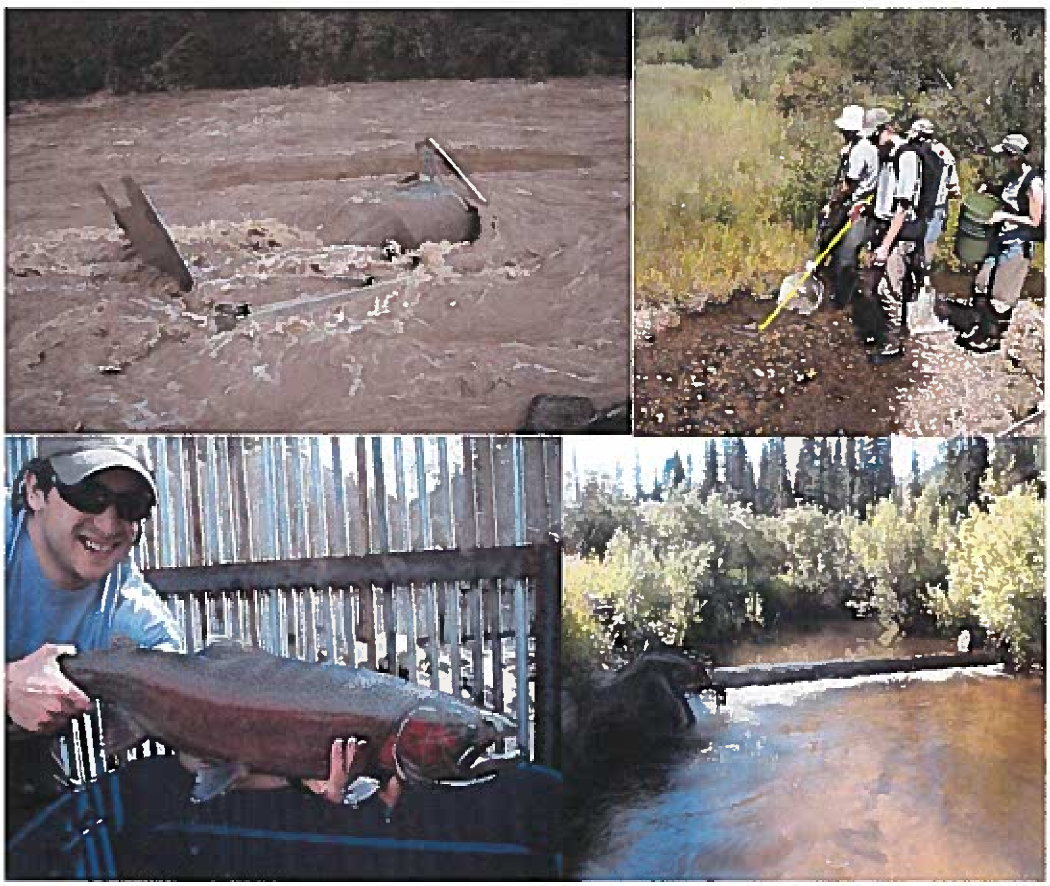
POTLATCH RIVER STEELHEAD MONITORING AND EVALUATION PROJECT

Annual Report

2012



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ABBREVIATIONS AND ACRONYMS

BBC	Big Bear Creek
BPA	Bonneville Power Administration
EFK	East Fork Potlatch River
EPA	Environmental Protection Agency
GRTS	Generalized Random Tessellation Stratification
ICTRT	Interior Columbia Basin Technical Recovery Team
IDFG	Idaho Department of Fish and Game
IDL	Idaho Department of Lands
ITD	Idaho Department of Transportation
IMW	Intensively Monitored Watershed
LBC	Little Bear Creek
LGR	Lower Granite Dam
LWD	Large Woody Debris
LWHAP	Low Water Habitat Availability Protocol
NOAA	National Oceanic and Atmospheric Administration
NPPC	Northwest Power and Planning Council
PIT	Passive Integrated Transponder
PRSME	Potlatch River Steelhead Monitoring and Evaluation
PTAGIS	PIT Tag Information System
PTC	Potlatch Timber Corporation
UILT	Upper Incipient Lethal Temperature
USFS	United States Forest Service
WFLBC	West Fork Little Bear Creek

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INTRODUCTION

This Potlatch River Steelhead Monitoring and Evaluation (PRSME) report contains results from 2012 which was the eighth field season for the monitoring and evaluation effort in the lower drainage and the fifth field season in the upper drainage. Field activities included adult escapement estimates, juvenile outmigration estimates, juvenile survival estimates, in-stream density estimates, habitat surveys, temperature monitoring, stream discharge monitoring and culvert surveys. The PRSME project was initiated in 2005 to assess steelhead *Oncorhynchus mykiss* production and productivity throughout the entire Potlatch River drainage. This project provides habitat restoration effectiveness monitoring as well as a high intensity monitoring drainage for the lower Clearwater River steelhead population. The project is funded by Pacific Coastal Salmon Recovery Funds and National Oceanic and Atmospheric Administration (NOAA) Fisheries Intensively Monitored Watershed (IMW) Funds.

The Potlatch River likely has the strongest component of wild steelhead present within the Clearwater River Lower Mainstem population (Bowersox et al. 2008). The Interior Columbia River Technical Recovery Team (ICTRT) estimated that the Potlatch River drainage contains 25% of the populations historic intrinsic potential including one Major Spawning Aggregation (Upper Potlatch River; including Big Bear Creek and East Fork Potlatch River) and two Minor Spawning Aggregations (Middle Potlatch Creek and Little Potlatch Creek)(NOAA Draft Recovery Plan 2006). Potlatch River steelhead are genetically distinct from other Clearwater River steelhead groups such as Dworshak hatchery strain steelhead (Byrne 2005). The geographic location of the drainage and lack of hatchery influence within Potlatch River steelhead make understanding population dynamics of this group extremely important regarding recovery actions for Clearwater River steelhead (ICTRT 2003).

Land use, primarily agricultural and timber harvest, has significantly altered the aquatic habitat and the hydrograph in the Potlatch River watershed. A variety of limiting factors for steelhead in the Potlatch River have been identified by previous work (Johnson 1985; Bowersox and Brindza 2006). Identified limiting factors include:

1) Extreme flow variation,
2) High summer water temperatures,
3) Lack of riparian habitat,
4) High sediment loads, and
5) Lack of in-stream habitat complexity.

In the lower Potlatch River basin, the most significant limiting factor is extreme flow variation, most prominently the lack of base flow during summer months. This limiting factor has been identified and subsequently monitored using a Low Water Habitat Availability Protocol (LWHAP). Surveys conducted the first week of August in the Lower Potlatch River tributaries have consistently documented de-watering. Addressing this limiting factor is the highest priority in the lower basin.

In the upper Potlatch River basin, the most significant limiting factor is the lack of in-stream habitat complexity. Previous surveys in the upper Potlatch River basin have shown a positive correlation between large woody debris (LWD) and steelhead density (Bowersox and Brindza, 2006). LWD is critical in developing pools, collecting spawning gravels, and providing habitat diversity and cover for salmonids (Wade, 2000). Addressing this limiting factor is the highest priority in the upper basin.

The Potlatch River has received focus from governmental and non-governmental agencies regarding its restoration potential. The Latah Country Soil and Water Conservation District, Idaho Department of Fish and Game, Natural Resource Conservation Service, and the U.S. Forest Service have begun significant restoration efforts throughout the drainage. The goal of the ongoing monitoring and evaluation project is to determine steelhead population response (production and productivity) to habitat enhancement.

OBJECTIVES

1) Monitor steelhead production and productivity throughout the Potlatch River drainage.
2) Provide the monitoring component to restoration projects within the Potlatch River drainage (fish and habitat response).
3) Describe steelhead life history strategies exhibited within the Potlatch River drainage.

STUDY AREA

The Potlatch River drainage is located in Latah, Nez Perce, and Clearwater counties. The mainstem Potlatch River is 89.4 km long and has a total drainage area of 152,621 ha (Department of Agriculture 1994). The drainage is approximately 78% private ownership (Schriever and Nelson 1999). The lower drainage, which includes the Big Bear Creek drainage, is almost entirely privately owned while the upper drainage, which includes the East Fork Potlatch River drainage, has two dominate landowners, Potlatch Timber Corporation and the U.S. Forest Service. Dominant land use and land type differ between the two drainages. The lower drainage is dominated by agricultural use and agricultural uplands and canyon bottomlands while the upper drainage is dominated by timberland and timberland ecotypes (Bowersox and Brindza 2006).

There is intensive monitoring in the lower and upper Potlatch River drainage (Figure 1). In the lower drainage, the intensive monitoring occurs in the Big Bear Creek (BBC) drainage, including Little Bear Creek (LBC). In the upper drainage, the monitoring occurs in the East Fork Potlatch River (EFK). The bulk of monitoring infrastructure is located in these drainages (Figure 1). We will report monitoring activities in these areas by stream abbreviations.

Mean daily stream discharge, measured at the USGS flow site (13341570) approximately five kilometers upstream of the mouth of the Potlatch River, ranged from 3 to 18,000 cfs during 2012 (Figure 2). Stream flows exceeded 1,000 cfs for 56 days and 5,000 cfs for seven days during the 2012 adult trapping season (Figure 2). Daily stream temperature during the spring trapping season, as measured at the BBC and EFK screw traps, ranged from 1.0 and 16.0 °C (February 9th – June 20th) and 0.5 and 14.5 °C (March 14th – June 21st) respectively.

METHODS

Adult Steelhead

Picket weirs were constructed in the lower drainage to capture upstream migrating adult steelhead on February 10th and February 11th at Big Bear (BBC) and Little Bear Creeks (LBC), respectively (Figure 1). Initially, weirs were outfitted with only an upstream migrant trap box. Both weirs were maintained and checked for fish daily. Weirs were not operational due to high flows for 45 days in BBC and 36 days in LBC. Weirs were removed at the end of the spring trapping season on May 30th for both BBC and LBC.

A floating weir was constructed in the upper drainage to capture upstream migrating adult steelhead on March 21st at the East Fork Potlatch River (EFK) (Figure 1). Initially, the weir was outfitted with only an upstream migrant trap box. The weir was maintained and checked for fish daily. The EFK weir was not fully operational for 15 days due to extreme high water or unsafe working conditions. The weir was removed at the end of the spring trapping season on June 21st.

Steelhead trapped migrating upstream were anesthetized with MS-222, marked with a right operculum punch and tagged with a passive integrated transponder (PIT) tag. The gender, weight, length, and the presence of any marks were recorded. All wild upstream migrants were released above the weir. Hatchery steelhead captured at the weirs were not passed upstream.

Downstream trap boxes and kelt wings were installed at BBC and LBC weirs on April 11th and May 2nd at the EFK weir location. The downstream trap boxes and kelt wings were not operational at the BBC and LBC weir sites for 6 days due to high flow events. Crowding techniques using nets and temporary barriers were also used at all weir locations to capture additional kelts within 100 m of the upstream side of the weir. Previously PIT tagged fish captured in the downstream box or by net were given a left operculum punch and released immediately downstream of the weir. All unmarked fish were given a left operculum punch and a PIT tag and released downstream. Gender, weight, length, the presence of a previous operculum punch and PIT tag number if present were recorded for all fish captured. Traps were pulled after adult steelhead kelt outmigration was complete.

Adult steelhead escapement above the weirs was calculated using a mark-recapture model using a maximum likelihood estimator (Steinhorst et al., 2004). Variables used for the estimate included marked adults passed upstream, marked adults recaptured as kelts and unmarked adults captured as kelts. Assumptions required are that marked and unmarked adults had the same survival during spawning and individual fish are recaptured independently with equal probability.

Scale samples were collected on all unique adult fish captured during the 2012 field season. Scales were collected posterior to the dorsal fin above the lateral line. Three to four scales were taken from each side of the fish. Scales were stored on Rite-in-Rain paper inside scale envelopes. Scale samples were sent to the Nampa Research Aging Laboratory in Nampa, Idaho for aging.

Juvenile Steelhead

A rotary screw trap was operated in the lower drainage in BBC from February 9th - June 20th and from December 5th till December 21st. The BBC trap was located 250 m upstream from the confluence with the Potlatch River and below the confluence of Big Bear and Little Bear Creeks. Therefore, the screw trap estimated total juvenile steelhead emigration out of both Big Bear and Little Bear Creeks and their tributaries. During the spring season the BBC trap was not operational for 19 full days and 3 partial days due to high water events and was no longer operational by mid-June due to insufficient flows. Trapping resumed when sufficient flows were present in the fall.

A rotary screw trap was operated in the upper drainage on EFK from March 14th – June 21st and October 31st till December 6th. The EFK screw trap was located approximately 300 m above the confluence with the mainstem Potlatch River. The EFK trap was not operational for 10 full days and 6 partial days due to high water events and was pulled at the end of the spring outmigration. Trapping resumed once sufficient flows were present in the fall.

Fish captured at the screw traps were identified and enumerated. Sub-samples of non-target species were weighed and measured. All steelhead were weighed, measured, and scanned for the presence of PIT tags. Juvenile steelhead (>80 mm) not previously tagged were anesthetized using MS-222 solution and tagged in the abdomen with a PIT tag following PIT tagging best practice procedures (Columbia Basin Fish and Wildlife Authority 1999). All PIT tagged individuals were allowed to recover in live wells and were then released approximately 500 m upstream of the screw trap to estimate trapping efficiency. Tag files were created within the P3 PIT tag data management computer program and uploaded to the PTAGIS (www.psmfc.org) database daily. Screw traps were checked daily throughout the spring emigration and on weekdays during the fall emigration due to low catch and personnel limitations.

Total juvenile steelhead emigration from BBC and EFK was estimated using the Bailey modified maximum likelihood method developed by Steinhorst et al. (2004). The trapping season was divided into periods based upon trapping efficiency for each trap. A running average of weekly trapping efficiency was plotted in order to visually estimate efficiency periods. Trapping days were grouped based upon periods of similar recapture probability. Input variables included; number of marked (PIT tagged) fish released upstream for recapture, number of marked fish recaptured, and the number of unmarked fish captured. Assumptions required for the use of this method are that all fish, marked and unmarked, are captured independently with the same probability during each period. Juvenile emigrant arrival rates to Lower Granite Dam (LGR) were estimated using Survival Under Proportional Hazards (SURPH) 2.2 software (Lady et al. 2001). These are considered arrival rates since some individuals will not emigrate until subsequent years or residualize within the Potlatch River drainage.

Scales were collected off every fifth fish in order to randomly sample over the entire juvenile emigration. Scales were sampled posterior to the dorsal fin above the lateral line. Scales were stored on Rite-in-Rain paper inside scale envelopes. The scale samples were sent to the Nampa Research Aging Laboratory in Nampa, Idaho to be aged. Scales were used to establish age structure of juvenile emigrants and assign age proportions to juvenile emigration estimate.

Roving Tagging

Juvenile in-stream survival was monitored in Potlatch River tributaries using juvenile steelhead that were tagged during the 2011 field season and subsequent detections at LGR in 2012. Fly-fishing and backpack electrofishing were conducted at selected locations during 2011 to collect fish for PIT-tagging. All juvenile steelhead >80 mm were anesthetized in MS-222, measured, weighed, and PIT-tagged. The PIT-tag data was uploaded to the PTAGIS database on a daily basis. Detections at LGR were used to estimate survival of those tag groups to the 2012 outmigration using SURPH software (Lady et al. 2001). These are considered arrival rates since some individuals will not emigrate until subsequent years or residualize within the Potlatch River drainage. Recaptures of PIT-tagged fish had daily growth rates estimated in mm/day.

Additional roving tagging was conducted in 2012 throughout the Potlatch River basin from June 6th through December 12th. During this time, juvenile steelhead were collected with a Smith-Root LR-24 backpack electrofishing and hook and line gear. Each fish captured > 80mm was anesthetized in MS-222, PIT tagged if not previously tagged, measured, weighed and released in close proximity to their place of capture. Tagging was consistent with NOAA criteria (NOAA 2000).

Snorkel Surveys

Snorkel surveys were conducted from May 25th – July 11th within the Potlatch River drainage. Sample sites were selected using a generalized random tessellation stratification (GRTS) design to provide a spatially balanced panel of survey sites (Stevens and Olsen 2004). Potential sites for the Potlatch River basin were selected from the GIS anadromous stream layer obtained from personnel at the US-EPA, Corvallis, Oregon office. A minimum of twenty sites were completed in the BBC and EFK drainages to provide enough statistical power to track annual variation in juvenile steelhead density over time. The sample size needed was generated by conducting a power analysis of 2008 snorkel data from the Potlatch River drainage. Density (fish/100m^2) was calculated based upon fish counted within the site. The number of snorkelers surveying each site was based upon site width. Survey sites were >80m in length and a minimum of five widths were taken. Site length and average width was used to calculate site area. Salmonids observed were enumerated and length estimated to the nearest inch. Non-salmonids were enumerated within each site. Data from all species and habitat characteristics were entered into the IDFG Stream Survey database.

Freshwater Productivity

Freshwater productivity (juvenile recruits/female spawner) was estimated for BBC and EFK. Annual female spawners was calculated by applying the observed sex ratio at each weir to the total adult escapement estimate. The juvenile production associated with a brood year of female spawners was estimated by applying age class proportions to subsequent years juvenile emigration estimates (i.e. Brood year 2010 females produce age-1 juveniles in 2011, age-2 juveniles in 2012, etc). The number of female spawners estimated in each brood year was divided by the total juvenile outmigration produced by that brood year to estimate juvenile recruits/female spawner.

Habitat Monitoring

Low Water Habitat Availability

Low Water Habitat Availability Protocol (LWHAP) surveys were conducted July 31st – August 2nd to evaluate wetted habitat and pool quality present within lower Potlatch River tributaries. Tributaries were stratified into upland and canyon reaches to disperse transects throughout each tributary. Within each strata, sample sites were selected using a generalized random tessellation stratification (GRTS) design to provide a spatially balanced panel of survey sites (Stevens and Olsen 2004). Two 500 m transects were surveyed within each strata and in each tributary resulting in four transects per tributary. The length of wetted habitat and the number of pools was recorded within each transect. The maximum depth, modal depth, pool length, pool width, temperature, and whether or not salmonids were present (visual observation) was recorded for each pool.

Flow Monitoring

A Marsh-McBirney model 2000 portable flow meter was used to measure and calculate stream velocities and discharge once a month from June through November at sites within the Potlatch River basin. At each site, horizontal distance, stream depth and water velocities were taken at a minimum 15 locations across the stream channel. The flow sensor was set at 60% total depth for thrity seconds and a velocity was recorded. Total discharge for each site was calculated in cubic feet per second (cfs) based on site area and velocity. The baseflow measurement for each site was taken in August.

Temperature Monitoring

Stream temperature was monitored and recorded in all major tributaries in the Potlatch River basin from June 11th to November 20th. HOBO Pro v2 data loggers were programmed to record date, time and water temperature in 2-hour intervals to obtain a seasonal temperature profile at each site. Each logger was placed in a perforated protected housing, attached to semi-permanent structure and deployed into a deep pool. The daily mean, minimum and maximum temperatures were computed for each site. Total days exceeding 20°C and 25°C were calculated for each site. Temperature data collected will be archived with USFS Rocky Mountain Research Station's Norwest Stream Temp database: http://www.fs.fed.us/rm/boise/AWAE/projects/NorWest.html.

Culvert Surveys

A culvert assessment was conducted in the EFK drainage to identify potential fish passage issues from September 17th through October 24th. Potential culvert locations were identified by overlapping GIS road network and stream layers. Locations where road and stream layers overlapped were then visited. Each culvert location was marked with GPS and assigned a unique site identification number. Fish passage was assessed by measuring several culvert characteristics and fish presence above and below culverts. At sites where more than one culvert was present, each culvert was measured and recorded separately. Length, culvert diameter and head cutting at upstream and downstream ends were recorded. Culvert condition was estimated based on visual observation of the culvert and assigned a good, fair or poor rating. Stream flow exiting the culvert was measured at each site using a Marsh-McBirney Model 2000 portable flow meter. Culvert slope was determined using a Sokkia C410 automatic level. Elevations at each end of the culvert were subtracted from each other, divided by the length of the culvert and then multiplied by 100 to give % slope. Fish presence/absence was determined by electrofishing for 100 meters above and below each culvert site using a Smith-Root LR-24 series backpack electrofisher. Fish species observed were identified and enumerated. Fish passage was assessed based on professional judgment using the measured variables at each site.

RESULTS

Adult Steelhead

Adult Abundance and Migration Timing

Two hundred and ninety adult steelhead were captured at Potlatch River weirs during spawn year 2012, 218 in BBC and 72 in EFK. Of the 218 fish captured at the BBC drainage weirs, 53 were marked and released as upstream spawners and 146 were captured as downstream kelts, with 34 fish being recaptures. The escapement estimate for the BBC drainage was 317 fish (95% CI 235 – 346). The first upstream spawner arrived on March 3rd (Figure 3). Fifty percent of the run was passed upstream on April 10th with the final upstream spawner arriving on May 18th (Figure 3). The first downstream kelt was captured on April 17th (Figure 4). Fifty percent of the downstream kelts were captured and passed on April 29th with the final kelt being passed on May 22nd (Figure 4). One hatchery steelhead was captured at BBC drainage weirs during the 2012 spawning season.

Seventy-two adult steelhead were captured at the EFK weir. Forty-five were marked and released as upstream spawners and 46 were captured as downstream kelts, with 19 fish being recaptures. The escapement estimate for the EFK was 106 fish (95% CI 72 – 159). The first upstream spawner arrived at the EFK weir on April 9th with fifty percent of the run being passed upstream by April 23rd (Figure 3). The final upstream spawner arrived on May 14th (Figure 3). The first downstream kelt was captured on May 4th and fifty percent of the downstream kelts were captured by May 16th with the final kelt being passed on June 16th (Figure 4). No hatchery steelhead were captured at the EFK weir during the 2012 spawning season.

Adult Life History Characteristics

Fork length of fish captured at the BBC drainage weirs ranged from 530 – 779 mm for females and 502 – 865 mm for males (Table 1). Fish captured at the EFK drainage weir ranged in size from 550 – 787 mm for females and 523 – 830 mm for males (Table 1). The observed sex ratios were 0.47 males per female in the BBC drainage and 0.84 males per female in the EFK drainage. Captures of female and male fish was 148 and 70 at the BBC drainage weirs and 39 and 33 fish at the EFK drainage weir. The estimated adult escapement by gender for 2012 was 216 and 101 (females and males) at the BBC drainage weirs and 57 and 49 (females and males) at the upper drainage weir.

Two hundred eighty-nine adult steelhead scale samples were collected during the 2012 field season. Ten scale samples were unable to be aged and 27 samples were only partially aged. Seven different freshwater/saltwater life history strategies were observed from these scales (Table 2). The 2 - freshwater, 2 – saltwater life history was the dominant strategy for both the BBC drainage (58% of fish) and EFK (34% of fish) (Table 2). Freshwater and saltwater ages ranged from 1 – 3 years for the BBC and EFK samples.

Juvenile Steelhead

Spring Emigration

The BBC screw trap captured 4,069 juvenile steelhead during the 2012 spring trapping season and 1,825 were PIT tagged and released above the trap to estimate trap efficiency. Of these, 649 steelhead were recaptured resulting in an overall trap efficiency of 37% (Table 3).

Total juvenile steelhead spring outmigration from the BBC drainage was an estimated 12,611 fish (95% CI 11,405 – 13,919) (Table 3).

The EFK screw trap captured 1,300 juvenile steelhead during the 2012 spring trapping season and 888 were PIT tagged and released above the trap to estimate trap efficiency. Of these, 99 were recaptured resulting in an overall trap efficiency of 10% (Table 4). Total juvenile steelhead spring outmigration from the EFK drainage was an estimated 12,908 fish (95% CI 9,994 – 17,106) (Table 4).

Fall Emigration

The BBC screw trap captured 49 juvenile steelhead during the 2012 fall season. Forty were PIT tagged and released above the trap to estimate trap efficiency. Of these, 16 fish were recaptured resulting in an overall trap efficiency of 40% (Table 5). Estimated juvenile steelhead fall emigration from the BBC drainage was 118 fish (95% CI 80 – 181) (Table 5).

The EFK screw trap captured 215 juvenile steelhead during the 2012 fall season. Seventy-seven were PIT tagged and released above the trap to estimate trap efficiency. Of these, 12 fish were recaptured resulting in an overall trap efficiency of 15% (Table 6). Estimated juvenile steelhead fall emigration from the EFK drainage was 1,225 fish (95% CI 712 – 2,043) (Table 6).

Length and Age Distribution

During the spring, steelhead sampled from BBC screw trap had a larger size distribution than those sampled at EFK screw trap (Figure 5). Fork length of juvenile fish captured at the BBC and EFK screw traps ranged from 26 – 310 mm and 28 – 201 mm, respectively. Mean fork length of steelhead sampled was 143 mm at the BBC screw trap compared to 96 mm at the EFK screw trap. Scale samples were collected on 312 and 237 juvenile steelhead at BBC and EFK screw traps, respectively. Of these, 288 scale samples were assigned an age for BBC and 231 for EFK. The dominant age class represented was age-2 (57%) at the BBC screw trap and age-1 (70%) at the EFK screw trap (Figure 6). Fish captured at the BBC screw trap were larger in all age classes represented (Figure 7).

Smolt Out-migrant Arrival Rates

Six hundred forty-six (24%) of the juvenile fish PIT tagged at screw traps during the spring of 2012 were detected downstream in the hydro system, 592 from BBC and 54 from EFK. Arrival rates of these fish from tributary screw traps to LGR was 32% (SE = 0.02) for BBC and 6% (SE = 0.01) for EFK (Table 7). Capture probability at LGR was 37% (SE = 0.02) for BBC and 56% (SE = 0.07) for EFK. Out-migrating smolts from BBC and EFK were detected at LGR March 27th through June 9th and April 21st through June 13th, respectively.

<u>Roving Tagging</u>

2011 Roving Tagged Fish Arrival Rates

In 2011, 2,034 juvenile steelhead were captured and tagged during roving tagging surveys. Fish were tagged in six tributary reaches with three of these being located within the BBC drainage (Table 8). Arrival rates of these tag groups to LGR in 2012 were highest in Little

Bear Creek and Cedar Creek with 25% and 23% respectively (Table 8). EFK juveniles had the lowest arrival rate at 9% (Table 8). The BBC drainage as a whole (Big Bear Creek, Little Bear Creek, West Fork Little Bear Creek) had an arrival rate to LGR of 21%.

2012 Roving Tagging

Nine-hundred and thirty steelhead were captured using electrofishing and 67 with hook and line during the 2012 roving tagging surveys (Table 9). The majority of the tags (n=897) were placed in fish in the BBC drainage while the remaining were placed in the EFK drainage. Estimates on outmigration timing and over summer survival will become available as these fish outmigrate past downstream PIT tag arrays and LGR during the spring of 2013.

Snorkel Surveys

2012 Snorkel Surveys

Seventy-one snorkel sites were surveyed in 17 different streams during the 2012 season. Two species of salmonids were identified during the surveys, steelhead and Brook Trout. Juvenile steelhead and Brook Trout were observed at 55% (n=39) and 21% (n=15) of the sites. Mean steelhead densities in the entire basin were 1.83 fish/100m^2 while Brook Trout densities averaged 0.39 fish/100m^2 (Table 10). Mean steelhead density was much higher in the BBC drainage than the EFK drainage with 2.89 and 0.41 fish/100m^2, respectively (Table 10). Trout fry were observed at 21% (n=15) of the sites and had a mean density of 3.08 fish/100m^2 (Table 10). Brook Trout densities in the EFK drainage were 1.35 fish/100m^2 compared to <0.01 fish/100m^2 in the BBC drainage.

Freshwater Productivity

Brood Year Productivity

Complete brood year productivity estimates in juveniles / spawner have been generated for five brood years in the BBC drainage. Juveniles / spawner estimates have ranged from 62 in brood year 2005 up to 270 in brood year 2006 (Table 11). A partial (missing age-3) estimate has been generated for brood year 2010 with 51 juveniles / spawner. There have been two complete brood year productivity estimates generated for the EFK. Juveniles / spawner estimates were 358 and 714 in brood years 2008 and 2009, respectively. A partial estimate has been generated for brood year 2010 with 258 juveniles / spawner (Table 11). Initial productivity estimates for BBC and EFK display a density-dependent relationship (Figure 8).

Habitat Monitoring

Low Water Habitat Availability

Surveys conducted in 2012 estimated that 83% of stream channel length within the lower Potlatch was wetted during the first week in August (Table 12). This was the second highest percent wetted stream channel observed since surveys began in 2007. The West Fork Little Bear Creek was 100% wetted for the third straight year and Pine Creek was the least wetted with 56% (Table 12). Pool density was the highest in BBC with 7.40 pools/100m^2 and the lowest in Pine Creek with 1.5 pools/100m^2 (Table 12).

Flow Monitoring

The average decrease in stream flow from early summer (June/July) to base flow (Sept.) was 94.6% in the lower drainage and 84.8% in the upper drainage (Table 14). Three sites went dry, Big Meadow Creek (site 10) and Corral Creek (site 18) in the lower basin and Fry Creek (site 24) in the upper basin (Table 13, Figures 10 and 11). During base flow conditions, the lower drainage was dominated by intermittent flow and the upper drainage with the exception of Fry Creek, maintained perennial flow all year long.

The index tributaries, BBC and EFK, displayed similar flow regimes throughout the 2012 season. The most significant decrease in stream flow occurred from June through July with BBC and EFK having stream flow reductions of 70 and 84%, respectively (Figure 9). Discharge remained relatively stable during base flow from August through September with a rebound of stream flows in September through October (Figure 9).

Base Flow Monitoring

Eleven sites in the lower basin had a base stream discharge < 0.1 cfs and two sites were dry. The remaining four sites had base stream discharge >0.2 cfs with the highest discharge of 5.0 cfs being measured in the mainstem lower Potlatch River (site 16) (Table 13, Figure 10). The BBC drainage (site 1) had an average base flow in September of 0.34 cfs and the BBC tributaries had an average base flow of 0.06 cfs (Table 14, Figure 10). The other lower basin tributaries had an average base flow of 0.12 cfs.

Four sites in the upper basin had a base discharge < 0.1 cfs and one site, Fry Creek, was dry. Of the remaining 11 sites, six had stream discharge >0.5 cfs with the highest discharge of 7.24 cfs being recorded at the mainstem upper Potlatch River (site 21) (Table 13, Figure 11). The EFK (site 22) had an average base flow in September of 4.46 cfs and the EFK tributaries had an average base flow of 0.29 cfs (Table 14, Figure 11). The remaining upper basin tributaries had an average base flow of 0.17 cfs.

Temperature Monitoring

Average daily temperatures were over 3°C warmer in the lower basin than the upper basin in the 2012 season (Table 15). Of the nine sites in the lower basin, eight sites (89%) had temperatures exceed 20°C and four sites (44%) had temperatures exceed 25°C (Table 15). BBC (site 1) was the only site to have an extended period of days exceeding 25°C (Table 15, Figure 12). The only site to not exceed 20°C was the East Fork of BBC (site 2), which had the lowest mean daily temperature of 10.34°C (Table 15, Figure 12). The highest mean daily temperature was at the Corral Creek site with 16.42°C. The temperature logger at the Corral Creek site was out of water from August 17th through October 27th and those dates were not reported.

In the upper basin, six of 11 sites (55%) had temperatures exceed 20°C and two sites (18%) had temperatures exceed 25°C (Table 15). The Potlatch River (site 11) was the only site to have an extended period of days exceeding 25°C (Table 15, Figure 12). Four sites (36%) did not exceed 20°C and had a combined mean daily temperature of 9.33°C (Table 15). The lowest mean daily temperature was in Mallory Creek at 8.57°C, while the Potlatch River had the highest mean daily temperature of 14.57°C (Table 15). Three temperature loggers were out of the water from July 3rd through October 13th (sites 10, 14, and 16; Table 15) and those dates were not reported.

Year round water temperature monitoring sites were established at 16 sites in the BBC and EFK drainages during the fall of 2012 and data from those sites will be included in future reports.

Culvert Surveys

Sixteen road crossings were identified and surveyed in the EFK drainage during the fall of 2012 (Figure 13). Two crossings included tandem culverts resulting in 18 culverts surveyed. Specific characteristics of each culvert, including dimensions and slope, can be found in Table 16. Six of the eighteen (33%) culverts had headcuts or culvert drop > 0.25 m and were considered "perched" culverts (Table 16). Two culverts sites (sites 7, 13) had slopes exceeding 10% (Table 16, Figure 13). Culvert condition was estimated as good at 14 sites, fair at two sites and poor at two sites (Table 16). The two culvert sites (sites 2, 3) recorded as poor condition were both located on Jackson Creek (Figure 13). Site 2 was heavily damaged and plugged with debris while site 3 was a severely perched culvert. Thus, based on professional judgment and fish presence, these two sites were determined to be barriers to upstream movement of fish. The remaining 14 sites were not considered passage barriers.

DISCUSSION

Steelhead productivity in the Potlatch River basin appears to be highly density dependent. The juvenile recruits per female spawner productivity estimates for BY 2005 – 2010 in BBC and BY 2008 – 2010 in EFK show a sharp decline in productivity as female escapement into the drainage increases. The presence of density-dependent effects has been well documented in salmonid populations. Achord et al. (2003) found Chinook parr survival to be negatively related with initial density. Survival from rearing tributary to Lower Granite Dam of Chinook juveniles found in high initial density streams was half that of fish found in low density streams (Achord et al. 2003). Elliot (1994) found that Brown Trout survival was negatively correlated with initial egg density in Black Brows Beck, England. He also found loss rates of Brown Trout in various life stages to be highly density-dependent (Elliot 1994). The suite of habitat restoration approaches currently being implemented within the Potlatch River Drainage should reduce the density dependent effects currently observed within the drainages.

Initial brood year productivity estimates for the EFK are significantly higher than those observed in the BBC drainage. However, other steelhead life history differences between the two index streams needs to be taken into account prior to drawing the conclusion that the EFK is more productive than the BBC drainage. The productivity curves represent juvenile emigrants per female spawner for each tributary. Previous work by PRSME has consistently displayed a much younger age structure of emigrants leaving the EFK compared to BBC drainage. Therefore, EFK emigrants are subject to a reduced mortality prior to emigration out of the natal tributary. EFK emigrants typically rear an additional year downstream in the Potlatch River drainage prior to ocean outmigration subjecting them to additional mortality prior to smoltification (Bowersox et al. 2012). It is therefore likely that smolts per female spawner productivities for both index tributaries are similar leaving the mouth of the Potlatch River since the majority of emigrants from BBC are in fact smolting while emigrants from the EFK are still juveniles and will not smolt till the following year.

Emigrant age at the two Potlatch River screw traps may be influenced by limiting factors within the index tributaries or position of the two traps within the larger Potlatch River drainage as a whole. One of our hypotheses is that EFK fish emigrate younger due to a lack of over-winter habitat within that index tributary. Bjornn (1971), postulated that fish found the stream environment unsuitable during the winter, resulting in movements of non-smolt trout and salmon from areas with no rubble substrate to areas with large rubble substrate. A second hypothesis is that fish undergo micro-migrations from hatching reaches to lower in natal tributaries prior to ocean outmigration. This hypothesis is supported by Leider et al (1986) who found that many juvenile Steelhead would emigrate from Gobar Creek to the mainstem Kalama River and rear an additional year prior to smoltification and ocean outmigration while others would rear entirely within the tributary. As habitat restoration aimed at improving in-stream habitat complexity occurs within the EFK, we will continue to monitor any changes in age structure of juvenile emigrants.

In addition to fish in/fish out monitoring, the PRSME project also monitors juvenile habitat. Starting in 2013 the PRSME project will implement a BACI design in both the lower and upper index tributary areas. This design incorporates a control that is measured at the same time as the treatment area to account for environmental variation (Stewart-Oaten et al., 1986). Both BBC and EFK will serve as treatment areas where habitat restoration efforts are planned. Pine Creek and the upper Potlatch River will serve as control areas for the lower and upper drainages respectively. Measured fish response variables in each of these areas will include juvenile Steelhead abundance, growth, and summer survival. Measured habitat response variables will be different between the lower and upper index tributaries given the different limiting factors. Late-summer base flow, wetted habitat, and pool density will be the measured habitat variable in the lower drainage while water temperature, LWD density, and pool density will be measured in the upper drainage. This study design framework will provide additional power to detect changes associated with habitat restoration in the Potlatch River drainage.

A lack of water retention and late summer Steelhead rearing habitat is the limiting factor in the lower Potlatch River drainage. In 2012, stream flow decreased 94.6% in the lower Potlatch River basin from early summer (June/July) to base flow (Sept.) with intermittent flow and intermittent channels dominating the lower basin by August. The efficacy of late summer water releases to supplement steelhead rearing habitat was studied within the West Fork Little Bear Creek WFLBC drainage by Brooks and Treasure (2014). They found that a release of 0.21 cfs from a headwater reservoir provided an additional 10 km of wetted habitat resulting in 100% connectivity in the immediate downstream reach (Brooks and Treasure 2014). In addition, water quality within the reach improved, specifically an increase in dissolved oxygen levels (Brooks and Treasure 2014). This research exhibited the ability for low volume water releases to significantly improve the quantity and quality of downstream juvenile Steelhead rearing habitat. Two opportunities have been identified in the BBC drainage for water releases to supplement late summer flows from two headwater reservoirs, Spring Valley Reservoir and Big Meadow Creek Reservoir.

Meadow restoration has also been identified as a potential restoration approach to increase late summer instream flow and address the limiting factor within the lower Potlatch River drainage (LSWCD Watershed Management Plan 2007). Corral Creek is the primary tributary where this approach is being tested. Corral Creek LWHAP transects were 36% wetted in 2007 but had increased to 68% wetted in 2012 (Figure 14). The documented increase is encouraging regarding the efficacy of meadow restoration for increasing baseflow but environmental variation may also account for the increase. Initial years of LWHAP surveys in Corral Creek have tracked very similarly to Pine Creek, a drainage with limited meadow systems and no restoration actions (Figure 14). Both systems have showed increases in wetted habitat in 2011 but Corral Creek wetted habitat remained at this level during 2012 surveys, whereas Pine Creek decreased (Figure 14). In addition, the Big Bear Creek surveys have also documented increases in wetted habitat available in 2011 and 2012, however the increase has been at a reduced magnitude to what was observed in Corral Creek (Figure 14). These fluctuations may be influenced by a variety of environmental factors in each drainage. In order to understand if these baseflow changes in Corral Creek are attributable to meadow restoration, additional years of data on Corral Creek and neighboring drainages are needed.

In addition to low water release strategies, barrier removal or modification can be used to reconnect steelhead habitat by restoring access to spawning and rearing areas. Three barrier removal sites were identified and are at various stages of implementation. The Dutch Flat Dam removal project on the WFLBC is scheduled to be completed in 2013 (Latah County Soil and Water Conservation District), with the Big Meadow Creek culvert and BBC Falls projects scheduled to be assessed in 2013-2014. These three projects will restore access to over 48 km of steelhead habitat. Fish surveys conducted in each of these areas above and below the barriers have documented significant increases, in some reaches 100 fold, in juvenile steelhead densities immediately below these sites compared to above. We expect a significant increase in steelhead production within the BBC drainage upon the completion of these projects.

The major limiting factor in the EFK is stream channel complexity and over-winter habitat for juvenile rearing steelhead due to low density of large woody debris (LWD). IDFG has partnered with Potlatch Timber Corporation to address these issues. In 2009, LWD treatments were initiated within the EFK to increase stream complexity and over-winter rearing habitat for steelhead. To date over seven kilometers of steelhead habitat within the EFK has had LWD treatments or is planned to have LWD treatments. All LWD and habitat restoration efforts are located within the core distribution of steelhead in the EFK covering an estimated at 67 kilometers of stream. With an additional 4-5 years of project implementation we hope to enhance approximately 25% of the core steelhead distribution in the EFK..

Improving instream habitat complexity in the EFK should increase steelhead densities. Solazzi et al. (2000), studied the effects of increasing over-wintering habitat on salmonids by installing LWD and found that following habitat modification, migrant populations of steelhead increased in the two treatment streams by 800 and 400% while reference streams increased by 65 and 40%. Standardized capacity ratings developed by the System Planning Group for the NPPC estimated parr densities of excellent, good, fair, and poor habitat at 20, 14, 10 and 6 parr/100m^2, respectively (Petrosky and Holubetz 1988). The EFK drainage is currently dominated by the Rosgen C channel type, which gives the EFK a habitat class rating of good if the habitat is undisturbed (Hall-Griswold and Petrosky 1998). However, habitat in the EFK drainage is currently impaired. Steelhead densities for 2012 were < 6 parr/100m^2 for every site in the EFK, which is below the estimated carrying capacity of fair habitat. As LWD, riparian fencing, and meadow restoration projects are implemented in the EFK habitat quality will increase and commensurate increases in steelhead density should be observed by the monitoring framework.

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TABLES

Table 1. Length characteristics for male and female upstream spawners captured at Big Bear Creek drainage and East Fork Potlatch River, Idaho, weirs during the 2012 field season.

Location	Sex	n	Min Length (mm)	Max Length (mm)	Average Length (mm)	SD	SE
BBC	Female	148	530	779	699	50.4	4.2
BBC	Male	70	502	865	675	88.1	10.5
EFK	Female	39	550	787	686	54.8	8.8
EFK	Male	33	523	830	663	90.3	15.7

Table 2. Freshwater (FW) and saltwater (SW) ages of spawning adult steelhead captured at Big Bear Creek drainage and East Fork Potlatch River, Idaho, weirs during the 2012 field season.

FW/SW Age	Lower (n)	%	Upper (n)	%	Total	%
1:1	6	3	2	3	8	2.8
1:2	14	6	1	2	15	5.2
2:1	42	19	15	21	57	19.7
2:2	126	58	24	34	150	51.9
2:3	0	0	2	3	2	0.7
3:1	2	1	11	16	13	4.5
3:2	2	1	5	7	7	2.4

Table 3. Number of juvenile steelhead captured, marked and recaptured at the Big Bear Creek, Idaho, screw trap including five single period out-migrant estimates and the total outmigration estimate for the 2012 spring trapping season. Also included are average efficiency, migrant estimate, and 95% confidence intervals (CI) for each sampling period.

Dates	Captured	Marked	Recaptured	Efficiency (%)	Migrant Estimate	Lower 95% CI	Upper 95% CI	SE
2/29 - 3/21	152	117	16	14	1,055	680	1,723	271.9
4/17 - 5/8	562	493	63	13	4,338	3,427	5,491	536.4
5/11 - 6/4	3,069	1,100	506	46	6,665	6,201	7,116	234.9
6/5 - 6/11	95	53	36	68	139	112	174	15.4
6/12 - 6/18	191	62	28	45	415	313	567	62.3
Total	**4,069**	**1,825**	**649**	**37**	**12,611**	**11,405**	**13,919**	**633.9**

Table 4. Number of juvenile steelhead captured, marked and recaptured at the East Fork Potlatch River, Idaho, screw trap including four single period out-migrant estimates and the total outmigration estimate for the 2012 spring trapping season. Also included are average efficiency, migrant estimate, and 95% confidence intervals (CI) for each sampling period.

Dates	Captured	Marked	Recaptured	Efficiency (%)	Migrant Estimate	Lower 95% CI	Upper 95% CI	SE
3/19 - 5/1	328	138	9	7	4,559	2,579	8,646	1711.5
5/2 - 5/14	484	325	51	16	3,034	2,345	3,958	419.7
5/15 - 5/25	277	232	26	11	2,390	1,652	3,434	466.8
5/26 - 6/18	211	193	13	7	2,924	1,746	5,141	899.5
Total	**1300**	**888**	**99**	**10**	**12,908**	**9,994**	**17,106**	**1,909.7**

Table 5. Number of juvenile steelhead captured, marked and recaptured at the Big Bear Creek, Idaho, screw trap including one single period out-migrant estimate and the total outmigration estimate for the 2012 fall trapping season. Also included are average efficiency, migrant estimate, and 95% confidence intervals (CI) for each sampling period.

Date	Captured	Marked	Recaptured	Efficiency (%)	Migrant Estimate	Lower 95% CI	Upper 95% CI	SE
12/6 - 12/17	49	40	16	40	118	76	178	28
Total	**49**	**40**	**16**	**40**	**118**	**80**	**181**	**26.3**

Table 6. Number of juvenile steelhead captured, marked and recaptured at the East Fork Potlatch River, Idaho, screw trap including two single period out-migrant estimates and the total outmigration estimate for the 2012 fall trapping season. Also included are average efficiency, migrant estimate, and 95% confidence intervals (CI) for each sampling period.

Date	Captured	Marked	Recaptured	Efficiency (%)	Migrant Estimate	Lower 95% CI	Upper 95% CI	SE
10/31-11/13	124	28	4	14	719	325	1,479	282.7
11/14-12/6	91	49	8	16	506	275	988	198.1
Total	**215**	**77**	**12**	**15**	**1,225**	**712**	**2,043**	**345.7**

Table 7. Arrival probabilities to Lower Granite Dam for fish tagged in Potlatch River, Idaho, screw traps in 2012. Interrogation data was queried from the 2012 out-migration.

Stream	n	Arrival to LGR (SE)
Big Bear Creek	1,850	0.32 (0.02)
East Fork Potlatch River	894	0.06 (0.01)

Table 8. Arrival probabilities to Lower Granite Dam for fish tagged in Potlatch River, Idaho, tributaries in summer of 2011 and subsequently detected in 2012. N/A represents insufficient interrogations for arrival estimation.

Stream	n	Arrival to LGR (SE)
East Fork Potlatch	430	0.09 (0.03)
Cedar Creek	406	0.23 (0.03)
Pine Creek	410	0.19 (0.03)
Little Bear Creek	383	0.25 (0.03)
WF Little Bear Creek	380	0.16 (0.02)
Big Bear Creek	25	N/A
Big Bear Drainage	788	0.21 (0.02)

Table 9. Number of juvenile steelhead/Rainbow Trout PIT tagged in Big Bear Creek and East Fork Potlatch River, Idaho, drainages during roving tagging in 2012.

Stream	# Tags
Big Bear Creek	198
Little Bear Creek	400
W.F. Little Bear Creek	299
E.F. Potlatch River	100
Total	**997**

Table 10. Salmonid density observed at sites snorkeled in Potlatch River, Idaho, tributaries during 2012. Non-salmonid presence and density was recorded during surveys but is not reported on this table.

Index Tributary	Stream	Sites (n)	Steelhead	Trout Fry	Brook Trout
Big Bear Creek					
	Big Bear Creek	6	5.22	1.40	0.00
	Big Meadow Creek	5	0.71	0.00	0.00
	East Fork Big Bear Creek	1	1.97	0.00	0.00
	Little Bear Creek	4	6.13	50.69	0.00
	Middle Fork Big Bear Creek	1	0	0.00	0.00
	Schwartz Creek	1	5.67	0.00	0.00
	West Fork Big Bear Creek	1	0	0.00	0.00
	West Fork Little Bear Creek	8	3.40	7.02	0.03
	Big Bear Creek Mean	**3.38**	**2.89**	**7.39**	**0.004**
East Fork Potlatch River	Bobs Creek	4	0.79	0	2.21
	East Fork Potlatch River	12	0.10	0.10	0.19
	Ruby Creek	3	0.34	0	1.66
	East Fork Potlatch River Mean	**6.33**	**0.41**	**0.03**	**1.35**
Other Tributaries	Cedar Creek	4	0.94	1.85	0.17
	Cougar Creek	1	0	0	0.76
	Feather Creek	1	0.43	0.43	1.72
	Leopold Creek	2	1.71	0	0.16
	Little Potlatch Creek	2	0	0	0
	Middle Potlatch Creek	2	0	0	0
	Pine Creek	1	7.71	0	0
	Potlatch River	10	1.49	0.01	0
	West Fork Potlatch River	2	0	0	0.98
	Overall Mean	**2.78**	**1.83**	**3.08**	**0.39**

Table 11. Estimate of brood year productivity in juvenile steelhead out-migrants per female spawner in Big Bear Creek drainage and the East Fork Potlatch River, Idaho.

BY	Adult Escapement Estimate	Proportion Female	# female spawners	Outmigrant Age 0	1	2	3	Total BY Production	Juveniles/ Spawner
Big Bear Creek									
2005	214	0.72	154	0	3,091	6,414	87	9,592	62
2006	57	0.40	23	0	2,740	2,497	917	6,153	270
2007	108	0.74	80	0	2,903	4,175	199	7,278	91
2008	121	0.39	47	0	1,256	6,171	155	7,582	161
2009	135	0.45	61	0	3,583	3,367	309	7,259	118
2010	251	0.60	151	0	348	7,293	*	7,641	51
2011	124	0.46	57	0	4,994	*	*	*	*
2012	317	0.68	216	133	*	*	*	*	*
East Fork Potlatch River									
2008	140	0.36	50	583	9,486	7,905	80	18,054	358
2009	92	0.46	43	0	25,776	4,097	673	30,546	714
2010	71	0.81	57	0	11,890	2,753	*	14,643	258
2011	33	0.58	N/A	0	9,911	*	*	*	*
2012	106	0.54	57	795	*	*	*	*	*

*Partial brood years only.

Table 12: Low water habitat availability protocol (LWHAP) results from 2012 surveys in the Potlatch River drainage, Idaho.

Tributary	Strata	Site	Total Wetted Length(m)	% Wetted	Total # Pools	Total Length of Pools(m)	Average Pools/100m
Big Bear Creek	U	UBC1	500.0	100	20.0	31.0	4.0
Big Bear Creek	U	UBC3	344.7	69	17.0	157.2	3.4
Big Bear Creek	L	LBBC1	500.0	100	47.0	190.2	9.4
Big Bear Creek	L	LBBC2	500.0	100	64.0	41.5	12.8
Big Bear Average			**461.2**	**92**	**37.0**	**104.9**	**7.4**
Little Bear Creek	U	ULBC1-A	491.5	98	25.0	94.2	5.0
Little Bear Creek	U	ULBC2	413.0	83	15.0	68.2	3.0
Little Bear Creek	L	LLBC1	500.0	100	15.0	34.9	3.0
Little Bear Creek	L	LLBC2	500.0	100	45.0	37.9	9.0
Little Bear Average			**476.1**	**95**	**25.0**	**58.8**	**5.0**
WFLBC	U	UWF1	500.0	100	12.0	54.4	2.4
WFLBC	U	UWF2	500.0	100	11.0	32.1	2.2
WFLBC	L	LWF4	500.0	100	10.0	86.8	2.0
WFLBC	L	LWF5	500.0	100	10.0	83.9	2.0
West Fork Little Bear Average			**500.0**	**100**	**10.8**	**64.3**	**2.2**
Cedar Creek	U	UCEC3	545.8	91	30.0	80.5	6.0
Cedar Creek	U	CECU2	273.0	55	5.0	56.0	1.0
Cedar Creek	L	CEC1	500.0	100	40.0	80.6	8.0
Cedar Creek	L	CEC2	500.0	100	70.0	82.3	14.0
Cedar Average			**454.7**	**86**	**36.6**	**74.9**	**7.3**
Pine Creek	U	UPC2-A	31.3	6	1.0	22.6	0.2
Pine Creek	U	UPC3-A	88.0	18	3.0	25.2	0.6
Pine Creek	L	LPC5-A	500.0	100	15.0	85.1	3.0
Pine Creek	L	LPC6-A	500.0	100	10.0	140.7	2.0
Pine Average			**279.8**	**56**	**7.3**	**68.4**	**1.5**
Corral Creek	U	UCOC7	500.0	100	21.0	134.2	4.2
Corral Creek	U	UCOC4	323.6	65	16.0	77.9	3.2
Corral Creek	L	LCOC1	71.6	14	2.0	21.2	0.4
Corral Creek	L	LCOC2	468.0	94	7.0	28.1	1.4
Corral Average			**340.8**	**68**	**11.5**	**65.4**	**2.3**
Drainage Average			**418.8**	**83**	**21.6**	**77.9**	**4.3**

Table 13: Stream discharge collected monthly in the Potlatch River basin, Idaho, from June through November in 2012.

Stream	Site ID	Flow (cfs)					
Lower Basin		**June**	**July**	**Aug**	**Sep**	**Oct**	**Nov**
Big Bear Creek	1	10.4	3.16	0.34	0.34	10.14	
Big Bear Creek	2			0.07	0.06	4.51	
Big Bear Creek	3			0.04			
East Fork Big Bear Creek	4			0.08		0.09	
East Fork Big Bear Creek	5			< .05			
Schwartz Creek	6			0.22			0.72
Middle Fork Big Bear Creek	7			< .05			
West Fork Big Bear Creek	8			Dry			
Big Meadow Creek	9			< .05			
Big Meadow Creek	10	1.4	0.1	Dry	Dry		1.0
W.F. Little Bear Creek	11			0.02	0.02		1.53
W.F. Little Bear Creek	12		0.2	< .05	< .05		2.53
Little Bear Creek	13						0.32
Little Bear Creek	14			0.1	0.28	5.63	
Pine Creek	15	1.5	0.5	0.09	0.05	0.86	
Potlatch River @ Cedar Creek	16		21.2	5	4.9	61.52	
Cedar Creek	17	3.9	0.8	0.22	0.28	3.01	
Corral Creek	18	2.7		< .05	Dry		
Corral Creek	19	0.45					< .05
Stream	**Site ID**	**Flow (cfs)**					
Upper Basin		**June**	**July**	**Aug**	**Sep**	**Oct**	**Nov**
West Fork Potlatch River	20		3.7	0.63	0.65	52.57	
Mainstem Potlatch River	21		13.6	7.24	5.3		
East Fork Potlatch River	22	74.9	11.8	5.7	4.46	36.84	
Ruby Creek	23	7.98	1.9	0.54	0.54		1.97
Fry Creek	24	0.6	0.03	Dry	Dry		
Jackson Creek	25	2.9		0.22	0.66		0.47
Bobs Creek	26	5.95		0.16	0.06		1.33
Rogers Creek	27			< .05			< .05
Bloom Creek	28	4.2	1.7	0.72	0.48		1.23
Pivash Creek	29			0.4	0.24		0.5
East Fork Potlatch River	30			4.01	0.35		
Mallory Creek	31				0.04	0.22	1.13
Mallory Creek	32				0.01		
Purdue Creek	33			< .05			
Nat Brown Creek	34			< .05			
Feather Creek	35			0.43			
Laguna Creek	36			0.23			
West Fork Potlatch River	37			0.09			

* All discharge measurements taken near the mouth unless noted otherwise.

Table 14: Stream discharge, baseflow and percent decrease per site from early summer (June/July) to baseflow (Sept.) in the Potlatch River, Idaho, and tributaries in 2012.

Stream	Site ID	Early Summer (cfs)	Base flow (cfs)	% Decrease
		Lower Basin		
Big Bear Creek	1	10.40	0.34	97%
Big Meadow Creek	10	1.40	0.00	100%
West Fork Little Bear Creek	12	0.20	0.05	98%
Pine Creek	15	1.50	0.05	97%
Potlatch River	16	21.2	4.90	77%
Cedar Creek	17	3.90	0.22	94%
Corral Creek	18	2.70	0.00	100%
Total Average Lower Basin				**95%**
		Upper Basin		
West Fork Potlatch River	20	3.70	0.63	83%
Potlatch River	21	13.6	5.30	61%
East Fork Potlatch River	22	74.90	4.46	94%
Ruby Creek	23	7.98	0.54	93%
Fry Creek	24	0.60	0.00	100%
Jackson Creek	25	2.90	0.22	92%
Bobs Creek	26	5.95	0.06	99%
Bloom Creek	28	4.20	0.48	89%
Pivash Creek	29	0.40	0.24	52%
Total Average Upper Basin				**85%**
Total Average				**90%**

Table 15: Temperature monitoring data from the Potlatch River basin, Idaho. Temperatures were recorded from June through November 2012.

Site				Average		
Lower Basin	**Site ID**	**Days > 20° C**	**Days >25° C**	**Mean (°C)**	**Max (°C)**	**Min (°C)**
Big Bear Creek	1	55	32	15.81	19.24	13.56
East Fork Big Bear Creek	2	0	0	10.35	11.24	9.56
Little Bear Creek	6	58	0	15.25	16.7	14.06
Little Bear Creek	5	35	0	12.55	14.45	10.61
Big Meadow Creek	3	15	0	11.43	12.87	10.07
West Fork Little Bear Creek	4	32	6	11.99	13.63	10.27
Pine Creek	7	65	0	15.56	16.65	14.69
Cedar Creek	8	52	2	13.03	14.97	11.22
Corral Creek[1]	9	63	4	16.42	20.95	12.82
Average				**13.6**	**15.63**	**11.87**

Upper Basin	**Site ID**	**Days > 20° C**	**Days >25° C**	**Mean (°C)**	**Max (°C)**	**Min (°C)**
Potlatch River	11	79	44	14.57	18.03	11.55
Potlatch River[2]	10	14	0	9.47	11.45	7.75
East Fork Potlatch River	12	55	6	13.43	15.67	11.28
Bloom Creek	18	13	0	10.7	13.3	8.78
Bobs Creek	16	0	0	10.25	11.41	8.98
Fry Creek[3]	14	6	0	10.82	12.31	9.46
Jackson Creek	15	0	0	9.69	10.57	8.7
Mallory Creek	20	0	0	8.57	9.5	7.5
Pivash Creek[4]	19	10	0	8.89	10.95	7.07
Rogers Creek	17	0	0	8.8	9.92	7.77
Ruby Creek	13	No data				
Average				**10.52**	**12.31**	**8.88**

1 – Out of Water 8/17 – 10/27

2 – Out of Water 8/12 – 10/13

3 – Out of Water 7/3 – 9/7

4 – Out of Water 7/24 – 10/13

Table 16: Culvert assessment results from the East Fork Potlatch River drainage, Idaho, collected in the fall of 2012.

Stream	Site ID	Length (m)	Slope (%)	Upstream Headcut (m)	Downstream Headcut (m)	Flow (cfs)	Fish Above	Fish Below	Culvert Condition	Barrier (Y/N)
Ruby Creek	1	28.7	2.6	0	0.1	<1.0	Yes	Yes	Good	N
Jackson Creek	2	8.45	5	0	0.965	<0.1	No	Yes	Poor	Y
Jackson Creek	3	30	6.9	0	0.25	<1.0	No	Yes	Poor	Y
Jackson Creek	4	12.3	7.6	0	0.29	<.05	No	No	Good (HDPE)	N
Bloom Creek	5	18.4	6.2	0.075	0	0.1	Yes	Yes	Fair	N
Pivash Creek	6	16.26	7.07	0	0	<.05	No	No	Fair	N
Pivash Creek	7	12.27	11.25	0	0	<.05	No	No	Good	N
E.F. Potlatch River	8	9.88	0.61	0.05	0.12	< 4.0	Yes	Yes	Good	N
E.F. Potlatch River	9	15	8	0.07	0.26	>1.0	Yes	Yes	Good	N
Mallory Creek	10	9.15	0	0	0.36	<.05	Yes	Yes	Good	N
Mallory Creek	11	18.45	1.63	0	0.17	0.03 5	Yes	Yes	Good	N
Rogers Creek	12	12.3	4.19	0	0.25	<.05	No	Yes	Good	N
Rogers Creek	13	18.2	14.07	0.03	0.17	Dry	No	No	Good	N
Bobs Creek (2)	14	15.4	1.17	0.13	0	0.06	Yes	Yes	Good	N
Bobs Creek (2)	14	12.2	1.64	0	0.14	Dry	Yes	Yes	Good	N
Bobs Creek	15	19	1.63	0	0.1	<.05	No	No	Good	N
Fry Creek (2)	16	9.19	3.1	0.05	0	Dry	No	Yes	Good	N
Fry Creek (2)	16	9.19	3.7	0.09	0	Dry	No	Yes	Good	N

FIGURES

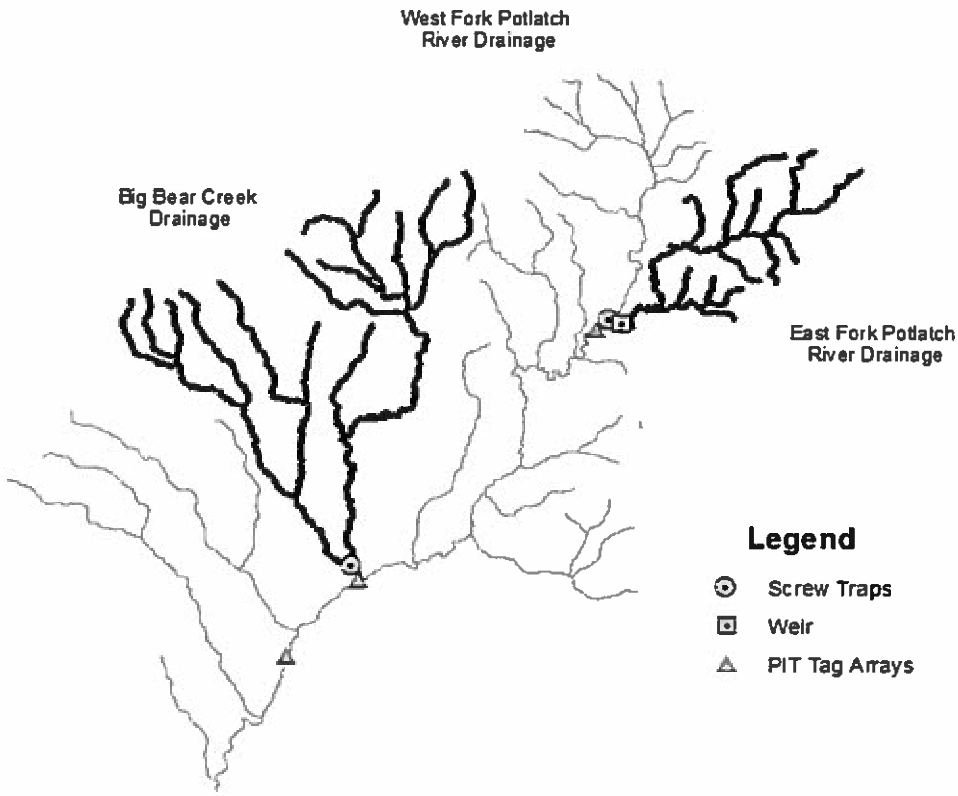


Figure 1. Map of intensive monitoring drainages and associated sampling infrastructure within the Potlatch River drainage, Idaho, during the 2012 field season.

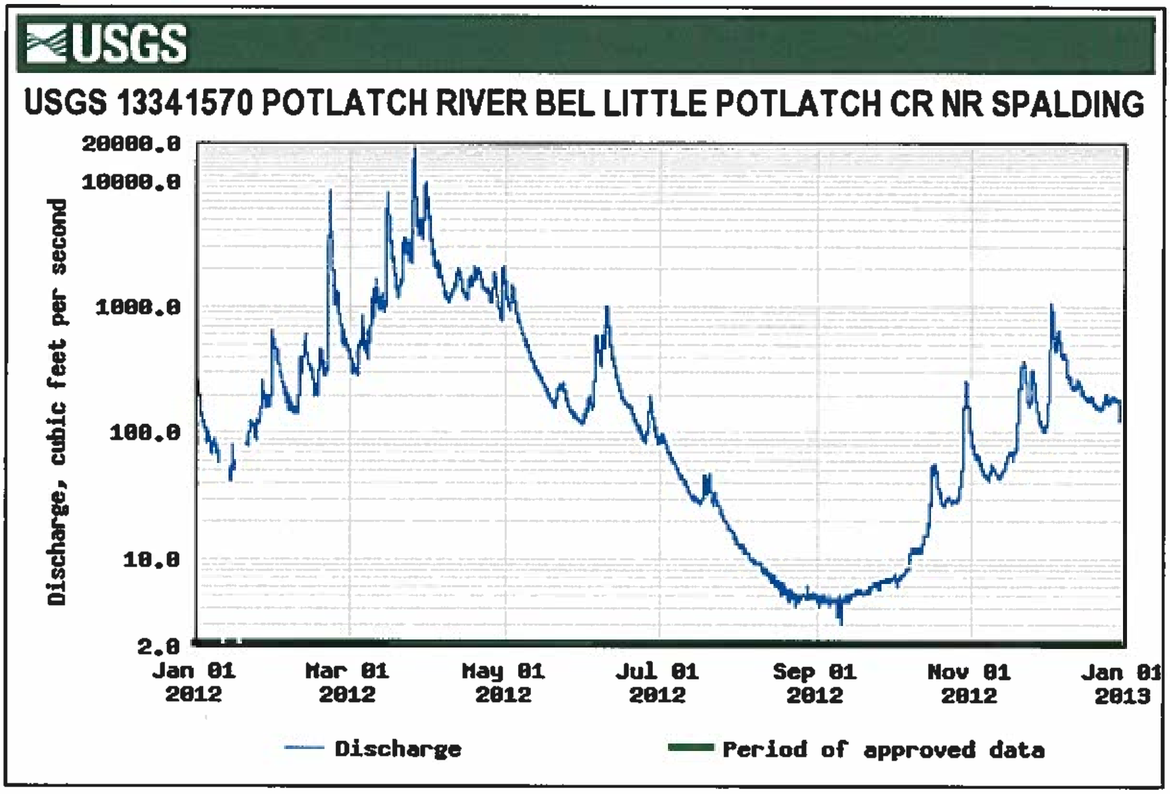


Figure 2. Daily mean discharge of main stem Potlatch River, Idaho, recorded during 2012.

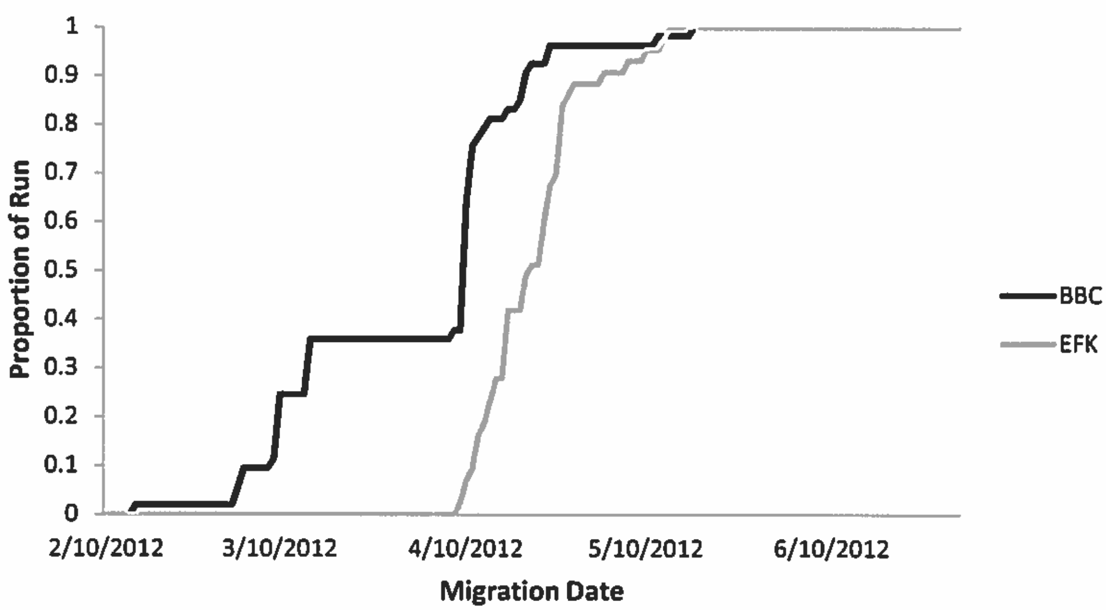


Figure 3. Upstream spawning migration timing for adult steelhead captured at the Big Bear Creek drainage and the East Fork Potlatch River, Idaho, weirs during the 2012 trapping season.

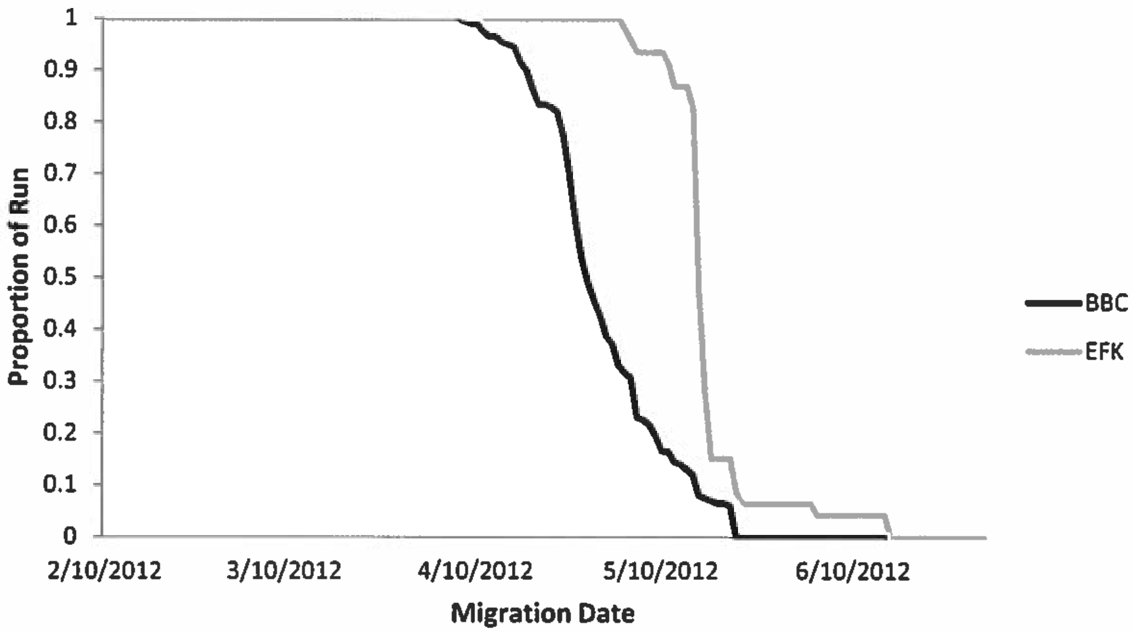


Figure 4. Downstream kelt migration timing for adult steelhead captured at the Big Bear Creek drainage and the East Fork Potlatch River, Idaho, weirs during the 2012 trapping season.

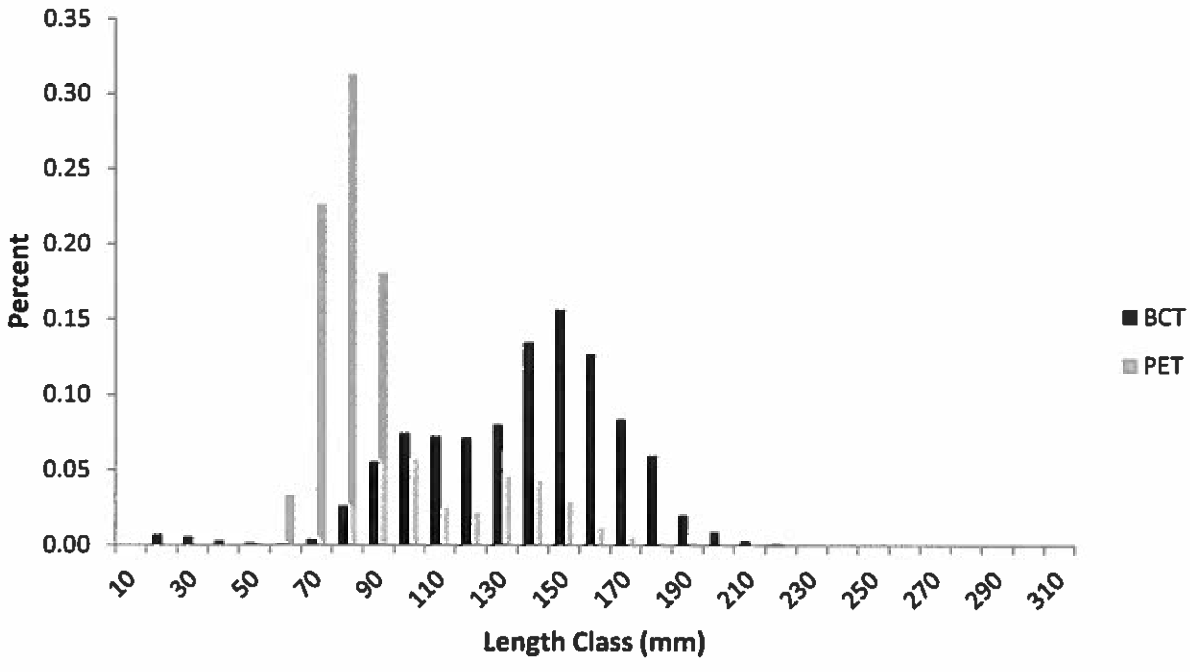


Figure 5. Length frequency histogram of juvenile steelhead captured and measured at the Big Bear Creek and East Fork Potlatch River, Idaho, screw traps in the spring of 2012.

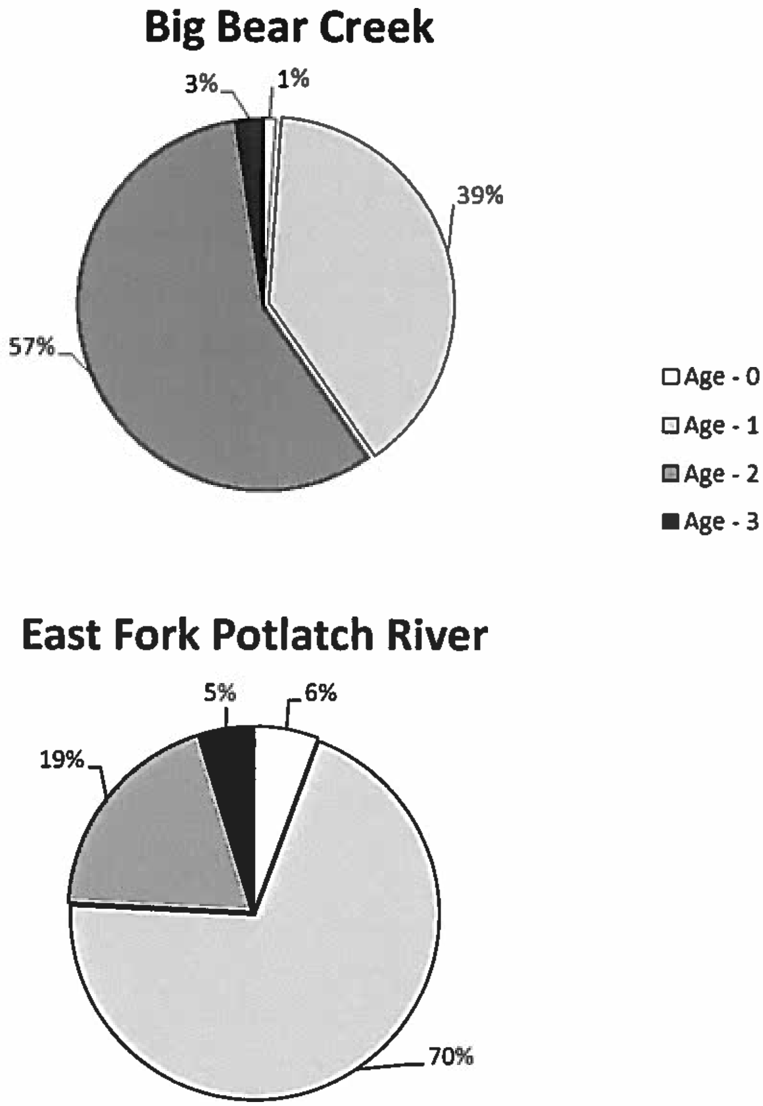


Figure 6. Age composition of juvenile steelhead from the Big Bear Creek and East Fork Potlatch River, Idaho, screw traps during the spring 2012 field season (n = 288 and 231 at Big Bear Creek and East Fork Potlatch River, respectively).

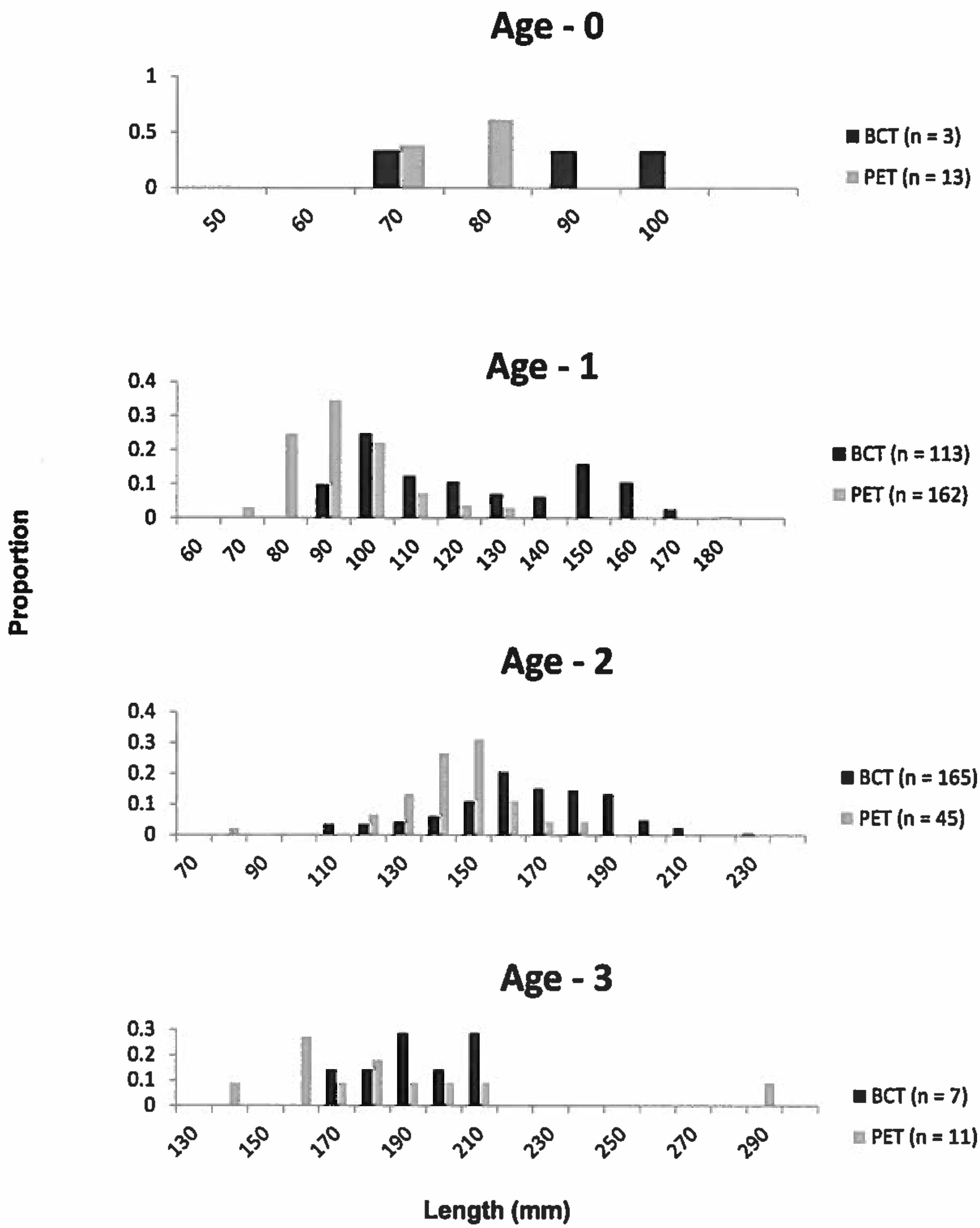
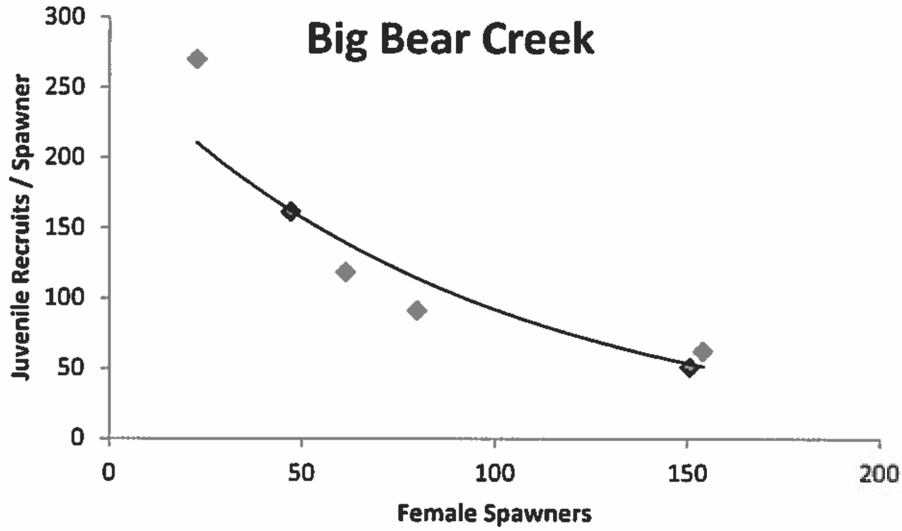


Figure 7. Length frequency of juvenile steelhead captured at Big Bear Creek and the East Fork Potlatch River, Idaho, screw traps during the 2012 spring trapping season.



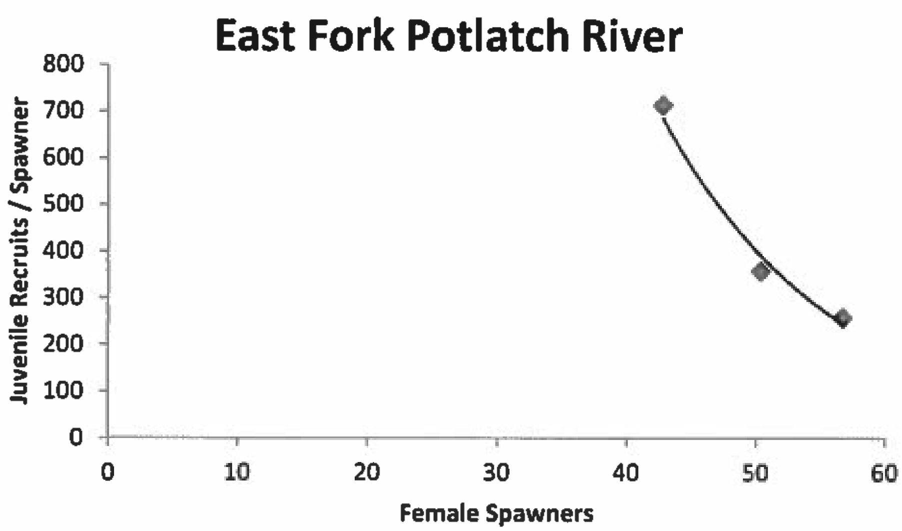


Figure 8. Juveniles recruits/female spawner for the Big Bear Creek and East Fork Potlatch, Idaho. Data are from brood years 2005-2010 for Big Bear Creek and 2008-2010 for ` East Fork Potlatch.

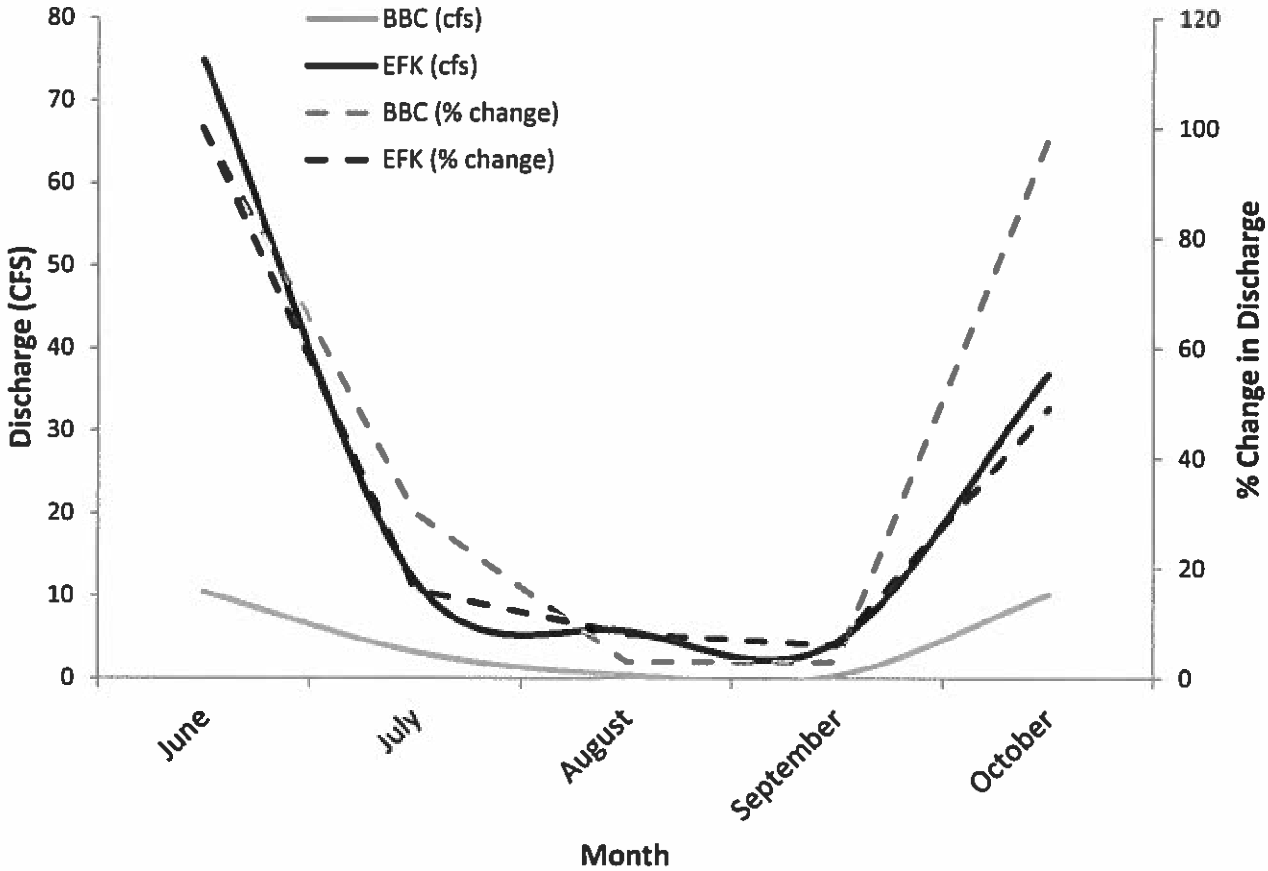


Figure 9. Stream discharge (cfs) and percent change in discharge for two index tributary sites, Big Bear Creek (BBC) and East Fork (EFK) Potlatch River, Idaho, during 2012.

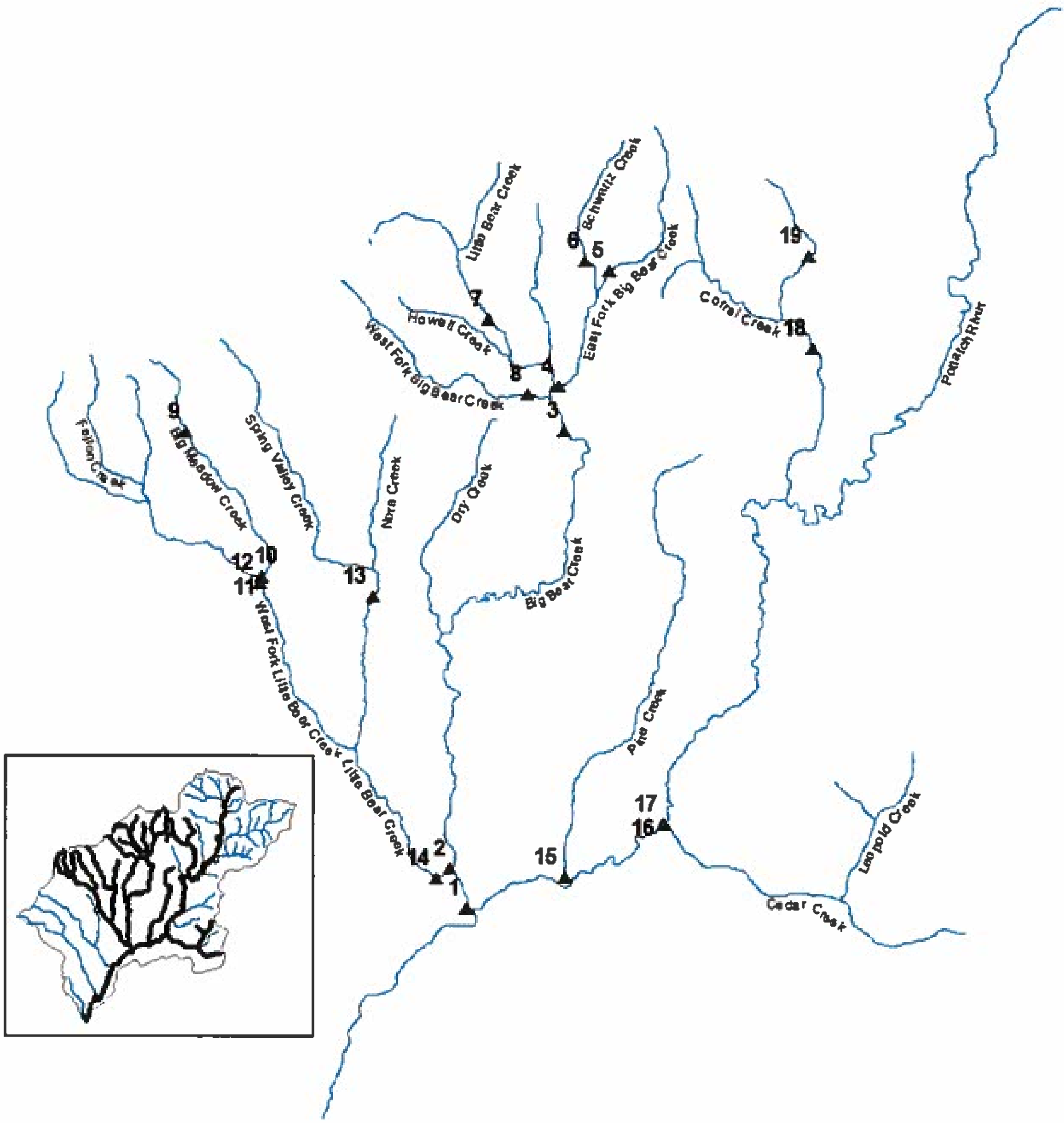


Figure 10. Location of stream discharge monitoring sites in the Big Bear Creek drainage and other tributaries of the lower Potlatch River basin, Idaho, 2012. Sites are labeled with a unique site ID number that corresponding with Appendix A.

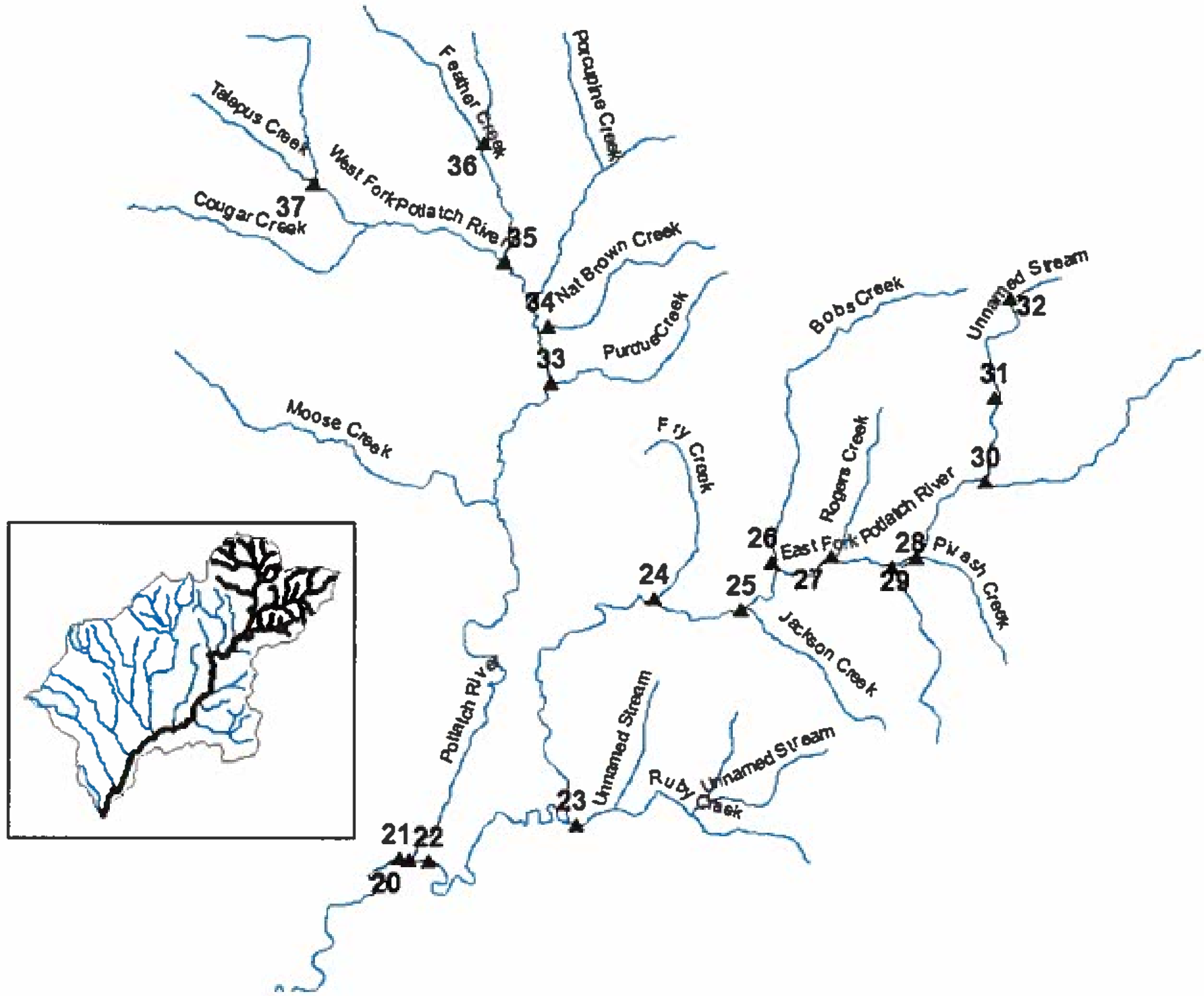


Figure 11. Location of stream discharge monitoring sites in the East and West Fork Potlatch River, Idaho, 2012. Sites are labeled with a unique site ID number that corresponding with Appendix A.

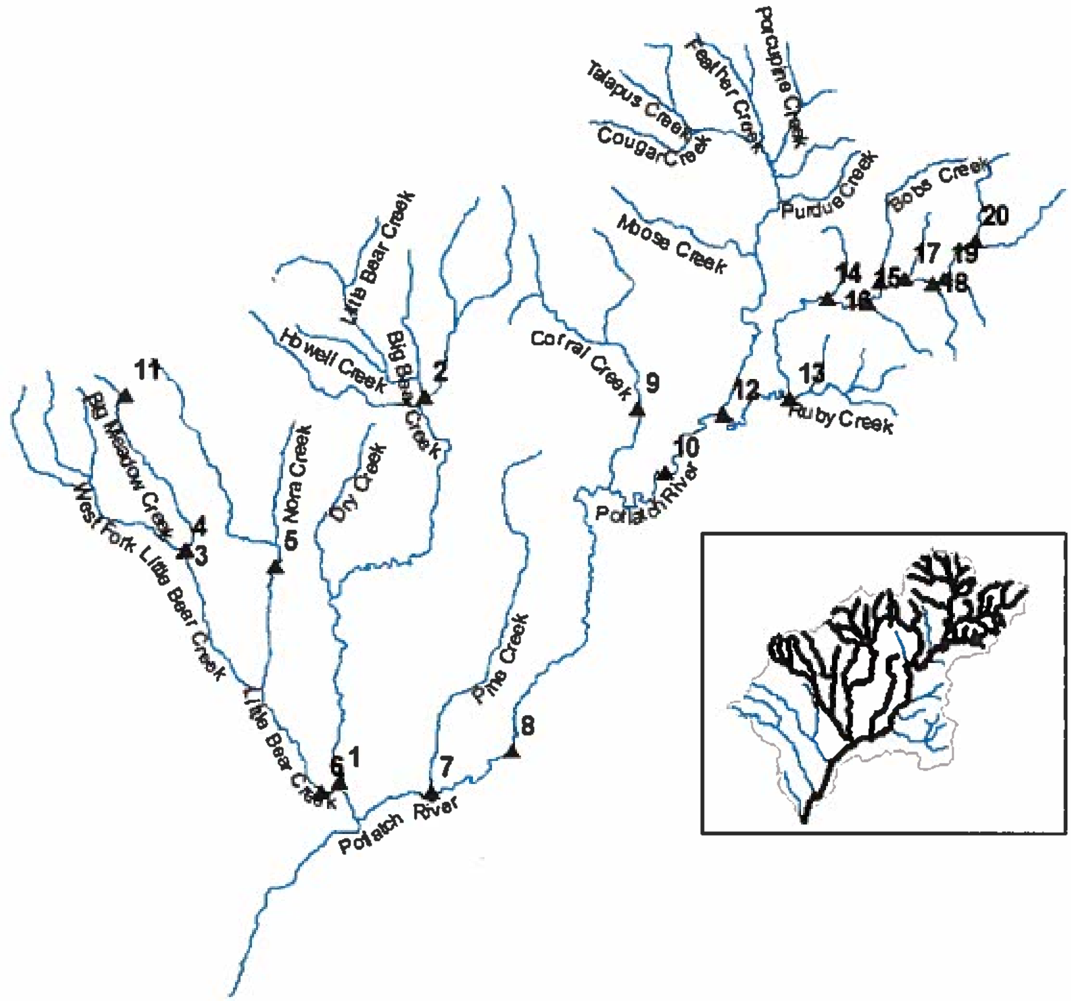


Figure 12. Temperature logger locations in the Potlatch River, Idaho, basin in 2012. Sites are labeled with a unique site ID number that corresponding with Appendix B.

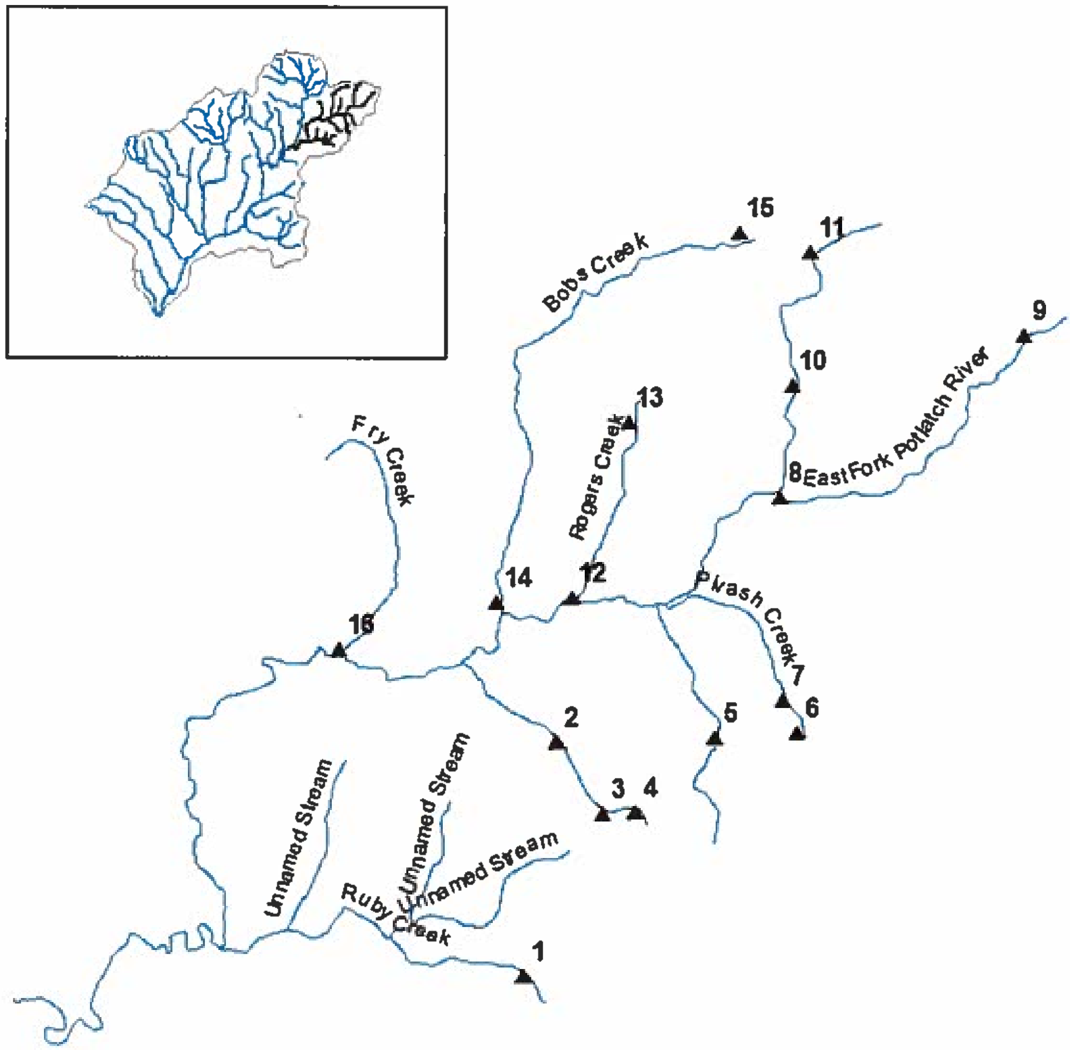


Figure 13. Culvert locations identified and surveyed in the East Fork Potlatch River, Idaho, in 2012. Sites are labeled with a unique site ID number that corresponding with Table 16.

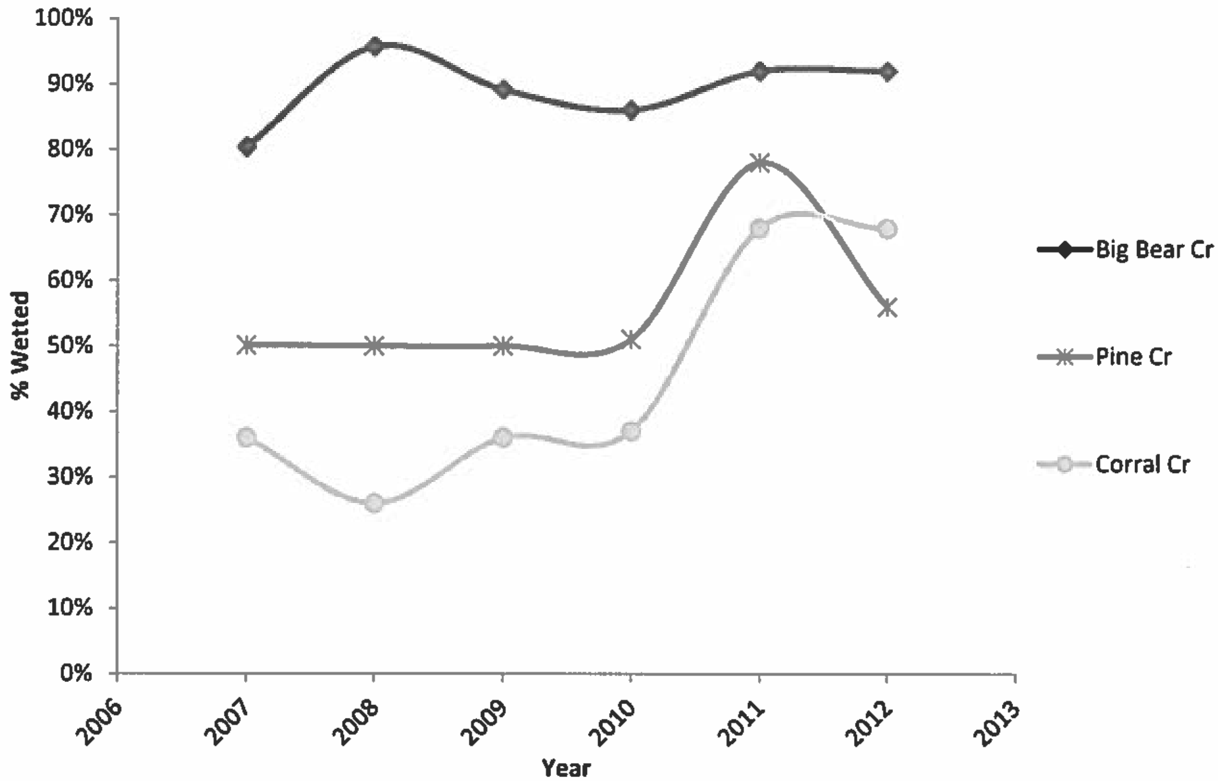


Figure 14: Combined Low Water Habitat Survey data for three tributaries surveyed in the lower Potlatch River drainage, Idaho, during base flow conditions from 2007 – 2012.

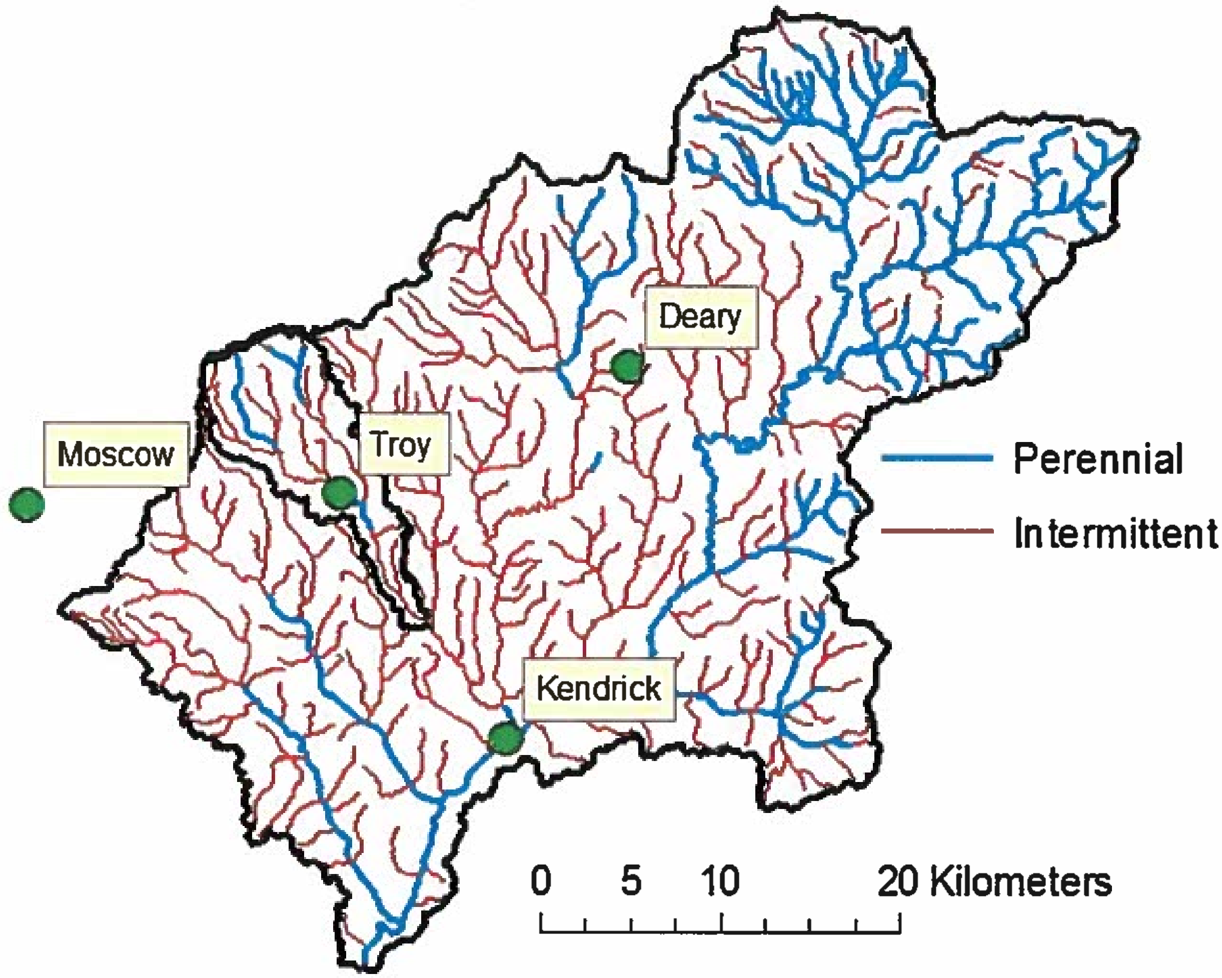


Figure 15: Map of perennial and intermittent flow present within the Potlatch River basin, Idaho (Brooks and Treasure 2014).

APPENDICIES

Appendix A: Stream discharge monitoring site ID's and GPS coordinates for all sites within the Potlatch River basin, Idaho, 2012.

Stream	Site ID	Waypoint	
Lower Basin		**Lat**	**Long**
Big Bear Creek	1	46.6189	-116.6469
Big Bear Creek	2	46.6327	-116.6558
Big Bear Creek	3	46.787	-116.6055
East Fork Big Bear Creek	4	46.8024	-116.609
East Fork Big Bear Creek	5	46.8438	-116.5854
Schwartz Creek	6	46.8466	-116.5979
Middle Fork Big Bear Creek	7	46.8251	-116.646
West Fork Big Bear Creek	8	46.7992	-116.6251
Big Meadow Creek	9	46.7818	-116.7988
Big Meadow Creek	10	46.7325	-116.757
W.F. Little Bear Creek	11	46.7321	-116.7576
W.F. Little Bear Creek	12	46.73	-116.7575
Little Bear Creek	13	46.7267	-116.6999
Little Bear Creek	14	46.6288	-116.6627
Pine Creek	15	46.6311	-116.5974
Potlatch River @ Cedar Creek	16	46.6504	-116.5487
Cedar Creek	17	46.6508	-116.5478
Corral Creek	18	46.8187	-116.4798
Corral Creek	19	46.851	-116.4835
Upper Basin			
West Fork Potlatch River	20	46.9297	-116.4588
Mainstem Potlatch River	21	46.799	-116.4284
East Fork Potlatch River	22	46.7986	-116.4202
Ruby Creek	23	46.8067	-116.3782
Fry Creek	24	46.8513	-116.3584
Jackson Creek	25	46.8496	-116.3332
Bobs Creek	26	46.859	-116.3252
Rogers Creek	27	46.8605	-116.3083
Bloom Creek	28	46.8587	-116.291
Pivash Creek	29	46.8607	-116.2838
East Fork Potlatch River	30	46.8758	-116.2652
Mallory Creek	31	46.8922	-116.263
Mallory Creek	32	46.9118	-116.2598
Purdue Creek	33	46.8924	-116.3893
Nat Brown Creek	34	46.9035	-116.391
Feather Creek	35	46.9157	-116.404
Laguna Creek	36	46.9387	-116.4105
West Fork Potlatch River	37	46.9297	-116.4588

Appendix B: Stream temperature monitoring site ID's and GPS coordinates for all sites within the Potlatch River basin, Idaho, 2012.

Lower Drainage	Site ID	Lat	Long
Big Bear Creek	1	46.6342	-116.6548
East Fork Big Bear Creek	2	46.8024	-116.6091
Little Bear Creek	6	46.6297	-116.6665
Little Bear Creek	5	46.7267	-116.7004
Big Meadow Creek	3	46.7328	-116.7569
West Fork Little Bear Creek	4	46.732	-116.7574
Pine Creek	7	46.6311	-116.5974
Cedar Creek	8	46.6503	-116.5474
Corral Creek[1]	9	46.8005	-116.4747
Upper Drainage	**Site ID**	**Lat**	**Long**
Potlatch River	11	46.7987	-116.7988
Potlatch River[2]	10	46.7734	-116.4566
East Fork Potlatch River	12	46.7986	-116.4206
Bloom Creek	18	46.8587	-116.291
Bobs Creek	16	46.859	-116.3252
Fry Creek[3]	14	46.8512	-116.3582
Jackson Creek	15	46.8495	-116.3331
Mallory Creek	20	46.8775	-116.2657
Pivash Creek[4]	19	46.861	-116.2844
Rogers Creek	17	46.8602	-116.3088
Ruby Creek	13	46.8067	-116.3796

Appendix C. Photo of downstream headcut of culvert located in Jackson Creek, Idaho, 2012.

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