Lower Salmon River Sub-basin Fish Habitat Condition and Utilization Assessment

1990/1991

Final Report

Prepared by

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EXECUTIVE SUMMARY

The Klamath River system provides habitat for chinook salmon *Oncorhynchus tshawytscha*, coho salmon *O. kisutch*, steelhead trout *O. mykiss*, and other anadromous and non-anadromous species. Aquatic habitat quality and quantity may determine the number of salmon and steelhead juveniles which survive to smolt and enter the Klamath River estuary. The Salmon River remains one of the larger tributaries considered important to the maintenance of wild salmonid populations in the Klamath system between Iron Gate dam and the Trinity River (Kier et al. 1991).

Little site specific information was available on habitats being selected by salmon and steelhead, overall condition and availability of spawning and rearing habitat, and extent of habitat utilization prior to these investigations.

The Klamath National Forest conducted investigations of fish habitat condition and utilization in the upper Salmon River subbasin under an Interagency Agreement with the U.S. Fish and Wildlife Service in fiscal year 1989. Two reports summarizing the results of field work completed between October 1, 1988 and September 30, 1989 were published in 1990 (West et al. 1990; Olson and West 1990). In 1989 the Klamath National Forest proposed to expand rearing and spawning habitat investigations to include anadromous habitat in the lower Salmon River subbasin. Results of spawning ground surveys undertaken in fiscal year 1990 funded under Interagency Agreement (#14-16-0001-90532) were published in January, 1992 (Olson and Dix 1992). Results of the expanded rearing habitat investigations undertaken between October 1, 1989 and September 30, 1990 are summarized in this report. In addition, habitat condition information collected in the study area during fiscal years 1991 and 1992 have been included where appropriate.

The purpose of this investigation was to expand the assessment of condition and utilization of anadromous habitat in the Salmon River sub-basin to include the mainstem and lower reaches of the North and South Forks. Inclusion of these reaches with habitat investigated in 1989 should enhance the basin-level perspective of anadromous habitat conditions in the Salmon River watershed.

The objectives of this assessment are to: (a) determine the quantity and quality of spawning and rearing habitat available to salmonids at base flow conditions, (b) estimate the observed juvenile salmon and steelhead standing crop during summer 1990 for the reaches surveyed, (c) evaluate and describe habitat utilization by juvenile salmon and steelhead in the large order river reaches investigated, (d) contrast existing habitat conditions with key habitat quality indicators.

Physical habitat inventories were conducted during summer base flow conditions using methods similar to those employed during upper South and North Fork Salmon River surveys conducted in 1989 (West et al 1990). Slight changes in habitat classification were made with the inclusion of two new habitat type descriptions, step pool and bedrock sheet. Structurally modified habitats, previously identified as enhanced weir, enhanced deflector, and enhanced pocket water were not present in any of the 1990 study area reaches.

The majority of physical habitat parameters measured in 1990 remained unchanged from 1989 investigations. Assessment of key habitat conditions with the intention of developing measurable forest standards led to the addition of a key course woody material (CWM) parameter. This entails the quantification of whole pieces of CWM where at least 20 percent of their volume exists within the bankfull channel and the dimensions equal or exceed 15.2 m long by average diameter of 61 cm.

The sampling schedule for substrate composition, embeddedness, percent shade, overstory composition, CWM recruitment potential, and enumeration of rearing salmonids was targeted for 12.5 percent. Species composition and abundance were obtained from ocular counts by divers snorkeling upstream from the lower habitat boundary. Habitat unit area and volume estimates were obtained by direct measure rather than ocular methods. Estimates of species abundance, by age class, were obtained by application of a correction factor to ocular counts stratified by run, riffle and pool unit types (Hankin and Reeves 1988). Diver efficiency was calculated by comparison of population estimates, obtained from electrofishing, to actual diver counts.

Habitat specific utilization was described using an electivity index from Jacobs (1974) to relate the proportion of the population found within a particular habitat type to the relative availability of that habitat type among all habitats sampled in the study area.

A total of 1,705,305 m^2 of habitat was identified within the wetted channel during summer low flow conditions in 1990. Units were composed of 19 habitat types, dominated by low gradient riffle (LGR), high gradient riffle (HGR) and run (by area). Lateral scour pool (LSP) and main channel pool (MCP) also composed a large portion of the habitat in the area surveyed.

The stream bed composition was dominated by cobble (76-304 mm) and boulder (>305 mm) size classes. Boulders, white water, and bedrock ledges composed the larger fraction of available object and overhead cover to fish while woody cover was largely absent.

Juvenile salmon and steelhead utilization of available habitat was assessed from sampling, by direct observation, 396 habitat units from a total of 1,518 units (sample fraction = 26%) identified during inventories of the lower North and South Forks, and mainstem Salmon River. A total of 17,105 1+ steelhead, 4,739 0+ chinook and 122 0+ coho salmon were observed in sampled units. Observation results for 0+ steelhead and 0+ coho are displayed in the Appendices, however they are not discussed at length in the narrative.

Yearling steelhead densities were clearly highest in higher velocity habitats with the exception of dammed pool (DPL), n=1. Based upon available rearing habitat, the standing crop contribution came predominantly from LGR, HGR, run, and step-run (SRN). Electivity indices, which weight habitat use to availability, again tend to show higher than average use by 1+ steelhead for riffle habitat. Plunge pool (PLP) habitat, n=4, is also highly utilized, a pattern consistent for 0+ steelhead and 0+ chinook as well.

Young of the year chinook salmon densities were highest in secondary channel pool (SCP), n=5, backwater pool (BWP), n=5, and PLP. Glide, run, SRN, and MCP habitats had the highest overall estimated standing crops based upon habitat availability. In general, electivities for 0+ chinook were highest for pool habitats and negative or average for high velocity habitats.

Other species, including green sturgeon, american shad, dace, Pacific lamprey, and suckers have been observed in the sub-basin, however, their population size and distribution were not assessed during these investigations.

Approximately 13,725 m^2 of suitable salmon and/or steelhead spawning habitat was present under summer base flow conditions during the 1989/90 study period in the lower Salmon River subbasin. Roughly 3,000 chinook redds and 9,150 steelhead redds could be accommodated by existing suitable habitat under base flow conditions, disregarding any territorial needs of either species within the study area, excluding tributary spawning area.

Information provided by this assessment quantitatively summarizes the condition of key habitat parameters in the lower South Fork, North Fork, and mainstem Salmon River. This information can also be used to assess the suitability of stream habitat from a fisheries perspective.

Sub-optimal water temperatures exist for salmonid growth for extended periods during summer months. In recent years, elevated water temperatures have undoubtedly been aggravated by drought conditions which have resulted in record low flows. The importance of the role temperature plays in growth and survival of juveniles and adult salmonids makes this parameter a priority for restoration.

Pool frequency on the South Fork (except Forks to Methodist Ck reach) and mainstem Salmon River appear to fall within a natural range expected for their channel sizes. However, none of the North Fork Salmon River reaches investigated fell within pool frequency ranges expected and are probably indicative of excess sediment storage. Structural habitat modification is not a practical remedy in these large river habitats. However, watershed restoration techniques, focusing on reducing inputs of course sediment production, may accelerate recovery of channel processes.

The present density of CWM is low and not considered representative of natural conditions, however further study is needed to develop measurable standards for this bioregion. Reintroduction of CWM to some reaches of the study area may be an appropriate and cost effective technique to increase habitat complexity. Long term recruitment can be maintained through protection and restoration of riparian areas.

The two measures of stream bed habitat quality employed (percent fines and embeddedness) provided a tool for comparing relative conditions between reaches investigated. In general, results suggest conditions may fall within suitable criteria, however validation is required.

Riparian condition parameters evaluated describe the existing condition within the study area. Our assessment indicated little shade (<15%) is currently provided by the riparian canopy and CWM recruitment may be low (< 3 trees per ha).

Assessment of spawning and summer rearing habitat utilization by salmon and steelhead is perhaps most useful from a use versus availability context. Our investigations suggest less than 25 percent of the currently available spawning habitat is utilized by average salmon and steelhead escapements returning in recent (1989-92) years within the study area.

Recommendations

(1) Establishment and implementation of measurable standards for key habitat suitability parameters for the Klamath bioregion needs to be undertaken for management, restoration planning, and monitoring.

(2) Many reaches in the study area remain under utilized by spawning salmon and steelhead despite the presence of suitable habitat conditions. The Klamath National Forest should utilize this information to ensure adequate spawning escapements are allocated by the Pacific Fisheries Management Council.

(3) Prescriptions designed to bring water temperatures closer to ranges optimal for salmonid production should focus on small (2-4 order) tributaries where riparian condition is poor. Re-establishment of native mixed composition stands of hardwoods and conifers should account for local ecological and morphological constraints. Prescribe and implement an out-year riparian restoration strategy.

(4) Traditional forms of instream restoration (eg. CWM structures) may be appropriate for restoring cover and habitat complexity where lacking in the lower Salmon River subbasin. However, successful recovery of channel scale habitat (ie. pool frequency) will be most effective using watershed restoration techniques. In general, use of instream structures should be discouraged in 6th order and larger streams.

(5) Substrate conditions need to be re-examined by quantitative, statistically valid sampling methods for describing existing conditions and monitoring. Watershed restoration measures which address chronic sources of fine sediment will provide the most effective means to maintain or improve stream bed habitat quality.

(6) Establishment of permanent stations for monitoring channel cross-section profiles can provide information on course sediment storage in critical reaches identified in this assessment. A historical record of channel profiles at USGS water gauge stations on the North Fork, South Fork, and mainstem Salmon River may be obtained for the period of record.

(7) Key pool frequency should be represented by residual pool depth rather than max depth.

(8) Bank full width measurements should be incorporated into habitat data collection protocol.

(9) Complete Watershed Improvement Needs Inventories in the Salmon sub-basin. Implement watershed restoration techniques which will reduce the risk of future catastrophic stream impacts and accelerate channel recovery.

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Introduction

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As a result of reported declines in fish production over past decades, Congress enacted the Klamath River Fish and Wildlife Restoration Act (P.L. 99-552) on October 27, 1986. This law authorized the Secretary of the Interior to restore anadromous fish populations to optimum levels in the Klamath and Trinity Rivers through a program of fish harvest management and habitat restoration. A Klamath River Fishery Management Council was established to recommend management of fish harvests and a Task Force was established to implement appropriate habitat restoration measures.

The Klamath National Forest conducted investigations of fish habitat condition and utilization in Salmon, Scott, Shasta, and Mid Klamath subbasins under an Interagency Agreement with the U.S. Fish and Wildlife Service in fiscal year 1989. Two reports summarizing the results of field work completed between October 1, 1988 and September 30, 1989 were published in 1990 (West et al. 1990; Olson and West 1990). Field work focused on identification of salmonid spawning and rearing habitat condition and use. Eleven streams (total length 208 km (125 mi)) located in Salmon, Scott, Shasta, and Mid-Klamath subbasins were investigated. In addition, the performance of ten in-stream structure types were evaluated under the same agreement and the results reported separately.

Little site specific information was available on habitats being selected by salmon and steelhead, overall condition and availability of spawning and rearing habitat, and extent of habitat utilization prior to these investigations.

In 1989 the Klamath National Forest proposed to expand rearing and spawning habitat investigations to include anadromous habitat in the mainstem Salmon River and unsurveyed reaches of the North Fork and South Fork Salmon River. Results of spawning ground surveys undertaken in fiscal year 1990 funded under Interagency Agreement (#14-16-0001-90532) were published in January, 1992 (Olson and Dix 1992). Results of the expanded rearing habitat investigations undertaken between October 1, 1989 and September 30, 1990 are summarized in this report. In addition, habitat condition information collected in the study area during fiscal years 1991 and 1992 have been included in this report where appropriate.

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b) Estimate the observed juvenile salmon and steelhead standing crop during summer 1990 for the reaches surveyed.

c) Evaluate and describe habitat utilization by juvenile salmon and steelhead in the large order river reaches investigated.

d) Contrast existing habitat conditions with key habitat quality indicators.

Background

The Salmon River sub-basin has long been known for its exceptional salmon and steelhead fisheries. The watershed provides habitat for the largest wild run of spring chinook salmon remaining in the Klamath River system (Campbell and Moyle 1991; West 1991). Other indigenous fish stocks include fall, winter, and summer-run steelhead, fall-run chinook salmon, coho salmon, rainbow trout, pacific lamprey *Lampetra tridentata*, green sturgeon *Acipenser medirostris*, speckled dace *Rhinichthys Osculus klamathensis*, Klamath small scale sucker *Catostomus rimiculus*, marbled sculpin *Cottus klamathensis*, and coast range sculpin *Cottus aleuticus*. Introduced fish stocks include American shad *Alosa sapidissima*, brown trout *Salmo trutta*, and brook trout *Salvelinus fontinalis*.

Although the Salmon River sub-basin historically supported large salmon and steelhead runs, run sizes in recent years have been reduced to critical levels. A number of variables are potentially responsible for the decline of spawning escapements including historic logging, mining, and road building practices, floods, fires, and harvest.

Floods

Floods and associated landslide events have significantly influenced the condition of aquatic and riparian habitat in the Salmon River watershed. Major flooding in 1955 and 1964 delivered large quantities of sediment to stream channels (Figure 1). Aerial photo inventories display major channel alterations occurred during the 1964 flood resulting in aggredation, scour, migration, and widening (USFS in press). In less confined reaches, this resulted in reduction of the channel capacity and extensive alteration of riparian vegetation on floodplains and terraces. Course sediment deposited in confined channels was likely removed in the succeeding 10 years (Lisle 1981), while less confined channels in low gradient reaches will probably continue to degrade for decades in absence of additional large sediment deliveries. The recovery of riparian vegetation to pre-flood conditions will be on the order of 100 years or longer.

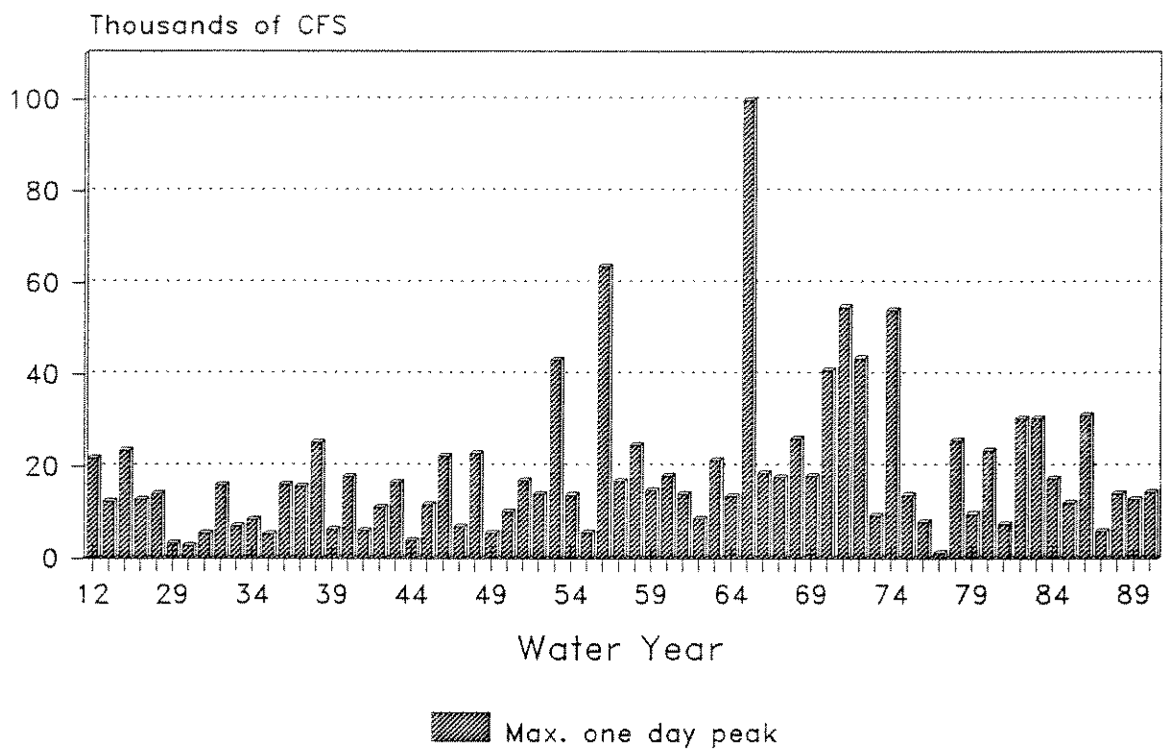


Figure 1 Annual maximum one day peak discharge for the Salmon River at Somes Bar for the period of record, 1912-1990.

Mining

Various mining activities have been present in the basin since the 1850's. Hydraulic mining along the major tributaries occurred from about 1880 to 1950, affecting approximately 480 ha (1200 acres), and delivering an estimated 11.4 million cubic meters of sediment into the rivers (USFS in press). Hydraulic operations were concentrated during the spring due to the availability of water. In addition to the direct impacts from large quantities of sediment introduced to stream channels, log crib dams used to divert water for hydraulic operations often formed obstacles to migrating salmon and steelhead (see Migration Barriers).

Wildfires

The Salmon River watershed has a high natural frequency of lightening occurrence which has been responsible for ignition of the larger fires in recent years. In 1977, the Hog Fire burned approximately 32,000 ha (80,000 ac) in the lower North and South Fork, Nordheimer, and Crapo Creek watersheds (Faustini and Vandewater 1991). Wildfires in 1987 burned 40,948 ha (102,369 ac), including 8,181 ha (20,454 ac) previously burned by the Hog Fire (USFS in press).

Migration Barriers

Although presently no man made barriers to fish migration exist on anadromous habitat within the study area, at least three dams were removed by CDFG prior to 1953 (CDFG 1953). These structures were constructed of logs and existed on the North Fork, South Fork, and White's Gulch and acted as complete or partial barriers to migrating salmon and steelhead. The Bonally Mining Company Dam, constructed approximately 9.7 km (6 mi) upstream from the mouth on the North Fork in 1906 or 1909, was 54 m (177 ft) long and 3.3 m (11 ft) high and described as a serious obstacle to fish passage. Removed by dynamite on October 7, 1946, this dam affected fish migration for at least 35 years. Two other dams further upstream were altered with fish ladders sometime between 1946 and 1953, restoring approximately 50 km (31 mi) of spawning and rearing habitat to anadromous fish.

The Smith Dam, located about a 1.6 km (1 mi) from the mouth of White's Gulch, tributary to the North Fork, was 7.6 m (25 ft) long and 2.4 m (8 ft) high. It was removed by dynamite on September 14, 1949 (CDFG 1953; Taft and Shapovalov 1935).

Located on the South Fork, approximately 8 km (5 mi) from the mouth, the Bennett-Smith Dam was described as a serious migration barrier to salmon and steelhead (CDFG 1953). The log dam was about 3 m (10 ft) high and was destroyed by flood during the last week of October, 1950.

Historically, numerous dams were present on tributaries to the mainstem Salmon River and lower reaches of the North Fork and South Fork (Taft and Shapovalov 1935). The locations and purpose of these dams is summarized in Appendix A.

Most of the natural barriers to anadromous fish migration, consisting of falls and bedrock restrictions, occurring within the study area have been modified to provide for passage during low flow conditions. Bloomer Falls, located on the mainstem Salmon River approximately 21.7 km (13.5 mi) from the mouth, formed a partial migration barrier during low flow conditions and was modified by dynamite in the summer of 1983. Two partial barriers on the South Fork Salmon River were also modified by explosives in July or August of 1984. These include the falls at Methodist Roughs located at 10.5 km (6.5 mi) and falls upstream from Matthews Creek at 16.4 km (10.2 mi). The role of these specific partial barriers in segregating fall from spring-run fish is not known but should be a consideration in future barrier modification projects.

Study Area

Salmon Subbasin

The Salmon Subbasin ranges from the headwaters of the Salmon River to the Klamath River near Somes Bar. The watershed area is 1943 km^2 (750 mi^2) and nearly all ownership is public, under management of the Klamath National Forest (CH2M Hill 1985). The Salmon River is a federally designated Wild and Scenic River. The study area includes tributaries located in the lower Salmon River sub-basin of the Klamath River Basin (Figure 2). Stream reach descriptions for rearing habitat inventories are summarized in Table 1.

Table 1. Summary of stream reaches investigated during 1989/90 habitat productivity surveys.

Sub-basin/Tributary	**Area Surveyed**	**Reach Length**
Salmon Sub-basin		
South Fork Salmon River	Cecil Creek to Mouth	24.9 km(15.5 mi)
North Fork Salmon River	White's Gulch to Mouth	25.8 km(16.0 mi)
Salmon River (Mainstem)	Forks of Salmon to Mouth	29.8 km(18.5 mi)

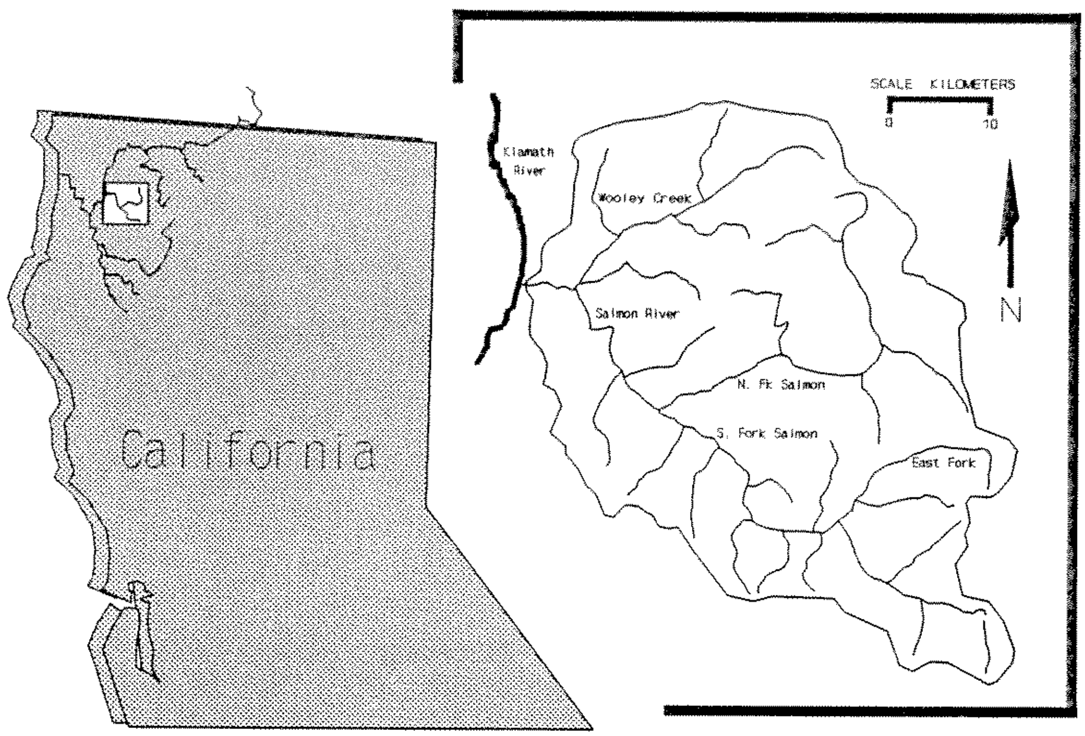


Figure 2 Project Area Location.

Salmon River

The Salmon River study area includes approximately 29.8 km (18.5 mi) of mainstem habitat from the Klamath River confluence upstream to Forks of Salmon. The watershed area drained by the Salmon River at the mouth totals 190,400 ha (476,000 ac). Wooley Creek, a watershed of about 40,000 ha (100,000 ac), enters the Salmon River approximately 6.4 km (4 mi.) from the Klamath River confluence. The US Geological Survey maintains a gauging station at Somes Bar (No. 11-5225) with continuous records available from October 1927. The average discharge is 54 cms (1,805 cfs) with extremes ranging from 3,990 cms (133,000 cfs) to 2.1 cms (70 cfs). The average summer flow during the survey period was 9 cms (300 cfs).

South Fork Salmon River

The South Fork Salmon River study area is located in the upper portion of the Salmon River sub-basin, from the mouth at Forks of Salmon upstream to the Little South Fork. The study area was expanded from 1988/89 surveys to include to an additional 29 km (18 mi.) of habitat from the mouth of Cecil Creek to Forks. The drainage area for the lower South Fork Salmon River averages 150,000 acres. Flow records were maintained for about 10 years (1953-1965) by USGS station (11-5223) located near Methodist Creek. Flow extremes ranged from 942 cms (31,400 cfs) to 0.8 cms (27 cfs).

North Fork Salmon River

The North Fork Salmon River study area extended from the mouth at Forks of Salmon upstream 29 km (18 mi.) to White's Gulch. This study area was also expanded from 1988/89 surveys conducted upstream to Right Hand Fork. The lower North Fork Salmon River drains a watershed of approximately 110,000 acres. A USGS water-stage recorder (11-5224) was maintained on the North Fork for a few years (1958-1964) through September 1964. Flow extremes during this period ranged from 315 cms (10,500 cfs) to 0.8 cms (28 cfs).

Methods

Physical habitat inventories were conducted during summer base flow conditions using methods similar to those employed during upper South and North Fork Salmon River surveys conducted in 1989 (West et al 1990). Slight changes in habitat classification were made with the inclusion of two new habitat types (Appendix B), step pool (type 23) and bedrock sheet (type 24). Structurally modified habitats, previously identified as enhanced weir (30), enhanced deflector (31), and enhanced pocket water (32) were not present in any of the 1990 study area reaches.

The majority of physical habitat parameters measured in 1990 (Appendix C) remained unchanged from 1989 investigations and are described by West et al. (1990). Assessment of key habitat conditions with the intention of developing measurable forest standards, such as those described by Sedell (1988), led to the addition of a key course woody material (CWM) parameter. This entails the quantification of whole pieces of CWM where at least 20 percent of their volume exists within the bankfull channel (BF) and the dimensions equal or exceed 15.2 m (50 ft) long by average diameter of 61 cm (24 in).

The sampling schedule for substrate composition, embeddedness, percent shade, overstory composition, CWM recruitment potential, and enumeration of rearing salmonids was targeted for 12.5 percent. Sampling was applied systematically by habitat type after a non-random start on the first unit occurring within a survey reach. Species composition and abundance were obtained from ocular counts by divers snorkeling upstream from the lower habitat boundary. Habitat unit area and volume estimates were obtained by direct measure rather than ocular methods. Estimates of species abundance, by age class, were obtained by application of a correction factor to ocular counts stratified by run, riffle and pool unit types (Hankin and Reeves 1988). Diver efficiency was calculated from comparison of population estimates obtained by electrofishing to actual diver counts. Correction factors, sample size and correlation coefficient applied to direct counts are displayed in Table 2.

Table 2. Correction factors, correlation coefficient, and sample size by species and age class applied to diver counts for estimating abundance.

Species/Age class	Habitat	Correction	r^2	n Units sampled
0+ Steelhead	Riffle	1.4	0.67	10
	Pool	1.0	0.10	5
	Run	1.2	0.90	8
1+ Steelhead	Riffle	4.0	0.49	10
	Pool	1.4	0.90	5
	Run	1.7	0.15	8
0+ Chinook	Riffle	1.0	0.34	10
	Pool	1.0	0.04	5
	Run	1.0	0.79	8

Habitat specific utilization was described using an electivity index from Jacobs (1974) to relate the proportion of the population found within a particular habitat type to the relative availability of that habitat type among all habitats sampled in the study area. The formula used is:

$$\text{Electivities (D)} = \frac{r - p}{(r + p) - 2rp}$$

where:

$$r = \frac{\text{number of fish estimated in a particular habitat}}{\text{total number of fish estimated in all habitats}}$$

$$p = \frac{\text{quantity of a particular habitat type sampled}}{\text{total quantity of all habitat sampled}}$$

Values of this index can range from -1 to +1. Negative electivity values indicate that utilization of a specific habitat for rearing is less than the average based upon the relative availability. A positive electivity value indicates habitat specific use is greater than average compared to the available quantity. A value of zero indicates that the specific habitat is being used in proportion to its occurrence in the study area. Electivity values approaching -1 or +1 suggest the absence or presence of habitat conditions selected by juvenile salmon and steelhead at the time sampled. Electivities are calculated and displayed by habitat volume and area weighting.

Results

A total of 1,705,305 m^2 of habitat was identified within the wetted channel during summer low flow conditions in 1990. Units were composed of 19 habitat types (Appendix D), dominated by low gradient riffle (LGR), high gradient riffle (HGR) and run (by area). Lateral scour pool (LSP) and main channel pool (MCP) also composed a large portion of the habitat in the area surveyed.

The stream bed composition was dominated by cobble 76-304 mm (3-11 in) and boulder 305 mm (=> 12 in) size classes. Boulders, white water, and bedrock ledges composed the larger fraction of available object and overhead cover to fish while woody cover was largely absent.

Salmon and steelhead utilization of available habitat was assessed from sampling, by direct observation, 396 habitat units from a total of 1,518 units (sample fraction = 26%) identified during inventories of the lower North and South Forks, and mainstem Salmon River. A total of 17,105 1+ steelhead, 4,739 0+ chinook and 122 coho salmon were observed in sampled units. Abundance and utilization statistics results discussed below will be accompanied by the sample size when seven or fewer units were sampled. Observation results for 0+ steelhead and 0+ coho are displayed in the Appendices, however they are not discussed at length in the narrative.

Yearling steelhead densities were clearly highest in higher velocity habitats with the exception of dammed pool (DPL), n=1. Based upon available rearing habitat, the standing crop contribution came predominantly from LGR, HGR, run, and step-run (SRN). Electivity indices, which weight habitat use to availability, again tend to show higher than average use by 1+ steelhead for riffle habitat. Plunge pool (PLP) habitat, n=4, is also highly utilized, a pattern consistent for 0+ steelhead and 0+ chinook as well.

Young of the year chinook salmon densities were highest in secondary channel pool (SCP), n=5, backwater pool (BWP), n=5, and PLP. Glide, run, SRN, and MCP habitats had the highest overall estimated standing crops based upon habitat availability. In general, electivities for 0+ chinook were highest for pool habitats and negative or average for high velocity habitats. Other species, including green sturgeon, american shad, dace, Pacific lamprey, and suckers have been observed in the sub-basin, however, their population size and distribution were not assessed during these investigations.

Approximately 28,250 m^2 of suitable salmon and/or steelhead spawning habitat was present under summer base flow conditions during the 1988/89 and 1989/90 study period. Although this estimate includes available spawning habitat identified in upper North and South Forks of the Salmon River, tributary spawning area is not included. From 1989 investigations average chinook redd surface area (4.6 m^2; n= 520) and average steelhead redd surface area (1.5 m^2; n= 194) were not significantly different (p=0.05) between study areas or between habitat types within study areas (West et al. 1990). Roughly 3,000 chinook redds and 9,150 steelhead redds could be accommodated by existing suitable habitat under base flow conditions, disregarding any territorial needs of either species (Table 3) within the study area. By comparison, roughly 6,100 chinook and steelhead 18,800 redds can be accommodated by anadromous habitat in the North Fork, South Fork, and mainstem Salmon River, excluding their tributaries.

Table 3. Area (m^2) of available spawning habitat and potential number of redds accommodated on North Fork, South Fork and mainstem Salmon Rivers.

	Spawning Habitat (m^2)		Redds Accommodated	
	Salmon	Steelhead	Salmon	Steelhead
Salmon River	1,500	1,500	330	1,000
N.Fk. Salmon[1]	4,545	4,545	1,000	3,030
S.Fk. Salmon[2]	7,680	7,680	1,670	5,120
		Total	3,000	9,150

Mainstem Salmon River

A total of 676,419 m^2 of rearing habitat was estimated available during summer low flow conditions. Run, SRN, LSP (12), MCP, and glide composed most of the available habitat (by area). By volume, however, LSP (12) and MCP clearly dominated the habitat composition within the mainstem. Although cobble dominated the stream bed surface, gravel, boulder, and fines appeared more equally represented than in the North and South Forks Salmon River. White water, boulders, and bedrock ledges composed the dominant cover components. Cover provided by woody debris was negligible.

Surveyors identified a total of 419 habitat units, composed of 16 types, on mainstem Salmon River (Appendix E). One hundred two units (24% of total units) were sampled during summer 1990. Crews observed 3,453 1+ steelhead, 686 0+ chinook, and no coho salmon during snorkel surveys of 124,365 m^2 of habitat.

The highest 1+ steelhead densities were observed in LGR and HGR habitat by both volume and area calculations. Yearling standing crop contribution from riffles accounted for about 55 percent of the estimated total with much of the balance from run and SRN habitat. As expected, LGR and HGR had strong positive electivity indices.

[1] Forks of Salmon to White's Gulch

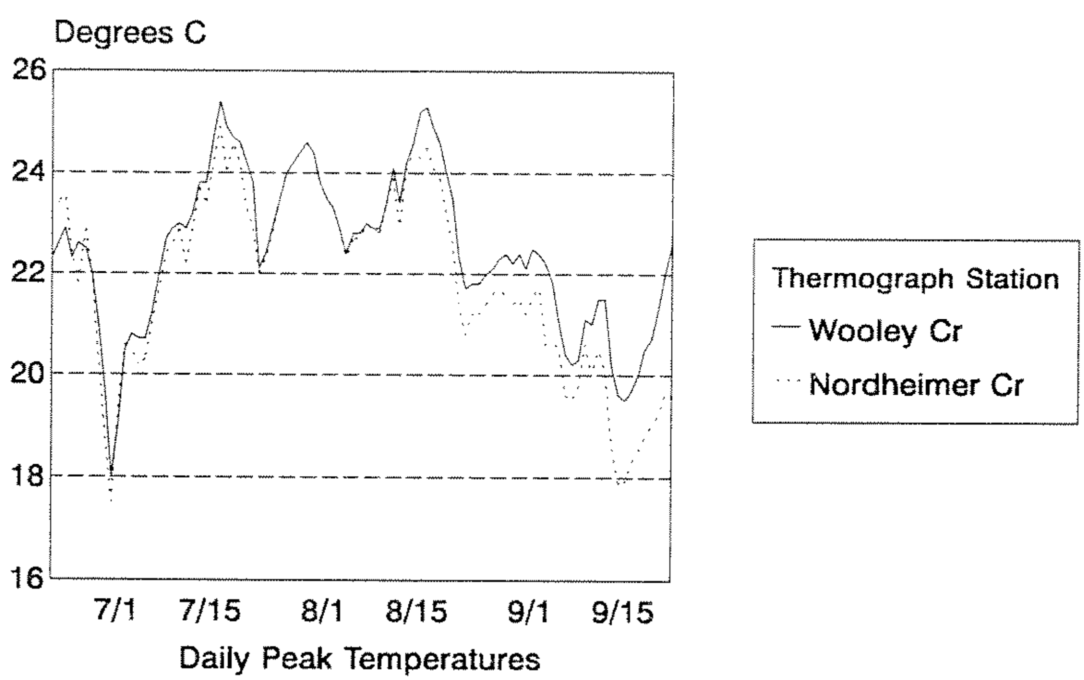
[2] Forks of Salmon to Cecil Creek

Of those habitats sampled with larger (>6) sample sizes, 0+ chinook densities were highest in HGR (by volume) and MCP (area). Main channel pool was observed to contribute the largest fraction of the total 0+ chinook standing crop. HGR and MCP show the strongest positive electivities for habitats with larger sample sizes.

An estimated 1,500 m^2 of suitable salmon and steelhead spawning habitat was observed during the summer 1990 habitat condition survey. This habitat could potentially accommodate approximately 330 chinook redds and 1,000 steelhead redds. Spawning habitat was located in glide, run, low gradient riffle, and step-run habitat types.

Daily water temperatures were collected by crews during physical and biological habitat inventories, however these provided only a point data perspective of thermal conditions. Continuous summer

June 21 to September 22, 1992



Estimated temperature data for Wooley Creek station 7/22 to 8/10

Figure 3 Mainstem Salmon River water temperature data collected during summer 1992 from two continuous recording thermograph stations, upstream Nordheimer Creek and upstream Wooley Creek.

water temperature records for two locations on the mainstem Salmon River were maintained during water years 1991 and 1992. Fairly complete records are available for summer 1992 (Appendix G). A maximum peak temperature of 25.4 °C was recorded above Wooley Creek on July 16, 1992. The average seven day maximum temperature was 24.7 °C in mid-August. Peak daily water temperatures ranged from about 18 to 25 °C during the entire summer period of record (Figure 3).

Primary Habitat Attributes

Table 4. Existing condition of key physical habitat parameters, by reach, for the mainstem Salmon River, 1990.

Survey Reach	Pools per 300m	Avg No. Channel Widths/Pool	Bankfull Channel Width m	No. Key Wood per/1000 m	Average % Shade	% Embeddedness Riffles	% Fines Riffle
Mouth to Wooley Creek	1.2	3.3	76	0	3	7	4
Wooley Creek to Bloomer Falls	1.6	3.1	61	0.04	1	17	5
Bloomer Falls to Forks of Salmon	1.3	3.2	73	0.07	1	10	3
Combined Mouth to Forks	1.5	3.2	64	0.04	2	13	4

South Fork Salmon River

An estimated 448,460 m^2 of available habitat was inventoried on the lower South Fork Salmon River during summer 1990. Habitat was stratified into 19 categories (Appendix F) with step-run habitat dominating (by area). Low gradient riffle, run, GLD, and MCP accounted for a large proportion of the remaining habitat. Although cobble dominates the stream bed particle size category, gravel 0.5-7.6 cm (0.20-3.0 in) also comprises a large portion. Boulder, bedrock ledges, and white water provide most of the available cover. Woody cover is largely absent, providing a small fraction (<2%) of the available cover.

One hundred sixty-three habitat units were sampled (26%) from a total of 615 identified during the physical inventory. Snorkel crews observed 7,557 1+ steelhead, 2900 0+ chinook, and 100 0+ coho salmon in 120,713 m^2 of lower South Fork Salmon River habitat units.

Yearling steelhead densities were highest in LGR, HGR, CAS (n=5), trench pool (n=5), and pocket water (n=2) habitats by both area and volume. Because LGR and HGR account for nearly 22 percent of the total habitat area, their high fish densities produce 41 percent of the total estimated standing crop. Not surprisingly, electivity indices for riffle habitat are positive by both area and volume weighting.

Chinook densities were highest in habitat types where only a few samples (n<7) were available. Lateral scour pool (12), glide, and run had moderate densities, providing the highest estimated contribution to total standing crop. Electivities are highest, in general, for pool habitat, although small sample sizes weaken this generalization.

During 1990 surveys an estimated 7,680 m^2 of suitable anadromous spawning habitat was available during low flow conditions in the study area, compared to 14,602 m^2 for the entire South Fork Salmon River. This habitat, which excludes spawning area in tributaries, could accommodate a maximum of 1,670 chinook redds and 5,120 steelhead redds. Spawning ground investigations in recent years (1989-1992) have shown 90 percent of the chinook salmon redds observed in the South Fork occur in the reach from Forks to Cecil Creek.

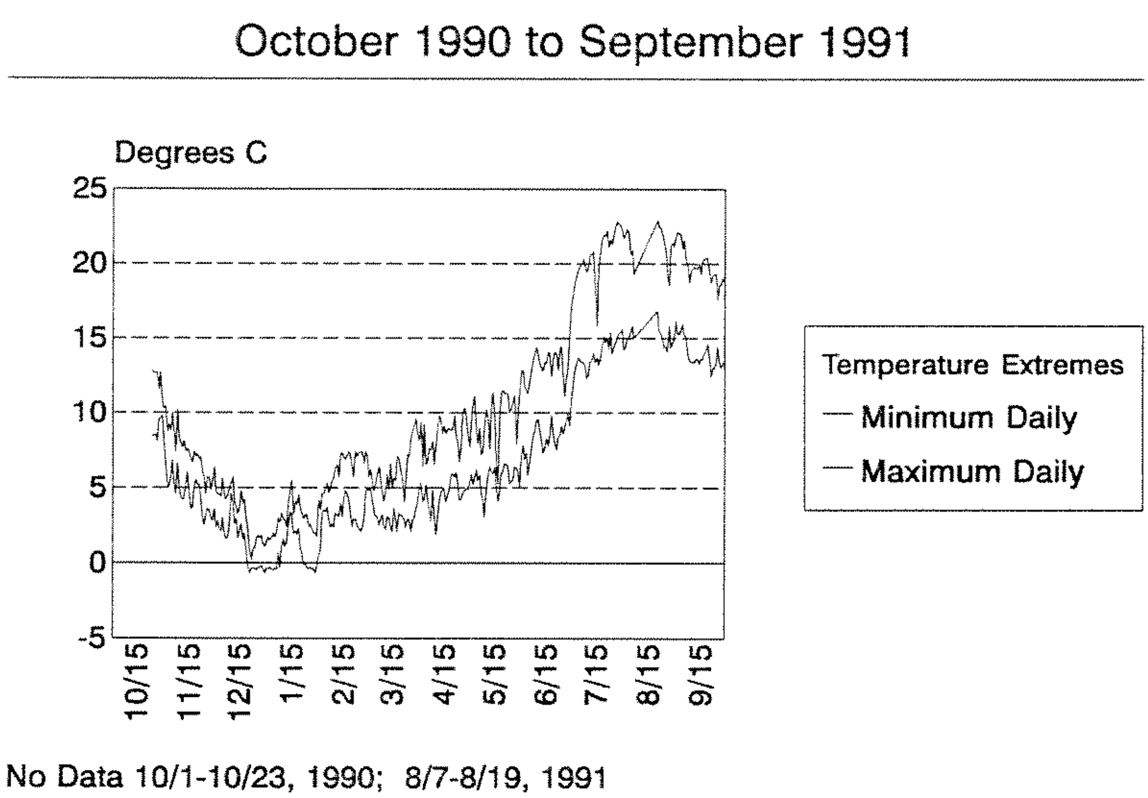


Figure 4 Water temperature records for the upper South Fork Salmon River station located upstream from East Fork for the 1991 water year.

Peak daily water temperatures were available from thermograph records, collected on lower South Fork Salmon River,near the mouth, during summer months for 1983, 1985, and 1988 through 1992 (Appendix G). Collection of year-round continuous water temperature data began in fall 1990 above the East Fork confluence to provide information on seasonal extremes (Figure 4; Appendix G). Records for this station are nearly complete with temperatures for the 1992 water year ranging from 0.4 (January 23) to 24.2 °C (August 13). An average seven day maximum temperature of 23.6 °C was sustained during mid-August, 1992.

Primary Habitat Attributes

Table 5. Existing condition of key physical habitat parameters, by reach, for the South Fork Salmon River, 1990.

Survey Reach	Pools per 300 m	Avg No. Channel Widths/Pool	Bankfull Channel Width m	No. Key Wood per/300 m	Average % Shade	% Embeddedness Riffles	% Fines Riffle
Forks of Salmon to Methodist Ck	1.2	8.8	29	0	6	8	5
Methodist Creek to Graham Gulch	2.0	5.9	26	0	0	n/s	n/s
Graham Gulch to Matthews Creek	1.5	7.0	29	0.1	6	17	6
Matthews Ck to Limestone Gulch	2.0	5.9	26	1.4	6	20	3
Limestone Gulch to St. Clair Ck	1.9	5.5	29	2.5	13	11	5
St. Clair Creek to Cecil Creek	1.8	4.4	38	0.1	34	0	0
Combined Forks to Cecil Creek	1.6	6.6	29	0.6	10	11	3

North Fork Salmon River

A total of 580,411 m^2 of rearing habitat was identified during the 1990 physical habitat inventories conducted during summer 1990 on lower North Fork Salmon River. Eighteen habitat types were represented on the lower North Fork Salmon River reach. Of these, LGR dominated (by area) with run and SRN comprising a large portion of the remaining habitat (Appendix I). Cobble and boulder composed the dominant particle size categories. Boulders and bedrock ledges provided much of the available cover, while woody cover was relatively scarce.

A total of 486 habitat units were identified during physical habitat investigations on lower North Fork Salmon River. Of these, 131 were sampled (27%) by snorkel crews. Crews observed 6,095 1+ steelhead, 1153 0+ chinook, and 22 coho salmon in 157,983 m^2 of sampled habitat.

Yearling steelhead densities were highest in LGR and HGR habitat with the exception for some habitat units with small (n<3) sample sizes by both area and volume. Nearly 61% (by area) of the total estimated standing crop contribution was observed in LGR and HGR habitat. Low gradient riffle and HGR habitat types have the highest electivity indices among units with adequate sample size (>6).

Young of the year chinook salmon densities are relatively high in corner pool habitat (n=6) by both area and volume weighting. However, RUN and MCP habitat had the highest estimated standing crops. Electivities are difficult to interpret for chinook in the North Fork Salmon River because of the small sample size of many habitat categories.

An estimated 4,545 m^2 of suitable salmon and steelhead spawning habitat was available in the study area, which accounts for roughly 37% of the total found within the North Fork Salmon River. This habitat could accommodate about 1,000 chinook redds and 3,030 steelhead redds. During recent years (1989-1992), 90 percent of the chinook redds observed during spawning ground investigations have occurred in the study area reach. Over 87% of the available spawning habitat is associated with glides and runs.

Summer peak water temperature records for the North Fork Salmon River are available for 1983 to 1985 and 1988 through 1992 (Appendix G). Temperatures were collected by thermograph near the mouth.

Primary Habitat Attributes

Table 6. Existing condition of key physical habitat parameters, by reach, for the North Fork Salmon River, 1990.

Survey Reach	Pools per 300m	Avg No. Channel Widths/Pool	Bankfull Channel Width m	No. Key Wood per/300 m	Average % Shade	% Embeddedness Riffles	% Fines Riffle
Forks of Salmon to Doughherty	1.5	7.4	27	0.2	0	5	5
Doughherty Bluff to Heiney Bar	1.4	7.9	27	0.9	12	28	4
Heiney Bar to Little North Fork	0.7	15.9	27	0.6	12	23	10
Little N. Fork to Jackass Gulch	0.8	10	38	0.0	6	4	1
Jackass Gulch to Sawyers Bar	0.8	13.8	27	0.0	14	4	3
Sawyers Bar to Flapjack Bar	1.1	7.2	38	0.1	3	3	7
Flapjack Bar to White's Gulch	0.8	13.8	27	0.4	2	5	10
Combined Forks to White's Gulch	1.0	10.0	30	0.3	8	14	7

Discussion

Observations of salmon and steelhead habitat utilization consist of snorkel surveys conducted during summer low flow conditions. Because salmonid habitat requirements change through the natal residency of a given cohort, the results of this biological assessment provide only point estimates of fish densities, standing crop, and habitat electivity. Seasonal habitat shifts will result in a completely different set of statistics on biological utilization.

Assessment of spawning habitat quantity and condition suggests that current salmon and steelhead escapements conservatively utilize less than 25 percent of the currently available habitat in the North and South Forks and mainstem Salmon River. This contention is supported by observations on spawning grounds of relatively few adults in proportion to available suitable spawning habitat.

Desired future condition standards (DFC's) have been developed for some third to fifth order streams in the Columbia Basin and western Oregon (Sedell 1988; USFS 1992). Stream size upon which these standards are applied are generally described using stream order (Strahler 1957) which, although widely used, provides a fairly ambiguous description. Use of watershed area (see study area description) may provide a more useful description of stream size, particularly in similar climates and terrain types. Although the applicability of these standards to rivers in northern California remains under investigation, the Klamath N.F. has adopted Sedell's (1988) DFC's as interim goals for habitat protection and restoration. Development of key habitat quality attributes for large order (6th and 7th) rivers such as the lower North and South Fork, and mainstem Salmon River, has been undertaken for the Upper Grand Ronde River Basin in northeastern Oregon (USFS 1992). Where quantifiable standards were not readily obtainable, research has been initiated to provide site specific information to address future parameter guidelines.

Much of the value in collecting basin-level habitat condition information is to describe the existing state of specific physical parameters, which taken as a whole, may yield some insight to the health of the aquatic environment. For some parameters, the resolution provided by an analysis of this level may only distinguish potential habitat deficiencies of a gross nature. When potential problem areas are identified, methodologies with higher resolution (and generally higher cost) may be employed. Similarly, the reliability of some parameters as monitoring tools has much to do with both resolution and repeatability. Information obtained in the course of this investigation which may be suitable for use in development of DFC's or as a measure change are presented in the following discussion.

Water Quality

Water temperatures can significantly influence the suitability of habitat conditions through all phases of salmonid life history. Fall, winter, and spring water temperatures will determine incubation rates, survival, and emergence timing. Growth rates and survival may be influenced during all seasons of juvenile rearing and adult holding depending on natal life history strategies.

Optimum incubation temperatures for chinook salmon eggs occur between 5.0 and 14.4 °C (Bell 1986). Lower water temperatures can be tolerated, but only after the critical initial stages of embryonic development have been completed. Incubation mortality will, however, increase as water temperatures decrease below 2-3 °C (Velson 1987). Winter water temperatures measured on the upper South Fork Salmon River during water years 1991 and 1992 generally border the 2-3 °C degree threshold for days or weeks at a time (Appendix G). During December 1990, minimum temperatures descended to -0.7 °C, which may have had significant effects on incubation survival.

Elevated summer temperatures are a primary concern in the lower Salmon River Basin. Peak temperatures measured in 1992 reached 26 and 27 °C respectively on the South and North Forks of the Salmon River. The sustained average seven day maximum temperature for the mainstem, above Wooley Creek, was 24.7 °C during mid-August 1992. Clearly, sub-optimum thermal conditions exist for salmonid growth during portions of the summer in the study area. Assessment of existing thermal conditions with respect to standards reported in literature are quite dramatic. If for example, the desired maximum daily temperature for the North and South Fork was 16.1 °C, daily peaks would have exceeded this threshold, on average, about 90 percent of the summer based upon temperature records available to date (Figure 5 and 6). A daily maximum standard of 20 °C, such as that used for large order streams in the upper Grande Ronde River (USFS 1992) would have been met approximately 50 percent of the summer days for the same time period. Low summer flows, aggravated by drought conditions, have undoubtedly had an effect on the distribution of peak summer temperatures (Appendix G). It is important to note, however that some pre-drought temperature data was included in the construction of these curves and that even in a year of high smowmelt runoff (1983), both the 16.1 and 20 °C standards were exceeded at least 5 percent of the summer period. Similar to daily peaks, sustained seven day maximum temperatures also failed to meet standards cited for the upper Grande Ronde River (USFS 1992) and by Sedell (1988).

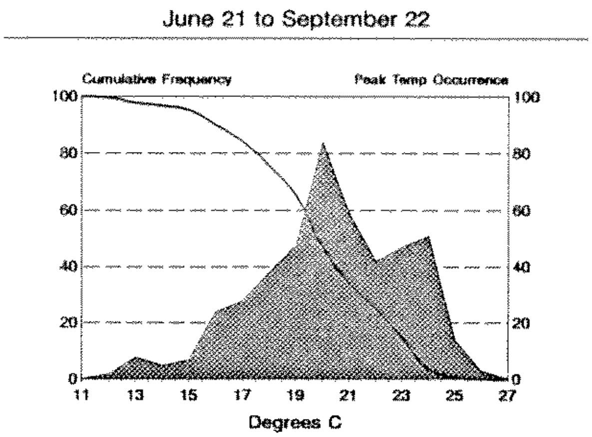


Figure 5 Cumulative frequency of peak summer water temperatures recorded on South Fork Salmon River near the mouth, 1983, 1985, 1988-1992.

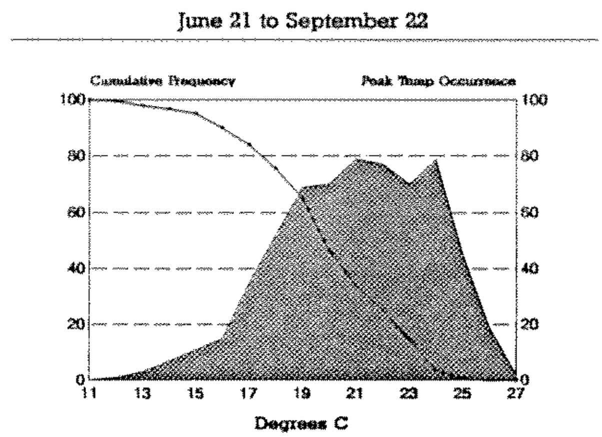


Figure 6 Cumulative frequency summer peak water temperature information recorded on North Fork Salmon River near the mouth, 1983-1985, 1988-1992.

Pool Frequency and Residual Pool Depth

Pools provide essential rearing and holding habitat for salmonids and other indigenous non-game fish species. Also, spawning habitat, formed by the sorting and deposition of gravels, is often associated with pool tailouts. Pools can also be highly sensitive indicators of changes in watershed condition, (EPA 1991) reflecting changes in their frequency, volume, and depth.

Pool frequency can be measured by linear distance (ie. pools per 300 m) or by morphological parameters such as mean width at bankfull (BF) discharge (ie. pool per number BF channel widths). Because some ambiguity may exist in defining pool habitat, only primary pools are counted in this measure. Primary pools are defined in this analysis as those which have a maximum depth of at least 0.9 m (36 in) and occupy at least 50 percent of the low flow channel. Sedell's (1988) desired future condition criteria recommend maintenance of at least one primary pool every 3 to 6 BF channel widths (Table 7) based upon the natural hydraulic charter of undisturbed systems.

Pool frequency for individual and combined reaches in the study area are displayed in Tables 4, 5, and 6. Mainstem Salmon River pool frequencies appear to fall within the natural range expected given our estimates of BF channel width (Table 4). Although the mainstem falls outside of the stream size category for which Sedell (1988) describes standards (Table 7), we assumed the pool/BF channel relationship was applicable.

Table 7. Summary of desired key pool frequencies in moderately steep gradient (>3%) boulder-rubble streams for Columbia River Basin National Forests in Washington and Oregon from Sedell (1988).

Bankfull stream width	Pools per 1.61 km	Pools per 300 m	Channel widths per pool
15	13-22	4-7	3-6
23	7-14	2-4	3-6
23	5-10	2-3	3-6
46	3-7	1-2	3-6

South Fork Salmon River pool frequencies varied by reach, but were on average, within an acceptable range resembling natural conditions (Table 5). Bankfull width estimates for the South Fork Salmon River were made from few (n=4) field measurements, by channel type, and could skew pool frequency calculations slightly either way. The relatively low pool frequency estimated for the "Forks to Methodist Creek" reach possibly reflects course sediment storage from historic floods.

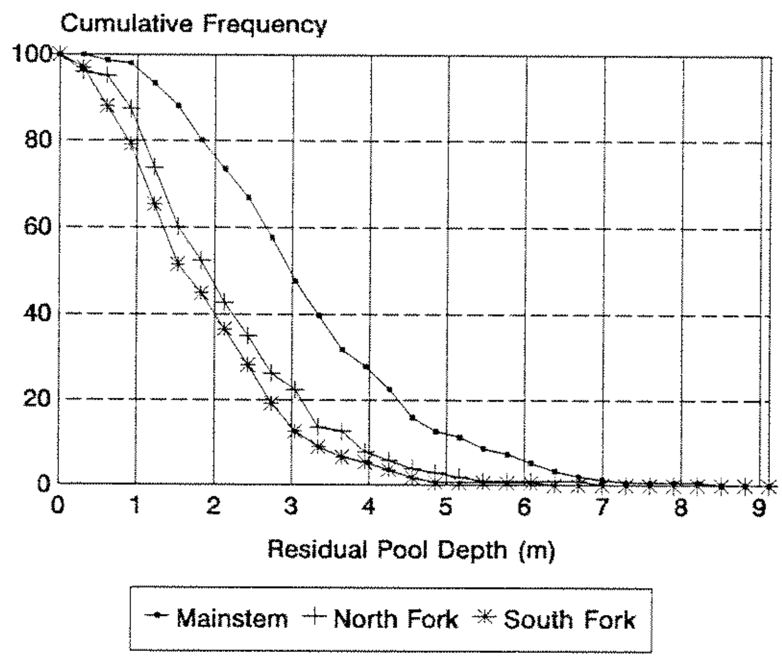


Figure 7 Residual pool depth (in meters) cumulative frequency for North Fork, South Fork, and mainstem Salmon River, 1990.

Pool frequencies on the North Fork Salmon River were low and not within the range expected under natural conditions (Table 6). Again, BF width estimates were made from relatively few (n=5) field measurements which may change results slightly. Pool frequencies were, on average, about 50 percent of those expected.

Residual pool depths reflect net pool depth independent of flow conditions which can provide a repeatable measure of relatively high precision (Lisle 1987). A quantitative description of pool size classes, represented by residual pool depths, can be easily displayed in the form of a cumulative frequency curve for the North Fork, South Fork, and mainstem Salmon River (Figure 7).

Key Wood Frequency

Course woody material (CWM) influences stream channels in a number of ways and is considered an important component for quality fish habitat. Stream size is a critical factor in determining the role CWM plays within the channel. The role wood plays in the formation of primary pools decreases as channel width increases, however wood in large rivers forms pools along stream margins and secondary channels (Bisson et al 1987). Wood is also an important source of object and overhead cover for juvenile and adult salmonids. Certainly, one of the principle benefits of CWM is to increase habitat complexity, which provides habitat and cover through a range of flow and seasonal conditions. Catastrophic events such as floods, landslides, windstorms, and wildfire have a major effect on the quantity and location of CWM deliveries to the channel (Sedell et al 1988; Bisson et al 1987). While stream morphology is usually the dominant factor influencing CWM density in the channel(through recruitment and retention), humans have played a major role in determining the current amount of wood in the lower Salmon River basin. Considerable efforts to remove large quantities of wood, deposited by the 1964 flood, from the North and South Forks of the Salmon River were expended by state agencies and the USFS following that event. The present density of CWM present in the study area is not considered representative of natural conditions (Tables 4, 5, and 6). The applicability of Sedell's (1988) DFC standards (20 key pieces/300 m) to the river size and channel morphology of the lower Salmon River still requires validation.

Stream Bed Character

The composition of material composing the stream bed is an important feature of the stream channel. The size of bed particles influences the flow resistance in the channel, stability of the bed, and quantity as well as quality of aquatic habitat available to small fish and invertebrates. Channel characteristics, including confinement and slope, determine the energy available to transport bed material. The equilibrium which exists between sediment delivery and transport may be shifted by changes in the quantity of sediment input or water availability. Human influences on forested lands generally result in a decrease in the mean particle size of bed material (Meehan 1991).

Stream bed composition was ocularly estimated from subsampling a portion of all habitat types inventoried within the study area. Cobble, boulder, and bedrock compose a large proportion of the stream bed in the lower North and South Forks, and mainstem Salmon River (Figure 8; Appendix D). The bed character is generally reflective of high transport capacity channels. Retention of spawning gravels is most commonly associated with primary pools and in-channel roughness elements in the study area. Accumulations of CWM may have also played a role in spawning bed formation.

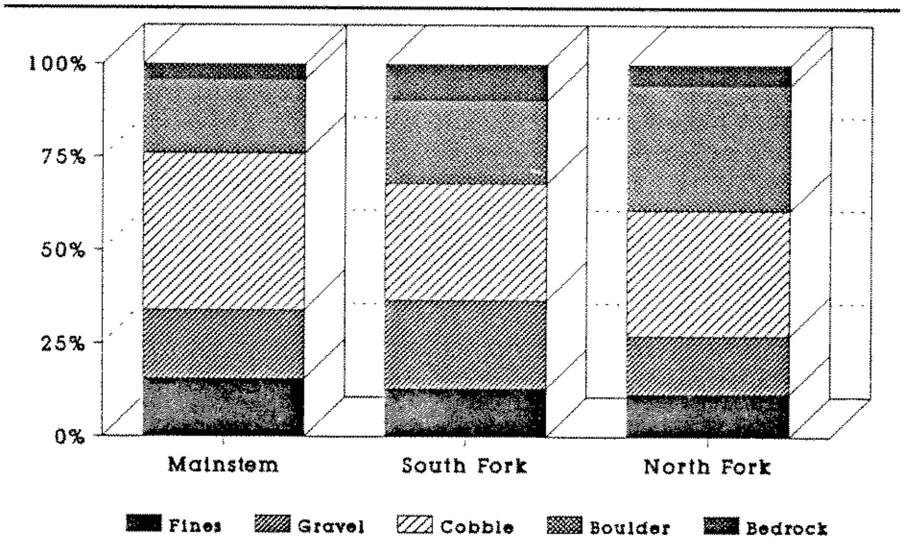


Figure 8 Composition of surface substrate particle sizes from ocular estimates on North Fork, South Fork and mainstem Salmon Rivers, 1990.

The quantity of fines present in the bed matrix will influence the amount and quality of interstitial habitat available within the bed. The availability of interstitial stream bed habitat will directly effect overwinter survival of juvenile salmon and steelhead. Bed permeability is also affected by fines, which will influence the concentration of dissolved oxygen and metabolic wastes present during development of salmonid eggs, alevins, and invertebrates.

Two measures of stream bed habitat quality, embeddedness and percent fines, were assessed during habitat surveys. Embeddedness provides a measure of the extent to which larger stream bed particles are surrounded by fine sediment. The amount of fine material, defined as particles less than 5.0 mm in diameter, was

Table 8. Comparison of embeddedness and percent fine particle composition observed on North, South Fork, and mainstem Salmon River, 1990, with desirable conditions described by Sedell (1988) and USFS (1992).

Parameter	DFC Sedell (1988)	DFC Grande Ronde (1992)	observed Salmon River	observed South Fork	observed North Fork
Embeddedness	< 25%	no standard	10 %	11 %	14 %
Percent Fines	< 20	< 15	4	3	7

estimated ocularly as a proportion of other particle size classes observed on the bed surface. Ocular estimates were not correlated with other assessment techniques, therefore the relative accuracy of the results may be variable. Fine material, as defined in standards developed for the upper Grande Ronde Basin (USFS 1992) and by Sedell (1988) is material of 1.0 mm in diameter or smaller. Further, techniques prescribed by Sedell (1988) measure both surface and sub-surface percent fines from a core sample and are probably not be equivalent to our techniques in terms of precision or accuracy. Sedell's techniques for measuring fines and embeddedness are standardized and valid for statistical comparison; ours are valuable only for comparing relative conditions between habitats and areas we investigated. Levels of embeddedness and percent fines observed during the lower Salmon River basin habitat inventories fall within standards developed in both recovery plans (Table 8), however validation of these results is necessary prior to drawing definite conclusions.

Riparian Condition

Water quality and the condition of the stream channel are influenced by vegetation within the riparian zone. Vegetation within the riparian community affects the input of sediment, sunlight, CWM, and nutrients to the stream channel. Vegetation can also control the stability and width of the channel.

First and second order streams are most significantly influenced by vegetation along the channel. The direct influence of the riparian vegetation is reduced as channel width increases to the scale of fifth order and larger streams (Sedell et al, 1988). The degree to which the riparian area can moderate summer and winter stream water temperatures will decrease as channel order increases. Temperature moderation is linked to the amount of surface shade measured adjacent to the channel. The contribution of CWM to the stream channel will depend on adjacent riparian sources and frequency of landslides, fire, and debris torrents.

Assessment of riparian condition during 1990 investigations included three parameters designed to help define the existing condition; percent shade at noon, CWM recruitment potential, and percent coniferous composition of recruitable tree species. The existing riparian habitat condition, as measured by these parameters, is summarized with literature reported DFC's for comparison in Table 9.

Table 9. Riparian condition parameters including water surface shade at noon, CWM recruitment potential (# trees/ha), and percent coniferous composition of recruitable tree species for lower North and South Fork, and mainstem Salmon River, 1990.

Parameter	DFC Sedell (1988)	DFC Grande Ronde (1992)	observed Salmon River	observed South Fork	observed North Fork
Shade	no std	no standard	2 %	11 %	8 %
Recruitment	> 34	n/a	1.4	2.4	2.4
Coniferous	90 %	n/a	70 %	59 %	50 %

Conclusions

Information provided by this assessment quantitatively summarizes the condition of key habitat parameters in the lower South Fork, North Fork, and mainstem Salmon River . The resolution provided by methodologies employed to obtain data may or may not be appropriate for future monitoring. However, much of this information provides valuable preliminary estimates from which sampling strategies can be developed. This information can also be used to assess the suitability of stream habitat from a fisheries perspective. We have displayed values, where available from research, to compare the existing conditions for individual parameters measured in the study area.

Sub-optimal water temperatures exist for salmonid growth for extended periods during summer months. In recent years, elevated water temperatures have undoubtedly been aggravated by drought conditions which have resulted in record low flows. The importance of the role temperature plays in growth and survival of juveniles and adult salmonids makes this parameter a priority for restoration.

Pool frequency on the South Fork (except Forks to Methodist Ck reach) and mainstem Salmon River appear to fall within a natural range expected for their channel sizes. However, none of the North Fork Salmon River reaches investigated fell within pool frequency ranges cited by Sedell (1988). Low pool frequencies are probably indicative of excess sediment storage. An increase, through time, in pool frequency should be expected in absence of additional large sediment inputs. Structural habitat modification is not a practical remedy in these large river habitats. However, watershed restoration techniques, focusing on reducing inputs of course sediment production, may accelerate recovery of channel processes. Residual pool depth monitoring may provide an effective tool to evaluate channel recovery.

The present density of CWM is low and not considered representative of natural conditions, however further study is needed to develop measurable standards for this bioregion. Reintroduction of CWM to some reaches of the study area may be an appropriate and cost effective technique to increase habitat complexity. Long term recruitment can be maintained through protection and restoration of riparian areas.

The two measures of stream bed habitat quality employed (percent fines and embeddedness) provided a tool for comparing relative conditions between reaches investigated. Because the methods employed lack measures of precision and accuracy they are not directly comparable to standards or desired future conditions used by Sedell (1988) and USFS (1992). In general, results suggest conditions may fall within suitable criteria, however validation is required. Watershed restoration measures which address chronic sources of fine sediment will provide the most effective means to maintain or improve stream bed habitat quality.

Riparian condition parameters evaluated describe the existing condition within the study area, however, no standards are currently set for streams larger than 5th order. Our assessment indicated little shade (<15%) is currently provided by the riparian canopy and CWM recruitment may be low (< 3 trees per ha). Additional riparian inventories are planned for fiscal year 1993 by the KNF to address these parameters and prescribe standards.

Assessment of spawning and summer rearing habitat utilization by salmon and steelhead is perhaps most useful from a use versus availability context. Our investigations suggest less than 25 percent of the currently available spawning habitat is utilized by average salmon and steelhead escapements returning in recent (1989-92) years within the study area.

Recommendations

(1) Establishment and implementation of measurable standards for key habitat suitability parameters for the Klamath bioregion needs to be undertaken for management, restoration planning, and monitoring.

(2) Many reaches in the study area remain under utilized by spawning salmon and steelhead despite the presence of suitable habitat conditions. The Klamath National Forest should utilize this information to ensure adequate spawning escapements are allocated by the Pacific Fisheries Management Council.

(3) Prescriptions designed to bring water temperatures closer to ranges optimal for salmonid production should focus on small (2-4 order) tributaries where riparian condition is poor. Re-establishment of native mixed composition stands of hardwoods and conifers should account for local ecological and morphological constraints. Prescribe and implement an out-year riparian restoration strategy.

(4) Traditional forms of instream restoration (eg. CWM structures) may be appropriate for restoring cover and habitat complexity where lacking in the lower Salmon River subbasin. However, successful recovery of channel scale habitat (ie. pool frequency) will be most effective using watershed restoration techniques. In general, use of instream structures should be discouraged in 6th order and larger streams.

(5) Substrate conditions need to be re-examined by quantitative, statistically valid sampling methods for describing existing conditions and monitoring.

(6) Establishment of permanent stations for monitoring channel cross-section profiles can provide information on course sediment storage in critical reaches identified in this assessment. A historical record of channel profiles at USGS water gauge stations on the North Fork, South Fork, and mainstem Salmon River may be obtained for the period of record.

(7) Key pool frequency should be represented by residual pool depth rather than max depth.

(8) Bank full width measurements should be incorporated into habitat data collection protocol.

(9) Complete Watershed Improvement Needs Inventories in the Salmon sub-basin. Implement watershed restoration techniques which will reduce the risk of future catastrophic stream impacts and accelerate channel recovery.

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APPENDIX A. HISTORIC WATER DIVERSIONS

STREAM	LOCATION ABOVE MOUTH	VOLUME IN SEC FT	USE	DAM TYPE AND HEIGHT	LADDER
Mouth to Forks	only small mining diversions				
Merrill	mouth abandoned			P3	N
Merril	0.3	0.25	I	T1.0	
Somes	0.3	2.0	I	T1.5	
Monte	mouth				
Steinacher					
T7E-T21N-S15	0.3	0.3	ID	P6	N
Duncan	0.1				
Butler	0.3	3.0	I	P8	N
Butler	0.2	0.1	I		
Butler	0.3				
Portuguese					
Morehouse	mouth				
Morehouse	two small diversions above falls				
Lewis	0.1	0.5	I	P12	N
Nordheimer	1.75	abandoned		P25	
Nordheimer	4.75			P	
Hammel	0.1	2.0		T	
Hammel	0.15	abandoned		P6	
Hammel	1.0				
Crapo	1.5	4.0	IM		
Crapo	1.5				
Horn	0.1	0.3	M	T2	
No. Fork	6.0	abandoned	M	P11	N

No. Fork	14.0	2.0	D	P8	Y
No.Fork	17.5	abandoned	M	P8	Y
Olsen	entire stream used for mining in winter				
Boulder	entire stream used for mining in winter				
Eddy Gulch	entire stream used for mining in winter				
Little No. Fork	2.3	6.0	M	P6	Y
Big	mouth	0.1	D	T2	
Big	0.25				
Shiltos	0.1				
Jackass Gl.	mining in winter				
Jackass Gl.	0.25				
Jessups Gl.	several short mining diversions				
Whites Gl.	1.0	1.0	M	P7	N
So. Russian	0.5	0.75	ID	P4.5	N
So. Russian	1.75	1.6	P	T	
No. Russian	0.1	0.1	I		
Taylor	mouth	0.5	IM		
Taylor	dry				
No. Fork Salmon	1.0	3.0	ID	P9	N
Mill	mouth			P5	N
So. Fork Salmon	4.0	12.0	IMD	P11	Y

McNeal	0.5	1.0		T1	
Methodist	0.25	1.5	ID	P5	N
Methodist	hydraulic mine pipe used in winter				
Crawford	two small ditches - one dry				
Cecil	0.5	0.1	I		
So. Fork Salmon (above E.Fork)	6.0	12.0	IM	T1	
Rays Gl.	0.1			P7.5	N
Rush	1.5	2.5	I	P5	N
E. Fork Salmon	0.5	1.0	ID	T1	
E. Fork Salmon	4.5	3.0		P5	N
Taylor	0.25	1.75		T1	
Taylor	0.3	dry	MP	T1	
Taylor	hydraulic not in use				
Shadow		dry	I		

APPENDIX B. HABITAT CLASSIFICATION

Habitat Types	Number	Abbreviation
Riffles		
Low Gradient Riffle	1	LGR
High Gradient Riffle	2	HGR
Cascade	3	CAS
Flat Water		
Secondary Channel Pool	4	SCP
Backwater Pool-Boulder	5	BWP
Backwater Pool-Rootwad	6	BWP
Backwater Pool-Log	7	BWP
Trench Pool	8	TRP
Plunge Pool	9	PLP
Lateral Scour Pool-Log	10	LSP
Lateral Scour Pool-Rootwad	11	LSP
Lateral Scour Pool-Bedrock	12	LSP
Dammed Pool	13	DPL
Glide	14	GLD
Run	15	RUN
Step Run	16	SRN
Main Channel Pool	17	MCP
Edgewater	18	EGW
Channel Confluence Pool	19	CCP
Lateral Scour Pool	20	LSP
Pocket water	21	POW
Corner Pool	22	CRP
Habitat Type Additions for 1990		
Step Pool	23	STP
Bedrock Sheet	24	BRS

APPENDIX C. HABITAT TYPING PROTOCOL AND FIELD DATA FORM

Habitat Typing Protocol

All spaces on the data sheet must be accounted for. There will be no blank spaces, zeroes or null (---) must be in every field.

Header Information :

Enter information for all fields on every sheet. Be sure to note time when temperatures are taken.

Adjusted Station :

This field is the only field that does not get filled out on the stream. This is used to adjust station numbers when two or more crews are working the same stream in tandem (one crew starting at the mouth, and the other starting at a known point upstream).

Field Station :

This is a unique number, starting with "1" and continuing throughout the survey. All habitat units must have a station number. Braided channels will be denoted a decimals (12.1, 12.2 etc.).

% Slope :

This is the average water slope in the channel. The reading may extend over several habitat units. Measaured from water surface to water surface.

Sample # :

Enter the unique number for the sample. This is the dive unit number and is recorded on flagging to mark the boundary of the unit.

Habitat Type :

Enter the habitat type number. Use the Region 5 key to determine habitat type. Do not create new habitat types.

Spawning Area :

Determine the number of square feet of actual spawning area in the habitat unit. Species and size of gravel will be dependant upon criteria set by the District biologist.

Mean Length, Width, Depth, Max Depth :

Enter the average values. Length and width are taken to the nearest foot. Average and max depth is taken to the nearest tenth. To determine average depth, divide the habitat into three and take three to four measurements along the transect.

Depth @ Riffle Crest :

This measurement is only taken at the tail of a pool where the surface flow breaks into the riffle. This measure is used to determine residual pool depth.

Instream Cover-Total % :

Determine the percentage of the habitat unit that has overhead cover.

Undercut banks, swd, lwd, terrestrial vegetation, aquatic vegetation, white water, boulders, bedrock ledges : Breakdown the Instream cover into its component parts. The sum of these 8 factors must equal 100.

Key LWD :

Enter the number of pieces of large woody debris with a diameter greater than 24" and a length of at least 50' (west side), or a diameter of 12" and a length of at least 35' (east side) that have at least 20% of their mass within the bank full width of the channel.

Cover Complexity :

Enter: 1 for low complexity, 2 for moderate complexity, or
3 for high complexity.

In general, one cover component alone will rate Low complexity, two to three components will rate Moderate complexity, and more than three components will rate High. Highly complex cover would have to have rootwads, logjams and willow rootwads associated with it.

% Exposed Substrate :

Enter the percentage of the habitat unit area that has substrate that is above the existing water level within the wetted perimeter.

Substrate Composition :

Enter the percentage of the habitat unit area that is covered by Fines, Gravel, Cobble, Boulder, Bedrock. The sum of these values must equal 100.

% Substrate Embedd. :

Take this observation only in pool tailouts and in low gradient riffles. Take ten samples of the substrate to determine the degree of embeddedness. A pool tail must be less than 3' in depth. Bedrock will be excluded and treated as a null value.

% Shade (Noon) :

Estimate the percentage of the habitat area that will be in shade at noon that day. Face south to determine the location of the sun. Shade can be created either by vegetation or topographic features. Use keywords in comments for typographic shade.

% Evergreen :

Estimate the percentage of the riparian vegetation that is evergreen (conifer, live oak, pacific madrone etc.). Observation will be limited to the up and downstream unit boundaries extended 200 ft up each slope from the bankfull width. Estimated by crown cover, not the number of trees.

% Deciduous :

Estimate the percentage of the riparian vegetation that is deciduous (alder, maple, willow, black oak etc.). Observation will be limited to the up and downstream unit boundaries extended 200 ft from the bankfull width. Estimated by crown cover, not the number of trees.

LWD Recruitment Potential :

Enter a count of the number of trees greater than 24" DBH (West side) or 12" (East side) that are within the up and downstream boundaries extending 100' up the slope from the bankfull width.

Comments :

The comment field is a very important portion of the data. Certain guidelines to its use are needed to make it effective. Data entry people will not interpret or correct statements. Make use of full sentences and keywords wherever possible. Criptic comments are not appropriate. Be sure to include structural conditions in comment for habitat units that have enhancements. Keywords will be employed to assist in using the data collected.

Habitat Typing Protocol
(4)

HT Tally :

Maintain an accurate count of habitat types surveyed so that the proper number of habitat units are sampled.

Rosgen Channel Class :

When the channel classification changes, check off the appropriate values for observations made.

Channel Cross Section :

Every time the channel type changes, a cross section, drawn to scale must be included.

Guidlines for Keyword Use

1. Keywords are not substitutes for a complete description of the feature.

2. Avoid comments that are criptic. Be concise and clear. One word comments and comments like "lots of fish" are inadequate.

3. Use keywords in the comments field whenever possible.

4. The comments field and maps must correspond. Always include known geographic features in the comment field to tie the habitat unit to it.

5. Note amphibians in the comment field. This is to determine presence or absence of species.

6. New keywords may be added to the list as needed by the biologist. Please recommend words that will assist in finding important data.

Recommended Key Words

Keyword	Use
Weir	Man-made weir. Always note what the weir is made of (boulders, logs, gabions, etc)
Group	Man-made boulder, boulder-rootwad groups. These may be typed as POW (pocket water), but not in all instances.
Deflector	Man-made deflectors of any kind. These may be typed into several different habitat types, depending on their location.
Cover	Any man-made cover structure. Describe stream location, condition, and type of structure.

****** NOTE: Always include structure condition information in comments. ******

Keyword	Use
Trib	Confluence of a tributary. Include stream name, flow estimate, temperature. Also indicate if the tributary is an intermittent, perennial, or ephemeral stream. Be sure to note whether it enters the stream on the left or right.
Bridge	Note road number, type of construction, and any effects on the stream channel.
LWC	Low Water Crossing. Be sure to note impact to the stream, and a measure of how often it is being used; continuous use, occasional, rarely.
Falls	Waterfalls. The description should also have the keyword 'barrier' in it if applicable.
Dredge	Location of dredging activity. The dredge does not have to be present, just the indications of its use.
Mining	Mining activity that is out of the stream, but may be affecting the riparian areas. The name of the claim would be good to include in the comments field.
Camp	Obvious campsites that are being regularly used by the public. This includes campgrounds as well as seasonal primitive sites. Include campground name.

Recommended Key Words
(continued)

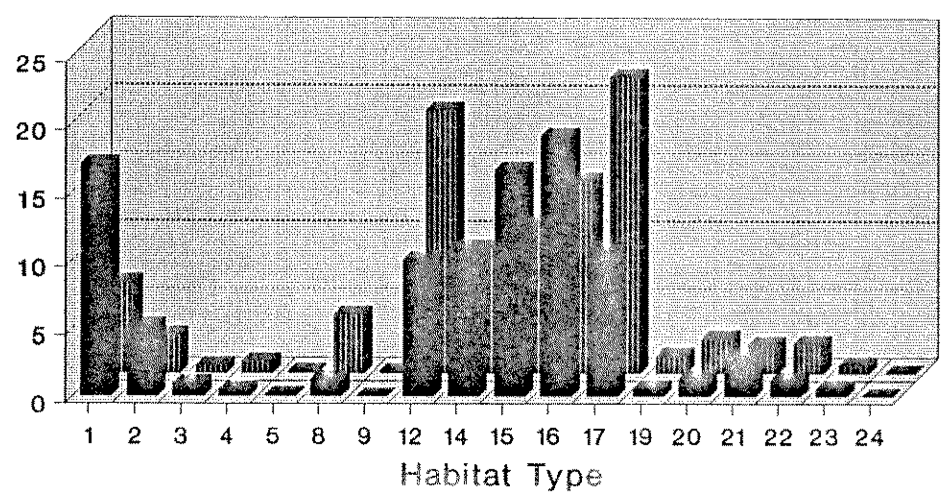
Culvert	Include culverts that are tributary, as well as those that the stream flows through. Note potential barriers, and erosion problems.
Diversion	Include vital information: Amount of flow diverted (CFS), barrier potential, presence of screens.
Barrier	Fully describe the barrier or potential barrier. Include what the barrier is formed by, height, affected species, etc.
Frog	Note the presence of frogs and a count if possible. Include tailed frogs seen in direct observation.
LWD	Large Woody Debris--24" x 10' in minimum length, rootwads with stumps greater than 24" (West Side). Or 12" x 10' in minimum length, rootwads with stumps greater than 12" (East Side).
Topo	Enter comment for shde created by topographic features, as opposed to vegetation created shade.

APPENDIX D. HABITAT CONDITION AND USE - ALL STUDY AREAS COMBINED

Salmon River
(North Fork Below White's Gulch)
(South Fork Below Cecil Creek)
Physical Typing Summary

Habitat Type	Total Units	Total Length m	Total Area m^2	Total Vol m^3	Avg Length m	Avg Width m	Avg Depth m	Avg Volume m^3	Area %	Vol %	Embedd %	Fines %	Gravel %	Cobble %	Boulder %	Bedrock %	Spawn Area m^2	Key LWD Pieces
1	261	14673	290954	2110612	56.2	17.7	0.39	423.80	17	7	1.7	5	17	41	35	3	1133	6.0
2	151	5688	88432	46159	37.7	14.5	0.48	305.69	5	3	2.4	2	6	34	56	2	31	3.0
3	38	1286	16921	9694	33.8	12.3	0.55	255.10	1	1	1.5	5	5	15	54	21	1	3.0
4	16	622	8831	14786	38.9	15.0	0.74	924.18	1	1	3.5	10	43	35	9	4	5	2.0
5	10	309	2965	2679	30.9	9.8	0.75	267.91	0	0	6.3	27	28	30	10	5	38	0.0
8	34	1702	23198	71360	50.1	10.9	2.59	2098.83	1	4	5.2	16	7	5	15	57	6	0.0
9	6	115	1561	2308	19.2	13.2	1.60	384.76	0	0	7.6	5	10	17	59	9	0	0.0
12	146	8790	171555	320007	60.2	17.5	1.61	2206.94	10	19	7.7	31	24	24	13	9	586	4.0
13	1	4	10	2	4.9	2.1	0.24	2.51	0	0	5.0		25	40	35		0	0.0
14	135	9410	186179	152662	69.7	18.7	0.77	1130.83	11	9	3.0	19	27	33	15	6	4858	15.0
15	281	17421	284529	184001	62.0	14.8	0.65	654.81	17	11	1.6	8	23	44	22	3	3434	14.0
16	149	19242	326673	234565	129.1	15.2	0.64	1584.90	19	14	1.7	8	18	46	24	5	2063	30.0
17	175	10242	184998	360447	58.5	16.5	1.82	2095.62	11	22	5.7	31	17	22	17	13	588	7.0
19	14	602	10927	21614	43.0	16.9	1.59	1543.90	1	1	22.7	17	22	38	19	4	189	0.0
20	27	1140	23555	42464	42.2	19.8	1.72	1633.23	1	3	7.0	18	20	40	19	4	17	2.0
21	39	2709	51857	35104	69.5	16.6	0.70	900.11	3	2	4.2	4	9	23	58	6	88	5.0
22	21	1261	21535	35489	60.1	16.1	1.60	1774.45	1	2	17.6	26	25	24	12	12	662	2.0
23	13	780	10611	10142	60.0	12.5	1.15	780.19	1	1	18.8	20	20	17	29	14	26	3.0
24	1	6	14	2	6.1	2.4	0.18	2.69	0	0							0	0.0

Habitat Distribution
Salmon River (Including Both Forks)



Salmon River
(North Fork Below White's Gulch & South Fork Below Cecil Creek)
Direct Observation Results

Habitat	# Units	0+ Sthd	1+ Sthd	0+ King	0+ Coho	Total Area m^2	Total Volume m^3	Habitat	Observed Area m^2	Observed Volume m^3	Corrected 0+ Sthd	Corrected 1+ Sthd	Corrected 0+ King
1	63	3056	3110	288	6	290954	110612	1	59441	23653	4278	12440	403
2	36	1330	1720	125	0	88432	46159	2	18705	9215	1862	6880	175
3	8	140	250	7	6	16922	9694	3	2573	1634	196	1000	10
4	5	50	0	26	0	8831	14787	4	1234	384	50	0	26
5	5	115	117	30	0	2966	2679	5	1125	756	115	140	30
8	9	230	634	74	2	23198	71360	8	4220	10300	230	761	74
9	4	109	213	82	0	1561	2309	9	970	1599	109	256	82
12	36	908	1218	369	0	171556	320007	12	40226	75163	908	1462	369
13	1	7	1	0	0	10	3	13	11	2	7	1	0
14	36	1759	894	462	0	186180	152662	14	45042	32785	2111	1520	554
15	67	3142	2061	685	11	284529	184001	15	61831	35199	3770	3504	822
16	38	1957	2028	415	22	326674	234565	16	73278	34444	2348	3448	498
17	41	1460	1770	906	75	184999	360447	17	45764	130407	1460	2124	906
19	9	549	520	135	0	10927	21615	19	9123	17653	549	624	135
20	9	328	271	245	0	23555	42464	20	8738	13969	328	325	245
21	12	854	1347	172	0	51857	35104	21	15142	11534	1025	2290	206
22	10	394	271	551	0	21535	35489	22	9585	19652	394	325	551
23	7	358	680	167	0	10612	10142	23	6054	6236	358	816	167

Cover Composition

Habitat	No. Units	Cover %	Undercut %	SWD %	LWD %	Vegetation %	White Water %	Boulders %	Bdrk Ledge %	SShade %
1	261	40	0	0	0	10	39	48	2	1
2	151	66	0	0	0	4	53	41	2	2
3	38	72		0	0	3	46	46	5	3
4	16	13		2	0	27	2	15	54	3
5	10	35				2	3	59	36	1
8	34	53	56		0		8	17	19	1
9	6	42					35	42	23	0
12	146	21	24	0		4	11	28	33	2
13	1	15	70				2	28		90
14	135	12	1	1	0	11	1	60	26	1
15	281	20	0	0	0	8	17	61	13	2
16	149	25	1	0	0	9	30	50	9	2
17	175	22	20	0	0	4	4	32	39	1
19	14	16		1		3	26	48	22	3
20	27	22	27			3	10	45	15	3
21	39	55		0	0	7	29	58	6	2
22	21	24	0	0		5	3	44	47	5
23	13	48		0		4	21	59	15	3

Salmon River
(North Fork Below White's Gulch)
(South Fork Below Cecil Creek)

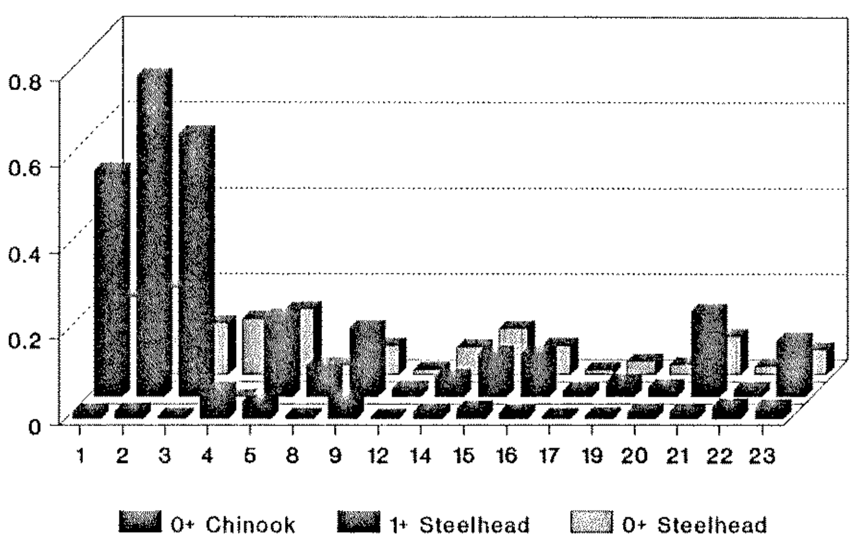
Estimated Fish Density (Per M^3)

Habitat	0+ Sthd	1+ Sthd	0+ King	0+ Coho
1	0.181	0.526	0.017	0.000
2	0.202	0.747	0.019	0.000
3	0.120	0.612	0.006	0.004
4	0.130	0.000	0.068	0.000
5	0.152	0.186	0.040	0.000
8	0.022	0.074	0.007	0.000
9	0.068	0.160	0.051	0.000
12	0.012	0.019	0.005	0.000
13	3.472	0.595	0.000	0.000
14	0.064	0.046	0.017	0.000
15	0.107	0.100	0.023	0.000
16	0.068	0.100	0.014	0.001
17	0.011	0.016	0.007	0.001
19	0.031	0.035	0.008	0.000
20	0.023	0.023	0.018	0.000
21	0.089	0.199	0.018	0.000
22	0.020	0.017	0.028	0.000
23	0.057	0.131	0.027	0.000

Estimated Fish Density (Per M^2)

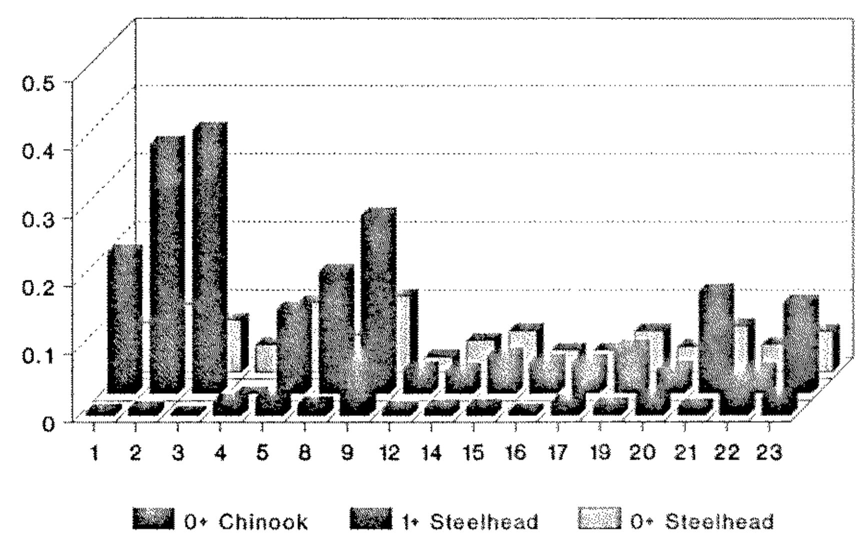
Habitat	0+ Sthd	1+ Sthd	0+ King	0+ Coho
1	0.072	0.209	0.007	0.000
2	0.100	0.368	0.009	0.000
3	0.076	0.389	0.004	0.002
4	0.041	0.000	0.021	0.000
5	0.102	0.125	0.027	0.000
8	0.055	0.180	0.018	0.000
9	0.112	0.263	0.085	0.000
12	0.023	0.036	0.009	0.000
13	0.627	0.108	0.000	0.000
14	0.047	0.034	0.012	0.000
15	0.061	0.057	0.013	0.000
16	0.032	0.047	0.007	0.000
17	0.032	0.046	0.020	0.002
19	0.060	0.068	0.015	0.000
20	0.038	0.037	0.028	0.000
21	0.068	0.151	0.014	0.000
22	0.041	0.034	0.057	0.000
23	0.059	0.135	0.028	0.000

Estimated Fish Densities
Salmon River (Including both Forks)



Fish Per Cu. Meter

Estimated Fish Densities
Salmon River (Including both Forks)



Fish Per Sq. Meter

Salmon River
(North Fork Below White's Gulch)
(South Fork Below Cecil Creek)
Direct Observation Results

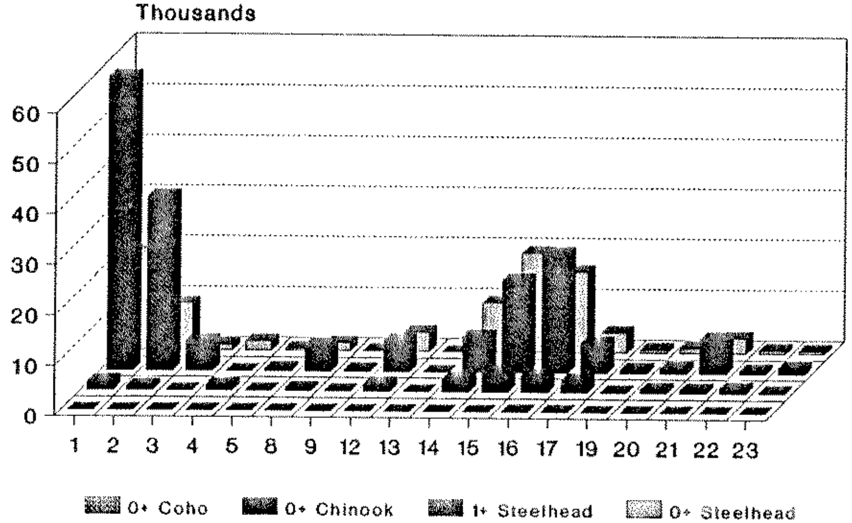
Estimated Standing Crop (Volume)

Habitat	0+ Sthd	1+ Sthd	0+ King	0+ Coho
1	20008	58175	1886	28
2	9327	34464	877	0
3	1163	5934	58	36
4	1925	0	1001	0
5	408	498	106	0
8	1594	5271	513	14
9	157	369	118	0
12	3866	6223	1571	0
13	9	1	0	0
14	9829	7077	2582	0
15	19710	18316	4297	58
16	15993	23479	3391	150
17	4035	5871	2504	207
19	672	764	165	0
20	997	989	745	0
21	3119	6969	628	0
22	711	587	995	0
23	582	1327	272	0
TOTAL	94104	176313	21709	492

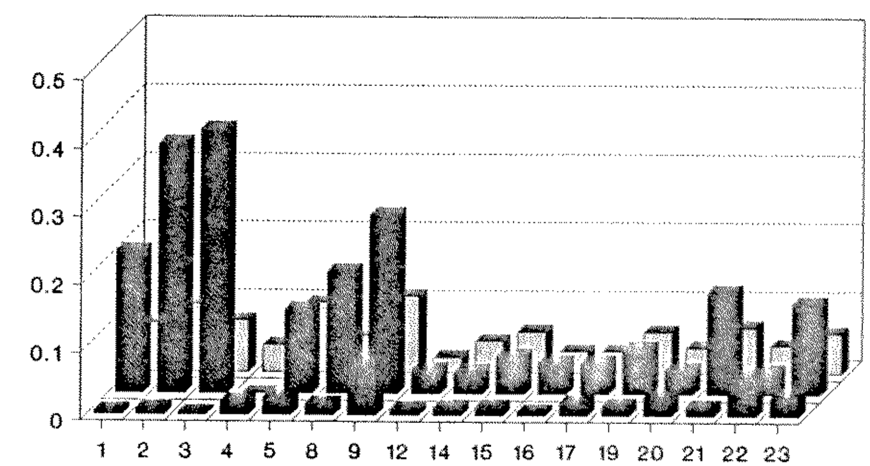
Estimated Standing Crop (Area)

Habitat	0+ Sthd	1+ Sthd	0+ King	0+ Coho
1	20942	60892	1974	29
2	8803	32527	827	0
3	1289	6577	64	39
4	358	0	186	0
5	303	370	79	0
8	1264	4182	407	11
9	175	411	132	0
12	3872	6233	1574	0
13	7	1	0	0
14	8725	6282	2292	0
15	17350	16123	3783	51
16	10469	15369	2220	98
17	5902	8586	3662	303
19	658	747	162	0
20	884	877	660	0
21	3510	7842	707	0
22	884	731	1238	0
23	628	1430	293	0
	86023	169181	20259	532

Estimated Standing Crop
Salmon River (Including both Forks)

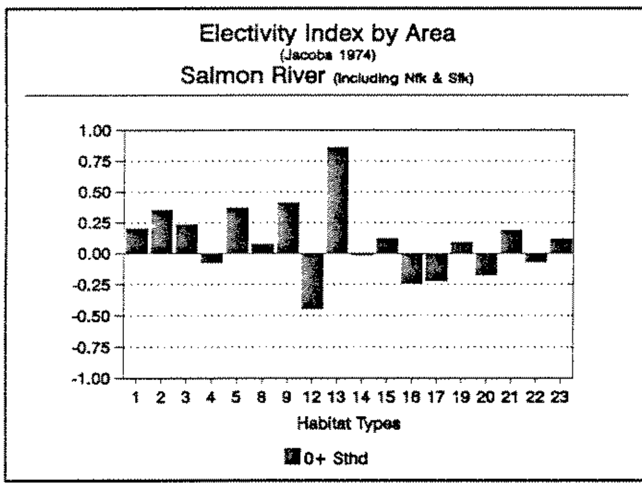


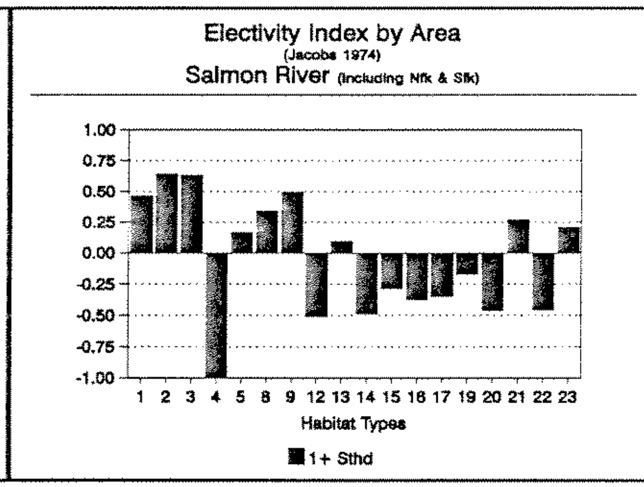
Estimated Fish Densities
Salmon River (Including both Forks)

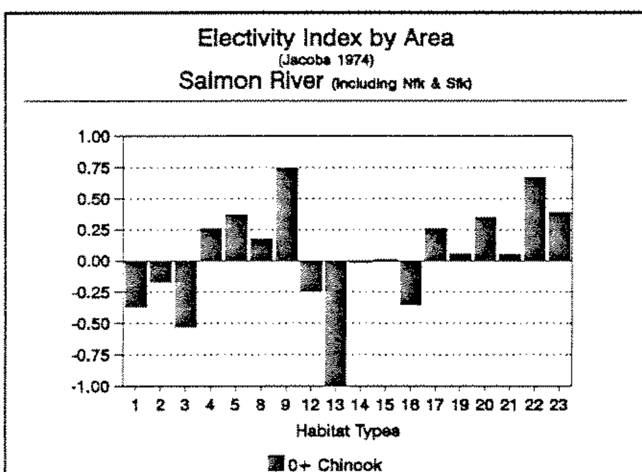


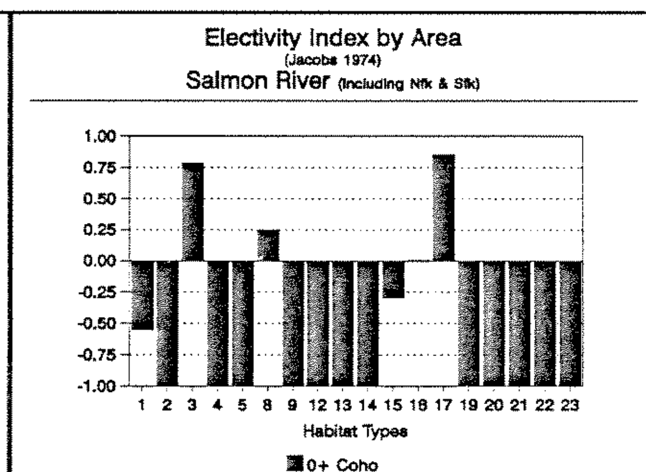
Salmon River (Including NFk and Sfk)
Electivity Index by Area

Habitat	0+ Sthd	1+ Sthd	0+ Chinook	0+ Coho
1	0.204	0.464	-0.365	-0.551
2	0.356	0.641	-0.169	-1.000
3	0.236	0.633	-0.530	0.790
4	-0.077	-1.000	0.262	-1.000
5	0.369	0.167	0.368	-1.000
8	0.072	0.343	0.176	0.249
9	0.409	0.496	0.748	-1.000
12	-0.446	-0.510	-0.241	-1.000
13	0.860	0.094	-1.000	-1.000
14	-0.014	-0.486	-0.011	-1.000
15	0.117	-0.283	0.008	-0.296
16	-0.244	-0.371	-0.351	0.005
17	-0.220	-0.348	0.259	0.857
19	0.087	-0.170	0.056	-1.000
20	-0.172	-0.462	0.351	-1.000
21	0.186	0.271	0.051	-1.000
22	-0.071	-0.454	0.671	-1.000
23	0.114	0.208	0.389	-1.000



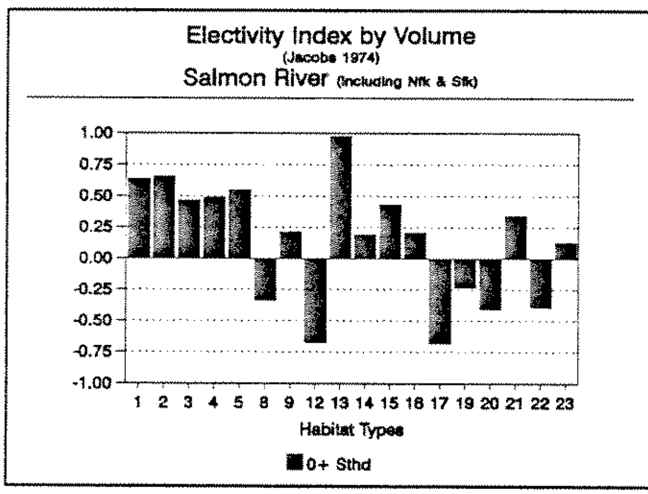


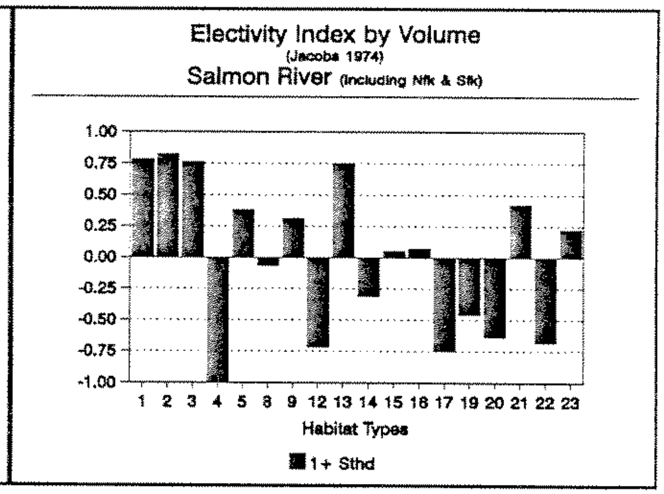


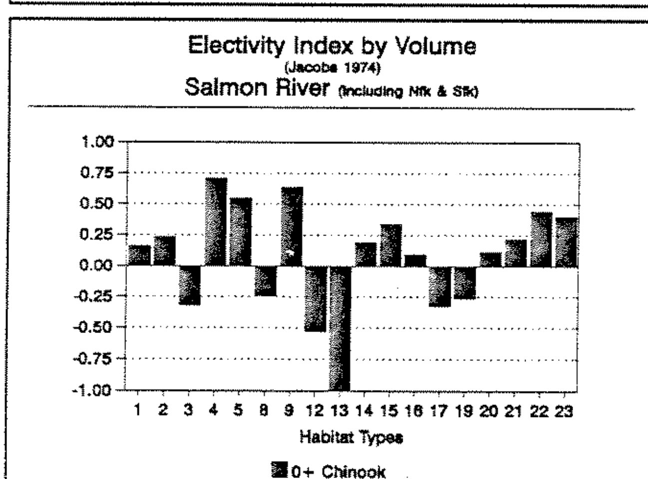


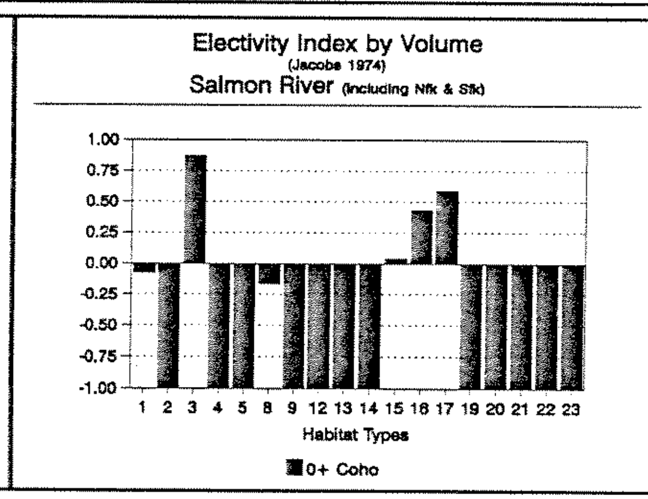
Salmon River (Including NFk and Sfk)
Electivity Index by Volume

Habitat	0+ Sthd	1+ Sthd	0+ Chinook	0+ Coho
1	0.64	0.78	0.16	-0.07
2	0.65	0.82	0.24	-1.00
3	0.46	0.76	-0.32	0.87
4	0.49	-1.00	0.71	-1.00
5	0.55	0.38	0.55	-1.00
8	-0.34	-0.06	-0.24	-0.17
9	0.21	0.31	0.63	-1.00
12	-0.68	-0.72	-0.53	-1.00
13	0.97	0.75	-1.00	-1.00
14	0.19	-0.31	0.19	-1.00
15	0.43	0.05	0.34	0.04
16	0.21	0.07	0.09	0.43
17	-0.68	-0.75	-0.33	0.59
19	-0.23	-0.46	-0.26	-1.00
20	-0.40	-0.64	0.11	-1.00
21	0.35	0.42	0.22	-1.00
22	-0.39	-0.68	0.44	-1.00
23	0.13	0.22	0.40	-1.00







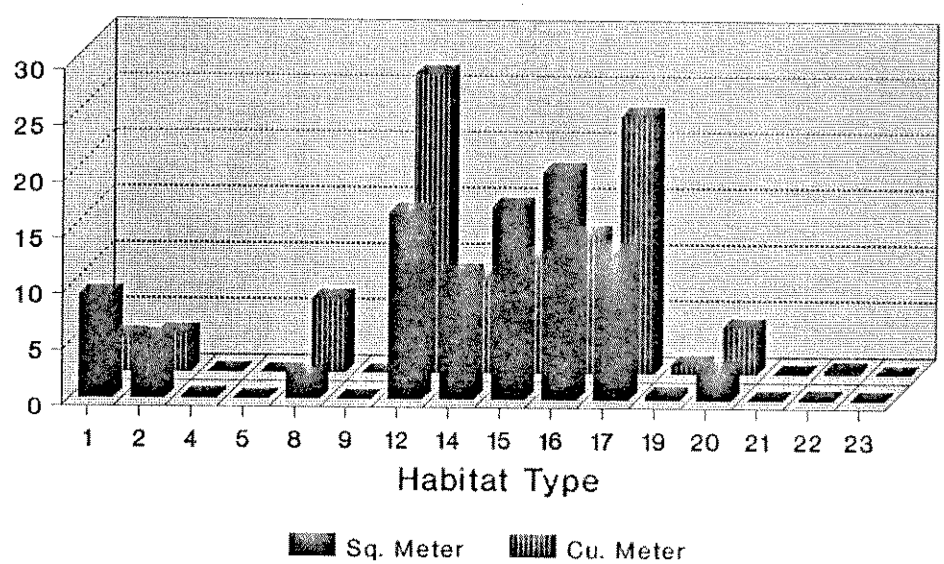


APPENDIX E. HABITAT CONDITION AND USE - MAINSTEM SALMON RIVER

Mainstem Salmon River
Physical Typing Summary

Habitat Type	Total Units	Total Length m	Total Area m^2	Total Vol m^3	Avg Length m	Avg Width m	Avg Depth m	Avg Volume m^3	Area %	Vol %	Embedd %	Fines %	Gravel %	Cobble %	Boulder %	Bedrock %	Spawn Area m^2	Key LWD Pieces
1	53	2675	62469	28428	50.5	22.4	0.47	536.38	9	3	1.6	4	15	43	37	1	327	0.0
2	52	1997	36656	30965	38.4	18.2	0.70	595.50	5	3	1.3	3	6	40	51	1	0	
4	6	315	1464	830	52.6	5.9	0.60	138.38	0	0	0.9		20	80			0	0.0
5	3	121	477	198	40.5	3.8	0.40	66.22	0	0	1.3	5	41	38	10	6	0	0.0
8	13	945	15384	59370	72.7	14.8	4.12	4566.93	2	7	6.4	19	9	3	6	62	0	0.0
9	1	19	241	385	19.8	12.2	1.62	385.84	0	0	5.0	2	3	10	70	15	0	0.0
12	64	5050	113576	239381	78.9	21.5	2.06	3799.71	17	27	5.8	30	28	27	10	5	213	0.0
14	35	3187	76779	75417	91.1	24.9	1.01	2154.79	11	8	0.3	17	22	42	16	2	201	1.0
15	72	5723	116723	91512	79.5	19.4	0.86	1271.01	17	10	0.3	8	16	55	19	2	325	0.0
16	41	6602	138097	111606	161.0	20.4	0.87	2722.11	20	12	0.2	6	16	57	19	2	196	3.0
17	53	4321	90525	205878	81.5	20.4	2.32	4117.57	13	23	5.4	34	20	24	17	5	217	0.0
19	3	143	3193	8211	47.7	21.1	2.39	2737.22	0	1	20.9	15	10	57	14	4	9	0.0
20	19	844	18888	37753	44.4	21.8	1.96	1987.00	3	4	4.0	12	17	49	19	4	3	0.0
21	1	30	604	728	30.5	19.8	1.22	728.00	0	0	0.0	10	10	30	40	10	0	0.0
22	2	72	1157	3034	36.3	14.2	2.36	1517.40	0	0	13.5	26	22	38	14	1	9	0.0
23	1	15	186	476	15.3	12.2	2.59	476.00	0	0		10	30	45	5	10	0	0.0

Habitat Distribution
Mainstem Salmon River



Mainstem Salmon River
Direct Observation Results

Habitat	# Units	0+ Sthd	1+ Sthd	0+ King	0+ Coho	Total Area m^2	Total Volume m^3	Habitat	Observed Area m^2	Observed Volume m^3	Corrected 0+ Sthd	Corrected 1+ Sthd	Corrected 0+ King
1	11	480	496	42	0	62469	28428	1	9537	4108	672	1984	59
2	11	301	383	39	0	36656	20114	2	5714	2768	421	1532	55
4	1	0	0	0	0	1464	830	4	91	46	0	0	0
5	2	4	0	0	0	478	199	5	388	171	4	0	0
8	3	56	155	55	0	15384	59370	8	2862	8263	56	186	55
9	1	15	48	5	0	242	386	9	297	537	15	58	5
12	15	171	651	74	0	113577	239382	12	23300	47245	171	781	74
14	9	53	65	12	0	76780	75418	14	13421	10650	64	111	14
15	17	367	364	54	0	116723	91512	15	20835	12690	440	619	65
16	9	421	466	34	0	138098	111607	16	16225	11360	505	792	41
17	12	265	604	361	0	90526	205878	17	21133	93439	265	725	361
19	3	67	84	1	0	3193	8212	19	3654	9295	67	101	1
20	4	54	75	0	0	18888	37753	20	4802	9537	54	90	0
21	1	62	56	6	0	605	728	21	651	823	74	95	7
22	2	9	2	3	0	1157	3035	22	1157	3035	9	2	3
23	1	2	4	0	0	186	476	23	298	762	2	5	0

Cover Composition

Habitat	No. Units	Cover %	Undercut %	SWD %	LWD %	Vegetation %	White Water %	Boulders %	Bdrk Ledge %	Shade %
0	1									
1	53	41			0		61	36	3	0
2	52	76		0			63	36	1	1
4	6	20				22	5	23	51	0
5	3	6						60	40	3
8	13	58	85				6	2	7	1
9	1	50					50	40	10	0
12	64	19	37	0		2	13	25	23	0
14	35	7		0		2	2	66	30	0
15	72	14		0	1	0	24	59	15	0
16	41	21	0	0	0	1	42	45	11	1
17	53	21	41	0	0	2	5	26	26	0
19	3	7				3	54	20	23	3
20	19	21	33				9	43	15	0
21	1	75			5		25	40	30	5
22	2	18	6				40	18	37	0
23	1	85					85	5	10	5

Mainstem Salmon River

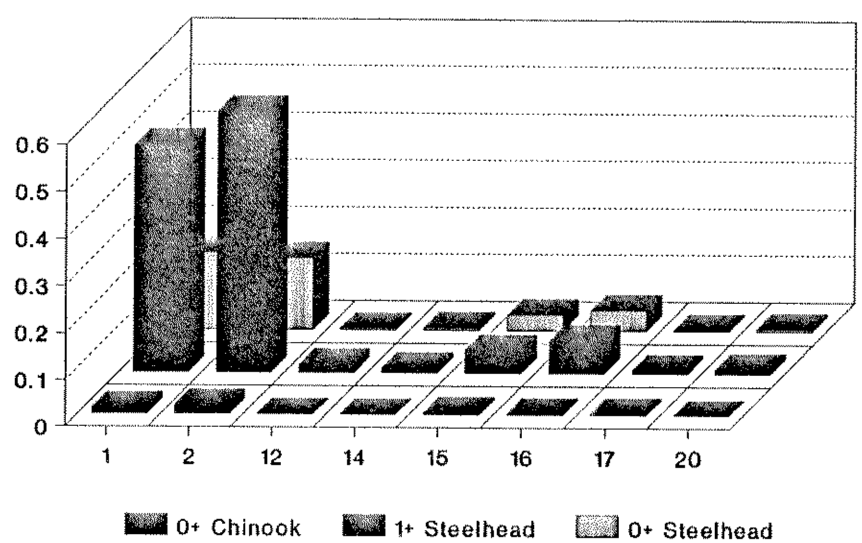
Estimated Fish Density (Per M^3)

Habitat	0+ Sthd	1+ Sthd	0+ King	0+ Coho
1	0.164	0.483	0.014	0.000
2	0.152	0.553	0.020	0.000
4	0.000	0.000	0.000	0.000
5	0.023	0.000	0.000	0.000
8	0.007	0.023	0.007	0.000
9	0.028	0.107	0.009	0.000
12	0.004	0.017	0.002	0.000
14	0.006	0.010	0.001	0.000
15	0.035	0.049	0.005	0.000
16	0.044	0.070	0.004	0.000
17	0.003	0.008	0.004	0.000
19	0.007	0.011	0.000	0.000
20	0.006	0.009	0.000	0.000
21	0.090	0.116	0.009	0.000
22	0.003	0.001	0.001	0.000
23	0.003	0.006	0.000	0.000

Estimated Fish Density (Per M^2)

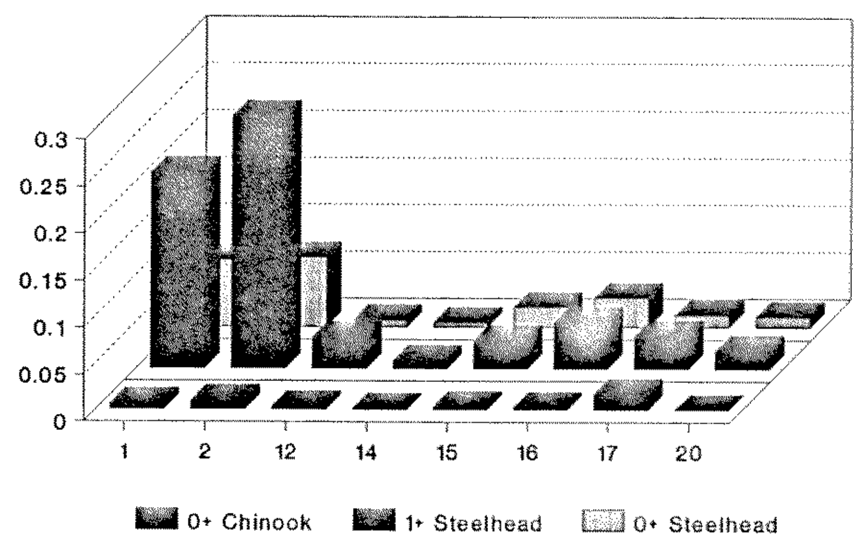
Habitat	0+ Sthd	1+ Sthd	0+ King	0+ Coho
1	0.070	0.208	0.006	0.000
2	0.074	0.268	0.010	0.000
4	0.000	0.000	0.000	0.000
5	0.010	0.000	0.000	0.000
8	0.020	0.065	0.019	0.000
9	0.050	0.194	0.017	0.000
12	0.007	0.034	0.003	0.000
14	0.005	0.008	0.001	0.000
15	0.021	0.030	0.003	0.000
16	0.031	0.049	0.003	0.000
17	0.013	0.034	0.017	0.000
19	0.018	0.028	0.000	0.000
20	0.011	0.019	0.000	0.000
21	0.114	0.146	0.011	0.000
22	0.007	0.002	0.003	0.000
23	0.007	0.016	0.000	0.000

Estimated Fish Densities
Mainstem Salmon River



Fish Per Cu. Meter

Estimated Fish Densities
Mainstem Salmon River



Fish Per Sq. Meter

Mainstem Salmon River

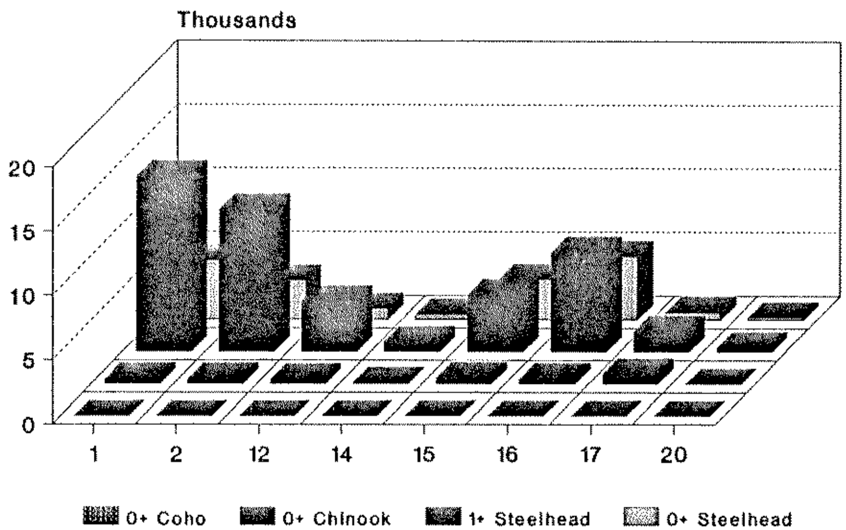
Estimated Standing Crop (Volume)

Habitat	0+ Sthd	1+ Sthd	0+ King	0+ Coho
1	4651	13730	407	0
2	3062	11131	397	0
4	0	0	0	0
5	5	0	0	0
8	402	1336	395	0
9	11	41	4	0
12	866	3958	375	0
14	450	782	102	0
15	3176	4462	467	0
16	4963	7783	401	0
17	584	1597	795	0
19	59	89	1	0
20	214	356	0	0
21	66	84	6	0
22	9	2	3	0
23	1	3	0	0
Total	18519	45357	3353	0

Estimated Standing Crop (Area)

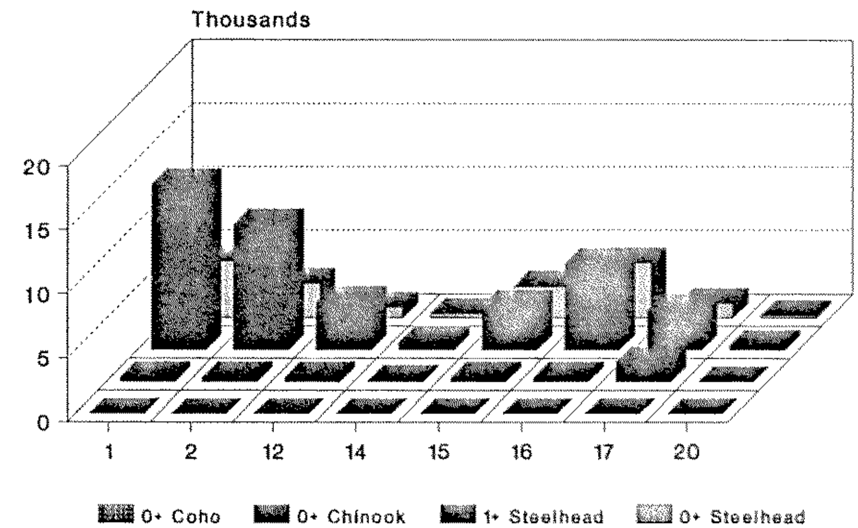
Habitat	0+ Sthd	1+ Sthd	0+ King	0+ Coho
1	4402	12995	385	0
2	2703	9828	350	0
4	0	0	0	0
5	5	0	0	0
8	301	1000	296	0
9	12	47	4	0
12	834	3808	361	0
14	364	632	82	0
15	2467	3467	363	0
16	4300	6743	347	0
17	1135	3105	1546	0
19	59	88	1	0
20	212	354	0	0
21	69	88	7	0
22	9	2	3	0
23	1	3	0	0
	16873	42161	3745	0

Estimated Standing Crop
Mainstem Salmon River



Derived From Fish per Cu M

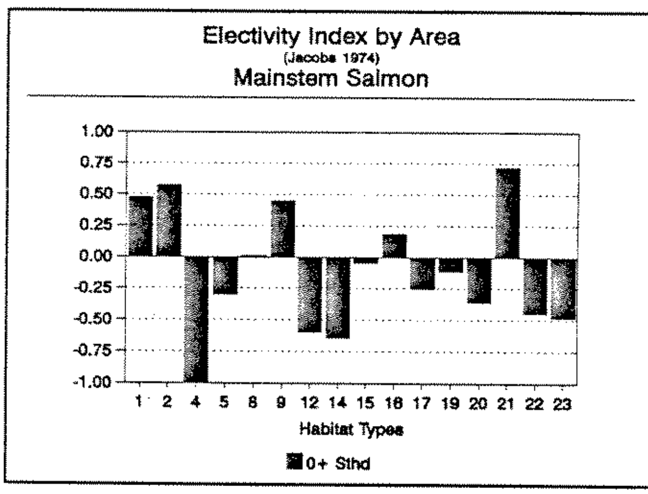
Estimated Standing Crop
Mainstem Salmon River

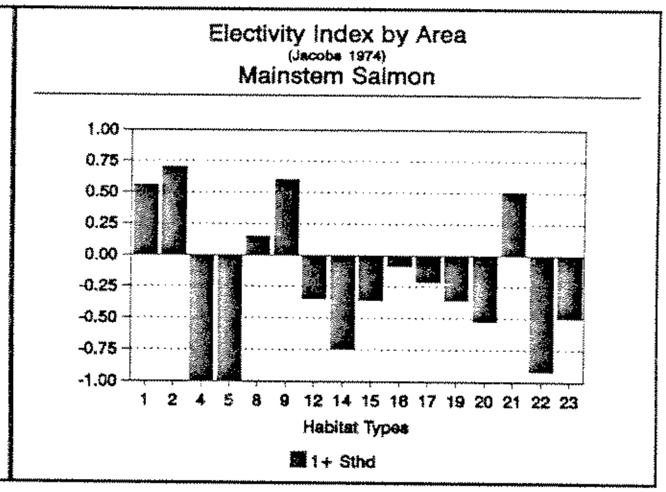


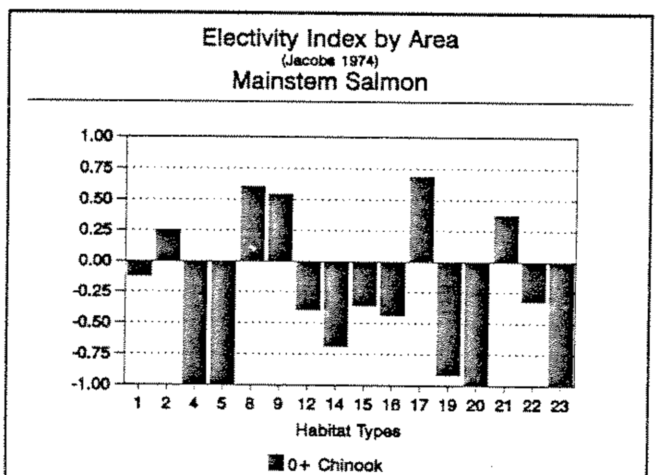
Derived From Fish per Sq M

Mainstem Salmon River
Electivity Index by Area

Habitat	0+ Sthd	1+ Sthd	0+ Chinook	0+ Coho
1	0.477	0.557	-0.123	n/a
2	0.572	0.705	0.250	n/a
4	-1.000	-1.000	-1.000	n/a
5	-0.302	-1.000	-1.000	n/a
8	0.010	0.152	0.603	n/a
9	0.450	0.604	0.541	n/a
12	-0.596	-0.346	-0.393	n/a
14	-0.646	-0.742	-0.687	n/a
15	-0.043	-0.356	-0.355	n/a
16	0.188	-0.084	-0.437	n/a
17	-0.255	-0.210	0.690	n/a
19	-0.110	-0.355	-0.915	n/a
20	-0.359	-0.525	-1.000	n/a
21	0.718	0.508	0.377	n/a
22	-0.449	-0.918	-0.322	n/a
23	-0.482	-0.499	-1.000	n/a

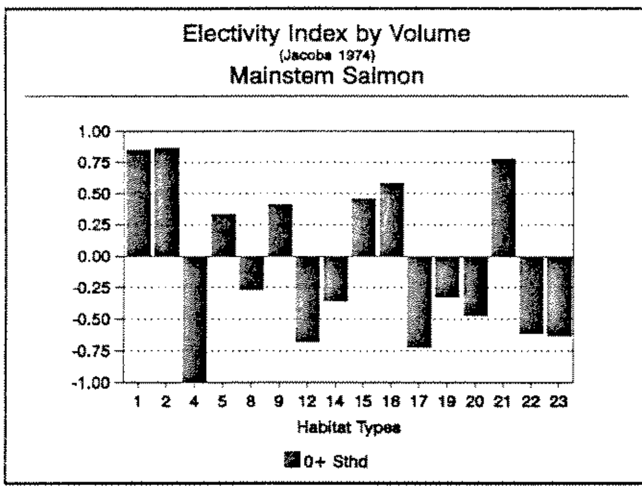


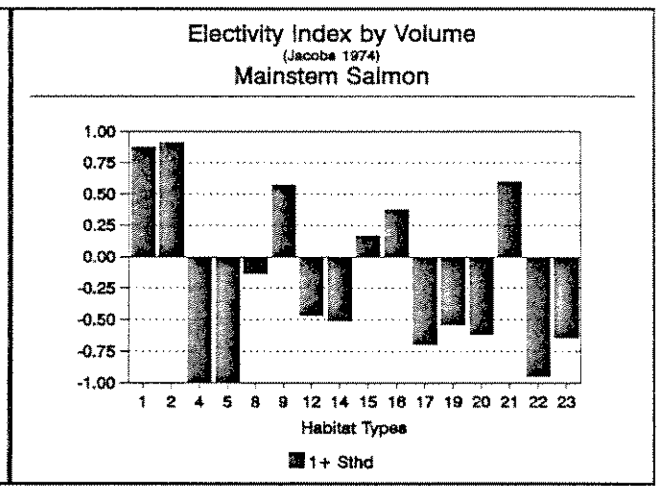


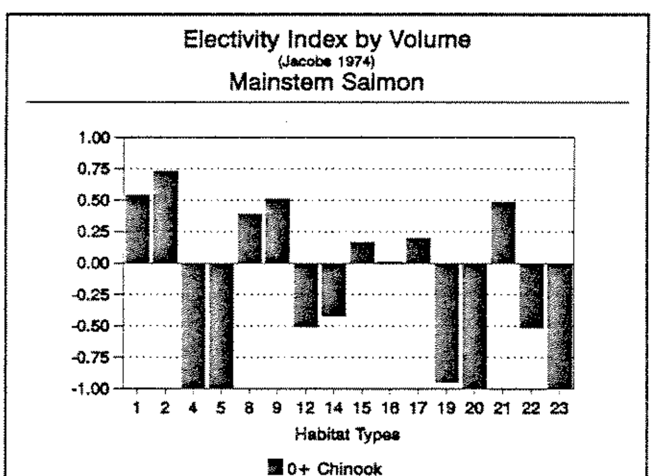


Mainstem Salmon River
Electivity Index by Volume

Habitat	0+ Sthd	1+ Sthd	0+ Chinook	0+ Coho
1	0.85	0.88	0.54	n/a
2	0.87	0.91	0.73	n/a
4	-1.00	-1.00	-1.00	n/a
5	0.34	-1.00	-1.00	n/a
8	-0.27	-0.13	0.39	n/a
9	0.41	0.57	0.51	n/a
12	-0.68	-0.47	-0.51	n/a
14	-0.36	-0.51	-0.42	n/a
15	0.46	0.17	0.17	n/a
16	0.59	0.38	0.01	n/a
17	-0.72	-0.70	0.20	n/a
19	-0.33	-0.54	-0.95	n/a
20	-0.47	-0.62	-1.00	n/a
21	0.78	0.60	0.49	n/a
22	-0.61	-0.95	-0.51	n/a
23	-0.63	-0.65	-1.00	n/a





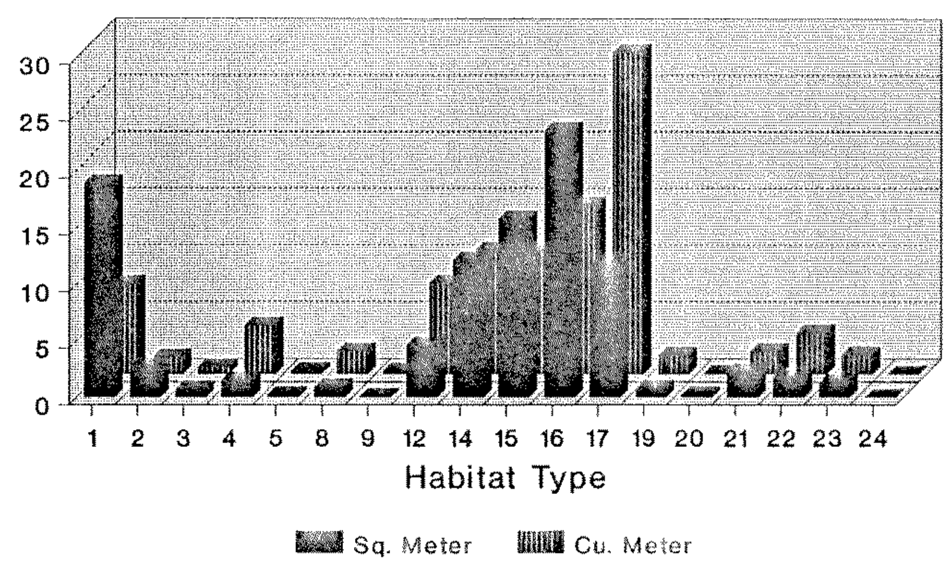


APPENDIX F. HABITAT CONDITION AND USE - SOUTH FORK SALMON RIVER

South Fork Salmon River
Physical Typing Summary

Habitat Type	Total Units	Total Length m	Total Area m^2	Total Vol m^3	Avg Length m	Avg Width m	Avg Depth m	Avg Volume m^3	Area %	Vol %	Embedd %	Fines %	Gravel %	Cobble %	Boulder %	Bedrock %	Spawn Area m^2	Key LWD Pieces
0	2	75			37.8												0	0.0
1	113	5653	84810	25484	50.0	14.1	0.31	225.53	19	8	2.1	4	20	40	30	5	553	4.0
2	42	1184	12454	4867	28.2	10.1	0.39	115.90	3	2	0.1	2	8	30	51	9	14	2.0
3	17	393	3591	2149	23.2	9.0	0.55	126.43	1	1	0.0	4	5	17	44	30	0	2.0
4	8	237	6915	13836	29.7	23.8	0.96	1729.50	2	4	3.7	12	44	27	12	5	5	2.0
5	4	93	1177	988	23.3	12.4	0.82	247.00	0	0	13.4	49	19	22	6	5	0	0.0
8	15	493	4377	6543	32.9	7.2	1.70	436.25	1	2	0.2	2	2	1	9	86	0	0.0
9	3	46	619	981	15.4	12.8	1.75	327.02	0	0		10	30	20	20	20	0	0.0
12	43	1604	20882	25866	37.3	12.6	1.13	601.54	5	8	8.6	28	16	20	14	21	235	2.0
14	63	3670	54729	35081	58.3	14.6	0.64	556.85	12	11	3.0	18	33	31	12	5	3357	9.0
15	111	5539	70677	35177	49.9	11.7	0.53	316.92	16	11	1.5	6	32	35	20	6	1945	10.0
16	69	7756	105889	47700	112.4	12.3	0.51	701.48	24	15	1.9	8	23	37	24	9	1124	18.0
17	83	3747	53361	90822	45.2	13.5	1.63	1094.25	12	28	5.6	35	17	15	14	19	253	5.0
19	6	258	3686	5524	43.2	14.3	1.27	920.69	1	2	20.5	23	43	24	8	2	86	0.0
20	3	78	1142	454	26.2	13.9	0.84	227.26	0	0	27.2	27	21	25	26		0	2.0
21	17	715	10481	6507	42.1	13.4	0.68	382.82	2	2	0.0	1	3	25	61	10	65	2.0
22	9	500	7874	11760	55.6	15.6	1.54	1470.03	2	4	16.9	33	41	14	5	7	30	1.0
23	7	495	5782	5697	70.7	9.4	1.08	813.88	1	2	24.5	26	26	24	14	9	13	1.0
24	1	6	14	2	6.1	2.4	0.18	2.69	0	0							0	0.0

Habitat Distribution
South Fork Salmon River



South Fork Salmon River
Direct Observation Results

Habitat	# Units	0+ Sthd	1+ Sthd	0+ King	0+ Coho	Total Area m^2	Total Volume m^3	Habitat	Observed Area m^2	Observed Volume m^3	Corrected 0+ Sthd	Corrected 1+ Sthd	Corrected 0+ King
1	30	1368	1328	210	6	84810	25485	1	25603	8735	1915	5312	294
2	12	461	591	55	0	12455	4868	2	3602	1588	645	2364	77
3	5	47	114	4	6	3592	2149	3	1214	547	66	456	6
4	3	50	0	0	0	6916	13836	4	946	278	50	0	0
5	2	80	115	30	0	1177	988	5	461	434	80	138	30
8	5	168	364	13	2	4378	6544	8	869	1447	168	437	13
9	1	8	67	35	0	620	981	9	149	358	8	80	35
12	11	480	375	209	0	20882	25866	12	4892	6238	480	450	209
14	15	1018	456	317	0	54729	35082	14	13378	9688	1222	775	380
15	27	1159	970	404	11	70678	35178	15	17713	9358	1391	1649	485
16	18	884	1105	355	0	105889	47701	16	28527	12852	1061	1879	426
17	19	717	681	390	75	53362	90823	17	12438	21570	717	817	390
19	3	313	191	77	0	3687	5524	19	3018	3268	313	229	77
20	2	107	123	221	0	1143	455	20	758	188	107	148	221
21	6	327	719	129	0	10481	6508	21	2557	1711	392	1222	155
22	2	88	51	406	0	7874	11760	22	1976	3570	88	61	406
23	2	69	307	45	0	5783	5697	23	2612	2366	69	368	45

Cover Composition

Habitat	No. Units	Cover %	Undercut %	SWD %	LWD %	Vegetation %	White Water %	Boulders %	Bdrk Ledge %	Shade %
0	2									
1	113	34	0	0	0	8	39	50	1	3
2	42	58		0	0	1	54	38	6	2
3	17	71			0	0	49	39	11	3
4	8	10				26	2	15	58	4
5	4	27					4	78	18	1
8	15	43			0		12	42	46	1
9	3	44					26	31	43	0
12	43	18	0			3	11	39	46	3
14	63	12	3	2	1	9	1	53	30	1
15	111	22	1	1	1	6	21	58	13	6
16	69	24	3	0	0	14	24	48	11	3
17	83	24	1	0	0	4	3	35	57	2
19	6	17				2	24	51	23	2
20	3	21				2	10	78	10	4
21	17	44		1		2	23	63	11	1
22	9	22		1		2	2	59	36	2
23	7	35				2	14	64	20	0
24	1									

South Fork Salmon River

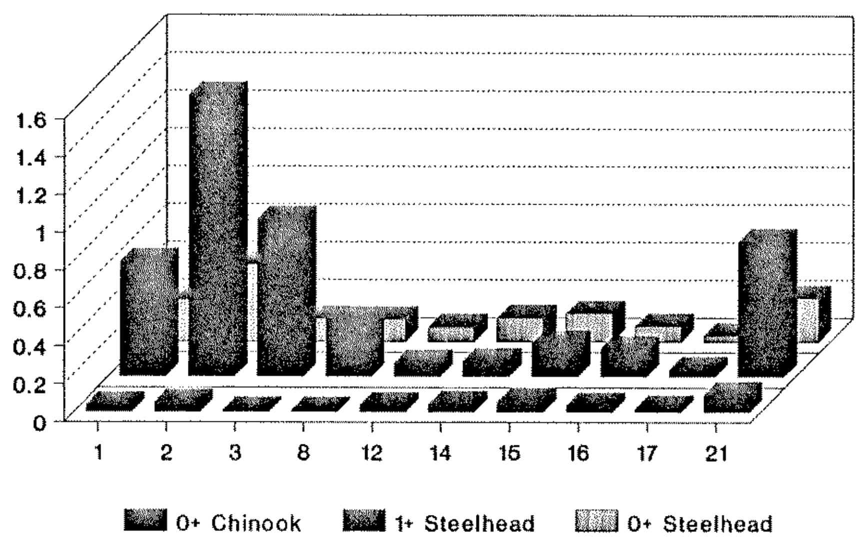
Estimated Fish Density (Per M^3)

Habitat	0+ Sthd	1+ Sthd	0+ King	0+ Coho
1	0.219	0.608	0.034	0.001
2	0.406	1.488	0.048	0.000
3	0.120	0.833	0.010	0.011
4	0.180	0.000	0.000	0.000
5	0.184	0.318	0.069	0.000
8	0.116	0.302	0.009	0.001
9	0.022	0.224	0.098	0.000
12	0.077	0.072	0.034	0.000
14	0.126	0.080	0.039	0.000
15	0.149	0.176	0.052	0.001
16	0.083	0.146	0.033	0.000
17	0.033	0.038	0.018	0.003
19	0.096	0.070	0.024	0.000
20	0.569	0.784	1.175	0.000
21	0.229	0.714	0.090	0.000
22	0.025	0.017	0.114	0.000
23	0.029	0.156	0.019	0.000

Estimated Fish Density (Per M^2)

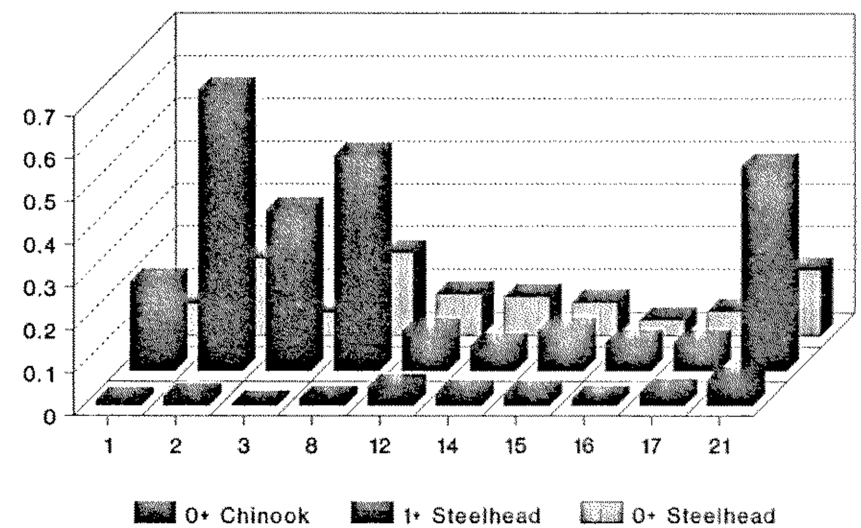
Habitat	0+ Sthd	1+ Sthd	0+ King	0+ Coho
1	0.075	0.207	0.011	0.000
2	0.179	0.656	0.021	0.000
3	0.054	0.376	0.005	0.005
4	0.053	0.000	0.000	0.000
5	0.173	0.299	0.065	0.000
8	0.193	0.503	0.015	0.002
9	0.054	0.540	0.235	0.000
12	0.098	0.092	0.043	0.000
14	0.091	0.058	0.028	0.000
15	0.079	0.093	0.027	0.001
16	0.037	0.066	0.015	0.000
17	0.058	0.066	0.031	0.006
19	0.104	0.076	0.026	0.000
20	0.141	0.195	0.292	0.000
21	0.153	0.478	0.061	0.000
22	0.045	0.031	0.205	0.000
23	0.026	0.141	0.017	0.000

Estimated Fish Densities
South Fork Salmon River



Fish Per Cu. Meter

Estimated Fish Densities
South Fork Salmon River



Fish Per Sq. Meter

South Fork Salmon River

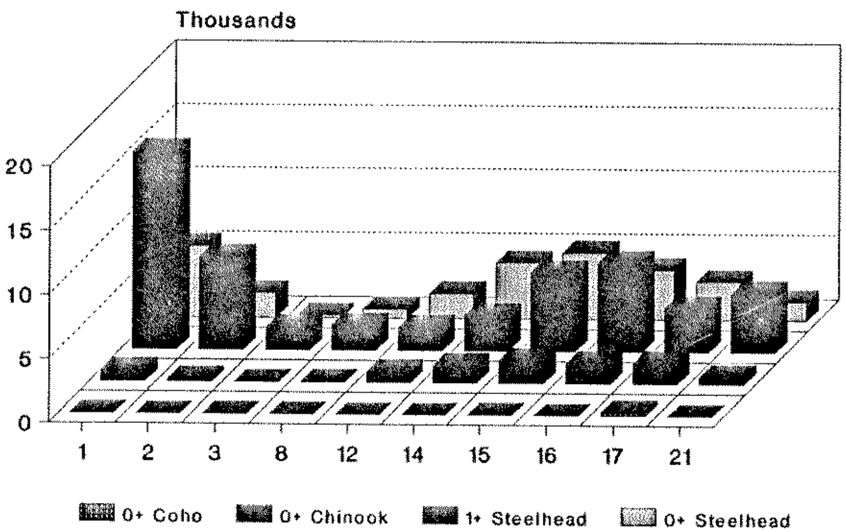
Estimated Standing Crop (Volume)

Habitat	0+ Sthd	1+ Sthd	0+ King	0+ Coho
1	5588	15498	858	18
2	1978	7244	236	0
3	258	1791	22	24
4	2487	0	0	0
5	182	314	68	0
8	760	1976	59	9
9	22	220	96	0
12	1990	1866	867	0
14	4424	2807	1377	0
15	5228	6199	1822	41
16	3937	6972	1581	0
17	3019	3441	1642	316
19	529	387	130	0
20	258	357	534	0
21	1493	4650	589	0
22	290	202	1337	0
23	166	887	108	0
Total	32610	54810	11327	407

Estimated Standing Crop (Area)

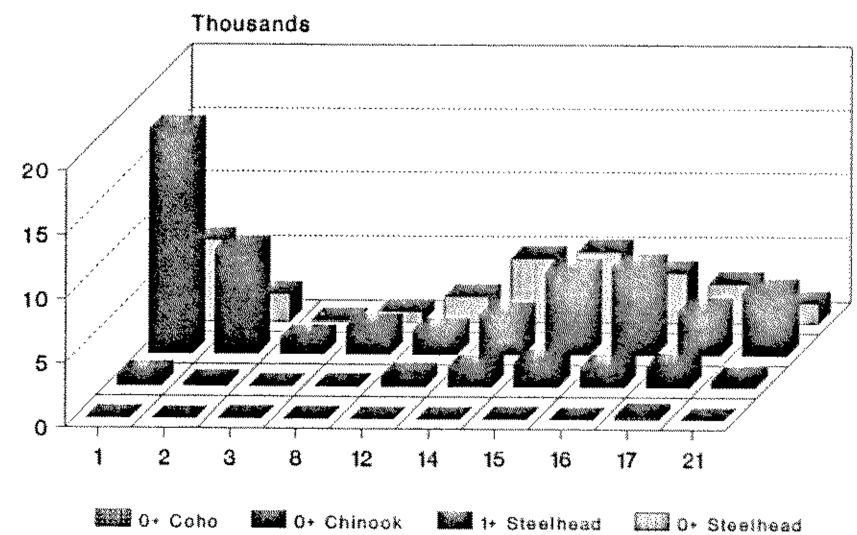
Habitat	0+ Sthd	1+ Sthd	0+ King	0+ Coho
1	6344	17596	974	20
2	2231	8173	266	0
3	195	1349	17	18
4	365	0	0	0
5	204	352	77	0
8	847	2201	66	10
9	33	335	146	0
12	2049	1921	892	0
14	4997	3171	1556	0
15	5549	6580	1934	44
16	3938	6973	1581	0
17	3076	3506	1673	322
19	382	280	94	0
20	161	223	333	0
21	1608	5010	634	0
22	351	244	1618	0
23	153	816	100	0
	32485	58729	11961	413

Estimated Standing Crop
South Fork Salmon River



Derived From Fish per Cu M

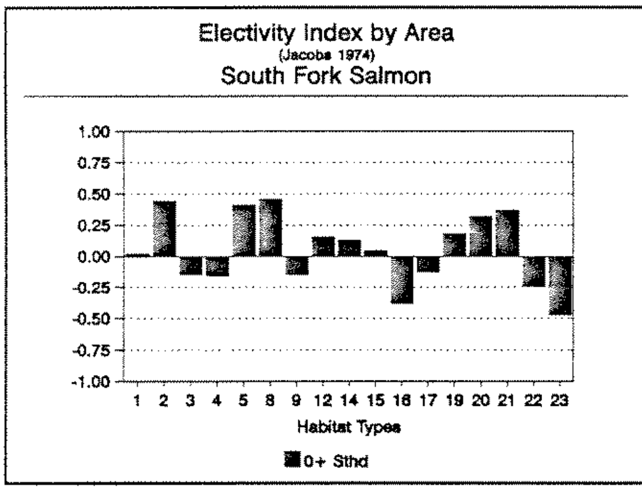
Estimated Standing Crop
South Fork Salmon River

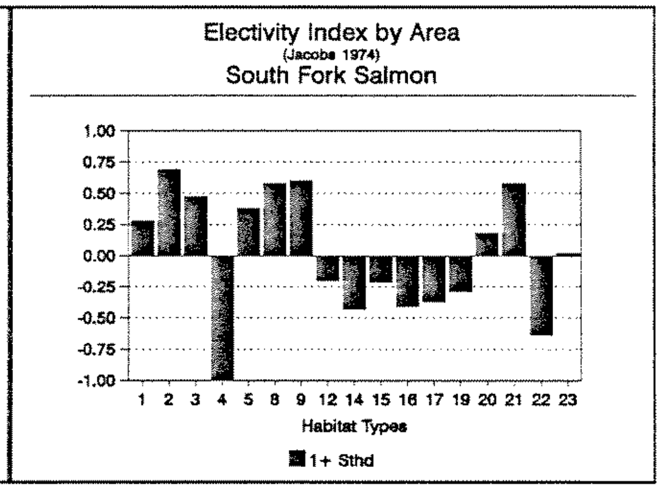


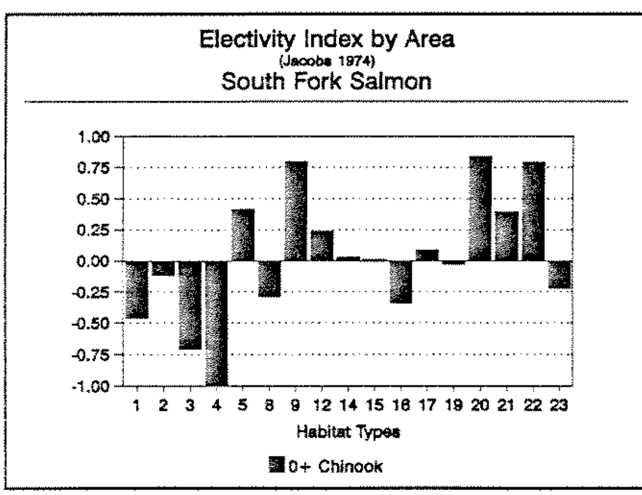
Derived From Fish per Sq M

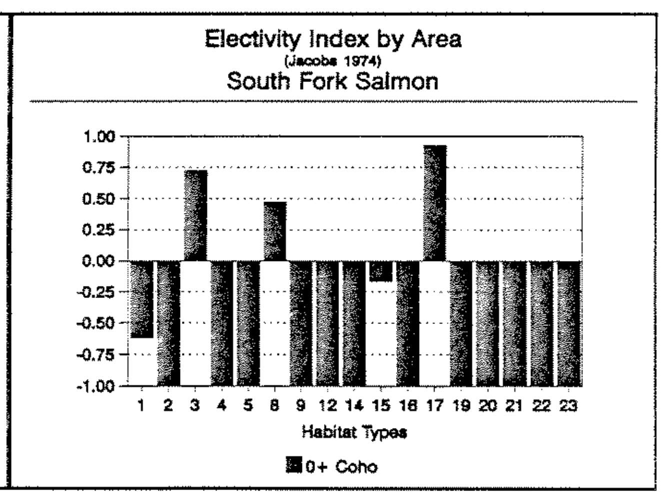
South Fork Salmon River
Electivity Index by Area

Habitat	0+ Sthd	1+ Sthd	0+ Chinook	0+ Coho
1	0.018	0.281	-0.460	-0.617
2	0.442	0.691	-0.118	-1.000
3	-0.147	0.476	-0.709	0.725
4	-0.159	-1.000	-1.000	-1.000
5	0.412	0.378	0.417	-1.000
8	0.459	0.581	-0.287	0.476
9	-0.150	0.600	0.796	-1.000
12	0.156	-0.199	0.239	-1.000
14	0.130	-0.430	0.031	-1.000
15	0.046	-0.212	0.010	-0.164
16	-0.385	-0.410	-0.344	-1.000
17	-0.127	-0.373	0.086	0.926
19	0.181	-0.288	-0.027	-1.000
20	0.323	0.180	0.841	-1.000
21	0.368	0.577	0.396	-1.000
22	-0.243	-0.632	0.791	-1.000
23	-0.472	0.020	-0.223	-1.000



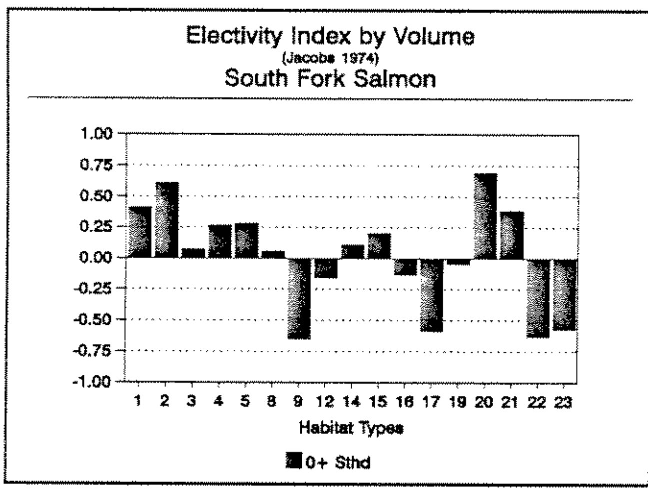


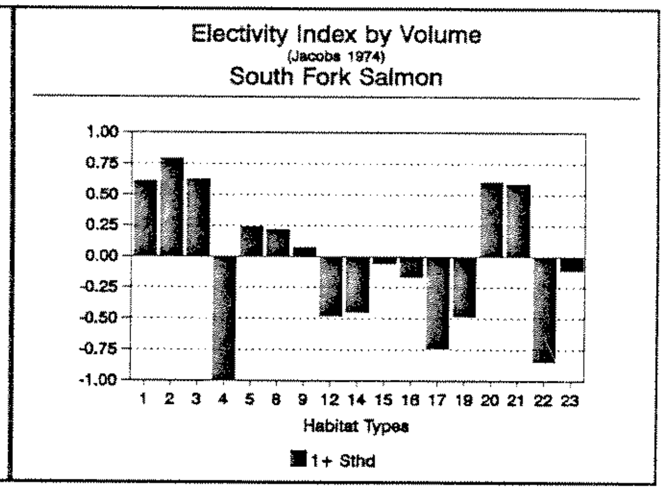


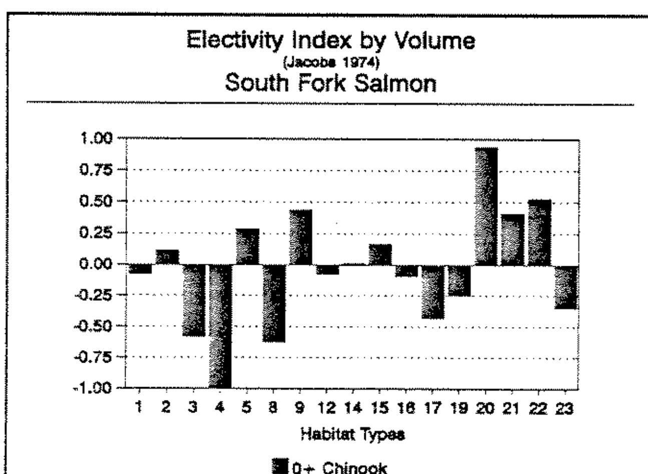


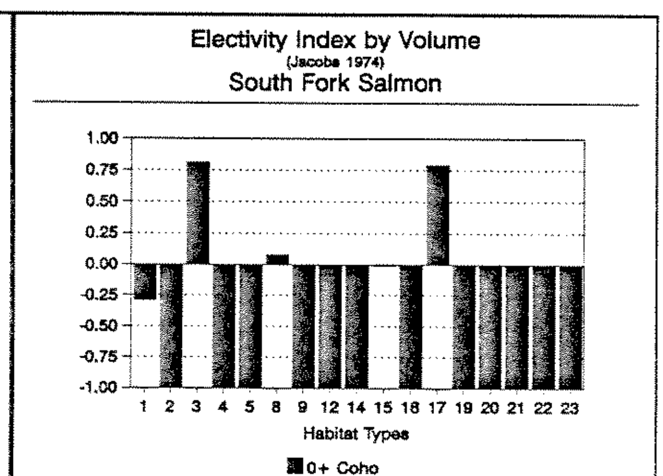
South Fork Salmon River
Electivity Index by Volume

Habitat	0+ Sthd	1+ Sthd	0+ Chinook	0+ Coho
1	0.41	0.61	-0.08	-0.29
2	0.61	0.80	0.12	-1.00
3	0.07	0.63	-0.58	0.81
4	0.27	-1.00	-1.00	-1.00
5	0.28	0.24	0.28	-1.00
8	0.06	0.22	-0.63	0.08
9	-0.65	0.07	0.44	-1.00
12	-0.16	-0.48	-0.08	-1.00
14	0.11	-0.45	0.01	-1.00
15	0.20	-0.06	0.17	-0.01
16	-0.13	-0.16	-0.09	-1.00
17	-0.59	-0.74	-0.43	0.79
19	-0.04	-0.48	-0.25	-1.00
20	0.69	0.60	0.94	-1.00
21	0.39	0.59	0.41	-1.00
22	-0.63	-0.84	0.53	-1.00
23	-0.57	-0.11	-0.35	-1.00

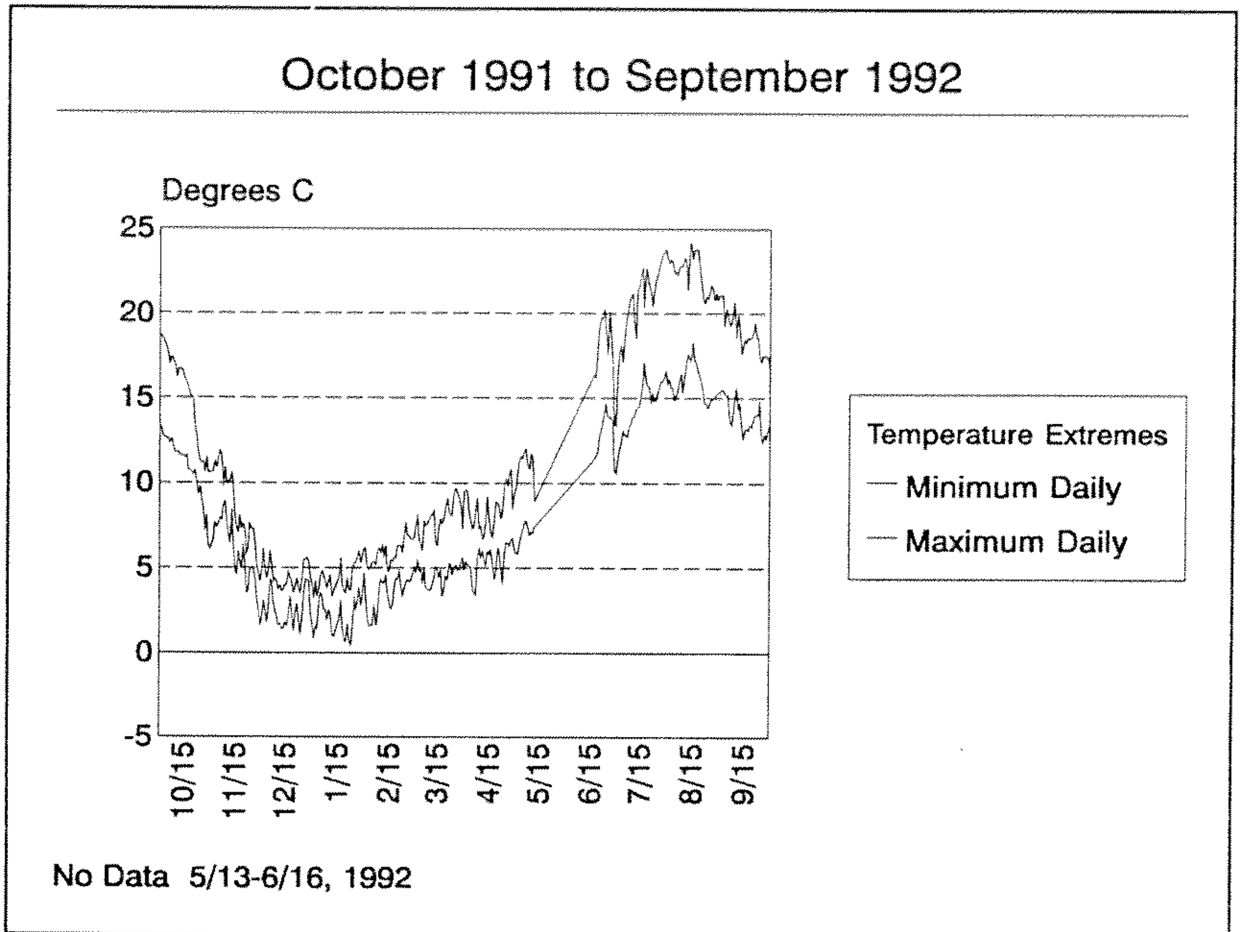




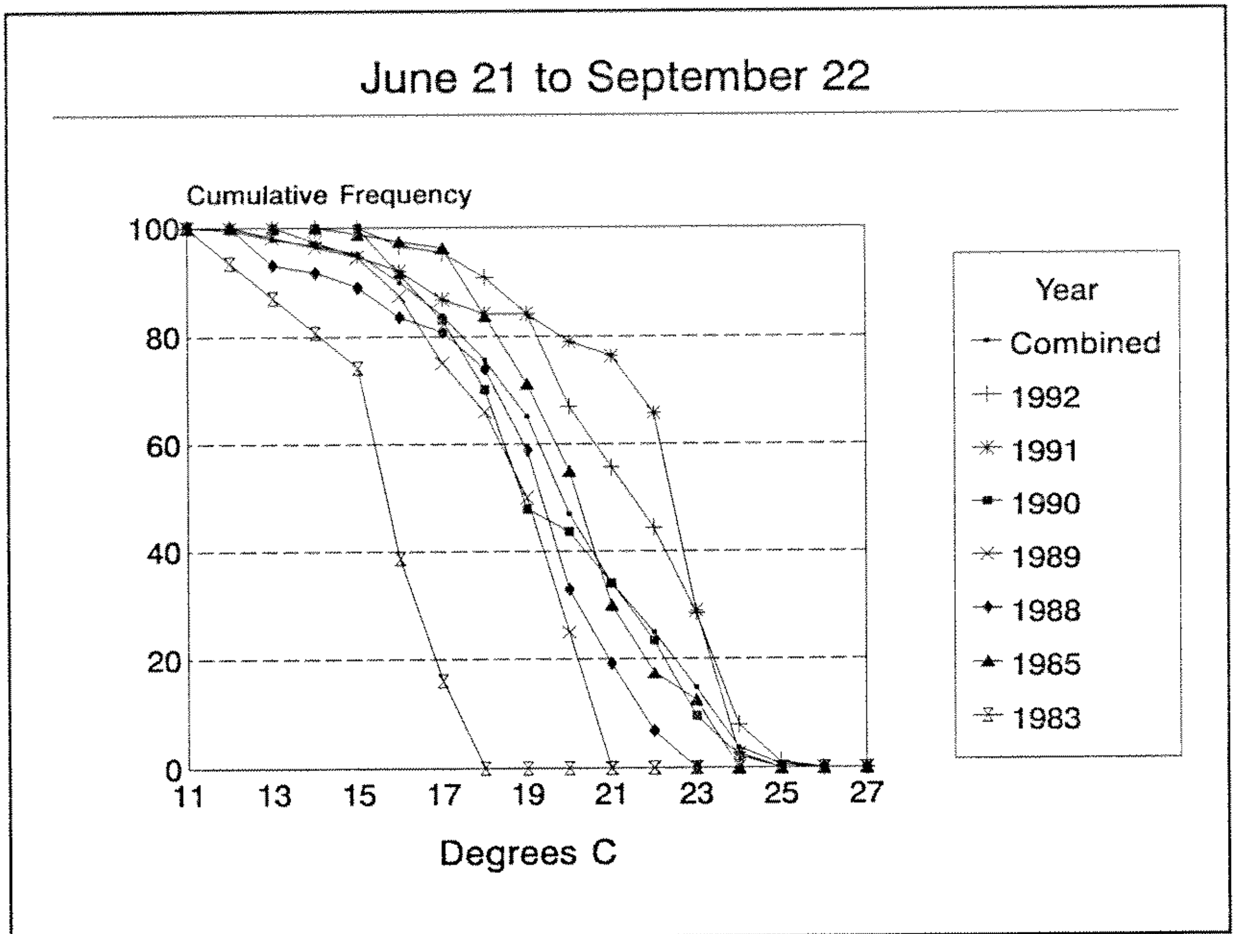




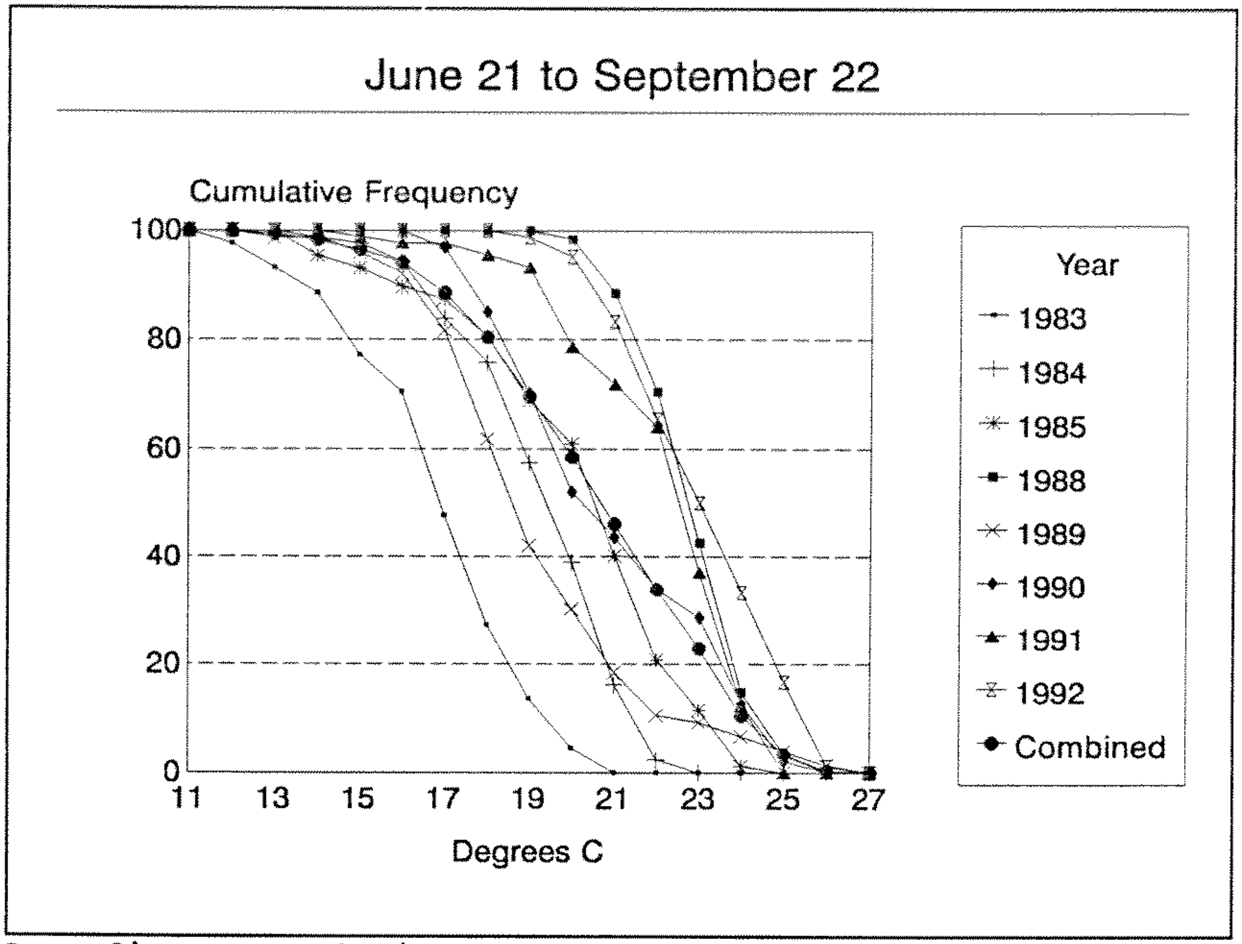
APPENDIX G. WATER TEMPERATURE RECORDS



Appendix G. Water temperature records for the upper South Fork Salmon River station located upstream from East Fork of the south fork Salmon River for the 1992 water year.



Appendix G. Cumulative frequency of summer peak water temperature information recorded on the South Fork Salmon River near the mouth, 1983, 1985, 1988-1992.



Appendix G. Cumulative frequency summer peak water temperature information recorded on the North Fork Salmon River near the mouth, 1983-1985, 1988-1992.

Klamath River Basin WATER YEAR - 1991
Salmon River upstream from junction of Wooley Creek
Salmon River subbasin, Ukonom RD, Klamath NF
Instrument: Ryan Tempmentor

Temperature - Degrees Celsius, Water Year October 1990 to September 1991
Daily Mean Values

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	22.6	21.0
2	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	22.0	21.1
3	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	22.1	21.4
4	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	22.4	21.6
5	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	22.0	21.8
6	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	21.9	21.9
7	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	21.4	21.4
8	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	21.7	20.5
9	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	22.2	19.8
10	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	22.1	19.5
11	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	22.1	19.4
12	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	22.2	19.3
13	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	22.0	19.3
14	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	21.8	19.4
15	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	21.7	19.2
16	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	21.6	19.2
17	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	21.8	19.3
18	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	21.9	19.4
19	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	21.9	19.6
20	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	21.9	19.8
21	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	22.0	19.4
22	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	21.8	18.6
23	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	21.7	18.1
24	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	21.3	18.1
25	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	23.0	21.1	18.2
26	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	22.4	20.8	18.3
27	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	22.7	20.1	18.3
28	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	23.2	19.8	18.2
29	ERR	ERR	ERR	ERR		ERR	ERR	ERR	ERR	23.6	20.2	18.3
30	ERR	ERR	ERR	ERR		ERR	ERR	ERR	ERR	23.6	20.8	18.3
31	ERR		ERR	ERR		ERR		ERR		23.4	20.8	
Mean	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	21.6	19.6
Max	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	22.6	21.9
Min	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	19.8	18.1

Instantaneous Peaks
Maximum 24.5 on July 30 Minimum 17.6 on September 24

Average 7 day maximum temperature
24 on July 29, 1991

Klamath River Basin WATER YEAR - 1992
Salmon River upstream junction of Wooley Creek
Salmon River subbasin, Ukonom RD, Klamath NF
Instrument: Ryan Tempmentor

Temperature - Degrees Celsius, Water year October 1991 to September 1992
Daily Mean Values

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	18.2	9.0	3.8	4.3	ERR	ERR	ERR	ERR	19.9	17.9	ERR	20.9
2	18.2	9.2	4.4	3.8	ERR	ERR	ERR	ERR	20.0	19.4	ERR	21.2
3	18.0	9.6	4.8	3.7	ERR	ERR	ERR	ERR	20.1	19.9	ERR	21.1
4	17.6	10.0	4.6	4.2	ERR	ERR	ERR	ERR	20.2	19.9	ERR	20.8
5	17.3	10.2	4.4	4.9	ERR	ERR	ERR	ERR	19.7	19.8	ERR	20.3
6	17.1	10.3	5.2	5.6	ERR	ERR	ERR	ERR	19.4	19.8	ERR	19.7
7	16.7	10.6	6.6	5.7	ERR	ERR	ERR	ERR	19.3	20.4	ERR	19.3
8	16.7	10.9	6.0	ERR	ERR	ERR	ERR	ERR	19.4	21.2	ERR	19.4
9	16.6	11.3	4.9	ERR	ERR	ERR	ERR	ERR	19.2	21.6	ERR	20.1
10	16.4	11.2	4.3	ERR	ERR	ERR	ERR	ERR	18.8	21.9	ERR	20.5
11	16.1	10.8	3.6	ERR	ERR	ERR	ERR	ERR	17.6	21.8	23.6	20.5
12	15.9	10.5	3.3	ERR	ERR	ERR	ERR	ERR	16.5	22.0	23.2	20.4
13	15.8	10.7	3.2	ERR	ERR	ERR	ERR	ERR	16.1	22.5	23.2	19.4
14	15.6	10.3	3.0	ERR	ERR	ERR	ERR	ERR	16.1	22.6	23.7	18.5
15	15.5	9.1	3.0	ERR	ERR	ERR	ERR	ERR	16.7	23.0	24.2	18.3
16	15.3	8.0	3.0	ERR	ERR	ERR	ERR	ERR	17.6	23.7	24.2	18.6
17	15.2	8.1	3.2	ERR	ERR	ERR	ERR	ERR	18.2	23.9	23.8	18.8
18	14.7	8.3	4.4	ERR	ERR	ERR	ERR	ERR	18.8	23.4	23.3	19.4
19	14.3	7.9	4.9	ERR	ERR	ERR	ERR	ERR	19.7	23.3	22.9	19.7
20	14.1	8.5	4.2	ERR	ERR	ERR	ERR	15.6	20.3	22.8	22.4	20.2
21	14.0	8.6	4.0	ERR	ERR	ERR	ERR	15.1	21.1	22.2	21.5	20.9
22	13.9	7.4	4.5	ERR	ERR	ERR	ERR	15.5	21.6	ERR	20.6	21.4
23	13.2	6.5	4.8	ERR	ERR	ERR	ERR	16.4	21.8	ERR	20.5	21.5
24	12.5	6.9	4.2	ERR	ERR	ERR	ERR	17.4	21.7	ERR	20.6	21.6
25	12.3	7.6	4.0	ERR	ERR	ERR	ERR	17.4	21.6	ERR	20.8	20.9
26	11.7	8.3	4.4	ERR	ERR	ERR	ERR	16.9	21.4	ERR	21.0	20.6
27	11.0	8.4	5.6	ERR	ERR	ERR	ERR	17.2	21.2	ERR	21.1	20.7
28	10.3	6.6	6.3	ERR	ERR	ERR	ERR	17.2	20.5	ERR	21.0	20.7
29	10.5	5.5	6.4	ERR	ERR	ERR	ERR	18.0	19.1	ERR	21.1	20.7
30	10.0	4.3	6.1	ERR		ERR	ERR	18.9	17.5	ERR	21.0	20.8
31	9.3		5.2	ERR		ERR		19.6		ERR	20.8	
Mean	14.6	8.8	4.5	ERR	ERR	ERR	ERR	ERR	19.4	ERR	ERR	20.2
Max	18.2	11.3	6.6	ERR	ERR	ERR	ERR	ERR	21.8	ERR	ERR	21.6
Min	9.3	4.3	3.0	ERR	ERR	ERR	ERR	ERR	16.1	ERR	ERR	18.3

Instantaneous Peaks
Maximum 25.4 on July 16 Minimum 2.8 on December 14

Average 7 day maximum temperature
24.7 on August 16, 1992

Klamath River Basin WATER YEAR - 1991
South Fork Salmon River approx. 1/4 mile upstream confluence with East Fork
Salmon River Subbasin, Salmon River RD, Klamath NF
Instrument: Ryan TempMentor

Temperature, Degrees Celsius, Water Year October 1990 to September 1991
Daily Mean Values

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	ERR	8.2	3.5	0.2	2.2	5.8	6.3	6.2	9.9	13.6	17.7	18.3
2	ERR	6.6	3.5	0.3	3.9	5.1	6.6	7.4	10.2	14.6	17.9	18.2
3	ERR	6.7	3.3	0.7	4.0	5.5	5.2	7.7	9.3	15.3	18.2	18.3
4	ERR	7.3	3.3	0.3	4.2	5.1	6.3	8.2	9.1	15.9	18.1	18.4
5	ERR	8.3	4.4	0.3	4.3	4.0	5.9	7.6	8.6	16.3	17.9	18.1
6	ERR	6.4	2.8	0.7	3.7	3.8	5.4	6.8	9.5	16.2	18.1	18.0
7	ERR	6.1	2.6	1.3	3.5	4.1	5.0	7.4	10.4	16.3	16.5	17.4
8	ERR	7.8	2.7	1.1	3.8	4.0	5.0	6.2	10.9	16.4	ERR	16.5
9	ERR	6.5	3.5	1.8	3.7	4.2	6.1	5.2	11.4	15.9	ERR	15.9
10	ERR	5.8	4.9	2.0	4.4	4.0	4.5	6.0	11.8	15.5	ERR	16.1
11	ERR	5.6	4.7	1.9	4.5	3.2	4.4	7.2	11.4	15.8	ERR	16.1
12	ERR	5.9	3.3	1.8	4.3	3.5	5.5	7.6	10.9	16.6	ERR	16.3
13	ERR	6.4	3.2	3.3	5.1	4.2	6.6	6.9	10.4	16.7	ERR	16.4
14	ERR	6.6	2.5	4.1	4.8	3.8	6.5	8.1	10.0	16.7	ERR	16.3
15	ERR	5.7	2.8	4.4	5.3	3.8	6.4	8.4	10.4	15.7	ERR	16.3
16	ERR	4.9	3.3	2.5	5.6	3.5	6.5	7.7	10.5	14.7	ERR	16.3
17	ERR	5.1	2.5	2.9	5.4	4.3	6.3	5.9	10.8	16.0	ERR	16.6
18	ERR	6.0	2.9	2.9	5.3	4.0	6.4	4.8	11.1	16.8	ERR	16.9
19	ERR	6.1	1.6	3.2	4.8	4.2	6.7	6.7	10.6	17.6	ERR	17.0
20	ERR	5.9	0.8	2.0	4.1	4.6	7.0	8.4	10.8	18.0	ERR	17.1
21	ERR	5.9	-0.1	1.5	4.2	4.4	7.1	8.7	10.7	17.9	20.5	16.2
22	ERR	5.3	-0.3	1.3	4.6	4.3	7.5	8.9	10.6	18.0	18.6	15.4
23	ERR	4.2	-0.1	1.3	4.3	3.5	7.1	8.7	10.1	17.3	18.5	15.7
24	11.0	3.8	0.0	1.1	4.3	3.5	6.5	8.6	11.2	17.8	18.0	15.9
25	10.3	3.9	0.2	0.7	4.3	4.4	5.4	7.7	11.3	17.2	17.5	16.1
26	10.3	4.2	0.3	0.8	4.3	4.3	5.6	7.8	10.5	17.7	17.2	15.8
27	10.2	4.2	0.3	0.5	4.4	4.6	6.7	8.2	10.1	18.1	16.5	15.6
28	10.4	3.8	0.8	0.4	5.8	5.2	7.2	8.6	10.9	18.5	16.8	15.5
29	10.7	4.1	0.0	0.2		5.6	7.3	7.1	11.3	18.7	17.4	15.7
30	10.2	4.9	-0.1	0.4		6.0	6.7	7.4	12.2	18.7	17.7	15.8
31	9.5		0.1	1.9		6.0		8.3		18.4	17.7	
Mean	ERR	5.7	2.0	1.5	4.4	4.4	6.2	7.4	10.6	16.7	ERR	16.6
Max	ERR	8.3	4.9	4.4	5.8	6.0	7.5	8.9	12.2	18.7	ERR	18.4
Min	ERR	3.8	-0.3	0.2	2.2	3.2	4.4	4.8	8.6	13.6	ERR	15.4

Instantaneous Peaks
Maximum 22.9 on August 21 Minimum -0.7 on December 21

Average 7 day maximum temperature
22.3 on July 28,1992

Klamath River Basin WATER YEAR - 1992
South Fork Salmon River approx. 1/4 mile upstream confluence with East Fork
Salmon River Subbasin, Salmon River RD, Klamath NF
Instrument: Ryan TempMentor

Temperature, Degrees Celsius, Water Year October 1991 to September 1992
Daily Mean Values

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	15.7	8.2	3.2	2.0	4.9	5.8	7.3	7.7	ERR	13.1	19.1	18.0
2	15.6	8.4	4.3	2.6	3.3	5.8	7.3	8.2	ERR	14.4	18.9	18.0
3	15.3	9.2	3.5	2.4	2.9	6.3	6.8	8.7	ERR	14.7	18.7	17.0
4	15.2	8.9	3.0	3.3	2.8	5.5	6.1	9.1	ERR	14.8	18.1	17.3
5	15.1	9.2	3.6	3.9	3.0	5.6	5.2	9.3	ERR	15.0	18.4	17.1
6	14.9	9.6	5.0	3.9	3.6	5.0	5.1	9.6	ERR	15.5	18.5	16.2
7	14.5	9.4	4.7	3.4	3.0	5.9	5.9	9.6	ERR	15.9	18.9	16.2
8	14.7	9.3	3.5	3.2	3.8	5.4	7.1	9.2	ERR	16.6	18.9	16.7
9	14.4	9.7	3.2	2.7	4.9	5.3	6.9	8.8	ERR	16.9	18.7	17.5
10	14.2	8.6	2.9	3.2	4.9	5.4	6.6	9.4	ERR	17.1	19.4	16.9
11	13.8	8.1	2.5	3.2	5.0	5.6	6.3	9.3	ERR	16.4	19.8	16.9
12	14.0	8.2	2.5	2.0	5.0	5.8	6.1	8.1	ERR	16.6	19.5	16.7
13	13.9	9.3	2.2	2.1	5.3	6.1	6.3	ERR	ERR	17.4	20.3	15.4
14	13.9	8.0	2.3	2.3	4.3	5.8	7.3	ERR	ERR	17.7	20.3	15.3
15	13.8	6.1	2.6	2.8	3.8	5.2	6.9	ERR	ERR	18.3	20.4	15.6
16	13.6	5.9	2.5	3.1	3.8	5.5	6.8	ERR	ERR	19.0	20.2	15.6
17	13.5	6.6	3.4	4.1	4.1	5.9	5.9	ERR	14.5	18.5	20.0	15.7
18	12.9	6.3	4.1	2.6	4.5	5.2	6.1	ERR	13.5	18.9	19.8	15.9
19	12.7	6.0	3.3	1.8	5.0	5.5	6.8	ERR	14.5	18.7	19.3	15.8
20	12.6	6.9	2.3	1.9	5.1	6.2	7.5	ERR	15.5	18.3	18.8	16.0
21	12.4	6.3	3.0	2.6	5.4	6.3	7.1	ERR	16.0	17.6	17.8	16.5
22	11.8	4.7	3.3	2.0	5.0	6.6	6.1	ERR	16.3	17.3	17.3	16.3
23	11.0	4.7	2.5	1.8	4.5	6.5	6.3	ERR	16.6	17.6	17.4	16.1
24	10.4	6.0	2.2	2.7	5.0	6.3	7.7	ERR	16.3	18.1	17.4	16.0
25	10.6	6.0	3.1	3.9	5.6	6.8	8.4	ERR	14.9	18.5	17.8	14.8
26	9.9	6.0	4.4	3.7	5.5	7.0	8.0	ERR	16.6	18.9	18.0	14.9
27	9.4	5.9	4.8	4.3	5.5	6.8	8.3	ERR	16.0	19.3	18.0	15.2
28	8.8	3.9	4.9	4.9	5.5	6.9	8.8	ERR	14.9	19.4	17.8	15.0
29	9.7	3.5	4.6	3.8	5.6	7.0	7.5	ERR	12.2	19.6	18.0	15.2
30	8.1	2.6	3.4	4.3		6.5	7.5	ERR	11.8	19.7	17.9	15.2
31	8.0		2.4	5.3		6.8		ERR		19.2	17.9	
Mean	12.7	7.1	3.3	3.1	4.5	6.0	6.9	ERR	ERR	17.4	18.8	16.2
Max	15.7	9.7	5.0	5.3	5.6	7.0	8.8	ERR	ERR	19.7	20.4	18.0
Min	8.0	2.6	2.2	1.8	2.8	5.0	5.1	ERR	ERR	13.1	17.3	14.8

Instantaneous Peaks
Maximum 24.2 on August 13 Minimum 0.4 on January 23

Average 7 day maximum temperature
23.6 on August 16, 1992

APPENDIX H. KEY HABITAT PARAMETERS - SUMMARY STATISTICS

1990 Salmon River Habitat DFC Summary (9-16-92)

Mouth to Wooley Creek

No Primary Pools	32				
Prim Pools/1000 ft	1.2689852				
No Key Wood	0				
No Key Wood/1000 ft	0	n	N	Range	Std Dev
Avg % Shade	0.0343602	21	95	0-30%	10.428462
Embeddedness HT-1	0.0733472	3	15	5-10%	2.3570226
% Fines (spawn Areas)	0.0416289	3	15	0-5%	2.3570226

Wooley Creek to Bloomer Falls

No Primary Pools	85				
Prim Pools/1000 ft	1.6749758				
No Key Wood	2				
No Key Wood/1000 ft	0.0394111	n	N	Range	Std Dev
Avg % Shade	0.0068187	42	206	0-5%	1.8633899
Embeddedness HT-1	0.1671936	4	22	10-25%	5.5901699
% Fines (spawn Areas)	0.0474308	4	22	2-10%	2.8722813

Bloomer Falls to Forks

No Primary Pools	38				
Prim Pools/1000 ft	1.2998118				
No Key Wood	2				
No Key Wood/1000 ft	0.0684111	n	N	Range	Std Dev
Avg % Shade	0.0145425	39	119	0-10%	1.8246746
Embeddedness HT-1	0.1	1	16	0	0
% Fines (spawn Areas)	0.0288935	3	16	0-5%	2.3570226

Combined: Mouth to Forks

No Primary Pools	155	105199			
Prim Pools/1000 ft	1.4733980				
No Key Wood	4				
No Key Wood/1000 ft	0.0380521	n	N	Range	Std Dev
Avg % Shade	0.016	102	420	0-30%	
Embeddedness HT-1	0.13	8	53	5-25%	
% Fines (spawn Areas)	0.04	10	53	0-10%	

1990 South Fork Salmon River Habitat DFC Summary (9-23-92)

Forks to Methodist Creek	Length: 35875				
No Primary Pools	42				
Primary Pools/1000 ft	1.1707317				
No Key Wood	0				
No Key Wood/1000 ft	0	n	N	Range	Std D
Avg % Shade	0.0563521	44	154	0-50	10.357
Embeddedness HT-1	0.0775904	8	32	0-25	8.2915
% Fines HT-1	0.0528442	8	32	0-30	9.3541

Methodist Creek to Graham Gulc	Length: 4905				
No Primary Pools	10				
Primary Pools/1000 ft	2.0387359				
No Key Wood	0				
No Key Wood/1000 ft	0	n	N	Range	Std D
Avg % Shade	0	6	26		0
Embeddedness HT-1	--	0	2	--	--
% Fines HT-1	--	0	2	--	--

Graham Gulch to Matthews Creek	Length: 62713				
No Primary Pools	24				
Primary Pools/1000 ft	1.4781966				
No Key Wood	2				
No Key Wood/1000 ft	0 0.1231830	n	N	Range	Std D
Avg % Shade	0.0612910	28	80	0-25	6.4786
Embeddedness HT-1	0.1728588	5	20	0-20	8.1240
% Fines HT-1	0.0593661	6	20	0-10	3.7267

Matthews Creek to Limestone Gulch					
No Primary Pools	47				
Primary Pools/1000 ft	1.9850487				
No Key Wood	34				
No Key Wood/1000 ft	1.4359927	n	N	Range	Std D
Avg % Shade	0.0572485	36	168	0-40	7.7620
Embeddedness HT-1	0.2	1	18		0
% Fines HT-1	0.0308922	5	18	0-5	

Limestone Gulch to St. Clair Creek					
No Primary Pools	18				
Primary Pools/1000 ft	1.9438444				
No Key Wood	23				
No Key Wood/1000 ft	2.4838012	n	N	Range	Std D
Avg % Shade	0.1253857	20	71	0-45	14.254
Embeddedness HT-1	0.1119718	2	15	5-15	
% Fines HT-1	0.0481891	4	15	0-5	2.1650

St. Clair Creek to Cecil Creek					
No Primary Pools	27				
Primary Pools/1000 ft	1.8224772				
No Key Wood	1				
No Key Wood/1000 ft	0.0674991	n	N	Range	Std D
Avg % Shade	0.3418814	29	107	0-70	27.659
Embeddedness HT-1	0	1	27		0

1990 North Fork Salmon River Habitat DFC Summary (9-24-92)

Dougherty Bluff to Heiney Bar					
No Primary Pools	6				
Prim Pools/1000 ft	1.4197823				
No Key Wood	4				
No Key Wood/1000 ft	0.9465215	n	N	Range	Std Dev
Avg % Shade	0.1169265	16	19	0-30	9.1001373
Embeddedness HT-1	0.2796601	4	4	20-40	8.6602540
% Fines HT-1	0.0408390	4	4	2-10	3.2691742

Heiney Bar to Little N.Fork		29136			
No Primary Pools	22				
Prim Pools/1000 ft	0.7550796				
No Key Wood	17				
No Key Wood/1000 ft	0.5834706	n	N	Range	Std Dev
Avg % Shade	0.1244116	25	124	0-65	15.793669
Embeddedness HT-1	0.2267938	4	23	15-30	5.5901699
% Fines HT-1	0.0993893	4	23	5-15	3.5355339

Little N.Fk to Jackass Gulch					
No Primary Pools	11				
Prim Pools/1000 ft	0.8414288				
No Key Wood	0				
No Key Wood/1000 ft	0	n	N	Range	Std Dev
Avg % Shade	0.0644189	22	70	0-90	18.942933
Embeddedness HT-1	0.0383134	5	17	0-5	2
% Fines HT-1	0.0116865	5	17	0-5	2

Jackass Gulch to Sawyers Bar					
No Primary Pools	6				
Prim Pools/1000 ft	0.7905138				
No Key Wood	0				
No Key Wood/1000 ft	0	n	N	Range	Std Dev
Avg % Shade	0.1370836	8	42		8.0302163
Embeddedness HT-1	0.0373493	2	9	0-10	5
% Fines HT-1	0.0313253	2	9	0-5	2.5

Sawyers Bar to Flapjack Bar					
No Primary Pools	9				
Prim Pools/1000 ft	1.1081014				
No Key Wood	1				
No Key Wood/1000 ft	0.1231223	n	N	Range	Std Dev
Avg % Shade	0.0344325	10	37	0-10	3.0016662
Embeddedness HT-1	0	3	10	0	0
% Fines HT-1	0.0710718	3	10	2-10	3.2998316

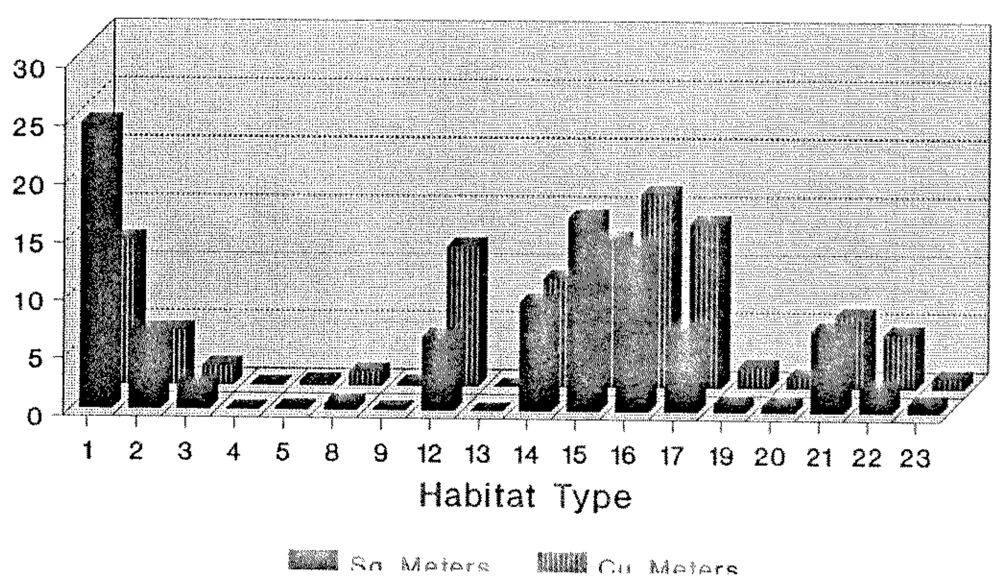
Flapjack Bar to White's Gulch					
No Primary Pools	9				
Prim Pools/1000 ft	0.8426177				
No Key Wood	4				
No Key Wood/1000 ft	0.3744967	n	N	Range	Std Dev
Avg % Shade			53		
Embeddedness HT-1					

APPENDIX I. HABITAT CONDITION AND USE - NORTH FORK SALMON RIVER

North Fork Salmon River
Physical Typing Summary

Habitat Type	Total Units	Total Length m	Total Area m^2	Total Vol m^3	Avg Length m	Avg Width m	Avg Depth m	Avg Volume m^3	Area %	Vol %	Embedd %	Fines %	Gravel %	Cobble %	Boulder %	Bedrock %	Spawn Area m^2	Key LWD Pieces
0	1	61			61.0												0	0.0
1	95	6344	143675	56699	66.8	19.2	0.44	596.84	25	13	1.5	5	14	41	39	1	254	2.0
2	57	2507	39321	21177	44.0	14.4	0.50	371.54	7	5	4.2	2	6	32	59	1	17	1.0
3	21	892	13330	7544	42.5	15.0	0.54	359.27	2	2	1.9	5	5	14	59	17	1	1.0
4	2	68	451	120	34.5	6.7	0.27	60.29	0	0	8.8	4	50	45		1	0	0.0
5	3	94	1310	1492	31.5	12.3	1.03	497.47	0	0	1.8	10	30	40	20		38	0.0
8	6	263	3436	5446	43.9	11.8	1.50	907.71	1	1	5.7	16	5	11	42	26	6	0.0
9	2	49	699	941	24.7	14.2	1.37	470.82	0	0	15.3	5	8	19	63	5	0	0.0
12	39	2135	37096	54759	54.8	16.4	1.39	1404.08	6	12	13.1	33	19	20	17	12	138	2.0
13	1	4	10	2	4.9	2.1	0.24	2.51	0	0	5.0		25	40	35		0	0.0
14	37	2552	54670	42162	69.0	19.8	0.75	1139.54	9	9	6.8	21	24	26	18	10	1300	5.0
15	98	6158	97128	57310	62.8	14.8	0.63	584.80	17	13	3.3	11	22	38	27	2	1164	4.0
16	39	4883	82686	75258	125.2	15.1	0.62	1929.70	14	17	3.9	9	15	42	31	3	744	9.0
17	39	2173	41111	63746	55.7	17.7	1.55	1634.51	7	14	6.6	21	10	28	21	20	118	2.0
19	5	200	4047	7878	40.1	17.4	1.49	1575.77	1	2	26.2	12	14	33	36	4	93	0.0
20	5	217	3524	4256	43.4	15.7	1.13	851.28	1	1	16.7	24	24	30	17	5	14	0.0
21	21	1963	40771	27868	93.5	19.0	0.69	1327.06	7	6	5.3	5	10	22	58	4	23	3.0
22	10	687	12503	20694	68.8	16.9	1.49	2069.40	2	5	18.4	24	21	25	14	16	622	1.0
23	5	269	4643	3969	54.0	16.8	0.96	793.86	1	1	12.4	15	13	8	44	19	13	2.0

Habitat Distribution
North Fork Salmon River



North Fork Salmon River
Direct Observation Results

Habitat	# Units	0+ Sthd	1+ Sthd	0+ King	0+ Coho	Total Area m^2	Total Volume m^3	Habitat	Observed Area m^2	Observed Volume m^3	Corrected 0+ Sthd	Corrected 1+ Sthd	Corrected 0+ King
1	22	1208	1286	36	0	143675	56699	1	24301	10811	1691	5144	50
2	13	568	746	31	0	39321	21178	2	9388	4858	795	2984	43
3	3	93	136	3	0	13330	7545	3	1359	1086	130	544	4
4	1	0	0	26	0	451	121	4	198	60	0	0	26
5	1	31	2	0	0	1310	1492	5	276	150	31	2	0
8	1	6	115	6	0	3436	5446	8	490	590	6	138	6
9	2	86	98	42	0	700	942	9	524	704	86	118	42
12	10	257	192	86	0	37097	54759	12	12035	21680	257	230	86
13	1	7	1	0	0	10	3	13	11	2	7	1	0
14	12	688	373	133	0	54671	42163	14	18242	12447	826	634	160
15	23	1616	727	227	0	97128	57311	15	23282	13151	1939	1236	272
16	11	652	457	26	22	82687	75258	16	28526	10231	782	777	31
17	10	478	485	155	0	41111	63746	17	12193	15398	478	582	155
19	3	169	245	57	0	4047	7879	19	2451	5090	169	294	57
20	3	167	73	24	0	3525	4256	20	3178	4245	167	88	24
21	5	465	572	37	0	40772	27868	21	11934	9000	558	972	44
22	6	297	218	142	0	12504	20694	22	6451	13048	297	262	142
23	4	287	369	122	0	4643	3969	23	3144	3109	287	443	122

Cover Composition

Habitat	No. Units	Cover %	Undercut %	SWD %	LWD %	Vegetation %	White Water %	Boulders %	Bdrk Ledge %	Shade %
1	95	44		0	0	16	30	52	2	1
2	57	60	0	0	1	8	44	46	1	2
3	21	73		0		4	45	48	3	3
4	2	25		34	3	58		6		0
5	3	53				5	4	41	50	1
8	6	39					11	51	39	0
9	2	37					39	51	10	0
12	39	27		1		9	5	29	57	4
13	1	15	70				2	28		90
14	37	19	0		0	24	0	58	17	2
15	98	25	0	0	0	18	5	67	10	2
16	39	33	0	0	0	18	17	61	4	2
17	39	23		0	0	9	3	43	45	2
19	5	22		3		3	6	68	20	5
20	5	30				16	15	48	20	15
21	21	57			0	9	31	57	4	2
22	10	26				7	0	37	56	6
23	5	63		0		6	27	56	10	7

North Fork Salmon River

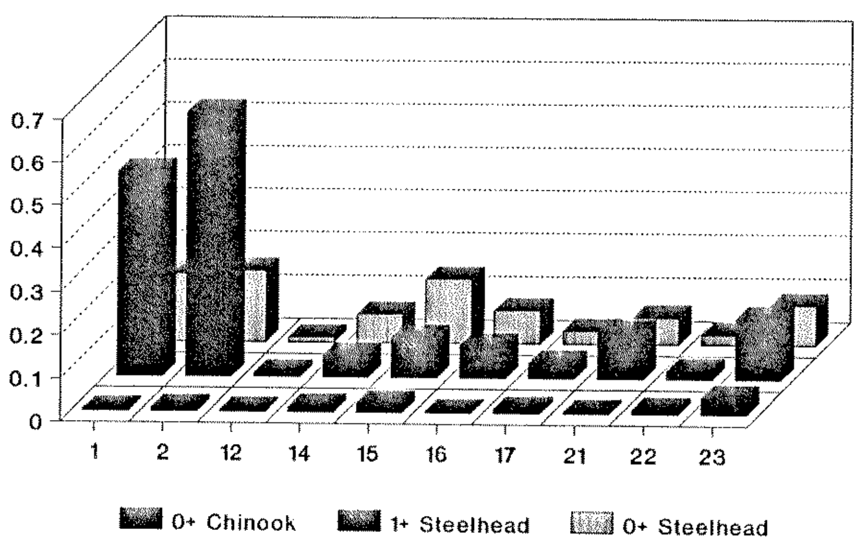
Estimated Fish Density (Per M^3)

Habitat	0+ Sthd	1+ Sthd	0+ King	0+ Coho
1	0.156	0.476	0.005	0.000
2	0.164	0.614	0.009	0.000
3	0.120	0.501	0.004	0.000
4	0.000	0.000	0.437	0.000
5	0.207	0.016	0.000	0.000
8	0.010	0.234	0.010	0.000
9	0.122	0.167	0.060	0.000
12	0.012	0.011	0.004	0.000
13	3.472	0.595	0.000	0.000
14	0.066	0.051	0.013	0.000
15	0.147	0.094	0.021	0.000
16	0.076	0.076	0.003	0.002
17	0.031	0.038	0.010	0.000
19	0.033	0.058	0.011	0.000
20	0.039	0.021	0.006	0.000
21	0.062	0.108	0.005	0.000
22	0.023	0.020	0.011	0.000
23	0.092	0.142	0.039	0.000

Estimated Fish Density (Per M^2)

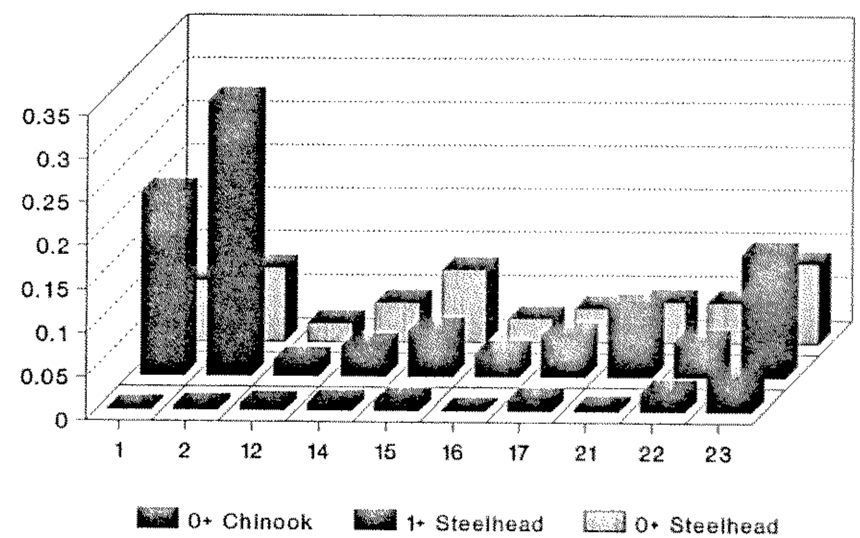
Habitat	0+ Sthd	1+ Sthd	0+ King	0+ Coho
1	0.070	0.212	0.002	0.000
2	0.085	0.318	0.005	0.000
3	0.096	0.400	0.003	0.000
4	0.000	0.000	0.132	0.000
5	0.112	0.009	0.000	0.000
8	0.012	0.282	0.012	0.000
9	0.164	0.224	0.080	0.000
12	0.021	0.019	0.007	0.000
13	0.627	0.108	0.000	0.000
14	0.045	0.035	0.009	0.000
15	0.083	0.053	0.012	0.000
16	0.027	0.027	0.001	0.001
17	0.039	0.048	0.013	0.000
19	0.069	0.120	0.023	0.000
20	0.053	0.028	0.008	0.000
21	0.047	0.081	0.004	0.000
22	0.046	0.041	0.022	0.000
23	0.091	0.141	0.039	0.000

Estimated Fish Densities
North Fork Salmon River



Fish Per Cu. Meter

Estimated Fish Densities
North Fork Salmon River



Fish Per Sq. Meter

North Fork Salmon River

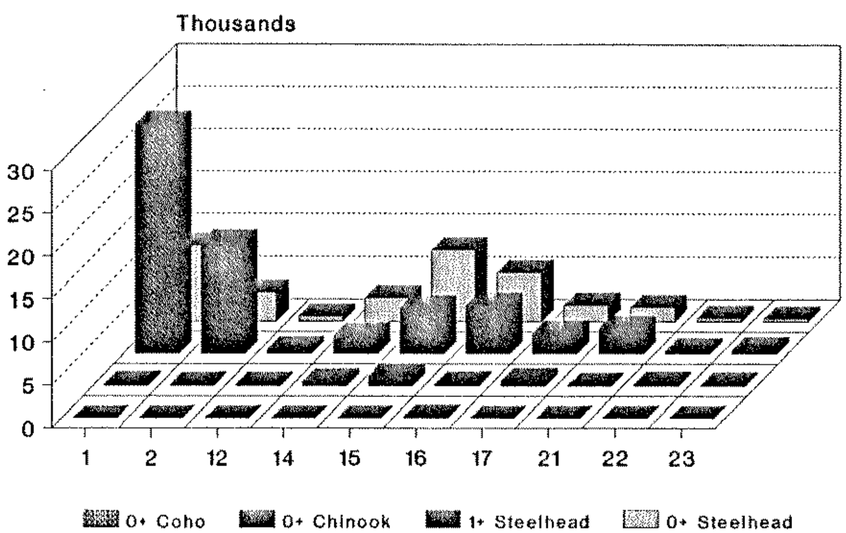
Estimated Standing Crop (Volume)

Habitat	0+ Sthd	1+ Sthd	0+ King	0+ Coho
1	8870	26979	264	0
2	3467	13008	189	0
3	904	3778	29	0
4	0	0	53	0
5	309	24	0	0
8	55	1275	55	0
9	115	157	56	0
12	649	582	217	0
13	9	1	0	0
14	2797	2148	541	0
15	8451	5386	1187	0
16	5755	5715	229	162
17	1979	2409	642	0
19	262	455	88	0
20	167	88	24	0
21	1728	3011	137	0
22	471	415	225	0
23	366	565	156	0
TOTAL	36354	65998	4094	162

Estimated Standing Crop (Area)

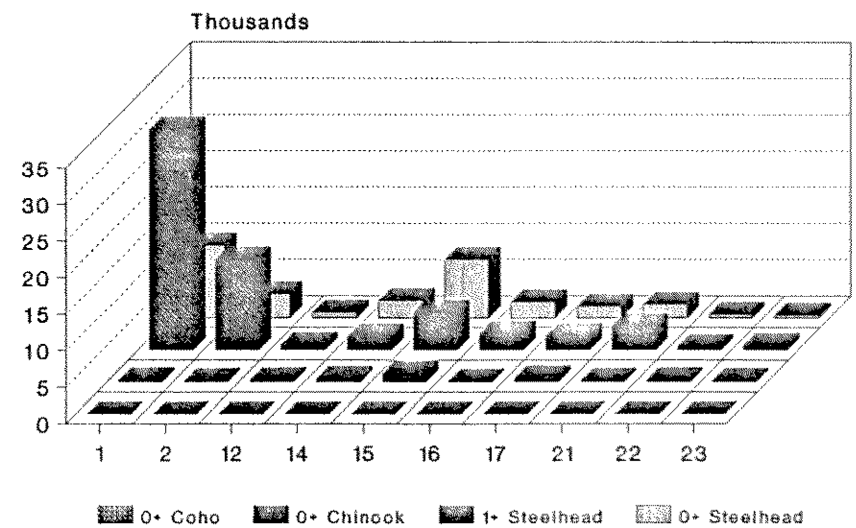
Habitat	0+ Sthd	1+ Sthd	0+ King	0+ Coho
1	9999	30413	298	0
2	3330	12498	182	0
3	1277	5337	41	0
4	0	0	59	0
5	147	11	0	0
8	42	969	42	0
9	115	157	56	0
12	792	710	265	0
13	7	1	0	0
14	2474	1900	478	0
15	8090	5156	1136	0
16	2268	2252	90	64
17	1612	1962	523	0
19	279	485	94	0
20	185	97	27	0
21	1906	3322	152	0
22	576	507	275	0
23	424	654	180	0
	33523	66432	3899	64

Estimated Standing Crop
North Fork Salmon River



Derived From Fish per Cu M

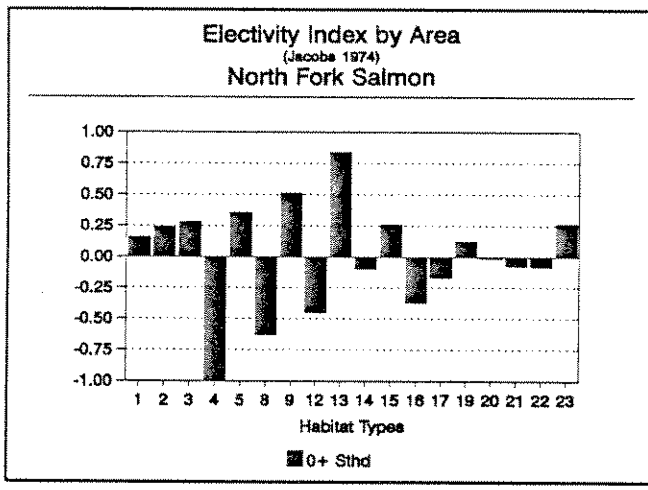
Estimated Standing Crop
North Fork Salmon River

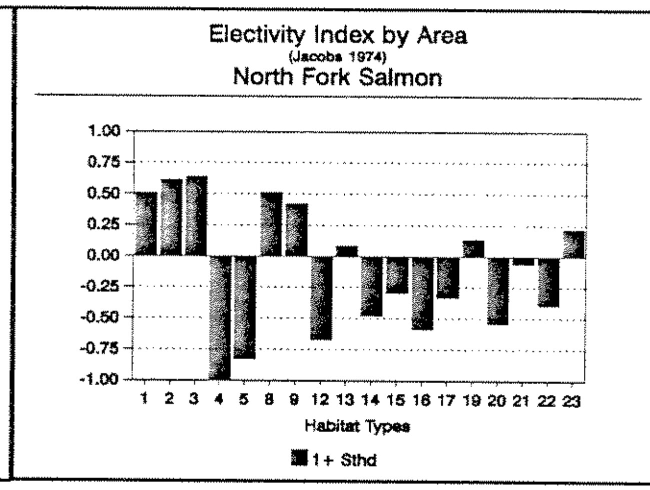


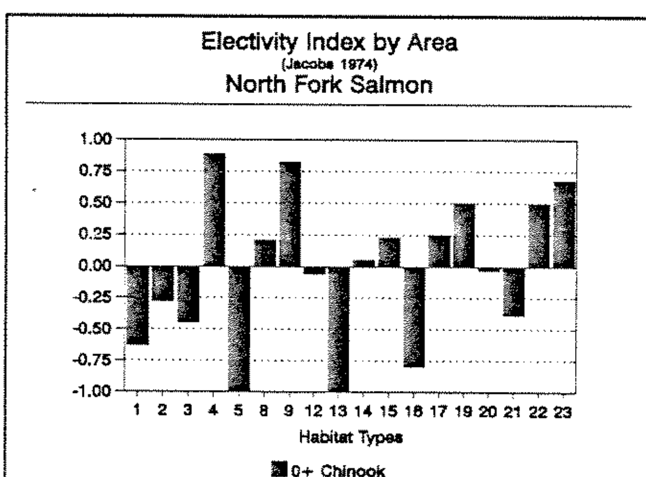
Derived From Fish per Sq M

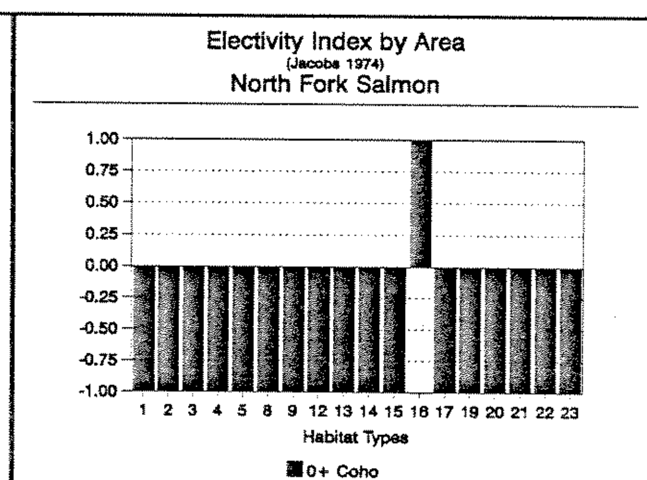
North Fork Salmon River
Electivity Index by Area

Habitat	0+ Sthd	1+ Sthd	0+ Chinook	0+ Coho
1	0.154	0.505	-0.628	-1.000
2	0.240	0.609	-0.280	-1.000
3	0.284	0.637	-0.445	-1.000
4	-1.000	-1.000	0.887	-1.000
5	0.352	-0.827	-1.000	-1.000
8	-0.630	0.512	0.210	-1.000
9	0.508	0.423	0.823	-1.000
12	-0.452	-0.672	-0.061	-1.000
13	0.842	0.081	-1.000	-1.000
14	-0.097	-0.480	0.050	-1.000
15	0.262	-0.298	0.227	-1.000
16	-0.370	-0.590	-0.794	1.000
17	-0.168	-0.332	0.251	-1.000
19	0.125	0.137	0.499	-1.000
20	-0.012	-0.542	-0.030	-1.000
21	-0.076	-0.062	-0.384	-1.000
22	-0.081	-0.396	0.496	-1.000
23	0.265	0.218	0.680	-1.000



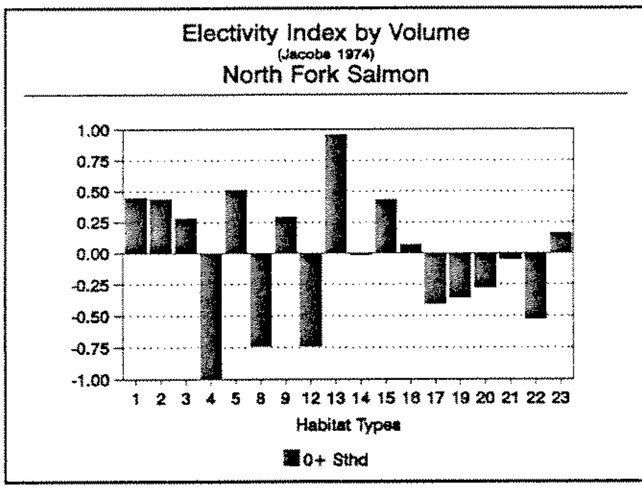


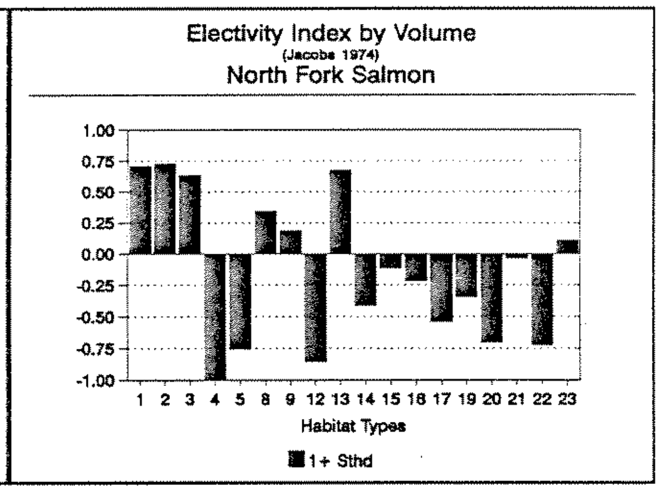


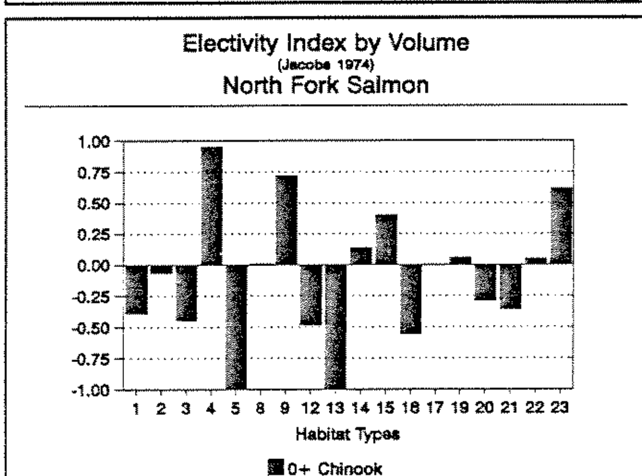


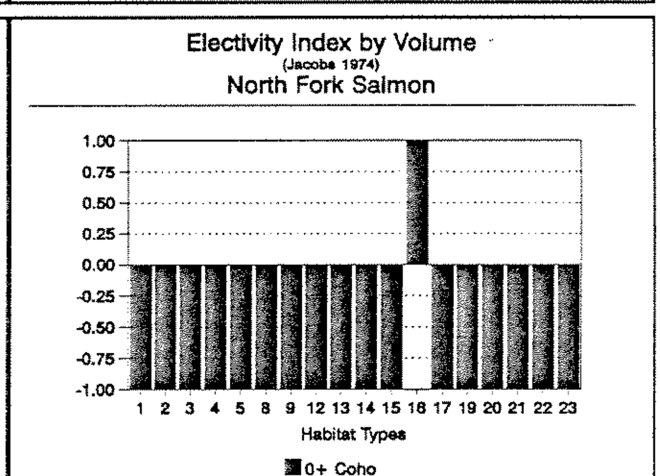
North Fork Salmon River
Electivity Index by Volume

Habitat	0+ Sthd	1+ Sthd	0+ Chinook	0+ Coho
1	0.45	0.71	-0.39	-1.00
2	0.44	0.73	-0.06	-1.00
3	0.28	0.64	-0.45	-1.00
4	-1.00	-1.00	0.96	-1.00
5	0.51	-0.76	-1.00	-1.00
8	-0.74	0.34	0.01	-1.00
9	0.29	0.19	0.72	-1.00
12	-0.74	-0.86	-0.48	-1.00
13	0.96	0.68	-1.00	-1.00
14	-0.01	-0.41	0.14	-1.00
15	0.43	-0.11	0.40	-1.00
16	0.07	-0.22	-0.56	1.00
17	-0.40	-0.54	-0.00	-1.00
19	-0.35	-0.34	0.06	-1.00
20	-0.27	-0.70	-0.29	-1.00
21	-0.05	-0.03	-0.36	-1.00
22	-0.52	-0.73	0.04	-1.00
23	0.16	0.11	0.62	-1.00



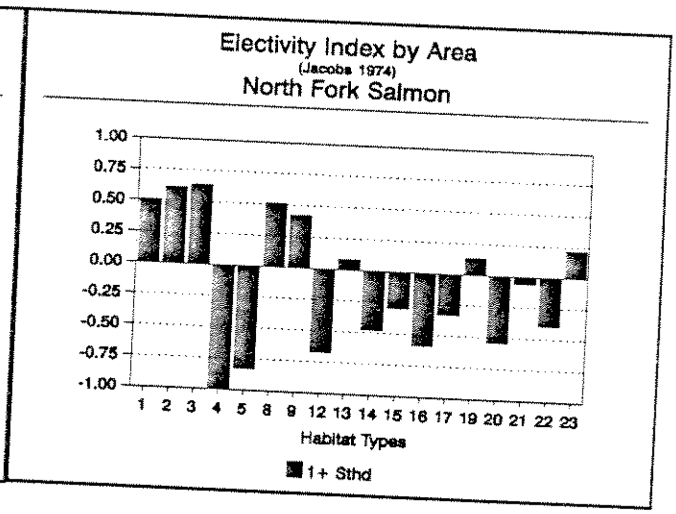


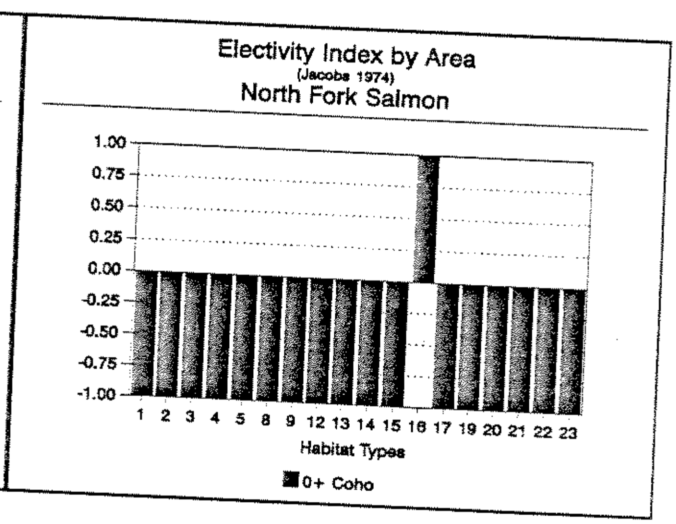




Fork Salmon River
ivity Index by Area

1+ Sthd	0+ Chinook	0+ Coho
0.505	-0.628	-1.000
0.609	-0.280	-1.000
0.637	-0.445	-1.000
-1.000	0.887	-1.000
-0.827	-1.000	-1.000
0.512	0.210	-1.000
0.423	0.823	-1.000
-0.672	-0.061	-1.000
0.081	-1.000	-1.000
-0.480	0.050	-1.000
-0.298	0.227	-1.000
-0.590	-0.794	1.000
-0.332	0.251	-1.000
0.137	0.499	-1.000
-0.542	-0.030	-1.000
-0.062	-0.384	-1.000
-0.396	0.496	-1.000
0.218	0.680	-1.000





PENDITURES

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SFS ibution	Project Total
,400	49,647
550	4,550
,950	8,950
,400	$63,147