

0708:

Status of Summer Steelhead Trout (*Oncorhynchus mykiss*)
in Redwood Creek, Redwood National Park.

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Abstract

Summer steelhead trout, a declining stock in Redwood National Park, have been monitored by snorkeling Redwood Creek since the summer of 1981. The adult fish migrate upriver in the spring, hold in pools during the summer, and spawn the following winter. As a result of land use activities and large flood events, large and numerous pools have been filled in. The resultant high water temperatures up to 25°C, and lack of pool habitat and cover have restricted the distribution of summer steelhead in Redwood Creek. Schools of fish are rare and observed only in pools adjacent to tributaries where cooler water enters Redwood Creek. A 25.9 km index reach of the creek's best habitat was used to determine trends in the population. Numbers of fish observed peaked in 1984 and 1985 at 44, but have since declined. Problems facing summer steelhead and prospects for recovery are discussed.

Introduction

Summer steelhead trout are an anadromous race of rainbow trout. Their life cycle differs from the more numerous winter run steelhead. Adult summer steelhead ascend the rivers in spring, and hold over in deep pools in summer, before spawning the following winter. This isolates them both spatially and temporally from winter run fish. Because they are in freshwater for eight to ten months (Roelofs 1983), they are susceptible to many detrimental environmental and human-caused factors.

Since 1981, Redwood National Park has been monitoring the status of adult summer steelhead in Redwood Creek. To determine whether the fish we observed were winter run steelhead stranded in the creek due to low summer flows or summer run fish, two females were sacrificed in 1986. Their gonads were in an immature state of development, and had the low gonad to body weight ratio indicative of summer steelhead.

Approximately 25 summer steelhead populations are known in California. In 1990, almost 1900 adults were counted; over half were observed in two rivers. Most river locations had less than 100 adults. The species, though not federally or state listed, is classified as a sensitive species or species of special concern by various resource agencies. Roelofs (1983) and most recently the summer steelhead management advisory committee under the auspices of the California Department of Fish and Game have documented the status of summer steelhead populations in California.

Study Area

The 108-km long Redwood Creek drains a 730 km² watershed in Humboldt County, California (Figure 1). The basin is steep-sided and narrow with a total basin relief of 1,616 meters. The climate is Mediterranean, with an estimated average precipitation of 203 cm a year. Mainstem stream flow is lowest between August and October.

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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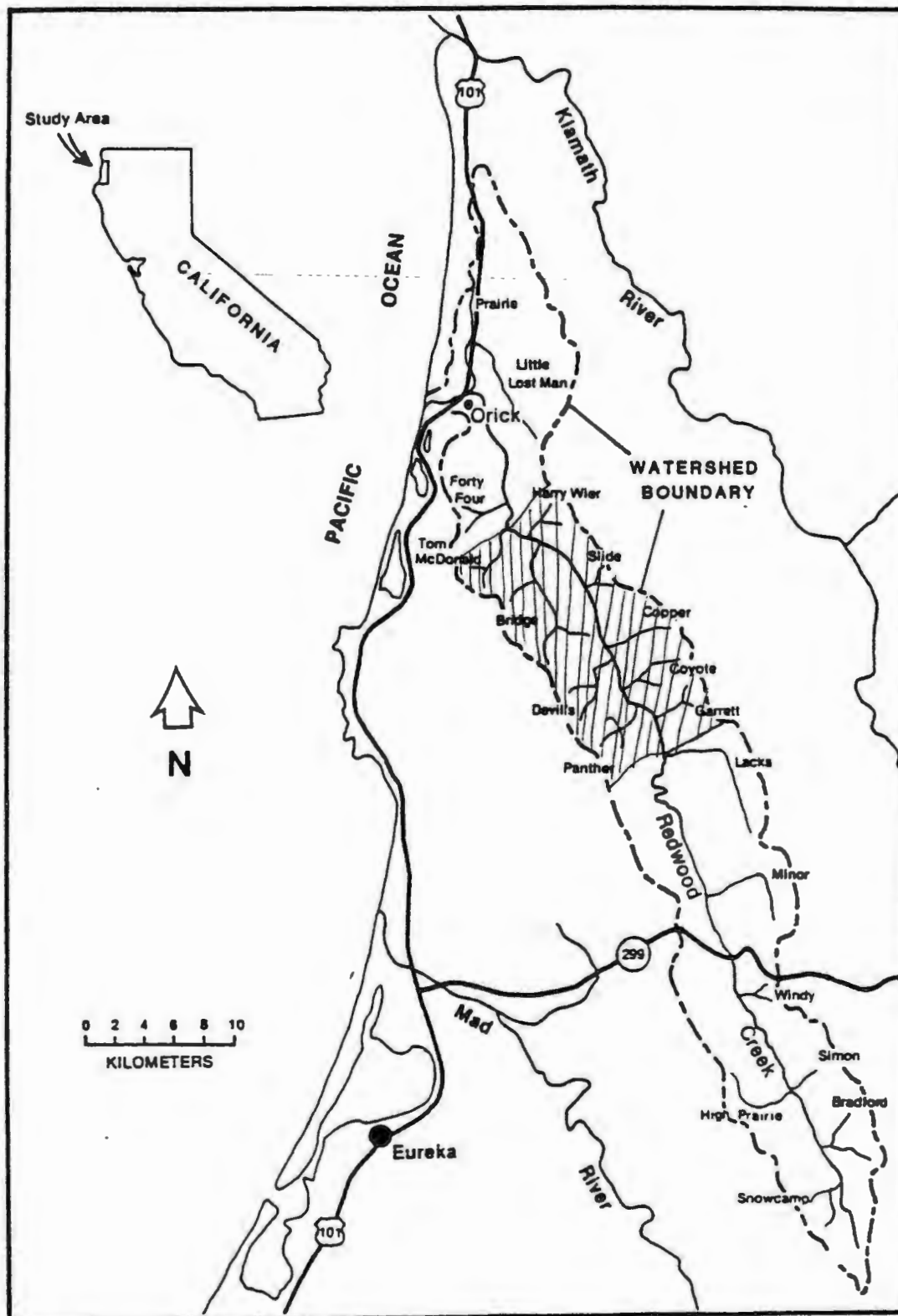
Acknowledgements

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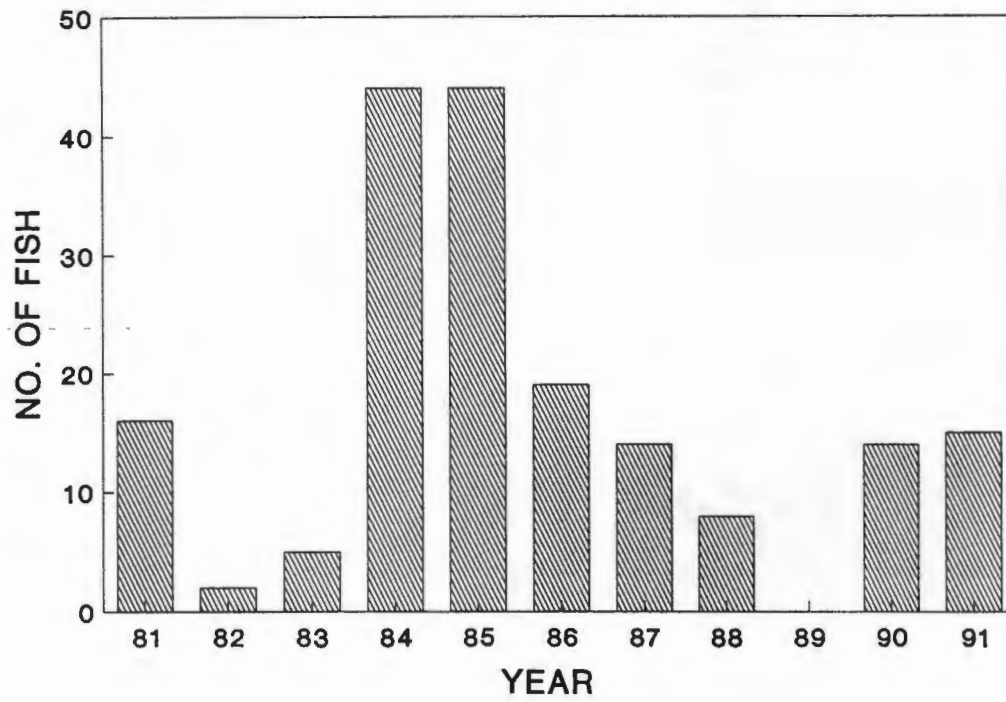
Figure 1. Redwood Creek, Humboldt County, California. Shaded area represents index reach snorkel surveyed.

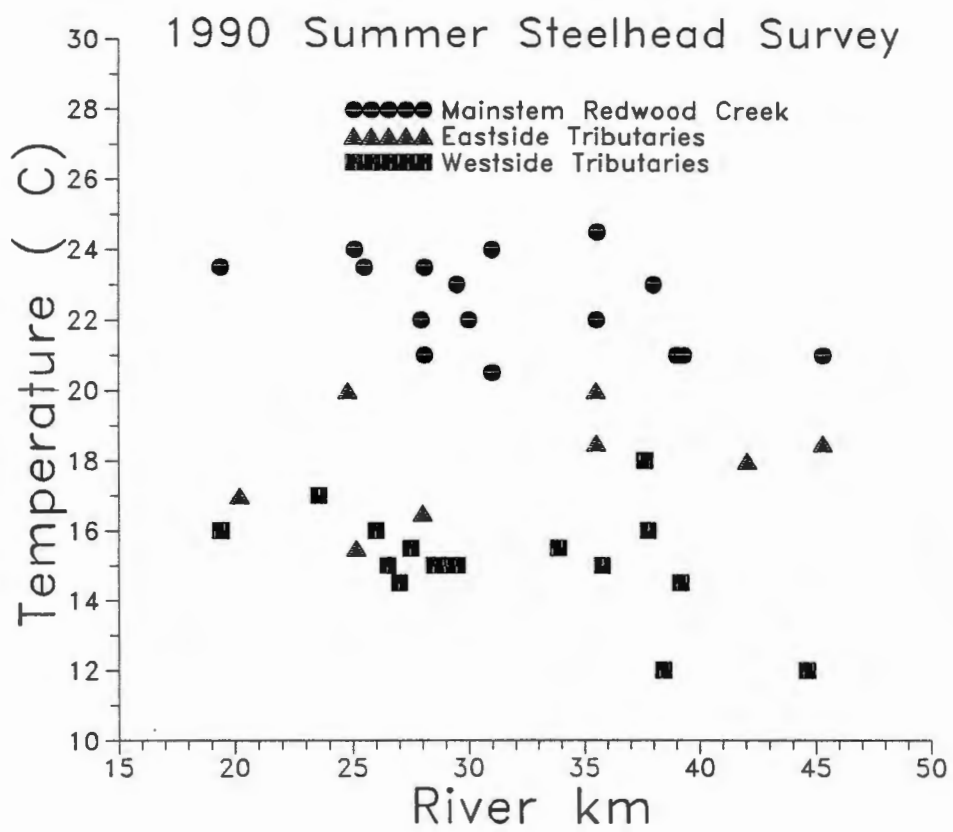
Figure 2. Observed numbers of summer steelhead observed each summer since 1981 on a 25.9 km index reach of Redwood Creek, Humboldt County, California.

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 REDWOOD CREEK SUMMER STEELHEAD TROUT SURVEY

DATES: July 31, August 1, 2, and 3, 1990

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*, Heidi Eberwine*, John O'Brien, Carolyn Meyer*, Sabra Steinberg*, Jeff Grenier, Victor Vrell, and Mary-Claire Kier
(* 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; Coyote Creek on rehabed K&K-RNP road; Slide Creek/Pig Pen Prairie on brushed trail along rehabed 2005 Rd at K&K-RNP road; Bridge Creek on Redwood Creek trail from Otter Camp near Tom McDonald Creek; Tall Trees Grove/Tom McDonald Creek at Tall Trees trail on C-Line-RNP.

ITINERARY:

7/31	Coey, Eberwine, O'Brien Lacks Creek to Panther Creek	3.8 miles	(0 SSHD)
7/31	Anderson, Meyer, Vrell Panther Creek to Coyote Creek	2.3 miles	(3 SSHD)
8/01	Coey, Eberwine, Steinberg Coyote Creek to Copper Creek	2.8 miles	(8 SSHD)
8/01	Anderson, Meyer, O'Brien Copper Creek to Pig Pen Prairie (just south of Slide Creek)	1.9 miles	(1 SSHD)
8/02	Anderson, Coey, Eberwine, Grenier Pig Pen Prairie to Bridge Creek	2.7 miles	(2 SSHD)
8/03	Anderson, Eberwine, Kier Bridge Creek to Tom McDonald Creek	2.6 miles	(0 SSHD)

TOTAL NUMBER OF SUMMER STEELHEAD TROUT (SSHD) OBSERVED IN 1990: 14

Date	Map Location	No. of SSHD	Estimated Fork Length (inches)	Habitat Description
7/31	# 1	1	17 - 18"	Hidden under rock ledge in cascade at head of pool (4' Deep x 60' Long x 40' Wide). Head in under ledge, could only see portion of tail. Water temperature 21.0 °C. (T8NR2E sec11)
7/31	# 2	1	15 - 20"	Fish holding in pool wedged against boulder in shade. Pool (5'D x 150'L x 50'W) located downstream of small west side tributary (16.5°C). Redwood Cr. water temperature 23.0°C. (T8NR2E sec11)
7/31	# 3	1	~ 20"	Found in same pool as #2 in 3 feet of water next to an old rusty underwater culvert pipe. (T9NR2E sec 11)
8/01	# 4	2 2 4	20 - 24" 18" 16"	All in pool at Devils Creek confluence with Redwood Creek in colder water. Devils Creek water temperature 15.5°C. (T9NR2E sec 34)
8/01	# 5	1	24"	Holding at bottom of pool against large boulder. Pool (8'D x 60'L x 35'W). Water temperature 23.0°C. Pictures taken. Fish stayed until touched by swimmer. (T9NR2E sec 22)
8/02	# 6	1 1	18" 20"	Holding at bottom of pool next to boulder. Pool (7'D x 90'L x 60'W). Water temperature 22.0°C. Pictures taken. When spooked, one swam into a boulder cave in middle of pool. (T9NR2 sec 16)
Total SSHD Number: 14				

This is the 10th summer steelhead trout survey of Redwood Creek, the first in 1981. The count was much higher from last year's (1989) 0 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 1990 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

* 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. Covers best habitat.

1990 was a low water year, and except for the one storm in June, summer flow was low in Redwood Creek. The Devils Creek pool on Redwood Creek had the greatest number of fish in one location, eight summer steelhead. In past years, this pool has contained many fish also. This cold water pool which is partially shaded, and contains numerous hiding places in the boulder banks, is good summer steelhead habitat. All the fish this year were found in pools.

Six Coastal cutthroat trout (estimated length 12") and large steelhead residents were observed. Many juvenile steelhead trout, Y-O-Y, 1+, 2+, etc. were observed in the upper reaches of the index reach, but the numbers dropped dramatically downstream of the 'gorge area'. More schools of suckers and three spine stickleback were seen downstream of the 'gorge area'.

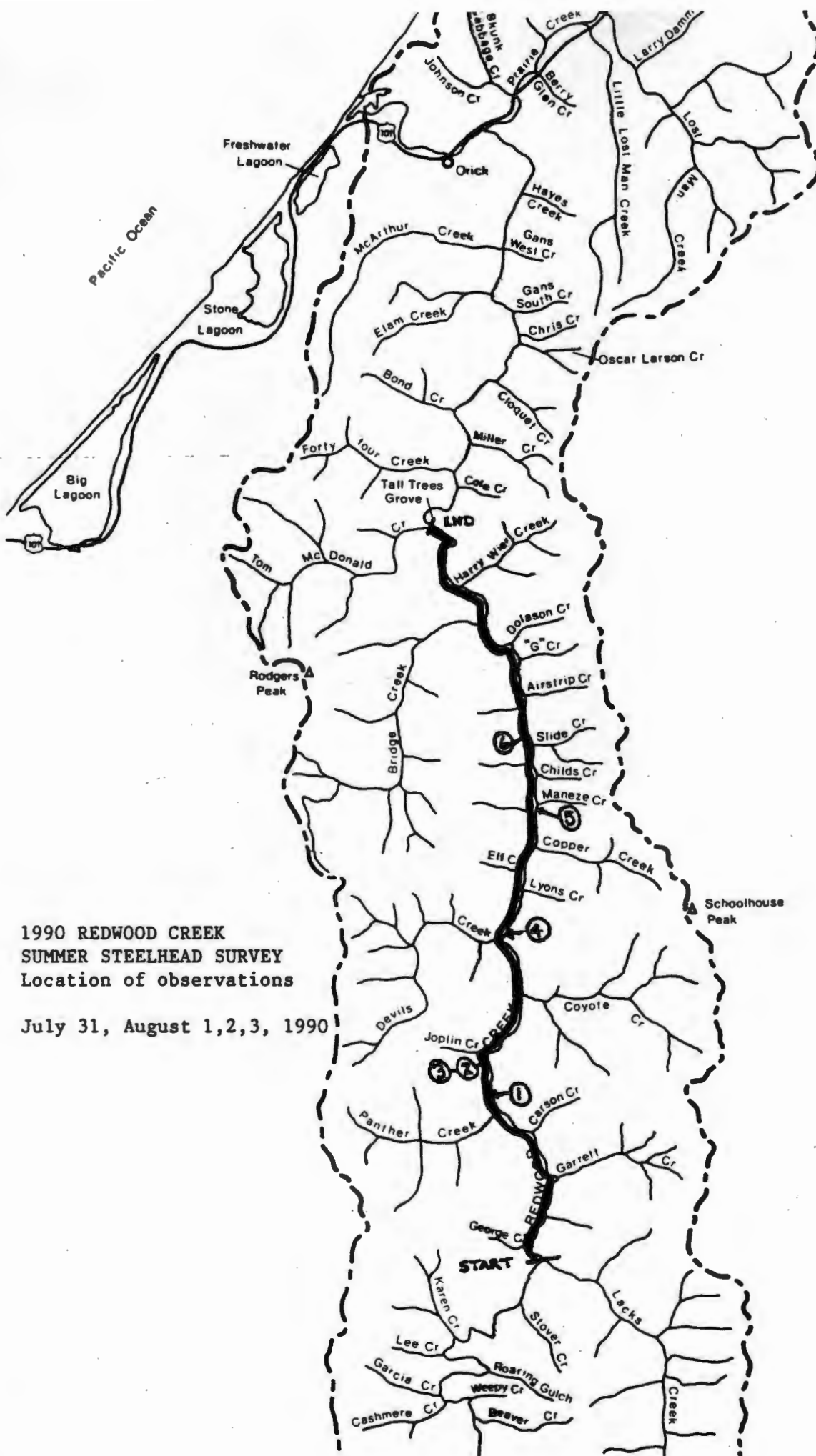
Only two backpackers were observed camping on Redwood Creek and they were below the 'gorge area' and upstream of Bridge Creek. Remnants of fire rings on river bars were observed as well as footprints. The extent of sport fishing on summer steelhead in the park and upstream is unknown. People without access to the K & K road have to hike in from Redwood Valley or the Tall Trees Grove, or go cross country from the Bald Hills Road. The presence of these fish, however, is known to some.

Water temperatures in Redwood Creek ranged from 20.5°C (at 1100) to 24.5°C (at 1625) (Table 2). Mainstem water temperatures increased during the day. Tributary water temperatures ranged from 12.0°C (George Creek at 1003) to 20.0°C (Coyote Creek at 1625 and Dolason Creek at 1708). In all cases, tributary water temperatures were lower than those of Redwood Creek. West side tributaries were generally cooler than east side tributaries. The mean water temperature of east side tributaries, 18.1°C (n=6), was warmer than water from west side tributaries, 15.2°C (n=17). Many of the west side tributaries measured were very small first order streams. Temperatures in Redwood Creek were high for salmonid fish, above optimum temperatures.

Table 2. Water and Air temperatures (°C) measured during the 1990 Redwood Creek summer steelhead trout survey. Locations are listed south to north.

Location (East side/West side)	Date	Time	Temperature°C	
			Water	Air
Redwood Creek (at Lacks Creek)	7/31	0930	21.0	23.0
Lacks Creek (E)	7/31	0930	18.5	
George Creek (W)	7/31	1003	12.0	
Garrett Creek (E)	7/31	1245	18.0	
Redwood Creek (upstream of Panther Cr)	7/31	1030	21.0	
Panther Creek (W)	7/31	1030	14.5	
Redwood Creek	7/31	1130	21.0	
unnamed tributary (W)	7/31	1140	12.0	
Redwood Creek	7/31	1320	23.0	
Unnamed tributary (W)	7/31	1322	16.0	
Joplin Creek (W)	7/31	1351	18.0	
Unnamed tributary (upstm of Coyote Cr)(W)	7/31	~1600	15.0	
Redwood Creek (upstream of Coyote Cr)	7/31	1625	24.5	
Coyote Creek (E)	7/31	1625	20.0	
Coyote Creek (E)	8/01	1145	18.5	38.0
Redwood Creek (at Coyote Cr)	8/01	1145	22.0	
Devils Creek (W)	8/01	1520	15.5	
Redwood Creek (at Copper Cr)	8/01	1715	24.0	
Redwood Creek (at Copper Cr)	8/01	1100	20.5	
Redwood Creek (township sec 22)	8/01	1245	22.0	29.5
Redwood Creek (township sec 22)	8/01	1400	23.0	
Unnamed tributary (W)	8/01	1430	15.0	
Unnamed tributary (W)	8/01	1440	15.0	
Unnamed tributary (W)	8/01	1500	15.0	
Redwood Creek (at Pig Pen Prairie)	8/01	1530	23.5	
Redwood Creek (at Pig Pen Prairie)	8/02	1145	21.0	32.8
Slide Creek (E)	8/02	1215	16.5	
Redwood Creek (downstream of Slide Cr)	8/02	~1300	22.0	
Unnamed tributary (W)	8/02	1415	15.5	
Unnamed tributary (W)	8/02	1430	14.5	
Unnamed tributary (W)	8/02	1515	15.0	
Unnamed tributary (W)	8/02	1620	16.0	
Redwood Creek	8/02	1640	23.5	
G Creek (E)	8/02	1700	15.5	
Redwood Creek (downstream of G Cr)	8/02	1700	24.0	
Dolason Creek (E)	8/02	1708	20.0	
Bridge Creek (W)	8/02	1750	17.0	
Bridge Creek (W)	8/03	1250	17.0	
Emerald Creek (a.k.a. Harry Wier Cr)(E)	8/03	1410	17.0	
Redwood Creek (upstrm of Tom McDonald Cr)	8/03	1605	23.5	
Tom McDonald Creek (W)	8/03	1610	16.0	

Map of locations of 1990 summer steelhead observations follows.



1990 REDWOOD CREEK
SUMMER STEELHEAD SURVEY
Location of observations

July 31, August 1,2,3, 1990