A BIOLOGICAL AND PHYSICAL INVENTORY OF CLEAR CREEK, OROFINO CREEK, AND THE POTLATCH RIVER, TRIBUTARY STREAM OF THE CLEARWATER RIVER, IDAHO

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ABSTRACT

Clear Creek, Orofino Creek, and Potlatch Creek, three of the largest tributaries of the lower Clearwater River Basin, were inventoried during 1984. The purpose of the inventory was to identify where anadromous salmonid production occurs and to recommend enhancement alternatives to increase anadromous salmonid habitat in these streams.

Anadromous and fluvial salmonids were found in all three drainages. The lower reach of Clear Creek supported a low population of rainbow-steelhead, while the middle reach supported a much greater population of rainbow-steelhead. Substantial populations of cutthroat trout were also found in the headwaters of Clear Creek. Rainbow-steelhead and brook trout were found throughout Orofino Creek. A predominant population of brook trout was found in the headwaters while a predominant population of rainbow-steelhead was found in the mainstem and lower tributaries of Orofino Creek. Rainbow-steelhead and brook trout were also found in the Potlatch River. Generally, the greatest anadromous salmonid populations in the Potlatch River were found within the middle reach of this system.

Several problems were identified which would limit anadromous salmonid production within each drainage. Problems affecting

Clear Creek were extreme flows, high summer water temperature, lack of riparian habitat, and high sediment load. Gradient barriers prevented anadromous salmonid passage into Orofino Creek and they are the main deterrent to salmonid production in this system. Potlatch River has extreme flows, high summer water temperature, a lack of riparian habitat and high sediment loads.

Providing passage over Orofino Falls is recommended and should be considered a priority for improving salmonid production in the lower Clearwater River Basin. Augmenting flows in the Potlatch River is also recommended as an enhancement measure for increasing salmonid production in the lower Clearwater River Basin.

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INTRODUCTION

The Nez Perce people, the Nee-Mee-Poo, have always been concerned with the well being of the anadromous fish. Idaho tributaries to the Columbia River, specifically the Clearwater and Salmon drainages, once supported substantial populations of anadromous salmonids. Fifty-five percent of all steelhead, 39% of all spring chinook, and 45% of all summer chinook produced in the Columbia Basin originated in Idaho waters (Mallet, 1974). Approximately 90% of the anadromous fish producing streams in Idaho lie within the ceded lands of the Nez Perce Tribe (Figure 1). The anadromous fish are an inseparable part of the cultural and religious beliefs of the Nez Perce. Fishing for subsistence, religious, and trade activities is as important as hunting or root gathering to the Nee-Mee-Poo (Morrison-Maierle, 1979). Presently, with the advent of hydroelectric power facilities, commercial fishing, and various land use activities, the runs of anadromous salmonids are greatly reduced. The Tribe, therefore, has a profound concern with the status and management of this valuable resource.

There has been limited data on the potential or existing anadromous salmonid habitat within the Nez Perce Reservation in the lower Clearwater Basin. The Tribe received funding in 1982 from the Bonneville Power Administration (BPA) to survey the streams within the reservation in order to establish the baseline information necessary to make decisions regarding the enhancement, management, or restoration of anadromous salmonids in the lower Clearwater drainage. The 1982 inventory surveyed only those stream reaches which flowed within the reservation boundaries. In 1983, the inventory was continued to include the stream reaches outside the reservation boundaries. This, the final inventory, focused on the total drainages of three of the largest, but little-studied tributaries of the lower Clearwater River; Potlatch River, Orofino Creek, and Clear Creek.

The objective of the biological and physical inventory is to collect the biological and hydrological information needed to assess the stream and habitat conditions such that recommendations for enhancement of the anadromous fish resources can be made. This will be accomplished by: 1) utilizing fish collection or observation techniques to identify major fish species present and to estimate existing densities and standing crops of anadromous salmonids; 2) quantifying existing habitat parameters associated with representative reaches of the inventory streams; 3) identifying hydrological or physical limitations to production of anadromous salmonids; and 4) recommending specific enhancement measures which would result in either creating additional anadromous salmonid habitat or protecting the existing habitat.

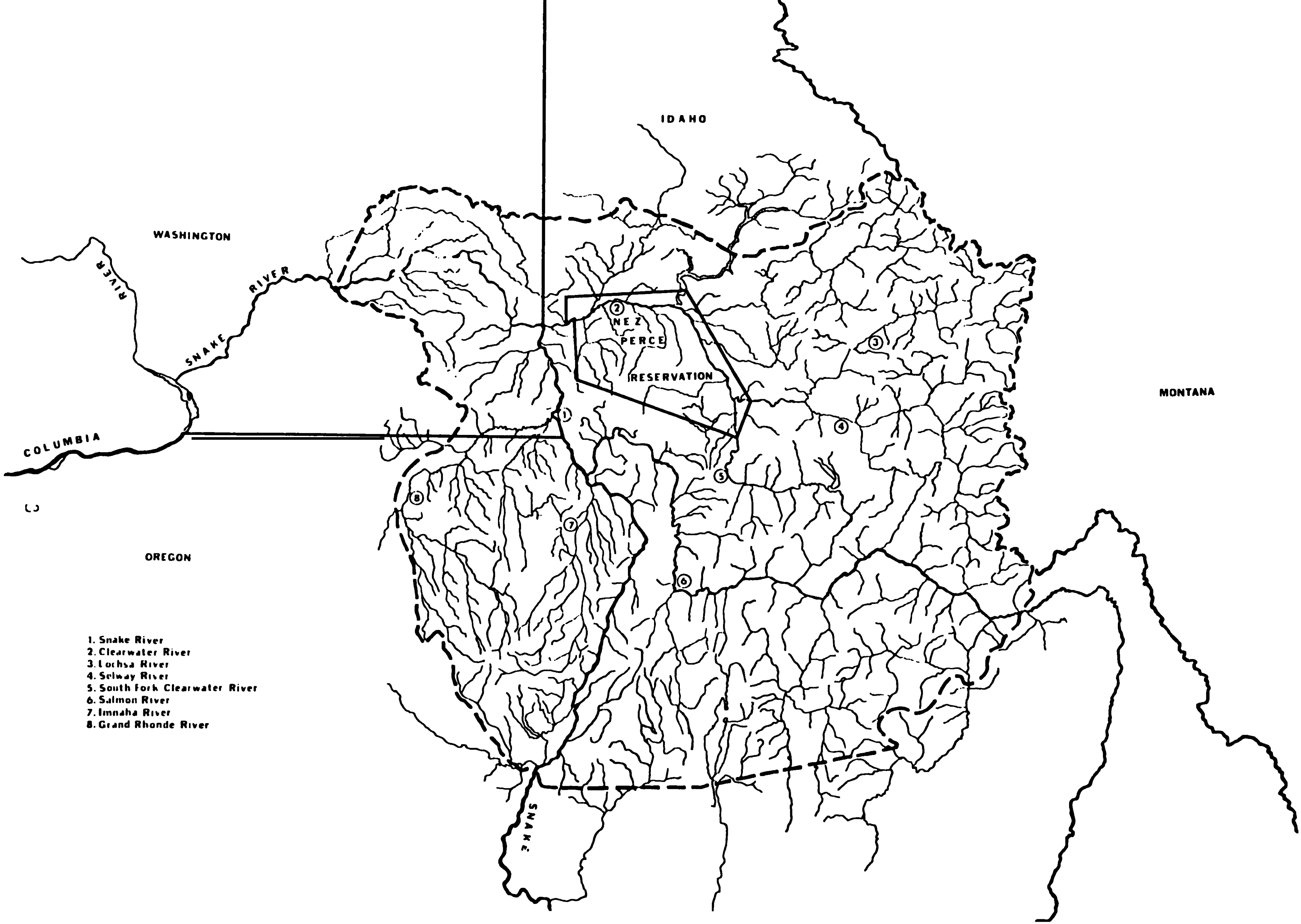


Figure 1. Map of ceded lands of Nez Perce Tribe

STUDY AREA

The Nez Perce Reservation encompasses approximately 3237 km2 in north central Idaho, including the entire lower Clearwater River Basin (Figure 2). The principal drainages sampled during 1984, Potlatch, Orofino, and Clear Creeks, are among the largest of the lower Clearwater River tributaries. These systems reflected the entire range of elevations of the lower Clearwater, from 200 m to 1844 m. General habitat types include semi-arid canyons, agricultural prairie, and coniferous forest. Average annual rainfall for the 10 year period, 1972-1982, recorded at Lewiston, Idaho, was 31.6 cm. Rainfall at the higher elevations, however, would be somewhat greater. Summer air temperatures ranged from 37.7 C in the lowlands to 26.6 C in the higher forested elevations. Dworshak National Fish Hatchery, located at the mouth of the North Fork of the Clearwater River, was established as mitigation for the Dworshak Dam. The dam blocks passage into one of the most historically productive salmonid habitats in the Clearwater Basin. Presently, the hatchery is the source of a successful hatchery steelhead run into the Clearwater River.

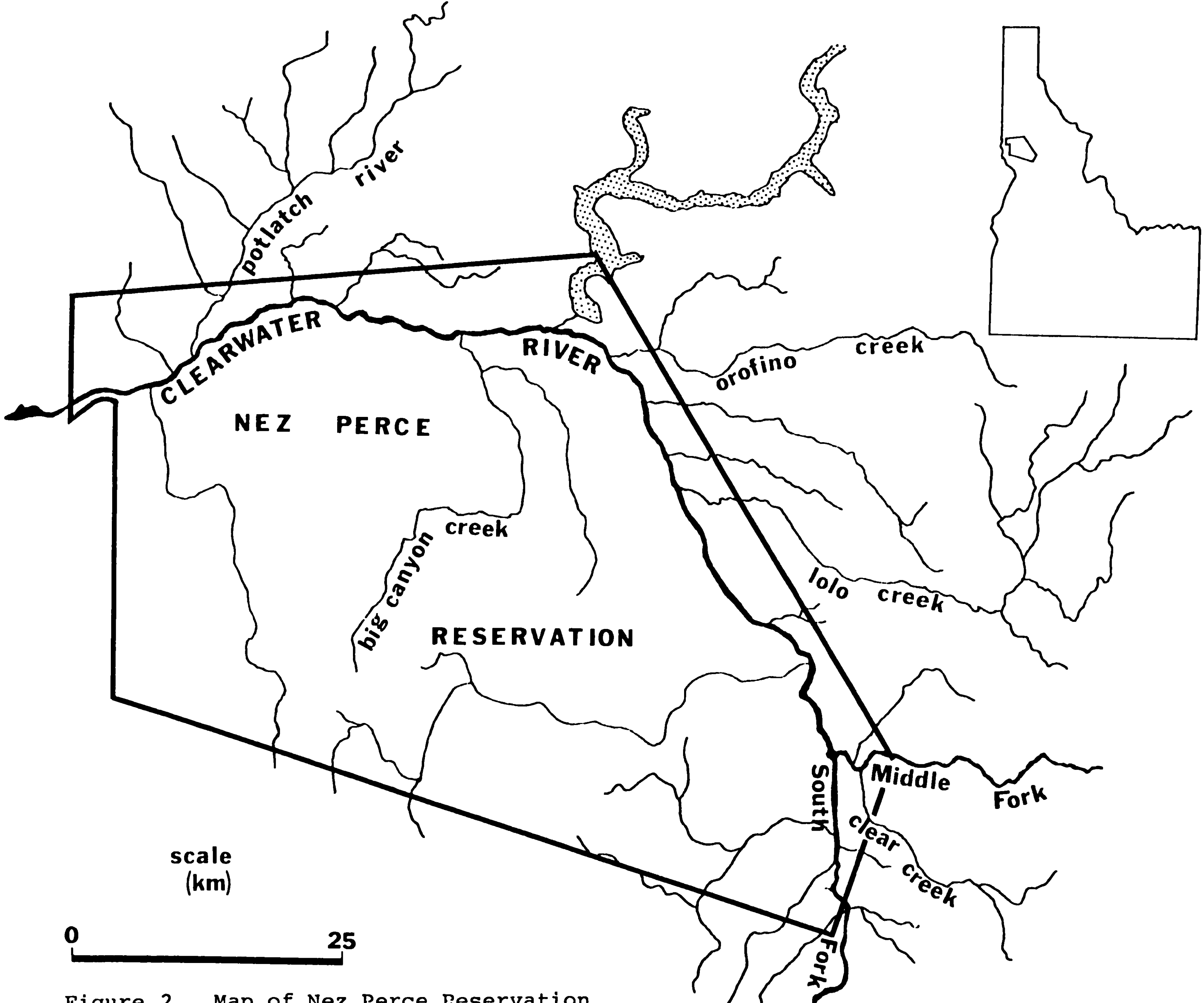


Figure 2. Map of Nez Perce Reservation

MATERIALS AND METHODS

SITE SELECTION

The major drainages were surveyed by automobile, railroad car, and aerially, at the beginning of the study season. The topographical character of each drainage and major barriers or limits within the habitat were identified. Later, most of the barriers were examined from the streambed: Tributary streams or stream reaches were walked when possible but this inventory contained some 2205 km of streams, which made this method, for the most part, prohibitive. Stream sample stations were selected as being representative of habitat types (e.g. 9 high meadow or lowland), particular stream reaches (by distance from the mouth), or individual tributary streams. Access into the drainages determined which areas could be sampled. Each sample station consisted of a 40 to 100 m section from which fish population and physical parameter information was collected.

FISH POPULATIONS

Fish population estimates were made by two methods, electrofishing and snorkeling. Where flow and depth were suitable, electrofishing techniques were utilized. Electrofishing equipment consisted of a Georator portable generator, with a single electrode set at 230 volts direct current. The sample section was blocked off with block nets and the fish were shocked and captured from downstream to upstream. A removal method (Zippen, 1958; Seber and LeCren, 1967) was used to determine fish densities, which required at least a 60% reduction in the target species between consecutive passes. Between passes, the fish were stored in large plastic garbage cans, individually weighed to the nearest gram, and measured (total length and fork length) to the nearest millimeter. After sampling was completed, the fish were returned to the stream. A list of fish species sampled in the lower Clearwater is presented in Table 1.

Snorkeling methods (Platts, 1983) were utilized where extreme depth or stream flow prevented the effective use of electrofishing equipment. The station length was snorkeled, at least twice, from downstream to upstream. Fish were counted and identified and conservative estimates of population numbers were made. Salmonids were recorded as being over-yearling (>90 mm) or subyearlings (<90 mm). Since neither individual weights nor lengths were obtained biomass estimates could not be made.

Table 1. List of fish species sampled in the streams within the lower Clearwater Basin, 1982-1984.

Common Name	Scientific Name
Rainbow-Steelhead Trout a	Salmo gairdneri
Chinook Salmon	Oncorhynchus tshawytscha
Kokanee Salmon	Oncorhynchus nerka
Bull Trout	Salvelinus confluentus
Brook Trout a	Salvelinus fontinalis
Cutthroat Trout a	Salmo clarki
Mountain Whitefish	Prosopium williamsoni
Small Mouth Bass a	Micropterus dolomieui
Pumpkinseed a,b	Lepomis gibbosus
Longnose Date a	Rhinichthys cataractae
Speckled Date a	Rhinichthys osculus
Paiute Sculpin a	Cottus beldingi
Torrent Sculpin a,b	Cottus rhotheus
Northern Squawfish a	Ptychocheilus oregonensis
Chiselmouth	Acrocheilus alutaceus
Redside Shiner a	Richardsonius balteatus
Bridgelip Sucker a	Catostomus columbianus
Largescale Sucker	Catostomus macrocheilus
Pacific Lamprey (ammocoete) a,b	Entosphenus tridentatus

[a] Sampled during 1984

[b] Probable species identification

PHYSICAL ATTRIBUTES

Twelve physical parameters were measured at each sample station. These parameters were determined by Binns and Eiserman (1979) and the U.S. Forest Service Ocular Method to be those which have the greatest effect, singularly or synergistically, on salmonid production. Fuller et al. (1984) explained the relative importance of each physical parameter to salmonid production, hence, they will only be described here.

1. Late summer stream flow:

   Representative of late or low summer stream flow estimated by the formula:

   Flow (m3/sec) = velocity (m/sec) x width (m) x depth (m)

2. Annual stream flow variation:

   A subjective estimate of variation in flow determined by evidence of scouring, past flood marks, and bed load deposition (Binns and Eiserman, 1979).

3. Summer water temperature:

   Water temperature (C) recorded during late summer flow. Maximum temperatures were taken at the lower mainstem reach of each of the principal tributary streams during the initial, 1982, inventory.

4. Water velocity:

Measured by determining sample station thalweg length and the amount of time necessary for a small quantity of dye to pass through this length in cm/sec.

5. Stream width:

Measured distance (m) across the wetted perimeter of the sample station channel at 10 m intervals.

6. Stream depth:

Pleasured stream depth (cm) at 10 equal intervals on the stream width transect.

7. Instream cover:

Measured surface area (m2) of instream cover components within the sample section and recorded as percent of total sample section area. Instream cover consisted of: overhanging vegetation, submerged rocks and debris, depth, surface turbulence, and undercut banks.

8. Eroding bank:

Measured length of eroding bank (m) and recorded as percent of total sample station banks.

9. Cobble embeddedness:

Estimated by gasket effect and amount of substrate surface area covered by fine sediment (Table 2); recorded as percent gasket of total sample stream area.

10. Major substrate type:

Highest percent of a substrate size as classified by a modified Wentworth scale (Table 2).

11. Pool/riffle ratio:

Measured length of pool and riffle areas in each sample station recorded as a ratio.

12. Periphyton coverage:

Estimated substrate surface area covered by algae and recorded as percent of total sample station area.

In addition to these measurements, pool stability was noted, and a general description of the riparian habitat and the amount of stream area shaded by the riparian habitat were included.

The physical habitat measurements were compared with generally accepted indices of habitat quality for salmonids. Summer water

Table 2. Example of bottom substrate and cobble embeddedness or gasket categories utilized in Clearwater River Basin inventories, 1982-1984.

Bottom substrate:

1. Bedrock	5. Small Rubble (3-6”)
2. Large Boulder (3’+)	6. Loose Gravel (l-3”)
3. Small Boulder (l-3’)	7. Fine Gravel (.1-l”)
4. Large Rubble (6-12")	8. Sand, silt, clay

Cobble embeddedness (Gasket effect)

0 gasket:	Cobble easily moved, resting and surrounded by large substrate (greater than 0.25 inch).
l/4 gasket:	Cobble still easily moved, however, l/4 of surface area surrounded by sand and fine material.
l/2 gasket:	Cobble difficult to move with hand or foot; l/2 of surface area lost to sand and fine material.
3/4 gasket:	Cobble very difficult to move; 3/4 of surface material lost to sand and fine material.
Full gasket:	Cobble almost impossible to dislocate from streambed; surface area needed for aquatic insect habitat almost completely choked off or eliminated; "gasket" of sediment even with upper surface of cobble.

temperatures, water velocity, depth, and major substrate types were compared with the probability-of-use curves developed by Bovee (1978) for juvenile rainbow-steelhead. The curves represent an optimum from a wide range of juvenile rainbow-steelhead habitats and may not reflect the optimum juvenile steelhead habitat in any particular stream system (Figure 3). However, these curves are currently employed by the Idaho Department of Fish and Game and, in order to keep habitat evaluation techniques comparable, were also used here. The results in this report will describe optimum conditions as those being greater than 0.8 and the suboptimum condition or range being less than 0.8 on the juvenile steelhead probability-of-use curves. The effects of cobble embeddedness or sediment content on salmonid habitat was described by Bjornn et al. (1977) and their results will be used in assessing substrate conditions of the streams inventoried during the present sample season. A gasket effect of 25% or greater will indicate that steelhead habitat is being reduced. Pool/riffle ratio of 40:60 to 60:40 is generally considered to provide suitable holding area and habitat diversity for both juvenile salmonids and benthic invertebrates, which are utilized as prey items by the salmonids. Periphyton abundance can indicate relative primary production and will be used as such in the results. Zero to 30% periphyton coverage will indicate low primary production, 30% to 60%, moderate primary production, and

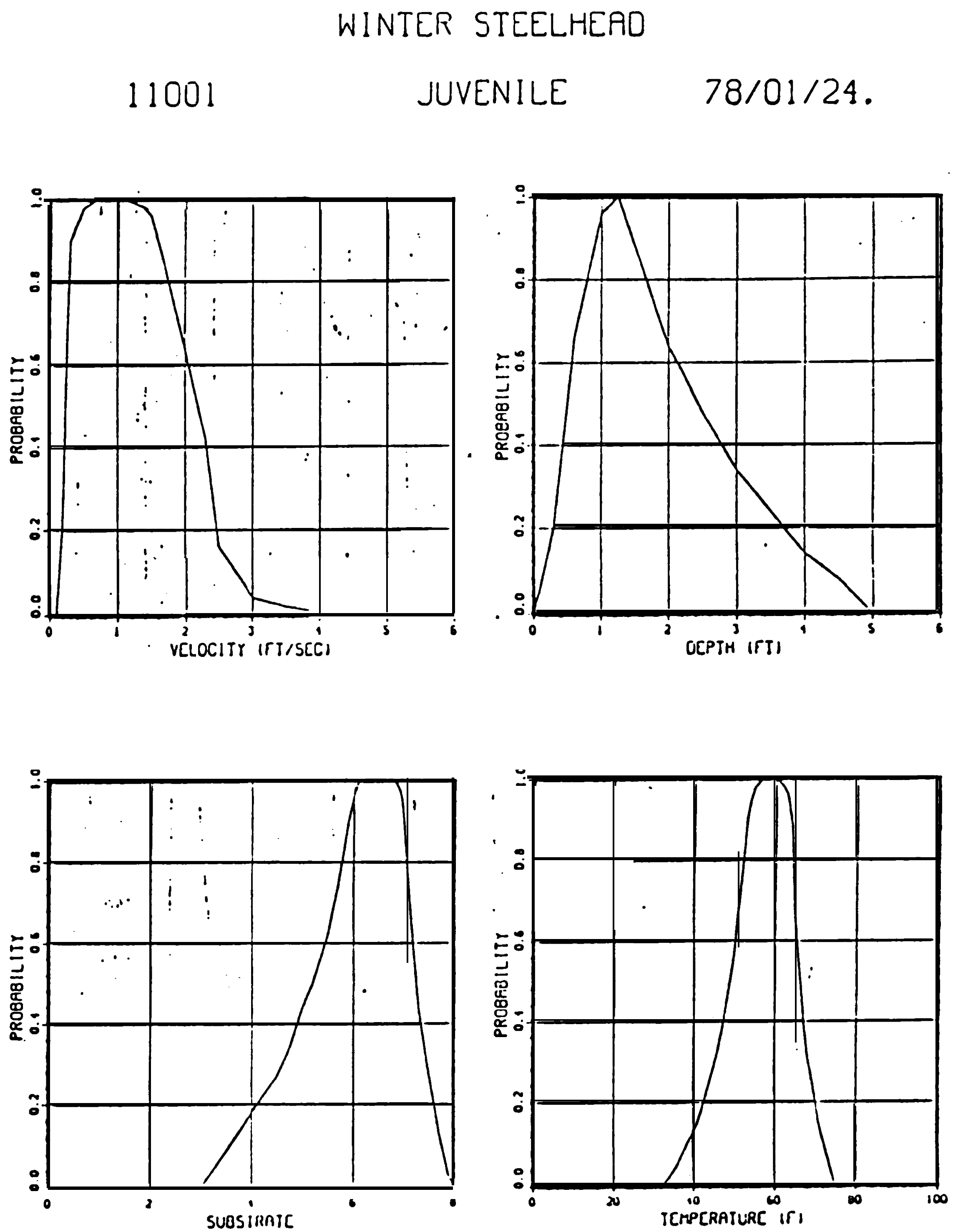


Figure 3. Probability-of-use curves for juvenile rainbow-steelhead trout, from Bovee (1978).

greater than 60%, high primary production.

WATER CHEMISTRY DATA

Water samples were collected from 13 sample stations during 1984. The 1982 (Kucera et al., 1983) and 1983 (Fuller et al., 1984) inventories found that water quality in the lower Clearwater Basin streams was not detrimental to salmonid production. Therefore, during the 1984 inventory, water samples were not collected in the lower stream reaches but were chosen to represent the higher upstream areas. Water samples were collected in 1-qt plastic jugs, labeled, cooled in ice chests, and transported to the University of Idaho Analytical Laboratory where they were analyzed within 24 hours. All water samples were taken during mid-September and early October. Parameters measured, methodology, and detection limits are presented in Table 3.

Table 3. Water sample analysis outlining constituents measured, methods of detection, and detection limits for samples taken from Clear Creek, Orofino Creek, and the Potlatch River, Idaho, 1984.

Constituent	Detection Method	Detection Limit
Carbonate, CO_3	Titrimetric-H_2SO_4 and phenolphthalein	0.22 mg/l
Bicarbonate, HCO_3	Titrimetric-H_2SO_4 and methyl orange	0.09 mg/l
Sulfate, SO_4	Turbidimetric	1.0 mg/l
Nitrate, NO_3	Colorimetric, automated, cadmium reduction	0.01 mg/l
Orthophosphate, PO_4	Colorimetric, automated ascorbic acid	0.01 mg/l
Chloride, Cl	Titrimetric- Sliver nitrate and potassium chromate	0.01 mg/l
Calcium, Ca	Inductively Coupled Plasma-Atomic Emission Spectrometer	0.15 mg/l
Magnesium, Mg	Inductively Coupled Plasma-Atomic Emission Spectrometer	0.25 mg/l
Sodium, Na	Inductively Coupled Plasma-Atomic Emission Spectrometer	0.10 mg/l
Potassium, K	Inductively Coupled Plasma-Atomic Emission Spectrometer	0.05 mg/l
Total Dissolved Solids	Gravimetric	10.0 mg/l
pH	Colorimetric	0.1 unit

R E S U L T S A N D D I S C U S S I O N

Stream Narrative-Clear Creek System

CLEAR CREEK

Clear Creek (Figure 4) is approximately 33 km in length and contains 264 km of tributary streams. The stream flows in a southwesterly direction from the source on the southwest slope of Lookout Butte to SK 13. There it turns, flowing northwesterly, and discharges into the Middle Fork of the Clear-water River at RK 3.2. The lower 6 km of Clear Creek flow through the Nez Perce Reservation. Three tributaries, Lietch Creek, Little Cedar Creek, and Big Cedar Creek flow into the lower 12 km of Clear Creek. These tributaries drain a watershed of private land utilized for farming and grazing. The upper 17.7 km of Clear Creek flows within the Nez Perce National Forest. West Fork Clear Creek, South Fork Clear Creek, Middle Fork Clear Creek, Pine Knob Creek, and Browns Spring Creek are the major tributaries to upper Clear Creek.

Upper Clear Creek flows through a forested, steep, mountain terrain. Logging and livestock grazing are the primary land use activities within the upper drainage. Access into upper Clear Creek is limited. Generally, the upper reach supports a well developed riparian habitat.

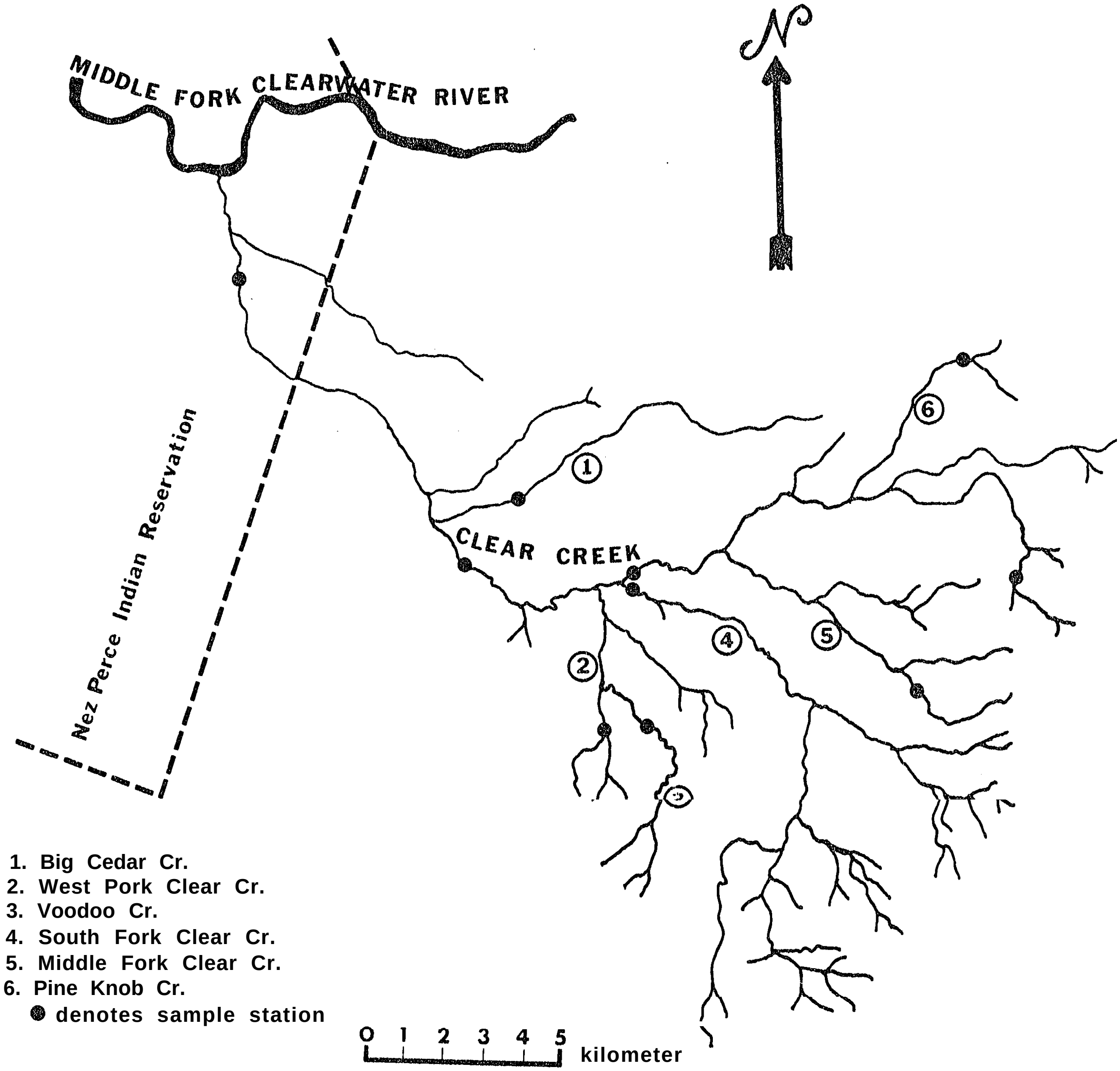


Figure 4. Map of Clear Creek, Idaho, indicating sample stations.

Residences are located along the lower 14 km of Clear Creek and a road parallels this stream reach. Livestock are penned at several locations adjacent to the lower reach and overgrazing has reduced or removed most of the riparian vegetation in this area.

The U.S. Fish and Wildlife Service operates the Kooskia Hatchery, a spring chinook salmon hatchery, near the mouth of Clear Creek. Returning adult chinook and steelhead are captured in an electric weir below the hatchery; steelhead are allowed to pass above the weir while chinook are spawned in the hatchery. Occasionally, during extreme flows, chinook have escaped the weir and spawned upstream.

Murphy and Metsker (1962) visually surveyed Clear Creek, Big Cedar Creek, West Fork Clear Creek, South Fork Clear Creek, Middle Fork Clear creek, and Pine Knob Creek for the Idaho Department of Fish and Game. They calculated the total amount of spawning gravels available to both rainbow-steelhead and chinook salmon. They also gave general descriptions of the watershed, noting that logging activities and natural erosion had caused considerable siltation in Clear Creek.

Mallet (1974) estimated abundance of spawning gravels and fishing pressure by sports fishermen in Clear Creek, South Fork Clear Creek, Middle Fork Clear Creek, and Pine Knob Creek.

Martin (1976) conducted an ocular survey for the Idaho Department of Fish and Game and the Nez Perce National Forest on Clear Creek, South Fork Clear Creek, Middle Fork Clear Creek, and Pine Knob Creek. He described several stream substrate components on each creek. He also estimated available spawning habitat, benthos quality, and used angling techniques to determine the fish species present.

The U.S. Forest Service (1980) visually surveyed the Clear Creek drainage within the National Forest boundaries. Their survey described, by elevation: stream substrate characteristics, pool quality, channel stability, and barriers to anadromous fish migration.

The U.S. Fish and Wildlife Service (1981) conducted anadromous fish habitat and population surveys on the lower 12.5 km of Clear Creek. They also modeled the effects of improved flow regimes and riparian and instream enhancement on anadromous fish production in the lower reach.

During the present inventory, four sample stations were established on the mainstem of Clear Creek. Stations #l and #2, inventoried during 1982, were representative of the lower impacted reach of

Clear Creek. The stream flowed through a wide flood channel, riparian habitat was denuded or limited, summer temperatures could be stressful to anadromous salmonids, and actual biomass of rainbow-steelhead was low. The middle station, typical of low impact rather pristine conditions for this system, supported a good population of rainbow-steelhead. Standing crop of both overyearling and subyearling rainbow-steelhead ranked fourth of the streams sampled during 1984 (Appendices-Tables 1 and 2). A high biomass of cutthroat trout was found in the headwaters of Clear Creek. Streams in this area were generally small, shallow, shallow, moderate gradient streams, possibly acting as nursery areas for fish inhabiting the deeper waters downstream.

Station #1. Station #l was established on Clear Creek at SK 2.4. Moderate to heavy grazing occurred throughout this reach, riparian growth was limited, and Clear Creek Road paralleled the sample station.

Fish species present in Station #1 were rainbow-steelhead, mountain whitefish, speckled date, longnose date, paiute sculpin, and torrent sculpin. Overyearling rainbow steelhead were not captured in sufficient numbers to estimate standing crop or density. Estimated standing crop of subyearling rainbow-steelhead was 3.4 kg/ha, with a density of 0.17 fish/m2 (Table 4).

Late summer stream flow was 0.85 m3/sec, with moderate variation in annual flow. Maximum summer water temperature was 21.7 C, approaching the lethal limit of juvenile rainbow-steelhead (Bovee, 1978). Mean stream velocity was 53.7 cm/sec, within the optimum range for juvenile rainbow-steelhead (Bovee, 1978). Stream width averaged 7.92 m. Mean stream depth was 20.0 cm, a suboptimum depth for juvenile rainbow-steelhead. Instream cover for juvenile rainbow-steelhead was provided by 19.2% of the stream area surveyed. Depth and surface turbulence were the primary components of instream cover. Eleven percent of the stream banks showed signs of erosion. Overall channel stability was good. Pool/riffle ratio was 20:80, indicating a lack of holding area for juvenile salmonids. The major substrate type was small rubble, a slightly suboptimum substrate size for juvenile rainbow-steelhead (Bovee, 1978). Cobble embeddedness was 50%, limiting to steelhead production (Bjornn et al., 1977). Periphyton was present on 50% of the substrate, indicating moderate primary production. The riparian habitat was sparse and provided 10% of the stream section with shade (Table 5).

Station #2. Station #2 was established at SK 12.4. Sparse patches of vegetation lined the sample site, several residences were situated nearby, and Clear Creek Road paralleled this site.

Fish species present at station #2 were rainbow-steelhead, paiute and torrent sculpin, and speckled date. Overyearling rainbow-steelhead were present but not in adequate numbers for a population estimate. Estimated standing crop of subyearling rainbow-steelhead was 4.7 kg/ha, with a density of 0.13 fish/m2 (Table 4).

Late summer stream flow was 0.93 m3/sec, with moderate variation in annual flow. Maximum summer water temperature was 21.7 C, approaching lethal limits for rainbow-steelhead (Bovee, 1978). Water temperature recorded on the sampling date, October 11, was 7.2 C. Stream width was 9.07 m. Mean stream depth was 25.0 cm, within optimum range for juvenile rainbow-steelhead (Bovee, 1978). Stream velocity averaged 41.1 cm/sec, which is within the optimum range for juvenile rainbow-steelhead. Instream cover for juvenile rainbow-steelhead was provided by 9.0% of the stream area surveyed. Depth was the primary component of instream cover. Thirteen percent of the stream banks showed signs of erosion. Overall channel stability was good. The pool/riffle ratio was 10:90, indicating a lack of holding area for juvenile rainbow-steelhead. The major substrate type was small rubble, a slightly suboptimum substrate size for juvenile rainbow-steelhead (Bovee, 1978). Cobble embeddedness was 75%, limiting steelhead production (Bjornn et al., 1977). Periphyton covered 50% of the available substrate, indicating moderate primary production. The riparian habitat was underdeveloped but provided 30% of the stream area with shade (Table 5).

Station #3. Station #3 was established at SK 18.1, approximately 100 meters above the confluence with South Fork Clear Creek. Station #3 was located in a steep narrow canyon, the southern slope of the canyon was brushy and the northern slope heavily timbered. A debris jam was present below the sample site.

Rainbow-steelhead, cutthroat trout, and paiute sculpin were captured in station #3. Estimated overyearling rainbow-steelhead standing crop was 28.84 kg/ha, with a density of 0.13 fish/m2. Subyearling rainbow-steelhead standing crop was 5.66 kg/ha, with a density of 0.18 fish/m2 (Table 4). One juvenile cutthroat trout was captured (Table 6).

Late summer stream flow was 0.42 m3/sec, with moderate annual stream flow variation. The water temperature was 9.4 C, which is suboptimum for steelhead production (Bovee, 1978). However, the temperature was recorded on September 27th, and did not represent maximum summer temperatures. Instream cover was provided by 4.0% of the stream area surveyed. Mean water velocity was 40.0 cm/sec, within the optimum range for juvenile rainbow-steelhead (Bovee, 1978). The mean stream width was 6.02 m. Mean depth was 17.5 cm, which is slightly suboptimum for juvenile rainbow-steelhead (Bovee, 1978). Cobble embeddedness was zero, optimum for steelhead production (Bjornn et al., 1977). The major substrate types were large and small rubble, the optimum substrate size for juvenile rainbow-steelhead (Bovee, 1978). Signs of erosion were present along 10% of the stream banks. Overall channel stability was fair. A pool/riffle ratio of 25:75 indicated a lack of holding area for overyearling rainbow-steelhead. Small pools formed behind boulders, but most of the sample section was a riffle-run. The gradient for the sample section was low to moderate. Periphyton covered 20% of the substrate, indicating low primary production. Alders, willows, and herbaceous plants were the primary components of the well developed riparian zone and shaded 30% of the stream (Table 6).

Station #4. Station #4 was established on a tributary of the headwaters of Clear Creek. It was located approximately 0.4 km from SK 31.6. The station was below Forest Service Road 286 in a small high meadow, bordered by brushy timbered slopes. Woody debris was abundant in the Clear Creek headwaters.

Cutthroat trout and frogs were captured at station #4. Estimated standing crop of overyearling cutthroat trout was 64.95 kg/ha, with 0.80 fish/m2. Juvenile cutthroat were not observed (Table 5.)

Late summer stream flow was 0.02 m3/sec, with moderate annual stream flow variation. Summer water temperature was 11.1 C, which is optimum for juvenile rainbow-steelhead (Bovee, 1978). Instream cover was provided by 3.0%, of the area surveyed. Signs of erosion were present along 40% of the stream banks. Mean water velocity was 19.1 cm/sec, an optimum stream velocity for juvenile rainbow-steelhead Bovee, 1978). The stream width averaged 1.85 m at low flow. Mean depth was 5.8 cm, which is at the minimum limit for rainbow-steelhead (Bovee, 1978). Cobble embeddedness was 25%, possibly limiting steelhead production (Bjornn et al., 1977). The major substrate types were large and small rubble, which is optimum for juvenile rainbow-steelhead (Bovee, 1978). The channel stability was poor to fair, as spring snow melt undoubtedly would make a marsh of the small meadow. Stream gradient for the sample section was low to moderate. The pool/riffle ratio of 25:75 indicated a lack of holding area for juvenile rainbow-steelhead. Pools formed below woody debris. Periphyton was not observed on the substrate, indicating limited primary production. Sparse patches of moss covered 2% of the exposed stream substrate. The riparian habitat was well developed, consisting of ferns, herbaceous plants, and a few conifers and shaded 50% of the stream (Table 6).

Table 4. Rainbow-steelhead trout population statistics of four sample stations on Clear Creek, a tributary of Middle Fork Clear-water River, Idaho, 1982, 1984.

Biological Parameter	Units	Station 1 Value	Station 2 Value	Station 3 Value	Station 4 Value
Age 0+ Rainbow-Steelhead					
Density	fish/m^2	0.17	0.13	0.18	0
Standing Crop	kg/ha	3.4	4.7	5.66	0
Mean Weight	gm	NA	3.7	3.1	0
Mean Length (TL-FL)	mm	NA	NA-78	74-70	0
Age 1+ Rainbow-Steelhead					
Density	fish/m^2	NA	NA	0.13	0
Standing Crop	kg/ha	NA	NA	28.84	0
Mean Weight	gm	NA	32.0	21.7	0
Mean Length (TL-FL)	mm	NA	NA-136	132-125	0

Table 5. Measured physical parameters of four sample stations on Clear Creek, a tributary of Middle Fork Clearwater Idaho, 1932, 1984.

Physical Parameter	STATION 1 Value	STATION 2 Value	STATION 3 Value	STATION 4 Value
Station Length (m)	90	81	60	60
Station Area (m2)	712.80	734.67	361.20	111.00
Late Summer Stream Flow (m3/sec)	0.85	0.93	0.42	0.02
Annual Stream Flow Variation	Moderate	Moderate	Moderate	Moderate
Summer Temp. (C)	21.7	21.7	9.4	11.1
Water Velocity (cm/sec)	42.3	41.1	40.0	19.1
Stream Width (m)	7.92	9.07	6.02	1.85
Stream Depth (cm)	20.0	25.0	17.5	5.8
Instream Cover (%)	19.2	9.0	4.0	3.0
Eroding Banks (%)	11	13	10	40
Cobble Embeddedness (%)	50	75	0	25
Major Substrate Type	Sm. R.	Sm. R.	Lg./Sm.R.	Lg./Sm.R.
Pool/Riffle Ratio	20:80	10:90	25:75	25:75
Periphyton Coverage (%)	50	50	20	0

Table 6. Cutthroat trout population statistics of four sample stations on Clear Creek, a tributary of Middle Fork Clearwater River, Idaho, 1984.

Biological Parameter	Units	Station 1 Value	Station 2 Value	Station 3 Value	Station 4 Value
Age 0+ Cutthroat Trout					
Density	fish/m^2	0	0	0	0
Standing Crop	kg/ha	0	0	0	0
Mean Weight	gm	0	0	0	0
Mean Length (TL-FL)	mm	0	0	0	0
Age 1+ Cutthroat Trout					
Density	fish/m^2	0	0	0.003	0.80
Standing Crop	kg/ha	0	0	0.47	64.95
Mean Weight	gm	0	0	17.0	8.1
Mean Length (TL-FL)	mm	0	0	134-127	95-90

BIG CEDAR CREEK

Big Cedar Creek is approximately 12.2 km in length and contains 14.6 km of tributary streams. Big Cedar Creek flows southwesterly, discharging into Clear Creek at SK 11.2. The creek originates within the Nez Perce National Forest and flows through private lands for the lower 9.5 km of its length. The upper 6.5 km of Big Cedar Creek flow intermittently and surface permanently at the community of Big Cedar, Idaho. The lower 5.6 km flow through both forested valley and cleared ranch lands. Livestock graze throughout the total length of Big Cedar Creek. The gradient in Big Cedar Creek is low to moderate. Access to lower Big Cedar Creek is provided by Big Cedar Creek Road.

A station was established at SK 1.6, below the Big Cedar Creek Road. The creek was small and brushy, bordered by a grassy north slope and a sparsely timbered south slope.

Rainbow-steelhead, paiute sculpin, frogs, and crayfish were captured in Big Cedar Creek. Estimated standing crop of overyearling rainbow-steelhead was 18.54 kg/ha, with a density of 0.09 fish/m2. The estimated standing crop of subyearling rainbow-steelhead was 4.64 kg/ha, with a density of 0.08 fish/m2 (Table 7).

The Big Cedar Creek system is probably the most productive of the lower tributary streams. Although the stream was small, streamside cover was plentiful and the stream was generally well shaded, which might have compensated for a lack of instream cover. Standing crop of overyearling rainbow-steelhead ranked seventh and standing crop of subyearlings, fifth, of the streams sampled during 1984 (Appendix-Tables 1 and 2).

Late summer stream flow was 0.04 m3/sec, with moderate variation in annual stream flow. The summer water temperature was 16.7 C, which is within the optimum range for juvenile salmonids (Bovee, 1978). Instream cover for juvenile rainbow-steelhead was provided by 1.3% of the stream area. Erosion of stream banks was 10%. Mean water velocity was 21.0 cm/sec, within the optimum range for juvenile steelhead (Bovee, 1978). The average width during low flow was 2.63 m. Mean water depth was 7.9 cm, the minimum limit for juvenile rainbow-steelhead (Bovee, 1978). Cobble embeddedness was 50%, indicating a siltation problem which could reduce salmonid production (Bjornn et al., 1977). The major substrate type was small rubble with a high content (25%) of sand and silt. These substrate sizes are suboptimum for juvenile rainbow-steelhead (Bovee, 1978). Coverage of the substrate by periphyton was 5%, indicating low primary productivity. The pool/riffle ratio was 33:66. The pools were small, forming behind roots or debris. Channel stability was fair, being structurally supported by riparian growth. Deciduous trees and low brush shaded 50% of the sample section (Table 8).

Table 7. Rainbow-steelhead trout population statistics of one sample station on Rig Cedar Creek, a tributary of Clear Creek, Idaho, 1984.

Biological Parameter	Units	Station 1 Value
Age 0+ Rainbow-Steelhead		
Density	fish/m^2	0.08
Standing Crop	kg/ha	4.64
Mean Weight	gm	6.1
Mean Length (TL-FL)	mm	95-90
Age l+ Rainbow-Steelhead		
Density	fish/m^2	0.09
Standing Crop	kg/ha	18.54
Mean Weight	gm	19.5
Mean Length (TL-FL)	mm	114-107

Table 8. Measured physical parameters of one sample station on Big Cedar Creek, a tributary of Clear Creek, Idaho, 1984.

Physical Parameter	STATION 1 Value
Station Length (m)	40
Station Area (m2)	105.20
Late Summer Stream flow (m3/sec)	0.04
Annual Stream Flow Variation	Moderate
Summer Temp. (C)	16.7
Water Velocity (cm/sec)	21.0
Stream Width (m)	2.63
Stream Depth (cm)	7.9
Instream Cover (%)	1.3
Eroding Banks (%)	10
Cobble Embeddedness (%)	50
Major Substrate Type	Sm. R.
Pool/Riffle Ratio	33:66
Periphyton Coverage (%)	5

WEST FORK CLEAR CREEK

West Fork Clear Creek is approximately 8.5 km long and contains 24.3 km of tributary streams. West Fork Clear Creek originates on the north slope of Corral Hill and flows in a northerly direction, discharging into Clear Creek at SK 17.5. Lost Mule Creek and Hoodoo Creek are the major tributaries of West Fork Clear Creek. Lost Mule Creek is 5.0 km in length, contains 2.8 km of tributary streams, and discharges into West Fork Clear Creek at SK 1.0. Hoodoo Creek is 7.1 km in length, contains 4.8 km of tributary streams, and discharges into West Fork Clear Creek at SK 2.7. The West Fork Clear Creek drainage flows entirely within the Nez Perce National Forest. West Fork Clear Creek is located in a steep, forested, mountainous terrain. The stream has a high gradient above SK 0.5 which has prevented passage of anadromous fish (Murphy and Metsker, 1962). A survey conducted by the U.S. Forest Service (1980) did not document the presence of fish above the gradient barrier. Debris is abundant in West Fork Clear Creek causing temporary barriers to fish migration. Livestock grazing and logging have occurred in the upper reaches of West Fork Clear Creek. Access to West Fork Clear Creek is provided by Forest Service Road 650.

A station was established on West Fork Clear Creek at SK 5.4, approximately 100 m above Forest Service Road 650. The stream was typical of the headwater streams; small and shallow in a high narrow valley, with conifers, principally red cedar, lining the stream.

Cutthroat trout, frogs, and crayfish were captured at the West Fork Clear Creek sample station. As in the other cutthroat streams of this study, standing crop was extremely high (Appendix-Table 5). The estimated standing crop of overyearling cutthroat trout was 51.96 kg/ha, with a density of 0.33 fish/m2. Subyearling trout were observed but not captured, due to the inefficiency of the electrofishing equipment to stun the smaller fish (Tables 9 and 10).

Late summer stream flow was 0.03 m3/sec, with moderate variation of annual stream flow. The summer water temperature was 12.2 C, which is within the optimum range for juvenile rainbow-steelhead (Bovee, 1978). Instream cover for overyearling rainbow-steelhead was provided by 4.8% of the total area surveyed. Signs of erosion were observed along 30% of the stream banks. Overall channel stability was poor. During spring runoff, the abundant debris can cause considerable alteration of the stream course. Mean water velocity was 18.4 cm/sec, an optimum velocity for juvenile rainbow-steelhead (Bovee, 1978). The average stream width was 2.04 m. Mean stream depth was 9.0, close to the minimum limit for juvenile rainbow-steelhead (Bovee, 1978). Cobble embeddedness was 50%, limiting steelhead production (Bjornn et al., 1977). The major substrate type was sand, which is a suboptimum substrate size for juvenile rainbow-steelhead (Bovee, 1978). The pool/riffle ratio of 33:66 indicated the prescence of holding area for juvenile salmonids. Pools were formed behind debris jams. The stream gradient at the sample site was moderate. Periphyton covered 10% of the substrate, indicating limited primary production in West Fork Clear Creek. Moss was present in the stream, covering 20% of the available substrate. The riparian habitat was well developed, composed primarily of brush, herbaceous plants, and conifers. Woody debris was abundant in the sample station (Table 11).

Table 9. Rainbow-steelhead trout population statistics of one sample station on West Fork Clear Creek, a tributary of Clear Creek, Idaho, 1984.

Biological Parameter	Units	Station 1 Value
Age 0+ Rainbow-Steelhead		
Density	fish/m^2	0
Standing Crop	kg/ha	0
Mean Weight	gm	0
Mean Length (TL-FL)	mm	0
Age l+ Rainbow-Steelhead		
Density	fish/m^2	0
Standing Crop	kg/ha	0
Mean Weight	gm	0
Mean Length (TL-FL)	mm	0

Table 10. Cutthroat trout population statistics of one sample station on West Fork Clear Creek, a tributary of Clear Creek, Idaho, 1984.

Biological Parameter	Units	Station 1 Value
Age 0+ Cutthroat Trout		CT Present
Density	fish/m^2	
Standing Crop	kg/ha	
Mean Weight	gm	
Mean Length (TL-FL)	mm	
Age 1+ Cutthroat Trout		
Density	fish/m^2	0.33
Standing Crop	kg/ha	51.96
Mean Weight	gm	15.9
Mean Length (TL-FL)	mm	115-110

Table 11. Measured physical parameters of one sample station on West Fork Clear Creek, a tributary of Clear Creek, Idaho, 1984.

Physical Parameter	STATION 1 Value
Station Length (m)	60
Station Area (m2)	122.40
Late Summer Stream flow (m3/sec)	0.03
Annual Stream Flow Variation	Moderate
Summer Temp. (C)	12.2
Water Velocity (cm/sec)	18.4
Stream Width (m)	2.04
Stream Depth (cm)	9.0
Instream Cover (%)	4.8
Eroding Banks (%)	30
Cobble Embeddedness (%)	50
Major Substrate Type	Sand
Pool/Riffle Ratio	33:66
Periphyton Coverage (%)	10

HOODOO CREEK

Hoodoo Creek is approximately 7.1 km long and located within the Nez Perce National Forest. The stream flows in the northeasterly direction to its confluence with West Fork Clear Creek at SK 2.7. Hoodoo Creek contains 4.8 km of tributary streams. The Hoodoo Creek watershed is in a steep, timbered, mountainous terrain. Logging activities, including several clear cuts, have occurred in the Hoodoo Creek watershed. There is an impassable barrier to anadromous fish migration, formed by a 23 m stretch of rock waterfalls, located approximately 1 km from the confluence with West Fork Clear Creek. The entire length of Hoodoo Creek flows through a moderate to high gradient, and, combined with the abundant debris present, causes temporary barriers to fish migration. Access into Hoodoo Creek is limited to foot travel with the exception of Forest Service Roads 650 and 1106.

A sample station was established at SK 1.7, approximately 100 m above Forest Service Road 650. The small, shallow stream flowed through a high narrow, valley and conifers, principally red cedar, lined the stream.

Frogs and crayfish were captured at the sample station.

There were no trout present (Table 12).

Late summer stream flow was 0.04 m3/sec, with moderate annual stream flow variation. The summer water temperature was 11.7 C, which is within the optimum range for rainbow-steelhead. Instream cover for juvenile steelhead was provided by 3.17, of the area surveyed. Bank erosion occurred over 50% of the stream banks within the station. Mean water velocity was 17.5 cm/sec, the optimum velocity for juvenile rainbow-steelhead (Bovee, 1978). The average stream width was 2.95 m. Mean water depth was 7.0 cm, the minimum limit for steelhead production (Bovee, 1978). Cobble embeddedness was 75% and the major substrate type was sand. Both of these substrate components can limit salmonid production (Bjornn et al., 1977). The high sediment levels are attributed to the clear cutting in the Hoodoo Creek watershed (U.S. Forest Service, 1980). There was no periphyton coverage on the substrate, indicating low primary production. However, moss did cover 10% of the available substrate. A pool/riffle ratio of 25:75 Indicated a lack of holding area for juvenile salmonids; the pools formed behind woody debris and boulders. The channel stability was rated as fair. Riparian vegetation consisted of ferns, herbs, and conifers. Shading was provided by both high canopy and overhanging debris (Table 13).

Table 12. Rainbow-steelhead trout population statistics of one sample station on Hoodoo Creek, a tributary of West Fork Clear Creek, Idaho, 1984.

Biological Parameter	Units	Station 1 Value
Age 0+ Rainbow-Steelhead		
Density	$fish/m^2$	0
Standing Crop	kg/ha	0
Mean Weight	gm	0
Mean Length (TL-FL)	mm	0
Age 1+ Rainbow-Steelhead		
Density	$fish/m^2$	0
Standing Crop	kg/ha	0
Mean Weight	gm	0
Mean Length (TL-FL)	mm	0

Table 13. Measured physical parameters of one sample station on Hoodoo Creek, a tributary of West Fork Clear Creek, Idaho, 1984.

Physical Parameter	STATION 1 Value
Station Length (m)	60
Station Area (m2)	177.00
Late Summer Stream flow (m3/sec)	0.04
Annual Stream Flow Variation	Moderate
Summer Temp. (C)	11.7
Water Velocity (cm/sec)	17.5
Stream Width (m)	2.95
Stream Depth (cm)	7.0
Instream Cover (%)	3.1
Eroding Banks (%)	50
Cobble Embeddedness (%)	75
Major Substrate Type	Sand
Pool/Riffle Ratio	25:75
Periphyton Coverage (%)	0

SOUTH FORK CLEAR CREEK

South Fork Clear Creek is a major tributary in the Clear Creek drainage, second only to Clear Creek in flow and total length. South Fork Clear Creek is approximately 15.2 km in length and contains 83.8 km of tributary streams, including Kay Creek and the West Branch of South Fork Clear Creek. The entire drainage is located within the Nez Perce National Forest. South Fork Clear Creek originates on the southwest slope of Baldy Mountain and flows northwesterly, discharging into Clear Creek as SK 18.0. Kay Creek and West Branch of South Fork Clear Creek are the major tributaries of South Fork Clear Creek. Kay Creek is 7.4 km long, contains 16.8 km of tributary streams, and discharges into South Fork Clear Creek at SK 5.0. West Branch of South Fork Clear Creek is 6.7 km long, contains 6.0 km of tributary streams, and discharges into South Fork Clear Creek at SK 10.2. South Fork Clear Creek is located in a heavily timbered, steep, mountainous terrain. The stream gradient is moderate to high. Several debris jams and small rock waterfalls occur throughout the length of South Fork Clear Creek. There is a high content of sediments in the South Fork Clear Creek which is attributed to logging activities in the West Branch of South Fork Clear Creek (Martin, 1976). Martin's (1976) survey determind the presence of rainbow-steelhead and cutthroat trout in the South Fork Clear Creek. Access into this system is limited to foot travel.

One station was established on the South Fork Clear Creek at SK 0.1, just above the confluence with Clear Creek. The sample station was located in a narrow, heavily timbered canyon.

Rainbow-steelhead and paiute sculpin were captured in South Fork Clear Creek. Estimated standing crop of overyearling rainbow-steelhead was 1.51 kg/ha, with a density of 0.01 fish/m2. Only one subyearling rainbow-steelhead was captured (Table 14).

Late summer stream flow was 0.51 m3/sec, with moderate annual stream flow variation. The water temperature was 3.9 C, which approaches the minimum limit for steelhead production (Bovee, 1978). However, the temperature was recorded on September 28th and did not represent maximum summer temperatures. Instream cover was provided by 8.4% of the stream area surveyed. Mean water velocity was 46.2 cm/sec, which is within the optimum velocity range for juvenile rainbow-steelhead (Bovee, 1978). The mean stream width was 5.15 m.

Mean depth was 21.5 cm, which is within optimum range for juvenile rainbow-steelhead (Bovee, 1978). Cobble embeddedness was 75% and the major substrate type was sand. The high values for these substrate parameters can limit steelhead production (Bjornn et al., 1977). Signs of erosion were present along 60% of the stream bank, due primarily to the abundant topsoil along each bank. However, overall channel stability was fair, as the stream was contained within a rather narrow canyon. Periphyton covered 10% of the available substrate, indicating limited primary production. Moss was present on 20% of the exposed substrate and along the stream banks. A pool/riffle ratio of 25:75 indicated a lack of holding area for overyearling rainbow-steelhead. Pools were formed behind boulders and below sharp decreases in stream gradient. The overall gradient for the sample station was moderate. Alders, willows, and herbaceous plants were the primary components of the well developed riparian zone and shaded 30% of the stream (Table 15).

Table 14. Rainbow-steelhead trout population statistics of one sample station on South Fork Clear Creek, a tributary of Clear Creek, Idaho, 1984.

Biological Parameter	Units	Station 1 Value
Age 0+ Rainbow-Steelhead		
Density	fish/m^2	0.003
Standing Crop	kg/ha	0.19
Mean Weight	gm	6.0
Mean Length (TL-FL)	mm	87-83
Age 1+ Rainbow-Steelhead		
Density	fish/m^2	0.01
Standing Crop	kg/ha	1.51
Mean Weight	gm	11.7
Mean Length (TL-FL)	mm	114-108

Table 15. Measured physical parameters of one sample station on South Fork Clear Creek, a tributary of Clear Creek, Idaho, 1984.

Physical Parameter	STATION 1 Value
Station Length (m)	60
Station Area (m2)	309.00
Late Summer Stream flow (m3/sec)	0.51
Annual Stream Flow Variation	Moderate
Summer Temp. (C)	3.9
Water Velocity (cm/sec)	46.2
Stream Width (m)	5.15
Stream Depth (cm)	21.5
Instream Cover (%)	8.4
Eroding Banks (%)	60
Cobble Embeddedness (%)	75
Major Substrate Type	Sand
Pool/Riffle Ratio	25:75
Periphyton Coverage (%)	10

MIDDLE FORK CLEAR CREEK

Middle Fork Clear Creek is approximately 10.1 km long, and including Solo Creek, contains 18.8 km of tributary streams. Middle Fork Clear Creek is located within the Nez Perce National Forest. The stream originates at an elevation of 1770 m and flows in a northwesterly direction, discharging into Clear Creek at SK 21.3. Solo Creek, a primary tributary of this drainage, discharges into Middle Fork Clear Creek at SK 3.0. Solo Creek is 5.3 km in length and contains 5.5 km of tributary streams. Middle Fork Clear Creek flows within a timbered, steep, mountainous terrain. Previous logging activities within the watershed include several clear cuts. Martin (1976) and the U.S. Forest Service (1980) reported several debris jams in Middle Fork Clear Creek just above the confluence with Solo Creek which might act as barriers to anadromous fish migration. However, the U.S. Forest Service (1980) survey reported the presence of rainbow-steelhead above this reach. The overall stream gradient of Middle Fork Clear Creek is moderate to high and access into the stream, with the exception of Forest Service Road 286, is limited to foot travel.

A sample station was established at SK 6.4, below Forest Service Road 9703. The sample section was in a high meadow bordered by steep timbered slopes.

Rainbow-steelhead were the only fish captured in the Middle Fork Clear Creek. Estimated standing crop for overyearling rainbow-steelhead was 9.84 kg/ha, with a density of 0.04 fish/m2. Subyearling rainbow-steelhead standing crop was 2.56 kg/ha, with a density of 0.05 fish/m2 (Table 16).

Late summer stream flow was 0.03 m3/sec, with moderate variation in annual stream flow. Summer water temperature was 11.7 C, which is optimum for rainbow-steelhead production (Bovee, 1978). Instream cover was provided by 1.7% of the total area surveyed. Signs of erosion were present along 25% of the stream banks. Mean water velocity was 14.8 cm/sec, an optimum velocity for juvenile rainbow-steelhead (Bovee,1978). The stream width averaged 3.52 m at low flow. Mean depth was 6.1 cm, which is at the minimum limit for rainbow-steelhead production (Bovee, 1978). Cobble embeddedness was 25%, possibly limiting steelhead production (Bjornn et al., 1977). The major substrate types were large and small rubble, an optimum substrate size for juvenile rainbow-steelhead (Bovee, 1978). The channel stability was fair; however, the channel would be breached under high flows. Stream gradient for the sample station was low to moderate. Pool/riffle ratio was 17:83 indicating limited holding area for juvenile rainbow-steelhead. Pools were formed below debris. Periphyton coverage was zero, indicating poor primary productivity in Middle Fork. Sparse patches of moss were present on 2% of the exposed substrate. Riparian vegetation consisted of ferns, herbaceous plants, and conifers and provided approximately 5% of the stream with shade (Table 17).

Table 16. Rainbow-steelhead trout population statistics of one sample station on Middle Fork Clear Creek, a tributary of Clear Creek, Idaho, 1984.

Biological Parameter	Units	Station 1 Value
Age 0+ Rainbow-Steelhead		
Density	fish/m^2	0.05
Standing Crop	kg/ha	2.56
Mean Weight	gm	5.4
Mean Length (TL-FL)	mm	87-83
Age l+ Rainbow-Steelhead		
Density	fish/m^2	0.04
Standing Crop	kg/ha	9.84
Mean Weight	gm	23.1
Mean Length (TL-FL)	mm	136-129

Table 17. Measured physical parameters of one sample station on Middle Fork Clear Creek, a tributary of Clear Creek, Idaho, 1984.

Physical Parameter	STATION 1 Value
Station Length (m)	60
Station Area (m2)	211.20
Late Summer Stream flow (m3/sec)	0.03
Annual Stream Flow Variation	Moderate
Summer Temp. (C)	11.7
Water Velocity (cm/sec)	14.8
Stream Width (m)	3.52
Stream Depth (cm)	6.1
Instream Cover (%)	1.7
Eroding Banks (%)	25
Cobble Embeddedness (%)	25
Major Substrate Type	Lg/ Sm. R.
Pool/Riffle Ratio	17:83
Periphyton Coverage (%)	0

PINE KNOB CREEK

Pine Knob Creek is approximately 6.5 km in length and contains contains 4.0 km of tributary streams. Pine Knob Creek is located within the Nez Perce National Forest. The stream originates on the southern slopes of Pine Knob Mountain and flows southwesterly, discharging into Clear Creek at SK 25.7. The Pine Knob watershed is in a forested terrain and has been severely impacted by several large clear cuts and logging roads, which have resulted in a high sediment content throughout the drainage. In the uppermost tributaries, logging has occurred right down into the streambed, indicating some extremely poor logging practices. (Martin, 1976, U.S. Forest Service, 1980). Overall stream gradient is moderate. The U.S. Forest Service (1980) and Martin's (1976) survey documented the presence of cutthroat trout and rainbow-steelhead in Pine Knob Creek. Access to Pine Knob Creek, with the exception of Forest Service Road 1114, is limited to foot travel.

A station was established on Pine Knob Creek at SK 4.7, just above Forest Service Road 1114, in a narrow, brushy canyon. Water quality analysis indicated no limitations to salmonid production (Appendix-Table 7).

Cutthroat trout and crayfish were captured on Pine Knob Creek. An unusually high population of cutthroat trout was supported at this sample station (Appendix-Table 5). Estimated juvenile cutthroat trout standing crop was 71.0 kg/ha, with a density of 0.53 fish/m2. Subyearling cutthroat trout were observed but not captured, due to the inefficiency of the electrofishing equipment to stun the smaller fish (Tables 18 and 19).

Late summer stream flow was 0.01 m3/sec, with moderate variation of annual stream flow. Summer water temperature was 12.2 C, which is optimum for juvenile rainbow-steelhead production (Bovee, 1978). Instream cover for juvenile rainbow-steelhead was provided by 2.9% of the stream area surveyed. Erosion of the stream banks was 20% and channel stability was fair. Mean water velocity was 4.8 cm/sec, the minimum limit for juvenile rainbow-steelhead (Bovee, 1978). The average width was 2.78 m. Mean water depth was 7.7 cm, which is close to the minimum limit for juvenile rainbow-steelhead (Bovee, 1978). Cobble embeddedness was 50% and the major substrate type was sand. The high values for these substrate parameters can limit steelhead production (Bjornn et al., 1977). Periphyton coverage was zero, indicating low primary production. Sparse patches of moss covered 5% of the exposed substrate. The pool/riffle ratio of 20:80 indicated a lack of holding area for juvenile salmonids. Generally, pools formed behind debris, but a small, man-made drafting pool was located at the bottom of this sample station. The riparian vegetation was well developed, consisting of alders, herbaceous plants, grasses, and conifers and provided 20% of the stream with shade (Table 20).

Table 18. Rainbow-steelhead trout population statistics of one sample station on Pine Knob Creek, a tributary of Clear Creek, Idaho, 1984.

Biological Parameter	Units	Station 1 Value
Age 0+ Rainbow-Steelhead		
Density	fish/m^2	0
Standing Crop	kg/ ha	0
Mean Weight	gm	0
Mean Length (TL-FL)	mm	0
Age 1+ Rainbow-Steelhead		
Density	fish/m^2	0
Standing Crop	kg/ha	0
Mean Weight	gm	0
Mean Length (TL-FL)	mm	0

Table 19. Cutthroat trout population statistics of one sample station on Pine Knob Creek, a tributary of Clear Creek, Idaho, 1984.

Biological Parameter	Units	Station 1 Value
Age 0+ Cutthroat Trout		CT
Density	fish/m^2	Present
Standing Crop	kg/ha	
Mean Weight	gm	
Mean Length (TL-FL)	mm	
Age l+ Cutthroat Trout		
Density	fish/m^2	0.53
Standing Crop	kg/ha	71.10
Mean Weight	gm	13.4
Mean Length (TL-FL)	mm	117-111

Table 20. Measured physical parameters of one sample station on Pine Knob Creek, a tributary of Clear Creek, Idaho, 1984.

Physical Parameter	STATION 1 Value
Station Length (m)	40
Station Area (m2)	111.20
Late Summer Stream flow (m3/sec)	0.01
Annual Stream Flow Variation	Moderate
Summer Temp. (C)	12.2
Water Velocity (cm/sec)	4.8
Stream Width (m)	2.78
Stream Depth (cm)	7.7
Instream Cover (%)	2.9
Eroding Banks (%)	20
Cobble Embeddedness (%)	50
Major Substrate Type	Sand
Pool/Riffle Ratio	20:80
Periphyton Coverage (%)	0

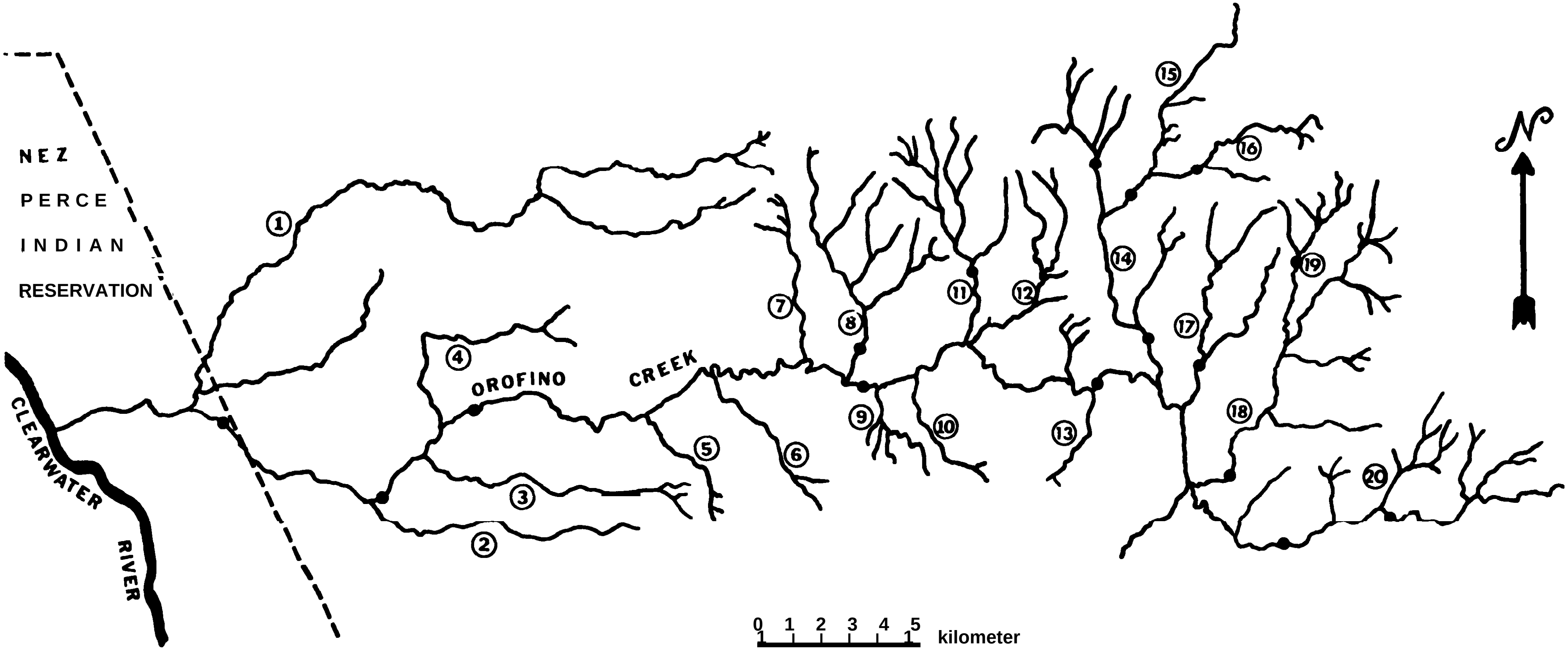
Stream Narrative-Orofino Creek System

OROFINO CREEK

Orofino Creek (Figure 5) is one of the larger tributaries of the lower Clearwater River. Orofino Creek is approximately 82.0 km in length and contains 542 km of tributary streams. Orofino Creek originates on the western slopes of Hemlock Butte and flows westerly, discharging into the Clearwater River at RK 72.4. The town of Orofino, Idaho, is located at the mouth of Orofino Creek.

The upper 35 km of Orofino Creek flows through the Clearwater National Forest. The lower 47 km flow through Potlatch Forest Industries, private, and Idaho State lands. The lower 6.4 km of Orofino Creek are within the Nez Perce Reservation.

Within the Clearwater National Forest, Orofino Creek flows westerly through steep, mountainous terrain. Upon leaving the National Forest boundaries, Orofino Creek turns north and flows through a large valley near Pierce, Idaho. Between Pierce and the Nez Perce Reservation boundary, Orofino Creek flows westerly through a deep, steep sided canyon. From the reservation boundary to the mouth, the creek winds



1. Whiskey Cr.
2. Cook Cr.
3. Cooper Cr.
4. Cedar Cr.
5. Rudo Cr.
6. Bennett Cr.
7. Rainy Cr.
8. Cow Cr.
9. Olson Cr.
10. Placer Cr.
11. Poorman Cr.
12. McCauley Cr.
13. Flat Cr.
14. Quartz 2 Cr.
15. Trail Cr.
16. Little Beaver Cr.
17. Canal Gulch Cr.
18. Rhodes Cr.
19. Shanghai Cr.
20. Rosebud Cr.

• denotes sample station

Figure 5. Map of Orofino Creek, Idaho, indicating sample stations.

through the same basin in which Orofino, Idaho is situated.

Several tributaries enter Orofino Creek throughout the canyon reach. The largest of these, Cow Creek and Poorman Creek, are the only streams which might support significant steelhead production. The other tributaries, Cook Creek, Cooper Creek, Cedar Creek, Rudo Creek, Bennett Creek, Rainy Creek, Olson Creek, and Placer Creek, are of a similar habitat type. They originate on the plateau above the canyon and flow through farmland and cattle pastures. Flow during the summer is reduced and often intermittent. Although these systems were not inventoried, small populations of brook trout might be supported in isolated pockets within the headwaters. The tributaries travel through extreme gradients within Orofino canyon to their confluence with Orofino Creek. A minimal amount of habitat is available at each tributary mouth for rearing of rainbow-steelhead. Providing passage for steelhead into these tributaries is not recommended. Logging is the primary land use activity affecting the canyon reach of Orofino Creek.

The upper Orofino Creek drainage is characterized by timbered slopes and high meadows. This area is impacted by several land use activities. Residences are found throughout the Pierce valley. Logging and timber processing have long supported the community of Pierce. Agricultural activities are limited but extensive livestock grazing occurs within the area. Several recreation sites are also found in the upper Orofino Creek drainage. Tributaries of upper Orofino Creek headwater on the steep surrounding slopes and generally flow through moderate to low gradient meadows to their confluence with the mainstem.

The Idaho Department of Fish and Game stocks upper Orofino Creek annually with catchable size rainbow trout. They have focused their stocking on streams which receive high recreational use, primarily Rhodes Creek and Quartz Creek. Two hatchery reared rainbow trout were captured during the inventory.

A cataract canyon at SK 8.0 prevents passage of anadromous fish into the upper 74 km of Orofino Creek. The cataract 25 m over a distance of 152 m. A second falls, approximately 3.0 m high, is located at SK 30.8 on Orofino Creek. Passage at these falls is possible but should be evaluated in more detail.

With the exception of the Burlington Northern Railroad tracks, access from Orofino to Pierce is limited to a few logging roads. From Pierce to SK 62, access is provided by State Highway 11 and the Hemlock Butte Road.

Several studies have been completed on the lower reach of Orofino Creek. Murphy and Metsker (1962) determined the amount of spawning habitat available to anadromous fish between the mouth of Orofino Creek and the cataract. Mallet (1974) estimated the abundance of spawning gravels, use by sports fishermen, and game fish present in Orofino Creek. The Idaho Department of Health and Welfare (1980) conducted water quality tests at several locations along Orofino Creek and documented high fecal coliform counts below Pierce, Idaho. The U.S. Bureau of Reclamation (1984) determined the amount of habitat available to anadromous fish if passage over the Orofino Creek cataract was provided. Fuller et al., (1984) conducted an inventory on Whiskey Creek, a major tributary to Orofino Creek, for the Nez Perce Tribe. Their results will not be included in this report.

Seven sample stations were established on the mainstem of Orofino Creek; an additional nine stations were established on tributaries to Orofino Creek and will be discussed in their own narratives. Electrofishing techniques were not utilized on four of the lower stations of Orofino Creek, because the size and flow of the mainstem limited the effective use of this method. Therefore, these four lower stations were sampled by snorkeling.

Station #1. Station #1 was established at SK 7.4 and sampled during 1982. Riparian growth was limited and several residences were located near the sample site.

Fish species present at station #1 were rainbow-steelhead, bull trout, kokanee salmon, bridgelip sucker, longnose date, and paiute sculpin. The large stream width within this station reduced the effectiveness of electrofishing; therefore, neither standing crop nor densities were estimated (Table 21 a).

Late summer stream flow was 2.15 m3/sec, with moderate variation in annual flow. Maximum summer water temperature was 22.2 C, which approaches the limit of rainbow-steelhead trout (Bovee, 1978). Water temperature recorded on the sample date, October 12, was 8.9 C. Mean stream velocity was 63.0 cm/sec, greater than the optimum range for juvenile rainbow-steelhead (Bovee, 1978). Stream width averaged 12.42 m. Mean stream depth was 27.5 cm, within the optimum depth range for juvenile rainbow-steelhead (Bovee, 1978). Instream cover for juvenile rainbow-steelhead was provided by 20.6% of the stream area surveyed. Depth and surface turbulence were the primary components of instream cover. Eleven percent of the stream banks were eroded. Overall channel stability was good. The pool/riffle ratio was 20:80, indicating a lack of holding area for juvenile rainbow-steelhead. The major substrate type was small rubble, a slightly suboptimum substrate size for juvenile rainbow-steelhead (Bovee, 1978). Cobble embeddedness was 25%, possibly limiting steelhead production (Bjornn et al., 1977). Periphyton was observed on 65% of the stream substrate, indicating moderate primary production. Riparian habitat was underdeveloped and shaded 30% of the stream section (Table 22 a).

Station #2. Station #2 was established above the confluence of Cook Creek and Orofino Creek at SK 11.7. The station was located in a large flood channel, bordered by steep timbered slopes. The overall gradient at station #2 was low. Overyearling rainbow-steelhead, date, and crayfish were observed in station #2 (Table 21 a).

Late summer stream flow was 1.88 m3/sec, with moderate variation is annual stream flow. Water temperature was 15.0 C, which is optimum for juvenile rainbow-steelhead (Bovee, 1978), but probably does not represent maximum summer water temperature. Mean stream velocity was 42.9 cm/sec, which is within the optimum range for juvenile rainbow-steelhead (Bovee, 1978). Stream width was 12.30 m. Mean depth was 35.7 cm, close to the optimum depth for juvenile rainbow-steelhead (Bovee, 1978). Instream cover, consisting primarily of depth, was provided by 31.6% of the total area surveyed. The channel butted against a rock wall and the floodplain, so no erosion was observed. Overall channel stability was good. Cobble embeddedness was 25%. The major substrate type was large rubble, an optimum substrate size for juvenile rainbow-steelhead (Bovee, 1978). The pool/riffle ratio was 70:30, indicating abundant holding space for juvenile salmonids. The pools formed behind boulders and sharp drops in stream gradient. Periphyton covered 80% of the stream substrate, indicating high primary production. The riparian vegetation was sparse, consisting of a few conifers, alders, grasses, and herbs. Twenty percent of the sample section was shaded (Table 22 a).

Station #3. Station #3 was established above the confluence of Cedar Creek and Orofino Creek at SK 15.4. The station was located in a moderately sized flood channel, confined by a steep, timbered, canyon wall and the embankment supporting railroad tracks. The overall gradient at station #3 was low. One overyearling rainbow-steelhead, date, and sculpin were observed in station #3 (Table 21 a).

Late summer stream flow was 1.85 m3/sec, with moderate variation in annual stream flow. Water temperature was 7.2 C, which is suboptimum for juvenile rainbow-steelhead production (Bovee, 1978). However, the temperature was recorded on September 25, and may not represent maximum summer temperatures. Mean stream velocity was 28.6 cm/sec, within the optimum range for juvenile rainbow-steelhead (Bovee, 1978). Stream width was 13.34 m. Mean depth in late summer was 48.4 cm, within the optimum depth range for juvenile rainbow-steelhead (Bovee, 1978). Instream cover, consisting primarily of depth, was 45.4% of the total area surveyed. Signs of eroding banks were not evident and overall channel stability was good. Cobble embeddedness was 25%. The major substrate type was large rubble, the optimum substrate size for juvenile rainbow-steelhead (Bovee, 1978). There was not a definite division between pool and riffle at station #3; the section was primarily a run with uniform depth. Periphyton was observed on 80% of the stream substrate. Riparian habitat was absent from the sample section (Table 22 a).

Station #4. Station #4 was established above the confluence of Cow Creek and Orofino Creek at SK 30.8. The station was located in a steep sided canyon just below the second falls on Orofino Creek. Water quality analysis indicated no limitations to salmonid production (Appendix-Table 8).

The large plunge pool below the falls was snorkeled. Approximately 10 overyearling rainbow-steelhead, 6 overyearling brook trout, 5 subyearling brook trout, date, and sculpin were observed. Because of excessive depth, measurements of the physical habitat were prevented.

A second station was established just below the plunge pool. Habitat parameters were measured here and snorkeling was used to identify fish. Three overyearling rainbow-steelhead, 4 subyearling rainbow-steelhead, 3 overyearling brook trout, date, and sculpin were observed at this station (Tables 21a and 23a).

Late summer stream flow was 1.35 m3/sec, with moderate variation in annual flow. Water temperature was 14.4 C, which is optimum for juvenile rainbow-steelhead (Bovee, 1978). Mean stream velocity was 81.2 cm/sec, greater than the optimum velocity for juvenile rainbow-steelhead (Bovee, 1978). Stream width was 5.67 m. Mean stream depth was 29.4 cm, within the optimum range for juvenile rainbow-steelhead (Bovee, 1978). Instream cover for juvenile rainbow-steelhead was provided by 15.9% of the total area surveyed. Eroding banks were not observed. The channel was confined within a steep canyon and channel stability was excellent. Cobble embeddedness was 25%. The major substrate type was loose gravel, a slightly suboptimum substrate size for salmonid production (Bovee, 1978). There was not a definite division between pool and riffle at station #4; the section was primarily a run of uniform depth. Periphyton was present on 60% of the substrate, indicating moderate primary production. Grasses and alders provided some riparian habitat and shaded 1% of the stream (Table 22 a).

Station #5. Station #5 was established above the confluence of Flat Creek and Orofino Creek at SK 40.1. The station was bordered by a wide meadow and a steep timbered slope. Orofino Creek was wide, meandering, and slow throughout this section. Five overyearling rainbow-steelhead, 1 subyearling rainbow-steelhead, 3 overyearling brook trout, 2 subyearling brook trout, and date were observed (Tables 21 b and 23 b).

Late summer stream flow was 1.11 m3/sec, with moderate annual flow variation. Summer water temperature was 15.0 C, which is optimum for juvenile rainbow-steelhead production (Bovee, 1978). Stream velocity was 30.9 cm/sec, an optimum velocity for juvenile rainbow-steelhead (Bovee, 1978). Stream width was 10.01 m. Mean stream depth was 35.9 cm, an optimum depth for juvenile rainbow-steelhead (Bovee, 1978). Instream cover for juvenile rainbow-steelhead was provided by 15.9% of the total area surveyed. Depth and undercut banks were the primary components of instream cover. Fifty percent of the stream banks showed signs of erosion. Overall channel stability was fair. Cobble embeddedness was 25%. The major substrate type was small rubble, a slightly suboptimum substrate size for juvenile-steelhead (Bovee, 1978). Pool/riffle ratio was 80:20, indicating available holding area but limited habitat diversity, for juvenile rainbow-stealhead. Periphyton was present on 100% of the substrate, indicating high primary production. The riparian habitat was well developed and consisted of alders, grasses, and herbs. One percent of the stream section was shaded by riparian vegetation (Table 22 b).

Station #6. Station #6 was established just within the Clear-water National Forest boundary at SK 50.5. The lower part of the station was below a series of fast, moderate-sized falls, bordered by a canyon wall and a road embankment. The upper half of the station was in a brushy, riffle-run area. Water quality analysis indicated no limitation to salmonid production (Appendix-Table 9).

Rainbow-steelhead, brook trout, long nose dace, speckled date, and paiute sculpin were captured at station #6. The electrofishing efficiency may have been affected by low conductivity and the deep plunge pools in this station. Estimated standing crop of overyearling rainbow-steelhead was 18.25 kg/ha, with a density of 0.03 fish/m2. No subyearling rainbow-steelhead were captured (Table 21 b). Estimated standing crop of overyearling brook trout was 4.23 kg/ha, with a density of 0.01 fish/m2. No subyearling brook trout were captured (Table 23 b).

Late summer stream flow was 0.45 m3/sec, with moderate variation in annual flow. Summer water temperature was 15.5 C, which is optimum for juvenile rainbow-steelhead production (Bovee, 1978). Mean stream velocity was 38.6 cm/sec, the optimum velocity for juvenile rainbow-steelhead (Bovee, 1978). Stream width was 4.93 m. Mean stream depth was 23.6 cm, within the optimum range for juvenile rainbow-steelhead (Bovee, 1978). Instream cover for juvenile rainbow-steelhead was provided by 9.4% of the stream area surveyed. Surface turbulence and depth were the primary components of instream cover. Five percent of the stream banks showed signs of erosion. Overall channel stability was good. Cobble embeddedness was 25%. The major substrate types were large boulder, large rubble, small rubble, and large gravel, within the optimum substrate size range for juvenile rainbow-steelhead (Bovee, 1978). The pool/riffle ratio was 17:83, indicating a lack of holding area for juvenile rainbow-steelhead. Periphyton was observed on 5% of the stream substrate. Above the series of falls, the riparian habitat was well developed, consisting primarily of alders. Thirty percent of the stream section was shaded by the riparian vegetation (Table 22 b).

Station #7. Station #7 was established above the confluence of Rosebud Creek and Orofino Creek at SK 62.5. The station was located approximately 100 m above Forest Service Road 5170 in a narrow, brushy valley, bordered by steep, timbered slopes. Water quality analysis indicated no limitations to salmonid production (Appendix-Table 10).

The electrofishing equipment was ineffective in this section, possibly due to the low conductivity of the water. However, rainbow-steelhead and brook trout were observed (Table 21 b and 23 b).

Late summer stream flow was 0.44 m3/sec, with moderate annual flow variation. Summer water temperature was 13.9 C, which is optimum for juvenile rainbow-steelhead (Bovee, 1978). Mean stream velocity was 43.8 cm/sec, within optimum velocity range for juvenile rainbow-steelhead (Bovee, 1978). Stream width was 4.87 m. Mean stream depth was 17.1 cm, slightly suboptimum for juvenile rainbow-steelhead (Bovee, 1978). Instream cover was provided by 5.6% of the total area surveyed. Overhanging vegetation and surface turbulence were the primary components of instream cover. Eroding banks were not evident. Overall channel stability was good. The average gradient was low to moderate. Cobble embeddedness was OS,, allowing for high steelhead production (Bjornn et al., 1977). The major substrate type was large rubble, an optimum substrate size for juvenile steelhead production (Bovee, 1978). The pool/riffle ratio was 50:50, indicating available holding area and good habitat diversity for juvenile rainbow-steelhead. Pools formed below debris, boulders, and sharp drops in gradient. Five percent of the substrate was covered with periphyton. The riparian habitat was well developed, consisting of alders, herbs, grasses, and some conifers. Approximately 30% of the stream was shaded (Table 22b).

Table 21 (A). Rainbow-steelhead population statistics of seven stations on Orofino Creek, a tributary of the Clearwater River, Idaho, 1982, 1984.

Biological Parameter	hits	Station 1 Value	Station 2 Value	Station 3 Value	Station 4 Value
Age 0+ Rainbow-Steelhead		RB Present			RB Present
Density	fish/m^2		0	0	
Standing Crop	kg/ha		0	0	
Mean Weight	SK		0	0	
Mean Length (TL-FL)	mm		0	0	
Age 1+ Rainbow-Steelhead		RB Present	RB Present	RB Present	RB Present
Density	fish/m^2				
Standing Crop	kg/ha				
Mean Weight	gm				
Mean Length (TL-FL)	mm				

Table 21(B). Rainbow-steelhead trout population statistics of seven sample stations on Orofino Creek, a tributary of the Clearwater River, Idaho, 1982, 1984.

Biological Parameter	Units	Station 5 Value	Station 6 Value	Station 7 Value
Age 0+ Rainbow-Steelhead		RB		RB
Density	fish/m^2	PreSent	0	Present
Standing Crop	kg/ha		0	
Mean Weight	gm		0	
Mean Length (TL-FL)	mm		0	
Age 1+ Rainbow-Steelhead		RB		RB
Density	fish/m^2	PreSent	0.03	Pre8ent
Standing Crop	kg/ha		18.25	
Mean Weight	gm		20.0	
Mean Length (TL-FL)	mm		154-146	

Table 22 (A). Measured physical parameters of seven sample stations on Orofino Creek, a tributary of the Clearwater River, Idaho, 1982, 1984.

Physical Parameter	STATION 1 Value	2 Value	3 Value	4 Value
Station Length (m)	81	55	50	65
Station Area (m2)	1006.02	676.50	667.00	368.55
Late Summer Stream Flow (m3/sec)	2.15	1.88	1.85	1.35
Annual Stream Flow Variation	Moderate	Moderate	Moderate	Moderate
Summer Temp. (C)	22.2	15.0	7.2	14.4
Water Velocity (cm/sec)	63.0	42.9	28.6	81.2
Stream Width (m)	12.42	12.30	13.34	5.67
Stream Depth (cm)	27.5	35.7	48.4	29.4
Instream Cover (%)	20.6	31.6	45.4	15.9
Eroding, Ranks (%)	11	0	0	0
Cobble Embeddedness m	25	25	25	25
Major Substrate Type	Sm. R.	Lg. R.	Lg. R.	Gr.
Pool/Riffle Ratio	20:80	70:30	Run	Run
Periphyton Coverage (%)	65	80	80	60

Table 22 (B). Measured physical parameters of seven sample stations on Orofino Creek, a tributary of the Clearwater River, Idaho, 1982, 1984.

Physical Parameter	STATION 5 Value	STATION 6 Value	STATION 7 Value
Station Length (m)	94	70	80
Station Area (m2)	940.94	345.10	339.60
Late Summer Stream Flow (m3/sec)	1.11	0.45	0.44
Annual Stream Flow Variation	Moderate	Moderate	Moderate
Summer Temp. (C)	15.0	15.5	13.9
Water Velocity (cm/s)	30.9	38.6	43.8
Stream Width (m)	10.01	4.93	4.87
Stream Depth (cm)	35.9	23.6	17.1
Instream Cover (%)	15.9	9.4	5.6
Eroding Banks (%)	50	5	0
Cobble Embeddedness (%)	25	25	0
Major Substrate Type	Sm. R.	Lg/B., 9 Lg.B.Gr.	Lg.R.
Pool/Riffle Ratio	80:20	17:83	50:50
Periphyton Coverage (%)	100	5	5

Table 23 (A). Brook trout population statistics of seven stations on Orofino Creek, a tributary of the Clearwater River, Idaho, 1982, 1984.

Biological Parameter	Units	Station 1 Value	Station 2 Value	Station 3 Value	Station 4 Value
Age 0+ Brook Trout					
Density	fish/m^2	0	0	0	0
Standing Crop	kg/ha	0	0	0	0
Mean Weight	gm	0	0	0	0
Mean Length (TL-FL)	mm	0	0	0	0
Age 1+ Brook Trout					
Density	fish/m^2	0	0	0	0
Standing Crop	kg/ha	0	0	0	0
Mean Weight	gm	0	0	0	0
Mean Length (TL-FL)	mm	0	0	0	0

Table 23 (B). Brook trout population statistics of seven sample stations on Orofino Creek, a tributary of the Clearwater River, Idaho, 1982, 1984.

Biological Parameter	Units	Station 5 Value	Station 6 Value	Station 7 Value
Age 0+ Brook Trout		BT		BT
Density	$fish/m^2$	Present	0	Present
Standing Crop	kg/ha		0	
Mean Weight	gm		0	
Mean Length (TL-FL)	mm		0	
Age l+ Brook Trout		BT		BT
Density	$fish/m^2$	Present	0.01	Present
Standing Crop	kg/ha		4.23	
Mean Weight	gm		29.2	
Mean Length (TL-FL)	mm		145-138	

COW CREEK

Cow Creek is approximately 9.7 km long, contains 32.0 km of tributary streams, and is located on private, Idaho State, and Potlatch Forest Industries land. The stream originates on the southeast slope of Democrat Mountain and flows southeasterly, discharging into Orofino Creek at SK 29.7.

Upper Cow Creek provides only a limited amount of habitat for salmonids. Cow Creek flows through a wide meadow from its origin to State Highway 11. Heavy grazing has resulted in a reduced riparian zone, high water temperatures, and a high sediment load. In addition, a few stock tanks interrupt stream flow. Logging activities in the upper Cow Creek basin have also contributed to reducing the potential salmonid rearing area.

Below State Highway 11, stream conditions are more favorable to salmonid production. The stream gradient increases, providing more pool-riffle area and the lower reach is not as severely affected by livestock. However, a logging road parallels the stream, which adds to the sediment load and diminishes some riparian habitat.

Nelson Creek, Bargamain Creek, and Harvey Creek are the major tributaries to Cow Creek. Nelson Creek is 4.3 km long, contains 1 km of tributary streams, and discharges into Cow Creek at SK 2.3. Bargamain Creek is 4.0 km long, contains 4.7 km of tributary streams, and discharges into Cow Creek at SK 3.3. Harvey Creek is 4.0 km long, contains 0.7 km of tributary streams, and discharges into Cow Creek at SK 5.0.

All three major tributaries are heavily impacted by logging activities. Logging debris often chokes flow within the streams. Road building has severely reduced the riparian habitat and added to sediment load. Rearing habitat prior to logging was probably limited by low flow, but is reduced even more by the present logging activities.

A sample station was established on Cow Creek at SK 1.0, below Cow Creek Road. The Cow Creek station was narrow, brushy, and bordered by sparsely timbered slopes. Debris was abundant in the sample station.

Rainbow-steelhead, brook trout, paiute sculpin, and crayfish were captured in Cow Creek. Estimated standing crop of overyearling rainbow-steelhead was 22.37 kg/ha, with a density of 0.08 fish/m2. Subyearling rainbow-steelhead standing crop was 3.12 kg/ha, with a density of 0.04 fish/m2 (Table 24). Estimated standing crop of overyearling brook trout was 2.00 kg/ha, with a density of 0.01 fish/m2 (Table 25).

Of the streams sampled during 1984, Cow Creek rated sixth in standing crop of both subyearling and overyearling rainbow-steelhead (Appendicies Table 1 and 2). Although these fish were probably resident rainbow trout, since Cow Creek is above Orofino Falls, no distinction between the two strains of trout was noted. The sample section was covered with a thick riparian canopy which, in all likelihood, offered the greatest cover for these salmonids; compensating for lack of instream cover, pool habitat, and shallow mean depth.

Late summer stream flow was 0.04 m3/sec, with moderate variation of annual stream flow. Summer water temperature was 15.0 C, which is optimum for juvenile rainbow-steelhead (Bovee, 1978). Mean water velocity was 12.2 cm/sec, within the optimum velocity range for juvenile steelhead (Bovee, 1978). The average stream width at low flow was 2.93 m. Mean water depth was 10.4 cm, approaching the minimum level for juvenile steelhead production (Bovee, 1978).

Instream cover for juvenile rainbow-steelhead was provided by 8.3% of the total area surveyed. Submerged rocks and debris were the primary components of instream cover. Eroding banks were not apparent, as the riparian growth provided firm bank structure. The channel stability was fair. Cobble embeddedness was 50%, which is limiting to steelhead production (Bjornn et al., 1977). The major substrate types were large and small rubble, the optimum substrate size for juvenile rainbow-steelhead (Bovee, 1978). The pool/riffle ratio was 20:80, indicating a lack of holding area for juvenile rainbow-steelhead. Pools were formed below debris jams. Periphyton covered 25% of the substrate, indicating low to moderate primary production. Moss was present on all of the exposed stream substrate. The well developed riparian habitat consisted of alders, willows, herbaceous plants, and grasses. One hundred percent of the stream was shaded by the low to intermediate canopy (Table 26).

TAble 24. Rainbow-Steelhead trout population statistics of one sample station on Cow Creek, a tributary of Orofino Creek, Idaho, 1984.

Biological Parameter	Units	Station 1 Value
Age 0+ Rainbow-Steelhead		
Density	fish/m^2	0.04
Standing Crop	kg/ha	3.12
Mean Weight	gm	7.8
Mean Length (TL-FL)	mm	94-89
Age l+ Rainbow-Steelhead		
Density	fish/m^2	0.08
Standing Crop	kg/ha	22.27
Mean Weight	gm	26.1
Mean Length (TL-FL)	mm	149-141

Table 25. Brook trout population statistics of one sample station on Cow Creek, a tributary of Orofino Creek, Idaho, 1984.

Biological Parameter	Units	Station 1 Value
Age 0+ Brook Trout		
Density	fish/m^2	0
Standing Crop	kg/ha	0
Mean Weight	gm	0
Mean Length (TL-FL)	mm	0
Age 1+ Brook Trout		
Density	fish/m^2	0.01
Standing Crop	kg/ha	2.00
Mean Weight	gm	35.0
Mean Length (TL-FL)	mm	167-161

Table 26. Measured physical parameters of one sample station on Cow Creek, a tributary of Orofino Creek, Idaho, 1984.

Physical Parameter	STATION 1 Value
Station Length (m)	60
Station Area (m2)	175.80
Late Summer Stream flow (m3/sec)	0.04
Annual Stream Flow Variation	Moderate
Summer Temp. (C)	15.0
Water Velocity (cm/sec)	12.2
Stream Width (m)	2.93
Stream Depth (cm)	10.4
Instream Cover (%)	8.3
Eroding Banks (%)	0
Cobble Embeddedness (%)	50
Major Substrate Type	Lg/Sm. R.
Pool/Riffle Ratio	20:80
Periphyton Coverage (%)	25

creek appears to be restored to its natural condition.

Late summer stream flow was 0.06 m3/sec, with moderate variation in annual stream flow. Summer water temperature was 14.4 C, which is optimum for juvenile rainbow-steelhead production (Bovee, 1978). Mean water velocity was 26.7 cm/sec, an optimum velocity for juvenile rainbow-steelhead (Bovee, 1978). The average stream width at low flow was 3.05 m. Mean water depth was 7.4 cm, approaching the minimum limit for juvenile steelhead (Bovee, 1978). Instream cover for juvenile rainbow-steelhead was provided by 1.4% of the stream area surveyed. Surface turbulence was the primary component of instream cover. Fifty percent of the banks showed signs of erosion. The channel stability was fair. Cobble embeddedness was 50%, which can limit steelhead production (Bjornn et al., 1977). The major substrate type was small rubble, a slightly suboptimum substrate size for juvenile rainbow-steelhead (Bovee, 1978). The pool/riffle ratio of 33:66 indicated that holding might be limiting for juvenile rainbow-steelhead. Pools formed below debris jams and sharp decreases in gradient. Periphyton was not observed in the stream, indicating low primary production. However, moss covered 60%, of the exposed substrate. The riparian habitat was well developed and consisted of alders, herbaceous plants, and conifers. The low canopy provided 40% of the stream with shade (Table 29).

Table 27. Rainbow-steelhead trout population statistics of one sample station on Poorman Creek, a tributary of Orofino Creek, Idaho, 1984.

Biological Parameter	Units	Station 1 Value
Age 0+ Rainbow-Steelhead		
Density	fish/m^2	0.13
Standing Crop	kg/ha	1.13
Mean Weight	P	0.9
Mean Length (TL-FL)	mm	50-48
Age l+ Rainbow-Steelhead		
Density	fish/m^2	0.09
Standing Crop	kg/ha	24.90
Mean Weight	P	26.8
Mean Length (TL-FL)	mm	139-132

POORMAN CREEK

Poorman Creek is approximately 8.3 km in length and contains 34.3 km of tributary streams. The Poorman Creek drainage flows through private, Idaho State, and Potlatch Forest Industry owned lands. Poorman Creek originates on the southern slope of Bald Mountain and discharges into Orofino Creek at SK 34.3. McCauley Creek and Hay Creek are the major tributaries to Poorman Creek. McCauley Creek is 8.0 km long, contains 9.7 km of tributary streams, and discharges into Poor-man Creek at SK 0.7. Hay Creek is 4.7 km long, contains 2.0 km of tributary streams, and discharges into Poorman Creek at SK 3.0. Campbells Pond, a recreation pond administered by the Potlatch Forest Industries, is located on Hay Creek at SK 2.0, and is an impassable barrier to anadromous fish migration. The Idaho Department of Fish and Game stocks catchable size rainbow trout in Campbells Pond. Poorman Creek flows through a timbered, hilly terrain. The Poorman Creek watershed is used extensively for logging, and livestock graze in the upper reaches of the stream. The overall gradient of Poorman Creek is moderate. Access to Poorman Creek is limited. There are logging roads above Poorman Creek but they're subject to closure upon completion of the logging contract.

A sample station was established on Poorman Creek at SK 2.7. The narrow, brushy creek was bordered by steep hills. The western slope was extensively logged and the eastern slope was timbered. The Poorman Creek sample section was relatively free of debris.

Rainbow-steelhead and brook trout were captured in Poorman Creek. Estimated standing crop of overyearling rainbow-steelhead was 24.90 kg/ha, with a density of 0.09 fish/m2. Subyearling rainbow-steelhead standing crop was 1.13 kg/ha, with a density of 0.13 fish/m2 (Table 27). Overyearling brook trout standing crop was estimated at 7.67 kg/ha, with a density of 0.05 fish/m2. Estimated subyearling brook trout standing crop was 2.80 kg/ha, with a density of 0.10 fish/m2 (Table 28).

Poorman Creek provided a relatively unaltered habitat for salmonid production. Standing crop of overyearling rainbow-steelhead was ranked fifth (Appendix-Table 1) and standing crop of subyearling rainbow-steelhead ranked eighth (Appendix-Table 2) of the streams sampled during 1984. Standing crop of overyearling brook trout ranked sixth (Appendix-Table 3) and subyearling standing crop ranked fourth (Appendix-Table 4) of the 13 sample stations where brook trout were present. Although Poorman Creek has been subject to intensive logging, old logging roads are now revegetated and present road construction is kept far above the streambed. The

Table 28. Brook trout population statistics of one sample station on Poorman Creek, a tributary of Orofino Creek, Idaho, 1984.

Biological Parameter	Units	Station 1 Value
Age 0+ Brook Trout		
Density	fish/m^2	0.10
Standing Crop	kg/ ha	2.80
Mean Weight	gm	2.7
Mean Length (TL-FL)	mm	75-72
Age 1+ Brook Trout		
Density	fish/m^2	0.05
Standing Crop	kg/ha	7.67
Mean Weight	gm	15.6
Mean Length (TL-FL)	mm	121-114

Table 29. Measured physical parameters of one sample station on Poorman Creek, a tributary of Orofino Creek, Idaho, 1984.

Physical Parameter	STATION 1 Value
Station Length (m)	60
Station Area (m2)	183.00
Late Summer Stream flow (m3/sec)	0.06
Annual Stream Flow Variation	Moderate
Summer Temp. (C)	14.4
Water Velocity (cm/sec)	26.7
Stream Width (m)	3.05
Stream Depth (cm)	7.4
Instream Cover (%)	1.4
Eroding Banks (%)	50
Cobble Embeddedness (%)	50
Major Substrate Type	Sm. R.
Pool/Riffle Ratio	33:66
Periphyton Coverage (%)	0

QUARTZ CREEK

Quartz Creek, one of the major tributaries of Orofino Creek, is approximately 12.0 km in length and contains 57.9 km of tributary streams. The Quartz Creek drainage flows through private, National Forest, Idaho State, and Potlatch Forest Industries lands. Quartz Creek flows southeasterly from its origin in the Bald Mountain area to its confluence with Orofino Creek at SK 42.5.

Three Mile Creek and Trail Creek are the principal tributaries to Quartz Creek. Three Mile Creek is 4.0 km in length, contains 0.7 km of tributary streams, and discharges into Quartz Creek at SK 2.0. Trail Creek is 6.3 km long and contains 26.8 km of tributary streams. The Trail Creek system is typical of upper Orofino Creek streams, arising on steep slopes and flowing through wetland meadows.

Generally, Quartz Creek flows through a high meadow terrain. From its origin to the Hollywood turnoff, the creek flows through a relatively wide meadow. The creek is typical of these meadows; it is lined with brush, moving slowly and meandering frequently, and debris is abundant within the stream channel. From the Hollywood turnoff to SK 3.0, Quartz

Creek flows through a high use area. Jaype Mill, a plywood plant operated by Potlatch Forest Industries, and a loading dock for Burlington Northern Railroad are situated in this meadow. This stretch is impacted by heavy traffic both into the mill and beside the creek. Riparian growth has been reduced and the stream carries a high sediment load. From SK 3.0 to the mouth, Quartz Creek flows through a moderate gradient, narrow canyon reach. Riparian growth is again well developed but interrupted by the road paralleling the stream. All of Quartz Creek receives some fishing pressure, as access is provided along its whole length by State Highway 11 and the Bald Mountain Ski Area Road. Burlington Northern Railroad tracks also follow most of the Quartz Creek and Trail Creek systems.

Two stations were established on Quartz Creek proper and two on tributaries to Quartz Creek. The stations on Quartz Creek were representative of the lower canyon reach and the upper high meadow area.

Station #l. Station #l was located at SK 2.7, bordered by a steep timbered west slope and State Highway 11. Water quality analysis indicated no limitation to salmonid production (Appendix-Table 11).

Rainbow-steelhead, brook trout, long nose date, and paiute sculpin were captured at this station. Estimated standing crop of overyearling rainbow-steelhead was 2.43 kg/ha, with a density of 0.02 fish/m2. No subyearling rainbow-steelhead were captured (Table 30). Estimated standing crop of juvenile brook trout was 25.19 kg/ha, with a density of 0.06 fish/m2. One subyearling brook trout was captured (Table 31).

This stream section appeared to offer abundant salmonid habitat, which was not reflected by the standing crop of rainbow-steelhead trout. Ample pool habitat and instream cover were available. Primary production was high as the sample station was downstream of the logging mill, and released effluents undoubtadly enriched the stream. Standing crop of overyearling brook trout ranked third of the 13 sample stations where brook trout were present (Appendix-Table 3). But standing crop of overyearling rainbow-steelhead, presumably resident fish, ranked seventeenth of the streams sampled in 1984 (Appendix-Table 1). The station was located by a roadside turnoff and low standing crop of rainbow-steelhead could be related to the moderate fishing pressure received at this particular site.

Late summer stream flow was 0.23 m2/sec, with moderate variation of annual flow. Summer water temperature was 19.4 C, which is greater than the optimum for juvenile steelhead production (Bovee, 1978). Mean water velocity was 37.6 cm/sec, an optimum velocity for rainbow-steelhead (Bovee, 1978). Stream width at low flow was 3.90 m. Mean depth was 16.3 cm, which is suboptimum for juvenile rainbow-steelhead (Bovee, 1578). Instream cover for juvenile rainbow-steelhead was provided by 14.1% of the total area surveyed. The stream banks showed no signs of erosion. Overall channel stability was good at station #1. Cobble embeddedness was 75%, which is limiting to steelhead production (Bjornn et al., 1977). Major substrate types were large rubble, small rubble, and large gravel, a slightly suboptimum substrate size for juvenile rainbow-steelhead (Bovee, 1978). The pool/ riffle ratio of 50:50 indicated available holding area for juvenile rainbow-steelhead. Pools were formed below boulders. Periphyton was evident on 80% of the stream substrate, indicating high primary production. Mosses were found on 10% of the exposed stream substrate and stream banks. The riparian vegetation consisted of sumac, alders, grasses, and herbaceous plants and shaded 15% of the stream channel (Table 32).

Station #2. Station #2 on Quartz Creek was established at SK 10.0, located in a meadow above the Bald Mountain Road turnoff. Brook trout and paiute sculpin were captured at station #2. Estimated standing crop of overyearling brook trout was 65.31

kg/ha, with a density of 0.25 fish/m2. Standing crop of subyearling brook trout was 2.29 kg/ha, with a density of 0.19 fish/m2 (Table 30 and 31).

Apparently, upper Quartz Creek contains very productive brook trout habitat. Although no large adults were found and spawning gravels were minimal, juvenile brook trout were abundant in this section. Standing crop of overyearling brook trout ranked second (Appendix-Table 3) and standing crop of subyearlings ranked fifth (Appendix-Table 4) of the 13 sample stations where brook trout were present. Much of the stream was sheltered by grasses and riparian growth, which offered ample cover for the char. Underseeding, competition, or limits of the physical habitat might have prevented rainbow-steelhead from occupying this area.

Late summer stream flow was 0.03 m3/sec, with moderate variation of annual flow. Summer water temperature was 13.3 C, optimum for rainbow-steelhead production (Bovee, 1978). Mean water velocity was 10.4 cm/sec, which is suboptimum for juvenile rainbow-steelhead (Bovee, 1978). Stream width was 1.24 m. Mean depth was 19.9 cm, within the optimum range for juvenile rainbow-steelhead (Bovee, 1978). Instream cover for juvenile rainbow-steelhead was provided by 14.0% of the stream area surveyed. Depth and overhanging vegetation were the principal components of instream cover. Erosion was present along 20% of the stream banks. Overall channel stability was fair. The major substrate type was sand, a suboptimum substrate size for juvenile rainbow-steelhead (Bovee, 1978). The low gradient stream meandered slowly, never forming a distinct pool-riffle section. Periphyton was not observed, indicating low primary production. Sparse patches of moss were present on the exposed stream debris. The riparian habitat consisted of grasses, herbaceous plants, and alders, and shaded 85% of the stream (Table 32).

Table 30. Rainbow-steelhead trout population statistics of two sample stations on Quartz Creek, a tributary of Orofino Creek, Idaho, 1984.

Biological Parameter	Units	Station 1 Value	Station 2 Value
Age 0+ Rainbow-Steelhead			
Density	$fish/m^2$	0	0
Standing Crop	kg/ha	0	0
Mean Weight	gm	0	0
Mean Length (TL-FL)	mm	0	0
Age l+ Rainbow-Steelhead			
Density	$fish/m^2$	0.02	0
Standing Crop	kg/ha	2.43	0
Mean Weight	gm	14.2	0
Mean Length (TL-FL)	mm	117-111	0

Table 31. Brook trout population statistics of two sample stations on Quartz Creek, a tributary of Orofino Creek, Idaho, 1984.

Biological Parameter	Units	Station 1 Value	Station 2 Value
Age 0+ Brook Trout			
Density	$fish/m^2$	0.003	0.19
Standing Crop	kg/ha	NA	2.29
Mean Weight	gm	NA	1.2
Mean Length (TL-FL)	mm	38-37	51-49
Age 1+ Brook trout			
Density	$fish/m^2$	0.06	0.25
Standing Crop	kg/ha	25.19	65.31
Mean Weight	gm	42.1	26.2
Mean Length (TL-FL)	mm	159-152	140-134

Table 32. Measured physical parameters of two sample stations on Quartz Creek, a tributary of Orofino Creek, Idaho, 1984.

Physical Parameter	STATION 1 Value	STATION 2 Value
Station Length (m)	60	55
Station Area (m2)	234.00	68.20
Late Summer Stream flow (m3/sec)	0.23	0.03
Annual Stream Flow Variation	Moderate	Moderate
Summer Temp. (C)	19.4	13.3
Water Velocity (cm/s)	37.6	10.4
Stream Width (m)	3.90	1.24
Stream Depth (cm)	16.3	19.9
Instream Cover (%)	14.1	14.0
Eroding Banks (%)	0	20
Cobble Embeddedness (%)	75	Sand
Major Substrate Type	Lg./Sm. R., Gr.	Sand
Pool/Riffle Ratio	50:50	Run
Periphyton Coverage (%)	80	0

TRAIL CREEK

Trail Creek is approximately 7.7 km in length, contains 26.8 km of tributary streams, and flows through private, National Forest, Idaho State, and Potlatch Forest Industries lands. Trail Creek originates at an elevation of 1162 m and flows southwesterly, discharging into Quartz Creek at SK 6.7. Little Beaver Creek, the major tributary of Trail Creek, is 7.2 km long, contains 17.3 km of tributary streams, and discharges into Trail Creek at SK 2.0. Trail Creek flows primarily through high meadow terrain. The Trail Creek basin is used for livestock grazing and logging access. Burlington Northern railroad tracks parallel most of the stream length of. The overall gradient of Trail Creek is low.

One station was established on Trail Creek at SK 1.0. Dense riparian growth edged the Trail Creek station. The station was bordered by a sparsely timbered southern slope and the Trail Creek meadow. Water quality analysis indicated no limitation to salmonid production (Appendix-Table 12).

Rainbow-steelhead, brook trout, longnose date, and paiute sculpin were captured at the Trail Creek station. Estimated standing crop of juvenile rainbow-steelhead was 2.98 kg/ha, with a density of 0.01 fish/m2. No subyearling rainbow-steelhead were captured (Table 33). Estimated standing crop of overyearling brook trout was 13.74 kg/ha, with a density of 0.03 fish/m2. Standing crop of subyearling brook trout was estimated at 0.44 kg/ha, with a density of 0.02 fish/m2 (Table 34).

The fish population of Trail Creek was typical of the upper Orofino Creek drainage; predominantly brook trout with a few rainbow-steelhead. Standing crop of overyearling brook trout ranked fourth (Appendix-Table 3) and standing crop of subyearlings ranked sixth (Appendix-Table 4) of the 13 sample stations containing brook trout. Standing crop of overyearling rainbow-steelhead ranked sixteenth of the streams sampled in 1984 (Appendix-Table 1).

Late summer stream flow was 0.07 m3/sec, with moderate variation in annual flow. Summer water temperature was 16.7 C, within optimum range for juvenile rainbow-steelhead (Bovee, 1978). Mean stream velocity was 9.6 cm/sec, slightly suboptimum for juvenile rainbow-steelhead (Bovee, 1978). Stream width at low flow averaged 3.80 m. Mean stream depth was 18.9 cm, which is less than the preferred depth of juvenile rainbow-steelhead (Bovee, 1978). Instream cover for juvenile rainbow-steelhead was provided by 7.2% of the stream area surveyed. Surface turbulence, overhanging vegetation, and depth were the primary components of instream cover. Fifty percent of the stream banks were eroded. Overall channel stability was fair. Cobble embeddedness was 50%, limiting production of steelhead (Bjornn et al., 1977). The major substrate type was sand, a suboptimum substrate size for juvenile rainbow-steelhead (Bovee, 1978). Pool/riffle ratio was 33:66, providing holding area for juvenile rainbow-steelhead. Although periphyton was not observed, moss was present on 15% of the available substrate. The riparian habitat was well developed and consisted of herbs, grasses, alders, and a few conifers (Table 35).

Table 33. Rainbow-steelhead trout population statistics of one sample station on Trail Creek, a tributary of Quartz Creek, Idaho, 1984.

Biological Parameter	Units	Station 1 Value
Age 0+ Rainbow-Steelhead		
Density	fish/m^2	0
Standing Crop	kg/ha	0
Mean Weight	gm	0
Mean Length (TL-FL)	mm	0
Age l+ Rainbow-Steelhead		
Density	fish/m^2	0.01
Standing Crop	kg/ha	2.98
Mean Weight	gm	34.0
Mean Length (TL-FL)	mm	140-136

Table 34. Brook trout population statistics of one sample station on Trail Creek, a tributary of Quartz Creek, Idaho, 1984. .

Biological Parameter	Units	Station 1 Value
Age 0+ Brook Trout		
Density	fish/m^2	0.02
Standing Crop	kg/ha	0.44
Mean Weight	gm	2.5
Mean Length (TL-FL)	mm	52-50
Age 1+ Brook Trout		
Density	fish/m^2	0.03
Standing Crop	kg/ha	13.74
Mean Weight	gm	52.2
Mean Length (TL-FL)	mm	149-143

Table 35. Measured physical parameters of one sample station on Trail Creek, a tributary of Quartz Creek, Idaho, 1984.

Physical Parameter	STATION 1 Value
Station Length (m)	60
Station Area (m2)	228.00
Late Summer Stream flow (m3/sec)	0.07
Annual Stream Flow Variation	Moderate
Summer Temp. (C)	16.7
Water Velocity (cm/sec)	9.6
Stream Width (m)	3.80
Stream Depth (cm)	18.9
Instream Cover (%)	7.2
Eroding Banks (%)	50
Cobble Embeddedness (%)	50
Major Substrate Type	Sand
Pool/Riffle Ratio	33:66
Periphyton Coverage (%)	0

LITTLE BEAVER CREEK

Little Beaver Creek is approximately 7.2 km in length, contains 17.3 km of tributary streams, and flows through Idaho State and Potlatch Forest Industry lands. Little Beaver Creek originates at an elevation of 1383 m and flows southwesterly, discharging into Trail Creek at SK 2.3. Trapper Creek, the major tributary of Little Beaver Creek, is 2.7 kilometers long and contains 3.7 kilometers of tributary streams. Little Beaver Creek flows through a steep narrow valley and high meadow terrain. The watershed is used for logging and livestock grazing. The overall gradient of Little Beaver Creek is moderate.

One station was established on Little Beaver Creek at SK 1.0, in a narrow meadow, bordered by sparsely timbered slopes. Brook trout and paiute sculpin were captured at the Little Beaver Creek station. Estimated standing crop of overyearling brook trout was 11.27 kg/ha (Table 36) and ranked fifth (Appendix-Table 3) of the 13 sample stations containing brook trout. No subyearling brook trout were captured (Table 37).

Low summer stream flow was 0.04 m3/sec, with moderate variation in annual flow. Summer water temperature was 16.1 C, which is optimum for juvenile rainbow-steelhead (Bovee, 1978). The water velocity was 8.8 cm/sec, less than optimum for juvenile rainbow-steelhead (Bovee, 1978). Stream width at low flow was 3.53 m. Mean stream depth was 12.8 cm, a suboptimum depth for juvenile rainbow-steelhead (Bovee, 1978). Instream cover for juvenile rainbow-steelhead was provided by 11.5% of the total area surveyed. Surface turbulence and depth were the primary components of instream cover. Five percent of the stream banks showed signs of erosion and overall channel stability was good. Cobble embeddedness was 25%. The major substrate type was small rubble, a slightly suboptimum substrate size for juvenile rainbow-steelhead (Bovee, 1978). The pool/riffle ratio was 25:75, indicating limited holding area for juvenile rainbow-steelhead. Although periphyton was not observed, moss was present on 80% of the exposed substrate. The riparian habitat was well developed and shaded 5% of the stream (Table 38).

Table 36. Brook trout population statistics of one sample station on Little Beaver Creek, a tributary of Trail Creek, Idaho, 1984.

Biological Parameter	Units	Station 1 Value
Age 0+ Brook Trout		
Density	$fish/m^2$	0
Standing Crop	kg/ha	0
Mean Weight	gm	0
Mean Length (TL-FL)	mm	0
Age 1+ Brook Trout		
Density	$fish/m^2$	0.06
Standing Crop	kg/ha	11.27
Mean Weight	gm	19.9
Mean Length (TL-FL)	mm	122-119

Table 37. Rainbow-steelhead trout population statistics of one sample station on Little Beaver Creek, a tributary of Trail Creek, Idaho, 1984.

Biological Parameter	Units	Station 1 Value
Age 0+ Rainbow-Steelhead		
Density	$fish/m^2$	0
Standing Crop	kg/ ha	0
Mean Weight	gm	0
Mean Length (TL-FL)	mm	0
Age l+ Rainbow-Steelhead		
Density	$fish/m^2$	0
Standing Crop	kg/ha	0
Mean Weight	gm	0
Mean Length (TL-FL)	mm	0

Table 38. Measured physical parameters of one sample station on Little Beaver Creek, a tributary of Trail Creek, Idaho, 1984.

Physical Parameter	STATION 1 Value
Station Length (m)	40
Station Area (m2)	141.20
Late Summer Stream flow (m3/sec)	0.04
Annual Stream Flow Variation	Moderate
Summer Temp. (C)	16.1
Water Velocity (cm/sec)	8.8
Stream Width (m)	3.53
Stream Depth (cm)	12.8
Instream Cover (%)	11.5
Eroding Banks (%)	5
Cobble Embeddedness (%)	25
Major Substrate Type	Sm. R.
Pool Riffle Ratio	25:75
Periphyton Coverage (%)	0

CANAL GULCH

Canal Gulch is approximately 7.3 km in length, contains 18.5 km of tributary streams, and flows through private, National Forest, Idaho State, and Potlatch Forest Industries land. Canal Gulch originates at an elevation of 1219 m and flows southwesterly, discharging into Orofino Creek at SK 44.2. Moore Gulch and East Fork Canal Gulch are the major tributaries to Canal Gulch. Moore Gulch is 1.1 kilometers in length and discharges into Canal Gulch at SK 0.7. East Fork Canal Gulch is 5.7 km long, contains 5.0 km of tributary streams, and discharges into Canal Gulch at SK 2.1. The Canal Gulch drainage flows through a terrain of logged slopes and high meadows. The lower 0.5 km of Canal Gulch travels through the outskirts of Pierce, Idaho. The Robert K. Duffey Dam is located at SK 2.0 and provides water for Pierce. The overall gradient of Canal Gulch is low. Access to Canal Gulch is provided by the Canal Gulch road.

A station was established on Canal Gulch at SK 1.8. The sample site was narrow, shallow, and brushy, bordered by a northern timbered slope and the Canal Gulch Road.

Rainbow-steelhead, brook trout, longnose date, speckled date, paiute sculpin, and crayfish were captured at the Canal Gulch station. Estimated standing crop of overyearling rainbow-steelhead was 0.61 kg/ha, with a density of 0.01 fish/m2. No subyearling rainbow-steelhead were captured (Table 39). Estimated standing crop of overyearling brook trout was 2.22 kg/ha, with kg/ha, with a density of 0.02 fish/m2. Standing crop of subyearling brook trout was 5.62 kg/ha, with a density of 0.31 fish/m2 (Table 40).

The Canal Gulch station supported a large standing crop of subyearling brook trout, while biomass of overyearling brook trout and rainbow-steelhead were marginal. Standing crop of rainbow-steelhead ranked nineteenth, and last, of the streams sampled in 1984 (Appendix-Table 1). Standing crop of overyearling brook trout was ranked tenth (Appendix-Table 3), and standing crop of subyearlings second (Appendix-Table 4) of the 13 sample stations containing brook trout. Flow, depth, and instream cover were probably adequate to support smaller size individuals but insufficient for the needs of the larger fish.

Low summer stream flow was 0.07 m3/sec, with moderate variation in annual flow. Summer water temperature was 18.9

C, which is sub- optimum for juvenile rainbow-steelhead production (Bovee, 1978). The stream velocity was 23.3 cm/sec, optimum for juvenile rainbow- steelhead (Bovee, 1978). Stream width at low flow was 2.99 m. Mean depth was 9.9 CD, a suboptimum depth for juvenile rainbow-steelhead (Bovee, 1978) . Instream cover for juvenile rainbow-steelhead was provided by 1.7% of the sample area. Depth was the primary component of instream cover. Ten percent of the stream banks were eroded. Overall channel stability was fair. Cobble embeddedness was 25%. The major substrate type was small rubble, a slightly suboptimum substrate size for juvenile rainbow-steelhead (Bovee, 1978). The pool/riffle ratio of 17:83 indicated limited holding area for juvenile rainbow-steelhead. Pools were small and formed below boulders. Periphyton and moss covered 20% and 30%, respectively, of the stream substrate, indicating moderate primary production. The riparian habitat was well developed, consisting of grasses, herbs, alders, and conifers. Seventy percent of the stream section was shaded by the intermediate canopy (Table 41).

Table 39. Rainbow-steelhead trout population statistics of one sample station on Canal Gulch, a tributary of Orofino Creek, Idaho, 1984.

Biological Parameter	Units	Station 1 Value
Age 0+ Rainbow-Steelhead		
Density	fish/m^2	0
Standing Crop	kg/ha	0
Mean Weight	gm	0
Mean Length (TL-FL)	mm	0
Age l-t- Rainbow-Steelhead		
Density	fish/m^2	0.01
Standing Crop	kg/ ha	0.61
Mean Weight	gm	11 .0
Mean Length (TL-FL)	mm	115-108

Table 40. Brook trout population statistics of one sample station on Canal Gulch, a tributary of Orofino Creek, Idaho, 1984.

Biological Parameter	Units	Station 1 Value
Age 0+ Brook Trout		
Density	fish/m^2	0.31
Standing Crop	kg/ha	5.62
Mean Weight	gm	1.8
Mean Length (TL-FL)	mm	72-69
Age 1+ Brook Trout		
Density	fish/m^2	0.02
Standing Crop	kg/ha	2.22
Mean Weight	gm	13.3
Mean Length (TL-FL)	mm	111-106

Table 41. Measured physical parameters of one sample station on Canal Gulch, a tributary of Orofino Creek, Idaho, 1984.

Physical Parameter	STATION 1 Value
Station Length (m)	60
Station Area (m2)	179.40
Late Summer Stream flow (m3/sec)	0.07
Annual Stream Flow Variation	Moderate
Summer Temp. (C)	18.9
Water Velocity (cm/sec)	23.3
Stream Width (m)	2.99
Stream Depth (cm)	9.9
Instream Cover (%)	1.7
Eroding Banks (%)	10
Cobble Embeddedness (%)	25
Major Substrate Type	Sm. R.
Pool/Riffle Ratio	17:83
Periphyton Coverage (%)	20

RHODES CREEK

Rhodes Creek is 12.0 km in length, contains 29.1 km of tributary streams, originates at an elevation of 1256 m on the Shanghai Divide, and flows southwesterly, discharging into Orofino Creek at SK 46.3. The Rhodes Creek drainage flows within National Forest, Idaho State, Potlatch Forests Industries, and private lands. The Rhodes Creek terrain is primarily timbered hills and high meadows. Logging, grazing, and recreation are the principal land use activities in the Rhodes Creek watershed. The Clearwater National Forest maintains a picnic area on Clearwater Gulch. An old logging mill, the Cardiff Mill, was located at the mouth of Rhodes Creek. A few people still reside in the Cardiff Mill meadow. Access to Rhodes Creek is provided along the lower 5 km by the Rhodes Creek Road. Rhodes Creek receives moderate fishing pressure, primarily during the summer months.

Clearwater Gulch, Pierce Creek, and Shanghai Creek are the major tributaries to Rhodes Creek. Clearwater Gulch is 3.3 km long, contains 1.9 km of tributary streams, and discharges into Rhodes Creek at SK 4.1. Pierce Creek is 3.0 km long and enters Rhodes Creek at SK 6.1. Shanghai Creek is 6.1 km long, contains 4.1 km of tributary streams, and discharges into Rhodes Creek at SK 6.4.

One station was established on Rhodes Creek at SK 0.9. The sample station was located in a narrow valley, bordered by a timbered northern slope and the Rhodes Creek Road. Water quality analysis indicated no limitation to salmonid production (Appendix-Table 13).

Rainbow-steelhead, brook trout, paiute sculpin, longnose and speckled date, bullhead, and crayfish were captured. Estimated standing crop of overyearling rainbow-steelhead was 8.09 kg/ha, with a density of 0.05 fish/m2. One subyearling rainbow-steelhead was captured (Table 42). Estimated standing crop of overyearling brook trout was 2.81 kg/ha, with a density of 0.01 fish/m2. Standing crop of subyearling brook trout was estimated to be 3.13 kg/ha, with a density of 0.12 fish/m2 (Table 43).

The Rhodes Creek station was well suited for anadromous salmonid production, as flow and depth were sufficient, spawning gravels were available, and the riparian habitat was generally well developed. Standing crop of overyearling rainbow-steelhead ranked twelfth of the streams sampled in 1984 (Appendix-Table 1). Standing crop of overyearling and subyearling brook trout ranked tenth (Appendix-Table 3), and third (Appendix-Table 4), respectively, of the 13 sample stations where brook trout were present.

Late summer stream flow was 0.40 m3/sec, with moderate variation in annual flow. Summer water temperature was 18.3 C, which is suboptimum for juvenile rainbow-steelhead production (Bovee, 1978). Mean water velocity was 41.8 cm/sec, within the optimum velocity range for juvenile rainbow-steelhead (Bovee, 1978). Stream width at low flow was 4.99 m. Mean stream depth was 19.6 cm, which is slightly suboptimum for juvenile rainbow-steelhead (Bovee, 1978). Instream cover for juvenile rainbow-steelhead was provided by 5.3% of the stream area surveyed and consisted primarily of surface turbulence. Thirteen percent of the stream banks showed signs of erosion. The overall channel stability was fair. Cobble embeddedness was 25%. The major substrate types were large and small rubble, the optimum substrate size for juvenile rainbow-steelhead (Bovee, 1978). The stream gradient at the sample station was low. No well defined pools were present and the stream section was primarily riffle-run. Periphyton was present on 30% of the substrate, indicating low to moderate primary production. The riparian habitat, consisting of herbs, alders, grasses, and conifers, shaded 20% of the stream section (Table 44).

Table 42. Rainbow-steelhead trout population statistics of one sample station on Rhodes Creek, a tributary of Orofino Creek, Idaho, 1984.

Biological Parameter	Units	Station 1 Value
Age 0+ Rainbow-Steelhead		
Density	fish/m^2	0.003
Standing Crop	kg/ha	NA
Mean Weigh t	gm	NA
Mean Length (TL-FL)	mm	38-37
Age 1+ Rainbow-Steelhead		
Density	fish/m^2	0.05
Standing Crop	kg/ha	8.09
Mean Weight	gm	17.3
Mean Length (TL-FL)	mm	120-112

Table 43. Brook trout population statistics of one sample station on Rhodes Creek, a tributary of Orofino Creek, Idaho, 1984.

Biological Parameter	Units	Station 1 Value
Age 0+ Brook Trout		
Density	fish/m^2	0.12
Standing Crop	kg/ha	3.13
Mean Weight	gm	2.6
Mean Length (TL-FL)	mm	69-66
Age l+ Brook Trout		
Density	fish/m^2	0.01
Standing Crop	kg/ha	2.81
Mean Weight	gm	21.0
Mean Length (TL-FL)	mm	133-127

Table 44. Measured physical parameters of one sample station on Rhodes Creek, a tributary of Orofino Creek, Idaho, 1984.

Physical Parameter	STATION 1 Value
Station Length (m)	60
Station Area (m2)	299.00
Late Summer Stream flow (m3/sec)	0.40
Annual Stream Flow Variation	Moderate
Summer Temp. (C)	18.3
Water Velocity (cm/sec)	41.8
Stream Width (m)	4.99
Stream Depth (cm)	19.6
Instream Cover (%)	5.3
Eroding Banks (%)	13
Cobble Embeddedness (%)	25
Major Substrate Type	Lg./Sm. R.
Pool/Riffle Ratio	Run
Periphyton Coverage (%)	30

SHANGHAI CREEK

Shanghai Creek is approximately 6.1 km long and contains 4.1 km of tributary streams. Shanghai Creek originates at an elevation of 1372 m on the Shanghai Divide and flows southwesterly, discharging into Rhodes Creek at SK 6.4. The Shanghai Creek drainage flows through Potlach Forest Industries land. Shanghai Creek flows through a heavily logged valley; the creek is extremely brushy and carries a high content of sediments. The gradient of Shanghai Creek is low to moderate, preventing extreme meandering. Access to Shanghai Creek is provided by a logging road that parallels the upper 4 km of the stream.

A sample station was established on Shanghai Creek at SK 3.0. The sample station was narrow and brushy, bordered by a clear cut northern slope and the Shanghai Creek road.

Rainbow-steelhead, brook trout, and paiute sculpin were captured at the Shanghai Creek station. Estimated standing crop of overyearling rainbow-steelhead was 9.83 kg/ha, with a density of 0.02 fish/m2. No subyearling rainbow-steelhead were captured (Table 45). Estimated standing crop of juvenile brook trout was

65.67 kg/ha, with a density of 0.29 fish/m2. Standing crop of subyearling brook trout was estimated to be 13.65 kg/ha, with a density of 0.62 fish/m2 (Table 46).

Shanghai Creek was an extremely productive brook trout stream, despite the effects of logging activities in the upper drainage. The sample station was well covered with riparian growth, bugs were abundant, providing ample food supply, and brook trout tend to like a smaller substrate size, such as was characteristic of the sample station. Standing crop of overyearling rainbow-steelhead ranked eleventh of the streams sampled during 1984 (Appendix-Table 1). Standing crops of overyearling and subyearling brook trout ranked first of the 13 sample stations containing brook trout (Appendices-Tables 3 and 4).

Late summer stream flow was 0.06 m3/sec, with moderate variation in annual flow. Summer water temperature was 15.5 C, which is optimum for juvenile steelhead production (Bovee, 1978). Mean water velocity was 16.5 cm/sec, the optimum velocity for juvenile rainbow-steelhead (Boveee, 1978). Stream width at low flow was 2.66 m. Mean depth was 13.2 cm, a suboptimum depth for juvenile rainbow-steelhead (Bovee, 1978). Instream cover for -juvenile rainbow-steelhead was provided by 8.1% of the total stream area and consisted primarily of undercut banks and overhanging vegetation. Ten percent of the stream banks showed signs of erosion. Overall channel stability was fair. Cobble embeddedness was 25%. The major substrate type was sand, which can limit steelhead production (Bjornn et al., 1977). The pool/riffle ratio was 66:33, indicating that holding area for juvenile rainbow-steelhead was available. Periphyton was not observed, indicating low primary production. However, moss was present on 30% of the exposed substrate. The well developed riparian habitat, consisting of herbs, grasses, and alders provided 50% of the stream section with shade (Table 47).

Table 45. Rainbow-steelhead trout population statistics of one sample station on Shanghai Creek, a tributary of Rhodes Creek, Idaho, 1984.

Biological Parameter	Units	Station 1 Value
Age 0+ Rainbow-Steelhead		
Density	$fish/m^2$	0
Standing Crop	kg/ha	0
Mean Weight	gm	0
t-lean Length (TL-FL)	mm	0
Age l+ Rainbow-Steelhead		
Density	$fish/m^2$	0.02
Standing Crop	kg/ha	9.83
Mean Weight	gm	52.3
Mean Length (TL-FL)	mm	170-160

Table 46. Brook trout population statistics of one sample station on Shanghai Creek, a tributary of Rhodes Creek, Idaho, 1984.

Biological Parameter	Units	Station 1 Value
Age 0+ Brook Trout		
Density	fish/m^2	0.62
Standing Crop	kg/ha	13.65
Mean Weight	gm	2.2
Mean Length (TL-FL)	mm	68-65
Age l+ Brook Trout		
Density	fish/m^2	0.29
Standing Crop	kg/ha	65.67
Mean Weight	gm	22.3
Mean Length (TL-FL)	mm	170-160

Table 47. Measured physical parameters of one sample station on Shanghai Creek; a tributary of Rhodes Creek, Idaho, 1984.

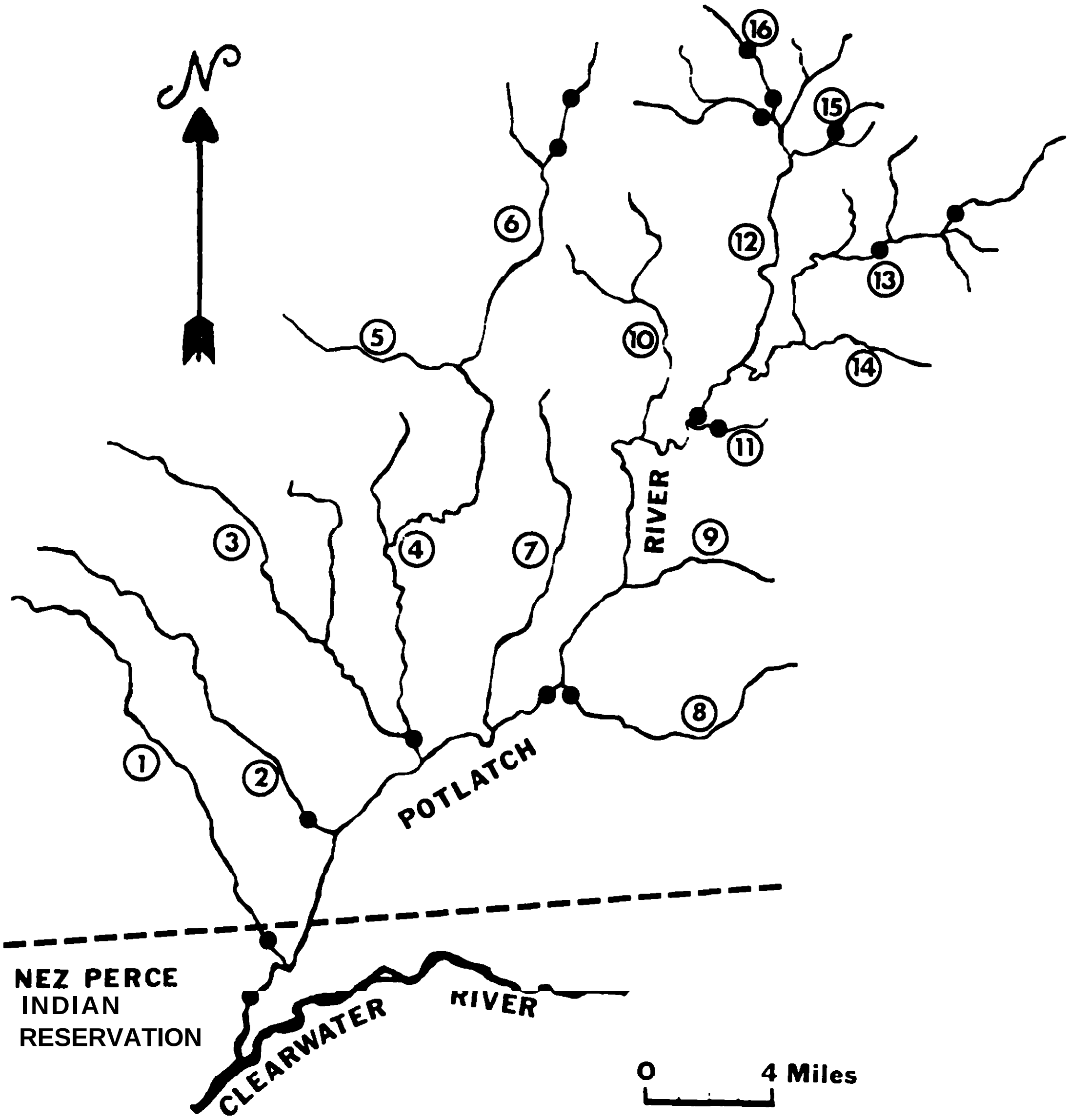
Physical Parameter	STATION 1 Value
Station Length (m)	60
Station Area (m2)	159.60
Late Summer Stream flow (m3/sec)	0.06
Annual Stream Flow Variation	Moderate
Summer Temp. (C)	15.5
Water Velocity (em/sac)	16.5
Stream Width (m)	2.66
Stream Depth (cm)	13.2
Instream Cover (%)	8.1
Eroding Banks (%)	10
Cobble Embeddedness (%)	25
Major Substrate Type	Sand
Pool/Riffle Ratio	66:33
Periphyton Coverage (%)	0

STREAM NARRATIVE-POTLATCH RIVER SYSTEM

POTLATCH RIVER

The Potlatch River (Figure 6)is one of the largest tributaries of the lower Clearwater River system. It has a length of 85 km, contains 1199 km of tributary streams, and drains a watershed of approximately 870 km2. Potlatch River originates in the Beal Butte area of the Clearwater National Forest. Land ownership is divided between the private sectors, the National Forest, Idaho State, Potlatch Forest Industries, Diamond International, and the Bureau of Land Management. The lower 11.3 km of Potlatch River flows through the Nez Perce Reservation. Bovill, Deary, Troy, Kendrick, and Juliaetta are the principal communities within the Potlatch River basin.

Little Potlatch, Middle Potlatch, Big Bear Creek, Pine Creek, and Cedar Creek are the main tributaries of the lower Potlatch River. The East Fork and West Fork are the main tributaries of upper Potlatch.



1. Little Potlatch Cr.
2. Middle Potlatch Cr.
3. W. Fork Little Bear Cr.
4. Big Bear Cr.
5. West Fork Big Bear Cr.
6. East Fork Big Bear Cr.
7. Pine Cr.
8. Cedar Cr.
9. Boulder Cr.
10. Corral Cr.
11. Little Boulder Cr.
12. W. Fork Potlatch River
13. E. Fork Potlatch River
14. Ruby Cr.
15. Purdue Cr.
16. Feather Cr.

▪ denotes sample station

Figure 6. Map of Potlatch River, Idaho, indicating sample stations.

The geological and hydrological features of the upper and lower reaches of the Potlatch River are quite distinct. The lower Potlatch River basin contains a series of large deep canyons which traverse through the Palouse Plateau. This area is basaltic and much of the stream substrate is large, primarily boulders and large rubble. Stream flow within the lower basin is regulated more by local precipitation than springs and snow pack. High runoff occurs early in the spring and subsides rapidly by early summer, extreme low flows are typical throughout the summer and stream flow increases again with the onset of the fall and winter rainy seasons. The riparian vegetation is severely diminished within the lower Potlatch River as the high, scouring, spring runoff precludes the establishment of a suitable riparian habitat. There is essentially no streamside cover provided by vegetation in the lower Potlatch basin. Extreme fluctuations in water temperature are also typical of the lower Potlatch River; late summer water temperatures can exceed lethal limits for salmonid production.

The upper basin and headwaters of the Potlatch River flow through timbered hills and high meadow terrain. These streams provide a more stable flow than those in the lower Potlatch; the watershed in the upper basin is not farmed as intensively as the lower basin; therefore, runoff is not as rapid or extreme.

From the source of the Potlatch River to the mouth of the East Fork, the soil is composed of soft granitic materials, which decompose rapidly to form suitable spawning gravels. However, upper Potlatch now carries a considerable silt load, attributed to logging activities, which covers much of these prime spawning gravels. Riparian habitat is generally well developed throughout the upper drainage, which provides streamside cover, stabilizes the bank structure, and reduces high summer water temperatures.

Water quality tests conducted by Idaho Department of Health and Welfare (1978) revealed that non-point sources of pollution contributed substantial amounts of total solids, nutrients, and total coliform to the lower Potlatch River. Most of the Palouse within the lower Potlatch is farmed without extensive irrigation control. Soil erosion rates averaging 25-40 tons per acre per year have been documented in the Palouse farming country (Idaho Department of Health and Welfare, 1977). The Soil Conservation Service has established a program to reduce soil erosion in the Palouse farmland but no major improvement activities have occurred in the Potlatch River basin (U.S. Bureau of Reclamation, 1984). Murphy and Metsker (1962) attributed much of the high sediment content within the East Fork Potlatch River to logging activities and road construction. High phosphorous and total solids discharged by the FILTROL clay mining operation near

Bovill also impacted the upper Potlatch River (Idaho Department of Healht and Welfare, 1978). Mallet (1974) noted that periodic fish kills have resulted from effluent released by the clay mine. The clay mine has since decreased production and changed owners; Clayburn Industries currently manages the mining site, which was actually in operation during a two month period in 1984.

Several visual surveys estimating salmonid habitat have been conducted on the Potlatch River. Parkhurst and Motor (1938) surveyed the lower 22 miles of Potlatch and determined that low flows and high summer water temperatures caused the stream to be unsuitable for salmon production. However, he noted that the upper Potlatch may be of some value to steelhead and resident trout. Murphy and Metsker (1962) indicated that the principal steelhead spawning area was located between Cedar Creek and Bovill. The primary tributaries within this reach, Cedar Creek, Boulder Creek, the East Fork Potlatch and its tributaries were also considered to be major spawning and rearing habitats. Murphy and Metsker (1962) also estimated abundance of spawning gravels and condition of pool-riffle habitat within the Potlatch River. Fulton (1968) found that, although chinook salmon may have utilized the upper two-thirds of the Potlatch River, they were no longer present in this area. Mallet's (1974) survey described the game fish present, angler use, and detrimental factors to salmonid production in the Potlatch River drainage. The U.S. Bureau of Reclamation (1984) studied the feasibility of establishing a dam in the upper basin to control flow and temperature regimes and enhance steelhead production in the Potlatch River.

The Idaho Department of Fish and Game has stocked the Potlatch River system with catchable size rainbow trout for several years. The IDFG also manages Spring Valley Reservoir, a stocked recreation area in the headwaters of Little Bear Creek and Moose Creek Reservoir, a stocked recreation area near Bovill, Idaho.

State Highways 3 and 8 provide access to much of the Potlatch drainage. Access into mainstem Potlatch between Cedar Creek and Bovill is extremely limited.

Three sample sites were located on the mainstem Potlatch River. Station #l, at SK 5.0, was surveyed in 1982. Stations #2 and #3 located at SK 33.0 and 58.4, respectively, were surveyed during 1984.

Station #1. Fish species present at this station were smallmouth bass, northern squawfish, chiselmouth, bridgelip sucker, and speckled date. Abundant numbers of juvenile smallmouth bass indicated that this lower stretch of Potlatch River may act as a nursery stream for this species. No rainbow-steelhead were captured at station #l (Table 48).

Late summer stream flow was 6.07 m3/sec, with moderate variation in annual flow. Summer water temperature was 20.0 C, which is above optimum temperature for juvenile rainbow-steelhead (Bovee, 1978). Mean stream velocity was 39.0 cm/sec, an optimum velocity for juvenile rainbow-steelhead (Bovee, 1978). Mean stream width at low flow was 12.97 m. Mean stream depth was 120 cm, which is greater than the optimum depth for juvenile rainbow-steelhead (Bovee, 1978). Instream cover for juvenile rainbow-steelhead was provided by 11.4% of the stream area surveyed. Depth was the primary component of instream cover. Ten percent of the stream banks showed signs of erosion. Overall channel stability was good. Cobble embeddedness was 50 percent, limiting to steelhead production (Bjornn et al., 1977). The major substrate type was small boulder, which is greater than the optimum substrate size for juvenile rainbow-steelhead (Bovee, 1978). Pool/riffle ratio was 15:85, indicating a lack of holding area for juvenile rainbow-steelhead. Periphyton covered 75% of the stream substrate, indicating high primary production. The riparian habitat was sparse, providing a minimum amount of stream shading(Table 49).

Station #2. Station #2 was located below Cedar Creek in a wide flood channel, bordered by a road embankment and a sparsely timbered slope. Evidence of past flooding was indicated by the large boulders present within the streambed. Depth and a large stream width prevented the effective use of electrofishing at the site, hence, snorkeling methods were utilized at station #2. Water quality analysis indicated no limitation to salmon production (Appendix-Table 14).

Redside shiners and crayfish were present in station #2. No salmonids were observed on the sampling date (Table 48). This station was snorkeled three weeks prior to the sample date and revealed quite a different species diversity. Redside shiners, bridgelip suckers, two rainbow-steelhead, two sunfish, and four smallmouth bass were observed. Stream flow was lower and water temperature higher during the initial snorkeling survey. It is assumed that most of the fish migrated downstream in a freshet that occurred between the two snorkeling dates.

Late summer stream flow was 0.99 m3/sec, with extreme variation in annual flow. Water temperature recorded on September 11 was 12.8 C, which probably did not represent maximum summer water temperature. Mean stream velocity was 14.6 cm/sec, within optimum range for juvenile rainbow-steelhead (Bovee, 1978). Mean width was 12.42 m. Mean stream depth was 54.8 cm, greater than the optimum depth for juvenile rainbow-steelhead (Bovee, 1978). Instream cover for juvenile rainbow-steelhead was provided by 81.9% of the stream area surveyed. Depth was the primary component of instream cover. Erosion was not evident within this sample section as much of the bank was bedrock. Overall channel stability was good. Cobble embeddedness was 25%, possibly limiting steelhead production (Bjornn et al., 1977). The major substrate types were large and small boulder and small rubble, a greater than optimum size for juvenile rainbow-steelhead (Bovee. 1978). Pool/riffle ratio was 95:5, providing abundant holding area but little habitat diversity for juvenile salmonids. Periphyton was present on 80% of the substrate, indicating high primary production. Riparian vegetation, consisting of sparse annual grasses, had essentially no effect on the sample section (Table 49).

Station #3. Station #3 was located within a large flood channel above the confluence of Little Boulder Creek and the Potlatch River. Overall depth and stream width prevented the effective use of electrofishing; therefore, snorkeling observations were utilized. Water quality analysis indicated no limitation to salmonid production (Appendix-Table 15). Speckled date, paiute sculpin, crayfish, fresh water mussels, and one overyearling rainbow-steelhead were observed in station #3 (Table 48).

Late summer stream flow was 0.58 m3/sec, with extreme variation in annual flow. Water temperature recorded on September 12 was 12.2 C, and probably did not represent maximum summer temperatures. Mean stream velocity was 9:l cm/sec, which borders the optimum range for juvenile rainbow-steelhead (Bovee, 1978). Stream width was 12.47 m at low flow. Mean stream depth was 51.1 cm, a slightly suboptimum depth for juvenile rainbow-steelhead (Bovee, 1978). Instream cover for juvenile rainbow-steelhead was provided by 77.3% of the stream area surveyed. Depth was the only component of instream cover. No signs of bank erosion were observed in station #3. Overall channel stability was good. Cobble embeddedness was 25%, possibly limiting steelhead production (Bjornn et al, 1977). The major substrate type was small rubble, which is a slightly suboptimum substrate size for juvenile rainbow-steelhead (Bovee, 1978). Pool/riffle ratio was 92:8, providing abundant cover but little habitat diversity, for juvenile rainbow-steelhead. Periphyton was present on 90% of the substrate, indicating high primary production. The riparian vegetation, consisting of alders and grasses, was not close enough to the stream to provide any significant cover (Table 49).

Table 48. Rainbow-steelhead trout population statistics of three sample stations on Potlatch River, a tributary of the Clearwater River, Idaho, 1982, 1984.

Biological Parameter	Units	Station[1]		
		1	2	3
		Value	Value	Value
Age 0+ Rainbow-Steelhead				
Density	$fish/m^2$	0	0	0
Standing Crop	kg/ha	0	0	0
Mean Weight	gm	0	0	0
Mean Length (TL-FL)	mm	0	0	0
Age 1+ Rainbow-Steelhead				RB Present
Density	$fish/m^2$	0	0	
Standing Crop	kg/ha	0	0	
Mean Weight	gm	0	0	
Mean Length (TL-FL)	mm	0	0	

Table 49. Measured physical parameters of three sample stations on Potlatch River, a tributary of the Clearwater River, Idaho, 1984.

Physical Parameter	STATION 1 Value	STATION 2 Value	STATION 3 Value
Station Length (m)	85.5	60	83
Station Area (m2)	1108.94	745.20	1035.01
Late Summer Stream Flow (m3/sec)	6.07	0.99	0.58
Annual Stream Flow Variation	Moderate	Extreme	Extreme
Summer Temp. (C)	20.0	12.8	12.2
Water Velocity (cm/s)	39.0	14.6	9.1
Stream Width (m)	12.97	12.42	12.47
Stream Depth (cm)	120.0	54.8	51.1
Instream Cover (%)	11.4	81.9	77.3
Eroding Banks (%)	10	0	0
Cobble Embeddedness (%)	50	25	25
Major Substrate Type	Sm. B.	Lg./Sm.B., Sm. R.	Sm. R.
Pool/Riffle Ratio	15:85	95:5	92:8
Periphyton Coverage (%)	75	80	90

LITTLE POTLATCH CREEK

Little Potlatch is approximately 28 km in length and contains 32 km of tributary streams. Little Potlatch originates on the southeastern slope of Paradise Ridge and flows southeasterly, discharging into Potlatch River at SK 9.3. Little Potlatch is contained entirely within private lands. The upper 20 km of Little Potlatch flow through hill and meadow terrain, and the lower 8 km flow through a steep narrow canyon, spreading out over the last 3 km into a wide floodplain. A rockslide at SK 4.0 in 1980 resulted in an impassable barrier to anadromous fish migration. The Little Potlatch watershed is used primarily for livestock grazing and farming. Access along the upper 20 km of Little Potlatch is provided by various country roads, while access into the Little Potlatch canyon is limited to foot travel.

One station was established in Little Potlatch at SK 2.4, in a wide flood channel, bordered by sparsely timbered slopes. Speckled date and tadpoles were captured at the Little Potlatch station. No salmonids were present (Table 50).

Late summer streamflow was 0.07 m3/sec, with extreme variation in annual flow. Summer water temperature was 31.1 C, which is higher than the lethal limit for juvenile rainbow-steelhead (Bovee, 1978). Mean stream velocity was 20.9 cm/sec, which is optimum for juvenile rainbow-steelhead (Bovee, 1978). Stream width at low flow was 3.66 m. Mean depth was 8.8 cm, approaching the minimum limit for juvenile rainbow-steelhead (Bovee, 1978). Instream cover for juvenile rainbow-steelhead was provided by 1.0% of the stream surveyed. The stream was not confined within well defined banks, hence, erosion was not evident. Overall channel stability was poor. Cobble embeddedness was 50%, which can limit steelhead production (Bjornn et al., 1977). The major substrate types were small boulder and large rubble, which are greater than the optimum substrate size for juvenile rainbow-steelhead (Bovee, 1978). The pool/riffle ratio was 25:75, indicating a lack of holding area for juvenile rainbow-steelhead. The stream gradient for this section was low. Periphyton was observed on 75% of the stream substrate, indicating high primary production. Riparian vegetation was lacking and consisted only of sparse clumps of grass. There was no shading within the stream section by riparian growth (Table 51).

Table 50. Rainbow-steelhead trout population statistics of one sample station on Little Potlatch Creek, a tributary of the Potlatch River, Idaho, 1984.

Biological Parameter	Units	Station 1 Value
Age 0+ Rainbow-Steelhead		
Density	fish/m^2	0
Standing Crop	kg/ha	0
Mean Weight	gm	0
Mean Length (TL-FL)	mm	0
Age 1+ Rainbow-Steelhead		
Density	fish/m^2	0
Standing Crop	kg/ha	0
Mean Weight	gm	0
Mean Length (TL-FL)	mm	0

Table 51. Measured physical parameters of one sample station on Little Potlatch Creek, a tributary of the Potlatch River, Idaho, 1984.

Physical Parameter	STATION 1 Value
Station Length (m)	40
Station Area (m2)	146.40
Late Summer Stream flow (m3/sec)	0.07
Annual Stream Flow Variation	Extreme
Summer Temp. (C)	31.1
Water Velocity (cm/sec)	20.9
Stream Width (m)	3.66
Stream Depth (cm)	8.8
Instream Cover (%)	1.0
Eroding Banks (%)	0
Cobble Embeddedness (%)	50
Major Substrate Type	Sm. B., Lg. R.
Pool/Riffle Ratio	25-75
Periphyton Coverage (%)	75

MIDDLE POTLATCH CREEK

Middle Potlatch Creek is approximately 29 km in length and contains 88 km of tributary streams. Middle Potlatch originates on the eastern slope of Tomer Butte and flows southeasterly, discharging into the Potlatch River at SK 16.2. Middle Potlatch Creek is contained entirely within private lands. The upper 5 km of Middle Potlatch flows through hill and meadow terrain and the lower 24 km of Middle Potlatch flows through a steep, timbered canyon. Falls, located at approximately SK 12.9, are an impassable barrier to anadromous fish migration. The Middle Potlatch watershed is used primarily for farming, logging, and livestock grazing. Several ranch houses are situated along the lower 4 km of Middle Potlatch Creek. Access to Middle Potlatch Creek is provided along the lower 6 km and the upper 6 km, while access into the Middle Potlatch canyon is limited to foot travel.

One station was established in Middle Potlatch Creek at SK 1.8. A small spring fed the stream just above the sample station; upstream from the spring, the creek was dry. This sample station supported an unusually large standing crop of rainbow-steelhead. Standing crops of overyearling and subyearling rainbow-steelhead ranked first and third, respectively, of the streams sampled during 1984 (Appendices-Tables 1 and 2). Two relatively deep, sheltered pools were present in the station, which might provide an important refuge for the trout during the dry summer months. As indicated earlier, the reach above the spring flows subsurface, the reach below the station receives considerable impact from land use activities. So this particular station probably had the most optimum salmonid habitat of the lower reach of Middle Fork Potlatch Creek. Although rather high cation and anion concentrations were observed (Appendix-Table 16), water chemistry was not limiting to salmonid production.

Rainbow-steelhead, speckled date, redside shiners, and bridgelip suckers were abundant in the sample station. Estimated standing crop of overyearling rainbow-steelhead was 76.14 kg/ha, with a density of 0.08 fish/m2. Standing crop of subyearling rainbow-steelhead was 6.96 kg/ha, with a density of 0.15 fish/m2 (Table 52).

Late summer stream flow was 0.06 m3/sec, with extreme variation in annual flow. Summer water temperature was 20.0 C, which is sub optimum for juvenile rainbow-steelhead (Bovee, 1978). Mean stream velocity was 11.4 cm/sec, an optimum velocity for juvenile rainbow-steelhead (Bovee, 1978). Stream width at low flow was 3.45 m. Mean stream depth was 14.2 cm, within the suboptimum range for juvenile rainbow-steelhead (Bovee, 1978). Instream cover for juvenile rainbow-steelhead was provided by 9.1% of the stream area surveyed and consisted primarily of depth. Eroding banks were not evident. Overall channel stability was good and the stream gradient was low to moderate. Cobble embeddedness was 50%, which is limiting to steelhead production (Bjornn et al., 1977). The major substrate types were large and small rubble, an optimum substrate size range for juvenile rainbow-steelhead (Bovee, 1978). The pool/riffle ratio of 28:72 indicated that holding area for juvenile rainbow-steelhead was limited. Pools formed below large boulders and bedrock. Periphyton was present on 100%, of the substrate, indicating high primary production. The riparian habitat consisted of grasses and deciduous trees. Thirty percent of the stream section was provided with shade (Table 53).

Table 52. Rainbow-steelhead trout population statistics of one sample station on Middle Potlatch Creek, a tributary of the Potlatch River, Idaho, 1984.

Biological Parameter	Units	Station 1 Value
Age 0+ Rainbow-Steelhead		
Density	fish/m^2	0.15
Standing Crop	kg/ ha	6.96
Mean Weight	gm	4.5
Mean Length (TL-FL)	mm	79-76
Age l+ Rainbow-Steelhead		
Density	fish/m^2	0.08
Standing Crop	kg/ ha	76.14
Mean Weight	gm	98.5
Mean Length (TL-FL)	mm	215-203

Table 53. Measured physical parameters of one sample station on Middle Potlatch Creek, a tributary of the Potlatch River, Idaho, 1984.

Physical Parameter	STATION 1 Value
Station Length (m)	60
Station Area (m2)	207.00
Late Summer Stream Flow (m3/sec)	0.06
Annual Stream Flow Variation	Extreme
Summer Temp. (C)	20.0
Water Velocity (cm/sec)	11.4
Stream Width (m)	3.45
Stream Depth (cm)	14.2
Instream Cover (%)	9.1
Eroding Banks (%)	0
Cobble Embeddedness (%)	50
Major Substrate Type	Lg./Sm. R.
Pool/Riffle Ratio	28:72
Periphyton Coverage (%)	100

BIG BEAR CREEK

Big Bear Creek is the largest tributary to the Potlatch River. Big Bear Creek is approximately 34 km in length and contains 315 km of tributary streams. Most of the Big Bear system flows intermittently; the only steady annual flow being found in East Fork Big Bear and close to the mouth of Big Bear. The West Fork of Big Bear Creek originates on the southern slopes of the Palouse Range. The East Fork of Big Bear Creek originates on the southern slope of Mica Mountain. Big Bear Creek flows through a patchwork of private, Potlatch Forest Industries, National Forest, and Idaho State lands. Lower Big Bear Creek and the lower tributaries flow through steep timbered canyons. The lower reaches are utilized for logging and grazing, but most of the lower reaches are inaccessible, so land use is limited. The upper reaches of Big Bear Creek flow through high meadow and palouse terrain, and are utilized primarily for farming and logging activities. Spring Valley Reservoir, a popular recreation site, is located on one of the upper tributaries of Little Bear Creek. The Idaho Department of Fish and Game stocks Spring Valley Reservoir with catchable and fingerling size rainbow trout. Falls on Big Bear Creek, at SK 9.0, act as an impassable barrier to anadromous fish migration. Visual surveys and preliminary electrofishing revealed that only date were present in the 1 km reach above the falls.

Three stations were established on Big Bear Creek. Two stations were located in the upper East Fork area and the third was close to the mouth of Big Bear Creek.

Station #1. Station #1 was established on Big Bear Creek at SK 1.0. The sample station was located in a wide flood channel, bordered by a sparsely timbered west slope and the embankment of the Big Bear Creek road.

One rainbow-steelhead, redside shiners, paiute sculpin, speckled date, bridgelip suckers, and northern squawfish were captured at station #1. Estimated standing crop of overyearling rainbow-steelhead was 5.00 kg/ha, with a density of 0.002 fish/m2 (Table 55).

Summer stream flow was 0.23 m3/sec, with extreme variation in annual flow. Summer water temperature was 21.1 C, which approaches the lethal limit for juvenile rainbow-steelhead (Bovee, 1978). Mean stream velocity was 11.1 cm/sec, which was within the optimum range for juvenile rainbow-steelhead (Bovee, 1978). Stream width was 7.64 m. Mean stream depth was 27.3 cm, within the optimum range for juvenile rainbow-steelhead (Bovee, 1978). Instream cover for juvenile rainbow-steelhead was provided by 32.7% of the stream section. This cover consisted entirely of the one large deep pool. Eroding banks were not observed. Channel stability was poor, as much brading occurred in this lower reach of Big Bear Creek. Cobble embeddedness was 50% and limiting to juvenile rainbow-steelhead production (Bjornn et al., 1977). The major substrate type was small rubble, a slightly suboptimum substrate size for juvenile rainbow-steelhead (Bovee, 1978). The pool/riffle ratio was 30:70 and holding area was limited to the large pool. Periphyton was observed on 80% of the stream substrate, indicating high primary production. There was a lack of riparian vegetation in the lower reach of Big Bear Creek. The riparian growth consisted only of sparse clumps of grass. No shading was provided in the sample section (Table 55).

Station #2. Station #2 was established on East Fork Big Bear Creek at SK 6.8. Access to this station was provided by Forest Service Road 3347. The station was located in a moderately wide wide, grassy meadow. The stream meandered frequently and was lined by heavy brush. Overall gradient for this sample area was low.

Speckled date and frogs were abundant in station #2. No salmonids were captured (Table 54).

Late summer stream flow was 0.007 m3/sec, with moderate variation in annual flow. Summer water temperature was 17.8 C, which is within the optimum range for juvenile rainbow-steelhead (Bovee, 1978). Mean stream velocity was 2.9 cm/sec, the minimum limit for juvenile rainbow-steelhead (Bovee, 1978). Stream width was 1.86 m. Mean stream depth was 12.7 cm, a suboptimum depth for juvenile rainbow-steelhead (Bovee, 1978). Instream cover for juvenile rainbow-steelhead was provided by 6.5% of the stream section surveyed. Depth was the primary component of instream cover. Twenty five percent of the stream banks showed signs of erosion. Overall channel stability was fair. The major substrate types were sand and silt, which can limit rainbow-steelhead production (Bjornn et al., 1977; Bovee, 1978). The stream section was all a "run" type, no distinct pools and riffles were formed. Periphyton was not observed on the sandy stream substrate, indicating low primary production; however, moss was found on 15% of the woody debris in the channel. Woody debris was abundant in the stream section. The riparian habitat was well developed, consisting of grasses and alders. Twenty percent of the stream was shaded by the low canopy (Table 55).

Station #3. Station 63 was established on East Fork Big Bear Creek at SK 8.6., in a narrow, brushy meadow approximately 100 m above Forest Service Road 3347. The creek was narrow and shallow, woody debris was abundant throughout the stream bed, and timbered slopes bordered both sides of the meadow. This station supported a good standing crop of overyearling rainbow-steelhead, which ranked third of the streams sampled during 1984 (Appendix-Table 1). It is surprising that there should be any rainbow-steelhead in the upper Big Bear Creek system, since the barrier on the mainstem, at SK 9.0, is impassable. The fish that were present might be resident trout, offspring of a hatchery stock transplanted into the west fork of the Big Bear Creek drainage. This particular reach of the East Fork Big Bear Creek seemed to be well suited as a nursery stream; streamside cover was well developed and perhaps compensated for lack of significant depth or pool cover, which might otherwise provide suitable rearing habitat for salmonids.

Rainbow-steelhead trout, speckled date, and frogs were captured at station #3. Estimated standing crop of overyearling rainbow-steelhead was 43.94 kg/ha, with a density of 0.12 fish/m2 Subyearling rainbow-steelhead standing crop was estimated to be 1.30 kg/ha, with a density of 0.19 fish/m2 (Table 54).

Late summer stream flow was 0.007 m3/sec, with moderate variation in annual flow. Summer water temperature was 14.4 C, which is optimum for juvenile rainbow-steelhead production (Bovee, 1978). Mean stream velocity was 3.1 cm/sec, the minimum limit for rainbow-steelhead juveniles. Stream width at low flow was 1.97 m. Mean stream depth was 11.6 cm, within the suboptimum range for juvenile rainbow-steelhead (Bovee, 1978). Instream cover for juvenile rainbow-steelhead was provided by 1.3% of the stream area surveyed. Thirty percent of the stream banks showed signs of erosion. Overall channel stability was fair. Cobble embeddedness was zero, which is optimum for juvenile steelhead production (Bjornn et al., 1977). The major substrate type was gravel, a suboptimum substrate size for juvenile rainbow-steelhead (Bovee, 1978). No distinct pool-riffle zones as existed, the section was primarily a run. Periphyton was not observed, indicating low primary production. Moss was present on 15% of the exposed substrate and woody debris. The riparian habitat was well developed, consisting of alders, herbs, grasses, and conifers. The overhanging canopy shaded 90% of the stream and acted as the primary source of cover for the juvenile rainbow-steelhead (Table 55).

Table 54. Rainbow-steelhead trout population statistics of three sample stations on Big Bear Creek, a tributary of the Potlatch River, Idaho, 19%.

Biological Parameter	Units	Station 1 Value	Station 2 Value	Station 3 Value
Age 0+ Rainbow-Steelhead				
Density	fish/m^2	0	0	0.19
Standing Crop	kg/ha	0	0	1.30
Mean Weight	gm	0	0	0.7
Mean Length (TL-FL)	mm	0	0	44-43
Age 1+ Rainbow-Steelhead				
Density	fish/m^2	0.002	0	0.12
Standing Crop	kg/ha	5.00	0	43.94
Mean Weight	gm	229.0	0	37.1
Mean Length (TL-FL)	mm	288-279	0	155-147

Table 55. Measured physical parameters of three sample stations on Big Rear Creek, a tributary of the Potlatch River, Idaho, 1934.

Physical Parameter	STATION 1 Value	STATION 2 Value	STATION 3 Value
Station Length (m)	60	50	60
Station Area (m2)	458.40	93.00	118.20
Late Summer Stream Flow (m3/sec)	0.23	0.007	0.007
Annual Stream Flow Variation	Extreme	Moderate	Moderate
Summer Temp. (C)	21.1	17.5	14.4
Water Velocity (cm/s)	11.1	2.9	3.1
Stream Width (%)	7.64	1.86	1.97
Stream Depth (cm)	27.3	12.7	11.6
Instream Cover (%)	32.7	6.5	1.3
Eroding Banks (%)	0	25	30
Cobble Embeddedness (%)	50	Sand	0
Major Substrate Type	sm. R.	Sand	Gr.
Pool/Riffle Ratio	30:70	Run	Run
Periphyton Coverage (%)	80	0	0

CEDAR CREEK

Cedar Creek is approximately 15 km long and contains 72 km of tributary streams. Cedar Creek originates on the northern slope of Teakean Butte and flows northwesterly, discharging into Potlatch River at SK 33.3. Leopold Creek and Kauder Creek are the major tributaries of Cedar Creek. Leopold Creek is approximately 8 km length and contains 9 km of tributary streams. Kauder Creek is approximately 6 km in length, contains 11 km of tributary streams, and discharges into Cedar Creek at SK 9.0. The Cedar Creek system flows through private, Potlatch Forest Industries, Idaho State, and Bureau of Land Management lands. The upper Cedar Creek drainage flows through rolling hills and meadow farmlands. The lower 6 km of Cedar Creek flows through a steep, narrow canyon. Farming, logging, and grazing are the primary land use activities in the Cedar Creek watershed. Access into Cedar Creek is limited to foot travel.

Murphy and Metsker (1962) documented the presence of two log jams acting as fish barriers in the lower 4.8 km of Cedar Creek. The lower of these two jams was not a barrier during the present study.

One station was established in Cedar Creek at SK 0.2, in a narrow channel, bordered by steep timbered slopes. Overall stream gradient at the sample site was moderate.

Cedar Creek is recognized as a primary steelhead producing stream in the Potlatch River (Murphy and Metsker, 1962). The creek is situated upstream of the lower impacted basin(i.e., from the mouth to Kendrick), and is the first relatively undisturbed tributary available to migrating anadromous salmonids. Problems typical of the Potlatch River, low flow, high summer water temperatures, and cobble embeddedness were also present in Cedar Creek, but this stream maintains a more steady flow and better pool habitat than the lower tributary streams. Standing crop of overyearling rainbow-steelhead ranked thirteenth of the streams sampled during 1984 (Appendix-Table l, but standing crop of subyearlings ranked second (Appendix-Table 2), indicating that this stream might be a valuable rearing area for salmonids.

Rainbow-steelhead, speckled date, paiute sculpin, and crayfish were captured in Cedar Creek. Estimated standing crop of overyearling rainbow-steelhead was 5.45 kg/ha, with a density of 0.03 fish/m2. Estimated standing crop of subyearling rainbow-steelhead was 9.54 kg/ha, witha density of 0.33 fish/m2 (Table 56).

Summer stream flow was 0.06 m3/sec, with moderate variation in annual flow. Summer water temperature was 23.3 C, approaching the lethal limit of juvenile rainbow-steelhead (Bovee, 1978). Mean stream velocity was 8.8 cm/sec, a suboptimum velocity for juvenile rainbow-steelhead (Bovee, 1978). Low flow stream width was 4.46 m. Mean stream depth was 15.0 cm, asuboptimum depth for juvenile rainbow-steelhead (Bovee, 1978). Instream cover for juvenile rainbow-steelhead was 7.0% and much of the instream cover was provided by depth. Eroding banks were not evident and overall channel stability was good. Cobble embeddedness was50%, which is limiting to steelhead production (Bjornn et al., 1977). The major substrate types were large and small rubble, an optimum substrate size for juvenile rainbow-steelhead (Bovee, 1978).The pool/riffle ratio of 50:50 indicated that holding area was available and habitat diversity was good, for juvenile rainbow-steelhead. Periphyton covered 100% of the stream substrate, indicating high primary production. Moss also covered 75% ofthe exposed and submerged substrate. The riparian habitat was well developed and consisted of conifers, alders, herbs, and grasses. Ten percent of the sample section was shaded by the riparian habitat (Table 57).

Table 56. Rainbow-steelhead trout population statistics of one sample station on Cedar Creek, a tributary of the Potlatch River, Idaho, 1984.

Biological Parameter	Units	Station 1 Value
Age 0+ Rainbow-Steelhead		
Density	$fish/m^2$	0.33
Standing Crop	kg/ha	9.54
Mean Weight	gm	2.9
Mean Length (TL-FL)	mm	63-60
Age 1+ Rainbow-Steelhead		
Density	$fish/m^2$	0.03
Standing Crop	kg/ha	5.45
Mean Weight	gm	16.2
Mean Length (TL-FL)	mm	124-118

Table 57. Measured physical parameters of one sample station on Cedar Creek, a tributary of the Potlatch River, Idaho, 1984.

Physical Parameter	STATION 1 Value
Station Length (m)	60
Station Area (m2)	267.60
Late Summer Stream Flow (m3/sec)	0.06
Annual Stream Flow Variation	Moderate
Summer Temp. (C)	23.3
Water Velocity (cm/sec)	8.8
Stream Width (m)	4.46
Stream Depth (cm)	15.0
Lnstream Cover (%)	7.0
Eroding Banks (%)	0
Cobble Embeddedness (%)	50
Major Substrate Type	Lg./Sm. R.
Pool/Riffle Ratio	50:50
Periphyton Coverage (%)	100

LITTLE BOULDER CREEK

Little Boulder Creek is approximately 5 km in length and contains 6 km of tributary streams. Little Boulder Creek originates on the western slope of McGary Butte and flows westerly, discharging into Potlatch River at SK 56.1. The Little Boulder Creek drainage is within National Forest, Potlatch Forest Industries, and private lands, and is primarily timbered high valley. Little Boulder Campground, administered by the Clearwater National Forest, is located near the mouth of Little Boulder Creek. Logging and recreation are the principal land use activities of the Little Boulder Creek watershed, and the Little Boulder Creek road parallels most of the stream length.

One station was established on Little Boulder Creek at SK 1.4. The creek was small, narrow, and brushy, and bordered by timbered slopes. The stream gradient in the sample section was low.

Rainbow-steelhead and crayfish were captured in Little Boulder Creek. Estimated standing crop of overyearling rainbow-steelhead was 47.57 kg/ha, with a density of 0.36 fish/m2. Estimated standing crop of subyearling rainbow-steelhead was 16.94 kg/ha, with a density of 2.12 fish/m2 (Table 58).

This sample station supported the greatest standing crop of subyearling rainbow-steelhead (Appendix-Table 2) and the second greatest standing crop of overyearling rainbow-steelhead (Appendix-Table l), of the sample sites inventoried during 1984. Although the habitat for large trout was marginal, the stream section was almost entirely covered by a low overhanging canopy, which possibly compensated for a lack of pool habitat or depth. The section was also close to a large water body, the middle reach of the Potlatch River, and the surrounding terrain was relatively unimpaired by land use activities. These factors combined could explain why this stream is of such value as a nursery area for salmonids.

Late summer stream flow was 0.004 m3/sec, with moderate variation in annual flow. Summer water temperature was 15.0 C, the optimum temperature for juvenile rainbow-steelhead (Bovee, 1978). Mean stream velocity was 8.0 cm/sec, within the suboptimum range for juvenile rainbow-steelhead. Low flow stream width was 1.11 m. Mean stream depth was 4.7 cm, which approaches the lower limit for juvenile rainbow-steelhead. Instream cover for juvenile rainbow-steelhead was provided by 3.4% of the stream area surveyed. Instream cover consisted entirely of overhanging vegetation. Ten percent of the stream banks showed signs of erosion. Overall channel stability was good. Cobble embeddedness was 50%, which is limiting to steelhead production (Bjornn et al., 1977). The major substrate type was sand, a suboptimum substrate size for juvenile rainbow-steelhead (Bovee, 1978). The pool/riffle ratio was 10:90, indicating a lack of holding area for juvenile rainbow-steelhead. Pools formed below small debris jams. Periphyton was not observed in the sample station, indicating low primary production. However, moss was present on 20% of the available substrate. The riparian habitat was very well developed, consisting of alders, herbs, and grasses, and shaded ninety percent of the stream (Table 59).

Table 58. Rainbow-steelhead trout population statistics of one sample station on Little Boulder Creek, a tributary of the Potlatch River, Idaho, 1984.

Biological Parameter	Units	Station 1 Value
Age 0+ Rainbow-Steelhead		
Density	fish/m^2	2.12
Standing Crop	kg/ha	16.94
Mean Weight	gm	0.8
Mean Length (TL-FL)	mm	45-44
Age 1+ Rainbow-Steelhead		
Density	fish/m^2	0.36
Standing Crop	kg/ha	47.57
Mean Weight	gm	13.2
Mean Length (TL-FL)	mm	119-114

Table 59. Measured physical parameters of one sample station on Little Boulder Creek, a tributary of the Potlatch River, Idaho, 1984.

Physical Parameter	STATION 1 Value
Station Length (m)	40
Station Area (m2)	44.40
Late Summer Stream Flow (m3/sec)	0.004
Annual Stream Flow Variation	Moderate
Summer Temp. (C)	15.0
Water Velocity (cm/sec)	8.0
Stream Width (m)	1.11
Stream Depth (cm)	4.7
Instream Cover (%)	3.4
Eroding Banks (%)	10
Cobble Embeddedness (%)	50
Major Substrate Type	Sand
Pool/Riffle Ratio	10:90
Periphyton Coverage (%)	0

EAST FORK POTLATCH

East Fork Potlatch Creek is one of the larger tributaries of the Potlatch River. East Fork Potlatch Creek is approximately 30 km long and contains 103 km of tributary streams. The creek originates on the western slope of Hemlock Butte and flows southwesterly, discharging into Potlatch River at SK 61.8. The East Fork Potlatch system is contained within National Forest, Potlatch Forest Industries, Diamond International, Idaho State, Bureau of Land Management, and private lands. Most of East Fork Potlatch flows through a high wide meadow. Livestock graze throughout the basin and logging occurs in the upper reaches of this system. The riparian zone of the lower 5 km of East Fork Potlatch Creek has been diminished due to overgrazing. The slopes bordering this area have also been logged intensively. Scouring within the channel proper is evident, indicating extreme fluctuation in stream flow.

The upper reach of East Fork Potlatch is within a typical meadow terrain. The gradient is low, the stream flows slowly and meanders frequently. Several debris jams and beaver dams interrupt flow throughout this area.

The tributaries of East Fork Potlatch generally flow through steep gradient, narrow valleys. These creeks are also extremely brushy, with debris jams and beaver darns interrupting flow throughout their lengths. Brook trout have been observed in several. locations in the tributary streams. Murphy and Metsker (1962) identified the East Fork Potlatch Creek and its tributaries as the principal spawning streams for steelhead in the Potlatch River system.

Two stations were established on East Fork Potlatch Creek. The first station represented a middle reach of East Fork Potlatch Creek. Riparian vegetation was abundant, the gradient was low to moderate, and there was a well defined pool-riffle structure within this section. The upper station was representative of the upper reaches of East Fork Potlatch. Riparian vegetation was also well developed, but the creek was slow moving and meandered frequently. Debris jams and beaver dams were present in this section.

Station #l. Station #1 was established on East Fork Potlatch Creek at SK 18.5. Water quality analysis indicated no limitation to salmonid production (Appendix-Table 17). Species composition of this station consisted of rainbow-steelhead, one brook trout, redside shiners, bridgelip suckers, speckled date, paiute sculpin, and crayfish. Estimated standing crop of overyearling rainbow-steelhead was 14.81 kg/ha, with a density of 0.05 fish/m2. Subyearling rainbow-steelhead were very abundant, but not collected (Tables 60 and 61), as their small size prevented effective sampling with the electrofishing equipment. This same problem could have also prevented effective sampling of subyearling brook trout.

Late summer stream flow was 0.42 m3/sec, with moderate variation in annual flow. Summer water temperature was 20.0 C, well above the optimum range for juvenile rainbow-steelhead (Bovee, 1978). Mean stream velocity was 28.1 cm/sec, the optimum velocity for juvenile rainbow-steelhead (Bovee, 1978). The mean stream width at low flow was 4.98 m. Stream depth averaged 29.8 cm, within the optimum range for juvenile rainbow-steelhead. Instream cover for juvenile rainbow-steelhead was provided by 6.0% of the stream area surveyed; the primary components of instream cover were depth and overhanging vegetation. Thirteen percent of the stream banks showed signs of erosion. The overall channel stability was fair. Cobble embeddedness was 25%, and might be limiting to steelhead production (Bjornn et al., 1977). The major substrate types were large rubble, small rubble, and sand. The high content of sand would make the overall substrate size slightly suboptimum for juvenile rainbow-steelhead (Bovee, 1578). The pool/riffle ratio was 70:30, providing abundant holding area for juvenile salmonids. Periphyton was observed on 30% of the available substrate, indicating moderate primary production. The riparian habitat, consisting of alders, herbs, and grasses, provided 10% of the stream with shade (Table 62).

Station #2. Station #2 was established on East Fork Potlatch at SK 22.8. Rainbow-steelhead, brook trout, speckled date, paiute sculpin, and crayfish were captured at station #2. Estimated standing crop of overyearling rainbow-steelhead was 4.76 kg/ha, with a density of 0.05 fish/m2. Subyearling rainbow-steelhead were not observed (Table 60). Standing crop of overyearling brook trout was estimated at 0.66 kg/ha, with a density of 0.006 fish/m2 (Table 61).

Late summer stream flow was 0.04 m3/sec, with moderate variation in annual flow. The summer water temperature of 19.4 C is above optimum for rainbow-steelhead growth (Bovee, 1578). Mean stream velocity was 1.5 cm/sec, below the lower limit for juvenile rainbow-steelhead. Mean stream width at low flow was 6.05 m. Stream depth averaged 37.5 cm, which is within the optimum depth range for juvenile rainbow-steelhead (Bovee, 1978). Tnstream cover for juvenile rainbow-steelhead was provided by 18.3% of the stream area surveyed. Instream cover consisted primarily of depth and overhanging vegetation. Twenty three percent of the banks were eroding. Overall channel stability was fair. The major substrate types were sand and silt, limiting to steelhead production (Bjornn et al., 1977). The pool/riffle ratio, 90:10, indicated that abundant holding area was available but habitat diversity was limited. Periphyton was observed on 10% of the stream substrate, indicating low primary production. Dense groth of alders, grasses, and herbs shaded 30% of the channel (Table 62).

Table 60. Rainbow-steelhead trout population statistics of two sample stations on East Fork Potlatch Creek, a tributary of the Potlatch River, Idaho, 1984.

Biological Parameter	Units	Station 1 Value	Station 2 Value
Age 0+ Rainbow-Steelhead		RB	
Density	fish/m^2	Present	0
Standing Crop	kg/ha		0
Mean Weight	gm		0
Mean Length (TL-FL)	mm		0
Age 1+ Rainbow-Steelhead			
Density	fish/m^2	0.05	0.05
Standing Crop	kg/ha	14.81	4.76
Mean Weight	gm	31.6	9.6
Mean Length (TL-FL)	mm	130-124	112-106

Table 61. Brook trout population statistics of two sample stations on East Fork Potlatch Creek, a tributary of the Potlatch River, Idaho, 1984.

Biological Parameter	Units	Station 1 Value	Station 2 Value
Age 0+ Brook Trout			
Density	fish/m^2	0	0
Standing Crop	kg/ha	0	0
Mean Weight	gm	0	0
Mean Length (TL-FL)	mm	0	0
Age l+ Brook Trout			
Density	fish/m^2	0.001	0.006
Standing Crop	kg/ha	3.44	0.66
Mean Weight	gm	206.0	12.0
Mean Length (TL-FL)	mm	260-251	123-118

Table 62. Measured physical parameters of two sample stations on East Fork Potlatch Creek, a tributary of the Potlatch River, Idaho, 1984.

Physical Parameter	STATION 1 Value	STATION 2 Value
Station Length (m)	60	60
Station Area (m2)	298.80	363.00
Late Summer Stream Flow (m3/sec)	0.42	0.04
Annual Stream Flow Variation	Moderate	Moderate
Summer Temp. (C)	20.0	19.4
Water Velocity (cm/s)	28.1	1.9
Stream Width (m)	4.98	6.05
Stream Depth (cm)	29.8	37.5
Instream Cover (%)	6.0	18.3
Eroding Banks (%)	13	23
Cobble Embeddedness (%)	25	Sand
Major Substrate Type	Lg./Sm.R., Sand	Sand
Pool/Riffle Ratio	70:30	90:10
Periphyton Coverage (%)	30	10

PURDUE CREEK

Purdue Creek is approximately 6 km long and contains 5 km of tributary streams. Purdue Creek originates at an elevation of 1097 m and flows southwesterly, discharging into Potlatch River at SK 76.1. The Purdue Creek drainage is contained within National Forest, Idaho State, Potlatch Forest Industries, and private lands. The Purdue Creek terrain is primarily high meadow. Most of Purdue Creek is a slow moving, low gradient, meandering stream. The well defined channel travels through deep humic topsoil. The principal land use activity of the Purdue Creek watershed is livestock grazing. Acess to lower Purdue Creek is provided by the Purdue Creek road.

One station was established on Purdue Creek at SK 3.1, and was typical of the overall stream type. Rainbow-steelhead, redside shiners, speckled date, paiute sculpin, and crayfish were captured on Purdue Creek. Three subyearling rainbow-steelhead were captured (Table 63); however, the small size of these fish prevented the measurement of an accurate weight.

Late summer stream flow was 0.02 m3/sec, with moderate variation in annual flow. Summer water temperature was 17.2 C, which is within the optimum range for juvenile rainbow-steelhead (Bovee, 1978). Mean stream velocity was 3.7 cm/sec, the minimum limit for juvenile rainbow-steelhead (Bovee, 1978). Stream width was 1.01 m at low flow. Mean stream depth was 39.6 cm, an optimum depth for juvenile rainbow-steelhead (Bovee, 1978). Instream cover for juvenile rainbow-steelhead was provided by 66.1% of the stream area surveyed. Depth was the primary component of instream cover. Fifty percent of the stream banks showed signs of erosion. Overall channel stability was fair. The stream substrate was primarily sand and silt. Ten percent of the total substrate was gravel. The high content of sand and silt (90%) in Purdue Creek can limit production of rainbow-steelhead (Bjornn et al., 1977). The pool/riffle ratio was 80:20, indicating abundant holding area, but limited habitat diversity, for juvenile rainbow-steelhead. Periphyton was not observed in the sample station, indicating low primary production. However, moss was present on 15% of the available woody debris. The riparian habitat consisted of grasses, herbs, and alders. Woody debris was abundant in the sample section. Ten percent of the stream was shaded by the riparian vegetation (Table 64).

Table 63. Rainbow-steelhead trout population statistics of one sample station on Purdue Creek, a tributary of the Potlatch River, Idaho, 1984.

Biological Parameter	Units	Station 1 Value
Age 0+ Rainbow-Steelhead		
Density	fish/m^2	0.007
Standing Crop	kg/ha	NA
Mean Weight	gm	NA
Mean Length (TL-FL)	mm	35-33
Age l+ Rainbow-Steelhead		
Density	fish/m^2	0
Standing Crop	kg/ha	0
Mean Weight	P	0
Mean Length (TL-FL)	mm	0

Table 64. Measured physical parameters of one sample station on Purdue Creek, a tributary of the Potlatch River, Idaho, 1984.

Physical Parameter	STATION 1 Value
Station Length (m)	40
Station Area (m2)	40.40
Late Summer Stream Flow (m3/sec)	0.02
Annual Stream Flow Variation	Moderate
Summer Temp. (C)	17.2
Water Velocity (cm/sec)	3.7
Stream Width (m)	1.01
Stream Depth (cm)	39.6
Instream Cover (%)	66.1
Eroding Banks (%)	50
Cobble Embeddedness (%)	Sand
Major Substrate Type	Sand
Pool/Riffle Ratio	80:20
Periphyton Coverage (%)	0

WEST FORK POTLATCH

West Fork Potlatch is approximately 11 km in length and contains 41 km of tributary streams. West Fork Potlatch originates at an elevation of 1120 m and flows southeasterly, discharging into Potlatch River at SK 78.0. Feather Creek, Cougar Creek, and Talapus Creek are the major tributaries of West Fork Potlatch. Feather Creek is 8 km long, contains 4 km of tributary streams, and enters West Fork Potlatch at SK 1.3. Cougar Creek is 6 km long, contains 2 km of tributary streams, and discharges into West Fork Potlatch at SK 4.5. Talapus Creek is 3 km long and enters West Fork Potlatch at SK 6.0. The West Fork Potlatch drainage is contained within National Forest, private, Potlatch Forest Industries, and Diamond International lands. West Fork Potlatch terrain is primarily high meadow. The stream is slow moving, has a low gradient and meanders frequently. Grasses and alders are the major vegetation types in the meadow. Head water streams are shallow and narrow. They flow over a moderate to high gradient through timbered, steep mountain slopes. The principal land use activity impacting West Fork Potlatch is livestock grazing. Reduced riparian habitat and high sediment loads result from the grazing. Access to West Fork Potlatch is provided by Forest Service Road 1954.

Three stations were established on West Fork Potlatch. Two were representative of the slow moving, meandering, high meadow streams, and the third represented the headwater streams.

Station #l. Station #l was established on West Fork Potlatch at SK 1.6. Water quality analysis indicated no limitation to salmonid production (Appendix-Table 13). Redside shiners, speckled date, paiute sculpin, and crayfish were captured at station #1. Redside shiners and speckled date were abundant. No salmonids were captured at this station (Table 65).

Late summer stream flow was 0.02 m3/sec, with moderate variation in annual flow. Summer water temperature was 17.2 C, which is within the optimum range for juvenile rainbow-steelhead (Bovee, 1978). Mean stream velocity was 3.7 cm/sec, the minimum limit for juvenile rainbow-steelhead (Bovee, 1978). Stream width at low flow was 2.47 m. Mean stream depth was 31.8 cm, within the optimum range for juvenile rainbow-steelhead (Bovee, 1978). Instream cover was provided by 32.1% of the stream area surveyed. Depth was the primary component of instream cover. One hundred percent of the stream banks were in various stages of erosion, and overall channel stability was poor. Sand and silt were the principal substrate types; only four percent of the total substrate content was small rubble and gravel. The high content of fine substrate size is limiting to steelhead production (Bjornn et al., 1977). The pool/riffle ratio was 98:2, indicating abundant holding area, but limited habitat diversity, for juvenile rainbow-steelhead. Periphyton was not observed on the stream substrate. The riparian habitat was well developed and consisted of alders and grasses. Twenty percent of the stream was shaded from this low to intermediate canopy (Table 66).

Station #2. Station #2 was established on Feather Creek at SK 0.6. A few conifers lined the stream, but the principal vegetation types were grasses and alders. Woody debris was abundant in the sample station.

Redside shiners, bridgelip suckers, speckled date, paiute sculpin frogs, and crayfish were captured at station #2. Bridgelip suckers were less abundant than the other species captured. No salmonids were captured at this station (Table 65).

Late summer stream flow was 0.07 m3/sec, with moderate variation in annual flow. Summer water temperature was 18.3 C, which is within the suboptimum range for juvenile rainbow-steelhead (Bovee, 1978). Mean stream velocity was

9.5 cm/sec, also within the suboptimum range for juvenile rainbow-steelhead. Stream width at low flow was 2.67 m. Mean stream depth was 28.1 cm, the optimum depth for juvenile rainbow-steelhead (Bovee, 1978). Instream cover for juvenile rainbow-steelhead was provided by 6.6% of the stream area surveyed. Depth was the principal component of instream cover. Thirty eight percent of the banks showed signs of erosion. Overall channel stability was fair. The major substrate types were sand and silt, which is limiting to juvenile steelhead (Bjornn et al., 1977). The pool/riffle ratio was 44:56, indicating abundant holding area, and for good habitat diversity for juvenile salmonids. Periphyton was not observed, which indicated a lack of primary production. Moss was present on 30% of the woody debris and stream substrate. The riparian habitat consisted of grasses, herbs, and alders. Ten percent of the stream was shaded by the low to intermediate canopy (Table 66) .

Station #3. Station #3 was established on Upper Feather Creek at SK 4.5. The stream flowed through a narrow timbered valley.

Brook trout were the only fish captured. Estimated standing crop of overyearling brook trout was 6.42 kg/ha, with a density of 0.06 fish/m2. No subyearling brook trout were captured (Table 67).

Late summer stream flow was 0.04 m3/sec, with moderate variation in annual flow. Summer water temperature was 13.3 C, within the optimum range for juvenile rainbow-steelhead. Mean stream velocity was 13.3 cm/sec, also within optimum range for juvenile rainbow-steelhead. Low flow stream width was 3.08 m. Mean depth was 10.4 cm, which is a suboptimum depth for juvenile rainbow-steelhead (Bovee, 1978). Instream cover for juvenile rainbow-steelhead was provided by 55.0% of the stream area surveyed. The principal component of instream cover was overhanging vegetation. Fifty percent of the stream banks showed signs of erosion, and overall channel stability was fair. Cobble embeddedness was 25%. The major substrate types were small boulder, large and small rubble, the optimum substrate size for juvenile rainbow-steelhead (Bovee, 1978). Pool/riffle ratio was 50:50, providing abundant holding area and for good habitat diversity for juvenile rainbow-steelhead. Periphyton was present on 50%, of the substrate, indicating moderate primary production. The riparian habitat was well developed consisting of alders, grasses, ferns, herbs, and conifers. Seventy percent of the stream section was shaded from the high conifer canopy (Table 66).

Table 65. Rainbow-steelhead trout population statistics of three sample stations on West Fork Potlatch Creek, a tributary of the Potlatch River, Idaho, 1984.

Biological Parameter	Units	Station 1 Value	Station 2 Value	Station 3 Value
Age 0+ Rainbow-Steelhead				
Density	fish/m^2	0	0	0
Standing Crop	kg/ha	0	0	0
Mean Weight	gm	0	0	0
Mean Length (TL-FL)	mm	0	0	0
Age 1+ Rainbow-Steelhead				
Density	fish/m^2	0	0	0
Standing Crop	kg/ha	0	0	0
Mean Weight	gm	0	0	0
Mean Length (TL-FL)	mm	0	0	0

Table 66. Brook trout population statistics of three sample stations on West Fork Potlatch Creek, a tributary of the Potlatch River, Idaho, 1984.

Biological Parameter	Units	Station 1 Value	Station 2 Value	Station 3 Value
Age 0+ Brook Trout				
Density	$fish/m^2$	0	0	0
Standing Crop	kg/ha	0	0	0
Mean Weight	gm	0	0	0
Mean Length (TL-FL)	mm	0	0	0
Age 1+ Brook Trout				
Density	$fish/m^2$	0	0	0.06
Standing Crop	kg/ha	0	0	6.42
Mean Weight	gm	0	0	11.3
Mean Length (TL-FL)	mm	0	0	109-105

Table 67. Measured physical parameters of three sample stations on West Fork Potlatch Creek, a tributary of the Potlatch River, Idaho, 1984.

Physical Parameter	STATION 1 Value	STATION 2 Value	STATION 3 Value
Station Length (m)	60	60	40
Station Area (m2)	148.20	160.20	123.20
Late Summer Stream Flow (m3/sec)	0.02	0.07	0.04
Annual Stream Flow Variation	Moderate	Moderate	Moderate
Summer Temp. (C)	17.2	18.3	13.3
Water Velocity (cm/s)	3.7	9.5	13.3
Stream Width (m)	2.47	2.67	3.08
Stream Depth (cm)	31.8	28.1	10.4
Instream Cover (%)	32.1	6.6	55.0
Eroding Banks (%)	100	38	50
Cobble Embeddedness m	Sand	Sand	25
Major Substrate Type	Sand	Sand	Sm.B., Lg./Sm.R.
Pool/Riffle Ratio	98:2	44:56	50:50
Periphyton Coverage (%)	0	0	50

ENHANCEMENT RECOMMENDATIONS

The baseline data described on the inventory streams will be used to recommend enhancement measures to increase or improve salmonid habitat within the study area. Throughout the stream narratives, we have given brief descriptions of the inventory streams, the land use activities which affect each, and more thorough descriptions of physical habitat and estimates of salmonid populations within representative reaches. In the following section, we will decribe the problems which currently limit salmonid production in each of the inventory streams and solutions to remedy the problems. The solutions will include the specific activities necessary and the predicted results of those enhancement activities.

Enhancenent Recommendations-Clear Creek System

CLEAR CREEK

Problems: Lack of riparian habitat; sedimentation; lack of instream cover; low summer flows; high summer water temperatures; and migratory barriers.

The lower 12 km of Clear Creek is the most severely impaired reach of this stream. Private residences, cattle pens, and small farm plots line much of the lower reach. Overgrazing has diminished riparian vegetation, thereby contributing to high summer water temperatures, unstable bank structure, reduction of streamside cover, extreme fluctuation in flow, and increased sedimentation. Furthermore, agricultural and grazing activities are most intense within the lower tributary basins, adding to sediment content of mainstem Clear Creek. Sedimentation can reduce pool habitat, cover good spawning gravels, cause braiding of the stream course, reduce survival of emerging fry, and diminish diversity of prey type.

The upper drainage receives a high content of sediment from logging and roading activities. Clear cuts have long impacted the headwaters of Clear Creek. Martin (1976) and the U.S. Forest Service (1980) found that upper Clear Creek would be excellent salmonid rearing habitat if not for the sediment load attributed to logging in this area. The present inventory found that the lower Clear Creek stations supported a small population of rainbow-steelhead, the middle reach a moderate population with a greater number of overyearlings, and the headwaters an excellent population of juvenile cutthroat trout. Since much of Clear Creek flows through steep, narrow, high gradient canyons, debris jams often form and act as temporary barriers to migrating anadromous salmonids.

Solution: Extensive revegetation and exclusion of livestock from the lower 12 km stream reach would address the lack of riparian habitat and its associated effects. Cooperation and coordination with local farmers and ranchers for better land management practices is needed. The upper basin would benefit from better logging practices, reforestation or revegetation of clear cuts, and reseeding unused logging roads. The upper basin will always be subject to debris jam barriers, but they should be removed and monitored annually. Check dams and placement of large boulders throughout the stream drainage would increase pool habitat and instream cover. Stream braiding in the lower reach could be corrected with rechannelization and bank reinforcement. Head sloping of existing vertical banks and bank reinforcement would correct sites of mass erosion. And, flow augmentation by construction of a storage reservoir in the headwaters of Clear Creek, would reduce low flow effects, increase instream cover, and reduce high summer water temperatures.

Predicted results:

1. Stabilize banks.
2. Reduce sedimentation.
3. Increase streamside cover.
4. Increase instream cover.
5. Reduce high summer water temperatures.
6. Increase pool habitat.
7. Provide anadromous salmonid access into the upper reaches.
8. Flow augmentation.

Specific activities:

1. Revegetation of the lower 12 km of stream banks.
2. Fencing to exclude livestock from most of the lower 12 km of stream.
3. Construction of approximately 30 check dams in the lower 20 km of stream.
4. Placement of large boulders or wing deflectors in the lower 20 km of stream.

5. Headsloping of vertical banks and bank reinforcement on sites of mass erosion in the lower 12 km of stream.
6. Removal of debris jams and annual monitoring.
7. Revegetation of clear cuts and logging roads affecting the upper 5 km of stream.
8. Construction of a storage reservoir in the headwaters of Clear Creek.
9. Rechannel areas of excessive stream braiding in the lower 12 km of stream.

Land ownership:

54% U.S. Forest Service;

46% private.

BIG CEDAR CREEK

Problem: Low summer flow; shallow mean depth; sedimentation; lack of good pool structure; and loss of riparian habitat.

Big Cedar Creek flows overground from the community of Big Cedar to the mouth of the creek, a distance of approximately 9.5 km. Livestock graze in several sites along this reach and have not severely impacted the riparian zone but, nevertheless, influence sediment load and bank structure. A road paralleling the creek and agricultural activities on the surrounding slopes also contribute to the sediment load. Since this is generally a low land stream, flow and mean depth are regulated by seasonal precipitation. Pools are formed primarily by small debris jams and are structurally controlled by flow variation.

Solution: Fencing off cattle yards to exclude livestock from the stream banks would promote riparian development, thereby reducing extreme fluctuations in water temperature, reduce sedimentation, and provide greater streamside cover. The construction of a storage reservoir below Big Cedar would augment flows, increasing overall depth, pool habitat and instream cover, and reduce extreme variations in water temperature. Check dams at several sites within the lower reach would act as sediment traps, provide a more stable pool structure, and increase instream cover.

Predicted results:

1. Increase streamside cover.
2. Reduced sedimentation.
3. Reduced variation in water temperature.
4. Increased pool cover.
5. Augment low summer flow.
6. Increase instream cover.

Specific activities:

1. Approximately 3 km of riparian enhancement and fencing below cattle use areas.
2. Construction of a storage reservoir below Big Cedar, Idaho.
3. Construction of approximately 10 check dams on the lower 8 km of Big Cedar Creek.

Land ownership:

100% Private.

WEST FORK CLEAR CREEK

Problem: Migratory barriers; low summer flow; unstable stream course; lack of instream cover; shallow mean depth; lack of good pool habitat; and sedimentation.

Migratory barriers are the main deterrent to anadromous salmonid production in West Fork Clear Creek. Several debris jams and extreme stream gradient prevent the passage of fish above SK 0.5. Within the headwaters, low summer flow regulates pool habitat, mean depth, and amount of instream cover. The channel was shallow, not well defined, and could be altered by small accumulations of debris. Sedimentation, attributed to logging and roading activities, also reduced potential of this stream as rearing habitat for anadromous salmonids. Despite the unsuitability for anadromous fish, a relatively productive cutthroat trout population was supported in the headwaters of West Fork Clear Creek.

Solution: Providing passage above the barriers in West Fork Clear Creek is not recommended. As the creek travels through a narrow, high gradient canyon, debris jams will be an annual occurrence with the advent of spring runoff. Development of spring sources and the construction of a storage reservoir in the headwaters would enhance the cutthroat trout population, but have negligible effect enhancing the anadromous salmonid habitat of the lower 0.5 km of West Fork Clear Creek.

Specific Activities:

None.

Land ownership:

100% U.S. Forest Service.

HOODOO CREEK

Problem: Migratory barriers; low summer flows; unstable stream course; lack of instream cover; shallow mean depth; lack of good pool habitat; and sedimentation.

Migratory barriers are the main deterrent to salmonid production in Hoodoo Creek. Falls, located at SK 1.0, and the West Fork Clear Creek barriers at SK 0.5, prevent the passage of anadromous fish into this stream. A population of cutthroat trout could be supported in the upper reaches of Hoodoo Creek, since the habitat is similar to West Fork Clear Creek, but the fish would have to be transplanted into this system. The problems associated with low flow, shallow mean depth, lack of instream cover, lack of pool habitat, and unstable stream course, also impact Hoodoo Creek. Sedimentation, attributed to logging and roading activities, reduces the potential salmonid habitat of this stream.

Solution: Providing passage over the falls on Hoodoo Creek is not recommended. The stream flows through a narrow, high gradient canyon which would be susceptible to annual debris jams. No other enhancement procedures are recommended.

Specific activities:

None.

Land ownership:

100% U.S. Forest Service.

SOUTH FORK CLEAR CREEK

Problem: Sedimentation; lack of instream cover; lack of pool and occasional debris jams.

South Fork Clear Creek receives a high sediment load from logging activities in the West Branch of South Fork Clear Creek. The South Fork Clear Creek and the Clear Creek #3 stations were similar in almost every aspect, excepting sediment content. The Clear Creek #3 station produced a relatively high standing crop of rainbow-steelhead, while few rainbow-steelhead occupied the South Fork station. Sedimentation results in reduced pool volume, reduced instream cover, and decreasing the diversity of benthic invertebrates (Bjornn et al., 1977). Sediment also covers spawning gravels, reducing potential for adult spawning and survival of emerging fry.

Solution: Both instream cover and pool habitat could be improved by placement of check dams or sediment traps at several sites in the stream. However, South Fork Clear Creek flows over a moderate to high gradient; small waterfalls are abundant and should already act as check dams. Evidently, these are not effective, so other enhancement measures must address the sediment problem.

Control of the source of sedimentation is necessary. Revegetation of the clear cut areas and unused logging roads, in addition to protection of existing riparian habitat in the headwaters, could reduce the amount of sediment continually washing into South Fork Clear Creek. Much of the clear cut areas in the upper basin are naturally becoming revegetated. After the soil becomes tied down, high spring flows should clear the sediment from the streambeds. Methods have been developed to actually wash the substrate by using caterpillar tractors or a suction dredge, but access into South Fork Clear Creek is extremely limited, making these procedures cost ineffective.

Predicted results:

1. Reduced sedimentation.
2. Increase pool cover.
3. Increase instream cover.
4. Increase streamside cover.

Specific activities:

1. Approximately 30 km of riparian enhancement in both the West Branch and Kay Creek tributaries and in the headwaters of South Fork Clear Creek.
2. Revegetation of old logging roads in the upper South Fork Clear Creek basin.

Land ownership:

100% U.S. Forest Service.

MIDDLE FORK CLEAR CREEK

<u>Problem</u>: Low summer stream flow; lack of instream cover; shallow mean depth; lack of pool habitat; and migratory barriers.

Previous studies by Martin (1976) and the U.S. Forest Service (1980) determined that Middle Fork Clear Creek is of little use to anadromous fish. Martin (1976) attributed the poor condition of Middle Fork to high sediment content, marginal benthos production, high gasket effect, and a series of 3-4 m high waterfalls just above the confluence with Solo Creek, acting as migratory barriers. The U.S. Forest Service (1980) found that the barriers and lack of spawning habitat rendered the Middle Fork unsuitable for salmonid production.

The present inventory found that a population of rainbow-steelhead was supported above the barriers cited in Martin's (1976) and the U.S. Forest Service (1980) reports. Rainbow-steelhead density in this reach was more likely regulated by abundance of spawning pairs, than the limitations of the rearing habitat. Low summer flow contributed to lack of instream cover, shallow mean depth, and lack of pool habitat.

Solution: Improved passage over the falls in the middle reach would result in the most significant increase of anadromous salmonids in this stream, but access into Middle Fork Clear Creek is limited, and most enhancement measures would be restricted to hand work. Boulders and check dams would provide for greater pool habitat and increase instream cover. Construction of a storage reservoir in the headwaters would also augment low summer flow, increase overall stream depth, pool habitat, instream cover, and reduce extreme fluctuations of water temperature. Revegetation of selected stream banks would provide greater streamside cover, reduce stream sedimentation, and reduce fluctuations of water temperature. Although sedimentation and gasket effect were determined to limit salmonid production of Middle Fork in the earlier studies (Martin, 1976; U.S. Forest Service 1980), these substrate parameters were not inordinately high over the stream area surveyed in the present inventory.

Predicted results:

1. Increase passage into the upper and middle reaches of the stream.
2. Increase pool habitat.
3. Increase instream cover.
4. Increase overall stream depth.

5. Augment low summer flows.
6. Reduce extreme temperatures.
7. Increase streamside cover.
8. Reduce sediment load.

Specific activities:

1. Improve passage over the falls above the confluence with Solo Creek.
2. Placement of approximately 30 check dam structures between the confluence of Solo Creek with Middle Fork Clear Creek and Forest Service Road 286.
3. Placement of large boulders or wing deflectors above the confluence of Solo Creek with Middle Fork Clear Creek and Forest Service Road 286.
4. Revegetate approximately 6 km of stream banks between the Solo Creek confluence and Forest Service Road 286.
5. Construct a storage reservoir in the headwaters of Middle Fork Clear Creek.

Land ownership:

100% U.S. Forest Service.

PINE KNOB CREEK

Problem: High sedimentation and gasket effect; low summer flow; lack of instream cover; shallow depth; and lack of pool habitat.

A clear cut in the headwater area of Pine Knob Creek has resulted in extensive stream sedimentation and cobble embeddedness. Martin's (1976) survey reported that, although this system has a good pool-riffle structure and riparian zone, sediment content reduced the beneficial effects these parameters might have contributed to salmonid production. The U.S. Forest Service (1980) also noted that poor logging practices in the clear cuts added excessive sediment to Pine Knob Creek. The present inventory documented an unusually high population of cutthroat trout occupying Pine Knob Creek; however, the sample station was located above the sites of massive erosion.

Solution: Enhancement measures must focus on reducing the source of sediment and promoting cleansing of the existing sand from the stream. Methods of stabilizing erosion are revegetation of the stream banks where buffer zones have been degraded and revegetation within the clear cut itself. Natural revegetation is now occurring, but could be enhanced. Once the sources of erosion have been controlled, instream cover and pool habitat will gradually be restored. Seasonal runoff would sweep much of the sand and silt downstream. Low flow and shallow depth could be augmented by construction of by construction of a storage reservoir in the headwaters of Pine Knob Creek.

Predicted results:

1. Decreased sediment load and gasket effect.
2. Increase pool habitat.
3. Increase streamside cover.
4. Increase instream cover.
5. Flow augumentation.

Specific activities:

1. Identify the sites of denuded riparian zone and replant these areas.
2. Revegetation of the clear cut slopes.
3. Construction of a storage reservoir in the headwaters of Pine Knob Creek.

Land ownership:

100% U.S. Forest Service.

Enhancement Recommendations-Orofino Creek System

OROFINO CREEK

Problem: Migratory barriers; slight cobble embeddedness; high summer water temperatures; lack of pool habitat; lack of riparian habitat; lack of instream cover.

The cataract falls barrier on lower Orofino Creek is the greatest deterrent to anadromous salmonid production in this system. Overall, the habitat was well suited to salmonid production. Problem areas determined in this study, cobble embeddedness (25%), high summer water temperatures, lack of pool habitat, lack of riparian habitat, and lack of instream cover, were marginal. If the barrier were removed, an exceptional salmonid spawning habitat would be provided to the lower Clearwater River. The U.S. Bureau of Reclamation (1984) predicted that an estimated 72,000 smolts or 1,200 returning adult spawners could utilize the habitat above the falls. Commercial and sports fishermen could also harvest an additional 2,400 adult steelhead.

The second falls, just above the confluence of Cow Creek and Orofino Creek, might also be a barrier to rainbow-steelhead migration. These falls are not as great an obstruction as the cataract, but improved passage is recommended.

The present inventory found populations of brook and rainbow trout in all the sampled tributary streams. Limited populations, but larger size brook and rainbow trout, occupied the mainstem. The tributary streams may act as a nursery area for the large mainstem trout.

Solution: Passage over the cataract falls and the smaller falls above Cow Creek should be provided. Further enhancement recommendations for tributaries of Orofino Creek will be proposed as if passage has been provided.

Predicted results:

1. 74 km of additional steelhead habitat in the mainstem Orofino Creek.

Land ownership:

34% private;
34% Potlatch Forest Industries;
16% Idaho State land;
16% U.S. Forest Service.

COW CREEK

Problem: Low summer flow; shallow mean depth; high sediment content; cobble embeddedness; lack of riparian habitat; and lack of stable pool habitat.

The Cow Creek system consists of small, shallow, brushy streams. Historically, the greatest impairment of this drainage was low summer flow, which influenced shallow mean depth, instream cover, and water temperature. Pool structure was temporary as small debris jams are regulated by fluctuations in runoff.

Significant salmonid production is probably limited to the lower 1.5 km of Cow Creek, the headwaters of Cow Creek, and headwaters of the tributary streams. The middle reaches are impacted by both logging and grazing activities. Logging sites on the tributaries have denuded riparian habitat and cluttered the stream beds with debris. The road paralleling Cow Creek receives moderate use from logging trucks and private vehicles, contributing to sediment content and hence, cobble embeddedness. Cattle graze in the middle meadow reach, also adding to loss of riparian habitat, sediment load, and unstable bank structure.

Solution: Logging practices should be amended and logging sites cleared up such that impact on the salmonid producing streams is limited. Revegetation of denuded stream banks would control sediment load, reduce high summer water temperatures, and increase streamside cover. Fencing to exclude livestock and restoration of the meadow riparian zone would also enhance salmonid production in the middle reach. Construction of a storage reservoir in the headwaters of Cow Creek would augment low summer flows, reduce high summer water temperatures, increase mean depth and instream cover. Check dams should be constructed at several locations in the stream to provide a more stable pool habitat and increase the pool/riffle ratio.

Predicted results:

1. Increase streamside cover.
2. Reduce sediment load.
3. Reduce high summer water temperatures.
4. Augment low summer flow.
5. Increase instream cover.
6. Increase pool habitat.

Specific activities:

1. Revegetation of approximately 10 km of denuded stream banks

on all three tributaries and the middle, meadow reach of Cow Creek.

2. Revegetation of loading zones impacting the tributary streams.
3. Clearing logging debris from approximately 2 km of stream channel in the logged areas.
4. Fencing to exclude livestock from approximately 2 km of the meadow reach.
5. Construction of a storage reservoir in the headwaters of Cow Creek.
6. Construction of 10 check dam structures in the lower 3 km of Cow Creek.

Land Ownership:

57% Potlatch Forest Industries;

28% Private;

15% Idaho State.

POORMAN CREEK

Problem: Low summer stream flow; shallow mean depth; lack of instream cover; bank erosion; cobble embeddedness; and lack of good pool habitat.

Poorman Creek is subject to low summer flows, hence, shallow mean depth, lack of instream cover, and lack of pool habitat. Although Campbells Pond, a storage reservoir, is located on a tributary of Poorman Creek, the purpose of the pond is for providing a recreation area, not for flow augmentation in the lower stream. Cobble embeddedness is attributed to logging activities in the drainage and can limit successful spawning of salmonids. Presently, logging is focused on the western slope of the drainage, above the confluence of Hay Creek and Poorman Creek, and in the headwaters above Highway 11. The actual streambed runs through a steep valley from Highway 11 to the mouth and receives little logging impact. Enhancement measures should concentrate on improving the habitat within the stream itself.

Solution: Constructing a storage facility on the headwaters of Poorman Creek to augment low summer flow would also increase mean depth, instream cover, and pool habitat. Check dams and boulders would also provide additional pool habitat and instream cover. Eroding banks could be stabilized by headsloping and bank reinforcement.

Predicted results:

1. Augment low summer flow.
2. Increase mean depth.
3. Increase instream cover.
4. Increase pool habitat.
5. Stabilize eroding banks.

Specific activities:

1. Construction of a storage facility in the headwaters of Poorman Creek.
2. Construction of approximately 10 check dam structures between Highway 11 and the mouth of Poorman Creek.
3. Placement of large boulders in several sites within the creek.
4. Stabilize approximately 2 km of eroding stream banks, between Highway 11 and the mouth of Poorman Creek.

Land ownership:

70% Potlatch Forest Industries;

30% Idaho State.

QUARTZ CREEK

Problem: High use area; lack of riparian habitat; high sediment content; high cobble embeddedness.

Several land use activities impact Quartz Creek which will limit the effectiveness of any enhancement measures. Both Highway 11 and the Bald Mountain Ski Area Road parallel the entire stream length. Traffic into Jaype Mill is constant and the mill yard itself borders this reach of stream bank. Livestock are penned in the upper meadow and a repair yard for logging trucks operates there. The riparian habitat has been reduced in the logging yard, the meadow reach, and beside the highway. Cobble embeddedness and sediment content are both high, thereby reducing potential spawning grounds for anadromous salmonids. This stream will continue to be subject to heavy vehicle traffic, making enhancement measures rather futile. Brook trout populations should survive in the upstream meadow as long as the thick riparian habitat remains relatively undisturbed. It is recommended that Quartz Creek continue to be managed as a "put-and-take" rainbow-steelhead stream; no enhancement measures are proposed.

Specific activities:

None.

Land ownership:

77% Potlatch Forest Industries;

9% Idaho State;

9% private;

5% U.S. Forest Service.

TRAIL CREEK

Problem: Low summer flow; lack of instream cover; cobble embeddedness; high sediment load; lack of pool habitat; and bank erosion.

Trail Creek winds through typical meadow habitat. Riparian growth is generally well developed but in areas where it's absent, the humic topsoil rapidly erodes into the stream? adding to sediment load and cobble embeddedness. The upper drainage has been logged, which also contributes to sediment load. Low summer flows limit both pool habitat and instream cover. Riparian growth has been impaired by grazing livestock, contributing to bank erosion and sediment load.

Solution: Bank erosion should be controlled by headsloping of vertical banks and stabilizing sites of mass erosion. Revegetation of denuded banks and excluding livestock from the streambed will also control erosion and sediment load. Check dams and boulders or wing deflectors would provide for increased pool habitat and instream cover. A storage reservoir in the headwaters of Trail Creek would augment low summer flows, increasing pool habitat and instream cover.

Predicted results:

1. Reduce sediment load and cobble embeddedness.
2. Increase instream cover.
3. Increase streamside cover.
4. Increase pool habitat.
5. Augment low summer flows.

Specific activities:

1. Headsloping and stabilizing approximately 4 km of eroding stream banks throughout the stream length.
2. Revegetate approximately 2 km of stream banks.
3. Construction of approximately 15 check dam structures throughout the stream length.
4. Placement of boulders or wing deflectors throughout the stream length.
5. Construction of a storage reservoir in the headwaters to augment low summer flows.

Land ownership:

10% Potlatch Forest Industries;

20% U.S. Forest Service

LITTLE BEAVER CREEK

Problem: Low summer flow; shallow mean depth; and lack of pool habitat.

The greatest deterrent to anadromous salmonid production in Little Beaver Creek is low summer flow. Overall, habitat conditions and land use activities were not disadvantageous to rainbow-steelhead, but several parameters relating to flow could be enhanced.

Solution: A storage reservoir constructed in the headwaters of Little Beaver Creek would augment low summer flows, increasing mean depth and providing pool habitat. Check dams and boulders or wing deflectors would also increase pool habitat and instream cover.

Predicted results:

1. Augment low summer flows.
2. Increase pool habitat.
3. Increase mean depth.
4. Increase instream cover.

Specific activities:

1. Construction of a storage reservoir in the headwaters of Little Beaver Creek.
2. Construction of approximately 10 check dams throughout the stream length.
3. Placement of boulders or wing deflectors throughout the stream length.

Land ownership:

95% Potlatch Forest Industries;

5% Idaho State.

CANAL GULCH

Problem: Debris jams; low summer flow; lack of pool-riffle structure; lack of instream cover; high sediment load.

Most of the Canal Gulch system flows through a low gradient, brushy, meadow habitat. The drainage contains a high sediment load, which is attributed to logging and logging traffic. The creeks are often choked with debris, creating numerous small ponds, which probably support a substantial population of brook trout, but do not provide favorable habitat for anadromous salmonids. Production of rainbow-steelhead is limited by lack of spawning gravels, pool-riffle structure, and instream cover; all attributed to the low gradient and sediment load of this system.

Solution: Enhancement measures on Canal Gulch are limited. The low gradient, brushy habitat will continue to promote formation of debris jams. Since flow, gradient, and velocity are not sufficient to flush accumulated sediment from the streambed, spawning substrate, pool-riffle structure, and instream cover will not be improved. Therefore, no enhancement measures are proposed for the Canal Gulch system.

Specific activities:

None.

Land ownership:

70% Potlatch Forest Industries;

21% Idaho State;

5% U.S. Forest Service;

2% private.

RHODES CREEK

Problem: Lack of instream cover; lack of distinct pool riffle structure.

Rhodes Creek is in fairly good condition; the only habitat parameters in need of enhancement are instream cover and pool habitat. The upper reaches of Rhodes Creek are impacted by logging activities but the system apparently controls any adverse effects associated with the operation.

Solution: Wing deflectors and large boulders should provide the instream cover necessary. Pool habitat is available, but due to the relatively large size of this creek, there is considerable distance between each. The system needs a few small obstructions to interrupt flow, create small pools, and additional instream habitat.

Predicted results:

1. Increase pool habitat.
2. Increase instream cover.

Specific activities:

1. Placement of wing deflectors and boulders throughout the lower 6 km of Rhodes Creek.

Land ownership:

84% Potlatch Forest Industries;
10% Idaho State;
4% U.S. Forest Service;
2% private.

SHANGHAI CREEK

Problem: Low summer stream flow; high sediment content; shallow mean depth.

Upper Shanghai Creek was the site of a substantial logging operation but most of the activity is now over. Although log trucks still use the Shanghai Creek Road, the stream is slowly returning to its natural state. Moderate gradient and the good riparian structure will facilitate transport of sediment load downstream. The clear cut needs to regrow a multi-layered canopy to better hold the soil. Presently, the clear cut contains ferns, annual grasses, and little else. From the Shanghai Creek Road to the confluence with Rhodes Creek, the stream travels through a narrow steeper gradient which is relatively undisturbed by land use activities. This draw might provide the best habitat for rainbow-steelhead.

Solution: Enhancement measures should focus on encouraging this basin to return to its undisturbed state. Revegetation of the clear cut with conifers, and, perhaps creating greater flow regimes with a storage reservoir, would diminish the sediment load of this system.

Predicted results:

1. Decrease sedimentation.
2. Augment low summer flows.

Specific activities:

1. Revegetate approximately 3.8 km2 of the upper basin with conifers.
2. Construct a storage facility in the headwaters of Shanghai Creek.

Land ownership:

90% Potlatch Forest Industries;

10% Idaho State.

Enhancement Recommendations-Potlatch River System

POTLATCH RIVER

Problem: Extreme flow variation; high summer water temperatures; unsuitable substrate; lack of riparian habitat.

The Potlatch River can be divided into three separate stream reaches; from the mouth to the confluence with Cedar Creek, from the confluence with Cedar Creek to the confluence with the East Fork, and upstream from the confluence with East Fork. Each has its own stream conditions determined by the topography and the degree of use of the surrounding watershed. Generally, the limiting parameters which occur throughout the drainage are high summer water temperatures and extreme fluctuation in flow.

The most severely impacted reach of the Potlatch River is between Cedar Creek and the mouth. This reach receives runoff from the streams which flow through heavily agricultural watersheds. The water temperatures are highest and the variability in flow the most extreme, which has resulted in denuded banks, embedded large cobble, and limited spawning gravels. The reach also receives effluent from the communities of Juliaetta and Kendrick. The habitat upstream from Kendrick improves considerably.

The mainstem Potlatch, from Cedar Creek to the confluence with East Fork Potlatch, is relatively undisturbed and provides the best salmonid habitat in the drainage. Pool-riffle structure is good, gravels are suitable for spawning, riparian vegetation is the most undisturbed of the mainstem, and this area receives little direct impact from land use activities. Any habitat improvement recommendations should focus on improving this reach of Potlatch, since the upstream and downstream areas offer so little potential.

From the confluence of the East Fork to the headwaters, salmonid habitat is again reduced. The stream gradient levels out, causing a decrease in stream velocity, which allows the sediment to build up and cover any suitable spawning gravels. Instream cover is limited to woody debris, and undercut banks, a partial canopy provided by annual grasses. Pool-riffle structure is lacking, as the stream is primarily an even depth run. The stream also travels through grazing lands (which results in unstable bank structure), and the outskirts of the community of Bovill. Enhancement alternatives would provide little benefit to salmonid production within this reach, and, as mentioned above, should concentrate on improving the habitat, primarily as related to flow and temperature, within the middle reach.

Solution: The U.S. Bureau of Reclamation (1984) studied the feasibility of putting a storage reservoir in the middle reaches of the East Fork Potlatch to augment low summer flows, control high summer water temperatures, and reduce erosion in the mainstem of the Potlatch River. Since this recommendation would provide the greatest improvement to the middle reach of Potlatch, it is still considered to be the most viable alternative. However, the Bureau of Reclamation's (1984) study determined that the costs associated with the reservoir would be greater than the benefits. Tine benefits include an optimistic estimate of 1,300 returning adult steelhead spawners after a five year build up period. But the capital expenditures and the operating costs were much greater than the monetary benefits attributed to increased steelhead production. Yet the fact still remains that flow and temperature regimes must be controlled to promote increased salmonid use of the Potlatch River. Therefore, the storage reservoir will still be recommended as the best enhancement measure for the Potlatch.

Predicted Results:

1. Flow augmentation.
2. Decreased summer water temperatures.
3. An additional 1,300 returning adult steelhead into the Potlatch River.

Specific Activities:

1. Construction of the Fry Meadow Reservoir as proposed by the Bureau of Reclamation.

Land ownership:

60% Private;

20% Potlatch Forest Industries;

15% U.S. Forest Service;

5% Idaho State.

LITTLE POTLATCH CREEK

Problem: Extreme flow variation; high summer water temperatures; shallow mean depth; lack of instream cover; cobble embeddedness; lack of pool habitat; and lack of riparian vegetation.

Little Potlatch is of marginal use as salmonid habitat. The entire length of the creek receives runoff from agricultural land, which results in high sediment and nutrient content, and extreme, rapid fluctuations in flow. The lower 3 km in particular, evidence the extreme flow conditions impacting this stream. The channel is very wide, the substrate is large,(predominantly boulder and rubble size) vegetation is absent, and during summer, the stream may occupy only five percent of the channel. High summer water temperatures are typical in the lower reach, and often exceed the lethal limit of salmonids. The upper reaches provide only minimal flow, they also carry a high sediment load and flow over a low gradient, which decreases the probability of natural rehabilitation. In addition most of the upper streams flow through farmlands, and receive more immediate effects from livestock and farming activities. The only suitable habitat for salmonids might be found just below the falls in the middle reach. At least pools are present here, which might provide more cover than is generally available. No enhancement recommendations will be made for Little Potlatch Creek.

Specific activities:

None.

Land ownership:

100% private.

MIDDLE POTLATCH CREEK

Problem: Extreme flow variation; subsurface flow; high summer water temperatures; cobble embeddedness; and lack of riparian habitat.

Middle Potlatch is typical of the lower tributaries of the Potlatch River. Agricultural activities throughout the surrounding watershed contribute to extreme, rapid runoff, which precludes the establishment of a suitable riparian zone, summer water temperatures are often very high, and the stream contains a high sediment and nutrient load. Most of the lower 10 km of stream, throughout the canyon reach, is unsuitable for salmonid production. As indicated earlier, the sample station during the present study was a typical of overall stream conditions, and may have been the site of a "glory hole" for rainbow-steelhead which were pushed into the pool by receeding flow and high water temperatures. The 3 km reach above and below the falls at SK 12.9 might offer the most suitable habitat for salmonids, as pool cover and riparian structure were better developed, but this area was inaccessible for sampling. And, the upper tributary streams flow through farmlands and cattle pastures which results in more immediate detrimental impacts to salmonid habitat. Unless agricultural practices can be ammended, extreme runoffs and the associated effects, will continue to be a problem throughout this drainage. Therefore, no enhancement measures will be recommended.

Specific activities:

None.

Land ownership:

100% private.

BIG BEAR CREEK

Problem: Migratory barrier; extreme flow variation; high summer water temperatures; lack of riparian vegetation.

An aerial observation of the Big Bear Creek drainage indicated that the stream habitat in the canyon reach was well suited for salmonid production. The canyon slopes were heavily timbered (providing some control of agricultural runoff), pool-riffle habitat was well developed, stream flow was adequate, and the reach received little direct impact from land use activities. Much of this habitat was unavailable to salmonids, however, as the falls at SK 9.0 are impassable. From the top of the canyon reach at SK 22, to the mouths of the upper tributaries at approximately SK 30, the stream flows through agricultural lands, which have directly impaired stream conditions and quality. While the headwaters above the farmlands, appear to provide some valuable salmonid rearing habitat, as evidenced by the rainbow-steelhead population in the uppermost station.

Solution: Providing passage above the falls would result in the most immediate improvement of the Big Bear Creek salmonid production potential. Additional enhancement measures should focus on reducing the effects of agricultural use, stabilizing stream banks, constructing sediment traps, and excluding livestock from the streambed. And, a storage reservoir in the upper canyon reach could augment flows, reducing high summer water temperatures and allowing a riparian zone to become established in the middle and lower canyon.

Predicted results:

1. Passage above the falls would provide an additional 13 km of suitable steelhead rearing area.
2. Reduce sediment load.
3. Increased riparian structure.
4. Flow augmentation.
5. Reduce high summer water temperatures.

Specific activities:

1. Provide passage over the falls at SK 9.0.
2. Construct check dams in the 8 km reach above the canyon.
3. Construction of a storage reservoir in the upper canyon.

Land ownership:

- 75% private
- 10% U.S. Forest Service
- 10% Potlatch Forest Industries
- 5% Idaho State

CEDAR CREEK

Problem: High summer water temperatures; shallow mean depth; cobble emdeddedness.

The lower canyon reach of Cedar Creek provides the only significant amount of habitat for salmonids. From the headwaters on the plateau, to the beginning of the canyon reach, the stream flows through farming and grazing lands. The upper canyon reach flows over an extreme gradient until approximately SK 5.0. Below the gradient barrier, pool-riffle structure is good, the riparian zone is well developed, and spawning substrate is available. However, the lower reach is also susceptible to debris jams, (which can be impassable), and high summer water temperatures. But habitat conditions in the lower reach are generally well suited for salmonid production.

Solution: A storage reservoir just below the gradient barrier would augment low flows, increase overall depth, reduce extreme summer water temperatures, and act as a sediment trap, thereby reducing cobble embeddedness. However , present stream conditions are not degraded to such an extent that would warrant making this enhancement recommendation a priority.

Predicted results:

1. Augment low summer flows.
2. Increase mean depth.
3. Reduce high summer water temperatures.
4. Reduce cobble embeddedness.

Specific activities:

1. Construction of a storage reservoir below the gradient barrier at SK 5.0.

Land ownership:

90% private;

10% Potlatch Forest Industries.

LITTLE BOULDER CREEK

Problem: Low summer stream flow; shallow mean depth; high cobble embeddedness; lack of pool habitat.

No enhancement measures will be proposed for Little Boulder, Creek, since the stream is already suitable for salmonids, and no signigicant land use activities are occurring which might reduce the stream condition. Although depth and pool cover are lacking, and the flow is minimal, the stream provides some very important salmonid rearing habitat, as evidenced by the high biomass of subyearling and overyearling rainbow-steelhead. The surrounding higher slopes are being logged, but the direct impact on the stream itself is marginal. Evidently, the stream can respond to the present level of activity and still provide valuable rearing habitat, such that enhancement measures would not be necessary.

Specific Activities:

None.

Land owenership:

100% U.S. Forest Service.

EAST FORK POTLATCH CREEK

<u>Problem</u>: Lack of riparian habitat; high sediment load; high summer water temperatures; lack of pool-riffle structure.

Overall stream conditions in the East Fork Potlatch are quite suitable for rainbow-steelhead, but a few problem areas have been identified. The lower 5 km of the East Fork is grazed heavily, and as such, riparian habitat is reduced. This area also has a high degree of cobble embeddedness and its summer water temperatures can get to be extreme. The middle reach paralleling the highway and to the east of Bovill also receives livestock use, but this area has a more stable riparian zone. The stream substrate in this reach is of good quality for both rearing and spawning salmonids. However, it does contain a high content of finer particle size, which if allowed to continue, can be detrimental to salmonid production. The upper reaches, from SK 20 to the headwaters, has a high sediment load. Stream flow is frequently blocked by debris jams, within the headwaters, which results in a loss of good pool-riffle structure. Presently though, these jams act as sediment traps which affords some protection to the downstream area.

Solution: The lower 5 km of stream should be revegetated and protected from excessive livestock use. Control of the sediment sources in the headwaters is also recommended, which would require revegetation of logged areas and unused logging roads.

Predicted results:

1. Decreased sediment load.
2. Increased streamside cover.
3. Reduced summer water temperatures.

Specific activities:

1. Revegetation and fencing to exclude livestock from approximately 5 km of the lower stream.
2. Revegetation of unused logging roads and logged areas in all of the upper tributary streams.

Land Ownership:

29% U.S. Forest Service;

28% Potlatch Forest Industries;

23% private;

20% Idaho State.

PURDUE CREEK

Problem: High sediment load; low stream velocity; eroding bank structure.

Purdue Creek is typical of the higher meadow streams of the Potlatch system. These streams are slow moving, generally have a well developed riparian structure, but also have a very high sediment load, which is unsuitable for salmonid production. The meadow streams flow through a deep humic topsoil, which is constantly eroding into the stream. In addition, there is not enough energy provided by gradient or velocity to flush the sediment from the streambed. Rainbow-steelhead were present in Purdue Creek, but in very low numbers. Although instream and streamside cover was abundant, the substrate size is too small to promote any significant salmonid use. And, since this condition is regulated by the topography of the drainage, no enhancement measures are recommended.

Specific activities:

None.

Land ownership:

50% Idaho State;

30% US Forest Service;

20% private

WEST FORK POTLATCH CREEK

Problem: High sediment content; low stream velocity; bank erosion.

The potential for salmonid production in West Fork Potlatch is substantially reduced by the unsuitable susbstrate type. The streams in the West Fork Potlatch drainage are, for the most part, low gradient, meandering, meadow streams. The humic meadow topsoil readily decomposes, resulting in a high sediment load, and the streams lack the velocity necessary to flush the sediment from the streambed. In addition, livestock grazing in the meadow can further erode stream banks, contributing to sediment load. Generally, depth, instream cover, and a suitable riparian structure are available for salmonids, and it was surprising to not see a larger population of brook trout in the lower reaches. The headwater areas might be the only sites suitable for anadromous salmonid production as the velocity is greater, water temperatures are somewhat cooler, and although cobble embeddedness is high, there is still a differential substrate size. However, the middle reaches at the upper ends of the meadows, are cluttered with beaver dams and debris jams, which may act as barriers to migrating salmonids. It is doubtful that any enhancement measure, short of actually removing the existing sediment from the stream channel, will be effective in developing suitable anadromous salmonid habitat in West Fork Potlatch. Therefore, no enhancement measures will be recommended.

Specific activities:

None.

Land Ownership:

80% U.S. Forest Service;

20% private.

SUMMARY AND CONCLUSIONS

CLEAR CREEK

SALMONID PRODUCTION

Three zones of salmonid production were present in Clear Creek. The lower reach, from the mouth to SK 14, had a relatively low population of rainbow-steelhead. Estimated standing crops of subyearling rainbow-steelhead at the first and second Clear Creek stations were 3.4 kg/ha and 4.7 kg/ha, respectively. Big Cedar Creek, the largest tributary of the lower tributary streams, supported a larger population of juvenile rainbow-steelhead. Estimated standing crops of subyearling and overyearling rainbow-steelhead at the Big Cedar Creek stations were 4.64 kg/ha and 18.54 kg/ha, respectively. The advantage of the Big Cedar Creek habitat might be that this stream offered abundant streamside cover. The middle reach of Clear Creek, represented by the third sample station, supported the largest population of rainbow-steelhead. Estimated standing crops of subyearling and overyearling rainbow-steelhead at station #3 were 5.66 kg/ha and 28.84 kg/ha, respectively. The upper, headwater areas of Clear Creek, represented by the West Fork Clear Creek, Clear Creek #4, and Pine Knob Creek stations, supported substantial populations of cutthroat trout. Estimated standing crops of overyearling cutthroat trout at the West Fork Clear Creek, Clear Creek #4, and Pine Knob Creek stations were 51.96 kg/ha, 64.95 kg/ha, and 71.0 kg/ha, respectively.

HABITAT

The best salmonid habitat was found throughout the middle reaches of the mainstem of Clear Creek. This area is relatively pristine and receives little direct impact from land use activities. The measured physical parameters, velocity, depth, substrate size, cobble embeddedness, and riparian structure, were all adequate for salmonid production. Generally, pool riffle structure was good (although this was not evidenced by our specific sample station) and the stream is wide enough to provide ample rearing area. However, the tributary streams of this middle reach were not as suitable for salmonid production.

South Fork Clear Creek flows into the middle reach of Clear Creek and our sample station indicated that sedimentation may limit salmonid production in this stream. As described earlier, this stream appeared to be similar in every respect to the mainstem, excepting for the sediment load and juvenile steelhead biomass. Estimated standing crop of overyearling rainbow-steelhead in the

South Fork station was 1.51 kg/ha, cobble embeddedness was 7%, and 45% of the substrate type was sand. The actual extent of the sediment problem was not determined, although we observed that Kay Creek, a tributary of the South Fork, also had an extreme sediment load. Present and historic logging activities in the upper reaches of South Fork Clear Creek would suggest that sediment content is high throughout the stream length. South Fork Clear Creek is the largest tributary of Clear Creek but as long as the sediment level is high, the stream will not provide an optimum salmonid habitat.

Middle Fork Clear Creek, another tributary to the middle reach of Clear Creek, also provided only limited salmonid habitat. This was attributed to a gradient barrier located near the mouth of the stream. We did find a low population of rainbow-steelhead in the Middle Fork station (estimated standing crops of overyearling and subyearling rainbow-steelhead were 9.84 kg/ha and 2.56 kg/ha, respectively) but the barrier will prevent full utilization of this habitat.

The lower reach and headwater areas of Clear Creek were largely inadequate for substantial anadromous salmonid production. The lower reach travels through a high use area, has limited (if any) riparian structure, and problems with high summer water temperatures and cobble embeddedness. Although habitat conditions may be suitable for salmonid production in the headwaters, these areas are inaccessible to migrating salmonids, due to log jams and gradient barriers. The lower reach and headwaters should be enhanced to promote increased production of anadromous salmonids.

ENHANCEMENT

Several alternatives to either create additional habitat or enhance the existing habitat were recommended for the Clear Creek drainage. Enhancement of the lower reach would be provided by flow augmentation and the development of a suitable riparian zone. This would increase the quantity of habitat and reduce high summer water temperatures. Removal of gradient barriers or debris jams in the upper reaches would provide additional salmonid habitat but these areas would always be subject to debris jams, so the long term effects of such an enhancement measure might be negligible. Sediment load in the tributaries could be controlled by revegetating logging sites and logging roads. Controlling and reducing sediment content would also increase salmonid habitat. However, the implementation of these enhancement alternatives on Clear Creek is not a priority.

Returning adult salmonids will be excluded from the Clear Creek drainage for at least the next three years. The Kooskia hatchery is presently the early rearing facility for the Dworshak hatchery steelhead. The Dworshak hatchery has had a problem with IHN viral contamination and subsequent mortality of the fish raised in their water source, the North Fork Clearwater River. Clear Creek water is presently IHN free; so, the Kooskia hatchery rears all of Dworshaks fish during the life stage that the fish are most susceptible to IHN. Since IHN is transferred by spawning adults, some Dworshak hatchery stray fish might migrate up Clear Creek and contaminate the water source. Without a tagging identification system, it is impossible to determine the origin of the returning adults such that Dworshak fish could be kept separate from wild or other hatchery fish. Therefore, all returning adults will be trapped at the Kooskia hatchery weir and prevented from entering the mainstem Clear Creek. The adult spawners will then be transferred to other suitable spawning areas in the Clearwater Basin. Consequently, stream enhancement measures will not encourage salmonid production in Clear Creek until after the stream is reopened to spawning salmonids.

OROFINO CREEK

SALMONID PRODUCTION

Rainbow-steelhead and brook trout were found throughout the Orofino Creek drainage. All sample stations supported populations of either rainbow-steelhead, brook trout, or both species combined. It was assumed that the rainbow-steelhead present in all stations, excluding Orofino #1, were resident fish, since Orofino Falls are an impassable barrier to anadromous fish. Exclusive populations of rainbow-steelhead were found in Orofino Creek stations #1, #2, and #3. No estimates of standing crops or densities were made at these stations. Exclusive populations of brook trout were found in the headwaters of Quartz Creek at the Quartz Creek 12 and Little Beaver Creek stations. The Quartz Creek #2 station supported a substantial population of brook trout. Estimated standing crops of overyearling and subyearling brook trout were 65.31 kg/ha, and 2.29 kg/ha, respectively. Little Beaver Creek supported a moderate population of brook trout; estimated standing crop of overyearlings was 11.27 kg/ha. The other stations supported sympatric populations of rainbow and brook trout, but the population date suggested that the species inhabited separate zones within the drainage.

Larger populations of rainbow than brook trout were found in the tributaries of the canyon reach and in two of the mainstem stations. Estimated standing crops of overyearling rainbow-steelhead and brook trout in the Cow Creek station, a canyon reach tributary, were 22.37 kg/ha, and 2.00 kg/ha, respectively.

Estimated standing crops of over-yearling rainbow-steelhead and brook trout in the Poorman Creek station, the other canyon reach tributary, were 24.90 kg/ha and 7.67 kg/ha, respectively. Observations in the mainstem Orofino Creek, at the #4 station, found that rainbow trout outnumbered brook trout. Estimated standing crops of rainbow-steelhead and brook trout in the Orofino Creek 16 station were 18.25 kg/ha and 4.23 kg/ha, respectively.

Approximately equal populations of rainbow-steelhead and brook trout were found in two of the sample stations. Observations at the mainstem #5 station found that populations of brook and rainbow were similar. Rhodes Creek had a higher standing crop of overyearling rainbow-steelhead than brook; 8.09 kg/ha and 2.81 kg/ha, respectively. But this station had only one subyearling rainbow-steelhead and a modreate population of subyearling brook trout; estimated standing crop was 3.13 kg/ha.

The upper tributaries of Orofino Creek all had larger populations of brook trout than rainbow-steelhead. As described earlier, Quartz Creek #2 and Little Beaver Creek stations had exclusively brook trout. Estimated standing crops of overyearling rainbow-steelhead and brook trout at the Trail Creek station, a Quartz Creek tributary, were 2.98 kg/ha and 13.74 kg/ha, respectively. Estimated standing crops of overyearling rainbow-steelhead and brook trout at the Quartz Creek 81 station were 2.43 kg/ha and 25.19 kg/ha, respectively. Estimated standing crop of overyearling rainbow-steelhead and brook trout in the Canal Gulch station were 0.61 kg/ha and 2.22 kg/ha, respectively. In addition, no subyearling rainbow-steelhead were found, while estimated standing crop of subyearling brook trout was 5.62 kg/ha. Estimated standing crop of overyearling rainbow-steelhead and brook trout at the Shanghai Creek station, on a headwater tributary of Rhodes Creek, were 9.83 kg/ha and 65.67 kg/ha, respectively. A large number of subyearling brook trout were also found in the Shanghai Creek station; estimated standing crop was 13.65 kg/ha.

The variability in species composition could have several causes. Habitat preference, competitive interactions, differential seeding, sampling bias, and fishing pressure could all account for the variability. However, it appeared that rainbow-steelhead were predominant throughout the mainstem and in the lower reaches, while brook trout were predominant in the headwater streams.

HABITAT

Throughout the mainstem, habitat conditions were optimum for anadromous salmonids. The large size and flow of this system may make it a prime chinook salmon habitat. Pool structure was good, mean depth and velocity were optimum, and most of the mainstem receives little direct impact from land use activities. Substrate was also present for both spawning and rearing salmonids. High summer water temperatures and cobble embeddedness may be a problem to salmonids but in neither case were the values extreme.

Within the canyon reach, Cow Creek and Poorman Creek were the greatest potential salmonid producing tributaries. The other tributaries within this reach flowed through too steep of gradients to be of much use to anadromous salmonids; they had only limited rearing or spawning area at their mouths. Cow Creek's best feature was that it did not have a gradient barrier and had enough flow to provide some potential rearing area. However, this stream had problems with sediment load and debris jams, which were attributed to logging and grazing in the drainage. Poorman Creek was currently, a less impacted, more natural stream.

Quartz Creek, Canal Gulch, and Rhodes Creek were the largest tributaries outside the canyon reach and, with the exception of Rhodes Creek, had little potential anadromous salmonid habitat. Quartz Creek flowed through a high use area, had a high sediment load and cobble embeddness. The tributaries of Quartz Creek, Trail Creek, and Little Beaver Creek, were typical meadow streams, and as such, were probably better suited for brook trout. Canal Gulch had problems with sediment load and debris jams and was also a brook trout stream. Rhodes Creek offered potential anadromous salmonid habitat. It had a great enough flow and area to be very productive. In addition, depth was sufficient, spawning gravels were available, and riparian habitat was well developed.

ENHANCEMENT

It was proposed that the Orofino Falls be enhanced such that anadromous salmonid passage be provided into Orofino Creek above SK 8.0. Improved passage over the second falls on Orofino Creek was also recommended. These enhancement measures were the priorities for improving anadromous salmonid habitat within the Orofino Creek.

Enhancement measures were also recommended for Cow Creek, Poorman Creek, Rhodes Creek, Trail Creek, Little Beaver Creek, and Shanghai Creek. Those streams which offer the greatest anadromous salmonid potential, Cow Creek, Poorman Creek, and Rhodes Creek, should be the priority enhancement streams. Although enhancement measures were recommended for Shanghai Creek and Little Beaver Creek, these streams will probably continue to offer the greatest potential as brook trout streams.

POTLATCH RIVER

SALMONID PRODUCTION

The inventory found that the greatest continuous reach of anadromous salmonid production in the Potlatch River was located between the town of Kendrick and the upper headwater area of East Fork Potlatch Creek. The Cedar Creek, Little Boulder Creek, East Fork Potlatch Creek, and Potlatch River #2 and #3 stations represented this middle reach of Potlatch, and most of these supported moderate populations of rainbow-steelhead. The Cedar Creek station had a moderate population of overyearling and a high population of subyearling rainbow-steelhead. Estimated standing crops of overyearling and subyearling rainbow-steelhead were 5.45 kg/ha and 9.54 kg/ha, respectively. The Little Boulder Creek station had a substantial population of both overyearling and subyearling rainbow-steelhead steelhead. Estimated standing crops of overyearling and subyearling rainbow-steelhead were 47.57 kg/ha and 16.94 kg/ha, respectively. The East Fork Potlatch #1 station had a moderate population of overyearlings but a large population of subyearling rainbow-steelhead. Estimated standing crop of overyearling rainbow-steelhead was 14.81 kg/ha. Although subyearling steelhead were not captured effectively, it was noted that they were present in very abundant numbers. The mainstem Potlatch itself was also sampled but exhibited only minor populations of rainbow-steelhead. Substantial numbers of rainbow-steelhead were also found in isolated areas within a headwater stream and a lower mainstem tributary; however, these populations did not appear to be characteristic of those particular reaches of the Potlatch River.

The lower reach of the Potlatch River, from the mouth to Kendrick, supported a marginal population of rainbow-steelhead. This area was represented by the Little Potlatch Creek, Middle Potlatch Creek, Rig Bear Creek #1, and Potlatch River #l stations. The Little Potlatch Creek station and Potlatch River #l station did not have any salmonids present. A large number of smallmouth bass were found in the lower Potlatch River station, which seemed to indicate that this reach might be an important nursery area for that species. The Middle Potlatch Creek station supported the largest population of overyearling rainbow-steelhead found during the inventory, but apparently, this was an anomaly of the sample station. Estimated standing crops of overyearling and subyearling rainbow-steelhead in the Middle Fork Potlatch Creek station were 76.14 kg/ha and 6.96 kg/ha, respectively. The Middle Fork Potlatch Creek sample station was located in a series of spring-fed pools upstream from a heavily agricultural area and downstream from a dry streambed. The fish may have been "pushed" into this area by receding stream flow and high summer water temperatures. Station #1 on Big Bear Creek, another representative of lower Potlatch, had only one rainbow-steelhead present.

The upper reaches of Potlatch, represented by the Purdue Creek, West Fork Potlatch, and upper Big Bear Creek stations, generally had marginal populations of rainbow-steelhead and brook trout. The West Fork Potlatch Creek #l and #2 stations did not have any salmonids. The West Fork Potlatch Creek 63 station contained a small population of brook trout. Estimated standing crop of overyearling brook trout in the West Fork Potlatch Creek #3 station was 6.42 kg/ha. The Purdue Creek station had just 3 subyearling rainbow-steelhead. No rainbow-steelhead were found in the Big Bear Creek #2 station. The Big Bear Creek #3 station supported a large population of overyearlings and a small population of subyearling rainbow-steelhead. It was assumed that these fish were resident fish, or that the gradrent barrier on Big Bear Creek is not immpassable. Estimated standing crops of overyearling and subyearling rainbow-steelhead in the Big Bear Creek #3 station were 43.94 kg/ha and 1.30 kg/ha, respectively.

HABITAT

The best habitat for anadromous salmonid production on the Potlatch River was located between Kendrick and the headwaters of the East Fork Potlatch Creek. This area received relatively little direct impact from land use activities. The land above the steep canyon reach from Kendrick to the confluence with East Fork Potlatch, is farmed, but the canyon is heavily timbered, which helps control rapid runoff into the streams. The tributary streams within this reach are in good condition and provide ample rearing habitat. The mainstem itself had good pool-riffle structure and abundant spawning and rearing gravels. The East Fork Potlatch Creek system also had suitable substrate characteristics, good pool-riffle structure, and a well developed riparian zone. The middle canyon reach of Big Bear Creek could also provide a suitable anadromous salmonid habitat. Again, pool-riffle structure was good, the area received little direct impact from land use activities, and substrate was relatively satisfactory. However, a falls in the middle of this reach would limit the potential of this habitat. The remainder of the Potlatch River system was largely unsuitable for substantial anadromous salmonid production.

The lower mainstem Potlatch and the western tributaries of this reach offered little potential salmonid habitat. Extreme flows and high summer water temperatures are typical of the entire Potlatch watershed but these conditions are exaggerated in the lower Potlatch drainage. Most of the surrounding terrain is farmed intensively and has a diminished capacity for retaining precipitation; therefore, runoff is extreme and rapid. The lower basin areas are hardest hit by the effects of high, rapid runoff throughout the drainage. The upper and middle reaches of the western tributary streams, Little Potlatch, Middle Potlatch, the Big Bear Creek system, and Pine Creek, flow directly through agricultural and grazing lands. They exhibited high sediment loads, lack of pool-riffle structure, and lack of riparian habitat, in addition to extreme low summer flows and high summer water temperatures.

The headwater areas of these western tributaries might provide salmonid rearing habitat, as they were generally upstream of the agricultural areas. These areas had more of an unaltered riparian zone than the lower reaches. They also flowed over a steeper gradient, which provided more pool-riffle habitat. However, sediment load was still rather high in these headwater areas.

The upper reaches of the mainstem Potlatch provided only limited anadromous salmonid habitat. The main problems impacting this area were high sediment load and lack of pool-riffle habitat. Much of this problem is related to the topography of this area as the streams were typical meadow systems; slow flowing, meandering, depositional streams.

ENHANCEMENT

Few enhancement measures were recommended for the Potlatch River drainage. The most important was to augment flows by construction of a storage reservoir in East Fork Potlatch Creek. This reservoir would augment flows and reduce water temperatures during the dry summer months. The area receiving the most benefits of this reservoir, the middle reach of Potlatch River, currently offers the greatest amount of potential salmonid habitat. Since the Potlatch River is one of the largest tributaries of the lower Clearwater Basin, it could show the greatest results from enhancement measures. Providing enhancement for the Potlatch River should be a priority. The enhancement measures recommended for the tributaries of the Potlatch River will not result in as great an improvement of salmonid production in this drainage.

Providing flow augmentation, restoration of riparian habitat and providing passage above a barrier were recommended for some tributary streams. Augmenting flow was suggested for Big Bear

Creek and Cedar Creek. Restoration of riparian habitat was suggested for East Fork Potlatch Creek. It was also recommended that the gradient barrier on Big Bear Creek be altered to provide passage into this drainage.

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Table 1. A ranking of overyearling rainbow-steelhead populations found in sample stations on Clear Creek, Orofino Creek, and Potlatch River, tributaries of the Middle Fork Clearwater River and lower Clearwater River, Idaho, 1984.

Stream	Station	Standing Crop (kg/ha)	Density (fish/m2)
Middle Potlatch Cr.	1	76.14	0.08
Little Boulder Cr.	1	47.57	0.36
Big Bear Cr.	3	43.94	0.12
Clear Cr.	3	28.84	0.13
Poorman Cr.	1	24.90	0.09
Cow Cr.	1	22.34	0.08
Big Cedar Cr.	1	18.54	0.09
Orofino Cr.	6	18.25	0.03
East Fork Potlatch Cr.	1	14.81	0.05
Middle Fork Clear Cr.	1	9.84	0.04
Shanghai Cr.	1	9.83	0.02
Rhodes Cr.	1	8.09	0.05
Cedar Cr.	1	5.45	0.03
Big Bear Cr.	1	5.00	0.002
East Fork Potlatch Cr.	2	4.76	0.02
Trail Cr.	1	2.98	0.01
Quartz	1	2.43	0.02
South Fork Clear	1	1.51	0.01
Canal Gulch	1	0.61	0.01

Table 2. A ranking of subyearling rainbow-steelhead populations found in sample stations on Clear Creek, Orofino Creek, and Potlatch River, tributaries of the Middle Fork Clearwater River and lower Clearwater River, Idaho, 1984.

Stream	Station	Standing Crop (kg/ha)	Density (fish/m2)
Little Boulder Cr.	1		
Cedar Cr.	1		
Middle Potlatch Cr.	1		
Clear Cr.	3		
Big Cedar Cr.	1		
Cow Cr.	1		
Middle Fork Clear Cr.	1		
Big Bear Cr.	3		
Poorman Cr.	1		
South Fork Clear Cr.	1		

Table 3. A ranking of overyearling brook trout populations found in sample stations on Orofino Creek and Potlatch River, tributaries of the lower Clearwater River, Idaho, 1984.

Stream	Station	Standing Crop (kg/ha)	Density (fish/m2)
Shanghai Cr.	1	65.67	0.29
Quartz Cr.	2	65.31	0.25
Quartz Cr.	1	25.19	0.06
Trail Cr.	1	13.74	0.03
Little Beaver Cr.	1	11.27	0.06
Poorman Cr.	1	7.67	0.05
West Fork Potlatch Cr.	3	6.42	0.06
Orofino Cr.	6	4.23	0.01
East Fork Potlatch Cr.	1	3.44	0.001
Rhodes Cr.	1	2.81	0.01
Canal Gulch Cr.	1	2.22	0.02
Cow Cr.	1	2.00	0.01
East Fork Potlatch Cr.	2	0.66	0.006

Table 4. A ranking of subyearling brook trout populations found in sample stations on Orofino Creek and Potlatch River, tributaries of the Lower Clearwater River, Idaho, 1984.

Stream	Station	Standing Crop (kg/ha)	Density (fish/m2)
Shanghai Cr.	1	13.63	0.62
Canal Gulch Cr.	1	5.62	0.30
Rhodes Cr.	1	3.13	0.12
Poorman Cr.	1	2.80	0.10
Quartz Cr.	2	2.29	0.19
Trail Cr.	1	0.44	0.02

Table 5. A ranking of overyearling cutthroat trout populations found in sample stations on Clear Creek, a tributary of the Middle Fork Clearwater River, Idaho, 1984.

Stream	Station	Standing Crop (kg/ha)	Density (fish/m2)
Pine Knob Cr.	1	71.10	0.53
Clear Cr.	4	64.95	0.80
West Fork Clear Cr.	1	**51.96**	0.33
Clear Cr.	3	0.47	0.003

Table 6. Water sample analysis from sample station #4 on Clear Creek, a tributary of Middle Fork Clearwater River, Idaho, 1984.

Constituent	Value
Calcium, Ca, mg/l	3.71
Magnesium, Mg, mg/l	0.86
Sodium, Na, mg/l	2.09
Potassium, K, mg/l	0.78
Chloride, Cl, mg/l	0.09
Bicarbonate, HC03, mg/l	0.33
Sulfate, S04, mg/l	0.8
Nitrate, N04, mg/l	0.48
Phosphate, P04, mg/l	0.02
Total Residue, mg/l	49.6
Non-Filtered Residue mg/l	7.8
pH	7.27

Table 7. Water sample analysis from the sample station on Pine Knob Creek, a tributary of Clear Creek, Idaho, 1984.

Constituent	Value
Calcium, Ca, mg/l	4.89
Magnesium, Mg, mg/l	1.70
Sodium, Na, mg/l	2.67
Potassium, K, mg/l	1.84
Chloride, Cl, mg/l	0.10
Bicarbonate, HC03, mg/l	0.57
Sulfate, S04, mg/l	0.9
Nitrate, N04, mg/l	0.08
Phosphate, P04, mg/l	0.02
Total Residue, mg/l	75.8
Non-Filtered Residue mg/l	16.3
pH	7.41

Table 8. Water sample analysis from sample station #4 on Orofino Creek, a tributary of lower Clearwater River, Idaho, 1984.

Constituent	Value
Calcium, Ca, mg/l	5.77
Magnesium, Mg, mg/l	1.80
Sodium, Na, mg/l	3.07
Potassium, K, mg/l	0.64
Chloride, Cl, mg/l	0.08
Bicarbonate, HCO 3, mg/l	0.69
Sulfate, S04, mg/l	< 1
Nitrate, N04, mg/l	0.02
Phosphate, P04, mg/l	0.04
Total Residue, mg/l	33
Non-Filtered Residue mg/l	2.5
pH	7.71

Table 9. Water sample analysis from sample station #6 on Orofino Creek, a tributary of lower Clearwater River, Idaho, 1984.

Constituent	Value
Calcium, Ca, mg/l	2.98
Magnesium, Mg, mg/l	0.79
Sodium, Na, mg/l	2.13
Potassium, K, mg/l	<0.6
Chloride, Cl, mg/l	0.10
Bicarbonate, HC03, mg/l	0.33
Sulfate, S04, mg/l	< 1
Nitrate, N04, mg/l	0.07
Phosphate, P04, mg/l	< 0.01
Total Residue, mg/l	23
Non-Filtered Residue mg/l	0.9
pH	7.54

Table 10. Water sample analysis from sample station 117 on Orofino Creek, a tributary of lower Clearwater River, Idaho, 1984.

Constituent	Value
Calcium, Ca, mg/l	2.10
Magnesium, Mg, mg/l	0.51
Sodium, Na, mg/l	1.76
Potassium, K, mg/l	< 0.60
Chloride, Cl, mg/l	0.09
Bicarbonate, HC03, mg/l	0.28
Sulfate, S04, mg/l	0
Nitrate, N04, mg/l	< 0.01
Phosphate, P04, mg/l	< 0.01
Total Residue, mg/l	10
Non-Filtered Residue mg/l	1.5
pH	7.29

Table 11. Water sample analysis from sample station #l on Quartz Creek, a tributary of Orofino Creek, Idaho, 1984.

Constituent	Value
Calcium, Ca, mg/l	5.86
Magnesium, Mg, mg/l	2.31
Sodium, Na, mg/l	3.28
Potassium, K, mg/l	1.09
Chloride, Cl, mg/l	0.08
Bicarbonate, HC03, mg/l	0.65
Sulfate, S04, mg/l	2
Nitrate, N04, mg/l	0.02
Phosphate, P04, mg/l	0.03
Total Residue, mg/l	47
Non-Filtered Residue mg/l	1.1
p H	7.76

Table 12. Water sample analysis from the sample station on Trail Creek, a tributary of Quartz Creek, Idaho, 1984.

Constituent	Value
Calcium, Ca, mg/l	4.51
Magnesium, Mg, mg/l	1.43
Sodium, Na, mg/l	2.71
Potassium, K, mg/l	0.67
Chloride, Cl, mg/l	0.10
Bicarbonate, HC03, mg/l	0.49
Sulfate, S04, mg/l	< 1
Nitrate, N04, mg/l	0.03
Phosphate, P04, mg/l	0.02
Total Residue, mg/l	30
Non-Filtered Residue mg/l	2.2
pH	7.60

Table 13. Water sample analysis from the sample station on Rhodes Creek, a tributary of Orofino Creek, Idaho, 1984.

Constituent	Value
Calcium, Ca, mg/l	6.54
Magnesium, Mg, mg/l	1.86
Sodium, Na, mg/l	2.73
Potassium, K, mg/l	<0.60
Chloride, Cl, mg/l	0.09
Bicarbonate, HC03, mg/l	0.65
Sulfate, S04, mg/l	< 1
Nitrate, N04, mg/l	< 0.01
Phosphate, P04, mg/l	0.04
Total Residue, mg/l	30
Non-Filtered Residue mg/l	2.1
pH	7.51

Table 14. Water sample analysis from sample station #2 on the Potlatch River, a tributary of lower Clearwater River, Idaho, 1984.

Constituent	Value
Calcium, Ca, mg/l	6.92
Magnesium, Mg, mg/l	2.37
Sodium, Na, mg/l	3.39
Potassium, K, mg/l	1.19
Chloride, Cl, mg/l	0.10
Bicarbonate, HC03, mg/l	0.73
Sulfate, 504, mg/l	< l
Nitrate, N04, mg/l	< 0.01
Phosphate, P04, mg/l	<0.01
Total Residue, mg/l	34
Non-Filtered Residue mg/l	1.5
p H	8.13

Table 15. Water sample analysis from sample station #3 on the Potlatch River, a tributary of lower Clearwater River, Idaho, 1984.

Constituent	Value
Calcium, Ca, mg/l	6.81
Magnesium, Mg, mg/l	2.27
Sodium, Na, mg/l	3.14
Potassium, K, mg/l	0.81
Chloride, Cl, mg/l	0.08
Bicarbonate, HC03, mg/l	0.73
Sulfate, S04, mg/l	< 1
Nitrate, N04, mg/l	<0.01
Phosphate, P04, mg/l	<0.01
Total Residue, mg/l	47
Non-Filtered Residue mg/l	0.3
pH	7.75

Table 16. Water sample analysis from the sample station on Middle Fork Potlatch Creek, a tributary of the Potlatch River, Idaho, 1984.

Constituent	Value
Calcium, Ca, mg/l	27.60
Magnesium, Mg, mg/l	10.21
Sodium, Na, mg/l	9.99
Potassium, K, mg/l	3.59
Chloride, Cl, mg/l	0.10
Bicarbonate, HC03, mg/l	2.40
Sulfate, S04, mg/l	2
Nitrate, NO4, mg/l	0.91
Phosphate, P04, mg/l	0.16
Total Residue, mg/l	177
Non-Filtered Residue mg/l	5.6
pH	8.08

Table 17. Water sample analysis from sample station #l on East Fork Potlatch Creek, a tributary of the Potlatch River, Idaho, 1984.

Constituent	Value
Calcium, Ca, mg/l	6.71
Magnesium, Mg, mg/l	2.01
Sodium, Na, mg/l	2.74
Potassium, K, mg/l	0.67
Chloride, Cl, mg/l	0.15
Bicarbonate, HC03, mg/l	0.69
Sulfate, S04, mg/l	< 1
Nitrate, NO4, mg/l	< 0.01
Phosphate, PO4, mg/l	< 0.01
Total Residue, mg/l	40
Non-Filtered Residue mg/l	2.0
pH	7.39

Table 18. Water sample analysis from sample station #l on West Fork Potlatch Creek, a tributary of the Potlatch River, Idaho, 1984.

Constituent	Value
Calcium, Ca, mg/l	4.29
Magnesium, Mg, mg/l	1.37
Sodium, Na, mg/l	3.15
Potassium, K, mg/l	0.79
Chloride, Cl, mg/l	0.12
Bicarbonate, HC03, mg/l	0.61
Sulfate, S04, mg/l	< 1
Nitrate, NO4, mg/l	<0.01
Phosphate, P04, mg/l	0.02
Total Residue, mg/l	39
Non-Filtered Residue mg/l	2.5
pH	7.17