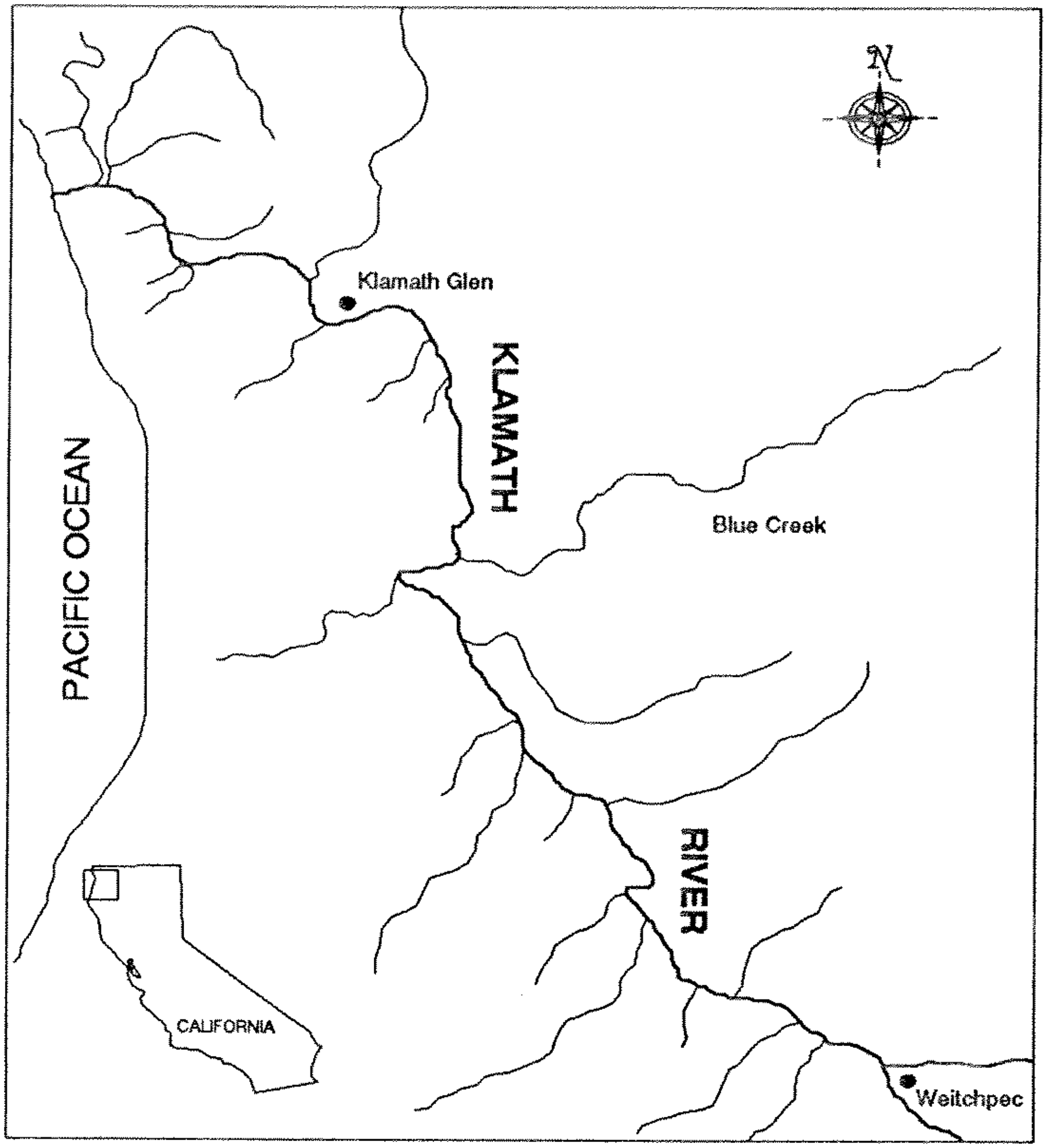
KLAMATH RIVER FISHERIES ASSESSMENT PROGRAM

INVESTIGATIONS ON THE LOWER TRIBUTARIES TO THE KLAMATH RIVER

Annual Progress Report FY 1991
February 1992



Coastal California Fishery Resource Office
Arcata, California
Western Region

91(FP-3)

PROGRESS REPORT FOR

INVESTIGATIONS ON THE LOWER TRIBUTARIES

TO THE KLAMATH RIVER

FY 1991
Third year of Investigations

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Funded by the
Klamath River Basin Fisheries Task Force

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DISCLAIMER

TABLE OF CONTENTS

List of Tables

Table

List of Figures

Figure

List of Appendices

Appendix

PROGRESS REPORT FOR

INVESTIGATIONS ON THE LOWER TRIBUTARIES TO THE KLAMATH RIVER

Third Year of Investigations - FY 1991

ABSTRACT

The U.S. Fish and Wildlife Service at its Coastal California Fishery Resource Office (CCFRO) in Arcata, CA, was funded by the Klamath River Basin Fishery Task Force to investigate chinook salmon (Oncorhynchus tshawytscha) spawning use, juvenile production, habitat availability, and determine abundance indices for salmonid species in tributary streams to the Klamath River downstream of the Hoopa Valley Indian Reservation. Investigations began in October, 1988, and continued through July of 1991. Existing spawning ground surveys, cursory habitat inventories, accessibility, and historical records were used to prioritize streams for intensive investigations.

In the spring of 1991, during the fifth year of a drought, six streams (High Prairie, Tarup, Ah Pah, Surpur, Mettah, and Roach creeks) were selected, to define adult spawning usage, juvenile emigration and production, and stream habitat conditions. Adult salmonid surveys of Ah Pah Creek found 6 redds with steelhead (O. mykiss) adults in the vicinity, 1 coho salmon (O. kisutch) jack and 1 coho adult carcass. In Roach Creek a chinook redd was found, and on subsequent surveys, this redd was superimposed by other spawning adults. A spring survey by the California Department of Fish and Game (CDFG) reported finding 6 cutthroat trout (O. clarki) redds on Tarup Creek (J. Schwabe, CDFG, per. com.). No chinook and steelhead redds or adults were found on High Prairie, Surpur, or Mettah creeks.

In 72 nights of outmigrant trapping, only 7 chinook juveniles were captured in the streams sampled. Eighty two coho yearlings were captured in Ah Pah Creek with one peak occurring in early April and a second smaller peak during late May-early June. In Roach Creek 37 coho were sampled throughout the trapping period. Steelhead fry were the dominant catch (127) in Roach Creek with peak outmigration occurring in late May to early June. Yearling steelhead outmigration peaked in mid-April in Mettah and Roach Creeks (82 and 45, respectively). One chum salmon (O. keta) fry was captured in Mettah Creek. Cutthroat trout yearlings dominated the catch in Tarup Creek (55), with peak emigration occurring in early April.

Extrapolation of trapping totals resulted in juvenile estimates of 40 chinook, 939 coho, 751 steelhead fry, 1,383 steelhead yearlings, 539 cutthroat trout, and 7 chum salmon fry emigrating from the six sampled creeks between late March and early July. Since these totals were derived from six creeks, salmonid production appears to be considered critically low in these lower tributaries to the Klamath River.

Habitat inventories covered 4.25 river kilometers (rkm) of High Prairie Creek, 8.5 rkm of Tarup Creek, 6.5 rkm of Ah Pah Creek, 4.0 rkm of Surpur Creek, 3.5 rkm of Mettah Creek, and 4.0 rkm of Roach Creek. Relative to other lower tributary streams, High Prairie Creek contained moderate (between 25-50% of areas inventoried contained suitable rearing habitat) rearing and minimal (<25% of areas inventoried contained adequate spawning conditions) spawning habitat, with several large woody debris barriers beginning at rkm 2.0. Tarup Creek is the last stream to open for adult immigrations and the first to go subsurface, thereby blocking juvenile emigrations. Rearing and spawning habitat in Tarup Creek was in moderate condition (between 25-50% of areas inventoried contained adequate rearing or spawning habitat). The spawning habitat in Ah Pah Creek was embedded and in poor (minimal) condition, with rearing habitat in moderate order. Surpur Creek held moderate spawning and rearing habitats with a barrier obstructing immigrations at rkm 1.4. Poor spawning conditions were found in Mettah Creek and rearing habitat was in moderate abundance. A low flow barrier at the mouth and at rkm 1.8 may impede immigrations up Mettah Creek. Rearing habitat was excellent (>50% of areas inventoried contained suitable rearing habitat) in Roach Creek, but spawning habitat was scarce in the surveyed reaches. Several boulder obstacles hamper immigration up the lower 4.0 rkm of Roach Creek.

Recommendations for stream improvements should begin with a monitoring and modification program for stream mouths which are immigration barriers in early fall. This includes Surpur and Mettah creeks, and other lower tributaries not covered in this report. Barriers and immigration obstacles should be removed or modified in Salt Creek (rkm 1.1 and 1.2), High Prairie (beginning at rkm 2.0), Ah Pah (rkm 4.9, 5.16, and 5.85), Surpur (rkm 1.4), Mettah (rkm 1.82), and Roach (rkm 0.3 and 1.6) creeks. In Surpur and Mettah creeks the addition of spawning gravel retention structures could aid in salmonid production.

INTRODUCTION

The 1990 fall chinook salmon run into the Klamath River was the smallest recorded run since 1978, when annual basin wide figures began to be tabulated by the California Department of Fish and Game (CDFG). The declining runs of chinook salmon, coho salmon, steelhead trout, and cutthroat trout in the Klamath River basin (Basin) is of major concern to all fisheries involved. These declines have accelerated during recent decades concurrent with increased demands for timber, fish, land, and water resources. In response, Congress enacted P.L. 99-552, the Klamath River Basin Fishery Resources Restoration Act on October 27, 1986, which authorizes the Secretary of the Interior to restore Basin anadromous stocks to "optimum" levels through management and restoration of anadromous species and their habitats under guidance by the Klamath River Fishery Management Council and the Klamath River Basin Fishery Task Force (KRBFTF).

In 1988, the Coastal California Fishery Resource Office (CCFRO) in Arcata, CA, submitted a proposal to the KRBFTF to gain initial funding for investigations on tributaries to the Klamath River downstream of its confluence with the Trinity River (Figure 1). These investigations were designed to continue until 1993 and are needed to supplement information collected by the CDFG on natural production of chinook salmon in the Basin, to confirm the contributions by these tributaries toward basinwide chinook production, and to provide data necessary for informed decisions to be made on restoration efforts within the Basin.

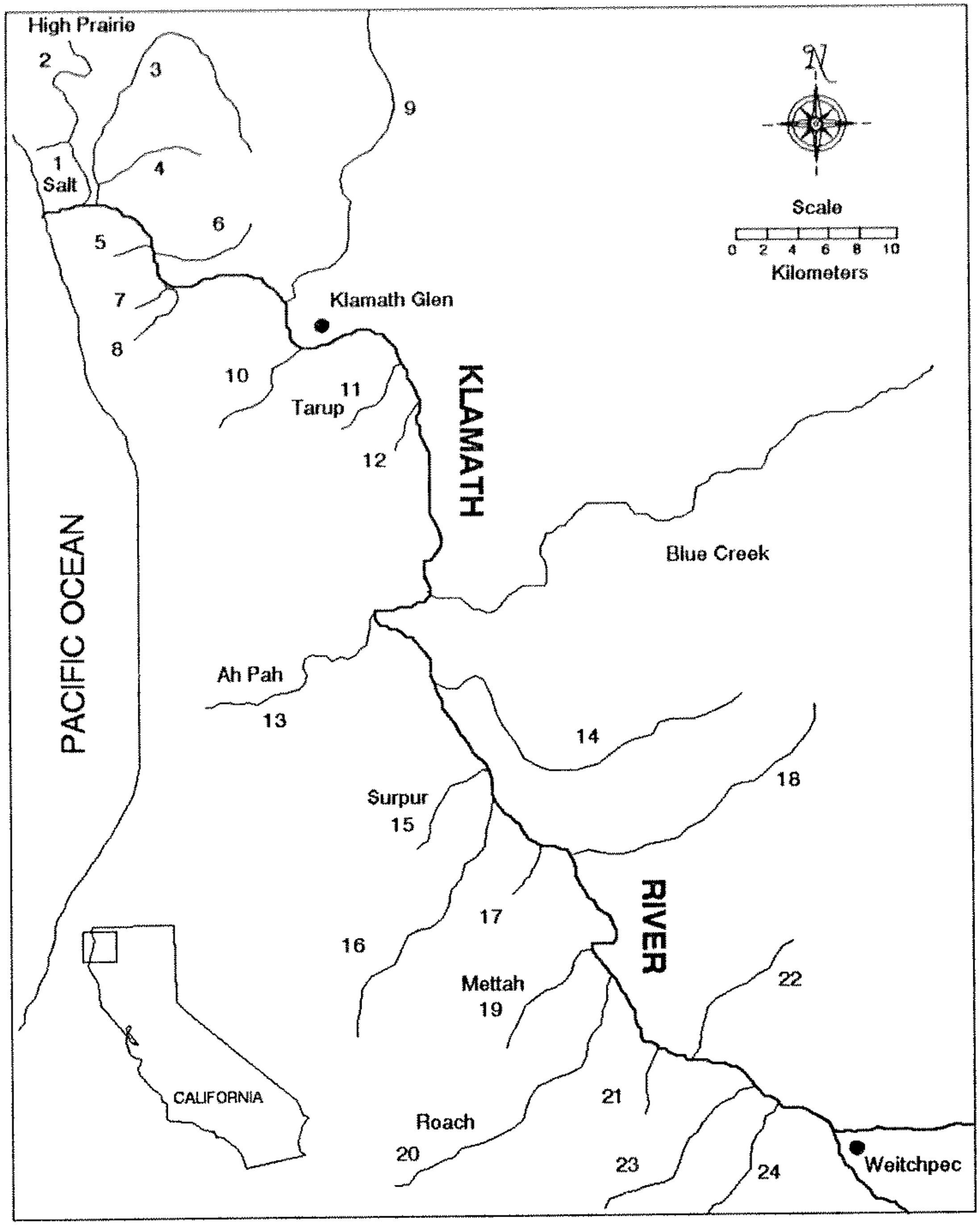
A second year of investigations continued in Fiscal Year (FY) 1990 and a third proposal was approved for funding in the FY 1991. The 1992 work was not approved by the KRBFTF and it appears that future funding to complete these investigations is unlikely. This report summarizes findings during October, 1990, through July, 1991. Efforts were concentrated on juvenile production and habitat inventories, especially for chinook salmon and steelhead trout. Investigations on these tributaries have occurred during a long term drought with 1991 representing the fifth consecutive year of drought. These conditions have reduced river and stream flows to critical levels. Subsequently, stream flows were subsurface at the mouth of many inventoried streams, rendering them inaccessible to adult salmonids during most of the spawning season. Limited access combined with the diminishing Klamath River stocks have resulted in minimal returns into the lower tributaries, especially for chinook salmon. The low numbers of chinook encountered in spawning ground surveys and juvenile outmigrant trapping reflect this condition. A more accurate understanding of the potential for salmonid production in these streams would be gained if multiple years of sampling were conducted to reflect production in "normal" and high water years.

METHODS AND MATERIALS

Selection of Study Areas

All streams included in this investigation enter the Klamath River downstream of the Hoopa Valley Indian Reservation. From a total of 24 tributary streams to the lower Klamath River, excluding Blue Creek, six

Figure 1. Tributaries to the Klamath River included in this investigation.



NUMBERED CREEKS:

1 Salt	7 Saugep	13 Ah Pah	19 Mettah
2 High Prairie	8 Waukell	14 Bear	20 Roach
3 Hunter	9 Terwer	15 Surpur	21 Morek
4 Mynot	10 McGarvey	16 Tectah	22 Cappell
5 Richardson	11 Tarup	17 Johnson	23 Tully
6 Hoppaw	12 Omagaar	18 Pecwan	24 Pine

tributaries (High Prairie, Tarup, Ah Pah, Surpur, Mettah, and Roach Creeks) were selected for investigations in 1991 (Figure 1). These tributaries were chosen based on preliminary investigations in 1988-1989 of juvenile production, spawning ground surveys, cursory surveys for spawning and rearing habitat availability and use, and from findings reported in past reports (Table 1) (Noble and Lintz 1990). They represent tributary streams where conditions are thought to be best for anadromous fish production.

Stream Habitat Inventories

Habitat inventories were conducted to estimate the amount and condition of spawning and rearing habitat and to document channel types, habitat types, instream and overhead cover, present and potential inputs of large woody debris, identify and locate fish barriers, estimated embeddedness and types of substrate, and streambank stability. A systematic reach approach was used to assess the condition and availability of spawning and rearing habitat in High Prairie, Tarup, Surpur, Ah Pah, Mettah, and Roach creeks. In our survey, each kilometer (km) of stream was subdivided into 250 meter (m) reaches, with one reach from each kilometer of stream surveyed progressively as we moved upstream. Within each surveyed reach, we recorded channel type as described by Rosgen (1985) (Appendix A), habitat type of five main habitat categories (pool, flatwater, low gradient riffle, high gradient riffle, and cascade/falls) (Appendix B), mean stream width, bankfull width, stream depth, and pool depth. Appendix C contains ratings for rearing habitat, riparian cover (modified from Hamilton and Bergerson 1984), spawning habitat, streambank stability (modified from Armour et al. 1983), substrate mixture and embeddedness (Armour et al. 1983), and dominant instream cover types. The number of large woody debris present in the wetted stream channel and trees available from the slopes for recruitment were counted. As the count of instream large woody debris was taken at low summer flows and of wetted wood only, it does not fully represent the actual number of logs present along the streambanks and in log jams. The location of barriers, flow obstructions and observations of upslope condition were noted throughout the stream.

Fall Spawning Ground Surveys

Spawning ground surveys were conducted to determine the presence and extent of fall chinook spawning. Surveys for fall chinook spawners occurred on High Prairie, Tarup, Ah Pah, Surpur, Mettah, and Roach creeks from November through mid-December, 1990. Attempts were made to survey Tarup Creek, but its mouth was subsurface throughout our survey period. Counts for redds and adult salmon began at the mouth of each stream. The location and estimated age of redds were recorded. Live adult counts were made from the bankside, and/or snorkle counts, and fish were identified to species and sex when possible.

Juvenile Trapping Operations

Trapping of downstream migrating juvenile salmonids was conducted to document the species using a stream for spawning and rearing, determine patterns in timing and duration of juvenile emigration, and estimate the

Table 1. Tributaries to the lower Klamath River basin considered for investigations, their ratings for potential spawning and rearing habitats, and their rankings for investigation efforts.

Creek name effort	Klamath River (kilometers	Entry into Drainage area from mouth)	observed or previously (km²)	Salmonids potential spawning reported [1]	Ratings for potential rearing habitat	Ratings forRanking for investigations and estimated year for habitatconcentrated
Salt	1.8	11.4	STH, CUTT	minimal	minimal	Fourth - 1993
High Prairie	Creek	enters Salt	10.9 hybrids	CUTT, CUTT/RBT		lowmoderateThird - 1992
Hunter	1.8	61.6	CHN, STH, Coho, CUTT	moderate	low	First - 1989, 1990
Panther	enters Hunter	--	unknow	low	low	1990
Mynot	enters Hunter	12.7	CHN, STH, CUTT	low	low	Third - 1990
Richardson 1993		4.5	4.7	CHN, STH, CUTT		minimalminimalFourth -
Hoppaw	4.7	12.7	unknown	minimal	minimal	Fourth - 1993
Saugep	5.8	4.4	unknown	minimal	minimal	Fourth - 1992
Waukell	5.8	9.3	unknown	minimal	minimal	Fourth - 1992
Terwer	8.5	85.0	CHN, STH, Coho	high	moderate	First - 1989,1992 [2]
McGarvey	10.6	22.3	CHN, STH, CUTT	minimal	minimal	Fourth - 1993
Tarup	12.6	12.7	CHN, STH, Coho, CUTT	low	moderate	Second - 1989, 1991
Omagaar	16.9	6.5	CHN, RBT/STH	minimal	minimal	Fourth - 1993
Ah Pah	27.7	42.2	CHN, STH, Coho	low	moderate	Second - 1989, 1991
Bear	29.9	50.0	CHN, STH, Coho	moderate	moderate	Second - 1989, 1990
Surpur	33.0	14.8	CHN, STH	low	moderate	Second - 1991
Tectah	35.6	51.5	CHN, STH, Coho	high	high	First - 1989, 1990
Johnson	39.1	8.8	CHN, STH, CUTT	low	low	Third - 1992
Pecwan	40.7	71.7	STH, Coho	minimal	low	Third - 1989, 1992
Mettah	46.3	27.7	STH	low	moderate	Third - 1991
Roach	50.7	76.4	CHN, STH	moderate	high	Second - 1989, 1991
Morek	52.3	10.4	STH	minimal	minimal	Fourth - 1993
Cappell	53.3	22.3	STH	minimal	minimal	Fourth - 1993
Tully	62.0	44.8	STH	low	moderate	First - 1989, 1990
Pine	65.8	123.8	CHN, STH	high	high	First - 1989, 1990

1) Observations were made by Service employees using snorkeling, bankside observations, and/or electroshocking but do not include findings from juvenile sampling in 1989 since ratings were made prior to that operation; CHN = chinook, STH = steelhead, CUTT = Cutthroat trout, RBT = rainbow trout.
2) Although rated first for investigations, operations in Terwer Creek were postponed at the request of Simpson Timber Company.

abundance of juvenile salmonids emigrating from a stream. We began our assessment of juvenile salmonid production in March of 1991.

Outmigrant traps were operated overnight based on observations by Hoar (1953), Miller (1970), Reimers (1973), and Faudskar (1980), who documented that the majority of juvenile salmonids migrate under the cover of darkness. Traps in Tarup, Ah Pah, Surpur, and Mettah Creeks consisted of a 1.07 m x 1.52 m fyke net of 0.47 cm delta mesh with a live box attached to the cod end. Weir panels, constructed of 0.64 cm hardware cloth mounted on wooden frames, abutted on each side of the fyke net to increase the proportion of the stream sampled. A pipe trap consisting of a 25.4 cm coupler attached to a 20.3 cm by 3 m pipe and live box, and weir panels were used in High Prairie Creek. In Roach Creek, a larger tributary, weir panels and a 1.5 m x 3.0 m frame net of 0.47 cm delta mesh was used in place of the fyke net. Two streams were sampled each trap night with one trap set per stream. Traps were set near the mouth of each creek in areas accessible during spring flood events and where the traps could sample 100% of the stream width.

All fish were removed from the traps the next day and were identified to species, counted, measured, and released. All chinook, coho, and steelhead were further identified to year class by length frequency categories. Up to 30 individuals of each salmonid species and age class captured each night were measured for fork length (to the nearest millimeter (mm)) and volumetric displacement in milliliters), and then released.

Stream width, and stream depth at the trap mouth, and weather conditions were noted. Stream temperature was recorded over each trap night with a Taylor maximum/minimum thermometer. Stream flow (ft/sec) into the trap mouth was measured with a pygmy flow meter. Trapping operations ceased in mid-April on Tarup Creek when the access bridge began to fail, and on High Prairie in early May and on Ah Pah, Surpur, Mettah, and Roach creeks in early July when either the flow dropped below operable levels or the stream went subsurface.

Treatment of Data

Data were entered onto LOTUS 123 spreadsheets with mean length, standard deviation, and length frequency, analyzed using STATGRAPHICS software package. Comparisons, using ANOVA, with 1989 data were made regarding outmigration timing, length frequencies, age classes, extrapolated and actual catch numbers. A trap night was defined as the operation of a trap through one period of darkness (one night). Expanded estimates were made for the total number of juveniles of each species by age class, emigrating from a stream each trap night. These estimates were calculated as:

$$E_i = N_i / P_i$$

where N_i = the actual number of juveniles of a species of age class captured in a trap on night i, P_i = the proportion of total stream width that was sampled during that trap night, and E_i = the expanded number of juveniles of a species or age class emigrating past a trap on night i. Such expansions were made with the assumptions that all species and age classes were equally distributed across the stream channel, juveniles captured were migrating from the stream, and the trap was equally efficient in capturing all migrating fishes.

Estimates were also made for the total number of juveniles of a species or age class that emigrated past a trap site during the entire trapping season. These were made by summing all E_i for a stream and extrapolating expanded estimates for nights when traps were not operational. These extrapolated estimates were made under the previously stated assumptions and additionally that: 1) stream width at a trap site did not substantially decrease or increase between one trap night and the next, 2) emigration by a species or age class of juveniles was at a constant rate between trap nights.

RESULTS AND DISCUSSION

High Prairie Creek

Habitat Inventory

High Prairie Creek enters Salt Creek 2.8 km above Salt Creek's confluence with the Klamath River (Fig. 1). A systematic reach inventory was not performed on Salt Creek, but the stream was inspected on October 15, 1990, to evaluate stream condition and to assess adult passage problems.

The inspection of Salt Creek covered from the mouth to the confluence with High Prairie Creek at rkm 2.8. The surveyed area of Salt Creek is in a D2 channel type, exhibiting low gradient, slightly entrenched and no confinement. Up to rkm 1.0 the stream had well defined banks that are covered with forbs, alders, and willows. The dense forbs and high water table of the valley produces a marsh from rkm 1.0 to 3.5. The stream through this reach had flatwater as the only habitat type. Instream cover was available along the grass covered undercut banks and stream edges. Cattle have entered the stream in several locations and have contributed to eroding the streambanks, exposing the sand and silt substrate. A beaver dam, located at rkm 1.0, was 11 meters (m) wide and 0.5 m high. This structure could be a barrier to anadromous fish. At rkm 1.2 a larger beaver dam, 40 m across, is retaining a pond of about 6 hectors with a surface elevation approximately 1 m above that of the stream. The section of dam spanning the stream channel appears to have been replaced this year. At very high flows this portion of the dam may collapse, allowing migrating salmonids upstream. In 1990 the beaver dam was still intact when the last adult/redd survey on High Prairie Creek was completed on December 20. Above the beaver dam the stream channel was no longer identifiable due to the pond stretching upstream to rkm 2.2. In the area from rkm 2.2 to the confluence with High Prairie Creek (at rkm 2.8), Salt Creek had all flatwater habitat. Three small beaver dams, all of which had been partially dismantled by humans, were found in this section. These dams are not currently barriers to upstream migration. Spawning gravels were not found in the areas surveyed on Salt Creek. If anadromous fish are able to get past the two lower most dams the beaver ponds may provide good nursery areas for outmigrant and resident salmonids.

High Prairie Creek was inventoried from the confluence with Salt Creek to rkm 4.25. The first reach surveyed, from the mouth to rkm 0.25, was in a C4 channel type. This reach retains surface flow all year due to the high water table of the Salt Creek valley. The dominant habitat type in this reach was flatwater (Fig. 2), with rearing habitat in and around the undercut banks, and under the copious overhanging grasses. Spawning habitat was sparse and highly embedded (Table 2). A levee parallels the left bank of the creek from rkm 0.05 to 0.26. Cattle cross through the stream at approximately rkm 0.25, and the stream banks in this area are degraded. On May 31, 1991 the stream had an intermittent surface flow from rkm 0.5 to 2.0, which included the second survey reach (rkm 1.0 to 1.25). Reach 2 consisted of pools, flatwater, and some dry sections. The rearing and spawning habitat was poor due to lack of cover and heavily embedded gravels. Reach 3, rkm 2.0 to 2.25, had excellent rearing and moderate spawning habitat. Large woody debris was very abundant in the stream channel. Log jams of mixed large and small woody debris were found approximately every 30 m, from rkm 1.5 to the top of the survey (rkm 4.5). Many of these jams were passible barriers, but several appeared to be complete migratory barriers.

Overall, High Prairie Creek retains fair to moderate rearing habitat and low quality spawning habitat. With the beaver dam barriers in Salt Creek and multiple log jams in High Prairie Creek, anadromous salmonid access is a concern. The effort to open the stream, and keep it open (the beaver dams would have to be removed yearly), may not presently be worth the small potential benefits realized in fish production from this system.

Spawning Ground Surveys

Three surveys were conducted on High Prairie Creek on December 4, 11, and 20, 1990, to rkm 2.3, 3.2, and 1.6, respectively. No chinook, coho, or steelhead redds or adults were found on these surveys; however, cutthroat trout adults were observed above rkm 2.0.

Juvenile Trapping Operation

The pipe trap was located at rkm 0.5 and ran for 8 nights, from May 21 to June 9, 1991, when flows dropped below operable levels. Only 7 cutthroat trout were captured (Table 3). Cutthroat trout ranged in length from 99 to 144 mm and averaged 122 mm. Three of these fish were smolts indicating anadromous cutthroat trout production occurs in this system. The expanded number of cutthroat trout juveniles emigrating from High Prairie Creek between May 21 to June 9, 1991, was 48 (Table 4). Other species captured in High Prairie Creek are listed in Table 5.

Tarup Creek

Habitat Inventory

Tarup Creek enters the Klamath River at rkm 12.5 and was inventoried from the mouth upstream to rkm 8.5. On June 20, 1991, the stream was dry from the mouth to rkm 1.0; this included the first reach, rkm 0.25 to 0.5. This first reach, in a D2 channel type, encompasses a dry pond 250 m long, 40 m wide, with a surface area of 10 hectares, an estimated maximum depth of 2.5 m, and an average depth of 1.0 m. This pond must first fill and over flow before stream flow can reach the Klamath River. On January 2, 1991 Tarup Creek flows had not yet filled this pond. The next three

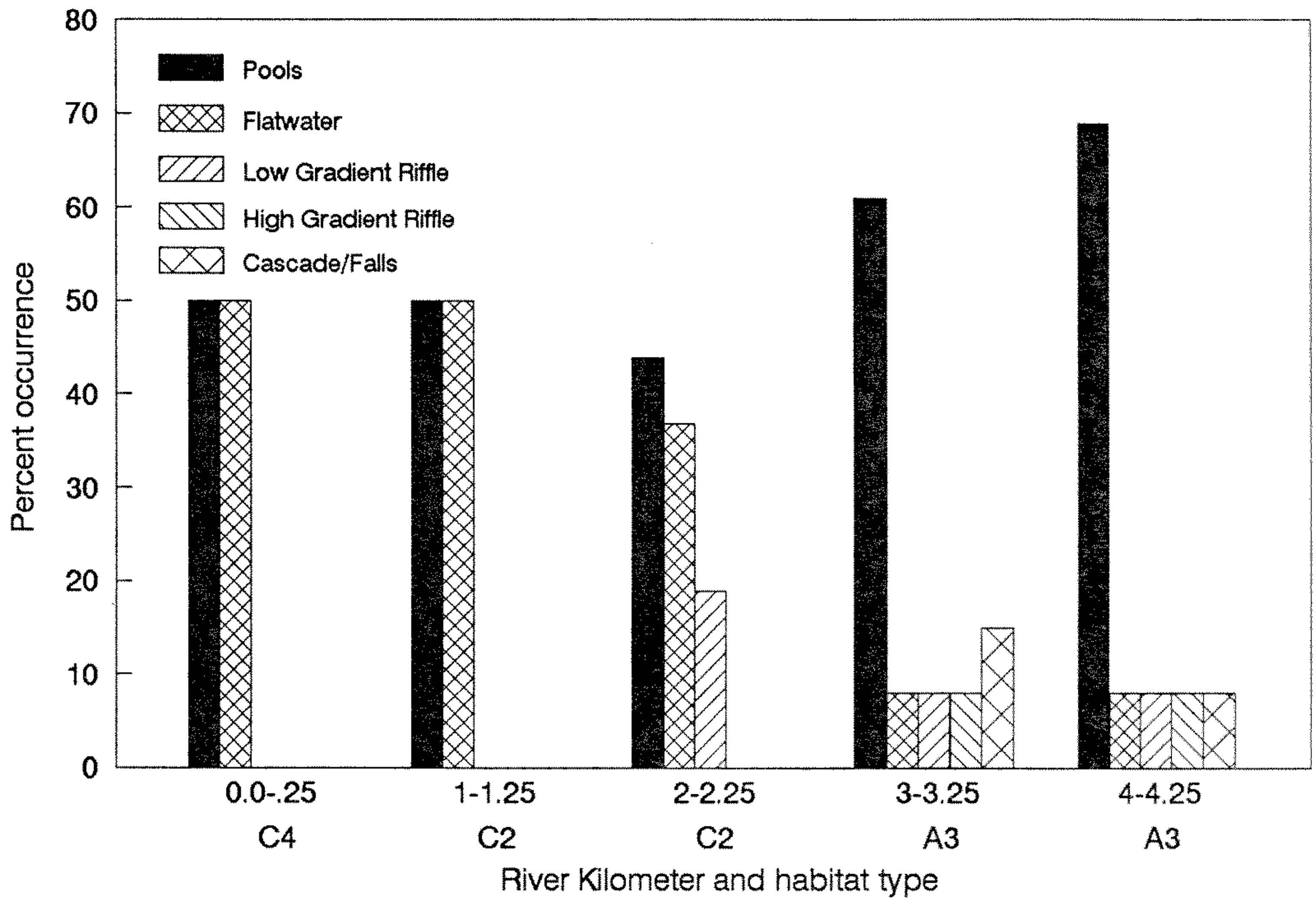


Figure 2. High Prairie Creek channel and habitat types, 1991.

Table 2. Physical stream characteristics and inventory ratings for High Prairie Creek.

Reach	RKM	Channel Type	% Habitat Types: Pool	Flat-Water	LGR	HGR	Cascade Falls
1	0.0-0.25	C4	50	50	0	0	0
2	1.0-1.25	C2	50	50	0	0	0
3	2.0-2.25	C4	44	37	19	0	0
4	3.0-3.25	A3	61	8	8	8	15
5	4.0-4.25	A3	69	8	8	8	8

Reach	Mean Stream (meters): Width	Depth	Pool Depth	Bankfull Width	Dominant Instream Cover[a]	Substrate Mix[b]	Percent Embeddedness
1	4.9	0.5	1.1	8.4	Aqu. Veg.	SFG	75-100%
2	3.6	0.9	0.8	10.2	Aqu. Veg.	SGC	75-100%
3	3.7	0.1	0.7	13.7	LWD	GCS	25-50%
4	4.7	0.3	0.9	9.5	LWD	GCF	25-50%
5	4.1	0.2	0.7	8.5	LWD	GCS	50-75%

Reach	Ratings[c]: Rearing Habitat	Spawning Habitat	Riparian Cover	Streambank Stability	Number Large Woody Debris: Instream	Recruitment
1	Mod	Min	Exc	Mod	0	0
2	Min	Min	Exc	Exc	4	1
3	Exc	Mod	Exc	Exc	11	38
4	Fair	Min	Exc	Exc	76	47
5	Exc	Min	Exc	Exc	72	24

[a]Instream Cover: Aqu. Veg.= Aquatic Vegetation, LWD= Large Woody Debris
[b]Substrate Mix: F=Fines, S=Sand, G=Gravels, C=Cobbles, Bo=Boulders, Be=Bedrock: dominant type listed first in sequence.
[c]Rating: Exc=Excellent, Mod=Moderate, Fair, Min=Minimal, Ext=Extreme

Table 3. High Prairie Creek trapping and salmonid catch data in 1991.

Date	Weather[a] at trap Set/Pull	Percent Stream Sampled	Total Hours Fished	Temperature Max-Min (C^0)	Flow (ft/sec)
3/21/91	LR/Oc	100	23:00	8.9 - 6.7	2.49
3/26/91	Cl/PC	48	22:30	10.0 - 7.8	1.11
4/04/91	Oc/HR	100	22:45	11.1 - 10.0	1.34
4/11/91	Cl/Cl	100	20:40	10.0 - 7.8	1.77
4/18/91	Oc/PC	100	27:20	10.0 - 8.9	1.71
4/25/91	Oc/LR	100	23:45	11.1 - 8.9	0.96
5/02/91	Oc/Cl	100	27:10	10.0 - 8.9	1.25
5/09/91	Cl/Cl	100	29:15	10.5 - 8.3	1.20

	Salmonid Catch				
		Steelhead			
Date	Chinook	Fry	Yearlings	Coho	Cutthroat Trout
3/21/91	0	0	0	0	0
3/26/91	0	0	0	0	0
4/04/91	0	0	0	0	1
4/11/91	0	0	0	0	0
4/18/91	0	0	0	0	2
4/25/91	0	0	0	0	4
5/02/91	0	0	0	0	0
5/09/91	0	0	0	0	0
Total	0	0	0	0	7

[a] Weather at time of trap installation and removal: Cl= Clear, PC= Partly Cloudy, Oc= Overcast, LR= Light Rain, HR= Heavy Rain.

Table 4. Actual catches and extrapolated numbers of fish emigrating the lower tributaries during the trapping period in 1991.

	Days		Chinook		Steelhead Fry		Steelhead Yearling		Coho		Cutthroat Trout	
Stream	Actual	Expanded	Act.	Extrap.	Act.	Extrap.	Act.	Extrap.	Act.	Extrap.	Act.	Extrap.
High Prairie	8	80	0	0	0	0	0	0	0	0	7	48
Tarup	4	20	0	0	0	0	7	59	5	23	55	373
Ah Pah	15	97	0	0	0	0	4	28	82	550	11	77
Surpur	14	88	1	7	0	0	6	40	0	0	6	34
Mettah	14	95	0	0	12	78	82	850	1	7	2	7
Roach	17	105	6	33	127	673	45	406	37	359	0	0
Totals	72	485	7	40	139	751	144	1383	125	939	81	539

Table 5. Number of days trap operated, and number of salmonids and other species captured in each of the lower tributaries sampled in 1991.

	High Prairie	Tarup	Ah Pah	Surpur	Mettah	Roach
# of Days Trap Operated	8	4	15	14	14	17
Chinook	0	0	0	1	0	6
Steelhead 0+	0	0	0	0	12	127
Steelhead 1+	0	7	4	6	82	45
Coho	0	5	82	0	1	37
Cutthroat	7	55	11	6	2	0
Chum	0	0	0	0	1	0
Stickleback	0	1	4	3	335	132
Sucker	10	55	12	34	97	21
Lamprey	2	1	1	1	0	16
Dace	2	86	57	186	1074	371
Sculpin	1	96	20	135	441	62
Western Toad	0	0	15	3	32	39
Yellow Legged Frog	0	0	0	9	0	6
Red Legged Frog	*	*	*	**	**	**

* Found in these creeks, but not captured in the traps.

** Status unknown in these creeks.

reaches, 2, 3, and 4, (rkm 1.25 to 1.5, 2.25 to 2.5, and 3.25 to 3.5, respectively) were in a C4 channel type. The habitat types in these reaches were pools and flatwater (Fig. 3). In these reaches the rearing habitat was in moderate condition with cover provided by large woody debris, physical stream characteristics and ratings for the inventoried reaches of Tarup Creek are given in Table 6. Most of this cover was supplied by instream structures installed by the California Conservation Corp (CCC). Spawning habitat was fair, with adequate, but highly embedded, spawning gravels. Reach 5, rkm 4.25 to 4.5, was in an A2 channel type. High gradient riffles and pools dominated the habitat types in this reach. Spawning habitat was infrequent and rearing habitat was minimal with little cover available in this reach. Reaches 6, 7, and 8 (rkm 5.25 to 5.5, 6.25 to 6.5, and 7.25 to 7.5, respectively) were in channel types B4, B3, and B4, respectively. Spawning habitat improves in frequency and condition in these reaches. At rkm 7.2 a large woody debris jam spans the channel, and retains some gravels. The stream above this jam becomes subsurface for 1.0 m as it filters through the accumulated gravels and represents a low flow barrier to salmonid migrations. At rkm 7.9 a beaver dam and pond barrier, 5 m wide, 28 m long, and 0.85 m deep, is retaining large quantities of silt and fines. Four unidentified salmonids, presumed to be cutthroat trout, were seen in this pond. At rkm 8.1 the stream had an intermittent flow for several meters. A large woody debris jam has created a 1.3 m falls at rkm 8.17. Reach 9, rkm 8.25 to 8.5, is in a C2 channel type with an average stream width of 1.7 m and depth of 0.1 m. At rkm 8.28 a deteriorating beaver dam was found, above this at rkm 8.59 a 7.5 m wide, 15 m long, 0.85 m deep beaver dam and pond was found. A third beaver dam and pond at rkm 8.61, 12 m wide, 30 m long, 1.5 m deep, was the uppermost point of the survey. All of these beaver dams were retaining large quantities of silt and fines. Their removal would release these stored sediments causing degradation of spawning gravels downstream.

Spawning Ground Surveys

The mouth of Tarup Creek was inspected periodically. On January 2, 1991, examination of the mouth found that the stream flow had partially filled the pond. A survey by the CDFG on February 14 and 20, 1991, from rkm 4.6 to 6.2, found 6 cutthroat trout redds (460 to 510 mm in diameter), and several adult cutthroat trout (size estimated at 350 mm Fl) were seen in the area (J. Schwabe, CDFG, pers. comm.).

Juvenile Trapping Operation

The fyke trap was located in a pool tailout at rkm 2.0. Between March 26 and April 15, 1991 only four nights of trapping took place in Tarup Creek as a failing bridge (at rkm 4.5) on the access road prevented us from reaching our trap site. The flow at the stream mouth went subsurface about April 18, 1991. Cutthroat trout yearlings dominated the catch with 55 fish sampled. Cutthroat trout length ranged from 91 to 310 mm, and averaging 125 mm. Cutthroat trout emigration peaked during a spring freshet on April 4, 1991, with 38 fish sampled. Seven steelhead trout yearlings and 5 coho yearlings were also sampled (Table 7). Young of the year salmonids were not captured. The expanded numbers for the 20 day trapping period for emigrating steelhead yearlings was 59, 23 for coho, and 373 cutthroat trout (Table 4). Other species sampled are listed in Table 5.

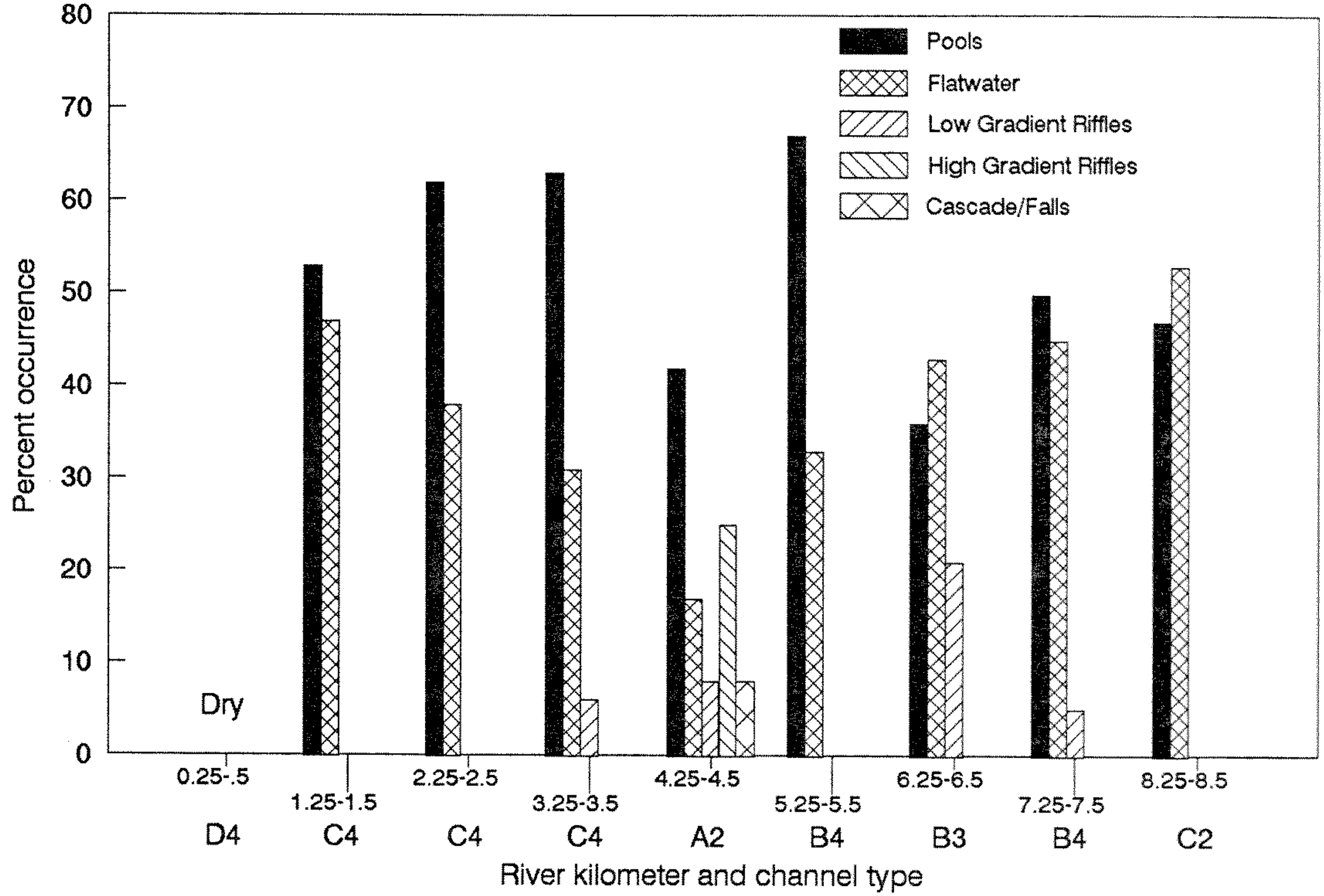


Figure 3. Tarup Creek channel and habitat types, 1991.

Table 6. Physical stream characteristics and inventory ratings for Tarup Creek.

Reach	RKM	Channel Type	% Habitat Types: Pool	Flat-Water	LGR	HGR	Cascade Falls
1	0.25-0.5	D2	0	0	0	0	0
2	1.25-1.5	C4	53	47	0	0	0
3	2.25-2.5	C4	62	38	0	0	0
4	3.25-3.5	C4	63	31	6	8	0
5	4.25-4.5	A2	42	17	8	25	8
6	5.25-5.5	B4	67	33	0	0	0
7	6.25-6.5	B3	36	43	21	0	0
8	7.25-7.5	B4	50	45	5	0	0
9	8.25-8.5	C2	47	53	0	0	0

Reach	Mean Stream (meters): Width	Depth	Pool Depth	Bankfull Width	Dominant Instream Cover[a]	Substrate Mix[b]	Percent Embeddedness
1	0	0	0	30.0	Ter. Veg.	FSG	75-100%
2	3.2	0.2	0.7	8.3	SWD	GFS	75-100%
3	4.4	0.2	0.8	8.8	LWD	GFS	25-50%
4	3.7	0.1	0.6	15.8	LWD	GFS	25-50%
5	2.5	0.2	0.9	14.7	Sub.	BoCG	25-50%
6	3.5	0.2	0.7	12.2	LWD	GSC	25-50%
7	4.3	0.1	0.7	13.2	Sub.	GCS	25-50%
8	3.3	0.1	0.7	9.7	Sub.	GCS	5-25%
9	1.7	0.1	0.5	8.6	Sub.	GFC	25-50%

Reach	Ratings[c]: Rearing Habitat	Spawning Habitat	Riparian Cover	Streambank Stability	Number Large Woody Debris: Instream	Recruitment
1	Dry	Dry	Min	Fair	1	5
2	Fair	Min	Exc	Exc	7	6
3	Mod	Mod	Exc	Exc	36	9
4	Mod	Mod	Exc	Exc	13	24
5	Min	Min	Exc	Exc	30	21
6	Exc	Mod	Exc	Mod	40	13
7	Mod	Mod	Exc	Exc	21	25
8	Mod	Mod	Exc	Exc	48	16
9	Exc	Min	Exc	Exc	21	20

[a]Instream Cover: Ter. Veg.= Terrestrial Vegetation, LWD= Large Woody Debris, SWD= Small Woody Debris, Sub.= Substrate

[b]Substrate Mix: F=Fines, S=Sand, G=Gravels, C=Cobbles, Bo=Boulders, Be=Bedrock: dominant type listed first in sequence.

[c]Rating: Exc=Excellent, Mod=Moderate, Fair, Min=Minimal, Ext=Extreme

Table 7. Tarup Creek trapping and salmonid catch data in 1991.

Date	Weather[a] at trap Set/Pull	Percent Stream Sampled	Total Hours Fished	Temperature Max-Min (C^o)	Flow (ft/sec)
3/26/91	Cl/PC	100	23:45	10.0 - 6.7	2.41
4/04/91	OC/HR	100	21:20	12.8 - 10.0	2.20
4/11/91	Cl/Cl	100	26:10	10.5 - 7.8	2.30
4/15/91	PC/PC	44	27:30	14.4 - 7.8	1.71

	Salmonid Catch				
		Steelhead			Cutthroat
Date	Chinook	Fry	Yearlings	Coho	Trout
3/26/91	0	0	5	0	8
4/04/91	0	0	2	1	38
4/11/91	0	0	0	4	9
4/15/91	0	0	0	0	0
Total	0	0	7	5	55

[a] Weather at time of trap installation and removal: Cl= Clear, PC= Partly Cloudy, Oc= Overcast, LR= Light Rain, HR= Heavy Rain.

Habitat Inventories

Ah Pah Creek was inventoried from the mouth to a migration barrier at rkm 6.75. The first 1.5 rkm of Ah Pah Creek is seasonally subsurface. Reach 1, rkm 0.25 to 0.5 and Reach 2, rkm 1.25 to 1.5 are in channel types C2 and C3, respectively. Within these reaches pools and flatwater were the dominant habitat types (Table 8, Fig. 4). Reaches 3, 4, and 5 (rkm 2.25 to 2.5, 3.25 to 3.5, and 4.25 to 4.5, respectively) are in a B3 channel type. Pools, flatwater, and low gradient riffles were the dominant habitat types in these reaches. At rkm 2.8 to 3.0 a series of Hewitt ramps to improve fish passage were installed by CDFG and CCC in 1987. These ramps replaced a cascade barrier. A log jam at rkm 4.9, 20 m wide and 1.5 m tall, and another log jam 60 m wide by 50 m long at rkm 5.16 are both migration obstacles. Reach 6, rkm 5.25 to 5.5, is in a C3 channel type. On the right bank at rkm 5.4 a tributary enters the main stem. At the top of this reach (rkm 5.5) another log jam spans the channel, and this jam is not currently a barrier. A massive log jam (120 m long) clogs the stream channel at rkm 5.85. Salmonid fry were observed above this obstacle. In reach 7, rkm 6.25 to 6.5, the channel type becomes a B1. Cascades and high gradient riffles were present in this reach. Anadromous migrations end at rkm 6.75 where a log jam fills the channel, raising the stream bed elevation 8 m. Removal of this barrier would release vast quantities of stored sediments; removal is not recommended. Up to the barrier salmonid juveniles were infrequently observed; no juveniles were seen above this barrier.

The substrate embeddedness level progressively increased through the stream, reaching over 75% in reaches 6 and 7. The sediment load has affected the spawning gravels in these reaches and as it moves through the system will have an adverse affect on the remaining gravels.

The tributary at rkm 5.4 was inventoried from the confluence to rkm 0.25. This fork was in a B4 channel type and contained poor spawning and moderate rearing habitat (Table 8). Five log jam barriers were present through this reach. One juvenile salmonid was observed below the first barriers.

Spawning Ground Surveys

The lower portion of the creek is seasonally subsurface. The stream was open to adult migrations on November 25, 26, and 27, and again on December 10, 11, and 12, 1990. The stream went subsurface between and after these periods. Stream surveys occurred on November 29, December 14, 1990, and January 2, 1991 after streamflows opened the lower reaches. The CDFG conducted a survey from the mouth to rkm 3.0 on November 29, 1990; they reported observing 2 coho (1 female and 1 male), below rkm 2.0, with no redds found (J. Schwabe, CDFG, per. comm.).

The December 14, 1990, survey found 6 redds between rkm 1.5 and 2.8. One adult steelhead was observed on a redd and 3 other adult steelhead were found near other redds. One coho jack was seen and a coho carcass was found at rkm 1.9. No new redds or adults were found on the January 2, 1991, survey.

Table 8. Physical stream characteristics and inventory ratings for Ah Pah Creek and a tributary (A) entering at river kilometer 5.4.

			% Habitat Types				
Reach	RKM	Channel Type	Pool	Flat-Water	LGR	HGR	Cascade Falls
1	0.25-0.5	C2	50	50	0	0	0
2	1.25-1.5	C3	31	61	8	0	0
3	2.25-2.5	B3	50	20	30	0	0
4	3.25-3.5	B3	55	23	22	0	0
5	4.25-4.5	B3	40	27	13	20	0
6	5.25-5.5	C3	50	29	21	0	0
7	6.25-6.5	B1	27	28	18	9	18
A	0.0-0.25	B4	40	33	27	0	0

	Mean Stream (meters)						
Reach	Width	Depth	Pool Depth	Bankfull Width	Dominant Instream Cover[a]	Substrate Mix[b]	Percent Embeddedness
1	4.7	0.1	0.7	13.7	SWD	GSC	5-75%
2	6.9	0.7	0.8	26.7	Ter. Veg.	GS	50-75%
3	4.9	0.1	0.7	10.8	LWD	CGS	25-50%
4	4.8	0.2	0.7	11.1	Ter. Veg.	GSC	25-50%
5	4.4	0.2	0.7	13.2	LWD	CGS	50-75%
6	2.2	0.2	0.6	10.0	LWD	GSC	75-100%
7	3.5	0.2	0.6	7.6	SWD	SGC	75-100%
A	1.9	0.5	0.6	6.2	LWD	GCS	25-50%

	Ratings[c]				Number Large Woody Debris	
Reach	Rearing Habitat	Spawning Habitat	Riparian Cover	Streambank Stability	Instream	Recruitment
1	Min	Fair	Exc	Exc	8	21
2	Mod	Fair	Mod	Exc	9	5
3	Mod	Mod	Exc	Exc	12	17
4	Fair	Fair	Mod	Mod	13	14
5	Mod	Fair	Exc	Exc	19	56
6	Mod	Fair	Mod	Mod	22	21
7	Exc	Min	Exc	Mod	19	24
A	Mod	Fair	Mod	Mod	17	20

[a]Instream Cover: Ter. Veg.= Terrestrial Vegetation, LWD= Large Woody Debris, SWD= Small Woody Debris.

[b]Substrate Mix: F=Fines, S=Sand, G=Gravels, C=Cobbles, Bo=Boulders, Be=Bedrock: dominant type listed first in sequence.

[c]Rating: Exc=Excellent, Mod=Moderate, Fair, Min=Minimal, Ext=Extreme.

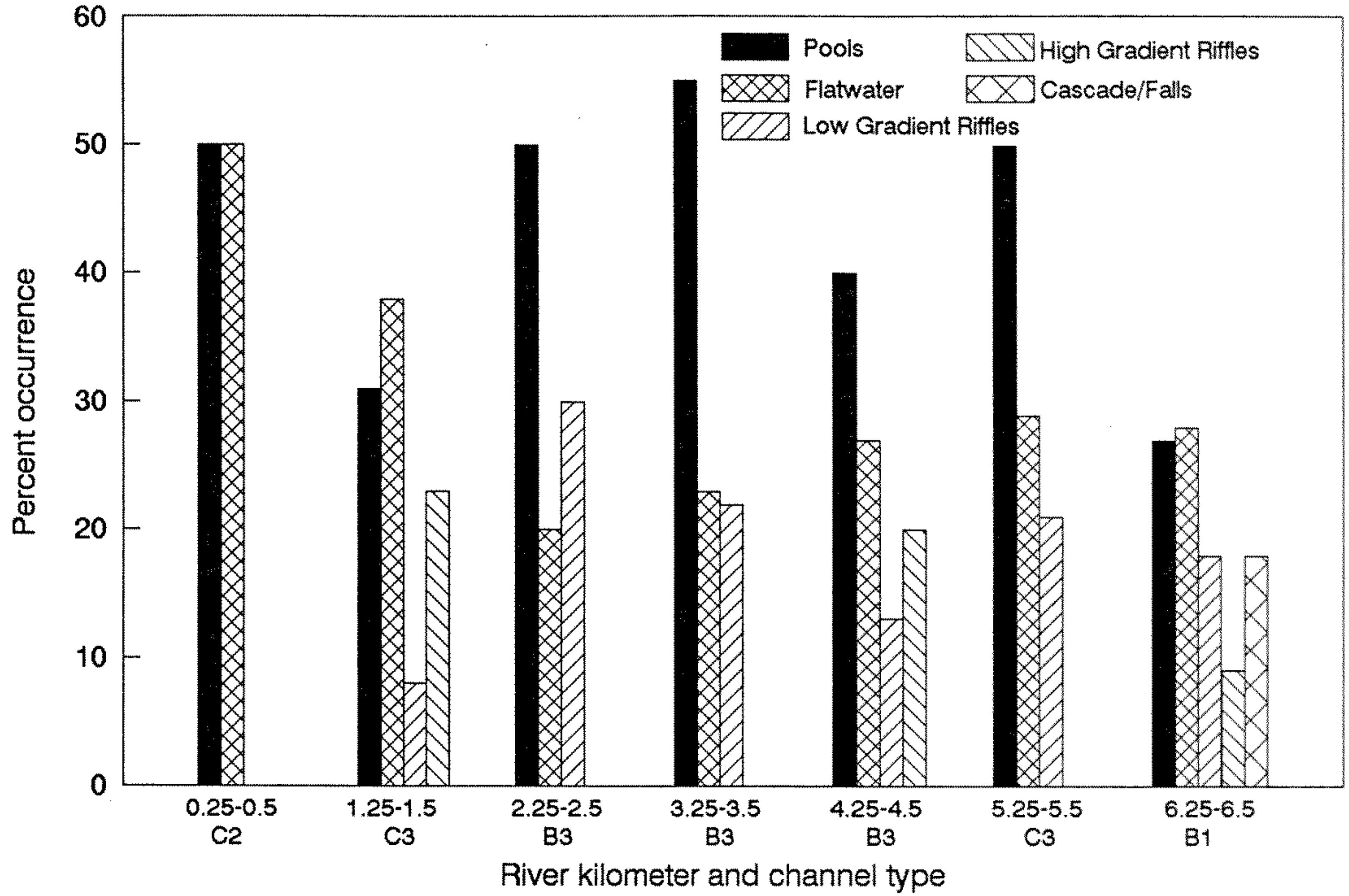


Figure 4. Ah Pah channel and habitat types, 1991.

Juvenile Trapping Operation

Ah Pah Creek was sampled from March 21 to June 26, 1990; 15 nights of trapping occurred during this period. The fyke trap was located at rkm 1.4. Eighty five coho young of the year, 11 cutthroat trout yearlings, and 4 steelhead yearlings were captured throughout the trapping period (Table 9). The average length of coho was 82 mm (range 35 to 72 mm) and cutthroat trout averaged 119 mm (range 96 to 209 mm). Two emigrant catch peaks occurred; the first on April 4, 1991 during a spring freshet and subsequent drop in water temperature, and a second peak on June 6, 1991 for which there was no apparent cause (Fig. 5). For the 97 days of the trapping period, expanded catch totals for coho emigration was 550, 25 for steelhead yearlings, and 77 for cutthroat trout (Table 4). Other species captured are listed in Table 5.

Surpur Creek

Habitat Inventory

Four river kilometers of Surpur Creek were surveyed in June 1991. The first 0.4 rkm of the creek is seasonally subsurface. Of the streams studied in 1990, Surpur Creek is one of the first creeks to have a surface flow in fall. The first reach (rkm 0.75 to 1.0), was in a B4 channel type. No barriers or obstacles were found in this reach. Long flatwater sections, short high gradient riffles, and pools made up the existing habitat types (Table 10, Fig. 6). At rkm 1.4 a log diagonally spans the creek creating a 2.0 m rise in the creek bed elevation. About 80% of the stream flow pours through a gravel and root-wad filter on the rightbank side and the remaining flow is a thin sheet spreading over the log. No jump pool is available below the log. This log is a barrier to upstream migration. Rearing habitat is abundant in reach 2 (rkm 1.75 to 2.0), and moderately embedded spawning habitat is available. A log and dirt bridge crosses the creek at rkm 2.1. Reach 3 and 4 (rkm 2.75 to 3.0 and 3.75 to 4.0, respectively), are in a B3 channel type. From rkm 3.0 to 3.34, a sequence of cascades and falls are caused by a series of log jams and a sharp increase in the stream gradient (15%). This chain of barriers may represent the end of the anadromous area of this stream. If fish could ascend these barriers, the next barrier, a 100 m long log jam, at rkm 3.76, would be the end of their journey. The last reach, reach 4 (rkm 3.75 to 4.0), contains a variety of habitat types created as the stream weaves through the large woody debris accumulation. Spawning habitat in this reach was poor due to high embeddedness caused by sediment entering from a slide (22 m long and running 30 m upslope) on the left bank stream channel.

Surpur Creek has abundant rearing habitat with cover provided by large woody debris and the cobble substrate. Spawning habitat is available but of low quality due to the high sediment content and embeddedness. The cover and quality of the riparian zone is good, with nearly 80% of the stream covered by shade. Small slides (>15 m across at the base) were found scattered throughout the creek. Many of the slides appeared stable, but several were actively delivering sediment and gravels into the stream channel.

Table 9. Ah Pah Creek trapping and salmonid catch data in 1991.

Date	Weather[a] at trap Set/Pull	Percent Stream Sampled	Total Hours Fished	Temperature Max-Min (C^{0})	Flow (ft/sec)
3/21/91	LR/Oc	100	22.15	8.9 - 5.6	1.75
3/26/91	Pc/PC	76	20:00	12.2 - 8.9	3.35
4/04/91	Oc/HR	100	25:00	10.5 - 8.9	2.53
4/11/91	Cl/Cl	100	22:45	8.9 - 6.7	2.77
4/18/91	Oc/PC	100	24:20	10.0 - b	2.43
4/25/91	Pc/LR	100	22:30	10.0 - 7.8	2.19
5/02/91	Oc/Cl	100	26:45	11.1 - 8.3	2.14
5/09/91	Pc/Cl	100	26:20	12.2 - 10.0	1.89
5/15/91	Oc/LR	100	23:00	11.1 - 7.8	2.11
5/23/91	Cl/Cl	100	29:30	11.7 - 8.3	2.36
5/30/91	Oc/Cl	100	23:50	11.1 - 8.3	2.43
6/06/91	Cl/Cl	100	22:50	12.8 - 9.4	2.31
6/13/91	Cl/Cl	100	21:30	13.3 - 9.4	1.38
6/19/91	Oc/PC	100	22:15	11.1 - 10.5	2.05
6/26/91	Oc/Oc	100	24:00	11.7 - 10.5	1.75

	Salmonid Catch				
		Steelhead			Cutthroat
Date	Chinook	Fry	Yearlings	Coho	Trout
3/21/91	0	0	0	0	0
3/26/91	0	0	0	0	0
4/04/91	0	0	0	17	2
4/11/91	0	0	0	13	1
4/18/91	0	0	4	6	3
4/25/91	0	0	0	0	1
5/02/91	0	0	0	1	3
5/09/91	0	0	0	0	0
5/15/91	0	0	0	7	0
5/23/91	0	0	0	4	0
5/30/91	0	0	0	11	0
6/06/91	0	0	0	12	1
6/13/91	0	0	0	5	0
6/19/91	0	0	0	4	0
6/26/91	0	0	0	2	0
Total	0	0	4	82	11

[a] Weather at time of trap installation and removal: Cl= Clear, PC= Partly Cloudy, Oc= Overcast, LR= Light Rain, HR= Heavy Rain.
b Maximum temperature only due to equipment malfunction.

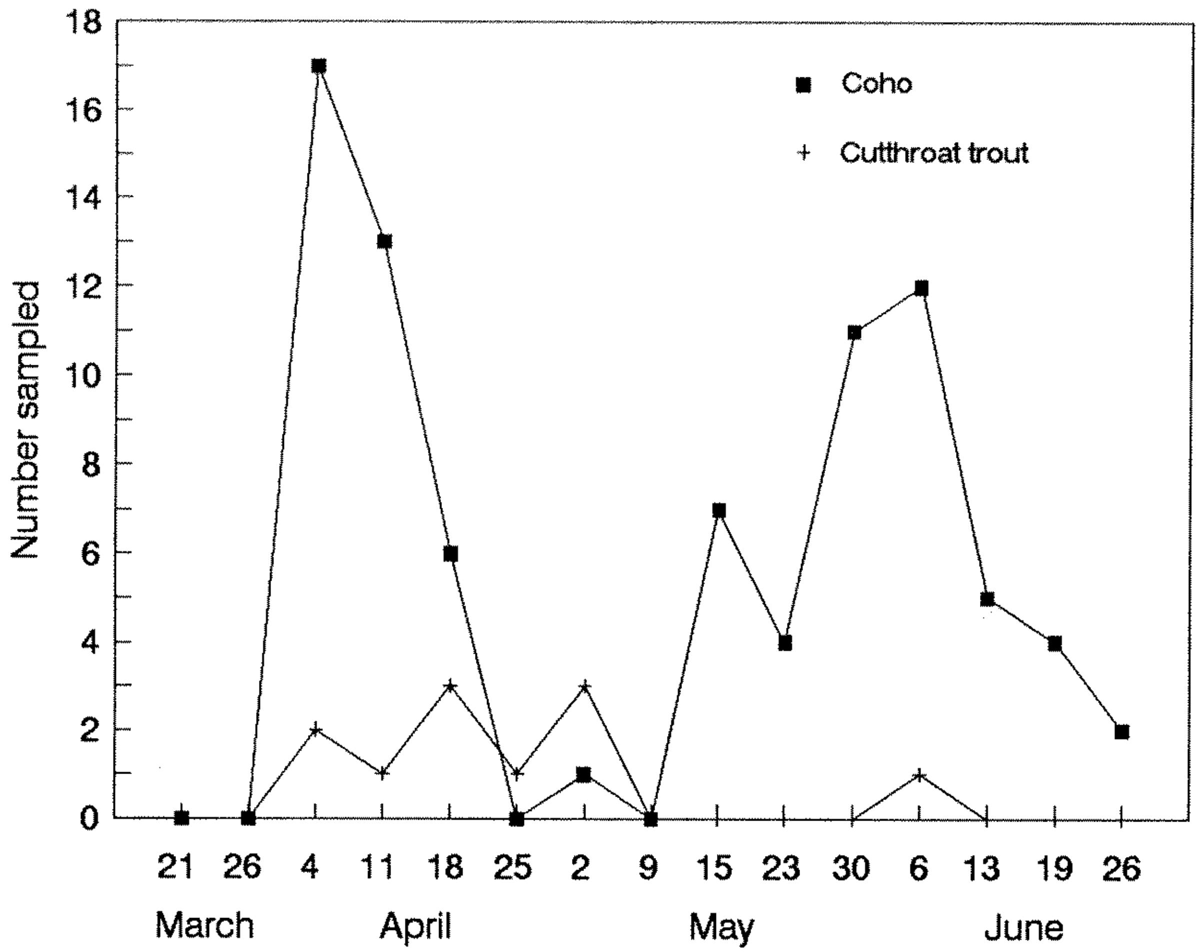


Figure 5. Juvenile coho and cutthroat trout outmigrant timing from Ah Pah Creek, 1991.

Table 10. Physical stream characteristics and inventory ratings for Surpur Creek.

Reach	RKM	Channel Type	% Habitat Types: Pool	Flat-Water	LGR	HGR	Cascade Falls
1	0.75-1.0	B4	50	25	0	25	0
2	1.75-2.0	B2	31	37	21	11	0
3	2.75-3.0	B3	39	39	0	22	0
4	3.75-4.0	B3	48	33	5	9	5

Reach	Mean Stream (meters): Width	Depth	Pool Depth	Bankfull Width	Dominant Instream Cover[a]	Substrate Mix[b]	Percent Embeddedness
1	5.1	0.2	0.8	7.2	Sub.	GSC	50-75%
2	4.6	0.1	0.6	9.2	Sub.	CGS	25-50%
3	4.8	0.1	0.7	10.1	Sub.	GCF	50-75%
4	2.8	0.4	0.6	9.6	LWD	CGBe	5-25%

Reach	Ratings[c]: Rearing Habitat	Spawning Habitat	Riparian Cover	Streambank Stability	Number Large Woody Debris: Instream	Recruitment
1	Mod	Fair	Mod	Mod	13	11
2	Exc	Mod	Mod	Mod	33	33
3	Mod	Fair	Exc	Mod	24	47
4	Exc	Mod	Mod	Mod	60	61

[a]Instream Cover: Sub.= Substrate, LWD= Large Woody Debris
[b]Substrate Mix: F=Fines, S=Sand, G=Gravels, C=Cobbles, Bo=Boulders, Be=Bedrock: dominant type listed first in sequence.
[c]Rating: Exc=Excellent, Mod=Moderate, Fair, Min=Minimal, Ext=Extreme

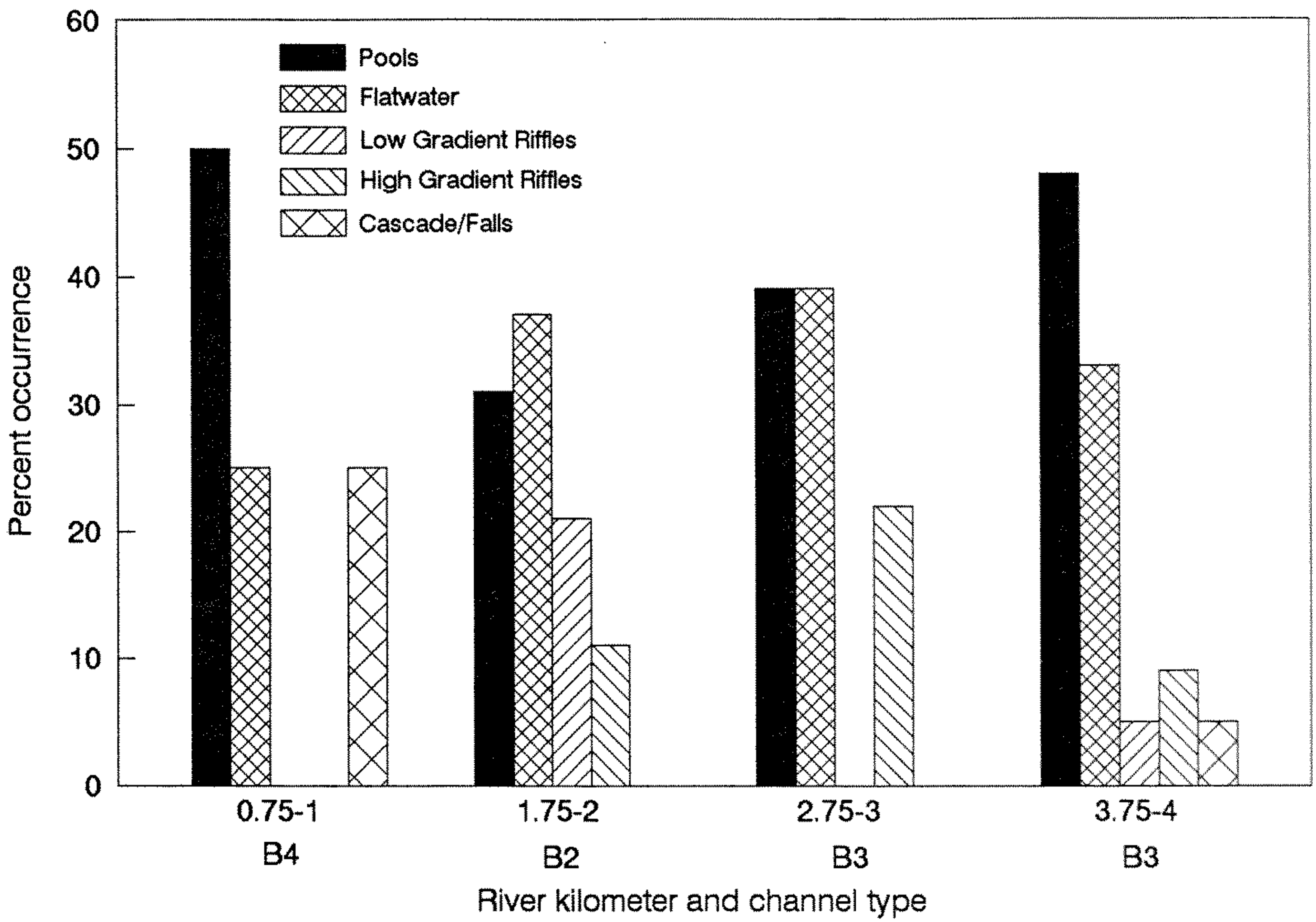


Figure 6. Surpur Creek channel and habitat types, 1991.

The removal of the log at rkm 1.4 may increase the habitat available to anadromous salmonids. The removal of the cascade falls barrier starting at rkm 3.0 and the log jams upstream would increase the available habitat as well, but may also increase the sediment load of the stream.

Spawning Ground Surveys

A survey to rkm 2.0 took place on January 4, 1991, no redds or adults were found.

Juvenile Trapping Operation

Fourteen nights of juvenile trapping took place between March 28 and June 24, 1991. The trap was located at rkm 0.05. Six steelhead yearlings, 6 cutthroat trout yearlings, and one chinook young of the year were captured (Table 11). Average lengths of steelhead yearlings were 103 mm (range 95 to 120 mm), cutthroat trout averaged 122 mm (range 108 to 135 mm), the chinook was 63 mm. For the 88 day trapping period, expanded catch numbers totaled 7 chinook juveniles, 40 steelhead yearlings, and 34 cutthroat trout (Table 4). Other species captured are listed in Table 5.

Mettah Creek

Stream Inventory

During the fall months, the mouth of Mettah Creek expanded to form a fan (30 m wide, 0.05 m deep) across a Klamath River gravel bar. This condition is a hindrance to migratory salmonids and persists until a channel is cut by high stream flows or the Klamath River flows rises to inundate the gravel bar. On December 17, 1990, (our last examination) passage across the mouth of Mettah Creek was still a barrier to adult migrations

This creek was surveyed from the mouth to rkm 3.5 in July, 1991. Reach 1 (rkm 0.25 to 0.5), is in a C1 channel type. Much of this reach is exposed to direct sunlight with little instream cover available to juvenile salmonids. Flatwater and low gradient riffles dominate this reach (Fig. 7). Spawning habitat is in poor condition throughout the surveyed areas due to a high degree of embeddedness (Table 12). Reaches 2, 3, and 4, (rkm 1.25 to 1.75, 2.25 to 2.5, and 3.25 to 3.5, respectively) are in a B3 Channel type. Progressing upstream, habitat types increased in diversity. Rearing habitat was excellent in reaches 2 and 3, but reach 4 was rated as fair because overhead and instream cover was lacking. One potential low flow barrier, was found at rkm 1.82. This barrier had a 2 m waterfall on the left bank and a log jam spanning the channel to the right bank. Approximately half of the flow was over the falls and the remainder was through the log jam. At the base of the falls a 0.9 m deep plunge pool may provide an adequate jump pool. Above this barrier spawning habitat was still of low quality, although rearing habitat was abundant. No other barriers were encountered to the end of the survey at rkm 3.5.

Spawning Ground Surveys

On December 13, 1990, a spawning ground survey to rkm 2.0 observed no redds or adult salmonids in Mettah Creek. At the time of the survey the shallow flow over the mouth of Mettah Creek was believed to be a barrier to salmonid access.

Table 11. Surpur Creek trapping and salmonid catch data in 1991.

Date	Weather[a] at trap Set/Pull	Percent Stream Sampled	Total Hours Fished	Temperature Max-Min (C°)	Flow (ft/sec)
3/28/91	Cl/Cl	30	21:45	11.1 - 7.8	2.55
4/01/91	LR/Oc	100	23:00	10.0 - 7.8	1.63
4/08/91	Oc/PC	100	24:15	10.0 - 8.9	2.22
4/15/91	Oc/PC	100	24:40	10.0 - b	1.73
4/22/91	Oc/Oc	100	22:30	9.4 - 8.3	3.06
4/29/91	Cl/Oc	100	23:20	11.1 - b	3.24
5/06/91	LR/Oc	100	22:45	11.1 - 8.9	2.33
5/13/91	LR/PC	100	23:40	11.1 - 8.3	2.96
5/21/91	Cl/Cl	100	23:35	11.1 - 8.9	1.75
5/28/91	Cl/LR	100	23:50	11.1 - 8.3	2.93
6/03/91	Cl/Cl	100	24:50	12.8 - 7.8	1.87
6/10/91	Cl/Cl	100	22:55	14.4 - 10.0	2.88
6/17/91	Cl/Cl	100	24:15	11.7 - 10.0	2.15
6/24/91	Oc/Oc	100	23:10	11.1 - 10.0	2.34

	Salmonid Catch				
		Steelhead			Cutthroat
Date	Chinook	Fry	Yearlings	Coho	Trout
3/28/91	0	0	0	0	0
4/01/91	0	0	1	0	4
4/08/91	0	0	0	0	0
4/15/91	0	0	4	0	0
4/22/91	0	0	0	0	0
4/29/91	1	0	0	0	0
5/06/91	0	0	1	0	2
5/13/91	0	0	0	0	0
5/21/91	0	0	0	0	0
5/28/91	0	0	0	0	0
6/03/91	0	0	0	0	0
6/10/91	0	0	0	0	0
6/17/91	0	0	0	0	0
6/24/91	0	0	0	0	0
Total	1	0	6	0	6

[a]Weather at time of trap installation and removal: Cl= Clear, PC= Partly Cloudy, Oc= Overcast, LR= Light Rain, HR= Heavy Rain.
b Maximum temperatures only due to equipment malfunction.

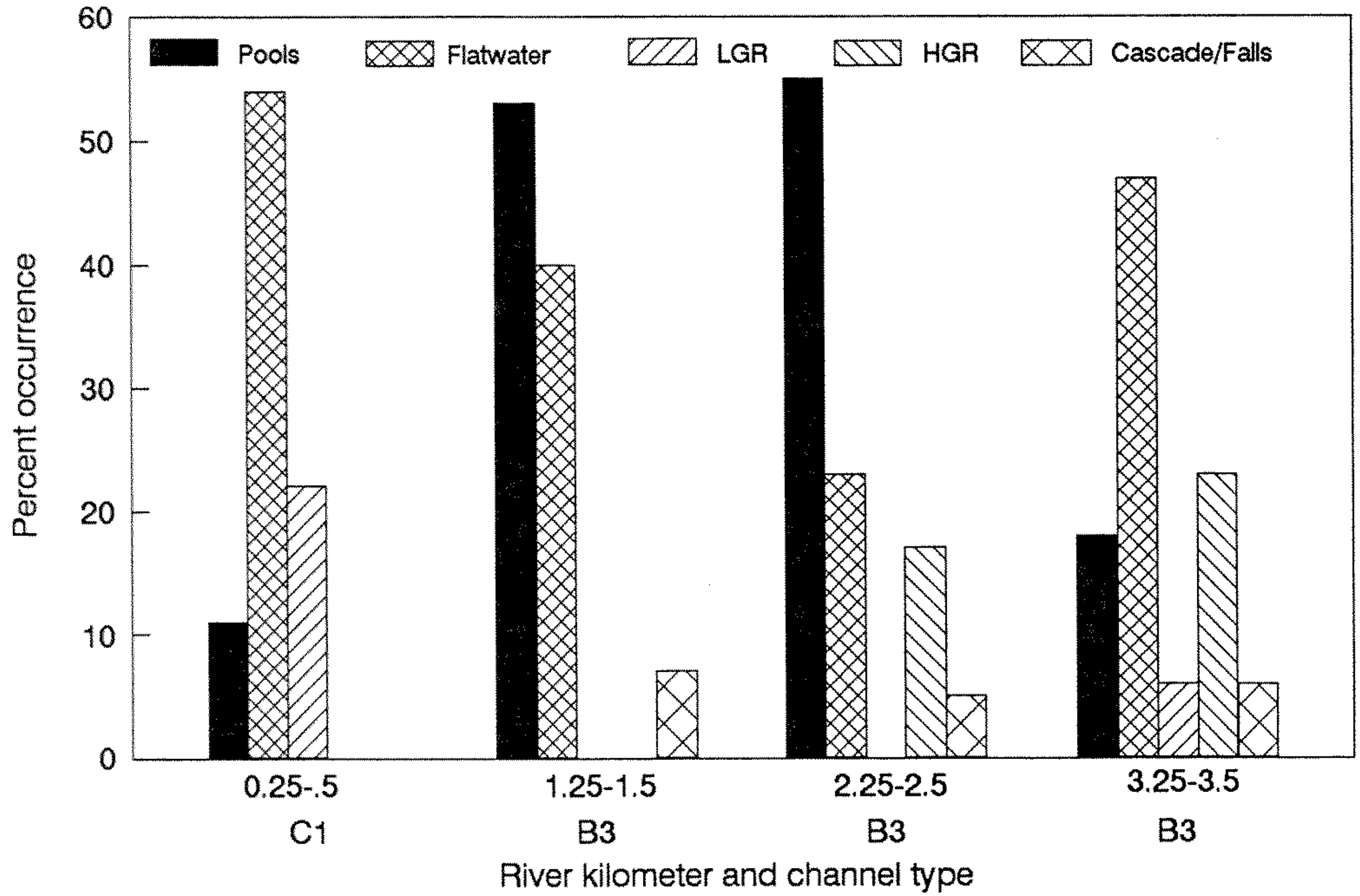


Figure 7. Mettah Creek channel and habitat types, 1991.

Table 12. Physical stream characteristics and inventory ratings for Mettah Creek.

Reach	RKM	Channel Type	% Habitat Types: Pool	Flat-Water	LGR	HGR	Cascade Falls
1	0.25-0.5	C1	11	54	22	0	0
2	1.25-1.5	B3	53	40	0	0	7
3	2.25-2.5	B3	55	23	0	17	5
4	3.25-3.5	B3	18	47	6	23	6

Reach	Mean Stream (meters): Width	Depth	Pool Depth	Bankfull Width	Dominant Instream Cover[a]	Substrate Mix[b]	Percent Embeddedness
1	4.7	0.2	1.0	17.0	Sub.	CGS	50-75%
2	7.2	0.5	0.9	12.0	Sub.	CGBo	50-75%
3	4.6	0.4	1.3	7.5	Sub.	CGBe	50-75%
4	6.4	0.2	0.7	9.4	Sub.	CGS	50-75%

Reach	Ratings[c]: Rearing Habitat	Spawning Habitat	Riparian Cover	Streambank Stability	Number Large Woody Debris: Instream	Recruitment
1	Min	Min	Fair	Min	1	4
2	Exc	Min	Mod	Exc	6	21
3	Exc	Min	Mod	Mod	11	10
4	Fair	Min	Mod	Fair	6	31

[a]Instream Cover: Sub.= Substrate.
[b]Substrate Mix: F=Fines, S=Sand, G=Gravels, C=Cobbles, Bo=Boulders, Be=Bedrock: dominant type listed first in sequence.
[c]Rating: Exc=Excellent, Mod=Moderate, Fair, Min=Minimal, Ext=Extreme

Juvenile Trapping Operations

From March 28 to July 1, 1991, 14 nights of trapping took place on Mettah Creek. The trap was located at rkm 0.1. Steelhead yearlings were captured throughout the trapping period, with an emigration peak occurring on April 15, 1991 (Fig. 8). A spring freshet on April 1, 1991, and a subsequent drop in stream temperatures may have triggered the emigration of the steelhead yearlings. Steelhead ranged from 75 to 200 mm in length and averaged 98 mm. Steelhead fry began to appear in the trap on May 21, 1991, with 12 captured intermittently throughout the remaining trapping period (Table 13). One coho fry (46 mm), one chum fry (44 mm), and a single cutthroat trout yearling (116 mm) were also sampled. Other species captured are listed in Table 5.

Roach Creek

Habitat Inventories

Four river kilometers of Roach Creek were surveyed in July, 1991. The areas surveyed were mostly in an A2 channel type, with the last reach becoming a B type channel. Rearing habitat was abundant and in excellent condition throughout the surveyed areas (Table 14). Pools dominated the habitat types found in Roach Creek, with associated high gradient riffles and cascades (Fig. 9). Infrequent patches of spawning gravels and predominantly large substrate material resulted in low spawning habitat ratings. Only 3 pieces of instream large woody debris were present in these reaches, although potential recruitment of large woody debris averaged 24 pieces per reach. Several boulder-formed obstacles were encountered in the first 4.0 rkm of the stream. The first obstacle at rkm 0.6 had the majority (90%) of the stream flow passing through the substrate under an immense boulder. At higher flows this boulder is bypassed on a right bank side channel, opening the stream to salmonid passage. A similar situation is found at rkm 1.65, with the entire stream flow passing under an enormous boulder cluster. Salmonid passage is not possible until the flow passes over the boulders and or a left bank side channel. Another obstacle, a boulder cascade at rkm 1.68, could also impede migration. All of these obstacles are apparently passible by steelhead, since steelhead fry and yearlings were encountered up to rkm 4.0, the end of the survey.

Spawning Ground Surveys

Four spawning ground surveys, on November 15, 27, and December 3, 17, 1990, were made from the mouth to rkm 1.5. On November 27, 1990, a redd was found at the tailout of a boulder pool at rkm 0.24. Unlike the other streams, access into the creek was not hampered by low flow conditions at the mouth, but at rkm 0.6 the boulder was impeding migration at low flow.

Juvenile Trapping Operation

From April 1 to July 15, 1991, 17 nights of trapping occurred during this period. The trap was located at rkm 0.1. Steelhead young of the year dominated the catch in Roach Creek with 127 captures, followed by steelhead yearlings (45), coho (32), chinook fry (6), and coho fry (4) (Table 15). The steelhead fry averaged 34 mm, and ranged from 27 to 65 mm. Steelhead fry exhibited three emigration periods, on May 28, June 10, and on the last day of trapping July 15, 1991 (Fig. 10). The first outmigrant peak may have been caused by a freshet which occurred that night. The

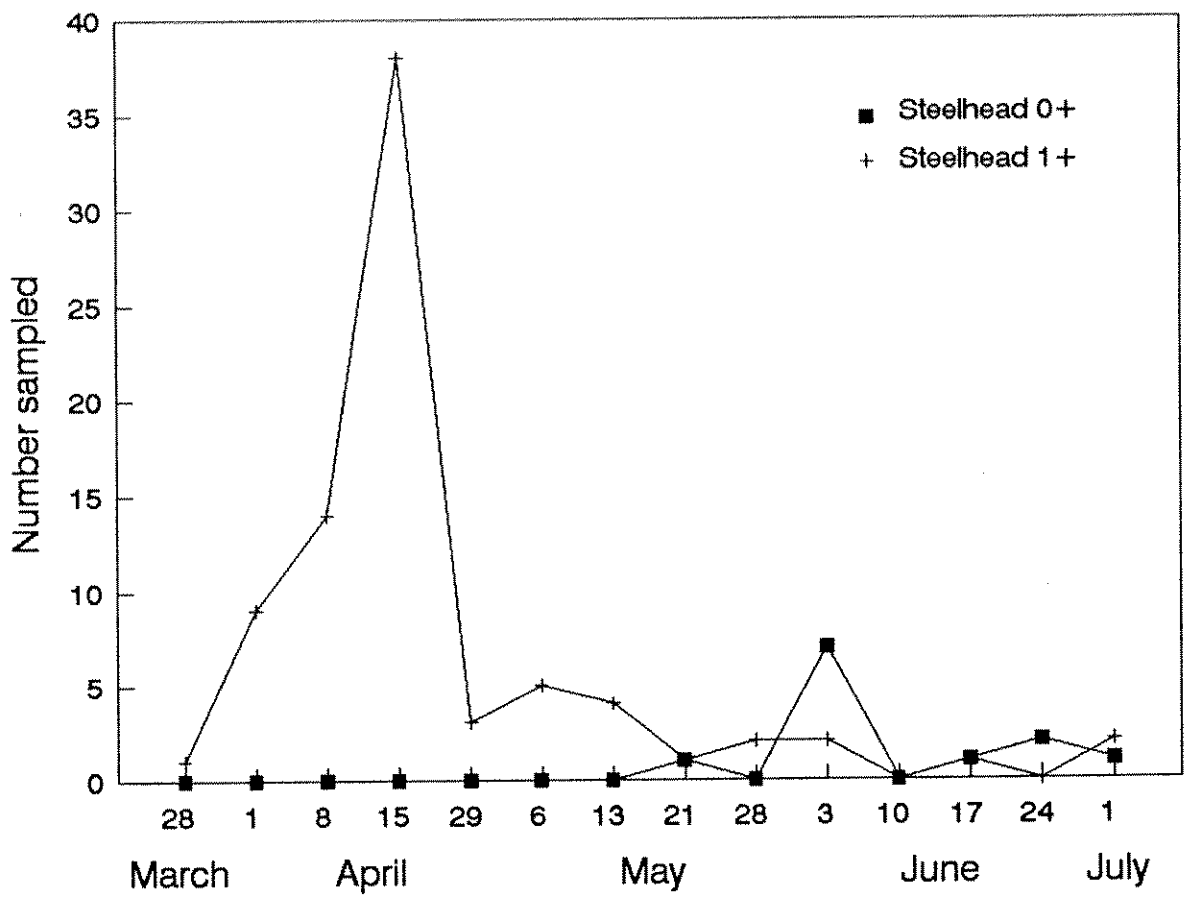


Figure 8. Steelhead fry and yearling outmigrant timing from Mettah Creek, 1991.

Table 13. Mettah Creek trapping and salmonid catch data in 1991.

Date	Weather[a] at trap Set/Pull	Percent Stream Sampled	Total Hours Fished	Temperature Max-Min (C^{O})	Flow (ft/sec)
3/28/91	PC/Cl	17	22:00	11.7 - 8.3	2.41
4/01/91	LR/PC	100	23:40	10.0 - b	2.83
4/08/91	LR/LR	100	22:00	10.0 - 7.8	2.94
4/15/91	PC/PC	100	22:15	10.0 - 7.8	2.71
4/29/91	Cl/Oc	100	23:00	11.1 - 7.8	2.37
5/06/91	LR/Oc	100	23:00	11.1 - 10.0	1.89
5/13/91	LR/PC	100	23:50	11.1 - 8.9	1.79
5/21/91	Cl/Cl	100	23:35	11.1 - 9.4	2.32
5/28/91	Cl/LR	100	23:40	11.7 - 10.0	2.17
6/03/91	Cl/Cl	100	23:15	13.3 - 8.9	1.62
6/10/91	Cl/Cl	100	22:20	15.0 - 11.1	1.53
6/17/91	Cl/Cl	100	24:30	13.3 - 10.5	2.27
6/24/91	Oc/Oc	100	23:00	14.4 - 10.0	1.46
7/01/91	Cl/Cl	100	18:15	15.5 - 12.2	1.76

	Salmonid Catch					
		Steelhead			Cutthroat	
Date	Chinook	Fry	Yearlings	Coho	Trout	Chum
3/28/91	0	0	1	0	0	0
4/01/91	0	0	9	0	0	0
4/08/91	0	0	14	0	0	0
4/15/91	0	0	38	0	0	0
4/29/91	0	0	3	0	0	0
5/06/91	0	0	5	0	1	0
5/13/91	0	0	4	0	0	0
5/21/91	0	1	1	0	0	0
5/28/91	0	0	2	0	0	0
6/03/91	0	7	2	1	0	1
6/10/91	0	0	0	0	0	0
6/17/91	0	1	1	0	0	0
6/24/91	0	2	0	0	0	0
7/01/91	0	1	2	0	0	0
Total	0	12	82	1	1	1

[a]Weather at time of trap installation and removal: Cl= Clear, PC= Partly Cloudy, Oc= Overcast, LR= Light Rain, HR= Heavy Rain.
b Maximum temperatures only due to equipment malfunction.

Table 14. Physical stream characteristics and inventory ratings for Roach Creek.

Reach	RKM	Channel Type	% Habitat Types: Pool	Flat-Water	LGR	HGR	Cascade Falls
1	0.75-1.0	A2	75	0	0	25	0
2	1.75-2.0	A2	71	15	0	0	14
3	2.75-3.0	A2	64	27	0	9	0
4	3.75-4.0	A2	70	30	0	0	0

Reach	Mean Stream (meters): Width	Depth	Pool Depth	Bankfull Width	Dominant Instream Cover[a]	Substrate Mix[b]	Percent Embeddedness
1	15.3	0.5	1.0	30.0	Sub.	BoCG	5-25%
2	10.2	0.8	1.3	19.0	Sub.	BoCG	5-25%
3	11.3	0.5	1.4	13.2	Sub.	BoCG	5-25%
4	20.3	0.4	1.1	25.0	Sub.	BoCG	25-50%

Reach	Ratings[c]: Rearing Habitat	Spawning Habitat	Riparian Cover	Streambank Stability	Number Large Woody Debris: Instream	Recruitment
1	Exc	Min	Exc	Exc	1	25
2	Exc	Fair	Exc	Exc	2	31
3	Exc	Fair	Exc	Exc	0	22
4	Exc	Min	Exc	Exc	0	18

[a]Instream Cover: Sub.= Substrate.
[b]Substrate Mix: F=Fines, S=Sand, G=Gravels, C=Cobbles, Bo=Boulders, Be=Bedrock: dominant type listed first in sequence.
[c]Rating: Exc=Excellent, Mod=Moderate, Fair, Min=Minimal, Ext=Extreme

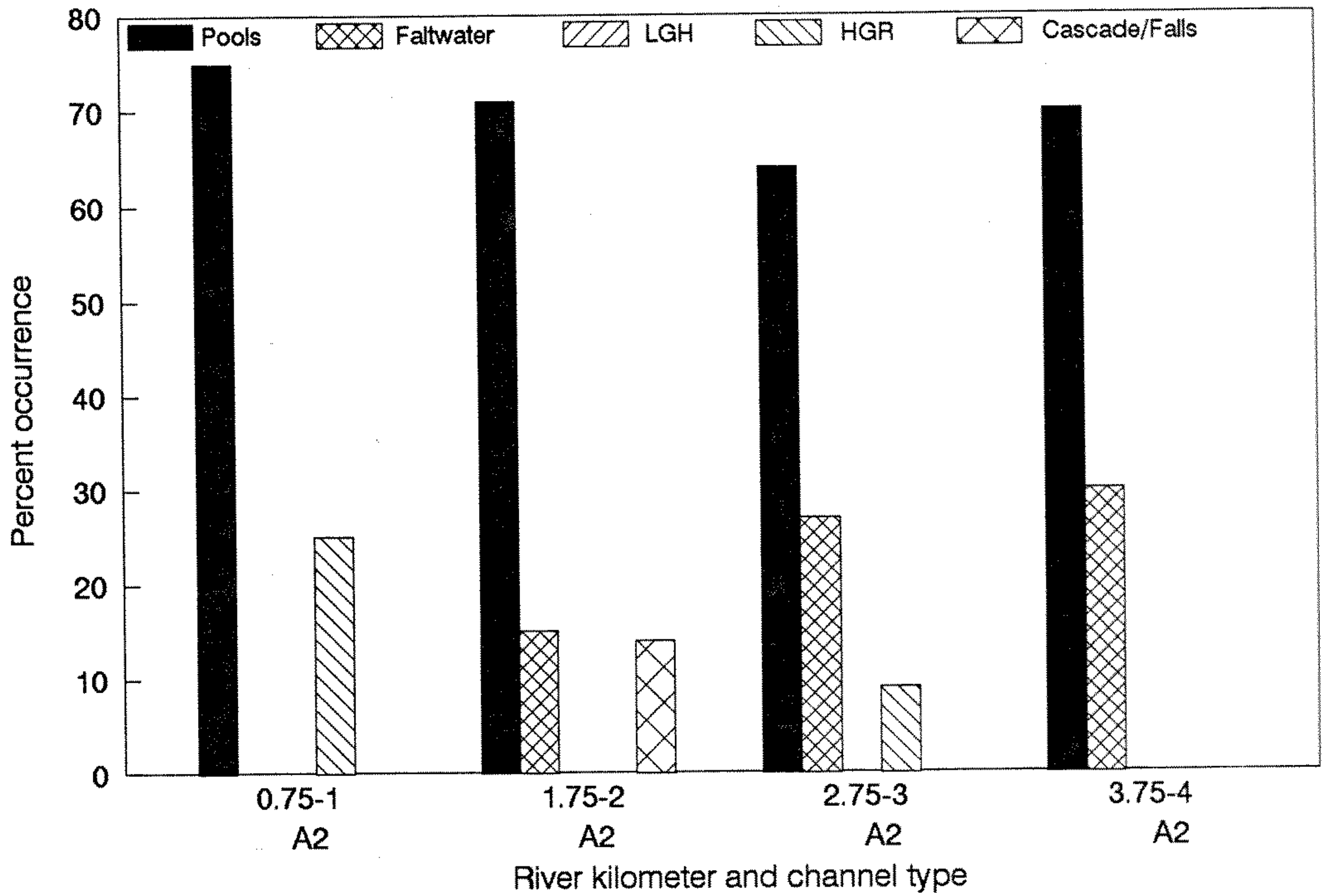


Figure 9. Roach Creek channel and habitat types, 1991.

Table 15. Roach Creek trapping and salmonid catch data in 1991.

Date	Weather[a] at trap Set/Pull	Percent Stream Sampled	Total Hours Fished	Temperature Max-Min (C^{O})	Flow (ft/sec)
4/01/91	LR/PC	60	24:00	11.1 - 7.8	3.15
4/08/91	Oc/Oc	60	24:30	b - 4.4	2.72
4/15/91	LR/Cl	63	22:20	8.9 - 6.1	3.34
4/22/91	Oc/Oc	100	23:50	10.0 - 8.3	2.36
4/29/91	Cl/Oc	100	24:00	12.2 - 8.3	2.98
5/06/91	Oc/Oc	100	24:45	11.1 - 9.4	2.95
5/13/91	LR/Cl	100	23:50	12.2 - 8.9	2.98
5/21/91	Cl/Cl	100	24:40	12.8 - 10.0	3.61
5/28/91	Cl/LR	100	24:30	12.8 - 10.0	2.73
6/03/91	Cl/Cl	100	24:45	13.9 - 9.4	2.65
6/10/91	Cl/Cl	100	23:15	17.2 - 9.4	2.45
6/17/91	Cl/Cl	100	25:10	14.4 - 11.1	2.66
6/24/91	Oc/Oc	100	22:30	14.4 - 12.2	2.19
7/01/91	Cl/Cl	100	18:40	18.9 - 15.5	1.89
7/02/91	Cl/Cl	100	24:00	18.3 - 15.5	1.80
7/08/91	Cl/Cl	100	26:45	21.1 - 16.7	2.00
7/15/91	LR/LR	100	16:00	18.9 - 16.7	2.07

	Salmonid Catch				
		Steelhead			Cutthroat
Date	Chinook	Fry	Yearlings	Coho	Trout
4/01/91	0	0	5	0	0
4/08/91	0	0	2	0	0
4/15/91	0	0	14	9	0
4/22/91	0	0	10	0	0
4/29/91	0	0	3	0	0
5/06/91	0	0	0	4	0
5/13/91	0	1	1	0	0
5/21/91	0	1	2	0	0
5/28/91	0	44	0	0	0
6/03/91	0	3	2	9	0
6/10/91	0	35	0	1	0
6/17/91	0	5	0	3	0
6/24/91	0	1	2	1	0
7/01/91	1	4	1	0	0
7/02/91	3	1	2	4	0
7/08/91	2	1	1	3	0
7/15/91	0	31	0	3	0
Total	6	127	45	37	0

[a]Weather at time of trap installation and removal: Cl= Clear, PC= Partly Cloudy, Oc= Overcast, LR= Light Rain, HR= Heavy Rain.
b Maximum temperatures only due to equipment malfunction.

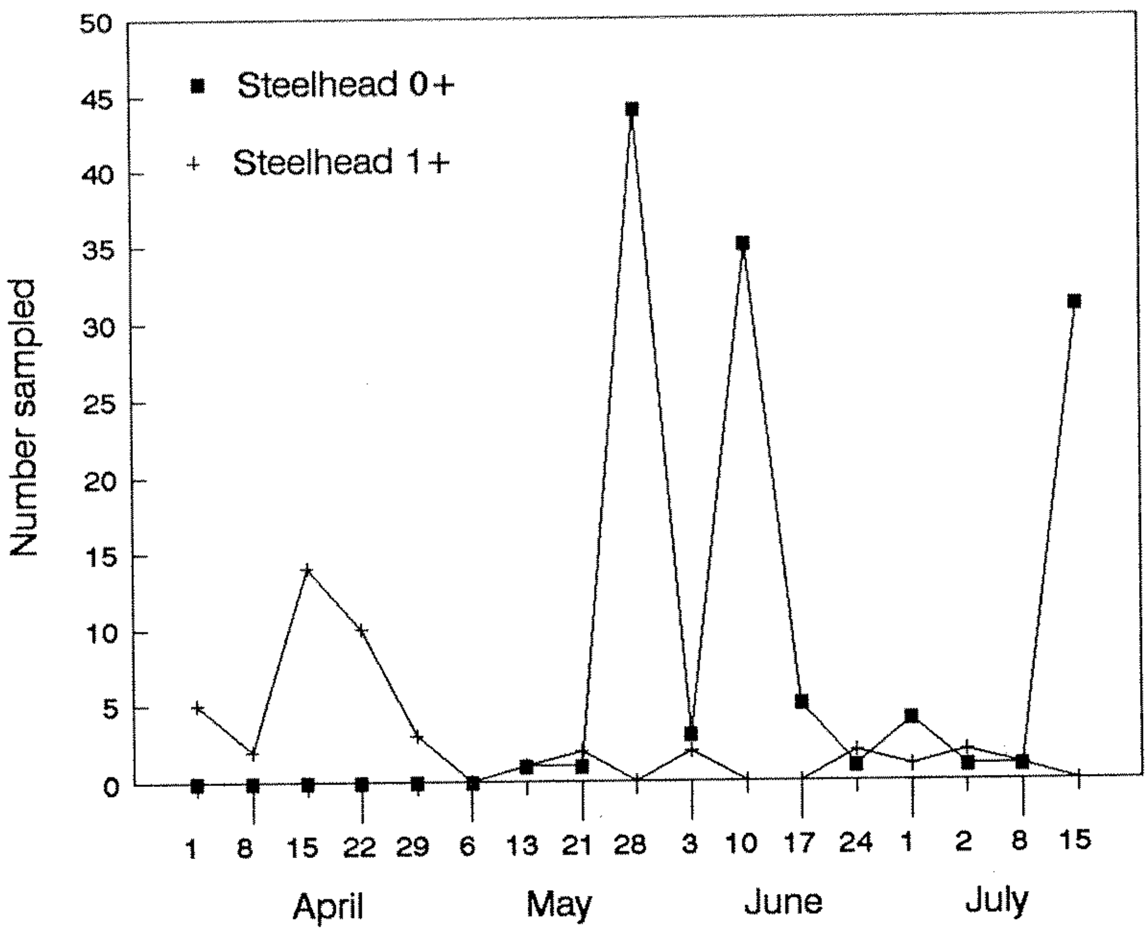


Figure 10. Steelhead fry and yearling outmigrant timing from Roach Creek, 1991.

second peak emigration could have been prompted by an increase in water temperatures. The third steelhead fry migration occurred during a spring freshet. Steelhead yearlings peak emigration occurred in mid-April. Peak yearling steelhead emigrations from Roach Creek in 1989 (Noble and Lintz 1990) and 1991 occurred during the same calendar time period. The steelhead yearlings ranged in length from 82 to 202 mm, with a mean of 110 mm. The coho migrants did not exhibit any emigration peaks, and were sampled throughout the trapping period. The six chinook ranged in length from 69 to 105 mm. These chinook may have entered Roach Creek to escape the high temperatures of the Klamath River.

Trapping Summary

In High Prairie, Tarup, and Surpur Creeks yearlings made up the majority of the catch (Table 5). With only yearling fish captured in High Prairie and Tarup creeks, and only one fry captured in Surpur Creek, it is probable that very few or no adults of the 1990 return year entered these streams to spawn. The low number of young of the year captures in the tributaries could be due to the effects of six years of drought combined with low numbers of returning adults into the Klamath River. Our spawning ground surveys found very few redds which reflect the low number of adults returning to the Klamath River system. Another possible contributing factor is poor survival of eggs and fry to the outmigrant life stage. But, with steelhead yearlings (coho and cutthroat trout to a lesser extent) emigrating from these creeks, overwintering habitat seems to be available.

Improving access into the streams would enhance the possibility of spawners entering the creeks during the few opportunities available. Payne (1989) documented the physical characteristics of deltas occurring at the mouths of Bear, Tectah, and Roach creeks and recommended a monitoring program to evaluate the passage conditions of all tributary mouths and taking site specific actions to correct these conditions. By monitoring the creek mouths and providing a channel for adult migrations the returning fish would have greater opportunities to enter the creeks. Any efforts to create a channel through the creek mouth would begin after the stream has a surface flow. If the stream mouth is found inadequate for passage a channel would be dug to breach the mouth of the stream. The opened stream channel would be periodically inspected to assure continued passage and modified if so needed. This effort to open the creek mouths would not take a large amount of labor and could potentially increase salmonid utilization and production.

Three Year Trapping Summary
(1989, 1990, and 1991)

Over the past three drought years, intermittent openings of lower Klamath River tributaries, combined with the low number of returning spawners may have reduced the production of salmonids from the lower tributaries (Fig. 11). The difference in the chinook fry catch from 152 in 1989 to 7 in 1991 is substantial, but due to the change in streams sampled each year it may not be an adequate trend representation of chinook production. The streams were sampled about 15% of all possible days. Fish

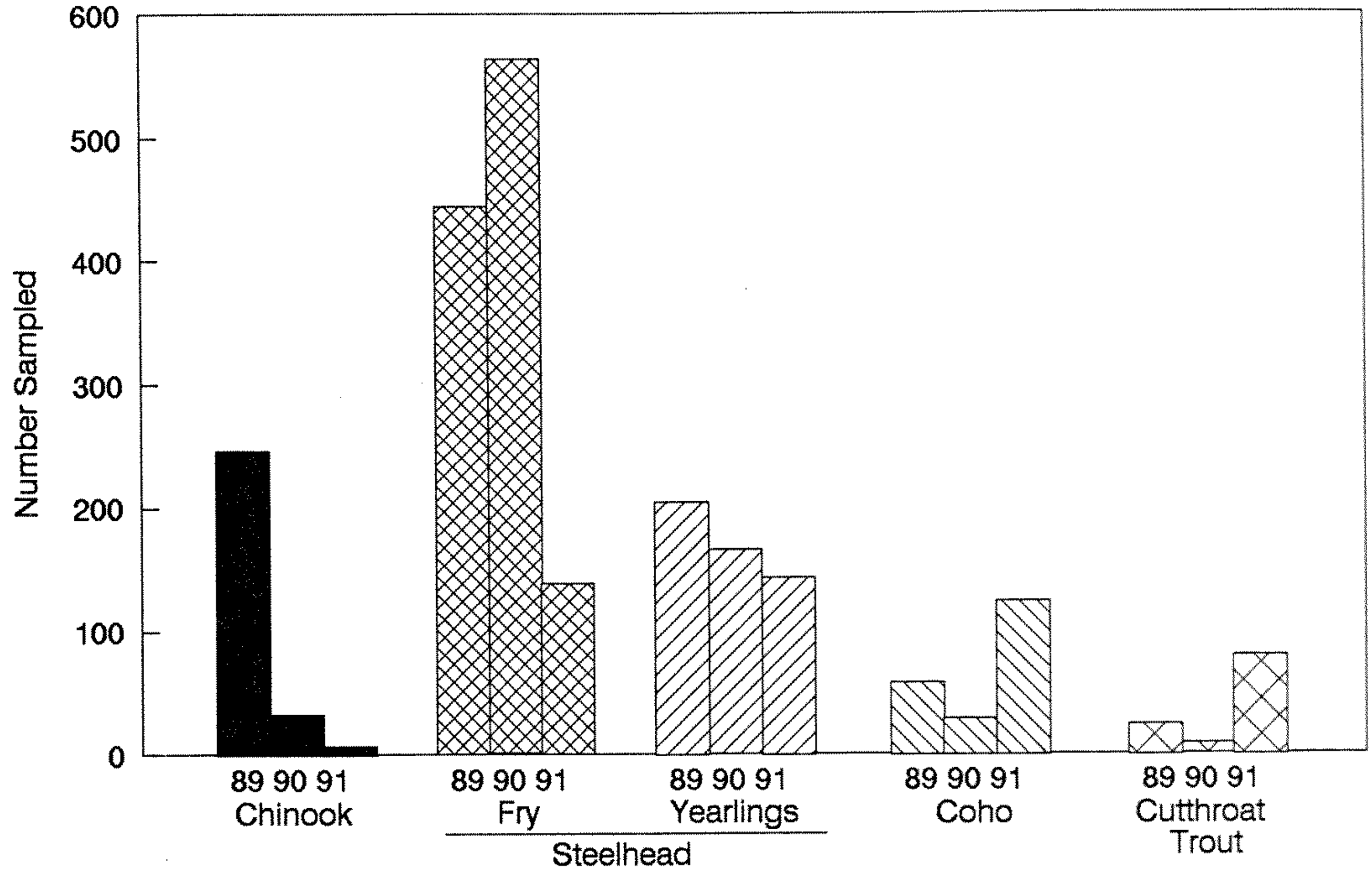


Figure 11. Juvenile salmonid trapping totals for all streams sampled in 1989, 1990, and 1991.

emigrating these streams during the non-sampling periods limits the utility of the data expansions. Using the expanded number for chinook from 1991 (40) and assuming an optimistic return of 5%, we would expect 2 adults might return. It is possible that viable chinook populations may not now exist in these small streams. Moyle et al. (1989) lists coho salmon and cutthroat trout as species of special concern, recommending that special attention be given in order to sustain their genetic diversity and to enhance their production. Special concern should be given to the remaining salmonids in the lower tributaries to the Klamath River.

Chinook were found emigrating in the highest numbers from Terwer Creek and in fewer numbers from Hunter and Tectah creeks (Table 16). Over 20 chinook redds were found in Pine Creek in the fall of 1989, however, very few chinook fry were captured in the trap. Chinook fry were also found in small numbers emigrating from Panther, Ah Pah, Bear, Surpur, Roach, and Pine creeks. The possibility of juveniles from the Klamath River or other tributaries migrating up of these streams would inflate salmonid production, or falsely identify them as salmonid producers. Hunter, Terwer, Tectah, and Pine creeks should be further investigated for salmonid production. Terwer Creek warrrants particular attention, as this watershed has been heavily logged over the last several years and future instream impacts are likely. Hunter Creek should also be monitored for chinook production, bit only the lower 3.0 rkm of stream are suitable for chinook spawning. This is due to subsurface flows above this point for most of the fall and spring, thereby stranding juvenile and adult fish upstream. Since fall chinook typically emigrate as fingerlings and do not overwinter, the upper portions of Hunter Creek are best managed as coho, steelhead and cutthroat trout streams. Also, Hunter Creek is being used by the Yurok tribal fisheries program as a location for hatchbox raised chinook releases, and to capture returning chinook adults. Chinook may not use some of these streams even in high return or normal water years when access into the streams is presumed adequate. Spawning habitat is poor in some of the streams including; Panther Creek, which lacked spawning gravels (Noble and Lintz 1989), High Prairie Creek, with inadequate substrate size and embeddedness, and Tully Creek, with it's steep gradient near the mouth and no suitable spawning gravels below the barrier at rkm 1.24.

Coho were captured in all but High Prairie, Surpur, Pecwan and Pine creeks (Table 16). With only one year of catch data (two years for Pine Creek) from these streams their use by coho can not be fully determined. The numbers of coho sampled from all streams was low and relative to 1989 showed a decline in 1990 and an increase in 1991 (Fig. 11). This "increase" is due to higher catches from Ah Pah and Roach creeks. The number of coho juveniles observed in any one year is negligible.

Steelhead fry were captured only from Tectah, Pecwan, Mettah, Roach, Tully, and Pine creeks (Fig. 12). Whereas, steelhead yearlings were captured in all but High Prairie and Pecwan creeks. Pine, Tully, and, Roach creeks contain steep gradients and high flows which may be responsible for effectively flushing steelhead fry from their systems. The streams downstream from Roach Creek contain lower gradients, lower flows, and are prone to subsurface flows in early spring which efficiently retain the steelhead fry. The overwintering habitat in these streams becomes very important to steelhead production.

Table 16. Trapping totals from the sampled lower tributaries in 1989, 1990, and 1991.

1989

Stream	# of Days Sampled	Chinook	Steelhead Fry	Steelhead Yearling	Coho	Cutthroat Trout
Hunter	9	30	0	3	1	1
Terwer	15	117	4	94	37	8
Tarup	6	0	0	10	2	7
Ah Pah	12	2	0	5	7	8
Bear	6	3	1	10	3	0
Tectah	11	87	85	22	6	0
Pecwan	7	0	6	0	0	0
Roach	8	4	250	60	2	0
Tully	7	0	89	0	0	0
Pine	7	4	10	1	0	0

1990

Stream	# of Days Sampled	Chinook	Steelhead Fry	Steelhead Yearling	Coho	Cutthroat Trout
Hunter	12	4	1	50	2	6
Panther	12	1	0	6	13	2
Bear	10	6	0	26	1	1
Tectah	15	19	0	65	12	0
Tully	12	0	278	9	1	0
Pine	9	2	284	8	0	0

1991

Stream	# of Days Sampled	Chinook	Steelhead Fry	Steelhead Yearling	Coho	Cutthroat Trout
High Prairie	8	0	0	0	0	7
Tarup	4	0	0	7	5	55
Ah Pah	15	0	0	4	82	11
Surpur	14	1	0	6	0	6
Mettah	14	0	12	82	1	2
Roach	17	6	127	45	37	0

Yearly Totals

Year	Number of days	Chinook	Steelhead Fry	Steelhead Yearlings	Coho	Cutthroat Trout
1989	88	247	445	205	58	24
1990	70	32	563	167	29	9
1991	72	7	139	144	125	81
TOTALS	230	286	1147	516	212	114

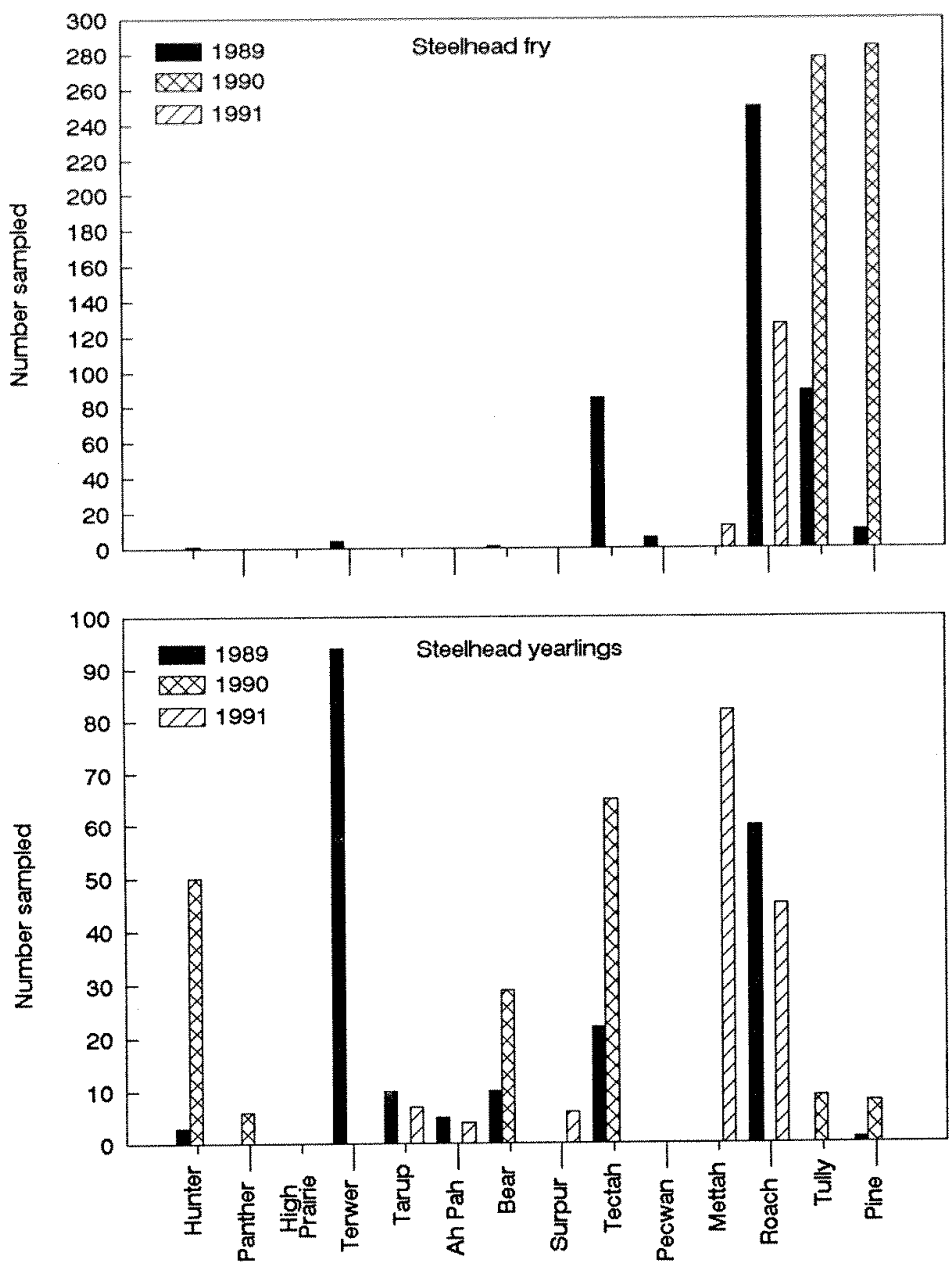


Figure 12. Steelhead fry and yearlings emigrating from the lower tributaries in 1989, 1990, and 1991.

Cutthroat trout yearlings were sampled in all streams below Mettah Creek (Klamath River km 46), with the exception of Pecwan and Tectah Creeks (Table 16). Tarup Creek held 54% of all cutthroat trout sampled from all streams during the three trapping years. The mouth of Tarup Creek has a pond which must fill before it can flow into the Klamath River. Filling this pond delays fall adult migrations into the creek each year. The pond may also be contributing to the success of cutthroat trout in this stream by providing rearing habitat.

Multiple years of sampling are needed particularly during normal climatic regimes to fully determine juvenile salmonid production from the lower tributaries. The three years of data, gathered during drought conditions, indicate that these streams are underutilized by chinook. The low numbers of returning adults may be a primary factor in the poor chinook production from the creeks. This combined with the limited access into the creeks, especially during dry years, raises concerns to their stock viability. Therefore, to increase escapement for any returning adults into the tributaries the stream mouths of Tarup, Bear, Surpur, Tectah, Mettah, and Roach creeks should be given the priority for monitoring and modification. Each fall, inspections could be made to ensure that passage is unimpaired for the few returning adults. If low water or stream access is keeping adult fish from using their natal stream these fish may spawn in the mainstem or enter other open tributaries, like Blue and Pine creeks. To alleviate other pressures on the stock efforts should be made to reduce the harvest of fish in the Klamath River near the creek mouths while fish are holding and waiting to migrate upstream.

Summary of Recommendations

Listed below is a summary of recommendations for the streams sampled. Priority should be given to highlighted streams. Hunter, Terwer, Tectah and Pine creeks could be used to gather further information on chinook production.

Hunter Creek. Restrict livestock and establish a riparian zone along the first kilometer of the creek and enhance spawning and rearing habitat below rkm 5.0.

Tarup Creek: Modification (dredging, slope alteration) of the pond at rkm 0.25, and repair or removal of the failing log and dirt bridge at rkm 4.5.

Surpur Creek: Yearly monitoring and modification of the mouth and removal of the log barrier at rkm 1.4, and addition of spawning gravel retention structures.

Mettah Creek: Yearly monitoring and modification of the mouth, removal or modification to a low flow barrier at rkm 1.82, and addition of spawning gravel retention structures.

Roach Creek: Removal or modification of low flow barriers at rkm 0.3 and 1.6.

Salt Creek: Remove beaver dams below confluence of High Prairie Creek to aid in fish passage.

High Prairie Creek: Increase rearing habitat diversity from the mouth to rkm 2.0 and removal or modification of log jams.

Terwer Creek: Timber harvesting of the watershed and gravel extraction have placed stresses on this system. Their impacts should be monitored and rectified as needed.

Ah Pah Creek: Remove or modify log jams at rkm 4.9, 5.16, and 5.85, which may be obstacles to immigrations.

Bear Creek: Yearly monitoring and modification of the mouth, modification or removal of a 2.5 m falls at rkm 3.0, addition of gravel retention structure to increase spawning habitat below rkm 3.5.

Tectah Creek: Yearly monitoring and modification of the mouth.

Tully Creek: Removal or modification of a low flow barrier at rkm 1.24, improving access into the stream by reduction or modification of the steep gradient over the first 0.25 rkm.

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PERSONAL COMMUNICATIONS

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Appendix A. Channel classification as described by Rosgen 1985.

Stream Type	Gradient (%)	Dominant Partical Size of Channel Materials	Channel Entrenchment Valley Confinment
A1	4-10	Bedrock	Very deep; very well confined
A1-a	10+	Same as A1	
A2	4-10	Large & small boul-ders w/mixed cob-bles	Same as A1
A2-a	10+	Same as A2	
A3	4-10	Small boulders, cobbles, coarse gravels, some sand.	Same as A1
A3-a	10+	Same as A3	
A4	4-10	Predominantly gravel, sand, and some silts.	Same as A1
A4-a	10+	Same as A4	
A5	4-10	Silt and/or clay bed and bank materials.	Same as A1
A5-a	10+	Same as A5	

Stream Type	Gradient (%)	Dominant Partical Size of Channel Materials	Channel Entrenchment and Valley Confinement
B1-1	1.5-4.0	Bedrock bed:banks are cobble, gravel, some sand.	Shallow entrenchment; moderate confinment
B1	2.5-4.0 (X=3.5)	Predominately small boulders and very large cobble.	Moderate entrenchment; moderate confinment
B2	1.5-2.5 (X=2.0)	Large cobble mixed w/small boulders and coarse gravels	Moderate entrenchment; moderate confinment
B3	1.5-4.0 (X=2.5)	Cobble bed w/mixture of gravel and sand. Some small boulders	Moderate entrenchment; well confined
B4	1.5-4.0 (X=2.0)	Very coarse gravel w/cobbles, sand and finer materials	Deeply entrenched; well
B5	1.5-4.0 (X=2.5)	Silt / clay	Deeply entrenched; well confined.
B6	1.5-4.0	Gravel w/few cobbles and w/noncohsive sand and finer soil.	Deeply entrenched; slightly confined

Appendix A continued. Channel classification as described by Rosgen 1985.

Stream type	Gradient (%)	Dominant Particale Size of Channel Materials	Channel Entrenchment Valley Confinment
C1-1	1.5 or less (X=1.0)	Bedrock bed, gravel sand or finer banks.	Shallow entrenchment; partially confined.
C1	1.0-1.5 (X= 1.3)	Cobble, coarse gravel bed, gravel, sand banks.	Moderate entrenchment; well confined.
C2	0.3-1.0 (X=0.6)	Large cobble bed w/mixture of small boulders and coarse gravel.	Moderate entrenchment; well confined.
C3	0.5-1.0 (X=0.8)	Gravelbed w/mixture of small cobble and sand.	Moderate entrenchment; slightly confined.
C4	0.1-0.5 (X=0.3)	Sandbed w/mixture of gravel and silt. No bed armor.	Moderate entrenchment; slightly confined.
C5	0.1 or less (X=0.05)	Silt clay w/mixture of medium to fine sand, no bed armor.	Moderate entrenchment; slightly confined.
C6	0.1 or less (X=0.05)	Sandbed w/mixture of silt and some gravel.	Deeply entrenched; unconfined.

Stream Type	Gradient (%)	Dominant Particle Size of Channel Materials	Channel Entrenchment Valley Confinement
D1	1.0 or greater (X=2.5)	Cobble bed w/mixture of coarse gravel, sand, and small boulders.	Slightly entrenched; no confinement.
D2	1.0 or less (X=1.0)	Sandbed w/mixture of small to medium gravel and silt.	Slightly entrenched; no confinement.
F1	1.0 or less	Bedrock bed w/few boulders, cobble and gravel.	Total confinement.
F3	1.0 or less	Cobble/gravel bed with locations of sand in depositional sites.	Same as F1
F4	1.0 or less	Sand bed with smaller amounts of silt and gravel.	Same as F1
F5	1.0 or less	Silt/clay bed and banks with smaller amounts of sand.	Same as F1

APPENDIX B

Habitat types as described by McCain et al. (1990) listing the five general types used on the lower tributaries (pools, flatwater, low gradient riffle, high gradient riffles, cascades/falls).

Appendix B. Habitat types and descriptions.

HABITAT TYPES

Number	Name	Description
POOLS:		
4	Secondary Channel Pool (SCP):	Pools formed outside of the average wetted channel width. During summer, these pools will dry up or have very little flow. Mainly associated with gravel bars and may contain sand and silt substrates.
5	Backwater Pool (BwBo): Boulder Formed	Found along channel margins and caused by eddies around obstructions such as boulders, rootwads, or woody debris. These pools are usually shallow and are dominated by fine grain substrates. Current velocities are quite low.
6	Backwater Pool (BwRw): Root Wad Formed	Same description as 5.
7	Backwater Pool (BwL): Log Formed	Same description as 5.
8	Trench/Chute (TRC):	Channel cross sections typically U-shaped with bedrock or coarse grained bottom flanked by bedrock walls. Current velocities are swift and the direction of flow is uniform. May be pool-like.
9	Plunge Pool (PLP):	Found where stream passes over a complete or nearly complete channel obstruction and drops steeply into the streambed below, scouring out a depression; often large and deep. Substrate size is highly variable.
10	Lateral Scour Pool (LsL): Log Formed	Formed by flow impinging against one streambank or against a partial channel obstruction. The associated scour is generally confined to <60% of wetted channel width. Channel obstructions include rootwads, woody debris, boulders and bedrock.
11	Lateral Scour Pool (LsRw): Root Wad Formed	Same description as 10.
12	Lateral Scour Pool (LsBk): Bedrock Formed	Same description as 10.

Appendix B. continued

HABITAT TYPES

Number	Name	Description
13	Dammed Pool (DPL):	Water impounded from a complete or nearly complete channel blockage (debris jams, rock landslides or beaver dams). Substrates tend toward smaller gravels and sand.
17	Mid-Channel Pool (MCP):	Large pools formed by mid-channel scour. The scour hole encompasses more than 60% of the wetted channel. Water velocity is slow, and the substrate is highly variable.
18	Edgewater (EGW):	Quiet, shallow area found along the margins of the stream, typically associated with riffles. Water velocity is low and sometimes lacking. Substrates vary from cobbles to boulders.
19	Channel Confluence Pool (CCP):	Large pools formed at the confluence of two or more channels. Scour can be due to plunges, lateral obstructions or scour at the channel intersections. Velocity and turbulence are usually greater than those in other pool types.
20	Lateral Scour Pool (LsBo): Boulder Formed	Formed by flow impinging against boulders that create a partial channel obstruction. The associated scour is confined to <60% of wetted channel width.
22	Corner Pool (CRP):	Lateral Scour Pools formed at a bend in the channel. These pools are common in lowland valley bottoms where stream banks consist of alluvium and lack hard obstructions.
23	Step Pool (STP):	A series of pools separated by short riffles or cascades. Generally found in high gradient, confined mountain streams dominated by boulder substrate.

Appendix B. Continued.

HABITAT TYPES Number	Name	Description
FLATWATER:		
14	Glides (GLD):	A wide uniform channel bottom. Flow with low to moderate velocities, lacking pronounced turbulence. Substrate usually consists of cobble, gravel and sand.
15	Run (RUN):	Swiftly flowing reaches with little surface agitation and no major flow obstructions. Often appears as flooded riffles. Typical substrates are gravel, cobble and boulders.
16	Step Run (SRN):	A sequence of runs separated by short riffle steps. Substrates are usually cobble and boulder dominated.
24	Bedrock Sheet (BRS):	A thin sheet of water flowing over a smooth bedrock surface.
LOW GRADIENT RIFFLE:		
1	Low Gradient Riffle (LGR):	Shallow reaches with swiftly flowing, turbulent water with some partially exposed substrate. Gradient <4%, substrate is usually cobble dominated.
21	Pocket Water (POW):	A section of swift flowing stream containing numerous boulders or other large obstructions which create eddies or scour holes (pockets) behind the obstructions.
HIGH GRADIENT RIFFLES:		
2	High Gradient Riffle (HGR):	Steep reaches of moderately deep, swift, and very turbulent water. Amount of exposed substrate is relatively high. Gradient is >4%, and substrate is boulder dominated.
CASCADE/FALLS:		
3	Cascade (CAS):	The steepest riffle habitat, consisting (CAS/FALLS) of alternating small waterfalls and shallow pools. Substrate is usually bedrock and boulders.

APPENDIX C

Criteria for rating habitat variables in lower tributaries to the Klamath River.

Appendix C. Lower Tributary inventory ratings and codes.

REARING HABITAT RATING:

Excellent: Quality rearing habitat is abundant, >50% of total 100 m reach; cover complexity is high; water temperatures never reach 21.1 degrees Celsius (°C).

Moderate: Quality rearing habitat is frequent and generally occurs in pockets along stream edges and the tail of riffles where cover complexity is moderate; generally 25 - 50% of total 100 m reach; water temperatures remain below 21.1°C.

Fair: Quality rearing habitat is infrequent and occurs in occasional isolated pockets usually along stream edges, generally <25% of total 100 m reach; cover complexity is low; water temperatures may reach up to 21.1°C infrequently during the summer months.

Minimal: Rearing habitat consists of isolated pockets of marginal habitat at best, <25% of total 100 m reach; very little or no overhead or instream cover; water temperatures may frequently reach or exceed 21.1°C.

No rearing habitat available.

RIPARIAN ZONE/COVER RATING: (Modified from Hamilton and Bergerson 1984)

Excellent: Combined cover of trees, shrubs, grass, and forbs >90% of the ground. Openings in this nearly complete cover are small and evenly dispersed. A variety of plant species and age classes are represented. Growth is vigorous and reproduction of species in both the under- and overstory is proceeding at a rate to ensure continued ground cover conditions. A deep, dense root mat is assumed. The potential for recruitment of LWD in the stream is high.

Moderate: Plants cover between 70 and 90% of the ground. Shrub species are more prevalent than trees. Openings in the tree canopy are larger than the space resulting from the loss of a single mature individual. Although growth vigor is generally good for all species, advanced reproduction may be sparse or lacking. A deep root mat is not continuous, and serious erosion is possible in the openings. Potential recruitment of LWD in the stream is moderate.

Fair: Plant cover ranges from 50 to 70%. Lack of vigor is evident in some individuals or species. Seedling reproduction is nil. This condition is ranked fair, based mostly on the percent of the area not covered by vegetation with a deep root mat potential and less on the kind of plants that make up the overstory. Potential recruitment of LWD in the stream is low.

Minimal: Less than 50% of the ground is covered by vegetation. Trees are virtually absent. Shrubs exist largely in scattered clumps and grass and forbs may dominate. Growth and reproduction vigor is generally poor. Root mats are discontinuous and shallow. There is very poor potential for recruitment of LWD in the stream.

Extreme: Over 50% of the ground has no vegetation, and the dominant material is soil, rock, bridge materials, road materials, culverts, and mine tailings. When vegetation is present, it is in the form of sparse grasses and forbs. There is no potential for recruitment of LWD in the stream.

Appendix C. continued.

SPAWNING HABITAT RATING:

Excellent: Quality spawning habitat is abundant at tail-out of pools, in glides and runs, and in isolated pockets behind large substrate, >50% of total 100 m reach; embeddedness and armoring are low; fines compose <10% of total substrate composition; pools are numerous and generally >1 m in depth.

Moderate: Quality spawning habitat is available in frequent isolated pockets often immediately downstream of large substrate or in the tail-out of pools, usually 25 -50% of total 100 m reach; embeddedness and armoring are moderate; fines compose <15% of total substrate composition; pools are usually few in number but often >1 m in depth.

Fair: Spawning habitat is largely marginal in character but quality habitat does occur infrequently in isolated pockets, <25% of total 100 m available for spawning; embeddedness and armoring are high; fines may compose 15 - 25% of total substrate composition; pools are generally shallow.

Minimal: Spawning habitat is marginal in character and gravels occur in isolated pockets, <25% of total 100 m available for spawning; embeddedness and armoring are high; fines often compose >25% of total substrate composition or substrate is too large to be used for redd material; pools are infrequent and shallow.

No spawning habitat available.

STREAMBANK STABILITY RATING: (Modified from Armour et al. 1983)

Excellent: Over 80% the streambank surfaces are covered by vegetation in vigorous condition. If the streambank is not covered by vegetation, it is protected by materials that do not allow bank erosion (i.e. bedrock, boulders and cobble, etc.). Streambanks are stable and are not being altered by water flows or animals.

Moderate: Between 50 and 79% of the streambank surfaces are covered by vegetation. Areas not covered by vegetation are protected by materials that allow only minor erosion, such as gravel or larger materials. Streambanks may be stable or lightly altered in that <25% are false, broken down, or eroding.

Fair: Between 25 and 49% of the streambank surfaces are covered by vegetation. Areas not covered by vegetation are covered by materials that give limited protection, including gravel or larger materials. Streambanks may be moderately altered where less than 50% of the streambanks are false, broken down, or eroding.

Minimal: Less than 25% of the streambank surfaces are covered by vegetation or by gravel or larger material. Areas not covered by vegetation have little or no protection from erosion, and the banks are usually eroded some each year by high water flows. Between 50 and 75% of the streambank is false, broken down, or eroding.

Extreme: Less than 5% of the streambank surfaces are covered by vegetation or by gravel or larger material. Areas not covered by vegetation are actively eroding and exhibit mass wasting that contributes fines to the channel even during light rains. Over 75% of the streambank is false, broken down, or eroding.

Appendix C. continued.

SUBSTRATE MIXTURE AND EMBEDDEDNESS: (Armour et al. 1983)

Substrate Mix:
Fines (<0.1 mm)
Sand (0.1 mm - .4 cm)
Gravel (0.4 - 7 cm)
Cobble (7 - 25 cm)
Boulder (>25 cm)
Bedrock

Embeddedness:
Gravel, cobble, and boulder particles have less than 5% of their surface covered by fine sediment.
Gravel, cobble, and boulder particles have between 5 and 25% of their surface covered by fine sediment.
Gravel, cobble, and boulder particles have between 25 and 50% of their surface covered by fine sediment.
Gravel, cobble, and boulder particles have between 50 and 75% of their surface covered by fine sediment.
Gravel, cobble, and boulder particles have over 75% of their surface covered by fine sediment.

INSTREAM COVER TYPES:

1 = Undercut banks
2 = SWD (<12"dbh)
3 = LWD and Rootwads
4 = Terrestrial vegetation
5 = Aquatic vegetation
6 = White water
7 = Boulders/Substrate
8 = Bedrock ledges