State of California
The Resources Agency
DEPARTMENT OF FISH AND GAME

FISH POPULATION SURVEY, WALKER CREEK,

MARIN COUNTY, 1981

by

John W. Emig
Inland Fisheries, Region 3

Anadromous Fisheries Branch

Administrative Report No. 84-02

1984

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ABSTRACT

The fish populations of Walker Creek, Marin County, were surveyed by electro-fishing six 30-m sections in October 1981. The steelhead rainbow trout, Salmo gairdneri, population was estimated at 36,756 fish (observed biomass: 20.3 kg/ha). Most of these steelhead were less than 125 mm FL. Only five young-of-the-year coho salmon, Oncorhynchus kisutch, were found in the study sections, producing a population estimate of 875 fish (observed biomass: 0.4 kg/ha). California roach, Lavinia symmetricus, was the most common species, with an estimated population of 111,290 fish (observed biomass: 23.1 kg/ha). Threespine stickleback, Gasterosteus aculeatus, was found throughout the stream and was particularly abundant at two of the study sections. The estimated population of stickleback was 34,627 fish (observed biomass: 1.3 kg/ha). Sculpins, Cottus spp., were estimated to number 11,983 fish (observed biomass: 6.7 kg/ha). while Pacific lamprey ammocoetes Lampetra tridentata, numbered 8,874 (observed biomass: 1.4 kg/ha). One bluegill, Lepomis macrochirus, and one mosguitofish, Gambusia affinis, were collected.

Although the juvenile salmonid population was greater than that found prior to enhancement flow releases from Soulajule Reservoir, it was much less than anticipated. Increased summer flow releases appear to have helped improve the habitat for salmonids, however, these releases should be made as specified in the agreement between the Department and the Marin Municipal Water District.

Sediment problems resulting from poor land use practices appear to be limiting salmonid production. Therefore, I recommend that riparian vegetation be established and other erosion control measures be initiated in the Walker Creek drainage. Additionally, coho salmon smolts should be planted annually to establish a run in Walker Creek. Stocking should take place in March when water temperatures are low so that smolt survival will be optimal. Fish populations should be monitored annually to evaluate the success of improved streamflow releases and erosion control measures.

Specific survey data for each of the six stations samples are filed by the Department of Fish and Game, Region 3 Headquarters, 7329 Silverado Trail, Napa, California 94558.

1/ Anadromous Fisheries Branch Administrative Report No. ____ Submitted _____

INTRODUCTION

The fish populations of Walker Creek, Marin County, were surveyed in October 1981, in an effort to estimate fish populations produced as a result of enhancement flows released from Soulajule Reservoir in the upper drainage.

Walker Creek, a tributary of Tomales Bay in northern Marin County (Figure 1) , historically had excellent spawning populations of coho salmon and steelhead trout. These species have declined substantially due to reduced summer flows and erosion resulting from overgrazing (Kelley 1976). The production of juvenile salmonids was limited by the amount and quality of available rearing habitat (Kelley and Reineck 1978).

An opportunity to restore the salmon and steelhead runs developed with construction of Soulajule Reservoir by the Marin Municipal Water District (MMWD) in 1979. Runoff stored in the reservoir was needed to augment the MMWD supply only during dry periods and, therefore, the storage could be used to provide suitable spawning and rearing flows in Walker Creek in most years. An agreement was entered between MMWD and the Department of Fish and Game (DFG) on August 24, 1976, which provided for maintaining winter flows of 20 cfs in normal years (63% of years) and 10 cfs in dry years (11% of years), summer flows of 5 cfs in normal years and 2 cfs in dry years. In critically dry years (26% of years) the flow release was to be maintained at 0.5 cfs year-round. The DFG agreed to stock 18,300 yearling coho salmon each year for three consecutive years to reestablish this species in the stream, and to maintain the population by stocking the same number following critical dry years. It was estimated that the project would restore spawning runs averaging 400 to 600 salmon and 300 to 600 steelhead annually. The ocean commercial catch would be increased by 10,000 lb of salmon annually, and about 700 adult salmon and 400 steelhead would be available to the sport fishery in Tomales Bay and lower Walker Creek. The salmon would produce 1,000 angler days of recreation and the steelhead would support 2;000 angler days (Kelley 1976; Fullerton 1977). As reimbursement for the enhancement features of the Soulajule Project, MMWD was awarded a grant of $400,000 under the Davis-Grunsky Act by the California Water Commission (Resolution No. 80-09).

On April 3, 1979, 15,300 coho salmon smolts were planted and on May 8, 1980, 18,363 coho weighing 1,625 lb were stocked. High water temperatures of the stream and poor conditions of the fish resulted in excessive mortality of the second stocking, and returns will probably be negligible. Because of limited supplies of coho salmon eggs, no further plants have been made.

METHODS

Six stations were selected on Walker Creek for the population survey (Figure 1). Stations 2 through 6 were in the areas studied by Kelley (1976) in developing his analysis of the steelhead and coho salmon populations in Walker Creek. Stations 1, 4, and 6 were also the approximate sites studied by Kelley and Reineck (1978) to assess the relation between streamflow and salmonid rearing habitat. Comparison with these studies was the primary criteria for study site selection.

The survey method used was the same as reported by Price and Geary (1979) for fish population estimates of streams in the Big Sulphur Creek drainage, Sonoma County. Each station consisted of a 30-m section of stream which was measured and

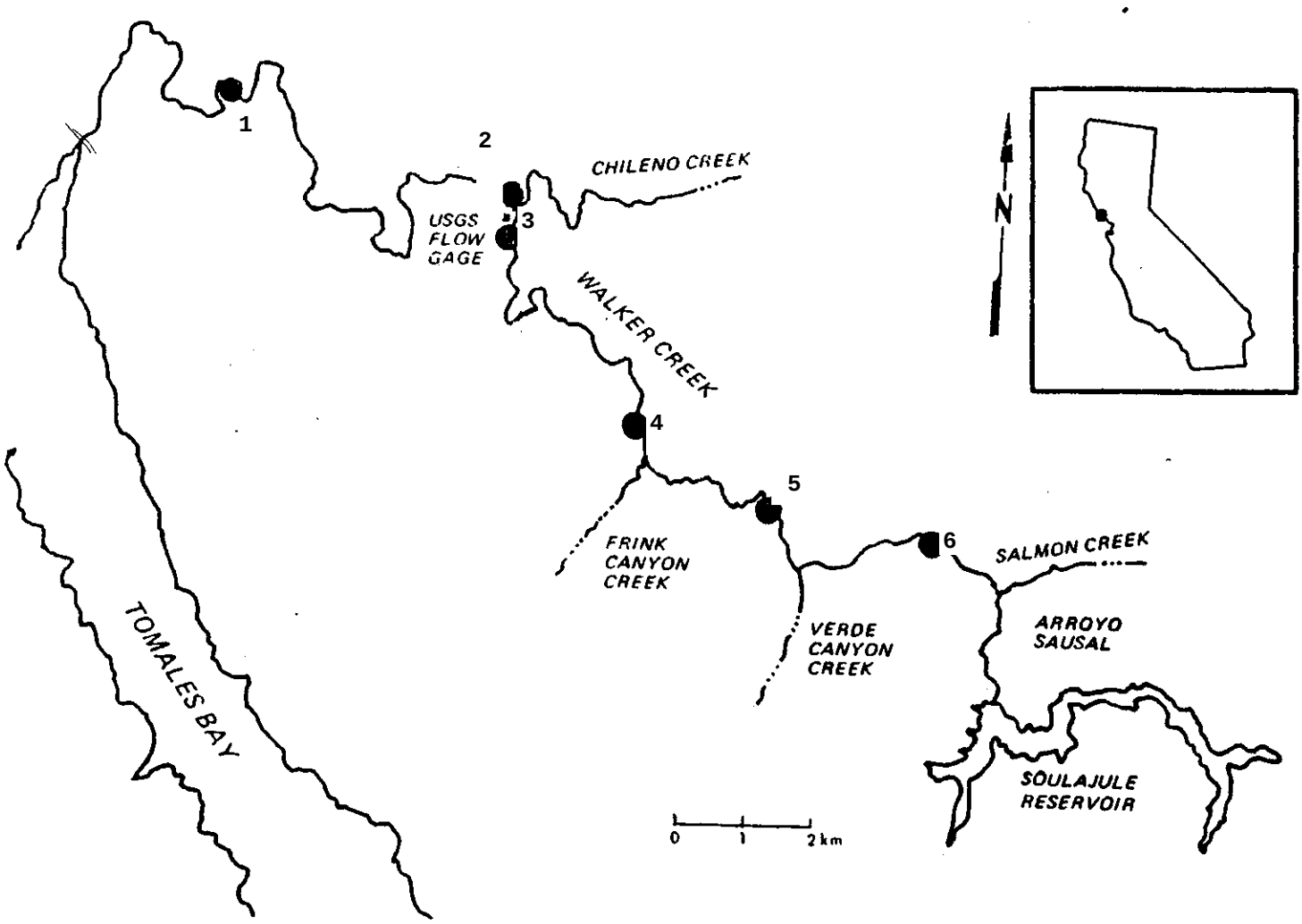

FIGURE 1. Fish sampling stations, Walker Creek, Marin County, October, 1981. Map adapted from Kelley (1976)

blocked with 6 mm square mesh stop nets. Within a given area, the stations were selected to include representative habitats. For example, if the area had both pools and riffles, the station was delineated to include each of these habitats in approximately the same proportion as found in the area. After placement of the stop nets, measurements were made of temperature, dissolved oxygen, conductivity, and pH. A water sample was collected for turbidity analysis in the laboratory.

Following collection of water quality data, a back-pack electrofishing unit (Smith-Root Type 7) was used to sample the fish population. Each pass was made through the station by beginning at the downstream net and working upstream. The collected fish were identified, counted, and weights were taken by volumetric displacement. Fork length (FL) measurements were made of all steelhead and salmon, and of a sample of the nongame species. A second pass was made with approximately the same effort as the first, pass. If the total number of fish taken on the second pass exceeded the maximum necessary for estimating the population within 10% with a 95% confidence interval, a third pass was made. The population of each species was estimated by one of three methods: (i) summing the totals of the passes, (ii) the method of Seber and LeCren (1967) for two-pass stations, or (iii) the Leslie method (Ricker 1975) for three-pass stations.

After electrofishing, stream widths and depths were measured to characterize the stream habitat. Width measurements were made perpendicular to the flow at each 3-m along the length of the station. At each width transect, the stream depth was measured at the quarter, half, and three-quarter points. Cover, streamflow, streambed composition, the pool-riffle-run ratio, and canopy were estimated. Records of streamflow measurements on the sampling dates were supplied by the U.S. Geological Survey, Santa Rosa, from a flow measuring gauge maintained on Walker Creek just above the junction with Chileno Creek. Station elevations were determined with topographic maps. Photos were taken to record each station.

A more detailed description of the sampling methodology is presented by Price and Geary (1979).

RESULTS

In addition to steelhead and coho salmon, Walker Creek contained Pacific lamprey, California roach, threespine stickleback, sculpins, mosquitofish, and bluegill. All except mosquitofish and bluegill are common residents of coastal streams in California. Only one each of these two species were found; they probably entered the stream with flood flows from Soulajule Reservoir or farm ponds in the drainages. Sculpin were difficult to identify, and this group was not separated by species.

Steelhead Rainbow Trout

The steelhead population was estimated at 36,756 fish (Table 1). This species was the second most common in numbers and was also second in total biomass (341 kg). The observed biomass was 20.3 kg/ha (Table 2).

Steelhead populations ranged from 11 at Station 1 to 93 at Station 4. Stations 2, 3, and 4 had the greatest numbers of steelhead as well as the greatest biomass.

TABLE 1. Fish Population Report, Walker Creek, Marin County, October 1981.

Species	Station Population Estimated						Mean	SD	Total Population		
	1	2	3	4	5	6			(1)	(2)	(3)
Pacific Lamprey	13	2	17	23	9	6	12	8	8,784	4%	9,149
Coho salmon	0	0	6	0	0	1	1	2	875	0%	791
Rainbow trout	11	74	84	93	12	21	49	38	36,756	18%	34,346
California roach	40	14	90	392	252	102	148	145	111,290	54%	124,478
Mosquitofish	1	0	0	0	0	0	0	0	125	0%	135
Threespine	117	1	2	8	149	0	46	68	34,627	17%	43,719
Bluegill	1	0	0	0	0	0	0	0	125	0%	135
Sculpin	31	8	46	1	1	9	16	18	11,983	6%	11,503
									204,565		224,256

Stream length: 22,526 m

(1) Based on station population estimates.
(2) Species composition based on (1).
(3) Based on population density.

TABLE 2. Fish Biomass Report, Walker Creek, Marin County, October 1981

Species	Station Densities						Mean	SD	Total biomass	
	1	2	3	4	5	6				
Pacific lamprey	2.1	0.1	1.6	2.8	0.9	1.0	1.4	1.0	22	3%
Coho salmon	0.0	0.0	1.7	0.0	0.0	0.5	0.4	0.7	6	1%
Rainbow trout	5.9	34.6	21.4	29.8	19.1	11.2	20.3	10.9	341	40%
California roach	1.8	3.8	12.4	71.4	24.0	25.1	23.1	25.6	352	41%
Mosquitofish	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0%
Threespine	2.8	0.0	0.2	0.7	3.8	0.0	1.3	1.6	17	2%
Bluegill	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.1	1	0%
Sculpin	9.9	7.3	17.3	0.2	2.0	3.5	6.7	6.3	115	14%
									854	

Total biomass calculated from biomass captured.
Stream length: 22,526 m

Steelhead juveniles had a mean length of 84.2 mm FL (Table 3) . The larger fish were concentrated at Stations 2 and 3 near the mouth of Chileno Creek. A length histogram indicates a peak at 70 mm FL (Figure 2) and probably most young-of-the-year were less than 100 mm FL.

Coho Salmon

Few coho salmon were collected. Four were taken at Station 3 and one at Station 6. The total population was estimated at 875 fish, and the observed biomass was 6 kg (0.4 kg/ha). The mean fork length was 90.8 mm.

Other Species

California roach were the most abundant species (111,290), but barely exceeded steelhead in observed biomass (352 kg; 23.1 kg/ha). Fork lengths ranged from 28 to 113 mm, and averaged 58.8 mm.

Threespine stickleback, another common nongame species, were found primarily at Stations 1 and 5. Total population was estimated at 34,627 but observed biomass was only 17 kg (1.3 kg/ha). Fork lengths ranged from 29 to 52 mm (mean = 38.0 mm) .

Sculpin were found throughout the stream, but populations were concentrated at stations in lower reaches. Although fourth in numbers (11,983), they were third in observed biomass (115 kg; 6.7 kg/ha). Fork lengths ranged from 52 to 153 mm, with a mean of 99.0 mm.

Pacific lamprey occurred at every station. The total population was estimated at 8,784 ammocoetes and observed biomass was 22 kg (1.4 kg/ha). Lengths ranged from 59 to 135 mm, with a mean of 101.1 mm.

Only one mosquitofish and one bluegill were collected, both at Station 1 in the area just above tidewater. They are not common residents of Walker Creek.

WALKER CREEK FLOW, 1981 WATER YEAR

Stream discharges were recorded at the USGS Chileno Guage from October 1980 to September 1981 (Table 4, from U.S. Geological Survey 1982). The DFG-MMWD agreement provided for winter flows of 20 cfs and summer flows of 5 cfs. Winter flows were as low as 3.1 cfs on January 14. Summer flows averaged 3.18 cfs in June, 4.31 cfs in July, and 4.20 cfs in August. Minimum daily flows were 2.2 cfs in June, 3.3 cfs in July, and 1.5 cfs in August. Low flows in winter would adversely affect salmon and steelhead migration, spawning, and egg incubation, and low flows in both winter and summer would adversely affect growth, survival, and total populations of juvenile fish.

TABLE 3. Fish Fork Length Report, Walker Creek, Marin County, October 1981.

Species	Total collected	Sample size	Mean length (mm)	Standard deviation	Length range (mm)
Pacific lamprey	68	22	101.1	22.2	59-135
Coho salmon	5	5	90.8	—	77-98
Rainbow trout	263	263	84.2	25.6	54-245
California roach	844	85	58.8	19.2	28-113
Mosquitofish	1	1	33.0	—	—
Threespine stickleback	224	38	38.0	5.9	29-52
Bluegill	1	1	66.0	—	—
Sculpin	111	31	99.0	27.6	52-153

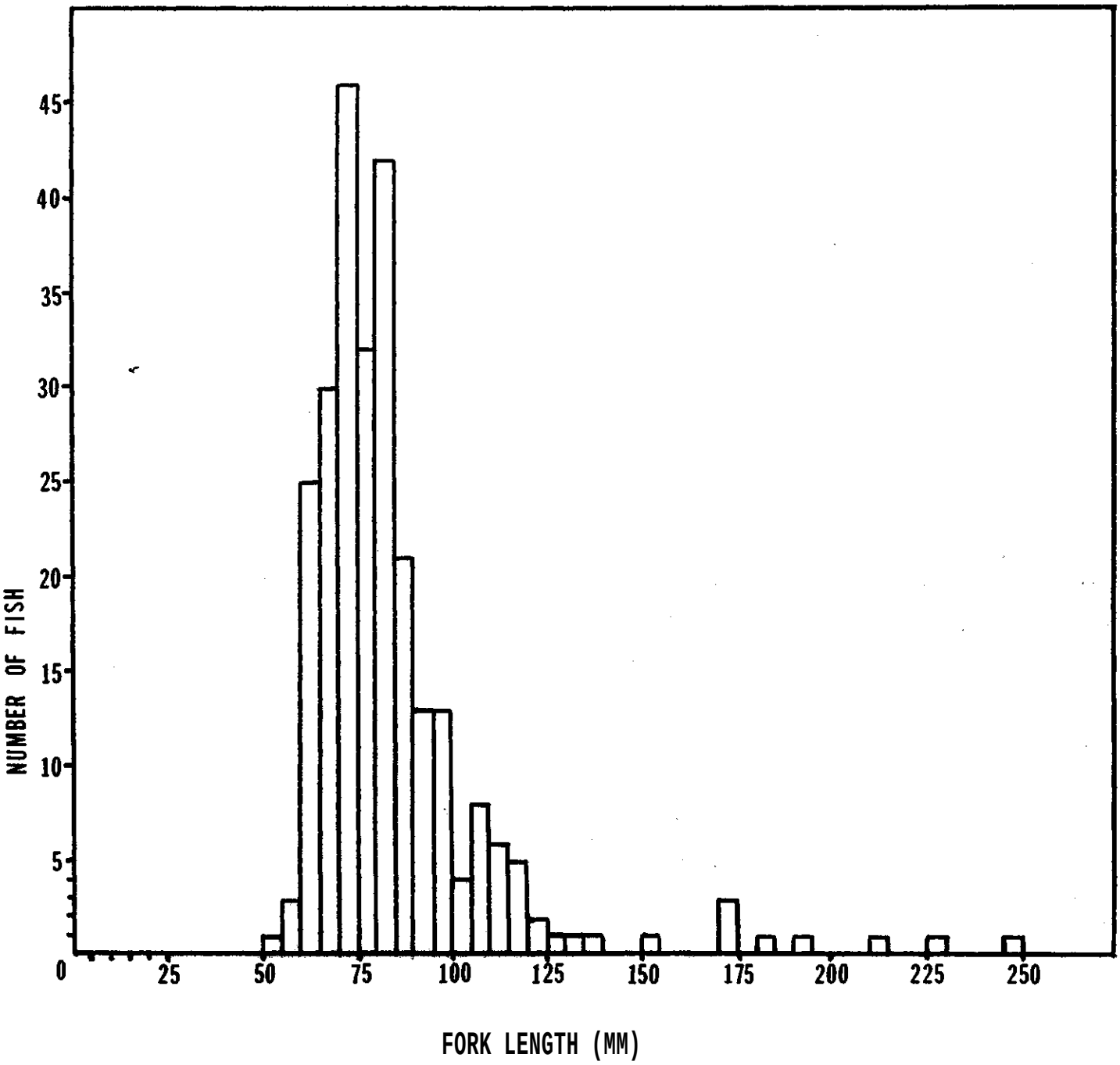

FIGURE 2. Steelhead Rainbow Trout Pork Lengths, Walker Creek, Marin County, October 1981.

TABLE 4. Walker Creek Discharge in Cubic Feet per Second, Water Year October 1980 to September 1981

MEAN VALUES

Day	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	4.6	4.9	5.5	8.0	59	12	43	12	3.2	3.4	4.7	6.7
2	4.5	4.9	11.	8.0	45	11	35	11	3.5	3.3	4.9	6.6
3	4.5	5.0	42	7.8	30	9.7	28	11	4.2	3.4	4.5	6.3
4	4.5	5.0	20	7.6	23	21	23	11	4.3	3.4	4.6	5.0
5	4.5	5.3	6.9	10	18	16	19	11	4.4	3.8	4.0	5.0
6	4.7	5.3	6.7	13	16	13	17	11	4.5	3.8	4.1	5.5
7	4.4	5.7	6.3	12	14	11	15	10	4.6	3.5	4.1	5.7
8	4.3	5.9	6.3	11	13	11	14	9.9	4.5	3.6	4.1	5.7
9	4.2	5.6	6.3	11	15	9.9	13	10	4.0	3.9	4.3	5.6
10	4.3	5.3	6.5	10	12	9.2	14	10	3.6	3.9	4.6	5.6
11	4.5	5.1	6.8	10	12	8.5	15	9.9	3.8	3.9	4.8	5.6
12	4.7	4.9	7.2	10	11	7.9	14	8.1	3.5	4.1	1.5	5.7
13	4.8	4.9	9.9	9.2	29	19	14	7.8	3.2	4.3	2.6	5.7
14	4.5	4.9	10	3.1	54	12	13	6.5	3.1	4.6	3.8	5.8
15	4.3	5.0	12	4.4	28	22	12	6.1	2.9	4.9	3.9	5.7
16	4.4	5.0	12	5.4	20	31	6.1	4.6	2.6	5.3	3.9	5.6
17	4.2	5.0	12	6.2	17	24	12	4.6	2.6	5.6	3.9	5.6
18	4.1	4.9	13	5.5	15	36	12	7.3	2.4	5.4	4.1	5.6
19	3.8	4.9	13	6.9	13	46	13	3.5	2.4	5.0	4.0	5.4
20	3.8	4.7	15	9.7	11	63	12	2.8	2.3	4.9	3.6	5.2
21	3.8	4.5	16	9.9	9.6	235	11	2.7	2.2	4.7	3.5	5.4
22	3.9	5.9	17	42	8.5	126	9.6	2.7	2.2	4.6	3.3	5.2
23	3.9	5.1	14	34	8.0	111	12	2.6	2.3	4.5	3.4	5.5
24	3.9	4.5	12	21	13	99	11	2.7	2.4	4.8	3.3	6.2
25	4.0	4.5	11	18	14	286	12	2.8	2.4	4.4	3.1	7.0
26	4.5	4.0	10	19	12	240	12	2.7	2.7	4.4	3.1	6.2
27	4.9	3.8	9.5	311	11	152	11	2.7	2.8	4.6	5.2	6.6
28	4.8	4.0	9.0	281	12	108	11	2.7	2.6	4.7	6.1	6.4
29	4.9	4.3	8.6	370	——	84	11	2.8	2.8	4.6	6.2	6.0
30	4.9	5.3	8.3	141	——	66	11	2.9	3.3	4.1	6.5	6.0
31	4.9	——	8.2	82	——	49	——	3.0	——	4.3	6.6	——
TOTAL	136.0	148.1	352.0	1497.1	543.1	1949.2	455.7	198.4	95.3	133.7	130.3	174.1
MEAN	4.39	4.94	11.4	48.3	19.4	62.9	15.2	6.40	3.18	4.31	4.20	5.80
MAX	4.9	5.9	42	370	59	286	43	12	4.6	5.6	6.6	7.0
MIN	3.8	3.8	5.5	3.1	8.0	7.9	6.1	2.6	2.2	3.3	1.5	5.0
AC-FT	270	294	698	2970	1080	3870	904	394	189	265	258	345

DISCUSSION

The observed steelhead population biomass of 20.3 kg/ha is similar to that found in other coastal streams in California (Table 5). In Walker Creek, Stations 2 through 5 had the best steelhead populations. The rearing habitat index developed by Kelley and Reineck (1978) indicated that the population at Station 4 would be poor, but the biomass at 29.8 kg/ha was second highest. The lowest biomass of steelhead was found at Station 1 (5.9 kg/ha) and Station 6 (11.2 kg/ha). Station 1 was in the lower reach. Kelley and Reineck (1978) reported that this area had a relatively lower rearing index value until flows were above about 10 cfs. The stream section in which Station 6 was located had a relatively high rearing index value (Kelley and Reineck 1978) but the steelhead population here was much less than would be anticipated. Summer flows were higher than they have been before Soulajule Reservoir was completed, and water temperatures were suitable. The area does have unstable soils and has been overgrazed. A motorcycle club has trails on hills draining into the stream and there is an abandoned mercury mine in the drainage above this site. Construction of Soulajule Reservoir may also have added to sediment deposition in this area. These factors or a combination may account for the low salmonid numbers in this area.

The coho salmon smolts stocked in April 1979, should have returned as adults during the winter of 1980-81, spawned, and the resulting progeny would appear in this survey. Because of the low numbers found, the 1979 stocking was a failure. The 1980 stocking experienced high mortalities when planted because of high water temperatures and poor condition of the fish. Future plants should be made in March, when water temperatures are lower and survival would be improved.

Comparisons of salmonid populations with previous studies indicate substantial improvements resulting from flows released from Soulajule Reservoir. In the area of Station 3, Kelley (1976) found 2,258 salmonids/ha; this study found 3,694 salmonids/ha. Near Station 4, Kelley (1976) found 1,880 salmonids/ha; this study found 4,377 salmonids/ha. Although these figures are encouraging, the estimated total of 37,631 salmonids in Walker Creek is far below the 244,000 fish expected by Kelley (1976). Several years of the present flows, regular stocking of coho salmon by DFG, and vegetation plantings in riparian areas are needed to improve habitat and increase the salmonid population.

California roach, a common minnow in coastal streams, were the most abundant species. Roach are adaptable and are able to survive under unfavorable conditions; these factors account for its widespread distribution (Moyle 1976). They feed on filamentous algae and do not compete with salmonids. Roach were also found to be one of the most abundant species collected in the Big Sulphur Creek drainage, Sonoma County (Price and Geary 1979).

The sculpin population of Walker Creek is also comparable to Big Sulphur Creek. Sculpin's main food is aquatic insects, but they will eat small fish, including young salmon and steelhead. These species have adapted over a considerable evolutionary period, however, so it is not believed that sculpin will be detrimental to the more desirable salmonids.

Threespine stickleback, the third most common species in Walker Creek, were concentrated at two locations: Station 1 near the upper limits of tidewater, and

TABLE 5. Juvenile Steelhead Population Biomass in California Streams.

Stream, Date [1]	Estimated Biomass (kg/ha)
North Fork Caspar Creek	
Mendocino County	
October 1967	14.6
October 1968	14.4
October 1969	11.3
Godwood Creek[2]	
Humboldt County	
July 1967	5.7
July 1968	4.9
July 1969	4.1
Bummer Lake Creek[2]	
Del Norte County	
September 1967	39.6
September 1968	31.5
September 1969	48.3
Little North Fork Noyo River	
Mendocino County	
October 1966	3.7
October 1968	1.7
October 1969	2.1
South Fork Caspar Creek	
Mendocino County	
June 1967	22.1
October 1967	9.5
June 1968	14.2
October 1968	14.9
June 1969	23.1
October 1969	22.3
South Fork Yager Creek	
Humboldt County	
August 1967	17.5
August 1968	29.6
August 1969	36.1

Stream, Date, Stream Type [3]	Observed Biomass (kg/ha)
Big Sulphur Creek	
Sonoma County	
June-July 1976	
Stream Type 1	12.2
Stream Type 2	9.4
Stream Type 3	48.5
Stream Type 4	3.5
Stream Type 5	4.1
Little Sulphur Creek	
Sonoma County	
July-August 1976	
Stream Type 2	11.1
Stream Type 3	29.1
North Branch Little Sulphur Creek	
Sonoma County	
July 1976	
Stream Type 2	39.1
Squaw Creek	
Sonoma County	
July 1976	
Stream Type 2	92.2
Stream Type 3	23.2
Frasier Creek	
Sonoma County	
June 1976	
Stream Type 2	47.0
Alder Creek	
Sonoma County	
July-August 1976	
Stream Type 2	40.8

[1] Data from Burns (1971, 1972)

[2] Includes both steelhead and coast cutthroat trout, Salmo clarki.

[3] Data on Sonoma County streams by Price and Geary (1979) . Stream Type is based on watershed characteristics. Stream Type 1: agricultural; Stream Type 2: chaparral; Stream Type 3: forest; Stream Type 4: gravel bar; Stream Type 5: affected by natural geothermal activity.

Station 5 near the Synanon ranch headquarters. Stickleback prefer areas of low velocity, with aquatic vegetation for cover (Moyle 1976) . These factors were found in both stations where stickleback were abundant. At Station 5, surface water temperature was the highest recorded (17.5°C). Stations 1 and 5 were the sites with the fewest numbers of steelhead juveniles, although those steelhead at Station 5 were quite large, resulting in a suitable biomass density.

All Pacific lamprey collected were ammocoetes, and were fairly evenly distributed throughout the stream. With an estimated population of 8,784, lamprey were 5th in total numbers and 4th in total biomass. A survey of Big Sulphur Creek, Sonoma County, reported 3,632 lamprey ammocoetes (2 kg/ha) in 32,779 m of stream (Price and Geary 1979). Lamprey comprised only 1% of the total number of fish collected. The lamprey population of Walker Creek is considerably higher than in Big Sulphur Creek. Length distributions were similar.

The fish populations should be considered as being less than what would have developed if flows had been maintained as provided in the DFG-MMWD agreement. The lack of compliance has been recognized and MMWD has revised operational procedures so that the required flows will be maintained as specified in the agreement.

CONCLUSIONS AND RECOMMENDATIONS

The fish population of Walker Creek is typical of California coastal streams. Juvenile steelhead are increasing in abundance, particularly when compared with the pre-project populations. Coho salmon should increase if a run is established by smolt stocking as contemplated by the MMWD-DFG agreement. Both species should increase if favorable summer flows released in 1981 can be continued.

The following recommendations are warranted by the study results:

1. The same locations should be monitored in October each year to assess the effects of streamflow releases in Walker Creek and the results of stream management. This would provide an index of trends in the fish populations. To develop more accurate estimates of the total population and biomass, additional stations should be sampled.

2. Coho salmon smolts should be stocked to establish this species in the stream as contemplated in the DFG-MMWD agreement of August 24, 1976. These fish should be stocked in March.

3. Riparian areas should be planted as stated in the application of the Marin Municipal Water District for a grant under the Davis-Grunsky Act.

4. Erosion and stream sedimentation control measures should be implemented in the Walker Creek drainage.

5. Flows at the Chileno Guage should be closely monitored for compliance with the DFG-MMWD agreement.

ACKNOWLEDGEMENTS

R. Eugene Geary, Biologist, Pacific Gas and Electric Company, arranged for computer analysis of the data which greatly facilitated preparation of this report. Fishery Biologists W. Cox and D. Eimoto, and Seasonal Aids T. Chapman, L. Harris, and D. Lopez participated in the collection of data.

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