ANNUAL REPORT
NIMBUS SALMON AND STEELHEAD HATCHERY 1977-78 FISCAL YEAR[1/]

by

Chester Riley
Region 2

ABSTRACT

This report describes the operation of Nimbus Salmon and Steelhead Hatchery from July 1, 1977 through June 30, 1978. Tables present numbers of adult fish trapped, eggs taken, fish reared and released, and daily river flow, weather conditions, and water and air temperatures.

There were 6,868 chinook salmon (Oncorhynchus tshawytscha) trapped, which produced 11,438,840 eggs. The 619 winter-run steelhead (Salmo gairdneri gairdneri) which were trapped produced 580,580 eggs.

During the year we planted or transferred an estimated 7,516,845 fingerling chinook salmon, 390,326 fingerling and 390,575 yearling winter-run steelhead.

Due to anticipated warm water and low flows, all 1976 broodyear chinook salmon were planted by June 17, 1977.

[1/] Anadromous Fisheries Branch Administrative Report No. 79-9. Submitted February 1979.

INTRODUCTION

This is the 23rd 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 1977-78 with particular reference to numbers of fish trapped, spawned and released; eggs taken and fish produced; and other pertinent information.

PRODUCTION SUMMARY

During 1977-78 we took an estimated 12,019,420 eggs and planted approximately 8,197,746 salmon and steelhead (Table 1).

TABLE 1. Production Summary, Nimbus Salmon and Steelhead Hatchery, 1977-78

Species	Adults trapped	Eggs taken	Fingerlings planted	Yearlings planted	Total kg planted	On hand 6/30/78
Chinook salmon						
1976 BY	--	--	--	--	--	--
1977 BY	6,868	11,438,840[a/]	7,516,845[b/]	--	32,971	388,519
Steelhead						
1977 BY	--	--	121,500	390,575	27,823	--
1978 BY	619	580,580[c/]	168,826	--	--	830,175

a/ Including 1,111,310 shipped to Coleman National Fish Hatchery and 200,020 shipped to Mokelumne River Fish Installation.
b/ Including 2,498,880 shipped to Coleman National Fish Hatchery.
c/ An additional 424,040 eggs were received from Mad River Salmon and Steelhead Hatchery.

HATCHERY OPERATION

The Weir

At the end of the 1976-77 spawning season the weir was left in place with the pickets up to allow free passage of fish. This was possible because of drought conditions with the anticipated flow less than 155.7 m^3/s (5,500 cfs), the maximum flow allowed with the weir in place.

During October 1977 the Nimbus crew filled large holes beneath the weir with granite boulders. On October 28 the pickets were lowered and capped, and the weir began operating.

On January 17 the weir was removed by the Bureau of Reclamation crew because the river flow was going to exceed the maximum flow for the weir. Since the salmon migration had ended and sufficient steelhead were on hand the weir was not scheduled to be reinstalled until fall.

Water Temperature Control

Shutters remained inoperative from the middle of September 1976 to January 1978 because Folsom Reservoir surface elevation did not rise above the minimum operating level of 122.5 m (402 ft).

Disposal of Salmon Carcasses

Edible carcasses were given to State and county institutions, welfare and community action groups, and several groups of councils representing California Indians. Local zoos received carcasses of questionable quality and a local rendering plant received all inedible carcasses. The total dispensed for each category was 24,546 kg (54,115 lb) edible; 680 kg (1,500 lb) animal food and 8,233 kg (18,150 lb) inedible.

Public Relations

An estimated 169,938 persons visited Nimbus Hatchery this year. This number was arrived at by use of a car counter at the parking lot exit gate and by an employee count or estimate of the bus passengers and bicyclists. November was the peak visitation month with 46,154 visitors.

CHINOOK SALMON MAINTENANCE PROGRAM

History of the 1977 Brood Year

Chinook Salmon Counts

The first salmon was observed at the weir site on October 28 when the pickets were lowered and capped. The salmon began ascending the fish ladder soon afterward and the first spawning took place November 9, 1977.

A total of 6,868 salmon entered the holding ponds. In addition 501 were removed from the weir. Migrants to the holding pond included 3,496 large males, 2,874 large females and 498 grilse[2/]. Carcasses counted and removed from the weir included 282 large males, 96 large females and 123 grilse including 8 small females. Approximately 95% of the carcasses seen on the weir were recovered.

Sorting and Spawning

Of the large females counted in the holding pond, 2,116 (72%) were spawned, 628 (21%) died in the pond, 14 were immature when killed, 9 were overripe or killed accidentally and 107 were returned to the river unspawned.

During the spawning season, November 9, 1977 to January 20, 1978, we took 11,438,840 eggs for an average of 5,406 per female. Fertility as determined by difference between green and eyed eggs ranged from 59.0 to 97.8% and averaged 89.8%.

2/ Fish <60 cm (23.6 in.) are considered grilse.

We shipped 1,111,310 eyed eggs to Coleman National Fish Hatchery and 200,020 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. Fork lengths and sex were recorded (Appendix Tables 2 and 3), and heads were removed from any fish with an Ad mark for recovery of coded wire tags.

Chinook Salmon Planting

1976 Brood Year

All 1976 broodyear salmon were planted by June 17, 1977 in order to avoid expected drought-caused adverse conditions such as water temperature extremes and low flows.

1977 Brood Year

We released or transferred 7,516,845 fry and fingerlings (Table 2). No fish were marked. On June 30, 1978, there were an estimated 388,519 fish on hand to be released in the fall as yearlings.

TABLE 2. Planting Summary, 1977 Broodyear Chinook Salmon, Nimbus Salmon and Steelhead Hatchery, 1977-78

Date	Release site	Fingerlings	Fry	Size	Weight (kg)
Jan. 1978	Am. River at hatchery	0	191,520	0.36 g	68
Apr. 1978	Am. River at hatchery	138,600	0	4.4-6.0 g	8,916
Apr. 1978	Sac. River - Rio Vista	1,810,750	0	4.9 g	633
May 1978	Sac. River - Rio Vista	325,070	0	5.3-8.6 g	2,168
Jun. 1978	Sac. River - Rio Vista	2,552,025	0	5.8-9.7 g	18,601
Totals		4,826,445	191,520*		30,386 (66,990 lb)

* An additional 2,498,880 fingerlings were transferred to Coleman National Fish Hatchery.

Chinook Salmon Disease Information

1976 Brood Year

Infectious hematopoietic necrosis (IHN) was the dominant disease problem. Evidence of IHN began showing up about the first week of April and accounted for approximately 79,000 or 62% of recorded pond losses.

Warmer water than normally experienced in early spring caused some problems with columnaris, but this disease was kept under control with copper sulfate flushes and terramycin in the diet.

WINTER-RUN STEELHEAD MAINTENANCE PROGRAM

History of the 1978 Winter Run

Due to the shortage of early-run steelhead (those arriving prior to October 29), no attempt was made to select early-run fish this season. The 22 steelnead entering the hatchery before December 20 were marked and released unspawned. All steelhead arriving after December 20 were spawned and designated as late- or winter-run.

The first late-run steelhead was counted on December 20, 1977, and the last on February 22, 1978 (Table 3). All steelhead were examined for marks as they were spawned or released and a record kept of fork lengths and sex of marked steelhead (Appendix Table 3).

TABLE 3. Counts of Winter-run Steelhead, Nimbus Salmon and Steelhead Hatchery, 1977-78

	Spawned & released		Died in pond		Released unspawned		
Date	M	F	M	F	M	F	Total
1977							
12/20	--	--	3	4	38	--	45
12/29	--	--	2	5	62	13	82
1978							
1/ 6	--	--	5	2	46	18	71
1/11	13	24	15	16	37	26	131
1/18	7	8	9	5	--	--	29
1/20	4	7	3	--	45	24	83
1/27	11	15	3	2	15	5	51
2/ 3	8	17	3	2	10	4	44
2/10	6	12	1	--	8	23	50
2/22	6	5	3	2	14	3	33
Totals	55	88	47	38	275	116	619

The 88 females spawned produced 580,580 eggs for an average of 6,598 per female. Survival of green eggs to eyed ranged from 84.7-99.3% and averaged 93.8%. A total of 424,040 eyed eggs were obtained from Mad River Hatchery to make up the balance of eggs needed for the yearling program.

Spawned and surplus fish were transported either downstream to Howe Avenue bridge or to the basin below Nimbus Dam. Surplus steelhead were those arriving prior to November 29, those not needed for spawning, or fish that were $<$58.4 cm (23 in. FL). The only fish marked were those considered to be surplus. The upper corner of the caudal fin was removed from these steelhead to prevent duplicating the count or classifying them as late- or winter-run.

Marked Adult Steelhead Recovered

We recovered 31 marked adult steelhead (Appendix Table 3).

Winter-run Steelhead Planted

1977 Brood Year

From August 11, 1977 to February 24, 1978, 512,075 winter-run steelhead were planted (Table 4). Of these, 33,945 were classified as early-run fingerlings, 87,555 late-run fingerlings, 172,425 early-run yearlings, and 218,150 late-run yearlings. In July 85,500 early-run and 59,890 late-run were transferred to Feather River Hatchery.

TABLE 4. Planting Data, 1977 Broodyear Winter-run Steelhead, Nimbus Salmon and Steelhead Hatchery, 1977-78

Date	Release site	Number of fingerlings	Number of yearlings	Average size(g)	Weight (kg)
8/77	Sac. River - Garcia Bend	121,500	--	16.2-10.1	1,469
1/78	Sac. River - Garcia Bend	--	390,575	82.5-59.7	26,354
Totals		121,500	390,575		27,823 (61,340 lb)

1978 Brood Year

Prior to June 30, 1978, there were 168,826 fingerling steelhead released into the river at the base of the fish ladder (Table 5). On June 30, 1978, there were 830,175 fish on hand of which 500,000 were to be released in the spring of 1979.

TABLE 5. Steelhead Planting Data, 1978 Brood Year, Nimbus Salmon and Steelhead Hatchery, 1977-78

Date	Release site	Average size (g)	Number
6/20	American River at Nimbus	1.7	100,000
6/21	American River at Nimbus	1.1	68,826
Total			168,826

Steelhead Disease Information

1977 Brood Year

Columnaris was the dominant factor as water temperatures began rising in July and continued to a high of 72°F (22.2°C) in September. Regular treatments of copper sulfate and salt plus additions of terramycin to the feed periodically

kept losses down to a minimum. In October they became infected with furunculosis. Treatments of corn oil and Furox 50 added to the feed failed to hold the losses down so sulfamerazine was substituted for Furox 50 and losses declined in three days. Disease problems disappeared when water temperatures dropped in late November.

1978 Brood Year

No IHN-related losses occurred this year.

The usual heavy losses due to columnaris was again dominant while the young steelhead were in the hatchery building. Periodical terramycin baths held the losses down to an acceptable level and the disease problem declined when they were moved to the raceway ponds.

Appendix Table 1. Summary of Anadromous Fish Trapped[a] at Nimbus Salmon and Steelhead Hatchery

	Chinook salmon					Steelhead		
Season	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	2,506[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

[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. Fork Lengths of Marked Chinook Salmon Recovered at Nimbus Salmon and Steelhead Hatchery, 1977-78 Season

FL(cm)	Ad Male	Ad Female
49	2	1
50	1	
51	3	1
52	2	
53	2	
54	4	
55	5	
56	2	
57	3	
58	1	
59	2	
60		
61	1	1
62		
63	2	
64		1
65		
66		
67		2
68		1
69		1
70	2	1
71		3
72	1	3
73	1	3
74	1	6
75	2	1
76	2	3
77	3	3
78		1
79		
80	3	
81		
82	1	
83	3	
84	1	
85	1	2
86	1	
87	1	
88	2	
95	1	
Total	56	34
Grand Total	90	

Appendix Table 3. Fork Lengths of Marked Steelhead Recovered at Nimbus Salmon and Steelhead Hatchery, 1977-78 Season

FL(cm)	LV		LV-RV		RV	
	Male	Female	Male	Female	Male	Female
65						1
66						1
67						1
68						
69		1				1
70	2	1	2			3
71						
72		1			1	
73			1			1
74					1	1
75						
76			1		2	
77						1
78			1		3	
79						
80						
81						
82	1					
Total	3	3	5		7	10
Grand Total	6		5		17	

LP	LV-LP	LV-RV-RP
65 F	70 F	66 F

Nimbus Salmon and Steelhead Hatchery Weather, Water, and Fish Trapping Data July 1, 1977 through June 30, 1978

1977 July	Temperature (C*) Air Maximum	Air Minimum	Water Maximum	Water Minimum	Weather	American River flow at Hatchery (m^3/sec**)	Salmon	Steelhead
1	35.0	21.1	19.4	16.7	partly cloudy	31.688		
2	32.2	15.0	18.3	17.2	cloudy; rain	31.320		
3	30.0	15.0	18.3	17.2	clear	31.376		
4	30.0	17.2	18.3	17.2	clear	31.008		
5	33.3	12.2	18.3	17.2	clear	22.938		
6	35.6	13.3	18.3	17.2	clear	22.286		
7	33.3	15.6	18.3	17.2	clear	22.343		
8	33.3	15.6	18.9	17.2	clear	22.315		
9	34.4	14.4	18.3	17.2	clear	22.484		
10	37.8	13.3	18.9	18.3	clear	22.456		
11	39.4	17.2	18.9	18.3	clear	22.484		
12	33.3	14.4	18.9	17.8	clear	22.683		
13	35.6	12.8	19.4	18.3	clear	22.768		
14	38.3	15.0	19.4	18.3	clear	22.739		
15	40.6	16.7	19.4	18.3	clear	23.221		
16	42.8	18.3	20.0	19.4	clear	22.456		
17	41.7	16.7	20.6	18.9	clear	22.569		
18	36.7	19.4	19.4	18.3	clear	22.711		
19	35.6	14.4	20.0	18.9	partly cloudy	22.739		
20	36.7	14.4	20.0	18.3	partly cloudy	22.711		
21	36.7	16.1	20.0	18.9	clear	23.023		
22	37.8	15.6	20.0	18.9	partly cloudy	22.739		
23	37.8	18.3	20.0	18.9	clear	22.654		
24	30.0	13.3	19.4	18.3	partly cloudy	22.598		
25	36.7	13.3	20.0	18.9	clear	22.796		
26	37.8	14.4	20.6	19.4	clear	22.541		
27	37.8	15.6	20.0	18.9	clear	22.938		
28	36.7	15.6	20.0	19.4	clear	22.966		
29	40.6	16.7	22.8	20.0	clear	23.419		
30	43.3	18.3	21.1	20.0	partly cloudy	31.320		
31	41.7	21.1	22.2	20.0	partly cloudy	30.980		

*Temperature measured to nearest whole degree F, and later converted to C.
**Flows measured in cfs, and later converted to m^3/sec.

Appendix Table 4 (Continued)

August	Temperature (C*) Air Maximum	Air Minimum	Water Maximum	Water Minimum	Weather	American River flow at Hatchery (m^3/sec**)	Salmon	Steelhead
1	41.1	21.1	21.7	20.0	partly cloudy	31.320		
2	40.0	24.4	21.1	20.0	partly cloudy	26.704		
3	38.9	18.3	20.6	20.0	clear	22.569		
4	30.0	15.6	20.6	20.0	partly cloudy	23.023		
5	36.1	13.3	21.1	20.0	partly cloudy	23.023		
6	30.6	14.4	20.0	19.4	cloudy	23.107		
7	31.1	14.4	20.6	20.0	clear	23.079		
8	35.0	17.8	21.1	20.0	clear	23.051		
9	36.7	13.3	20.6	20.0	clear	23.107		
10	37.2	13.3	21.1	20.0	clear	22.909		
11	39.4	15.0	21.1	20.0	clear	22.938		
12	35.6	16.7	21.1	20.6	clear	22.938		
13	35.0	14.4	21.1	20.0	clear	23.419		
14	35.6	15.0	21.1	20.6	clear	28.601		
15	38.9	14.4	21.7	20.6	clear	25.883		
16	39.4	16.7	21.7	20.6	clear	23.023		
17	36.1	18.9	21.1	20.6	partly cloudy	23.051		
18	33.9	16.7	21.1	20.6	clear	23.051		
19	34.4	16.7	21.7	20.6	partly cloudy	23.023		
20	33.3	17.8	21.7	20.6	clear	22.994		
21	37.8	15.6	22.2	20.6	clear	23.023		
22	34.4	16.7	22.2	21.1	clear	22.598		
23	35.6	17.2	22.2	21.1	clear	22.484		
24	33.3	17.8	22.2	21.1	partly cloudy	22.711		
25	32.2	15.6	21.7	20.6	partly cloudy	22.711		
26	30.0	15.6	22.2	20.6	clear	22.739		
27	33.9	15.0	22.2	21.1	clear	22.711		
28	37.8	20.0	22.8	21.7	clear	22.711		
29	37.8	18.3	22.8	21.7	clear	22.711		
30	36.7	16.7	22.8	22.2	clear	22.768		
31	34.4	16.7	22.2	20.6	clear	22.484		

*Temperature measured to nearest whole degree F, and later converted to C.
**Flows measured in cfs, and later converted to m^3/sec.

Appendix Table 4 (Continued)

September	Temperature (C*) Air Maximum	Air Minimum	Water Maximum	Water Minimum	Weather	American River flow at Hatchery (m^3/sec**)	Salmon	Steelhead
1	32.2	14.4	22.2	21.1	clear	14.697		
2	32.2	13.9	22.2	21.1	clear	14.187		
3	35.6	13.3	22.8	21.1	clear	14.102		
4	37.8	13.9	22.8	21.7	clear	14.159		
5	39.4	16.7	23.3	22.2	clear	14.159		
6	40.0	17.8	23.3	22.2	clear	14.329		
7	40.0	17.8	23.3	22.2	clear	14.244		
8	39.4	17.8	23.3	22.2	clear	14.272		
9	37.2	19.4	23.3	22.8	clear	13.961		
10	32.2	14.4	22.8	21.7	clear	13.932		
11	32.2	12.2	22.8	21.7	clear	13.876		
12	31.7	11.7	22.8	21.7	clear	13.848		
13	31.1	15.0	22.8	21.1	partly cloudy	13.876		
14	31.1	13.3	21.7	21.1	partly cloudy	13.819		
15	26.7	14.4	21.1	20.6	cloudy	14.187		
16	20.0	13.9	20.6	20.6	cloudy; rain	13.791		
17	26.7	20.6	21.1	20.6	cloudy	13.961		
18	28.3	18.9	20.6	20.0	clear	13.961		
19	22.2	15.6	20.0	20.0	rain	13.876		
20	26.7	11.1	21.1	20.0	partly cloudy	14.527		
21	28.3	10.0	21.1	20.0	clear	14.074		
22	28.3	11.1	21.1	20.0	clear	14.046		
23	30.0	10.0	21.1	20.0	clear	14.244		
24	30.0	16.1	21.1	20.0	partly cloudy	14.272		
25	30.6	18.3	21.1	20.0	partly cloudy	14.952		
26	28.9	12.8	21.1	20.0	clear	14.867		
27	28.9	15.0	21.1	20.0	partly cloudy	15.490		
28	29.4	17.2	20.6	20.0	partly cloudy	14.867		
29	25.6	16.7	20.0	20.0	partly cloudy	13.904		
30	26.7	11.1	21.1	19.4	clear	13.649		

*Temperature measured to nearest whole degree F, and later converted to C.
**Flows measured in cfs, and later converted to m^3/sec.

Appendix Table 4 (Continued)

October	Temperature (C*) Air Maximum	Air Minimum	Water Maximum	Water Minimum	Weather	American River flow at Hatchery (m^3/sec**)	Salmon	Steelhead
1	30.0	10.0	21.1	19.4	clear	7.306		
2	30.0	16.7	20.6	19.4	clear	7.306		
3	31.1	10.6	21.1	19.4	clear	7.306		
4	30.6	11.1	21.1	20.0	clear	7.306		
5	25.6	10.0	20.6	19.4	partly cloudy	7.306		
6	26.1	11.1	20.0	18.9	partly cloudy	7.306		
7	26.7	9.4	20.6	18.9	clear	7.306		
8	28.3	10.6	20.6	19.4	clear	7.306		
9	28.9	10.6	20.6	18.9	clear	7.306		
10	28.9	10.0	20.6	18.9	clear	7.306		
11	30.6	12.2	20.6	19.4	clear	7.306		
12	28.9	11.1	20.0	19.4	clear	7.306		
13	31.7	10.0	20.0	18.9	partly cloudy	7.306		
14	30.0	10.0	20.6	18.9	partly cloudy	7.306		
15	33.3	14.4	20.6	19.4	partly cloudy	7.306		
16	27.8	13.3	20.0	18.9	clear	7.306		
17	27.8	10.0	20.0	18.9	clear	7.306		
18	26.1	10.6	20.0	18.9	partly cloudy	7.306		
19	23.3	8.9	19.4	18.3	partly cloudy	7.306		
20	21.1	9.4	18.9	17.8	cloudy	7.306		
21	20.6	8.3	18.9	17.8	partly cloudy	7.306		
22	26.7	10.0	18.9	17.8	partly cloudy	7.306		
23	27.2	9.4	18.9	17.8	partly cloudy	7.306		
24	26.7	11.1	19.4	18.3	clear	7.306		
25	28.9	13.3	19.4	18.3	partly cloudy	7.306		
26	26.7	12.2	18.9	17.8	partly cloudy	7.306		
27	20.0	9.4	18.3	17.8	partly cloudy	7.306		
28	21.1	10.6	18.3	17.8	partly cloudy; rain	7.306		
29	21.1	11.7	17.8	17.2	cloudy	7.306		
30	21.1	10.0	17.8	17.2	cloudy	7.306		
31	21.1	6.7	17.8	16.7	partly cloudy	7.306		

*Temperature measured to nearest whole degree F, and later converted to C.
**Flows measured in cfs, and later converted to m^3/sec.

Appendix Table 4 (Continued)

November	Temperature (C*) Air Maximum	Air Minimum	Water Maximum	Water Minimum	Weather	American River flow at Hatchery (m^3/Sec**)	Salmon	Steelhead
1	22.2	5.6	17.8	16.7	partly cloudy	7.080		
2	23.3	6.7	17.8	16.7	partly cloudy	7.080		
3	20.0	7.2	17.2	16.7	clear	7.080		
4	20.0	7.8	16.7	16.1	cloudy	7.080		
5	20.0	7.8	16.7	16.1	cloudy	7.080		
6	16.7	5.6	16.7	15.6	partly cloudy	7.080		
7	22.2	7.8	16.7	15.6	clear	7.080		
8	20.6	9.4	16.7	15.6	clear	7.080		
9	20.0	3.9	16.1	15.0	clear	7.080	523	
10	22.2	7.2	15.6	15.0	clear	7.080		
11	21.7	7.2	15.6	15.0	clear	7.080		
12	22.8	7.8	15.6	15.0	clear	7.080		
13	20.0	7.2	15.6	14.4	clear	7.080		
14	20.0	4.4	15.6	14.4	partly cloudy	7.080	775	
15	20.6	4.4	15.6	14.4	clear	7.080		
16	20.6	5.6	15.0	14.4	clear	7.080		
17	22.2	5.6	15.0	14.4	clear	7.080		
18	18.3	3.9	15.0	13.9	partly cloudy	7.080	883	
19	13.3	3.3	13.9	13.9	partly cloudy	7.080		
20	14.4	1.1	13.9	13.9	partly cloudy	7.080		
21	10.0	4.4	13.3	13.3	rain	7.080		
22	18.3	6.7	13.3	12.8	clear	7.080	1,152	
23	17.8	5.0	13.3	12.8	clear	7.080		
24	14.4	4.4	13.3	12.8	clear	7.080		
25	17.8	5.6	13.3	12.8	partly cloudy	7.080	604	
26	20.0	6.1	13.3	12.8	clear	7.080		
27	21.1	5.6	13.3	12.8	clear	7.080		
28	20.0	5.6	13.3	12.8	clear	7.080	955	
29	21.1	6.7	13.3	12.8	clear	7.080		
30	21.1	6.1	13.9	12.8	partly cloudy	7.080		
TOTALS							4,892	

*Temperature measured to nearest whole degree F, and later converted to C.
**Flows measured in cfs, and later converted to m^3/sec.

Appendix Table 4 (Continued)

December	Temperature (C*) Air Maximum	Air Minimum	Water Maximum	Water Minimum	Weather	American River flow at Hatchery (m^3/sec**)	Salmon	Steelhead
1	20.0	5.6	13.3	12.2	clear	7.080	461	
2	17.8	4.4	13.3	12.2	clear	7.080		
3	15.6	6.1	12.8	12.2	fog	7.080		
4	17.2	5.6	12.8	12.2	clear	7.080		
5	14.4	4.4	12.2	12.2	fog	7.080	293	
6	15.6	5.6	12.2	12.2	fog	7.080		
7	15.0	5.6	12.2	11.7	fog	7.080		
8	14.4	3.3	12.2	11.7	fog; clear	7.080		
9	14.4	4.4	12.2	11.7	fog; clear	7.080	247	
10	14.4	2.2	12.2	11.7	fog; clear	7.080		
11	13.3	4.4	11.1	11.1	cloudy	7.363		
12	10.6	7.8	11.7	11.1	partly cloudy	7.363		
13	12.8	8.3	11.7	11.7	partly cloudy	7.363	250	
14	14.4	7.8	11.1	11.1	cloudy; rain	7.080		
15	16.7	8.9	11.1	11.1	partly cloudy	7.080		
16	13.3	5.0	11.7	11.1	cloudy; rain	7.080	185	
17	13.3	9.4	11.1	10.6	rain	7.080		
18	12.2	3.9	10.6	10.6	partly cloudy	7.080		
19	7.8	0.0	11.1	10.6	partly cloudy	7.080		
20	13.3	2.2	11.1	10.6	cloudy; fog	7.080		45
21	17.2	10.0	10.6	10.6	cloudy; rain	7.080		
22	18.9	9.4	10.6	10.6	cloudy; rain	7.080	189	
23	14.4	11.1	11.1	10.6	partly cloudy	7.080		
24	16.7	6.7	11.1	10.6	partly cloudy	7.080		
25	14.4	6.1	10.6	10.0	partly cloudy	7.080		
26	15.6	6.1	10.6	10.6	rain	7.080		
27	13.3	6.7	11.1	10.6	fog; rain	7.080		
28	15.6	10.0	11.1	10.6	fog; rain	7.080		
29	16.7	12.2	10.6	10.6	cloudy; rain	7.080	141	82
30	16.1	2.8	11.1	10.6	cloudy	7.080		
31	13.3	2.8	11.1	10.0	clear	7.080		
TOTALS							1,766	127

*Temperature measured to nearest whole degree F, and later converted to C.
**Flows measured in cfs, and later converted to m^3/sec.

Appendix Table 4 (Continued)

1978 January	Temperature (C*) Air Maximum	Air Minimum	Water Maximum	Water Minimum	Weather	American River flow at Hatchery (m^3/Sec**)	Salmon	Steelhead
1	13.3	4.4	10.6	10.0	cloudy; rain	7.080		
2	10.0	8.3	10.6	10.0	cloudy; rain	7.080		
3	15.6	6.7	11.1	10.6	rain	7.080		
4	14.4	7.2	10.6	10.0	rain	7.080		
5	12.2	8.9	10.6	10.0	rain	19.426		
6	16.7	10.0	11.1	10.6	partly cloudy	12.460	129	71
7	15.6	5.0	10.6	10.0	partly cloudy	7.080		
8	17.8	5.6	10.0	10.0	cloudy; rain	7.080		
9	16.1	10.6	10.6	10.0	p. cloudy; rain	7.080		
10	16.7	8.9	11.1	10.6	partly cloudy	7.080		
11	17.8	8.3	10.6	10.6	partly cloudy	7.080	67	131
12	18.3	10.0	11.1	10.6	rain	7.080		
13	16.7	8.9	11.1	10.6	rain	7.080		
14	15.0	5.0	11.1	10.6	rain	17.812		
15	13.3	3.3	10.6	10.6	rain	27.723		
16	15.6	10.0	10.6	10.6	rain	29.762		
17	16.7	8.9	11.1	10.6	partly cloudy	49.387		
18	15.6	8.3	10.6	9.4	rain	199.274		29
19	16.7	6.7	9.4	9.4	partly cloudy	210.997		
20	14.4	5.0	10.0	9.4	clear	212.385	14	83
21	15.6	5.0	9.4	9.4	partly cloudy	212.385		
22	13.3	3.9	9.4	8.9	clear	212.385		
23	11.1	3.3	9.4	8.9	clear	209.412		
24	11.1	- 0.6	9.4	8.9	clear	145.555		
25	11.1	2.2	9.4	8.9	clear	141.788		
26	12.2	2.2	9.4	8.9	clear	99.934		
27	15.0	3.3	9.4	8.9	clear	98.688		51
28	14.4	4.4	9.4	8.9	clear; fog	99.226		
29	13.9	4.4	8.9	8.9	fog	98.943		
30	10.0	6.7	8.9	8.9	clear	97.556		
31	10.0	6.7	8.9	8.3	clear	70.597		
TOTALS							210	365

*Temperature measured to nearest whole degree F, and later converted to C.
**Flows measured in cfs, and later converted to m^3/sec.

Appendix Table 4 (Continued)

February	Temperature (C*) Air Maximum	Air Minimum	Water Maximum	Water Minimum	Weather	American River flow at Hatchery (m^3/Sec**)	Salmon	Steelhead
1	15.6	6.7	8.9	8.3	p.cloudy; rain	44.119		
2	17.2	7.8	8.9	8.3	clear	42.534		
3	17.2	7.2	9.4	8.9	clear	38.201		44
4	20.0	6.1	8.9	8.9	p.cloudy; fog	41.627		
5	16.7	9.4	8.9	8.3	cloudy; rain	44.827		
6	16.7	10.6	8.9	8.3	rain	43.723		
7	14.4	10.0	8.9	8.9	rain	173.278		
8	16.7	7.8	8.9	8.3	cloudy; rain	212.838		
9	15.6	7.8	8.9	8.3	cloudy	212.866		
10	15.0	6.1	8.9	8.3	cloudy; rain	213.659		50
11	14.4	5.6	8.9	8.3	partly cloudy	211.649		
12	11.1	5.6	8.9	8.3	cloudy; rain	212.895		
13	15.6	6.7	8.9	8.3	partly cloudy	212.017		
14	15.6	1.7	8.9	8.3	clear	212.130		
15	15.0	7.8	9.4	8.9	partly cloudy	214.679		
16	16.1	3.3	8.9	8.3	partly cloudy	216.746		
17	15.6	3.3	8.9	8.3	clear	213.319		
18	15.6	5.0	9.4	8.9	clear	144.337		
19	17.8	5.0	8.9	8.3	clear	141.930		
20	20.0	5.0	8.9	8.3	clear	141.363		
21	21.1	4.4	9.4	8.3	clear	140.712		
22	21.7	6.1	8.9	8.3	clear	100.472		33
23	22.8	6.7	8.9	8.3	clear	98.179		
24	18.9	10.0	8.9	8.3	clear	98.150		
25	19.4	8.9	8.9	8.3	partly cloudy	71.673		
26	18.3	8.9	8.3	8.3	p.cloudy; rain	70.653		
27	19.4	7.8	8.9	8.3	partly cloudy	70.314		
28	21.1	7.2	9.4	8.9	p.cloudy; rain	70.568		
TOTALS								127

*Temperature measured to nearest whole degree F, and later converted to C.
**Flows measured in cfs, and later converted to m^3/sec.

Appendix Table 4 (Continued)

1978 March	Temperature (C*) Air Maximum	Air Minimum	Water Maximum	Water Minimum	Weather	American River flow at Hatchery (m^3/Sec**)	Salmon	Steelhead
1	23.3	10.6	9.4	8.3	cloudy; rain	69.719		
2	17.8	12.2	8.9	8.3	rain	70.767		
3	19.4	10.6	8.9	8.3	cloudy	104.805		
4	17.8	11.1	8.9	8.3	rain	216.803		
5	17.8	11.1	8.9	8.3	rain	251.719		
6	19.4	7.2	10.0	8.9	clear	428.366		
7	22.2	8.3	10.6	9.4	partly cloudy	427.800		
8	18.3	11.1	10.0	9.4	rain	426.497		
9	16.1	10.6	10.6	10.0	p.cloudy; rain	425.308		
10	20.6	6.7	10.6	10.0	partly cloudy	348.453		
11	19.4	10.0	10.0	9.4	cloudy; rain	212.328		
12	16.7	6.7	10.0	9.4	partly cloudy	213.716		
13	20.0	3.9	10.0	9.4	cloudy	213.404		
14	20.0	7.8	11.1	9.4	clear	212.895		
15	21.1	4.4	10.6	9.4	clear	212.895		
16	23.9	6.1	10.6	9.4	clear	213.008		
17	26.7	6.7	10.6	10.0	clear	212.866		
18	26.7	8.9	10.0	10.0	clear	212.696		
19	24.4	8.3	10.0	9.4	clear	212.668		
20	26.1	10.0	10.0	9.4	partly cloudy	211.281		
21	20.6	8.3	10.6	10.0	p.cloudy; rain	174.071		
22	23.3	11.7	10.6	10.0	partly cloudy	141.930		
23	19.4	11.1	10.6	10.0	p.cloudy; rain	141.222		
24	21.1	6.1	11.1	10.0	clear	141.817		
25	24.4	6.7	11.1	10.6	clear	141.307		
26	24.4	7.8	10.6	10.0	partly cloudy	141.363		
27	25.0	7.8	10.6	10.0	clear	140.882		
28	23.9	10.0	11.1	10.6	clear	140.967		
29	17.8	10.0	10.6	10.6	cloudy	142.383		
30	21.7	12.2	11.7	10.6	rain	142.666		
31	17.2	10.0	11.7	10.6	rain	140.740		

*Temperature measured to nearest whole degree F, and later converted to C.
**Flows measured in cfs, and later converted to m^3/sec.

Appendix Table 4 (Continued)

1978 April	Temperature (C*) Air Maximum	Air Minimum	Water Maximum	Water Minimum	Weather	American River flow at Hatchery (m^3/Sec**)	Salmon	Steelhead
1	16.7	11.1	11.7	11.1	rain	139.948		
2	19.4	6.7	11.1	10.6	rain	140.995		
3	18.3	8.9	11.7	11.1	cloudy; rain	139.381		
4	17.8	8.9	11.7	11.1	partly cloudy	141.194		
5	16.7	6.1	11.1	11.1	cloudy	142.128		
6	12.8	7.8	11.1	10.6	cloudy; rain	143.431		
7	21.1	3.3	12.2	10.6	partly cloudy	141.250		
8	22.8	7.8	12.8	11.1	clear	141.760		
9	28.3	7.2	13.3	11.7	clear	141.335		
10	26.7	10.6	12.2	11.7	clear	142.440		
11	26.7	11.1	12.2	12.2	clear	141.448		
12	25.6	11.1	12.2	11.7	clear	139.608		
13	21.1	12.2	12.2	11.1	partly cloudy	140.910		
14	15.6	10.0	11.1	11.1	cloudy; rain	141.335		
15	15.6	10.6	11.1	11.1	rain	141.562		
16	15.0	6.1	11.1	10.6	rain	140.061		
17	25.0	6.1	12.8	11.1	clear	102.766		
18	21.7	5.6	12.8	11.7	partly cloudy	98.660		
19	20.6	8.3	12.8	11.7	partly cloudy	99.651		
20	18.3	10.0	12.2	11.7	partly cloudy; rain	99.481		
21	19.4	10.0	12.8	11.7	clear	98.773		
22	22.2	5.6	12.8	11.7	clear	138.135		
23	25.0	7.2	12.2	11.7	cloudy	169.200		
24	17.8	11.1	11.7	11.7	rain	170.899		
25	16.7	12.2	11.7	11.1	cloudy; rain	170.984		
26	22.2	10.0	12.2	11.1	partly cloudy	171.834		
27	25.6	10.6	12.2	11.7	clear	171.182		
28	23.9	11.1	12.2	11.7	partly cloudy	171.296		
29	25.6	10.0	12.8	11.7	clear	184.407		
30	18.3	12.2	11.7	11.1	partly cloudy; rain	198.481		

*Temperature measured to nearest whole degree F, and later converted to C.
**Flows measured in cfs, and later converted to m^3/sec.

Appendix Table 4 (Continued)

1978 May	Temperature (C*) Air Maximum	Air Minimum	Water Maximum	Water Minimum	Weather	American River flow at hatchery (m^3/Sec**)	Salmon	Steelhead
1	27.2	10.0	12.8	11.1	clear	197.886		
2	30.0	10.6	13.3	12.2	clear	199.274		
3	28.9	11.7	13.3	11.7	clear	225.864		
4	26.7	11.7	13.3	11.7	clear	229.687		
5	22.2	10.0	12.8	12.2	clear	229.716		
6	25.0	10.0	13.9	12.8	clear	231.103		
7	29.4	11.7	13.3	12.2	clear	227.960		
8	31.1	11.1	13.3	12.8	clear	226.686		
9	27.8	13.3	13.3	12.2	clear	227.252		
10	25.6	10.0	12.8	12.2	clear	226.629		
11	26.1	10.0	13.3	12.2	clear	226.742		
12	31.1	10.0	13.9	12.2	clear	224.873		
13	32.2	13.3	13.9	12.8	clear	200.293		
14	26.1	13.3	13.3	12.2	clear	198.198		
15	22.2	12.2	12.8	12.2	partly cloudy	197.207		
16	26.1	7.8	13.9	12.8	clear	170.786		
17	30.0	10.0	15.0	13.3	clear	170.758		
18	32.8	11.1	13.9	13.3	clear	171.211		
19	32.8	12.8	15.0	13.3	clear	172.768		
20	33.3	13.3	14.4	13.3	clear	171.664		
21	26.1	14.4	13.3	12.8	clear	170.474		
22	24.4	9.4	13.9	12.8	clear	146.942		
23	24.4	8.9	13.3	12.8	partly cloudy	141.194		
24	24.4	8.3	13.3	12.8	partly cloudy	142.326		
25	23.3	7.8	13.9	12.8	partly cloudy	142.779		
26	28.9	10.6	13.9	13.3	clear	145.101		
27	33.3	11.1	14.4	13.3	clear	145.158		
28	35.0	13.9	13.9	13.3	clear	145.385		
29	35.6	13.9	14.4	13.3	clear	141.137		
30	32.2	15.6	14.4	13.9	clear	142.779		
31	33.9	17.8	14.4	13.3	clear	145.866		

*Temperature measured to nearest whole degree F, and later converted to C.
**Flows measured in cfs, and later converted to m^3/sec.

Appendix Table 4 (Continued)

1978 June	Temperature (C*) Air Maximum	Air Minimum	Water Maximum	Water Minimum	Weather	American River flow at hatchery (m^3/Sec**)	Salmon	Steelhead
1	29.4	12.2	13.9	13.3	clear	143.572		
2	31.1	11.7	14.4	13.3	clear	115.821		
3	31.7	13.9	13.9	13.3	clear	113.385		
4	37.8	13.9	14.4	13.3	clear	114.320		
5	40.0	15.6	14.4	13.9	clear	114.829		
6	40.6	17.2	14.4	13.9	clear	117.152		
7	37.8	16.7	15.0	13.9	clear	116.132		
8	38.9	14.4	15.0	13.9	clear	115.028		
9	32.8	15.6	15.0	13.9	clear	86.766		
10	28.3	13.3	15.0	13.9	clear	85.719		
11	32.8	18.9	15.0	13.9	clear	85.634		
12	28.9	13.3	15.0	13.9	partly cloudy	83.566		
13	30.6	14.4	15.0	13.9	clear	83.935		
14	30.0	12.2	15.6	14.4	clear	86.143		
15	30.6	12.2	15.0	13.9	clear	86.710		
16	30.6	12.2	15.0	14.4	clear	86.653		
17	28.3	11.1	15.0	13.3	clear	84.529		
18	33.9	11.1	15.0	13.3	clear	88.182		
19	33.3	11.7	15.0	13.9	clear	87.418		
20	30.0	12.2	15.6	14.4	clear	87.786		
21	33.3	12.8	15.6	14.4	clear	87.757		
22	30.6	12.2	15.0	13.9	clear	85.747		
23	28.9	12.8	15.0	14.4	clear	86.738		
24	28.9	12.8	15.6	14.4	clear	87.248		
25	30.6	12.2	15.6	15.0	clear	87.163		
26	30.6	13.9	16.1	15.0	cloudy; rain	86.880		
27	27.8	14.4	16.1	14.4	cloudy; rain	86.795		
28	26.1	15.6	15.0	14.4	partly cloudy	85.690		
29	30.6	13.3	16.1	14.4	clear	85.719		
30	29.4	13.3	16.1	15.0	clear	85.747		

*Temperature measured to nearest whole degree F, and later converted to C.
**Flows measured in cfs, and later converted to m^3/sec.