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DEPARTMENT OF FISH AND GAME

AMERICAN RIVER STEELHEAD
(SALMO GAIRDNERII GAIRDNERII) MANAGEMENT, 1956-1974

by

Jerome R. Staley
Region 2, Inland Fisheries

Anadromous Fisheries Branch
Administrative Report No. 76-2

1976

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ABSTRACT

This paper reviews the steelhead management activities on the American River 1956 through 1974, subsequent to the construction of Folsom and Nimbus dams. The Nimbus Hatchery steelhead production is summarized, along with the numbers of adult steelhead entering the hatchery each year. The results of fin marking and tagging studies on yearling steelhead reared at Nimbus Hatchery are reported.

During the 1971 through 1974 period, creel census and tagging studies were carried out to determine the size of the run, timing of migration, angler harvest rate, percentage of the run entering Nimbus Hatchery, and amount of steelhead angler use.

From October 1971 through February 1972, American River steelhead anglers fished an estimated 150,508 hours and caught 5,369 steelhead--27.4% of the estimated American River run of 19,583 fish.

From September 1973 through February 1974, the estimated catch was 3,265 fish--27% of the estimated run of 12,274 fish.

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INTRODUCTION

The American River, the lower-most major tributary to the Sacramento River, is an important spawning stream for several species of anadromous fish. Fall-run king salmon (Oncorhynchus tshawytscha), steelhead trout (Salmo gairdnerii gairdnerii) and American shad (Alosa sapidissima) enter the river in the fall, winter, and spring, respectively, to spawn. Striped bass (Morone saxatilis) are also found in the river but significant spawning probably does not occur because of low spring water temperatures.

The completion of Folsom and Nimbus Dams in 1955 restricted the anadromous species to the lower 37 km (23 miles) of the river. The U. S. Bureau of Reclamation (USBR) constructed Nimbus Hatchery approximately 366 m (1,200 feet) downstream from Nimbus Dam to compensate for the loss of salmon and steelhead spawning and rearing areas upstream from the dam. The Department of Fish and Game operates this hatchery under a contract with the USBR. The USBR pays operating costs.

From the start of hatchery operations in Fiscal Year 1955-56, through Fiscal Year 1961-62 the number of adult steelhead annually entering the hatchery ranged from 51 to 778, and averaged 230 (Appendix Table 1). These were winter-run fish, and essentially all entered the hatchery during the period January through April. So few adults entered the hatchery during this seven-year period that in most years it was necessary to supplement the Nimbus egg take with eggs taken at the Van Arsdale Fisheries Station (Snow Mountain Station) in the upper Eel River system. The number of yearling steelhead annually planted during the first 7-year period averaged 168,700 (Appendix Table 2).

During the 1960's and early 1970's changes were made in hatchery procedures which resulted in increases in yearling production. Changes were also made in planting procedures which increased survival of planted yearlings. As a result, hatchery counts have increased markedly. The number of adults entering Nimbus Hatchery from the 1968-69 season through the 1972-73 season averaged 2,527. Annual yearling production from 1969 through 1973 averaged 452,161.

This report presents (1) descriptions of Nimbus Hatchery management programs conducted from 1956 through 1974, and (2) the results of investigations designed to evaluate the American River steelhead fishery.

DESCRIPTION OF AREA

The lower American River lies in the Sacramento metropolitan area and as a result the river has become a prime outdoor recreational attraction for the area's residents. Sacramento County and the California Wildlife Conservation Board have bought and developed much of the adjacent land, and are in the

process of completing the American River Parkway which will extend all the way from the mouth of the river to Nimbus Dam (Figure 1). As a result, access to the river is good.

The main steelhead angler use area begins at the base of Nimbus Dam and extends to the downstream end of Glenn Hall Park. Most fishing above Glenn Hall Park is done from shore. The area downstream from Glenn Hall Park is less intensively used by steelhead anglers, and much of the fishing is from boats which are launched at Discovery Park at the mouth of the river.

The upper 16 km (10 miles) of river contain the bulk of the spawning gravels used by king salmon. To protect spawning salmon, the section of river from the Hazel Avenue Bridge to the downstream end of Ancil Hoffman Park is closed to all fishing from October 16 through December 31. The area downstream from the fishing closure is characterized by long pools separated by short riffles of gravel, sand and gravel, or hardpan.

The water regulation by Nimbus and Folsom Dams has substantially altered the flow pattern of the lower American River. The principal effects have been a reduction in the fluctuation of winter flows, and an increase in summer flows.

The early operation of Folsom Dam resulted in fall water temperatures which were sometimes too high for spawning salmonids. However, the USBR in 1962 installed a shutter system on the Folsom Reservoir penstock intakes to correct the problem. The current flow and temperature regimen are as follows:

Table 1

Mean Flows (m³/sec) and Maxima and Minima of Daily Mean Flows, by Month, 1968-1972, American River at Fair Oaks^{1/}

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|------|-------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Mean | 270 | 158 | 144 | 107 | 91 | 91 | 95 | 80 | 79 | 69 | 75 | 121 |
| Max | 1,902 | 348 | 348 | 237 | 230 | 196 | 136 | 119 | 118 | 130 | 131 | 340 |
| Min | 58 | 59 | 40 | 42 | 26 | 41 | 56 | 27 | 26 | 26 | 26 | 65 |

Table 2

Five-Year (1968-1972) Monthly American River at Fair Oaks Water Temperature (C^o) Range^{1/}

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|-----|------|-----|------|------|------|------|------|------|------|------|------|------|
| Max | 11.0 | 9.5 | 12.5 | 14.0 | 17.0 | 17.0 | 21.0 | 23.0 | 21.0 | 19.0 | 16.0 | 14.0 |
| Min | 6.0 | 7.0 | 7.0 | 8.0 | 11.0 | 13.0 | 14.0 | 16.0 | 15.0 | 13.5 | 12.0 | 7.5 |

^{1/} From "Water Resources Data for California", U. S. Dept. Interior Geological Survey publications.

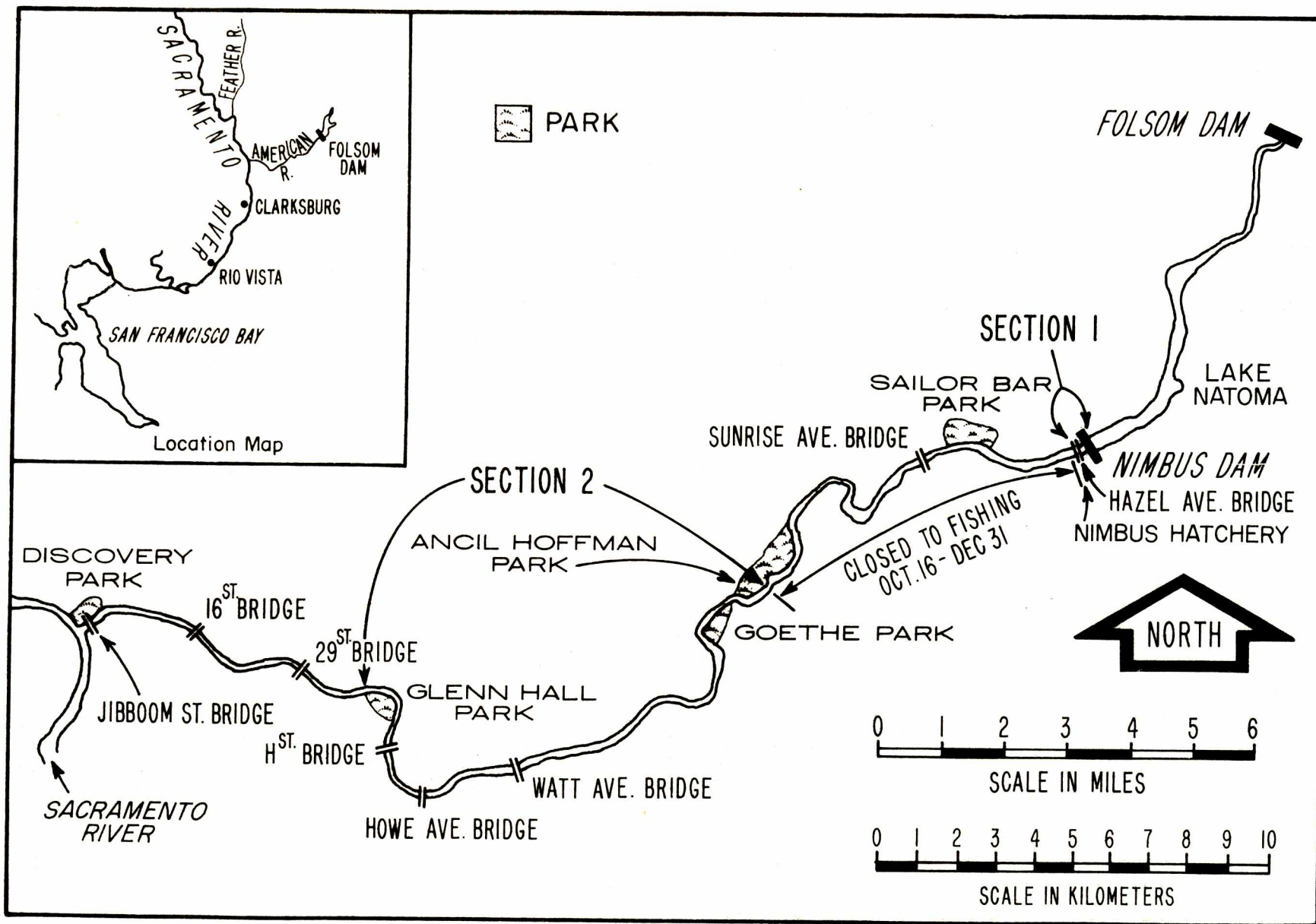


Figure 1. Map of the American River, from Folsom Dam to the mouth.

HATCHERY MANAGEMENT PROGRAMS

Winter-run Steelhead Fin Marking Experiments

The earliest fin marking experiment involved the release of 100,218 marked yearlings in March 1958, in the American River near the hatchery (Table 3). These fish, which were derived from Eel River stock, returned the following three years with a total return to the hatchery of 155 adults (0.15%). Eighty-seven percent of the returns were three year-old fish. A similar experiment was begun in January 1961, with the release of 100,992 marked yearlings in the American River. A total of 566 (0.56%) fish returned to the hatchery during the next three years with 98% returning two years after liberation (Table 3).

Because of the low adult return rate a study was begun to see if yearlings stocked in the Sacramento River at Clarksburg would produce greater adult returns than yearlings stocked in the American River at the hatchery. A total of 184,685 yearlings from the 1962, 1963, and 1965 brood-years were marked by the removal of the right ventral fin and planted at Clarksburg. The American River group of 180,787 yearlings from the same brood years had the left ventral fin removed (Table 3). These fish returned over the following six years with the Sacramento River group producing 1,106 returning adults (0.60%) to the hatchery and the American River group returning 525 adults (0.29%).

Because of the higher return rates for Clarksburg-released fish, most yearling plants beginning with the 1966 broodyear were made in the Sacramento River, primarily at Clarksburg. Virtually all (98%) of the 1966 and 1967 broodyear yearlings stocked were marked by the removal of the adipose fin. The 426,660 marked yearlings produced 4,001 (0.94%) adult returns to Nimbus Hatchery during the next four years. (Table 3).

Adult returns of these Ad-marked fish indicated the hatchery was producing the bulk of the run. During the 1968-69 season, Jochimsen (1970) noted that 85.8% of the Nimbus Hatchery returns were marked with adipose finclips. Hooper (1970) found that 53.5% of the 99 adult steelhead he examined during a February through April, 1969 creel census were marked Ad.

Fish from the 1969 broodyear were used in an experiment to determine if stocking the yearlings at Rio Vista on the Sacramento River would produce superior returns to stocking at Clarksburg. The returns from the two groups were nearly identical (Table 3) indicating no benefit was derived from the longer trucking required to reach Rio Vista.

Yearling Tagging Experiments

In 1970 and 1971 we tagged and released yearling steelhead to evaluate fishery harvest rates on these fish as juveniles. The fish were tagged in the dorsal musculature under the dorsal fin with an oval tag 1 x 1.6 x 0.9 cm

Table 3

Winter-run Steelhead Yearling Fin-marking Experiments,
1957 through 1969 Brood Years

| Brood year | Release data | | | | Adult returns by season | | | | | | Total returns | % returns | | | | | |
|------------|--------------|--------|-------|-------------------------|-------------------------|-------|-------|-------|-------|-------|---------------|-----------|-------|-------|-------|-------|-------|
| | Number | Date | Mark | Location | 58-59 | 59-60 | 60-61 | 61-62 | 62-63 | 63-64 | | | 64-65 | 65-66 | 66-67 | 67-68 | 68-69 |
| 1957 | 100,218 | 3/58 | RV | American River | 11 | 135 | 9 | | | | | | | | | 155 | 0.15 |
| 1960 | 100,992 | 1/61 | LV | American River | 5 | 556 | 5 | | | | | | | | | 566 | 0.56 |
| 1962 | 16,390 | 1-3/63 | LV | American River | | | | | | | | | | | | | |
| 1963 | 91,182 | 1-2/64 | LV | American River | | | | | | | | | | | | | |
| 1965 | 73,215 | 2-3/66 | LV | American River | | | | | | | | | | | | | |
| Total | 180,787 | | | | 27 | 162 | 206 | 23 | 103 | 4 | | | | | | 525 | 0.29 |
| 1962 | 23,029 | 1-3/63 | RV | Sacto. R. at Clarksburg | | | | | | | | | | | | | |
| 1963 | 92,658 | 1-2/64 | RV | Sacto. R. at Clarksburg | | | | | | | | | | | | | |
| 1965 | 68,998 | 2-3/66 | RV | Sacto. R. at Clarksburg | | | | | | | | | | | | | |
| Total | 184,685 | | | | 20 | 444 | 422 | 72 | 145 | 3 | | | | | | 1,106 | 0.60 |
| 1966 | 216,820 | 3-4/67 | Ad | Sacto. R. at Clarksburg | | | | | | | | | | | | | |
| 1967 | 209,840 | 3/68 | Ad | Sacto. R. at Clarksburg | | | | | | | | | | | | | |
| Total | 426,660 | | | | 168 | 2,624 | 1,184 | 25 | | | | | | | | 4,001 | 0.94 |
| 1969 | 25,200 | 3/70 | Ad-LV | Sacto. R. at Clarksburg | 6 | 125 | 5 | | | | | | | | | 136 | 0.54 |
| 1969 | 25,000 | 3/70 | Ad-RV | Sacto. R. at Rio Vista | 5 | 121 | 3 | | | | | | | | | 129 | 0.52 |

(3/8 x 5/8 x 0.035 inches) made of laminated vinylite. Tags were applied as a disc dangler is applied (Chadwick, 1966) with 0.3 mm- (0.012 inch-) diameter stainless steel wire.

Groups of tagged fish were released in three locations in June 1970: in the American River above Watt Avenue, the Sacramento River at Clarksburg, and the Sacramento River at Rio Vista. In March, 1971, another group was released in the Sacramento River at Clarksburg. In three of the four groups, some of the fish were tagged with \$5.00 reward tags to estimate nonresponse. Tagging and recovery results are summarized in Table 4.

For only two of the released groups were enough tags returned to estimate nonresponse: the June 1970 releases, in the American River (53% nonresponse) and in the Sacramento River at Clarksburg (47% nonresponse). When reward tag data were available, it was used to estimate the harvest rate. In the one experiment where only nonreward tags were used, I adjusted the returns by assuming 50% nonresponse.

The results indicate low harvest rates for yearlings planted in the lower Sacramento River in March or in June (1.0-5.8%). Such exploitation rates for juveniles would not have a serious impact on subsequent adult runs. However, the fact that as many as 6% of the June-Clarksburg releases were caught in the American River, indicates that a sizeable proportion of the June-released fish is moving upstream. Their size when caught indicated they had never entered the ocean.

Fishing pressure on yearlings released in June in the American River is very high. Here, the estimated juvenile harvest rate (55.1%) compared favorably with harvest rates in successful catchable trout programs, but is exceptionally high for a program managed for an adult steelhead fishery.

Tag returns from Clarksburg releases indicate that the juvenile harvest rates of March-released fish are lower than those of June-released fish.

Fall Run and Summer Steelhead Programs

Until 1969, the established American River winter steelhead run entered the river late in the season; most fish entered the hatchery after January 1. Weather and water conditions during winter, however, are less conducive to good steelhead fishing than in the late-summer and fall months. To diversify the fishery, we began programs in 1969 to convert part of the Nimbus Hatchery yearling steelhead production to earlier-run fish.

Summer Steelhead Program

Summer steelhead eggs of the 1969, 1970, 1971, and 1973 broodyears were imported in an attempt to establish a summer run. The 1969 and 1970 brood-year eggs were obtained from the Skamania Hatchery on the Washougal River in Washington (Jochimsen 1971). The 1971 broodyear eggs were obtained from the Roaring River Hatchery on the Siletz River in Oregon.

Table 4

Results of Four Yearling Steelhead Tagging Experiments

| Release location | American River, Nimbus Hatchery to Watt Ave. | | Sacramento River at Clarksburg | | Sacramento River at Rio Vista | Sacramento River at Clarksburg | |
|---|--|------------|--------------------------------|------------|-------------------------------|--------------------------------|-----------------|
| Release date | June 30, 1970 | | June 24, 1970 | | June 19, 1970 | March 5, 1971 | |
| Type of tag | Non reward | \$5 reward | Non reward | \$5 reward | Non reward | Non reward | \$5 reward |
| Number released | 1,004 | 98 | 1,040 | 400 | 999 | 1,192 | 394 |
| Total tags returned | 259 | 54 | 32 | 23 | 9 | 5 | 8 |
| American River fishery returns, juveniles ^{a/} | 254 | 54 | 32 | 23 | 6 | 2 | 2 |
| Sacramento River fishery returns, juveniles | 0 | 0 | 0 | 0 | 0 | 0 | 4 |
| Fishery exploitation rate ^{b/} , juveniles | | 55.1% | | 5.8% | 1.2%(12/999) | | 1.0% |
| Miscellaneous returns | 5 _{c/} | 0 | 0 | 0 | 3 _{d/} | 3 _{e/} | 2 _{f/} |

^{a/} "Juveniles" refers to fish caught less than 6 months after release.

^{b/} Based on reward tags, or assumed nonresponse of 50% with nonreward tags.

^{c/} All caught in American River: four Jan-May 1971, and one Nov 2, 1972.

^{d/} One in Redwood Creek, Humboldt County Dec. 1970; one in the Gallinas Canal, Marin County, Jan. 1971; and one in the American River, Feb., 1972.

^{e/} One was found in a striped bass stomach, June 1970; one was returned July, 1970, from an unknown location; and one was caught January, 1973 in the American River.

^{f/} One was caught in the Gulf of Farallones, date unknown; one was caught October, 1971 in the American River.

The imported 1973 broodyear eggs were obtained from the Washougal River, and were used to produce 52,701 1973 broodyear yearlings. An additional 51,903 1973 broodyear yearlings were produced from 43 marked adult summer steelhead entering Nimbus Hatchery during the 1972-73 season.

All summer steelhead yearling releases were in the Sacramento River at Clarksburg. The releases of summer steelhead, and subsequent returns of marked fish, are summarized as follows:

Table 5

Summer Steelhead Production Summary

| Brood Year | 1969 | 1970 | 1971 | 1973 |
|--------------------------------|--------|--------|--------|--------|
| Unmarked yearlings released | 0 | 7,275 | 8,925 | 52,701 |
| Marked (LP) yearlings released | 18,700 | 60,170 | 60,115 | 51,903 |

Table 6

Summer Steelhead Hatchery Returns

| Season | 1971-72 | 1972-73 | 1973-74 | 1974-75 |
|------------------------------|---------|---------|---------|---------|
| Number marked (LP) recovered | 5 | 43 | 80 | 131 |

"Several" anglers have reported catching these fish during the summers of 1972 and 1973. The success of this program is yet undetermined.

A creel census program is planned for the period May through October, 1975 to evaluate the summer steelhead sport fishery contribution.

Fall Run Program

The program to establish a fall steelhead run in the American River consisted of (1) selecting and isolating early migrant adults at the hatchery, and (2) trapping early migrant adults in the Sacramento River.

Adult steelhead entering Nimbus Hatchery prior to November 23, 1970 were isolated and spawned separately from later migrants. A group of 40,680 yearlings produced from early migrant eggs were marked LP-RV and planted at Clarksburg during February 1972, along with 40,232 yearlings produced from later migrants and marked RP-LV.

During the 1973-74 season (when these marked fish returned to the hatchery as three-year-olds) marked fish were recorded by date, as they entered the hatchery. During the 1972-73 and 1974-75 seasons, steelhead were examined for marks only during spawning operations: time of entry into the hatchery was not recorded.

A greater proportion of the progeny from early migrants returned to the hatchery prior to the end of December than did progeny of later migrants. The early migrants also returned at a greater rate (0.34%) than the later migrants (0.19%) (Table 7).

Table 7
Results of Early vs Late Migrant Marking Experiment

| Parent stock | Number released | Hatchery recovery data | | | | | | |
|----------------|-----------------|------------------------|-----|-----|-------|----------|-----------------------|------------|
| | | By age | | | Total | % return | Time of recovery--3's | |
| | | 2's | 3's | 4's | | | Oct-Dec 73 | Jan-Mar 74 |
| Late migrants | 40,232 | 25 | 48 | 4 | 77 | 0.19 | 4 | 44 |
| Early migrants | 40,680 | 46 | 91 | 2 | 139 | 0.34 | 41 | 50 |

The fall migrant program was continued with the production of 37,040 1973 brood year yearlings produced from adults trapped on the Sacramento River in the fall of 1972. For the 1974 brood year, 37,880 yearlings were produced from adult steelhead migrating into Nimbus Hatchery prior to November 30, 1973.

Current hatchery guidelines call for the production of about 100,000 fall migrant steelhead yearlings annually. Attempts will be made to continually select earlier migrants with the goal of having a large number of adults arrive in October.

The success of this program will be measured by the proportion of the annual steelhead run entering the hatchery during the fall, and by periodic angler surveys to measure fall fishing success.

One concern with the fall migrant program is the potential conflict between angler harvest of these fish and the October 16 through December 31 fishing closure in the salmon spawning area. Fall migrant adults may hold in the

salmon spawning area during the closed fishing period thus reducing harvest rates. If this occurs, the pros and cons of (1) changing the length of time of the closed period, or (2) a salmon-fishing-only closure may have to be considered.

THE AMERICAN RIVER STEELHEAD FISHERY

Early Studies of the Fishery

Prior to late 1971 three limited studies of the American River steelhead fishery had been conducted.

Gerstung (1967) estimated that approximately 8,000 angler days were spent from September through December, 1966, fishing for "small steelhead". The estimated September-December catch was 400 fish. Gerstung's estimate of steelhead angling pressure from January through March, 1967 was 18,000 angler days. Gerstung classified all rainbow trout 30.5 cm (12.0 inches) or longer as steelhead. Gerstung did not publish an estimate of the January-March 1967 catch. He did, however, make his unpublished creel census data available to me (Table 8). His data suggest that the January-March angler success rate was more than twice that of the October-December period. Applying the catch rate to the estimated 18,000 angler days of effort indicates the January-March catch was several times that of the September-December period.

Table 8

Summary of 1966-67 American River creel census data

| Month | Anglers interviewed | Hours fished | Fish caught | Catch/Hr. | Steelhead caught | Steelhead catch/hr. |
|--------------|---------------------|--------------|-------------|-----------|------------------|---------------------|
| October 1966 | 2,088 | 4,887 | 188 | 0.04 | 60 | 0.01 |
| November | 1,632 | 4,546 | 102 | 0.02 | 36 | 0.01 |
| December | 128 | 209 | 7 | 0.03 | 5 | 0.02 |
| January 1967 | 333 | 426 | 10 | 0.02 | 10 | 0.02 |
| February | 993 | 2,058 | 178 | 0.09 | 87 | 0.04 |
| March | 351 | 645 | 47 | 0.07 | 22 | 0.03 |

Hooper (1970) conducted a creel census of the steelhead angling, February 22 through July, 1969. Hooper estimated that from February 22 through April, 20,360 anglers fished 50,853 hours and caught 1,992 steelhead.

From February, 1970, through February, 1971 five groups of adult steelhead, totaling 238 fish, were tagged with disk dangler tags and released in the American River to estimate harvest rates.

The first group, 50 adults from Nimbus Hatchery, was tagged with \$1 reward tags and planted at Watt Avenue February 11, 1970. Consistent records of tag returns at the hatchery were kept only for one week, but after the first week 14 (28%) of this first group had returned to the hatchery. On February 18 another 50 hatchery-trapped adults were tagged and released. Tagged adults were repeatedly transported to Watt Avenue and released when they returned to the hatchery. Anglers returned 18 of the 100 tags and one was found on a dead fish. Studies at Lake Tahoe (Nicola and Cordone, 1974) found a substantial nonreturn of tags with only \$1 reward, so it is possible that the harvest rate was actually much higher than 18%.

Between November 13, 1970 and February 19, 1971 we trapped and tagged 38 adult steelhead in a 3.1 m- (10 ft-) diameter fyke trap. All were tagged with \$5 reward tags. One of this group entered Nimbus Hatchery and 16 (42%) were caught by anglers.

On December 17, 1970, another 100 hatchery-trapped adults were tagged, 50 with \$5 reward tags and 50 with nonreward tags and released at Watt Avenue. Anglers returned 14 (28%) of the reward tags from live fish, and one was found on a dead fish. One reward-tagged fish also returned to Nimbus Hatchery. Anglers turned in five (10%) of the nonreward tags and four were noted at Nimbus Hatchery.

The harvest rates of the hatchery-trapped fish may not have been representative of upstream-migrating adults. They tended to reenter the hatchery soon after release. The 41.6% tag returns by anglers of the river-trapped fish indicated a fairly high fishery harvest rate, but the sample size for this group was small--only 38 fish were trapped and tagged.

1971-72 Creel Census and Use Counts

Methods

General: We conducted creel censuses and made use counts studies October, 1971, through March, 1972, to estimate American River steelhead fishery effort, catch-per-unit-of-effort, and catch.

From October through December the study area was partitioned into two sections as follows: section 1--the area between Nimbus Dam and the Hazel Avenue Bridge, a distance of approximately 366 m (1,200 ft) and section 2--the area between Ancil Hoffman Park and Glenn Hall Park (Figure 1). Section 2 is approximately 16 km (10 miles) long. These two sections encompass most of the October-December fishery. Very little steelhead effort ever occurs downstream from Glenn Hall Park, and the 16-km (10-mile) reach between the two sections is closed to all fishing from October 16 through December 31.

From January through March we sampled the area from Nimbus Dam to the downstream boundary of Goethe Park, and grouped the data from the entire study area. We did not sample downstream from Goethe Park after January 1 because little effort occurs in this area from January through March, when the salmon spawning area closure is open to fishing.

During creel census sampling the following data were collected from each angler: (1) length of time spent fishing, (2) whether fishing from bank or boat, (3) whether the angler was through fishing or planned to continue, (4) species, sex, and FL of fish caught, (5) marks or tags on fish, and (6) county of residence. Only those rainbow trout 35.6 cm (14.0 inches) FL or longer were classified as "steelhead". Fish smaller than this were classified as "rainbow trout".

Section 1 (October-December Sampling): Use-counts were scheduled above Hazel Avenue for three weekdays and one weekend day each week. The count days were changed each week so that every day of the week was sampled with about the same frequency each month. Use counts were made every two hours, on the even hour, between 0800 and 1800.

A creel census was conducted between two use counts on each weekday. Creel censuses were scheduled to progress from one time period to the next on successive days, e.g.: on the first day from 0800 to 1000, on the second day from 1000 to 1200, etc., except that the latest period censused was from 1500 to 1700 because of hatchery shift schedules. (Hatchery personnel did the sampling in this upper section.)

Section 2 (October-December Sampling): Use counts were conducted from Ancil Hoffman Park to Glenn Hall Park from October through December by a roving checker, stopping at all major places of public access, and covering the entire section. Four or five counts were made each count day. The first count each day was begun at times ranging from 0730 to 0930. Successive counts were begun at 2-hour intervals. Use counts were scheduled on all weekend days and on one to three weekdays each week. Weekday count days were chosen as in the upper section.

Roving creel censuses were conducted on four or five days each month on days when no use counts were scheduled.

January-March Sampling (All Areas Combined): On January 1 and 2 creel censuses were made at two check stations, one at Sailor Bar on the north side of the river, and the other at the Hazel Avenue end of the access road that runs along the south side of the river between Sunrise Avenue and Hazel Avenue. These are major access areas for the 16-km (10-mile) river section which opens January 1.

Otherwise, use count and creel census procedures were essentially the same as used in section 2 from October through December.

Methods of Estimation: Separate estimates of use in angler hours were calculated for weekend days and weekdays, by month. From October through December separate estimates were made for each of the two sections. The estimates were made as follows:

I calculated the mean instantaneous use (number of anglers) as the simple mean of all counts made in the stratum. I then estimated use in angler hours by multiplying the mean instantaneous use by the average length of fishing day (hours) for that month and by the number of weekdays (or weekend days) in the stratum. The length of fishing day was defined as one-half hour before sunrise to one-half hour after sunset, and was determined from U. S. Weather Bureau records.

The creel census data was summarized monthly for each section and the average catch rate was applied to the total estimated angler use in the section to provide an estimate of total fish catch and steelhead catch.

Results (1971-72 Creel Census and Use Counts)

Angler Use: The daily count data and the mean instantaneous use (numbers of anglers) by stratum appear in Appendix Table 3. Daily summaries of creel census data appear in Appendix Table 4. The mean instantaneous use for weekday anglers in Section 1 increased from 20.9 in October to 48.6 in November and then dropped sharply to 9.0 in December. The observed pattern of use on weekends followed a similar trend with average counts of 39.1, 78.4 and 26.1 for the months of October, November, and December respectively.

In Section 1 the estimated angling hours in October were 10,125 and the use in November was 18,830 hours. The use in December declined to 3,951 angling hours (Table 9).

In Section 2 the average weekday counts for months from October through December were 47.6, 51.6 and 23.4 respectively. The averages for weekend day counts were 101.1 for October, 105.4 for November, and 51.3 for December; about twice as high as the weekday counts for the same period.

The estimated angling effort in Section 2 was 24,529 hours in October, 21,961 hours in November and 9,012 hours in December. (Table 9). Combining sections 1 and 2 produces an estimated angling use of 34,654 angling hours in October. For November, 40,791 hours were fished while the December effort declined to 12,963 hours.

Following the low use in December, fishing effort increased dramatically in January. The salmon spawning closure ended on December 31 and substantial numbers of large steelhead started migrating into the American River in mid-December. The average weekend day count in January was 168.0 with weekdays averaging 72.8. Use declined somewhat in February with weekday counts of 56.3 and weekend counts of 142.0. Fishing effort declined sharply in March with weekend and weekday counts of 42.5 and 35.7 respectively. The estimated angling use was 34,976 hours in January, 27,124 hours in February, and 14,978 hours in March (Table 9). The estimated American River use by anglers from October through March was 165,486 angling hours.

Table 9

Estimated American River Catch, Effort, and Catch/Effort,
October, 1971 through March, 1972

| Month | Section* | Estimated angling use-hours | Catch/hour (all fish) | Estimated total catch | Steelhead catch/hr. | Estimated steelhead catch |
|-----------------|----------|-----------------------------|-----------------------|-----------------------|---------------------|---------------------------|
| October | 1 | 10,125 | 0.046 | 466 | 0.010 | 101 |
| | 2 | 24,529 | 0.092 | 2,257 | 0.053 | 1,300 |
| TOTAL October | | 34,654 | 0.079 | 2,723 | 0.040 | 1,401 |
| November | 1 | 18,830 | 0.108 | 2,034 | 0.004 | 75 |
| | 2 | 21,961 | 0.077 | 1,691 | 0.037 | 813 |
| TOTAL November | | 40,791 | 0.091 | 3,725 | 0.022 | 888 |
| December | 1 | 3,951 | 0.133 | 525 | 0.070 | 277 |
| | 2 | 9,012 | 0.088 | 793 | 0.072 | 649 |
| TOTAL December | | 12,963 | 0.102 | 1,318 | 0.071 | 926 |
| January | | 34,976 | 0.055 | 1,924 | 0.036 | 1,259 |
| February | | 27,124 | 0.052 | 1,410 | 0.033 | 895 |
| TOTAL Oct.-Feb. | | 150,508 | 0.074 | 11,100 | 0.036 | 5,369 |
| March | | 14,978 | No estimate | No estimate | No estimate | No estimate |
| TOTAL Oct.-Mar. | | 165,486 | | | | |

* Section 1 - Nimbus Dam to Hazel Avenue; Section 2 - Ancil Hoffman Park through Glenn Hall Park. Beginning January 1 all areas surveyed were grouped.

Catch, and Catch-per-unit-of-effort: In October the total estimated catch in the two censused areas was 2,723 fish with about 50% of the catch being steelhead. However, the observed catch in Section 1 consisted primarily of small king salmon (Table 10) which had passed through the Nimbus Hatchery fish racks. Virtually all the steelhead caught in October were in the 35.6 to 45.5-cm (14.0 to 17.9-inch) FL range (Table 12). Nine of the 49 steelhead seen in October's census bore fin clips applied at Coleman National Fish Hatchery (Table 11). In view of the facts that (1) only about 30% (662,323 out of 2,179,875) of the Coleman Hatchery releases during 1970 and 1971 were marked, and (2) about 50% of the Coleman Hatchery fish were stocked at Rio Vista, it is reasonable to assume that a large proportion of the October steelhead catch came from Coleman releases which strayed into the American River.

The estimated November catch in the two sections was 3,725 fish, of which only 24% were steelhead. The marked difference between Sections 1 and 2 in the ratio of salmon to steelhead in the observed catch was evident again.

in November. Salmon comprised 95% of the observed November catch in section 1 and 24% in section 2 (Table 10). The steelhead were in the same size range as in October but only one Coleman Hatchery fin clip was seen.

In December the catch rate increased, but the angling pressure declined to produce an estimated catch of 1,318 fish, of which 926 were steelhead. The catch rates for steelhead were approximately equal in both sections but salmon catch rates were higher in section 1. A few large steelhead started to appear in the catch (Table 12). No salmon were observed in the catch in the lower section (Table 10).

Table 10
Species Composition of Censused Angler Catch
October, 1971-February, 1972

| Month | Section* | Rainbow trout | | King salmon | Other | Total |
|-----------------------|----------|---------------------------|--------------|-------------|-------|-------|
| | | Steelhead ≥ 35.6 cm FL | < 35.6 cm FL | | | |
| October | 1 | 4 | 0 | 13 | 1 | 18 |
| | 2 | 45 | 23 | 6 | 4 | 78 |
| TOTAL October | | 49 | 23 | 19 | 5 | 96 |
| November | 1 | 3 | 0 | 82 | 1 | 86 |
| | 2 | 16 | 9 | 8 | 0 | 33 |
| TOTAL November | | 19 | 9 | 90 | 1 | 119 |
| December | 1 | 10 | 1 | 8 | 0 | 19 |
| | 2 | 18 | 4 | 0 | 0 | 22 |
| TOTAL December | | 28 | 5 | 8 | 0 | 41 |
| January | | 127 | 55 | 11 | 0 | 193 |
| February | | 30 | 17 | 0 | 0 | 47 |
| GRAND TOTAL Oct.-Feb. | | 253 | 109 | 128 | 6 | 486 |

* Section 1 = Area from Nimbus Dam to Hazel Avenue Bridge; Section 2 = Ancil Hoffman Park through Glenn Hall Park. After January 1, all sampling areas were grouped.

Table 11

Marked Steelhead Observed in 1971-72 Creel Census

| Month | Coleman Hatchery | | Nimbus Hatchery | | | | Mokel. Riv. Fish. Inst. | | Unmarked |
|----------|------------------|-------|-----------------|----|-------|-------|-------------------------|-----|----------|
| | Ad-LP | Ad-RP | LP | RP | Ad-LV | Ad-RV | LV | | |
| October | 4 | 5 | 4 | 1 | 0 | 0 | 1 | 34 | |
| November | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 17 | |
| December | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 27 | |
| January | 0 | 4 | 2 | 0 | 7 | 2 | 1 | 111 | |
| February | 0 | 0 | 0 | 0 | 3 | 1 | 0 | 26 | |

Table 12

Length-Frequency of Steelhead Observed in 1971-72 Creel Census

| Fork length (cm) | Month | | | | | Total |
|------------------|---------|----------|----------|---------|----------|-------|
| | October | November | December | January | February | |
| 35.6-45.5 | 44 | 11 | 5 | 12 | 2 | 74 |
| 45.6-55.6 | 0 | 0 | 0 | 13 | 2 | 15 |
| 55.7-65.8 | 1 | 0 | 2 | 15 | 3 | 21 |
| 65.9-75.9 | 0 | 0 | 3 | 54 | 16 | 73 |
| 76.0-86.1 | 0 | 0 | 0 | 14 | 0 | 14 |
| TOTAL | 45 | 11 | 10 | 108 | 23 | 197 |

The relative abundance of salmon in the sport catch declined in January with salmon comprising only 6% of the observed catch. Sixty-six percent of the January catch was steelhead and 28% was resident rainbow trout. Steelhead ranged from 35.6 to 86.1 cm (14.0-33.9 inches) FL with the mode in the 68.6- to 70.9-cm (27.0- to 27.9- inch) FL group. Coleman Hatchery marks continued to appear in the steelhead catch as did marks applied to Nimbus Hatchery production.

The February catch of 1,410 fish was composed of 895 steelhead and the remainder resident trout. The size range of the steelhead catch was similar to that of January. From October through February, anglers fished an estimated 150,508 hours and caught 5,369 steelhead, for an average catch per hour of 0.036 (Table 9).

Creel census sampling in March was inadequate to estimate catch or catch-per-unit-of-effort.

Angler Origin: Censused anglers came predominately from Sacramento County (71.6%). Most of the remaining users came either from counties surrounding Sacramento or from San Francisco Bay area counties (Table 13). The proportion of anglers which were Sacramento County residents varied from a low of 50.5% in February to a high of 85.4% in October. The proportion of anglers which were Bay Area residents was highest in January and February when the fishing for large steelhead was at its peak.

1971-72 Tagging Study

The purpose of this program was to estimate the American River adult steelhead run, using a tag and recapture program.

Methods

Steelhead were captured in hexagonal wire fyke traps, fished in the area between the Watt Avenue and Howe Avenue bridges. Three to five traps were fished at one time. The traps were attached to the bank by a head cable and were fished on the river bottom next to the bank in 2-3 m (6-10 ft) of water. Two cables with floats attached to their loose ends were attached to the top of each trap to pull the traps up **for servicing**.

The servicing barge consisted of two sections bolted together. Each section consisted of two styrofoam floats 31 x 62 cm x 2.4 m (1 x 2 x 8 ft) encased in a sheet metal skin on the sides and bottom, and decked with two 5 x 31 cm x 2.4 m (2 x 12 inch x 8 ft) planks. Steel bands held the float assembly together. The floats were beveled at a 45° angle on the front to cut down drag. The two floats were connected with three 2.5 cm- (1 inch-) diameter pipe arches bent on a 137-cm (4.5-ft) radius. Bracing was added to the lower end of the arches which allowed them to be lag bolted into the 5 x 31-cm (2 x 12-inch) planks. Pipe cross-bracing was added between arches for rigidity. A hand winch was mounted on each section and the cable was run through a snatch block suspended from the top of the pipe superstructure. The cable then came down and was attached to the trap cable with swing link for trap servicing.

The two barge sections were launched, then bolted together about 31 cm (12 inches) apart. The sections were attached together with four lengths of pipe. The upper two pipes, one on each side, ran between the middle arches of each section. The lower two pipes which were right above the floats ran from the middle arch of the front section, and extended about 66 cm (26 inches) past the end of the second section. Two planks 5 x 31 cm x 3.4-m (2 x 12 inch x 13 ft) were bolted to the projecting pipes. This served as a walkway from one side of the barge to the other and also as a place to attach the boat used to push the barge. A 3.4-m (13-ft) Boston Whaler with an 18 h.p. motor was used to push the barge. The bow of the boat was attached to the center of the plank across the stern of the barge. The stern of the boat was attached by ropes to the outside back corners of the barge. This arrangement allowed us to maneuver the barge easily,

Table 13

Origins of Anglers Interviewed During 1971-72 Creel Census

| County | October | | November | | December | | January | | February | | March | | TOTAL | |
|---------------|------------|------|------------|------|------------|------|--------------|------|------------|------|-----------|------|--------------|------|
| | No. | % | No. | % | No. | % | No. | % | No. | % | No. | % | No. | % |
| Sacramento | 387 | 85.4 | 320 | 73.9 | 151 | 80.3 | 779 | 69.7 | 156 | 50.5 | 14 | 63.6 | 1,807 | 71.6 |
| Placer | 23 | 5.1 | 36 | 8.3 | 5 | 2.7 | 54 | 4.8 | 11 | 3.6 | 3 | 13.6 | 132 | 5.2 |
| San Joaquin | 2 | 0.4 | 15 | 3.5 | 3 | 1.6 | 48 | 4.3 | 15 | 4.9 | 0 | 0 | 83 | 3.3 |
| Santa Clara | 0 | 0 | 0 | 0 | 2 | 1.1 | 56 | 5.0 | 20 | 6.5 | 0 | 0 | 78 | 3.1 |
| Alameda | 5 | 1.1 | 9 | 2.1 | 4 | 2.1 | 34 | 3.0 | 14 | 4.5 | 0 | 0 | 66 | 2.6 |
| Contra Costa | 2 | 0.4 | 7 | 1.6 | 4 | 2.1 | 25 | 2.2 | 15 | 4.9 | 0 | 0 | 53 | 2.1 |
| Solano | 2 | 0.4 | 2 | 0.5 | 0 | 0 | 24 | 2.1 | 15 | 4.9 | 0 | 0 | 43 | 1.7 |
| El Dorado | 3 | 0.6 | 11 | 2.5 | 0 | 0 | 16 | 1.4 | 6 | 1.9 | 4 | 18.1 | 40 | 1.6 |
| San Francisco | 8 | 1.8 | 0 | 0 | 0 | 0 | 19 | 1.7 | 8 | 2.6 | 0 | 0 | 35 | 1.4 |
| Los Angeles | 1 | 0.2 | 12 | 2.8 | 1 | 0.5 | 10 | 0.9 | 6 | 1.9 | 0 | 0 | 30 | 1.2 |
| Napa | 0 | 0 | 1 | 0.2 | 1 | 0.5 | 12 | 1.1 | 13 | 4.2 | 0 | 0 | 27 | 1.1 |
| Yolo | 7 | 1.5 | 5 | 1.2 | 2 | 1.1 | 4 | 0.4 | 2 | 0.6 | 1 | 4.5 | 21 | 0.8 |
| San Mateo | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 0.9 | 9 | 2.9 | 0 | 0 | 19 | 0.8 |
| Other | 13 | 2.7 | 15 | 3.5 | 15 | 8.0 | 27 | 2.4 | 19 | 6.1 | 0 | 0 | 89 | 3.5 |
| Total | 453 | | 433 | | 188 | | 1,118 | | 309 | | 22 | | 2,523 | |

even in swift currents. Two men were required to operate the trap servicing rig. One man operated the boat while the other attached the front winch cable to the front trap cable. The slack was taken out of the cable and the front of the trap lifted slightly. This held the barge in place while the second man hooked up the back cable. The trap was raised straight up until about 0.3 m (1 ft) of water remained in the bottom of the trap. The fish were removed, a few at a time, and anesthetized with MS 222 (Tricaine methane sulfonate). Only steelhead in good condition, 35.6 cm (14 inches) FL or longer were tagged. The following information was recorded: (1) fork length, (2) sex, and (3) marks and tags. Each fish was tagged with an oval tag 9.5 x 15.9 x 0.9 mm (3/8 x 5/8 x .035 inch) made of laminated vinylite. The tags were applied through the back under the dorsal fin as a disk-dangler is applied (Chadwick 1966) with 0.3-mm (.012-inch) diameter stainless steel wire. All tags were serially numbered and contained a request that the tags be returned to the address printed on the tag.

The traps were serviced on Monday, Wednesday and Friday except during the peak of the run when daily servicing was required. We did not observe any adverse effects on fish held in the traps up to three days.

Tagging Results and Population Estimate

The trapping of adult steelhead began October 1, 1971 and continued, uninterrupted, until March 6, 1972. During this period 295 adult steelhead were tagged^{2/} (Table 14). Trapping produced few fish until the last week in December.

Anglers returned 47 tags from fish caught during the season of tagging (before July 1, 1972) and one during the 1972-73 Fiscal Year. Of those caught in the American River before July 1, 1972 the median time at large was 16 days (range 2-92 days). Nimbus Hatchery personnel saw 33 tags during the first season and two the second year.

I estimated the 1971-72 steelhead run using the modified Petersen formula:

$$\hat{N} = \frac{M(C+1)}{R+1}, \text{ where}$$

\hat{N} = the population estimate

M = the number of fish tagged (295)

C = the number of tagged and untagged fish entering Nimbus Hatchery (2,256)

R = the number of tagged fish entering Nimbus Hatchery (33)

The 1971-72 American River steelhead population estimate is 19,583. The 95% confidence limits, calculated using Chapman's (1948) formula no. 55, are 14,422 and 28,233.

The estimated catch of 5,369 steelhead (based on the catch and effort study) is 27.4% of the population estimate.

^{2/} An additional 196 fish were tagged with reward tags. These fish were tagged from October 1 through December 22, 1971. Unfortunately, uncorrectable errors were made in reward tag recovery, and the resulting reward tag recovery data could not be used. Recovery data for these reward tags is not discussed further in this report.

Table 13

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| County | October | | November | | December | | January | | February | | March | | TOTAL | |
|---------------|------------|------|------------|------|------------|------|--------------|------|------------|------|-----------|------|--------------|------|
| | No. | % | No. | % | No. | % | No. | % | No. | % | No. | % | No. | % |
| Sacramento | 387 | 85.4 | 320 | 73.9 | 151 | 80.3 | 779 | 69.7 | 156 | 50.5 | 14 | 63.6 | 1,807 | 71.6 |
| Placer | 23 | 5.1 | 36 | 8.3 | 5 | 2.7 | 54 | 4.8 | 11 | 3.6 | 3 | 13.6 | 132 | 5.2 |
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| Solano | 2 | 0.4 | 2 | 0.5 | 0 | 0 | 24 | 2.1 | 15 | 4.9 | 0 | 0 | 43 | 1.7 |
| El Dorado | 3 | 0.6 | 11 | 2.5 | 0 | 0 | 16 | 1.4 | 6 | 1.9 | 4 | 18.1 | 40 | 1.6 |
| San Francisco | 8 | 1.8 | 0 | 0 | 0 | 0 | 19 | 1.7 | 8 | 2.6 | 0 | 0 | 35 | 1.4 |
| Los Angeles | 1 | 0.2 | 12 | 2.8 | 1 | 0.5 | 10 | 0.9 | 6 | 1.9 | 0 | 0 | 30 | 1.2 |
| Napa | 0 | 0 | 1 | 0.2 | 1 | 0.5 | 12 | 1.1 | 13 | 4.2 | 0 | 0 | 27 | 1.1 |
| Yolo | 7 | 1.5 | 5 | 1.2 | 2 | 1.1 | 4 | 0.4 | 2 | 0.6 | 1 | 4.5 | 21 | 0.8 |
| San Mateo | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 0.9 | 9 | 2.9 | 0 | 0 | 19 | 0.8 |
| Other | 13 | 2.7 | 15 | 3.5 | 15 | 8.0 | 27 | 2.4 | 19 | 6.1 | 0 | 0 | 89 | 3.5 |
| Total | 453 | | 433 | | 188 | | 1,118 | | 309 | | 22 | | 2,523 | |

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3/25
1972
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Table 14

Summary of 1971-72 Tagging Experiment

| Number tagged | Tagging period | Tag recoveries | | | |
|---------------------|-----------------|-----------------|---------|---------------|-------------------------|
| | | Nimbus Hatchery | | Angler caught | |
| | | 1971-72 | 1972-73 | 1971-72 | 1972-73 |
| 98 | 12/30/71-1/3/72 | 12 | 1 | 17 | 0 |
| 100 | 1/3-21/72 | 14 | 0 | 13 | 1 |
| 97 | 1/21-3/6/72 | 7 | 1 | 17 | <u>1</u> / ¹ |
| TOTAL 295 | | 33 | 2 | 47 | 2 |

1/¹ Reported by creel checker--tag not turned in.

Table 15

Length-frequencies of 1971-72 Trap-caught Steelhead, by Time Period

| Fork Length (cm) | 10/1-12/22/71 | | 12/22-30/71 | | 12/30/71-1/3/72 | | 1/3-21/72 | | 1/21-3/6/72 | | Total 10/1/71-3/6/72 | |
|---------------------|---------------|--------|-------------|--------|-----------------|--------|-----------|--------|-------------|--------|-------------------------|--------|
| | Number | % | Number | % | Number | % | Number | % | Number | % | Number | % |
| 35.6-45.9 | 55 | (56.7) | 32 | (34.8) | 19 | (19.6) | 28 | (28.0) | 29 | (29.9) | 163 | (33.7) |
| 45.6-55.6 | 14 | (14.4) | 12 | (13.0) | 9 | (9.3) | 14 | (14.0) | 24 | (24.7) | 73 | (15.1) |
| 55.7-65.8 | 17 | (17.5) | 18 | (19.6) | 21 | (21.6) | 28 | (28.0) | 22 | (22.7) | 106 | (21.9) |
| 65.9-75.9 | 9 | (9.3) | 27 | (29.3) | 46 | (47.4) | 26 | (26.0) | 22 | (22.7) | 130 | (26.9) |
| 76.0-86.1 | 2 | (2.1) | 3 | (3.3) | 2 | (2.1) | 4 | (4.0) | 0 | (0) | 11 | (2.3) |
| TOTALS | 97 | (100) | 92 | (100) | 97 | (100) | 100 | (100) | 97 | (100) | 483 | (100) |

As was observed in the creel census, there was a preponderance of small steelhead in the early trap-caught fish (Table 15).

Observations of Steelhead Marked Outside the American River

We made numerous observations in the American River of steelhead which had been tagged or marked elsewhere in the Sacramento River system. The Anadromous Fisheries Branch was conducting a tagging study concurrent with ours, on the Sacramento River. They tagged steelhead at Miller Park, about 4.8 km (3 miles) downstream from the mouth of the American River, and at Fremont Weir near the mouth of the Feather River 37.0 km (23 miles) upstream. Our trapping operations recaptured 24 of the AFB tagged fish, seven from the Miller Park and 17 from the Fremont Weir operations. The median elapsed time between Sacramento River tagging and retrapping in the American River was 74 days (range 48-133) for fish tagged at Fremont Weir and 18 days (range 2-59) for fish tagged at Miller Park. Four of the Sacramento River-tagged fish were subsequently caught by American River anglers. Nimbus Hatchery personnel recovered 18 tagged fish tagged at Miller Park and 10 tagged at Fremont Weir.

The fin-marked steelhead observed during the trapping operations and at Nimbus Hatchery appear in Table 16. The returns from the 1970 broodyear releases (November 1970 and spring 1971) were distinguished from earlier releases (1968 and 1969 brood years) on the basis of length frequency distribution. Marked Coleman steelhead less than 48.3 cm (19.0 inches) FL and other marked steelhead less than 55.7 cm (22.0 inches) FL were assigned to the 1970 broodyear.

The Coleman Hatchery experiment was designed to determine if releasing yearlings at Rio Vista would provide upper Sacramento River returns which were superior to those of Battle Creek releases. Trucking the fish to Rio Vista caused large numbers of returning adults to stray into the American River: At Nimbus Hatchery the ratio of Rio Vista-released fish to Battle Creek-released fish was about 9:1. In contrast, observations at Red Bluff Diversion Dam indicated about a 1:7 ratio (Richard Hallock, California Department Fish and Game, pers. comm.). The Coleman marks were observed at a much higher frequency in the traps than at Nimbus Hatchery (Table 16). Most of the Coleman fish observed at Nimbus were 1969 brood year as contrasted to the trap recoveries, where about 40% of the recaptures were 1970 brood year, predominately small males.

Table 16

Fin-marked Steelhead Observed During Trapping Operations and at Nimbus Hatchery, 1971-72 Season

| Mark | Brood year | Hatchery | Date stocked | Location stocked | No. marked | Number observed | |
|-------|------------|-----------------|-----------------|-------------------------------|------------|-----------------|-----------------|
| | | | | | | Traps | Nimbus Hatchery |
| Ad-RV | 69 | Nimbus | March 1970 | Sacto. R.-Rio Vista | 25,000 | } 17 | 122 |
| | 69 | Mokelumne River | March 1970 | Mokelumne R.-New Hope Landing | 980 | | |
| | 70 | Mokelumne River | November 1970 | Mokelumne R.-New Hope Landing | 6,000 | | |
| Ad-LV | 69 | Nimbus | March 1970 | Sacto. R.-Clarksburg | 25,200 | } 13 | 124 |
| | 69 | Mokelumne River | March 1970 | Three Mile Slough | 980 | | |
| | 70 | Mokelumne River | November 1970 | Three Mile Slough | 9,000 | | |
| Ad-RP | 69 | Coleman | Feb.-April 1970 | Sacto. R.-Rio Vista | 118,186 | 34 | 30 |
| | 70 | Coleman | Feb.-March 1971 | Sacto.-R.-Rio Vista | 211,653 | 28 | 3 |
| Ad-LP | 69 | Coleman | Feb.-April 1970 | Battle Creek | 119,036 | 2 | 10 |
| | 70 | Coleman | Feb.-April 1971 | Battle Creek | 213,698 | 3 | 0 |
| Ad | 68 | Mokelumne River | March 1969 | Three Mile Slough | 22,579 | 2 | 18 |
| | 70 | Feather River | March 1971 | Feather River | 50,200 | 3 | 2 |
| LV | 68 | Mokelumne River | March 1969 | Three Mile Slough | 40,951 | } 11 | 39 |
| | 69 | Mokelumne River | March 1970 | Three Mile Slough | 42,922 | | |
| | 70 | Mokelumne River | Jan.-March 1971 | Three Mile Slough | 46,452 | | |
| | 70 | Feather River | March 1971 | Feather River | 49,500 | | |
| RV | 68 | Mokelumne River | March 1969 | Mokelumne R.-New Hope Landing | 37,674 | } 0 | 6 |
| | 69 | Mokelumne River | March 1970 | Mokelumne R.-New Hope Landing | 42,840 | | |
| | 70 | Mokelumne River | Jan.-March 1971 | Mokelumne R.-New Hope Landing | 46,420 | | |
| | 70 | Feather River | March 1971 | Feather River | 49,900 | | |

Length

Trap-caught steelhead and all marked steelhead entering Nimbus Hatchery were measured. The distribution for trap-caught fish is bimodal with one peak at 41 cm (16 inches) FL and another at 69 cm (27 inches) FL. The shorter group probably represents those two-year-old Sacramento River-Coleman Hatchery fish that strayed into the American River, while the longer group is made up of 3-year-old American River-Nimbus Hatchery stock.

These conclusions are substantiated by a comparison of the length frequencies for trap-caught fish with those of marked Coleman Hatchery fish and of marked Nimbus Hatchery stock fish (Figures 2a-2c).

The American River steelhead stock are substantially longer than the Sacramento River stock at a given age. Three-year-old marked American River steelhead ranged from 58.4 to 81.3 cm (23 to 32 inches) with an average of 68.6 cm (27.0 inches). This stock has produced 2-year-old grilse (71 marked 1971 broodyear fish returning to Nimbus Hatchery in 1973) with a mean length of 48.5 cm (19.1 inches) with a range of 40.6 to 55.9 cm (16-22 inches).

Weight-length Relationship

In early January 1973, 229 unspawned steelhead (both sexes combined) were weighed and measured at Nimbus Hatchery. The data were grouped by 1.27 cm (one-half inch) FL intervals, and the data were fitted by the least squares method to the model: $\text{weight (kg)} = a \text{ FL (cm)}^b$. The resulting weight-length relationship is expressed by the equation: $\text{Log } W = -4.518 + 2.743 \text{ log } \text{FL}$.

The American River stock are substantially lighter at any given length than were Sacramento River stock in 1956 (Hallock 1961) as shown by the comparison in Figure 3.

1972-73 Creel Census

From September 1972 through March 1973 the salmon and steelhead fishery was censused on 75 days. During the first four months the census effort was conducted in the area from the downstream end of the salmon spawning closure through Glenn Hall Park (Figure 1). During the remaining three months the census effort was in the area from Nimbus Dam down through Goethe Park.

Daily creel census observations appear in Appendix Table 5. The angling success for steelhead reached one peak in October and then slowly declined through December (Table 17). The catch rate picked up in January after the salmon spawning area closure ended, and held up fairly well through February.

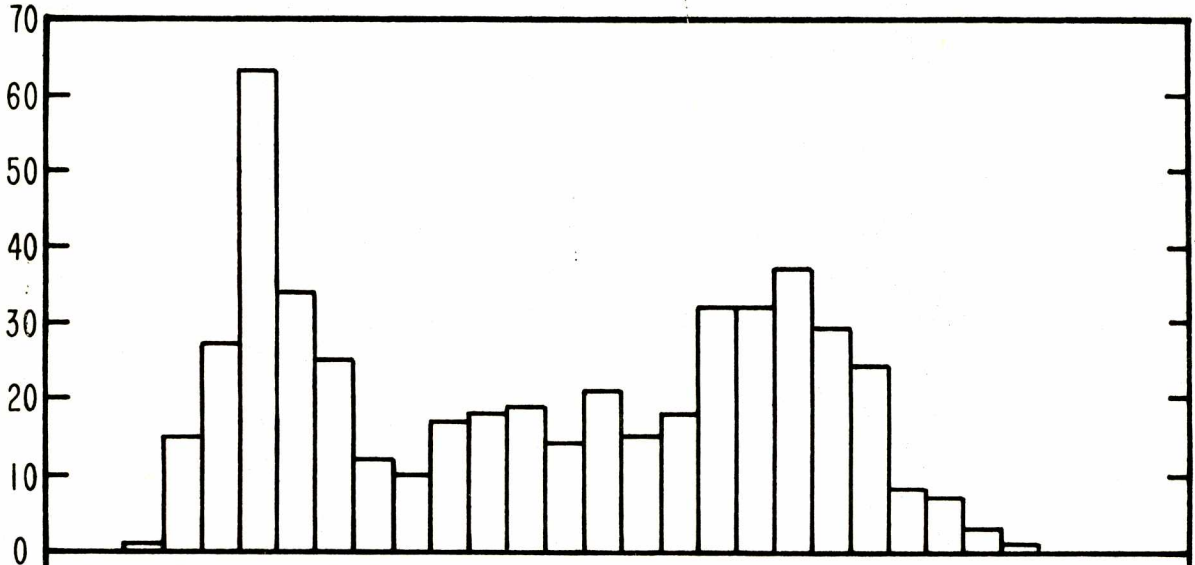


Figure 2a. Length frequencies of steelhead caught in American River traps, 1971-72 season.

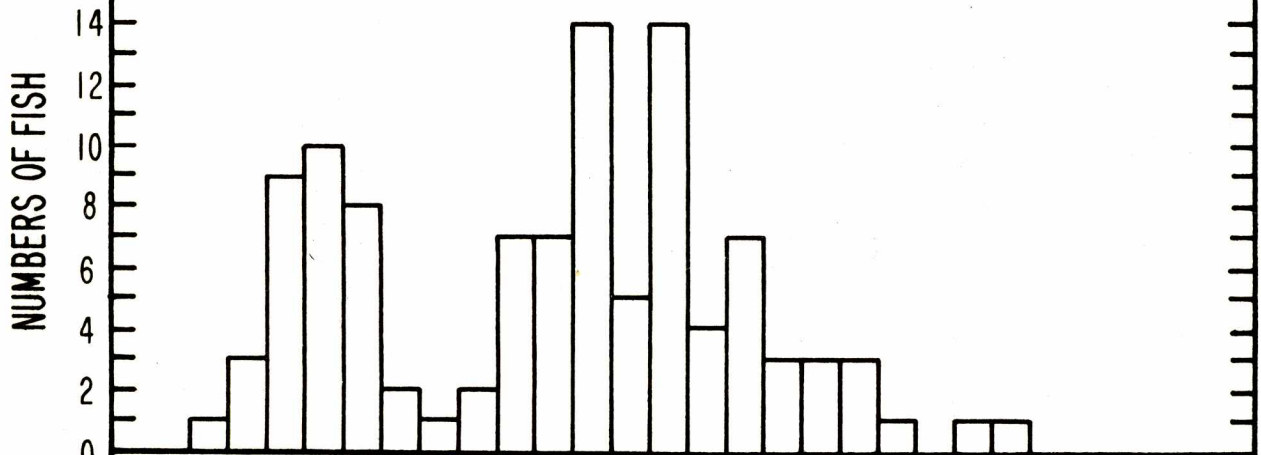


Figure 2b. Length-frequencies marked of Coleman Hatchery-produced steelhead, 1971-72 season (traps plus Nimbus Hatchery).

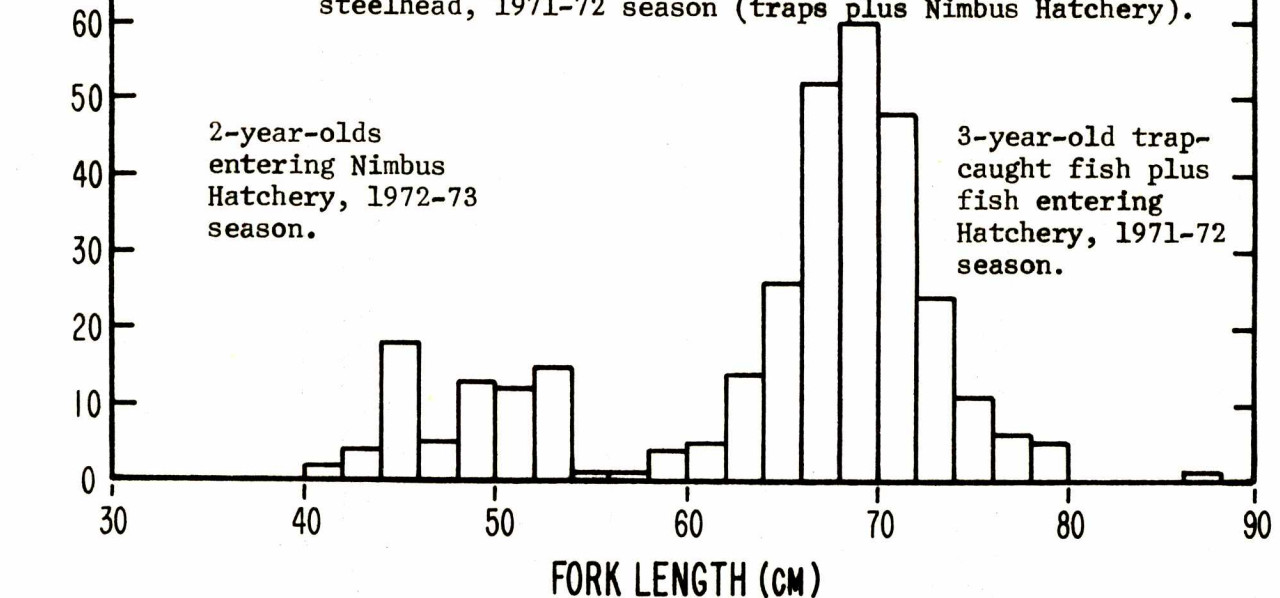


Figure 2c. Length frequencies of marked Nimbus Hatchery-produced winter-run steelhead.

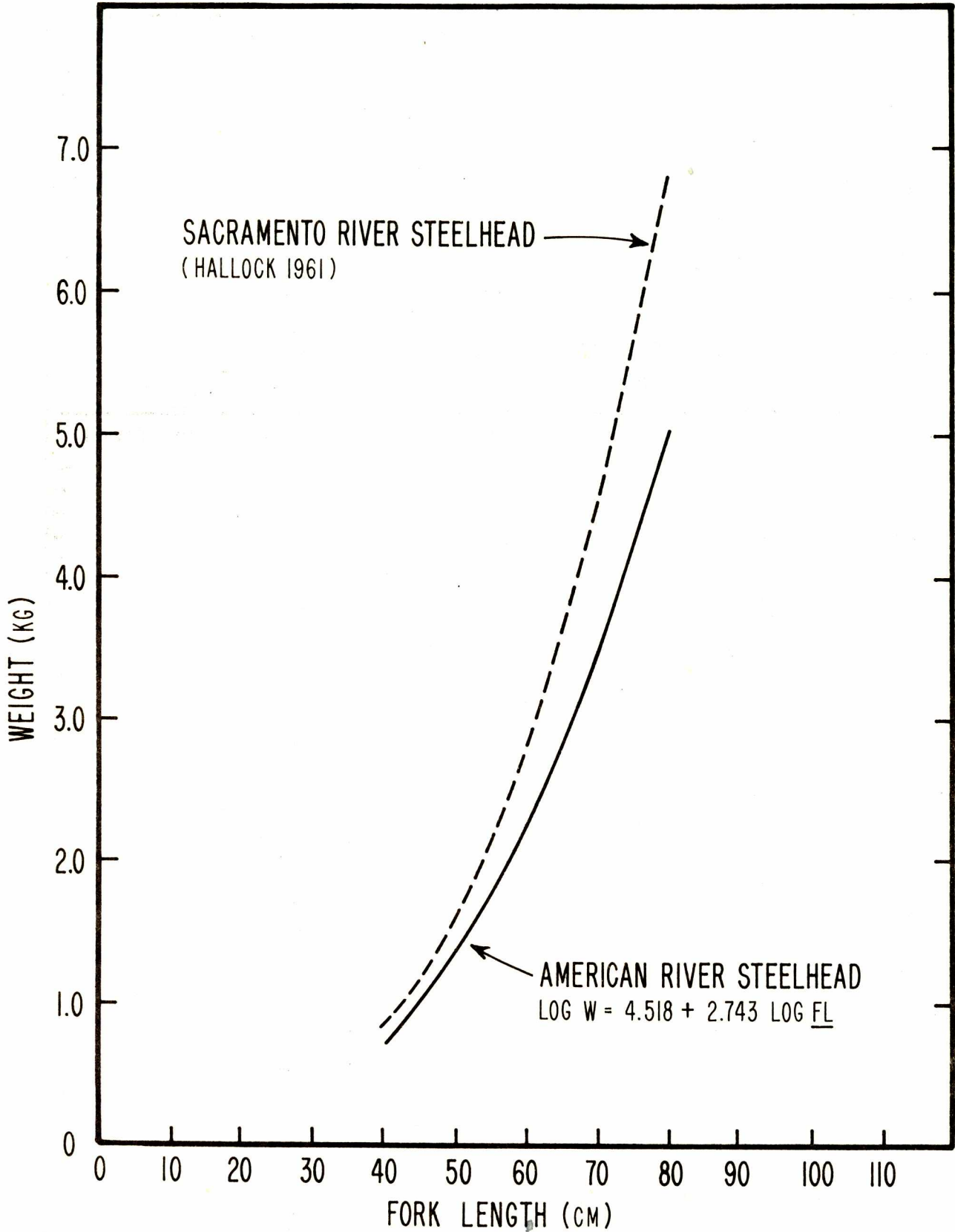


Figure 3. Comparison of weight-length relationships: American River-stock steelhead with Sacramento River-stock steelhead.

Steelhead made up 55% of the catch, and 30% of the catch was rainbow trout under 35.6 cm (14 inches) FL. King salmon were an important element of the catch only in October when they made up 33% of the catch.

Table 17

Summary of Creel Census Data 1972-73 Season

| Month | Anglers interviewed | Hours fished | Observed in catch | | | | | Catch/hour | |
|--------------|---------------------|----------------|-------------------|--------------------------------|---------------------------------|-------------|----------|-------------|-------------|
| | | | All species | Steelhead (≥ 35.6 cm FL) | Rainbow trout (< 35.6 cm FL) | King salmon | Other | All species | Steelhead |
| <u>1972</u> | | | | | | | | | |
| Sept. | 945 | 1667.5 | 101 | 52 | 42 | 2 | 5 | 0.06 | 0.03 |
| Oct. | 1,112 | 2529.5 | 239 | 116 | 43 | 80 | 0 | 0.09 | 0.05 |
| Nov. | 435 | 974.5 | 55 | 25 | 25 | 4 | 1 | 0.06 | 0.03 |
| Dec. | 241 | 423.5 | 19 | 7 | 11 | 1 | 0 | 0.04 | 0.02 |
| <u>1973</u> | | | | | | | | | |
| Jan. | 662 | 1,966.0 | 124 | 97 | 23 | 3 | 1 | 0.06 | 0.05 |
| Feb. | 608 | 1,556.5 | 92 | 60 | 31 | 1 | 0 | 0.06 | 0.04 |
| Mar. | 94 | 203.5 | 31 | 7 | 24 | 0 | 0 | 0.15 | 0.03 |
| TOTAL | 4,097 | 9,321.0 | 661 | 364 | 199 | 91 | 7 | 0.07 | 0.04 |

1973-74 Tagging Study

Methods

The equipment, trap location, and tag application method used in the 1973-74 study were identical to the 1971-72 tagging study. In addition, during October, steelhead were captured with a boat-mounted electroshocker and tagged. Every third tag applied was a \$5 reward tag. At Nimbus, every time the salmon and steelhead in the holding pond were sorted for spawning, the tags were removed from all steelhead and the data recorded. Sorting was generally done biweekly during November, and weekly from December through early April. Spawmed steelhead and unspawmed surplus fish were returned to the river.

Results

During October, 15 steelhead were captured with the electrofishing gear and tagged, 5 with reward tags and 10 with nonreward tags. One reward-tagged fish entered Nimbus Hatchery and three were caught by anglers. Three non-reward tags were returned by anglers; no nonreward tags were seen at Nimbus.

The fish tagged during electrofishing were not used in the rest of the analysis.

Trapping began in early November with the first steelhead tagged on November 14, 1973. Tagging continued uninterrupted until March 4, 1974 even though periodic flood flow releases were made from Folsom Dam. For several days in mid-January the river was flowing at 708 m³/sec (25,000 cfs). We tagged a total of 489 trap-caught steelhead; 164 with reward tags and 325 with nonreward tags. Fish were captured at a relatively even rate throughout the period with 243 trapped and tagged through December and 246 tagged during the remainder of the season.

The size distribution of the tagged steelhead (Figure 4a) was substantially different than what was observed in the 1971-72 trapping (Figure 2a). Only 46 fish were tagged that were less than 44 cm (17.3 inches) FL whereas 160 fish of this size were tagged in 1971-72. There was a large group of fish (289) between 44.0 and 59.9 cm (17.3 and 23.6 inches) FL with a mode in the 52.0-53.9 cm (20.5- to 21.2- inch) group. There were 127 fish relatively evenly spread in the 60.0- to 71.9-cm (23.6- to 28.3- inch) FL size range. We measured 19 fish longer than 72.0 cm (28.3 inches) FL with the largest being 88.5 cm (34.8 inches).

The size distribution of fish entering Nimbus in 1974 was similar to that of the 1973-74 trap-caught fish but relatively more fish over 60 cm (23.6 inches) FL were found at Nimbus (Figure 4b). Fewer fish less than 44 cm (17.3 inches) FL were seen at Nimbus because the smaller fish are not used for spawning and they were returned to the river before the sample was measured in late February and early March 1974.

Nimbus Hatchery recaptured 128 tagged steelhead (40 reward and 88 nonreward). This amounted to 26.2% of the number tagged. Fish tagged before the end of December entered Nimbus at a significantly higher rate (33.7%) than fish tagged after January 1 (19.1%). Fish tagged before December 31, 1973 also took longer to reach Nimbus (mean 26.7 days, median 24 days, range 3 to 118 days) than those tagged after January 1 (mean 19.7 days, median 17 days, range 3 to 60 days). There were no apparent differences in the rates at which small steelhead, less than 60 cm (23.5 inches) FL, and large steelhead entered Nimbus or the speed of their migration to the hatchery.

Because tags were removed from fish entering the hatchery, there was no empirical basis for estimating the harvest rate of these fish after they were returned to the river. I assumed that these fish were harvested at the same rate as fish which never entered the hatchery. The overall harvest rate and the rate of nonresponse were estimated using fishery returns only from the 361 tagged fish which never entered the hatchery.

Anglers returned 33 reward tags and 34 nonreward tags from fish caught during the first season, before July 1, 1974. Significantly (X^2 test 0.95 level) more reward tags were returned (26.6%) than nonreward tags (14.3%). Assuming all the reward tags were returned, the nonreturn rate on nonreward tags is about 46%. There was a slightly lower angler catch rate for fish tagged after January 1 but the difference was not significant (X^2 test, 0.95 level). Anglers did catch the smaller steelhead, less than 60 cm (23.6 inches) FL, at a far higher rate (34.6%) than the larger steelhead (12.5%).

Only two of the first season tag returns came from outside the American River, and these were of nonreward tags. One was from a fish fin-marked as a yearling at Feather River Hatchery and it was caught in the Feather River. The other was from a fish fin-marked at Coleman Hatchery and released at Rio Vista.

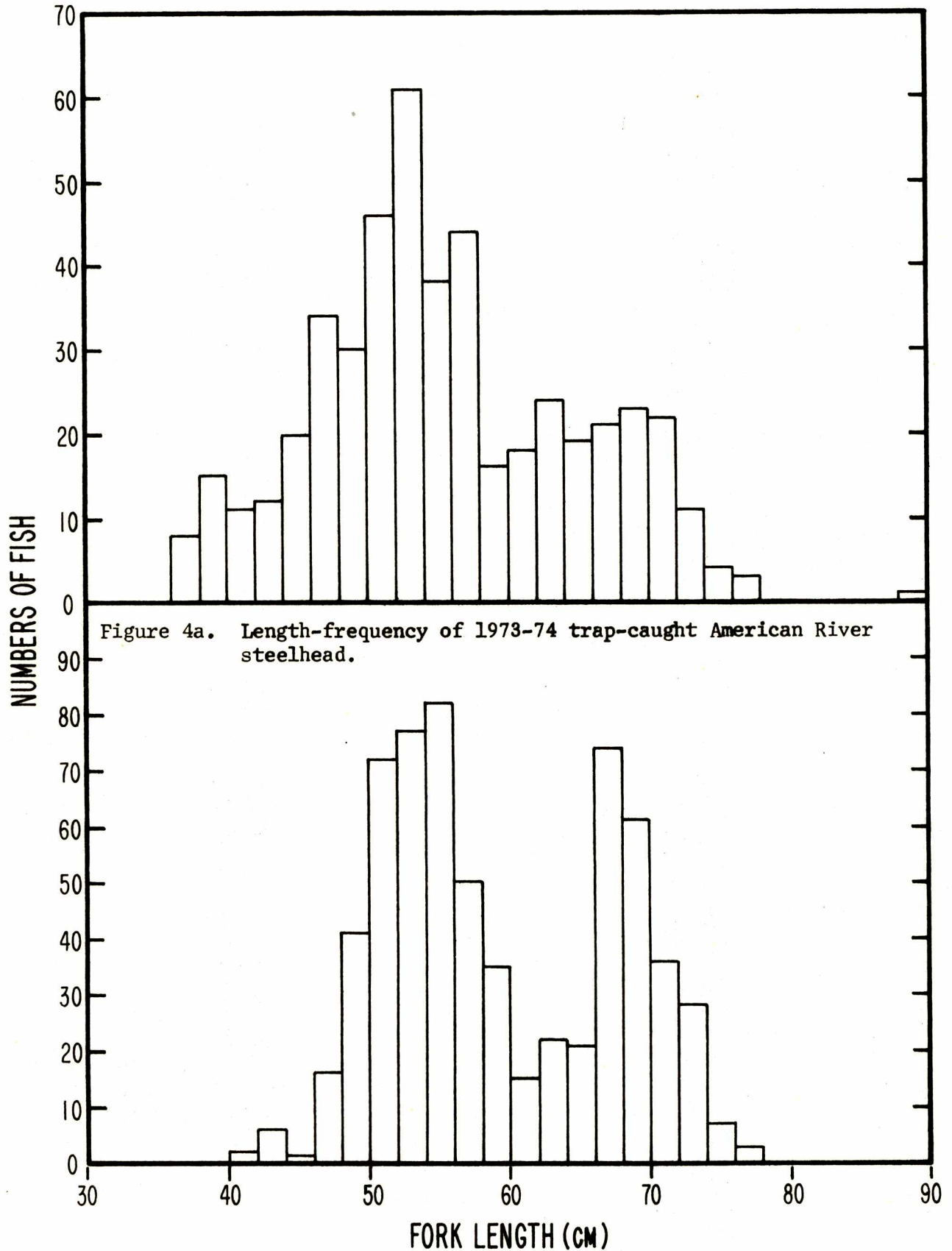


Figure 4b. Length-frequency of steelhead measured at Nimbus Hatchery, February-March, 1974.

This fish was caught in the Carquinez Strait near Martinez. The majority of the tag returns came from fish caught above Sunrise Boulevard Bridge in the American River. The next most frequent recapture locality was the section of the American River between Watt Avenue Bridge and Glenn Hall Park. Only three fish were reported caught between the Watt Avenue and Sunrise Boulevard Bridges. Of fish caught the first season, the median time to recapture was 19 days (mean, 23; range, 1 to 82).

During the second season (1974-75 Fiscal Year) anglers returned four nonreward tags. One fish was caught in the American River and two in the Sacramento River between Red Bluff and Anderson. The fourth fish, marked as a yearling at Feather River Hatchery, was caught in the Feather River near Gridley. All of these fish were less than 46 cm (18.1 inches) FL at the time of tagging. Nimbus Hatchery recovered one nonreward tag during the second season.

The 1973-74 American River steelhead run was estimated using the modified Petersen formula:

$$\hat{N} = \frac{M(C+1)}{R+1}, \text{ where}$$

\hat{N} = The population estimate

M = Number of fish tagged during trapping operations (489)

C = Number of tagged and untagged fish entering Nimbus Hatchery (3,237)

R = Number of tagged fish recovered at the hatchery (128)

Confidence limits were determined by using equation no. 55 from Chapman (1948).

The 1973-74 American River steelhead population estimate is 12,274 with 95% confidence limits of 10,433 and 14,664. If the reward tag return rate (26.6%) is applied to this estimated population, then an estimated 3,265 steelhead were harvested by anglers during the season.

1973-74 Creel Census

During the 1973-74 steelhead fishing season on the American River a total of 2,114 anglers who had fished 5,590 hours were interviewed during the September through February period. The areas of the census were the same as those of the 1972-73 census. They caught a total of 111 steelhead, 154 rainbow trout, 31 king salmon and 3 fish of other species (Table 18). A daily summary of the 1973-74 creel census observations appears in Appendix Table 6. There was one peak in steelhead angling success in October, followed by poor catches in November and December. After the salmon spawning closure ended, steelhead angling success improved and remained fairly constant at 0.03 steelhead per angling hour for January and February. Angling success in November and December was lower than normal, probably because of many periods of high flows during these months.

4/13/67
198 revised
spare

Table 18
Monthly Summaries of 1973-74 Creel Census Data

| | Anglers interviewed | Hours fished | Observed in catch | | | | | Catch/hour | |
|--------------|---------------------|--------------|-------------------|--------------------------------|---------------------------------|-------------|----------|-------------|-------------|
| | | | All species | Steelhead (≥ 35.6 cm FL) | Rainbow trout (< 35.6 cm FL) | King salmon | Other | All species | Steelhead |
| 1973 | | | | | | | | | |
| September | 287 | 713 | 30 | 1 | 25 | 1 | 3 | 0.04 | <0.01 |
| October | 359 | 924 | 52 | 20 | 18 | 14 | 0 | 0.06 | 0.02 |
| November | 219 | 463 | 19 | 2 | 10 | 7 | 0 | 0.04 | <0.01 |
| December | 204 | 372 | 22 | 4 | 12 | 6 | 0 | 0.06 | 0.01 |
| 1974 | | | | | | | | | |
| January | 659 | 2,001 | 84 | 53 | 28 | 3 | 0 | 0.04 | 0.03 |
| February | 386 | 1,117 | 92 | 31 | 61 | 0 | 0 | 0.08 | 0.03 |
| TOTAL | 2,114 | 5,590 | 299 | 111 | 154 | 31 | 3 | 0.05 | 0.02 |

SUMMARY

The winter-run steelhead population in the American River is produced in large part from yearlings reared at Nimbus Hatchery and released at Clarksburg on the Sacramento River. Continued increases have been made in the number of yearlings released and in the survival from yearling to adult. As a result, the number of adult steelhead entering Nimbus Hatchery has increased from an average of 230 per year for the 1956-1962 period, to 2,645 per year during the 1969-1974 period.

Fin-marking experiments involving 1962, 1963, and 1964 broodyear steelhead indicated Nimbus Hatchery return rates for yearlings released in the lower Sacramento River were approximately twice the return rates for yearlings released in the American River. Beginning with the 1966 brood year, most yearling steelhead plants have been made in the lower Sacramento River, primarily at Clarksburg.

Yearling tagging experiments indicated that 51.2% of fish released in June, 1970 in the American River were caught by anglers as juveniles. Tagged yearlings released in the lower Sacramento River were harvested as juveniles at much lower rates (1.0-5.8%). Tagged fish released at Clarksburg (lower Sacramento River) showed lower juvenile harvest rates when released in March, compared to June (1.0 vs 5.8%).

5000
 15
 25 000
 5006

 75 000

Attempts to establish early (summer and fall-run) steelhead runs in the American began in 1969 and are continuing. Evaluations of these programs are incomplete, but one group of fall-run yearlings returned to the hatchery at a rate of 0.34%.

The steelhead sport fishery begins in September and extends through March. Peaks in angling success are generally in October and January. Most of the steelhead angling occurs downstream from Ancil Hoffman Park during the fall (September-December) and upstream from that park in January through March.

Several intensive studies to estimate American River steelhead populations, use, and catch, were conducted from 1970 through 1974.

Angling pressure on the American River is high during the salmon and steelhead fishing season. In 1971-72 an estimated 150,508 angling hours were spent from October through February. Anglers caught an estimated 5,369 steelhead for an average catch rate of 0.036 steelhead per hour.

In 1973-74 the estimated catch was 3,265 steelhead. The estimated angler success rate was 0.02 steelhead per hour. *x 20 day per 54*

Steelhead population estimates were 19,583 in 1971-72 and 12,274 in 1973-74.

In 1973-74, a high water year, anglers harvested about 27% of the run. The estimated angler harvest rate of small steelhead--35.6 to 49.9 cm (14 to 23.5 inches) FL--was more than 2.5 times higher than the rate for larger steelhead (34.6 vs 12.5%). In 1971-72 anglers harvested an estimated 27.4% of the run.

American River winter-run steelhead are large fish, averaging about 69 cm (27 inches) FL as 3-year-olds, and 48.5 cm (19 inches) as 2-year-olds. These fish make up the bulk of the January-March American River steelhead run. Most of these fish are the result of Nimbus Hatchery production.

From September through December a large proportion of the American River steelhead run consists of steelhead probably produced in the upper Sacramento River system. These fish are typically smaller than American River winter-run fish; they average approximately 53 cm (21 inches) FL as 3-year-olds. During the years of our study, their abundance in the American River resulted partly from the straying of Coleman Hatchery fish, planted as yearlings in the lower Sacramento River.

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Appendix Table 1

Adult Steelhead Counts at Nimbus Hatchery, 1955-1974

| Fiscal year | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | Total |
|--------------------------|---------|---------------|-----------|---------------|-------|-------------------------|------|-----|-------|
| 1955-56 | ← | 25 | → | ← | 85 | → | | | 110 |
| 1956-57 | ← | * | → | ← | 115 | → | | | 115 |
| 1957-58 | ← | * | → | ← | 51 | → | | | 51 |
| 1958-59 | ← | * | → | 59 | 34 | 0 | 9 | | 102 |
| 1959-60 | ← | * | → | 213 | 287 | 212 | 64 | 2 | 778 |
| 1960-61 | ← | * | → | 55 | 171 | 88 | 2 | | 316 |
| 1961-62 | ← | * | → | 14 | 72 | 33 | 18 | | 137 |
| 1962-63 | ← | * | 350 | 302 | 1,185 | 282 | 21 | | 2,141 |
| 1963-64 | ← | * | 119 | 663 | 325 | 109 | 0 | | 1,216 |
| 1964-65 | ← | * | 70 | 200 | 375 | 133 | 0 | | 778 |
| 1965-66 | ← | * | 261 | 330 | 283 | (Ladder closed 2/23/66) | | | 874 |
| 1966-67 | ← | * | 132 | 224 | 191 | 93 | 2 | | 642 |
| 1967-68 | ← | * | 102 | 352 | 663 | 66 | 0 | | 1,183 |
| 1968-69 | | Approx. 1,000 | | Approx. 2,000 | | | | | 3,066 |
| 1969-70 | ← 27 → | 556 | → | ← 1,151 → | | | | | 1,734 |
| 1970-71 | ← 65 → | 1,261 | → | ← 1,707 → | | | | | 3,033 |
| 1971-72 | ← 183 → | → | ← 2,073 → | | | | | | 2,256 |
| 1972-73 WR | 37 | 321 | ← 2,148 → | | | | | | 2,506 |
| 1972-73 Summer Steelhead | | | | | | | | | 40 |
| TOTAL 1972-73 | | | | | | | | | 2,546 |
| 1973-74 WR | 172 | 357 | 185 | ← 2,443 → | | | | | 3,157 |
| 1973-74 Summer Steelhead | | | | | | | | | 80 |
| TOTAL 1973-74 | | | | | | | | | 3,237 |

* Numbers not recorded for the indicated period; seasons' total counts are incomplete for seasons prior to 1968-69.

Appendix Table 2

Summary of Nimbus Hatchery--Steelhead Production, 1956-1973

| Hatchery production | | | | | | |
|---------------------|-----------|---------------------------|------------------------------|------------------------|----------------------|------------------|
| | Broodyear | Eggs taken or received | Egg source | Fingerlings planted | Yearlings planted | Total planted |
| Total | 1956 | 205,674 | Nimbus | 0 | 34,328 | 34,328 |
| | 1957 | 184,768 | Nimbus | ? | ? | 66,748 |
| | 1957 | 1,077,153 | Eel River | ? | ? | 924,189 |
| Total | 1957 | 1,261,921 | | ? | ? | 990,937 |
| | 1958 | 34,000 | Nimbus | 28,308 | 0 | 28,308 |
| | 1958 | 1,113,466 | Eel River | 337,500 | 371,345 | 708,895 |
| Total | 1958 | 1,147,466 | | 365,808 | 371,345 | 737,153 |
| | 1959 | 54,581 | Nimbus | 39,500 | 0 | 39,500 |
| | 1959 | 1,137,520 | Eel River | 274,252 | 176,640 | 450,892 |
| Total | 1959 | 1,192,101 | | 313,752 | 176,640 | 490,392 |
| | 1960 | 1,189,200 | Nimbus | 394,799 | 200,392 | 595,191 |
| | 1960 | 223,920 | Eel River | 165,120 | 0 | 165,120 |
| Total | 1960 | 1,413,120 | | 559,919 | 200,392 | 760,311 |
| Total | 1961 | 481,200 | Nimbus | 14,472 | 124,278 | 138,750 |
| | 1962 | 145,000 | Nimbus | 5,372 | 46,881 | 52,253 |
| | 1962 | 446,111 | Eel River | 0 | 58,338 | 58,338 |
| Total | 1962 | 591,111 | | 5,372 | 105,219 | 110,591 |
| Total | 1963 | 2,818,000 | Nimbus | 1,402,703 | 197,883 | 1,600,586 |
| Total | 1964 | 2,205,202 | Nimbus | 989,479 | 104,139 | 1,093,618 |
| | 1965 | 663,150 | Nimbus | 112,068 | 157,018 | 269,086 |
| | 1965 | 785,000 | Coleman Hatchery | 247,356 | 0 | 247,356 |
| Total | 1965 | 1,448,150 | | 359,424 | 157,018 | 516,442 |
| Total | 1966 | 1,716,840 | Nimbus | 87,725 | 217,090 | 304,815 |
| Total | 1967 | 737,855 | Nimbus | 40,240 | 217,430 | 257,670 |
| Total | 1968 | 2,511,180 | Nimbus | 62,400 | 308,905 | 371,305 |
| | 1969 | 1,768,790 | Nimbus | 624,120 | 343,740 | 967,860 |
| | 1969 | 194,000 | Washougal River (Summer Run) | 0 | 18,700 | 18,700 |
| Total | 1969 | 1,962,790 | | 624,120 | 362,440 | 986,560 |
| | 1970 | 1,872,720 | Nimbus | 383,535 | 393,300 | 776,835 |
| | 1970 | 87,300 | Washougal River (Sum. R.) | 0 | 67,445 | 67,445 |
| Total | 1970 | 1,960,020 | | 383,535 | 460,745 | 844,280 |
| | 1971 | 2,423,635 | Nimbus | 1,144,910 | 503,625 | 1,648,535 |
| | 1971 | 128,561 | Siletz River. (Sum. R.) | 23,200 | 69,040 | 92,240 |
| Total | 1971 | 2,552,196 | | 1,168,110 | 572,665 | 1,740,775 |
| Total | 1972 | 3,479,545 | | 1,112,675 | 355,150 | 1,467,825 |
| | 1973 | 1,921,965 | Nimbus | 737,655 | 368,162 | 1,105,817 |
| | 1973 | 115,445* | Nimbus (Summer Run) | 12,240 | 104,604 | 116,844 |
| | 1973 | 77,850 | Sacramento River | 6,100 | 37,040 | 43,140 |
| Total | 1973 | 2,115,260 | | 755,995 | 509,806 | 1,265,801 |

* An additional 63,163 Washougal strain-summer steelhead fingerlings were received from Moccasin Creek Hatchery.

Appendix Table 3 (page 1 of 3)

Angler Use Counts, October, 1971 through March, 1972

| Section 1--Nimbus Dam to Hazel Avenue | | | | | | | |
|---------------------------------------|------|------|------|------|------|------|------------------------|
| Date | 0800 | 1000 | 1200 | 1400 | 1600 | 1800 | Mean instantaneous use |
| Weekdays | | | | | | | |
| October 4 | 0 | 4 | 4 | 0 | 6 | 16 | |
| 5 | 6 | 1 | 1 | 1 | 7 | 20 | |
| 8 | 3 | 6 | 0 | 5 | 8 | 40 | |
| 12 | 3 | 8 | 4 | 0 | 12 | 17 | |
| 13 | 7 | 9 | 5 | 6 | - | 20 | |
| 14 | 10 | 9 | 8 | 12 | 10 | 22 | 20.9 |
| 18 | 4 | 12 | 9 | 8 | 18 | 31 | |
| 20 | 20 | 34 | 40 | 40 | 45 | 49 | |
| 22 | 29 | 23 | 16 | 25 | 28 | 92 | |
| 26 | 20 | 27 | 33 | 37 | 52 | 103 | |
| 28 | 18 | 23 | 33 | 27 | 55 | 73 | |
| 29 | 8 | 44 | 45 | 33 | - | - | |
| November 1 | 42 | 48 | 54 | 52 | 78 | 64 | |
| 3 | 36 | 38 | 52 | 60 | 65 | 87 | |
| 4 | 36 | 40 | 47 | 50 | 70 | 66 | |
| 9 | 45 | 53 | 52 | 55 | 60 | 76 | |
| 12 | 28 | 44 | 45 | 50 | 48 | - | 48.6 |
| 16 | 40 | 55 | 51 | 47 | 52 | - | |
| 18 | 46 | 53 | 36 | 41 | 39 | - | |
| 22 | 20 | 30 | 32 | 32 | 44 | - | |
| 26 | 88 | 93 | 62 | - | - | - | |
| 30 | - | 19 | 27 | 17 | 13 | - | |
| December 1 | 8 | 12 | 9 | 11 | 10 | 14 | |
| 2 | 4 | 6 | 7 | 11 | 7 | - | |
| 6 | 8 | 6 | 7 | 14 | 5 | - | |
| 7 | 5 | 8 | 2 | 12 | - | - | |
| 9 | 8 | 4 | 4 | 10 | - | - | |
| 13 | 6 | 10 | 5 | 8 | 8 | - | |
| 15 | 4 | 4 | 4 | 5 | 9 | - | 9.0 |
| 17 | 5 | 5 | 8 | 8 | 7 | - | |
| 21 | 13 | 10 | 13 | 10 | 14 | - | |
| 22 | 1 | 5 | 5 | - | - | - | |
| 23 | 6 | 7 | 4 | 19 | 21 | - | |
| 27 | 6 | 4 | - | 13 | 7 | - | |
| 28 | 14 | 24 | 16 | 15 | 18 | - | |
| 30 | 6 | 10 | 19 | 16 | - | - | |
| Weekend Days | | | | | | | |
| October 10 | 13 | 21 | 8 | 3 | 11 | 29 | |
| 16 | 29 | 30 | 26 | 35 | - | - | 39.1 |
| 30 | 77 | 89 | 70 | 74 | 72 | - | |
| November 7 | 144 | 121 | 114 | 119 | 105 | 107 | |
| 13 | 29 | 35 | 62 | 108 | - | - | 78.4 |
| 21 | 79 | 38 | 62 | 56 | - | - | |
| 27 | 52 | 60 | 58 | 62 | - | - | |
| December 5 | 29 | 27 | 25 | 26 | 23 | - | 26.1 |
| 11 | 26 | 21 | 29 | 29 | - | - | |

- No count made.

Appendix Table 3 Continued (page 2 of 3)

| Section 2--Ancil Hoffman Park through Glenn Hall Park | | | | | | | |
|---|--------------|-----|-----|-----|-----|-----|------------------------|
| Date | Count Period | | | | | 5 | Mean instantaneous use |
| | 1 | 2 | 3 | 4 | | | |
| Weekdays | | | | | | | |
| October | 4 | 27 | 21 | 13 | 36 | - | |
| | 8 | 63 | 45 | 36 | 45 | - | |
| | 19 | 60 | 48 | 54 | 46 | - | 47.6 |
| | 20 | 84 | 75 | 68 | 62 | - | |
| | 25 | 58 | 58 | 52 | 50 | 63 | |
| | 28 | 41 | 29 | 23 | 32 | - | |
| November | 17 | 46 | 62 | 72 | 76 | - | |
| | 18 | 48 | 60 | 35 | 28 | - | 51.6 |
| | 22 | 64 | 57 | 29 | - | - | |
| | 30 | 32 | 47 | 52 | 66 | - | |
| December | 2 | 14 | 18 | 28 | - | - | |
| | 9 | 6 | 6 | 10 | 12 | - | 23.4 |
| | 16 | 22 | 23 | 31 | 33 | - | |
| | 28 | 62 | 39 | - | - | - | |
| Weekend days | | | | | | | |
| October | 2 | 131 | 136 | 141 | 119 | 136 | |
| | 16 | 99 | 127 | 127 | 96 | 66 | |
| | 17 | 104 | 103 | 81 | 74 | 59 | 101.1 |
| | 23 | 87 | 103 | 149 | 159 | - | |
| | 31 | 48 | 60 | 73 | 86 | 62 | |
| November | 7 | 176 | 154 | 112 | 90 | - | |
| | 14 | 108 | 95 | 79 | 77 | - | 105.4 |
| | 20 | 149 | 155 | 148 | 133 | - | |
| | 28 | 58 | 52 | 59 | 42 | - | |
| December | 5 | 74 | 73 | 77 | 65 | - | |
| | 11 | 67 | 75 | 67 | 42 | - | |
| | 12 | 5 | 5 | 18 | 33 | - | 51.3 |
| | 18 | 62 | 50 | 57 | 54 | - | |
| | 26 | 63 | 64 | 37 | 37 | - | |

- No count made.

Appendix Table 3 Continued (page 3 of 3)

| Nimbus Dam through Goethe Park | | | | | | |
|--------------------------------|--------------|-----|-----|-----|------------------------|-------|
| Date | Count period | | | | Mean instantaneous use | |
| | 1 | 2 | 3 | 4 | | |
| Weekdays | | | | | | |
| January | 4 | 95 | 103 | 105 | 32 | 72.8 |
| | 13 | 78 | 85 | 83 | 106 | |
| | 14 | 66 | 62 | 68 | - | |
| | 19 | 46 | 43 | 72 | 62 | |
| | 24 | 62 | 71 | 68 | 76 | |
| February | 3 | 25 | 33 | - | - | 56.3 |
| | 4 | 39 | 61 | 47 | 39 | |
| | 10 | 57 | 74 | 60 | 76 | |
| | 14 | 58 | 63 | 52 | 40 | |
| | 16 | 63 | 98 | 77 | 82 | |
| | 24 | 63 | 61 | 53 | 44 | |
| | 29 | 43 | 56 | 53 | 46 | |
| March | 2 | 45 | 68 | 50 | 54 | 35.7 |
| | 7 | 27 | 36 | - | - | |
| | 14 | 12 | - | - | - | |
| | 19 | 10 | - | - | - | |
| | 24 | 19 | - | - | - | |
| Weekend days | | | | | | |
| January | 1 | 314 | 286 | 149 | 130 | 168.0 |
| | 2 | 189 | 118 | 119 | 83 | |
| | 8 | 311 | 229 | 194 | 170 | |
| | 15 | 187 | 216 | 195 | 173 | |
| | 16 | 167 | - | - | - | |
| | 22 | 121 | 210 | 200 | 165 | |
| | 23 | 147 | 146 | 109 | 50 | |
| | 30 | 138 | 143 | 114 | 99 | |
| February | 5 | 49 | 55 | - | - | 142.0 |
| | 6 | 144 | 150 | 136 | 127 | |
| | 12 | 192 | 162 | 152 | 157 | |
| | 13 | 174 | 157 | 156 | 113 | |
| | 26 | 158 | 196 | 142 | 152 | |
| | 27 | 134 | 146 | 136 | 135 | |
| March | 11 | 38 | 50 | 50 | 50 | 42.5 |
| | 18 | 39 | 34 | 33 | 45 | |
| | 26 | 34 | 49 | 43 | 45 | |

- No count made.

Appendix Table 4

Daily Summaries of 1971-72 American River Creel Census Data

| Section 1--Nimbus Dam to Hazel Avenue | | | | | Section 2--Ancil Hoffman through Glenn Hall Parks | | | | |
|---------------------------------------|---------------------|--------------|---------------|--------------------|---|---------------------|----------------|---------------|--------------------|
| Date | Anglers interviewed | Hours fished | Fish observed | Steelhead observed | Date | Anglers interviewed | Hours fished | Fish observed | Steelhead observed |
| October 1971 | | | | | October | | | | |
| 4 | 14 | 19.5 | 1 | 1 | 3 | 129 | 247.0 | 8 | 3 |
| 5 | 1 | 1.0 | 0 | 0 | 5 | 53 | 94.0 | 10 | 5 |
| 13 | 9 | 9.0 | 1 | 0 | 13 | 62 | 181.5 | 38 | 21 |
| 14 | 9 | 9.5 | 0 | 0 | 19 | 80 | 205.5 | 16 | 10 |
| 18 | 8 | 10.5 | 0 | 0 | 24 | 72 | 116.0 | 6 | 6 |
| 20 | 31 | 70.0 | 2 | 1 | TOTAL | 396 | 844.0 | 78 | 45 |
| 22 | 25 | 58.5 | 2 | 0 | November | | | | |
| 26 | 47 | 123.5 | 3 | 2 | 2 | 34 | 53.5 | 0 | 0 |
| 28 | 14 | 27.0 | 4 | 0 | 6 | 72 | 208.5 | 19 | 6 |
| 29 | 31 | 61.0 | 5 | 0 | 11 | 13 | 29.0 | 1 | 1 |
| TOTAL | 189 | 389.5 | 18 | 4 | 21 | 68 | 138.0 | 13 | 9 |
| November | | | | | TOTAL | 187 | 429.0 | 33 | 16 |
| 1 | 43 | 159.0 | 15 | 0 | December | | | | |
| 3 | 25 | 71.0 | 7 | 0 | 4 | 53 | 105.5 | 7 | 7 |
| 4 | 24 | 67.0 | 5 | 0 | 10 | 6 | 8.5 | 0 | 0 |
| 9 | 29 | 46.5 | 9 | 0 | 19 | 48 | 95.0 | 11 | 7 |
| 12 | 30 | 97.0 | 8 | 0 | 23 | 20 | 40.5 | 4 | 4 |
| 16 | 42 | 189.0 | 14 | 0 | TOTAL | 127 | 249.5 | 22 | 18 |
| 18 | 33 | 46.5 | 11 | 2 | Nimbus Dam to Goethe Park | | | | |
| 22 | 20 | 32.5 | 8 | 1 | January, 1972 | | | | |
| 26 | 26 | 77.0 | 9 | 0 | 1 | 428 | 1,428.0 | 79 | 64 |
| 30 | 6 | 12.0 | 0 | 0 | 2 | 275 | 774.5 | 29 | 25 |
| TOTAL | 278 | 797.5 | 86 | 3 | 9 | 169 | 472.5 | 23 | 12 |
| December | | | | | 16 | 137 | 322.5 | 21 | 8 |
| 1 | 4 | 4.0 | 1 | 0 | 20 | 92 | 260.0 | 27 | 12 |
| 2 | 7 | 9.0 | 1 | 0 | 29 | 80 | 251.5 | 14 | 6 |
| 6 | 6 | 9.0 | 2 | 2 | TOTAL | 1,181 | 3,509.0 | 193 | 127 |
| 7 | 7 | 26.5 | 5 | 1 | February | | | | |
| 9 | 6 | 8.5 | 1 | 1 | 5 | 66 | 160.0 | 6 | 5 |
| 13 | 8 | 13.5 | 1 | 0 | 13 | 93 | 237.5 | 10 | 6 |
| 15 | 3 | 3.0 | 0 | 0 | 15 | 48 | 121.0 | 14 | 7 |
| 17 | 3 | 3.0 | 2 | 0 | 26 | 101 | 382.0 | 17 | 12 |
| 18 | 1 | 6.0 | 1 | 1 | TOTAL | 308 | 900.5 | 47 | 30 |
| 21 | 15 | 26.0 | 4 | 4 | | | | | |
| 23 | 5 | 9.0 | 0 | 0 | | | | | |
| 27 | 4 | 10.0 | 1 | 1 | | | | | |
| 28 | 8 | 15.0 | 0 | 0 | | | | | |
| TOTAL | 77 | 142.5 | 19 | 10 | | | | | |

- No count made.

40/1/72

130/2/72

56/7/72

Appendix Table 5

Daily Creel Census Observations,
September, 1972 through March, 1973

| Date | No. anglers interviewed | No. hours fished | No. fish caught | No. SH caught | Date | No. anglers interviewed | No. hours fished | No. fish caught | No. SH caught |
|-----------------------|-------------------------|------------------|-----------------|---------------|----------------------|-------------------------|------------------|-----------------|---------------|
| September 1972 | | | | | December 1972 | | | | |
| 4 | 86 | 202.0 | 10 | 4 | 2 | 23 | 40.0 | 4 | 0 |
| 7 | 51 | 86.0 | 9 | 4 | 3 | 26 | 57.0 | 2 | 0 |
| 9 | 63 | 131.0 | 16 | 10 | 5 | 2 | 6.0 | 1 | 0 |
| 10 | 63 | 85.0 | 5 | 5 | 9 | 31 | 60.5 | 2 | 2 |
| 12 | 47 | 97.5 | 3 | 2 | 10 | 21 | 34.0 | 0 | 0 |
| 15 | 43 | 74.5 | 4 | 0 | 13 | 8 | 10.0 | 0 | 0 |
| 16 | 85 | 156.0 | 14 | 11 | 17 | 19 | 49.5 | 1 | 1 |
| 17 | 56 | 81.5 | 4 | 3 | 18 | 19 | 44.5 | 3 | 2 |
| 20 | 62 | 78.0 | 3 | 1 | 23 | 24 | 26.5 | 0 | 0 |
| 22 | 49 | 68.0 | 5 | 1 | 24 | 28 | 40.5 | 3 | 2 |
| 23 | 87 | 145.0 | 6 | 1 | 30 | 40 | 55.0 | 3 | 0 |
| 24 | 81 | 116.0 | 7 | 0 | TOTAL | 241 | 423.5 | 19 | 7 |
| 28 | 35 | 60.0 | 4 | 1 | January 1973 | | | | |
| 29 | 49 | 73.0 | 3 | 3 | 1 | 202 | 886.5 | 45 | 34 |
| 30 | 88 | 214.0 | 8 | 6 | 6 | 137 | 379.5 | 16 | 7 |
| TOTAL | 945 | 1,667.5 | 101 | 52 | 7 | 98 | 257.0 | 4 | 3 |
| October | | | | | 11 | 15 | 17.5 | 4 | 1 |
| 1 | 86 | 171.0 | 16 | 8 | 23 | 27 | 53.5 | 4 | 4 |
| 4 | 33 | 51.0 | 8 | 7 | 25 | 25 | 43.5 | 7 | 7 |
| 6 | 54 | 125.0 | 10 | 5 | 26 | 33 | 51.0 | 5 | 5 |
| 7 | 80 | 164.0 | 16 | 8 | 27 | 69 | 158.0 | 26 | 25 |
| 8 | 75 | 102.0 | 11 | 7 | 28 | 56 | 119.5 | 13 | 11 |
| 10 | 83 | 254.0 | 33 | 16 | TOTAL | 662 | 1,966 | 124 | 97 |
| 13 | 31 | 49.0 | 0 | 0 | February | | | | |
| 14 | 84 | 208.0 | 18 | 8 | 3 | 53 | 212.0 | 6 | 3 |
| 15 | 81 | 118.0 | 12 | 6 | 4 | 55 | 117.5 | 5 | 5 |
| 20 | 73 | 217.0 | 25 | 11 | 10 | 49 | 110.5 | 6 | 4 |
| 21 | 90 | 374.0 | 38 | 16 | 11 | 42 | 81.5 | 1 | 0 |
| 22 | 47 | 159.0 | 10 | 5 | 12 | 49 | 142.0 | 9 | 7 |
| 25 | 64 | 126.0 | 8 | 6 | 17 | 83 | 204.0 | 15 | 10 |
| 27 | 61 | 150.0 | 12 | 8 | 18 | 72 | 180.0 | 15 | 7 |
| 28 | 109 | 178.0 | 16 | 2 | 19 | 90 | 221.0 | 15 | 12 |
| 29 | 45 | 56.0 | 4 | 2 | 24 | 49 | 141.0 | 7 | 5 |
| 30 | 16 | 27.0 | 2 | 1 | 25 | 66 | 147.0 | 13 | 7 |
| TOTAL | 1,112 | 2,529.0 | 239 | 116 | TOTAL | 608 | 1,556.5 | 92 | 60 |
| November | | | | | March | | | | |
| 4 | 54 | 158.5 | 22 | 11 | 4 | 74 | 159.0 | 25 | 7 |
| 5 | 93 | 261.5 | 11 | 7 | 11 | 20 | 44.5 | 6 | 0 |
| 7 | 34 | 54.5 | 1 | 1 | TOTAL | 94 | 203.5 | 31 | 7 |
| 11 | 46 | 96.5 | 0 | 0 | <i>1972 hrs/ang</i> | | | | |
| 12 | 40 | 80.0 | 2 | 1 | | | | | |
| 15 | 10 | 13.0 | 2 | 1 | | | | | |
| 16 | 19 | 42.0 | 3 | 3 | | | | | |
| 18 | 36 | 81.5 | 5 | 0 | | | | | |
| 19 | 30 | 67.0 | 1 | 1 | | | | | |
| 24 | 28 | 34.5 | 1 | 0 | | | | | |
| 25 | 45 | 85.5 | 7 | 0 | | | | | |
| TOTAL | 435 | 974.5 | 55 | 25 | | | | | |

Appendix Table 6

Daily Summary of 1973-74 Creel Census Observations

| | | Anglers interviewed | Hours fished | Observed catch | |
|-----------|----|---------------------|--------------|----------------|-----------|
| | | | | All species | Steelhead |
| 1973 | | | | | |
| September | 8 | 47 | 88 | 2 | 0 |
| | 16 | 82 | 133 | 10 | 0 |
| | 22 | 101 | 206 | 18 | 1 |
| | 29 | 57 | 286 | 0 | 0 |
| TOTAL | | 287 | 713 | 30 | 1 |
| October | 6 | 64 | 138 | 22 | 11 |
| | 13 | 147 | 337 | 19 | 3 |
| | 20 | 70 | 239 | 7 | 2 |
| | 27 | 78 | 210 | 4 | 4 |
| TOTAL | | 359 | 924 | 52 | 20 |
| November | 3 | 101 | 278 | 5 | 0 |
| | 10 | 30 | 63 | 0 | 0 |
| | 18 | 26 | 36 | 3 | 0 |
| | 24 | 62 | 86 | 11 | 2 |
| TOTAL | | 219 | 463 | 19 | 2 |
| December | 2 | 37 | 54 | 4 | 0 |
| | 8 | 20 | 49 | 10 | 2 |
| | 16 | 32 | 74 | 2 | 0 |
| | 22 | 30 | 46 | 5 | 2 |
| | 23 | 52 | 109 | 1 | 0 |
| | 30 | 33 | 40 | 0 | 0 |
| TOTAL | | 204 | 372 | 22 | 4 |
| 1974 | | | | | |
| January | 1 | 328 | 1,271 | 37 | 30 |
| | 5 | 31 | 68 | 1 | 0 |
| | 11 | 70 | 105 | 8 | 2 |
| | 13 | 85 | 183 | 10 | 5 |
| | 19 | 34 | 70 | 1 | 0 |
| | 27 | 111 | 304 | 27 | 16 |
| TOTAL | | 659 | 2,001 | 84 | 53 |
| February | 3 | 89 | 266 | 24 | 6 |
| | 9 | 106 | 321 | 26 | 9 |
| | 17 | 101 | 292 | 23 | 10 |
| | 23 | 90 | 238 | 19 | 6 |
| TOTAL | | 386 | 1,117 | 92 | 31 |

2/27/74
36-00-44