REDWOOD CREEK BASIN 1993-1994 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 1993-1994 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

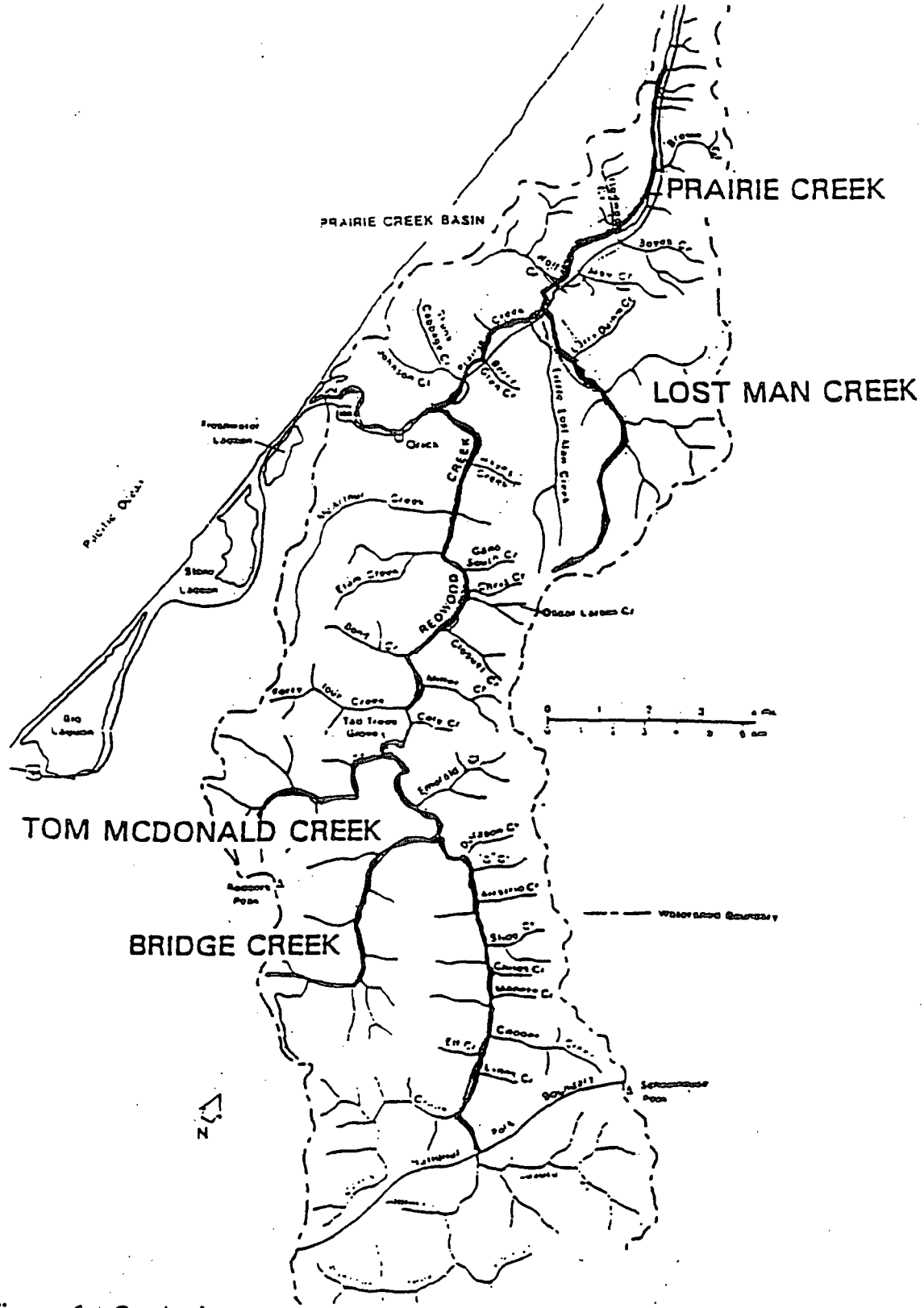


Figure 1: Study Area

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.

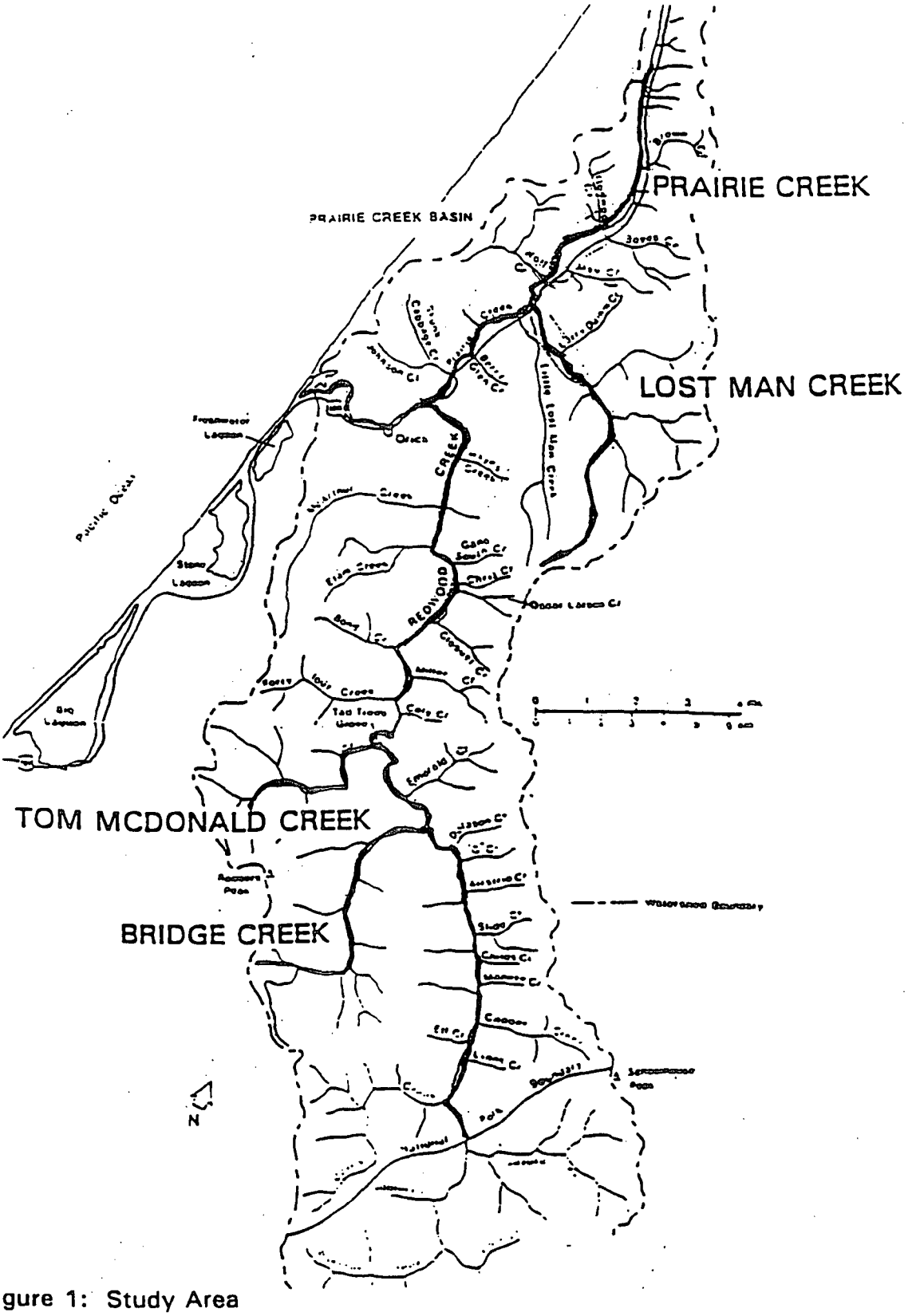
STUDY AREA

Surveys were conducted on index streams within the Redwood Creek basin (Figure 1). Redwood Creek, located in northwestern California, drains a 720 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. Lengths of reaches for Bridge and Tom McDonald Creeks were recalculated in 1993 using RNP's computerized Geographic Information System (GIS). Numbers presented on a per kilometer basis have been recalculated for all previous years using these more accurate lengths.

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 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.



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

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.

Survey reach lengths differ in reports prior to the 1992-93 spawning year due to the more accurate lengths which resulted when monumentation of the creek was accomplished. All data presented on a per kilometer basis for previous years has been recalculated to reflect the current reach lengths. The Channelization to Boyes reach begins 40 meters upstream of the Streelow Creek (aka Wolf Creek) confluence with Prairie Creek. The other two reaches are contiguous in an upstream northerly direction.

Lost Man Creek

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 29.52 km^2 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 km^2 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 three years.

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), as measured near the confluence with the main stem of 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 (# km over which gradient measured)
Redwood	7	108[1]	720[1]	<0.01 (11.6)
Prairie	7	23.3[2]	104	0.01 (18.9)
Lost Man	6	9.5[3]	32.2	0.01 (1.9)
Bridge	5	12.9[4]	29.5	0.02 (2.2)
Tom McDonald	5	7.5	18.0	0.02 (1.4)

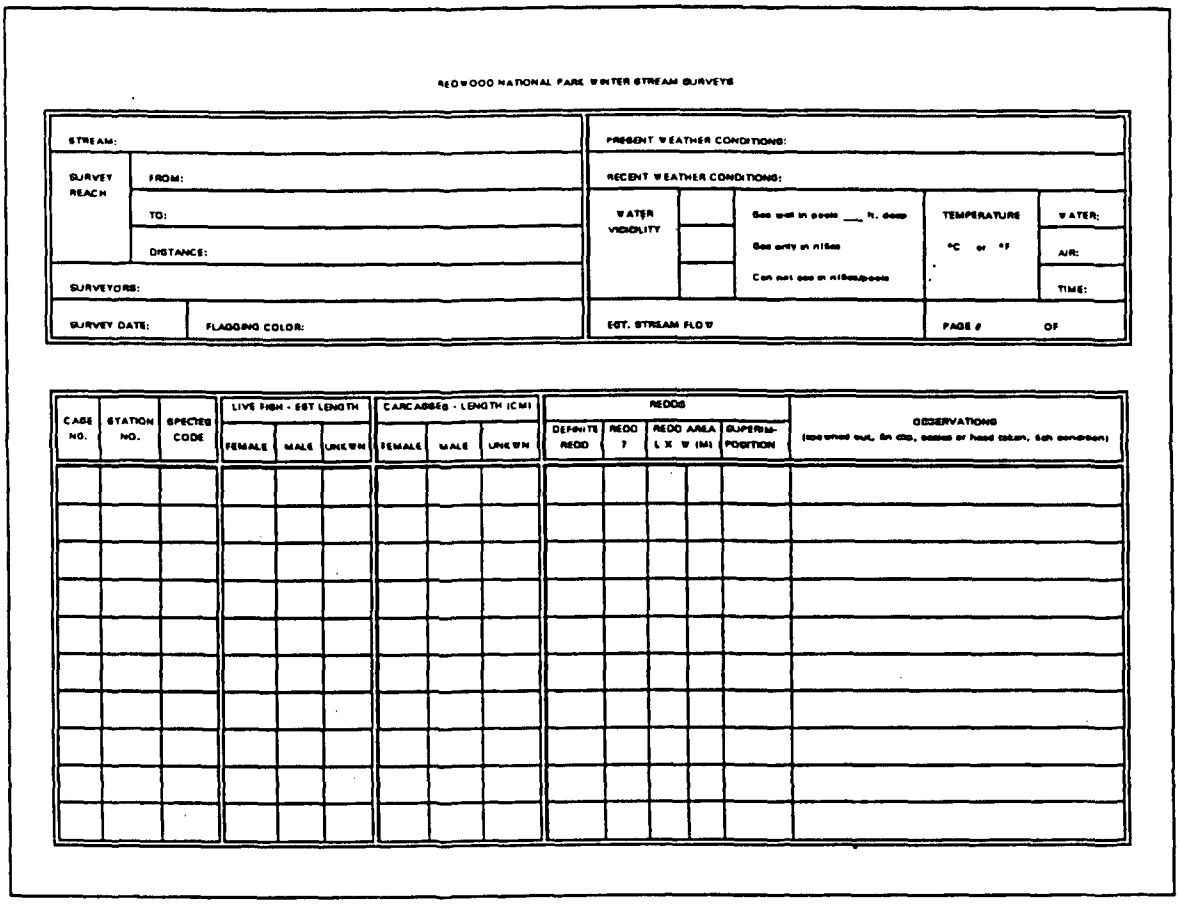
[1] Madej, 1984
[2] Meyer, et al., 1994
[3] Provided by RNP's Geographic Information System. (GIS)
[4] Pitlick, 1982

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 location of each live fish, carcass, or redd was recorded along with other pertinent

Figure 2: Data Sheet



REDWOOD NATIONAL PARK WINTER STREAM SURVEYS

STREAM:			PRESENT WEATHER CONDITIONS:			
SURVEY REACH	FROM:		RECENT WEATHER CONDITIONS:			
	TO:		WATER VISIBILITY		TEMPERATURE	WATER:
	DISTANCE:				°C or °F	AIR:
SURVEYORS:						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
			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®)

information discussed below. To facilitate the accurate location of fish and Redds, Lost Man Creek has been monumented from the mouth to "picnic bridge" (total = 2,050 meters); Prairie Creek has been monumented from Channelization to Boyes Creek (total = 4,160 meters). The remainder of the index reaches on Prairie Creek will be monumented in the near 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; 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 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 intermittently on Prairie Creek during the 1993-94 spawning year. 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 (December 1993 through March 1994). Summarized data from 4 spawning seasons (1990-91 through 1993-94) are also presented. Also included are nine 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.

Three complete surveys were conducted on each of the index reaches during the 1993-1994 spawning season. Two partial surveys were conducted on Bridge Creek. 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 1993-1994 SPAWNING SEASON ON PRAIRIE, LOST MAN, BRIDGE AND TOM McDONALD CREEKS, HUMBOLDT COUNTY, CALIFORNIA.

PRAIRIE CREEK		
BELOW CHANNELIZATION TO BOYES	BOYES TO BROWN	BROWN TO 1.5 ABOVE
12-13-93	12-20-93	12-21-93
01-21-94	01-26-94	01-31-94
02-23-94	02-28-94	03-02-94

LOST MAN CREEK
12-22-93
01-31-94
03-01-94

BRIDGE CREEK	
MOUTH TO LOG JAM	LOG JAM TO M-7 BRIDGE
12-20-93[a]	12-20-93[b]
12-28-93	12-28-93
02-01-94	02-01-94
03-10-94	03-10-94

TOM McDONALD CREEK
01-12-94
02-03-94
03-14-94

[a] Incomplete survey (33 + 00 to Log Jam)
[b] Incomplete survey (Log Jam to 69 + 00)

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 1993-94 spawning year. Tables C-2 through C-8 (Appendix C) list the same parameters by stream, reach, and date. Table C-9 summarizes trapping data from an upstream migrant fish weir operated on Prairie Creek from 1985 to the present (data supplied by Humboldt County's Prairie Creek Fish Hatchery, and PCFWWRA, formerly known as PCFFA). These results are also presented in graphic form in Figure 4. Table C-10 presents the Prairie Creek weir trapping schedule during spawning years 1985-86 through 1993-94 (corresponds with water years 1986 to 1994). Table C-11 summarizes the total number of fish trapped at the Prairie Creek weir by sex and species during spawning years 1989-90 through 1993-94 (data supplied PCFWWRA, formerly PCFFA). Table C-12 compares the numbers of fish and redds observed per survey for spawning years 1990-91 through 1993-94 on index reaches. Table C-13 compares the total numbers of fish and redds observed during surveys for spawning years 1990-91 through 1993-94. Table C-14 compares the number of live salmonids, carcasses and redds per kilometer per survey for index reaches for spawning years 1990-91 through 1993-94. Table C-15 compares the estimated average live salmonid fork length (cm) for spawning years 1990-91 through 1993-94. Table C-16 compares the average salmonid carcass fork length (cm) for spawning years 1990-91 through 1993-94.

The following is a summary of the live fish and carcasses observed on the index reaches during the 1993-1994 surveys (King = King or Chinook Salmon, Coho = Coho or Silver Salmon, SHD = Steelhead Trout, UNK = Unknown Salmonid). These numbers include fish trapped and removed at the weir in the lower reach of Prairie Creek.

	LIVE FISH				CARCASSES			
	King	Coho	SHD	UNK	King	Coho	SHD	UNK
Prairie Creek[a]	104	63	33	25	19	8	0	4
Lost Man Creek	5	7	109	77	6	2	4	1
Bridge Creek	19	2	1	17	2	0	0	0
Tom McDonald Creek	0	2	0	2	0	0	1	0

[a]Includes all fish trapped and removed from stream 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 (81% and 85% respectively). Fifty-six percent of live king salmon and 42% of live coho salmon reported for Prairie Creek were trapped at the weir. The majority (76%) of 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 the weir operated on Prairie Creek during water years 1991 to 1994 (corresponds with spawning years 1985-86 through 1993-94). 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-10 and C-11 for trapping schedules and data.

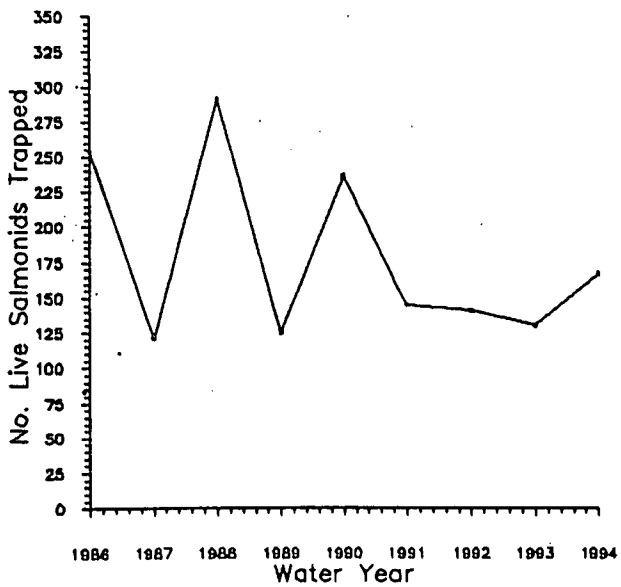


Figure 4: Total Numbers of Weir Trapped Salmonid Spawners on Prairie Creek, Water Years 1986-1994 (corresponds to spawning years 1985-86 to 1993-94).

One hundred eighty-eight definite and 19 questionable redds were found on the Prairie Creek index reaches; 54 definite, 9 questionable redds on Lost Man Creek; 23 definite, 3 questionable on Bridge Creek; and 9 definite on Tom McDonald Creek.

Table C-12, Comparison of Numbers of Fish and Redds Observed Per Survey for Spawning Years 1990-91 Through 1993-94 on Index Reaches, Table C-13: Comparison of Total Numbers of Live Fish, Carcasses and Redds Observed During

Surveys for Spawning Years 1990-91 Through 1993-94 on Index Reaches, and Table C-14, Live Salmonids, Carcasses and Redds per Kilometer per Survey for Index Reaches, Spawning Years 1990-91 through 1993-94, are comparative representations of observed spawning effort. 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.

Prairie Creek

The fewest numbers of live fish, carcasses and redds were observed during the 1991-92 spawning year for almost all of the parameters (Table C-13). Live king salmon numbers this year (45) were 8.3% lower than those observed during 1992-93 (54). Numbers of live steelhead trout are 33% greater this year than any previous year reported herein (total for all reaches = 33, previous high was 11). Numbers of live coho salmon (36) are about the same as in 1992-93 (38). The greatest number of redds (188 definite and 19 questionable) was observed during the 1993-94 season.

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

Live king salmon numbers on this reach are few, therefore it is difficult to make comparisons from year to year (Table C-13). The greatest number of live king salmon (5) was observed this year. Previously, the greatest number of live king salmon observed on this reach was one. Examination of king carcass data reveals that this species has been observed in greater numbers as carcasses than as live fish during each of the four spawning seasons under consideration. Most notable is the difference in the live:carcass ratio observed during 1990-91, 1:10.

Coho salmon appear to have made their greatest spawning effort (46 live fish, 17 carcasses) in 1991-92 and made a very poor showing (2 live, 1 carcass) in 1992-93. Their numbers this year are somewhat larger (7 live, 2 carcasses). Analysis of coho numbers for the 1990-91 spawning year (4 live, 23 carcasses) suggests that timing of the spawning surveys may have missed the peak of the coho run that year.

Live steelhead trout were observed in progressively greater numbers over the four year period, from 48 in 1990-91 up to 109 in 1993-94. Steelhead carcass data does not reflect this observation.

Redd activity was greatest in 1991-92 with 158 redds reported. Sixty-three redds were observed this year.

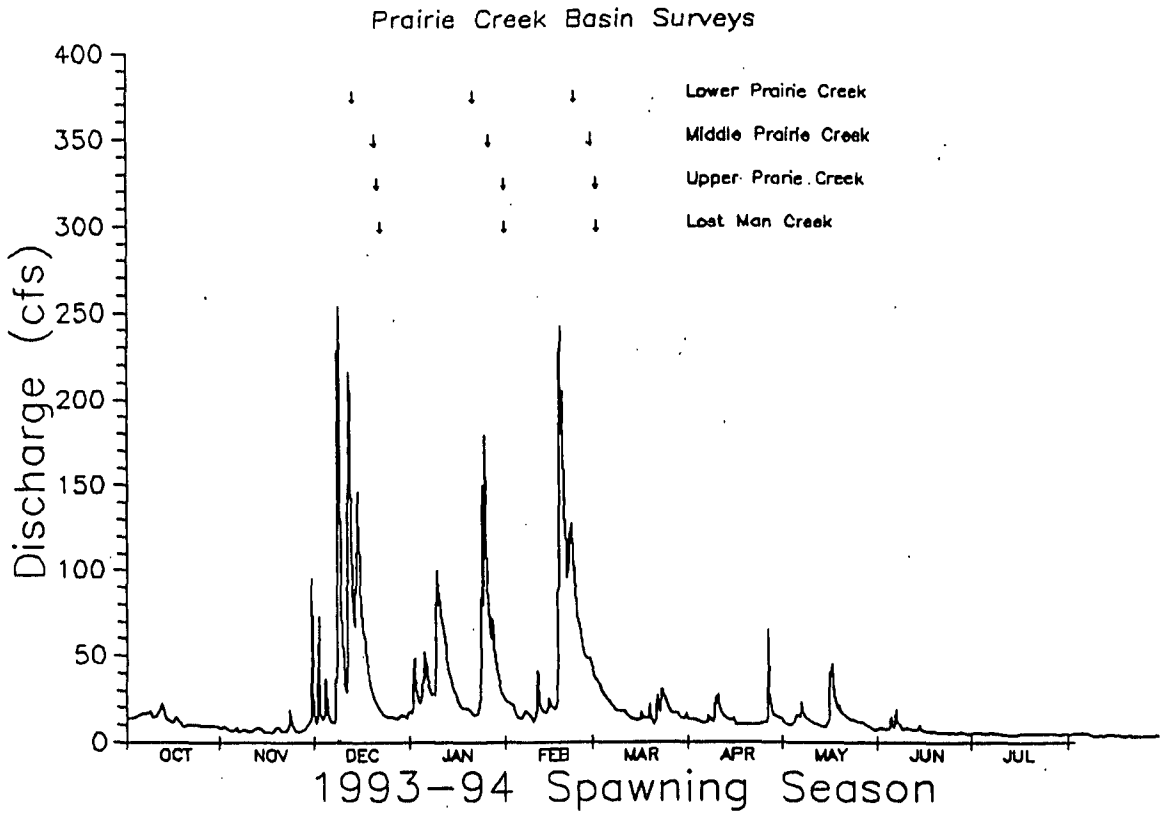


Figure 5: Timing of Prairie Creek Surveys in Relation to Flows on Prairie Creek, Spawning Season 1993-94 (water year 1994).

Bridge Creek

King salmon, totalling 20 live individuals, was the most commonly observed salmonid species on Bridge Creek this year (Table C-13). In previous years, steelhead was the most commonly observed salmonid species. Only one live steelhead was observed this year. For all years, almost all steelhead were observed above the log jam. King salmon were most frequently observed below the log jam. Roughly equal numbers of redds were observed above and below the log jam. During the four years under consideration, only three live coho were observed; two were observed below the log jam this year. Coho carcasses have not been recovered.

Tom McDonald Creek

Only three years of data are available for Tom McDonald Creek (Table C-13). The only live fish observed on this creek were two steelhead in 1992-93 as well as two coho and two unidentified salmonids this year. One steelhead carcass was observed this year; the only other carcass observed in this stream was a steelhead found in 1991-92. The observation of definite redds each year indicates 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 retained at the weir would have been detected by surveyors had fish migration been unimpeded. Some of the trapped fish were released back into the creek, thus allowing the possibility of counting fish twice. Therefore, only fish trapped and retained at the weir are reported in Tables C-1, C-2, and C-14 for the Channelization to Boyes reach; comparative annual tables C-12 and C-13 report only those fish actually observed during surveys. Because fish were removed from the naturally spawning population, redd data from Prairie Creek is not

necessarily a valid indicator of spawning effort. However, it is still useful as an index to wild spawning effort.

The nine years of data obtained at the Prairie Creek weir do not constitute a completely representative index of spawning effort on Prairie Creek. The weir was operated by three different organizations whose methods varied from year to year (Table C-11). PCFWWRA (formerly PCFFA) 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 rendered 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 coho salmon as well, but they do not appear to be returning in similarly impressive numbers. Some 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 is often considered to 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 can 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 allow 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 1993-94 spawning year is a reflection of the large numbers of chinook and coho spawners observed. The

moderate number of redds produced on Lost Man Creek is probably a reflection of the numbers of steelhead trout returning to spawn. Comparison of redd production over time may help to detect population trends.

Numbers of each parameter for Bridge and Tom McDonald Creeks are too few to make valid comparisons. Many more years of data are necessary to detect trends in numbers of adult salmonids and redds over time.

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

Results

Table 3 summarizes the distribution data on a per kilometer basis for the index reaches surveyed during the 1993-94 spawning season. Table 4 summarizes the distribution data calculated on a per kilometer per survey basis; Table C-14 compares the same data for spawning years 1990-91 through 1993-94. Table 5 compares numbers of live fish, carcasses and redds observed on a per kilometer basis for spawning years 1990-91 through 1993-94. Figures 6A, 6B, 7, and 8 are graphic representations of data presented on Table 5.

TABLE 3: LIVE SALMONIDS, CARCASSES, AND REDDS PER KILOMETER FOR INDEX REACHES SURVEYED, 1993-94

STREAM	INDEX REACH	LENGTH OF REACH (km)	LIVE FISH /km	CARCASSES /km	REDDS/km (Definite & Questionable)
PRAIRIE	CHAN TO BOYES[a]	4.03	38.5	4.5	20.3
	BOYES TO BROWN	3.38	14.8	2.4	26.9
	BROWN TO 1.5	3.08	6.5	1.6	11.0
	AVERAGE OF REACHES[a]	3.50	19.9	2.8	19.4
LOST MAN	HATCHERY TO DOUBLE BRIDGES	2.48	79.8	5.2	25.4
BRIDGE	MOUTH TO M-7 BRIDGE[b]	3.00	9.7	0.3	7.7
TOM McDONALD	MOUTH TO LOG JAM #6	1.32	3.0	0.8	6.8

[a] Includes fish trapped and removed at weir.
[b] Does not include partial survey of 12/20/93.

TABLE 4: LIVE SALMONIDS, CARCASSES, AND REDDS PER KILOMETER PER SURVEY FOR INDEX REACHES SURVEYED, 1993-94.

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[a]	4.03	3	12.8	1.5	6.8
	BOYES TO BROWN	3.38	3	4.9	0.8	9.0
	BROWN TO 1.5	3.08	3	2.2	0.5	3.7
	AVERAGE OF REACHES[a]	3.50	3	6.6	0.9	6.5
LOST MAN	HATCHERY TO DOUBLE BRIDGES	2.48	3	26.6	1.7	8.5
BRIDGE	MOUTH TO M-7 BRIDGE[b]	3.00	3	3.2	0.1	2.6
TOM McDONALD	MOUTH TO LOG JAM #6	1.32	3	1.0	0.3	2.3

[a] Includes fish trapped and removed at weir; this skews the results. Refer to Table C-14 for figures which do not include weir captures.

[b] Does not include partial survey of 12/20/93.

TABLE 5 - NUMBERS OF LIVE FISH, CARCASSES AND REDDS PER KILOMETER FOR WATER YEARS 1991 THROUGH 1994 (spawning years 1990-91 to 1993-94)

STREAM	REACH	NUMBER OF LIVE FISH/KM				NUMBER OF CARCASSES/KM				NUMBER OF REDDS/KM			
		1991	1992	1993	1994	1991	1992	1993	1994	1991	1992	1993	1994
PRAIRIE CREEK	CHANNELIZATION TO BOYES[a]	34.5	29.5	34.7	38.5	9.9	3.7	9.7	4.5	19.4	20.8	15.6	20.3
	CHANNELIZATION TO BOYES[b]	13.6	6.7	15.4	17.1	9.9	3.7	9.7	4.5	19.4	20.8	15.6	20.3
	BOYES TO BROWN	5.6	0.6	11.2	14.8	5.3	0.0	16.9	2.4	10.1	5.9	25.1	26.9
	BROWN TO 1.5 ABOVE	1.9	0.0	7.8	6.5	8.4	0.0	8.4	1.6	3.6	1.8	14.6	11.0
	AVERAGE PRAIRIE CREEK[a]	14.0	10.0	19.3	19.9	7.9	1.2	11.6	2.8	11.0	9.5	18.4	19.4
	AVERAGE PRAIRIE CREEK[b]	7.0	2.4	11.5	12.8	7.9	1.2	11.6	2.8	11.0	9.5	18.4	19.4
LOST MAN	HATCHERY TO DOUBLE BRIDGES	25.0	45.6	40.7	79.8	14.1	12.9	4.4	5.2	15.3	63.7	32.7	25.4
BRIDGE	MOUTH TO M-7 BRIDGE[c,d]	5.7	4.0	7.3	9.7	0.7	1.3	0.5	0.3	2.7	7.0	5.0	7.7
TOM McDONALD	MOUTH TO LOG JAM #6	-	0.0	1.5	3.0	-	0.8	0.0	0.8	-	12.1	5.3	6.8

[a] Includes fish trapped and removed from stream at weir.
[b] Does not include any fish trapped at weir.
[c] Surveys of 1992-93 went only to Rodgers Creek; does not include partial survey of 12/23/92.
[d] Does not include partial survey of 12/20/93.

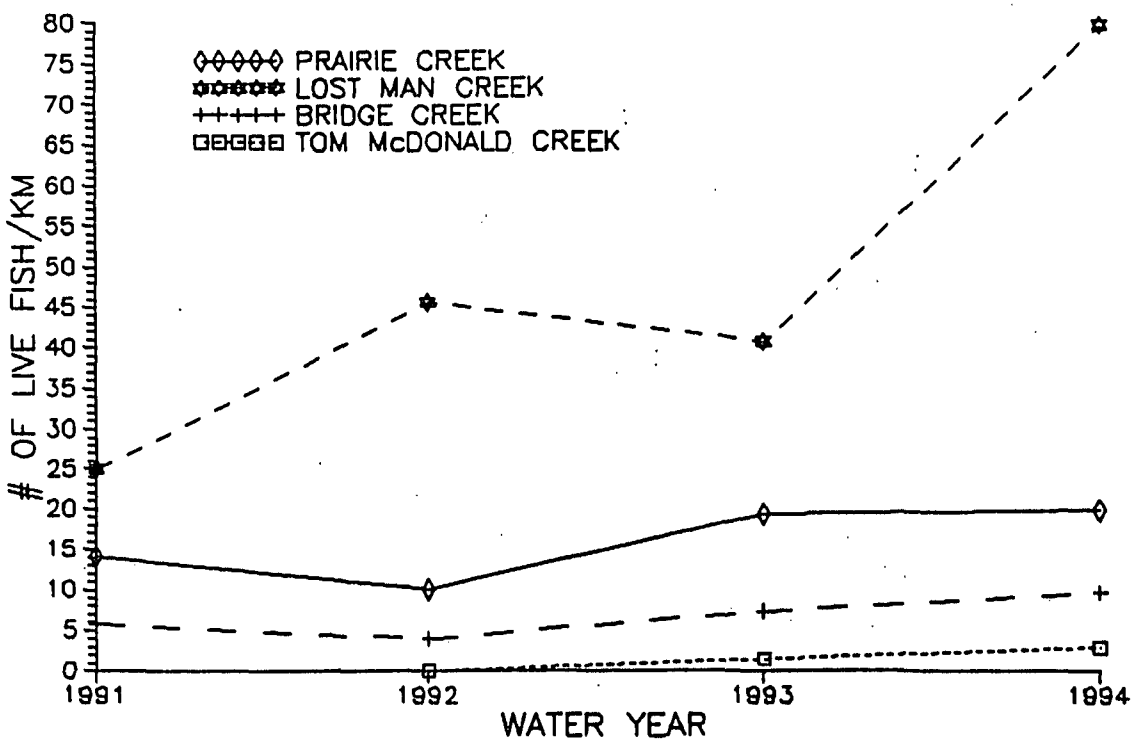


Figure 6A - Total number of live fish observed per kilometer (includes fish trapped and held at the Prairie Creek weir) on index streams for water years 1991 through 1994 (corresponds with spawning years 1990-91 to 1993-94).

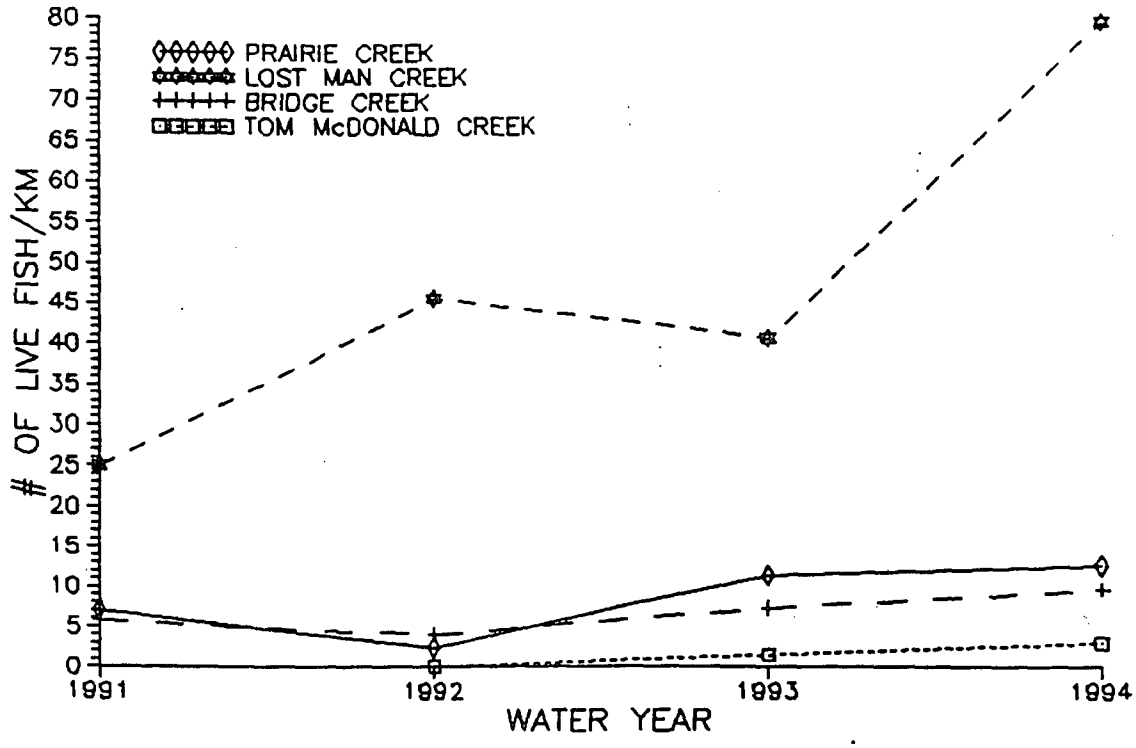


Figure 6B - Total number of live fish observed per kilometer (does not include any fish trapped at the Prairie Creek weir) on index reaches for water years 1991 through 1994 (corresponds with spawning years 1990-91 to 1993-94).

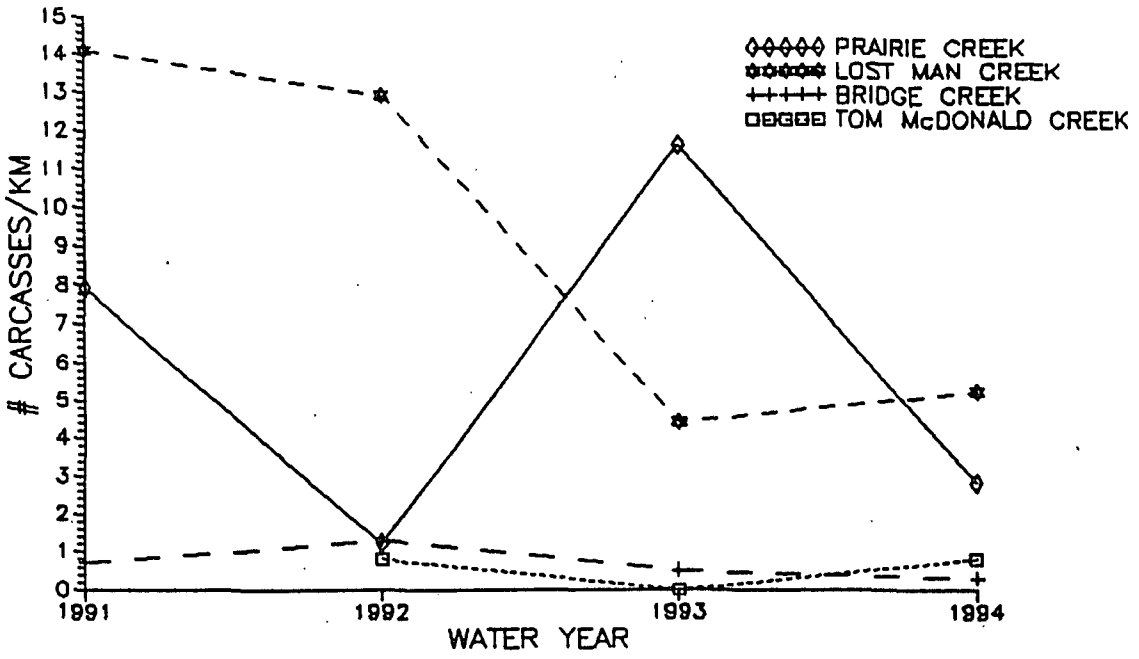


Figure 7 - Total number of carcasses observed per kilometer on index reaches for water years 1991 through 1994 (corresponds with spawning years 1990-91 to 1993-94).

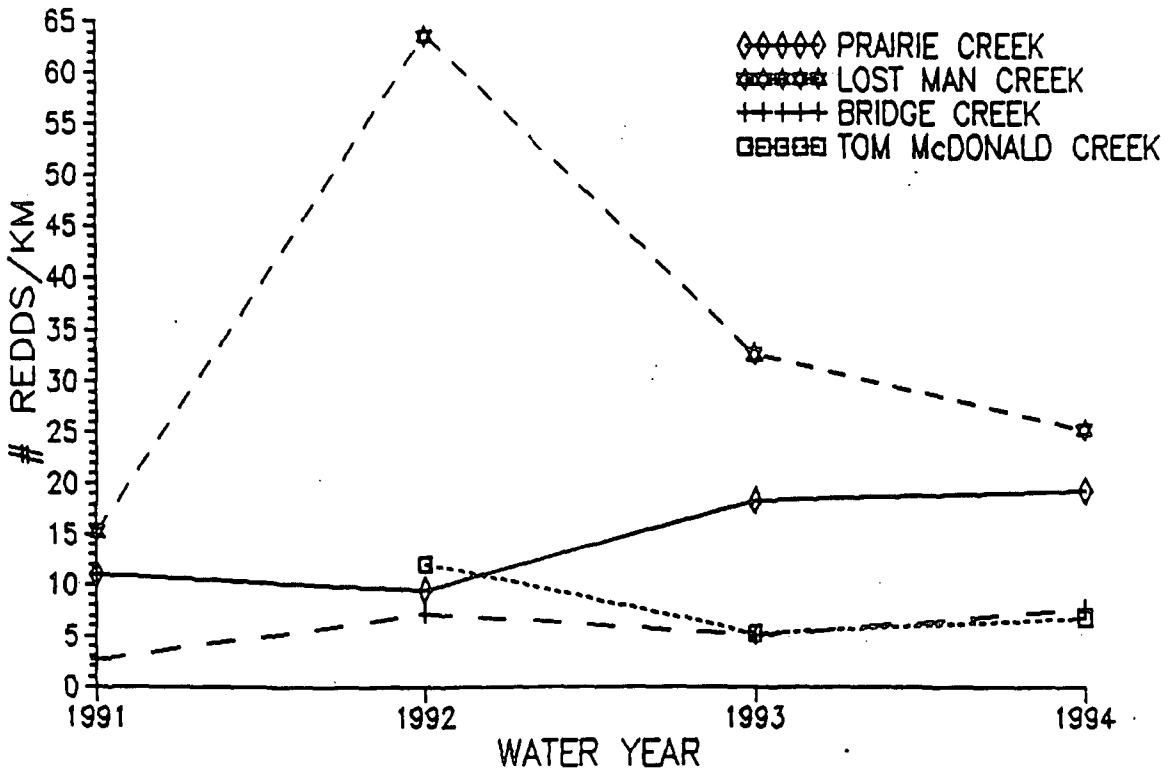


Figure 8 - Total number of redds observed per kilometer on index streams for water years 1991 through 1994 (corresponds with spawning years 1990-91 to 1993-94).

During 1993-94, the greatest number of live fish/km and carcasses/km reported on Prairie Creek were observed on the Channelization to Boyes reach. The greatest number of redds/km were observed on the Boyes to Brown reach (Table 3). Examination of Tables 5 and C-13 reveal that live fish/km, carcasses/km and redds/km are usually most numerous in the Channelization to Boyes reach regardless of whether or not one includes the fish trapped and held at the weir.

The total number of live fish per kilometer observed on Prairie Creek (including fish trapped and removed from the stream at the weir) for the last four years (spawning years 1990-91 through 1993-94, water years 1991 - 1994) ranges from 10.0 to 19.9 fish per kilometer (Table 5 and Figure 6A). The total number of carcasses observed for the same period fluctuates a great deal from year to year (Table 5 and Figure 7). Numbers observed range from 1.2 to 11.6 with a mean of 5.9 carcasses per kilometer. Total number of redds per kilometer for the same time period ranges from a low of 9.5 during water year 1992 to a high of 19.4 during water year 1994 (Table 5 and Figure 8).

In 1993-94, king salmon, both live and dead, and redds were observed above and below the log jam on Bridge Creek. Two coho were seen below the log jam; one steelhead was seen below the jam. Unidentified live salmonids were seen above and below the log jam.

Considering all of the index reaches surveyed, the Lost Man Creek reach was the most utilized by spawning salmonids this year (Tables 3 & 4) as well as in previous years for almost all parameters (Tables 5 and C-14).

Examination of Figures 6A, 6B, 7, and 8, indicates that the numbers of live fish/km and numbers of redds/km show a rough correlation for Prairie Creek but not for Lost Man Creek. The numbers of carcasses/km do not appear to reflect numbers of live fish/km or redds/km for Prairie Creek or Lost Man Creek. These discrepancies could indicate that fish are not spawning uniformly along each index reach or that timings of surveys are missing migration peaks.

One uprooted alder, with monument number 13+50, which had fallen into Lost Man Creek is the only change in habitat conditions noted this year.

Discussion

Comparative results of the recorded parameters may be skewed by methods 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. Comparison of data between years and between index reaches is facilitated by reporting in the standardized format of parameter/kilometer/survey, as in Tables 4 and C-14.

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, it will be impossible to make an accurate comparison of spawning distribution between these three reaches.

Results from the last four spawning seasons show that the "Log Jam" on Bridge Creek is not functioning as a barrier to salmonid migration. Live fish 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".

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

Results

Table 6 (next page) presents the average estimated lengths of live salmonids observed during the 1993-1994 spawning surveys. Table C-15 (Appendix C) presents a comparison of the same data for spawning years 1990-91 through 1993-94. Table 7 (next page) presents average measured lengths of all carcasses. Table C-16 (Appendix C) presents a comparison of the same data for spawning years 1990-91 through 1993-94. Table 8 (next page) presents sex ratios for king, coho, and steelhead carcasses found on the index streams during the surveys. Refer to Table C-11 to calculate sex ratios of fish trapped on Prairie Creek for spawning years 1989-90 through 1993-94.

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	83 (19)	75 (17)	58 (8)	66 (10)	64 (13)	59 (7)	59 (5)	60 (4)	58 (24)	33 (23)
LOST MAN*	65 (2)	48 (2)	60 (1)	46 (2)	43 (2)	38 (3)	-	-	56 (109)	47 (73)
BRIDGE	80 (6)	62 (3)	89 (10)	-	-	30 (2)	-	-	35 (1)	32 (13)
TOM MCDONALD	-	-	-	50 (1)	-	30 (1)	-	-	-	40 (1)

* 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	87 (10)	91 (6)	84 (2)	62 (3)	71 (4)	-	-	-	-	63 (4)
LOST MAN	66 (4)	67 (2)	-	67 (1)	58 (1)	-	68 (2)	65 (2)	-	-
BRIDGE	82 (1)	84 (1)	-	-	-	-	-	-	-	-
TOM MCDONALD	-	-	-	-	-	-	-	-	97 (1)	-

TABLE 8: CARCASS SEX RATIO

STREAM	KING ♂:♀ (#)	COHO ♂:♀ (#)	STEELHEAD ♂:♀ (#)
PRAIRIE CREEK	1:1.4 (17)	1.7:1 (8)	-
LOST MAN CREEK	1:2 (6)	1:1 (2)	1:1 (4)
BRIDGE CREEK	1:1 (2)	-	-
TOM McDONALD	-	-	-

Average estimated salmonid lengths for live females and males of king and coho salmon observed on Lost Man Creek this year were substantially shorter than those estimated for fish on Prairie or Bridge Creeks. Measured carcass lengths for king salmon demonstrate the same disparity. Live steelhead of unknown sex from Prairie and Lost Man Creeks are estimated to be approximately the same length. Comparison of estimated live steelhead lengths from fish in Bridge Creek is not possible because of the small (1) sample size. Comparison of steelhead carcass length is not possible because of lack of data.

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.

The shorter estimated lengths of king and coho salmon observed on Lost Man Creek this year could be a reflection of variability of length estimation by observers. Although the measured king carcass lengths seem to support the possibility of an actual difference in sizes of fish between streams, one must consider the small sample sizes. Because of these limitations, one cannot conclude that an actual disparity exists in the lengths of king and coho salmon found on Lost Man Creek as opposed to those found on Prairie and Bridge Creeks. The observed length discrepancy is not seen in other years.

Carcass and weir data provide the most accurate means for the determination of the size and sex ratio of spawning salmonids. Length data from the 1993-94 weir captures was not available at the time this report was written.

Except for Prairie Creek, too few carcasses were found to have confidence in the observed sex ratios. Generally, it is thought that more than one male should be available to fertilize a female's eggs. Considering only carcass data, it appears that there may have been too few male king salmon to provide adequate fertilization for females on Prairie Creek. When numbers of king salmon trapped at the weir are examined (Table C-11), the male:female ratio is 1.8:1. This is probably an adequate ratio to ensure fertilization.

IV. REDD CHARACTERISTICS

Results

Table 9 presents summary statistics for all redds observed (questionable and definite) on the index streams during RNP's 1993-1994 spawning surveys. Average redd lengths, widths, and areas were calculated for all redds with recorded dimensions (measured or estimated). Total redd area was calculated by summation of calculated areas. Table C-14 allows comparison of numbers of redds/km/survey between spawning years 1990-91 through 1993-94.

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	81	4.41	2.59	13.68	1108.20
PRAIRIE/Boyes to Brown	89	2.88	1.28	5.74	510.57
PRAIRIE/Brown to 1.5	34	3.02	1.44	5.27	179.09
TOTAL PRAIRIE	204	3.44	1.77	8.23	1797.86
LOST MAN	62	1.70	0.90	3.02	187.45
BRIDGE	25	2.70	1.13	3.82	95.42
TOM McDONALD	9	2.56	1.28	3.98	35.86
ALL STREAMS	280	3.65	1.81	6.52	2127.93

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, total area of redds and redd density (number/km., Table 3) observed on Lost Man Creek are a reflection of the large numbers of returning steelhead. The comparatively small average redd size observed on Lost Man Creek suggests that steelhead dig smaller redds than those produced by the king and coho salmon observed on Prairie, Bridge and Tom McDonald Creeks. 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

Two carcasses showed signs of possible adipose fin clips. The recovered heads did not contain coded wire tags. No other tagged salmonids were discovered.

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.

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 stocks, the Fish and Wildlife Branch of the Research and Resources Management Division of Redwood National Park annually surveys adult spawning salmonid populations within the park. This report summarizes results of the 1993-1994 surveys and compares them with data from spawning years 1990-91 through 1992-93. Information gained from long term monitoring of returning salmon and spawning habitat should assist the scientists of Redwood National Park in making appropriate recommendations to promote the future recovery of salmon stocks within the Redwood Creek basin.

The majority of king and coho salmon were observed on Prairie Creek; the majority of steelhead trout were observed on Lost Man Creek. Although the greatest total numbers of fish, carcasses and redds were observed on Prairie Creek, the greatest total numbers of fish/km, carcasses/km and redds/km were observed on Lost Man Creek. These high numbers are probably due to the steelhead releases made by the Prairie Creek fish hatchery from 1972 through December, 1992. Live steelhead trout were observed in progressively greater numbers on Lost Man Creek over the four year period, from 48 in 1990-91 up to 109 in 1993-94.

Considering all of the index reaches surveyed on a parameter/kilometer basis, the one on Lost Man Creek was the most utilized by spawning salmonids this year as well as in previous years. Prairie Creek was the next most utilized stream with most spawning activity taking place in the Channelization to Boyes reach. However, operation of a weir on this reach makes comparison of salmonid utilization between the Prairie Creek reaches difficult. Very few numbers of fish, carcasses and redds were observed on Bridge and Tom McDonald creeks, but results demonstrate that salmonids are definitely using the streams.

The numbers of carcasses/km do not appear to reflect numbers of live fish/km or redds/km for Prairie Creek or Lost Man Creek. These discrepancies could indicate that fish are not spawning uniformly along each index reach or that timings of surveys are missing migration peaks.

Average estimated salmonid lengths for live females and males of king and coho salmon observed on Lost Man Creek this year were substantially shorter than those estimated for fish on Prairie or Bridge Creeks. However, the limitations of observer variability and small sample size preclude the conclusion that an actual disparity exists. Also, this observation was not reflected in data from 1990-91 through 1992-93.

Results from Redwood National Park's 1993-94 spawning/carcass surveys show that, compared to historical conditions where so many carcasses were in the stream "you could hardly stand the smell" (Feranna and Ricks, 1981), low numbers of fish are returning to spawn in the index streams. Carcasses recovered were so few in number that calculation of valid statistics for average fork length and sex ratio of returning salmon is not possible. 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 steelhead in Lost Man Creek was 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.

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' data is untenable. Although general comparisons may be made between current and historic conditions, longer term data is necessary for determining population trends. Data from 1982 to 1994 are evaluated in a report by Meyer (1994).

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PERSONAL COMMUNICATIONS

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

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

APPENDIX A

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

PROJECT STATEMENT SHEET

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

----------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	12/13/93	OVERCAST, RAIN	OVERCAST AND RAIN	2.0	8.5	12.0	HIGH	RAIN LAST 1500 M. VISIBILITY POOR RNP GAGE-1.0 FT, FS GAGE-1.1 FT
PRAIRIE CREEK	CHAN	BOYES	01/21/94	PARTLY OVERCAST	CLEAR	4.0	0.0	46.0	MED	TEMPERATURE ESTIMATED. DATA TRANSCRIBED FROM MOORE'S NOTES
PRAIRIE CREEK	CHAN	BOYES	02/23/94	OVERCAST	OVERCAST	0.0	8.0	11.5	HIGH	MANY CARCASS PARTS FOUND IN REACH
PRAIRIE CREEK	BOYES	BROWN	12/20/93	SUNNY, CLEAR	SUNNY, CLEAR	4.0	6.0	3.0	MED	LAST MONUMENT #53, REMAINDER ESTIMATED
PRAIRIE CREEK	BOYES	BROWN	01/26/94	OVERCAST	OVERCAST, LIGHT RAIN	3.0	8.0	10.0	HIGH	RAIN LAST 1/4 MILE; POOR VISIBILITY
PRAIRIE CREEK	BOYES	BROWN	02/26/94	OVERCAST	LIGHT RAIN, OVERCAST	3.0	8.5	12.0	HIGH	BOYES TURBID, PRAIRIE CREEK ABOVE CLEAR
PRAIRIE CREEK	BROWN	1.5 ABOVE	12/21/93	SUNNY, CLEAR	SUNNY, CLEAR	4.0	5.5	3.5	MED	PRAIRIE CREEK ABOVE BROWN GAUGE - 0.46 FT
PRAIRIE CREEK	BROWN	1.5 ABOVE	01/31/94	SUNNY, CLEAR	SUNNY, CLEAR	4.0	6.5	4.5	MED	SURVEY TIME = 213 MIN
PRAIRIE CREEK	BROWN	1.5 ABOVE	03/02/94	PARTLY CLOUDY, WARM	CLEAR, COOL	4.0	9.0	11.0	MED	PRAIRIE CREEK BELOW BROWN TEMP = 9 DEG C.
LOST MAN	HATCHERY	DBL BRIDGES	12/22/93	SUNNY, CLEAR	SUNNY, CLEAR	3.0	5.5	3.0	MED	START AT HATCHERY LADDER POOL
LOST MAN	HATCHERY	DBL BRIDGES	01/31/94	SUNNY, COOL	SUNNY, COOL	2.0	6.5	4.5	MED	VISIBILITY NOT VERY GOOD, SUSPENDED SILT
LOST MAN	HATCHERY	DBL BRIDGES	03/01/94	CLEAR, COOL	CLEAR, COOL	2.0	7.5	8.0	HIGH	SURVEY TIME = 190 MIN
BRIDGE CREEK	33+00	LOG JAM	12/20/93	CLEAR, SUNNY	CLEAR, SUNNY	3.0	8.0	5.5	MED	TEMPERATURES ESTIMATED, INCOMPLETE SURVEY
BRIDGE CREEK	MOUTH	LOG JAM	12/28/93	CLEAR, SUNNY	CLEAR, SUNNY	4.0	7.0	5.0	MED	REDWOOD CRK ABOVE BRIDGE TEMP = 5.5 DEG C
BRIDGE CREEK	MOUTH	LOG JAM	02/01/94	SUNNY, 75% CLEAR	SUNNY, CLEAR	3.5	6.5	1.5	MED	REDWOOD CRK ABOVE BRIDGE TEMP = 5.5 DEG C BEAR TRACKS
BRIDGE CREEK	MOUTH	LOG JAM	03/10/94	OVERCAST, LIGHT RAIN	CLEAR, WARM	4.0	9.0	11.0	MED	REDWOOD CRK = 9 DEG C, NO CARCASSES/LIVE FISH/REDDS OBSERVED
BRIDGE CREEK	LOG JAM	69+00	12/20/93	CLEAR, SUNNY	CLEAR, SUNNY	3.0	8.0	5.5	MED	TEMPERATURES ESTIMATED, INCOMPLETE SURVEY
BRIDGE CREEK	LOG JAM	M7 BRIDGE	12/28/93	BROKEN OVERCAST	PARTLY CLOUDY	4.0	6.5	7.0	MED	FRESH BEAR TRACKS
BRIDGE CREEK	LOG JAM	M7 BRIDGE	02/01/94	SUNNY, COOL	SUNNY, COOL	4.0	6.5	7.0	MED	SURVEY TIM = 130 MIN
BRIDGE CREEK	LOG JAM	M7 BRIDGE	03/10/94	OVERCAST, LIGHT RAIN	CLEAR, WARM	4.0	9.5	13.0	MED	SURVEY TIME = 75 MIN NO CARCASSES/LIVE FISH/ REDDS OBSERVED
TOM MCDONALD	MOUTH	LOG JAM #6	01/12/94	SUNNY, CLEAR	RAINED 2 DAYS AGO	4.0	7.0	5.0	MED	SURVEY TIME = 162 MIN
TOM MCDONALD	MOUTH	LOG JAM #6	02/03/94	SUNNY, CLEAR	SUNNY, CLEAR	3.5	6.5	7.0	MED	SURVEY TIME = 159 MIN REDWOOD CRK ABOVE T. McD. TEMP = 5.5 DEG
TOM MCDONALD	MOUTH	LOG JAM #6	03/14/94	SUNNY, HIGH OVERCAST	SUNNY, HIGH OVERCAST	4.0	9.5	21.5	MED	SURVEY TIM = 118 MIN. REDWOOD CREEK = 10 DEG C.

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

APPENDIX C

SUMMARY OF RESULTS FROM
1993-1994 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*	104	63	33	25	10	7	2	3	5	0	0	0	0	0	0	4	188	19
LOST MAN	5	7	109	77	4	2	0	1	1	0	2	2	0	0	0	1	54	9
BRIDGE	19	2	1	17	1	1	0	0	0	0	0	0	0	0	0	0	23	3
T. MCDNLD	0	2	0	2	0	0	0	0	0	0	0	0	1	0	0	0	9	0
TOTAL	128	74	143	121	15	10	2	4	6	0	2	2	1	0	0	5	274	31

* Includes fish trapped and held at weir operated by PCFWWRA, (Channelization to Boyes reach). Number of trapped fish released upstream: King - 20, Coho - 51, Steelhead - 10.

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	?
12/13/93	7	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	7	4
01/21/94	15	20	0	3	5	2	1	0	1	0	0	0	0	0	0	2	57	2
02/23/94	0	1	20	1	4	1	0	1	0	0	0	0	0	0	0	1	11	1
Weir*	59	27	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	81	48	20	6	9	3	1	1	1	0	0	0	0	0	0	3	75	7

* Fish trapped and held at weir; does not include fish which were trapped and released. Refer to Table C-11 for Total Number of Fish Trapped.

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	?
12/20/93	13	5	0	7	0	0	0	0	0	0	0	0	0	0	0	0	39	2
01/26/94	2	6	0	0	1	0	1	2	3	0	0	0	0	0	0	1	30	4
02/28/94	0	0	13	4	0	0	0	0	0	0	0	0	0	0	0	0	16	0
TOTAL	15	11	13	11	1	0	1	2	3	0	0	0	0	0	0	1	85	6

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	?
12/21/93	5	0	0	4	0	3	0	0	1	0	0	0	0	0	0	0	10	2
01/31/94	3	4	0	3	0	0	0	0	0	0	0	0	0	0	0	0	17	4
03/02/94	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	1	0
TOTAL	8	4	0	8	0	4	0	0	1	0	0	0	0	0	0	0	28	6

TABLE C-5: 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	?
12/22/93	4	2	0	3	0	0	0	0	0	0	0	0	0	0	0	0	8	2
01/31/94	1	3	65	55	4	2	0	1	1	0	2	2	0	0	0	0	34	1
03/01/94	0	2	44	19	0	0	0	0	0	0	0	0	0	0	0	1	12	6
TOTAL	5	7	109	77	4	2	0	1	1	0	2	2	0	0	0	1	54	9

TABLE C-6: 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	?
12/20/93*	5	0	0	2	0	1	0	0	0	0	0	0	0	0	0	0	1	0
12/28/93	5	2	0	4	0	0	0	0	0	0	0	0	0	0	0	0	3	2
02/01/94	7	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	7	0
03/10/94	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	17	2	0	7	0	1	0	0	0	0	0	0	0	0	0	0	11	2

*Incomplete survey (33 + 00 to Log Jam)

TABLE C-7: 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	?
12/20/93*	3	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	2	0
12/28/93	0	0	0	6	1	0	0	0	0	0	0	0	0	0	0	0	7	1
02/01/94	0	0	1	3	0	0	0	0	0	0	0	0	0	0	0	0	3	0
03/10/94	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	3	0	1	10	1	0	0	0	0	0	0	0	0	0	0	0	12	1

*Incomplete survey (Log Jam to 69 + 00)

TABLE C-8: NUMBER OF FISH AND REDDS OBSERVED - TOM McDONALD CREEK (MOUTH TO LOG JAM #6)

STREAM	LIVE FISH				CARCASSES												REDDS	
					KING			COHO			STEELHEAD			UNKNOWN				
	KING	COHO	SHD	UNK	♀	♂	UNK	♀	♂	UNK	♀	♂	UNK	♀	♂	UNK	DEF	?
01/12/94	0	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
02/03/94	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0
03/14/94	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	2	0
TOTAL	0	2	0	2	0	0	0	0	0	0	0	0	1	0	0	0	9	0

TABLE C-9: NUMBER OF LIVE FISH TRAPPED ON PRAIRIE CREEK, SPAWNING YEARS 1985-86 THROUGH 1993-94 (WATER YEARS 1986-1994)

STATUS OF TRAPPED SALMONIDS	PCFWWRA[a]				PCFFA[b]	PRAIRIE CREEK FISH HATCHERY[c]			
	1993-94	1992-93	1991-92	1990-91	1989-90	1988-89	1987-88	1986-87	1985-86
Removed for spawning	86	78	92	77	106	3	10	7	13
Counted and released	81	52	49	68	130	122	281	114	241
TOTAL	167	130	141	145	236	125	291	121	254

[a] Trap was operated by Pacific Coast Fish, Wildlife and Wetlands Restoration Association (formerly PCFFA) and was located downstream of the Boyes Creek confluence.
[b] Trap was operated by Pacific Coast Federation of Fishermen's Associations, Inc. (PCFWWRA), 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.

TABLE C-10 TRAPPING SCHEDULE, PRAIRIE CREEK WEIR, SPAWNING YEARS 1985-86 THROUGH 1993-94 (WATER YEARS 1986-1994)

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 for 356.5 hours. Inoperable for 923 hours.
1993-94 (1994)	PCFWWRA	Downstream of Boyes Creek confluence.	Not available at time report written.

TABLE C-11 : TOTAL NUMBER OF FISH TRAPPED AT PRAIRIE CREEK WEIR, SPAWNING YEARS 1989-90 THROUGH 1993-94 (WATER YEARS 1990 - 1994)

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
1993-94	28	41	10	79	45	32	1	78	2	8	0	10	167

TABLE C-12: COMPARISON OF NUMBERS OF FISH AND REDDS OBSERVED PER SURVEY FOR SPAWNING YEARS 1990-91 THROUGH 1993-94 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)	0.40	1.60	1.80	1.60	0.60	1.40	0.40	0.60	14.80	2.00
1992-93 (3)	6.00	7.33	3.00	4.33	8.00	2.33	0.00	2.66	18.00	3.00
1993-94 (3)	7.33	7.00	6.66	2.00	4.33	0.67	0.00	1.00	25.00	2.33
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
1993-94 (3)	5.00	3.67	4.33	3.67	0.67	1.67	0.00	0.33	28.33	2.00
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
1993-94 (3)	2.67	1.33	0.00	2.67	1.33	0.33	0.00	0.00	9.33	2.00
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
1993-94 (3)	1.67	2.33	36.33	25.67	2.00	0.67	1.33	0.33	18.00	3.00

TABLE C-12: COMPARISON OF NUMBERS OF FISH AND REDDS OBSERVED PER SURVEY FOR SPAWNING YEARS 1990-91 THROUGH 1993-94 ON INDEX REACHES

SPAWNING YEAR (# of surveys)	LIVE FISH				CARCASSES				REDDS	
	KING	COHO	SHD	UNK	KING	COHO	SHD	UNK	DEF	?
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
1993-94[a] (4)	4.25	0.50	0.00	1.75	0.25	0.00	0.00	0.00	2.75	0.50
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
1993-94[c] (4)	0.75	0.00	0.25	2.50	0.25	0.00	0.00	0.00	3.00	0.25
TOM McDONALD CREEK - MOUTH TO LOG JAM #6										
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
1993-94 (3)	0.00	0.67	0.00	0.67	0.00	0.00	0.33	0.00	3.00	0.00

[a] Includes incomplete survey 12/20/93, (33 + 00 to Log Jam).
[b] Surveys went from Log Jam to Rodgers Creek.
[c] Includes incomplete survey 12/20/93, (Log Jam to 69 + 00).

TABLE C-13: COMPARISON OF TOTAL NUMBERS OF LIVE FISH, CARCASSES AND REDDS OBSERVED DURING SURVEYS FOR SPAWNING YEARS 1990-91 THROUGH 1993-94 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	31	8	8	8	28	8	0	4	63	15
1991-92	2	8	9	8	3	7	2	3	74	10
1992-93	18	22	9	13	24	7	0	8	54	9
1993-94	22	21	20	6	13	2	0	3	75	7
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
1993-94	15	11	13	11	2	5	0	1	85	6
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
1993-94	8	4	0	8	4	1	0	0	28	6
PRAIRIE CREEK - TOTAL OF REACHES										
1990-91	35	20	11	14	41	32	0	11	89	34
1991-92	2	10	9	8	3	7	2	3	97	13
1992-93	54	38	10	22	87	18	0	17	167	26
1993-94	45	36	33	25	19	8	0	4	188	19

TABLE C-13: COMPARISON OF TOTAL NUMBERS OF LIVE FISH, CARCASSES AND REDDS OBSERVED DURING SURVEYS FOR SPAWNING YEARS 1990-91 THROUGH 1993-94 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
1993-94	5	7	109	77	6	2	4	1	54	9
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
1993-94	17	2	0	7	1	0	0	0	11	2
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
1993-94	3	0	1	10	1	0	0	0	12	1
BRIDGE CREEK - TOTAL OF REACHES										
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
1993-94	20	2	1	17	2	0	0	0	23	3

TABLE C-13: COMPARISON OF TOTAL NUMBERS OF LIVE FISH, CARCASSES AND REDDS OBSERVED DURING SURVEYS FOR SPAWNING YEARS 1990-91 THROUGH 1993-94 ON INDEX REACHES

SPAWNING YEAR	LIVE FISH				CARCASSES				REDDS	
	KING	COHO	SHD	UNK	KING	COHO	SHD	UNK	DEF	?
TOM McDONALD CREEK - MOUTH TO LOG JAM #6										
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
1993-94	0	2	0	2	0	0	1	0	9	0

* Surveys went from Log Jam to Rodgers Creek.

TABLE C-14: LIVE SALMONIDS, CARCASSES AND REDDS PER KILOMETER PER SURVEY FOR INDEX REACHES, SPAWNING YEARS 1990-91 THROUGH 1993-94

SPAWNING YEAR	NUMBER OF SURVEYS	LIVE FISH /km/survey	CARCASSES /km/survey	REDDS /km/survey (Definite & Questionable)
CHANNELIZATION TO BOYES				
1990-91	7	4.9	1.4	2.8
1991-92	5.5	5.4	0.7	3.8
1992-93	3	11.6	3.2	5.2
1993-94	3	12.8	1.5	6.8
BOYES TO BROWN				
1990-91	4	1.4	1.3	2.5
1991-92	3	0.2	0.0	2.0
1992-93	2	5.6	8.5	12.6
1993-94	3	4.9	0.8	9.0
BROWN TO 1.5 ABOVE				
1990-91	5	0.4	1.7	0.7
1991-92	1	0.0	0.0	1.8
1992-93	2	3.9	4.2	7.3
1993-94	3	2.2	0.5	3.7
AVERAGE OF PRAIRIE CREEK REACHES				
1990-91	5.3	2.2	0.9	2.0
1991-92	3.2	1.8	0.2	2.4
1992-93	2.3	7.0	5.3	8.4
1993-94	3.0	6.6	0.9	6.5
LOST MAN CREEK				
1990-91	4	6.3	3.5	3.8
1991-92	3.5	13.0	3.7	18.2
1992-93	2	20.4	2.2	16.4
1993-94	3	26.6	1.7	8.5

TABLE C-14: LIVE SALMONIDS, CARCASSES AND REDDS PER KILOMETER PER SURVEY FOR INDEX REACHES, SPAWNING YEARS 1990-91 THROUGH 1993-94

SPAWNING YEAR	NUMBER OF SURVEYS	LIVE FISH /km/survey	CARCASSES /km/survey	REDDS /km/survey (Definite & Questionable)
BRIDGE CREEK				
1990-91	3	1.9	0.2	0.9
1991-92	3	1.3	0.4	2.3
1992-93[b]	3.5	2.1	0.1	1.6
1993-94[c]	3	3.2	0.1	2.6
TOM McDONALD CREEK				
1990-91	0	0.0	0.0	0.0
1991-92	2	0.0	0.4	6.1
1992-93	1	1.5	0.0	5.3
1993-94	3	1.0	0.3	2.3

[a] Includes fish trapped and held at weir.
Surveys were from Mouth to Rodgers Creek.
Does not include partial survey of 12/20/93.

TABLE C-15: AVERAGE ESTIMATED LIVE SALMONID FORK LENGTH (cm) SPAWNING YEARS 1990-91 THROUGH 1993-94

SPAWNING YEAR	KING (n)			COHO (n)			STEELHEAD		
	♀ (n)	♂ (n)	UNK (n)	♀ (n)	♂ (n)	UNK (n)	♀ (n)	♂ (n)	UNK (n)
PRAIRIE CREEK									
1990-91	76 (24)	65 (29)	55 (9)	65 (24)	57 (31)	51 (4)	-	-	50 (10)
1991-92	55 (1)	-	70 (1)	50 (2)	43 (7)	35 (1)	70 (2)	70 (2)	60 (4)
1992-93	84 (28)	76 (19)	83 (7)	61 (9)	46 (22)	50 (7)	50 (1)	50 (1)	56 (8)
1993-94	83 (19)	75 (17)	58 (8)	66 (10)	64 (13)	59 (7)	59 95)	60 (4)	58 (24)
PRAIRIE CREEK WEIR (lengths measured)									
1990-91	83 (13)	67 (23)	-	66 (22)	61 (22)	-	-	-	-
1991-92	-	-	-	-	-	-	-	-	-
1992-93	88 (18)	-	-	65 (10)	-	-	-	-	-
1993-94	-	-	-	-	-	-	-	-	-
LOST MAN CREEK									
1990-91	-	-	66 (1)	-	-	54 (2)	-	-	47 (3)
1991-92	-	-	70 (1)	57 (6)	49 (23)	52 (9)	80 (1)	69 (4)	61 (21)
1992-93	-	-	-	60 (1)	50 (1)	-	70 (18)	67 (26)	62 (34)
1993-94	65 (2)	48 (2)	60 (1)	46 (2)	43 (2)	38 (3)	-	-	56 (109)
BRIDGE CREEK									
1990-91	70 (1)	55 (2)	70 (4)	-	-	-	-	58 (2)	58 (7)
1991-92	-	55 (1)	-	65 (1)	-	-	-	-	65 (7)
1992-93	80 (3)	90 (1)	-	-	-	-	-	52 (8)	-
1993-94	80 (6)	62 (3)	89 (10)	-	-	30 (2)	-	-	35 (1)

TABLE C-15: AVERAGE ESTIMATED LIVE SALMONID FORK LENGTH (cm) SPAWNING YEARS 1990-91 THROUGH 1993-94

SPAWNING YEAR	KING (n)			COHO (n)			STEELHEAD		
	♀ (n)	♂ (n)	UNK (n)	♀ (n)	♂ (n)	UNK (n)	♀ (n)	♂ (n)	UNK (n)
TOM McDONALD CREEK									
1990-91	-	-	-	-	-	-	-	-	-
1991-92	-	-	-	-	-	-	-	-	-
1992-93	-	-	-	-	-	-	-	-	-
1993-94	-	-	-	50 (1)	-	30 (1)	-	-	-

TABLE C-16: AVERAGE SALMONID CARCASS FORK LENGTH (cm) SPAWNING YEARS 1990-91 THROUGH 1993-94									
SPAWNING YEAR	KING (n)			COHO (n)			STEELHEAD (n)		
	♀	♂	UNK	♀	♂	UNK	♀	♂	UNK
PRAIRIE CREEK									
1990-91	82 (18)	69 (8)	75 (2)	68 (5)	66 (8)	55 (2)	-	-	-
1991-92	-	72 (3)	-	69 (2)	56 (5)	-	80 (1)	70 (1)	-
1992-93	90 (35)	91 (43)	89 (6)	63 (2)	53 (13)	54 (2)	-	-	-
1993-94	87 (10)	91 (6)	84 (2)	62 (3)	71 (4)	-	-	-	-
LOST MAN CREEK									
1990-91	79 (6)	85 (2)	-	67 (5)	58 (11)	60 (1)	-	-	76 (1)
1991-92	77 (1)	100 (1)	-	63 (9)	61 (6)	-	-	73 (4)	65 (2)
1992-93	-	97 (2)	-	-	49 (1)	-	-	84 (4)	-
1993-94	66 (4)	67 (2)	-	67 (1)	58 (1)	-	68 (2)	65 (2)	-
BRIDGE CREEK									
1990-91	75 (1)	95 (1)	-	-	-	-	-	-	-
1991-92	94 (1)	95 (1)	-	-	-	-	-	55 (1)	-
1992-93	-	-	-	-	-	-	-	-	-
1993-94	-	-	-	-	-	-	-	-	-
TOM McDONALD CREEK									
1990-91	-	-	-	-	-	-	-	-	-
1991-92	-	-	-	-	-	-	-	-	-
1992-93	-	-	-	-	-	-	-	-	-
1993-94	-	-	-	-	-	-	-	-	97 (1)