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The Resources Agency
Department of Fish and Game
Region 2, Inland Fisheries

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MOKELUMNE RIVER FISH INSTALLATION
ANNUAL REPORT FOR 1969-70 SEASON^{1/}

by

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SUMMARY

This is the sixth annual report of the Mokelumne River Fish Installation. It covers the period of operation from July 1, 1969 to June 30, 1970.

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

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

From October 21 to December 7, 1969, 615 adult salmon were received at the Installation and 609 were placed in the spawning channel. By the end of the spawning season we had recovered 603 dead salmon from the channel of which 237 were females. From these an estimated 1,164,430 eggs were deposited in the gravel, and 497,130 young salmon were counted out of the channel and were planted. This is an egg-to-outmigrant survival of 42.7%. Pre-spawning mortality in the channel amounted to 77 female salmon.

No female salmon were artificially spawned this season.

One hundred thirty-four adult steelhead were received from December 28, 1969 to March 6, 1970. Fourteen females were spawned and resulted in 33,300 eggs collected. The average number of eggs per female was 2,379. An additional 300,810 steelhead eggs were received from Nimbus Hatchery, for a total of 334,110 eggs from the 1970 brood year.

From July 1, 1969, to January 31, 1970, 107,995 fingerling steelhead from the 1969 brood year were planted in the Mokelumne River. Then in the spring of 1970, an additional 122,822 yearlings were planted.

^{1/} Anadromous Fisheries Branch Administrative Report No. 71-16.
Submitted June 1971.

INTRODUCTION

This is the sixth annual report of the Mokelumne River Fish Installation and covers the period of operation from July 1, 1969 to June 30, 1970. The Installation was first operated on January 1, 1964. A summary of results of each year's salmon and steelhead operation is presented in Tables 1a and 1b.

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 river miles downstream from the dam, the Mokelumne River enters the San Joaquin River.

The Installation was constructed to compensate for the loss of fall-run king salmon and steelhead trout spawning area and rearing area which were inundated by Camanche Dam. The Installation is operated by the California Department of Fish and Game. East Bay Municipal Utility District paid construction costs and also pays the annual operating and maintenance costs.

DESCRIPTION OF INSTALLATION

A detailed description was given in the first annual report (Groh, 1965). A summary of the operation is as follows:

The Installation is made up of two parts: (1) a spawning channel for natural spawning and rearing of fall-run king salmon, and (2) hatchery and rearing pond 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 where they are mechanically lifted and deposited in a tank of anesthetic to be sorted and counted. From there, steelhead are placed in a holding tank, salmon are released into the spawning channel, and any 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. After a short time in the troughs, they are moved outside to rearing ponds. The fish are held for about one year and then released into the Mokelumne River. The hatchery and pond facilities have a capacity of 100,000 yearlings.

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 for spawning since the channel was first operated in the fall of 1964.

TABLE 1-a

King Salmon Spawning Channel Annual Summaries --
Mokelumne River Fish Installation 1964-65 through 1969-70 Seasons

Season	Number of females released in channel	Number female prespawning mortality	Potential number of eggs	Estimated egg deposition	Number of outmigrants	Estimated Percent Production	
						Of potential eggs	Of eggs deposited
1964-65	178	3	947,100	927,300	73,540	7.8	7.9
1965-66	33	1	157,043	150,883	76,435	48.7	50.6
1966-67	85	4	399,758	387,562	76,796	19.2	19.8
1967-68	93	0	490,186	487,220	177,542	36.2	36.4
1968-69	159	38	568,984	557,326	37,866	6.7	6.8
1969-70	314	77	1,183,953	1,164,430	497,130	42.0	42.7

TABLE 1-b

Steelhead Hatchery Annual Summaries --
Mokelumne River Fish Installation 1963-64 through 1969-70 Seasons

Season	Number native fish received	Number females spawned	Number eggs taken	Number eggs from Nimbus	Total eggs	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	163,280	92,520
1965-66	30	8	30,970	331,400	362,370	131,420	84,410
1966-67	17	3	13,524	164,600	178,125	94,520	74,630
1967-68	103	13	34,869	331,200	366,069	0	82,203
1968-69	24	4	25,580	301,240	326,820	125,760	101,207
1969-70	134	14	33,300	300,810	334,110	137,695	122,822

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

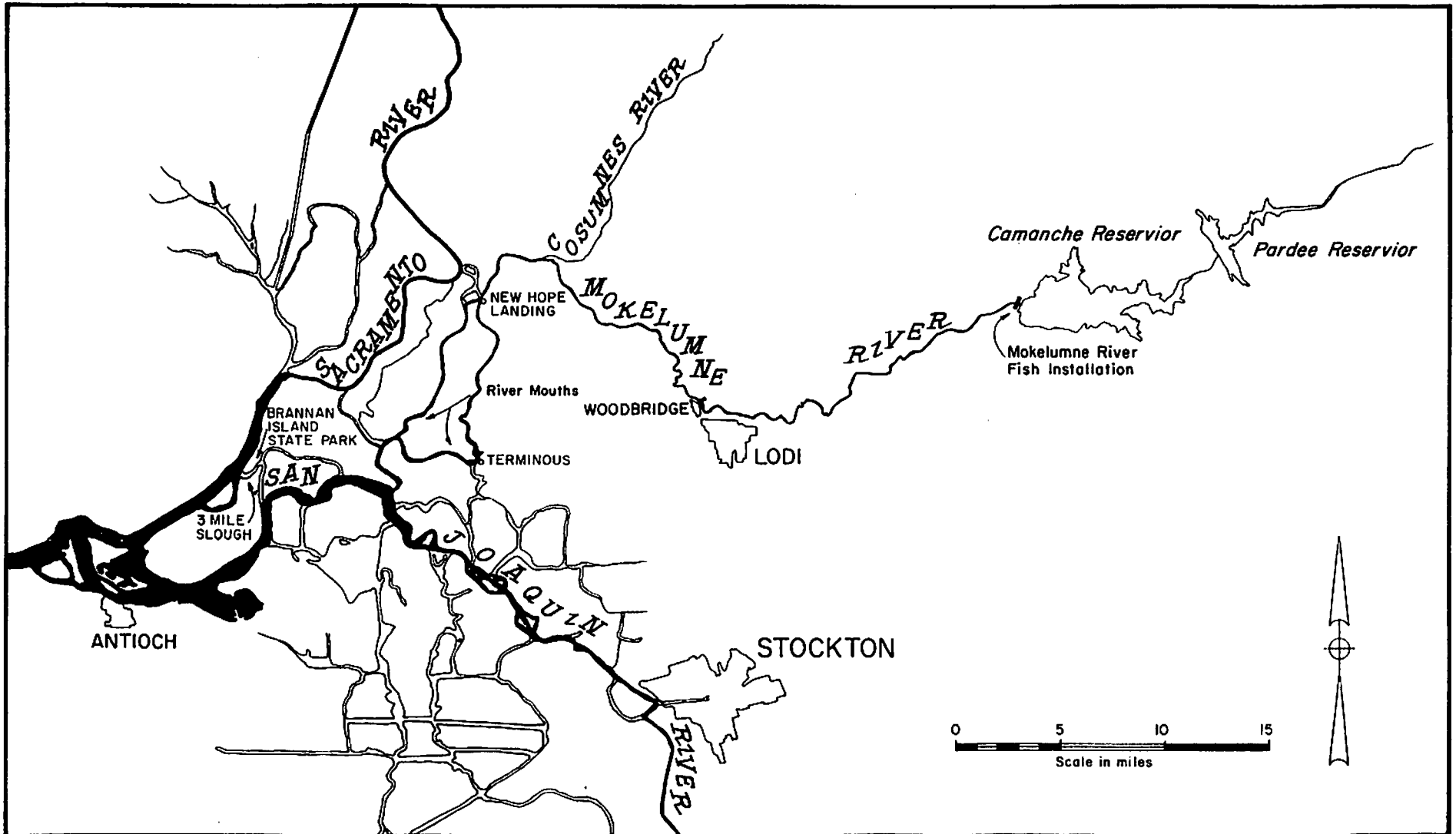


Figure 1. Map showing location of the Mokelumne River Fish Installation.

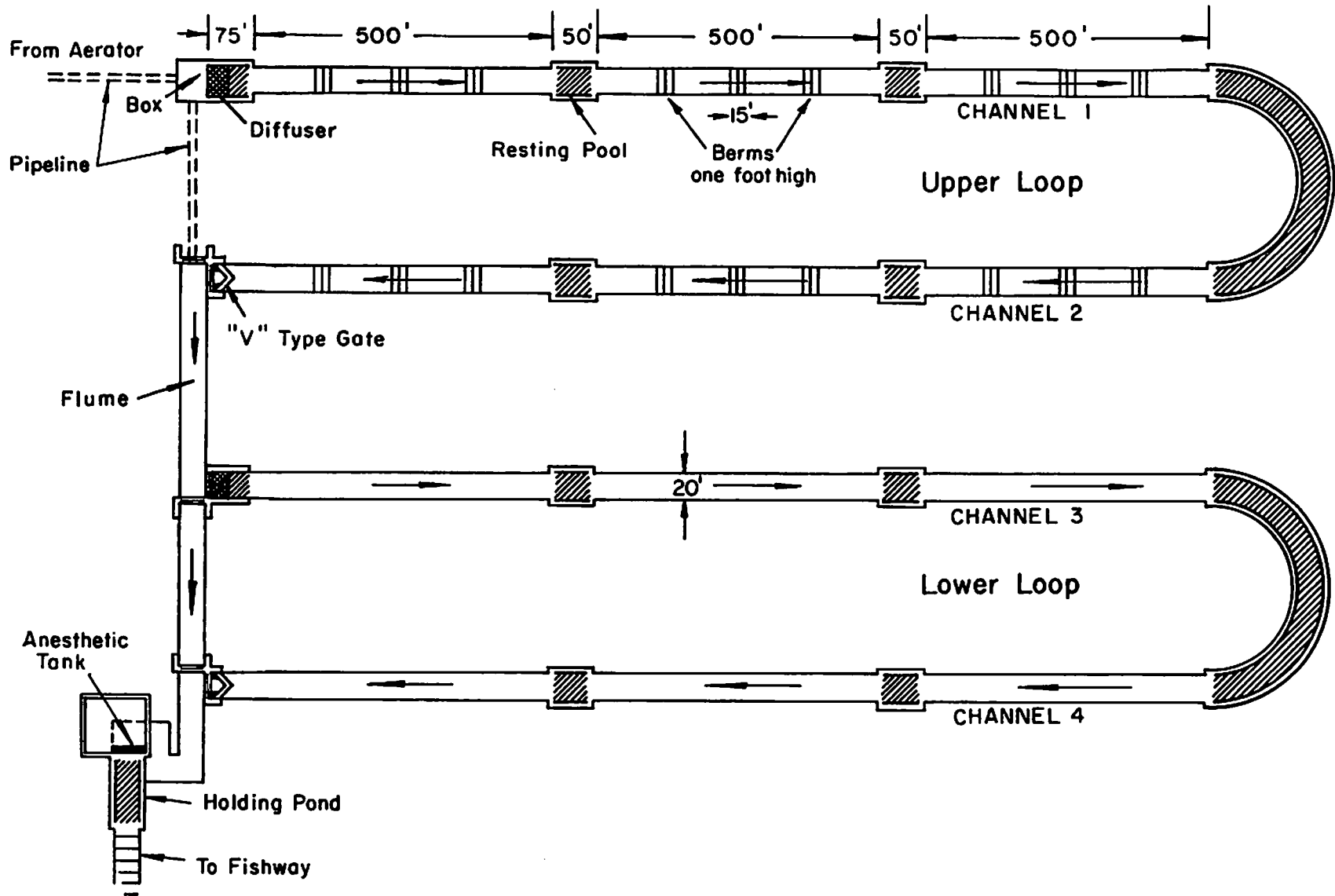


Figure 2. Diagram of the Mokelumne River Spawning Channel (not to scale).

Not enough adults have been available to warrant operating both loops. The channel is designed to operate during spawning at a flow of 69 cfs. At this flow the average depth is 1.5 feet and the average velocity 2 feet per second.

After spawning has been completed, water is allowed to flow through the lower loop and this section is then available for use by the young salmon. A migrant fish trap is installed at the end of channel four for enumeration purposes.

Aluminum bar racks, located between the holding pond and the flume leading to the spawning channel, prevent predator fish from entering the channel from the river. Another set of racks is located at the diffuser where water enters the channel to prevent predator fish from entering the channel from Camanche Lake and also to prevent escapement of out-migrant into the intake water supply.

KING SALMON MAINTENANCE PROGRAM

Spawning Season 1969 Brood Year

The spawning channel was in good condition at the start of the 1969 season; no gravel cleaning was required. The gravel berms that had been constructed for the 1968-69 season were rebuilt before the first fish was received. These berms are of uniform size, one foot higher in elevation than the channel bottom, perpendicular to the sides of the channel, 15 feet wide, and 150 feet apart. Their purpose is to curtail superimposition of redds.

On October 16, 1969, water was released into the spawning channel. The flow was maintained at 60 cfs throughout the spawning season.

Salmon were received at the Installation from October 21 through December 7, 1969. During this period 615 adult salmon were received and 609 were retained: 296 entered of their own volition and 319 were hauled from the trap at Woodbridge Dam. Of the ones entering of their own volition, 290 were placed in the spawning channel and each was given a cursory examination for marks, sex, and condition. Six surplus males were released back into the river. The fish that were hauled from Woodbridge Dam were unloaded directly into the spawning channel without being examined.

Carcass Recovery 1969 Brood Year

Dead salmon were removed on a daily basis. The majority were recovered near the V-trap at the lower end of channel two, and some were taken from the resting pools and the sides of the channel. Four females and thirteen males were taken from the water supply flume leading to the channel. It is doubtful that these fish had entered the channel and we are assuming that they had not. All carcasses were measured and cut open for examination. The condition of the gonads was recorded, and the eggs retained in each female were counted.

Of the 609 salmon retained in the spawning channel, 603 carcasses were recovered: 314 females, 265 males, and 24 of unidentifiable sex. Of the 314 females, 77 (24.5%) died without spawning. This loss was believed to consist primarily of fish trucked from Woodbridge Dam.

Estimated Egg Deposition 1969 Brood Year

Length-fecundity data for 18 females sampled in the 1966 run were 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 $\hat{y} = -4,983.99 + 350.24x$. This equation was applied to the 237 females that spawned in the channel and resulted in an estimated potential of 1,183,953 eggs (Appendix A). Subtracting the unspawned eggs (19,523)^{2/} gives a total estimate of 1,164,430 eggs deposited.

Downstream Migrant Production 1969 Brood Year

On December 5, 1969, the flow in the spawning channel was reduced to 15 cfs where it remained for the duration of the downstream migration season. Enumeration of voluntary outmigrants was accomplished by screening the entire flow at the end of channel four. The screen and trap used last year were used again this year.

The screen was provided with two four-inch diameter pipes which allowed fish to pass from the channel into the trap. These pipes were opened and closed depending on when or how many fish were to be trapped. Early in the migration season the pipes were left open and most of the fish were recycled back into the channel (Figure 3). We held the fish in the channel to determine the number that could be raised to the size of 90/lb (5.6/oz) by mid-summer, 1970 on natural feed. However, in late January it was evident from the poor growth rate that there were too many fish for the available food supply, so we started planting some of the fish in the river.

On March 7 the pipes were closed as it appeared that enough of the salmon had been removed so that the remaining fish would have adequate space and food to grow to 90/lb. On May 17 the pipes were opened again and left open for the remainder of the season and the fish were planted as they migrated out. At that time the average weight of fish was 128/lb (8/oz). By July 5 the fish had reached an average of 90/lb (5.6/oz).

Water to the channel was shut off on August 20 and the remaining fish seined out on August 22. During the season 497,130 migrants were counted out of the channel including 12,400 sac fry. There was no

^{2/} Includes only eggs left in the body cavities of those females which spawned.

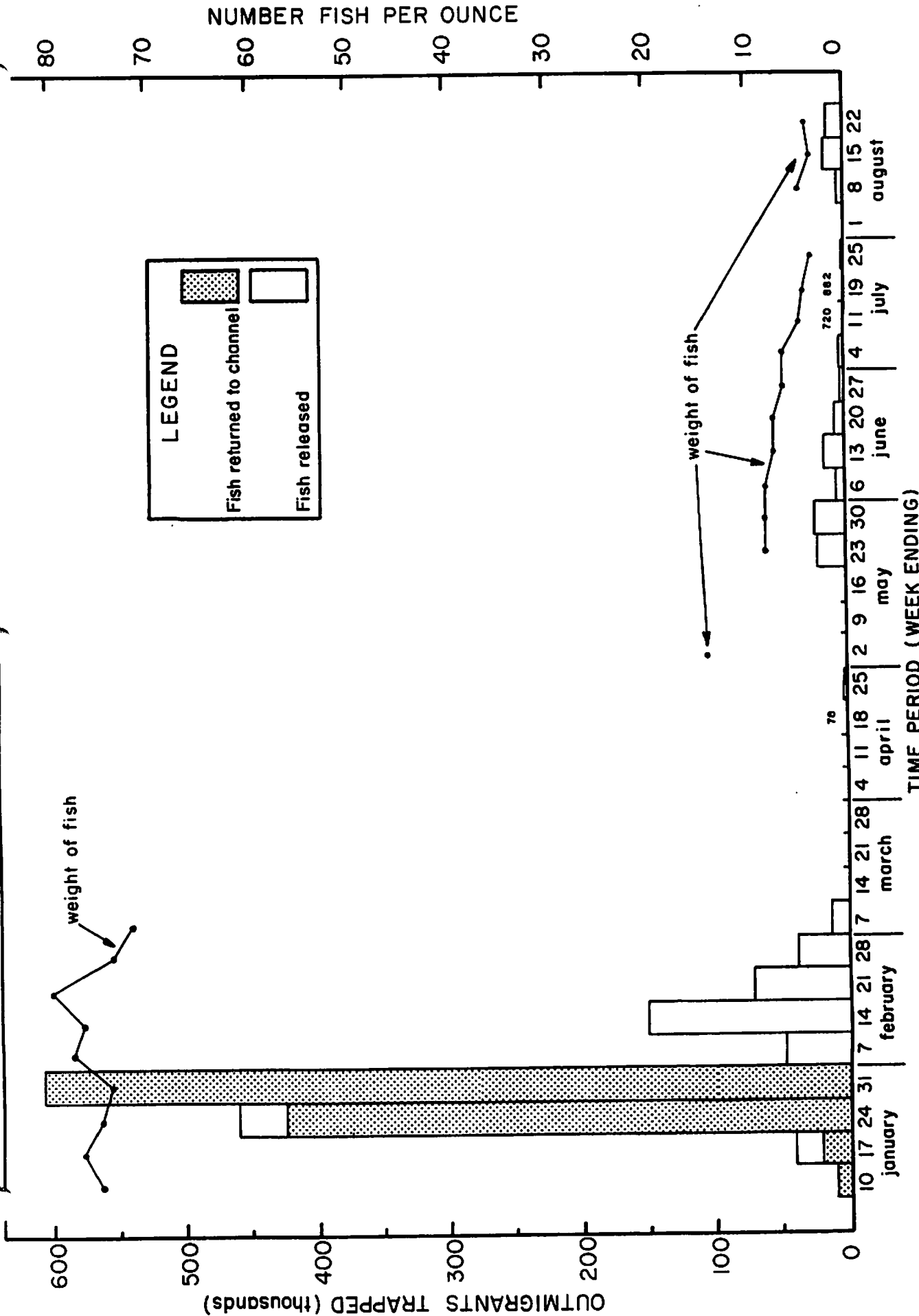


Figure 3. Number and average weights of king salmon leaving channel by weekly periods. Mokolunne River Spawning Channel 1969-70 season.

evidence this season of any mortalities from Sacramento River Chinook Disease and unknown causes. Thus the estimated deposited egg-to-outmigrant survival was 42.7%.

The outmigrants were planted in the Mokelumne River at two locations: (1) 383,163 about 1/4 mile downstream from the Installation and (2) 113,967 at New Hope Landing.

STEELHEAD MAINTENANCE PROGRAM

Hatchery Operation 1970 Brood Year

The first adult steelhead this season entered the Installation on December 28, 1969 and the last one on March 6, 1970. During this period 134 fish were received: 109 males and 25 females. The males averaged 15.8 inches and the females 16.0 inches fork length. Fourteen females were spawned and yielded 33,300 eggs, for an average of 2,379 eggs per female. Eleven females were too green to hold and were returned to the river unspawned. An additional 300,810 eggs were obtained from Nimbus Hatchery. This supplement was necessary to guarantee that at least 100,000 yearlings would be raised.

Planting 1969 Brood Year

As the steelhead from the 1969 brood year take of 326,820 eggs grew and the capacity of the ponds was reached, some of the fingerlings had to be removed. From July 1, 1969, to January 31, 1970, 107,995 surplus fingerlings were planted in the Mokelumne River and 29,700 were planted in Camanche Reservoir. In March of 1970, 122,822 steelhead yearlings were planted at several locations. Marks used and areas released are presented in the MARKING section. The objective of this experiment was to determine the best location for releasing yearling steelhead. Egg to planted fish survival of 1969 brood year steelhead was 79.7% (260,517 fish ÷ 326,820 eggs).

Disease

There were no significant disease problems affecting salmon or steelhead during this report period.

MARKING

Outmigrants

No formal marking of salmon was done during this report period.

The 29,700 fingerling steelhead of the 1969 brood year released into Camanche Reservoir were marked by removal of the right pectoral fin (RP). The 122,822 steelhead yearlings from the 1969 brood year, were marked and planted in the Mokelumne River as follows: (i) 35,100 LM in the Mokelumne River at Terminous; (ii) 42,922 LV and 980 Ad-LV in Three-Mile Slough at Brannan Island State Park, and (iii) 42,840 RV and 980 Ad-RV in the Mokelumne River at New Hope Landing.

Adult Recoveries

There were 14 marked adult salmon recoveries as follows: One LV from a release of 12,720 Mokelumne River Installation fingerlings of the 1967 brood year; one Ad-An mark from a release of 50,000 Feather River Hatchery fall-run yearlings of the 1967 brood year; and twelve Ad marks of unknown origin.

There were 36 adult marked steelhead recovered at the hatchery as follows:

Release Data

Mark	Origin	Brood year	Date	Area	Number	Size at release	Number recovered
Ad	Mokelumne Channel	1968	March 69	3-Mile Slough	22,579	6.7/lb	3
RV	"	"	"	New Hope Landing	37,677	8.2/lb	15
LV	"	"	"	3-Mile Slough	40,951	"	11
RM	Not known	Not determined	-	Unknown	-	-	7

STEELHEAD AGING

The ages and life histories of seven adult male steelhead were determined from scale samples. The findings are summarized in the following:

Number of fish	Fork length (inches)	Age	Life history
1	12.5	2	2 yrs. in freshwater
3	19.0	2	1 yr. freshwater, 1 yr. in the ocean
1	20.0	2	" "
1	21.0	3	2 yrs. freshwater, 1 yr. in the ocean
1	28.0	3	1 yr. freshwater, 2 yrs. in the ocean

WATER TEMPERATURES

Water temperatures were taken continuously throughout the period by means of a recording thermometer located near the entrance to the spawning channel. High water temperature reached 60° F in late August and persisted until late November; including therein the peak of the king salmon spawning season. Lows of 49° F were recorded in late January (Appendix B).

On April 6, 1970, the high-level outlet at Camanche Dam was put into operation and remained in operation until September 30, 1970. The purpose of this outlet is to release warm water from the surface of the lake during the summer so as to retain cooler water for release during the fall king salmon spawning season.

PUBLIC RELATIONS

During the 1969-70 fiscal year, as estimated 20,000 people visited the Installation. Tours of the Installation were conducted for many special interest groups.

REFERENCES

- Groh, Frederick H. 1965. Annual report Mokelumne River Fish Installation from January 1, 1964 to June 30, 1965. Calif. Dept. Fish and Game, Inland Fish. Admin. Rept. (65-21) :27 p. (mimeo).
- Groh, Frederick H., and R. S. Menchen. 1970. Mokelumne River Fish Installation annual report for 1965-66 season. Calif. Dept. Fish and Game, Anadromous Fish. Admin. Rept. (70-10) :18 p.
- Jewett, Philo F., and R. S. Menchen. 1970. Mokelumne River Fish Installation annual report for 1966-67 season. Calif. Dept. Fish and Game, Anadromous Fish. Admin. Rept. (70-12) :20 p.
- Jewett, Philo F. 1970. Mokelumne River Fish Installation annual report for 1967-68 season. Calif. Dept. Fish and Game, Anadromous Fish. Admin. Rept. (70-18) :17 p.
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APPENDIX A

Estimated Number of Eggs Contained in 237 Female Salmon
Using the Mokelumne River Spawning Channel in 1969-70 Season

Length inches	Estimated number of eggs per female based on length	Number of fish	Potential number of eggs contained in channel fish
22.5	2,896	1	2,896
23.0	3,072	5	15,360
24.0	3,422	6	20,532
24.5	3,597	1	3,597
25.0	3,772	13	49,036
26.0	4,122	16	65,952
26.5	4,297	2	8,594
27.0	4,472	25	111,800
27.5	4,648	4	18,592
28.0	4,823	42	202,566
28.5	4,998	6	29,988
29.0	5,173	40	206,920
29.5	5,348	1	5,348
30.0	5,523	31	171,213
30.5	5,698	2	11,396
31.0	5,873	22	129,206
31.5	6,049	1	6,049
32.0	6,224	9	56,016
32.5	6,399	1	6,399
33.0	6,574	4	26,296
33.5	6,749	1	6,749
34.0	6,924	1	6,924
34.5	7,099	1	7,099
36.0	7,625	1	7,625
36.5	7,800	1	7,800
	TOTALS	237	1,183,953

APPENDIX B

Water Temperature Data at Mokelumne River
Fish Installation 1969-70 Season

Water Temperature (°F)

<u>Date</u>	<u>Max.</u>	<u>Min.</u>	<u>Date</u>	<u>Max.</u>	<u>Min.</u>	<u>Date</u>	<u>Max.</u>	<u>Min.</u>
1969			Aug. 10	58	58	Sept. 20	59	58
July 1	56	56	11	58	58	21	59	58
2	56	56	12	58	58	22	59	58
3	56	56	13	58	58	23	59	58
4	56	56	14	58	58	24	59	58
5	56	56	15	59	58	25	59	58
6	56	56	16	59	58	26	59	58
7	56	56	17	59	58	27	59	58
8	57	56	18	59	58	28	59	58
9	57	56	19	59	59	29	59	58
10	57	56	20	59	59	30	59	58
11	57	56	21	59	58	Oct. 1	59	58
12	57	56	22	59	58	2	59	58
13	58	57	23	59	58	3	59	58
14	58	57	24	59	58	4	59	58
15	58	57	25	59	58	5	59	58
16	58	57	26	59	58	6	59	58
17	58	57	27	59	58	7	59	58
18	58	57	28	59	58	8	58	58
19	58	57	29	59	58	9	58	58
20	58	57	30	59	58	10	59	58
21	58	57	31	60	58	11	59	58
22	58	57	Sept. 1	60	58	12	59	58
23	58	57	2	60	58	13	59	58
24	58	57	3	60	58	14	59	59
25	58	57	4	60	58	15	59	59
26	58	57	5	60	58	16	59	59
27	58	57	6	60	58	17	59	59
28	58	57	7	60	58	18	59	59
29	58	57	8	60	58	19	59	59
30	58	57	9	60	58	20	60	59
31	58	57	10	60	58	21	60	59
Aug. 1	58	57	11	60	58	22	60	59
2	58	57	12	60	58	23	60	59
3	58	58	13	60	58	24	60	59
4	58	58	14	60	58	25	60	69
5	58	58	15	59	58	26	60	59
6	58	58	16	59	58	27	60	59
7	58	58	17	59	58	28	60	59
8	58	58	18	59	58	29	60	59
9	58	58	19	59	58	30	60	59
						31	60	59

APPENDIX B (Continued)

Water Temperature Data at Mokelumne River
Fish Installation 1969-70 Season

Water Temperature (°F)

<u>Date</u>	<u>Max.</u>	<u>Min.</u>	<u>Date</u>	<u>Max.</u>	<u>Min.</u>	<u>Date</u>	<u>Max.</u>	<u>Min.</u>
1969			Dec. 11	55	55	Jan. 20	51	50
Nov. 1	60	59	12	55	55	21	51	50
2	60	59	13	55	54	22	50	49
3	60	59	14	54	54	23	50	49
4	60	59	15	54	54	24	51	50
5	59	59	16	54	54	25	50	50
6	59	59	17	54	54	26	50	50
7	60	59	18	54	54	27	51	50
8	60	59	19	54	54	28	50	50
9	60	59	20	54	54	29	50	50
10	60	60	21	54	54	30	50	50
11	60	60	22	54	54	31	50	50
12	60	59	23	54	54	Feb. 1	50	50
13	60	59	24	54	54	2	50	50
14	60	59	25	54	53	3	50	50
15	60	59	26	54	53	4	50	50
16	60	59	27	54	53	5	50	50
17	60	59	28	54	53	6	50	50
18	60	59	29	53	52	7	50	50
19	60	59	30	53	52	8	50	49
20	59	58	31	53	52	9	50	50
21	59	58				10	50	50
22	59	58	1970			11	50	50
23	59	58	Jan. 1	52	51	12	49	49
24	59	58	2	52	51	13	50	50
25	59	58	3	52	51	14	50	49
26	58	57	4	52	50	15	50	49
27	58	57	5	52	51	16	50	49
28	58	57	6	52	51	17	50	49
29	58	57	7	52	51	18	50	49
30	58	56	8	51	51	19	50	49
Dec. 1	58	56	9	52	51	20	50	49
2	58	56	10	51	51	21	49	49
3	58	56	11	51	50	22	50	50
4	58	56	12	51	51	23	50	50
5	58	56	13	51	51	24	50	50
6	58	56	14	51	50	25	50	49
7	56	56	15	50	50	26	50	49
8	56	56	16	51	51	27	50	50
9	56	56	17	52	51	28	50	50
10	55	55	18	51	50			
			19	51	50			

APPENDIX B (Continued)

Water Temperature Data at Mokelumne River
Fish Installation 1969-70 Season

Water Temperature (°F)

<u>Date</u>	<u>Max.</u>	<u>Min.</u>	<u>Date</u>	<u>Max.</u>	<u>Min.</u>	<u>Date</u>	<u>Max.</u>	<u>Min.</u>
1970			11	51	50	22	53	52
Mar. 1	50	49	12	51	50	23	53	52
2	50	49	13	51	50	24	53	52
3	50	49	14	51	50	25	53	52
4	50	49	15	51	50	26	53	52
5	50	49	16	51	50	27	53	52
6	50	49	17	51	50	28	53	52
7	50	49	18	51	50	29	53	52
8	50	49	19	51	50	30	53	52
9	50	49	20	51	50	31	53	52
10	50	49	21	51	50	June 1	53	52
11	50	49	22	51	50	2	53	52
12	50	49	23	51	50	3	53	52
13	50	49	24	51	50	4	53	52
14	50	49	25	51	50	5	53	52
15	50	49	26	51	50	6	53	52
16	50	49	27	51	50	7	53	52
17	50	49	28	51	50	8	53	52
18	50	49	29	51	50	9	53	52
19	50	49	30	51	50	10	53	52
20	50	49	31	51	50	11	53	52
21	50	49	May 1	51	50	12	53	52
22	50	49	2	51	50	13	53	52
23	50	49	3	52	51	14	53	52
24	50	50	4	52	51	15	53	52
25	50	50	5	52	51	16	53	52
26	50	50	6	52	51	17	53	52
27	50	50	7	52	51	18	54	53
28	50	50	8	52	51	19	54	53
29	50	50	9	52	51	20	54	53
30	50	49	10	52	51	21	54	53
31	51	50	11	52	51	22	54	53
Apr. 1	51	50	12	52	51	23	54	53
2	51	50	13	52	51	24	54	53
3	51	50	14	52	51	25	54	53
4	51	50	15	52	51	26	54	53
5	51	50	16	52	51	27	54	53
6	51	50	17	53	52	28	54	53
7	51	50	18	53	52	29	54	53
8	51	50	19	53	52	30	54	53
9	51	50	20	53	52			
10	51	50	21	53	52			