POTLATCH RIVER STEELHEAD MONITORING AND EVALUATION PROJECT

Annual Report

2011

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ABSTRACT

Objectives of the Potlatch River Steelhead Monitoring and Evaluation (PRSME) project are to establish baseline levels of steelhead trout *Oncorhynchus mykiss* production and productivity and provide an umbrella monitoring component to the numerous habitat restoration projects currently occurring within the drainage. In 2008, the project expanded the monitoring effort into both the upper and lower Potlatch River drainages. This expanded effort was continued in 2011. A total of 94 adult steelhead were captured and handled at PRSME weir sites during the 2011 field season. Sixty-one and thirty-three unique steelhead were captured at the lower and upper drainage weirs respectively. Mark-recapture occurrences resulted in adult steelhead escapement estimates of 124 (95% CI 63-236) spawners in the Big Bear Creek drainage. No estimate was generated for the East Fork Potlatch River because of extremely low kelt captures at the site. Mark-recapture juvenile steelhead trapping at screw traps on Big Bear Creek and the East Fork Potlatch River during the 2011 field season resulted in outmigration estimates of 3,870 (95% CI, 2,441-6,614) and 16,067 (95% CI, 11,882-21,959) at the two sites respectively. Smolt arrival estimates to Lower Granite Dam were 81% and 7% respectively from Big Bear Creek and the East Fork Potlatch River screw traps. We tagged 2,467 juvenile steelhead across the Potlatch River drainage during summer roving tagging. Interrogations from these fish at Potlatch River arrays and downstream at interrogation facilities will provide over summer/winter survival estimates for each tributary. A total of 41 snorkel sites were sampled within the index drainages of Big Bear Creek and the East Fork Potlatch River during the 2011 field season. Mean steelhead densities were higher in the Big Bear Drainage than the East Fork Potlatch River with 1.63 and 0.32 fish / 100m^2 respectively. Lower than average snorkel densities during the 2011 surveys were attributed to poor visibility during the survey timeframe. Brood year productivity estimates in the Big Bear Creek Drainage continue to display a density dependent relationship based upon the juvenile recruits/female spawner curve. We hope that implementation of habitat restoration projects within this drainage in the next few years will begin to increase steelhead freshwater productivity.

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INTRODUCTION

The Potlatch River Steelhead Monitoring and Evaluation (PRSME) project was initiated in 2005 using Pacific Coastal Salmon Recovery Funds. In 2008, the project was expanded into the upper Potlatch River watershed using National Oceanic and Atmospheric Administration (NOAA) Fisheries Intensively Monitored Watershed Funds. The additional funds allowed work to occur simultaneously throughout the entire drainage. The expanded project in 2008 was initiated to assess steelhead *Oncorhynchus mykiss* production and productivity throughout the entire Potlatch River drainage.

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 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). They estimated that the Potlatch River drainage comprises 25% of the historic intrinsic potential of the Clearwater River Lower Mainstem steelhead population (NOAA Draft Recovery Plan 2006). The lower Clearwater River steelhead population is important to steelhead recovery; however no information was available regarding population production and productivity. This project was designed to establish baseline indices regarding population dynamics and expand the knowledge of steelhead life history strategies within the Potlatch River and the lower Clearwater River as a whole.

The Potlatch River watershed has undergone significant amounts of change over the past 150 years. Land practices and manipulation associated with agricultural use and timber harvest have significantly altered the aquatic habitats present within the drainage as well as flow dynamics associated with the hydrograph. These changes have resulted in a variety of limiting factors identified by previous work (Johnson 1985; Bowersox and Brindza 2006) within the drainage. These limiting factors include:

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

Despite the significantly altered condition of aquatic habitats within the Potlatch River drainage, it does support an important population of wild steelhead trout. Aside from general distribution and abundance data (Schriever and Nelson 1999; Bowersox and Brindza 2006) limited information was available with regards to levels of productivity, production, and life history strategies for steelhead in the Potlatch River Drainage.

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).

In recent years, the Potlatch River has received additional 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 Pacific Coastal Salmon Recovery Funds (PCSRF) project is to determine steelhead population response (production and productivity) to habitat enhancement.

This study is designed to provide baseline information on steelhead within the Potlatch River drainage as well as an umbrella monitoring component to habitat restoration projects being implemented within the drainage. The framework needs to be adaptive as well as rigid. It needs to be capable of shifting with monitoring needs as well as being able to detect steelhead production and productivity changes within the Potlatch River.

This report contains results from 2011 which was the seventh field season for the monitoring and evaluation effort in the lower drainage and the third field season in the upper drainage. Field activities included adult escapement estimation, juvenile outmigration estimates, juvenile survival estimates, in-stream density estimates, habitat surveys, adult telemetry surveys, and juvenile summer movement surveys.

OBJECTIVES

1) Establish baseline levels of steelhead production and productivity throughout the Potlatch River drainage.

2) Provide a monitoring component to the numerous habitat restoration projects currently ongoing within the Potlatch River drainage.

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 watershed, which includes the Big Bear drainage, is almost entirely privately owned while the upper watershed, which includes the East Fork Potlatch River drainage, has two dominate landowners, Potlatch Timber Corporation and the U.S. Forest Service (Figure 1). Dominant land use and land type differ between the two drainage areas. 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). Intensively monitored tributaries are Big Bear Creek and the East Fork Potlatch River drainages (Figure 1). The bulk of monitoring infrastructure is located in these drainages (Appendix A).

Mean daily stream discharge measured at the USGS flow site (13341570) approximately 5 kilometers above the mouth of the Potlatch River, ranged from 8,430 to 43 cfs during the 2011 trapping season (Figure 2). Stream flows exceeded 1,000 cfs for 76 days during the 2011 adult trapping season (Figure 2). Stream temperature during the spring trapping season, as measured at the Big Bear Creek and East Fork Potlatch River screw traps, ranged from 0.5 and 14.0 ^{o}C (January 1st – June 17th) and 1.5 and 11.5 ^{o}C (March 8th – June 24th) respectively.

METHODS

Adult Sampling

Picket weirs were constructed to capture upstream migrating adult steelhead on February 2nd and February 4th at Big Bear and Little Bear Creeks, respectively (Appendix A). 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 21 days and 35 days at Little Bear and Big Bear Creek weirs, respectively and partially operating for 2 days and 1 day at Little Bear and Big Bear Creek weirs, respectively during the spring trapping season.

A floating weir was constructed to capture upstream migrating adult steelhead on March 4th at the East Fork Potlatch River (Appendix A). Initially, the weir was outfitted with only an upstream migrant trap box. The weir was maintained and checked for fish daily. The East Fork Potlatch River weir was not operational for 9 days due to lack of crew availability and was unable to be checked for 7 days due to extreme high water and unsafe working conditions.

Trapped upstream migrants at all weirs were collected from the trap box and anesthetized in MS-222. Upstream fish were marked with a right operculum punch and passive integrated transponder (PIT) tag. On March 30th, PIT tag location changed from placement in the left cheek to placement in the pelvic girdle. The gender, weight, length, and the presence of any marks were recorded for all fish handled. All wild upstream migrants were released above the weir. Hatchery fish captured at the weirs were relocated below the weir. Traps were pulled after adult steelhead kelt outmigration was complete on June 6th and July 14th in Little Bear Creek and the East Fork Potlatch River respectively.

Downstream trap boxes and kelt wings were installed at lower weir locations by March 24th and by April 25th at the upper weir location. The downstream trap boxes and kelt wings were not operational at the lower sites for 28 days and the kelt wing was not operational at the upper site for 4 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. All previously PIT tagged fish and unmarked fish captured in the downstream box or by net were given a left operculum punch and released immediately downstream of the weir. Gender, weight, length, the presence of a previous operculum punch and/or PIT tag and PIT tag number if present were recorded for all fish captured.

Total adult escapement above the weirs was calculated using a maximum likelihood estimator (Steinhorst et al., 2004) using the variables of total kelt steelhead captured during the trapping season, marked adults passed upstream and number of marked adults recaptured as kelts. Assumptions required are that marked and unmarked adults had the same survival during spawning and individual fish are captured independently with equal probability.

Scale samples were collected from all unique adult fish captured during the 2011 field season. Scales were collected posterior to the dorsal fin above the lateral line. Three or four scales were taken from each side of the fish. 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 read and assigned freshwater and ocean ages according to protocols outlined in Ellsworth and Ackerman (2011).

Spawning Ground Surveys

To identify spawning reaches in the Big Bear Creek drainage and assess passage at Big Bear Creek falls, a subsample of prespawn adult female steelhead were captured at the two lower basin weirs from February 17th through March 28th and implanted with Lotek Model MCFT2-3A radio tags (Frequency 149.280). Fish were tagged across the season although weir failures during the spring trapping season made fish collection difficult. No retention structures such as rubber bands and/or barbs were used with the tags to increase the likelihood of removal and reuse for those fish recaptured as kelts. Selected females were anesthetized and gastrically radio-tagged at weir sites. Fish were then allowed to recover in a volitional release trap box on the upstream side of the weir. Fish were tracked using a Lotek SRX 600 telemetry receiver above the weir sites by truck, ATV and foot on a weekly basis during the spawning migration. When tags were located, the time, strength of signal, GPS position and whether or not the fish was actually observed was recorded. We also recorded if redd building and/or a completed redd was observed at the site. When fish were recaptured as kelts at the downstream weirs the tags were removed and the fish was released downstream of the weir untagged. Some tags were able to be reused in multiple females.

Redd survey walks were conducted in late April and early May between Big Bear Creek screw trap and the Big Bear Creek and Little Bear Creek weirs to document any spawning activity between the two sites. Stream reaches were walked by two individuals on each side of the stream bank. Any redds were documented and locations marked using a GPS. Any spawning redds documented will be included in the production estimate for the drainage and result in changes to the freshwater productivity estimate.

Juvenile Screw Trapping

Rotary screw traps were operated on Big Bear Creek and the East Fork Potlatch River during the 2011 field season (Appendix A). The Big Bear Creek trap was located approximately 250 m 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. The East Fork Potlatch River screw trap was located in the East Fork Potlatch River approximately 300 m above its confluence with the main stem Potlatch River. Screw traps were checked daily throughout the spring and fall trapping seasons. Spring trapping was conducted on Big Bear Creek from January 1st - June 17th and March 8th – July 14th at the East Fork Potlatch River during the spring outmigration. The traps were no longer operational by mid-June at the Big Bear Creek site and mid-July at the East Fork Potlatch River site due to insufficient flows. No fall trapping was conducted during the 2011 field season because of insufficient stream flow at both the Big Bear Creek and East Fork Potlatch River sites. During sampling periods, trapping was only interrupted due to extremely high or low stream discharge. All fish captured at the screw traps were identified and enumerated. In addition, sub-samples (first ten individuals from each species) of non-target species were weighed and measured on average three times a week. 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.

Total juvenile steelhead outmigration from Big Bear Creek and the East Fork Potlatch River was estimated using Gauss software, specifically 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 determine appropriate outmigration 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 outmigrant survival to Lower Granite Dam was estimated using Survival Under Proportional Hazards (SURPH) 2.2 software (Lady et al. 2001).

A total of 118 and 189 scales were randomly sampled from the outmigrating juveniles collected at the screw trap on Big Bear Creek and the East Fork Potlatch River, respectively. Every fifth fish had scales taken in order to spread samples out over the entire juvenile outmigration. 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 read and assigned freshwater ages according to protocols outlined in Ellsworth and Ackerman (2011).

Snorkel Surveys

Mark-resight snorkel surveys were conducted within index tributaries (Big Bear Creek drainage and the East Fork Potlatch River) during the 2011 field season (Copeland et al. 2008). Since Potlatch River drainage-wide sampling had been done in previous years and difficult snorkeling conditions were present during the 2011 sampling effort only index tributaries were sampled. Sample sites were selected using a generalized random tessellation stratification design to provide a spatially balanced panel of survey sites (Stevens and Olsen 2004). Potential sites for the Potlatch River basin were obtained from personnel at the US-EPA, Corvallis, Oregon office. A minimum of twenty sites were completed in the Big Bear Creek drainage and the East Fork Potlatch River to provide enough statistical power to track annual variation in juvenile steelhead density of time. The sample size needed was generated by conducting a power analysis of 2008 snorkel data from the Potlatch River drainage.

Roving Tagging

To estimate juvenile instream survival in the lower Potlatch River tributaries, juvenile steelhead/rainbow trout were tagged during the 2009-2010 field seasons. Fly-fishing and backpack electrofishing were conducted at selected locations throughout tributaries in 2009 and specifically within the Big Bear Creek drainage during 2010 to collect fish for PIT-tagging. All juvenile steelhead/rainbow trout >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 the mainstem Potlatch River Juliaetta array and Lower Granite Dam were used to estimate in-stream survival for those tag groups during the 2011 outmigration.

Additional roving tagging was conducted throughout the Potlatch River basin from June 1st through July 19th during the 2011 field season. During this time, juvenile steelhead were collected by backpack electroshocking and hook and line. Each fish captured > 80 mm was anesthetized in MS-222, PIT tagged if not previously tagged, measured, weighed and released in close proximity to their place of capture. Water temperatures were monitored to ensure that tagging temperatures did not exceed 18^{o} C maximum threshold required by NOAA. Tagging areas were distributed across the known steelhead distribution within tagging tributaries. Fish were released in close proximity to their place of capture within their respective tributary. Release group size for each tributary will be included in the 2011 PRSME Annual Report.

PIT-Tag Arrays

Three instream PIT Tag arrays were operated during the 2011 field season. All three arrays were arranged in an upstream and downstream antenna array configuration. One array was located on Big Bear Creek (Big Bear Creek Array), and two arrays were located on the mainstem Potlatch River, one near Juliaetta, ID (Juliaetta Array), and one near Helmer, ID (Helmer Array). Big Bear Creek Array was located approximately 250 m above the confluence with the mainstem Potlatch River. The Big Bear Creek Array was operated with six PVC antennas in an upstream and downstream array configuration that span the channel width. The PVC antennas were constructed by IDFG personnel out of the Clearwater Region. The Big Bear Creek Array was damaged and disabled due to flood events and experienced downtime of 53 days, 15 hours, and 8 minutes during the migration. The Juliaetta and Helmer Arrays were manufactured as a flat panel design by Biomark, Inc. of Boise Idaho. The Juliaetta Array, located approximately 13 km upstream of the confluence of the Clearwater River, consisted of three upstream and three downstream antennas. All antennas were twenty foot in width for a total array width of sixty feet. The Juliaetta Array was severely disabled during a high flow event January 14th -17th. Four of the six antennas were left inoperable by the event and extended high flows throughout the spring did not allow the site to be repaired during the spring migration. The

Helmer Array was located on the mainstem Potlatch River approximately 250 m below the confluence of the East Fork and West Fork Potlatch Rivers, at RKM 61. This array consisted of four flat panel antennas, two twenty foot and two ten foot antennas. All array sites were registered with the Columbia River Basin PTAGIS database, as in-stream interrogation sites. All data collected from the sites was uploaded to the PTAGIS database on a semi-monthly basis. All issues such as power outages and antenna failures encountered with each array were documented in the Site Event Logs on the PTAGIS Operations and Maintenance Website (http://www.ptoccentral.org).

Efficiency Estimates

To determine the performance of in-stream PIT tag arrays, detections of PIT-tagged fish were used to generate an estimate of detection efficiency (Appendix C). Detection efficiency is the percentage of PIT-tagged fish that were detected when and if they passed interrogation systems (Connolly et al. 2008). We used the two array detection probability model in the USER 4.7.0 (Lady and Skaliski 2009) to calculate the detection efficiency of migrating juvenile, adult, and kelt steelhead. Each individual's life stage is determined by the direction of travel over the arrays coupled with the age of the individual fish. Detection efficiencies were produced across the entire sample season for each migrant life stage.

Fish that displayed a milling and/or resident behavior over the antennas caused a need to create a set of rules for defining life stage migration through observation data. Detection events were filtered and grouped accordingly, based upon the following criteria:

- All life stages: If a subsequent detection occurs 24 hours after the first detection(s), it was considered a separate event.
- Juveniles: Select the last unique, downstream detection event. Use the timing associated with captures at screw traps and the detections at other arrays. Juvenile fish that appear to display a resident life history with multiple upstream and downstream events are excluded from the juvenile detection efficiency estimate.
- Adults: Select the last unique, upstream event before estimated spawning time. Use the timing associated with the detections at other antennas and weirs as well as adult migration timing to determine spawning time.
- Kelts: Select the last unique, downstream event after estimated spawning time. Use the timing associated with the detections at other antennas and weirs as well as adult migration timing to determine spawning time.

Juvenile Steelhead Reach Based Survival/Arrival

PIT tag interrogation data from instream arrays and dam passage facilities of fish tagged in the spring of 2010 at screw traps located on Big Bear Creek and the East Fork Potlatch River were used to estimate juvenile arrival rates to the Juliaetta Array and Lower Granite Dam using PitPro 4.19 (Westhagen and Skaliski 2011). Juvenile fish captured at screw traps were assumed to be actively migrating out of their natal tributary. Subsequent interrogations at downstream arrays and within the hydrosystem were used to determine smolting rates and downstream rearing reaches for the Big Bear Creek and East Fork Potlatch River tag groups.

PIT tag interrogation data from instream arrays and dam passage facilities of fish tagged in the summer of 2010 were used to estimate juvenile survival to the spring of 2011 to the Juliaetta Array and Lower Granite Dam from tributaries of the Lower Potlatch River with PitPro 4.19 (Westhagen and Skaliski 2011). One major assumption of comparing survival rates among tributaries is that equal rates of residency occurred within the group of tributaries sampled. Major tributaries that were sampled during 2010 roving tagging include: East Fork Potlatch River, Big Bear Creek, Little Bear Creek, and West Fork Little Bear Creek.

Habitat Surveys

Low water habitat availability surveys were conducted to estimate and evaluate wetted habitat quality present within lower Potlatch River tributaries (Big Bear Creek, Little Bear Creek, West Fork Little Bear Creek, Pine Creek, Cedar Creek, and Corral Creek). Transects were walked August 1 – August 3, 2011. Tributaries were stratified into upland and canyon reaches to disperse transects throughout each tributary. Two randomly selected 500 m transects were walked within each strata and in each selected tributary resulting in four transects surveyed per tributary. The length of wetted habitat and the number of pools was recorded within each transect. For each pool we also measured the maximum depth, modal depth, pool length, pool width, temperature, dissolved oxygen and whether or not salmonids were present (visual observation). A digital YSI Pro DO meter was used to collect temperature and dissolved oxygen readings from the top and bottom of the water column near the center of each pool.

Water Temperature Monitoring

Water temperatures were monitored and recorded in selected tributaries to the Potlatch River from May through October. Temperature loggers were distributed throughout the basin at five locations in the lower basin and two in the upper basin. Temperature was recorded every four hours to obtain a yearly temperature profile for these tributaries with populations of steelhead/rainbow trout. Water temperatures were monitored to provide baseline water temperature data during the juvenile steelhead rearing season in tributaries where roving PIT-tagging occurred. The data collected will be sent to USFS Rocky Mountain Research Station personnel to be included in the regional database.

Freshwater Productivity

Freshwater productivity estimates in juvenile recruits/female spawner have been estimated for brood years 2005-2009 on the Big Bear Creek drainage and brood year 2008 - 2009 on the East Fork Potlatch River drainage. These estimates were derived by estimating annual adult escapement and applying the observed sex ratio at each weir to the estimate to establish the number of annual female spawners. This estimate was then divided by the subsequent years juvenile outmigrants at the associated juvenile fish screw trap on that drainage. Age-classes of the outmigration are established through scale analysis. The number of female spawners estimated by each brood year were then divided by the total juvenile outmigration for that brood year to estimate juvenile recruits/female spawner.

RESULTS

Adult Steelhead

Abundance and Migration Timing

A total of ninety-four unique adult steelhead were captured during the 2011 field season. Of these fish, sixty-one were captured at lower drainage weirs (Big Bear and Little Bear) and thirty-three were captured at the upper drainage weir (East Fork). There were four dead kelts recovered that were not included in the data analysis. Results for the lower drainage weirs will be combined in this section of the report and reported separately from the upper drainage weir.

A total of sixty-one unique adult steelhead were captured at the lower Potlatch River weirs during the 2011 trapping season. Of these, thirty-one were captured and marked as upstream pre-spawn migrants. Thirty-eight adult steelhead were captured as downstream post-spawn migrants; eight of these fish were recaptures. The mark-recapture occurrences resulted in an adult steelhead escapement estimate into the Big Bear drainage (Big Bear and Little Bear Creeks) of 124 (95% CI 63 – 236) fish.

The first upstream spawner arrived at the lower weirs on February 8th at Little Bear Creek (Figure 3). Fifty percent of the run was passed upstream by March 26th and the final upstream spawner arrived at the lower weirs on April 16th (Figure 3). The first downstream post-spawn kelt arrived at the lower weirs on April 14th; fifty percent and final kelt arrival occurred on April 28th and May 16th, respectively (Figure 3).

A total of thirty-three unique steelhead were captured at the East Fork Potlatch River weir during the 2011 field season. Of these, thirty-one were captured and marked as upstream pre-spawn migrants. Two adult steelhead were captured and released downstream as post-spawn migrants; none of these were recaptures. There is no expanded adult steelhead escapement estimate based upon a mark-recapture estimate for the East Fork Potlatch River in 2011 due to lack of recaptured kelts. The minimum escapement estimate based upon unique fish handled was thirty-three.

The first upstream spawner arrived at the upper weir on March 27th (Figure 4). Fifty percent of the run was passed upstream by April 24th and the final upstream spawner arrived at the upper weir on May 26th (Figure 4). Downstream migrating kelts were only captured at the upper weir site on May 5th because of issues associated with high water during the kelt outmigration.

Spawning Ground Surveys

A total of twelve unique adult pre-spawn steelhead were tagged at the two weir sites in 2011. Three and nine radio tags were deployed at the Big Bear Creek and Little Bear Creek weir sites, respectively. The furthest documented spawning migration of an adult female steelhead was 16.84 km upstream of the Little Bear Creek weir in the West Fork Little Bear Creek at Dutch Flat Dam, the farthest extent of accessible steelhead spawning habitat on that tributary. Eighty percent of the detections in Little Bear Creek occurred within 4.0 km of the weir

(Figure 5). The furthest documented spawning migration in Big Bear Creek was 1.0 km above the weir. Our downstream trap boxes only recovered two radio tags from kelts. The high flow events that occurred frequently throughout the spring of 2011 greatly impacted our ability keep our traps operating and conduct radio telemetry. In addition, shed rates of tags was high during the 2011 field season and may have affected radio-telemetry detections. One steelhead redd was documented during radio-telemetry work 3.81 km above the Little Bear Creek weir in the W.F. Little Bear Creek. There was no active spawning observed on any of the redds documented.

Two steelhead redds were documented on Little Bear Creek below the weir during redd surveys. Both redds were located upstream of the confluence of Big Bear Creek and Little Bear Creek within 1.5 km of the weir site. Redds were not directly below the weir site indicating that weir avoidance did not affect redd building site selection.

Life History Characteristics

Female steelhead captured at lower drainage weirs ranged in length from 535 – 770 mm and males ranged from 540 – 860 mm (Table 1). Female steelhead captured in the upper drainage ranged from 510 – 748 mm and males ranged from 382 – 850 mm (Table 1). The observed sex ratio of females per males from the 2011 field season was 0.88 and 1.36 for lower and upper weirs, respectively. Total unique captures of males and females were thirty-two and twenty-eight at lower weirs and fourteen and nineteen at the upper weir, respectively. The estimated number of fish by sex comprising the 2011 run was sixty-six and fifty-seven fish in the lower drainage and fourteen and nineteen in the upper drainage for males and females, respectively. The sex ratio of males to females in the upper drainage is based upon the total unique fish handled of each sex at the weir, and is not an estimate.

Scale samples were taken from ninety-eight adult steelhead captured during the 2011 field season. Scale samples from ninety-one fish were assigned freshwater and ocean ages. Five fish were unable to be assigned freshwater ages and one fish was not able to be aged. One fish captured in the adult trap at the E.F. Potlatch River weir was aged at 4 freshwater years and had apparently not outmigrated to the ocean. Scale analysis displayed a variety of freshwater and ocean life history strategies being utilized within the population (Table 2). The 2-Fresh 2-Ocean life history was the most prevalent with 53 and 48% of the fish sampled displaying these strategies at the lower and upper weirs, respectively (Table 2). Freshwater rearing ranged from 1-3 years for both lower and upper adult fish and adult ocean residency ranged from 1-3 and 1-2 years in lower and upper adults respectively (Table 2).

A total of 23 steelhead tagged in the Potlatch River Basin as juveniles in 2007, 2008, and 2009; as well as one repeat spawner previously tagged as an upstream migrating adult, returned to the Columbia River Basin as upstream adult migrants based on observations at dam passage facilities and in-stream array detections (Appendix B). Twenty four fish were detected at Bonneville Dam during the summer of 2010 (Appendix B). Seventeen of these fish were subsequently detected passing Lower Granite Dam and six were detected passing the mainstem Potlatch River instream array later in the migration (Appendix B). The first upstream adult was detected at Bonneville Dam on July 5th, 2010 and the last detection was August 31st, 2010 (Appendix B). The first upstream adult was detected at Lower Granite Dam July 30th, 2010 and the last detection was March 28th, 2011 (Appendix B). Mean travel time from Bonneville Dam to Lower Granite Dam was 55.4 days and mean travel time from Lower Granite Dam to the mainstem Potlatch River array was 147.3 days (Appendix B). Ocean life histories included nine 1-oceans and eleven 2-oceans, of the twenty known ocean age returning adults. Three of these steelhead were tagged in the Potlatch River Basin as juveniles but were not detected during their juvenile out-migration, therefore the duration of their ocean life history is uncertain.

Juvenile Steelhead

Ocean Outmigration

The rotary screw trap on Big Bear Creek was operated during the spring trapping season from January 1st until June 17th, 2011. During this period, the trap operated a total of 123 days and was pulled for eleven days due to high water events. A total of 574 unique steelhead were captured, of which 572 were PIT tagged and released above the trap. Of these, ninety-one were recaptured. The trapping season was subsequently grouped into five periods with different trapping efficiencies (Table 3). An estimated 3,869 juveniles emigrated during the spring of 2011 from the Big Bear Creek system (95% CI 3,024 – 5,269) (Table 3).

The rotary screw trap on the East Fork Potlatch River was operated from March 8th until July 14th, 2011. During this period, the trap operated a total of 104 days. A total of 1,640 unique steelhead were captured, of which 1,283 were PIT tagged and released above the trap. Of these, 146 were recaptured. The trapping season was subsequently grouped into four periods with different trapping efficiencies (Table 4). An estimated 16,067 juveniles emigrated from the East Fork Potlatch River system (95% CI, 11,882-21,959) (Table 4).

Length and Age Distributions

Steelhead sampled from Big Bear Creek screw trap had a larger size distribution than those sampled at East Fork Potlatch River screw trap (Figure 6). Juvenile steelhead captured at Big Bear Creek and the East Fork Potlatch River ranged from 83 – 256 mm and 61 – 189 mm, respectively. Mean length of steelhead sampled at the screw traps was 173.6 mm at Big Bear Creek compared to 94.3 mm at the East Fork Potlatch River. Scales were aged off 114 and 188 juvenile steelhead at Big Bear Creek and East Fork Potlatch screw traps, respectively from the 2011 spring outmigration. The dominant age class represented was age-2 (87%) at Big Bear Creek and age-1 (74%) at the East Fork Potlatch River (Figure 7). Age-1 and age-2 fish from the Big Bear drainage occupied larger size classes than did age-1and age-2 fish from the East Fork drainage (Figure 8). Small sample sizes in the age-3 size classes did not allow for comparison (Figure 8).

Smolt Outmigrant Arrival Rates

A total of 458 juvenile steelhead tagged at Potlatch River screw traps during the spring 2011 outmigration were detected at Lower Granite Dam and/or other downstream dams (384-Big Bear and 74-East Fork Potlatch River). Smolt arrival estimate to Lower Granite Dam from Big Bear Creek and the East Fork Potlatch River was 81% and 7% respectively (SE 0.04 and

0.01). Capture probability at Lower Granite Dam was 36% and 43% for Big Bear Creek and the East Fork Potlatch River respectively (SE 0.03 and 0.06). Outmigrating smolts from Big Bear Creek were observed at Lower Granite Dam April 14th through June 13th and April 1st through June 4th for outmigrating smolts from East Fork Potlatch River.

2010 Roving Tagged Fish Survival

A total of 1,227 fish were tagged in 2010 field season, during annual roving tagging efforts. Roving tagging efforts during the 2010 field season were focused within the Big Bear Drainage with limited additional tagging occurring within the East Fork Potlatch River. Overall survival probability for fish tagged in Big Bear Drainage during the 2010 field season to Lower Granite Dam during the 2011 outmigration season was 0.21 (SE 0.02). Individual tributary (Big Bear Creek, Little Bear Creek, West Fork Little Bear Creek, and East Fork Potlatch River) survival probabilities to tributary arrays (Big Bear Creek and East Fork Potlatch River) ranged from 0.30 (SE 0.03) – 0.10 (SE 0.02) in West Fork Little Bear Creek and Big Bear Creek, respectively (Table 5). Little Bear Creek had the second lowest summer survival from release to tributary array with 0.15 (SE 0.02)(Table 5). Tributary to Lower Granite Dam arrival rates ranged from a high of 0.25 (SE 0.02) in West Fork Little Bear Creek to a low of 0.09 (SE 0.02) in Big Bear Creek (Table 5). The West Fork of Little Bear Creek experienced the highest summer survival to array locations downstream in the drainage and Lower Granite Dam, which is contradictory to findings from 2009 and 2010.

2011 Roving Tagging

A total of 2,467 fish were tagged throughout the Potlatch River basin during the summer and fall of 2011 (Table 6). Of these, 1,954 and 513 fish were collected with backpack electrofishing and hook and line methods, respectively. The greatest number of tags placed in a single tributary was 813 in the West Fork of Little Bear Creek (Table 6). The goal of tagging at least 400 fish per tributary was met or nearly meet in all locations except Big Bear Creek where only 25 fish were tagged (Table 6). Length of steelhead/rainbow trout tagged ranged from 80 mm – 302 mm in the lower basin and 80 mm – 223 mm in the upper basin. Estimates on outmigration timing and over summer survival will become available as these fish outmigrate past downstream PIT tag arrays and Lower Granite dam during the spring of 2012.

2011 Snorkel Surveys

Snorkel surveys were conducted June 12-15, 21, 2011. Snorkeling effort was focused in the two index tributaries, Big Bear Creek and the East Fork Potlatch River. A total of 41 snorkel sites were surveyed in these drainages (19 - Big Bear Creek drainage and 22 - East Fork Potlatch River drainage). Two salmonid species were identified in the surveys (steelhead and brook trout *Salvelinus fontinalis)*. Salmonids < 2" were also observed and characterized as trout fry because of difficulties in correct identification. Juvenile steelhead were well distributed in snorkel survey sites and observed at 70.7% (n=29) of the sites surveyed with a mean density of 1.09 fish/100 m^2. Brook trout were observed at 41.5% of sites (n=17) predominately within the East Fork Potlatch River drainage sites with a mean density of 1.02 fish/100 m^2. Trout fry were observed at 19.5% of the sites (n=8). The highest observed steelhead density occurred in

Spring Valley Creek (tributary to Little Bear Creek) with 4.39 fish / 100 m^2 (Table 7). The highest observed trout fry density occurred within Little Bear Creek with 5.29 fish / 100 m^2 (Table 7). Mean steelhead density was much higher in the Big Bear Creek drainage than the East Fork Potlatch River with 1.63 and 0.32 fish / 100 m^2 respectively (Table 7). Trout fry densities were also much higher in the Big Bear Creek drainage with 1.52 and 0.02 fish / 100 m^2 within Big Bear Creek and East Fork Potlatch River sample sites respectively (Table 7). Although brook trout were observed in low densities within the Big Bear Creek drainage, it is possible that these observations were incorrectly identified since no brook trout have been observed within the drainage during electrofishing surveys in previous years.

Snorkeling conditions in 2011 were challenging because limited visibility at most sites throughout the drainage due to saturated soil from extremely wet winter and spring seasons. As a result, some sites could not be surveyed. Snorkel densities are considered minimum estimates of fish density within sample reaches because of the difficult conditions.

Habitat Surveys

Low water habitat availability surveys conducted during the 2011 field season estimated 88% of stream channel within the lower Potlatch was wetted during the first week in August. Percent wetted habitat recorded in 2011 was the highest recorded since the protocol was initiated in 2007. Corral Creek had the lowest average percent wetted habitat of the tributaries with only 68% wetted habitat at the survey sites (Table 8). Corral Creek has consistently had the lowest percent wetted habitat available annually since 2007. The West Fork of Little Bear Creek and Little Bear Creek had the highest percentage of wetted habitat with 100 and 98 % wetted, respectively (Table 8). Corral Creek also had the lowest pool density with 1.35/100 m^2 and Cedar Creek had the highest pool density with 8.00/100 m^2 (Table 8).

Temperature Monitoring

Of the seven monitored sites, the East Fork Potlatch River site had the lowest seasonal mean temperature at 13.77 ^{o}C (Table 9). Big Bear Creek sites had the highest seasonal mean temperature at 16.34 and 16.21^{o}C at the PIT-array and weir sites respectively (Table 9). Overall, Big Bear Creek at the weir site had the highest temperature profile with 100 and 68 days over 20 and 25 ^{o}C respectively (Table 9). Within the lower Potlatch River tributaries, Cedar Creek had the lowest overall temperature profile. Cedar Creek is the only northern draining tributary in the lower Potlatch which likely results in lower temperatures. Of the upper two drainages, the West Fork Potlatch River had a much higher temperature profile than the East Fork Potlatch River. All monitored tributaries had daily maximum temperatures exceeding 20 ^{o}C ranging from 34 – 100 days (Table 9). Average daily temperatures only exceeded 25 ^{o}C at two sites, Big Bear Creek at the weir site and West Fork Potlatch River. Temperatures exceeded 25 ^{o}C at the Big Bear Creek and West Fork Potlatch River sites for 68 and 13 days, respectively (Table 9).

Brood Year Productivity

Complete brood year productivity estimates in juveniles / spawner have been generated for three brood years on the Big Bear Creek drainage. Juveniles / spawner estimates have ranged from 62.3 in brood year 2005 up to 269.9 in brood year 2006 (Table 10). A partial (missing age-3) estimate has been generated for brood year 2009 with 113.0 juveniles / spawner (Table 14). Initial productivity estimates for Big Bear Creek fit a density-dependent relationship based upon limited habitat for juvenile rearing (Figure 9).

Given the later start date for adult trapping on the East Fork Potlatch River (2008) we have only generated one complete and one partial brood year productivity estimate for that population. The complete estimate for brood year 2008 is 358.2 juveniles/spawner and the partial estimate for brood year 2009 is 698.0 juveniles/spawner (Table 10). The estimates for the East Fork Potlatch River group are not directly comparable with regards to active smolt outmigrants/spawner within the Big Bear Creek drainage since we have documented significant differences in juvenile life history between the two groups.

DISCUSSION

Steelhead productivity in the Big Bear Creek Drainage appears to be highly density dependent. The juvenile recruits per female spawner productivity estimates for BY 2005 – 2008 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). We believe that the Big Bear Drainage and the rest of the Lower Potlatch River and associated tributaries are extremely stream flow limited by mid to late summer. This lack of late summer rearing habitat would negatively impact steelhead production in these systems by limiting rearing habitat. As stream flow conditions improve we expect productivity in juvenile recruits per female spawner to also improve. Habitat restoration efforts in the Lower Potlatch River should be focused on stream flow improvement and/or allowing access to additional stream habitat through barrier removal.

Habitat restoration work intended to increase available rearing habitat and improve the quality of steelhead habitat available is needed to increase freshwater productivity in our monitored streams. Currently, three habitat restoration projects are planned within the Big Bear Creek drainage that have significant potential to increase steelhead production. All three projects will have positive impacts on the amount of steelhead rearing habitat available on the West Fork Little Bear Creek, which typically contains the highest densities of juvenile steelhead present in the Potlatch River drainage. First, the Dutch Flat Dam removal project on the West

Fork of Little Bear Creek which is scheduled to be completed in 2012 (Latah County Soil and Water Conservation District). The removal of the dam will open up ~ 5 miles of steelhead habitat that is currently underutilized. Surveys conducted below the dam site in 2011 showed a 100 fold increase in steelhead density compared to sites above the dam. Radio-telemetry work conducted in 2011 also showed the Dutch Flat Dam being the uppermost extent of upstream migration of radio-tagged anadromous steelhead female spawners within this drainage. We expect a significant increase in juvenile production upon the completion of this project. Second, the Big Meadow Creek (a tributary to the West Fork Little Bear Creek) is scheduled to be completed in 2012 (Idaho Department of Fish and Game). This project will remove a fish passage barrier that block ~ 5 miles of steelhead habitat. Juvenile steelhead densities located just downstream of the culvert on the West Fork Little Bear Creek exceeded 100 fish / 100m^2 in 2011. Third, the University of Idaho has received funding (PCSRF) to explore mid-late summer water releases from a municipal water storage reservoir located on Big Meadow Creek (a tributary to the West Fork Little Bear Creek) to supplement low flow conditions within Big Meadow Creek and the West Fork Little Bear Creek. A lack of water retention and late summer steelhead rearing habitat is the limiting factor in the lower Potlatch River drainage. This project may only increase summer base flows by 0.5 cfs however, these stream reaches often have intermittent flow conditions by mid-summer so any increase in stream discharge will have significant positive effects on steelhead production. Finally, we are assessing a potential fish passage barrier on Big Bear Creek that is currently blocking or impeding passage to ~ 20 miles of steelhead habitat upstream. Providing anadromous steelhead passage at Big Bear Creek Falls would quadruple the amount of steelhead spawning and rearing habitat currently available within Big Bear Creek. This action, coupled with project outlined above would produce a measureable change in steelhead production within the Big Bear Creek drainage in the next 4-5 years.

The major limiting factor in the East Fork Potlatch River is stream channel complexity and over-winter habitat for juvenile rearing steelhead. IDFG has partnered with Potlatch Timber Corporation to address these issues. In 2009 a LWD treatment project was initiated within the East Fork Potlatch River. To date, 1.7 kilometers of steelhead habitat within the East Fork Potlatch River have had LWD treatments put in place. In addition, another 3.2 kilometers of treatments are going to be submitted for funding in 2012 with an anticipated completion date for the summer of 2013. In addition, IDFG is working with a private landowner located downstream of the LWD treatments on a significant meadow restoration/LWD restoration project. This project is funded and scheduled for completion in 2012. The project will enhance ~ 2.2 kilometers of the East Fork Potlatch River within the current distribution of steelhead. All LWD and habitat restoration efforts are located within the core distribution of steelhead in the East Fork Potlatch River. The completion of these projects will enhance 7.1 kilometers of the current distribution of steelhead within the East Fork Potlatch River drainage. We estimate the core steelhead distribution area in the East Fork and tributaries to be 67 kilometers. Completion of these projects will enhance 10% of the distribution. With an additional 4-5 years of project implementation we hope to enhance ~25% of the distribution. This level of enhancement should produce a detectable change in the steelhead production.

Quantifying the resident component of the steelhead/rainbow trout population within the Potlatch River drainage is difficult. Based upon visual observations of spawning fish and phenotypic observations from electrofishing surveys within the drainage we believe there is a resident component. However, there is no definitive rule on visually assessing residency versus anadromy in these sympatric populations. Perhaps the best indication is the percentage of a sample group occupying larger size classes. To date, the largest PRSME PIT-tagged smolt interrogated downstream in the hydrosystem is 293 mm, however this is an outlier. Most interrogations downstream in the hydrosystem begin with some level of consistency around 210-220 mm length classes. Only 1.3% of the fish sampled during the 2011 roving tagging effort occupied 220 mm length class or greater. Based strictly upon length, this data suggests that there are very few resident steelhead/rainbow trout within the Potlatch River drainage. These findings agree with phenotypic observations (coloration, absence of parr marks, and spotting) during surveys that also suggests limited resident life histories present within the drainage. Recent studies have found that resident life histories can spawn and produce viable anadromous progeny in sympatric resident and anadromous steelhead populations (Christie et al. 2011 and Araki et al. 2007). Even if the resident component of steelhead within the Potlatch River is low, it may provide a valuable source of genetic and life history stability within the population. Examining strontium:calcium ratios from otolith microchemistry would be needed to establish the level of resident rainbow trout interactions currently occurring within the Potlatch River drainage.

Potential inter-specific competition between native rainbow trout/steelhead and non-native brook trout in the East Fork Potlatch River is a concern regarding habitat restoration activities in the drainage. A variety of studies have shown brook trout to outcompete and displace rainbow trout (*Salmo gairdneri*) under certain criteria. Cunjak and Green (1984) found brook trout to outcompete rainbow trout in slow water velocity habitat and no consistent dominance by either species in fast water velocity habitats. Cunjak and Green (1983) also found brook trout to occupy lower water velocity areas in both sympatric and nearby allopatric reaches with and without rainbow trout. Brook trout have also been shown to outcompete rainbow trout in cooler water temperatures (8 and 13 ^{o}C) with no detectable competitive advantage in warmer water temperatures (19 ^{o}C)(Cunjak and Green 1986). Contrary to these studies, work by Larson and Moore (1985) in Appalachian streams has shown non-native rainbow trout to outcompete native brook trout. They found that the invasion of rainbow trout has greatly reduced the range of brook trout in their study streams (Larson and Moore 1985). Studies finding brook trout outcompeting rainbow trout in low water velocity areas provide concern regarding LWD treatments in the East Fork Potlatch River. Increasing LWD densities in sympatric brook trout and rainbow trout populations needs to be examined critically. Structures should be designed to increase channel complexity, a limiting factor for steelhead in the drainage, but not reduce water velocities and increase potential brook trout habitat. It is also important to note that these studies were conducted with resident rainbow trout, a much different strain than native anadromous *Oncorhynchus mykiss*. Because of this and the conflicting findings in the literature we see merit in conducting our own investigation into brook trout and steelhead competition in the East Fork Potlatch River.

Snorkel surveys have been conducted in the East Fork Potlatch River since 1992. Over that time brook trout and steelhead densities have fluctuated on an annual basis. Although steelhead and brook trout populations in the East Fork Potlatch River are overwhelmingly sympatric certain areas and habitat types are often dominated by one of these species. Some areas such as Bob's Creek typically are dominated by brook trout. Bob's Creek has low velocity habitat and a fairly intact shrub riparian zone. The dominance by brook trout agrees with studies listed above showing brook trout preferring such habitat types. Other snorkel sites show an even distribution and/or dominance by steelhead. These are likely higher velocity areas with more pocket water and small pools, indicative of preferred steelhead habitat. In 2012, the PRSME project will initiate a more intensive examination of steelhead and brook trout density in LWD treated and untreated areas of the East Fork Potlatch River. Coupled with historical snorkel data we hope to determine what habitat variables and LWD treatments appear to maximize steelhead production.

Radio-telemetry locations of female spawners in 2011 did show an expanded spatial distribution for one radio-tagged individual when compared to 2010 data. This female migrated to Dutch Flat Dam a fish passage barrier located on the West Fork Little Bear Creek. Numerous untagged adult steelhead were also observed attempting to leap the passage barrier during the same time period. Water conditions during the 2011 spawning migration were much different than 2010 with much higher streamflow in 2011. The farthest upstream migration in 2011 was 6 km father than was documented in 2010. We believe this distance would have been farther if not for the presence of the passage barrier. That being said, many of the tagged fish, 80%, were still documented within 4 km of the weir. This suggests that much of the spawning does occur within the canyon reaches regardless of streamflow during the spawning migration. In a rearing habitat limited system such as the Big Bear Creek drainage, it is important to provide fish passage to the full extent of available steelhead spawning habitat and therefore expand the available rearing habitat. Density dependence has been well documented with the Big Bear Drainage. Expanding the spatial distribution of spawning and rearing habitat should result in an overall increase in productivity. Fish passage projects such as the removal of Dutch Flat Dam and providing fish passage through the State Highway 8 culvert into Big Meadow Creek (a tributary to the West Fork Little Bear Creek) are therefore a high priority within the drainage.

High flow events during the adult trapping season had a severe impact on our ability to estimate adult escapement during the 2011 field season. Flows in 2011 were higher and more variable than 2010. The average mean daily flow during the 2010 trapping season was 319 cfs and the average mean daily flow during the 2011 season was 1,390 cfs. There were two peaks in flow during the 2011 season that resulted in significant damage to our trap sites and trapping equipment. On January 17th, mean daily flow at the mainstem Potlatch River gage reached 12,500 cfs and the stream channel at Little Bear Creek weir site migrated across the floodplain. This event resulted in finding a new trapping site a few weeks from the beginning of our trapping season. The site that was chosen was not ideal and was more vulnerable to higher water flows than our previous site. On April 5th, 2011, there was a second high water event that occurred. On this date, mean daily flow at the mainstem Potlatch River gage reached 8,430 cfs. This event completely destroyed both of our lower weirs sites and did not allow us to rebuild our fish traps for twelve and nine days at our Big Bear and Little Bear Creek sites, respectively. Even with weir failures we were able to mark and recapture a sufficient number of upstream spawners and downstream kelts to estimate adult escapement. High flow events also hindered trapping on the East Fork Potlatch River. We were able to mark thirty-one upstream spawners but were only able to capture two downstream kelts. This did not allow for a mark-recapture estimate at that site. While the floating weir design at the East Fork Potlatch River has not been damaged by high flow, it is difficult to capture kelts during high flow events. During these periods, the floating weir panels are pushed below the water surface and downstream migrating kelts wash over the weir. Additional modifications will be made to the weir in 2012 to attempt to capture kelts; if these changes are unsuccessful a new weir design may be needed.

High stream discharge during the 2011 spring screw trapping season did not appear to negatively affect screw trap efficiency when compared to a low stream discharge year such as 2010. Average efficiency was 0.16 and 0.18 at Big Bear Creek screw trap and 0.14 and 0.09 at the East Fork Potlatch River screw trap during 2011 and 2010 respectively. Given the increased streamflow we had some concerns regarding recapture efficiency. However, efficiencies remained fairly consistent at Big Bear Creek and actually increased at the East Fork Potlatch River. Increased stream velocity associated with higher discharge may have reduced trap avoidance ability and allowed efficiencies to remain high.

The high flow event on January 14-17, 2011 severely impaired the mainstem Potlatch River array. Four of the six antennas at the site were compromised by the event. Because of water depth and velocity at the site, it was unable to be repaired until the fall of 2011. The site was operated with one operational antenna per upstream and downstream array during 2011. This left approximately two-thirds of the channel unmonitored for PIT-tag interrogations. Given this limitation, there are considerable statistical limitations for the detection data for 2011. Optimally, the entire channel width is monitored for PIT-tag interrogations at array sites. Survival data of outmigrant smolts from both screw trap tagging during 2011 and roving tagging in 2010 should be interpreted with this in mind.

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TABLES

Table1. Length distributions for male and female upstream spawners captured at lower and upper Potlatch River, Idaho, weirs during the 2011 field season.

Location	**Sex**	**n**	**Min Length (mm)**	**Max Length (mm)**	**Average Length (mm)**	**SE**
Lower Weirs	Female	31	535	770	673	13.15
Lower Weirs	Male	34	540	860	740	15.44
Upper Weirs	Female	20	510	748	659	16.64
Upper Weirs	Male	19	382	850	660	28.85

Table 2. Observed numbers and percentages of various freshwater and ocean life history strategies in adult steelhead captured at lower and upper weirs during the 2011 field season (n = 59 and 31 at the lower and upper weirs Potlatch River, Idaho, weirs respectively).

Location	Freshwater Age	Ocean Age	n	%
Lower Weirs	1	1	4	0.07
		2	11	0.18
	2	1	11	0.18
		2	32	0.53
		3	1	0.02
	3	1	1	0.02
Upper Weirs	1	1	1	0.03
	2	1	8	0.26
		2	15	0.48
	3	1	2	0.06
		2	5	0.16

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 2011 spring trapping season. Also included is an average efficiency, migrant estimate, and 95% confidence intervals (CI) for each sampling period.

Dates	Captured	Marked	Recaptured	Average Efficiency	Migrant Estimate	Lower 95% CI	Upper 95% CI
3/18 - 4/20	100	100	7	0.07	1263	631	2761
4/21 - 5/2	98	98	17	0.17	539	342	883
5/3 - 5/24	299	297	51	0.17	1714	1283	2295
5/25 - 6/1	54	54	10	0.19	270	151	486
6/2 - 6/8	20	20	4	0.2	84	34	189
Total	**571**	**569**	**89**	**0.16**	**3870**	**2441**	**6614**

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 2011 spring trapping season. Also included is an average efficiency, migrant estimate, and 95% confidence intervals (CI) for each sampling period.

Dates	Captured	Marked	Recaptured	Average Efficiency	Migrant Estimate	Lower 95% CI	Upper 95% CI
3/30 - 5/1	375	239	46	0.19	1915	1465	2458
5/2 - 5/17	121	108	22	0.2	573	385	865
5/18 - 6/7	615	463	45	0.1	6204	4768	8094
6/8 - 7/14	529	473	33	0.07	7375	5264	10542
Total	**1640**	**1283**	**146**	**0.14**	**16067**	**11882**	**21959**

Table 5. Summary table of survival probabilities to tributary arrays, Juliaetta Array (JUL), and Lower Granite Dam (LGR) for fish tagged in Potlatch River, Idaho, tributaries during the summer of 2010. Detection data was queried from the 2011 outmigration season. Big Bear drainage estimates included Little Bear Creek, Big Bear Creek, and West Fork Little Bear Creek release groups. N/A represents tag groups with insufficient interrogations for arrival estimation.

Stream	n	Arrival to Tributary Array	Arrival to JUL	Arrival to LGR
East Fork Potlatch	151	0.30 (0.06)	N/A	N/A
Little Bear Creek	298	0.15 (0.02)	0.51 (0.44)	0.14 (0.02)
WF Little Bear Creek	526	0.30 (0.03)	0.63 (0.52)	0.25 (0.02)
Big Bear Creek	252	0.10 (0.02)	0.16 (0.11)	0.09 (0.02)
Big Bear Drainage	1076	0.21 (0.02)	0.47 (0.22)	0.18 (0.01)

Table 6. Number of juvenile steelhead/rainbow trout PIT tagged by tributary in the Potlatch River, Idaho, during roving tagging efforts during the 2011 field season.

Stream	# Tagged
WF Little Bear Creek	813
Little Bear Creek	383
Big Bear Creek	25
Pine Creek	410
Cedar Creek	406
EF Potlatch River	430
Total	**2467**

Table 7. Snorkel survey salmonid density summary data from the sites snorkeled in Potlatch River, Idaho, index tributaries during the 2011 field season. 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	2	0.06	3.95	0.00
	East Fork Big Bear Creek	1	0.48	0.00	0.48
	Little Bear Creek	4	1.81	5.29	0.03
	Nora Creek	1	0.00	0.00	0.00
	Schwartz Creek	1	2.95	0.00	0.00
	Spring Valley Creek	1	4.39	0.00	0.00
	West Fork Little Bear Creek	9	1.72	1.39	0.27
	Big Bear Creek Mean	**2.71**	**1.63**	**1.52**	**0.11**
East Fork Potlatch River	Bloom Creek	1	0.00	0.00	4.24
	Bobs Creek	5	0.75	0.08	0.56
	East Fork Potlatch River	10	0.50	0.00	0.80
	Jackson Creek	2	0.00	0.00	4.82
	Ruby Creek	4	0.37	0.00	1.02
	East Fork Potlatch River Mean	**3.36**	**0.32**	**0.02**	**2.29**
	Overall Mean	**3.69**	**1.09**	**0.89**	**1.02**

Table 8. Low water habitat availability protocol results from the 2011 surveys in the Potlatch River drainage, Idaho.

Creek	Strata	Site	Total Wetted Length(m)	% Wetted	Total # Pools	Total Length of Pools(m)	Average Pools/100m
Big Bear	U	UBC1	500.00	1.00	13.00	78.10	2.60
Big Bear	U	UBC3	335.00	0.67	22.00	46.50	4.40
Big Bear	L	LBBC1	500.00	1.00	14.00	114.50	2.80
Big Bear	L	LBBC2	500.00	1.00	45.00	83.90	9.00
Big Bear Average			**458.75**	**0.92**	**23.50**	**80.75**	**4.70**
Little Bear	U	ULBC1-A	500.00	1.00	19.00	88.30	3.80
Little Bear	U	ULBC2	458.90	0.92	13.00	92.80	2.60
Little Bear	L	LLBC1	500.00	1.00	34.00	40.60	6.80
Little Bear	L	LLBC2	500.00	1.00	34.00	65.60	6.80
Little Bear Average			**489.73**	**0.98**	**25.00**	**71.83**	**5.00**
WFLBC	U	UWF1	500.00	1.00	21.00	47.10	4.20
WFLBC	U	UWF2	500.00	1.00	16.00	31.40	3.20
WFLBC	L	LWF4	500.00	1.00	8.00	148.90	1.60
WFLBC	L	LWF5	500.00	1.00	9.00	49.90	1.80
WF Little Bear Average			**500.00**	**1.00**	**13.50**	**69.33**	**2.70**
Cedar	U	UCEC3	500.00	1.00	31.00	79.10	6.20
Cedar	U	CECU2	336.10	0.67	7.00	80.90	1.40
Cedar	L	CEC1	500.00	1.00	36.00	93.20	7.20
Cedar	L	CEC2	500.00	1.00	86.00	68.00	17.20
Cedar Average			**459.03**	**0.92**	**40.00**	**80.30**	**8.00**
Pine	U	UPC2-A	488.00	0.98	13.00	294.20	2.60
Pine	U	UPC3-A	67.00	0.13	3.00	20.30	0.60
Pine	L	LPC5-A	500.00	1.00	9.00	74.00	1.80
Pine	L	LPC6-A	500.00	1.00	11.00	84.20	2.20
Pine Average			**388.75**	**0.78**	**9.00**	**118.18**	**1.80**
Corral	U	UCOC7	500.00	1.00	15.00	98.30	3.00
Corral	U	UCOC4	341.70	0.68	11.00	84.30	2.20
Corral	L	LCOC1	74.00	0.15	0.00	0.00	0.00
Corral	L	LCOC2	442.50	0.89	1.00	5.00	0.20
Corral Average			**339.55**	**0.68**	**6.75**	**46.90**	**1.35**
Drainage Average			**439.30**	**0.88**	**19.63**	**77.88**	**3.93**

Table 9. Average mean, maximum, and minimum daily recorded water temperature values for seven monitoring stations in the Potlatch River drainage, Idaho, during the 2011 field season. Averages are from 5/1/2011 through 10/1/2011. * Values exclude days when the HOBO was out of the water.

	Season Averages				
Site	**Mean**	**Max**	**Min**	**Days > 20 ^{o}C**	**Days > 25 ^{o}C**
Big Bear Creek-Weir	16.21	22.75	11.05	100	68
Big Bear Creek - PIT array	16.34	18.90	14.26	81	0
Cedar Creek	13.95	16.19	11.95	34	0
East Fork Potlatch River	13.77	15.93	11.58	47	0
Little Bear Creek	15.12	17.51	13.06	48	0
Pine Creek*	15.11	18.39	12.23	61	0
West Fork Potlatch River*	15.11	18.97	12.03	74	13

Table 10. 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.

Drainage	BY	Adult Escapement Estimate	Proportion Female	# female spawners	Juvenile Outmigration				Total BY Production	Juveniles/Spawner
					Age -0	Age-1	Age-2	Age-3		
Big Bear	2005	214	0.72	154.08	0	3091	6414	87	9592	62.26
Big Bear	2006	57	0.4	22.80	0	2740	2497	917	6153	269.88
Big Bear	2007	108	0.74	79.92	0	2903	4175	199	7278	91.06
Big Bear	2008	121	0.39	47.00	0	1256	6171	155	7582	161.32
Big Bear	2009	135	0.45	61.30	0	3583	3367	*	6950	113.38
Big Bear	2010	251	0.6	150.60	0	348	*	*	*	*
Big Bear	2011	124	0.46	57.04	0	*	*	*	*	*
East Fork	2008	140	0.36	50.40	583	9486	7905	80	18054	358.21
East Fork	2009	92	0.46	42.80	0	25776	4097	*	29873	697.97
East Fork	2010	71	0.81	56.70	0	11890	*	*	*	*
East Fork	2011	33*	0.58	N/A	0	*	*	*	*	*

FIGURES

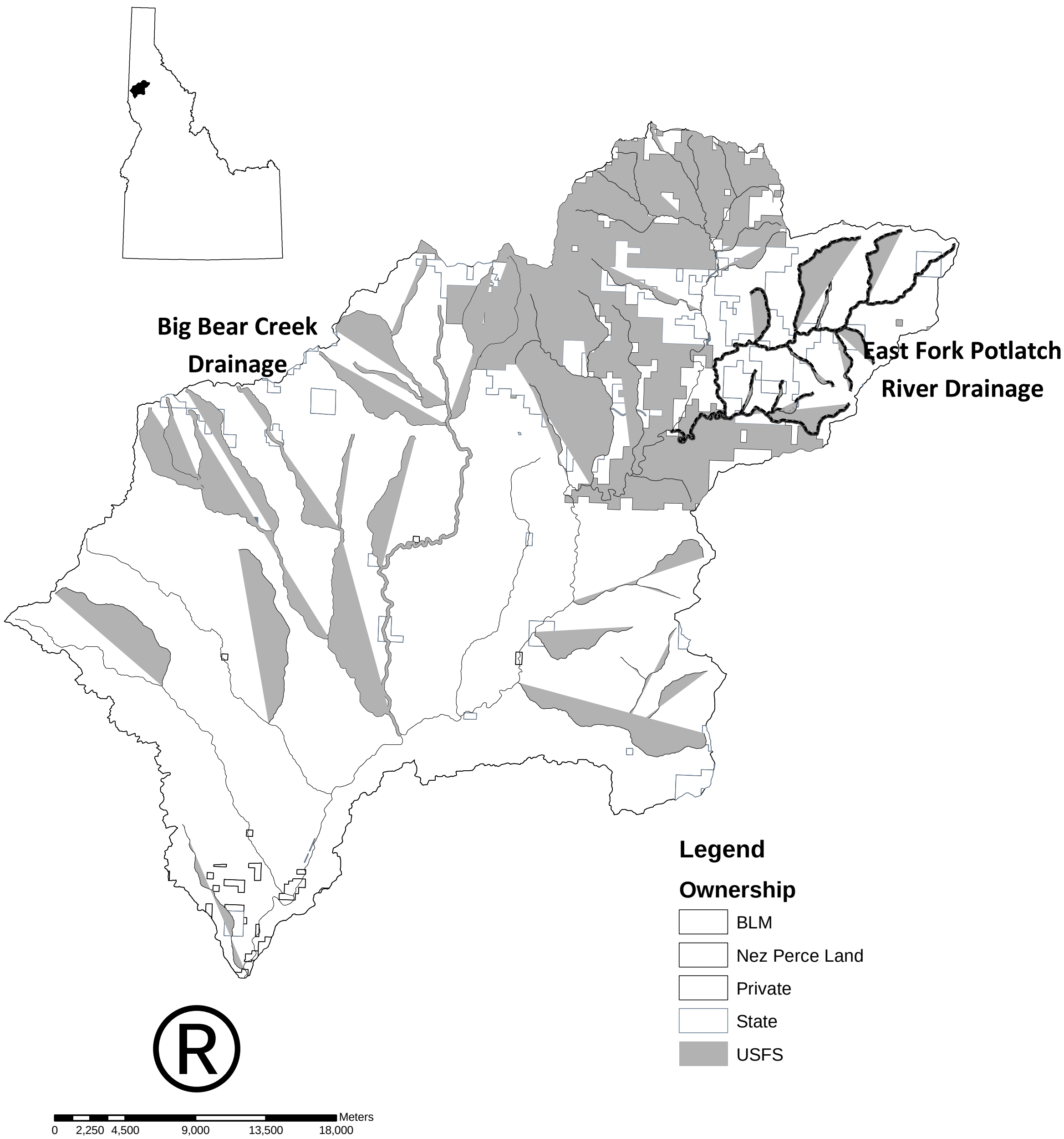


Figure 1. Potlatch River Drainage, Idaho, with intensively monitored tributaries, Big Bear and East Fork Potlatch River, highlighted in lower and upper portion of the drainage.

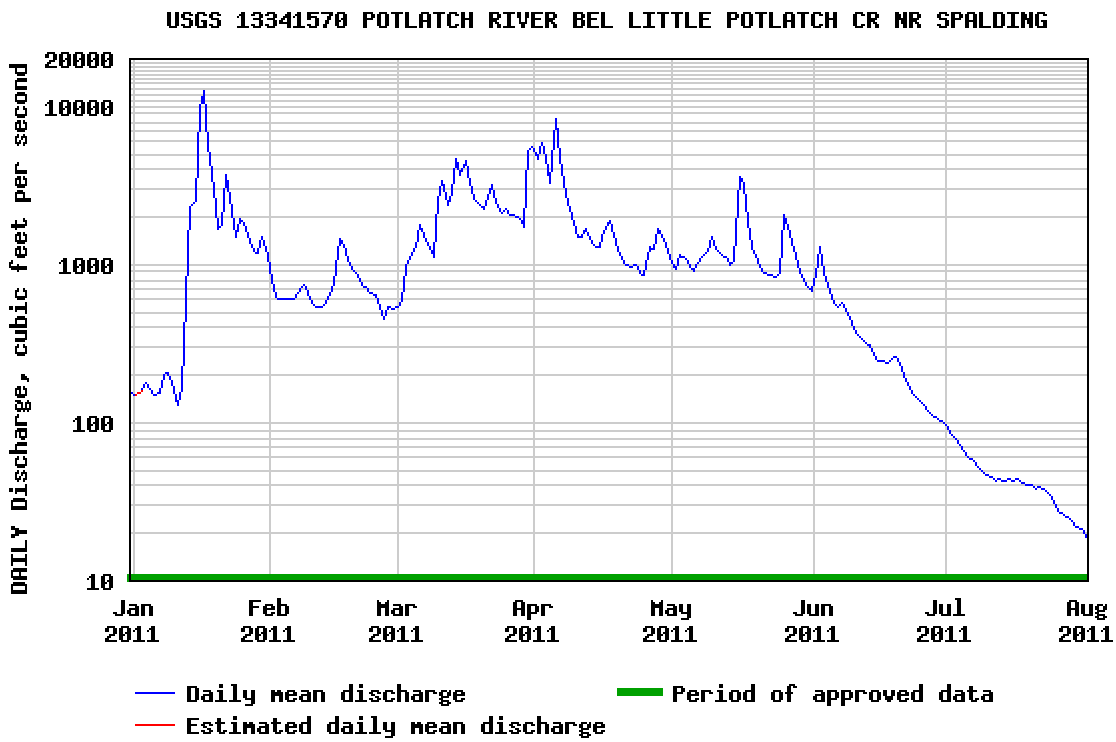


Figure 2. Main stem Potlatch River, Idaho, mean daily discharge recorded at USGS site 13341570 during the spring and summer of 2011.

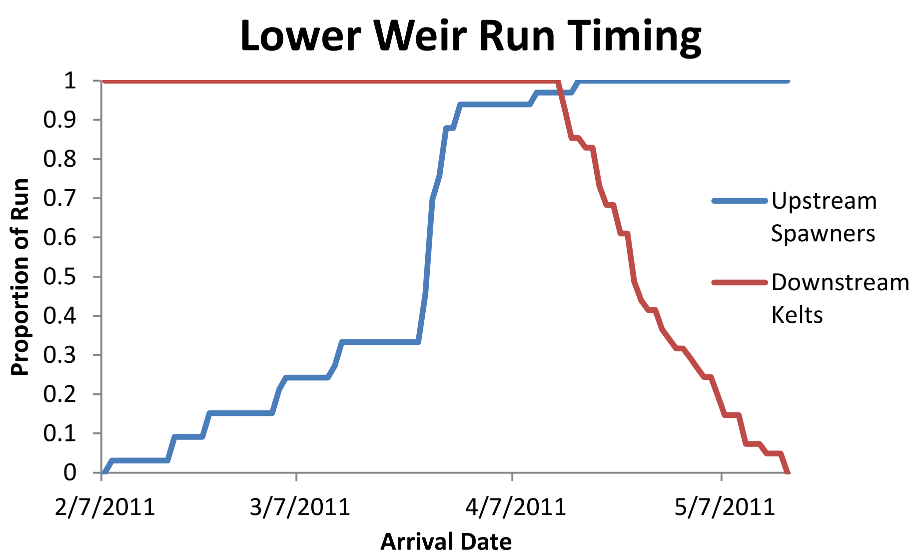


Figure 3. Spawning migration timing of adult steelhead captured at Big Bear Creek drainage, Idaho, weirs during the 2011 field season.

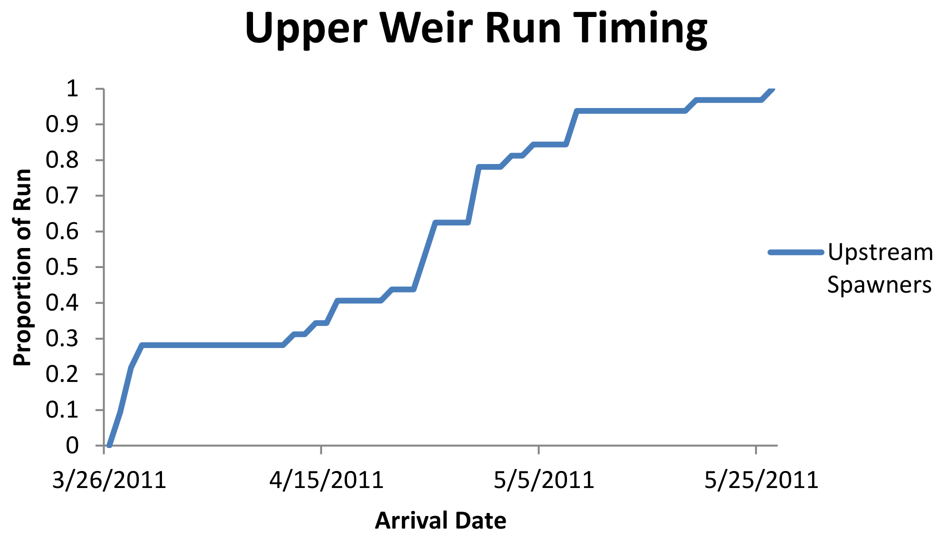


Figure 4. Spawning migration timing of upstream migrating adult steelhead captured at the East Fork Potlatch River, Idaho, weir during the 2011 field season. Downstream migrating kelts are not included due to a low number of captures.

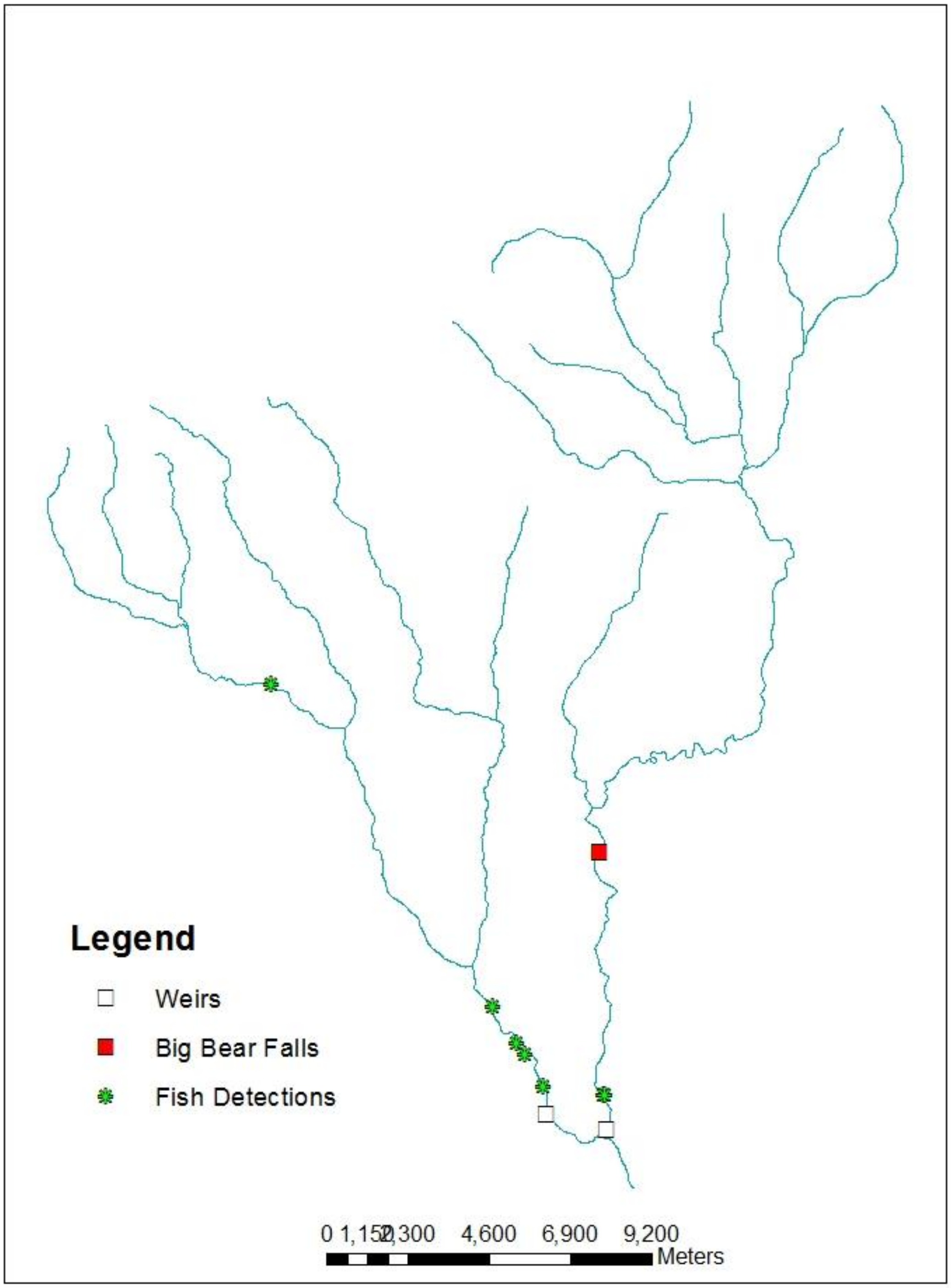


Figure 5. Farthest upstream radio-telemetry detections of female steelhead tagged within the Big Bear Drainage, Idaho, during the 2011 field season.

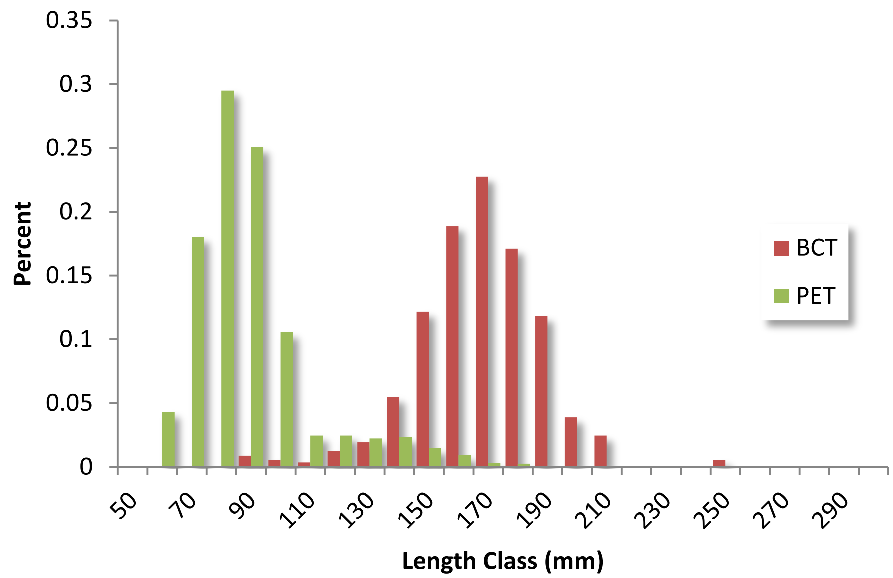


Figure 6. Length frequency histogram of juvenile steelhead captured and measured at the Big Bear Creek (BCT) and East Fork Potlatch River (PET), Idaho, screw traps during the spring emigration of 2011.

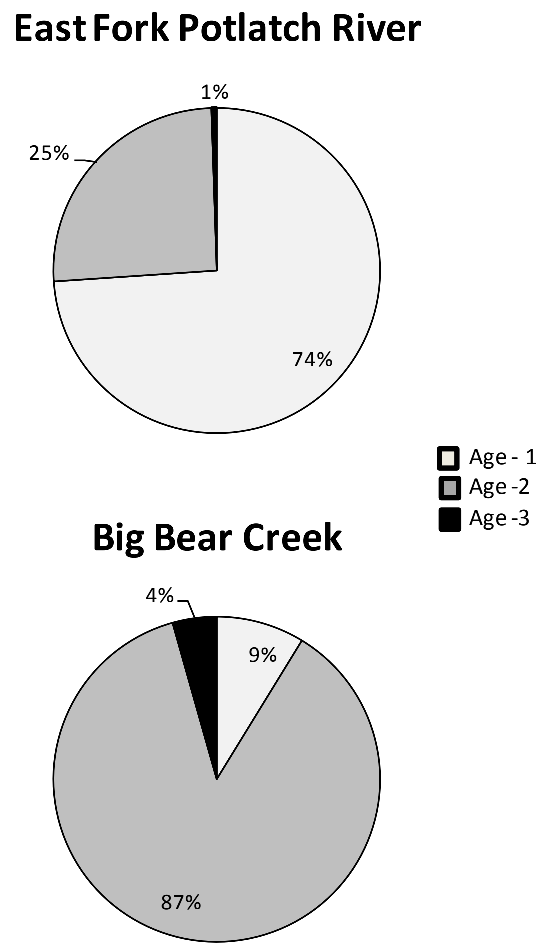


Figure 7. Age composition of juvenile steelhead determined from scale sampled collected from screw traps on Big Bear Creek and the East Fork Potlatch River, Idaho, during the 2011 field season (n = 114 and 188 at Big Bear Creek and the East Fork Potlatch River respectively).

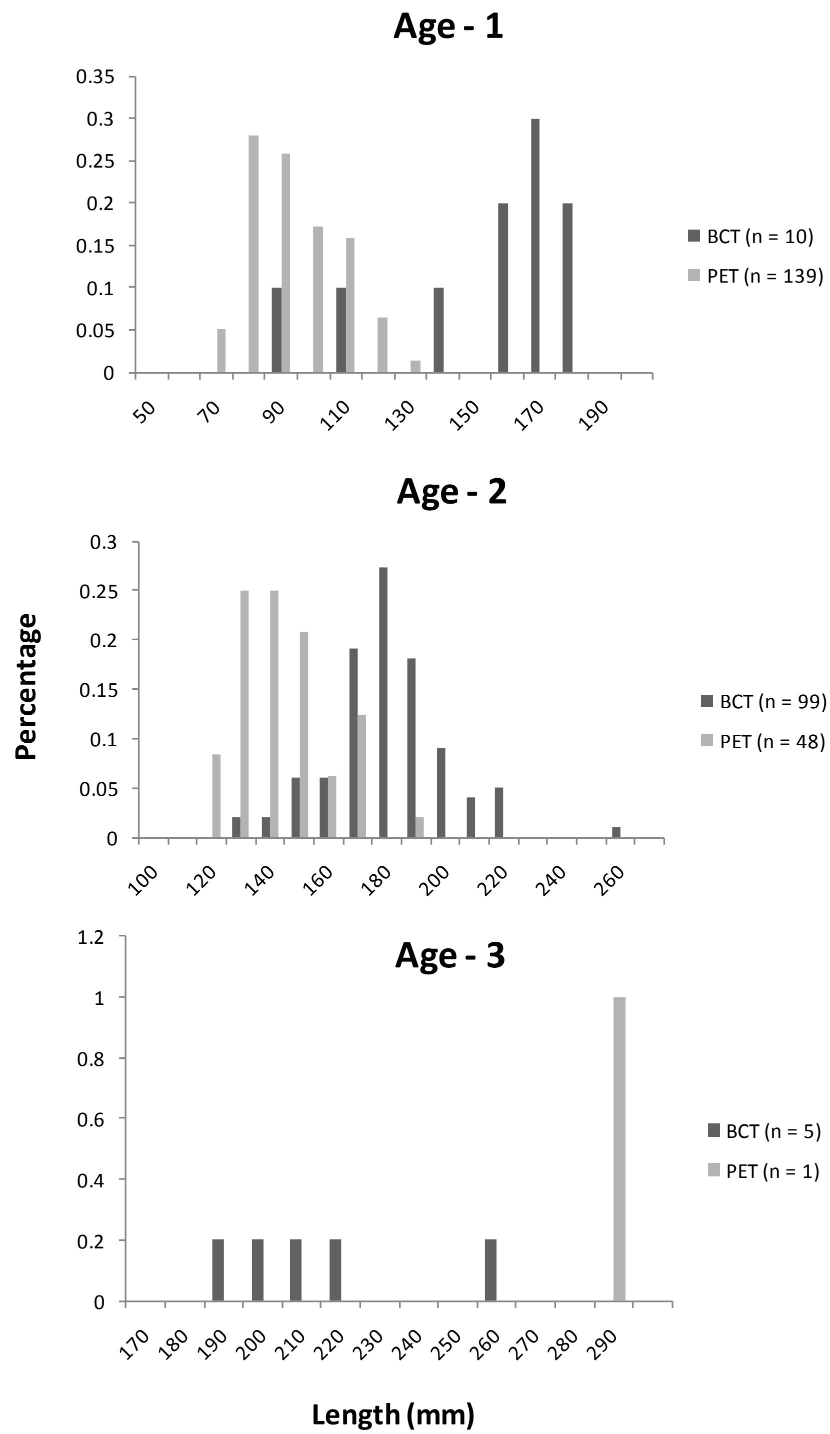


Figure 8. Length frequency of know age juvenile steelhead captured during the 2011 field season at Big Bear Creek (BCT) and the East Fork Potlatch River (PET), Idaho, screw traps by age class.

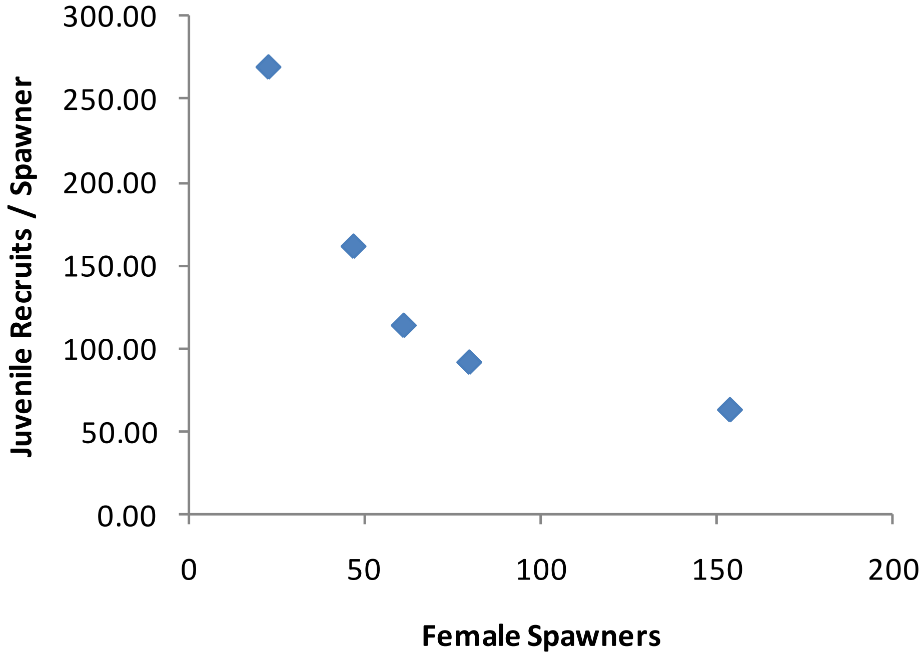
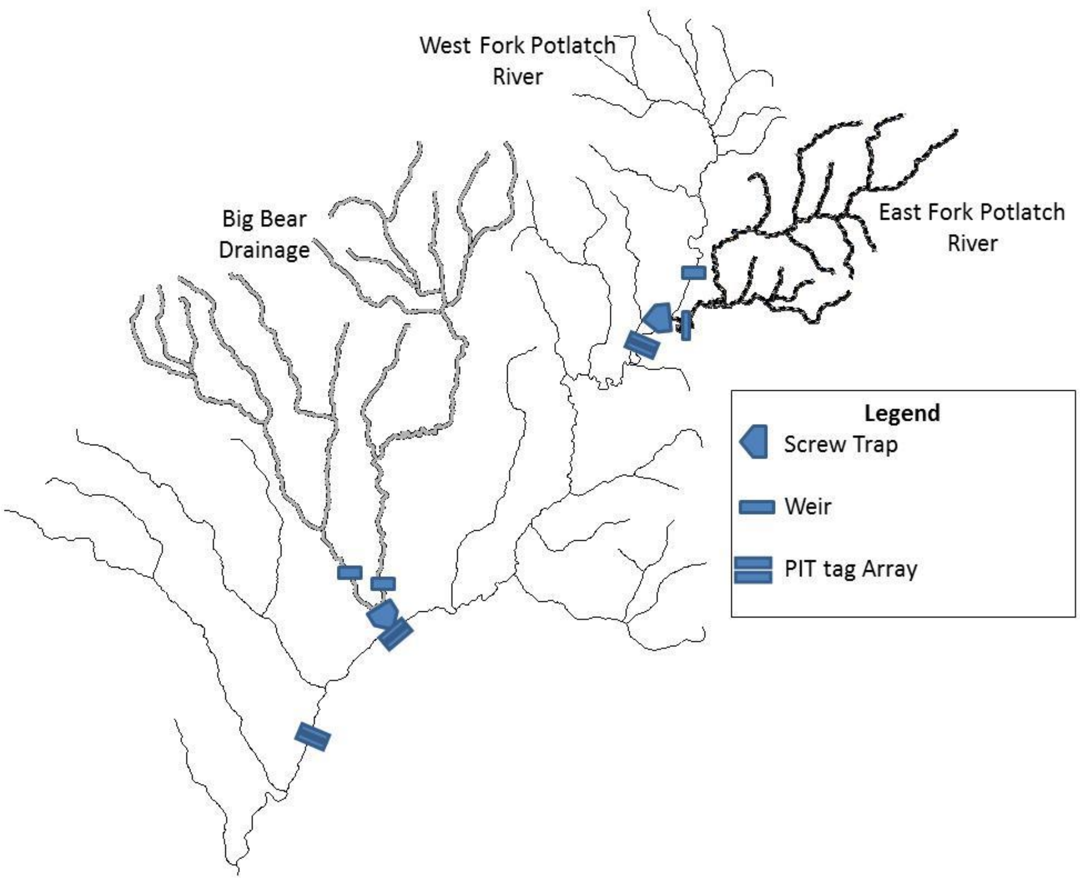


Figure 9. Productivity curve in juvenile recruits/female spawner for the Big Bear Drainage, Idaho, for brood years 2005-2009.

APPENDIX

Appendix A: Map of intensive monitoring drainages and associated sampling infrastructure within the Potlatch River drainage, Idaho, during the 2011 field season.



Appendix B. Spawning migration characteristics of adult steelhead from Bonneville Dam (BON), Lower Granite Dam (LRG) and the mainstem Potlatch River array (JUL) which were tagged as juveniles at sites within the Potlatch River Drainage, Idaho, (BIGBEC = Big Bear Creek, PINE2C = Pine Creek, LBEARC = Little Bear Creek, and POTREF = East Fork Potlatch River).

Tag ID	Juvenile Release Site	Tag Date	BON Observation Date	GRA Observation Date	JUL Observation Date	BON-GRA Travel Days	GRA-JUL Travel Days
3D9.1BF26AC5DC	BIGBEC	12/05/07	08/12/10	*	*	*	*
3D9.1BF2716827	BIGBEC	05/17/08	07/12/10	09/29/10	02/11/11	80	136
3D9.1BF27182B9	BIGBEC	04/30/08	08/01/10	09/14/10	03/03/11	45	171
3D9.1BF2718777	PINE2C	05/21/07	07/27/10	*	*	*	*
3D9.1BF2718BCE	BIGBEC	05/11/08	08/25/10	10/22/10	01/27/11	59	98
3D9.1BF2719073	BIGBEC	05/15/08	08/02/10	10/15/10	*	75	*
3D9.1BF27192C5	BIGBEC	05/02/08	07/30/10	*	*	*	*
3D9.1BF2719A98	BIGBEC	05/18/08	08/10/10	09/22/10	*	44	*
3D9.1BF271A8F9	BIGBEC	05/21/08	07/05/10	07/30/10	*	26	*
3D9.1C2C876271	BIGBEC	11/14/08	08/07/10	*	*	*	*
3D9.1C2C8EC678	BIGBEC	05/31/08	07/30/10	09/16/10	01/31/11	49	138
3D9.1C2C9DFCE6	POTREF	11/12/08	07/30/10	03/28/11	*	242	*
3D9.1C2C9DFE78	BIGBEC	11/14/08	08/31/10	10/23/10	03/07/11	54	136
3D9.1C2C9E0DF3	BIGBEC	05/30/08	08/23/10	09/06/10	*	15	*
3D9.1C2C9E1969	PINE2C	06/24/08	07/15/10	09/14/10	*	62	*
3D9.1C2C9E3E4D	POTREF	06/16/08	08/05/10	*	*	*	*
3D9.1C2C9E422E	BIGBEC	05/27/08	08/06/10	09/04/10	03/27/11	30	205
3D9.1C2C9E68E6	BIGBEC	05/23/08	07/23/10	*	*	*	*
3D9.1C2CA39F32	BIGBEC	05/27/08	08/04/10	08/13/10	*	10	*
3D9.1C2CF708C7	POTREF	04/29/09	07/27/10	*	*	*	*
3D9.1C2CF710FC	BIGBEC	04/22/09	07/11/10	09/10/10	*	62	*
3D9.1C2CF73CA2	POTREF	07/22/08	07/22/10	09/02/10	*	43	*
3D9.1C2D281390	BIGBEC	05/12/09	08/25/10	09/18/10	*	25	*
3D9.1C2D58216E	LBEARC	03/24/10	08/29/10	09/18/10	*	21	*
					Mean Travel Days	**55.4**	**147.3**

Appendix C. Detection efficiency estimates for all steelhead life stage groupings at instream arrays within the Potlatch River, Idaho, during the spring of 2011. Standard error is represented in parenthesis. The Mainstem Potlatch River array (JUL) is not included because of antenna failures during a high flow event on January 14 - 17, 2011.

	Life Stage		
Array Site	Juveniles	Kelts	Adults
HLM	0.78 (0.032)	0.82 (0.105)	N/A
KHS	0.63 (0.042)	0.94 (0.040)	0.79 (0.145)

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