

ANNUAL REPORT
NIMBUS SALMON AND STEELHEAD HATCHERY
1978-79 FISCAL YEAR^{1/}

by

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Region 2

ABSTRACT

This report describes the operation of Nimbus Salmon and Steelhead Hatchery from July 1, 1978 through June 30, 1979. Tables present numbers of adult fish trapped, eggs taken, fish reared and released, daily river flow, weather conditions, and water and air temperatures.

There were 8,162 chinook salmon, Oncorhynchus tshawytscha, trapped, which produced 14,876,210 eggs. The 680 winter-run steelhead, Salmo gairdneri, which were trapped produced 1,022,524 eggs.

During the year we planted or transferred an estimated 7,055,779 fingerling and 229,040 yearling chinook salmon and 617,846 fingerling and 410,446 yearling winter-run steelhead.

^{1/} Anadromous Fisheries Branch Administrative Report No. 82-16.
Submitted August 1980.

INTRODUCTION

This is the 24th annual report of the Nimbus Salmon and Steelhead Hatchery. The hatchery is operated by the California Department of Fish and Game under contract with the United States Bureau of Reclamation. This report summarizes the activities at the hatchery during 1978-79, with particular reference to numbers of fish trapped, spawned, and released; eggs taken and fish produced; and other pertinent information. The number of salmon and steelhead trapped during the 24 years of operation is summarized (Appendix Table 1).

PRODUCTION SUMMARY

During 1978-79, we took an estimated 15,898,734 eggs and planted approximately 8,313,111 salmon and steelhead (Table 1).

TABLE 1. Production Summary, Nimbus Salmon and Steelhead Hatchery 1978-79

Species	Number trapped	Eggs taken	Eggs received or transferred	Fingerlings planted or transferred	Yearlings planted	Total planted (kg)	On hand 6-30-79
Chinook salmon							
1977 BY	-	-	-	118,625 ^{a/}	229,040	15,159	-
1978 BY	8,162	14,876,210	5,666,065 ^{b/}	7,055,779	-	35,260	403,550
Steelhead							
1978 BY	-	-	-	184,412	410,446	39,409	-
1979 BY	680	1,022,524	200,890 ^{c/}	433,434	-	446	776,585 ^{d/}

^{a/} Fingerlings shipped to Mokelumne River Fish Installation.

^{b/} Includes 4,010,665 eggs shipped to Coleman National Fish Hatchery and 1,655,400 shipped to Mokelumne River Fish Installation.

^{c/} Includes 100,700 eggs shipped to Mokelumne River Fish Installation and 100,190 shipped to Feather River Hatchery.

^{d/} Includes 207,035 of original 216,562 Washougal-strain steelhead received from Silverado Field Operations Base.

HATCHERY OPERATION

The Weir

The weir was installed September 1, 1978 by the U. S. Bureau of Reclamation. The hatchery personnel spent approximately 80 man-hours filling holes beneath the weir and repairing or replacing bent pickets. The pickets were lowered and capped September 21.

On January 17, 1979 the weir was removed because flows were expected to exceed 155.7 m³/s (5,500 cfs), the maximum flow allowed with the weir in place. Since the salmon migration had ended and sufficient numbers of steelhead were on hand, the weir was not scheduled to be reinstalled until fall.

Water Temperature Control

Two wells were drilled for emergency standby use in October 1977 with emergency drought funds. The water temperature from both wells is a constant 65°F. By running both wells we found that during the months of January through April when our water temperatures are normally 45-47°F, we could maintain 57°F temperatures in one raceway and two nursery ponds. Since it has been established that water temperature above 56°F reduced heavy losses from infectious hematopoietic necrosis (IHN), we could also use these wells as a disease management tool. The wells were first used in January 1978 and soon the problem became gas-bubble disease, not IHN. A temporary aerator was constructed, but it also was found to be inadequate and a larger permanent one will be built before the wells are again put into service.

Disposal of Salmon Carcasses

Edible carcasses were given to State and county institutions, welfare and community action groups, and several groups or councils representing California Indians. Local zoos received carcasses of poor quality and a local rendering plant received all inedible carcasses. The total dispensed for each category was 22,362 kg (49,300 lb) edible, 476 kg (1,050 lb) animal food, and 8,732 kg (19,250 lb) inedible.

Public Relations

An estimated 189,498 persons visited Nimbus Hatchery this year. This number was determined by an employee count or estimate of the bus passengers and bicyclists. November was the peak visitation month, with 38,820 visitors.

CHINOOK SALMON MAINTENANCE PROGRAM

Chinook Salmon Counts

The first salmon was observed below the weir on or about October 10. The fish ladder was opened October 18 and the first spawning took place October 24.

A total of 8,162 salmon entered the holding ponds (Appendix Table 2), including 2,348 large males, 3,767 large females, and 2,047 grilse^{2/}. Carcasses counted and removed from the weir included 180 large males, 174 large females, and 159 grilse, including 14 small females.

Sorting and Spawning

Of the large females counted in the holding pond, 3,103 (82.4%) were spawned, 576 (15.3%) died in the pond, 76 (2.0%) were immature or accidentally killed, and 12 (0.3%) were overripe.

^{2/}

Fish 60 cm or smaller (23.6 inches) were considered grilse.

During the spawning season, October 24, 1978 to December 22, 1978, we took 14,876,210 eggs, for an average of 4,794 per female. Fertility as determined by difference between green and eyed eggs, ranged from 78.4 to 96.2%, and averaged 90.1%.

We shipped 4,010,665 eyed eggs to Coleman National Fish Hatchery and 1,655,400 to Mokelumne River Fish Installation.

Marked Chinook Salmon Recoveries

All fish were examined for marks as they were processed or were removed dead from the pond or weir. Fork lengths and sex were recorded (Appendix Table 3) and heads were removed from any fish with an Ad mark for recovery of coded wire tags.

CHINOOK SALMON PLANTING

1977 Brood Year

We had an estimated 388,520 chinook of the 1977 BY on hand July 1, 1978. In November all yearlings on hand were planted, unmarked (Table 2).

TABLE 2. Planting Data, 1977 Brood Year Chinook Salmon

Month	Release site	Number	Average size (g)	Total planted (kg)
Oct.	Rio Vista	107,380	55	5,940
Nov.	Rio Vista	121,660	70	8,484
TOTALS		229,040		14,424 (31,800 lb)

1979 Brood Year

We released 6,937,154 fingerlings and smolts (Table 3). No fish were marked. On June 30, 1979 there were approximately 398,750 chinook salmon on hand to be released in the fall as yearlings.

Table 3. Planting Data, 1978 Brood Year Chinook Salmon

Month	Release site	Fingerlings	Smolts	Average size (g)	Total planted (kg)
Jan. 1979	Am. Riv. at hatchery	352,500		0.32	113
Apr. 1979	Am. Riv. at hatchery	510,724		0.45-0.63	262
Apr. 1979	Rio Vista		864,735	3.60-5.21	3,713
May 1979	Rio Vista		2,860,120	3.94-7.56	17,269
June 1979	Am. Riv. at hatchery		18,375	9.26	170
June 1979	Rio Vista		2,330,700	3.75-8.89	13,740
TOTALS		863,224	6,073,930		35,267 (77,749 lb)

CHINOOK SALMON DISEASE INFORMATION

1977 Brood Year

Minor outbreaks of columnaris and bacterial gill disease were controlled by copper sulfate and salt flushes and Terramycin added to the diet. Losses were held to a minimum.

1978 Brood Year

Losses due to infectious hematopoietic necrosis (IHN) were low this year, although it did appear as usual about the first of April.

Minor outbreaks of columnaris, bacterial gill disease and Ichthyophthirius multifiliis (Ich) were of little significance and easily controlled with copper sulfate flushes and Terramycin in the diet.

Increasing losses in the yearling salmon was determined to be Lupus, for which there is no known cure. Random samples taken indicated that only about 25% of the fish were infected and to protect the remaining 75% an early release should be considered. Approximately 55% were released from September 11 through September 14, 1979 and the balance October 4 through October 11, 1979.

WINTER-RUN STEELHEAD MAINTENANCE PROGRAM

History of the 1979 Winter-run

All steelhead entering the hatchery prior to November 30, 1978 were spawned and classified as early run and those arriving after November 30 were considered late run. The first steelhead entering the hatchery were counted November 10, 1978, the last on January 29, 1979 (Table 4). All steelhead were examined for marks as they were spawned or released and a record kept of fork lengths and sex of marked fish (Appendix Table 4). Spawned-out or surplus fish were transported above the weir to the basin below Nimbus Dam.

Early Run

The 106 females spawned produced 562,346 eggs, for an average of 5,305 per female. Survival of green-to-eyed eggs ranged from 71.0-97.5%, and averaged 87.2%.

Late Run

The 152 females spawned produced 965,955 eggs for an average of 6,355 per female. Survival of green-to-eyed eggs ranged from 62.7-97.0%, and averaged 81.2%.

Summer-run Program

In an attempt to create a summer fishery, the Department obtained summer-run steelhead eggs from the Skamania Hatchery on the West Fork of the Washougal River in Washington. The eggs were hatched at the Silverado Field Operations Base in Region 3 and 216,562 fingerlings were delivered to Nimbus Hatchery in May 1979. These fish will be marked and released as yearlings in March or April 1980.

TABLE 4. Counts of Winter-run and Late-run Steelhead at
Nimbus Salmon and Steelhead Hatchery, 1978-79

	<u>Spawned and released</u>		<u>Died in pond</u>		<u>Released unspawned</u>		
<u>Date</u>	<u>M</u>	<u>F</u>	<u>M</u>	<u>F</u>	<u>M</u>	<u>F</u>	<u>Total</u>
<u>Early Run</u>							
<u>1978</u>							
12/ 8	4	5					9
12/14	3	5					8
12/19	3	4		1			8
12/29	11	17	1	3			32
<u>1979</u>							
1/ 2	6	7	3	1			17
1/ 8	7	8		6			21
1/15	10	15	7	8	8	3	51
1/19	3	27	4	11	6		51
1/25	4	12	5	7	6		34
1/29	3	6	2	2	4	4	21
TOTALS	54	106	22	39	24	7	252
<u>Late Run</u>							
<u>1978</u>							
12/14	4	4					8
12/19	3	4		1			8
12/29	10	11			5	1	27
<u>1979</u>							
1/ 2	5	5					10
1/ 8	10	10					20
1/15	11	27			43	10	91
1/19	9	24			24	3	60
1/24	15	41	3	7	33	9	108
1/29	11	26	2	9	45	3	96
TOTALS	78	152	5	17	150	26	428

Winter-run Steelhead Planted

1978 Brood Year

From September 6, 1978 to April 9, 1979, 594,858 winter-run steelhead were planted (Table 5). Of these, 184,412 were Nimbus fingerlings, 284,870 Mad River yearlings, and 125,576 Nimbus yearlings. Four hundred Nimbus steelhead yearlings were marked with red dye, an Ad fin clip, and \$5 reward tag, and planted at Rio Vista February 16, 1979. Five hundred Mad River yearlings were marked with green dye, an Ad fin clip, and a \$5 reward tag, and planted at Rio Vista the same day. On April 9, 1979, 400 Mad River yearlings were planted at Rio Vista with \$5 reward tags (no marks).

TABLE 5. Planting Data, 1978 Brood Year Winter-run Steelhead, Nimbus Salmon and Steelhead Hatchery, 1978-79

Date	Release site	Number of fingerlings	Number of yearlings	Average size (g)	Total planted (kg)
<u>1978</u>					
Sept.	Sacramento River				
	Garcia Bend	184,412		13.7	2,526
Nov.	Sacramento River				
	Garcia Bend		58,200	113.1	6,582
Nov.	Rio Vista		32,380	103.1	3,338
<u>1979</u>					
Jan.	Rio Vista		69,769	60.6	4,228
Feb.	Rio Vista		50,782	119.4	6,063
Mar.	Rio Vista		150,450	84.0	12,638
Apr.	Rio Vista		48,865	81.0	3,958
TOTALS		184,412	410,446		39,333 (86,729 lb)

1979 Brood Year

Prior to June 30, 1979 there were 433,434 Nimbus fingerling steelhead released into the river at the base of the ladder (Table 6). Of these, 137,521 were classified as early run and 295,913 were classified as late run. On June 30, 1979, there were 273,900 early-run and 285,650 late-run Nimbus fish, plus 207,035 Washougal steelhead on hand, from which 200,000 early, 150,000 late Nimbus yearlings, and 150,000 Washougal yearlings are to be released in the spring of 1980.

TABLE 6. Planting Data, 1979 Brood Year Steelhead, Nimbus Salmon and Steelhead Hatchery, 1978-79

Date	Release site	Number of fingerlings	Average size (g)	Total planted (kg)
<u>1979</u>				
5/ 2	American River at Nimbus	110,264	0.50	55
5/ 3	American River at Nimbus	89,170	0.46	41
5/21	American River at Nimbus	31,463	1.74	55
5/22	American River at Nimbus	83,869	2.02	169
5/23	American River at Nimbus	32,457	0.43	14
5/29	American River at Nimbus	86,211	1.31	113
TOTALS		433,434		447 (986 lb)

STEELHEAD DISEASE INFORMATION

1978 Brood Year

Columnaris once again was the dominant factor when water temperatures began rising in May. Treatment of copper sulfate and salt, plus Terramycin in the feed was sufficient to hold losses to a minimum. We found the most effective treatment for columnaris and gill bacteria was having 3% Terramycin milled into the feed and feeding it once a day (one third of the daily ration), for a period of 10 days.

Raceway A had one outbreak of Epistylis, but formalin flushes easily controlled it and losses were light.

1979 Brood Year

As usual, columnaris and gill bacteria were the dominant causes of fish loss, as the water temperatures began to approach 60°F. When the young steelhead were moved to the raceway ponds, the disease problem declined.

APPENDIX TABLE 1. Summary of Anadromous Fish Trapped^{a/} at
Nimbus Salmon and Steelhead Hatchery

Season	Chinook salmon					Steelhead		
	Males	Females	Total adults	Grilse	Total	Males	Females	Total
1955-56	4,427 ^{b/}	3,012	--	--	7,439 ^{b/}	36	74	110
1956-57	267	502	769	774	1,543	?	?	115
1957-58	297	341	638	252	890	33	18	51
1958-59	4,471	3,689	8,160	2,050	10,210	65	37	102
1959-60	3,003	7,366	10,369	2,866	13,235	354	424	778
1960-61	13,455	6,487	19,942	9,331	29,273	150	166	316
1961-62	3,446	9,257	12,703	1,638	14,341	85	51	137
1962-63	5,088	4,138	9,226	3,442	12,668	1,225	915	2,141
1963-64	1,218	1,215	2,428	813	3,241	472	744	1,216
1964-65	7,209	8,799	16,008	4,534	20,542	502	276	778
1965-66	5,295	7,595	12,890	786	13,676	374	500	874
1966-67	2,434	5,098	7,532	573	8,105	370	272	642
1967-68	2,022	2,392	4,414	733	5,147	?	?	1,183
1968-69	1,318	2,740	4,059	1,175	5,233	1,617	1,449	3,066
1969-70	1,061	1,488	2,549	521	3,070	1,088	646	1,734
1970-71	3,027	4,827	7,854	770	8,624	1,547	1,486	3,033
1971-72	3,384	4,493	7,877	1,269	9,146	1,148	1,108	2,256
1972-73	2,195	3,252	5,447	1,659	7,106	1,220	1,286	2,500 ^{c/}
1973-74	5,155	5,704	10,859	1,676	12,535	1,895	1,262	3,157 ^{d/}
1974-75	5,783	4,746	7,529	671	8,200	1,114	1,050	2,164 ^{e/}
1975-76	2,734	3,833	6,567	846	7,413	1,538	1,643	3,181
1976-77	2,002	2,340	4,342	894	5,236	592	715	1,307
1977-78	3,496	2,874	6,370	498	6,868	377	242	619
1978-79	2,348	3,767	6,115	2,047	8,162	333	347	680

^{a/} Fish which entered the holding ponds.

^{b/} Includes grilse.

^{c/} Plus 43 unsexed summer steelhead.

^{d/} Plus 40 male and 40 female summer steelhead.

^{e/} Plus 62 male and 69 female summer steelhead.

APPENDIX TABLE 2. Nimbus Salmon and Steelhead Hatchery Weather, Water, and Fish Trapping Data July 1, 1978 Through June 30, 1979

1978 July	Temperature (C*)				Weather	Flow of American River at hatchery (m ³ /sec**)	Salmon	Steelhead
	Air		Water					
	Maximum	Minimum	Maximum	Minimum				
1	27.8	12.2	15.6	14.4	clear	85.8		
2	27.8	12.8	16.1	14.4	clear	86.1		
3	30.0	13.3	16.1	16.1	clear	86.1		
4	33.3	14.4	16.7	15.6	clear	86.0		
5	36.1	15.6	16.7	15.0	clear	85.5		
6	36.7	17.2	16.7	15.0	clear	85.8		
7	34.4	14.4	16.7	15.6	clear	85.9		
8	38.3	18.9	16.7	15.6	clear	86.1		
9	39.4	20.0	17.2	15.6	clear	85.8		
10	31.1	14.4	16.7	15.6	clear	84.8		
11	29.4	11.7	17.2	15.6	clear	83.5		
12	31.7	12.2	17.2	15.6	clear	83.0		
13	36.7	16.7	17.8	16.1	clear	83.9		
14	38.9	17.8	18.3	16.1	clear	83.7		
15	33.9	18.3	17.8	16.7	clear	83.7		
16	36.1	15.6	18.3	16.7	clear	83.5		
17	38.3	15.6	18.3	16.7	clear	83.5		
18	38.3	19.4	18.9	16.7	clear	83.5		
19	38.9	18.3	18.9	16.7	clear	83.4		
20	37.8	17.2	19.4	17.2	clear	83.5		
21	40.0	16.7	20.0	17.8	clear	83.6		
22	39.4	14.4	20.6	18.3	clear	83.4		
23	38.9	18.3	20.6	17.8	clear	77.2		
24	41.1	16.7	21.1	16.7	clear	43.8		
25	36.7	19.4	21.1	18.9	partly cloudy	42.7		
26	35.6	17.2	20.6	17.8	clear	42.4		
27	36.1	16.7	17.8	17.8	clear	42.4		
28	36.1	15.6	17.8	17.2	clear	42.4		
29	36.7	14.4	17.8	16.7	clear	41.0		
30	37.2	15.0	18.3	16.7	clear	41.9		
31	40.0	16.7	17.8	16.7	clear	42.4		

*Temperature measured to nearest whole degree F, and later converted to C.

**Flows measured in cfs, and later converted to m³/sec.

Appendix Table 2 (continued)

1978 August	Temperature (C*)				Weather	Flow of American River at hatchery (m ³ /sec**)	Salmon	Steelhead
	Air		Water					
	Maximum	Minimum	Maximum	Minimum				
1	37.8	16.7	18.3	16.7	clear	42.4		
2	37.2	16.7	18.3	16.7	clear	42.4		
3	38.3	16.7	18.3	16.7	clear	42.4		
4	39.4	18.9	17.8	17.2	clear	44.4		
5	42.8	20.0	18.3	17.2	clear	81.2		
6	42.8	20.6	17.2	16.7	clear	83.5		
7	42.2	22.2	17.2	16.7	clear	83.6		
8	43.3	22.2	17.8	16.7	clear	85.1		
9	45.0	22.2	17.8	17.2	clear	85.0		
10	39.4	21.1	17.2	16.7	clear	85.0		
11	36.1	20.0	17.2	17.2	clear	85.0		
12	29.4	16.7	17.2	16.7	clear	85.0		
13	30.0	14.4	17.8	16.7	clear	85.0		
14	30.0	14.4	17.8	16.7	clear	85.2		
15	35.6	16.7	17.8	16.7	clear	83.3		
16	28.9	14.4	17.2	16.7	clear	45.7		
17	31.7	13.3	18.3	17.2	clear	42.4		
18	35.6	14.4	18.3	17.2	clear	42.4		
19	35.6	17.2	18.3	17.2	clear	42.6		
20	33.9	17.2	17.8	17.2	clear	42.4		
21	30.0	15.6	18.3	16.7	clear	41.2		
22	27.8	13.3	18.3	17.8	clear	41.8		
23	28.3	14.4	17.8	16.7	clear	42.6		
24	28.9	13.3	18.3	17.2	clear	42.8		
25	30.0	14.4	18.3	17.8	clear	46.9		
26	30.0	13.9	18.3	17.2	clear	96.3		
27	32.2	13.9	18.3	17.8	clear	98.6		
28	36.1	15.6	19.4	18.3	clear	98.4		
29	36.7	17.8	19.4	18.9	clear	98.3		
30	32.2	16.7	18.3	17.8	clear	100.2		
31	33.9	15.6	17.8	17.2	clear	99.6		

Appendix Table 2 (continued)

1978 September	Temperature (C*)				Weather	Flow of American River at hatchery (m ³ /sec**)	Salmon	Steelhead
	Air		Water					
	Maximum	Minimum	Maximum	Minimum				
1	35.6	14.4	17.8	16.7	clear	98.8		
2	37.8	14.4	17.2	16.7	clear	98.3		
3	32.8	15.6	17.8	16.7	clear	98.4		
4	28.3	14.4	18.3	17.8	clear	99.8		
5	26.7	16.7	18.9	17.8	rain	98.6		
6	26.1	14.4	18.3	17.8	cloudy	98.8		
7	25.6	12.2	18.3	17.8	partly cloudy	98.3		
8	28.9	11.1	17.8	17.2	clear	97.5		
9	20.6	18.3	17.2	16.7	cloudy	84.6		
10	27.8	18.3	17.2	16.1	partly cloudy	84.6		
11	27.8	12.2	19.4	17.8	clear	85.5		
12	31.1	12.2	20.0	18.9	clear	84.9		
13	32.2	13.3	19.4	17.8	clear	74.5		
14	32.2	14.4	18.9	17.8	clear	24.5		
15	40.6	14.4	18.3	17.2	clear	81.6		
16	32.8	22.2	17.8	17.2	clear	84.8		
17	25.6	10.0	18.3	17.2	clear	85.0		
18	21.1	8.9	18.3	17.2	clear	85.1		
19	31.7	8.9	18.3	17.2	clear	84.5		
20	30.0	6.1	18.3	17.2	clear	85.0		
21	30.0	7.8	18.9	17.8	clear	84.8		
22	31.7	11.1	18.9	17.8	clear	84.9		
23	36.1	12.8	18.9	17.8	clear	84.8		
24	36.1	13.3	18.3	17.8	clear	84.4		
25	36.7	16.7	17.8	17.8	clear	85.2		
26	35.6	15.6	18.9	17.8	clear	84.7		
27	35.0	14.4	18.3	17.8	clear	84.6		
28	35.6	14.4	18.9	17.8	clear	84.6		
29	35.0	12.2	18.9	18.3	clear	84.5		
30	34.4	13.9	18.9	17.2	clear	85.1		

Appendix Table 2 (continued)

1978 October	Temperature (C*)				Weather	Flow of American River at hatchery (m ³ /sec**)	Salmon	Steelhead
	Air		Water					
	Maximum	Minimum	Maximum	Minimum				
1	33.3	12.2	16.7	14.4	clear	85.1		
2	32.2	13.9	15.0	14.4	clear	85.4		
3	32.2	16.7	15.0	14.4	clear	85.1		
4	33.9	16.7	15.6	14.4	clear	84.1		
5	31.7	16.7	15.6	14.4	clear	83.7		
6	34.4	12.8	15.6	14.4	clear	84.5		
7	29.4	10.6	15.6	14.4	clear	85.4		
8	31.1	11.1	15.0	14.4	clear	83.2		
9	28.3	12.2	15.0	14.4	clear	82.5		
10	30.6	12.2	15.6	15.0	clear	46.0		
11	30.6	12.2	15.6	15.0	clear	41.9		
12	32.8	12.2	15.6	15.0	clear	42.1		
13	34.4	13.3	16.1	15.0	clear	41.7		
14	30.0	13.3	16.1	15.0	clear	35.6		
15	31.1	13.3	15.6	14.4	clear	38.1		
16	28.9	13.9	15.6	15.0	clear	38.0		
17	27.2	12.2	15.0	15.0	clear	35.8		
18	27.8	13.3	15.6	15.0	clear	35.7		
19	22.2	12.2	15.6	15.0	clear	35.7		
20	23.9	10.0	16.1	15.6	clear	35.7		
21	23.3	12.2	16.1	15.6	clear	35.8		
22	23.3	8.9	16.1	15.0	clear	35.6		
23	26.7	7.8	15.6	15.0	clear	35.6		
24	26.7	8.9	16.1	15.0	clear	35.7	460	
25	26.7	8.9	16.1	15.0	clear	35.5		
26	26.1	10.0	16.1	15.0	clear	35.5		
27	25.6	8.9	16.1	15.0	clear	35.9	428	
28	26.7	9.4	16.1	15.0	clear	35.7		
29	24.4	8.3	15.6	15.0	partly cloudy	35.7		
30	25.6	3.3	15.0	14.4	partly cloudy	35.7	402	
31	24.4	7.8	14.4	14.4	rain; cloudy	35.9		
TOTAL							1,290	

Appendix Table 2 (continued)

1978	Temperature (C*)				Weather	Flow of American River at hatchery (m ³ /sec**)	Salmon	Steelhead
	Air		Water					
	Maximum	Minimum	Maximum	Minimum				
November								
1	18.3	7.8	15.0	13.9	rain	35.7	388	
2	18.3	10.0	15.6	14.4	partly cloudy	35.8	284	
3	18.9	7.8	15.6	15.0	clear	34.5	526	
4	18.3	8.3	15.6	15.0	clear	36.3		
5	17.8	7.2	15.6	14.4	clear	36.1		
6	18.3	7.8	15.6	14.4	clear	36.1	601	
7	27.8	7.8	15.6	14.4	partly cloudy	34.2	267	
8	22.2	7.8	15.6	15.0	partly cloudy	35.7	395	
9	22.2	7.8	16.1	15.0	cloudy	35.7		
10	14.4	5.6	15.0	14.4	cloudy	35.4	406	125
11	15.6	4.4	14.4	13.3	rain	35.4		
12	14.4	4.4	13.3	12.8	rain	35.2		
13	8.9	3.3	13.3	12.8	rain	35.2	445	15
14	8.9	1.1	13.3	12.8	partly cloudy	35.1	200	5
15	12.2	3.3	13.3	12.8	partly cloudy	35.1	295	15
16	13.3	7.2	13.9	13.3	partly cloudy	35.2	358	1
17	18.9	2.2	13.9	13.3	clear	34.8	396	
18	17.8	1.1	13.9	12.8	clear	35.0		
19	7.2	5.6	12.8	12.8	rain	35.0		
20	13.9	6.1	13.3	12.8	rain	35.0	427	9
21	11.1	10.0	13.3	12.8	rain	35.2		13
22	13.9	6.7	12.8	12.8	partly cloudy	34.9	316	16
23	15.6	6.7	13.3	12.8	partly cloudy	34.6		
24	15.6	4.4	13.9	12.8	clear	34.6	210	19
25	13.9	7.8	12.8	12.2	partly cloudy	35.1		
26	15.6	1.1	12.8	12.2	fog	35.3		
27	8.9	2.2	12.2	11.7	clear	35.4	370	28
28	8.9	6.7	12.8	11.7	clear	35.7		
29	10.0	5.6	12.8	12.2	clear	35.6	159	6
30	11.1	6.1	12.8	12.2	cloudy; rain	35.4		
TOTALS							6,043	252
CUMULATIVE TOTALS							7,333	252

Appendix Table 2 (continued)

1978 December	Temperature (C*)				Weather	Flow of American	Salmon	Steelhead
	Air		Water			River at hatchery		
	Maximum	Minimum	Maximum	Minimum		(m ³ /sec**)		
1	15.0	5.0	13.3	12.8	partly cloudy	35.1	225	
2	13.3	5.0	12.8	12.2	clear	35.2		
3	15.0	4.4	11.7	11.1	clear	34.9		
4	15.6	2.2	11.7	11.1	clear	35.0	209	
5	13.3	3.3	11.7	11.1	clear	34.9		
6	10.0	-1.1	11.1	10.6	clear	35.5	87	39
7	4.4	0.0	10.6	10.0	clear	36.0		
8	4.4	-5.6	10.6	10.0	partly cloudy	36.3	75	10
9	6.1	1.1	11.1	10.0	partly cloudy	36.1		
10	7.2	6.7	11.1	10.0	partly cloudy	35.8		
11	6.1	2.2	11.1	10.6	clear	35.9	91	11
12	7.2	2.8	11.1	10.6	clear	35.6		
13	14.4	1.7	11.1	10.6	partly cloudy	35.4		
14	12.8	3.9	10.6	10.0	partly cloudy	35.6	50	13
15	12.8	1.1	11.1	10.0	fog	35.7		
16	15.6	6.1	10.6	10.0	rain	36.0		
17	12.8	2.2	10.0	10.0	cloudy	35.8		
18	16.1	5.6	10.0	10.0	rain; cloudy	35.8		
19	13.3	2.2	10.0	9.4	cloudy	35.9	64	16
20	11.1	1.1	10.0	8.9	clear	35.8		
21	9.4	-2.2	9.4	8.9	fog; clear	35.6		
22	5.6	-1.1	9.4	8.9	fog	36.2	28	
23	9.4	2.2	9.4	8.9	fog	36.3		
24	9.4	3.3	8.9	8.9	fog	36.2		
25	8.9	1.1	8.9	8.9	fog	36.1		
26	3.3	2.2	8.9	8.9	fog	35.8		
27	3.3	2.2	8.9	8.9	fog	35.5		
28	3.9	2.2	8.9	8.9	fog	35.3		
29	3.9	3.3	8.9	8.9	fog	35.2		59
30	4.4	-1.7	8.9	8.9	fog	34.0		
31	5.6	-3.9	8.9	8.3	clear	35.5		
TOTALS							829	148
CUMULATIVE TOTALS							8,162	400

Appendix Table 2 (continued)

1979 January	Temperature (C*)				Weather	Flow of American	Salmon	Steelhead
	Air		Water			River at hatchery		
	Maximum	Minimum	Maximum	Minimum		(m ³ /sec**)		
1	5.0	-3.3	8.9	8.3	fog; clear	35.0		
2	7.8	-2.2	8.9	8.3	partly cloudy	35.1		32
3	10.0	5.6	8.9	8.3	rain	35.4		
4	11.1	5.6	9.4	8.3	rain	35.5		
5	11.1	5.6	9.4	8.9	rain	35.5		
6	13.3	3.3	9.4	8.9	partly cloudy	35.4		
7	10.0	4.4	8.9	8.9	rain	35.1		
8	11.1	8.9	8.9	8.9	rain	35.3		64
9	12.2	6.7	9.4	8.9	partly cloudy	35.4		
10	12.2	7.8	8.9	8.9	rain	35.3		
11	12.8	9.4	8.9	8.9	rain	60.2		
12	10.0	8.3	8.9	8.9	partly cloudy	210.0		
13	10.0	3.3	8.9	8.9	rain	212.6		
14	11.1	7.8	8.9	8.3	rain	213.1		
15	11.1	6.7	10.0	8.9	rain	213.5		48
16	13.3	3.3	10.6	9.4	fog	214.5		
17	10.0	2.2	9.4	8.3	rain	215.2		
18	10.0	6.7	8.3	7.8	partly cloudy	210.6		
19	11.7	4.4	7.8	7.2	clear	151.7		99
20	12.8	4.4	8.3	7.2	clear	140.4		
21	13.3	4.4	8.9	8.3	clear	91.2		
22	7.8	6.7	8.9	8.3	clear	69.1		
23	7.8	6.7	8.9	8.3	fog	48.6		
24	7.8	6.7	8.3	8.3	fog	43.8		25
25	12.2	3.3	8.3	7.8	clear	43.2		
26	11.1	1.1	8.3	7.8	clear	43.0		
27	10.0	1.1	8.3	7.8	clear	43.0		
28	10.6	1.7	8.3	7.2	clear	42.8		
29	8.9	-4.4	7.8	7.2	partly cloudy	42.2		12
30	3.3	5.6	7.8	7.8	rain	35.6		
31	8.9	3.3	7.8	7.2	rain	35.9		
TOTAL								280
CUMULATIVE TOTAL								680

Appendix Table 2 (continued)

1979 February	Temperature (C*)				Weather	Flow of American	Salmon	Steelhead
	Air		Water			River at hatchery		
	Maximum	Minimum	Maximum	Minimum		(m ³ /sec**)		
1	8.9	1.1	7.8	7.2	rain	35.9		
2	11.1	8.9	8.3	7.8	partly cloudy	35.8		
3	13.3	-1.1	8.3	7.8	clear	36.1		
4	17.2	1.1	8.9	7.8	clear	36.3		
5	17.2	2.8	8.9	7.8	clear	36.1		
6	17.8	2.2	8.9	8.3	clear	35.9		
7	14.4	3.3	8.9	7.8	clear	35.6		
8	15.6	3.3	8.3	7.8	partly cloudy	35.6		
9	19.4	4.4	9.4	7.8	partly cloudy	35.5		
10	15.6	5.0	8.9	8.3	partly cloudy	35.4		
11	16.7	5.0	8.9	8.3	partly cloudy	35.3		
12	15.0	6.1	8.9	8.3	rain	35.0		
13	12.2	8.9	9.4	9.4	rain	34.8		
14	14.4	7.8	10.0	8.9	rain	34.9		
15	13.9	4.4	9.4	8.9	rain	34.8		
16	13.3	10.0	9.4	8.3	partly cloudy	35.3		
17	13.3	8.3	10.0	8.9	partly cloudy; rain	70.6		
18	12.2	7.8	10.0	9.4	rain	140.5		
19	13.3	7.8	10.0	8.9	partly cloudy	140.0		
20	10.0	6.7	8.9	8.9	rain	206.2		
21	15.0	6.7	8.9	8.3	partly cloudy	214.0		
22	12.2	5.6	8.9	8.9	rain	222.2		
23	12.2	4.4	8.9	7.8	partly cloudy	405.4		
24	17.2	6.1	8.9	7.8	partly cloudy	424.5		
25	16.1	6.7	8.9	7.8	partly cloudy	414.8		
26	15.6	6.7	9.4	8.3	partly cloudy	265.6		
27	14.4	3.3	10.0	7.8	clear	138.0		
28	9.4	4.4	10.0	8.9	rain	76.9		

Appendix Table 2 (continued)

1979 March	Temperature (C*)				Weather	Flow of American	Salmon	Steelhead
	Air		Water			River at hatchery		
	Maximum	Minimum	Maximum	Minimum		(m ³ /sec**)		
1	10.6	3.3	9.4	8.9	rain	70.6		
2	12.8	1.1	8.9	7.8	rain	135.6		
3	17.2	5.6	8.9	7.8	partly cloudy	142.7		
4	16.7	6.1	9.4	8.3	clear	142.9		
5	18.9	7.8	10.0	8.9	partly cloudy	138.9		
6	23.9	8.9	10.0	8.9	clear	140.4		
7	23.9	12.8	10.0	8.9	clear	138.9		
8	23.9	9.4	10.0	8.9	clear	80.4		
9	24.4	8.9	9.4	8.3	clear	72.3		
10	23.9	10.0	9.4	8.3	clear	70.8		
11	24.4	10.0	8.9	8.3	clear	70.9		
12	23.9	7.8	9.4	8.3	clear	70.5		
13	23.3	10.6	8.9	8.3	partly cloudy	68.4		
14	22.2	11.1	8.9	8.3	rain	69.5		
15	12.8	11.1	8.9	7.8	rain	70.8		
16	11.1	7.8	8.9	7.8	rain	72.8		
17	18.3	9.4	9.4	8.3	partly cloudy	134.3		
18	18.3	9.4	8.9	8.3	clear	142.3		
19	18.3	8.9	8.9	8.3	partly cloudy	142.3		
20	21.7	6.7	8.9	8.9	partly cloudy	140.3		
21	21.1	7.8	8.9	8.9	partly cloudy	77.0		
22	21.1	7.2	9.4	8.9	clear	70.2		
23	20.6	5.6	9.4	8.9	clear	68.9		
24	22.2	6.7	9.4	8.9	clear	70.1		
25	21.7	7.8	9.4	8.9	partly cloudy	70.6		
26	17.2	8.9	9.4	8.9	rain	70.2		
27	14.4	6.7	8.9	8.9	rain	71.5		
28	15.0	8.3	10.0	8.9	cloudy	70.8		
29	16.1	7.2	9.4	8.9	cloudy	70.7		
30	16.1	7.2	10.6	9.4	cloudy	71.2		
31	20.6	5.6	10.0	9.4	clear	71.3		

Appendix Table 2 (continued)

1979 April	Temperature (C*)				Weather	Flow of American	Salmon	Steelhead
	Air		Water			River at hatchery		
	Maximum	Minimum	Maximum	Minimum		(m ³ /sec**)		
1	20.0	5.6	11.1	9.4	clear	70.9		
2	20.6	4.4	10.6	9.4	clear	71.2		
3	21.1	6.7	10.6	9.4	partly cloudy	71.1		
4	23.9	7.8	10.0	9.4	clear	70.7		
5	21.1	9.4	10.0	9.4	cloudy	70.5		
6	11.1	11.1	10.6	9.4	rain	70.6		
7	22.8	11.1	10.6	9.4	clear	70.7		
8	20.0	9.4	10.0	9.4	partly cloudy	70.7		
9	20.6	10.6	11.1	9.4	partly cloudy	71.6		
10	20.0	6.7	10.0	9.4	cloudy	70.4		
11	20.6	7.8	10.6	9.4	cloudy	70.3		
12	20.0	7.8	10.6	9.4	cloudy	69.8		
13	21.1	9.4	11.1	9.4	clear	69.1		
14	26.7	9.4	10.6	9.4	clear	68.7		
15	23.9	9.4	10.6	10.0	clear	68.2		
16	20.0	9.4	10.0	9.4	rain	68.5		
17	14.4	8.3	10.6	9.4	rain	69.3		
18	21.1	4.4	10.6	9.4	partly cloudy	69.2		
19	18.9	3.3	11.1	10.0	clear	69.5		
20	18.9	5.1	11.1	10.6	clear	69.6		
21	21.1	7.8	11.1	10.6	partly cloudy	69.3		
22	18.3	11.1	10.6	10.0	partly cloudy	74.0		
23	18.9	8.3	10.6	10.0	cloudy; rain	121.9		
24	20.0	10.0	11.1	10.6	clear	136.2		
25	22.8	8.9	11.1	10.6	partly cloudy	135.5		
26	21.1	14.4	11.1	10.6	rain	98.9		
27	21.1	11.7	11.1	10.6	partly cloudy	71.6		
28	21.7	7.8	11.7	10.6	clear	70.9		
29	22.2	9.4	11.7	10.6	clear	71.0		
30	20.6	9.4	11.1	10.6	partly cloudy	71.7		

Appendix Table 2 (continued)

1979 May	Temperature (C*)				Weather	Flow of American	Salmon	Steelhead
	Air		Water			River at hatchery		
	Maximum	Minimum	Maximum	Minimum		(m ³ /sec**)		
1	19.4	12.2	12.2	10.6	clear	72.0		
2	26.7	9.4	11.1	10.6	clear	111.8		
3	22.8	10.6	11.1	10.0	partly cloudy	115.5		
4	20.6	10.0	11.1	10.6	clear	114.0		
5	16.7	11.7	11.1	10.0	rain	114.9		
6	15.0	8.9	10.0	10.0	rain	112.6		
7	19.4	8.9	10.6	10.0	clear	114.1		
8	20.0	6.1	11.7	10.6	clear	207.4		
9	23.3	7.8	11.7	10.6	clear	215.1		
10	26.7	10.0	11.7	10.6	clear	214.9		
11	28.9	10.0	11.7	11.1	clear	210.2		
12	32.2	12.2	11.7	11.1	clear	175.1		
13	33.3	12.2	11.7	11.1	clear	170.5		
14	30.0	13.3	11.7	11.1	clear	168.7		
15	24.4	11.1	11.1	11.1	clear	170.1		
16	28.9	10.0	11.1	11.1	clear	170.7		
17	33.3	12.8	12.2	11.7	clear	169.9		
18	35.6	13.9	12.8	11.7	clear	171.8		
19	30.6	13.3	11.7	11.1	clear	198.3		
20	29.4	13.9	11.1	11.1	clear	213.4		
21	29.4	12.8	11.7	11.1	clear	213.0		
22	26.7	13.3	11.7	11.1	partly cloudy	226.6		
23	26.7	14.4	11.7	11.1	partly cloudy	226.0		
24	32.2	12.8	12.8	11.1	clear	230.5		
25	35.6	16.1	12.8	11.7	clear	226.5		
26	34.4	16.7	12.8	11.7	clear	227.5		
27	30.0	13.3	12.2	11.1	partly cloudy	226.6		
28	30.6	13.3	12.8	11.7	clear	224.8		
29	27.8	12.8	13.3	11.7	clear	224.5		
30	31.7	11.1	13.9	11.7	clear	198.5		
31	33.9	12.2	13.9	12.2	clear	197.4		

Appendix Table 2 (continued)

1979 June	Temperature (C*)				Weather	Flow of American	Salmon	Steelhead
	Air		Water			River at hatchery		
	Maximum	Minimum	Maximum	Minimum		(m ³ /sec**)		
1	37.2	14.4	13.9	12.2	clear	168.4		
2	37.8	14.4	13.9	12.8	clear	144.3		
3	37.2	13.3	13.3	12.8	clear	141.6		
4	33.3	14.4	13.3	12.8	clear	141.4		
5	38.9	15.6	13.9	12.8	clear	127.1		
6	33.3	17.2	14.4	13.3	clear	114.1		
7	28.9	17.8	14.4	13.3	clear	113.5		
8	32.8	17.8	15.0	13.3	clear	112.3		
9	35.0	14.4	13.9	13.3	clear	100.6		
10	37.2	15.6	14.4	13.3	clear	97.3		
11	38.9	15.6	14.4	13.3	clear	86.0		
12	34.4	17.8	14.4	12.8	clear	86.0		
13	31.1	15.6	13.9	13.3	clear	85.7		
14	28.9	12.2	14.4	12.8	clear	86.0		
15	28.9	12.2	14.4	12.8	clear	85.9		
16	30.6	13.3	14.4	13.3	partly cloudy	85.7		
17	30.6	11.1	14.4	13.3	partly cloudy	86.2		
18	30.6	12.2	14.4	13.3	clear	86.3		
19	31.1	13.9	14.4	13.3	partly cloudy	86.9		
20	31.7	15.6	14.4	13.3	clear	86.3		
21	30.6	13.9	15.0	13.9	clear	72.1		
22	34.4	13.3	15.6	14.4	clear	70.1		
23	36.1	15.6	15.6	14.4	clear	71.5		
24	32.2	15.6	15.0	14.4	clear	71.2		
25	32.8	12.2	15.6	14.4	clear	72.1		
26	32.2	12.8	16.1	13.9	clear	71.7		
27	35.0	13.3	16.1	14.4	clear	70.8		
28	32.2	12.8	16.1	14.4	partly cloudy	71.2		
29	30.6	15.0	16.1	15.0	clear	71.1		
30	30.0	13.3	16.7	15.0	clear	71.6		

APPENDIX TABLE 3. Fork Lengths of Adipose Marked Chinook Salmon Recovered at Nimbus Salmon and Steelhead Hatchery, 1978-79 Season

FL(cm)	Ad		Mark	Miscellaneous	
	Male	Female		Male	Female
52	1				
54	1				
55	1	1			
58	1				
59		1			
60	2				
61		1			
62	2	1			
63		2			
64					
65		1			
66		1			
67		3			
68	1	3			
69	2	2			
70	1	2			
71	2	5			
72	4	2			1 ^{b/}
73	4	5			
74	3	2			1 ^{c/}
75		6			
76		4			
77	2	6			
78	1	3			
79	5	4			
80	2	1			
81	1	1			
82	4				
83	2	5			
84	2	2			
85	1	5			
86	2				
87	1	3			
88	3	1			
89	1	1			
90	1	3			
91	1				
92	2		RV	1 ^{a/}	
93	1				
94					
95					
96					
97	1				
98	1				
99					
100	1				

TOTAL by sexes	60	77
TOTAL sexes combined	137	

a/ Questionable mark - 50% regeneration of fin.
b/ Tyee Club tag #15347.
c/ Tyee Club tag #13254.

APPENDIX TABLE 4. Fork Lengths of Marked Steelhead Recovered at Nimbus Salmon and Steelhead Hatchery, 1978-79 Season

FL(cm)	LV-RV		RV		RP		LP		LP-RV-LV	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
56						1				
63						1				
65						1				
66		1								1
67							1			1
68								2		
73		1								
74	1									
76				1						
78			1							
TOTAL by sexes			F 10							
			M 3							
TOTAL sexes combined			13							