

State of California
The Resources Agency
Department of Fish and Game
Anadromous Fisheries Branch

MERCED RIVER KING (CHINOOK) SALMON SPAWNING CHANNEL
ANNUAL REPORT FOR 1970-71 SEASON^{1/}

by

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SUMMARY

This is the first annual report of the Merced River King Salmon Spawning Channel. It covers the period of operation from July 1, 1970, through June 30, 1971.

The channel was completed in the summer of 1970 and was first operated in the fall of that year. The purpose of the channel is to enhance the fall-run king salmon (Oncorhynchus tshawytscha) resource in the Merced River.

An estimated 152,722 salmon eggs were deposited in the gravel, and 59,127 juvenile salmon were estimated to have migrated from the channel. This is an egg-to-outmigrant survival of 38.7%. About 30,000 of the late migrants were trucked to Antioch.

A rearing pond for raising salmon to yearling size went into operation on April 26 when more than 100,000 Stanislaus River fingerlings were transferred to the pond from Moccasin Creek Hatchery.

King salmon production data of the Merced River Spawning Channel are as follows:

Number carcasses recovered from channel	Estimated females in channel	Female prespawning mortality	Estimated egg deposition	Estimated outmigrants	Yearlings on hand June 30, 1971
83	40	2	152,722	59,127	100,000

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INTRODUCTION

The Merced River Spawning Channel was built by the Merced Irrigation District (MID) with part of the Davis-Grunsky Act funds received by the District for recreation and fish enhancement. The Davis-Grunsky Act contract is between the California Department of Water Resources and the District. The channel is operated by the California Department of Fish and Game with operating assistance and maintenance costs provided by the District.

The channel is provided as a natural spawning facility for fall-run king salmon. It had been completed, except for tail screens, in time for use by the 1970 fall spawning run. This is the first annual report for this facility; it covers the period of operation from July 1, 1970, through June 30, 1971.

LOCATION

The spawning channel is immediately downstream from the Crocker-Huffman Dam on the Merced River, a tributary to the San Joaquin River, about 15 miles northeast of Merced (Figure 1). The channel is at the upper end of salmon migration in the Merced River.

PURPOSE

The purpose is to rebuild the king salmon resource in the Merced River. Salmon had all but vanished from the river during the mid-1960's chiefly because of very low flows during the salmon spawning seasons. A contributing factor was the limited amount of spawning gravel. Under the Davis-Grunsky grant, MID guarantees to release between 180 and 220 cfs flow in the river from November to April. The channel is to enhance the river population by providing additional spawning area.

DESCRIPTION OF THE SPAWNING CHANNEL

The spawning channel is made up of one loop containing spawning sections and resting pools (Figure 2). Fish enter the channel through a three-step fishway leading from the river.

Water is supplied directly from the reservoir backed up by Crocker-Huffman Dam. It enters the channel through two flumes leading into a diffusion chamber, which is provided to distribute the water evenly across the channel. It wells up with vertical velocity of 1/2 ft/sec. Diffusers discourage fish from jumping and injuring or tiring themselves.

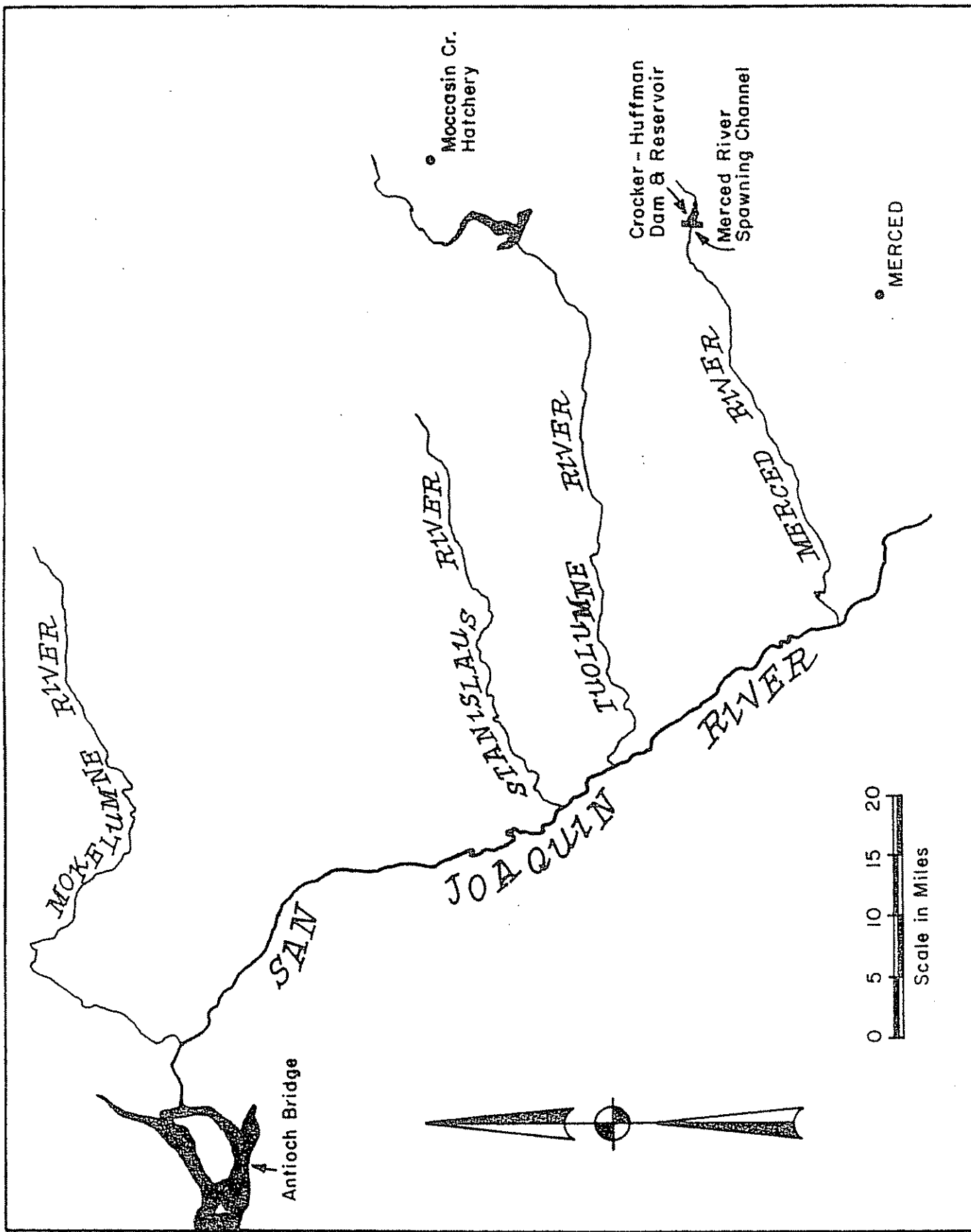


Figure 1. Map showing location of Merced River Spawning Channel.

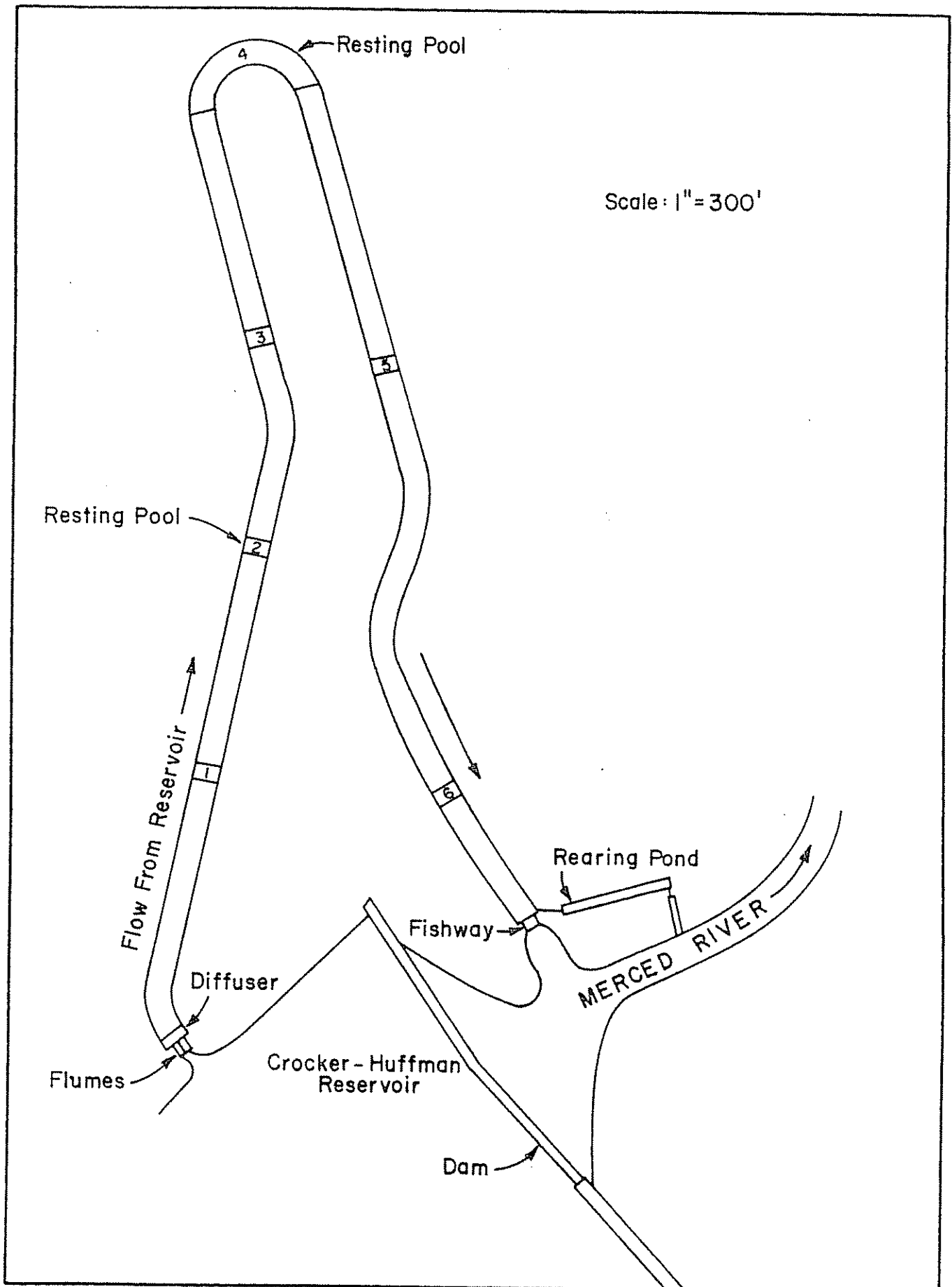


Figure 2. Merced River Spawning Channel

Two water intake gates, located in the headworks, are regulated by an automatic guage height recorder, which is about 200 ft downchannel. This device is used to keep the amount of water desired flowing through the channel at all times. A perforated plate screen is installed at the upper end after spawning is completed. This screen prevents young salmon from leaving the channel at the upper end, and also prevents predator fish from entering the channel from the reservoir. A similar screen will be installed at the lower end of the channel.

A gravel rearing pond is provided at the channel site (Figure 2). Water enters the pond from the channel through a perforated pipe buried in the gravel at the lower end of the channel. Flow through the pond is regulated by a valve at the entrance and another at the exit. The pond is to be used to rear 100,000 salmon to yearling size before releasing them in the Merced River. This pond rearing program is planned for 9 years beginning with 1969 brood-year fish.

The specifications of the Merced River Spawning Channel and the rearing pond are as follows:

- 1) Total length of channel = 4,372 ft. This includes everything from the head gates to the fishway as measured along inside perimeter.
- 2) One loop with 3,830 lineal ft of spawning gravel and 460 lineal ft of resting pool.
- 3) Bottom width = 63 ft.
- 4) Side slope = 2 to 1.
- 5) Channel gradient = 0.0008.
- 6) Side slope in pools = 2 to 1.
- 7) End slope in pools = 1-1/2 to 1.
- 8) Depth of water in resting pools at spawning flow = 4.5 ft.
- 9) Spawning gravel size: Sieve size was maximum of 5 inches and minimum of 3/4 inches. The material available in the surrounding area was used.
- 10) Depth of spawning gravel = 3 ft.
- 11) Spawning flow = 200 cfs.
- 12) Average velocity at 200 cfs = 2 ft/sec.
- 13) Average depth at 200 cfs = 1.5 ft.
- 14) Spawning gravel area = 241,900 ft².
- 15) King salmon spawning capacity = 12,000 (6,000 females).
- 16) Total drop for full length of channel = 6.4 ft (including an extra drop of 2.6 ft provided at the elbow in the channel so that it can be enlarged to an additional 500 ft of channel, if desired).
- 17) Rearing pond is 250 ft long by 15 ft wide.

KING SALMON PROGRAM

Spawning Season--1970 Brood Year

Water was released into the channel on October 20, 1970. The flow was maintained between 165 and 180 cfs throughout the spawning period. On January 5, 1971, the flow was reduced to 78 cfs where it was held until the outmigration was completed.

All salmon received in the channel came in of their own accord. No attempt was made to count the fish as they entered the channel. The number of spawners using the channel was estimated by recovering carcasses and counting redds.

Salmon began entering the channel as soon as it was filled with water. They continued to enter the channel with some degree of consistency through December 1. From then on, no fresh salmon were seen until December 20, when four fish were seen entering the channel. Only three fresh-run fish were known to have entered after this date.

In early November, after a number of salmon had been in the channel for awhile, a section of grill covering the diffuser was forced out by excessive water pressure. This allowed about 100 salmon to enter the reservoir above Crocker-Huffman Dam. Many of these fish were caught by fishermen, and a few spawned in the short section of river available to them above the channel.

During most of the spawning period a daily record was kept of redd construction in the channel. The bank was staked off in 50-ft intervals, and record sheets were kept of the location of all redds relative to the channel stakes.

This information will be used to identify unused spawning sections where minor manipulation of the gravel can be made to make them more attractive for spawning in future years.

Only a small amount of the channel gravel was used for spawning this season. The majority of spawners congregated in only five areas as follows:

- 1) between 200 and 240 ft downchannel from the diffuser,
- 2) between 10 and 30 ft downchannel from resting pool #1,
- 3) between 300 and 320 ft downchannel from resting pool #1,
- 4) between 370 and 410 ft downchannel from resting pool #3, and
- 5) between 60 and 100 ft downchannel from resting pool #6.

Superimposition of redds was not a serious problem this season because of the small number of spawners.

Carcass Recovery and Redd Count--1970 Brood Year

All carcasses were not recovered from the channel this season for two reasons: (1) carcass recovery did not start until November 21 and by that time some of them had disappeared, and (2) some carcasses may have drifted out of the channel into the river.

After November 21, the channel was surveyed its full length almost every day until the end of the spawning season to recover as many carcasses as was possible. Many of the carcasses were recovered from

the bottoms of the resting pools and some along the edges of riffle areas. The ones in the riffles were recovered on foot; the ones in the pools were recovered from a small boat while drifting down the channel. All carcasses were measured and cut open for examination. Condition of the gonads was recorded, and the number of eggs retained in the females was counted.

Eighty-three carcasses were recovered from the channel, of which 59 were males and 24 were females. Of the females recovered, 2 had died without spawning. The number of eggs left in the body cavities of the 22 fish that spawned was 2,046. The range/fish was from 0 to 842 with a mean of 93 eggs/female.

Based on carcass recovery and redd count, I estimated that 38 females spawned in the channel.

To estimate the number of eggs left in the body cavity of these fish, I multiplied 38 by 93 (average number unspawned eggs/fish), which gives 3,534 eggs unspawned.

Estimated Egg Deposition--1970 Brood Year

No information is available on the fecundity of Merced River salmon. The closest salmon stream in the Central Valley where these data are available is the Mokelumne River. I applied length-fecundity data from 18 females sampled in the Mokelumne in 1966 to the 38 females which used the Merced channel in 1970. The 22 females recovered were measured and the average size was found to be 25.97 inches FL. I assume the 16 females not recovered averaged the same length.

The Mokelumne River data had been 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 estimated average size (25.97 inches FL) of the 38 females that spawned in the Merced channel and resulted in an estimated average of 4,112 eggs/female. When multiplied by 38 this average gives an estimated potential deposition of 156,256 eggs. Subtracting the unspawned eggs (3,534) gives an adjusted estimate of 152,722 eggs deposited.

Downstream Migrant Production--1970 Brood Year

A downstream migrant screen and trap was not completed in time to be used this season for enumeration of outmigrants. To accomplish this task, a 6'x9'x60' "funnel type" net was anchored to the bottom of the 40-foot wide channel outlet, just above where the water from the channel enters the river. A live box was attached to the cod end. The net was fished almost continuously from January 22 to May 10, 1971, and then on a limited basis until it was removed for the season on June 3. A few fish migrated out of the channel prior to and following termination of netting operations.

All salmon captured in the net in good condition were marked and released back into the channel except for some that were trucked to Antioch. The ratio of marked-to-unmarked fish captured in the live box was used to estimate numbers of outmigrants.

The overall proportion of marked fish recovered (net efficiency) was 0.1877. I divided this figure into the weekly numbers of unmarked fish captured to obtain weekly and total outmigration estimates (Table 1).

The peak of migration occurred during the week of March 12-18. I estimate that 29,127 fingerling salmon migrated from the channel while the net was in operation.

Early in the season, all fish captured in the net were released in the river at the channel site. By mid-April the flow in the Merced River was too low to expect juvenile salmon to make a safe journey to the sea. It was evident that conditions would not improve so I decided to truck all fish captured in the net to the Delta. Starting on April 15, trapped fish were held in a live box in the channel. They were accumulated for one week at a time and trucked to a release point near the Antioch Bridge. After the second week, however, it was evident outmigrant trapping and trucking was not a paying proposition. From April 15 to May 4, a total of 432 fish was trucked.

On May 10, personnel from Region 4 and AFB seined an estimated 30,000 salmon fingerlings averaging 100/lb from the channel. They were hauled in a 600-gallon tank truck and released at the Antioch Bridge. All fish could not be removed from the channel because thick mats of algae reduced efficiency of the seining operation.

The sampling net was removed on May 10 when the water was shut off for the seining operation. It was replaced again on May 18 and finally removed for the season on June 3.

For the season, I can account for an estimated 59,127 salmon outmigrants (29,127 estimated based on mark recoveries in the sampling net, plus 30,000 that were seined), which is 38.7% of the estimated number of eggs deposited in the gravel. This is a minimal figure because some migration took place before the net was installed and some fish remained in the channel after the net was removed. The only fingerling mortality observed this season was a very small loss (165 fish) from handling during the netting operation.

Growth rate of outmigrants was determined by measuring a random sample of fish once each week (Table 2). Weekly measurements were taken beginning March 1-7. At this time the fish averaged 39 mm FL. In early June, the average length had increased to 86 mm; by the week of April 19-25 the average size was 76 mm. No weight samples were taken. Based on known weight and length relationships, fish averaging 76 mm would number about 90/lb.

Table 1

Estimated Numbers of Outmigrants Based on
Mark Recoveries, Merced River Spawning Channel 1970-71 Season

Week	Catch of unmarked fish	Fish marked	Marked fish recovered	Days sampled	Estimated migration on days sampled	Estimated migration based on 7 days
Jan. 22-28	57	28	0	7	304	304
Jan. 29- Feb. 4	289	267	65	7	1,540	1,540
Feb. 5-11	66	61	14	7	352	352
Feb. 12-18	385	363	76	7	2,051	2,051
Feb. 19-25	674	652	115	7	3,591	3,591
Feb. 26- Mar. 4	602	575	77	7	3,207	3,207
Mar. 5-11	729	711	113	7	3,884	3,884
Mar. 12-18	889	865	205	7	4,736	4,736
Mar. 19-25	253	238	52	6	1,348	1,573
Mar. 26- Apr. 1	282	272	49	7	1,502	1,502
Apr. 2-8	138	128	8	6	735	858
Apr. 9-15	129	64	11	4	687	1,202
Apr. 16-22	41	0	0	3	218	509
Apr. 23-29	179	38	8	7	954	954
Apr. 30- May 6	316	75	0	7	1,684	1,684
May 7-13*	3	0	36	2	16	56
May 14-20	38	38	0	3	202	471
May 21-27	21	21	0	3	112	261
May 28- June 3 †	21	21	0	2	112	392
TOTALS	5,112	4,417	829		27,235	29,127

Note: Percent marked fish recovered = 18.77.

* Channel seined on May 11.

† Net removed for season on June 3.

Table 2
Lengths of Outmigrants Merced River
Spawning Channel 1970-71 Season

Week	Number of fish measured	Range		Mean Length	
		mm	<u>FL</u>	mm	<u>FL</u>
Mar. 1-7	82	31	59	39.27	
Mar. 8-14	84	31	68	38.31	
Mar. 15-21	225	32	79	55.35	
Mar. 22-28	87	33	75	55.39	
Mar. 29- Apr. 4	86	35	80	59.06	
Apr. 5-11	76	38	84	68.37	
Apr. 12-18	101	33	92	70.34	
Apr. 19-25	27	38	91	76.30	
Apr. 26- May 2	144	33	102	83.46	
May 3-9	78	57	105	83.97	
May 10-16	-	-	-	-	
May 17-23	38	54	100	81.84	
May 24-30	21	52	95	84.19	
June 1-7	21	76	97	85.86	

OTHER FISH IN CHANNEL

A few rainbow trout (Salmo gairdnerii) took up residence in the channel sometime during the season. They were able to enter the channel from the lower end by ascending the fish ladder, or from the upper end if they were small enough to go through a 1.5-inch spaced bar rack.

Most of the trout were removed from the channel throughout the season by fishing and seining. From these methods, 20 trout ranging in size from 9 to 14 inches were removed.

Some of the trout spawned in the channel. On February 22, juvenile rainbow trout began appearing in the net and continued appearing periodically until the trap was removed. This season 32 juvenile trout were collected. I also noticed a good number of fingerling trout mixed in with the catches of salmon when the channel was seined. No attempt was made to estimate total numbers of juvenile trout in the channel.

A few fish other than trout were removed from the channel during the seining operation. Adult Sacramento suckers (Catostomus occidentalis), a few small white catfish (Ictalurus catus), and some green sunfish (Lepomis cyanellus) included most of the species recovered. Total of all species not including trout was less than 30 in number.

SALMON ABOVE THE CHANNEL

As mentioned previously, a few adult salmon escaped to spawn in the river above the channel. The young from these fish moved downstream, but were prevented from entering the channel by the screen at the upper end. During the season, 844 fingerlings were removed from the screen--some dead and some alive. The ones that were not impinged on the screen occupied the area of the flume and diffuser at the headworks. Several thousand fingerlings were still there at the end of this report period.

WATER TEMPERATURE

Water temperature in the channel was taken twice daily (morning and evening) with a hand thermometer from November 20, 1970, until January 22, 1971. After this period, a 30-day recording thermometer was installed at the head of the channel.

Water temperatures were about optimum for salmon production, most of the time. For the months of November through June, temperatures ranged from 59 to 48 F. On a monthly basis they were as follows:

<u>Month</u>	<u>Range F</u>
November	57 - 50
December	54 - 49
January	53 - 48
February	52 - 48
March	54 - 48
April	56 - 50
May	58 - 52
June	59 - 53

Water temperature in the channel usually varied only about 3 degrees during any 24-hour period and never exceeded 6 degrees.

REARING POND

The rearing pond, mentioned previously, was built as an off-channel facility where 100,000 salmon could be reared to yearling size. On April 26, more than 100,000 fingerlings salmon were transferred to the pond where they will be artificially fed and released in the river in late fall of 1971. These fish are the progeny of adults that were trapped and spawned in the Stanislaus River in the fall of 1970. The eggs were hatched at Moccasin Creek Hatchery.