Anderson, 1994

REDWOOD CREEK BASIN 1991-1992 SPAWNING AND CARCASS SURVEY

ANNUAL PROGRESS REPORT

Fish and Wildlife Branch

Research and Resource Management Division

Redwood National Park

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

INTRODUCTION

Redwood National Park (RNP) was established by an act of Congress in 1968 to "...preserve significant examples of the primeval coastal redwood (*Sequoia sempervirens*) forests and the streams and seashores with which they are associated for the purposes of public inspiration, enjoyment, and scientific study..." (Public Law 90-545). In 1978 Congress authorized an expansion of the park "... in order to protect irreplaceable Redwood National Park resources from damaging upslope and upstream land uses..." (Public Law 95-250). This expansion added 48,000 acres to the existing park and established a 30,000-acre park protection zone (Kiester 1993).

Historically, Redwood Creek and its tributaries had large runs of chinook (king) salmon (*Oncorhynchus tshawytscha*), coho salmon (*O. kisutch*), and steelhead trout (*O. mykiss*) (Feranna 1981). However, past and present land use practices have had negative impacts upon aquatic resources within Redwood National Park. Large scale logging in the basin began in the early 1950's, and by 1978, 69% of the forests of the lower watershed, 92% of the middle watershed and 81% of the upper watershed (approximately 81% of the entire watershed) had been logged (Best, 1984). Highly erodible hillslopes of the Redwood Creek basin (Jandra et al. 1975), combined with the effects of timber harvest and frequent winter storms have resulted in the deposition of large amounts of sediment into Redwood Creek and its tributaries. Construction of the US Highway 101 bypass, and ongoing logging upstream of park boundaries (as well as the legacy of past logging practices within the park) have continued to deliver sediment. This sedimentation has reduced available salmonid spawning habitat and the number of fish in these streams (RNP, 1992). Commercial, sport, and illegal fishing place additional pressures on already depleted stocks within the Park.

In the past, lack of quantitative data has made it difficult to determine the status of RNP's aquatic resources. In order to monitor the recovery or decline of salmonid stocks, the Fish and Wildlife Branch of the Research and Resources Management Division at Redwood National Park annually surveys salmonid populations within the Park. These spawning surveys fall under Natural Resources Project Statement REDW-N-259.000, Redwood Creek Fisheries Inventory and Monitoring (Appendix A). The results of the 1991-1992 surveys are summarized in this report.

OBJECTIVES

Information gained from long term monitoring of returning salmon and spawning habitat should enable scientists at Redwood National Park to make appropriate recommendations to promote the future recovery of salmon stocks within the

Redwood Creek basin. The objectives of the winter spawning and carcass surveys are listed below.

I. Determine numbers of adult salmonids and redds in the index streams.

II. Determine the distribution of spawning salmonids and note changes in habitat conditions which may affect salmonids.

III. Determine the size, sex ratio, and age of returning salmonid spawners.

IV. Obtain information on redd characteristics.

V. Recover data on tagged and fin clipped salmonids.

STUDY AREA

Surveys were conducted on index streams within the Redwood Creek basin (Figure 1). Redwood Creek, located in northwestern California, drains a 720 km^2 watershed and contains 74 tributaries of second or higher order. 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). Descriptions of the streams surveyed during the 1991-1992 season are given below.

Prairie Creek

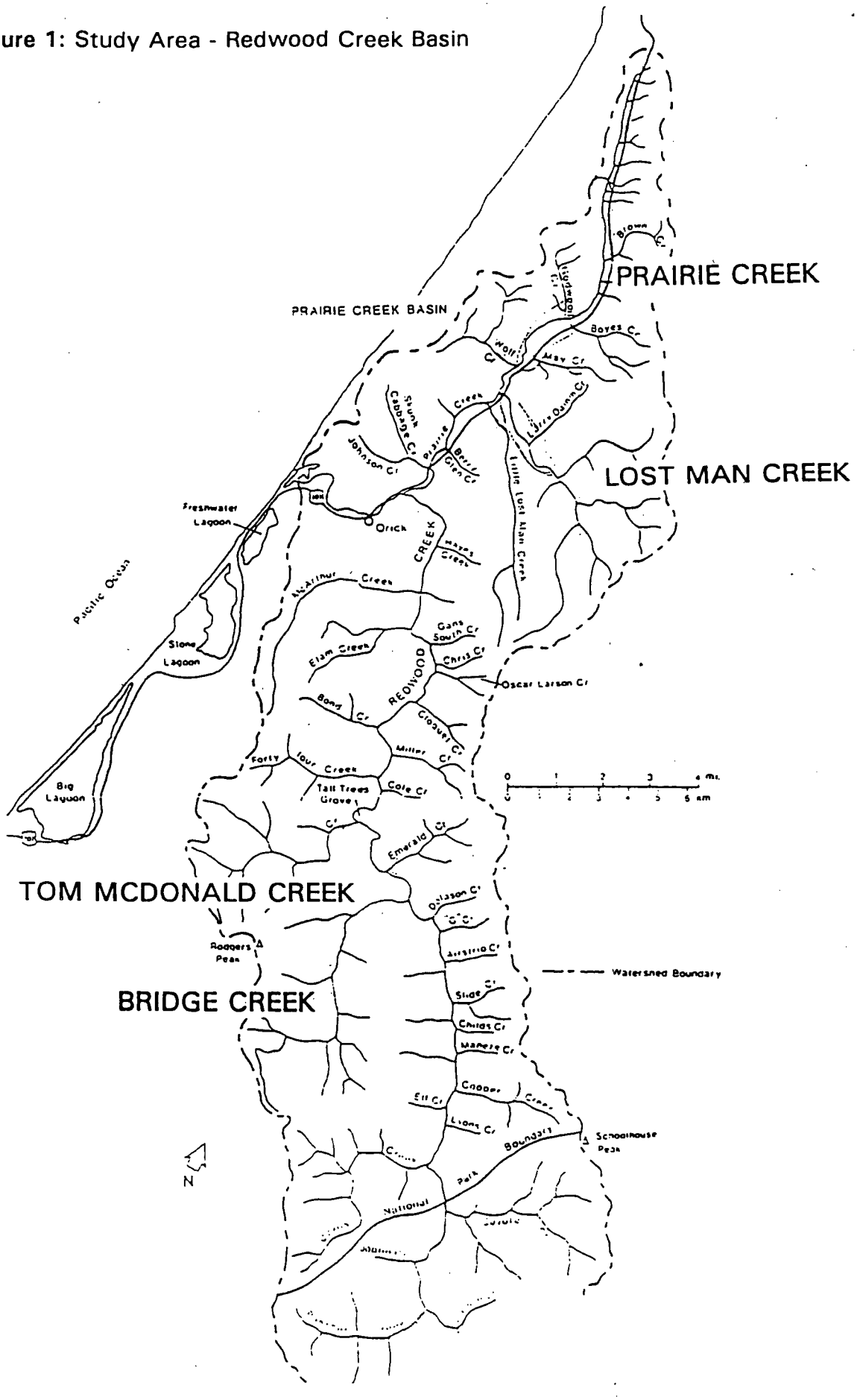
Prairie Creek flows into Redwood Creek north of the town of Orick, California. The 77.7 km^2 watershed is approximately 23.3 km in length, and flows along U.S. Highway 101 through private agricultural land (grazing), and the old-growth redwood forests of Prairie Creek Redwood State Park and Redwood National Park (Coey, et al., 1991). The three adjacent index reaches established on Prairie Creek are:

1. Lower (Channelization to Boyes) - U.S. Highway 101 Bypass study section, Prairie Creek below Channelization to Boyes Creek; 3,540 meters in length.

2. Middle (Boyes to Brown) - Boyes Creek to Brown Creek; 2,735 meters in length.

3. Upper (Brown to 1.5 Above) - Brown Creek to a point approximately 1.5 miles north of Brown Creek; 2,414 meters in length.

Figure 1: Study Area - Redwood Creek Basin



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 a upstream northerly direction.

Lost Man Creek

Lost Man Creek flows into Prairie Creek approximately 5 road kilometers north of the town of Orick, California. The 32.1 km^2 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 second of the "double bridges" where the road/trail crosses Lost Man Creek.

Bridge Creek

Bridge Creek, the fourth largest tributary of Redwood Creek, is 12.9 km in length with a 29.52km^2 watershed. This watershed is entirely within Redwood National Park. Two survey reaches have been established along this creek: 1) from the mouth to the "Log Jam", and 2) from the "Log Jam" to the old M-7 bridge. Most hillsides immediately adjacent to the creek channel were logged prior to 1978. Many logging induced and natural log jams were removed from the creek between 1950 and 1978. The Ed Mervich Memorial Log Jam ("Log Jam"), located approximately 1.3 kilometers upstream from the confluence with Redwood Creek, is a large jam which was modified in 1984 and 1990 to aid fish migration (Redwood National Park, 1991). The combined length of the two established reaches is 2,925 meters.

Tom McDonald Creek

Tom McDonald Creek is 7.5 km. in length, and drains a 18 km^2 watershed. The main channel of Tom McDonald Creek below the forks was, in large part, not logged (Kelsey, et al., 1981). This stream has been surveyed for the last two years, however, a study reach has not yet been defined.

The physical parameters of each creek are summarized in Table 1 (next page). Stream order is assigned according to Strahler (1957). First order streams are the smallest identifiable crenulations on 1:24000 USGS topographic maps (Brown 1988). Gradient is the slope of the stream channel (meters of elevation change per meter of horizontal distance), near the confluence with mainstem Redwood Creek. The value in parentheses is the distance of stream (in kilometers) over which change in elevation was measured. Unless noted, all data in Table 1 is from Brown (1988).

TABLE 1: PHYSICAL PARAMETERS OF INDEX STREAMS; HUMBOLDT COUNTY CALIFORNIA				
CREEK	ORDER	LENGTH (km)	DRAINAGE AREA (km^2)	GRADIENT
Redwood	7	108[1]	720[1]	<0.01 (11.6)
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)

[1]Madej, 1984
[2]Coey, et al., 1991
[3]Pitlick, 1982

METHODS

A decision to conduct spawning/carcass surveys presents several logistical difficulties to standardizing survey effort, and therefore imposes limitations on data analysis. Storm frequency and intensity during any given survey season dictate the number and timing of surveys performed. Rainfall, the resulting increased stream flows, and accompanying increase of turbidity (and therefore decrease in visibility) will determine when it is feasible to perform a survey, the interval between surveys, and therefore the number of surveys accomplished. In addition to logistical difficulties, there are difficulties arising from the variability inherent in natural systems. These difficulties are discussed briefly later in this report.

Techniques used for Redwood National Park's annual spawning/carcass surveys are consistent with established methodology (Downie and Peterson, unpublished; California Department of Fish and Game, unpublished; Six Rivers National Forest, unpublished; Oregon Department of Fish and Wildlife, unpublished). Each spawning and carcass survey was performed by two investigators. The stream channel was visually inspected for live salmonids, redds and carcasses; streambanks and organic debris were also inspected for carcasses. Investigators walked upstream in order to avoid obscuring the water column in front of them with sediment. All data were recorded on standardized data sheets printed on Rite-in-the-Rain® paper (Figure 2). The location of each live fish, carcass, or redd was recorded along with other pertinent information discussed below. Monuments have been placed at known intervals along portions of Lost Man Creek and Prairie Creek. Monumenting should be completed along the index reaches of these two creeks at the end of the 1993-1994 survey

Figure 2: Data Sheet

REDWOOD NATIONAL PARK WINTER STREAM SURVEYS

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

WATER: AIR: TIME:

CASE NO.	STATION NO.	SPECIES CODE	LIVE FISH - EST LENGTH			CARCASSES - LENGTH (CM)			REDDS					OBSERVATIONS (spawned out, fin clip, scales or head taken, fish condition)
			FEMALE	MALE	UNKWN	FEMALE	MALE	UNKWN	DEFINITE REDD	REDD ?	REDD AREA L X W (M)		SUPERIM-POSITION	

Figure 3: Equipment List

Equipment List for Winter Spawning/Carcass Surveys

- Chest Waders
- Gaff
- Polarized Sunglasses
- Measuring Tape (cm)
- Thermometer
- Knife
- Scale Envelopes
- Aluminum Clipboard
- Flagging
- Map
- Pencils
- Grease Pencils
- Waterproof Felt Pens (Black)
- First Aid Kit
- Radio
- Zip-lock Bags
- Data Sheets (Rite-in-the-Rain® Paper)
- Blank Paper (Rite-in-the-Rain®)

season. This will insure consistent and accurate identification of fish and redd locations in the future. A list of equipment needed for each survey is provided in Figure 3. Polarized lenses were used to increase visibility by diminishing surface glare.

Survey Conditions

The following information was collected and recorded for each survey: date of survey, time of survey, stream and reach surveyed, surveyor's names, weather conditions (present and recent), water visibility, estimated stream flow, water temperature, and air temperature.

Live Salmonids

Species (king, coho, steelhead, or unknown), sex (male, female, or unknown), and fork length (estimated in centimeters) were recorded for all adult live fish. The location of each fish and any pertinent behavior (e.g. digging a redd) was also recorded.

Carcasses

Species (king, coho, steelhead, or unknown), sex (male, female, or unknown), fork length (measured in centimeters), location, spawning condition, and presence of tags or fin clips were recorded for all adult carcasses. Whenever possible, 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. Biodegradable flagging was tied to the jaw of each carcass to avoid recounting on subsequent surveys, and the carcass was returned to the location where it was found.

Redds

All observed salmonid redds were measured, enumerated, and on Bridge Creek, mapped. Because redd features can be altered or erased by storm flows, identification can sometimes be difficult. Redds were identified as either "definite" or "questionable" depending upon a surveyor's confidence in his/her determination. Redd length was measured (in meters) from the leading edge of the pot to the end of the tailspill. Redd width was measured (in meters) at a point which appeared to be an average width for the redd. If measuring the redd would interfere with spawning fish, the dimensions were estimated. Superimposition of redds was noted. Each redd was flagged to avoid recounting on subsequent surveys and its location was recorded.

Additional Information

Any obvious changes, such as recently fallen trees, newly deposited large organic debris, and landslides in the stream, or any apparent barriers to fish migration were noted. Data from each survey was entered into a database with an in-house program using dBASEIII PLUS software.

Pacific Coast Fish, Wildlife & Wetlands Restoration Association (PCFWWRA) operated a fish weir on Prairie Creek from November 20, 1991 to April 14, 1992 (PCFWWRA, 1992). Adult salmon and steelhead were trapped at the weir and spawned under a contract through the California Department of Transportation 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 Creek and its tributaries. The results of this trapping effort are summarized in this report.

RESULTS AND DISCUSSION

Results presented in this report are from one spawning season only (December 1991 - April 1992). Although data from 3 survey seasons (1990-91, 1991-92, and 1992-93) have been entered into a data base, valid comparison of fish populations between years is difficult. Salmon typically have a 3-5 year life cycle. Therefore, salmon returning to a system on consecutive years do not necessarily belong to the same year class. Because each cohort may possess different year strengths (and because many environmental factors affect the number of returning salmon during any given spawning season) drawing conclusions about population trends based on a few years worth of data (essentially a snapshot in time) is risky. Although general comparisons may be made between current and historic conditions, long term data is necessary for determining population trends. Until entry of survey data from past seasons has been completed (and a long term data base is established), comparison with previous data and analysis of trends is not feasible.

Twenty-three surveys were conducted during the 1991-1992 spawning season. Table 2 lists the date and location of each survey. General survey conditions for each survey are listed in Appendix B. Because of time constraints and poor weather conditions, some sections took more than one day to complete.

The timing of Prairie Creek surveys in relation to the flows on Prairie Creek (at the Wolf Creek Bridge) is shown in Figure 4. Because of extremely dry conditions, PCFWWRA (1992) observed very few fish actively migrating during the normal time of peak migration and spawning activity (December and early January). They also reported an apparent delay in the sexual maturation of salmonids observed at their operation.

TABLE 2: DATES OF SPAWNING SURVEYS CONDUCTED DURING THE 1991-1992 SPAWNING SEASON ON PRAIRIE, LOST MAN, BRIDGE, AND TOM MCDONALD CREEKS; HUMBOLDT COUNTY, CALIFORNIA.

PRAIRIE CREEK

LOWER	MIDDLE	UPPER
12-09-91	01-10-92	02-18-92
12-30-91 (to fish weir)	02-03-92	
01-21-92	03-09-92	
01-30-92		
03-04-92 ┐ one complete		
03-10-92 ┘ survey		
03-31-92 ┐		
04-01-92 | one complete		
04-02-92 ┘ survey		

101 BRIDGE AT DAVISON RANCH TO US 101 MP 125.5: 01-08-92

LOST MAN CREEK

01-02-92	
01-29-92	(Hatchery to RNP Picnic Grounds)
02-13-92 ┐	(Hatchery to Sta. 15)
03-03-92 ┘	(Sta. 15 to Double Bridges)
03-24-92	

BRIDGE CREEK

Mouth to Log Jam	Log Jam to M-7 Bridge
01-06-92	01-06-92
02-06-92	02-06-92
03-26-92	03-26-92

TOM MCDONALD CREEK

01-13-92
03-05-92

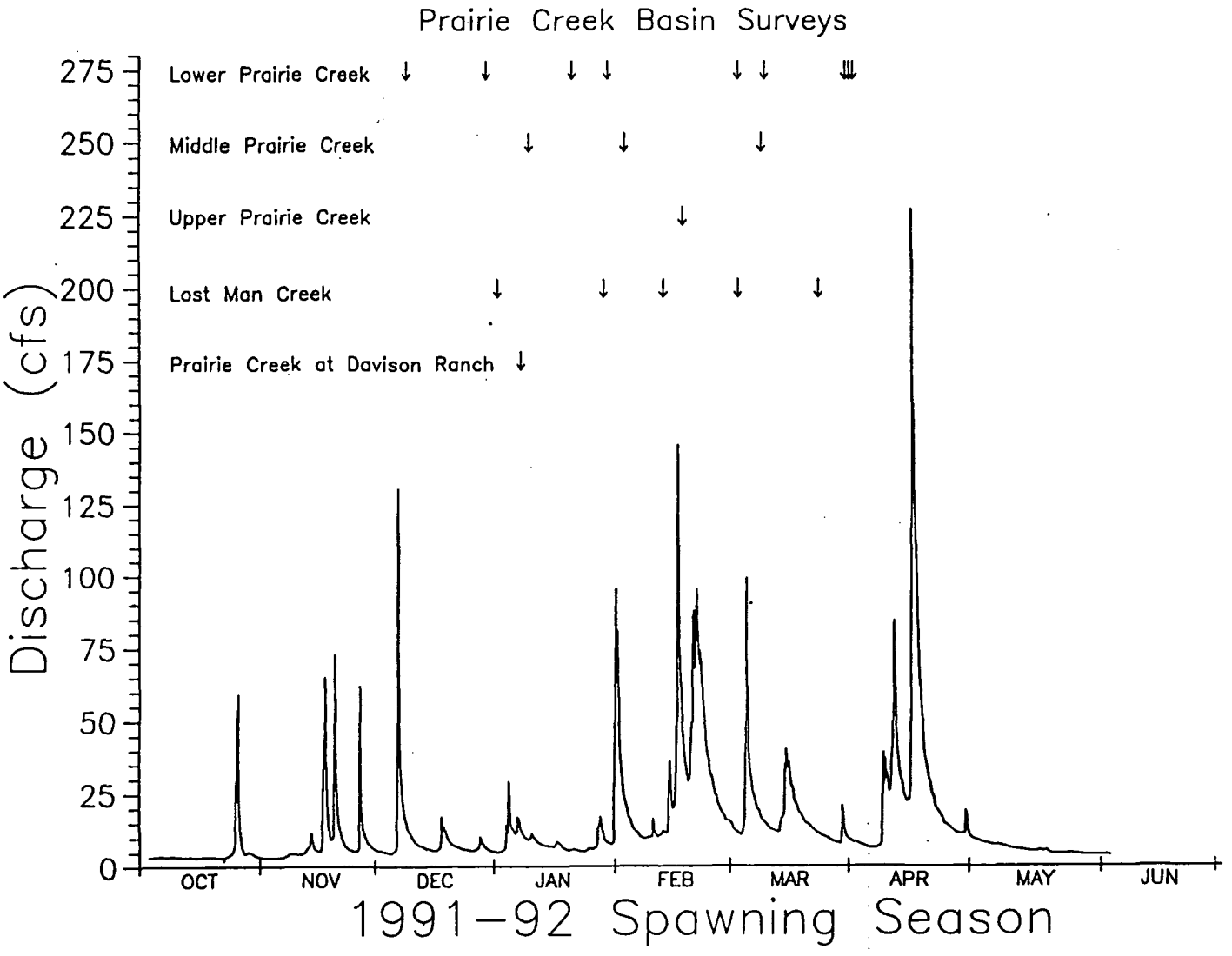


Figure 4: Timing of Prairie Creek Surveys in Relation to Flows on Prairie Creek

I. INDEX OF SPAWNING EFFORT

Results

Table C-1 (Appendix C) summarizes the total numbers of live fish, carcasses, and redds for all streams surveyed during the 1991-92 spawning year. Tables C-2 through C-11 (Appendix C) list the same parameters by stream, reach, and date. Redwood Creek data, presented in Table C-11, was collected during two float trips of Redwood Creek (from Tom McDonald Creek to the levees) on March 11 and March 18, 1992. This is observational data and has not been included in the discussion of the results. Prairie Creek, from the US HWY101 bridge at Davison Ranch to US HWY101 mile post 125.5, was surveyed on January 8, 1992 (Table C-5). This reach of Prairie Creek flows through recently acquired NPS property and was surveyed this year to determine what kind of fish activity was occurring in the area. Also, a section of Lost Man Creek above the double bridges was surveyed. These two reaches are not index reaches and have not been included in the discussion of the results.

The following is a summary of the live fish and carcasses observed on the index reaches during the 1991-1992 surveys (King = King or Chinook Salmon, Coho = Coho or Silver Salmon, SHD = Steelhead Trout, UNK = Unknown Salmonid). These numbers include fish trapped at the weir in the lower reach of Prairie Creek.

	LIVE FISH				CARCASSES			
	King	Coho	SHD	UNK	King	Coho	SHD	UNK
Prairie Creek	43*	80*	40*	15	3	7	2	3
Lost Man Creek	1	46	60	6	3	17	5	7
Bridge Creek	3	1	5	3	3	0	1	0
Tom McDonald Creek	0	0	0	0	0	1	0	0

*Includes fish trapped at weir operated by PCFWWRA.

The majority of live king salmon and coho salmon reported for the four index streams were found on Prairie Creek (91% and 63% respectively). Most of the live fish reported for Prairie Creek were trapped at the weir (95% of the king salmon, 88% of the coho salmon, and 78% of the steelhead trout). Over half of the live steelhead trout reported (57%) were observed on Lost Man Creek.

One hundred ten redds (97 definite, 13 questionable) were found on the Prairie Creek index reaches, 158 (155 definite, 3 questionable) on Lost Man Creek, 21 (15 definite, 6 questionable) on Bridge Creek, and 16 (12 definite, 4 questionable) on Tom McDonald Creek.

Discussion

It is difficult to accurately determine the entire spawning population or reproductive success without a fish weir to capture adults migrating upstream and juveniles migrating downstream. However, weirs are costly and demand extensive time 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 to determine population trends.

Spawning effort by species is determined by counting numbers of live fish, carcasses, and redds each year. Live fish and carcass data should be examined separately to avoid consideration of the same fish twice. It is important to remember that 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. Once data entry for previous spawning seasons is complete, comparison of the numbers of live fish, carcasses, and redds observed per unit of survey effort should be able to detect population trends on a gross scale.

The presence of the weir in the Channelization to Boyes reach of Prairie Creek makes interpretation of RNP's spawning surveys difficult. It is impossible to determine how many of the fish trapped at the weir would have been detected by surveyors had fish migration been unimpeded. Because fish were removed from the naturally spawning population, redd data from Prairie Creek upstream of the weir is not necessarily a valid indicator of spawning effort. In addition, valid comparison of data from a season when the weir was in operation and a season when it was not in operation cannot be made. These data will have to be treated separately in future analysis.

Even with the trapping of fish on Prairie Creek, the majority of steelhead trout were observed on Lost Man Creek. This may be a result of a hatchery run supported by the county fish hatchery on Lost Man Creek which raised and released primarily steelhead trout (until December 1992, when it ceased operation).

Redd production may be a more reliable indicator of spawning effort than fish counts because surveyors are able to see evidence of spawning activity without actually observing fish. Depending upon flows, a redd may be identifiable even weeks after it was dug. Unfortunately it is difficult to determine which species of salmonid dug a redd unless a surveyor witnesses fish digging or attending the redd. The large

number of redds produced on Lost Man Creek is probably due primarily to the return of fish reared at the county fish hatchery. Again, comparison of redd production over time may serve to detect population trends on a gross scale.

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

Results

Table 3 summarizes the distribution data for the index reaches surveyed during the 1991-1992 surveys.

TABLE 3: LIVE SALMONIDS, CARCASSES, AND REDDS PER KILOMETER FOR INDEX REACHES SURVEYED

STREAM	INDEX REACH	LENGTH OF REACH (km)	LIVE FISH / km	CARCASSES / km	REDDS / km (DEFINITE AND QUESTIONABLE)
PRAIRIE*	PBCH TO BOYES	3.540	5.4	4.0	23.7
	BOYES TO BROWN	2.735	0.7	0	7.3
	BROWN TO 1.5	2.414	0	0	2.5
	TOTAL	8.689	2.4	1.6	12.7
LOST MAN	HATCHERY TO DOUBLE BRIDGES	2.480	45.6	12.9	63.7
BRIDGE	MOUTH TO M7 BRIDGE	2.925	4.1	1.4	7.2

*Does not include fish trapped at weir (located in the PBCH to Boyes reach of Prairie Creek) operated by Pacific Coast Fish, Wildlife & Wetlands Restoration Association

Discussion

Streams are highly diverse and exhibit a wide variety of conditions in terms of substrate, large organic debris, cover, water depth, and water 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 may prove to be an indicator of changes in spawning habitat conditions.

No information was recorded referring to changes in habitat conditions. PCFWWRA (1992) noted in their report that the lower section of Prairie Creek (where much of the natural spawning took place) was heavily sedimented. RNP reports on studies carried out to address the effects of US Highway 101 bypass construction document habitat changes along portions of index reaches (Coey et al, 1991).

Again, operation of the weir in Prairie Creek makes comparison of salmonid utilization between the three reaches difficult. 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 these three reaches. For example, it is not known whether the decrease in the number of redds/km between adjacent upstream reaches of Prairie Creek (Table 3) is an artifact of the weir, the number of surveys conducted on each reach, or a reflection of natural conditions.

Results from the 1991-1992 spawning surveys showed that the "Log Jam" on Bridge Creek was not acting as a complete barrier to migration. Live fish (primarily steelhead trout) and redds were observed above the "Log Jam". Also, electrofishing on Bridge Creek (June 17, 1992) documented the presence of young-of-the-year coho salmon above and below the "Log Jam".

Results show that Lost Man Creek was the most utilized index creek in all three categories (number of live fish observed, number of carcasses observed, and the number of redds/km observed). This is probably a result of a run supplemented by hatchery production. Live fish, carcasses, and redd distribution for Lost Man Creek are discussed in further detail in the Lost Man Creek Dam Removal Report.

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

Results

Table 4 presents the average estimated lengths of the live salmonids observed during the 1991-1992 spawning surveys. Table 5 (next page) presents average measured lengths of the all carcasses, and Table 6 (next page) presents sex ratios for king and coho carcasses found on the index streams during the surveys.

TABLE 4: AVERAGE ESTIMATED LIVE SALMONID LENGTHS (cm)

STREAM	KING (no.)			COHO (no.)			STEELHEAD (no.)			UNK (no.)
	♀	♂	UNK	♀	♂	UNK	♀	♂	UNK	
PRAIRIE*	55 (1)	-	70 (1)	50 (2)	43 (7)	35 (1)	70 (2)	70 (2)	60 (4)	57 (8)
LOST MAN	-	-	70 (1)	57 (6)	49 (23)	52 (9)	80 (1)	69 (4)	61 (21)	50 (2)
BRIDGE	-	55 (1)	-	65 (1)	-	-	-	-	65 (7)	28 (3)
TOM MCDONALD	-	-	-	-	-	-	-	-	-	-

*Does not include data from 01/08/92 (101 Bridge at Davison Ranch to Mile Post 125.5): ♀Chinook - 75 (1); UNK - 61 (6).

TABLE 5: AVERAGE SALMONID CARCASS FORK LENGTH (cm)										
STREAM	KING (no.)			COHO (no.)			STEELHEAD (no.)			UNK (no.)
	♀	♂	UNK	♀	♂	UNK	♀	♂	UNK	
PRAIRIE[b]	-	72 (3)	-	69 (2)	56 (5)	-	80 (1)	70 (1)	-	-
LOST MAN	77 (1)	100 (1)	-	63 (9)	61 (6)	-	-	73 (4)	65 (2)	58 (4)
BRIDGE	94 (1)	95 (1)	-	-	-	-	-	55 (1)	-	-
TOM MCDONALD	-	-	-	-	-	-	-	-	-	-
REDWOOD[c]	-	-	-	-	-	-	-	79(1)	-	-

[b]Does not include data from 01/08/92 (101 Bridge at Davison Ranch to Mile Post 125.5): ♂Chinook - 65 (1); ♂Coho - 42 (1).
[c]Observational data. No survey performed.

TABLE 6: CARCASS SEX RATIO		
STREAM	KING ♂:♀ (#)	COHO ♂:♀ (#)
PRAIRIE CREEK	3:0 (3)	3:1 (8)
PRAIRIE - WEIR*	1.7:1 (41)	2.0:1 (70)
LOST MAN CREEK	1:1 (2)	1.6:1 (1.6)
BRIDGE CREEK	1:1 (2)	-

*Live fish trapped at weir operated by Pacific Coast Fish, Wildlife & Wetlands Restoration Association (Channelization to Boyes reach of Prairie Creek)

Discussion

In addition to genetic factors, the size of a salmonid when it returns to its natal stream is indicative of both freshwater and oceanic feeding conditions. Harvest pressure is another factor that may affect the age and size of returning salmon. Along with natural mortality, repeated ocean harvest will remove older individuals from a population. A population that is being severely harvested will exhibit a decrease in average age and length over time. Again, a long term data set may help determine what is happening to Redwood Creek stocks. The sex ratio allows biologists to ascertain the probability of fertilization for each female and can serve as an indication of the probability of reproductive success.

Scale samples were routinely collected during spawning surveys, however, none of these samples have been aged and therefore no age data is available at this time.

Carcass and weir data provide the most accurate means for the determination of the size and sex ratio of spawning salmonids because surveyors are able to make positive identifications and measure rather than estimate lengths. However, since few carcasses were recovered, these small sample sizes preclude any significant findings for either length or sex ratios. We received no length data from the weir captures, but the male:female ratio of fish captured at the weir indicates there were enough males to insure fertilization.

IV. REDD CHARACTERISTICS

Results

Table 7 presents summary statistics for the redds observed on the index streams during RNP's 1991-1992 spawning surveys. Average redd length and redd width was calculated using the dimensions of measured redds (not all redds were measured; the number of observed redds that were measured appears in parentheses). Total redd area was then estimated using the calculated averages and the number of redds observed.

TABLE 7: REDD DIMENSIONS

STREAM	NUMBER OF REDDS OBSERVED (MEASURED)	AVERAGE LENGTH (m)	AVERAGE WIDTH (m)	AVERAGE AREA (m^2)	TOTAL AREA (m^2)
PRAIRIE[d]	110 (108)	3.0	1.2	4.4	484
LOST MAN	158 (126)	3.6	1.3	7.9	1248
BRIDGE	21 (15)	3.0	1.3	4.7	99
TOM MCDONALD	16 (13)	2.5	1.6	4.2	67
ALL STREAMS	305 (262)	3.19	1.3	5.9	1898

[d]Does not include data from 01/08/92 (101 Bridge at Davison Ranch to Mile Post 125.5): 26 (20) redds, average length - 3.54 m, average width - 1.51 m, average area - 5.65 m^2, total area 147 m^2.

Discussion

Relative to other index streams, a large number of redds were observed on Prairie Creek and Lost Man Creek. This indicates that these two creeks are important areas for the production of salmon stocks in the Redwood Creek basin. The large number of redds observed on Lost Man Creek is probably due primarily to the return of fish reared at the county fish hatchery. The relatively large average area of redds on Lost Man Creek may be a result of multiple redds superimposed on one another. It will be interesting to watch future redd production in Lost Man Creek now that the fish hatchery is no longer in operation.

V. RECOVERY OF TAGGED AND FIN CLIPPED SALMONIDS

Results

Five adipose clipped coho salmon (4 females and 1 male) were captured at the PCFWWRA weir on lower Prairie Creek. One male adipose clipped coho salmon was recovered by RNP surveyors on Prairie Creek. The coded wire tag was removed and decoded (CWT no. 06-01-05-01-02).

The PCFWWRA weir also captured a female steelhead trout with a left ventral fin clip. RNP surveyors recovered a right ventral fin clipped male (55cm forklength) steelhead trout on Bridge Creek.

Discussion

Various state and federal agencies operate salmonid enhancement programs. To obtain information and evaluate enhancement efforts, some released fish are fin clipped and/or tagged with coded wire tags (CWT). The Prairie Creek Hatchery no longer marks their yearling releases, but Redwood National Park occasionally recovers marked fish that stray from other systems.

The two marked steelhead trout recovered this year (one at the PCFWWRA weir and one by RNP surveyors) came from the Mad River Hatchery (operated by CDFG)in Blue Lake, California. These fish were part of an feeding experiment comparing demand feeders and blower feeders. The three year experiment, using yearling steelhead trout releases (release years 1990, 1991, and 1992) seeks to determine the effects of the different feeding regimes on the survival and return of adults to the Mad River hatchery (Ken Gallagher, personal communication). Recovery of these fish in the Redwood Creek watershed illustrate straying between river systems by salmonids.

Some hatchbox fish raised by Trinidad Fishermen's Salmon Enhancement (TFSE) organization were tagged with CWTs. The adipose clipped coho salmon recovered by PCFWWRA and RNP surveyors were returning salmon from earlier hatchbox releases by the TFSE on Prairie Creek. Mitch Farro verified the CWT number as one of their fish. This 1989 brood year coho salmon was one of 37,258 juveniles (averaging 78mm) released in Prairie Creek between 06/25/90 and 07/12/90.

SUMMARY

Effects of land use practices (past and present) continue to have negative impacts upon aquatic resources within Redwood National Park. Commercial, sport, and illegal fishing place additional pressures on already depleted salmonid stocks. In order to

monitor the recovery or decline of these stocks, the Fish and Wildlife Branch of the Research and Resources Management Division at Redwood National Park annually surveys adult spawning salmonid populations within the Park. The results of the 1991-1992 surveys are summarized in this report. Information gained from long term monitoring of returning salmon (and spawning habitat) should enable scientists at Redwood National Park to make appropriate recommendations to promote the future recovery of salmon stocks within the Redwood Creek basin.

Despite limitations inherent in the data collected during spawning surveys, these surveys are an effective method for fisheries biologists to monitor long term population trends. Given the typical 3-5 year salmon life cycle, valid comparison of fish populations between years is difficult. Salmon returning to a system on consecutive years do not necessarily belong to the same year class. Because each cohort may possess different year strengths (and because many environmental factors affect the number of returning salmon during any given spawning season) drawing conclusions about population trends based on a few years worth of data (essentially a snapshot in time) is risky. Although general comparisons may be made between current and historic conditions, long term data is necessary for determining population trends.

Results from Redwood National Park's 1991-92 spawning/carcass surveys show that, overall, very low numbers of fish are returning to spawn in the index streams. Carcasses were recovered from these streams in numbers so low that calculation of valid statistics for average fork length and sex ratio of returning salmon was impossible. Observation of live fish, carcasses, and redds revealed that the majority of returning salmonids are utilizing Prairie Creek and Lost Man Creek, indicating that these two index streams contain very important habitat for salmonid production within the Redwood Creek basin. The relatively strong return of spawning salmon in Lost Man Creek was probably due, in large part, to past operation of a county fish hatchery on this creek. It will be interesting to monitor future returns to this creek now that the hatchery is no longer in operation.

PCFWWRA (1992) reported that they expected production of this year class of Chinook to be very low because of the "extremely poor survival suspected in the heavily sedimented lower section of Prairie Creek where much of their spawning took place". It will be several years before the ultimate success or failure of this year class may be assessed. Given the low numbers of fish returning to spawn in the Redwood Creek basin, the combined impacts of factors affecting fish populations (continued loss and degradation of habitat, harvest pressure, and unpredictable environmental conditions - drought, for example) would appear to place the long term survival of salmonid stocks within the Redwood Creek basin at great risk. Monitoring alone will not aid in the recovery of these stocks. The natural resiliency of these stocks must combine with creative and aggressive management of habitat and a large measure of luck for full recovery to occur.

APPENDIX A

PROJECT STATEMENT REDW-N-259.000
REDWOOD CREEK FISHERIES AND MONITORING

PROJECT NUMBER: REDW-N-259.000

TITLE: REDWOOD CREEK FISHERIES INVENTORY AND MONITORING

FUNDING STATUS: FUNDED: 100.00 UNFUNDED: 157.50

SERVICEWIDE ISSUES: N20 BASELINE DATA

CULTURAL RESOURCE TYPE CODE: N/A

10-238 PACKAGE NUMBER:

PROBLEM STATEMENT:

An initial salmonid nursery area study for all tributaries in the Redwood Creek basin was completed in 1981-82 to establish baseline conditions. A study documenting timing and numbers of downstream salmonid migrants in Redwood Creek was completed in the mid 1980's. A few tributary streams within the basin (Tom McDonald, Bridge, Emerald, Little Lost Man, Prairie, and Streelow Creeks) were electrofished with species identified, enumerated, weighed, and measured, and population size was occasionally estimated. Follow-up studies are needed to monitor the recovery of aquatic resources as the stream and watershed restoration program is implemented. Quantitative data are needed over the long-term on fisheries (including non-salmonids) and invertebrate productivity in Redwood Creek and its tributaries.

Spawning/carcass surveys on index reaches of Lost Man, Prairie, Bridge, and to a lesser extent lower Redwood Creek and Tom McDonald Creek have been conducted since the mid 1980's. Initially, the index sections were set up to monitor effects of(1) alterations of barriers to migration, (2) spawning above the Prairie Creek hatchery, and (3) effects of the Highway 101 Bypass construction, but the purpose needs to be shifted toward monitoring long-term population trends in the basin.

Most of the fisheries studies have been within the national and state park, with much less upstream of the park. More information is needed for the entire basin to evaluate the factors within the basin most limiting stream and fish productivity (see N-251).

Current Status:

Much of the initial information collected on these species came from studies using park base funding and by providing logistical support for graduate students attending Humboldt State University. University faculty support and outside funding sources have helped facilitate these studies. Studies completed during the 1980's included use of the Redwood Creek estuary by juvenile salmonids,

Proposal Date: 94

salmonid food habits in the estuary, a history of sedimentation of the estuary, downstream migration and timing of juvenile salmonids, physical and biological characteristics of salmonid nursery habitat of the entire Redwood Creek basin, the effect of fish carcasses and nutrient enrichment on the aquatic community, trends in spawning and summer steelhead counts, seasonal changes in aquatic invertebrate communities used as a food source, genetic identification of cutthroat trout stocks, and the characteristics and formation of cold pools needed for holding and rearing.

Based on monitoring and study results, analyses need to be conducted to determine problem areas or habitat deficiencies, identify any genetic or disease problems, and develop alternatives to solve those problems and restore the basin to a naturally functioning ecosystem.

DESCRIPTION OF RECOMMENDED PROJECT OR ACTIVITY:

Initiate a long-term monitoring program in aquatic habitat within the Redwood Creek basin. Permanent sampling sites for fisheries investigations in tributary streams within Redwood Creek would be established. A nursery area survey with the Redwood Creek basin would be repeated in order to provide a means of comparison for existing conditions with those shortly following park expansion. Parameters measured would include water quality, lengths and population estimates of fish species, and diversity and abundance of invertebrate communities and amphibians. Various sites would be established for investigating stream features and their contributions to fishery productivity. Winter spawning/carcass surveys of index streams would be continued to determine population trends and evaluate restoration projects. Mainstem Redwood Creek and tributary summer water temperatures would be monitored to correlate weather variables and to clarify temperature impacts on fish.

BUDGET AND FTEs:

----------FUNDED----------

Source	Act	Type	Budget ($1000s)	FTEs
Year 1: PKBASE-NR	MON		25.00	0.7
Year 2: PKBASE-NR	MON		25.00	0.7
Year 3: PKBASE-NR	MON		25.00	0.7
Year 4: PKBASE-NR	MON		25.00	0.7
Total:			100.00	2.8

Proposal Date: 94

PROJECT STATEMENT SHEET

----------UNFUNDED----------

Source	Act	Type	Budget ($1000s)	FTEs
Year 1: PKBASE-NR	MON		52.50	1.5
Year 2: PKBASE-NR	MON		35.00	1.0
Year 3: PKBASE-NR	MON		35.00	1.0
Year 4: PKBASE-NR	MON		35.00	1.0
Total:			157.50	4.5

(OPTIONAL) ALTERNATIVE ACTIONS/SOLUTIONS AND IMPACTS:

A. No action: No further information regarding relative contribution of tributary streams to the overall fisheries productivity of Redwood Creek would be obtained. No data with which to monitor recovery of the fish resource over time would be available nor would park staff be aware of any declines in the aquatic biological resources.

B. Implement the recommended project: Park staff could evaluate the effectiveness of the watershed restoration project on aquatic biological resources and determine the rate of recovery. This information would be used to develop or modify management activities in the basin.

COMPLIANCE CODE(s): EXCL

EXPLANATION: 516 DM2 APP. 2, 1.6

Proposal Date: 94

APPENDIX B

SURVEY CONDITIONS FOR 1991-92 SPAWNING/CARCASS SURVEYS

SURVEY CONDITIONS

STREAM	FROM	TO	DATE	PRESENT WEATHER	RECENT WEATHER	VFT	WT	AT	FLOW	NOTES
PRAIRIE CREEK	PBCH	BOYES	12/09/91	CLEAR,SUNNY,COLD	RAIN	3.0	8.5	8.5	LOW	USFS GAUGE - 0.28FT; RNP GAUGE - 0.65FT; 10:53
PRAIRIE CREEK	PBCH	BOYES	01/21/92	CLEAR AND SUNNY	CLEAR AND SUNNY	-	6.5	9.0	LOW	USFS GAUGE - 0.04FT; RNP GAUGE - 0.5FT
PRAIRIE CREEK	PBCH	BOYES	01/30/92	CLOUDY,WARM	SUNNY,HAZY	3.0	8.5	0.0	MED	RNP GAUGE - 0.54FT
PRAIRIE CREEK	PBCH	26+00	03/04/92	SHOWERS	INTERMITTENT SHOWERS	4.0	9.5	11.5	MED	USFS GAUGE - 0.27FT; RNP GAUGE - 0.64FT; VISIBILITY 1FT AFTER WIER
PRAIRIE CREEK	23+65	BOYES	03/10/92	CLEAR, SUNNY, THEN OVERCAST	RAIN	3.0	9.5	12.5	LOW	-
PRAIRIE CREEK	PBCH	15+76	03/31/92	CLEAR, SUNNY, WARM	RAIN	4.0	10.0	18.0	-	USFS GAUGE - 0.24FT; RNP GAUGE - 0.62FT
PRAIRIE CREEK	STATION 16	STATION 35	04/01/92	SUNNY, CLEAR, WARM	SUNNY, CLEAR, WARM	3.0	11.0	18.0	-	-
PRAIRIE CREEK	STATION 35	STATION 54+45	04/02/92	OVERCAST	MORNING DRIZZLE, YESTERDAY SUN	3.0	10.5	14.0	LOW	-
PRAIRIE CREEK	PBCH	23+65	12/30/91	CLEAR, SUNNY	MINOR STORM	3.0	7.5	17.0	LOW	USFS GAUGE - 0.6FT; RNP GAUGE - 0.5FT
PRAIRIE CREEK	BOYES	BROWN	01/10/92	DRIZZLE, OVERCAST	CLEAR	3.0	7.0	11.0	MED-LOW	TEMPERATURE - BOYES 7.5 DEG C, BROWN 7.5 DEG C; BOTH CLEAR
PRAIRIE CREEK	BOYES	BROWN	02/03/92	CLEAR, SUNNY	RAIN	3.0	7.5	10.5	MEDIUM-HIGH	GAUGING STATION BELOW BROWN "PL" - 0.82FT
PRAIRIE CREEK	BOYES	BROWN	03/09/92	CLEAR, SUNNY	RAIN	3.0	8.5	11.0	MED	GAUGING STATION BELOW BROWN "PL" - 0.78FT
PRAIRIE CREEK	BROWN	1.5	02/18/92	PARTLY CLOUDY, DRIZZLE @ NOON	LARGE STORM, RAIN	3.0	8.5	13.0	MED	FOOT BRIDGE GAUGE (PRAIRIE ABOVE BROWN) - 0.868FT
PRAIRIE CREEK	101 BRDG @ DR	MP 125.5	01/08/92	CLEAR, COLD	CLEAR, COLD	2.0	6.0	9.0	150 CFS	-
LOST MAN	HATCHERY	DBL BRIDGES	01/02/92	DRIZZLE	CLEAR	5.0	7.0	15.0	LOW	RNP GAUGE AT PICNIC BRIDGE - 2.6FT
LOST MAN	HATCHERY	DBL BRIDGES	03/24/92	CLEAR, COOL, SUNNY	RAIN	3.5	9.5	11.0	LOW	RNP GAUGE AT PICNIC BRIDGE - 2.8FT
LOST MAN	HATCHERY	15.05	02/13/92	PATCHY CLOUDS	LIGHT RAIN	3.0	9.0	15.0	-	-
LOST MAN	15.00	DBL BRIDGES	03/03/92	PATCHY CLOUDS, CLEARING	CLOUDY, NO RAIN	3.0	9.0	11.5	LOW	RNP GAUGE AT PICNIC BRIDGE - 2.8FT
LOST MAN	HATCHERY	PICNIC AREA	01/29/92	SLIGHT OVERCAST, COOL	LIGHT RAIN, WARMER	3.0	7.0	7.0	MED	RNP GAUGE AT PICNIC BRIDGE - 2.75FT
LOST MAN	DBL BRIDGES	ABOVE JAM	01/02/92	DRIZZLE	CLEAR	5.0	7.0	15.0	LOW	JAM POTENTIAL FISH BARRIER, 6 FT SED. TRAPPED BEHIND IT
LOST MAN	DBL BRIDGES	JAM	03/03/92	PATCHY CLOUDS, CLEARING	CLOUDY, NO RECENT RAIN	3.0	9.0	11.5	LOW	2.8FT (GAUGE AT PICNIC BRIDGE)
BRIDGE CREEK	MOUTH	LOG JAM	01/08/92	OVERCAST, COOL	RAIN, OVERCAST	4.0	6.0	12.0	-	LOT OF FINE SAND IN CREEK; REDWOOD CK 7.5C, 2'VIS, 3' BEL HW
BRIDGE CREEK	MOUTH	LOG JAM	02/06/92	CLEAR	CLEAR	4.0	7.0	10.0	-	REDWOOD CREEK 8.5 DEG C, MILKY
BRIDGE CREEK	MOUTH	LOG JAM	03/26/92	CLEAR, SUNNY, WARM	CLEAR, RAIN 4 DAYS EARLIER	-	10.5	17.0	LOW	-
BRIDGE CREEK	LOG JAM	M7 BRIDGE	01/08/92	OVERCAST	DRIZZLE, STORMY 1.75"RAINFALL	6.0	8.0	12.0	MED	-
BRIDGE CREEK	LOG JAM	M7 BRIDGE	02/06/92	CLEAR, SUNNY, COLD	CLEAR, SUNNY, RAIN 1 WK BEFORE	4.0	7.0	10.0	MED	-
BRIDGE CREEK	LOG JAM	M7 BRIDGE	03/26/92	SUNNY, WARM	CLOUDY	4.0	10.5	20.0	MED	-
TOM MCDONALD	MOUTH	-	01/13/92	OVERCAST, COLD	CLEAR	4.0	6.0	12.0	LOW	WATER LEVEL LOW AT MOUTH, DIFFICULT FOR FISH TO ENTER CREEK
TOM MCDONALD	MOUTH	JAM #6	03/05/92	RAIN	CLEAR	-	9.0	-	MED	VISIBILITY ONLY IN RIFFLES
REDWOOD CREEK	TOM MCDONALD	LEVEES	03/11/92	CLEAR, SUNNY, THEN OVERCAST	CLEAR, AND OVERCAST	-	10.0	17.0	MED	VISIBILITY ONLY IN RIFFLES
REDWOOD CREEK	TOM MCDONALD	LEVEES	03/18/93			-	-	-	-	-

VFT = VISIBILITY IN FEET, WT = WATER TEMPERATURE (DEGREES C), AT = AIR TEMPERATURE (DEGREES C)

APPENDIX C

SUMMARY OF RESULTS FROM 1991-1992 SPAWNING/CARCASS SURVEYS

PRAIRIE CREEK, LOST MAN CREEK, BRIDGE CREEK, AND TOM MCDONALD CREEK, HUMBOLDT COUNTY, CALIFORNIA.

TABLE C-1: TOTAL NUMBER OF FISH AND REDDS OBSERVED- ALL STREAMS

STREAM	LIVE FISH				CARCASSES												REDDS	
					KING			COHO			STEELHEAD			UNKNOWN				
	KING	COHO	SHD	UNK	♀	♂	UNK	♀	♂	UNK	♀	♂	UNK	♀	♂	UNK	DEF	?
PRAIRIE[a]	3	10	9	15	0	3	1	2	6	0	1	1	0	0	1	2	122	14
LOST MAN[b]	1	46	64	6	1	1	2	10	6	1	0	4	2	1	0	7	185	9
BRIDGE	3	1	5	3	1	1	1	0	0	0	0	1	0	0	0	0	15	6
T. MCDNLD	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	12	4
REDWOOD[c]	0	0	2	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0
P. CK. WEIR[d]	41	70	31	0	0	0	0	0	0	0	0	0	0	0	0	0	NA	NA

[a]Includes data from 02/18/92 survey (101 bridge at Davison Ranch to MP 125.5); outside Prairie Creek's three established index reaches.
[b]Includes data collected above double bridges (outside of defined reach).
[c]Observational data. No survey conducted.
[d]Total number of fish trapped at weir operated by Pacific Coast Fish, Wildlife & Wetlands Restoration Association (Channelization to Boyes reach of Prairie Creek). Number of trapped fish released: King - 7, Coho - 20, Steelhead 27.

TABLE C-2: NUMBER OF FISH AND REDDS OBSERVED - PRAIRIE CREEK (CHANNELIZATION TO BOYES)

STREAM	LIVE FISH				CARCASSES												REDDS	
					KING			COHO			STEELHEAD			UNKNOWN				
	KING	COHO	SHD	UNK	♀	♂	UNK	♀	♂	UNK	♀	♂	UNK	♀	♂	UNK	DEF	?
12/09/91	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	1
12/30/91[a]	1	4	0	2	0	2	0	0	2	0	0	0	0	0	1	0	14	3
01/21/92	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	13	3
01/30/92	0	4	0	5	0	0	1	1	1	0	0	0	0	0	0	1	3	3
03/04/92[b]	0	0	6	1	0	0	0	0	0	0	0	0	0	0	0	1	9	0
03/10/92[b]	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0
03/31/92[c]	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	20	0
04/01/92[c]	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	4	0
04/02/92[d]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0
WEIR[e]	41	70	31	0	0	0	0	0	0	0	0	0	0	0	0	0	NA	NA
TOTAL	43	78	40	8	0	2	1	2	5	0	1	1	0	0	1	2	74	10

[a]Incomplete survey (channelization to 23 + 65).
[b]03/04/92 survey incomplete (channelization to 26 + 00) because of rain; survey continued on 03/10/92 (23 + 65 to Boyes)
[c]03/31/92 survey incomplete (channelization to 15 + 76); survey continued on 04/01/92 (16 + 00 to 35 + 00)
[d]Incomplete survey (35 + 00 to 54 + 45)
[e]Fish trapped at weir operated by Pacific Coast Fish, Wildlife & Wetlands Restoration Association (Channelization to Boyes reach of Prairie Creek). Number of trapped fish released upstream: King - 7, Coho - 20, Steelhead - 27.

TABLE C-3: NUMBER OF FISH AND REDDS OBSERVED - PRAIRIE CREEK (BOYES TO BROWN)

STREAM	LIVE FISH				CARCASSES												REDDS	
					KING			COHO			STEELHEAD			UNKNOWN				
	KING	COHO	SHD	UNK	♀	♂	UNK	♀	♂	UNK	♀	♂	UNK	♀	♂	UNK	DEF	?
01/10/92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	2
02/03/92	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
03/09/92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	0
TOTAL	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17	3

TABLE C-4: NUMBER OF FISH AND REDDS OBSERVED - PRAIRIE CREEK (BROWN TO 1.5 ABOVE)

STREAM	LIVE FISH				CARCASSES												REDDS	
					KING			COHO			STEELHEAD			UNKNOWN				
	KING	COHO	SHD	UNK	♀	♂	UNK	♀	♂	UNK	♀	♂	UNK	♀	♂	UNK	DEF	?
02/18/92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0
TOTAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0

TABLE C-5: NUMBER OF FISH AND REDDS OBSERVED - PRAIRIE CREEK (101 BRIDGE AT DAVISON RANCH TO MP 125.5*)

STREAM	LIVE FISH				CARCASSES												REDDS	
					KING			COHO			STEELHEAD			UNKNOWN				
	KING	COHO	SHD	UNK	♀	♂	UNK	♀	♂	UNK	♀	♂	UNK	♀	♂	UNK	DEF	?
01/08/92	1	0	0	7	0	1	0	0	1	0	0	0	0	0	0	0	25	1
TOTAL	1	0	0	7	0	1	0	0	1	0	0	0	0	0	0	0	25	1

*Outside Prairie Creek's three defined reaches.

TABLE C-6: NUMBER OF FISH AND REDDS OBSERVED: LOST MAN CREEK (HATCHERY TO DOUBLE BRIDGES)

STREAM	LIVE FISH				CARCASSES												REDDS	
					KING			COHO			STEELHEAD			UNKNOWN				
	KING	COHO	SHD	UNK	♀	♂	UNK	♀	♂	UNK	♀	♂	UNK	♀	♂	UNK	DEF	?
01/02/92	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2	7	1
01/29/92[a]	1	26	4	2	0	0	0	2	2	0	0	0	0	0	0	0	24	0
02/13/92[b]	0	19	49	3	1	1	1	8	4	1	0	0	0	1	0	1	73	0
03/03/92[b]	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	1	10	2
03/24/92	0	0	4	1	0	0	0	0	0	0	0	3	2	0	0	2	41	0
TOTAL	1	46	60	6	1	1	1	10	6	1	0	3	2	1	0	6	155	3

[a]Incomplete survey (hatchery to picnic area)
[b]02/13/92 survey incomplete (hatchery to 15+05); survey continued on 03/03/92 and entered as 2 reaches (15+00 to double bridges; above double bridges)

TABLE C-7: NUMBER OF FISH AND REDDS OBSERVED - LOST MAN CREEK (ABOVE DOUBLE BRIDGES)

STREAM	LIVE FISH				CARCASSES												REDDS	
					KING			COHO			STEELHEAD			UNKNOWN				
	KING	COHO	SHD	UNK	♀	♂	UNK	♀	♂	UNK	♀	♂	UNK	♀	♂	UNK	DEF	?
01/02/92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	2
03/03/92	0	0	4	0	0	0	1	0	0	0	0	1	0	0	0	1	21	4
TOTAL	0	0	4	0	0	0	1	0	0	0	0	1	0	0	0	1	30	6

TABLE C-8: NUMBER OF FISH AND REDDS OBSERVED - BRIDGE CREEK (MOUTH TO LOG JAM)

STREAM	LIVE FISH				CARCASSES												REDDS	
					KING			COHO			STEELHEAD			UNKNOWN				
	KING	COHO	SHD	UNK	♀	♂	UNK	♀	♂	UNK	♀	♂	UNK	♀	♂	UNK	DEF	?
01/06/92	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
02/06/92	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	1	1
03/26/92	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	2	2
TOTAL	1	1	0	1	1	1	1	0	0	0	0	1	0	0	0	0	3	3

TABLE C-9: NUMBER OF FISH AND REDDS OBSERVED - BRIDGE CREEK (LOG JAM TO M-7 BRIDGE)

STREAM	LIVE FISH				CARCASSES												REDDS	
					KING			COHO			STEELHEAD			UNKNOWN				
	KING	COHO	SHD	UNK	♀	♂	UNK	♀	♂	UNK	♀	♂	UNK	♀	♂	UNK	DEF	?
01/06/92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
02/06/92	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0
03/26/92	0	0	5	2	0	0	0	0	0	0	0	0	0	0	0	0	6	3
TOTAL	2	0	5	2	0	0	0	0	0	0	0	0	0	0	0	0	12	3

TABLE C-10: NUMBER OF FISH AND REDDS OBSERVED - TOM MCDONALD CREEK[a]

STREAM	LIVE FISH				CARCASSES												REDDS	
					KING			COHO			STEELHEAD			UNKNOWN				
	KING	COHO	SHD	UNK	♀	♂	UNK	♀	♂	UNK	♀	♂	UNK	♀	♂	UNK	DEF	?
01/13/92	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	6	3
03/05/92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	1
TOTAL	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	12	4

[a]Study reach not yet defined for Tom McDonald Creek.

TABLE C-11: NUMBER OF FISH AND REDDS OBSERVED - REDWOOD CREEK[b]

STREAM	LIVE FISH				CARCASSES												REDDS	
					KING			COHO			STEELHEAD			UNKNOWN				
	KING	COHO	SHD	UNK	♀	♂	UNK	♀	♂	UNK	♀	♂	UNK	♀	♂	UNK	DEF	?
03/11/92	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	1	0
03/18/92	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
TOTAL	0	0	0	2	0	0	0	0	0	0	0	1	0	0	0	0	1	0

[b]Observational data only. No survey conducted.

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.

California Department of Fish and Game. 1980. Salmon Spawning Stock Survey Instructions. Unpublished. CDFG Anadromous Fisheries Branch, Sacramento, 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.

Downie, S. and G. Peterson, undated. Spawning Inventory. Unpublished instructions for conducting spawning inventories.

Feranna, R. and C. Ricks. 1981. Historic fisheries of Redwood Creek, Humboldt County, California. Unpublished manuscript, Redwood National Park, Arcata, California.

Jandra, R.J., K.M. Nolan, D.R. Harden, and S.M. Coleman. 1975. Watershed conditions in the drainage basin of Redwood Creek, Humboldt County, California, as of 1973. U.S. Department of the Interior Geological Survey Water Resource Division. Open File Report 75-568. Menlo Park, 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.

Kiester, Edwin. 1993. What if they made a park and nobody came? Smithsonian 24(7): 42-54.

Madej, M.A. 1984. Recent Changes in Channel-Stored Sediment, Redwood Creek, California. Redwood National Park Technical Report 11, National Park Service, Arcata, California.

Oregon Department of Fish and Wildlife. Undated. How to do spawning fish surveys. Unpublished. ODFW Salmon Trout Enhancement Program.

PCFWWRA, 1992. Preliminary Report, Pacific Coast Fish, Wildlife and Wetlands Restoration Association. PO Box 4574, Arcata, California 95521.

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.

Redwood National Park. 1992. Statement for Management. Arcata, California.

Six Rivers National Forest. Undated. Spawning ground count information. Unpublished instructions for conducting spawning inventories.

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