State of California
The Resources Agency
Department of Fish and Game

MOKELUMNE RIVER FISH INSTALLATION, ANNUAL REPORT FOR 1966-67 SEASON [1/]

by

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SUMMARY

This is the third annual report of the Mokelumne River Fish Installation. It covers the period of operation from July 1, 1966 to July 15, 1967.

Construction of this Installation was completed in 1964. The purpose of the project was to compensate for loss of spawning area of fall-run king (chinook) salmon, Oncorhynchus tshawytscha, and steelhead trout, Salmo gairdnerii, blocked by Camanche Dam.

The Installation is made up of two parts; a spawning channel for natural spawning of salmon and a hatchery for artificial spawning and rearing of steelhead trout.

During the period of this report, 489 adult salmon were received at the Installation. Of this number 430 (85♀ and 345♂) were placed in the spawning channel; the others (14♀ and 45♂) were either spawned artificially or returned to the river as excess males. Prespawning mortality in the spawning channel amounted to 4 females and 21 males.

An estimated 387,562 salmon eggs were deposited in the gravel and 76,796 young salmon were counted out of the channel. This is an egg to outmigrant survival of 19.8 percent.

A test was conducted to determine effects of high water temperature on salmon embryos. Results showed as they did last year, that about 70 percent survival will occur at temperatures found to be lethal in more northern waters.

Seventeen adult steelhead entered the Installation from January 23 to April 13, 1967. Three females from this group were spawned and produced a total of 13,525 eggs. An additional 164,600 eyed eggs were received from Nimbus Hatchery. This is a total of 178,125 steelhead eggs in the 1967 brood year.

In February, 1967, 74,630 yearling steelhead were planted in the Mokelumne River near the town of Thornton. These were 1966 brood year fish and averaged 10.6 per pound.

[1/] Anadromous Fisheries Administrative Report No. 70-12

INTRODUCTION

This is the third annual report of the Mokelumne River Fish Installation and covers the period of operation from July 1, 1966 to July 15, 1967. The Installation was first operated on January 1, 1964. A summary of results of each year's salmon and steelhead production is presented in Tables 1-a and 1-b.

The Installation is located on the south bank of the Mokelumne River at the base of Camanche Dam in San Joaquin County. It is about 40 miles southeast of Sacramento (Figure 1). Camanche Dam is presently the upper limit of anadromous fish migration in the river. About 61 miles downstream from the Dam, the Mokelumne River enters the San Joaquin River. The purpose of the Installation was to compensate for the loss of fall-run king salmon, and steelhead trout spawning area inundated by the Dam.

The California Department of Fish and Game is responsible for operating the Installation; East Bay Municipal Utility District paid construction costs and also pays for annual operation and maintenance costs.

DESCRIPTION OF INSTALLATION

A detailed description was given in the first annual report (1964-65 season). A summary of the operation is as follows:

The Installation is made up of two parts; (1) a spawning channel for natural spawning of fall-run king salmon, and (2) hatchery facilities for artificial spawning and rearing of steelhead trout. Fish enter the fishway at the base of Camanche Dam and ascend to the holding pond. A mechanical sweep crowds the fish to the upper end of the pond. A lift elevates the fish and deposits them in an anesthetic tank where they are sorted and counted. From there, the steelhead are placed in a holding tank, the salmon are released in the spawning channel, and unwanted fish are returned to the river.

The steelhead are held until they are ready for artificial spawning. After they are spawned, they are returned to the river and the eggs are hatched in incubators. When fry reach feeding stage, they are transferred to hatchery troughs. About April 15, they are moved outside to rearing ponds. The fish are raised for about one year and then released into the Mokelumne River. The hatchery facilities have a capacity to raise a maximum of 100,000 fish to yearling size.

The salmon spawning channel is 6,800 feet long by 20 feet wide at the bottom. It consists of two loops of equal length, each containing two channels with spawning sections and resting pools (Figure 2). Each loop can be operated independently. Only the upper loop has been used since the channel was first operated in the fall of 1964, because not enough fish have been available to operate both loops. The channel has a spawning capacity of 2,000 females.

TABLE 1-a

King Salmon Spawning Channel Annual Summaries
Mokelumne River Fish Installation 1964-65 through 1966-67 Seasons

Season	Number of Females Released In Channel	Potential Number of Eggs	Female Prespawning Mortalities	Estimated Egg Deposition	Estimated Number of Outmigrants	Estimated Percent Production	
						Of Potential Eggs	Of Eggs Deposited
1964-65	178	947,100	3	927,300	73,540	07.8	07.9
1965-66	33	157,043	1	150,883	76,435	48.7	50.6
1966-67	85	399,758	4	387,562	76,796	19.2	19.8

TABLE 1-b

Steelhead Hatchery Annual Summaries --
Mokelumne River Fish Installation 1963-64 through 1966-67 Seasons

Season	Number Native Fish Received	Number Females Spawned	Number Eggs Taken	Number Eggs From Nimbus	Total Eggs	Number Fry Transferred To Ponds	Number Planted as Fingerlings	Number Planted as Yearlings
1963-64	15	*	*	*	436,300		None	None
1964-65	30	Not Recorded	55,300	315,450	370,750	310,000	163,280	92,520
1965-66	30	8	30,970	331,400	362,370	283,200	131,420	84,410
1966-67	17	3	13,524	164,600	178,125	137,555	94,520	74,630

* Adult steelhead from Nimbus Hatchery and Mokelumne River Fish Installation were spawned together to obtain a total of 436,300 eggs.

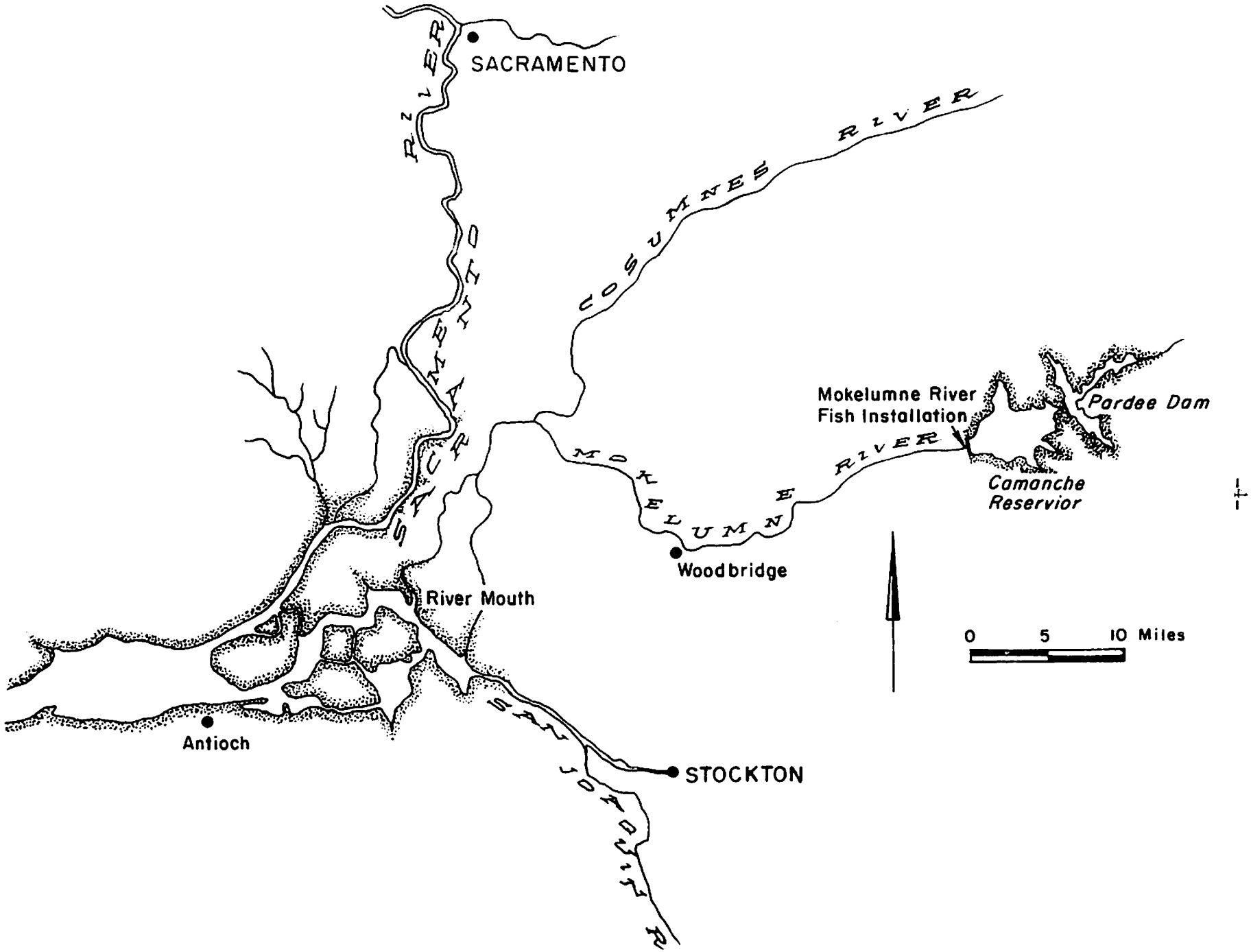

Figure 1. Map Showing Location of the Mokelumne River Fish Installation

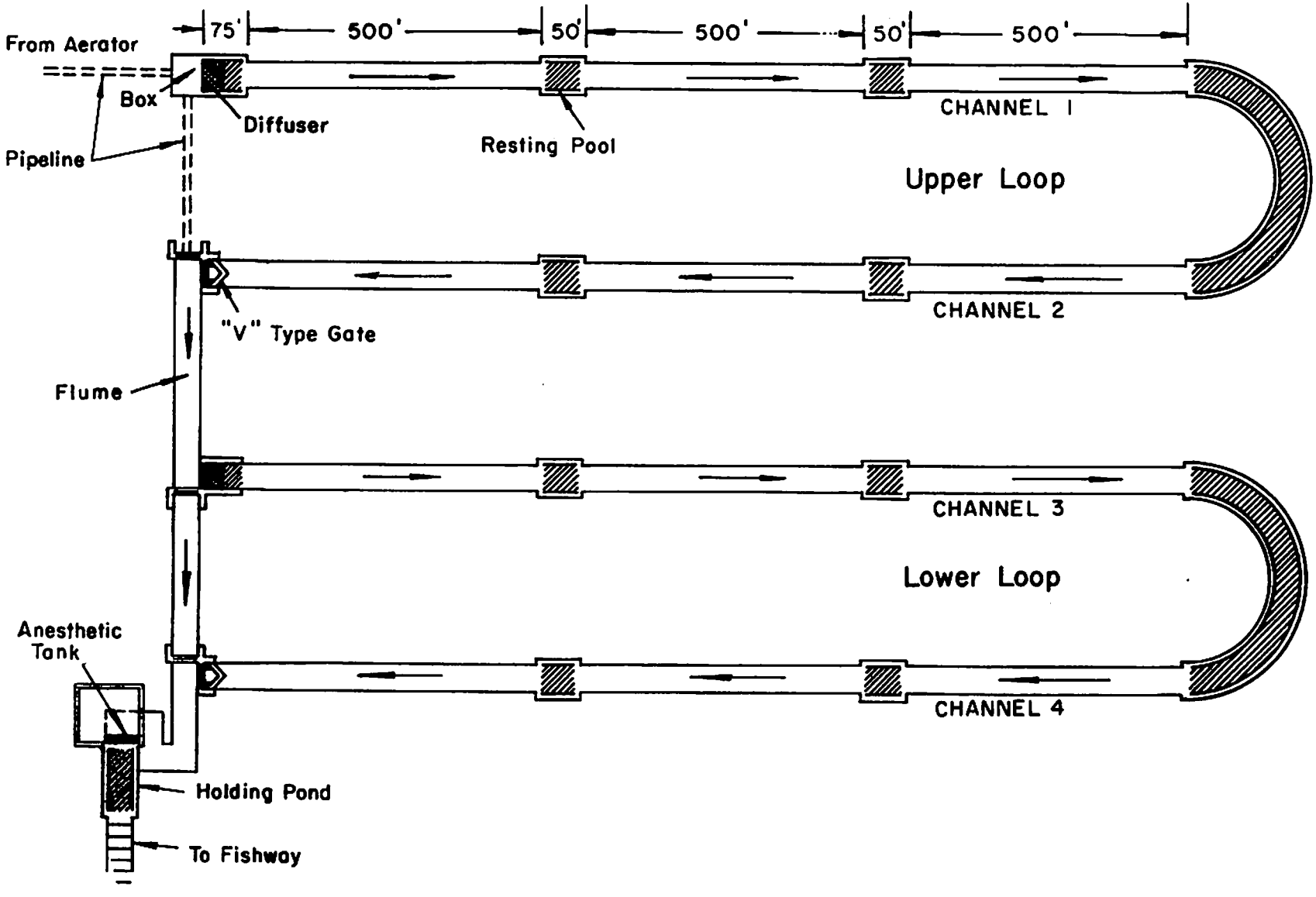

Figure 2. Diagram of the Mokelumne River Spawning Channel

After the fry emerge from the gravel, they are allowed to move out at will. A migrant trap is installed at the end of the channel section for enumeration purposes.

KING SALMON MAINTENANCE PROGRAM

Spawning Season 1966 Brood Year

The practice has been to dry up the channel after a season's operation is completed. In 1966 the channel was drained in mid-June, after the out-migration had been completed. The channel bottom was re-worked before the start of the 1966 spawning season and redds from the two previous spawning seasons were leveled.

In an effort to get better spawning distribution in the channels, some modifications were made in sections where no spawning occurred during the previous seasons. In one area a gravel berm, approximately six feet wide by one foot high, was constructed across the channel. In this same area two sets of smaller berms were constructed. They are about one foot high and two feet wide at the base and extend into the channel about six feet from the sides. A 12" x 12" timber was anchored across the channel at another location. At two other locations 20" x 20" square concrete blocks were set in the channel.

The channel was flooded on September 21 just before the fall run started up the Mokelumne River. A spawning flow of 50 cfs was maintained throughout the spawning season. Normally, the fish had been entering the channel of their own volition. This year, however, Woodbridge Dam (24 miles downstream) was inoperable and the fish had no way of going above the dam. Therefore, before the run started a trap was installed in the river about six miles below the dam at the Steffan Ranch. Later, a trap was installed in the lower part of the Woodbridge Dam ladder, and the Steffan Ranch trap was removed. Since the fish had to be trapped, it was decided to haul most of them directly to the spawning channel where we expected to get better production than if they spawned in the river. Also the channel out-migrants could be trapped at the channel and hauled below Woodbridge Dam to prevent any loss at the then unscreened Woodbridge Irrigation Diversion.

Salmon trapping at the Steffan Ranch site began on October 3 and terminated on October 21. During this period 59 salmon were hauled to the spawning channel. From October 22 to November 9 no trapping was done. Between November 10 and December 12 a trap was operated in the fishway at Woodbridge Dam. During this period 137 salmon were hauled to the spawning channel. Most of the males and a few of the females trapped at Woodbridge Dam were released into the river above the dam, giving them a choice of spawning in the river or going into the spawning channel. Of these fish 292 males and one female entered the Installation.

A total of 489 salmon were received at the Installation during the fall of 1966. Fourteen females and seven males were spawned artificially in the hatchery, and 38 excess males were returned to the river; the remaining fish (430) were placed in the channel.

Spawning activity started on November 7 and the last redd was constructed about December 10. As spawning occurred, records were kept of redd locations. Redd construction in relation to the various modifications made in channel sections mentioned previously indicated that the large gravel berm was the best method of encouraging fish to spawn in a given area; four or five females used this spot. One of the two smaller berms was used by two females. The 12" x 12" timber encouraged three females to spawn near it. Only one female spawned near the concrete blocks. Most of the spawning occurred in the upper half of channel 1, as was the case during the previous season.

Carcass Recovery 1966 Brood Year

Dead salmon were collected on a daily basis from all sections of the channel and at the lower end of channel 2 at the V-trap. All carcasses were measured to the nearest quarter inch fork length and cut open for examination. The condition of gonads was recorded and the number of eggs retained in the females were counted. Of the 430 carcasses recovered from the channel 345 were males and 85 were females. Twenty-one males and four females died without spawning. The four unspawned females contained 17,904 eggs. There were 12,196 eggs retained in the 81 females that spawned; egg retention in these fish ranged from 0 to 1,676 with an average of 149. Eight females were completely spawned out.

Estimated Egg Deposition 1966 Brood Year

Length-fecundity data from 18 females sampled in the 1966 run was used as a basis to estimate the number of eggs deposited in the gravel. Data were fitted to the linear model $y = a + bx$ by the least squares method where y = number of eggs, x = fork length in inches and a and b are constants. The regression line which represented this sample was $\hat{y} = -4983.99 + 350.24x$. This equation was applied to the 81 females that spawned in the channel and resulted in an estimated potential of 399,758 eggs (Appendix A). Subtracting the unspawned eggs (12,196) [2/] gives a total of 387,562 eggs deposited.

Downstream Migrant Production 1966 Brood Year

On December 16 the channel flow was reduced from 50 cfs to 25 cfs, and the inclined plane trap was installed.

On December 19, 1966 the first yolk-sac fry appeared in the trap. The last one was taken on February 27. Losses of yolk-sac fry were heavy. Of 3,755 trapped only 465 survived. In an attempt to increase survival some yolk-sac fry were transferred to hatchery troughs and incubators, but survival was not increased. Yolk-sac fry comprised 4.9 percent of the outmigration.

[2/] Includes only eggs left in the body cavity of those females which spawned.

On January 15, 1967 the first fingerlings appeared in the trap. Three peaks occurred in the out-migration (Figure 3). The first peak was in early February and the second one in early March. From the end of March to the end of May the migration was at a low level. The migration began increasing again in early June with the third peak occurring in mid-June. After that the migration dropped off sharply. The water to the spawning channel was shut off on July 14 and the remaining 2,560 fish in the channel were seined out. Fingerling mortality in the live trap amounted to 2,137 fish. The total outmigration was 76,796 fish which is 19.8 percent of the estimated 387,562 eggs deposited in the gravel. Mortality of outmigrants from the time the fish entered the trap to the time of planting amounted to 5,427 fish (3,290 sac fry and 2,137 fingerlings).

The method used to enumerate the outmigrants was to make an actual count if the number of fish was small. During periods of heavy migration the number of fish in a 16-ounce sample was counted to obtain the number of fish per ounce. The total weight of fish trapped was then multiplied by the number of fish per ounce to get total fish by time period.

Length and weight samples of outmigrants were taken weekly. The first fish leaving the channel ranged in size from 31 mm to 40 mm. When the migration ended (early July) the size ranged from 86 mm to 101 mm. The first weight samples were taken on January 29 when the fish averaged 1,424 per pound. From the first part of May on, most of the salmon were larger than 90 fish per pound, and by mid-July the average weight had increased to 32 per pound. The length-weight relationship is given in Table 2.

In this report season, 117,444 salmon were planted in the section of the Mokelumne River between Woodbridge Dam and Thornton. This includes 71,369 [3/] from the spawning channel, 42,075 from the artificially spawned group, and 4,000 of the 1965 brood year.

Predators

There was little loss from predators in the spawning channel this season. Five yearling steelhead trout were recovered from the channel. These were believed to have entered the channel as small fingerlings early in the season through the 3/8" spaced bar rack at the water inlet.

Subsurface Water and Oxygen

Subsurface velocity and dissolved oxygen data were collected from standpipes located at various sections of the spawning channel. Twenty-four of the type described by Gangmark and Bakkala (1958) were installed about 15 inches deep in series of three across the channel at locations 400, 800, 1,200, 1,600, 1,900, 2,200, 2,600 and 3,000 feet from the upper diffuser in the first loop.

[3/] Yolk-sac fry mortality plus fingerling mortality are subtracted from this figure.

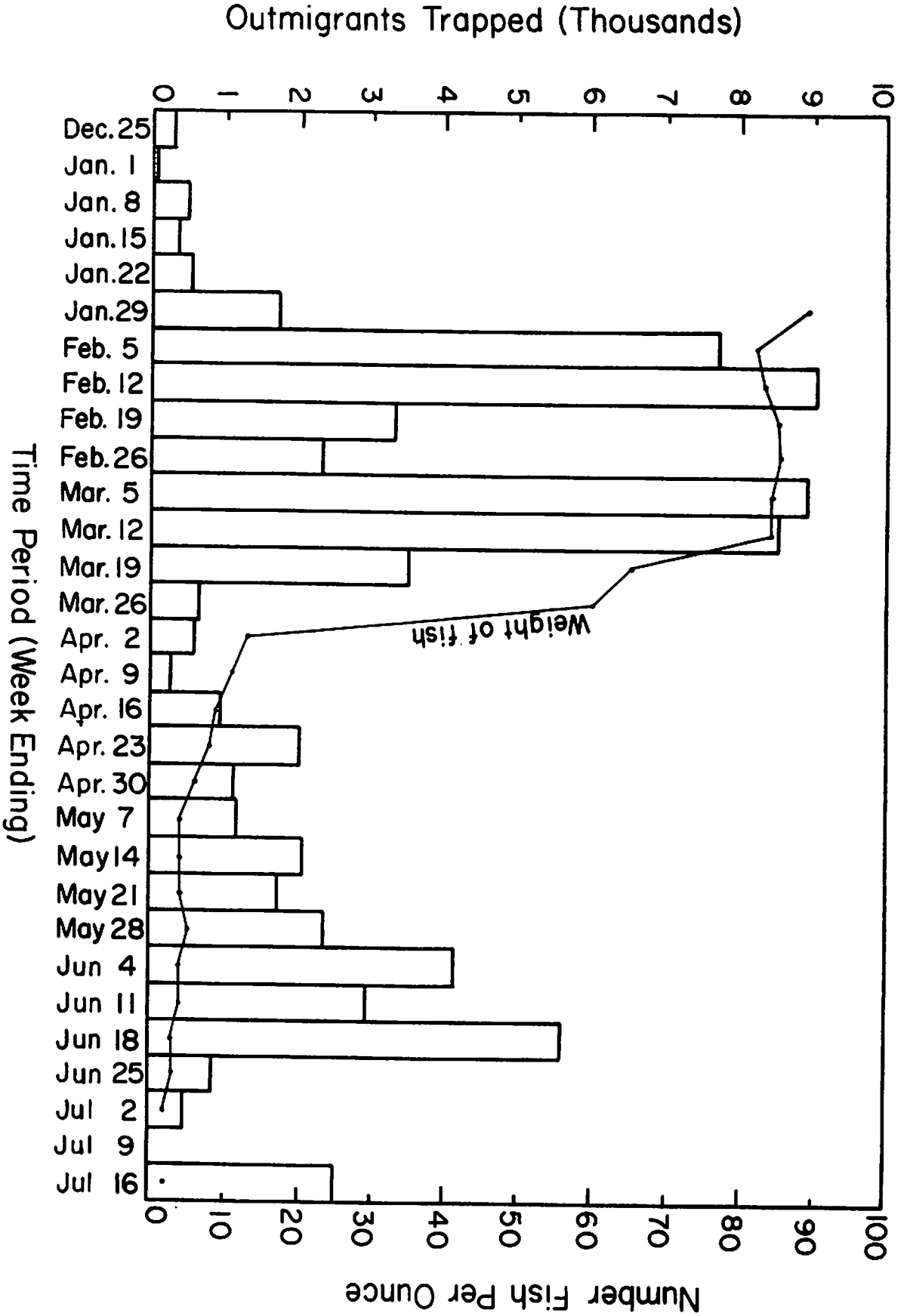

Figure 3. Weight and Number of King Salmon Outmigrants by Weekly Periods at Mokelumne River Spawning Channel, 1966-67 Season.

TABLE 2

Length and Weight of King salmon Out-migrants
1966-67 Season

Date	Fork Length Range in mm	Mean Fork Length mm	Number per Pound	Date	Fork Length Range in mm	Mean Fork Length mm	Number per Pound
1/22	31 - 40	35.0	*	4/22	48 - 90	68.2	128
1/29	30 - 38	36.4	1,424	4/29	55 - 96	77.4	88
2/4	30 - 40	34.6	1,312	5/6	57 - 104	82.7	67.2
2/11	30 - 42	36.1	1,328	5/14	55 - 109	81.7	65.6
2/18	31 - 44	36.0	1,360	5/21	63 - 110	79.7	72.0
2/26	32 - 41	36.4	1,360	5/27	64 - 102	80.1	75.2
3/5	32 - 45	36.0	1,344	6/3	70 - 109	85.4	72.0
3/11	31 - 47	36.2	1,344	6/10	76 - 105	88.5	57.6
3/19	33 - 65	46.5	950	6/17	83 - 109	95.5	44.8
3/25	30 - 66	47.4	960	6/24	82 - 113	96.8	44.8
4/1	32 - 66	57.4	208	7/1	88 - 115	99.9	40.0
4/9	38 - 77	61.7	176	7/8	86 - 116	101.2	38.4
4/15	43 - 85	65.4	144	7/15	**	**	32.0

* No weight counts taken.
** No measurements made.

Subsurface velocities were taken both before and after spawning and at different surface flows. After spawning had been completed, 10 redds were located near standpipe sites. At these locations intra-gravel water velocities before spawning ranged from 0.9 to 2.1 feet per hour with a mean of 1.4. This compares to velocities of 0.9 to 2.8 feet per hour with a mean of 1.7 from 14 other standpipes where there was no spawning (Table 3).

Dissolved oxygen content of surface and subsurface water was taken at various intervals of time. Oxygen readings were above the critical level in all standpipes (Table 4) and compared closely with the surface readings.

During the spawning period part of the water supply was bypassed around the aerator. Consequently, both intra-gravel and surface water had dissolved oxygen levels slightly below saturation. During the incubation period all water was run through the aerator and oxygen levels were at or near saturation at all locations.

Egg and Fry Survival at High Temperatures

Twelve female salmon were artificially spawned in the hatchery. The fish were divided into three groups to compare spawning success at various water temperatures (Table 5). Percentage of survival was calculated from spawning time until after feeding had commenced. The first group included three females. They were spawned at temperatures ranging from 57° to 60° F. One of the fish was "too green" when spawned and the eggs were lost. The other two produced 10,740 eggs and had a survival of 72.2 percent. The second group of three were spawned at a temperature of 58° F. These fish produced 13,950 eggs with a survival of 74.5 percent. The third group included six females. They were spawned at temperatures ranging from 54° to 55° F. Eggs from one were too green and were lost. The remainder produced 27,900 eggs and had a survival of 84.6 percent. Water temperature varied only slightly in any 24-hour period. Again it has been shown that king salmon from the Mokelumne River are able to spawn with about a 70 percent success under temperature conditions often considered to be lethal in more northern waters. The survivors from this test were artificially fed until May 13 and then released in the Mokelumne River just below Woodbridge Dam.

STEELHEAD MAINTENANCE PROGRAM

Hatchery Operation 1967 Brood Year

The first steelhead of the season entered the Installation on January 23, and the last one on April 15, 1967. During this period 17 fish were received, 12 males and 5 females. The males averaged 14.6 inches fork length, and the females 25.3 inches fork length. Three of the females were spawned. They produced 13,524 eggs, for an average of 4,508 eggs

TABLE 3

A comparison of Intra-gravel Water Velocities in Areas Selected for Spawning to Those Not Selected for Spawning

Mokelumne River Spawning Channel
1966-67 Season
Intra-gravel Water Velocities (Ft/hour)

Selected as spawning sites	No spawning
1.7	1.2
1.0	1.5
1.6	1.0
1.4	2.2
1.4	2.1
0.9	2.8
1.0	1.6
2.1	1.9
1.8	1.9
1.6	2.2
	1.5
	1.6
	0.9
	2.0
Average 1.4	1.7
Range 0.9 to 2.1	0.9 to 2.8

TABLE 4

Intra-gravel and Surface Dissolved Oxygen Data in ppm

1966-67 Season

Standpipe number	Pre-spawning period Surface DO	Pre-spawning period Intra-gravel DO	Early Incubation period Surface DO	Early Incubation period Intra-gravel DO	Late Incubation period Surface DO	Late Incubation period Intra-gravel DO
1	9.1	9.4	11.9	12.0		11.3
2	9.1	9.4		11.9		11.3
3	9.1	9.4		12.0		11.3
4	8.5	8.5		12.2		11.2
5	8.5	8.5		12.2		11.2
6	8.5	8.5		12.3		11.5
7	8.6	8.9	12.4	12.3		11.9
8	8.6			12.3		12.4
9	8.6	8.8		12.3		12.0
10	8.9	8.9				12.3
11	8.9	8.8				12.6
12	8.9					12.0
13	8.6	8.8		12.4		12.9
14	8.6	8.8		12.4		12.4
15	8.6			12.3		12.3
16	8.8	9.0	12.8	12.3		12.6
17	8.8			12.4		11.8
18	8.8	9.1		12.6		12.9
19	8.3					12.3
20	8.3	8.7				12.3
21	8.3	8.8				12.6
22				12.3	13.1	12.9
23				12.6	13.1	12.9
24				12.5	13.1	12.9

TABLE 5

King Salmon Artificial Spawning Data
Mokelumne River Fish Installation, 1966-67

	Date of Spawning	Lot No.	Water Temp (°F) at Spawning Time Max.	Min.	Length Female (Inches)	Ounces of Eggs	No. of Eggs/oz.	No. of Eggs	Days to Hatch	Hatching Date	No. of Fish	Percent Survival
Group 1	Nov. 10	1 1/	59	57	23.25	30	138	4,140		Total Loss		
	" 10	2	59	57	28.50	71	60	4,260	34	1/9	3,260	75.8
	" 16	3	60	60	33.00	90	72	6,480	38	1/22	4,500	69.4
Group 2	" 30	5	58	58	24.00	30	130	3,900	47	2/7	2,500	91.1
	" 30	6	58	58	22.50	25	132	3,300	47	2/7	2,900	87.9
	" 30	7	58	58	30.00	75	90	6,750	47	2/7	5,000	74.1
Group 3	Dec. 8	9	55	55	34.50	94	80	7,520	52	3/1	5,800	77.2
	" 8	10 1/	55	55	24.00	18	120	2,160		Total Loss		
	" 13	11	55	55	28.50	50	93	4,650	52	3/6	4,350	93.6
	" 13	13	55	55	26.00	40	112	4,480	52	3/6	3,820	85.3
	" 13	14	55	55	27.50	50	90	4,500	52	3/6	4,030	89.6
	" 15	17	54	54	35.00	75	90	6,750	53	3/14	5,590	82.9

1/ Eggs too green.

per female. Two males and two females died in the holding tank. An additional 164,600 eggs were obtained from Nimbus Hatchery. This supplement was necessary to guarantee at least 100,000 fish would be raised to yearling size.

Planting 1966 Brood Year

As the steelhead grew and the capacity of the Installation was exceeded, surplus fingerlings were planted in the Mokelumne River. In July 1966, 27,200 fish averaging 2,400 per pound were planted in the river at the Installation. In October, 46,320 fish averaging 128 per pound were planted about 17 miles below the Installation (3 miles above Woodbridge Dam); and another 21,000 averaging 91 per pound, were planted about 10 miles below the Installation. The remaining fish were held until they reached yearling size. These were planted during February and March 1967. At that time 53,150 fish averaging 11 per pound and 21,480 averaging 9.6 per pound were planted about 28 miles below the Installation (8 miles below Woodbridge Dam).

Miscellaneous

In February 1967 there was a large fish loss in the steelhead rearing ponds. A total of 17,600 yearling steelhead died in one period. Heavy metal pollution was the suspected cause. The salmon did not appear to be affected.

WATER TEMPERATURES

Water temperatures were taken throughout the season by means of a continuous temperature recorder located near the entrance to the spawning channel. Water temperatures in the high 50's and low 60's prevailed in the early part of the salmon spawning season. Temperatures dropped slowly about mid-November as they have in past years and reached a low of 46° F on January 12, 1967 (Appendix B).

Very little difference in water temperature occurred in any 24-hour period. By the time spawning started (November 7) the daily temperature variation was no more than three degrees, and no more than two degrees during the out-migration.

MARKING

Four thousand salmon from the 1965 brood year were marked right maxillary. No other marking of salmon or steelhead was done, and no mark recoveries were made in this fiscal year.

PUBLIC RELATIONS

During the 1966-67 fiscal year, an estimated 16,212 people visited the Installation. Tours of the Installation were conducted for several special interest groups.

APPENDIX A

Estimated Number of Eggs Contained in 81 Female Salmon Using the Mokelumne River Spawning Channel in 1966-67 Season

Length Inches	Estimated Number of Eggs Based on Length*	Number of Fish	Estimated Number of Eggs Contained in Channel Fish
22	2,722	4	10,888
23	3,072	3	9,216
24	3,422	7	23,954
25	3,773	8	30,184
26	4,123	9	37,107
27	4,473	5	22,365
28	4,823	5	24,115
29	5,173	7	36,211
30	5,523	9	49,707
31	5,873	8	46,984
32	6,223	3	18,669
33	6,573	4	26,292
34	6,924	5	34,620
35	7,274	3	21,822
36	7,624	1	7,624
	TOTAL	81	399,758

* $\hat{y} = -4,983.99 + 350.24x$

APPENDIX B

Water Temperature Data at Mokelumne River
Fish Installation 1966-67 Season

Water Temperature (^{o}F)

Date	Max.	Min.	Date	Max.	Min.	Date	Max.	Min.
1966								
Sept. 1	60	56	Oct. 16	60	56	Nov. 30	58	53
2	61	57	17	60	57			
3	61	57	18	63	60	Dec. 1	58	56
4	62	57	19	63	60	2	58	56
5	62	57	20	63	60	3	56	56
6	61	57	21	62	70	4	56	56
7	60	57	22	62	60	5	55	55
8	60	56	23	64	60	6	55	55
9	60	56	24	64	60	7	55	55
10	60	56	25	64	61	8	55	55
11	60	56	26	63	61	9	55	55
12	60	56	27	62	60	10	55	55
13	60	56	28	63	60	11	55	55
14	60	56	29	63	60	12	55	55
15	60	56	30	63	60	13	55	55
16	60	56	31	61	58	14	55	55
17	61	57				15	54	54
18	60	57	Nov. 1	61	58	16	54	54
19	60	57	2	61	58	17	54	54
20	60	57	3	60	58	18	53	53
21	60	57	4	60	58	19	53	53
22	60	57	5	60	58	20	53	53
23	60	57	6	60	58	21	53	52
24	60	57	7	59	57	22	52	52
25	60	57	8	59	57	23	52	52
26	60	57	9	59	57	24	52	51
27	61	58	10	59	57	25	51	51
28	61	58	11	59	57	26	51	51
29	61	58	12	59	57	27	50	50
30	60	57	13	59	57	28	50	50
			14	60	60	29	49	49
Oct. 1	60	57	15	60	60	30	49	49
2	60	57	16	60	60	31	49	49
3	60	57	17	60	60			
4	60	57	18	60	60	1967		
5	60	57	19	60	60	Jan. 1	49	48
6	60	57	20	60	60	2	49	48
7	60	57	21	59	59	3	49	48
8	60	57	22	59	58	4	49	48
9	60	57	23	58	56	5	49	48
10	60	57	24	58	56	6	48	48
11	60	57	25	58	56	7	48	47
12	60	57	26	58	56	8	48	47
13	59	56	27	58	56	9	48	46
14	59	56	28	58	56	10	48	48
15	59	56	29	58	58	11	48	48

APPENDIX B (Continued)

Date 1967		Max.	Min.	Date		Max.	Min.	Date		Max.	Min.
Jan.	12	48	46	Feb.	26	49	48	Apr.	11	50	50
	13	48	47		27	49	47		12	50	50
	14	48	48		28	49	47		13	50	50
	15	48	48						14	50	50
	16	48	48	Mar.	1	49	47		15	50	50
	17	48	48		2	49	47		16	50	50
	18	48	48		3	49	47		17	50	49
	19	48	48		4	49	47		18	50	49
	20	48	48		5	49	47		19	50	49
	21	48	48		6	49	47		20	50	49
	22	48	48		7	49	47		21	50	50
	23	48	48		8	49	47		22	50	50
	24	48	48		9	49	47		23	50	50
	25	48	48		10	48	48		24	50	50
	26	48	48		11	48	48		25	50	50
	27	48	48		12	49	49		26	50	50
	28	48	48		13	49	49		27	50	50
	29	49	48		14	50	49		28	50	50
	30	49	49		15	52	50		29	50	49
	31	49	49		16	52	52		30	51	50
					17	52	52				
Feb.	1	49	48		18	52	52	May	1	51	50
	2	48	48		19	52	51		2	51	50
	3	48	48		20	52	51		3	51	50
	4	48	48		21	51	50		4	51	50
	5	48	48		22	50	50		5	51	50
	6	47	47		23	50	49		6	52	50
	7	47	47		24	50	49		7	52	51
	8	47	47		25	50	49		8	53	52
	9	47	47		26	50	49		9	52	51
	10	47	47		27	50	49		10	51	51
	11	47	47		28	50	49		11	51	51
	12	48	47		29	50	49		12	52	51
	13	49	48		30	51	50		13	53	51
	14	49	47		31	51	50		14	53	51
	15	47	47						15	53	51
	16	48	46	Apr.	1	50	50		16	54	52
	17	48	46		2	50	50		17	54	52
	18	49	47		3	50	50		18	54	52
	19	49	47		4	50	50		19	54	52
	20	49	47		5	50	50		20	54	53
	21	49	47		6	50	50		21	54	53
	22	49	47		7	50	50		22	55	53
	23	49	47		8	50	50		23	54	53
	24	48	48		9	50	50		24	54	53
	25	48	48		10	50	50		25	54	53

APPENDIX B (Continued)

Date 1967		Max.	Min.	Date		Max.	Min.	Date		Max.	Min.
May	26	54	52	June	11	56	54	June	21	57	55
	27	54	53		12	56	54		22	57	55
	28	54	52		13	56	54		23	57	55
	29	53	52		15	56	54		24	57	55
	30	54	53		15	56	54		25	57	55
	31	53	53		16	56	54		26	56	55
					17	56	54		27	57	56
June	1	53	52		18	55	54		28	58	56
	2	53	54		19	55	54		29	58	57
	3	53	53		20	56	54		30	58	56
	4	55	53								
	5	54	54								
	6	54	54								
	7	55	54								
	8	55	54								
	9	55	54								
	10	56	54								

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