

**REDWOOD CREEK BASIN 1992-1993
SPAWNING AND CARCASS SURVEY**

ANNUAL PROGRESS REPORT

Fish and Wildlife Branch

Research and Resource Management Division

Redwood National Park

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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 and Ricks, 1981, Van Kirk, 1994). 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 (Redwood National Park, 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 1992-1993 surveys are summarized in this report.

OBJECTIVES

Information gained from long term monitoring of returning salmon and spawning habitat should assist scientists at Redwood National Park in making 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 trends in numbers of adult salmonids and redds in the index streams over time.
- 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 km² 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 1992-1993 season are given below. Lengths of reaches for Bridge and Tom McDonald Creeks were recalculated this year using RNP's computerized Geographic Information System (GIS). Numbers presented on a per kilometer basis use the more accurate reach lengths as derived by GIS; numbers from previous years have been recalculated using the reach lengths presented here.

Prairie Creek

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 of Prairie Creek Redwood State Park and Redwood National Park (Coey, et al., 1991). The established index reach on Prairie Creek is broken into three contiguous reaches which are:

1. Lower (Channelization to Boyes) - U.S. Highway 101 Bypass study section, Prairie Creek below Channelization to Boyes Creek; 4,030 meters in length.

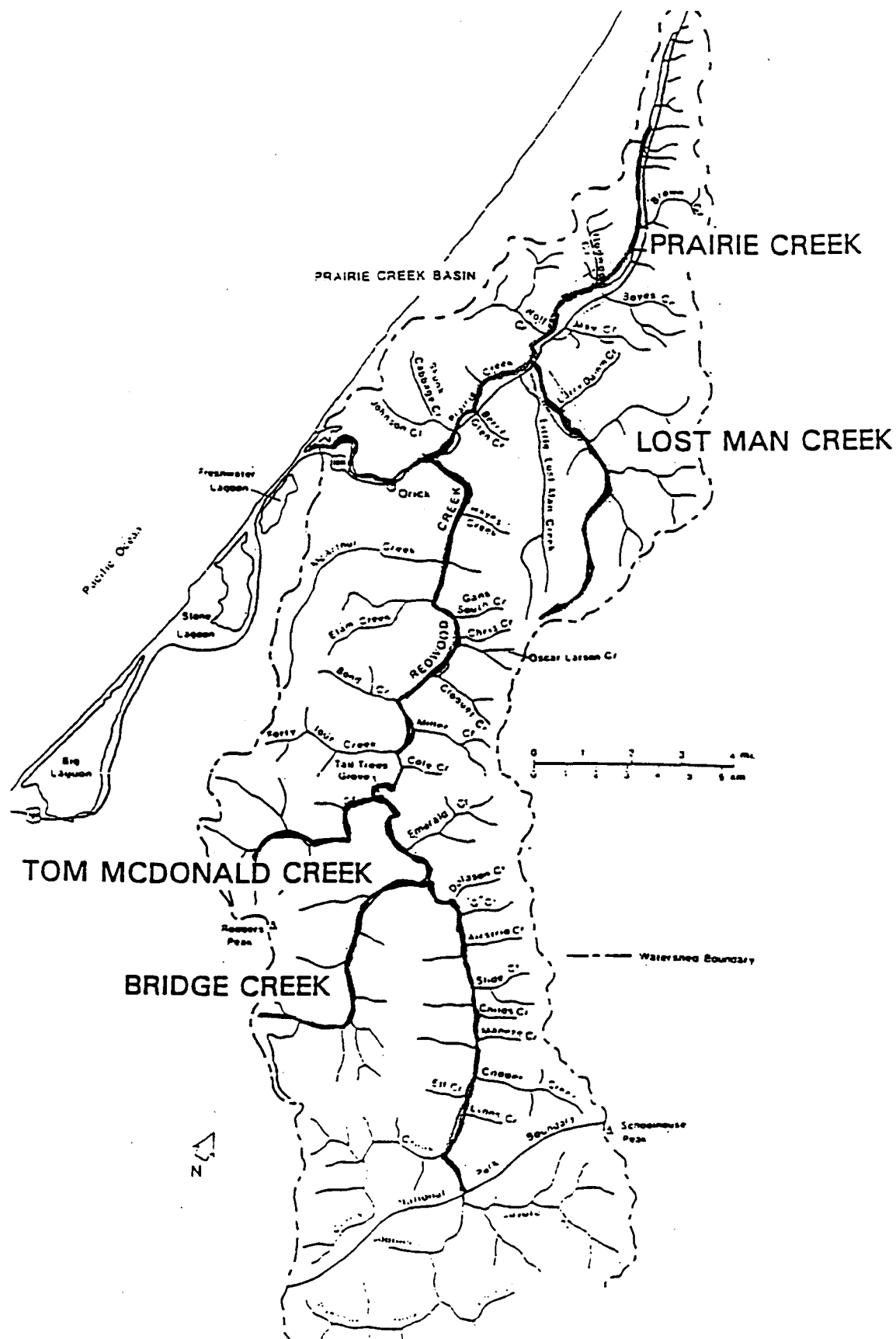


Figure 1: Study Area

2. Middle (Boyes to Brown) - Boyes Creek to Brown Creek; 3,380 meters in length.
3. Upper (Brown to 1.5 Above) - Brown Creek to a point approximately 1.5 miles north of Brown Creek; 3,080 meters in length.

Monumentation of Prairie Creek was accomplished this year. Survey reach lengths reflect the measured lengths and differ from lengths presented in previous reports. Data from previous years presented on a per kilometer basis have been recalculated to reflect the changed reach lengths. The Channelization to Boyes reach begins 40 meters upstream of the Streeflow Creek (aka Wolf Creek) confluence with Prairie Creek. The other two reaches are contiguous in an 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 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 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 29.52 km² watershed. This watershed is entirely within Redwood National Park. Two survey reaches have been established on the index reach 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 1.1 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 3.0 kilometers.

Tom McDonald Creek

Tom McDonald Creek is 7.5 km. in length, and drains a 18 km² watershed. The main channel of Tom McDonald Creek below the forks was, in large part, not logged (Kelsey, et al., 1981). The defined reach, 1.32 km. in length, is from the mouth to what is referred to as "Log Jam #6". This stream has been surveyed intermittently since the early 1980's, but often surveys did not cover the entire index reach. The surveys have covered the entire reach for the last two years.

The physical parameters of each creek are summarized in Table 1. 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), as measured 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 (km²)	GRADIENT (# km over elev. change measured)
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 Meyer, et al., 1994

³ Pitlick, 1982

METHODS

Standardization of survey effort is complicated by natural forces which impose limitations on data collection. Storm frequency, duration, and intensity during a survey season affect the number and timing of surveys performed. Rainfall increases stream flows and turbidity. Increased stream flow can prohibit surveyors' ability to conduct survey's and can flatten redds, making them visually indistinguishable from undisturbed streambed. Increased turbidity decreases visibility. The interval between surveys and the number of surveys which can be performed are weather dependent.

Techniques used for Redwood National Park's annual spawning/carcass surveys are consistent with established methodology (Downie and Peterson, undated; California Department of Fish and Game, 1980; Six Rivers National Forest, undated; Oregon Department of Fish and Wildlife, undated). Each spawning and carcass survey was performed by a minimum of two trained 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

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	WATER:
	DISTANCE:				See only in riffles	°C or °F	AIR:
SURVEYORS:				Can not see in riffles/pools	TIME:		
SURVEY DATE:		FLAGGING COLOR:		EST. STREAM FLOW		PAGE # OF	

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®)
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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 Lost Man Creek and Prairie Creek to facilitate the accurate location of fish and redds.

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) were 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; 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, landslides in the stream, or any apparent barriers to fish migration were noted. Data from each survey were 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 intermittently on Prairie Creek from November 18, 1992 to January 9, 1993 for a total of 356.6 hours (PCFWWRA, 1993). Adult salmon and steelhead were trapped at the weir and spawned under a contract through the California Department of Transportation in continuance of emergency measures to salvage adult salmon and steelhead returning to spawn in the Prairie Creek drainage. These measures were determined necessary due to extensive sedimentation deposited by an October 1989 storm; the sediment source was the U.S. Highway 101 Bypass construction project. Results of this trapping effort are summarized in this report.

RESULTS AND DISCUSSION

Results presented in this report are primarily from one spawning season (November 1992 through March 1993). Summarized data from 3 spawning seasons (1990-91, 1991-92, and 1992-93) are also presented. Also included are eight spawning years of data from a weir operated on Prairie Creek.

Comparison of salmonid populations between years is difficult due to several factors: the variable 3-5 year life cycles and death following spawning means that fish returning to a system in any one year are not from the same cohort, i.e., individuals from a cohort may return in different years; each cohort is affected by many environmental factors which determine the number returning to spawn; and survey conditions affect data collection. Drawing conclusions about population trends based on only a few years' data is untenable; long term data are necessary.

Two complete surveys were conducted on Prairie Creek and Lost Man Creek index reaches, three complete surveys were conducted on the Bridge Creek index reach and only one survey on Tom McDonald Creek index reach during the 1992-1993 spawning season. Because of time constraints and poor weather conditions, some index reaches took more than one day to complete. Additional surveys were conducted on some survey reaches of Prairie and Bridge Creeks. Sixteen surveys were conducted on other, non-index reaches. Table 2 lists the date and location of each survey. General survey conditions for each survey are listed in Appendix B.

**TABLE 2: DATES OF SPAWNING SURVEYS CONDUCTED DURING
THE 1992-1993 SPAWNING SEASON ON PRAIRIE, LOST MAN, BRIDGE
AND TOM McDONALD CREEKS; HUMBOLDT COUNTY,
CALIFORNIA.**

PRAIRIE CREEK		
BELOW CHANNELIZATION TO BOYES 12-16-92 01-12-93 } one complete 01-28-93 } survey 02-01-93 } 02-16-93	BOYES TO BROWN 01-06-93 } one complete 01-08-93 } survey 01-11-93 } 02-17-93	BROWN TO 1.5 ABOVE 01-12-93 } one complete 01-28-93 } survey 03-02-93
LOST MAN CREEK		
INDEX REACH 02-02-93 } one complete 02-03-93 } survey 03-09-93	OTHER REACHES 02-02-93 02-03-93 03-03-93	
BRIDGE CREEK		
MOUTH TO LOG JAM 12-23-92 01-26-93 02-10-93 03-10-93	LOG JAM TO RODGER'S CREEK 01-26-93 02-10-93 03-10-93	
TOM McDONALD CREEK		
Mouth to Log Jam #6 03-10-93		
REDWOOD CREEK		
BRIDGE CREEK TO TOM McDONALD CREEK 11-04-92 12-05-93	TOM McDONALD TO 44 CREEK 11-04-92 11-05-92 11-12-92 11-28-92	44 CREEK TO BOND CREEK 11-04-93
BOND CREEK TO ELAM CREEK 11-05-92 11-12-92 11-28-92	ELAM CREEK TO McARTHUR CREEK 11-05-92 11-12-92 11-28-92	

I. INDEX OF SPAWNING EFFORT

Results

Table C-1 (Appendix C) summarizes the total numbers of live fish, carcasses, and redds for all reaches of all streams surveyed during the 1992-93 spawning year. Tables C-2 through C-11 (Appendix C) list the same parameters by stream, reach, and date. The surveys conducted on the established Bridge Creek survey reach, Log Jam to the M-7 Bridge, (Table C-9) were not complete; they were conducted from the Log Jam to Rodgers Creek, falling short of the established survey reach by 0.82 km. Redwood Creek data, presented in Table C-11, was collected as observational data only and has not been included in the discussion of the results. Two sections of Lost Man Creek, Mouth to the Hatchery and Above the Double Bridges, were surveyed. These are not index reaches; results are presented but have not been included in the discussion. Table C-12 summarizes trapping data from an upstream migrant fish weir operated on Prairie Creek from water year 1986 (spawning year 1985-86) to the present (data supplied by Humboldt County's Prairie Creek Fish Hatchery, PCFFA and PCFWWRA). These results are also presented in graphic form in Figure 4. Table C-13 summarizes the number of fish trapped at the Prairie Creek weir during spawning years 1989-90 through 1992-93 by species and sex. Table C-14 presents the trapping schedule of the Prairie Creek weir for spawning years 1985-86 through 1992-93. Table C-15 compares the numbers of fish and redds observed per survey for spawning years 1990-91 through 1992-93 on the index reaches. Table C-16 compares the total numbers of fish and redds observed for spawning years 1990-91 through 1992-93 on index reaches.

The following is a summary of the live fish and carcasses observed on the index reaches during the 1992-1993 surveys (King = King or Chinook Salmon, Coho = Coho or Silver Salmon, SHD = Steelhead Trout, UNK = Unknown Salmonid). These numbers include fish trapped and held at the weir in the lower reach of Prairie Creek.

	LIVE FISH				CARCASSES			
	King	Coho	SHD	UNK	King	Coho	SHD	UNK
Prairie Creek ^a	106	64	10	22	87	18	0	17
Lost Man Creek ^b	0	2	69	30	2	1	5	3
Bridge Creek ^c	4	0	8	1	0	0	0	0
Tom McDonald Creek	0	0	2	0	0	0	0	0

^aIncludes fish trapped and held at weir operated by PCFWWRA.

^bDoes not include data from non-index reaches.

^cIncludes data from Log Jam to Rodgers Creek.

The majority of live king salmon and coho salmon reported for the four index streams was found on Prairie Creek (96.4% and 83.7% respectively). A large percentage of the live fish reported for Prairie Creek were trapped at the weir (49% of the king salmon and 59% of the coho salmon). The majority (80.5%) of the live steelhead trout reported were observed on Lost Man Creek.

Figure 4 is a graphic representation of the total numbers of live salmonid spawners trapped in a weir operated on Prairie Creek from spawning year 1985-86 to present (water year 1986 corresponds with spawning year 1985-86). Examination of total numbers of fish trapped reveal a year to year fluctuation ranging from a low of 121 fish in water year 1987 to a high of 291 in water year 1988. Refer to Tables C-12, C-13, and C-14 for data and trapping schedule.

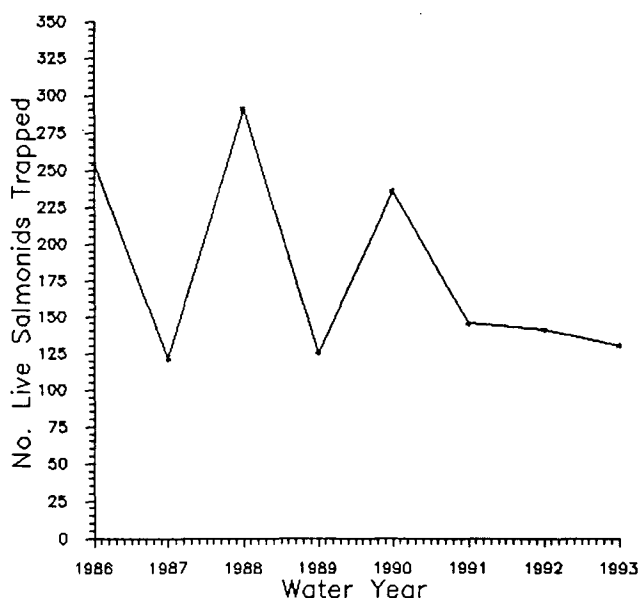


Figure 4: Total Numbers of Weir Trapped Salmonid Spawners on Prairie Creek, Water Years 1986 to 1993 (corresponds with spawning years 1985-86 to 1992-93).

One hundred sixty-seven definite and 26 questionable redds were found on the Prairie Creek index reaches; 71 definite, 10 questionable redds on the Lost Man Creek index reach; 10 definite, 1 questionable on Bridge Creek; and 6 definite, 1 questionable on Tom McDonald Creek.

Table C-15, Comparison of Numbers of Fish and Redds Observed Per Survey for Spawning Years 1990-91 Through 1992-93 on Index Reaches; is the best comparative representation of data presented here. Coho salmon and steelhead trout are currently being considered for status as threatened species by the U.S. Fish and Wildlife Service; it is therefore important to examine their numbers carefully. The following

results are in reference to Tables C-15 and C-16. Note that, for comparative purposes, no weir captured fish are included in these two tables.

Prairie Creek

The greatest number of live fish for all species were observed in the Channelization to Boyes reach for all years. Examination of carcass and redd data suggests that spawners arrive at the two upstream reaches in progressively fewer numbers. The high number of king carcasses and redds found on the Boyes to Brown reach in 1992-93 suggests that this reach may have had more king salmon spawner activity than the other two reaches this year.

The 1992-93 spawning year produced greater numbers of live fish, carcasses and redds per survey (Table C-15) for almost all parameters than either of the other spawning years. The least numbers of live fish, carcasses and redds were observed during the 1991-92 spawning year for almost all of the parameters. It appears that Prairie Creek king salmon and coho salmon exhibited the greatest spawning effort in 1992-93 and the least effort in 1991-92. Steelhead trout were observed in greatest numbers in 1991-92.

Figure 5 (next page) is a graphic representation of the surveys conducted on Prairie Creek in relation to water flows. Note that surveys generally occurred after peak flows. It is not physically possible for surveyors to perform surveys during peak flows.

Lost Man Creek

King salmon numbers on this reach are few and it is difficult to make comparisons from year to year. Coho salmon appear to have made the greatest spawning effort in 1991-92 and made very poor showings in 1990-91 and 1992-93. Steelhead trout were observed in progressively greater numbers over the three year period. Redd activity was greatest in 1991-92.

Bridge Creek

Steelhead trout were the most commonly observed salmonid species on Bridge Creek; king salmon were observed in slightly fewer numbers. Almost all steelhead were observed above the log jam. King salmon were also observed above the log jam. The greatest number of redds observed on Bridge Creek occurred above the log jam in 1991-92. In the three years under consideration, only one coho (live) was observed.

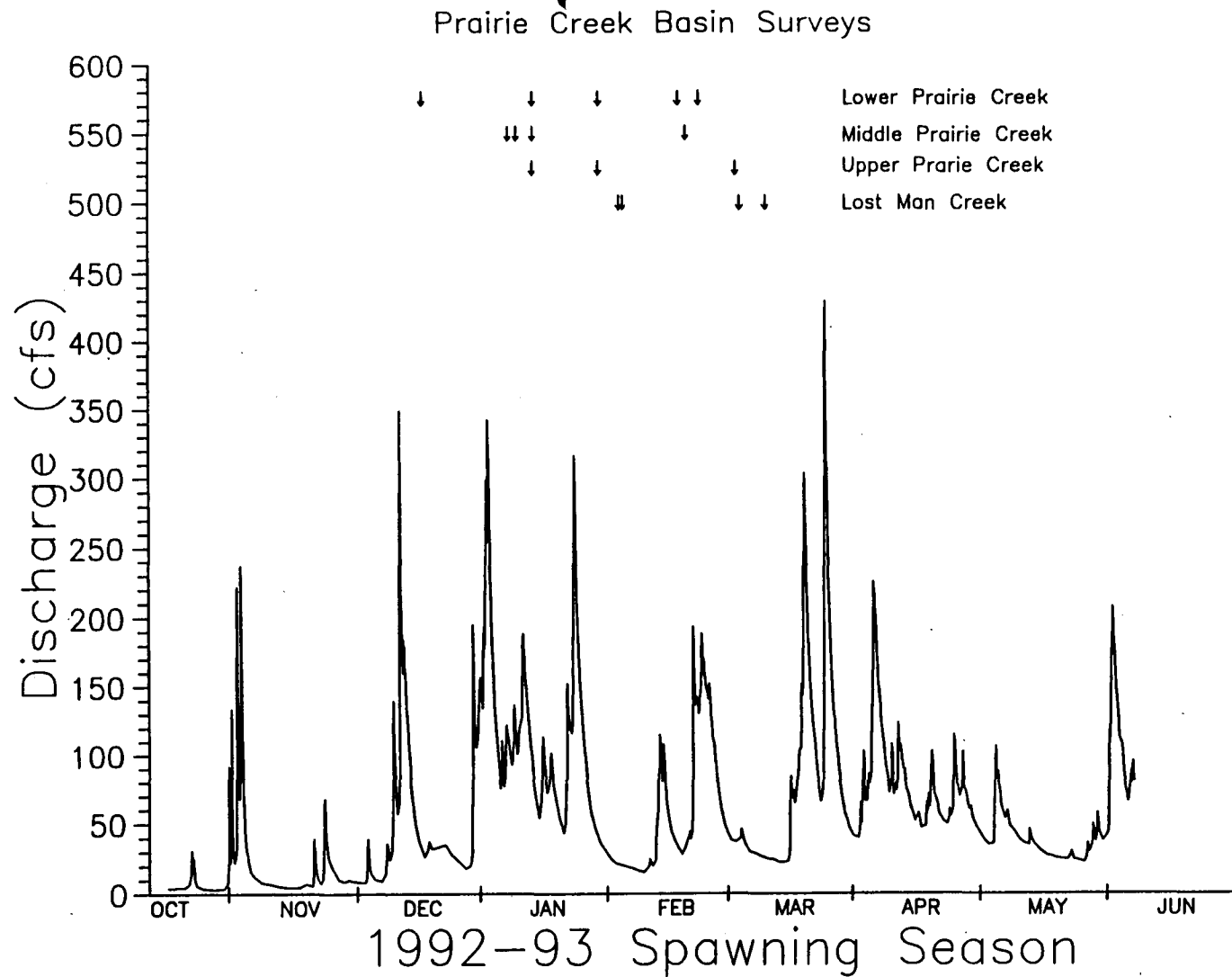


Figure 5: Timing of Prairie Creek Surveys in Relation to Flows on Prairie Creek, Spawning Season 1992-93 (water year 1993).

Tom McDonald Creek

Only two years of data are available for Tom McDonald Creek. The only live fish observed on this creek were two steelhead in 1992-93; a steelhead carcass was observed in 1991-92. Eighteen definite redds observed during the two years indicate that salmonids are using the creek for spawning.

Discussion

The most accurate means to determine the size of one year's spawning population is the employment of fish weirs to capture adults migrating upstream and juveniles migrating downstream; weirs are costly to maintain and operate. A less costly method is the conduction of spawning surveys on selected stream reaches in order to establish indices for comparison of spawning effort and population trends over time.

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. 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 a long term data base is established, comparison of the numbers of live fish, carcasses, and redds observed per unit of survey effort will assist researchers in detecting population trends.

The presence of the weir in the Channelization to Boyes reach of Prairie Creek makes interpretation of RNP's Prairie Creek spawning surveys difficult. It is impossible to determine how many of the fish trapped and held at the weir would have been detected by surveyors had fish migration been unimpeded.

The eight years of data obtained at the Prairie Creek weir cannot be used as a representative index of spawning effort on Prairie Creek. The weir was operated by two different organizations whose methods varied from year to year. For example, PCFWWRA (formerly PCFFA) operated the weir for a total of 1,264.5 hours during the 1991 spawning season and only 356.5 hours during the 1992 spawning season (see Table C-14). PCFWWRA trapped only until their required number of fish had been obtained from 1991 through 1993. Therefore, numbers trapped do not show much variation over these years. The weir was often made inoperable during high flows; a period of time when fish migration may be at its peak. It is not possible to discern a trend in the population of spawners solely from the weir data.

The majority of steelhead trout were observed on Lost Man Creek. This is a result of a county run fish hatchery on Lost Man Creek which raised and released steelhead trout from 1972 until December 1992. The hatchery raised and released king and

numbers. Steelhead will return to spawn more than once; each subsequent year class will add its numbers to the cumulative spawner population. King and coho salmon die after spawning so their numbers will not exhibit the same cumulative effect.

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, if flows are high, redds could be flattened and rendered unrecognizable. Also, it is difficult to determine which species of salmonid dug a redd unless a surveyor witnesses fish digging or attending the redd.

The undisturbed gravel substrates of Prairie and Lost Man Creeks are covered with plant growth (especially algae) and sometimes fine sediment. A disturbance which turns over gravel and dislodges fine sediment, such as redd digging, is easily detectable. These are low gradient (0.01) streams with rounded gravel; redds tend to be visible even after high flows.

In contrast, Bridge and Tom McDonald Creeks are steeper with gradients of 0.02; fine sediment does not tend to accumulate as it does on Prairie and Lost Man Creeks. The gravels have angled and flattened shapes which allows for greater gravel mobility; redds can be flattened out by even moderate flows. The gravel mobility inhibits the same extent of plant growth on them as on Prairie and Lost Man Creeks. Redds tend to be difficult for surveyors to see on Bridge and Tom McDonald Creeks.

The large number of redds observed on Prairie Creek during the 1992-93 spawning year is a reflection of the large numbers of chinook and coho spawners observed. The large number of redds produced on Lost Man Creek is probably a reflection of the numbers of steelhead trout returning to spawn.

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

Results

Table 3 summarizes the distribution data, calculated on a per kilometer basis, for the index reaches surveyed during the 1992-93 surveys. Table 4 summarizes the same data calculated on a per kilometer per survey basis. Table 5 compares the same data for spawning years 1990-91 through 1992-93.

TABLE 3: LIVE SALMONIDS, CARCASSES, AND REDDS PER KILOMETER FOR INDEX REACHES SURVEYED, 1992-93					
STREAM	INDEX REACH	LENGTH OF REACH (km)	LIVE FISH /km	CARCASSES /km	REDDS/km (Definite & Questionable)
PRAIRIE	CHAN. TO BOYES*	4.03	34.7	9.7	15.6
	BOYES TO BROWN	3.38	11.2	16.9	25.1
	BROWN TO 1.5	3.08	7.8	8.4	14.6
	AVERAGE OF REACHES*	10.49	19.3	11.6	18.4
LOST MAN	HATCHERY TO DOUBLE BRIDGES	2.48	40.7	4.4	32.7
BRIDGE	MOUTH TO RODGERS CREEK	2.18	7.3	0.5	5.0
TOM McDONALD	MOUTH TO LOG JAM #6	1.32	1.5	0	5.3

* Includes fish trapped and held at weir.

TABLE 4: LIVE SALMONIDS, CARCASSES, AND REDDS PER KILOMETER PER SURVEY FOR INDEX REACHES SURVEYED, 1992-93.						
STREAM	INDEX REACH	LENGTH OF REACH (km)	NO. OF SURVEYS	LIVE FISH /KM/SURVEY	CARCASSES /km/survey	REDDS /km/survey (Definite & Questionable)
PRAIRIE	CHAN. TO BOYES*	4.03	3	11.6	3.2	5.2
	BOYES TO BROWN	3.38	2	5.6	8.5	12.6
	BROWN TO 1.5	3.08	2	3.9	4.2	7.3
	AVERAGE OF REACHES*	10.49	2.3	7.0	5.3	8.4
LOST MAN	HATCHERY TO DOUBLE BRIDGES	2.48	2	20.4	2.2	16.4
BRIDGE	MOUTH TO RODGERS CREEK	2.18	3.5	2.1	0.1	1.6
TOM McDONALD	MOUTH TO LOG JAM #6	1.32	1	1.5	0.0	5.3

* Includes fish trapped and held at weir.

TABLE 5: NUMBERS OF LIVE FISH, CARCASSES AND REDDS OBSERVED PER KILOMETER FOR SPAWNING YEARS 1990-91 THROUGH 1992-93

STREAM	REACH	NUMBER OF LIVE FISH/KM			NUMBER OF CARCASSES/KM			NUMBER OF REDDS/KM		
		1990-91	1991-92	1992-93	1990-91	1991-92	1992-93	1990-91	1991-92	1992-93
PRAIRIE	CHANNEL TO BOYES*	34.5	29.5	34.7	9.9	3.7	9.7	19.4	20.8	15.6
	BOYES TO BROWN	5.6	0.6	11.2	5.3	0.0	16.9	10.1	5.9	25.1
	BROWN TO 1.5 ABOVE	1.9	0.0	7.8	8.4	0.0	8.4	3.6	1.8	14.6
	AVERAGE PRAIRIE CREEK*	14.0	10.0	19.3	7.9	1.2	11.6	11.0	9.5	18.4
LOST MAN	HATCHERY TO DOUBLE BRIDGES	25.0	45.6	40.7	14.1	12.9	4.4	15.3	63.7	32.7
BRIDGE	MOUTH TO M-7 BRIDGE ^b	5.7	4.0	7.3	0.7	1.3	0.5	2.7	7.0	5.0
TOM McDONALD	MOUTH TO LOG JAM #6	-	0.0	1.5	-	0.8	0.0	-	12.1	5.3

* Includes fish trapped and held at weir.

^b Surveys of 1992-93 went only to Rodgers Creek.

The greatest number of live fish and redds/kilometer (40.7 and 32.7, respectively) were observed on Lost Man Creek. The greatest number of carcasses/kilometer (16.9) were observed on the Boyes to Brown reach of Prairie Creek.

The greatest density of live fish/km/survey were observed in the Channelization to Boyes reach of Prairie Creek; this result is skewed because of the inclusion of fish trapped and held at the weir. The greatest density of carcasses and redds/km/survey in Prairie Creek were observed in the Boyes to Brown reach.

The only noted changes in habitat conditions occurred on the Channelization to Boyes reach of Prairie Creek. Two bank failures were noted; sediment and organic debris fell into the stream (Appendix B). Farro, 1993, noted the following in his report.

"The 1992/'93 winter was the first in six or more years with normal or better than normal precipitation. The rain came in moderate storms and produced very stable stream conditions for the salmon to access spawning reaches of Prairie Creek. No flood flows above the annual high water flow event were observed during the winter. Because of these conditions, the salmon were able to migrate upstream based on their own timing and were not held up by extreme low flows as in the past several years."

Discussion

Comparative results of the recorded parameters may be skewed by the method of reporting, total numbers and numbers per kilometer. The number of surveys performed on each reach vary each year; the numbers of live fish, carcasses and redds reported are dependent upon the number of surveys performed. Therefore, comparison of data between years and between index reaches is facilitated by the standardized format of parameter/kilometer/survey, as in Table 4.

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.

Operation of the weir in Prairie Creek makes comparison of salmonid utilization between the three reaches difficult. For example, fish encountering the barrier do not necessarily go into the trap; the barrier could cause fish to concentrate and spawn below the weir. It is unknown where the trapped and retained fish would have spawned naturally. As long as the weir operates, comparison of spawning distribution data between these three reaches will be tenuous. It appears that the water flows of water year 1993 allowed fish access to the upper reaches. Flows of water years 1991 and 1992 may have been too low to allow such access.

Results from the 1990-91, 1991-92 and 1992-93 spawning surveys show that the "Log Jam" on Bridge Creek is not functioning as a barrier to salmonid migration. Live fish (primarily steelhead trout) and redds were observed above the "Log Jam" each year. 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 indicate that, when numbers of live fish and redds/km/survey are considered, Lost Man Creek was the most utilized index creek this year. The great majority of the live fish seen there were steelhead; they generally survive spawning activity and so few carcasses were found in this stream. The greatest number of carcasses/km/survey were found on Prairie Creek; this reflects the greater number of king and coho salmon spawners observed there than on other streams.

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

Results

Table 6 presents the average estimated lengths of live salmonids observed during the 1992-1993 spawning surveys. Table 7 presents average measured lengths of all carcasses, and Table 8 (page 20) presents sex ratios for king, coho, and steelhead carcasses found on the index streams during the surveys. Refer to Table C-13 to calculate sex ratios of fish trapped on Prairie Creek for spawning years 1989-90 through 1991-92. Jacks (or grilse) are undersized males which return to spawn for the first time. It is common for jacks to return a year earlier than other members of the cohort.

Scale samples were routinely collected during spawning surveys: the samples have not yet been processed for age determination. No age data is available at this time.

TABLE 6: AVERAGE ESTIMATED LIVE SALMONID LENGTHS (cm)										
STREAM	KING (no.)			COHO (no.)			STEELHEAD (no.)			UNK (no.)
	♀	♂	UNK	♀	♂	UNK	♀	♂	UNK	
PRAIRIE	84 (28)	76 (19)	83 (7)	61 (9)	46 (22)	50 (7)	50 (1)	50 (1)	56 (8)	60 (20)
PRAIRIE WEIR (measured)	88 (18)	-	-	65 (10)	-	-	-	-	-	-
LOST MAN*	-	-	-	60 (1)	50 (1)	-	70 (18)	67 (26)	62 (34)	45 (1)
BRIDGE	80 (3)	90 (1)	-	-	-	-	-	-	52 (8)	51 (4)
TOM MCDONALD	-	-	-	-	-	-	-	-	-	-

* From index reaches only.

TABLE 7: AVERAGE SALMONID CARCASS FORK LENGTHS (cm)										
STREAM	KING (no.)			COHO (no.)			STEELHEAD (no.)			UNK (no.)
	♀	♂	UNK	♀	♂	UNK	♀	♂	UNK	
PRAIRIE	90 (35)	91 (43)	89 (6)	63 (2)	53 (13)	54 (2)	-	-	-	70 (10)
LOST MAN	-	97 (2)	-	-	49 (1)	-	-	84 (4)	-	80 (1)
BRIDGE	-	-	-	-	-	-	-	-	-	-
TOM MCDONALD	-	-	-	-	-	-	-	-	-	-

TABLE 8: CARCASS SEX RATIO			
STREAM	KING ♂:♀ (#)	COHO ♂:♀ (#)	STEELHEAD ♂:♀ (#)
PRAIRIE CREEK	1.3:1 (79)	7:1 (16)	-
PRAIRIE CREEK WEIR (Live fish)	2.3:1 (62)	2.7:1 (67)	1:0 (1)
LOST MAN CREEK	1:1 (6)	1:0 (1)	4:0 (4)
BRIDGE CREEK	-	-	-
TOM McDONALD	-	-	-
REDWOOD	-	0:1 (1)	-

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. 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.

Carcass and weir data provide the most accurate means for the determination of the size and sex ratio of spawning salmonids. Except for Prairie Creek, too few carcasses were observed to have confidence in the calculated sex ratios. Length data from the weir captures were reported only for those females which were retained for spawning. Comparison of the estimated live lengths and the measured carcass and weir captured female lengths indicate that surveyors estimated live fish lengths with an acceptable degree of accuracy.

IV. REDD CHARACTERISTICS

Results

Table 9 presents summary statistics for all redds observed (questionable and definite) on the index streams during RNP's 1992-1993 spawning surveys. Average redd lengths, widths, and areas were calculated for all redds with recorded dimensions (measured or estimated). Total redd area was calculated using the summation of calculated areas.

TABLE 9: REDD DIMENSIONS					
STREAM/Reach	NUMBER OF REDDS OBSERVED	AVERAGE LENGTH (m)	AVERAGE WIDTH (m)	AVERAGE AREA (m ²)	TOTAL AREA (m ²)
PRAIRIE/CHAN to Boyes	51	3.05	1.75	7.19	366.52
PRAIRIE/Boyes to Brown	71	3.79	1.68	7.39	524.44
PRAIRIE/Brown to 1.5	40	4.35	1.74	8.30	331.91
TOTAL PRAIRIE	162	3.88	1.72	7.55	1222.87
LOST MAN	57	3.30	1.82	5.26	299.75
BRIDGE	11	3.00	1.05	3.25	35.80
TOM McDONALD	7	3.57	1.06	3.69	25.80
ALL STREAMS	237	3.69	1.69	6.68	1584.22

Discussion

Relative to other index streams, large numbers 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 to the return of fish reared and released by the Prairie Creek Fish Hatchery. The large total area of redds and redd density (Table 3) on Lost Man Creek are a reflection of the huge spawning effort which was made by returning steelhead. Future spawning surveys will show whether or not the present steelhead run, induced by earlier hatchery releases will be self-sustaining.

V. RECOVERY OF TAGGED AND FIN CLIPPED SALMONIDS

Results

Four carcasses, 2 king and 2 coho, showed signs of possible adipose fin clips. The recovered heads did not contain coded wire tags. Farro (1993) reported 25 adipose fin clipped coho captured at the weir. One 70 cm female coho, bearing coded wire tag #06-01-05-01-02 was captured at the Prairie Creek weir on 01/13/93 (Farro, personal communication). She had been released in Prairie Creek or one of its tributaries between 06/25 and 07/12, 1990 along with a cohort of 32,116. She was from 1989 brood year stock (personal communication, Greg Goldstein).

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). Redwood National Park occasionally recovers marked fish that stray from other systems.

Carcasses are often in an advanced state of degeneration and can have pieces missing due to rot, mechanical abrasion, or depredation. Erring on the side of caution, RNP surveyors recover the head whenever an adipose fin is not present. This makes it probable that heads will be recovered from carcasses in which a CWT will not be present.

It is interesting to note that 37% of the 67 coho captured at the Prairie Creek weir were adipose clipped fish (signifying that they had been marked with CWT's), but that only 11% of the 18 carcasses recovered by RNP observers showed signs of an adipose clip (no CWT's were found in the recovered heads). Since all hatchery reared fish were adipose clipped, those without the adipose clip came from wild stock: 63% of weir trapped coho and 82% of recovered coho carcasses were from wild stocks.

SUMMARY

Land use practices have negative impacts upon the aquatic resources of the Redwood Creek watershed. Commercial, sport, and illegal fishing place additional pressures on already depleted salmonid stocks. In order to monitor the recovery or decline of these salmonid 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 1992-1993 surveys are summarized in this report. Information gained from long term monitoring of returning salmon and spawning habitat should assist scientists at Redwood National Park in making 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' of data is untenable. Although general comparisons may be made between current and historic conditions, long term data are necessary for determining population trends.

Results from Redwood National Park's 1992-93 spawning/carcass surveys show that, compared to historical conditions, low numbers of fish are returning to spawn in the index streams. Carcasses recovered in all streams except Prairie Creek were so few in number that calculation of valid statistics for average fork length and sex ratio of returning salmon is not possible. Observations of live fish, carcasses, and redds reveal 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.

Steelhead trout have been observed in progressively greater numbers over the last three years in Lost Man Creek. The relatively strong return of spawning steelhead in Lost Man Creek is probably due to past hatchery releases on this creek. It will be important to monitor future returns to this creek due to the cessation of hatchery operations.

Operation of the weir in Prairie Creek makes interpretation of spawning survey data difficult. It is impossible to determine how many of the fish trapped and held at the weir would have been detected by surveyors had fish migration been unimpeded. Comparison of salmonid utilization between the three reaches is difficult because it is unknown where the trapped and retained fish would have spawned naturally. Additionally, the weir may serve as a barrier causing fish to concentrate and spawn below the weir.

The eight years of data obtained by trapping at the Prairie Creek weir is not a representative index of spawning effort on Prairie Creek. Variation in weir operation from year to year and inoperation during high flows result in data which is incomplete and not comparable from year to year. Long term trends are not discernable.

Sixty three percent of the weir trapped coho and 82% of coho carcasses recovered from Prairie Creek this year were from wild stocks. Total numbers of coho observed on Prairie Creek have remained steady for the last three years.

Results from the 1990, 1991, and 1992 spawning surveys demonstrate that the "Log Jam" on Bridge Creek is not functioning as a barrier to salmonid migration.

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PERSONAL COMMUNICATIONS

Farro, Mitch, Pacific Coast Fish, Wildlife & Wetlands Restoration Association, Arcata, CA.

Ken Gallagher, Mad River Hatchery Manager, California Department of Fish and Game, Blue Lake, California.

Greg Goldstein, U.S. Fish and Wildlife Service, Fisheries Assistance Office, Arcata, CA.

APPENDIX A

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

PROJECT STATEMENT SHEET

REDW-N-259.000

PS Page: 0001

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,

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PROJECT STATEMENT SHEET

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PS Page: 0002

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	

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PROJECT STATEMENT SHEET

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-----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 1992-93 SPAWNING/CARCASS SURVEYS

SURVEY CONDITIONS

STREAM	FROM	TO	DATE	PRESENT WEATHER	RECENT WEATHER	VFT	WT	AT	FLOW	NOTES
PRAIRIE CREEK	CHAN	BOYES	12/16/92	20% OVERCAST	100% OVERCAST	3.0	8.0	7.0		USFS GAUGE - 0.60FT; RNP GAUGE - 0.60FT
PRAIRIE CREEK	CHAN	1600	01/12/93	PARTLY CLOUDY	CLEAR	2.0	7.5	6.5	MED HIGH	USFS GAUGE - 1.24FT; RNP GAUGE - 1.05FT
PRAIRIE CREEK	1600	23 + 65	01/28/93	CLEAR	CLEAR	3.0	9.0	11.5	MED	BANK FAILURE @18 + 00, LOG JAM W/NEW DEBRIS @21 + 90
PRAIRIE CREEK	23 + 65	BOYES	02/01/93	LIGHT CLOUDS	SUNNY	3.0	7.5	7.0	MED	RIGHT BANK SLUMP @32 + 20
PRAIRIE CREEK	CHAN	BOYES	02/16/93	CLEAR	CLEAR	3.0	6.5	7.0	MED	USFS GAUGE - 0.65FT
PRAIRIE CREEK	BOYES	52 + 20	01/06/93	OVERCAST, DRIZZLE	LIGHT RAIN	2.0	7.5	6.5	HIGH	-
PRAIRIE CREEK	52 + 20	BIG TREE CR	01/08/93	OVERCAST, SOME DRIZZLE	DRIZZLE	2.0	7.5	8.0	-	-
PRAIRIE CREEK	BIG TREE CR	BROWN	01/11/93	BROKEN OVERCAST	RAIN	2.0	7.0	6.0	HIGH	-
PRAIRIE CREEK	BOYES	BROWN	02/17/93	CLOUDY	VARIABLE, CLEAR & CLOUDY	4.0	7.5	-	MED	-
PRAIRIE CREEK	BROWN	HWY MRKR129.65	01/12/93		OVERCAST	RAIN				3.0 6.5 7.0 MED -
PRAIRIE CREEK	HWYMRKR129.65	1.5 ABOVE	01/28/93		CLEAR	OVERCAST, DRIZZLE				3.0 8.0 14.0 MED -
PRAIRIE CREEK	BROWN	1.5 ABOVE	03/02/93	DRIZZLE & RAIN	SHOWERS	4.5	8.0	8.0	MED	-
LOST MAN	MOUTH	HATCHERY	02/02/93	BROKEN CLOUDS	BROKEN CLOUDS	3.0	8.0	11.0	MED	-
LOST MAN	MOUTH	HATCHERY	03/09/93	OVERCAST	OVERCAST, DRIZZLE	3.0	9.0	14.0	MED	-
LOST MAN	HATCHERY	PICNIC BRIDGE	02/02/93	BROKEN CLOUDS	BROKEN CLOUDS	3.0	8.0	11.0	MED	-
LOST MAN	PICNIC BRIDGE	DOUBLE BRIDGES	02/03/93		OVERCAST	CLEAR	3.0	8.5	10.5	MED GAUGE AT PICNIC BRIDGE 2.79 FT
LOST MAN	HATCHERY	DOUBLE BRIDGES	03/09/93		OVERCAST	OVERCAST, DRIZZLE				3.0 9.0 14.0 MED -
LOST MAN	DOUBLE BRIDGES	OLD MILL SITE			02/03/93	OVERCAST	CLEAR	3.0		8.5 10.5 MED -
BRIDGE CREEK	MOUTH	LOG JAM	12/23/92	CLEAR	RAIN 2 DAYS PREVIOUS	3.0	8.5	13.0	MED	RECENT HIGH FLOWS
BRIDGE CREEK	MOUTH	LOG JAM	01/26/93	CLEAR	RAIN AND WIND	-	8.0	-	HIGH	WATER TURBID
BRIDGE CREEK	MOUTH	LOG JAM	02/10/93	SHOWERS	CLOUDY & SHOWERS	4.5	9.0	11.5	MED	-
BRIDGE CREEK	MOUTH	LOG JAM	03/10/93	INTERMITTENT RAIN	LIGHT SHOWERS	3.0	10.0	14.0	MED	-
BRIDGE CREEK	LOG JAM	RODGERS CREEK	01/26/93		CLEAR	FOG	0.5	7.5	8.0	MED WATER TRANSPORTING GRAVEL
BRIDGE CREEK	LOG JAM	RODGERS CREEK	02/10/93		SHOWERS	CLOUDY & SHOWERS				4.5 9.0 11.5 MED -
BRIDGE CREEK	LOG JAM	RODGERS CREEK	03/10/93		INTERMITTENT RAIN	LIGHT SHOWERS	3.0	10.0	14.0	MED -
TOM MCDONALD	MOUTH	LOG JAM #6			03/10/93	CLOUDY, SHOWERS				SHOWERS 4.0 10.5 - MED
REDWOOD CREEK		ALL REACHES THIS DATE	11/04/92		CLEAR	-		5.0	11.0	0.7 400 CFS EST -
REDWOOD CREEK		ALL REACHES THIS DATE	11/05/92		SUNNY, THEN OVERCAST	-	5.0	12.0	16.5	400 CFS EST -
REDWOOD CREEK		ALL REACHES THIS DATE	11/12/92		CLEAR, COOL	-	8.0	8.0	7.5	50-70 CFS EST -
REDWOOD CREEK		ALL REACHES THIS DATE	11/28/92		SUNNY	-	8.0	10.0	11.5	150 CFS EST -
REDWOOD CREEK	BRIDGE	TOM McDONALD			12/05/92	CLOUDY	CLEAR	-		5.0 6.5 176 CFS EST -

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

APPENDIX B

APPENDIX C

SUMMARY OF RESULTS FROM 1992-1993 SPAWNING/CARCASS SURVEYS

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

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TABLE C-1: TOTAL NUMBER OF FISH AND REDDS OBSERVED - ALL STREAMS, ALL REACHES																		
STREAM	LIVE FISH				CARCASSES												REDDS	
					KING			COHO			STEELHEAD			UNKNOWN				
	KING	COHO	SHD	UNK	♀	♂	UNK	♀	♂	UNK	♀	♂	UNK	♀	♂	UNK	DEF	?
PRAIRIE*	106	64	10	22	35	44	8	2	14	2	0	0	0	1	1	15	167	26
LOST MAN ^b	0	4	87	33	3	3	0	0	1	0	0	4	1	0	1	3	99	12
BRIDGE	4	0	8	4	0	0	1	0	0	0	0	0	0	0	0	0	10	1
T. McDONALD	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	6	1
REDWOOD	0	8-9 ^c	1	83-88 ^c	0	0	0	0	0	1	0	0	0	0	0	0	3	1
TOTALS	110	76-77	108	142-147	38	47	9	2	15	3	0	4	1	1	2	18	285	41

^a Includes fish trapped and held 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 - 10, Coho - 41, Steelhead - 1.

^b Includes non-index reaches.

^c Includes estimated numbers of fish in pools, survey date 11/05/92.

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TABLE C-2: NUMBER OF FISH AND REDDS OBSERVED - PRAIRIE CREEK (CHANNELIZATION TO BOYES)																		
DATES	LIVE FISH				CARCASSES												REDDS	
					KING			COHO			STEELHEAD			UNKNOWN				
	KING	COHO	SHD	UNK	♀	♂	UNK	♀	♂	UNK	♀	♂	UNK	♀	♂	UNK	DEF	?
12/16/92	14	8	0	8	0	1	0	0	0	0	0	0	0	0	0	0	16	6
01/12/93*	0	4	0	1	3	4	0	0	3	0	0	0	0	0	0	1	4	0
01/28/93*	1	7	0	0	1	2	1	0	0	0	0	0	0	0	0	0	9	1
02/01/93*	0	3	0	0	5	3	1	0	2	0	0	0	0	0	0	0	10	1
02/16/93	3	0	9	4	0	1	2	0	2	0	0	0	0	0	1	6	15	1
Weir ^b	52	26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTALS	70	48	9	13	9	11	4	0	7	0	0	0	0	0	1	7	54	9

*Incomplete survey, total of these dates equals one complete survey (channelization to 16 + 00; 16 + 00 to 23 + 65; and 23 + 65 to Boyes).

^bNumbers of fish trapped and held at weir; weir operated for 356.5 hours, 11/18/92 through 01/09/94.

TABLE C-3: NUMBER OF FISH AND REDDS OBSERVED - PRAIRIE CREEK (BOYES TO BROWN)																		
DATES	LIVE FISH				CARCASSES												REDDS	
					KING			COHO			STEELHEAD			UNKNOWN				
	KING	COHO	SHD	UNK	♀	♂	UNK	♀	♂	UNK	♀	♂	UNK	♀	♂	UNK	DEF	?
01/06/93*	7	5	0	0	8	5	0	0	0	0	0	0	0	0	0	0	23	4
01/08/93*	7	3	0	0	2	7	0	0	2	0	0	0	0	0	0	1	13	1
01/11/93*	6	2	0	6	3	4	0	1	1	0	0	0	0	0	0	2	28	8
02/17/93	0	0	1	1	9	5	3	0	0	2	0	0	0	0	0	2	8	0
TOTALS	20	10	1	7	22	21	3	1	3	2	0	0	0	0	0	5	72	13

*Incomplete survey, total of these dates equals one complete survey (Boyes to 52 + 20; 52 + 20 to 70 + 00; and 70 + 00 to Brown).

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

DATES	LIVE FISH				CARCASSES												REDDs	
					KING			COHO			STEELHEAD			UNKNOWN				
	KING	COHO	SHD	UNK	♀	♂	UNK	♀	♂	UNK	♀	♂	UNK	♀	♂	UNK	DEF	?
01/12/93*	16	6	0	1	1	6	0	1	1	0	0	0	0	0	0	1	24	3
01/28/93*	0	0	0	1	3	5	0	0	1	0	0	0	0	0	0	0	13	1
03/02/93	0	0	0	0	0	1	1	0	2	0	0	0	0	1	0	2	4	0
TOTALS	16	6	0	2	4	12	1	1	4	0	0	0	0	1	0	3	41	4

*Incomplete survey, total of these dates equals one complete survey (Brown to @ 1 mile; @1 mile to 1.5 miles above).

**TABLE C-5: NUMBER OF FISH AND REDDS OBSERVED - LOST MAN CREEK
(MOUTH TO HATCHERY)
(THIS IS NOT AN INDEX REACH.)**

DATES	LIVE FISH				CARCASSES												REDDS		
					KING			COHO			STEELHEAD			UNKNOWN					
	KING	COHO	SHD	UNK	♀	♂	UNK	♀	♂	UNK	♀	♂	UNK	♀	♂	UNK	DEF	?	
02/02/93	0	2	10	3	2	0	0	0	0	0	0	0	0	0	0	0	0	15	0
03/09/93	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
TOTALS	0	2	11	3	2	0	0	0	0	0	0	0	0	0	0	1	15	0	0

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

DATES	LIVE FISH				CARCASSES												REDDS	
					KING			COHO			STEELHEAD			UNKNOWN				
	KING	COHO	SHD	UNK	♀	♂	UNK	♀	♂	UNK	♀	♂	UNK	♀	♂	UNK	DEF	?
02/02/93*	0	2	59	1	0	1	0	0	1	0	0	0	0	0	1	2	48	8
02/03/93*	0	0	10	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1
03/09/93	0	0	0	29	0	0	0	0	0	0	0	4	1	0	0	0	22	1
TOTALS	0	2	69	30	0	2	0	0	1	0	0	4	1	0	1	2	71	10

*Incomplete survey, total of these dates equals one complete survey (hatchery to Picnic Bridge; Picnic Bridge to Double Bridges).

**TABLE C-7: NUMBER OF FISH AND REDDS OBSERVED - LOST MAN CREEK
(ABOVE DOUBLE BRIDGES)
(THIS IS NOT AN INDEX REACH.)**

STREAM	LIVE FISH				CARCASSES												REDDS		
					KING			COHO			STEELHEAD			UNKNOWN					
	KING	COHO	SHD	UNK	♀	♂	UNK	♀	♂	UNK	♀	♂	UNK	♀	♂	UNK	DEF	?	
02/03/93	0	0	7	0	1	1	0	0	0	0	0	0	0	0	0	0	0	13	2

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

DATES	LIVE FISH				CARCASSES												REDDS	
					KING			COHO			STEELHEAD			UNKNOWN				
	KING	COHO	SHD	UNK	♀	♂	UNK	♀	♂	UNK	♀	♂	UNK	♀	♂	UNK	DEF	?
12/23/92	4	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
01/26/93	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
02/10/93	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	5	1
03/10/93	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
TOTALS	4	0	0	4	0	0	1	0	0	0	0	0	0	0	0	0	6	1

**TABLE C-9: TOTAL NUMBER OF FISH AND REDDS OBSERVED - BRIDGE CREEK
(LOG JAM TO RODGERS CREEK)**

(Falls short of index reach which is to M-7 Bridge)

DATES	LIVE FISH				CARCASSES												REDDS	
					KING			COHO			STEELHEAD			UNKNOWN				
	KING	COHO	SHD	UNK	♀	♂	UNK	♀	♂	UNK	♀	♂	UNK	♀	♂	UNK	DEF	?
01/26/93	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
02/10/93	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03/10/93	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0
TOTALS	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0

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TABLE C-10: NUMBER OF FISH AND REDDS OBSERVED - TOM McDONALD CREEK																		
DATE	LIVE FISH				CARCASSES												REDDS	
					KING			COHO			STEELHEAD			UNKNOWN				
	KING	COHO	SHD	UNK	♀	♂	UNK	♀	♂	UNK	♀	♂	UNK	♀	♂	UNK	DEF	?
03/10/93	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	6	1

TABLE C-11: NUMBER OF FISH AND REDDS OBSERVED - REDWOOD CREEK REACHES (THIS IS NOT AN INDEX STREAM; OBSERVATIONAL DATA ONLY.)																		
DATE	LIVE FISH				CARCASSES												REDDS	
					KING			COHO			STEELHEAD			UNKNOWN				
	KING	COHO	SHD	UNK	♀	♂	UNK	♀	♂	UNK	♀	♂	UNK	♀	♂	UNK	DEF	?
BRIDGE CREEK TO TOM McDONALD CREEK																		
11/04/92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12/05/92	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	1	1
TOM McDONALD CREEK TO 44 CREEK																		
11/04/92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11/05/92	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11/12/92	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11/28/92	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	1	0
44 CREEK TO BOND CREEK																		
11/04/92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11/05/92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11/12/92	0	0	0	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11/28/92	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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TABLE C-11: NUMBER OF FISH AND REDDS OBSERVED - REDWOOD CREEK REACHES																		
(THIS IS NOT AN INDEX STREAM; OBSERVATIONAL DATA ONLY.)																		
DATE	LIVE FISH				CARCASSES												REDDS	
					KING			COHO			STEELHEAD			UNKNOWN				
	KING	COHO	SHD	UNK	♀	♂	UNK	♀	♂	UNK	♀	♂	UNK	♀	♂	UNK	DEF	?
BOND CREEK TO ELAM CREEK																		
11/05/92	0	6-7	1	10-15	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11/12/92	0	0	0	44	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11/28/92	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
ELAM CREEK TO McARTHUR CREEK																		
11/05/92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11/12/92	0	0	0	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11/28/92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
REDWOOD CREEK - ALL REACHES																		
TOTAL	0	8-9	1	83-88	0	0	0	0	0	1	0	0	0	0	0	0	3	1

* Includes estimated numbers of fish in pools.

TABLE C-12: NUMBER OF LIVE FISH TRAPPED ON PRAIRIE CREEK								
STATUS OF TRAPPED SALMONIDS	PCFWWRA ^a			PCFFA ^b	PRAIRIE CREEK FISH HATCHERY ^c			
	1992-93	1991-92	1990-91	1989-90	1988-89	1987-88	1986-87	1985-86
Removed for spawning	78	92	77	106	3	10	7	13
Counted and released	52	49	68	130	122	281	114	241
TOTAL	130	141	145	236	125	291	121	254

^a Trap was operated by Pacific Coast Fish, Wildlife and Wetlands Restoration Association and was located downstream of the Boyes Creek confluence.

^b Trap was operated by Pacific Coast Federation of Fishermen's Associations, Inc., and was located downstream of the Boyes Creek confluence.

^c Trap was operated by Humboldt County's Prairie Creek Fish Hatchery and was located upstream of the Lost Man Creek confluence. Data source, Coey, et al, 1991.

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**TABLE C-13 : NUMBER OF FISH TRAPPED, BY SPECIES AND SEX, AT PRAIRIE CREEK WEIR
SPAWNING YEARS 1989-90 to 1992-93.**

SPAWNING YEAR	KING				COHO				STEELHEAD				TOTAL ALL SPECIES
	♀	♂	JACK	TOTAL	♀	♂	JACK	TOTAL	♀	♂	JACK	TOTAL	
1989-90	13	19	25	57	22	15	115	152	9	18	0	27	236
1990-91	19	30	17	66	34	29	16	79	0	0	0	0	145
1991-92	7	26	7	40	23	35	12	70	12	19	0	31	141
1992-93	19	33	10	62	18	26	23	67	0	1	0	1	130

**TABLE C-14 TRAPPING SCHEDULE, PRAIRIE CREEK WEIR, SPAWNING YEARS 1985-86 TO 1992-93
(Water Years 1986-1993)**

SPAWNING YEAR (water year)	TRAP OPERATOR	TRAP LOCATION	PERIOD OF OPERATION
1985-86 (1986)	Humboldt County	Upstream of Lost Man Creek confluence.	Odd days.
1986-87 (1987)	Humboldt County	Upstream of Lost Man Creek confluence.	Odd days.
1987-88 (1988)	Humboldt County	Upstream of Lost Man Creek confluence.	Odd days.
1988-89 (1989)	Humboldt County	Upstream of Lost Man Creek confluence.	Odd days.
1989-90 (1990)	PCFFA	Downstream of Boyes Creek confluence.	11-26-89 - mid May except for periods of stream flows too low for fish movement and when high flows (<40 hrs.) rendered trap inoperable.
1990-91 (1991)	PCFWWRA	Downstream of Boyes Creek confluence.	11-20-91 to 01-18-91 except for periods of stream flow too high for fish movement and when high flows (<24 hrs.) rendered trap inoperable.
1991-92 (1992)	PCFWWRA	Downstream of Boyes Creek confluence.	11-20-91 to 04-14-92 except for periods of stream flow too low for fish movement and when high flows (<6 hrs.) rendered trap inoperable.
1992-93 (1993)	PCFWWRA	Downstream of Boyes Creek confluence.	11-18-92 to 01-09-92

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TABLE C-15: COMPARISON OF NUMBERS OF FISH AND REDDS OBSERVED PER SURVEY FOR SPAWNING YEARS 1990-91 THROUGH 1992-93 ON INDEX REACHES										
SPAWNING YEAR (# of surveys)	LIVE FISH				CARCASSES				REDDS	
	KING	COHO	SHD	UNK	KING	COHO	SHD	UNK	DEF	?
PRAIRIE CREEK - CHANNELIZATION TO BOYES (Does not include data from weir)										
1990-91 (7)*	4.43	1.14	1.14	1.14	4.00	1.14	0.00	0.57	9.00	2.14
1991-92 (5.5)	0.36	1.45	1.64	1.45	0.55	1.27	0.36	0.55	13.45	1.82
1992-93 (3)	6.00	7.33	3.00	4.33	8.00	2.33	0.00	2.66	18.00	3.00
PRAIRIE CREEK - BOYES TO BROWN										
1990-91 (4)	1.00	2.00	0.25	1.50	0.75	2.50	0.00	1.25	5.75	2.75
1991-92 (3)	0.00	0.66	0.00	0.00	0.00	0.00	0.00	0.00	5.66	1.00
1992-93 (2)	10.00	5.00	0.50	3.50	23.00	3.00	0.00	2.50	36.00	6.50
PRAIRIE CREEK - BROWN TO 1.5 ABOVE										
1990-91 (5)	0.00	0.80	0.40	0.00	2.00	2.80	0.00	0.40	0.60	1.60
1991-92 (1)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.00	0.00
1992-93 (2)	8.00	3.00	0.00	1.00	8.50	2.50	0.00	2.00	20.50	2.00

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TABLE C-15: COMPARISON OF NUMBERS OF FISH AND REDDS OBSERVED PER SURVEY FOR SPAWNING YEARS 1990-91 THROUGH 1992-93 ON INDEX REACHES										
SPAWNING YEAR (# of surveys)	LIVE FISH				CARCASSES				REDDS	
	KING	COHO	SHD	UNK	KING	COHO	SHD	UNK	DEF	?
LOST MAN CREEK - HATCHERY TO DOUBLE BRIDGES										
1990-91 (4)	0.25	1.00	12.00	2.25	2.50	5.75	0.25	0.50	8.50	1.00
1991-92 (3.5)	0.28	13.14	17.14	1.71	0.85	4.85	1.42	2.00	44.28	0.85
1992-93 (2)	0.00	1.00	34.50	15.00	1.00	0.50	2.50	1.50	35.50	5.00
BRIDGE CREEK - MOUTH TO LOG JAM										
1990-91 (4)	1.50	0.00	0.50	0.00	0.50	0.00	0.00	0.00	0.50	0.50
1991-92 (3)	0.33	0.33	0.00	0.33	1.00	0.00	0.33	0.00	1.00	1.00
1992-93 (4)	1.00	0.00	0.00	1.00	0.25	0.00	0.00	0.00	1.50	0.25
BRIDGE CREEK - LOG JAM TO M-7 BRIDGE										
1990-91 (2)	1.20	0.00	2.80	0.40	0.00	0.00	0.00	0.00	1.20	0.40
1991-92 (3)	0.66	0.00	1.66	0.66	0.00	0.00	0.00	0.00	4.00	1.00
1992-93 ^b (3)	0.00	0.00	2.66	0.00	0.00	0.00	0.00	0.00	1.33	0.00
TOM McDONALD CREEK ^b										
1990-91 (0)	-	-	-	-	-	-	-	-	-	-
1991-92 (2)	0.00	0.00	0.00	0.00	0.50	0.00	0.00	0.00	6.00	2.00
1992-93 (1)	0.00	0.00	2.00	0.00	0.00	0.00	0.00	0.00	6.00	1.00

^a Includes surveys conducted in April and June; likely to underestimate kings/survey because they rarely enter the stream after February.

^b Surveys went from Log Jam to Rodgers Creek.

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TABLE C-16: COMPARISON OF TOTAL NUMBERS OF FISH AND REDDS OBSERVED FOR SPAWNING YEARS 1990-91 THROUGH 1992-93 ON INDEX REACHES										
SPAWNING YEAR	LIVE FISH				CARCASSES				REDDS	
	KING	COHO	SHD	UNK	KING	COHO	SHD	UNK	DEF	?
PRAIRIE CREEK - CHANNELIZATION TO BOYES (Does not include data from weir)										
1990-91	97	87	8	8	28	8	0	4	63	15
1991-92	43	78	40	8	3	7	2	3	74	10
1992-93	80	89	10	13	24	7	0	8	54	9
PRAIRIE CREEK - BOYES TO BROWN										
1990-91	4	8	1	6	3	10	0	5	23	11
1991-92	0	2	0	0	0	0	0	0	17	3
1992-93	20	10	1	7	46	6	0	5	72	13
PRAIRIE CREEK - BROWN TO 1.5 ABOVE										
1990-91	0	4	2	0	10	14	0	2	3	8
1991-92	0	0	0	0	0	0	0	0	6	0
1992-93	16	6	0	2	17	5	0	4	41	4
TOTAL - PRAIRIE CREEK										
1990-91	101	99	11	14	41	32	0	11	89	34
1991-92	43	80	40	8	3	7	2	3	97	13
1992-93	116	105	11	22	87	18	0	17	167	26

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**TABLE C-16: COMPARISON OF TOTAL NUMBERS OF FISH AND REDDS OBSERVED
FOR SPAWNING YEARS 1990-91 THROUGH 1992-93 ON INDEX REACHES**

SPAWNING YEAR	LIVE FISH				CARCASSES				REDDS	
	KING	COHO	SHD	UNK	KING	COHO	SHD	UNK	DEF	?
LOST MAN CREEK - HATCHERY TO DOUBLE BRIDGES										
1990-91	1	4	48	9	10	23	1	2	34	4
1991-92	1	46	60	6	3	17	5	7	155	3
1992-93	0	2	69	30	2	1	5	3	71	10
BRIDGE CREEK - MOUTH TO LOG JAM										
1990-91	6	0	2	0	2	0	0	0	2	2
1991-92	1	1	0	1	3	0	1	0	3	3
1992-93	4	0	0	4	1	0	0	0	6	1
BRIDGE CREEK - LOG JAM TO M-7 BRIDGE										
1990-91	3	0	7	1	0	0	0	0	3	1
1991-92	2	0	5	2	0	0	0	0	12	3
1992-93*	0	0	8	0	0	0	0	0	4	0
TOTAL - BRIDGE CREEK										
1990-91	9	0	9	1	2	0	0	0	5	3
1991-92	3	1	5	3	3	0	1	0	15	6
1992-93	4	0	8	4	1	0	0	0	10	1
TOM McDONALD CREEK										
1990-91	-	-	-	-	-	-	-	-	-	-
1991-92	0	0	0	0	0	0	1	0	12	4
1992-93	0	0	2	0	0	0	0	0	6	1

* Surveys went from Log Jam to Rodgers Creek.