

ANNUAL REPORT NIMBUS SALMON AND STEELHEAD HATCHERY  
1976-77 FISCAL YEAR<sup>1/</sup>

by

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ABSTRACT

This report describes the operation of Nimbus Salmon and Steelhead Hatchery from July 1, 1976 through June 30, 1977. 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 5,236 king salmon (Oncorhynchus tshawytscha) trapped, which produced 9,463,625 eggs. The winter-run steelhead (Salmo gairdnerii gairdnerii) produced 1,507,875 eggs.

During the year we planted an estimated 4,312,175 fingerling and 127,170 yearling king salmon, and 121,300 fingerling and 370,260 yearling winter-run steelhead. Because of expected critically high temperatures, no king salmon were held for rearing to yearlings.

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<sup>1/</sup> Anadromous Fisheries Branch Administrative Report No. 78-11.  
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## INTRODUCTION

This is the 22nd 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 of the hatchery during the fiscal year 1976-77 with particular reference to numbers of fish trapped, spawned and released, eggs taken and fish produced.

## PRODUCTION SUMMARY

During 1976-77 we took an estimated 10,971,500 eggs and planted approximately 4,930,905 salmon and steelhead (Table 1).

Table 1. Nimbus Hatchery Production Summary, 1976-77

Species	Number trapped	Eggs taken	Fingerlings planted	Yearlings planted	Total kg planted	On hand June 30, 1977
King salmon						
1975 BY				127,170	6,123	
1976 BY	5,236	9,463,625 <sup>a/</sup>	4,312,175		18,066	
Steelhead						
1976 BY			121,300	370,260	40,068	
1977 BY	1,307	1,507,875 <sup>b/</sup>				673,390

<sup>a/</sup> Of these, 2,427,100 were shipped to the Coleman National Fish Hatchery and 500,550 were shipped to the Mokelumne River Fish Installation.

<sup>b/</sup> Of these, 291,440 were shipped as follows: 30,300 to the Mokelumne River Fish Installation, 41,900 to the Feather River Hatchery and 219,240 to the Coleman National Fish Hatchery.

## HATCHERY OPERATIONS

### The Weir

The fish weir was installed by Bureau of Reclamation personnel on September 22, 1976. Hatchery personnel removed rocks and debris from the picket channel and set pickets on October 4 and 5. Flows in the river were reduced to about 22.65 m<sup>3</sup>/s (800 cfs) on October 1 which made it much easier for the crew to work on the river-bed and picket channel.

During the week of October 18 several large king salmon were stranded on damaged portions of the weir foundation cover because of the low flows. It was decided to install sheets of plywood on the face of the north half of the weir, thus directing the river flow through the south half. This increased the water depth over the downstream portion of the weir foundation, eliminating stranding loss of fish.



The plywood remained in place until December 6, 1976, when some of the sheets were removed because the river flow was to be increased to approximately 28.31 m<sup>3</sup>/s (1,000 cfs) and on the 7th to 50.97 m<sup>3</sup>/s (1,800 cfs). Several of the sheets remained in place until early January because water pressure was too great for easy removal.

On January 24 picket caps were removed and all pickets were raised to allow free passage of fish. Because lower than normal flows were expected, we decided to leave the weir in place with pickets raised. This saved two work days for the Bureau of Reclamation crew, one for removal and one for fall installation.

#### Water Temperature Control

Because of the unusually low water level in Folsom Reservoir, the number 9 shutters were left in the raised position when the number 7 and 8 shutters were installed on January 8, 1976. The number 8 shutters were lifted on July 6 because the minimum reservoir level for efficient turbine operation had been achieved. The number 7 shutters were lifted on September 10 for the same reason. Pulling the number 8 shutters resulted in a reduction in temperature range. Prior to shutter manipulation the range was 20.0 to 22.2 C (68 to 72 F). After lifting, the range was 18.3 to 20.6 C (65 to 69 F). A few days after raising the number 7 shutters the temperature range was reduced to 15.0 to 15.6 C (59 to 60 F). The cool water pool was gradually exhausted so that by mid-October temperatures had increased to a range of 16.7 to 17.8 C (62 to 64 F) before starting a gradual decline throughout the fall and winter.

The shutters were not installed in early January because Folsom Reservoir surface elevation did not rise above the minimum operating level of 122.5 m (402 ft). Shutters have remained inoperative.

#### Disposal of Salmon Carcasses

State and county institutions, welfare, community action groups and Indian organizations received 15,195 kg (33,500 lb) of edible carcasses. Local zoos received 1,633 kg (3,600 lb) of somewhat inferior meat. The remaining carcasses, some 7,983 kg (17,600 lb) which were deemed inedible, were given to a local rendering plant, were used by gardeners for fertilizer or were dumped in the river below the weir.

#### Public Relations

By the use of a car counter at the parking lot exit gate, and adding bicyclists and bus passengers it was established that 181,088 persons visited the installation during the term of this report. November and December were peak visitation months with 66,162 persons counted.

#### Fish Counts

Fish are counted as they are disposed of (spawned, released unspawned, or carcass removed), not as they enter the hatchery. Therefore, the counts presented in Appendix Table 1 do not necessarily reflect the history of the spawning runs. This is particularly true for steelhead, which may accumulate for many weeks before spawning begins.



## KING SALMON MAINTENANCE PROGRAM

### History of the 1976 Brood Year

#### King Salmon Counts

The first report of salmon at the weir site was on October 5 when pickets were installed. Since the water temperature was still excessive for good egg development it was felt that any fish ascending the fish ladder would not hold as well in the relatively quiet environs of the holding pond. We therefore directed the fish into a side channel, where water velocity and exchange was excellent. The fish were held here until October 25 when the holding pond was opened. Water temperatures were then declining and fish could be expected to hold well.

A total of 5,236 salmon entered the pond. Also 297 were removed from the weir. Fish counted during the spawning season included 2,002 large males, 2,340 large females and 894 grilse<sup>2/</sup>. Also counted as grilse were 48 small females. Carcasses removed from the weir included 104 large males, 92 females, and 101 grilse including 4 small females. Almost all carcasses (95+%) which were seen on the weir were recovered.

#### Sorting and Spawning

Of the large females counted in the holding pond, 1,841 were spawned, 350 died in the pond, 11 were too immature when killed to be successfully spawned, 24 were overripe or were killed accidentally in the sorting apparatus, 19 did not recover from the effects of carbon dioxide used as an anesthetic, and 95 were returned to the river unspawned. Overall mortality for both sexes in the holding pond, excluding accidental was 704 or 13.4%.

During the spawning season, October 29, 1976 to January 3, 1977, there were 9,463,625 eggs produced for an average of 5,140/female. Fertility ranged from 74.4 to 94.4% and averaged 86.3%.

There were 2,427,100 eyed eggs shipped to the Coleman National Fish Hatchery and 500,550 were sent to the Mokelumne River Fish Installation.

#### Marked King Salmon Recoveries

All fish were examined for marks. Fork lengths and sex were recorded and heads were removed from fish marked Ad for possible coded wire tag recovery. A total of 137 fish bearing Ad marks was recovered (Appendix Table 2).

#### Miscellaneous Species

During the season one chum salmon (O. keta) and 10 silver salmon (O. kisutch) were counted while sorting.

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<sup>2/</sup> Fish <60 cm (23.6 inches) are considered grilse.



### Use of CO<sub>2</sub>

Because of restrictions imposed by the Department and by the Food and Drug Administration no salmon used for human consumption could be anesthetized with a chemical substance. We therefore developed the technique of using CO<sub>2</sub> and found it to be very satisfactory. Details of its use and effectiveness will be recounted in a forthcoming administrative report.

### King Salmon Planting

#### 1975 Brood Year

An estimated 127,170 yearling king salmon were released this year (Table 2).

#### 1976 Brood Year

Because of anticipated extremes in water temperatures it was decided to release all salmon produced and not to hold fish to a yearling size (Table 2). By June 17 all salmon had been planted.

Table 2. King Salmon Planting Summary, Nimbus Hatchery

Brood year/date	Release site	Number of yearlings	Number of smolts	Number of fingerlings	Average size(g)	Kg
1975						
10/76	Sac. River-Garcia Bend	127,170			41.2-63.9	6,123
1976						
2/77	Am. River-at hatchery			1,045,410	0.3-0.4	399
4/77	Am. River-at hatchery			75,920	0.4	33
4/77	Sac. River-Rio Vista		1,549,550		4.4-5.3	7,666
5/77	Sac. River-Rio Vista		797,600		4.5-6.8	4,649
5/77	Sac. River-Clarksburg		310,520		6.6-6.7	2,048
6/77	Sac. River-Rio Vista		449,100		5.1-7.3	2,869
6/77	Sac. River-Clarksburg		66,500		4.8	318
6/77	Am. River-at hatchery		17,575		4.8	84
TOTALS		127,170	3,190,845	1,121,330		24,189 (53,328 lb)

### King Salmon Disease Information

#### 1975 Brood Year

Columnaris bacteria was the dominant disease problem for yearling king salmon from early July until they were released in October 1976. Some measure of control was achieved by adding terramycin to the diet.



### 1976 Brood Year

This year the virus IHN did not cause the severe losses experienced with the 1973, 1974 and 1975 brood years. Losses from virus were first noted on March 26 and continued for about 5 weeks. Only fish in portions of the two raceway series were affected. Recorded losses attributed to the virus totaled 83,875 out of an initial pond population of 3,691,845. However, there was an unaccounted-for shortage of about 620,000 from those same ponds. Some of the shortage is probably attributable to conservative loss estimates. An estimate of percent of virus loss for all fish ponded would be 5%. No inoculation program was undertaken this year.

Periodically columnaris bacteria also affected these fish. Losses were not severe and each recurrence of the disease was quickly brought under control by oral administration of terramycin.

### WINTER-RUN STEELHEAD MAINTENANCE PROGRAM

#### History of the 1977 Winter-run Brood Year

Since 1970 we have been attempting to establish an early steelhead run in the American River by selectively spawning adults entering the hatchery in the fall. Our initial plan was to consider all steelhead arriving prior to October 31 as early and those after December 17 as late. Because of an insufficient number of arrivals by October 31, however, we decided to include all steelhead arriving by December 15 in the early migrant spawning pool.

Steelhead commenced arriving at the hatchery with the first appearance of salmon and were moved to the east holding pond as salmon were sorted for spawning. While we maintain a rough estimate of steelhead as they are moved (hatchery log), permanent count records are maintained from the first spawning until the close of the season (Table 3, Appendix Table 1). 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).

The 231 steelhead spawned (73 early and 158 late) produced 1,507,875 eggs for an average of 6,528/female. Survival of green to eyed eggs ranged from 74.6 to 97.8%, averaging 87.9%. The Feather River Fish Hatchery received 41,900 eyed eggs, Coleman National Fish Hatchery received 219,240 eyed eggs and the Mokelumne River Fish Installation received 30,300 eyed eggs.

Spawned out and surplus fish were hauled downstream and released at Howe Avenue. No steelhead were used for spawning which measured less than 58.4 cm (23 inches) FL.



Table 3. Counts of Winter-run Steelhead, Nimbus Hatchery,  
1976-77

Date	<u>Spawned &amp; released</u>		<u>Died in pond</u>		<u>Released unspawned</u>		Total
	M	F	M	F	M	F	
11/15			1	1			2
11/29			1				1
12/3			1	1			2
12/10			2	2			4
12/15			4	2			6
12/16		4	3	3			10
12/29	13	7	2	12			34
12/30	10	9					19
1/5	5	10	9	2	9	4	39
1/5	8	21					29
1/12	16	18	2				36
1/12	9	20	5	4	23	5	66
1/20	7	11	1		21	1	41
1/20	22	47	2	4	14	25	114
1/21					78	44	122
1/27	13	23			56	35	127
1/28	19	36	3	3	50	2	113
2/2					26	66	92
2/10	9	25	12	12	56	106	220
2/14					56	98	154
2/22			4	4	20	48	76
TOTALS	131	231	52	50	409	434	1,307

#### Marked Adult Steelhead Recovered

We recovered 353 marked adult steelhead (Appendix Tables 3 and 4).

#### Winter-run Steelhead Planted

#### 1976 Brood Year

From August 2, 1976 to March 10, 1977 491,560 winter-run steelhead were released including 121,300 fingerlings (Table 4).



Table 4. Planting Summary, 1976 Broodyear Steelhead,  
Nimbus Hatchery

Date	Release site	Fingerlings	Yearlings	Average size (g)	Kg
8/76	Am. River-Howe Avenue	87,300	-	5.7-14.1	855
8/76	Sac. River-Garcia Bend	34,000	-	26.7	907
9/76	Sac. River-Garcia Bend	-	30,000	30.2	907
12/76	Sac. River-Garcia Bend	-	122,825	88.9-126.0	12,542
1/77	Sac. River-Garcia Bend	-	26,390	87.2	2,302
2/77	Sac. River-Clarksburg	-	83,340	103.1-126.0	10,047
2/77	Sac. River-Rio Vista	-	13,140	126.0	1,656
3/77	Sac. River-Rio Vista	-	27,935	113.4-126.0	3,356
3/77	Sac. River-Clarksburg	-	66,630	105.5-126.0	7,496
TOTALS		121,300	370,260		40,068 (88,335 lb)

#### 1977 Brood Year

No fingerlings were planted.

### STEELHEAD DISEASE INFORMATION

#### 1976 Brood Year

Gill bacteria problems surfaced in early September coincidental with lower than normal oxygen levels. By thinning the ponds, increasing the water flow, and achieving lower water temperatures by shutter manipulation, losses were reduced to normal or near normal levels.

#### 1977 Brood Year

No IHN virus related losses occurred this season.

Young steelhead in the hatchery building suffered the usual bout with columnaris until they were ponded. Losses were somewhat less than in past years because fish were moved to the nursery and raceway ponds a little earlier than usual.

Several lots of fish had unusually high numbers of pinheads, or poorly developed fry, and losses were particularly high. No specific cause for this phenomenon could be determined.



Appendix Table 1

Nimbus Salmon and Steelhead Hatchery Weather, Water, and  
Fish Trapping Data July 1, 1976 through June 30, 1977

July	Temperature (C*)				Weather	American River flow at Hatchery (m <sup>3</sup> /sec**)	Salmon	Steelhead
	Air		Water					
	Maximum	Minimum	Maximum	Minimum				
1	33.3	17.8	21.7	18.9	clear	34.491		
2	33.3	14.4	21.7	19.4	clear	34.067		
3	35.0	13.3	21.1	18.9	clear	33.613		
4	37.2	14.4	21.7	18.9	clear	33.812		
5	37.2	14.4	22.2	19.4	clear	33.897		
6	38.9	13.3	22.8	20.0	clear	34.435		
7	37.8	17.2	22.2	20.6	clear	35.709		
8	39.4	16.7	22.2	20.0	clear	35.199		
9	37.8	18.9	22.2	20.0	clear	34.293		
10	39.4	17.2	21.1	18.9	clear	33.472		
11	35.6	16.7	20.6	18.9	clear	34.944		
12	36.7	16.1	21.1	18.3	clear	56.013		
13	39.4	17.2	21.7	19.4	clear	57.061		
14	38.9	16.7	21.1	18.9	clear	56.664		
15	38.9	16.7	20.6	18.3	partly cloudy	56.664		
16	33.3	17.2	20.0	18.3	partly cloudy	56.579		
17	35.0	15.6	20.6	18.3	partly cloudy	56.240		
18	35.0	13.9	20.0	18.3	clear	56.721		
19	35.6	16.7	20.6	17.8	clear	56.778		
20	37.2	15.6	20.6	18.3	clear	56.579		
21	36.1	16.1	20.6	18.3	clear	55.758		
22	39.4	14.4	21.7	19.4	clear	56.806		
23	40.0	23.9	21.7	20.0	clear	55.956		
24	40.0	17.8	22.2	20.0	clear	56.636		
25	42.2	20.0	22.2	20.6	clear	57.004		
26	41.7	20.6	22.2	20.0	partly cloudy	56.863		
27	41.1	21.1	22.2	20.6	partly cloudy	56.608		
28	36.7	21.7	21.7	20.6	partly cloudy	56.721		
29	36.1	17.8	21.7	20.0	clear	57.089		
30	32.8	15.6	21.1	19.4	partly cloudy	57.146		
31	28.9	15.0	20.0	19.4	cloudy	57.287		

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

\*\*Flows measured in cfs, and later converted to m<sup>3</sup>/sec.



Appendix Table 1 (continued)

August	Temperature (C*)				Weather	American River flow at Hatchery (m <sup>3</sup> /sec**)	Salmon	Steelhead
	Air		Water					
	Maximum	Minimum	Maximum	Minimum				
1	32.2	15.0	20.6	18.9				
2	31.1	15.0	20.6	18.9	partly cloudy	56.863		
3	27.2	15.0	20.0	18.9	partly cloudy	56.523		
4	30.6	13.3	20.0	18.3	cloudy	56.863		
5	30.0	13.3	20.0	18.3	clear	55.390		
6	28.9	13.3	20.0	18.3	partly cloudy	42.930		
7	31.1	14.4	20.6	18.9	cloudy	43.072		
8	34.4	15.0	21.1	18.9	clear	42.958		
9	36.1	16.1	21.7	18.9	partly cloudy	42.675		
10	36.1	16.7	21.7	19.4	clear	38.286		
11	35.0	15.0	21.7	19.4	partly cloudy	34.123		
12	33.9	14.4	21.1	18.9	clear	34.208		
13	29.4	13.9	20.6	18.9	partly cloudy	34.265		
14	21.1	14.4	19.4	19.4	cloudy	36.728		
15	25.6	14.4	19.4	18.3	rain	57.570		
16	27.8	12.2	19.4	18.3	partly cloudy; rain	68.133		
17	30.0	12.8	18.9	18.3	partly cloudy	66.859		
18	28.9	14.4	18.9	18.3	partly cloudy	56.494		
19	30.6	16.7	19.4	18.3	cloudy; rain	57.429		
20	32.8	15.6	20.6	18.9	cloudy; rain	57.344		
21	33.9	15.6	19.4	18.9	clear	56.693		
22	28.9	16.7	20.0	18.9	partly cloudy	56.919		
23	32.8	14.4	20.0	18.9	partly cloudy	57.089		
24	35.0	15.0	20.6	19.4	clear	57.174		
25	34.4	15.6	20.6	19.4	clear	56.494		
26	33.3	13.9	20.6	19.4	clear	56.438		
27	37.2	13.9	20.6	19.4	clear	57.769		
28	38.3	15.6	20.6	19.4	clear	69.068		
29	39.4	16.7	20.6	19.4	clear	71.248		
30	40.6	15.6	21.1	20.0	clear	84.359		
31	40.6	16.1	21.1	20.0	clear	84.954		
					clear	84.388		

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

\*\* Flows measured in cfs, and later converted to m<sup>3</sup>/sec.



Appendix Table 1 (continued)

September	Temperature (C*)				Weather	American River flow at Hatchery (m <sup>3</sup> /sec**)	Salmon	Steelhead
	Air		Water					
	Maximum	Minimum	Maximum	Minimum				
1	40.0	15.6	21.1	20.0	clear	85.011		
2	38.3	16.7	21.1	20.0	clear	84.303		
3	36.7	15.6	21.1	20.0	clear	75.751		
4	38.3	15.6	21.1	20.0	partly cloudy	76.487		
5	37.2	17.8	21.1	20.0	partly cloudy	76.402		
6	32.2	15.6	21.1	20.0	clear	76.459		
7	35.0	15.6	21.1	20.0	clear	70.540		
8	36.7	14.4	21.1	20.0	clear	42.958		
9	38.9	15.6	21.7	20.0	partly cloudy	32.877		
10	34.4	15.6	21.1	20.6	cloudy	42.902		
11	25.0	16.7	20.6	20.6	rain	42.873		
12	28.3	14.4	18.9	18.3	cloudy	43.015		
13	30.0	14.4	17.2	16.7	cloudy	43.072		
14	16.1	14.4	16.7	16.1	partly cloudy	42.364		
15	28.3	13.3	15.6	15.0	cloudy	33.982		
16	27.2	13.3	15.6	14.4	clear	33.925		
17	27.8	17.2	15.6	14.4	clear	34.123		
18	30.6	12.2	16.1	15.0	clear	34.236		
19	31.1	12.2	15.6	14.4	clear	34.463		
20	29.4	12.2	16.1	14.4	partly cloudy	34.378		
21	30.0	11.7	16.1	15.0	partly cloudy	34.293		
22	32.2	11.1	16.7	15.0	partly cloudy	34.520		
23	31.1	11.1	16.1	15.0	partly cloudy	42.505		
24	31.7	12.2	16.1	15.0	partly cloudy	42.732		
25	27.8	12.2	15.6	15.0	clear	42.562		
26	26.7	12.8	15.6	14.4	clear	42.590		
27	29.4	13.9	16.7	15.6	partly cloudy	34.576		
28	29.4	15.0	16.7	15.6	cloudy	33.953		
29	28.3	15.0	16.1	15.6	partly cloudy	33.953		
30	30.0	15.0	16.1	15.6	partly cloudy	28.658		

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

\*\* Flows measured in cfs, and later converted to m<sup>3</sup>/sec.



Appendix Table 1 (continued)

October	Temperature (C*)				Weather	American River flow at Hatchery (m3/sec**)	Salmon	Steelhead
	Air		Water					
	Maximum	Minimum	Maximum	Minimum				
1	26.1	14.4	15.6	15.0	partly cloudy	23.306		
2	24.4	15.6	15.6	15.0	cloudy	22.881		
3	26.1	10.6	16.1	15.0	partly cloudy	23.107		
4	27.2	09.4	16.7	15.6	clear	23.306		
5	28.9	10.6	16.7	15.6	clear	23.023		
6	30.6	12.2	17.2	15.6	clear	22.400		
7	31.7	13.3	16.7	15.6	partly cloudy	22.824		
8	31.7	12.2	17.2	15.6	partly cloudy	22.796		
9	32.2	12.2	17.2	16.1	clear	22.683		
10	30.6	13.3	17.2	16.1	partly cloudy	22.768		
11	31.1	11.1	17.8	16.1	clear	22.768		
12	31.7	10.6	17.8	16.7	clear	22.768		
13	30.6	12.8	17.2	16.7	clear	22.711		
14	29.4	10.6	17.2	16.1	clear	22.711		
15	27.8	18.3	17.2	15.6	clear	22.739		
16	28.3	10.0	16.1	15.6	partly cloudy	22.683		
17	26.1	09.4	15.6	15.0	partly cloudy	22.739		
18	26.7	08.3	15.6	15.0	clear	22.654		
19	26.7	08.3	15.6	15.0	clear	22.909		
20	27.2	16.7	15.6	14.4	partly cloudy	22.626		
21	27.2	08.3	15.0	15.0	clear	22.428		
22	25.6	11.1	15.0	14.4	partly cloudy	22.484		
23	18.3	10.0	15.0	13.9	partly cloudy	22.484		
24	22.2	07.8	15.0	13.9	partly cloudy	22.456		
25	22.8	11.1	15.0	14.4	clear	22.513		
26	24.4	07.8	15.6	14.4	clear	22.513		
27	23.3	05.6	15.0	14.4	clear	22.569		
28	23.3	05.6	14.4	13.3	clear	22.626		
29	24.4	05.6	14.4	13.3	clear	22.400		
30	21.7	05.0	14.4	13.3	clear	22.428		
31	22.8	06.7	14.4	13.3	partly cloudy	22.541		
TOTALS								
							295***	
							295	

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

\*\* Flows measured in cfs, and later converted to m<sup>3</sup>/sec.

\*\*\* Plus one chum salmon.



Appendix Table 1 (Continued)

November	Temperature (C*)				Weather	American River flow at Hatchery (m <sup>3</sup> /sec**)	Salmon	Steelhead
	Air		Water					
	Maximum	Minimum	Maximum	Minimum				
1	24.4	5.0	14.4	13.3	partly cloudy	22.654		
2	25.6	7.8	15.0	13.9	partly cloudy	22.598		
3	25.6	4.4	15.0	13.3	partly cloudy	22.598		
4	25.6	5.6	15.0	13.3	partly cloudy	22.598		
5	29.4	5.6	15.0	13.9	partly cloudy	22.626	437	
6	26.7	6.1	15.0	13.9	partly cloudy	22.626		
7	25.6	7.8	14.4	13.3	partly cloudy	22.598		
8	24.4	5.6	15.0	13.3	partly cloudy	22.541		
9	24.4	6.7	15.6	13.3	partly cloudy	22.626		
10	23.9	5.6	15.6	14.4	partly cloudy	22.598	538	
11	18.9	11.1	15.0	14.4	cloudy; rain	22.456		
12	20.0	4.4	14.4	13.9	partly cloudy; fog	22.484		
13	20.0	8.3	14.4	13.9	cloudy; rain	22.711		
14	15.6	11.1	13.9	13.3	cloudy; rain	22.796		
15	19.4	7.8	15.0	13.3	partly cloudy	22.796	449	
16	20.0	7.8	14.4	13.9	partly cloudy	22.824		
17	20.0	7.8	14.4	13.9	partly cloudy	22.768	324	
18	18.9	5.6	14.4	13.9	fog	22.824		
19	17.8	12.2	13.9	13.9	fog	22.739	343	
20	16.1	7.8	13.9	13.9	cloudy; fog	22.796		
21	14.4	10.0	13.3	13.3	cloudy; fog	22.824		
22	13.3	10.0	13.9	13.3	cloudy; fog	22.881	288	
23	13.9	10.0	13.9	13.3	partly cloudy; fog	23.164		
24	14.4	4.4	13.9	13.3	partly cloudy; fog	22.909	316	
25	12.2	6.7	13.3	12.8	cloudy	22.853		
26	15.6	6.7	13.9	13.3	partly cloudy	22.683	477	
27	14.4	3.3	12.8	12.2	partly cloudy	22.683		
28	13.3	-0.6	12.8	11.7	clear	22.768		
29	14.4	2.2	12.2	11.7	clear	22.654	221	
30	16.1	2.2	12.8	12.2	clear	22.711		
TOTALS							3,393	

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

\*\* Flows measured in cfs, and later converted to m<sup>3</sup>/sec.



December	Temperature (C*)				Weather	American River flow at Hatchery (m <sup>3</sup> /sec**)	Salmon	Steelhead
	Air		Water					
	Maximum	Minimum	Maximum	Minimum				
1	15.6	2.2	12.8	11.7	clear	22.683		
2	17.8	2.2	12.8	11.7	clear	22.853		
3	14.4	1.1	12.8	12.2	clear; p.cloudy	23.419	422	
4	15.6	1.1	12.2	11.7	clear	22.116		
5	16.1	1.1	11.7	11.7	partly cloudy	22.909		
6	16.7	1.7	12.8	11.7	clear	28.516	218	
7	15.6	1.1	12.8	11.7	clear	51.539		
8	15.0	1.1	12.8	11.7	clear	51.199		
9	17.2	1.1	12.8	11.7	clear	50.944		
10	16.7	8.9	12.2	11.7	clear	50.519	214	
11	16.1	1.7	12.2	11.1	clear	50.916		
12	13.3	-0.6	11.7	11.1	partly cloudy	50.972		
13	16.7	0.6	11.7	11.1	clear	50.774		
14	15.6	-1.1	11.7	11.1	clear	51.029		
15	16.7	-1.1	11.7	11.1	partly cloudy	51.086	227	15***
16	16.1	0.0	12.2	10.6	clear	51.114		10
17	16.7	-1.1	11.7	10.6	partly cloudy	51.001		
18	17.2	-1.1	11.1	10.6	partly cloudy	51.142		
19	15.0	-1.1	11.1	10.6	clear	51.029		
20	15.6	1.1	11.1	10.0	partly cloudy	51.057	123	
21	15.0	0.0	11.1	10.6	partly cloudy	50.774		
22	15.6	2.2	11.1	10.0	partly cloudy	51.142		
23	15.0	1.7	10.6	10.0	cloudy	50.972		
24	12.8	-2.2	10.6	10.0	partly cloudy	51.907		
25	15.0	0.0	10.6	10.0	partly cloudy	50.689		
26	13.9	-2.8	10.6	09.4	partly cloudy	51.086		
27	12.8	-3.3	10.0	09.4	clear	51.312	95	
28	12.8	0.0	10.0	09.4	partly cloudy	51.284		
29	13.3	-1.7	10.0	09.4	partly cloudy	51.142		
30	14.4	-2.2	09.4	09.4	rain	50.661		34
31	13.3	3.9	10.0	09.4	partly cloudy	44.403		19
TOTALS								
* Temperature measured to nearest whole degree F and later converted to C							1,299	78

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

\*\* Flows measured in cfs, and later converted to m<sup>3</sup>/sec.

\*\*\* Fifteen steelhead died in the holding pond prior to December 15.



Appendix Table 1 (Continued)

January	Temperature (C*)				Weather	American River flow at Hatchery (m3/sec**)	Salmon	Steelhead
	Air		Water					
	Maximum	Minimum	Maximum	Minimum				
1	14.4	1.1	10.0	9.4	Cloudy; rain	36.842		
2	12.8	7.8	9.4	9.4	cloudy; rain	29.819		
3	12.8	5.6	9.4	9.4	cloudy	23.249	194***	
4	11.7	1.1	10.0	8.9	partly cloudy	22.881		
5	12.2	2.2	9.4	8.9	partly cloudy	23.107		68
6	12.2	-2.2	9.4	8.9	clear	23.107		
7	10.0	-2.2	8.9	8.3	clear	22.824		
8	10.0	-2.2	8.9	8.3	clear	22.796		
9	11.7	-2.2	8.3	8.3	partly cloudy	23.079		
10	11.7	0.0	8.9	8.3	partly cloudy	22.683		
11	10.0	3.3	8.9	8.9	fog	22.881		
12	10.0	3.3	8.9	8.9	cloudy	22.824		102
13	10.6	2.2	8.9	8.9	cloudy	22.739	22	
14	11.7	3.3	8.9	8.9	partly cloudy	22.626		
15	10.6	0.0	8.9	8.9	cloudy	22.768		
16	7.2	3.3	8.3	8.3	cloudy	22.768		
17	8.3	2.2	8.9	8.3	cloudy	22.683		
18	5.6	1.1	8.3	8.3	cloudy; fog	22.739		
19	8.3	2.2	8.9	8.3	partly cloudy; fog	22.768		
20	13.3	2.2	8.3	8.3	cloudy; fog	22.739	19	155
21	10.0	6.7	8.9	8.3	rain	22.768		122
22	17.8	7.2	8.9	8.9	partly cloudy	22.739		
23	16.7	2.2	9.4	8.3	clear	22.654		
24	16.1	2.2	9.4	8.3	partly cloudy	22.683		
25	17.8	2.2	9.4	8.9	fog	22.654		
26	12.2	4.4	8.9	8.9	fog	22.654		
27	11.7	4.4	8.9	8.9	fog	22.456		127
28	8.3	0.6	8.9	8.9	fog	22.513	12	113
29	7.8	4.4	8.9	8.3	cloudy	22.456		
30	11.1	5.6	8.3	8.3	partly cloudy	22.569		
31	13.3	1.1	8.9	6.7	cloudy	22.400		
TOTALS							247	687

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

\*\* Flows measured in cfs, and later converted to m<sup>3</sup>/sec.

\*\*\* Plus 10 silver salmon.



Appendix Table 1 (Continued)

February	Temperature (C*)				Weather	American River flow at Hatchery (m <sup>3</sup> /sec**)	Salmon	Steelhead
	Air		Water					
	Maximum	Minimum	Maximum	Minimum				
1	13.3	4.4	8.9	8.3	partly cloudy; fog	22.230		
2	13.3	0.6	8.9	8.3	fog	22.428		
3	14.4	-1.1	8.9	8.3	partly cloudy	22.598		92
4	16.7	0.0	9.4	8.3	clear	22.626		
5	18.3	2.2	8.9	8.3	partly cloudy	22.598		
6	17.8	1.7	8.9	8.3	partly cloudy	22.541		
7	19.4	3.3	9.4	8.9	partly cloudy	22.683		
8	15.0	7.8	9.4	8.9	cloudy; rain	22.938		
9	16.7	4.4	10.0	8.9	partly cloudy	22.796		
10	16.7	4.4	9.4	8.9	partly cloudy	22.796		220
11	18.9	4.4	10.0	9.4	clear	22.768		
12	20.6	4.4	10.0	8.9	clear	22.739		
13	16.7	5.6	10.0	8.9	partly cloudy	22.711		
14	21.1	4.4	10.6	9.4	clear	22.739		154
15	24.4	5.6	10.6	9.4	partly cloudy	22.400		
16	24.4	6.1	10.6	9.4	clear	15.093		
17	24.4	5.6	10.6	9.4	clear	14.357		
18	24.4	6.7	11.1	10.0	clear	14.017		
19	24.4	5.0	10.6	10.0	partly cloudy	14.329		
20	15.6	5.6	10.0	10.0	cloudy; rain	14.131		
21	15.0	6.1	9.4	9.4	cloudy; rain	14.386		
22	16.7	5.6	10.6	10.0	partly cloudy	14.527	2	
23	17.2	6.7	10.6	9.4	partly cloudy; rain	14.102		76
24	15.6	1.1	11.1	10.0	partly cloudy	14.187		
25	15.6	-1.1	11.1	10.0	partly cloudy	14.159		
26	18.9	0.0	11.1	10.0	partly cloudy	14.470		
27	18.9	1.1	11.1	10.0	clear	14.414		
28	16.7	6.1	10.0	10.0	partly cloudy	14.386		
TOTALS								
*Temperature measured to nearest 0.2 C							2	542

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



Appendix Table 1 (Continued)

March	Temperature (C*)				Weather	Amerioan River flow at Hatchery (m <sup>3</sup> /sec**)	Salmon	Steelhead
	Air		Water					
	Maximum	Minimum	Maximum	Minimum				
1	15.0	-0.6	11.1	10.0	clear	13.904		
2	17.8	0.0	10.6	10.0	clear	7.080		
3	17.8	4.4	11.1	10.0	clear	6.796		
4	20.2	4.4	11.1	10.6	clear	6.372		
5	20.6	1.7	11.1	10.0	clear	6.570		
6	21.1	3.9	11.1	10.0	partly cloudy	7.080		
7	21.1	5.6	11.1	10.0	partly cloudy	7.080		
8	23.3	6.7	11.7	10.6	cloudy	7.080		
9	18.9	4.4	11.1	10.6	partly cloudy;rain	7.080		
10	16.7	1.1	11.7	10.6	clear	7.080		
11	20.0	0.0	11.7	10.6	partly cloudy	7.080		
12	17.8	7.8	11.7	11.1	cloudy; rain	7.221		
13	17.8	2.2	11.1	10.6	cloudy	7.221		
14	16.7	0.6	15.0	10.6	partly cloudy	7.080		
15	18.3	3.3	11.1	11.1	partly cloudy	7.080		
16	13.9	6.7	11.1	11.1	rain	7.080		
17	15.6	3.3	11.7	10.6	partly cloudy;rain	7.080		
18	18.9	0.6	11.7	11.1	partly cloudy	7.363		
19	20.0	0.6	12.2	11.1	clear	7.221		
20	22.8	3.3	12.8	11.1	clear	7.221		
21	23.3	4.4	13.3	12.2	clear	7.221		
22	25.6	6.7	13.3	11.7	partly cloudy	7.221		
23	18.9	7.2	12.2	10.6	cloudy; rain	7.221		
24	16.7	5.6	12.2	11.1	cloudy; rain	7.221		
25	19.4	3.3	12.8	11.7	clear	7.221		
26	24.4	2.2	13.9	11.7	clear	7.221		
27	24.4	5.6	13.9	12.8	partly cloudy	7.221		
28	24.4	2.8	12.8	12.2	clear	7.221		
29	18.9	2.2	13.3	12.2	partly cloudy	7.221		
30	21.7	2.2	13.3	12.2	partly cloudy	7.221		
31	22.2	4.4	12.8	12.2	partly cloudy	7.221		

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

\*\*Flows measured in cfs, and later converted to m<sup>3</sup>/sec.



Appendix Table 1 (Continued)

April	Temperature (C*)				Weather	American River flow at Hatchery (m <sup>3</sup> /sec**)	Salmon	Steelhead
	Air		Water					
	Maximum	Minimum	Maximum	Minimum				
1	23.3	6.1	13.3	12.2	partly cloudy	7.080		
2	22.2	6.7	13.9	12.8	clear	7.221		
3	26.7	6.7	15.0	12.8	clear	7.080		
4	27.8	7.2	14.4	13.3	clear	7.080		
5	28.9	7.8	14.4	13.3	clear	7.080		
6	31.1	8.3	15.0	12.8	clear	7.080		
7	25.0	8.3	14.4	12.2	partly cloudy	7.080		
8	23.3	7.8	15.0	12.8	cloudy	7.080		
9	20.0	5.6	15.6	13.9	partly cloudy	7.080		
10	25.6	7.2	16.1	14.4	clear	7.221		
11	27.2	7.8	15.6	15.0	partly cloudy	7.221		
12	31.1	8.9	15.6	13.3	clear	7.221		
13	27.8	12.8	15.6	13.3	partly cloudy	7.221		
14	28.9	10.0	16.7	15.0	clear	7.221		
15	32.2	8.3	16.1	14.4	clear	7.221		
16	30.6	7.8	15.6	13.9	partly cloudy	7.221		
17	28.3	8.3	17.2	15.0	clear	7.221		
18	28.3	10.0	16.7	15.6	clear	7.221		
19	29.4	8.9	16.1	15.6	clear	7.221		
20	30.0	7.2	15.6	13.3	clear	7.221		
21	30.6	7.2	15.0	13.3	clear	7.221		
22	31.1	6.7	15.6	13.9	clear	7.221		
23	32.2	8.3	16.1	14.4	partly cloudy	7.363		
24	32.2	11.1	15.0	14.4	partly cloudy	7.363		
25	26.1	11.7	15.0	13.9	partly cloudy	7.363		
26	28.3	10.0	15.6	13.9	clear	7.221		
27	27.8	7.8	15.6	13.9	clear	7.080		
28	27.2	7.8	15.6	13.9	clear	7.080		
29	30.0	11.1	16.1	15.0	cloudy	7.561		
30	29.4	11.1	15.6	13.3	partly cloudy; rain	13.876		

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

\*\*Flows measured in cfs, and later converted to m<sup>3</sup>/sec.



Appendix Table 1 (Continued)

May	Temperature (C*)				Weather	American River flow at Hatchery (m3/sec**)	Salmon	Steelhead
	Air		Water					
	Maximum	Minimum	Maximum	Minimum				
1	18.9	12.8	15.6	14.4	cloudy; rain	14.159		
2	25.0	11.1	15.6	14.4	clear	14.159		
3	25.0	8.9	14.4	12.2	cloudy	14.159		
4	23.9	7.2	15.6	13.9	partly cloudy	14.159		
5	22.2	6.1	14.4	12.8	partly cloudy; rain	14.159		
6	21.7	5.6	14.4	12.8	partly cloudy; rain	14.159		
7	18.3	6.1	15.0	13.3	partly cloudy; rain	14.159		
8	25.6	9.4	15.0	13.3	partly cloudy; rain	14.159		
9	21.1	15.6	14.4	13.3	rain	14.159		
10	21.1	10.0	13.3	12.8	cloudy; rain	14.159		
11	21.1	9.4	12.8	12.2	cloudy; rain	14.159		
12	23.3	12.8	13.9	12.8	partly cloudy	14.159		
13	27.8	10.0	14.4	12.8	partly cloudy	14.159		
14	26.1	8.9	14.4	12.8	partly cloudy	14.159		
15	25.6	8.9	15.0	12.8	partly cloudy	14.159		
16	24.4	8.9	15.0	14.4	partly cloudy	14.159		
17	24.4	5.6	15.0	14.4	partly cloudy	14.159		
18	23.9	14.4	15.0	12.8	cloudy; rain	14.159		
19	28.3	7.8	16.1	13.9	partly cloudy	14.159		
20	31.7	15.0	15.6	15.0	clear	14.159		
21	32.2	11.1	15.6	13.9	partly cloudy	14.159		
22	20.0	11.1	14.4	13.3	cloudy; rain	14.159		
23	25.0	10.0	15.0	13.9	cloudy	14.159		
24	28.3	8.9	16.1	14.4	clear	14.159		
25	26.7	8.3	15.0	13.9	partly cloudy	14.159		
26	15.6	12.2	15.6	13.9	cloudy	14.159		
27	27.8	7.2	15.6	13.3	clear	14.159		
28	30.0	7.8	15.6	14.4	clear	14.159		
29	30.6	10.0	15.6	14.4	clear	14.159		
30	34.4	11.1	17.8	15.0	partly cloudy	14.159		
31	38.3	14.4	17.8	17.8	clear	14.159		

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



Appendix Table 1 (Continued)

June	Temperature (C*)				Weather	American River flow at Hatchery (m <sup>3</sup> /sec**)	Salmon	Steelhead
	Air		Water					
	Maximum	Minimum	Maximum	Minimum				
1	34.4	14.4	16.1	14.4	clear	16.396		
2	34.4	14.4	17.8	15.0	partly cloudy	32.169		
3	37.2	14.4	16.7	15.6	partly cloudy	31.801		
4	37.8	14.4	17.2	15.6	partly cloudy	31.518		
5	42.2	16.7	16.7	15.6	partly cloudy	31.660		
6	41.1	21.1	17.2	15.0	partly cloudy	31.433		
7	41.7	21.1	16.7	15.6	partly cloudy	32.113		
8	37.8	17.8	16.7	15.6	partly cloudy	32.028		
9	26.7	14.4	15.0	14.4	partly cloudy	32.169		
10	28.3	14.4	15.6	14.4	partly cloudy	31.688		
11	31.1	11.1	16.1	14.4	partly cloudy	31.688		
12	32.2	11.7	16.1	13.9	partly cloudy	31.546		
13	30.6	12.8	16.1	14.4	partly cloudy	31.631		
14	31.1	13.9	16.7	15.0	partly cloudy	31.546		
15	34.4	12.2	16.1	15.0	partly cloudy	31.688		
16	35.6	13.3	15.6	15.0	partly cloudy	31.688		
17	27.8	12.8	16.1	15.0	partly cloudy	31.716		
18	28.9	11.7	16.1	15.0	partly cloudy	31.688		
19	33.3	13.3	16.1	15.0	partly cloudy	31.660		
20	35.0	13.3	17.2	15.0	partly cloudy	31.660		
21	39.4	21.7	18.3	16.1	clear	31.829		
22	42.2	21.1	17.2	16.7	clear	31.886		
23	41.1	17.8	17.8	16.1	clear	31.829		
24	46.7	20.0	18.3	16.7	clear	31.886		
25	42.2	20.6	18.3	17.2	partly cloudy	31.801		
26	40.0	19.4	18.3	16.1	clear	31.433		
27	38.9	17.8	18.3	17.2	clear	31.178		
28	41.1	20.6	18.9	17.2	clear	31.688		
29	37.8	17.2	18.9	17.2	clear	31.744		
30	39.4	17.8	18.9	17.8	clear	31.688		

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

\*\*Flows measured in cfs, and later converted to m<sup>3</sup>/sec.



Appendix Table 2

Fork Lengths (nearest cm) of Marked King Salmon Recovered at  
Nimbus Hatchery During the 1976-77 Season

FL(cm)	Ad	
	Male	Female
25	1	
44	2	1
45	6	
46	4	1
47	2	
48	4	
49	4	2
50	3	
51	1	1
52	3	
53	2	
54	2	
55	1	
56	1	
57	2	
58	6	
59	1	1
60	1	1
61	2	
62	1	
63		
64	2	
65		
66		2
67		2
68		2
69	1	3
70	5	3
71	1	3
72		3
73	1	5
74	1	7
75	1	5
76	1	3
77	2	2
78	1	1
79	2	1
80	1	2
81		1
82	1	
83	1	1
84	1	1
85		1
86	1	
87		1
88		
89	1	2
90	1	1
91	1	
92		1
95	2	
Total by Sexes	77	60
Total Sexes Combined	137	



Appendix Table 3

## Marked Steelhead Recoveries, Nimbus Hatchery, 1976-77

Mark	Brood year	Number recovered	Area released	Average size (g)	Date(s)	Number released	Origin
Ad	1973	1	Sacramento River-Brannon Is.	?	Oct. '74, Feb. '75	42,160	Mokelumne River Fish Installation
LV	1973	68	Sacramento River-Garcia Bend	99	March 1974	45,820	Nimbus Hatchery
	1974		Sacramento River-Garcia Bend	70	March 1975	45,370	Nimbus Hatchery
	1975		Sacramento River-Garcia Bend	84	March 1976	46,980	Nimbus Hatchery
LV-RV	1973	94	Sacramento River-Garcia Bend	86	March 1974	49,062	Nimbus Hatchery
	1974		Sacramento River-Garcia Bend	81-91	March 1975	46,640	Nimbus Hatchery
	1975		Sacramento River-Garcia Bend	86-91	Feb.-Mar. 1976	47,985	Nimbus Hatchery
LV-LP	?	1					
RV	1973	107	Sacramento River-Garcia Bend	80	January 1974	50,017	Nimbus Hatchery
	1974		Sacramento River-Garcia Bend	63	January 1975	45,070	Nimbus Hatchery
	1975		Sacramento River-Garcia Bend	63-76	January 1976	49,260	Nimbus Hatchery
LP	1973	81	Sacramento River-Garcia Bend	50-103	February 1974	104,598	Nimbus Hatchery
	1974		Sacramento River-Garcia Bend	94	March 1975	29,923	Nimbus Hatchery
RP	?	1					



Appendix Table 4

Fork Lengths (nearest cm) of Marked Steelhead Recovered at  
Nimbus Hatchery During the 1976-77 Season

FL(cm)	LP		LV		LV-RV		RV		Ad
	Male	Female	Male	Female	Male	Female	Male	Female	
49					1				72 F
50									
51									
52									
53									RP
54		1						2	
55									70 F
56		1				2	1		
57								1	
58									
59				1					
60		3		1			1	1	LP-LV
61	1				2				50 M
62	1	1		1	1	2			
63	3						2	1	
64		4	1	3	1	3		4	
65	4	2	1	5	1	4	3	4	
66	3	3		5	1	3	1	2	
67	4	5	1	6	2	7	1	6	
68	5	7	3	4	10	7	3	10	
69	2	4	1	4	2	7	2	10	
70	5	2	5	4	6	5	6	10	
71	2	1	4	1	2		4	3	
72	4	2	2	2	6	2	3	3	
73			3	4	4		4		
74	2				4		1	2	
75	4		1		2		3	1	
76					1		1	1	
77					2		3	1	
78			1		1		1		
79	1				1		2		
80			1		2		1		
81									
82			1						
83	2								
84									
85							1		
86			2						
87	1							1	
93	1								
Totals by Sexes	45	36	27	41	52	42	44	63	
Totals Sexes Combined	81		68		94		107		