

**REDWOOD CREEK BASIN 1990-1991
SPAWNING AND CARCASS SURVEY**

ANNUAL PROGRESS REPORT

Fish and Wildlife

Research and Resource Management Division

Redwood National Park

by
**Sandra Haux
David Anderson
December 1992**

REDWOOD CREEK BASIN 1990-1991

SPAWNING AND CARCASS SURVEY

Annual Progress Report

Redwood National Park

by

Sandra Haux

David Anderson

INTRODUCTION

Redwood National Park (RNP) was established by an act of Congress in 1968 to protect, preserve, and restore primeval redwood forests, associated streams, and seashores for the use and enjoyment of future generations. In order to monitor the recovery of aquatic resources and make management recommendations, the Fish and Wildlife Branch surveys salmonid populations within the park. These spawning surveys fall under Natural Resources Project Statement, Redwood Creek Fisheries Studies N-70 (Figure 1). Additionally, Redwood National Park reports its findings and make recommendations to the California Department of Fish and Game.

OBJECTIVES

Redwood Creek and its tributaries historically had very sizeable runs of chinook (aka king) salmon (Oncorhynchus tshawytscha), coho salmon (O. kisutch), and steelhead trout (O. mykiss). These runs

have been severely depressed. The lack of quantitative data makes and inventory and monitoring of these species difficult.

The objectives of this project are as follows:

- I. To survey index streams for spawning salmonids which can be used to compare annual numbers of fish and determine population trends;
- II. To determine the distribution of spawning salmonids in the index streams and note changes in habitat conditions which may affect salmonids;
- III. To determine the size, sex ratio, and age of returning salmonid spawners;
- IV. To obtain information on redd characteristics;
- V. To recover data on tagged and fin clipped salmonids.

In order to achieve the objectives of this project, spawning and carcass surveys were conducted during the 1990-91 spawning season, December 1990 through April 1991, on three index streams: Lost Man Creek, Bridge Creek, and Prairie Creek (Figure 2).

NATURAL RESOURCES PROJECT STATEMENT

1. Park and Region: Redwood National Park, Western Region
2. Project Name and Number: Redwood Creek Fisheries Studies, N-70
3. Statement of the Problem:

Little quantitative data are available regarding fisheries productivity of Redwood Creek and tributary streams. This makes monitoring the recovery of aquatic resources in these streams, from pre-park land use, difficult at best. A few tributary streams, Tom McDonald, Bridge, and Emerald Creek, have been electrofished with species identified, enumerated, weighed, measured and populations estimated on an infrequent basis. An initial nursery area study has been completed which established baseline conditions for 1981.

4. Alternative Actions and Their Probable Impacts:

(a) No Action: No further information regarding tributary streams' relative contribution to the overall fisheries productivity of Redwood Creek would be obtained. No data with which to monitor recovery or the fish resource over time would be available.

(b) Implement fisheries studies: Permanent sampling sites for fisheries investigations in tributary streams within Redwood Creek would be established. A nursery area survey within Redwood Creek would be repeated in order to provide a means of comparison for existing conditions with those shortly following park expansion. Various sites would be established for investigating stream features and their contributions to fishery productivity by providing or improving spawning or rearing habitat.

5. Recommended Course of Action:

Implement 4(b).

STUDY AREA

Redwood Creek, located in northwestern California, drains a 720 km² watershed. There are 74 tributaries of second or higher order in the basin. Large scale logging of the coniferous trees in the Redwood Creek Basin began in the early 1950's and the tractor yarding method accounted for 85 percent of all logging. By 1978, 69 percent of the forests of the lower watershed, 92 percent of the middle watershed and 81 percent of the upper watershed (approximately 81 percent of the entire watershed) had been logged (Best, 1984).

For much of its 108 km length, Redwood Creek flows along the trace of the Grogan Fault. Precipitation in the basin averages 200 cm per year, most of which falls between October and March (Madej, 1984).

Following are descriptions of the index streams surveyed.

Prairie Creek flows into Redwood Creek north of the town of Orick, California. The 77.7 km² watershed is approximately 23.3 km in length, and flows along U.S. Highway 101 through private agricultural land (grazing), and the old-growth redwood forests in Prairie Creek Redwood State Park and Redwood National Park (Coey, et al., 1991). The three adjacent index reaches established on Prairie Creek are: U.S. Highway 101 Bypass study section, Prairie below Channelization to Boyes Creek (Channelization to Boyes),

3,540 meters in length; Boyes Creek to Brown Creek (Boyes to Brown), 2,735 meters in length; and Brown Creek to point approximately 1.5 miles north of Brown Creek (Brown to 1.5), 2,414 meters in length. The Channelization to Boyes reach begins 40 meters upstream of the Streelow Creek (aka Wolf Creek) confluence with Prairie Creek. The other two reaches are contiguous in an upstream northerly direction.

Lost Man Creek flows into Prairie Creek approximately 5 road kilometers north of the town of Orick, California. The 32.1 km² basin has an average stream gradient of 0.64 percent on the lower portion of the creek (Redwood National Park, 1988). The index reach on Lost Man Creek begins at the former weir site of the Prairie Creek Fish Hatchery and continues upstream for 2,480 meters (1.5 miles), to the 'double bridges'.

Bridge Creek, at 12.9 km in length and 29.52 km² in area, is the fourth largest tributary of Redwood Creek. The basin is entirely within Redwood National Park. Most hillsides immediately adjacent to the creek channel were logged prior to 1978. Many natural and logging induced log jams were removed from the creek during the years of 1950-1978. The Ed Mervich Memorial Log Jam (Log Jam), located approximately 1.3 kilometers upstream from the confluence with Redwood Creek, is a large log jam which was modified in 1984 and 1990 to aid fish migration (Redwood National Park, 1991).

The combined length of the three sections surveyed on Bridge Creek is 2,925 meters.

Tom McDonald Creek is 7.5 km. in length, and has an area of 18 km². The main channel of Tom McDonald Creek below the forks was, in large part, not logged (Kelsey, et al., 1981). This stream was not surveyed this year, but it will be surveyed in future years. A study reach has not yet been established.

Physical parameters of the described creeks are summarized in Table 1.

METHODS

Spawning and carcass surveys were performed by two investigators walking upstream. This direction was employed to avoid obscuration of the streambed by disturbed stream sediment. Investigators wore polarized lenses to diminish surface glare. The channel, streambanks, and organic debris were visually inspected for live salmonids, fish carcasses, and redds. All data were recorded on forms printed on Rite-in-the-Rain paper (Figure 3). A list of survey materials needed is provided in Figure 4.

The Trinidad Fishermen's Salmon Enhancement (TFSE) Organization, a member of Pacific Coast Federation of Fishermen's Associations, Inc. (PCFFA), operated a fish weir on Prairie Creek from November 20, 1990 to January 18, 1991. They trapped and spawned adult salmon and steelhead as part of an effort to mitigate for the October 1989 storm which transported large amounts of fine sediment from the U.S. Highway 101 Bypass construction project into Prairie

Table 1. Physical Parameters of Redwood, Prairie, Lost Man, Bridge and Tom McDonald Creeks, Humboldt County, California.

CREEK NAME	ORDER ^a	LENGTH (km)	AREA ^b (km ²)	GRADIENT ^c
Redwood	6	108 ¹	720 ¹	.31-.34
Prairie	7	23.3 ²	104	0.01 (18.9)
Lost Man	6		32.2	0.01 (1.9)
Bridge	5	12.9 ³	29.5	0.02 (2.2)
Tom McDonald	5	7.5	18.0	0.02 (1.4)

Except as noted, all data is from Brown, 1988.

a - Order: Stream order (Strahler, 1957). First order streams are the smallest identifiable crenulations on 1:2400 USGS topographic maps.

b - Area: Drainage area, in square kilometers.

c - Gradient: Stream channel gradient, meter per meter, near confluence with mainstem Redwood Creek. Value in parentheses is distance of stream over which change in altitude was measured, in kilometers.

1 Madej, 1984

2 Coey, et al., 1991

3 Pitlick, 1982

STREAM:		PRESENT WEATHER CONDITIONS:			
SURVEY REACH	FROM:	RECENT WEATHER CONDITIONS:			
	TO:	WATER VISIBILITY	☐ See well in pools ____ ft. deep ☐ See only in riffles ☐ Can not see in riffles/pools	TEMPERATURE °C at °F	WATER:
	DISTANCE:				AIR:
SURVEYORS:				TIME:	
SURVEY DATE:		FLAGGING COLOR:		EST. STREAM FLOW	
				PAGE # OF	

[illegible]

Figure 3. Data form used by Redwood National Park to record spawning and carcass survey data, 1990-91.

Figure 4. List of Materials used for Spawning Surveys conducted by Redwood National Park Staff.

List of Materials for Spawning Surveys

Waders
Gaff
Aluminum notebook
Scale Envelopes
Survey Forms printed on Write-in-the-Rain Paper
blank paper (Write-in-the Rain)
knife
map
grease pencil
pencils
waterproof feltpens (black)
flagging
measuring tape (cm)
filet knife
polaroid glasses
thermometer
park radio
plastic bags

Creek and its tributaries. The results of the trapping effort are included in this report.

Live Salmonids - Species, sex, and fork length (cm) were estimated for all adult live fish. Their location and pertinent behavior, such as presence on a redd, was recorded.

Carcasses - Species (chinook, coho, or steelhead), sex, fork length (cm), spawning condition, and presence of tags or fin clips were recorded for all adult carcasses. Scale samples were taken from the left side above the lateral line, below and slightly behind the dorsal fin. Heads were collected from carcasses with an adipose fin clip so they could be examined for a coded wire tag (CWT). The heads were dissected at the U. S. Fish and Wildlife Service office in Arcata, California, for CWT extraction and tag decoding. Flagging was tied to the jaw of each carcass to avoid recounting on subsequent surveys. The carcass was returned to the location where it was found.

Redds - All observed salmonid redds were counted, measured, and on Bridge Creek, mapped. Redds were identified either as a definite redd, or as a questionable redd when a surveyor was uncertain. Redds can be altered by storm flows and some features erased making identification difficult. Redd length (m) was measured from the leading edge of the pot to the end of the tailspin. Redd width (m) was measured at a point which appeared to be an average width for

the redd. Superimposition of redds was noted. Each redd was flagged to avoid recounting on subsequent surveys.

Additional Information - Any obvious changes, such as recently fallen trees, newly deposited large organic debris, and landslides in the stream were noted.

I. INDEX OF SPAWNING EFFORT

It is difficult to determine the entire population or reproductive success of a salmonid run in a stream without a counting weir. Weirs are costly and demand a lot of personnel hours to maintain and operate. As an alternative, fishery biologists conduct spawning surveys on selected stream reaches in order to establish an index to compare spawning effort over time and determine population trends.

A. Results:

Twenty-eight surveys were conducted, the dates of surveys shown in Table 2. Table 3 summarizes the total numbers of live fish, carcasses, and redds for all streams surveyed during the 1990-91 spawning year. Tables 4 through 12 list the same parameters by stream reach and date. Observations of fish on Brown Creek by Victor Vrell (Physical Science Technician, RNP) and on Redwood Creek by David Anderson (Fishery Biologist, RNP) and Ian Gilroy

Table 2. Dates of Spawning Surveys Conducted during the 1990-1991 Spawning Year on Lost Man, Bridge, and Prairie Creeks, Humboldt County, California.

Lost Man	Bridge 1	Bridge 2	Bridge 3
01-16-91	01-03-91	01-03-91	
01-31-91	01-24-91	01-24-91	
02-27-91	02-13-91	02-13-91	02-13-91
03-18-91	04-12-91	04-12-91	04-12-91

Prairie 1	Prairie 2	Prairie 3
12-13-90	01-23-91	01-24-91
12-31-91	02-12-91	02-19-91
01-22-91	04-03-91	04-16-91
02-11-91	06-05-91*	06-06-91*
03-19-91		
04-30-91		

* Survey incorporated with removal of flagging marking redds

Bridge 1 is the reach from the Mouth to the "Log Jam".

Bridge 2 is the reach from the "Log Jam" to XS-126.

Bridge 3 is the reach from XS-126 to the old M7 bridge

Prairie 1 is the reach from the 101 Bypass study section, Prairie below Channelization to Boyes Creek.

Prairie 2 is the reach from Boyes Creek to Brown Creek.

Prairie 3 is the reach from Brown Creek to the log jam approximately 1.5 miles above Brown Creek.

Table 3. Total Numbers of Adult Live Salmonids, Carcasses, and Redds Observed During the 1990-91 Spawning Year in Prairie, Lost Man, Bridge, Redwood, and Brown Creeks, Humboldt County, California.

TOTAL NUMBERS OF FISH & REDDS - ALL STREAMS																		
STREAM	LIVE FISH				CARCASSES												REDDS	
					KING			COHO			STEELHEAD			UNKNOWN				
	KING	COHO	SHD*	UNKN*	F	M	UNKN	F	M	UNKN	F	M	UNKN	F	M	UNKN	DEF	QUES
FRAIRIE	101	88	11	14	26	10	5	13	11	8	0	0	0	0	0	11	88	34
LOST MAN	1	4	48	9	6	3	1	5	14	3	0	0	1	0	0	2	34	4
BRIDGE	8	0	8	1	1	1	0	0	0	0	0	0	0	0	0	0	6	3
REDWOOD*	-	-	62	-	1	-	-	-	-	-	2	-	-	-	-	-	-	-
BROWN*	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

^a SHD = Steelhead trout

^b UNKN = unknown, fish not identifiable

^c observational data, no survey conducted

Table 4. Total Numbers of Adult Live Salmonids, Carcasses, and Redds Observed During the 1990-91 Spawning Year in the Prairie Below Channelization to Boyes Index Reach of Prairie Creek, Humboldt County, California.

PRAIRIE CREEK - CHANNELIZATION TO BOYES																		
DATE	LIVE FISH				CARCASSES												REDDS	
					KING			COHO			STEELHEAD			UNKNOWN				
	KING	COHO	SHD*	UNKN*	F	M	UNKN	F	M	UNKN	F	M	UNKN	F	M	UNKN	DEF	QUES
12/05/90*	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0
12/13/90	2	0	0	1	0	1	2	0	0	0	0	0	0	0	0	0	10	2
12/31/90	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	10	2
01/22/91	26	8	0	6	1	1	0	0	2	0	0	0	0	0	0	0	17	3
02/11/91	4	0	4	0	17	4	2	1	2	2	0	0	0	0	0	1	8	3
03/18/91	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	1	7	4
04/30/91	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	10	1
WEIR*	66	79	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTALS	97	87	8	8	18	6	4	1	5	2	0	0	0	0	0	4	83	15

^a SHD = Steelhead trout

^b UNKN = unknown, fish not identifiable

^c Observational data

^d All fish captured at weir by TFSE from Nov 20 to Jan 18, 1990. Of the 145 fish trapped, 25 KING and 35 COHO were released upstream.

Table 5. Total Numbers of Adult Live Salmonids, Carcasses, and Redds Observed During the 1990-91 Spawning Year in the Boyes to Brown Index Reach of Prairie Creek, Humboldt County, California.

PRAIRIE CREEK - BOYES TO BROWN																		
DATE	LIVE FISH				CARCASSES												REDDS	
					KING			COHO			STEELHEAD			UNKNOWN				
	KING	COHO	SHD*	UNKN*	F	M	UNKN	F	M	UNKN	F	M	UNKN	F	M	UNKN	DEF	QUES
01/23/91	3	6	0	6	1	0	0	0	0	0	0	0	0	0	0	0	8	2
02/12/91	1	2	0	0	0	2	0	6	3	1	0	0	0	0	0	2	8	6
04/03/91	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	3	8	2
06/06/91	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
TOTALS	4	8	1	6	1	2	0	6	3	1	0	0	0	0	0	6	23	11

^a SHD = Steelhead trout

^b UNKN = unknown, fish not identifiable

Table 6. Total Numbers of Live Fish, Carcasses and Redds Observed During the 1990-91 Spawning Year in the Brown to 1.5 Index Reach of Prairie Creek, Humboldt County, California.

PRAIRIE CREEK - BROWN TO 1.5																		
DATE	LIVE FISH				CARCASSES												REDDS	
					KING			COHO			STEELHEAD			UNKNOWN				
	KING	COHO	SHD*	UNKN*	F	M	UNKN	F	M	UNKN	F	M	UNKN	F	M	UNKN	DEF	QUES
01/24/91	0	2	0	0	7	2	1	8	2	1	0	0	0	0	0	0	0	1
02/19/91	0	0	0	0	0	0	0	0	1	2	0	0	0	0	0	2	1	4
04/02/91	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04/16/91	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2	3
06/06/91	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTALS	0	4	2	0	7	2	1	8	3	3	0	0	0	0	0	2	3	8

^a SHD = Steelhead trout

^b UNKN = unknown, fish not identifiable

Table 7. Total Numbers of Adult Live Salmonids, Carcasses, and Redds Observed During the 1990-91 Spawning Year in the Index Reach of Lost Man Creek, Humboldt County, California.

LOST MAN CREEK																		
DATE	LIVE FISH				CARCASSES												REDDS	
					KING			COHO			STEELHEAD			UNKNOWN				
	KING	COHO	SHD*	UNKN*	F	M	UNKN	F	M	UNKN	F	M	UNKN	F	M	UNKN	DEF	QUES
01/16/91	1	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1
01/31/91	0	2	8	7	6	3	1	1	12	0	0	0	0	0	0	0	17	1
02/27/91	0	0	18	0	1	0	0	4	2	3	0	0	0	0	0	0	13	2
03/18/91	0	0	22	1	0	0	0	0	0	0	0	0	1	0	0	2	3	0
TOTALS	1	4	48	9	6	3	1	6	14	3	0	0	1	0	0	2	34	4

^a SHD = Steelhead trout

^b UNKN = unknown, fish not identifiable

Table 8. Total Numbers of Adult Live Salmonids, Carcasses, and Redds Observed During the 1990-91 Spawning Year in the Mouth to Log Jam Index Reach of Bridge Creek, Humboldt County, California.

BRIDGE CREEK - MOUTH TO LOG JAM																		
DATE	LIVE FISH				CARCASSES												REIDS	
					KING			COHO			STEELHEAD			UNKNOWN				
	KING	COHO	SHD*	UNKN*	F	M	UNKN	F	M	UNKN	F	M	UNKN	F	M	UNKN	DEF	QUES
01.03.91	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0
01/24.91	6	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	1
02/13/91	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
04/12/91	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTALS	6	0	2	0	1	1	0	0	0	0	0	0	0	0	0	0	2	2

^a SHD = Steelhead trout

^b UNKN = unknown, fish not identifiable

Table 9. Total Numbers of Adult Live Salmonids, Carcasses, and Redds Observed During the 1990-91 Spawning Year in the Log Jam to XS-126 Index Reach of Bridge Creek, Humboldt County, California.

BRIDGE CREEK - LOG JAM TO XS-126																		
DATE	LIVE FISH				CARCASSES												REIDS	
					KING			COHO			STEELHEAD			UNKNOWN				
	KING	COHO	SHD*	UNKN*	F	M	UNKN	F	M	UNKN	F	M	UNKN	F	M	UNKN	DEF	QUES
01/03/91	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
01/24/91	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
02/13/91	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04/12/91	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
TOTALS	3	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1

^a SHD = Steelhead trout

^b UNKN = unknown, fish not identifiable

Table 10. Total Numbers of Adult Live Salmonids, Carcasses, and Redds Observed During the 1990-91 Spawning Year in the XS-126 to the Former M7 Bridge Index Reach of Bridge Creek, Humboldt County, California.

BRIDGE CREEK - XS 126 TO M7 BRIDGE																		
DATE	LIVE FISH				CARCASSES												REDDS	
					KING			COHO			STEELHEAD			UNKNOWN				
	KING	COHO	SHD	UNKN	F	M	UNKN	F	M	UNKN	F	M	UNKN	F	M	UNKN	DEF	QUES
02/13/91	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0
04/12/91	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTALS	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0

^a SHD = Steelhead trout

^b UNKN = unknown, fish not identifiable

Table 11. Observational Data of Total Numbers of Adult Live Salmonids, Carcasses, and Redds Observed During the 1990-91 Spawning Year in the Section of Redwood Creek From the Estuary to the Lower Portion (Deli-Hole).

REDWOOD CREEK - ESTUARY TO LOWER (DELI-HOLE)																		
DATE	LIVE FISH				CARCASSES												RLDDS	
					KING			COHO			STEELHEAD			UNKNOWN				
	KING	COHO	SHD*	UNKN*	F	M	UNKN	F	M	UNKN	F	M	UNKN	F	M	UNKN	DEF	QUES
01/14/91	-	-	-	-	1	-	-	-	-	-	2	-	-	-	-	-	-	-
01/29/91	-	-	60	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
02-09-91	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTALS	-	-	62	-	1	-	-	-	-	-	2	-	-	-	-	-	-	-

^a SHD = Steelhead trout

^b UNKN = unknown, fish not identifiable

Table 12. Observational Data of Total Numbers of Live Adult Salmonids, Carcasses, and Redds Observed During the 1990-91 Spawning Year in the Upper Section of Brown Creek, Humboldt County, California.

BROWN CREEK - UPPER SECTION																		
DATE	LIVE FISH				CARCASSES												REDDS	
					KING			COHO			STEELHEAD			UNKNOWN				
	KING	COHO	SHD*	UNKN*	F	M	UNKN	F	M	UNKN	F	M	UNKN	F	M	UNKN	DEF	QUES
03/03/91	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

^a SHD = Steelhead trout

^b UNKN = unknown, fish not identifiable

(Fishery Biologist, USFWS, Arcata, CA.), were noted and are recorded on the data tables herein. These observations have not been included in discussion of the results because actual surveys were not performed.

It was not possible to determine the species of salmonid which dug a particular redd unless the surveyors observed the redd being dug. Salmonid spawning effort is established by examination of redd production each year. Spawning effort by species is determined by counting numbers of live fish and carcasses observed. Over a period of years, a population trend is established. The results presented herein are from one spawning year and serve as comparable data for other years.

One hundred and one live chinook and 99 live coho salmon were observed in Prairie Creek during the survey period. These numbers represent 91.8% and 96.1% of all live chinook and coho, respectively, found in all surveyed streams. One live chinook and four live coho salmon were found in Lost Man Creek; eight live chinook and no coho were found in Bridge Creek. Eleven, 48, and 3 steelhead were found in Prairie, Lost Man and Bridge Creeks, respectively. Fourteen, 9 and 1 unknown salmonids were reported in Prairie, Lost Man and Bridge Creeks, respectively.

Forty one chinook and 30 coho salmon carcasses were found in the three reaches of Prairie Creek. These results represent 77% of all chinook and 58% of all coho carcasses found among the index

streams. Only one steelhead carcass, found in Lost Man Creek, was reported for the surveyed streams.

The 89 definite redds and 34 questionable redds found in Prairie Creek represent 69% of all definite and 83% of all questionable redds found throughout the index streams. Thirty-four definite and four questionable redds were found in Lost Man Creek; and five definite and three questionable redds were found in Bridge Creek.

B. Discussion:

Live fish and carcass data should be examined separately to avoid consideration of the same fish twice, as a live salmon becomes a carcass soon after spawning. Not all carcasses are recovered, some are transported downstream, hidden from view, or scavenged by predators. Steelhead usually do not die after spawning and their numbers are not best represented by carcass data.

The presence of the weir in the Channelization to Boyes reach of Prairie Creek confounds and skews the results when comparing numbers of chinook and coho salmon between streams or the Prairie Creek reaches. Adult salmonids heading upstream were caught in the trap. (No data were recorded for captured steelhead trout by the operators of the trap.) Sixty-eight percent of the live chinook and 91% of the live coho found on Prairie Creek were trapped at the weir. They, however, released 25 chinook and 35 coho salmon

upstream of the weir. These fish may have been double counted upstream, but only four live chinook and 12 coho salmon were observed from Boyes Creek to 1.5. The majority of all live fish observations on Prairie Creek were made in the Channelization to Boyes reach which was surveyed six times and includes fish captured at the weir. The Bridge Creek reach from XS-126 to the M7 Bridge was surveyed only twice; all other reaches on all surveyed streams were surveyed four times each. Even with the disparity of survey effort, and the presence of the weir, there are greater numbers of chinook and coho in Prairie Creek than in the other streams. Redd data is also confounded due to the weir because some of the captured fish were removed from the naturally spawning population.

The highest percentage of live steelhead, 71.6%, were observed in Lost Man Creek; Prairie Creek and Bridge Creek were 16.4% and 11.9%, respectively. The larger numbers of steelhead found in Lost Man Creek is likely attributable to Prairie Creek Fish Hatchery, which was operated by Humboldt County and located on Lost Man Creek. The hatchery has released thousands of yearling steelhead into Lost Man Creek annually since the 1972-73 spawning year (Steven Sanders, personal communication).

In a standardized comparison among the streams, (no./km), Lost Man Creek, had more carcasses and redds per km than the other two streams, and was similar to Prairie Creek; 25.0 (Lost Man) versus 25.9 live fish per km (Prairie) (Table 13). Bridge Creek had the lowest values in all categories indicating a very small run. The

Figure 13.

Live Salmonids, Carcasses, and Redds per Km for Index Reaches Surveyed During the 1990-91 Spawning Year in Prairie, Lost Man, and Bridge Creeks, Humboldt County, California.

STREAM	INDEX REACH	LENGTH (km)	LIVE FISH / KM	CARCASSES / KM	REDDS / KM (Def and Ques)
PRAIRIE	Channel to Boyes	3.540	15.5 ^a	11.3	22.0
	Boyes to Brown	2.735	6.9	6.2	12.4
	Brown to 1.5	2.414	2.5	10.8	4.6
	Total Reach	8.689	25.9 ^b	9.4	14.2
LOST MAN	Hatchery to Double Bridges	2.480	25.0	14.1	15.3
BRIDGE	Mouth to M7 bridge	2.925	5.8	0.7	2.7

^a Does not include fish captured at TFSE wier.

^b Includes all, including fish captured at TFSE weir.

comparatively large run on Lost Man Creek is probably influenced by the presence of hatchery fish returning to the Prairie Creek Hatchery. The number of live fish per km on Prairie Creek, 25.9, includes those fish trapped at the TFSE weir, and could overestimate the true value as some of those fish would have probably spawned above the Brown to 1.5 reach and in some of the tributaries entering Prairie Creek. These figures when compared between years and streams will serve to plot possible trends.

II. DISTRIBUTION OF SALMONIDS IN THE INDEX STREAMS AND CHANGES IN HABITAT CONDITIONS

Streams are highly diverse and exhibit a wide variety of conditions in terms of substrate, large organic debris, cover, and water depth and velocity. Salmonids exhibit distinct preferences in the selection of spawning areas. Distribution of fish in a stream is useful in the assessment of the amount and location of available spawning habitat, and presence of migrational barriers. Comparison of redd distribution over time serves to detect changes in spawning habitat conditions.

A. Results:

Eighty-nine definite and 34 questionable redds were found in Prairie Creek. Most redds were found in the lower reach. Lost Man Creek had the second highest number of redds with 34 definite and

4 questionable redds counted. Surveys on Bridge Creek yielded only 5 definite and 3 questionable redds.

B. Discussion:

As noted before, the greatest number of chinook and coho salmon counted were captured in the trap located in the Channelization to Boyes reach of Prairie Creek. Presence of the trap makes comparison of chinook and coho utilization between reaches of Prairie Creek difficult because it is unknown where the trapped fish would have spawned naturally. As long as the weir operates, it will be impossible to make an accurate comparison of spawning distribution between the three Prairie Creek reaches. The decrease of redds per km between adjacent upstream reaches (^{Table} ~~Figure~~ 13) is probably a artifact of the weir but could reflect natural conditions.

The total number of definite and questionable redds on Bridge Creek were distributed evenly, four above and four below the log jam. Two definite redds were found in both the Mouth to Log Jam and XS-126 to M7 reaches, and one in the Log Jam to XS-126; and two, and one questionable redds were observed in the Mouth to Log Jam and Log Jam to XS-126 reaches, respectively (Figure 5). The modified Log Jam is passing fish, however, the problem now is there are very few fish to use the habitat. Bear tracks along the streambanks of Bridge Creek indicate some winter bear activity. To what extent they are hunting live salmonids is unknown.

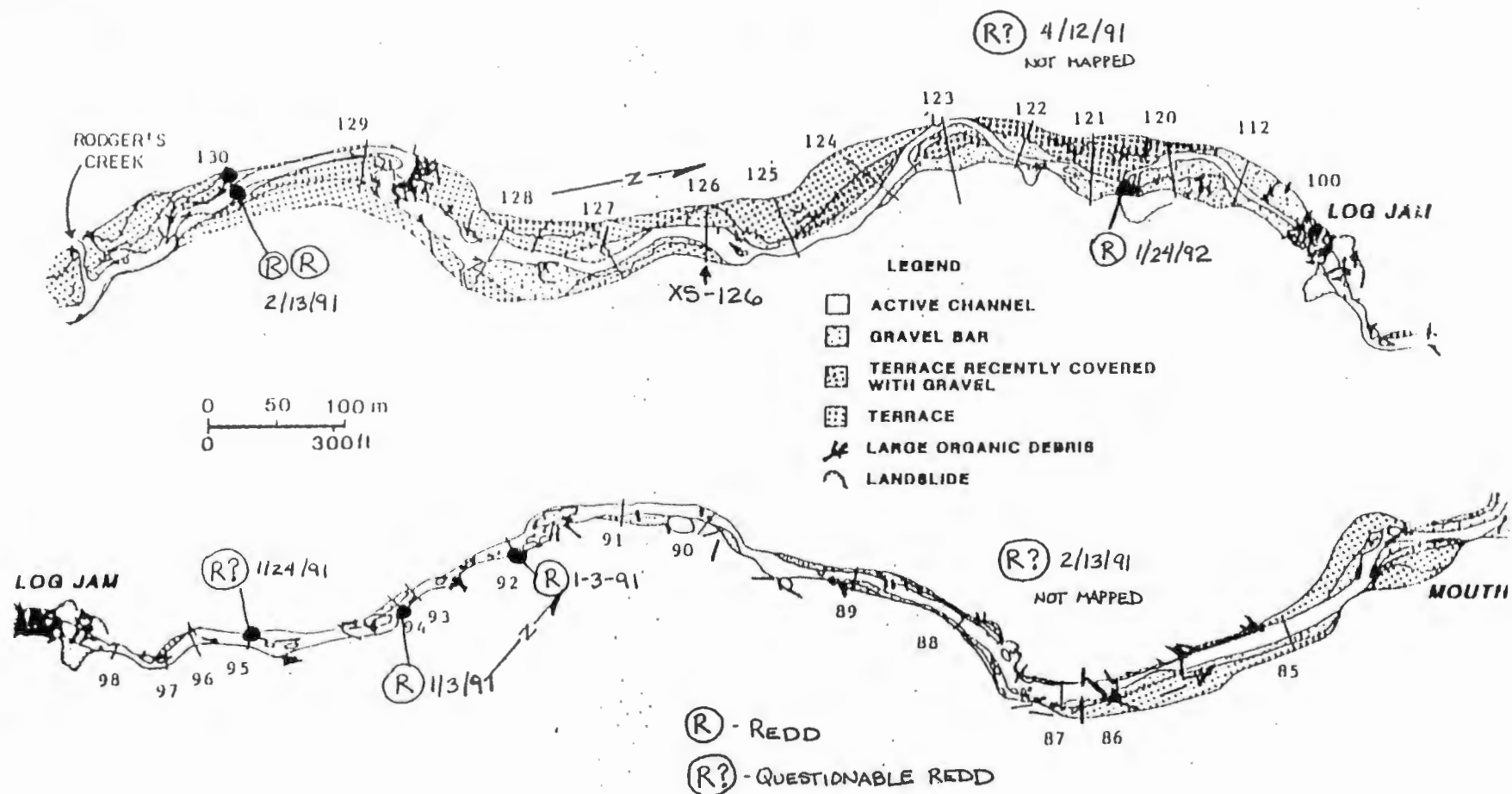


Figure 5. Map of Lower Bridge Creek, Humboldt County, California, with Survey Reaches Indicated: Mouth of Log Jam, Log Jam to XS-126, and XS-126 to M7 Bridge (Partially Shown), and Redd Locations Observed During the 1990-91 Spawning Season.

Redwood National Park investigators placed monuments every 50 meters on part of Lost Man Creek and are in the process of placing known-interval monuments on the survey reaches of Prairie Creek in order to identify fish and redd locations accurately for future analysis. Live fish, carcasses, and redd distribution for Lost Man Creek are discussed in the Lost Man Creek Dam Removal Annual Report.

III. DETERMINATION OF THE SIZE, AGE, AND SEX RATIO OF SALMONIDS

The size of a salmonid when it returns to its natal stream is indicative of both freshwater and oceanic feeding conditions. Ocean harvest pressure, to some extent will affect the mean length, as the number of older fish will decline as they are repeatedly subjected to ocean harvest each year, resulting in fewer older larger fish returning to spawn. Though scales were sampled, none of the scales have been aged. The sex ratio allows biologists to ascertain the probability of fertilization for each female and can serve as an indication of reproductive success. Though the averages of estimated live salmonid lengths are presented (Table 14), carcass data provides the most reliable means for the determination of the size and sex ratio of spawning salmonids.

A. Results:

Table 14. Averages of Estimated Live Salmonid Lengths (cm) for all Chinook and Coho Salmon, and Steelhead Trout Observed During the 1990-91 Spawning Year in Prairie, Lost Man, Bridge, and Brown Creeks, Humboldt County, California.

AVERAGES OF ESTIMATED LIVE SALMONID LENGTHS									
STREAM	CHINOOK SALMON Average Length (cm) (no.)			COHO SALMON Average Length (cm) (no.)			STEELHEAD TROUT Average Length (cm) (no.)		
	FEM	MALE	UNKN*	FEM	MALE	UNKN	FEM	MALE	UNKN
PRAIRIE	76 (24)	65 (29)	55 (9)	65 (24)	57 (31)	51 (4)	-	-	50 (10)
LOST MAN	-	-	66 (1)	-	-	54 (2)	-	-	47 (3)
BRIDGE	70 (1)	55 (2)	70 (4)	-	-	-	-	58 (2)	58 (7)
BROWN	-	-	-	-	-	-	-	57 (1)	

*UNKN = unknown, fish not identifiable

In Prairie Creek, the average length of chinook female carcasses, 82 cm, was greater than chinook male carcass length, 69 cm (Table 15). The same trend was exhibited for chinook salmon captured at the TFSE weir, females were 83 cm and males were 67 cm (Table 16). Though not as reliable, the averages of the estimated live chinook lengths confirmed the same trend (Table 14). It was the opposite on Lost Man Creek where the average length of male chinook carcasses, 85 cm, were longer than female chinook carcasses, 79 cm. The same was true for Bridge Creek, however, only one of each sex were recovered, a 75 cm female and 95 cm male carcass.

The average length of female coho carcasses, 68 cm, in Prairie Creek was not much larger than male coho, 66 cm (Table 15). The same was true for live coho trapped at the weir, average length for females and males, was 66 cm and 61 cm, respectively (Table 17). In Lost Man Creek, female coho carcasses, 67 cm, were longer than male coho carcasses, 58 cm.

Only one steelhead carcass at 76 cm, and sex unknown, in Lost Man Creek, was found in the surveyed streams during the 1990-91 spawning year.

Chinook salmon carcasses exhibited a female:male sex ratio of 2.6:1, 2:1, and 1:1 in Prairie, Lost Man, and Bridge Creeks, respectively (Table 18). Coho carcasses exhibited a female:male sex ratio of 1.2:1 and 0.4:1 in Prairie and Lost Man Creeks, respectively. No coho carcasses were found in Bridge Creek.

Table 15. Average Salmonid Carcass Fork Length for all Carcasses Measured During the 1990-91 Spawning Year in Prairie, Lost Man, Bridge, and Redwood Creeks, Humboldt County, California.

AVERAGE SALMONID CARCASS FORK LENGTH									
STREAM	CHINOOK SALMON Average Length (cm) (no.)			COHO SALMON Average Length (cm) (no.)			STEELHEAD TROUT Average Length (cm) (no.)		
	FEM	MALE	UNKN*	FEM	MALE	UNKN	FEM	MALE	UNKN
PRAIRIE	82 (18)	69 (8)	75 (2)	68 (5)	66 (8)	55 (2)	-	-	-
LOST MAN	79 (6)	85 (2)	-	67 (5)	58 (11)	60 (1)	-	-	76 (1)
BRIDGE	75 (1)	95 (1)	-	-	-	-	-	-	-
REDWOOD	87 (1)	-	-	-	-	-	73 (2)	-	-

*UNKN = unknown, fish not identifiable

Table 16. Average Length (cm) of Measured Chinook Salmon and Total Numbers of Chinook Salmon Captured at the Weir on Prairie Creek, Humboldt County, During the 1990-91 Spawning Year.

PRAIRIE CREEK - FISH WEIR		
CHINOOK SALMON		
	AVG. LENGTH (cm) (no.)	TOTAL NO.
MALES	67 (23)	47
FEMALES	83 (14)	19

Table 17. Average Length (cm) of Measured Coho Salmon and Total Numbers of Coho Salmon Captured at the Weir on Prairie Creek, Humboldt County, During the 1990-91 Spawning Year.

PRAIRIE CREEK - FISH WEIR		
COHO SALMON		
	AVG. LENGTH (cm) (no.)	TOTAL NO.
MALES	61 (22)	45
FEMALES	66 (22)	34

Table 18. Ratio of Female to Male Salmonid Carcasses, by Species, for All Identifiable King and Coho Carcasses Found in Prairie, Lost Man and Bridge Creeks During the 1990-91 Spawning Year.

SEX RATIO OF CHINOOK & COHO CARCASSES 1990-91		
STREAM	CHINOOK FEMALE : MALE	COHO FEMALE : MALE
Prairie	2.6 : 1	1.2 : 1
Lost Man	2 : 1	0.4 : 1
Bridge	1 : 1	-

B. Discussion:

The average female chinook and coho carcass lengths were longer than average male lengths, except for chinook carcasses found in Lost Man and Bridge Creeks. Small sample sizes of chinook carcasses, six females and two males in Lost Man Creek, and one male and female in Bridge Creek, diminish the value of size comparison by sex for chinook salmon in these two streams. Future comparisons with data from previous years will explain any trends.

The chinook carcass ratios of females to males in Prairie (2.6:1), and Lost Man (2:1) may not be adequate to ensure fertilization of all females. However, on Prairie Creek, in 19 of the cases where female chinook carcass cavities were checked for eggs, 18 were spawned-out. On Lost Man Creek, all four of the cases noted were spawned out. The 1:1 ratio of chinook carcasses in Bridge creek represents the entire sample set; two fish. Aside from the small Bridge Creek sample set, the major problem in Bridge Creek is too few fish returning to spawn. The ratio of female to male coho carcasses on Prairie Creek, 1.2:1 is probably adequate to ensure fertilization, and on Lost Man Creek, 0.4:1, more than adequate to ensure pairing of the sexes.

IV. REDD CHARACTERISTICS

A. Results:

The average area of a redd on Bridge Creek, 7.63 m^2 , was much larger than the average area for redds measured on Prairie or Lost Man creeks, 4.22 m^2 and 4.39 m^2 , respectively (Table 19). Redds in Bridge Creek ranged from 0.5 m^2 to 18 m^2 ; in Prairie Creek from 0.5 m^2 to 12.9 m^2 , and in Lost Man Creek from 1.5 m^2 to 8.4 m^2 .

B. Discussion:

The average redd area in Bridge Creek, 7.63 m^2 , is much larger than the redd areas in Lost Man and Prairie Creeks. The area difference between streams is most likely due to the fact that the larger chinook salmon dig bigger redds than coho salmon. No coho salmon were found in Bridge Creek and coho salmon were found in relatively large numbers in Prairie and Lost Man Creeks.

V. RECOVERY OF TAGGED AND FIN CLIPPED SALMONIDS

Various federal, state, and private agencies operate salmonid enhancement programs. To obtain information and evaluate enhancement efforts, some released fish are fin clipped and/or tagged. Redwood National Park occasionally recovers these fish that stray from other systems, as the Prairie Creek Hatchery no longer marks their yearling releases. Some of hatchbox fish raised

by TFSE were tagged, but we would not expect them to be returning in the 1990-91 spawning season.

A. Results:

One female chinook salmon carcass found in Lost Man Creek on the January 31, 1991 was marked with a top caudal fin clip.

B. Discussion:

The Prairie Creek Hatchery on Lost Man Creek clipped the top caudal fin of all returning adult salmonids that entered the fish ladder and were not spawned by the hatchery. They are released back into the creek (Steven Sanders, personal communication). This female was most likely one of the released fish.

Table 19. Total Numbers of Definite and Questionable Redds, Their Average Length (m), Width (m), Area (m²), and Estimated Total Area (m²) for All Redds, Definite and Questionable, Observed During the 1990-91 Spawning Year in Prairie, Lost Man and Bridge Creeks, Humboldt County, California.

REDD AREAS					
STREAM	NUMBER OF REDDS (Measured)	AVERAGE LENGTH (m)	AVERAGE WIDTH (m)	AVERAGE AREA (m ²)	TOTAL AREA (m ²)
Prairie	71	3.08	1.30	4.22	485.4*
Lost Man	17	3.22	1.34	4.39	168.2*
Bridge	5	4.48	1.24	7.63	61.0*
ALL STREAMS	93	3.18	1.31	4.44	714.6

* Estimated

REFERENCES

- Best, D.W. 1984. Land Use of the Redwood Creek Basin. Redwood National Park Technical Report 9, National Park Service, Arcata, California.
- Brown, R. 1988. Physical Rearing Habitat for Anadromous Salmonids in the Redwood Creek Basin, Humboldt County, California. Masters Thesis. Humboldt State University, Arcata, California.
- Coey, R.M., Klein, R.D., Madej, M.A., Meyer, C.B., Best, D.W., Ozaki, V.L. 1991. Monitoring the Impacts and Persistence of Fine Sediment in the Prairie Creek Watershed 1990-1991. National Park Service, Arcata, California.
- Kelsey, H., M.A. Madej, J. Pitlick, M. Coghlan, D. Best, R. Belding, P. Stroud. 1981. Sediment Sources and Sediment Transport in the Redwood Creek Basin: A Progress Report. Redwood National Park Technical Report 3, National Park Service, Arcata, California.
- Madej, M.A. 1984. Recent Changes in Channel-Stored Sediment, Redwood Creek, California. Redwood National Park Technical Report 11, National Park Service, Arcata, California.

Pitlick, J. 1982. Sediment Routing in Tributaries of the Redwood Creek Basin: Northwestern California. Redwood National Park Technical Report 8, National Park Service, Arcata, California.

Redwood National Park. 1988. Upper Dam Removal, Lost Man Creek. Redwood National Park, Environmental Assessment. Arcata, California.

Redwood National Park. 1991. Stream Monitoring and Habitat Restoration in Bridge Creek, 1991 Progress Report. Redwood National Park, Geology and Fish and Wildlife Branches. Arcata, California.

PERSONAL COMMUNICATIONS

David Anderson, Fishery Biologist, Redwood National Park, Orick, California.

Ian Gilroy, Fishery Biologist, U.S. Fish and Wildlife Service, Arcata, California.

Steve Sanders, Hatchery Superintendent, Prairie Creek Hatchery, Orick, California.

Victor Vrell, Physical Science Technician, Redwood National Park, Orick, California.