2	1	44
18:00	Note 2	Note 2	Note 3	7	17	0	0	45
18:30	Note 2	1	Note 3	20	20	1	14	46
19:00	Note 2	8	13	12	20	Note 3	9	47
19:30	Note 2	15	Note 3	3	9	Note 3	15	48
20:00	Note 2	10	Note 3	2	7	Note 3	Note 3	49
20:30	Note 2	2	Note 3	6	2	Note 3	22	50
21:00	22	3	17	12	3	Note 3	Note 3	51
21:30	14	5	19	2	1	Note 3	Note 3	52
22:00	18	4	Note 3	3	3	Note 3	Note 3	53
22:30	Note 3	1	13	5	0	Note 3	Note 3	54
23:00	12	1	12	14	4	Note 3	Note 3	55
23:30	Note 3	1	Note 3	0	3	Note 3	Note 3	56

TOTALS

132	173	172	191	208	35	132
23.24	33.19	30.87	7.19	7.19	79.39	39.53
190	250	200	206	224	170	25

Notes on 1988 Salmon River Echogram Counts

Note 1: Data unavailable due to transducer aiming and testing.

Note 2: Echogram unavailable due to paper jam, too much time between paper changes or other sampling problem.

Note 3: Data unreadable due to fish milling behavior in wier opening.

m

2 m

4 m

6 m

8 m

10/3/88

02:30 - 02:50

Wier opening from 5.5 m - 8 m

Many fish holding in wier opening.

1000-

2m

4m

6m

8m

10/3/88 23:45 - 10/4/88 00:20

Wier Operating from S.Sw - 2m
Many fish holding in wier opening