POTLATCH RIVER BASIN - FISHERIES INVENTORY

LATAH, CLEARWATER, AND NEZ PERCE COUNTIES, IDAHO

2003 - 2004

In Partial Fulfillment Of
Latah County Soil And Water Conservation District Contract

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IDFG 06-16
September 2006

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INTRODUCTION

The Potlatch River and its tributaries were historically a major producer of anadromous fish within the Clearwater River drainage. Since settlement the drainage has been impacted by many activities including agricultural, ranching, logging, and mining practices. These land use practices have altered the hydrologic cycle, instream habitat, and riparian habitat within the drainage.

From 1982 to 1984, the Nez Perce Tribe conducted a stream inventory of tributaries in the lower Clearwater River drainage, including the Potlatch River, in order to identify where anadromous salmonid production was occurring. They recommended enhancement alternatives to increase anadromous salmonid habitat. They identified four major problems occurring in the Potlatch River drainage:

1) Extreme flow variation
2) High summer water temperatures
3) Lack of riparian habitat
4) High sediment loads (Johnson, 1985)

The objective of the current project was to:

1) Determine distribution and abundance of fishes throughout the drainage.
2) Identify main rainbow/steelhead trout producing tributaries within the drainage.
3) Identify habitat parameters within each tributary that are associated with rainbow/steelhead trout distribution.
4) Prioritize tributaries for future management/rehabilitation consideration based upon findings

STUDY AREA

The Potlatch River drainage is located within Latah, Clearwater, and Nez Perce counties, of northern Idaho (figure 1). The Potlatch River is approximately 89.4 kilometers (55.6 miles) long and is a major tributary to the lower Clearwater River. Elevations range from 243.8 meters (800 feet) at the mouth to 999.8 meters (3,280 feet) above sea level in the headwaters. The drainage encompasses approximately 152,622 hectares (377,776 acres) (Department of Agriculture, 1994). The principle communities within the drainage are Bovill, Deary, Troy, Kendrick, and Juliaetta. Approximately 78% of the drainage is in private ownership. Forty two percent of the drainage is cropland, pastureland, and rangeland, and 57% forestland (Department of Agriculture, 1994). Overall, cropland and forested canyons predominate lower reaches while forestlands are found higher in the drainage. Major tributaries to the Potlatch River include Little Potlatch Creek, Middle Potlatch Creek, Big Bear Creek, Pine Creek, Cedar Creek, Corral Creek, and the East and West Forks of the Potlatch River.

The Potlatch River watershed is part of the Palouse Prairie ecosystem of Northern Idaho and Eastern Washington. This area is comprised of loess covered basalt plains with deeply incised canyons running off the upland regions. Historically, the upland was a bunchgrass prairie. The uplands are now predominately in agriculture and susceptible to soil erosion an overland flow. Although significantly altered by agriculture, this area is still known for its rich loamy soils, deep incised canyons, and rolling upland topography. In addition, changes in land use have decreased water infiltration into the soil increasing the magnitude of stream discharge following precipitation and decreasing summer base flows. The upland agriculture streams, those streams present in the low elevation cropland, are characterized by low gradients, incised channels, limited riparian vegetation, small substrate composition, and an altered hydrograph. Streams in watersheds with agricultural uplands sampled during this study include Big Bear Creek, Little Bear Creek, the West Fork of Little Bear Creek, Pine Creek, and Cedar Creek.

Canyons in the Potlatch River drainage are located lower in the drainage often below agricultural plateaus. Canyons are characterized by steep/timbered slopes, shallow soils, and are deeply incised due to the basalt bedrock composition. The main alterations in these ecosystems are associated with livestock grazing and timber harvest. However, changes to the upland agricultural areas have also impacted the hydrograph of the canyon streams. Many of these streams that were historically perennial, now undergo massive spring runoff events and maintain no surface flow late in the summer. Canyon streams within the Potlatch River drainage are characterized by high gradients, large substrate size, riffle/ pocketwater habitat types, and a distorted hydrograph. Streams in watersheds with a canyon component sampled during this study include Big Bear Creek, Little Bear Creek, the West Fork of Little Bear Creek, Pine Creek, Cedar Creek, Corral Creek, Boulder Creek and Leopold Creek.

Forestlands within the Potlatch River drainage are a mix of dense coniferous forest and meadow complexes. Forestland tributaries within the Potlatch River are predominately found in the upper portions of the drainage. Of the three stream ecosystem types present in the Potlatch Drainage, forestland types have undergone the fewest alterations although timber harvest and grazing have occurred and significantly changed fish habitat. Forestland streams are characterized by low gradients, dense canopy cover, meadow connectivity, stable banks, small substrate composition, and cool water temperatures. Streams in watersheds with a forestland component sampled during this study included Moose Creek, Pivash Creek, Feather Creek, Cougar Creek, Bob's Creek, Corral Creek, Boulder Creek, Little Boulder Creek and the East Fork of the Potlatch River.

Land ownership and drainage size varies greatly from tributary to tributary and among ecosystem types (Figure 1, Table 1). Private ownership dominates the lower elevation drainages and agricultural plateau. Public lands are more abundant in higher elevation drainages and forest land.

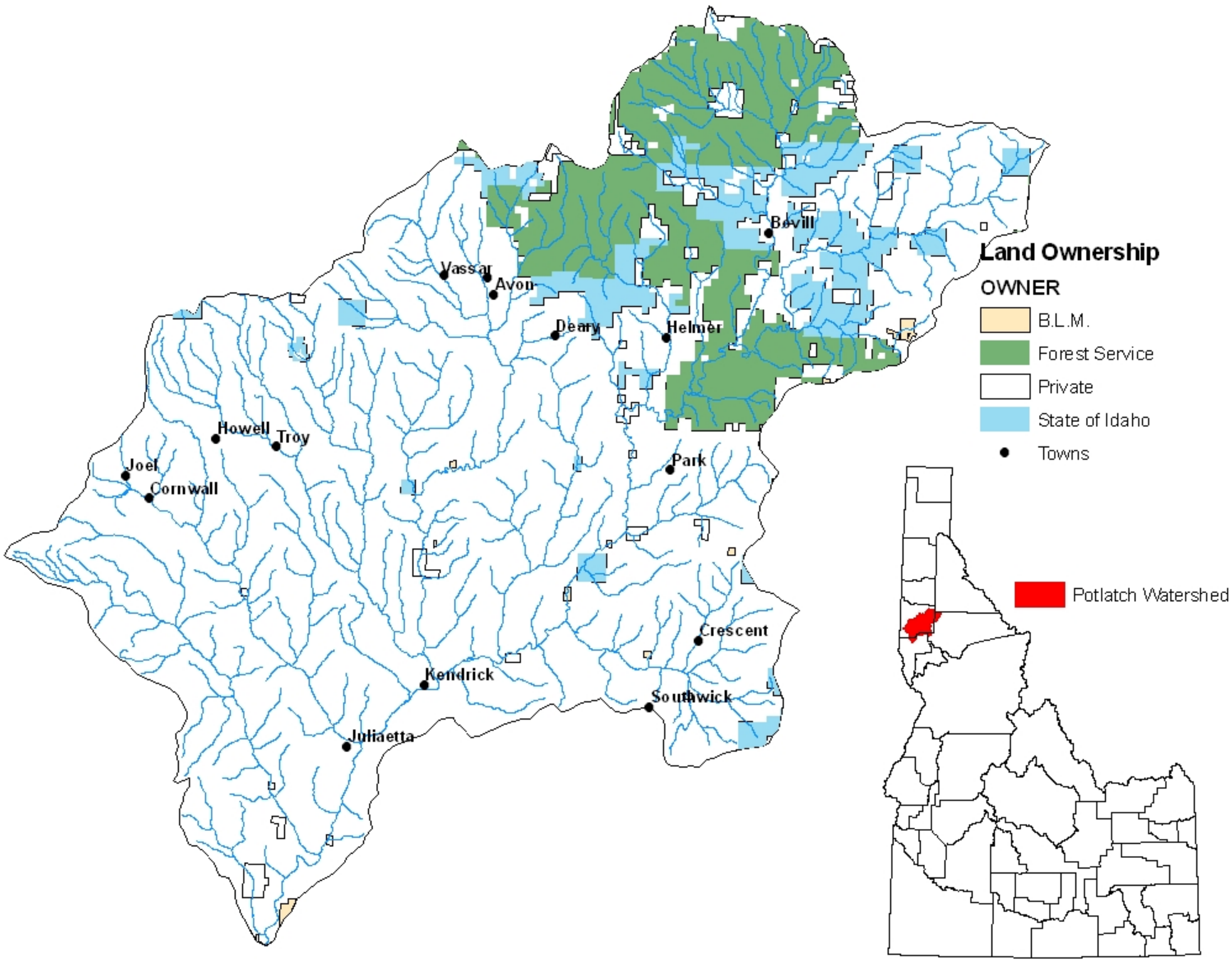

Figure 1. Potlatch River Drainage, Idaho.

Table 1. General statistics for important streams in the Potlatch drainage. Streams are listed in a counter clockwise fashion from the mouth of the Potlatch River.

Stream	Parent Stream	Length (km)	Number of Sites Sampled	Steelhead Rainbow Trout (Y/N)
Little Potlatch Creek	Potlatch River	28.6	0	Y*
Middle Potlatch Creek	Potlatch River	29.7	0	Y*
Big Bear Creek	Potlatch River	35	21	Y
Little Bear Creek	Big Bear Creek	15.2	15	Y
Little Bear Cr, WF	Little Bear Creek	19	10	Y
Spring Valley Creek	Little Bear Cr, WF	12.1	0	Y*
Pine Creek	Potlatch River	22.9	14	Y
Corral Creek	Potlatch River	18.3	6	Y
Moose Creek	Potlatch River	12.6	4	Y
Potlatch River, WF	Potlatch River	11.2	9	Y
Cougar Creek	Potlatch River, WF	6.2	4	N
Feather Creek	Potlatch River, WF	8.5	2	N
Purdue Creek	Potlatch River, WF	6.7	3	Y
EF Potlatch River	Potlatch River	30.5	8	Y
Bobs Creek	EF Potlatch River	10	8	Y
Pivash Creek	EF Potlatch River	4.3	3	Y
Ruby Creek	EF Potlatch River	26.2	0	Unknown
Little Boulder Creek	Potlatch River	5.9	6	Y
Boulder Creek	Potlatch River	11.7	5	N/Y*
Cedar Creek	Potlatch River	15.5	11	Y
Leopold Creek	Cedar Creek	*	3	Y

* Indicates the stream was sampled during the 1995-96 efforts and rainbow/steelhead were found.

METHODS

Stream surveys were conducted throughout the Potlatch River drainage during late Spring and early Summer of 2003 and 2004. Sampling sites for this study were based upon preexisting sample sites from a similar study in 1995-1996. Sites were accessed by road when possible or by hiking the streambed when no roads were available. Within each stream, approximately one 100 meter transect was surveyed per kilometer until juvenile steelhead/rainbow trout were no longer sampled. Transects began and ended at appropriate habitat breaks. We captured fish using a Smith-Root model 15D generator powered electrofishing unit with pulsed D.C. current. A single pass electrofishing technique was used to determine relative fish abundance, size, and distribution. In a few instances stream conditions did not allow for electrofishing and snorkeling was used to survey transects.

Stream surveys were conducted with a 4-person team, with one person operating an electrofishing unit, 2 people netting fish, and one person carrying a holding bucket. Electrofishing was conducted moving upstream working back and forth across the entire width of the stream. Weight and length measurements of captured fish were then recorded streamside.

The first 25 fish of each species collected from each transect were measured for total length and weight. The remaining fish of each species were counted and weighed as a whole. Within appropriate stream conditions, all rainbow/steelhead trout collected over 70mm were anesthetized with MS-222 and inserted with a PIT tag according to the standards of the PIT Tag Marking Procedures Manual (CBFWA 1999). After tagging, fish were allowed to recover in an instream livewell before release. Tagging did not occur if water temperatures exceeded 18.0 ^{o}C.

Within each transect, numerous habitat variables were measured upon completion of fish sampling. A total of five stream widths (0, 20, 40, 60, 80, 100m) were recorded for each of the sampled transects and at each width measurement site; five depths were taken at 0, 25, 50, 75, and 100 percent width across the stream. These measurements were used to determine sample area for each transect. In addition to stream profile depths, a maximum depth was measured within each transect. Substrate composition was ranked from 1-5 with 1 being the most dominate and the length of different habitat types (i.e. riffle, pocketwater, flat, pool) were measured within each transect. Channel type was recorded using the Rosgen channel type classification system. Water temperature (^{o}C) and conductivity (µS) were collected using a Hanna Combo meter. Bank stability and canopy cover were ranked and visually estimated by crew leaders. Finally, woody debris was enumerated and recorded into size classes based upon diameter. Diameter size classes recorded were <10cm, 10 to 20 cm, 20 to 40 cm, and greater than 40 cm. For analysis, diameters of 20cm and greater were classified as large organic debris (LOD).

Following data analysis we produced a qualitative habitat assessment using field observations and professional judgment with steelhead as the diagnostic fish. Qualitative habitat assessment (QHA) is a non-quantitative approach to prioritizing stream reaches for protection and restoration based on reference and current conditions developed by Mobrand Biometrics. Reference and current conditions of each reach were ranked for 11 habitat categories on a scale from 0 (low) to 4.0 (high). These scores were then weighted based on hypotheses of habitat use by spawning and incubation, rearing, and migration life stages of steelhead. Condition rankings were based on professional judgement and field observations during the fisheries survey. Reference conditions are speculative and based on professional judgement with a 4.0 ranking being the best condition found in the Potlatch River Basin historically (prior to significant settlement). Twenty-one stream reaches were analyzed.

RESULTS

Overall Drainage Results

From June 2 to July 30, 2003 and April 29 to June 27, 2004 we sampled 17 tributaries with 134 sample sites amounting to 66,477 m^2 of stream within the Potlatch River drainage (Table 1). Instream habitat was distributed among the habitat classifications. Riffle habitat represented 39% of the total in-stream habitat throughout the Potlatch River basin. Pocketwater was observed throughout 24% of the sampled in-stream habitat. Flatwater habitat represented 26%, and pool habitat represented 11% of the total in-stream habitat (Figure 2).

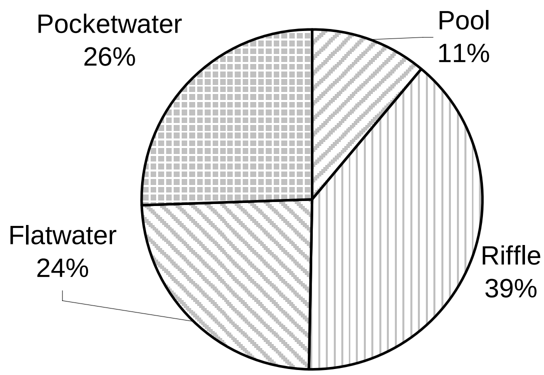

Figure 2. Habitat type composition of sampled transects within Potlatch River drainage, 2003-2004.

Most streams throughout the Potlatch River drainage were dominated by B and C channel types however some forestland streams such as Purdue Creek, Feather Creek, and Cougar Creek were predominately E channel types. A wide range of water temperatures were present during this study ranging from 9-26 ^{o}C (Table 2). Water temperatures increased substantially toward the end of sampling due to increased air temperatures and decreased stream discharge within the drainages. Large organic debris (LOD) counts were extremely low in canyon streams; often with no LOD present in the sampled transects. The occurrence of LOD within the stream channel increased in forestland streams higher in the drainage (Table 2). The same pattern was found with canopy cover; in general, higher percentages of canopy cover were found in forestland streams than canyon streams (Table 2).

We observed a total of 12,187 fish comprised of thirteen different taxa within sampled sites (Table 3). Sculpin were not identified to species. Of the 134 sample sites, 125 were sampled using electrofishing and 9 were sampled using snorkeling. Since the West Fork of the Potlatch River contained the only snorkel sites, overall results are reported separately for this stream. Stream accessibility and high water temperatures were sampling problems throughout much of the drainage.

Table 2. Habitat conditions in the 17 study streams. Streams are in order from the mouth of the Potlatch River to upper drainages followed by mainstem Potlatch River snorkel sites.

Drainage	# of Sites	Pools #/km	LOD #/km	% Canopy	Max. Temp (°C)	Min. Temp (°C)	Max. Depth (cm)
Big Bear Cr Below Barrier	8	6.7	1.3	6.3%	19	16	150
Big Bear Creek Above Barrier	13	3.9	1.5	12.7%	25	24	109
Little Bear Creek	15	13.2	7.2	12.5%	19	9	150
Little Bear Creek, WF	10	8.0	1.0	4.9%	22	18	85
Pine Creek	14	9.6	1.4	10.1%	18	13	110
Cedar Creek	11	17.3	5.5	11.1%	17	15	117
Leopold Creek	3	46.7	46.8	50.0%	13	12	95
Boulder Creek	5	14.7	69.3	68.0%	22	14	60
Corral Creek	6	4.8	11.5	27.5%	19	13	73
Little Boulder Creek	6	27.0	44.7	62.5%	11	13	0
EF Potlatch River	8	5.0	41.3	18.8%	25	16	108
Moose Creek	4	22.5	30.0	23.8%	22	15	160
Bobs Creek	8	33.8	183.8	62.5%	15	12	60
Pivash Creek	3	6.7	56.7	83.3%	13	11	46
Purdue Creek	3	13.3	16.7	48.3%	17	16	104
Feather Creek	2	30.0	20.0	35.0%	10	10	91
Cougar Creek	4	2.5	20.0	27.5%	14	10	210
Potlatch River	9	13.3		40.6%	26	21	156

Table 3. List of species sampled in 17 tributaries of the Potlatch River, 2003 and 2004.

Common Name	Scientific Name
Speckled Dace	*Rhinichthys osculus*
Longnose Dace	*Rhinichthys cataractae*
Rainbow/steelhead trout	*Oncorhynchus mykiss*
Hatchery Rainbow trout	*Oncorhynchus mykiss*
Brook trout	*Salvelinus fontinalis*
Largemouth bass	*Micropterus salmoides*
Pumpkinseed	*Lepomis gibbosus*
Northern pikeminnow	*Ptychocheilus oregonensis*
Redside shiner	*Richardsonius balteatus*
Sculpin	*Cottus sp.*
Bridgelip sucker	*Catostomus columbianus*
Largescale sucker	*Catostomus macrocheilus*
Yellow perch	*Perca flavescens*

We observed a total of 7,578 fish, comprised of thirteen different taxa with a total biomass of 59 kg in electrofished drainages. Speckled and Longnose dace were grouped into an overall dace category. Bridgelip and largescale suckers were grouped into an overall sucker category. Dace dominated the overall fish community; representing 42% of the total number sampled (Figure 3). Dace however were second to rainbow/steelhead trout in total biomass, representing 18% of the total biomass sampled (Figure 3). We found dace in 9 of the 16 tributaries sampled. Sculpin represented 14% of the total number sampled throughout the Potlatch River tributaries, and 6.2% of the total biomass (Figure 3). We found sculpin in 11 of the 16 tributaries sampled. Brook Trout represented 6.1% of the total number sampled throughout the Potlatch River drainage, and 5.1% of the total biomass (Figure3). We found brook trout in 7 of the 16 tributaries sampled. Sucker represented 2.5% of the total number sampled, and 7.3% of the total biomass (Figure 3). We found suckers in 7 of the 16 tributaries sampled. Redside shiner represented 3.8% of the total number sampled, and 1.6% of the total biomass (Figure 3). We found Redside shiners in 9 of the 16 tributaries sampled. Other species found in lesser abundance were northern pikeminnow, pumpkinseed, largemouth bass, yellow perch, and hatchery rainbow trout (Figure 3). Rainbow/steelhead trout were the most abundant fish and represented 31% of the number and 59% of the biomass sampled.

We PIT tagged 244 rainbow/steelhead trout throughout the Potlatch River tributaries; 43 in Big Bear Creek, 16 in Cedar Creek, 24 in Pine Creek, 55 in Little Bear Creek, 7 in Leopold Creek, 2 in Purdue Creek, 1 in Moose Creek, and 96 in the East Fork of the Potlatch River. Most of the rainbow/steelhead trout PIT tagged in the East Fork Potlatch River were caught with hook and line and were not included in the sampling densities. Unfortunately, quickly rising stream temperatures often prevented the PIT tagging of most rainbow/steelhead sampled during the survey.

Rainbow/steelhead trout were divided into age classes based upon the length frequency distribution of fish sampled throughout the study (Figure 4). Rainbow/steelhead trout less than 81mm were classified as age 0, fish 81-170mm were classified as age 1, and any rainbow/steelhead trout over 170mm were classified as age 2(+).

We observed a total of 4,609 fish, comprised of six different taxa in nine snorkel sites on the West Fork of the Potlatch River (Figure 5). Redside shiner and dace were the predominate fish species sampled comprising 45% and 37% of the total fish observed, respectively. Sucker were present in the West Fork of the Potlatch River comprising 15% of the total fish observed and rainbow/steelhead trout were present comprising 2.8% of the total fish observed. Brook trout and scuplin were present in lower numbers. Overall, much higher densities and numbers of fish were observed with snorkel surveys than electrofishing, especially when compared with similar forestland streams found higher in the Potlatch River drainage.

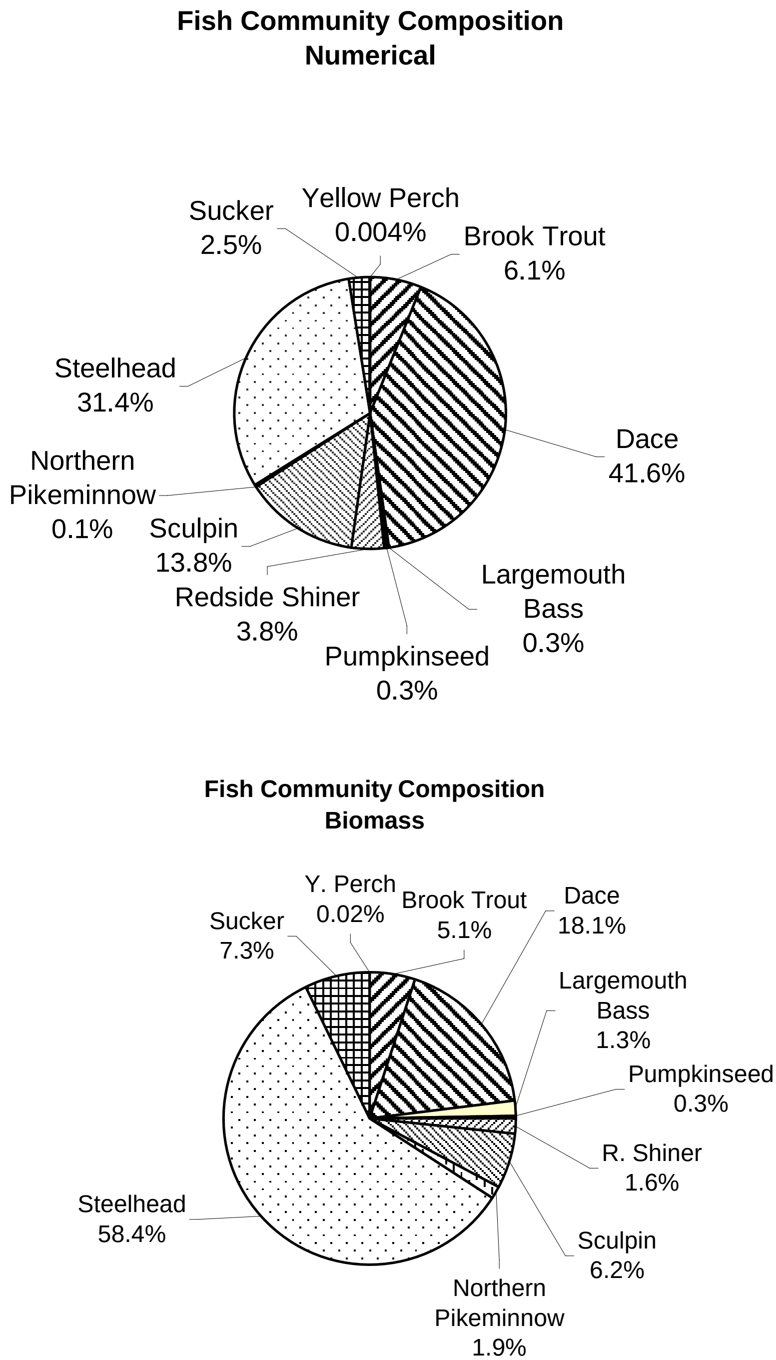

Figure 3. Comparison of overall fish number and biomass sampled by electrofishing within the Potlatch River drainage, 2003-2004.

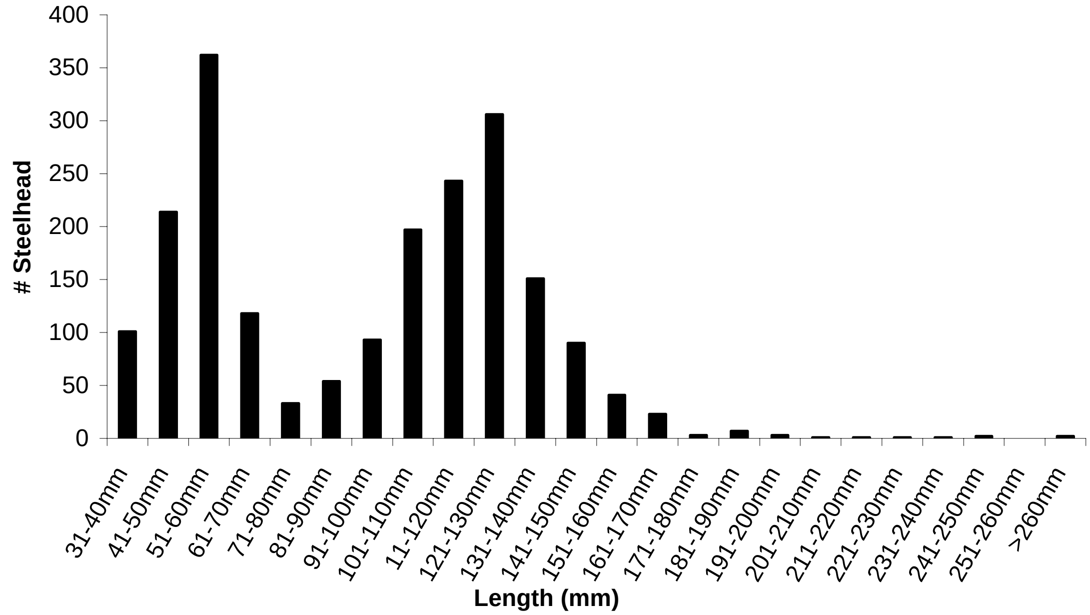

Figure 4. Length frequency histogram for rainbow/steelhead trout measured in the Potlatch River Basin during the 2003/2004 field season.

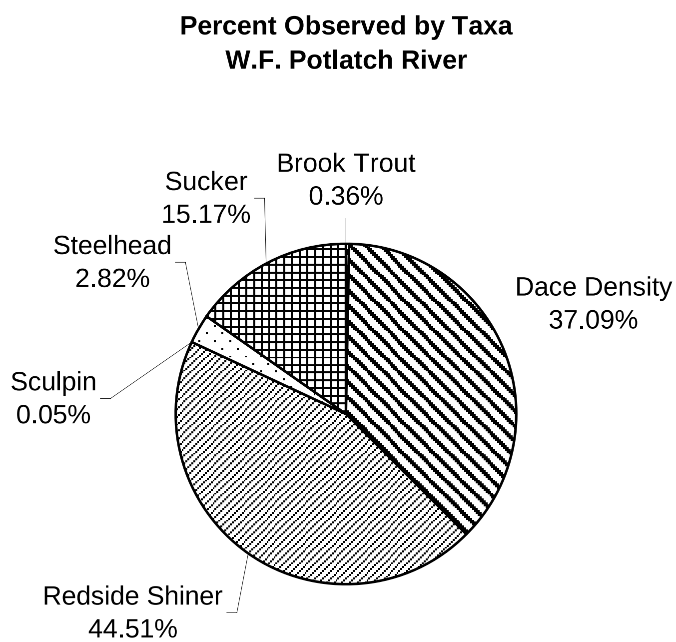

Figure 5. Overall species composition of fish observed in the West Fork Potlatch River during the 2003-2004 field season.

Individual Stream Results

The West Fork Potlatch River had the highest fish densities of all the streams sampled with an average of 94 fish/100m^2, however since a different sampling method was utilized these results cannot be directly compared with the rest of the drainage. The highest overall fish densities present in electrofishing sites were found in large canyon streams such as the West Fork of Little Bear Creek, Little Bear Creek, Big Bear Creek, and Cedar Creek (Figure 6). In these streams, dace and rainbow/steelhead trout constituted the majority of fish sampled (Figure 6). Within Big Bear Creek, it is important to note the presence of a natural barrier at approximately kilometer 9.0. There is an overwhelming dominance of dace above the barrier in Big Bear Creek. Species such as redside shiner, northern pikeminnow, and sucker sp. were absent from sites above the barrier and steelhead/rainbow were uncommon (Figure 6). Transitional and forestland streams such as Boulder Creek, Purdue Creek, and Pivash Creek had the lowest fish densities (Figure 6).

In addition to overall fish densities being different between upper and lower tributaries of the Potlatch River Drainage, species composition also differed. Streams downstream from the confluence of the East Fork and West Fork of the Potlatch River were dominated by dace and rainbow/steelhead trout (Figure 7). Brook trout, northern pikeminnow, and redside shiner were found to be a small portion of the fish community. In streams below the confluence with the East Fork Potlatch sculpin and brook trout were typically the dominate fish species sampled (Figure 7). Dace and rainbow/steelhead trout were present but often comprised a lesser percentage of the overall fish sampled compared to lower streams.

Rainbow/steelhead trout were present in 14 of the 17 sampled streams. Greatest rainbow/steelhead trout densities were found in the canyon streams lower in the Potlatch River drainage (Figure 8). The West Fork of Little Bear Creek had the highest rainbow/steelhead trout density of the sampled streams with a mean density of 13.2 fish/100 m^2 (Figure 8). Little Bear Creek had the next highest rainbow/steelhead trout densities with 10.7 fish/ 100 m^2 (Figure 8). Cedar Creek and Little Boulder Creek had the highest rainbow/steelhead trout densities outside of the Little Bear Creek drainage with 8.0 and 4.7 fish/100m^2 respectively (Figure 8). The ten remaining streams had rainbow/steelhead present but in much lower densities than previously mentioned streams. No rainbow/steelhead trout were sampled in Boulder Creek, Cougar Creek, and Feather Creek. Boulder Creek samples were from above a known natural barrier.

Similar to the overall rainbow/steelhead trout results, when rainbow/steelhead trout densities were separated into age classes, the West Fork of Little Bear Creek had the highest age-0 rainbow/steelhead trout density (Figure 9). Other streams with high age-0 steelhead trout densities included Little Bear Creek and Little Boulder Creeks (Figure 9). Unlike the overall rainbow/steelhead trout results, age-1 rainbow/steelhead trout densities were highest in Cedar Creek (Figure 9). Little Bear Creek also had higher age-1 rainbow/steelhead trout density than the West Fork of Little Bear Creek. All other streams had considerably lower age-1 rainbow/steelhead trout densities.

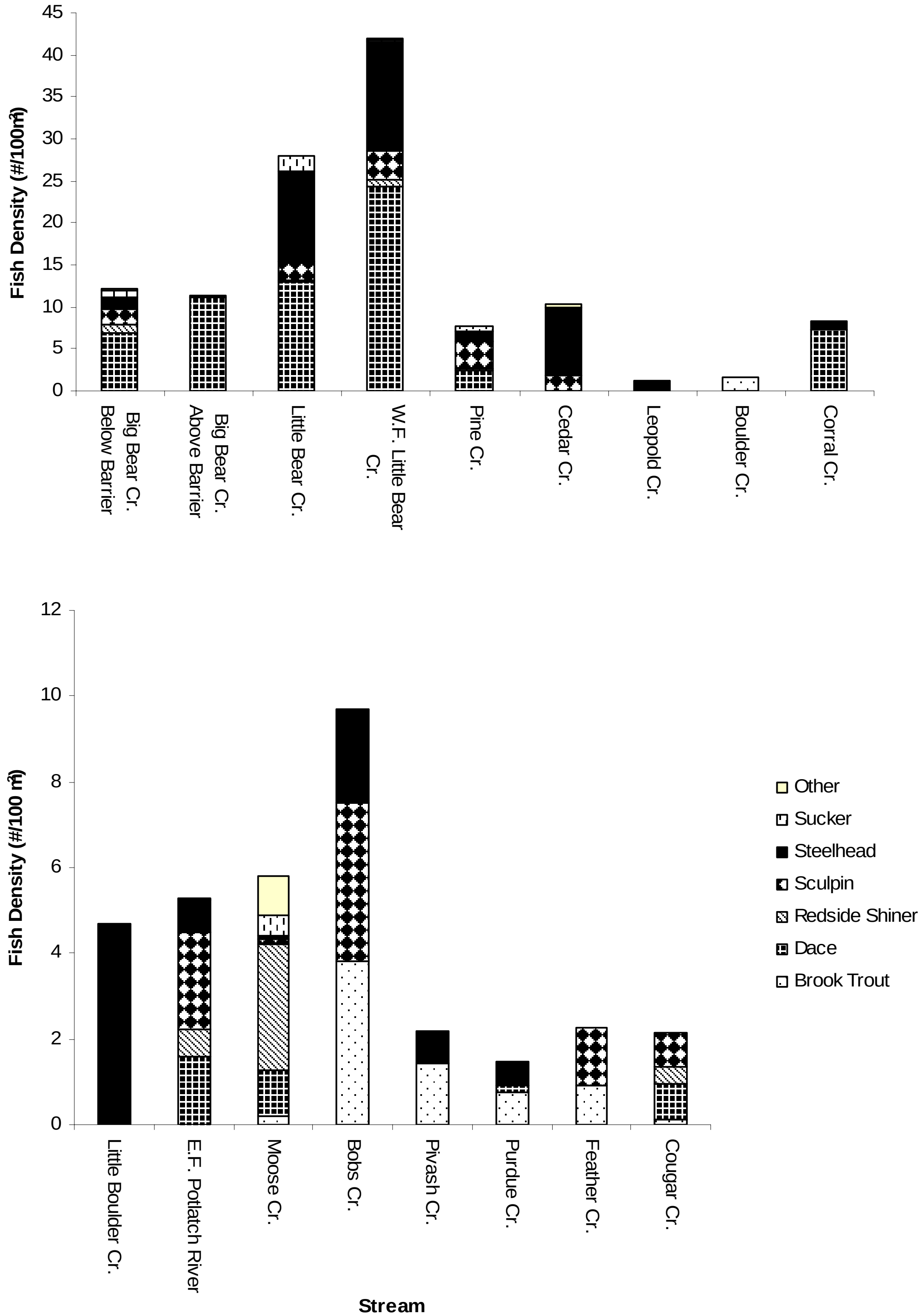

Figure 6. Average density of fish observed using electrofishing in the Potlatch River Basin during the 2003-2004 field seasons.

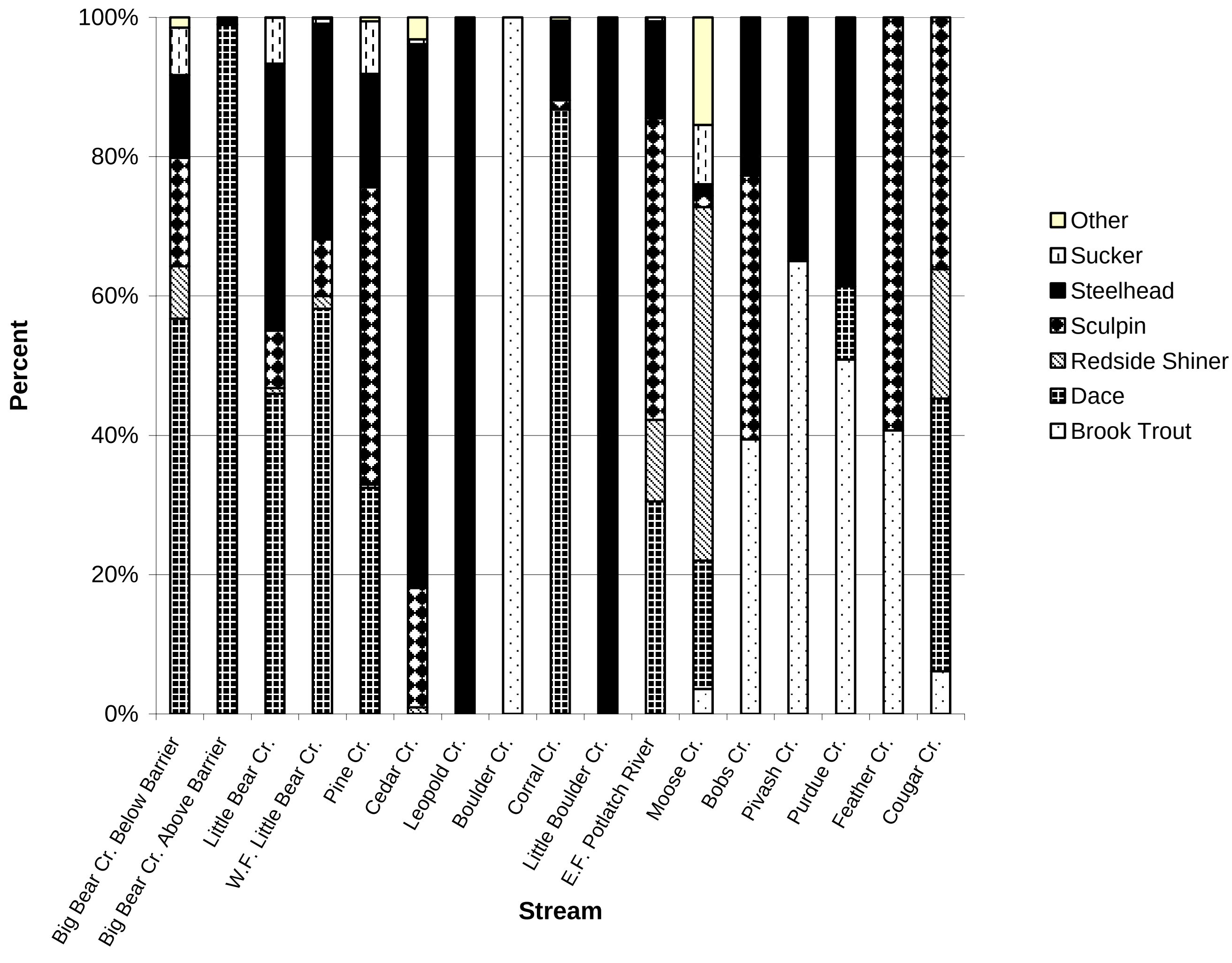

Figure 7. Fish community composition of sampled streams in the Potlatch River Drainage.

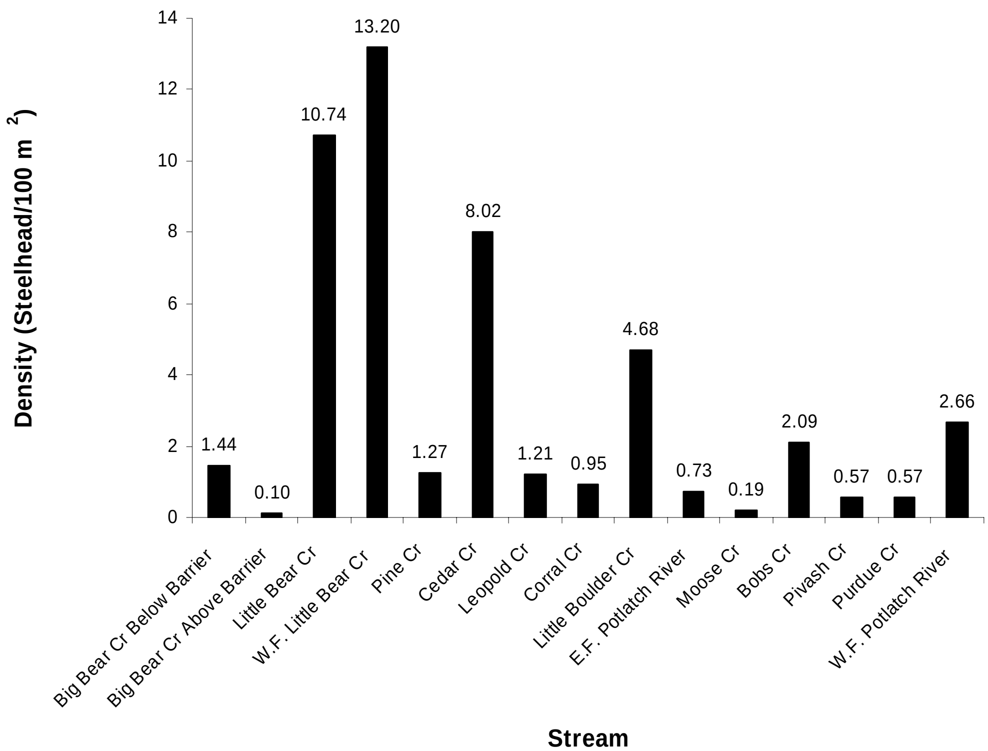

Figure 8. Average rainbow/steelhead trout densities present in tributaries to the Potlatch River sampled during the 2003-2004 field season.

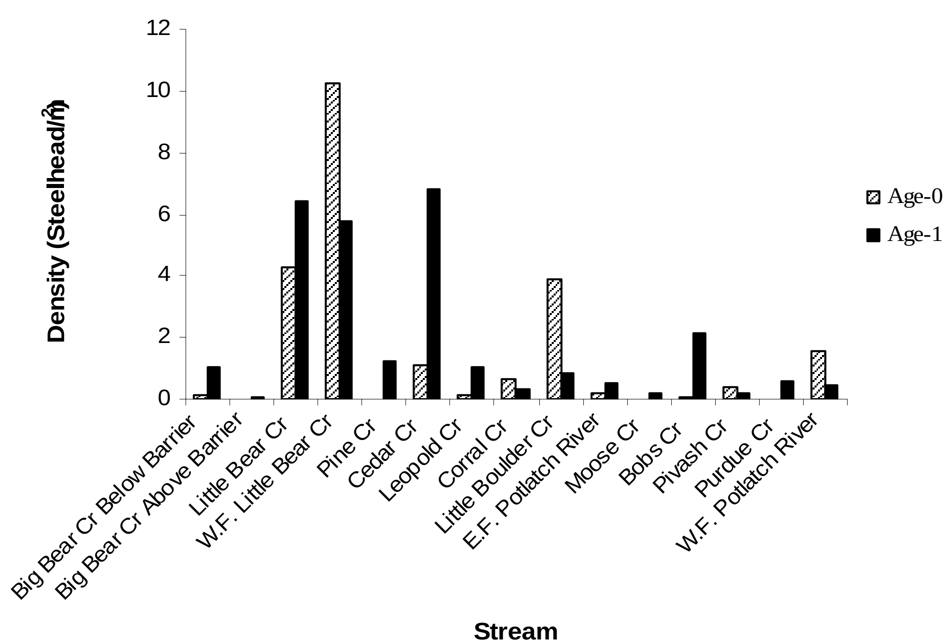

Figure 9. Rainbow/steelhead trout densities by age-class for all streams sampled in the Potlatch River Basin during the 2003-2004 field season.

Fish and Habitat Data

When examining overall fish and rainbow/steelhead trout density with habitat type composition within the sampled drainages, highest fish densities correspond to streams containing high percentages of riffle and pocketwater such as those found in the canyon reaches (Figure 10). Upland and forestland streams with higher percentages of flatwater and pools had lower rainbow/steelhead trout densities (Figure 10). Sampling methods, habitat use, stream productivity, and brook trout dominance in the upper basin could all contribute to this result.

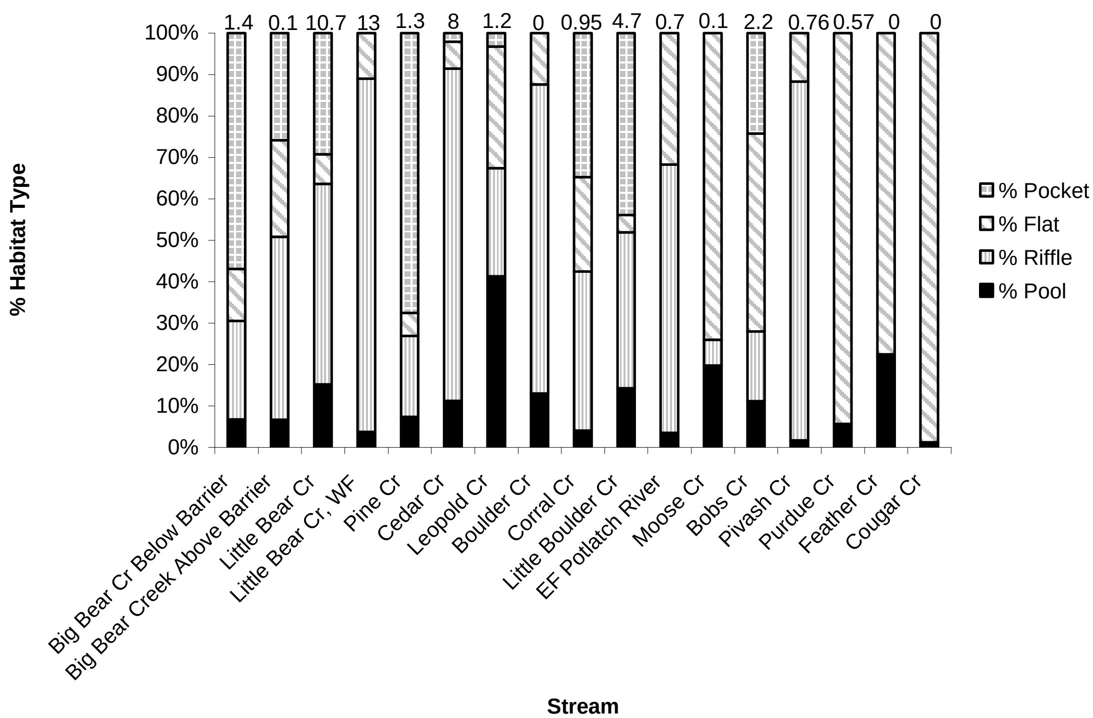

Figure 10. Habitat type composition for all streams sampled in the 2003-2004 field season. Numbers above bars indicate the average steelhead density observed in each stream.

Analysis of large woody debris (LWD) and fish densities in the forestland areas of the Potlatch River indicated a relationship between fish density and LWD. Two categories of LWD, >20cm and >40cm, were combined to create a classification of LWD we called large organic debris (LOD). We chose all LWD >20 cm for this analysis as these pieces tended to alter stream channel processes within the Potlatch Basin (field observations). Within the forestland systems, increases in LOD per kilometer correlated with increases in salmonid density (Figures 11). One site on Bobs Creek was removed from analysis since the extreme high density of LOD and riparian vegetation impacted the sampling crews' ability to successfully capture and observe fish.

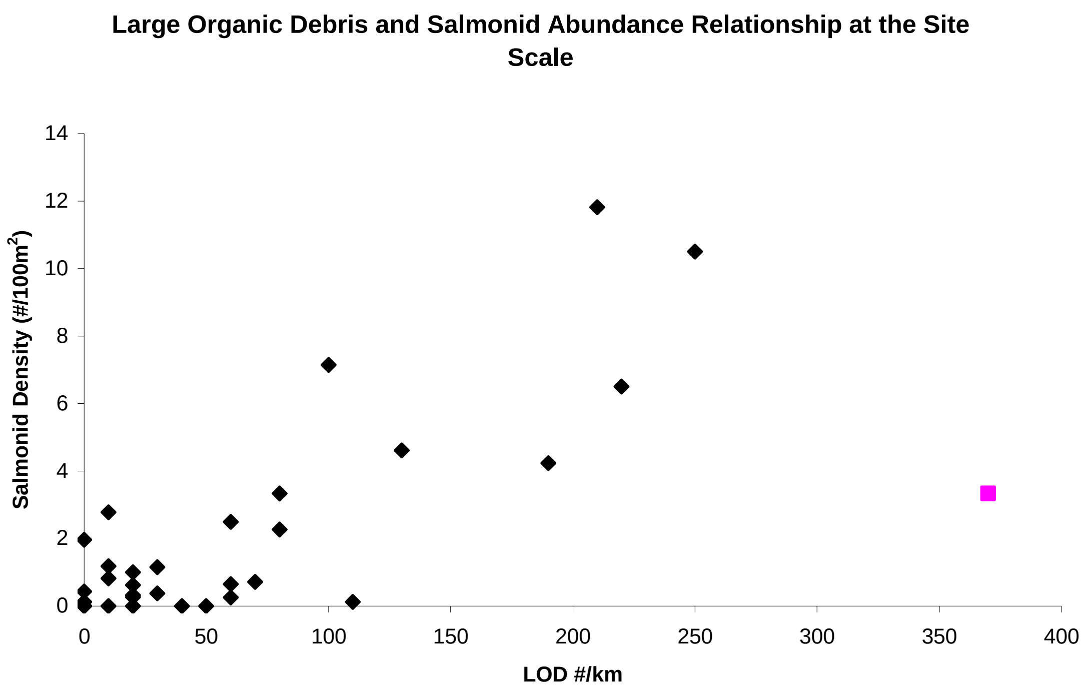

Figure 11. Large organic debris and salmonid abundance relationship at the site scale in the Potlatch River Basin forestland streams. LOD per km at each site is on the x-axis and the salmonid density at each site is on the y-axis. Excluded Bob's Creek point is shown as square rather than diamond.

<u>Qualitative Habitat Analysis</u>

Qualitative habitat analysis produced a ranked list of reaches for protection and restoration. The model also analyzed individual reach attributes and weighted these scores to provide a measure of which stream attributes are contributing to a need for protection or restoration. Higher priority protection reaches in the Potlatch River Basin are Bob's Creek, E.F. Potlatch River, Purdue Creek, Pivash Creek, and Moose Creek (Table 4). High priority restoration streams are Upper Big Bear Creek, Upper Pine Creek, Pine Creek, Big Bear Creek, and Upper Little Bear Creek (Table 5).

Reaches with similar watershed conditions and watershed types group together for restoration and protection. The less altered forestland watersheds are recommended for protection. These reaches are in watersheds with less alteration resulting in current conditions closer to historic steelhead productivity than agricultural drainages. Habitat attributes of forestland dominated watersheds high on the list for protection are typically habitat diversity, high flow, low temperature conditions, and low flow (Table 4). The forestland areas, though of lesser overall restoration rank, also have restoration needs. Restoration needs in forestland watersheds are typically high temperature conditions, fine sediment, low flow, and habitat diversity (Table 5). These restoration needs often could be met with standard Best Management Practices.

Agricultural and canyon complex streams rank low for protection. These watersheds are greatly altered from reference conditions. Attributes of these streams that should be protected are typically low temperature conditions and fine sediment as indicated by embeddedness. Suspended sediment was not considered in the analysis, but is a problem as indicated by listings in the 2002/2003 Draft Integrated Report (State of Idaho, Department of Environmental Quality 2004). Agricultural stream watersheds ranked highest for restoration indicating their departure from reference conditions. Attributes most in need of restoration for steelhead production include high temperature and high/low flow conditions.

Table 4. Protection ranking for stream reaches within the Potlatch River basin. Reach rank represents the priority for protection of a given stream reach. Habitat attributes are also rated for the importance to the reach rank. Lower values indicate attributes important for protection. NPC is not present current, indicating that steelhead are not presently found in the reach and therefore the reach was not ranked for protection.

Reach Name	Reach Rank	Riparian Condition	Channel stability	Habitat Diversity	Fine sediment	High Flow	Low Flow	Oxygen	Low Temperature	High Temperature	Pollutants	Obstructions
Upper Pine Creek	**NPC**											
Feather Creek	**NPC**											
Cougar Creek	**NPC**											
Bob's Creek	**1**	9	6	2	1	2	2	8	5	7	9	11
E Fork Potlatch River	**2**	8	6	3	3	3	1	8	1	7	8	11
Purdue Creek	**3**	9	5	1	6	1	1	7	1	7	9	11
Pivash Creek	**4**	8	6	1	1	1	1	8	1	7	8	11
Moose Creek	**5**	6	5	3	10	1	3	6	1	6	6	11
Ruby Creek	**6**	9	3	2	4	4	4	7	1	10	7	10
Upper Potlatch River	**7**	10	6	4	1	3	4	6	1	6	6	11
Boulder Creek	**8**	5	3	2	4	8	8	5	1	8	5	11
Leopold Creek	**9**	5	3	2	4	10	11	5	1	8	5	8
Middle Potlatch Creek	**10**	7	9	3	2	8	10	4	1	10	4	6
Little Bear Creek	**11**	8	4	3	1	9	10	4	1	11	4	7
Little Boulder Creek	**12**	8	3	3	2	3	10	3	1	10	3	9
Little Potlatch Creek	**13**	6	8	6	2	9	9	3	1	9	3	5
Cedar Creek	**14**	7	4	2	1	9	10	4	2	10	4	7
Big Bear Creek	**15**	6	8	6	2	9	9	3	1	9	3	5
Corral Creek	**16**	6	7	1	1	9	9	4	1	9	4	8
Pine Creek	**17**	8	6	7	2	9	9	2	1	9	2	5
Upper Little Bear Creek	**18**	7	5	5	1	4	7	2	7	7	2	7
Upper Big Bear Creek	**19**	6	5	4	7	7	7	2	1	7	2	7
Lower Potlatch River	**20**	5	5	5	4	5	5	3	2	5	5	1

Table 5. Restoration ranking for stream reaches within the Potlatch River basin. Reach rank represents the priority for restoration of a given stream reach. Habitat attributes are also rated for importance to the reach rank. Lower values indicate attributes important for restoration.

Reach Name	**Rank**	**Riparian Condition**	**Channel stability**	**Habitat complexity**	**Fine sediment**	**High Flow**	**Low Flow**	**Oxygen**	**Low Temperature**	**High Temperature**	**Pollutants**	**Obstructions**
Upper Big Bear Creek	**1**	8	6	5	2	1	2	9	7	2	9	11
Upper Pine Creek	**2**	6	5	4	6	1	2	9	6	2	9	11
Pine Creek	**3**	6	7	2	5	2	2	9	7	1	9	11
Big Bear Creek	**4**	8	6	2	5	2	2	9	6	1	9	11
Upper Little Bear Creek	**5**	7	4	5	8	1	1	10	5	1	10	8
Little Boulder Creek	**6**	8	6	3	5	3	1	9	7	1	9	9
Cedar Creek	**7**	8	7	4	6	3	2	9	4	1	9	11
Corral Creek	**8**	8	7	4	4	1	1	10	4	1	10	9
Little Bear Creek	**9**	7	7	3	5	3	2	9	5	1	9	11
Leopold Creek	**10**	6	9	5	4	2	1	6	11	2	6	10
Lower Potlatch River	**11**	4	6	1	7	4	1	8	10	3	8	10
Little Potlatch Creek	**12**	6	5	4	7	1	3	7	10	1	7	10
Upper Potlatch River	**13**	3	3	3	7	3	2	10	7	1	10	9
Ruby Creek	**14**	7	7	4	2	2	4	9	6	1	9	11
Moose Creek	**15**	9	8	3	1	5	3	9	5	2	9	5
Boulder Creek	**16**	7	10	5	3	3	2	7	6	1	7	10
Middle Potlatch Creek	**17**	6	4	5	7	3	1	7	10	1	7	10
Pivash Creek	**18**	7	6	2	2	2	2	7	11	1	7	10
E Fork Potlatch River	**19**	5	10	2	2	2	5	5	5	1	5	11
Feather Creek	**20**	4	8	4	4	2	2	9	9	1	4	9
Purdue Creek	**21**	4	7	8	4	2	2	8	8	1	4	8
Cougar Creek	**22**	2	8	3	3	3	3	9	9	1	3	9
Bob's Creek	**23**	2	4	11	4	4	4	4	4	1	2	4

DISCUSSION

Data Comparison 1995-1996 to 2003-2004

Average age 1+ densities of steelhead varied between streams in the 1995-96 and 2003-04 surveys. A two-factor ANOVA with stream and survey as factors indicated a significant stream and interaction effect (Appendix A). Graphical analysis of the interaction least squares means indicated that the primary differences between 1995-96 and 2003-04 surveys were increases in the density of age 1+ rainbow/steelhead in Little Bear Creek, W.F. Little Bear Creek, and Cedar Creek, and a decrease in the density in Big Bear Creek below the barrier (Appendix A, Figure 12). Age 1+ steelhead densities appeared similar in other tributaries from 1995-96 to 2003-04.

Age 0 steelhead densities showed similar patterns to age 1+ densities. A two-factor ANOVA with stream and survey as factors indicated a significant stream and interaction effect (Appendix B). Graphical analysis of the interaction least square means indicated the same differences between 1995-96 surveys and 2003-04 surveys with the addition of an increase in Age 0 abundance in Little Boulder creek as well (Appendix B).

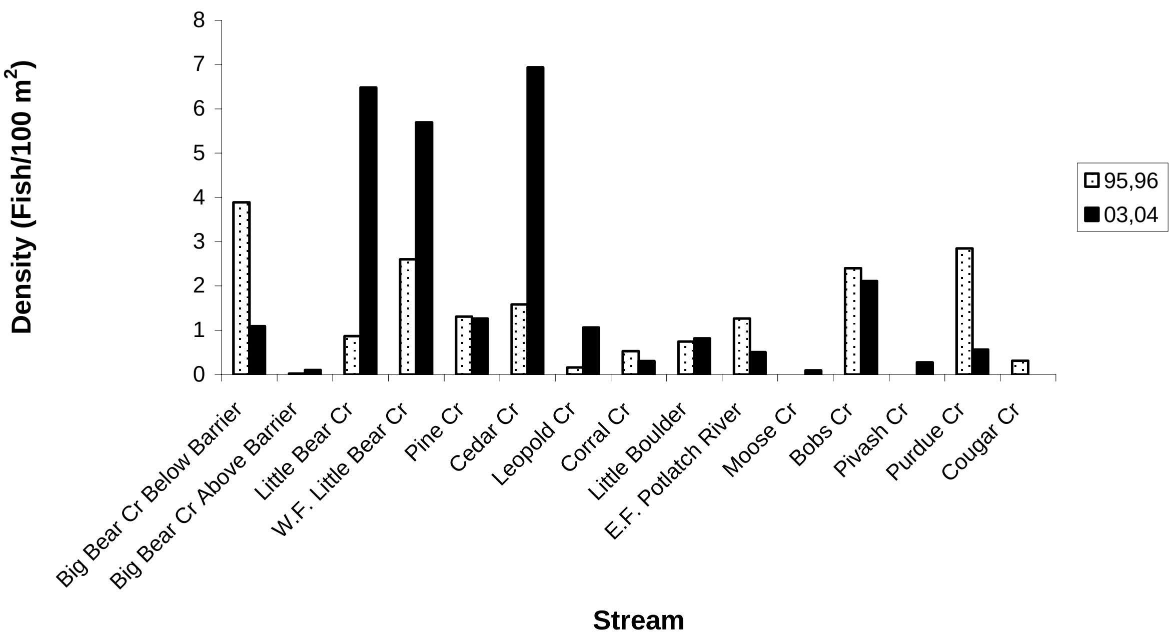

Figure 12. Comparison of average age 1+ rainbow/steelhead trout densities present in sampled streams during the 1995-1996 and 2003-2004 field season.

General Discussion

Dace and rainbow/steelhead trout were the predominate fish species sampled in the canyon streams both with regards to numbers and biomass. Dace densities were likely high since these species are tolerant of the wide variety of environmental conditions present within lower reaches of the Potlatch River drainage. Since rainbow/steelhead trout are more sensitive to environmental variables and since their densities varied between canyon streams, we conclude certain drainages such as the Little Bear system have more favorable conditions for salmonid spawning and rearing. Fish species composition in the forestland streams was dominated by brook trout and sculpin but overall species composition was more evenly distributed among a variety of species. Rainbow/steelhead trout densities in the upper reaches of the Potlatch were lower than many canyon streams but similar within the forestland streams. Difficult sampling conditions for electrofishing methods such as dense riparian vegetation, undercut banks, dense instream LOD, low conductivity and excessive channel depth in the forestland drainages likely contributed to lower observed fish and rainbow/steelhead trout densities.

Highest rainbow/steelhead trout densities were found in drainages having higher percentages of riffle and pocketwater habitat types. Since this study occurred in the late spring and early summers of 2003-2004, these habitat types were available to be utilized by rainbow/steelhead trout. Work by other researchers found higher densities of juvenile rainbow/steelhead trout within these habitat types compared to slower less turbulent habitat types such as pools and flatwater (Bisson et al. 1988, Hicks and Hall 2003). This contrasts with results from the 1995-96 study which found pool habitat to be the most important habitat to rainbow/steelhead (Schriever and Nelson 1999). Drastic decreases in stream discharge in the mid to late summer within the Potlatch River drainage, as evidenced by flows of less than 20 and often less than 10 cfs in the Potlatch River (USGS gauging station), cause many of the streams sampled in this study to flow underground in the interstitial spaces of the stream substrate. In many cases, the only surface water is present in deep pools. Coldwater inputs into these pools may provide the only areas where rainbow/steelhead trout are capable of rearing in the summer months. Therefore, while this study displays the importance of riffle and pocketwater habitat types during periods of higher flow it is important to conduct ground surveys later in the summer to determine habitat usage during low flow periods. Maintaining existing pool habitats and allowing for the formation of additional pools within the stream channel is likely important to maintaining rainbow/steelhead trout production in the later portions of the summer and fall as indicated by the Schriever and Nelson (1999) observations.

Even though large increases in rainbow/steelhead trout densities were present in some streams in 2003-2004 compared to 1995-1996, differences in sampling such as water levels and transect location may have resulted in these density differences rather than changes in the population. These differences may also be a result of yearly environmental parameters effecting rainbow/steelhead trout spawning and survival or differences in adult return numbers rather than changes in habitat composition and/or land use within the drainage. Rainbow/steelhead trout production within the Potlatch River drainage will likely fluctuate at similar levels in the future unless watershed improvements, watershed land use changes, and migratory survival improvements occur.

The barrier on the Big Bear Creek drainage was determined impassable for adult steelhead by previous studies on the drainage (Johnson 1985, Schriever and Nelson 1999).

However, in both these instances and during this study, at least one rainbow/steelhead trout was observed above the barrier. While some individuals may have residualized in the upper reaches of Big Bear Creek prior to the barriers existence, it is also possible that the barrier is passable at specific flows. Work by Stuart (1962) determined that adult salmonids have ideal leaping conditions when the height of the falls to the depth of the downstream pool is 1:1.25. Conditions below the Big Bear Creek barrier should meet or exceed this ratio, especially during higher flow years.

Results indicate a strong correlation between trout abundance and LOD in forestland streams. This is a common relationship in studies throughout a variety of stream ecosystems (Hicks et al. 1991, Harvey et al. 1999, Roni and Quinn 2001, Mossop and Bradford 2004). These studies have also shown that LOD aids in the formation of pool habitats, bank undercutting, and increased groundwater connectivity within the stream channel thereby reducing water temperatures. If riparian communities can be reestablished through fencing and riparian plantings, this should decrease the high water temperatures now present in the Potlatch River basin and allow for LOD inputs in the future.

The QHA model listed canyon streams with high restoration rankings and forestland streams with high protection rankings. High temperature and low flow were ranked as the highest restoration parameters within canyon streams by the model. Within these streams the actual canyon reaches are largely unaltered or have undergone minimal change. It will be important to maintain the relatively undisturbed condition within the canyons while focusing effort on restoring upland areas. Headwater reaches and smaller tributaries within these systems are where many of the alterations have occurred coincident with increases in agricultural use. Similar to canyon reaches in lower streams, protection of forestland streams and riparian areas should be given priority.

RECOMMENDATIONS

The results from this study show two different systems present within the Potlatch River drainage. Canyon streams displayed different habitat characteristics and fish communities than forestland streams found higher in the drainage. In the future it is important to adapt sampling strategies and data analysis to account for these two separate systems. Indices with regards to restoration efforts, changes in fish community, and long-term monitoring should be established individually for these two groups rather than the entire drainage.

Based upon much higher fish densities present in the West Fork of the Potlatch River compared with similar streams, it is our recommendation that future sampling in the upper portions of the Potlatch River be conducted using snorkel surveys. Not only is electrofishing difficult in these streams but snorkeling allows for more accurate single pass density estimates and does not require handling fish. Lower fish densities in forestland streams compared to canyon streams may be caused by sampling bias rather than actual differences in fish numbers. In addition to snorkeling in the upper portions of the drainage, additional hook and line sampling needs to be conducted for pit-tagging. During the 2003-2004 field season the majority of tagged rainbow/steelhead trout were caught with hook and line sampling. This method for obtaining taggable fish is more cost effective and less taxing on fish than electrofishing.

While the QHA ranked forestland streams with high protection rankings, this does not infer that these streams should not be considered for restoration effort. In many cases, slightly altered forestland streams may provide optimum restoration opportunities. For instance, fencing and/or riparian vegetation plantings may provide cooler instream water temperatures with minimal effort and resources. These positive effects high in the drainage would also have positive impacts in lower reaches. Furthermore, the policy of working down drainage should be implemented in all restoration efforts, even on smaller fishless tributaries. While in many streams optimal salmonid habitat is located in lower reaches, restoration efforts that improve upstream habitats will also benefit areas where salmonids such as rainbow/steelhead trout are present.

The Potlatch River drainage is subject to high water temperatures, high variability in flow, and altered riparian and upland habitats. These conditions have been present within this drainage since settlement and land-use change altered the landscape and hydrology within the Potlatch River. It is likely these conditions will remain relatively constant until further development or intense restoration efforts occur.

ACKNOWLEDGMENTS

We would like to acknowledge the many individuals and groups who helped make this project happen. Thank you to the Latah County Soil and Water Conservation District for funding and providing additional support and coordination. Special thanks to Ken Stinson and Trish Heekin for their efforts. We thank the Bonneville Power Administration for providing funding to the Latah SWCD for this project and other planning efforts in the Potlatch River Basin. A special thanks for the cooperation and interest of the many landowners within the Potlatch River for providing access, assisting with logistics, and their genuine interest and care for the future of steelhead trout in the Potlatch River. Finally, thank you to the many biological aides and technicians that worked on this project over the two years. Without your strong backs, formidable field skills, and dedication, the work would not get done.

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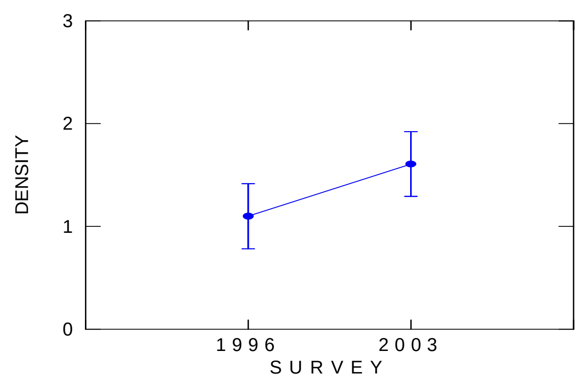
APPENDIX

Appendix A. Analysis of Variance.

Age 1+ Steelhead Analysis

Source	Sum-of-Squares	df	Mean-Square	F-ratio	P
Survey	12.624	1	12.624	1.289	0.257
Streams	559.187	16	34.949	3.569	0.000
Survey* Streams	270.568	16	16.910	1.727	0.043
Error	2350.259	240	9.793		

Least Squares Means



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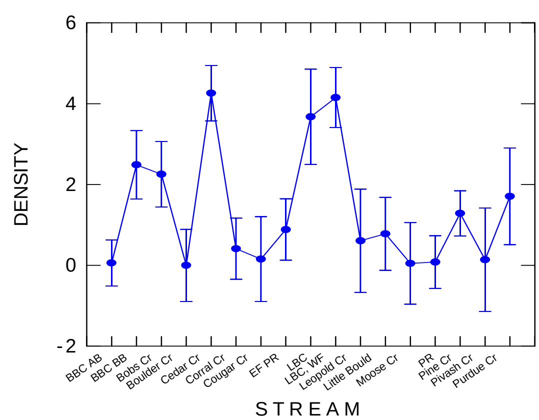
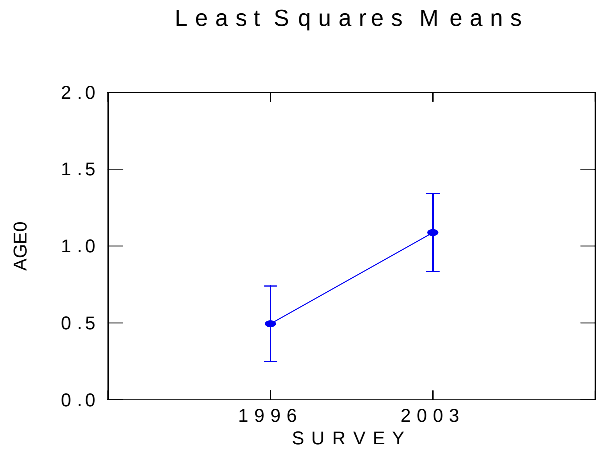
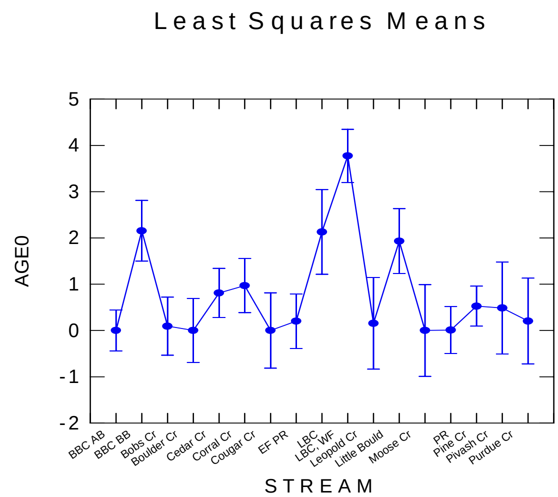


Appendix A, Continued

Age 0 Steelhead Analysis

Source	Sum-of-Squares	df	Mean-Square	F-ratio	P
Survey	16.584	1	16.584	2.810	0.095
Streams	283.034	16	17.690	2.997	0.000
Survey* Streams	377.907	16	23.619	4.001	0.000
Error	1404.837	238	5.903		





Appendix B. Graphical Analysis of Interaction Term.

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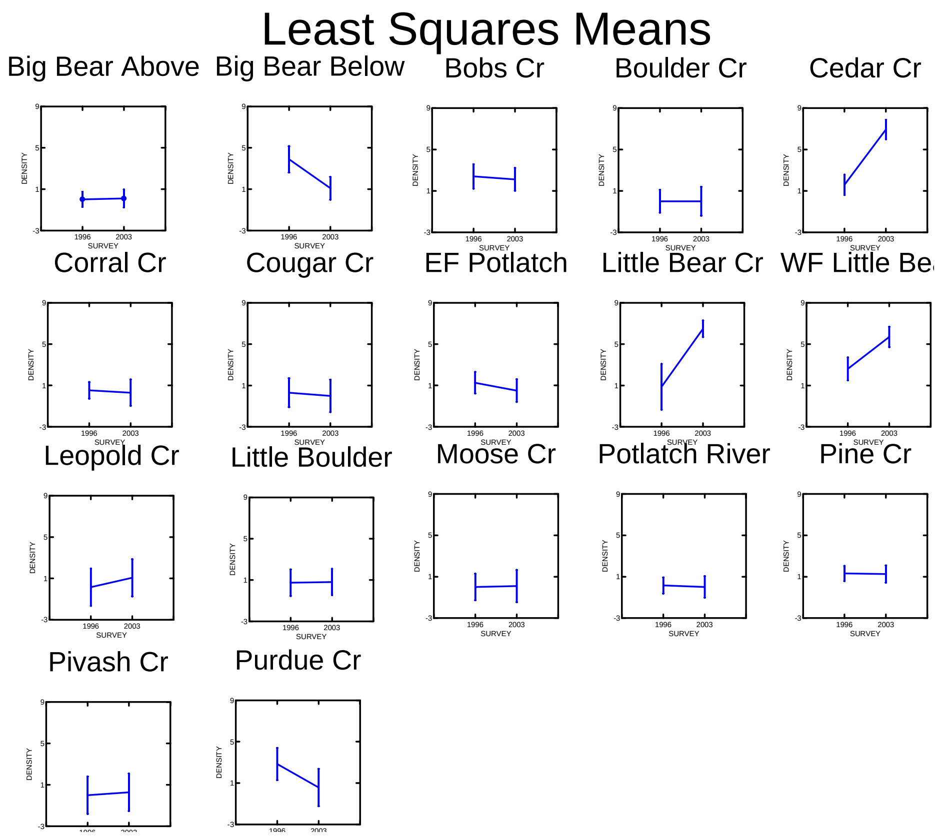
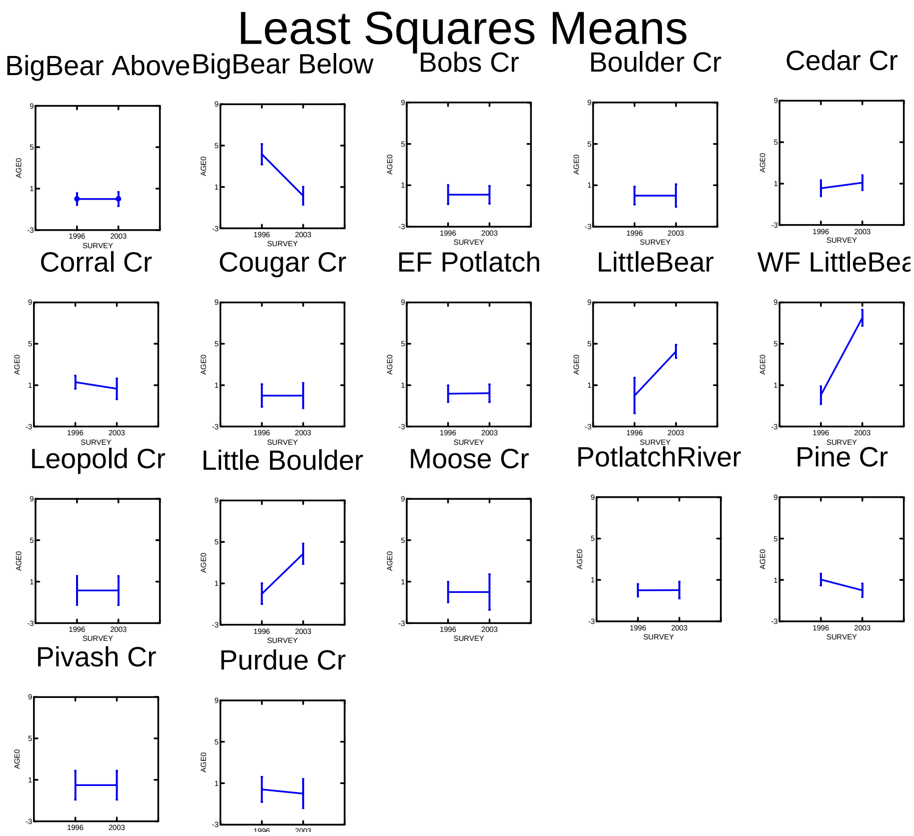
Age 1+ Steelhead Analysis



Appendix B, Continued.

Age 0 Steelhead Analysis



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