

UNITED STATES GOVERNMENT

memorandum

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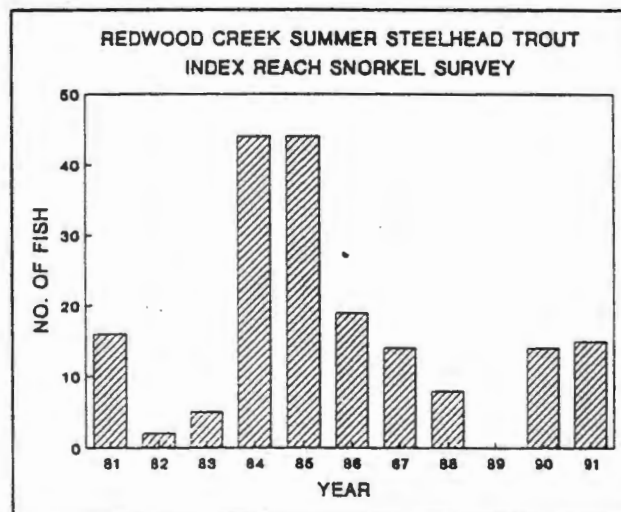
Date: November 13, 1991

To: Fish and Wildlife Biologist

From: Fishery Biologist

Subject: 1991 Redwood Creek Summer Steelhead (Oncorhynchus mykiss) Survey

Attached is the 1991 Redwood Creek summer steelhead report. The mainstem of Redwood Creek, between Lacks Creek and Tom McDonald Creek, a 16.1 mile index reach, was snorkel surveyed for adult summer steelhead on August 5, 6, 7, and 8, 1991. This was the eleventh consecutive summer the survey has been conducted. The number observed, 15, is similar to last year's total, 14, but lower than the counts of 44+ in 1984 and 1985. All fish were found in pools. A histogram of all survey results follows.



Water temperatures in the mainstem Redwood Creek ranged from 18°C to 24°C during the day. Tributary water temperatures ranged from 11°C to 22°C, with eastside tributaries warmer than the westside tributaries.

The summer steelhead run on Redwood Creek is in trouble. The numbers of fish observed are very low. The water quality of mainstem Redwood Creek is also poor. The high summer water temperatures are above those preferred by salmonids. As it will take time for the watershed to recover from past landuse practices and flood events, these conditions will probably persist. A change in fishing regulations, the fishing closure of Redwood Creek between Lacks Creek and Bridge Creek, proposed by the California Department of Fish and Game may be adopted by the Fish and Game Commission in December. This interim measure would protect those fish that hold in the index reach, an area of best habitat.

However, there is no protection for adult steelhead migrating up or downstream, or fish holding in other areas. Continued summer monitoring is appropriate, as well as discussion with others as to the possible alternatives and solutions for recovery.

If you have any questions, please contact me.

David Anderson

David Anderson
Fishery Biologist

Enclosures

1991 REDWOOD CREEK SUMMER STEELHEAD TROUT SURVEY

DATES: August 5, 6, 7, and 8, 1991

LOCATION: Redwood Creek, Humboldt County, California
Lacks Creek - river km 45.3 to Tom McDonald Creek (Tall Trees Grove-Redwood National Park) - river km 19.4

DISTANCE: 16.1 miles (25.9 km)

CREW: David Anderson*, Bob Coey*, Angela Matticola, Sabra Steinberg*, Michael Port, Linda Gelphman, Victor Vrell*, Mary-Claire Kier, Kathy O'Siggins, Pat Moriyasu, Cara Smith, Alice Berg* and Helen Scully.
(* Indicates person with prior summer steelhead survey experience)

METHOD: Visual observation by diving with mask and snorkel, and wetsuit top. Survey proceeded in the downstream direction.

ACCESS: Lacks Creek at Stover Ranch on Redwood Valley Road; Panther Creek and Coyote Creek at K&K road, Simpson Timber Company; Copper Creek on rehabilitated K&K and 1800 road; Slide Creek/Pig Pen Prairie on brushed trail along rehabilitated 2005 Rd at K&K-RNP road; Bridge Creek up creek to trail on M7.5 and on Redwood Creek trail from Otter Camp near Tom McDonald Creek; Tall Trees Grove/Tom McDonald Creek on westside at M-Line.

ITINERARY:

8/05	Lacks Creek to Panther Creek Anderson, Matticola, Steinberg, Scully	3.8 miles	(1 SSHD)
8/05	Panther Creek to Coyote Creek Coey, Gelphman, Smith, Berg	2.3 miles	(4 SSHD)
8/06	Coyote Creek to Copper Creek Anderson, Matticola, Port, O'Siggins	2.8 miles	(3 SSHD)
8/06	Copper Creek to Pig Pen Prairie (just south of Slide Creek) Coey, Steinberg, Kier	1.9 miles	(2 SSHD)
8/07	Pig Pen Prairie to Bridge Creek Anderson, Coey, Port, Matticola, Vrell	2.7 miles	(5 SSHD)
8/08	Bridge Creek to Tom McDonald Creek Anderson, Matticola, Gelphman, Moriyasu	2.6 miles	(0 SSHD)

TOTAL NUMBER OF SUMMER STEELHEAD TROUT (SSHD) OBSERVED IN 1991: 15

This is the 11th consecutive summer steelhead trout survey of Redwood Creek, the first was in 1981. This year's count of 15 was similar to last year's (1990) 14 count, but still lower than the counts of 44+ in 1984 and 1985 (Table 1).

Table 1. Numbers of Summer Steelhead Trout (SSHD) observed 1981 through 1991 in the 16.1 mile index section of Redwood Creek from Lacks Creek to Tom McDonald Creek, Humboldt County, California.

Year	No. of SSHD	Survey Dates
1981	16	8/10 - 13
1982 [*]	2	10/12 & 14
1983	5	8/22 - 25
1984	44+	8/08 - 10
1985	44+	8/20 - 22, 9/4
1986	19+	8/25 - 27
1987	14	7/14 - 16
1988	8	7/26 - 28
1989 ⁻	0	7/31, 8/1 - 2
1990	14	7/31, 8/1 - 3
1991	15	8/05 - 8/08

- ^{*} Survey from Stover Creek to Emerald Creek, 14 miles, covering most of index section and best pool habitat.
- ⁻ Survey from Lacks to Bridge Creek, minus Garret to Panther Creek, at total of 11.1 miles. Covers best pool habitat.

All, except one fish were observed between Panther and Bridge Creeks, with the greatest number, 5, in the Slide Creek to Bridge Creek reach, followed closely by the Panther to Coyote reach, with 4 fish. All fish were observed in pools. The greatest congregation of summer steelhead, 3, was at the confluence pool of Devils Creek. This long shaded pool into which cold 14°C water entered was partially stratified, with colder water at the bottom and at the mouth of Devils Creek. However, due to mixing, the water was 20.5°C at the tail of the pool. In past years, this pool has contained many fish. Ten of the 15 fish observed were found singularly. All the fish observed were found in pools, and 6 were observed in pools with westside tributaries entering them (Table 2).

Seven half-pounder size steelhead and cutthroat trout were observed. Many juvenile steelhead trout; young-of-the-year, 1+, 2+, etc. were observed in the upper reaches of the index reach, but the numbers of fish declined downstream of Airstrip Creek, the 'gorge area'. Schools of suckers were first observed in the Lacks Creek to Panther Creek reach. Beaver sign, chewed debarked tree limbs, were found floating in the creek. 1991 was another low water year, with the drought continuing.

Four backpackers were seen between Tom McDonald and Bridge Creek, but footprints were first seen downstream of the 'gorge'. Again, the extent of fishing pressure or human disturbance on summer steelhead in the index reach is unknown. We have never observed people fishing.

Water temperatures in Redwood Creek ranged from 18.0°C (at 1030) to 24.0°C (at 1600) (Table 3). The temperatures were generally 19.0 or 19.5°C in the morning around 0900 - 1100 and increased to 22.0 or 23.0°C in the afternoon around 1500. Temperatures of water entering Redwood Creek from the east and westside tributaries ranged from 11.0°C (Unnamed westside tributary at 1210) to 22.0°C (Dolason Creek at 1554). Except for two eastside tributaries, Copper and Dolason Creeks, tributary water temperatures were cooler than the mainstem Redwood Creek. Westside tributaries were usually cooler than eastside tributaries, a pattern that has repeated in past surveys. The mean water temperature of westside tributaries was 14.2°C (n= 20, std. dev.= 1.0°C, and range 11 to 16°C), and the

Table 2. Results of the 1991 Redwood Creek summer steelhead survey, including date observed, location on report map, number of steelhead, estimated length of fish (inches), habitat description, and USGS map coordinates.

Date	Map Location	No. of SSHD	Est. Length (inches)	Habitat Description
8/05/91	#1	1	unable to estimate	Seen swimming away from bubble curtain of cascade at head of a pool with many boulders and LOD. Water temperature 22.0 °C. (T8NR2Esec13)
8/05/91	#2	1	14 - 16"	Hidden under rootwad in pool. Pool 3'D X 20'W x 20'L. Water temperature 19.0°C. (T8NR2Esec14)
8/05/91	#3	1	18 - 20"	In pool under large boulder ledge in 2' of water. Pool 3'D x 25'W x 30'L. (T8NR2Esec14)
8/05/91	#4	1	20 - 22"	In pool at base of boulder in 30" of water. Pool 5'D x 20'W x 30'L. Tributary entering pool from westside @ 11.0°C. Water temperature in pool 19.5°C. (T8NR2Esec11)
8/05/91	#5	1	20"	Under ledge in pool in 3 - 4' of water. Pool 5'D x 20'W x 50'L. Water temperature 22.0°C. (T8NR2Esec11)
8/05/91	#6	3	~18"	All in pool at Devils Creek confluence with Redwood Creek. One under ledge in 4' of water. Other two swam to the head of the pool. Devils Creek @ 14.0°C. Water temperature of pool 20.5°C. Pool partially thermally stratified. (T9NR2Esec34)
8/06/91	#7	1	24 - 26"	Holding at base of bedrock in shadow in 4' of water. Pool 4'D x 30'W x 75'L. Water temperature 19.0 °C. (T9NR2Esec22)
8/06/91	#8	1	18"	Under ledge of boulder in bubble curtain in the thalweg at head of pool in 30" of water. Pool 3'D x 20'W x 30'L. Water temperature 21.5 °C. (T9NR2Esec22)
8/07/91	#9	1	16"	First spooked from ledge under boulder at head of pool. Pool 10'D x 30"W x 75'L. Water temperature 20.0 °C. (T9NR2Esec16)

Date	Map Location	No. of SSHD	Est. Length (inches)	Habitat Description
8/07/91	#10	1	20"	Under ledge in pool with boulders. Pool 12'D x 25'W x 100'L. Water temperature 19.5°C. (T9NR2Esec16)
8/07/91	#11	2	18 - 20"	At 'Rocky Gap Grotto Pool'. One spooked out from rock ledge. When in open swim together from one side of pool to the other in a pattern depending upon location of swimmer. Pool 15'D x 40'W x 40'L, but part of a long complex of pools. Small westside tributary entering tail of pool @ 14.0°C. Pool temperature 21.0°C. (T9NR2Esec9)
8/07/91	#12	1	18 - 20"	In pool with many boulders. Pool 10'D x 60'W x 125'L. Water temperature 21.5°C. (T9NR2Esec9)

mean water temperature of eastside tributaries was 16.7°C (n=14, std. dev.=2.2°C, and range 14 to 22°C). Many of the west side tributaries measured were small first order streams. Temperatures in Redwood Creek were high for salmonid fish, above the preferred temperature range reported by Reiser and Bjornn (1979) for steelhead of 7.3 to 14.6°C.

A map of locations of 1991 summer steelhead observations follows (Figure 1).

Literature Cited

Reiser, D.W., and T.C. Bjornn. 1979. Influence of forest and rangeland management on anadromous fish habitat in western North America: Habitat requirements of anadromous salmonids. U.S.D.A., Forest Service General Technical Report. PNW-96., 54 pp. Pacific Northwest Forest and Range Experiment Station, Portland, Oregon.

Table 3. Water and Air temperatures (°C) measured during the 1991 Redwood Creek summer steelhead trout survey. Locations are listed south to north. Alignment refers to creek position E = eastside, W = westside, REDW = mainstem Redwood Creek.

Location	Align ment	Date	Time	Temperature°C	
				Water	Air
Redwood Creek (upstream of Lacks Cr)	REDW	8/05	0900	19.5	15.5
Lacks Creek	E	8/05	0930	17.0	
Redwood Creek (upstream of George Cr)	REDW	8/05	1013	19.5	
George Creek	W	8/05	1013	13.5	
Redwood Creek	REDW	8/05	1200	20.5	22.5
Garrett Creek	E	8/05	1344	18.5	
Redwood Creek (pool at Garrett Cr)	REDW	8/05	1344	22.0	
Redwood Creek (downstream of Garret Cr)	REDW	8/05	1355	22.0	
Unnamed tributary	W	8/05	1417	15.0	
Redwood Creek (1 SSHD)	REDW	8/05	1442	22.0	
Carson Creek	E	8/05	1510	15.5	
Redwood Creek (upstream of Carson Cr)	REDW	8/05	1510	23.0	
Unnamed tributary	W	8/05	1527	14.5	
Redwood Creek (upstream of Panther Cr)	REDW	8/05	1611	23.0	
Panther Creek	W	8/05	1611	15.0	
Panther Creek	W	8/05	1015	13.5	
Redwood Creek	REDW	8/05	1015	19.0	18.5
Redwood Creek (1 SSHD)	REDW	8/05	-1100	19.0	
Redwood Creek (1 SSHD)	REDW	8/05	-1100	19.0	
Redwood Creek (1 SSHD)	REDW	8/05	-1130	19.5	
Unnamed tributary	W	8/05	1210	11.0	
Unnamed tributary	W	8/05	1310	13.0	
Redwood Creek (at unnamed tributary)	REDW	8/05	1310	20.5	
Unnamed tributary	W	8/05	-1330	14.0	
Joplin Creek	W	8/05	1350	13.5	
Redwood Creek (at Joplin Cr)	REDW	8/05	1350	23.0	
Redwood Creek (1 SSHD)	REDW	8/05	1404	22.0	
Coyote Creek	E	8/05	1536	17.5	
Redwood Creek (at Coyote Cr)	REDW	8/05	1536	23.0	
Redwood Creek (upstream of Coyote Cr)	REDW	8/06	0900	19.0	14.5
Coyote Creek	E	8/06	0900	16.5	
Unnamed tributary	E	8/06	1035	15.5	
Redwood Creek (at unnamed tributary)	REDW	8/06	1035	19.5	
Redwood Creek (upstream of Devils Cr)	REDW	8/06	1245	20.5	
Devils Creek	W	8/06	1305	14.0	
Redwood Creek (3 SSHD)	REDW	8/06	1145	20.5	
Redwood Creek (downstream of Devils Cr)	REDW	8/06	1245	20.5	
Lyons Creek	E	8/06	1414	16.5	
Redwood Creek (downstream of Lyons Cr)	REDW	8/06	1414	21.0	
Unnamed tributary	W	8/06	1504	14.5	
Redwood Creek (at unnamed W tributary)	REDW	8/06	1504	22.0	
Redwood Creek (at Copper Cr)	REDW	8/06	1523	22.0	
Copper Creek	E	8/06	1523	20.0	
Copper Creek	E	8/06	1030	18.0	
Redwood Creek (at Copper Cr)	REDW	8/06	1030	18.0	
Redwood Creek (1 SSHD)	REDW	8/06	-1100	19.0	
Unnamed tributary	W	8/06	-1200	14.5	
Redwood Creek (at unnamed W tributary)	REDW	8/06	-1200	21.0	
Maneze Creek	E	8/06	1345	15.0	
Redwood Creek (at Maneze Cr)	REDW	8/06	1345	21.5	
Redwood Creek (1 SSHD)	REDW	8/06	-1400	21.5	
Unnamed tributary	W	8/06	-1445	14.0	
Redwood Creek (at unnamed W tributary)	REDW	8/06	-1445	21.5	
Unnamed tributary	W	8/06	-1530	14.5	
Redwood Creek (at unnamed W tributary)	REDW	8/06	-1530	22.0	

Table 3. Water and Air temperatures (°C) measured during the 1991 Redwood Creek summer steelhead trout survey. Locations are listed south to north. Alignment refers to creek position E = eastside, W = westside, REDW = mainstem Redwood Creek. continued.

Location	Align ment	Date	Time	Temperature°C	
				Water	Air
Redwood Creek (at Pig Pen Prairie)	REDW	8/06	1545	22.0	
Redwood Creek (at Pig Pen Prairie)	REDW	8/07	1008	19.5	19.0
Slide Creek	E	8/07	1034	15.0	
Unnamed tributary	W	8/07	1052	14.0	
Redwood Creek (1 SSHD)	REDW	8/07	1100	20.0	
Redwood Creek (1 SSHD)	REDW	8/07	1130	19.5	
Unnamed tributary	W	8/07	1138	15.0	
Unnamed tributary	W	8/07	1236	14.5	
Redwood Creek (at unnamed W tributary)	REDW	8/07	1236	20.0	
Redwood Creek (2 SSHD)	REDW	8/07	1409	21.0	
Unnamed tributary	W	8/07	1409	14.0	
Redwood Creek (1 SSHD)	REDW	8/07	1430	21.5	
Unnamed tributary	E	8/07	1502	14.5	
Redwood Creek (at unnamed E tributary)	REDW	8/07	1502	22.0	
G Creek	E	8/07	1540	15.5	
Redwood Creek (at G Cr)	REDW	8/07	1540	23.0	
Dolason Creek	E	8/07	1554	22.0	
Redwood Creek (at Dolason Cr)	REDW	8/07	1554	23.0	
Bridge Creek	W	8/08	1132	15.0	21.0
Redwood Creek (upstream of Bridge Cr)	REDW	8/08	1132	21.0	
Emerald Creek (aka Harry Weir Cr)	E	8/08	1354	18.0	
Redwood Creek (at Emerald Creek)	REDW	8/08	1354	22.5	
Unnamed tributary	W	8/08	1426	13.5	
Redwood Creek (at unnamed W tributary)	REDW	8/08	1426	22.0	
Unnamed tributary	E	8/08	1536	15.5	
Redwood Creek (at unnamed E tributary)	REDW	8/08	1536	23.0	
Tom McDonald Creek	W	8/08	1600	16.0	
Redwood Creek (at Tom McDonald Cr)	REDW	8/08	1600	24.0	

1991 REDWOOD CREEK
SUMMER STEELHEAD SURVEY
Location of observations

August 5, 6, 7, & 8, 1991

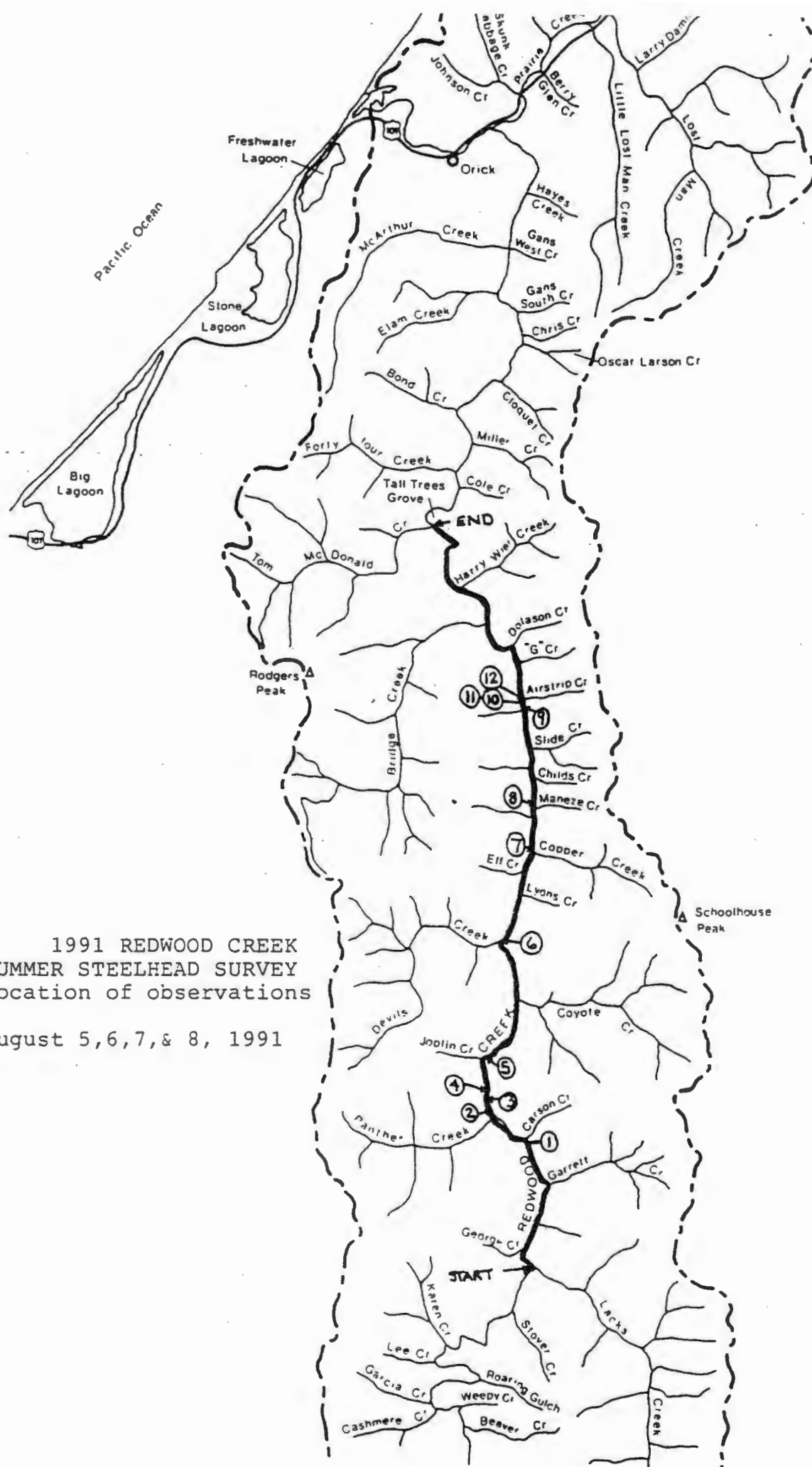
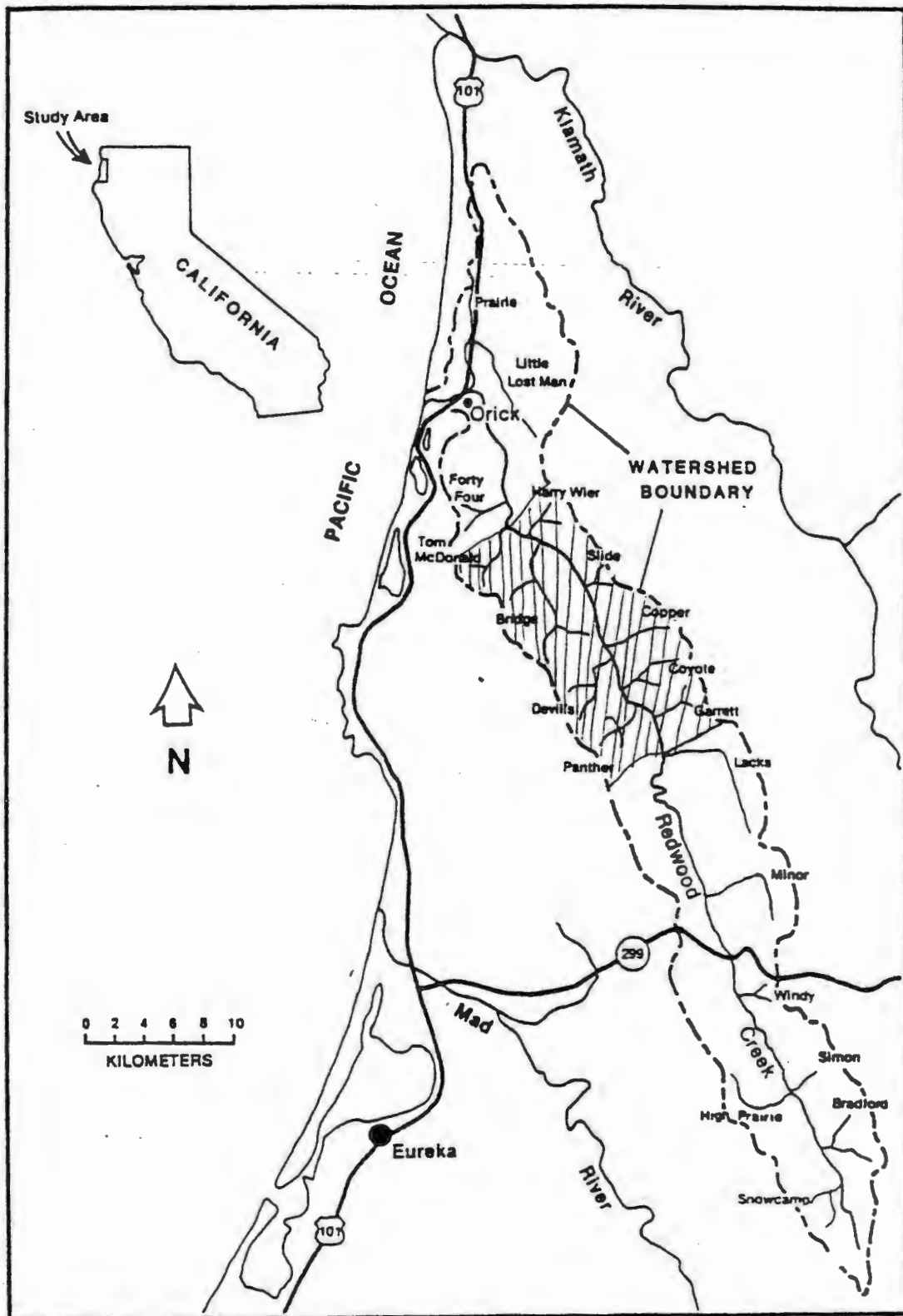


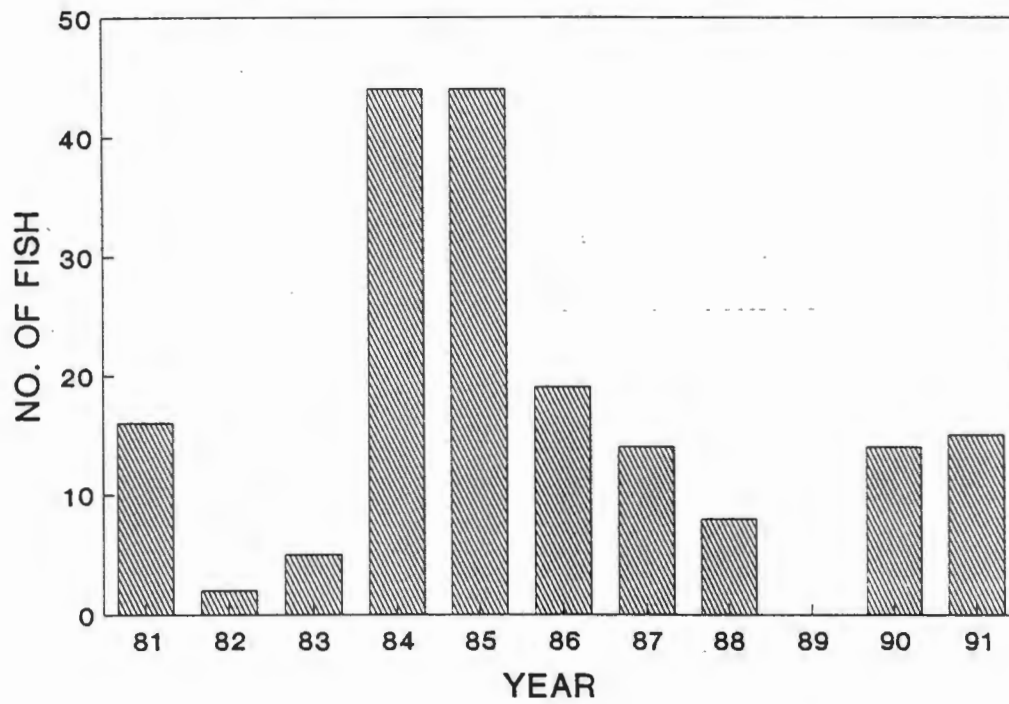
Figure 1. Redwood Creek, Humboldt County, California. Shaded area represents index reach snorkel surveyed.

Figure 2. Observed numbers of summer steelhead observed each summer since 1981 on a 25.9 km index reach of Redwood Creek, Humboldt County, California.

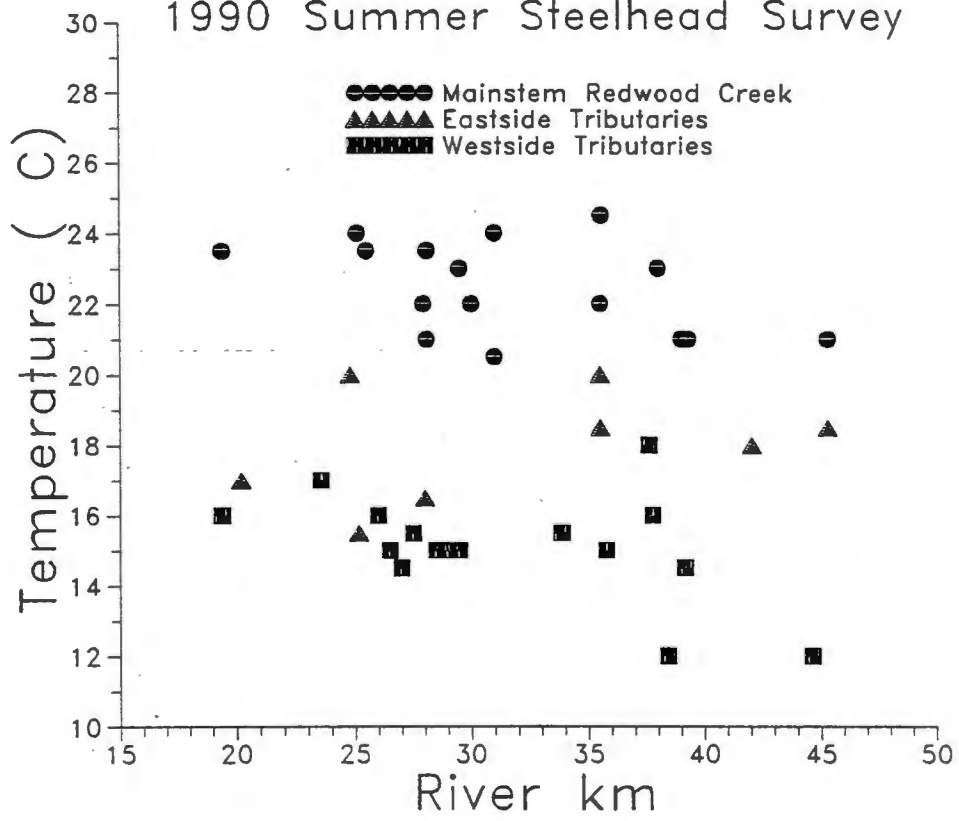
Figure 3. Mainstem, east and westside tributary water temperatures ($^{\circ}\text{C}$) at locations along the index reach of Redwood Creek during the July 31 through August 3, 1990 summer steelhead survey.



REDWOOD CREEK SUMMER STEELHEAD TROUT
INDEX REACH SNORKEL SURVEY



1990 Summer Steelhead Survey



Vegetation in the basin consists of coast redwood and Douglas-fir forests, their associated flora, and ridgetop prairies. Commercial timber harvest is one of the major land use practices in the basin. By 1978, 66 percent of the basin drainage, comprising 81 percent of the original conifer forests, had been logged (Best 1984). Logging no longer occurs in the lower one-third of the watershed, site of Redwood National Park. The park was established in 1968 and later expanded in 1978 to protect park resources.

Methods

A 25.9 km index reach, 24 percent of Redwood Creek, is snorkel surveyed during the summer, usually around the first week of August (Figure 1). Of the 25.9 km, 16.1 km is in Redwood National Park and 9.8 km is upstream of the park in commercial timber land. The index reach is divided into smaller sections and surveyed over a three to four day period. Following procedures of Roelofs (1983), crews of 3 to 5 people wearing wetsuit tops to stay warm, dive the creek using mask and snorkel to observe adult summer steelhead trout. The swimmers look under ledges, root wads and other large organic debris, at the base of boulders, and in the bubble curtains of turbulent water while proceeding downstream. Observations and locations are recorded on waterproof U.S.G.S. topographical maps. Water temperatures ($^{\circ}\text{C}$) were measured where summer steelhead are observed, and where tributaries entered Redwood Creek.

Results

Over the 11 summers of surveys, fish numbers peaked mid-decade at 44, but declined to no fish in 1989 (Figure 2). They increased to 15 fish in 1991. Numbers observed in the index section never exceeded 50 fish.

Mainstem and tributary water temperatures from the 1990 summer steelhead survey, representative of conditions measured in previous surveys, are presented in Figure 3. The highest water temperatures, ranging from 20.5 to 24.5 $^{\circ}\text{C}$ were measured in mainstem Redwood Creek. Eastside tributaries were cooler, and westside tributaries coolest, ranging from 15.5 to 20.0 $^{\circ}\text{C}$, and 12.0 to 18.0 $^{\circ}\text{C}$, respectively.

Discussion

Most of the summer steelhead were observed in pools and in locations where a deep pool and a cooler tributary flowing into it occurred together. The greatest numbers of fish are usually found at the confluence of a large westside tributary and Redwood Creek. Otherwise, fish were generally found singularly and not in schools.

In years where the survey was expanded to include more of Redwood Creek, most summer steelhead, were found in the index reach. This reach represents the best habitat in the basin for summer steelhead trout.

Several problems are facing summer steelhead in Redwood Creek; habitat degradation, water quality, sportfishing/poaching, and population size. Geologically, the Redwood Creek basin is very erosive. Large portions of the Redwood Creek basin have been logged and that, in conjunction with natural events such as the flood of 1964, have impacted fish habitat. The resulting erosion and hillslope mass wasting caused sedimentation of the mainstem and filled deep pools, the preferred habitat of summer steelhead. The widened streambed, and their shallow riffles provide little or no cover for fish.

With less riparian canopy cover over a wider channel, the stream receives more insolation which increased water temperatures and decreased water quality. Mainstem water temperatures are high in the summer months, well above the preferred temperature range reported by Reiser and Bjornn (1979) for steelhead of 7.3 to 14.6°C. Greater numbers of steelhead were found where a major westside tributary, at 15°C, entered Redwood Creek. There, in portions of the pool, water temperatures were noticeably cooler. This 'cold' pool was partially thermally stratified having cooler water on the bottom. Though not a typical cold pool where physical features such as a gravel bar isolate large volumes of cool water from the warmer mainstem (Ozaki 1988), the pool provided habitat for summer steelhead.

Sport fishing and poaching may be impacting the summer steelhead population. Though the pools are somewhat inaccessible, a few knowledgeable people could deplete the small population present. Further, fishing in the lower river impacts these fish when they are migrating upstream in the spring to the holding area.

Another factor making them susceptible is their hiding behavior. When approached by a diver in the water, they may only partially hide. Their head may be under a log, but their body will be in plain view, or they may rest in the open on the substrate at the base of a boulder. The fish are easy to approach, and usually do not move until touched. This behavior makes them very susceptible to spearfishing. The extent of poaching on this reach of Redwood Creek is unknown, but again because of the small population size, poaching could have an inordinate effect. Most summer steelhead in California are found in very remote canyons not readily accessible to people (Moyle and Morford 1989). On Redwood Creek, one would have to hike approximately 9 km to reach the holding pools, and on the private timber land, access is restricted to the public. This may indicate that besides habitat distribution, public access and the accompanying fishing pressures may influence their distribution.

The small population size and concomitant loss of genetic diversity of the summer steelhead of Redwood Creek may also affect their chances for recovery. The effective size of the population sufficient for the long term survival of this run needs to be determined. The small population size makes this run more prone to be severely affected by a natural or human-caused event, from which

the population may not be able to recover. The natural recovery of this population will also take longer. In their review of salmonid stocks at risk, Nehlsen, et al. (1991), rated the summer race of steelhead of Redwood Creek at a high risk of extinction, based primarily on the small adult escapement; and threats of further habitat destruction and overutilization.

The prospects of recovery for the summer steelhead of Redwood Creek are poor. The National Park Service has invested an extensive amount of time and funds into a comprehensive watershed rehabilitation program of erosion control and rehabilitation of logged over lands in the Redwood Creek basin, and in restoration projects on Redwood Creek, its tributaries, and estuary. These programs will benefit fish habitat in the long run by decreasing erosion and sedimentation, and increasing instream cover and spawning gravels. However, changes in present fishing regulations and watershed management practices are necessary in the interim. Closing the index reach to fishing, and more restrictive angling regulations decreasing the harvest during upstream migration would immediately protect summer steelhead. Most of the basin is already logged and recovery will be slow. Upstream of the park, better management practices to protect the inner gorge area and riparian canopy are needed to maintain the remaining habitat. Also, the Department of Fish and Game is writing a statewide summer steelhead management plan to address problems facing these fish and to plan their recovery. Creating additional holding pools, installing instream structures, and using artificial propagation have been proposed. These proposals have to be evaluated for their effectiveness on Redwood Creek.

What the future holds for summer steelhead is uncertain. The situation on Redwood Creek is not an isolated one. Most summer steelhead stocks are at risk in California. Choices, some unpopular, that further protect the stocks and their habitat may be the answer.

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Acknowledgements

I would like to thank the many Redwood National Park employees, volunteers, and California Department of Fish and Game personnel who have participated in the summer steelhead surveys over the past 11 years. Access to Redwood Creek on private land by the Stover family and Simpson Timber Company is much appreciated.