

-3-00

Redwood Creek Basin 1998-1999

Spawning and Carcass Survey

Annual Progress Report

Prepared by: Baker Holden III (NPS Fishery Biologist) 11/99

Fish and Wildlife Branch
Division of Resource Management and Science
Redwood National and State Parks

Introduction

The Redwood Creek winter spawning and carcass survey is a long-term monitoring project. Although in recent years survey effort has decreased, the surveys determines presence or absence of adult salmonids and redds in index streams, timing of runs, distribution of spawning salmonids within the streams and any migrational barriers, size and sex ratio of returning spawners, and obtain information on redds characteristics..

Study Location

The three creeks surveyed were Lost Man Creek, Bridge Creek and Prairie Creek, for the 1998-99 spawning season. Lost Man Creek is a Sixth order tributary, which flows into Prairie Creek approximately five road kilometers north of the town of Orick, California in Humboldt County (Figure 1). It is located within the National Park unit of Redwood National and State Parks. The 32.1 km² basin has an average stream gradient of 0.01 on the lower portion of the creek. The reach on Lost Man Creek began at the confluence of the creek with Prairie Creek and continued upstream for 2.7 km to the second of the "double bridges" where Holter Roadhike-hike trail crosses Lost Man Creek (Figure 1). Bridge Creek, the fourth largest tributary of Redwood Creek, is 12.9 km in length with a 29.52 km² watershed. The watershed is entirely within the Redwood National Park unit

NMFS Santa Cruz
Collection

Bill Jong
California Department of Fish & Game
North Coast California Coho Salmon
Investigation
5341 Erickson Way
Arcata, California 95521

Date received: 6/02/02
Received from: D. ANDERSON
Received by: B. SPENCE

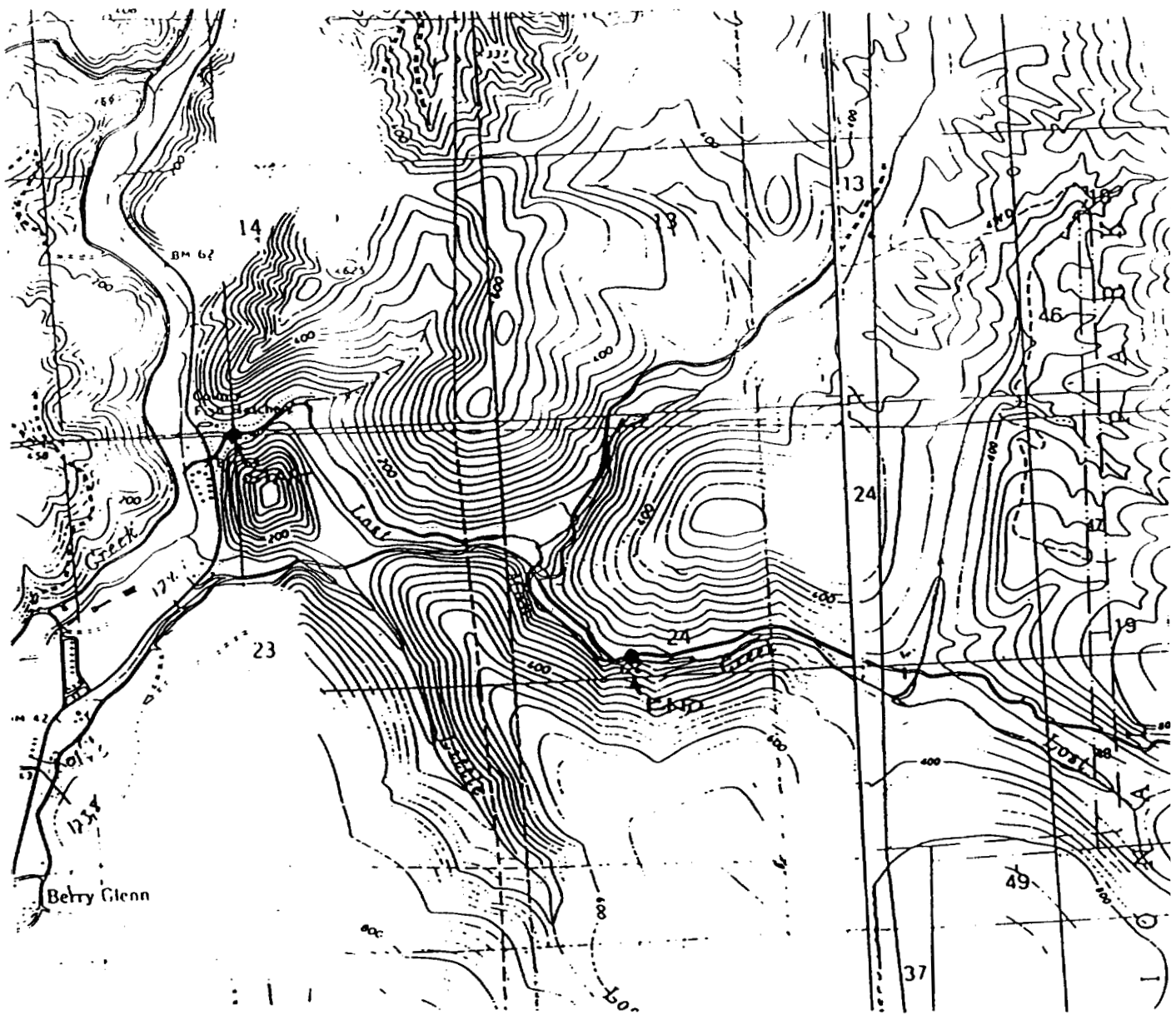


Figure 1 Lost Man Creek, Humboldt County, California (USGS 7.5' Orick Quad).

BRIDGE CREEK STUDY REACH

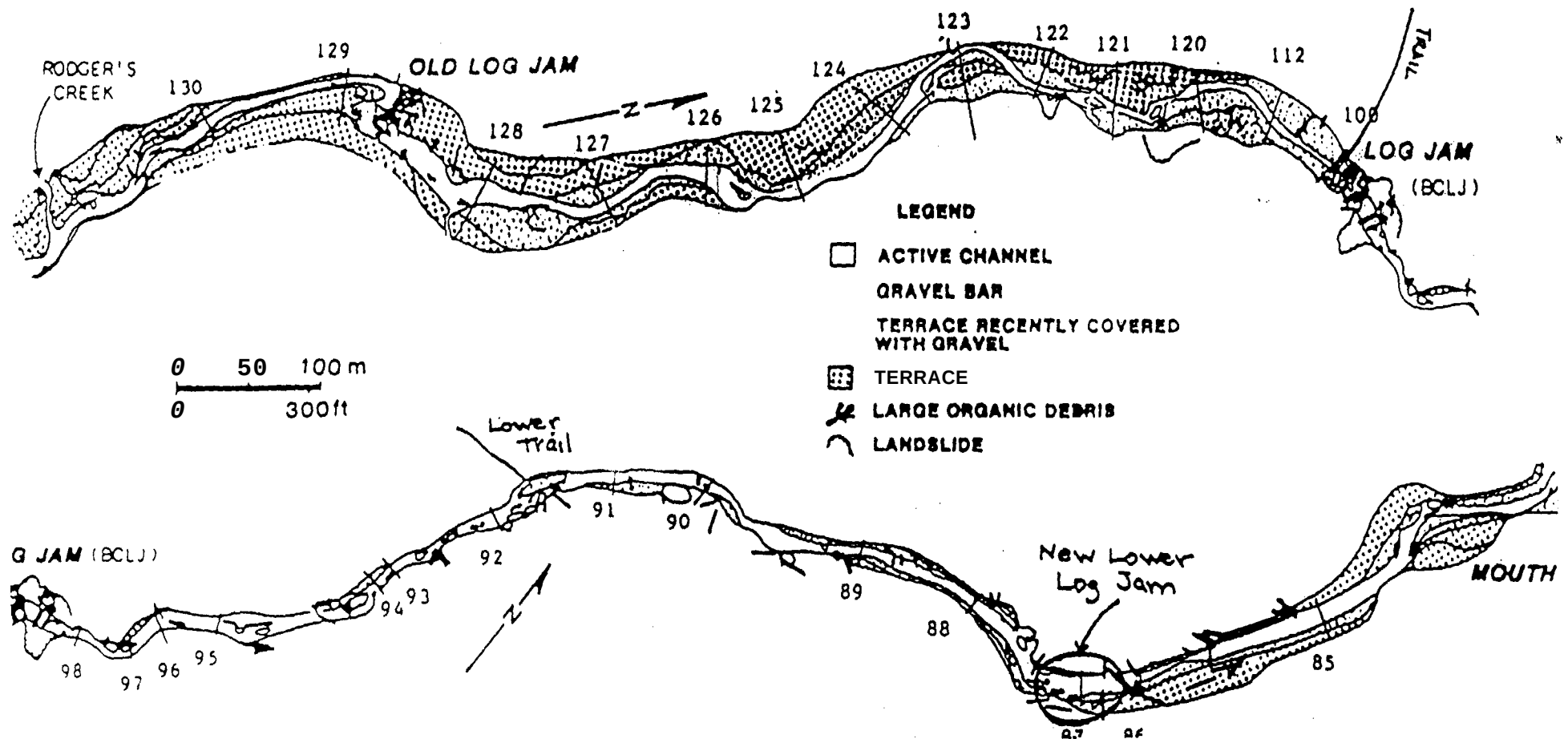


Figure 2. Bridge Creek spawning survey reach, Humboldt County, California. Survey reach for 1997-98 was from the confluence with Redwood Creek to cross section #126 above the log jam (BCLJ). (R. Klein RNP map)

of RNSP. Most hillsides adjacent to the creek channel were logged **prior** to **1978**, with the exception of the lower quarter mile of creek. The remaining parts **of** the Bridge Creek Log Jam (BCLJ), located **1.3 km** upstream from the confluence **of** Redwood Creek, was removed by natural means during very high winter flows in **1998-99**. The reach surveyed in **1998-99** was **from** the confluence at Redwood Creek to cross-section 126, a total distance of **1.8km** (Figure 2).

Prairie Creek a seventh order tributary and largest tributary to Redwood Creek has an area of 104km^2 , and exhibits gentler hillslope gradients and a regolith that **is** less susceptible to erosive processes. Humboldt State University Fisheries Department graduates students and technicians monitored Prairie Creek within **Prairie** Creek Redwoods State Park, including spawning surveys. The surveys were **part** of a coho study funded by the National Marine Fisheries Services under the direction **of** Dr. Walt Duffy.

Methods

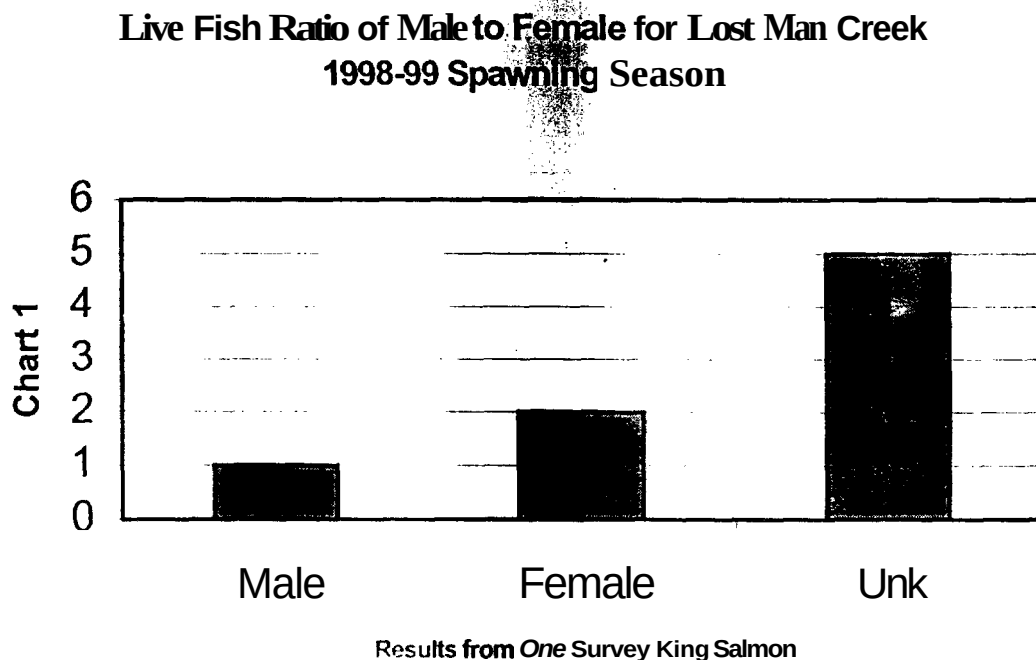
Methods **used** are detailed in the **1991-1992** annual spawning report (Anderson and McGuire 1994). Briefly, while walking upstream, the surveyors visually inspect the stream for live salmonid spawners, carcasses, and redds. Survey conditions; water visibility, estimated stream flow, and water and air temperature are recorded. The location of each fish, carcass, and redds are recorded along with other pertinent information on data sheets. Species, sex, fork length in centimeters, location, spawning condition, presence of tags **or** fin clips recorded for carcasses, scale samples taken, and the carcasses flagged with biodegradable flagging. Species, sex, estimated fork length, and location are recorded for all adult live fish, as well as spawning behavior. Redds

dimensions are measured, length and width in meters, enumerated, and location recorded. Redds locations are flagged to avoid recounting **on** subsequent surveys. **Also** noted are any apparent barriers to fish migration and new landslides.

Results

Lost Man Creek

Only one survey was done, on January 7, 1999, eight live Chinook salmon were counted. Eighteen Chinook carcasses were counted. **Thirteen** definite redds were counted and measured. Seven of the redds were single redds, **five** were double adjoining or superimposed redds and **for** one redd it **was** unclear whether or not it was a single redd **or** a superimposed redd. Lost **Man** Creek was **surveyed** from its **mouth** to the double bridges. See Chart 1-4.



Carcass Ratio of Male to Female King Salmon for Lost Man Creek 1998-99 Spawning Season Chart 2

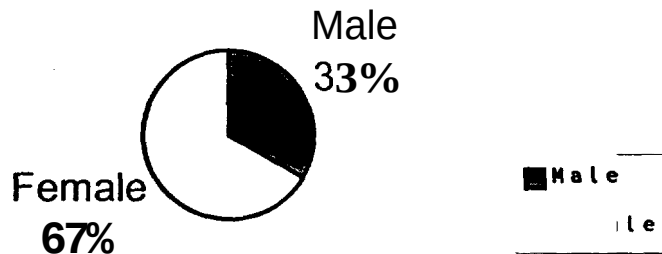


Chart 3. Mean fork length (cm). standard deviation (Std. Dev.) of live and dead spawners Observed during 1998-99 surveys of Lost Man Creek within Redwood National Park, Humboldt County, California. Surveys were conducted from the mouth of Lost Man Creek to the double bridges.

Lost Man Creek 1998-99							
Live Fish				Carcasses			
No.	Sex	Estimated Mean Fork length (cm)	Std. Dev (cm)	NO.	Sex	Estimated Mean Fork length (cm)	Std. Dev (cm)
Chinook Salmon							
0	F	---	---	12	F	86	10
1	M	75	---	6	M	82	15
				20	ALL	85	---
UKN SPECIES							
2	F	70	14	No unknown carcasses were found			
5	UKN	73	15				

*,

Chart 4. Length and Widths (m) of single and multiple redds observed during the 1998-99 surveys of Lost Man Creek.

	No.	Mean Lengths L x W	Area m ²
Single Redds	7	2.69 x 1.43	3.85
Multiple Redds	6	4.65 x 3.37	15.67

Bridge Creek

Bridge Creek was surveyed once, on March 16th 1999, during this survey, no fish or redds were found. **The** only significant data recorded was the absence of the Bridge Creek **Log** Jam (BCLJ) located 1.3km upstream from the confluence of Redwood Creek. The stream now **flows** at the proper grade, leaving the remaining portions of the BCLJ high and dry.

Prairie Creek Basin

An interim report **on** the results of **the** spawning surveys in the Prairie Creek has been received from Humboldt State University. See Attached in Appendix 1 is the interim report to NMFS (Duffy et al 1999) detailing spawning results.

Discussion

Chinook and coho salmon, and steelhead are present in and spawning in Lost Man Creek, and **are** migrating upstream of the Prairie Creek Hatchery dam. Bridge Creek has only one logjam that can be considered a partial migrational barrier. More systematic **surveys** must be conducted to make this study more meaningful, with the recent hiring of new employees Redwood National and State Parks survey efforts should increase greatly

References

Anderson, D. and H. McGuire. 1994. Redwood Creek basin 1991-1992 spawning and carcass survey. **Annual** Progress Report. Redwood National Park, Orick, California 33pp.

Appendix 1

References

Duffy, D., USGS California Cooperative Fisheries Research Unit, Hankin, **D. and** Roelofs, T., Fisheries Department, Humboldt State University. Coho salmon survival in Northern California streams **of** varying habitat quality Interim Report.

Adult coho salmon studies

Escapement spawning

We surveyed each stream reach for returning adult coho salmon, **and other** salmon species, beginning on **1** December 1998 and continuing until no fish had been observed for 2 consecutive weeks (3 March 1999). We observed 131 adult coho salmon during this period, 103 in Prairie **Creek**, 21 in Streelow Creek and 7 in Boyes Creek (**Figures 4 and 5**). However, **only 66** of the **103** fish recorded in Prairie Creek were **within** study the reach. **We** consider these **figures** to be minimal, since some fish that could **not** be identified in the field were likely **coho** salmon

A total of **24** redds were positively associated with coho salmon. Of this number, 11 were located in Prairie Creek (10 within the study reach), 8 were in Streelow Creek and 5 were located in Boyes Creek (Figures 6 and 7). Again, some redds listed **as of** unknown origin were likely constructed by coho salmon

Carcass surveys

Carcass surveys for coho and other salmon were conducted on each stream reach from 1 December 1998 through 3 March 1999. We found 33 coho salmon carcasses during this period. Of this total, 21 were found within and 6 were found outside the study reach of Prairie Creek (Figure 8). Six Salmon carcasses were also found in Streelow Creek (Figure 9). No coho salmon carcasses were found in Boyes Creek. Of the 27 coho salmon carcasses found in Prairie Creek, 13 were later recaptured (12 within the study reach). No coho salmon carcasses were recaptured in Streelow Creek.

Juvenile coho salmon Studies

Density

Juvenile coho salmon population surveys were initiated in October, following the completion of habitat typing. Juvenile population surveys were completed on Streelow and Prairie Creek. However, increasing discharge and decreasing visibility forced us to end fall surveys before completing Boyes Creek.

Habitat units were collapsed into pools, deep pools (>1.1m), runs, riffles, complex and other habitats for juvenile coho salmon surveys. Habitat units classified as complex or other units unsuitable for diver observations or electrofishing were excluded from juvenile surveys.

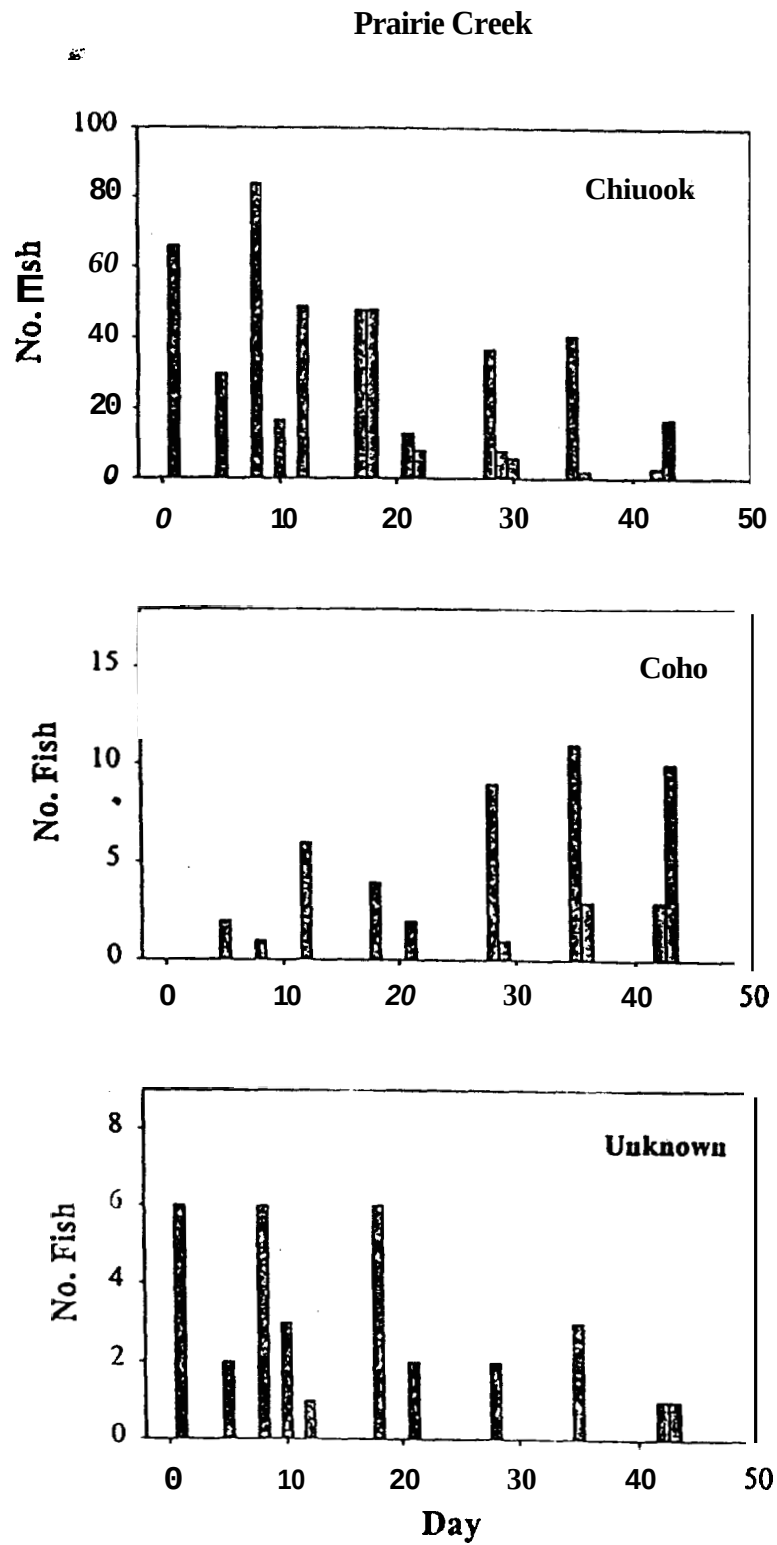
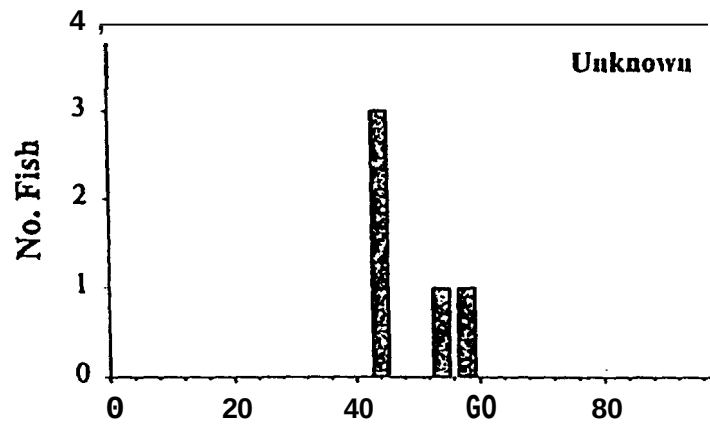
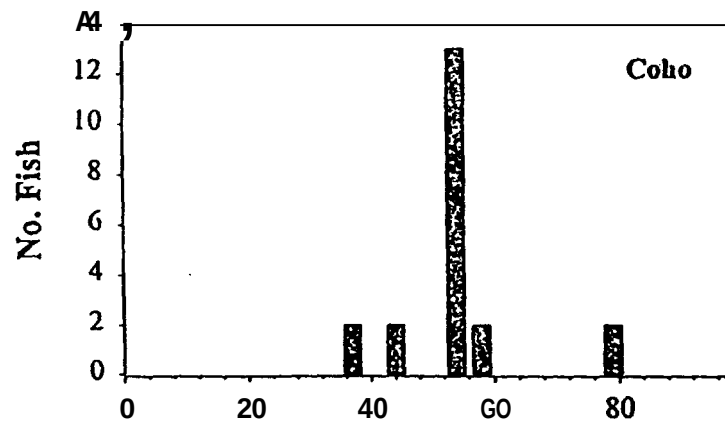


Figure 4. Number of adult chinook salmon, coho salmon and unidentified salmon or steelhead observed in Prairie Creek during weekly surveys during 1 December 1998 through 3 March 1999.

Streelow Creek



Boyes Creek

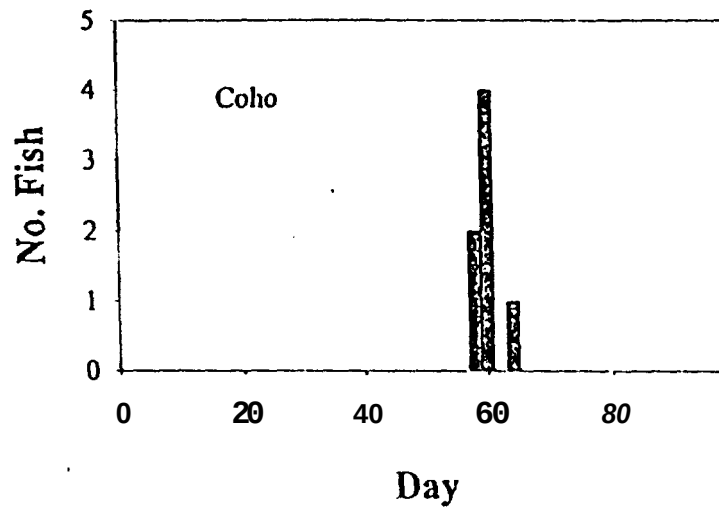


Figure 5. Number of adult coho salmon and unidentified salmon or steelhead observed in Streelow and Boyes Creeks during weekly surveys during 1 December 1998 through 3 March 1999.

Prairie Creek

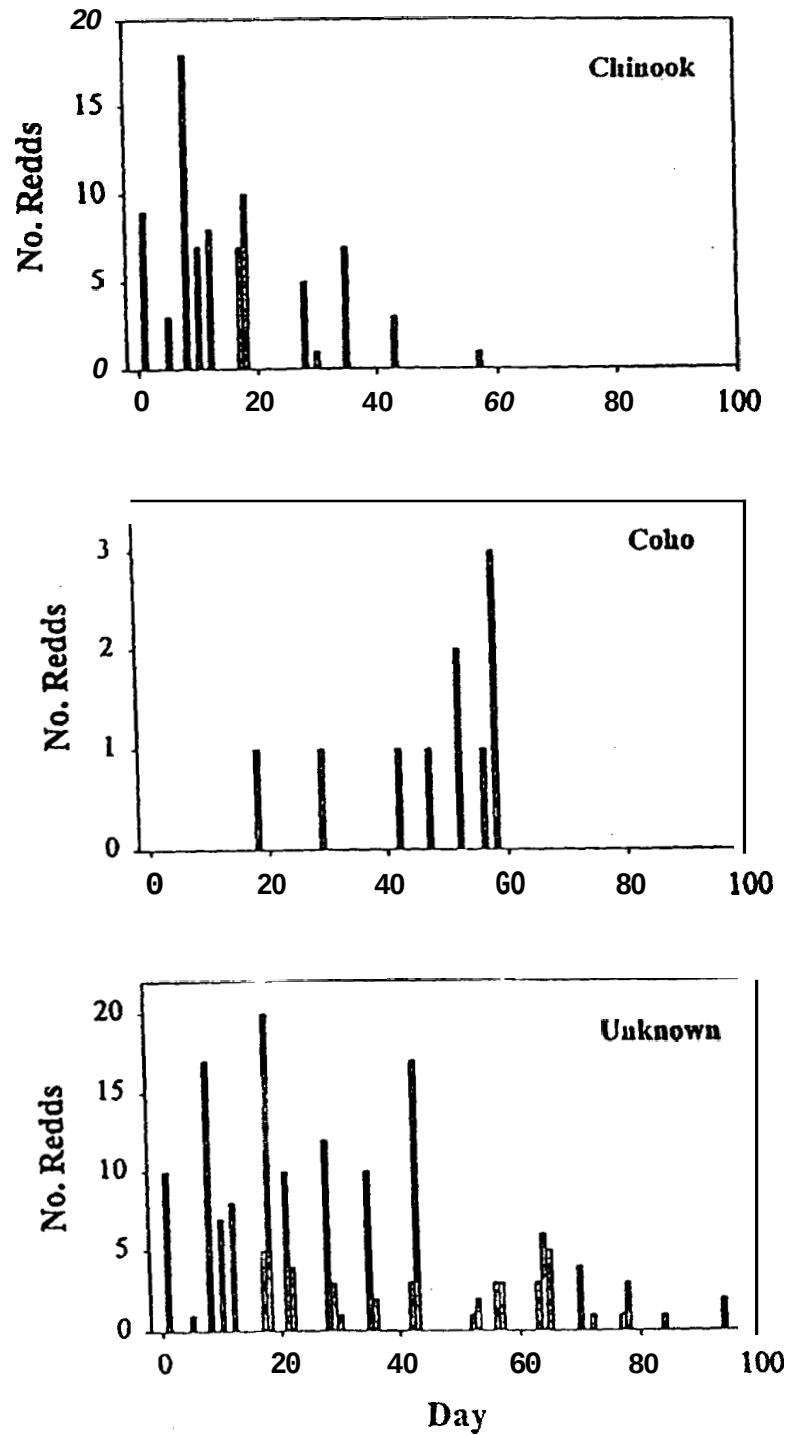


Figure 6. Number of chinook salmon, coho salmon and unidentified salmon or steelhead redds identified in Prairie Creek during weekly surveys during 1 December 1998 through 3 March 1999.

Streelow Creek

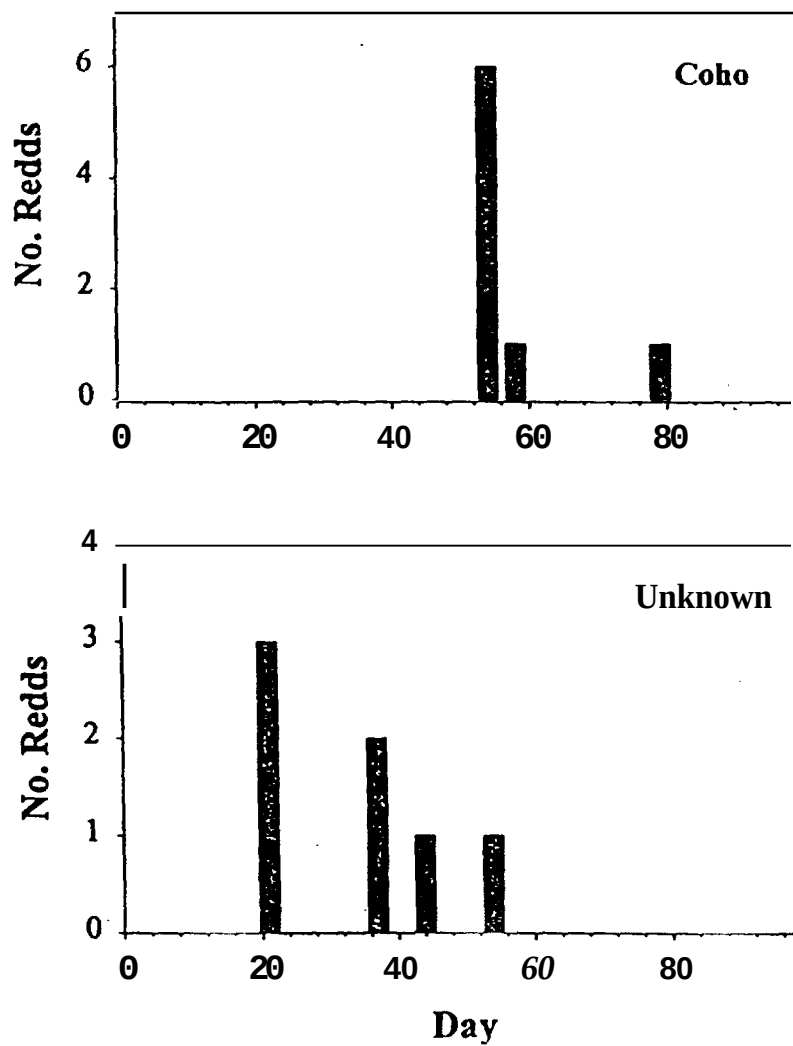


Figure 7. Number of coho salmon and unidentified salmon or steelhead redds identified in Streelow Creek during weekly surveys during 1 December 1998 through 3 March 1999.

Prairie Creek

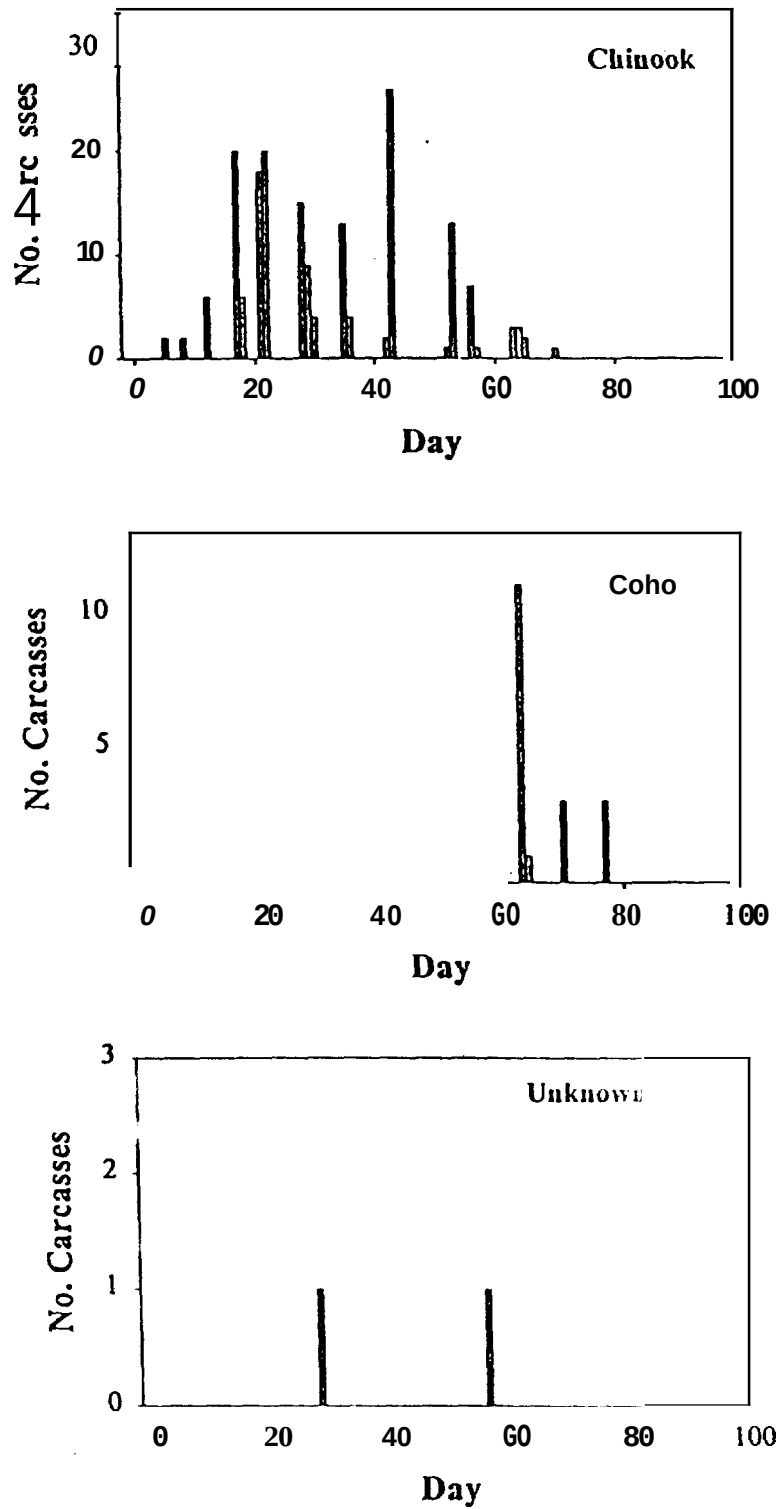


Figure 8. Number of chinook salmon, coho salmon and unidentified salmon or steelhead carcasses identified in Prairie Creek during weekly surveys during 1 December 1998 through 3 March 1999.

Streelow Creek

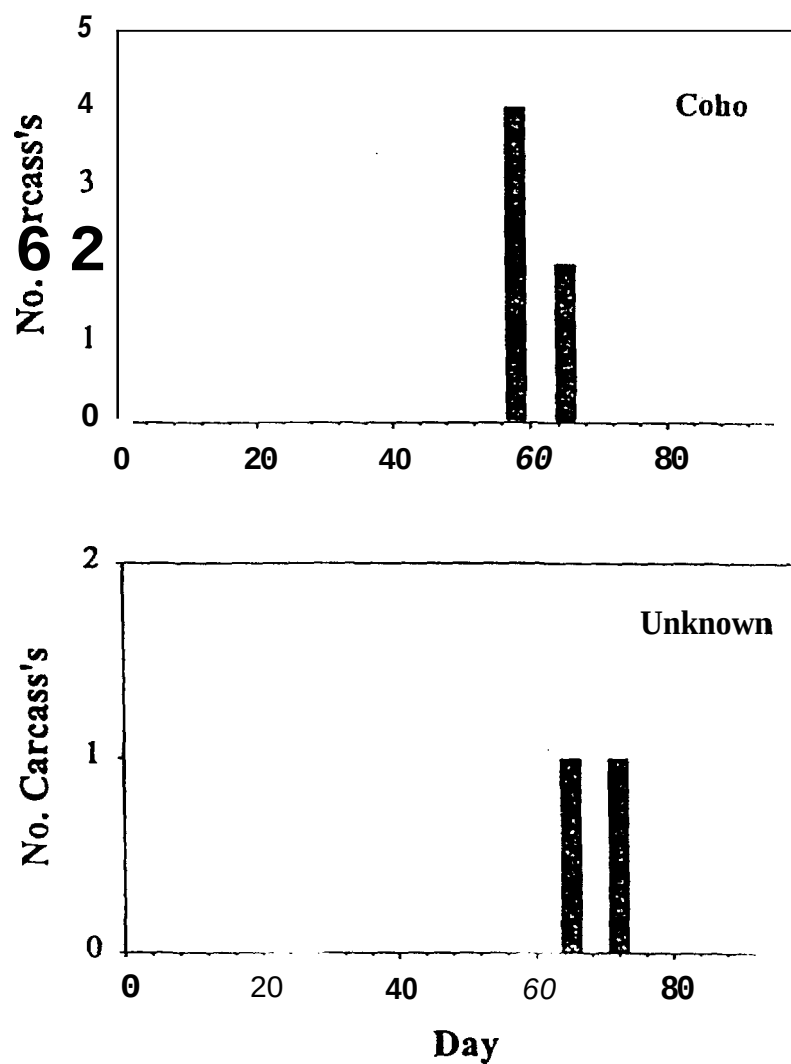


Figure 9. Number of coho salmon and unidentified salmon or steelhead carcass's identified in Streelow Creek during weekly surveys during 1 December 1998 through 3 March 1999.

A two-phase sequential random sampling design was used in selecting habitats for population surveys. Sequential independent sampling of units was used to select habitats **for** sampling. A probability of 0.5 **was** selected for phase I sampling, while a probability **of** 0.25 was selected **for** phase II sampling. In Prairie Creek, phase I sampling units were sampled using single-pass diver observation counts. In phase II sampling units, the method **of** bounded counts, based on **four** independent diver counts, was used **if** phase I diver counts were ≤ 30 coho salmon. **If** diver counts were > 30 coho salmon, depletion removal electrofishing **was** used to sample. In addition, pools > 1.1 m deep were sampled using diver observations only **and** every 12th rime was sampled using electrofishing.

Streelow Creek **was** sampled using three-pass removal electrofishing of phase II sampling units. Every 12th rime habitat **was** also sampled using electrofishing. Deep pool and complex habitats were not sampled since tannins reduced visibility and reliability of diver observations.

We sampled **2.2 km** of Streelow Creek, beginning at the streams confluence with Prairie Creek. Electrofishing **was** conducted on **12.6%** of pool, 19.6% of run and 6.5% **of** rime habitats (Table 1). Preliminary population estimates indicate 1,408 coho salmon inhabited Streelow Creek at the time. We consider this estimate low, since deep pool and complex habitats were not sampled. In 1999, we plan to sample before tannins are introduced to the stream and use diver observations within deep pool and complex habitats.

In Prairie Creek, we sampled **4.6 km** between 20 October and 4 November, 1998, before increasing discharge reduced visibility. We sampled 38.1% of pool, 49.2% of run **and** 33.0% of deep pool habitats using phase I dive surveys (Table 2). Phase II dive surveys were conducted on 5.6% of the pool and run habitats combined, while electrofishing was conducted on 3.1% of these two habitats.

Table 1. Habitat composition, habitats surveyed **and** estimated number of coho salmon in Streelaw Creek, California during September 1998.

Habitat	Units Surveyed	Units Sampled	Estimated number of coho salmon
Pool	87	11	1,083
Run	56	11	325
Riffle	31	2	0
Deep pool	17	0	--
Complex	13	0	--
Other	1	0	--

Table 2. Habitat **composition**, habitats surveyed and estimated number of **coho** salmon in upper Prairie Creek, California during October 1998.

Habitat	Units Surveyed	Units Sampled phase I dives	units Sampled phase II dives	units Sampled electro- fishing	Estimated number of coho salmon
Pool	97	37	5	4	
Run	63	31	4	1	
Riffle	96	0	0	5	
Deep pool	12	4	0	0	--
Complex	28	0	0	0	--
Other	2	0	0	0	--

Habitat fidelity during winter

Although not included in our proposal, we felt that a better understanding of habitats used by coho salmon during winter **was** important to understanding survival. Therefore, we undertook a **mark** and recapture study of coho salmon in Prairie Creek only. Objectives of the study were to; **1)** measure microhabitat fidelity, **2)** determine survival of coho salmon in specific microhabitats, **3)** measure growth rates in specific microhabitats, **4)** assess movement between microhabitat **units** of coho salmon during the winter.

In November **1998** **fifty** microhabitats in a 5.5km reach of upper Prairie Creek were delineated as either **main** channel pools, backwaters, or alcoves. Between **15** November and 15 December 705 juvenile coho salmon from these habitat **units** were marked with passive integrated transponders (PIT tags). Length (FL), weight (nearest 0.1 mg) and

specific habitat unit was recorded for each fish **marked**. To **assess** fidelity and growth, we sampled each habitat unit in mid-January. Overall recapture rate during January was **30%** and ranged from 0% to 71% within individual habitat **units**. An additional **345** coho salmon were tagged during the January **re-visit**, resulting in a total sample of 1050 pit-tagged individuals. We re-sampled the population in late February, but data have not yet been summarized.

We **considered** the proportion of fish tagged in a microhabitat unit that were subsequently **recaptured** in the same unit to be a **measure of fidelity** as well as an indicator of **the** ability **of a** unit to **retain** juvenile **fish during** winter discharge. **Mean** recapture rates for main channel **pools** was 26.5%, in backwaters it was 31.1%, and in alcoves it was 46.3%.

Instantaneous growth rates were measured for coho salmon recaptured. Overall mean **instantaneous** growth rates was $0.00057 \text{ g} \cdot \text{g}^{-1} \cdot \text{day}^{-1}$. **Mean** growth in main channel pools was $0.00096 \text{ g} \cdot \text{g}^{-1} \cdot \text{day}^{-1}$, in backwaters mean growth was $0.00177 \text{ g} \cdot \text{g}^{-1} \cdot \text{day}^{-1}$ and in alcoves **mean** growth was $-0.00057 \text{ g} \cdot \text{g}^{-1} \cdot \text{day}^{-1}$.

Movement **of** coho salmon was estimated from recapture **data**. Twenty individuals were recaptured in **units other** than those they were tagged in. In all cases, movement was downstream and ranged from 4 – 3,433 m. The most frequent movement was from alcoves to main channel pools. **This was** due in part to some alcoves **drying** during a period of low discharge in late December.

On 21 November 1998, a 15-year **flood** occurred in the Prairie Creek watershed. Prior to the flood **209** coho salmon had been tagged. **This** provided the opportunity to examine survival and habitat fidelity during a flood. Rates of recapture following the **flood were** 15.8% in main channel pools, 47.2% in backwaters, and **41.8%** in alcoves. One alcove and one backwater were eliminated by channel migration, with only two individuals recaptured in a nearby backwater. Of the individuals in alcoves or backwaters before the flood, two were recaptured in a different habitat unit. **Six** individuals from main channel **pools** were recaptured in different habitat **units** after the flood. Five had moved to a backwater, and one was found in a main channel pool downstream.

As of 3 May 1999, **131** of these pit tagged coho salmon had been recaptured in the

fyke and screw traps. Six of these recoveries were in the stomachs of cutthroat trout. Although data gathered since 3 May have not been collated, we have collected > 10 pit tagged coho salmon on **two** dates **as** well **as** lesser amounts on other dates. Thus recapture rates are probably in the range of 15-20%.

Emergence

We placed net caps over **15** coho salmon **redds**, **5** in each stream, to estimate number of **fry** emerging **from** gravel. First emergence of **fry** in Prairie Creek redds occurred between **12 and 25 January**. In Streeflow Creek first emergence ranged **from** 23 **January** - 17 February, while in Boyes Creek it ranged **from** 27 **January** - 2 February. In Prairie Creek, number of **fry** emerging **from** redds averaged 889 (range **498** - 1,764) (Figure 10). Numbers emerging **from** redds in Streeflow and Boyes Creeks were less consistent and mean number emerging **was** less (Figure 10). Three of five redds in Streeflow Creek produced **fry**, but **only** one redd in Boyes Creek produced **fry**.

Preliminary analysis of **fry** emergence data suggests number of **fry** emerging may be related to position in the watershed (Figure 11). However, we caution that emergence continues at the time of **this** writing, and one redd produced the first **fry** on **14 May** (data not included in the above discussion).

Downstream migration

A screw trap and fyke net were installed in Prairie Creek in early February. The **fyke** net **was** located at the lower end of the study reach while the screw trap was located at the confluence of Streeflow Creek. A **fyke** net was also install in Streeflow Creek and a pipe trap in Boyes Creek in late February. Traps on Prairie Creek have been fished continuously since installation, except for periods of **high** discharge. Traps in both Streeflow and Boyes Creeks suffered damage during discharge events, but both have been fished intermittently since installation.

Through 3 March, a total of 12,372 coho salmon had been captured in traps (Table 3). Most (83.3%) of these fish were captured in Prairie Creek traps. Most age 0+ coho were collected in the Prairie Creek fyke net, but **- 2,000** were also collected in both the

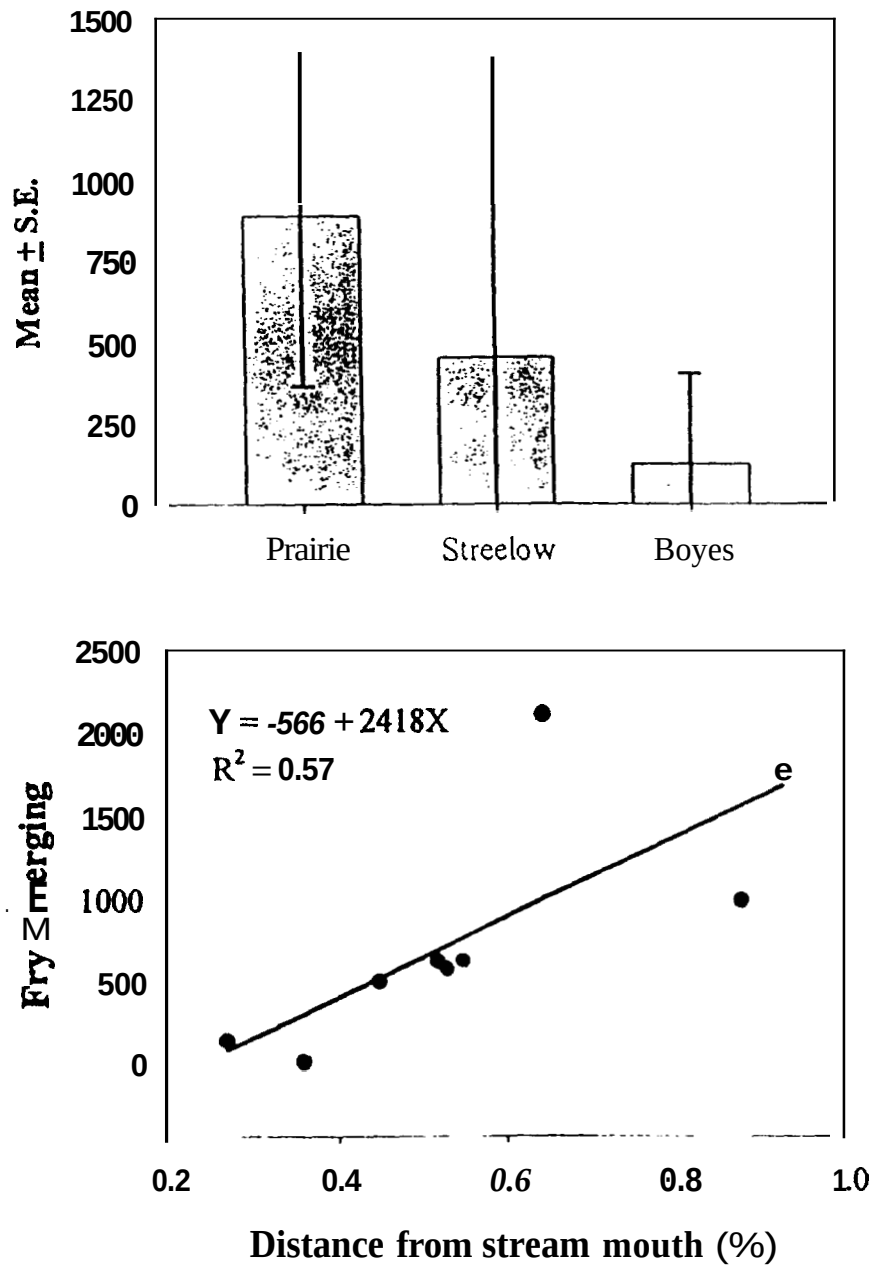


Figure 10. Top - **Mean** (+ S.E.) number of coho salmon fry emerging from redds in Prairie, Streelow and Boyes Creeks through 14 May 1999. Bottom - Results of linear regression of number of coho salmon fry emerging from redds **vs.** position of the redd in the watershed (% distance from bottom of study reach).

Table 3. **Number** of juvenile Salmonidae collected from Prairie, Streeflow and **Boyes Creeks** through 3 March 1999.

Species	Prairie Creek screw trap	Prairie Creek fyke net	Streeflow Creek fyke net	Boyes Creek pipe trap
Coho 0+	1,907	6,813	2,033	8
Coho 1+	1,129	468	7	7
Chinook 0+	41,387	95,192	321	2
Cutthroat	264	339	2	4
Steelhead	198	20	0	5
Trout 0+	4	34	27	0
Trout 1+	496	78	1	7

Prairie **Creek screw trap** and Streeflow Creek fyke net. Most age 1+ coho salmon were collected in the screw trap. Few of any species have been collected from Boyes Creek.

Timing of capture of age 0+ coho salmon in Prairie Creek suggests downstream migration. The first pulse of 0+ coho salmon was noted at the fyke net in early March 10-15 days before arriving at the downstream screw trap (Figures 11, 12). Pattern of movement in age 1+ coho salmon was similar between traps and also staggered 10-15 days. We will continue operating traps until downstream movement of coho salmon appears to cease, probably early June.

Size of age 1+ coho salmon increased weekly throughout spring (Figure 13). Mean size of fish in early February was ~ 70 mm (FL) and increased to ~ 90 mm by early May. We attribute a decrease in the size of fish in trapping week 11 to variability in movement of fish because of low discharge. Weight of age 1+ coho salmon collected from Prairie Creek has ranged from ~ 1.5 - 19.0 g wet weight (Figure 13). This length-weight relationship will be refined as more data are gathered.

Prairie Cr. Fyke

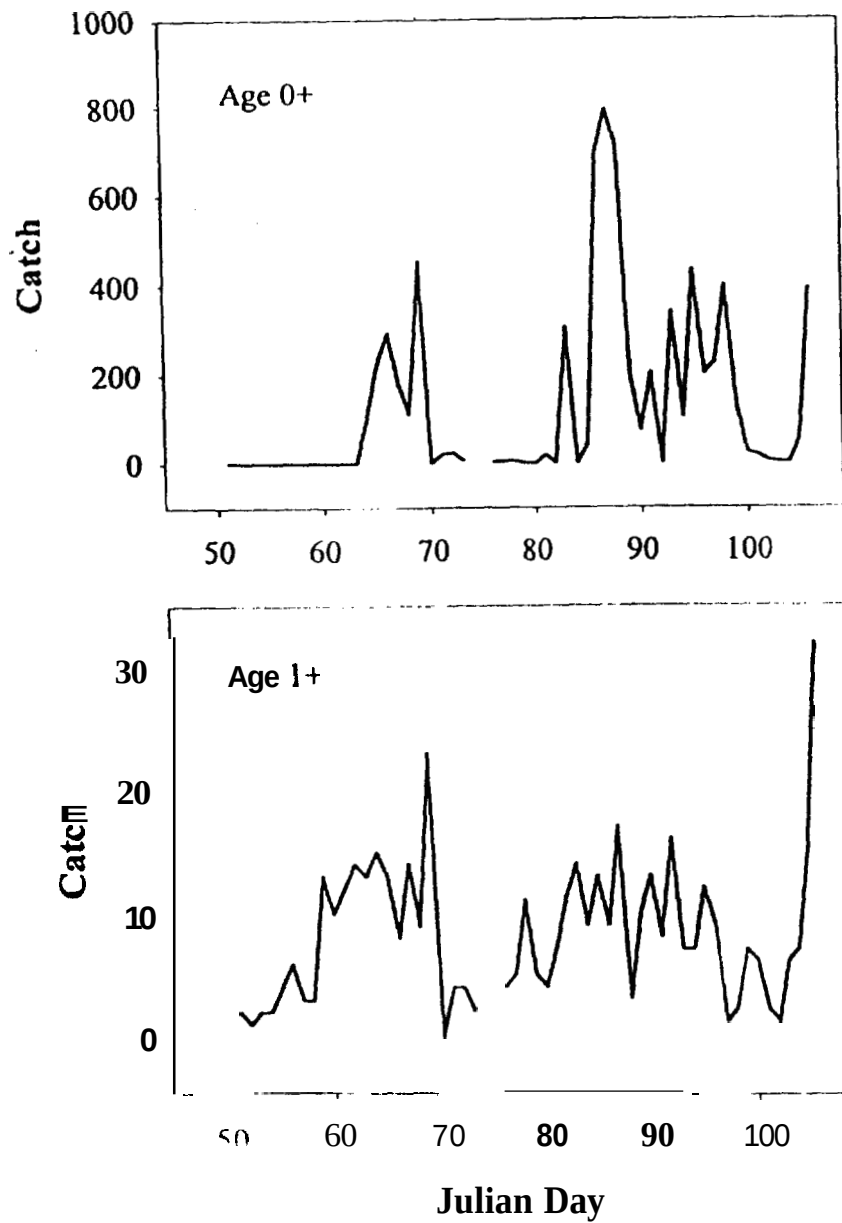


Figure 11. Number of age 0+ and 1+ coho salmon collected from the fyke trap on Prairie Creek.

Screw Trap

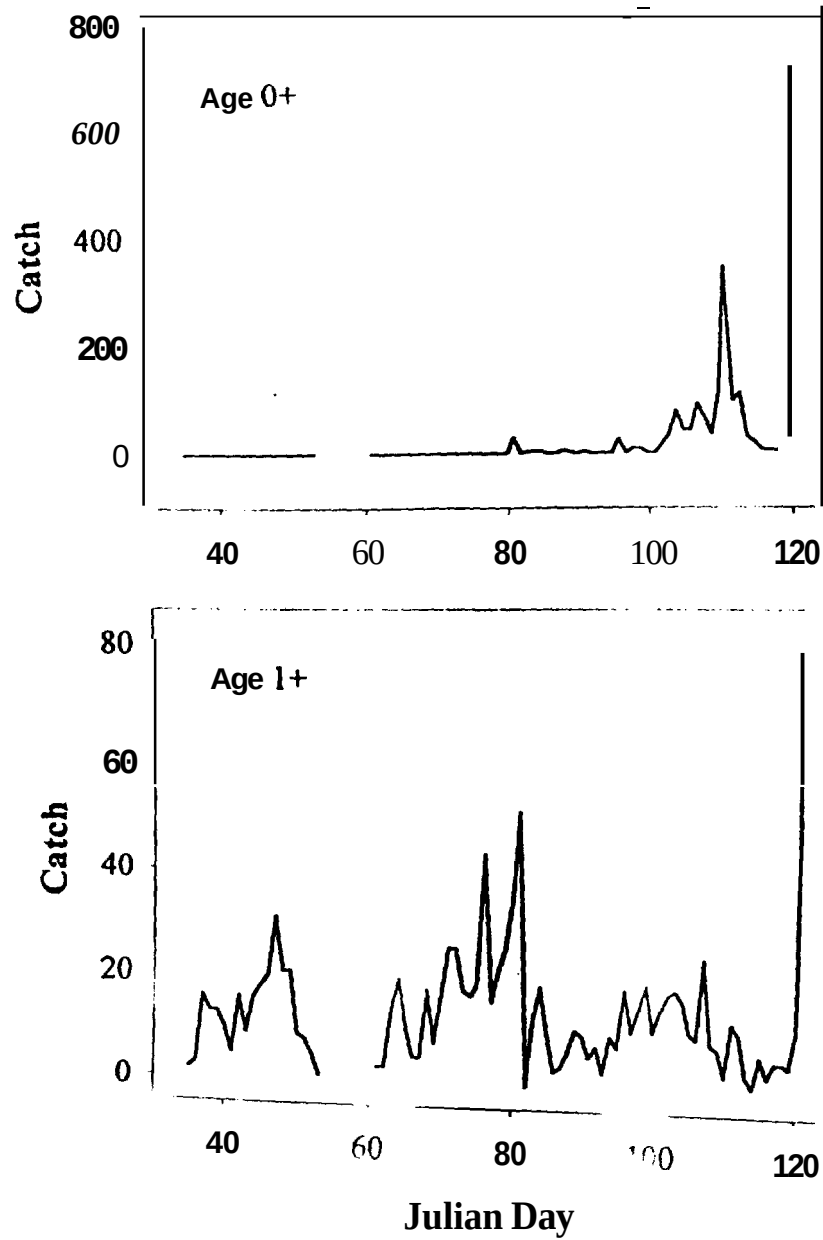


Figure 12. Number of age 0+ and 1+ coho salmon collected from the screw trap on Prairie Creek.

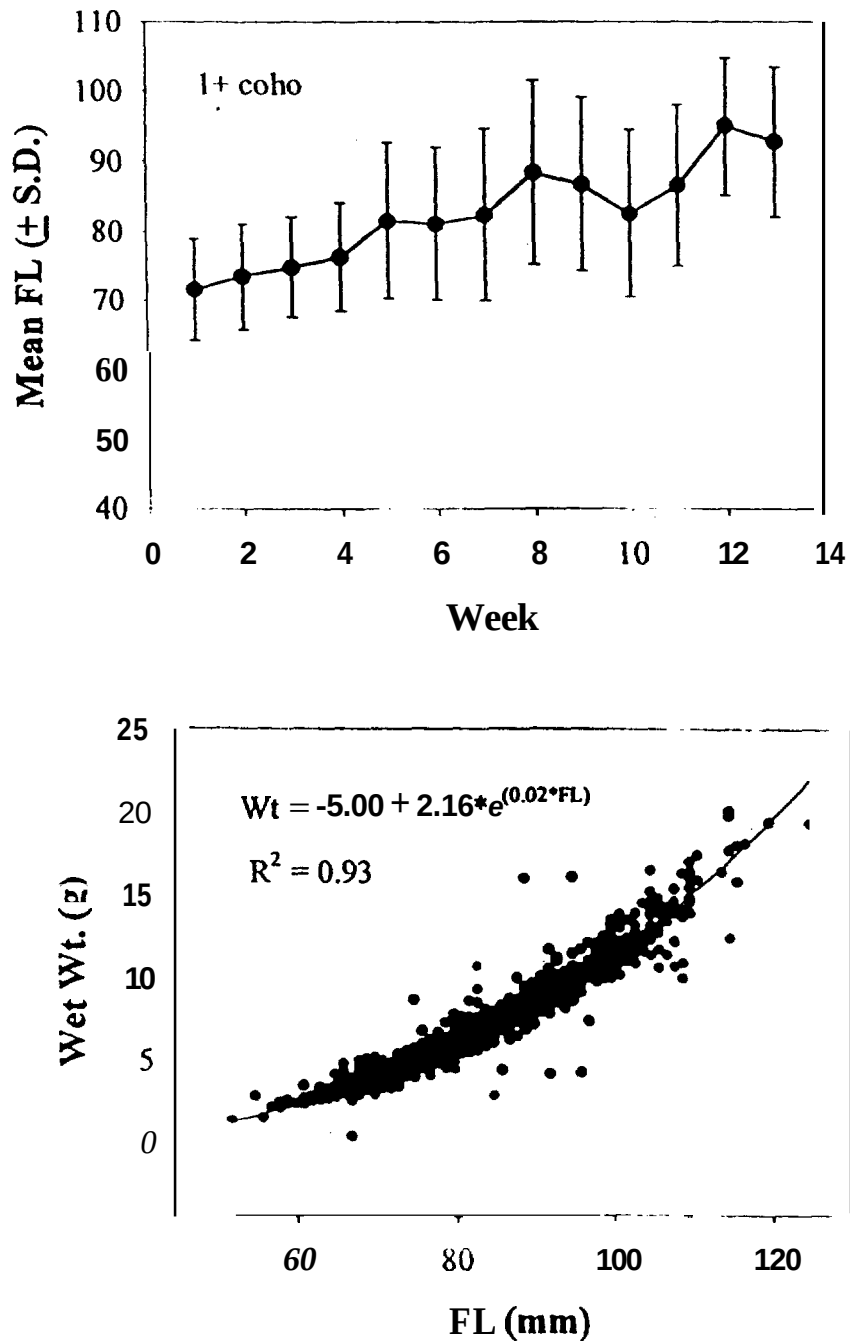


Figure 13. Top - Weekly mean size (FL) of age 1+ coho salmon collected from the screw trap on Prairie Creek, error bars are one standard deviation. Bottom - Length -- weight relationship for age 1+ coho salmon collected from the screw trap and fyke trap on Prairie Creek.

Cutthroat predation

In March **1999**, we began evaluating the diet of cutthroat trout, and larger fish of other species, collected in traps. Sampling will continue through May. These data are intended to provide preliminary information on within trap predation. **Our** preliminary data suggest cutthroat trout captured in traps may inflict substantial predation mortality on juvenile **chinook** and coho salmon. Number of juvenile salmon eaten **by** cutthroat trout in traps **increases** with the size of trout (Figure 14). Furthermore, number of juvenile salmon **eaten by** cutthroat trout in traps is qualitatively greater **than the** number eaten by trout ranging free in Prairie Creek (Figure 15). While **these** data are **a** cause for concern, they are also preliminary **and** we don't wish to overstate the relationships presented before **further** investigation **and** analysis are completed.

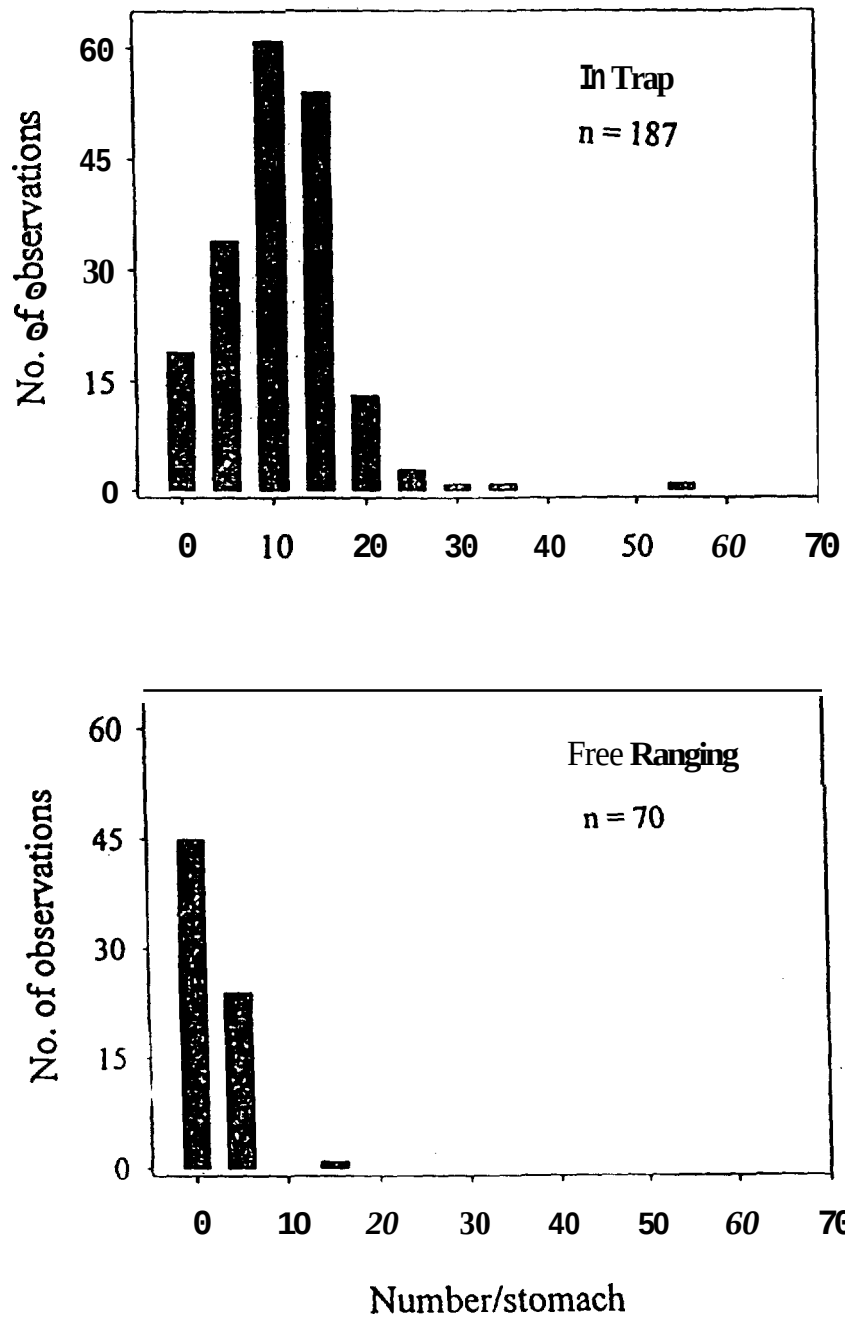


Figure 15. Frequency distribution of number of salmon fry per cutthroat trout stomach from fish in traps (top) and free ranging fish in Prairie Creek.