IDAHO NATIVE SALMONID RESEARCH AND MONITORING REPORT

2011 Progress Report

Idaho Tributary Habitat Acquisition and Enhancement Program

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ABSTRACT

The Idaho Tributary Habitat Acquisition and Fishery Enhancement Program, Appendix A of the Clark Fork Settlement Agreement, supports ongoing research and monitoring activities in tributary streams surrounding Lake Pend Oreille, Idaho. Since 2009, 14 Idaho tributaries have been surveyed using a systematic sample design that surveys broadly within focus steams allowing for interpretation of system changes on a tributary scale. Electrofishing depletion survey techniques were used to estimate abundance of salmonids in surveyed tributaries. In addition, bull trout adult spawner abundance has been monitored through tributary redd counts since 1983 in six index streams and periodically in up to fourteen other Lake Pend Oreille tributaries. Results of recent abundance monitoring surveys were compared to previous estimates of abundance and distribution to provide an understanding of the current condition and relative recent changes in tributary fish populations. In 2011, we surveyed 14 sections among three sampled tributaries between July 20 and August 23, 2011. Surveyed tributaries included Caribou, Morris, and Trestle creeks. Bull trout and westslope cutthroat trout were observed in all three tributaries in good abundance. This is the first known documentation of bull trout abundance and distribution in Caribou Creek. Rainbow trout and or rainbow x cutthroat trout hybrids were observed in all three streams in lesser abundance. Brook trout were observed in Caribou Creek only and mountain whitefish were observed in Trestle Creek only, both in low abundance. Mean length at age two for westslope cutthroat trout sampled between 2009 and 2011 ranged from 83 mm to 145 mm. Mean length at age two for rainbow trout sampled between 2009 and 2011 was greater ranging from 134 mm to 152 mm. Observed age frequency patterns in recent surveys suggested westslope cutthroat trout likely exhibit a mix of migratory and resident life histories, but rainbow trout primarily utilize a migratory life history strategy. Species distribution within individual tributary streams appeared to be influenced by a combination of physical barriers, present species combinations, and potentially by habitat quality. Fish stocking around the Pend Oreille basin since the early 1900's was believed to play a large role in defining the present species combinations. Comparison of density estimates between 1986-1987 and 2009-2011 demonstrated relatively consistent changes in abundance between survey periods for bull and westslope cutthroat trout. Bull trout and westslope cutthroat trout densities increased between survey periods. In contrast, brook trout demonstrated declines in abundance in two of the three streams in which they were well represented in both surveys. Rainbow trout densities shifts were not as consistent as other species, demonstrating a range of variation. In 2011, a total of 815 bull trout redds were counted among all surveyed streams. Index streams accounted for 474 of the total redds observed. Counts were at or below the previous ten year averages for total and index counts of 817 and 558 respectively, but represented an increase from the previous year's totals.

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INTRODUCTION

The Idaho Tributary Habitat Acquisition and Fishery Enhancement Program, Appendix A of the Clark Fork Settlement Agreement (CFSA), supports ongoing research and monitoring activities in Idaho tributary streams. The purpose of these activities is for the evaluation of effects associated with ongoing efforts in aquatic habitat protection and enhancement for Idaho's native fishes. Research and monitoring activities have largely focused on monitoring abundance and distribution of salmonids in Idaho tributaries to Lake Pend Oreille (LPO) through completion of electrofishing surveys and bull trout redd counts.

Idaho research and monitoring efforts since implementation of the CFSA have focused on evaluation of key bull trout *Salvelinus confluentus* and westslope cutthroat trout *Oncorhynchus clarkii lewisi* tributaries within the project area. Prior to 2009, juvenile salmonid abundance and distribution monitoring efforts consisted of non-random surveys at key sites directly associated with specific locations of interest or stream habitat enhancement projects. Since 2009 a systematic sample design has been employed that surveys broadly within multiple focus steams allowing for interpretation of system changes on a larger tributary scale. Fourteen tributaries have been surveyed since 2009 including; Caribou, Granite, Grouse, North Fork Grouse, North Gold, South Gold, West Gold, Johnson, Morris, Rapid Lightning, Strong, Trestle, and Twin creeks. Bull trout adult spawner abundance has been monitored through tributary redd counts since 1983 in six index streams and periodically in up to fourteen other LPO tributaries.

The intent of this report is to provide an update on tributary abundance surveys completed in 2011. This report is also intended to provide a comprehensive summary of tributary abundance surveys completed between 2009 and 2011 as well as bull trout redd counts trends since 1983 and within the previous ten years. Tributary abundance survey results were used to provide a historic perspective on changes in fish abundance and distribution. Results were also used to describe characteristics observed in contemporary populations.

Idaho Tributary Salmonid Abundance Monitoring

METHODS

We conducted monitoring of LPO tributaries in an effort to follow general trends in fish abundance, species composition, and distribution on a stream scale. In addition, this information in combination with information gathered from other tributaries within the project boundaries of the CFSA will enable broad scale evaluation of the effects associated with efforts in aquatic habitat protection and restoration accomplished by CFSA activities.

Abundance Monitoring

Survey sites were established on systematic intervals from the mouth of each stream through the upper reaches. We approximated measured stream distances in kilometers using Garmin Base Camp mapping software (Garmin Ltd. 2009). Our upstream most survey site was chosen as the sample section where water was no longer found, fish were no longer sampled, or where consistent sampling results relative to species composition and or abundance suggested further surveys would provide low expected variation among additional sample sites (Table 1). We did not replicate surveys at locations from any previous effort. However, results from 2011 sample efforts were intended to allow comparison with data collected in the 1980's.

We collected fish using a Smith-Root backpack electrofishing unit and pulsed DC settings, typically at 50Hz, 2ms, and 800 to 900 volts. Fish were identified, measured (total length; mm) and weighed (g). A subsample of westslope cutthroat trout, rainbow trout *O. mykiss* and cutthroat x rainbow trout hybrids were collected for otolith extraction and subsequent age estimation. Sacrificed fish were also evaluated for sex and maturity by observing gonad development in the lab.

To estimate abundance of tributary fish populations we used multi-pass removals (Zippin 1958) in combination with single pass samples in the Trestle Creek, Morris Creek and Caribou Creek drainages in 2011. Abundance estimates only included fish $\geq$75mm (total length; TL), due to sampling efficiency considerations. Sample sections were typically 100 m in length. We closed sample sections using block nets at the downstream end of each survey section to prevent escapement during downstream electrofishing passes. On multi-pass samples we completed sequential passes until captures of an individual pass were no more than 20% of the total capture by species of the first pass. Typically, two to three passes were completed. We derived abundance estimates and associated 95% confidence intervals for two and three pass samples using calculations for removal estimates in closed populations (Hayes et. al 2007). We reported the total catch on the first pass as the population estimate when all the individuals of a particular species were captured on the first pass. In cases where lower confidence bounds were less than the total number of fish captured, the total number of fish captured was reported as the lower bound. We reported density estimates as the number per 100 m^2. We also used sampled fishes to describe population characteristics within sampled streams including age, size structure, and species composition.

We sampled fish using multi-pass removal in combination with single pass removal samples in each drainage. Single pass sampling was used to increase the number of possible sample sites visited in a season, as each single pass required less time than a multi-pass sample. We estimated abundances from single pass samples by generating a multi-pass regression model of abundance based on first pass collections (Meyer and Schill 1999). The multi-pass regression model was generated from data collected from 12 streams sampled in 2009 and 2010 (Ryan and Jakubowski 2011a, Ryan and Jakubowski 2011b) and supplemented with multi-pass samples completed in 2011. A single model of abundance based on first pass collections was developed and included sample data from all tributaries and all target species. Capture efficiencies were consistent among all tributaries, species, and years providing support that model predictions were valid across these boundaries.

Age and Growth

Age distributions of fish sampled in tributary surveys were used to roughly examine the presence of resident and or migratory fish in each tributary. Estimates of age at outmigration from rearing tributaries by migratory westslope cutthroat and rainbow trout have been estimated at a range of ages from 1 to 4 in LPO and similar systems (Pratt 1984, Rieman and Apperson 1989). Therefore, a strong presence of fish four years of age or older remaining in the tributary environment may indicate the presence of resident fish. To estimate ages, we collected otoliths from a subsample of Oncorhynchus species in each sampled tributary between 2009 and 2011 (Ryan and Jakubowski 2011a, Ryan and Jakubowski 2011b, current report). Otoliths were mounted in epoxy resin, sectioned on the transverse plane, sanded to enhance viewing, and viewed on a dissecting microscope to determine age estimates. All otoliths were viewed by a single reader with a subset viewed and confirmed by a second reader. Resulting mean length at age estimates were used to generate growth parameters of the Von Bertalanffy growth function. Growth function parameters were estimated using FAST software (Fisheries Analyses and Simulation Tools, Auburn University). The resulting growth function was used to predict age by length for all sampled westslope cutthroat trout and rainbow trout. Growth functions were estimated for each stream in which sufficient target species were collected and were applied within each stream. In cases where insufficient collections were made to accurately estimate function parameters, a growth function estimated from all sampled tributaries was utilized.

Historical Comparisons

Understanding the current condition of fish populations in LPO and Lower Clark Fork River tributaries and their significance is difficult without some perspective on the historical condition of fish abundance and distribution. Although surveys of fish populations within the focus drainages have been completed in the past, no standardized sampling protocol was previously established. To provide historical perspective we compared the findings of our recent survey efforts with prior surveys and stocking histories as a qualitative evaluation of change in abundance and distribution relative to contemporary conditions.

To evaluate possible trends in distribution and relative abundance of fishes in tributaries sampled between 2009 and 2011, we compared contemporary density estimates with reported results from the same waters sampled in 1986-1987 (Hoelscher and Bjornn 1989). We used mean density by tributary as our comparative measure. Compared sampling efforts differed by collection method (snorkeling in the 1986-1987 survey and electrofishing depletion estimation in the contemporary survey) and location. However, relative sampling frequency within a given stream was similar. Because snorkeling efforts and electrofishing efforts are known to differ quantitatively (Thurow and Schill 1996), this comparison was considered qualitative in nature and was used to observe relative large shifts in abundance between the two sample periods. Not all streams were surveyed in both time periods. As such, data were only available for comparison from Grouse, N. F. Grouse, Rapid Lightning, Granite, Johnson, Twin, and Trestle creeks.

We also evaluated trends in fish distribution by comparing contemporary findings with observations from the same waters sampled in 1983 (Pratt 1984). Although fish density estimates were incorporated in these prior survey efforts, sampling was not widespread in all drainages making relative density comparisons questionable. Compared sampling efforts also differed by collection method (snorkeling in the 1983 survey and electrofishing depletion estimation in the contemporary survey) and location.

Fish stocking has likely influenced fish distribution in LPO tributaries. To examine the influence stocking and species introductions have had on present day fish communities in LPO tributaries, we examined stocking records and compared them to observed fish distributions from contemporary surveys. Stocking histories were acquired from IDFG stocking records (IDFG unpublished data). Two collections of stocking records were examined for this evaluation and included records from 1967 to the present and records prior to 1967 and including stocking events into the early 1900's. Pre-1967 records, although useful, were considered to be less reliable as location and species labels were not consistent during this time period. Therefore, stocking record evaluation was used only for generally describing past activities that may have influenced species composition observed in contemporary investigations.

RESULTS

Abundance Monitoring

We surveyed 14 sections among all sampled tributaries between July 20 and August 23, 2011. Water was present and an electrofishing survey was completed at all sections visited (Table 1). Fish were detected at 13 of the 14 sections.

In Caribou Creek, we sampled five sections over approximately 9 kilometers of stream within the drainage (Figure A-1). Survey sections were located approximately every two kilometers. The uppermost survey section (section 9) did not represent the upper limit of fish distribution, but appeared to be representative of habitat type and fish community assemblage. We sampled a total of three sections in Morris Creek over approximately 3 kilometers (Figure A-2). Survey sections were located approximately every kilometer. No fish were detected in section 3 supporting the assumption section 2 represented the approximate uppermost distribution of fish. In addition, six sections were surveyed over approximately 12 kilometers in Trestle Creek (Figure A-3). The uppermost survey section did not represent the upper limit of fish distribution in Trestle Creek. Survey sections were also spaced approximately every 2 kilometers in Trestle Creek.

We developed a single regression model to estimate abundance based on first pass collections (Figure 1). Capture efficiencies in multi-pass samples were consistent (0.81 ± 0.05, 95% confidence intervals) among tributaries and species, providing support that our model predictions were valid across these boundaries. Based on the developed linear model, our first pass collections described approximately 98% of the variation in estimated abundance from multi-pass samples.

Caribou Creek

We collected five fish species and one hybrid cross among all survey sites on Caribou Creek in 2011(Table 2) including bull trout, brook trout *Salvelinus fontinalis*, rainbow trout, sculpin species *Cottus spp*., westslope cutthroat trout, and rainbow x westslope cutthroat trout hybrids. Westslope cutthroat trout were the most abundant species found throughout Caribou Creek averaging 6 fish/100 m^2 (Table 3) and ranging from < 1 to 12 fish/100 m^2 (Table 2). Bull trout densities across survey sites ranged from 0 to 7 fish/100 m^2 (Table 2) and averaged approximately 3fish/100 m^2among all survey sections (Table 3). Bull trout were detected in all survey sections except section 9. We found only westslope cutthroat trout in section 9, suggesting fish passage for bull trout may be limited downstream of this location. Rainbow trout were less abundant with an average density of 1.2 fish/100 m^2 (Table 3) and were only found in sections 1 and 3. Brook trout and rainbow x westslope cutthroat trout hybrids were also detected in low abundance averaging less than 1fish/100 m^2 (Table 3). Both occurred primarily in the lower drainage, with brook trout found only in section 1 and rainbow x westslope cutthroat trout hybrids found in sections 1, 3, and 5. We noted the presence of sculpin only in section 1. No estimate of sculpin abundance was made. No specific survey of barrier locations was conducted and no barriers were documented.

Morris Creek

We collected two fish species and one hybrid cross among all survey sites on Morris Creek in 2011 (Table 2). Fish species collected included bull and westslope cutthroat trout and rainbow x westslope cutthroat trout hybrids. Westslope cutthroat trout were the most abundant species found in Morris Creek averaging 7 fish/100 m^2 (Table 3) and ranging in density from 1 to 13 fish/100 m^2 (Table 2). Bull trout were also abundant with an average density of 5.8 fish/100 m^2 and ranging in density from < 1 to 11 fish/100 m^2 (Table 2 and 3). We found rainbow x westslope cutthroat trout hybrids only in section 2 at a density of 1.8 fish/100 m^2. No fish were found in section 3. Although this section had water in 2011, the absence of fish suggested perennial flow may not occur in all years in this reach or passage is not available above section 2. No specific survey of barrier locations was conducted and no barriers were documented.

Trestle Creek

We collected four fish species and one hybrid cross among all survey sites on Trestle Creek in 2011 (Table 2). Fish species collected included bull trout, mountain whitefish *Prosopium williamsoni*, rainbow trout, westslope cutthroat trout, and rainbow x westslope cutthroat trout hybrids. Westslope cutthroat trout were the most abundant and widely distributed species found throughout Trestle Creek, averaging over 4 fish/100 m^2 (Table 3) among all sites and ranging from 2 to 14 fish/100 m^2(Table 2). We found bull trout were less abundant, but well distributed, with densities ranging from 0 to 6 fish/100 m^2 (Table 2), and occurring at all survey sections except 4 and 12 (uppermost section). Average bull trout density was approximately 2 fish/100 m^2 (Table 3). Rainbow trout were scarce in our samples, being found only in the lower drainage in survey section 2 at an estimated density of < 1 fish/100 m^2 (Table 2). Rainbow x westslope cutthroat trout hybrids were more widely distributed, being found at all sections except 12 and ranging in density where found from <1.0 and 2 fish/100 m^2. Mountain whitefish were only detected at survey section 2 with an estimated density of < 1 fish/100 m^2 (Table 2). Based on the distribution of fish species it is possible a fish passage barrier exists upstream of survey section 10. No specific survey of barrier locations was conducted and no barriers were documented.

Distribution and Barriers

Linear distributions of fish species within individual streams described in recent surveys (Ryan and Jakubowski 2011a, Ryan and Jakubowski 2011b) varied and appeared to be influenced by two main factors including fish passage barriers and species present (Figures B-1, B-2, B-3, B-4, and B-5). In streams where known passage barriers were present such as Twin, Johnson , and Rapid Lightning creeks, we observed westslope cutthroat trout dominated above these barriers. In streams where a mix of species were well represented including native and non-native fish such as in Caribou and Grouse creeks, we observed non-native fish (e.g. rainbow trout) largely dominated the lower reaches as in Caribou Creek, or as in Grouse Creek, the majority of the stream, with native fish occupying the upper most reaches. In contrast, streams where native fish made up the majority of all species observed, native fish were well distributed throughout.

Age and Growth

Estimated mean length at age was variable among tributaries and species (Table 4). Westslope cutthroat trout mean length at age two ranged from 83 mm to 145 mm. Rainbow trout grew more rapidly with mean length at age two ranging from 134 mm to 152 mm. The slowest growth in westslope cutthroat trout was observed in tributaries with high density cutthroat populations isolated above passage barriers such as Gold and Rapid Lightning creeks. However, this pattern was not consistent among all tributaries. Caribou Creek, believed to be largely an open system, demonstrated a relatively slow growth pattern with westslope cutthroat trout reaching an average of 102 mm at age two. In contrast rainbow trout from the same stream grew more rapidly reaching 134 mm by age two. The fastest growth rate for rainbow trout was observed in Grouse Creek.

A range of age frequencies were observed in sampled westslope cutthroat trout and rainbow trout among streams surveyed during monitoring efforts. A full composition of age classes from one to eight were identified in cutthroat trout samples (Figure 2). All streams sampled except Trestle and Grouse creeks included sampled cutthroat trout estimated to be seven to eight years of age. Age one cutthroat trout were sampled at the highest frequency in most streams and represented up to approximately 60% (range 14% to 61%) of sampled fish. In contrast, rainbow trout were represented by fewer age classes with an estimated average maximum age of five for streams where rainbow trout were well represented (Figure 2). In those same streams age one fish represented 66% to 89% of the sampled fish with subsequent age classes being represented at significantly lower rates. In two streams, Trestle and Strong creeks, only a single age class of rainbow trout was observed. In both locations surveys detected rainbow trout in only very limited abundance. Strong and Johnson creeks demonstrated frequency patterns in cutthroat trout contrary to other cutthroat trout populations, but similar to those observed in rainbow trout. In these streams, significant reductions in the frequency of sampled fish of two or three plus years of age occurred.

Historical Comparisons

Fish stocking around the Pend Oreille basin since the early 1900's played a large role in shaping the composition of species in tributary streams observed in recent tributary monitoring. Brook, bull, cutthroat, and rainbow trout were all commonly stocked around the drainage over the last century (Table 5; IDFG stocking records, unpublished data). Of those streams surveyed between 2009 and 2011, all but one was reported to have been stocked with rainbow trout of unspecified origin at some time since the early 1900's. Kamloops strain rainbow trout were stocked widely although less so than generic hatchery rainbow trout. No record of Kamloops rainbow stocking was found for Gold, Caribou, Morris, Strong, or Twin creeks. Brook trout and cutthroat trout were also stocked widely including all surveyed streams except Morris Creek. Brook Trout stocking largely occurred prior to the 1960's throughout the basin. More cutthroat trout were stocked in tributaries than any other species. The origin of stocked cutthroat trout was unclear in most cases, but likely was westslope cutthroat trout. However, records of stocking some non-native strains of cutthroat including Bear Lake and Henry's Lake fish (Bonneville and Yellowstone cutthroat trout) were noted. Native bull trout were also stocked in several of the listed tributaries although stocking events were less frequent than other species.

Species observations made in 1983 were not consistent with subsequent survey years for all species and streams (Table 6). Rainbow trout were observed widely in 1983, but were not present in recent surveys of Granite, South Gold, Johnson, or Morris creeks. The shift in rainbow trout abundance observed in Granite, Johnson, and Morris creeks represents a considerable reduction in abundance. Although, Pratt (1984) indicated rainbow trout were observed in South Gold Creek none were detected in 2009. In contrast to rainbow trout, bull trout were not observed in 1983 surveys of Caribou, Morris, or West Gold creeks, but were present in more contemporary surveys. Observations of westslope cutthroat trout and brook trout were largely consistent between surveys with the exception of brook trout present in Caribou Creek in 2011, but not observed in 1984.

Comparison of abundance estimates between 1986-1987 and 2009-2011 demonstrated relatively consistent pattern within species between surveys (Figure 3). Increased bull trout density was detected in four of the seven comparable streams. Of the three streams in which an increase was not observed, bull trout were either not detected in either survey or bull trout were poorly represented in the recent survey period. Increases in abundance were greater than 40% (up to 1700%) of early estimates in all streams where bull trout were observed. Increased density of 40% or greater was also detected for westslope cutthroat trout among all comparable tributaries. In contrast, brook trout demonstrated declines in abundance in two of the three streams in which they were well documented in both surveys. Estimated mean density was nearly equal in Rapid Lightning Creek. In Grouse Creek, brook trout were detected in measurable abundance (0.4 fish/100 m^2) in recent survey efforts, but had only previously been identified in very low abundance (>0.1 fish/100 m^2). Rainbow trout densities as compared between survey periods were not as consistent as other species, demonstrating notable increases in two tributaries (Grouse and Twin creeks), relatively stable abundance in two tributaries (N.F. Grouse and Rapid Lightning creeks), and potentially reduced abundance in one tributary (Trestle Creek). No rainbow trout were detected in Granite or Johnson creeks despite historical stocking introductions in both streams.

DISCUSSION

Abundance Monitoring

Westslope cutthroat trout were the dominant species observed in all three surveyed streams. Surveyed cutthroat densities in 2011 were relatively consistent with densities observed in many of the tributaries surveyed in 2009 and 2010. Densities in all surveyed streams were considered to represent strong populations. Rieman and Apperson (1989), suggested densities of 1 to 10 fish/100 m^2 in streams including cutthroat trout two years of age and older were strong populations. All streams sampled from 2009 to 2011 exceed average densities of at least 3 fish/100 m^2.

Our observations of bull trout in the Caribou Creek drainage represented potentially the first quantification of this species in this tributary. Presence was documented in unpublished U.S. Forest Service data (Personal Communication, Kevin Davis, U.S. Forest Service), but neither abundance nor distribution was quantified. No other record of bull trout use of this tributary was found. Our findings indicated bull trout were well distributed and abundant relative to other species and tributaries.

Juvenile bull trout were less abundant in 2011 surveys of Trestle Creek than anticipated. Annual bull trout redd monitoring efforts in Trestle Creek have identified an average of 250 redds between 2001 and 2010. Despite consistently producing the highest redd count the estimated mean density was low relative to other streams where bull trout are well represented. Potential explanations for this divergence from other streams may include earlier juvenile emigration to LPO, high rates of straying to Trestle Creek by spawning adults from other tributaries, or higher than average rates of juvenile to adult survival in LPO. However, bull trout age at emigration has was estimated by Downs et al 2006 and failed to detect adult return of age 0+ juvenile out-migrants suggesting juvenile emigration is not earlier in Trestle Creek than other LPO tributaries. In addition, DeHann et al. 2011 found low within stock genetic variation of Trestle Creek bull trout suggesting significant genetic contributions to Trestle Creek through straying of out-stock adults is low. The combination of existing information might suggest survival rates are a primary contributor to higher than average adult spawner recruitment. However, the mechanism that might create that type of variance is unclear. Other direct lake tributaries with greater instream juvenile density (Granite Creek) and similar available habitat quantity do not demonstrate similar rates of adult spawner recruitment.

The influences of rainbow trout introductions were evident in all three surveyed streams in 2011, despite rainbow trout being relatively abundant only in Caribou Creek. Phenotypically identified rainbow x cutthroat trout hybrids were present in all three streams at abundance levels greater than previously observed in recent surveys of other streams (Table 3). All three streams were historically stocked in at least one past event with rainbow trout of unknown origin. Kamloops rainbow trout were stocked directly only into Trestle Creek. The mechanism contributing to these variations in observed rates of hybridization are unknown and the true rate of hybridization may not accurately be reflected in phenotypic identification alone. Genotypic evaluation may provide additional quantification of actual hybridization rates that allow better understanding of the current condition and how it may impact native cutthroat trout. A better understanding of rainbow trout genetic origins or strains observed in tributary streams may also be of value in managing for a desired trophy rainbow trout fishery in LPO (IDFG 2007). Kamloops strain rainbow trout are believed to be one of the key factors in providing a trophy size rainbow trout in LPO (IDFG 2007). As such, dilution of genetic integrity of this strain through the influence of other rainbow trout strains (i.e. coastal) has the potential to reduce fishery quality. Alternatively, management for pure Kamloops strain rainbow trout in key tributaries may allow for enhancement of the fishery.

Age and Growth

Estimated mean length at age for both westslope cutthroat and rainbow trout from this study differed from previously reported LPO values by Pratt (1984,LPO cutthroat and rainbow trout) and Goodnight et al. (1978, LPO rainbow trout). Estimated length at age for cutthroat trout was more similar to that reported by Lukens (1978) in Wolf Lodge Creek, a tributary to Coeur d'Alene Lake, Idaho. Our estimates suggested both cutthroat and rainbow trout grew more slowly past age one than previously estimated. However, our estimates may have differed due to the location of fish capture and method of estimation. Both previous investigators utilized fish captured from LPO and estimated ages from scales using back calculations. Fish growth once fish enter LPO is believed to be considerably faster than growth in tributaries. In contrast, our investigation used fish capture in tributary streams and otoliths extracted from individuals without back calculation.

Age frequency patterns of sampled westslope cutthroat trout did not appear to definitively identify a migratory life history type in most tributaries, suggesting multiple life history types (resident and migratory) may occur in most LPO tributary streams. Pratt (1984) found that migratory cutthroat trout utilizing LPO left natal tributary streams primarily at one to two years of age, suggesting a distinct reduction of cutthroat abundance in early age classes should be present if tributaries supported exclusively migratory fish. This type of pattern was not clearly observed. Although reductions in age frequencies between ages one and two did occur, the level of change was not interpreted to be significant beyond that expected from natural mortality patterns in most streams. Our observations were contrary to Apperson et al. (1988), who suggested adfluvial stocks of westslope cutthroat trout were likely to dominate direct lake tributaries such as those in our surveys. Not consistent with our general observations were Strong and Johnson creeks, which did demonstrate distinct declines in age frequencies between ages one and two. Both of these streams are or were historically blocked to fish passage low in the drainage and have limited fish distribution above. Rieman and Apperson (1989) indicated adfluvial westslope cutthroat trout emigrate from rearing tributaries between two and four years of age, suggesting observed age frequency patterns may not necessarily be distinct but rather gradual and age frequency patterns may be difficult to discern as in our observed age frequencies. Maintenance of migratory cutthroat trout in this system is a priority and development of an alternate method of identifying contributing populations may be beneficial in focusing management activities.

Age frequency patterns of sampled rainbow trout were consistent with our expectation of migratory populations in surveyed streams where rainbow trout were well represented. The frequency of age two fish was significantly reduced following the age one year class, suggesting rainbow trout mortality was exceptionally high or fish migrated from these systems to LPO at age two. Pratt (1984) and Goodnight et al. (1978) both suggested rainbow trout found in Lake Pend Oreille leave natal tributaries at the highest proportion during their second year based on back calculated growth rates of lake caught fish. Their findings provided evidence our observed age frequency patterns are consistent with emigration rather than elevated rates of mortality. Given the consistency in our observed rainbow trout age frequencies among tributaries, our results supported the concept that the majority of rainbow trout in Idaho tributaries to LPO display a migratory life history.

Historical Comparisons

Past stocking efforts were reflected in recent surveys of many of the LPO tributaries. Rainbow and brook trout demonstrated perhaps the most detectable species retained from past stocking events. Although cutthroat and bull trout were stocked throughout the basin, differentiating the influence of stocking events from native recruits is unlikely. Rainbow trout were well represented in several tributaries sampled between 2009 and 2011 including Caribou, Grouse, N.F. Grouse, Rapid Lightning, and Twin creeks. Brook trout were also well represented in these same tributaries. Despite the persistence of introduced species in some drainages, surveys in others did not reflect past stocking events. Rainbow trout were heavily stocked in Granite, Johnson, and Trestle creeks, but recent surveys indicated current abundance is low or undetected. Similarly, brook trout, once stocked widely, now are more limited in distribution. No contemporary tributary survey identified any species that were not potentially attributable to some past introduction event, suggesting non-native expansion has been minimal and confined within drainages of introduction.

Contemporary distribution patterns (Ryan and Jakubowski 2011a, Ryan and Jakubowski 2011b) of species within individual LPO tributaries remained relatively consistent with observed patterns from the 1980’s. Pratt (1984, 1985) and Hoelscher and Bjornn (1989), noted a consistent distribution within tributaries where cutthroat and bull trout occupied upper reaches of tributaries and rainbow trout utilized the lower and mid reaches. In tributaries such as Grouse Creek, where a full complement of species were sampled in recent surveys, this same distribution was found. However, in recent surveys of tributaries where cutthroat trout and bull trout were the primary species and passage barriers were not a factor, such as Granite Creek, the distribution of these species was widespread occupying the entire drainage. This variance in distribution may suggest introduced species such as rainbow trout suppress native fish where available habitat is suitable for either species and that reductions in non-native fish abundance may benefit native fish. However, in some locations, such as lower Grouse Creek, habitat conditions may also be unsuitable for cutthroat or bull trout and distribution may be a function of habitat suitability. Grouse Creek is 303d listed by the EPA and has subsequently developed TMDL’s for limiting the factor of thermal loading (Idaho Department of Environmental Quality, http://www.deq.idaho.gov). Efforts are ongoing to improve habitat conditions in this tributary. Monitoring of stream conditions such as temperature is recommended to improve the understanding of how suitable habitat influences species distributions.

Our observations of abundance over approximately the last two decades suggested native fish have benefited from improving basin conditions. Qualitative comparisons of abundance demonstrated consistent increases in abundance beyond those differences expected due to differing quantification techniques. These changes have occurred largely in the absence of hatchery influences, suggesting changes in other factors such as habitat quantity, habitat quality, or angling pressure may be most influential.

RECOMMENDATIONS

- Maintain consistent monitoring protocol that evaluate both abundance and distribution and allow for quantifiable comparisons
- Identify alternative methods for describing origins of migratory westslope cutthroat trout utilizing LPO
- Investigate opportunities to reduce non-native fish where native fish are prioritized
- Investigate other Upper Pack River tributaries where little is known to better understand the current distribution and abundance of fishes
- Investigate hybridization rates in westslope cutthroat trout in LPO tributaries
- Investigate existing origins of rainbow trout in LPO tributaries
- Develop tributary habitat monitoring tools (e.g. stream temperature monitoring networks) to better understand how habitat conditions effect species distributions and how habitat improvement efforts may impact these distributions.

Table 1. Locations (UTM) of survey sections sampled during 2011 Lake Pend Oreille tributary abundance monitoring efforts. Waypoints represent the approximate lowermost points of each survey section. Section length and mean wetted width at the time of sampling are listed for each survey section.

Stream	Section (km)	Date	Datum	Zone	E	N	Section Dist(m)	Avg Width(m)
Caribou Creek	1	7/27/11	WGS84	11 U	532247	5368773	100	6.3
Caribou Creek	3	8/10/11	WGS84	11 U	530642	5368553	107	7.1
Caribou Creek	5	8/10/11	WGS84	11 U	528623	5367868	110	4.9
Caribou Creek	7	7/21/11	WGS84	11 U	526926	5367258	80	7.3
Caribou Creek	9	7/27/11	WGS84	11 U	525384	5366188	100	5.1
Morris Creek	1	7/20/11	WGS84	11 U	566267	5341041	100	6.4
Morris Creek	2	8/23/11	WGS84	11 U	566926	5340459	100	3.5
Morris Creek	3	8/9/11	WGS84	11 U	567791	5340213	100	NA
Trestle Creek	2	8/11/11	WGS84	11 U	549529	5348648	95	7.0
Trestle Creek	4	7/28/11	WGS84	11 U	551324	5349570	100	7.3
Trestle Creek	6	7/29/11	WGS84	11 U	553107	5350125	100	8.0
Trestle Creek	8	8/4/11	WGS84	11 U	554812	5350824	100	5.2
Trestle Creek	10	8/5/11	WGS84	11 U	556121	5352189	100	4.2
Trestle Creek	12	8/8/11	WGS84	11 U	557047	5353811	100	3.2

Table 2. Tributary monitoring results by stream, sampled reach, and species in 2011. Section number corresponds approximately to stream km, measured upstream from the mouth. Total catch includes all lengths (mm), while only fish ≥ 75 mm were included in abundance estimates (EST N). In cases of non-declining catch, abundance estimates were minimum estimates defined as the total catch, and no confidence intervals were calculated.

Stream	Section	Species	Caught	Min TL	Max TL	Est. N	95% CI -	95% CI +	Density/100m^2
Caribou Creek	1	BLT	5	88	138	6.16	5	16	0.98
Caribou Creek	3	BLT	28	45	143	26.46	25	30	3.47
Caribou Creek	5	BLT	32	45	157	36.93	30	47	6.91
Caribou Creek	7	BLT	21	33	125	24.62	20	35	4.22
Caribou Creek	1	BRK	6	99	174	7.39	6	17	1.17
Caribou Creek	7	ONC	2	55	62	NA	---	---	---
Caribou Creek	9	ONC	4	44	55	NA	---	---	---
Caribou Creek	1	RBT	27	83	195	33.24	27	43	5.28
Caribou Creek	3	RBT	5	104	200	9.00	5	7	1.18
Caribou Creek	1	SCL	4	68	103	NA	---	---	---
Caribou Creek	1	WCT	3	72	142	2.46	2	12	0.39
Caribou Creek	3	WCT	15	73	185	14.08	14	14	1.84
Caribou Creek	5	WCT	21	79	234	25.85	21	36	4.83
Caribou Creek	7	WCT	57	82	188	70.17	60	80	12.02
Caribou Creek	9	WCT	48	73	179	57.86	48	68	11.37
Caribou Creek	1	WRHY	8	78	197	9.85	8	20	1.56
Caribou Creek	3	WRHY	12	91	180	12.50	12	12	1.64
Caribou Creek	5	WRHY	1	113	113	1.23	1	11	0.23
Morris Creek	1	BLT	2	88	148	2.46	2	12	0.39
Morris Creek	2	BLT	38	82	154	39.38	38	43	11.23
Morris Creek	1	WCT	7	111	159	8.62	7	19	1.35
Morris Creek	2	WCT	43	76	247	44.16	43	47	12.60
Morris Creek	2	WRHY	12	116	252	12.50	12	15	3.57
Trestle Creek	2	BLT	2	121	193	2.46	2	2	0.37
Trestle Creek	6	BLT	6	34	147	6.16	5	16	0.77

Table 2 Continued.

Stream	Section	Species	Caught	Min TL	Max TL	Est. N	95% CI -	95% CI +	Density/100m^2
Trestle Creek	8	BLT	19	65	162	20.93	17	31	4.01
Trestle Creek	10	BLT	21	74	171	24.62	20	35	5.81
Trestle Creek	2	MWF	5	174	189	6.16	5	5	0.93
Trestle Creek	4	ONC	1	68	68	NA	---	---	---
Trestle Creek	2	RBT	1	126	126	1.23	1	1	0.19
Trestle Creek	2	WCT	17	77	265	17.07	17	18	2.57
Trestle Creek	4	WCT	18	86	248	22.16	18	32	3.03
Trestle Creek	6	WCT	32	59	180	29.55	24	40	3.72
Trestle Creek	8	WCT	10	72	144	8.62	7	19	1.65
Trestle Creek	10	WCT	6	98	152	7.39	6	17	1.74
Trestle Creek	12	WCT	50	45	187	45.71	45	48	14.40
Trestle Creek	2	WRHY	14	75	178	14.08	14	15	2.12
Trestle Creek	4	WRHY	10	75	162	12.31	10	22	1.68
Trestle Creek	6	WRHY	9	77	220	11.08	9	21	1.39
Trestle Creek	8	WRHY	1	159	159	1.23	1	11	0.24
Trestle Creek	10	WRHY	1	120	120	1.23	1	11	0.29

BLT = bull trout
BRK = brook trout
BBH = black bullhead
BBHY = brook trout x bull trout hybrid
LNDC = longnose dace
LSS = largescale sucker
MWF = mountain whitefish
ONC = unidentified Oncorhynchus spp.
RBT = rainbow trout
RSS = redside shiner
SCL = unidentified sculpin spp.
WCT = westslope cutthroat trout
WRHY = westslope cutthroat trout x rainbow trout hybrid

Table 3. Mean estimated density of sampled salmonids between 2009 and 2011during Lake Pend Oreille tributary monitoring efforts. Density estimates represent only fish ≥ 75 mm.

	Species (average fish/100m^2)					
Stream	BLT	BRK	MWF	RBT	WCT	WRHY
Grouse Creek	3.5	0.4	0.6	8.2	3.6	0.3
N.F. Grouse Creek	0.0	4.1	0.0	5.0	5.9	0.3
Rapid Lightning Creek	>0.01	3.2	1.2	1.0	5.2	0.3
Gold Creek	4.4	0.0	0.0	0.0	23.6	0.0
Granite Creek	4.6	0.0	0.2	0.0	6.7	0.0
Johnson Creek	1.4	0.0	0.0	0.0	5.1	0.0
Strong Creek	>0.01	0.0	0.0	0.0	7.1	0.0
Twin Creek	0.0	2.7	0.0	2.0	3.8	0.0
West Gold Creek	0.1	0.0	0.0	0.0	43.7	0.0
Caribou Creek	3.1	0.3	0.0	1.2	6.1	0.7
Morris Creek	5.8	0.0	0.0	0.0	7.0	1.8
Trestle Creek	1.8	0.0	0.1	0.0	4.5	1.0

BBHY = brook trout x bull trout hybrid
BLT = bull trout
BRK = brook trout
MWF = mountain whitefish
RBT = rainbow trout
WCT = westslope cutthroat trout
WRHY = westslope cutthroat trout x rainbow trout hybrid

Table 4. Estimated mean length at age and number sampled (n) for westslope cutthroat trout (WCT) and rainbow trout (RBT) sampled in Lake Pend Oreille/Lower Clark Fork River, Idaho tributaries in 2009–2011 tributary monitoring surveys.

		Age							
Stream	Species	1	2	3	4	5	6	7	8
Gold Creek	WCT	75(1)	97(12)	132(13)	137(2)	190(1)	207(1)		
Granite Creek	WCT	97(24)	145(6)	158(16)	189(4)	201(3)	207(2)		
Johnson Creek	WCT	75(2)	124(19)	153(11)	154(2)				
Strong (Creek)	WCT	92(18)	128(12)	161(15)	191(4)	208(1)	202(1)		
Twin Creek	WCT		116(19)	146(13)	162(3)	176(1)			
W. Gold Creek	WCT	86(13)	113(14)	148(16)	163(7)	187(4)	213(2)		
Grouse Creek	WCT	86(7)	114(10)	153(4)	165(1)	198(3)	222(2)	226(1)	
N.F Grouse Creek	WCT	81(6)	105(20)	143(7)	139(8)	168(3)	176(1)	182(3)	192(1)
Rapid Lightning Creek	WCT	80(1)	83(12)	113(13)	139(18)	180(5)	180(3)		233(1)
Morris Creek	WCT	74(2)	119(11)	149(10)	176(7)				
Caribou Creek	WCT	79(2)	102(11)	131(16)	155(8)	167(3)			
Trestle Creek	WCT	84(11)	119(27)	150(5)	187(4)	255(1)			
All Streams	WCT	89(87)	113(173)	144(139)	158(68)	187(25)	201(12)	193(4)	213(2)
Strong Creek	RBT				174(1)				
Twin Creek	RBT	92(19)	152(5)						
Grouse Creek	RBT	108(12)	137(8)	177(6)	196(2)				
Caribou Creek	RBT	96(21)	134(7)	186(1)					
All Streams	RBT	97(52)	140(20)	178 (7)	189 (3)				

Table 5. Approximate historic quantities of fish stocked by species in Pend Oreille drainage tributaries monitored between 2009 and 2011.

Stream	Brook Trout	Bull Trout	Cutthroat Trout	Non-Native Cutthroat Trout	Kamloops Rainbow Trout	Other Rainbow Trout
Caribou Creek	12,700		253,214			157,000
Gold Creek	238,210		1,447,834			251,304
Granite Creek	635,748	428,252	5,066,458	172,000	2,107,947	1,551,997
Grouse Creek	291,657	335,335	1,385,076		486,765	1,059,378
Johnson Creek	686,515	51,590	366,905		2,876	659,800
Morris Creek						30,000
N.F. Grouse Creek	15,216		1,600		2,262	2,520
Rapid Lightning Creek	35,400	346,432	721,328		905,889	265,615
South Gold Creek	200,000	89,644	208,614	215,000		
Strong Creek	70,000		10,950			22,500
Trestle Creek	63,600		587,568		52,382	103,049

Table 6. Comparison of observed fish species in Lake Pend Oreille/Lower Clark Fork River, Idaho monitoring surveys in 1983 (Pratt 1984) and between 2009 and 2011 (09-11). Symbols (X) in darkened boxes indicate observed presence.

	Rainbow Trout		Cutthroat Trout		Bull Trout		Brook Trout	
Stream	1983	09-11	1983	09-11	1983	09-11	1983	09-11
Johnson Creek	X		X	X	X	X		
Morris Creek	X		X	X		X		
Twin Creek	X	X	X	X	X	X	X	X
Granite Creek	X		X	X	X	X		
South Gold Creek	X		X	X	X	X		
West Gold Creek			X	X		X		
Trestle Creek		X	X	X	X	X		
Rapid Lightning Creek	X	X	X	X	X	X	X	X
Grouse Creek	X	X	X	X	X	X	X	X
N.F. Grouse Creek	X	X	X	X			X	X
Caribou Creek	X	X	X	X		X		X

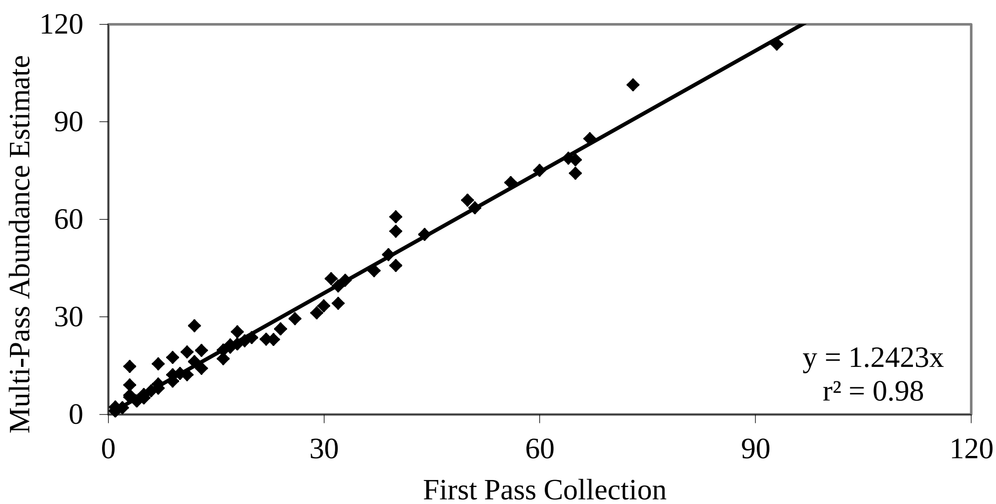
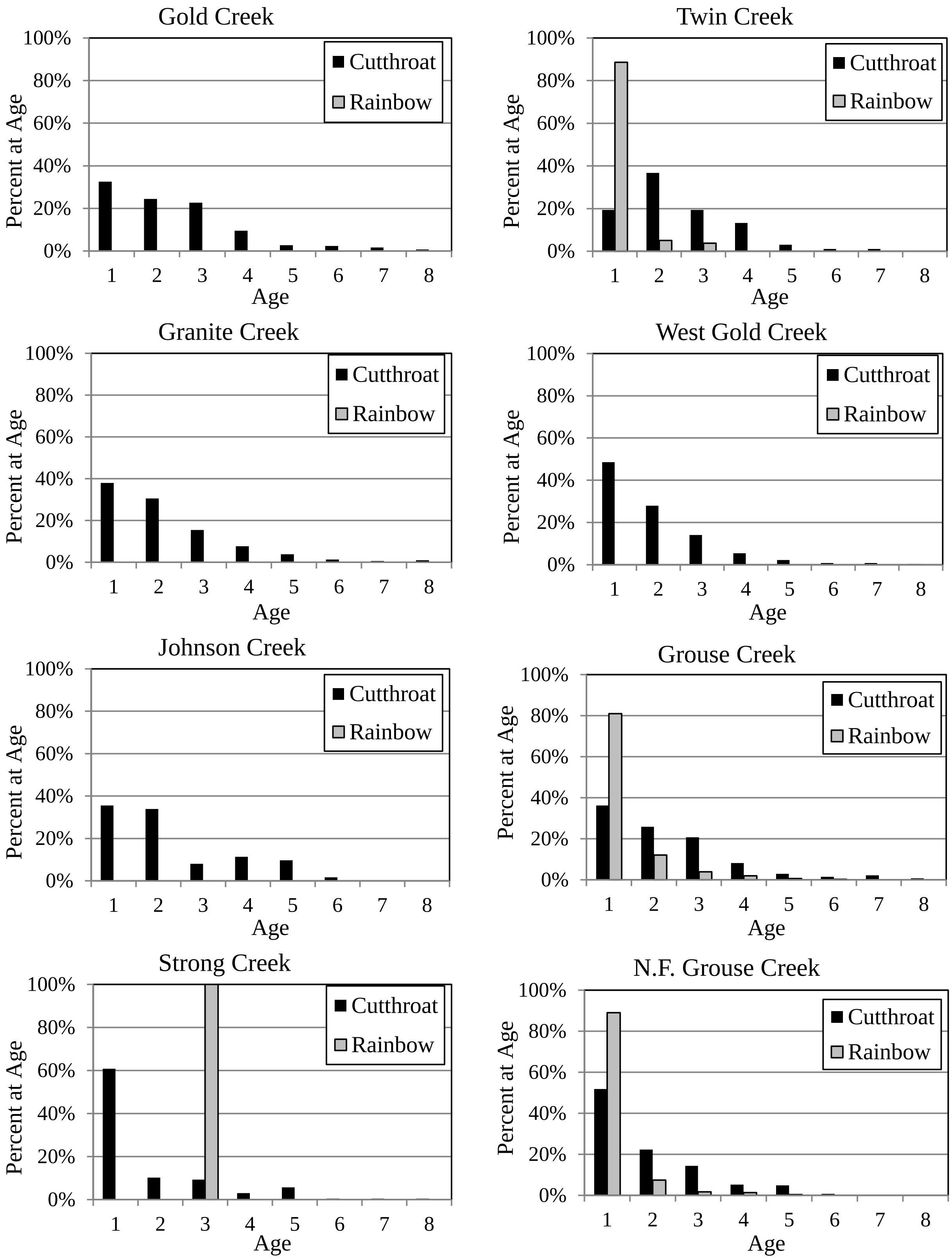


Figure 1. Regression model of estimated multi-pass abundance by first pass collections. Data represented 2009, 2010, and 2011 multi-pass removal efforts in Lake Pend Oreille tributaries.


Gold Creek
Twin Creek
Granite Creek
West Gold Creek
Johnson Creek
Grouse Creek
Strong Creek
N.F. Grouse Creek
Percent at Age
Age
Cutthroat
Rainbow
0%
20%
40%
60%
80%
100%
1
2
3
4
5
6
7
8

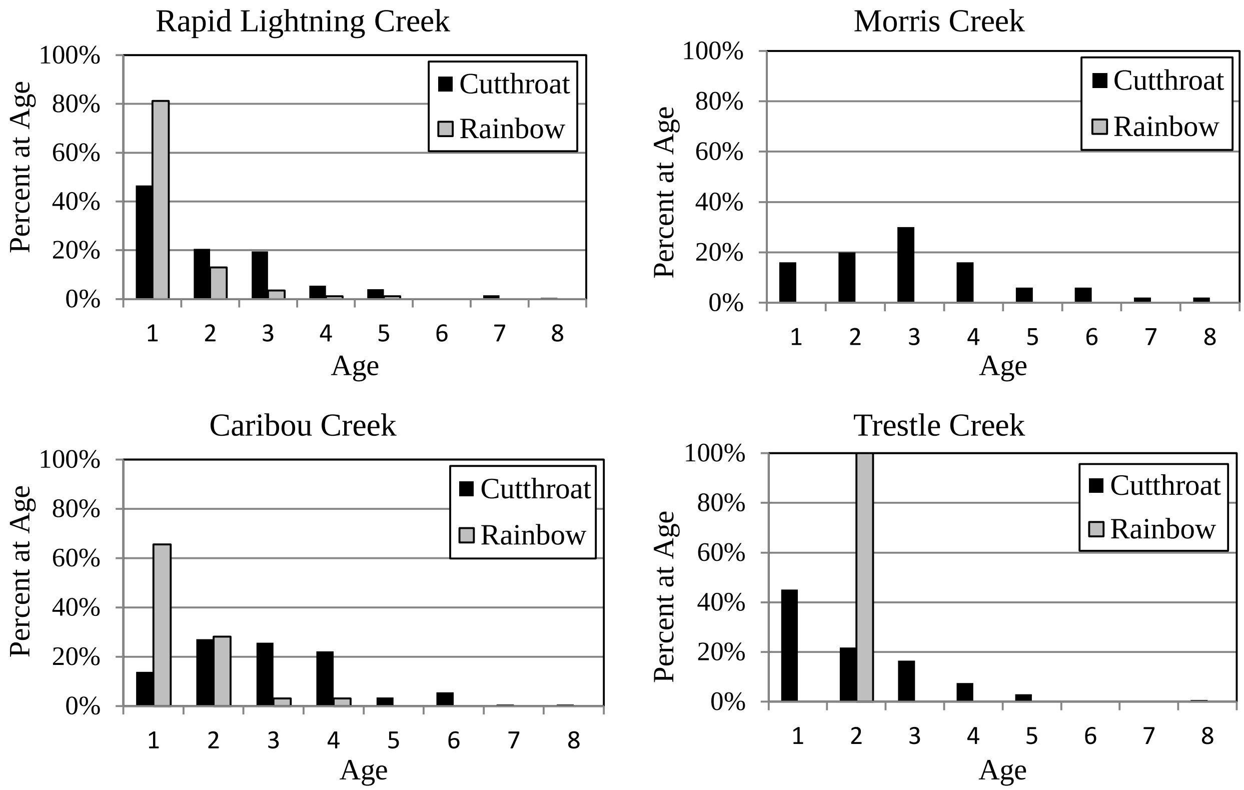


Figure 2. Estimated age frequencies by stream for westslope cutthroat trout and rainbow trout sampled in tributaries of Lake Pend Oreille and the Lower Clark Fork River, Idaho between 2009 and 2011.

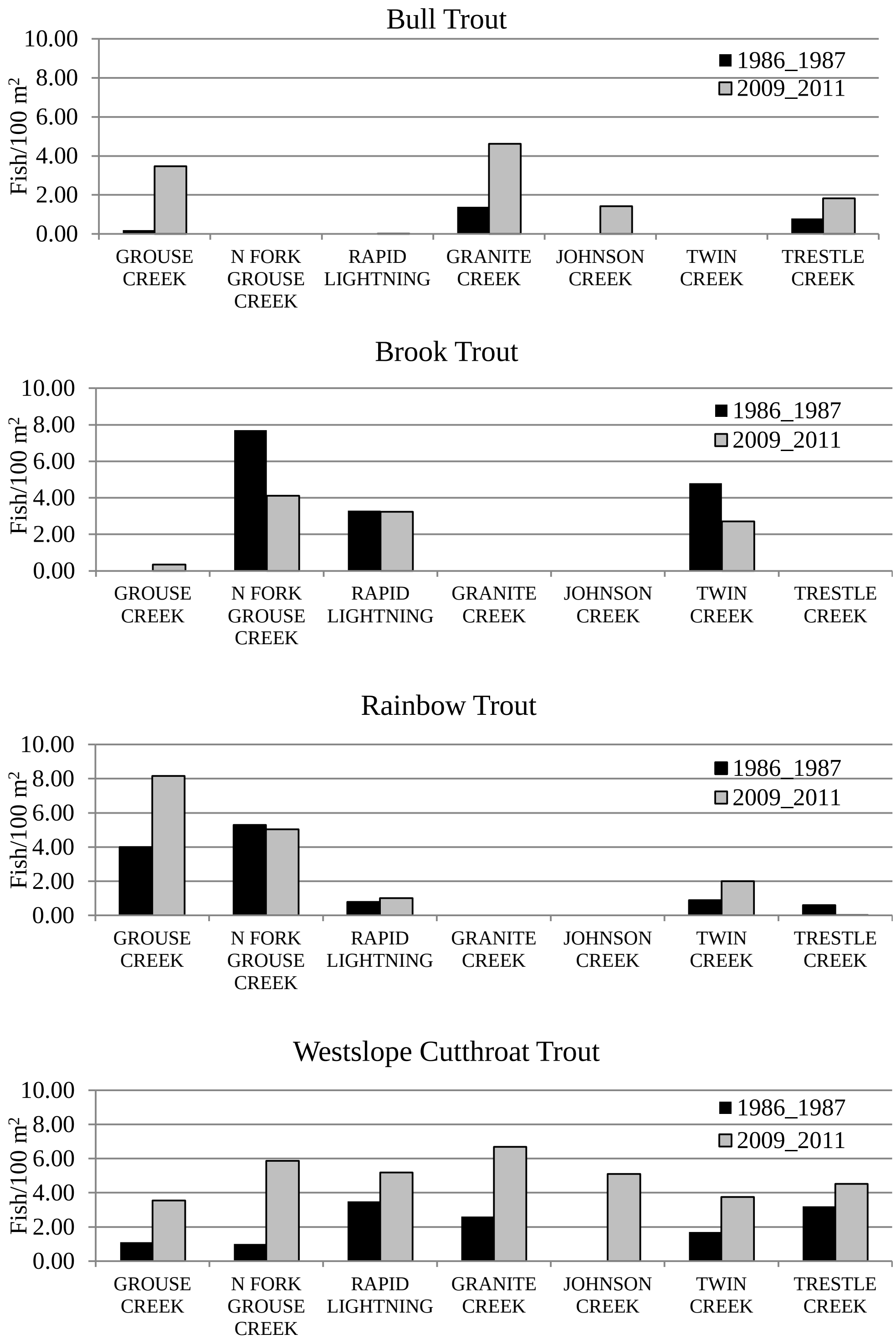


Figure 3. Mean density (fish/100 m^2) by species estimated from surveys of selected Lake Pend Oreille and Lower Clark Fork River, Idaho tributary streams sampled in recent (2009-2011) and past (1986-1987; Hoelscher and Bjornn 1989) survey efforts.

Pend Oreille Basin Bull Trout Redd Monitoring

METHODS

Idaho Department of Fish and Game, Avista, and US Forest Service staff conducted bull trout redd counts on 20 tributaries to Lake Pend Oreille (LPO), as well as the Clark Fork River. In addition, surveys were completed on the Middle Fork East River and Uleda Creek (tributaries to the lower Priest River). We located redds visually by walking along annually monitored sections within each tributary (Table 1). Bull trout redds were defined as areas of clean gravels at least 0.3 x 0.6 m in size with gravels of at least 76.2 mm in diameter having been moved by the fish, and with a mound of loose gravel downstream from a depression (Pratt 1984). In areas where one redd was superimposed over another redd, each distinct depression was counted as one redd. Redd surveys were conducted during the standardized time period. In addition, secondary counts were made in two locations following unexpectedly low survey results. In both cases, new experienced counters were selected to conduct the secondary counts.

We used a nonparametric rank-correlation procedure, Kendall's tau b ($\alpha = 0.05$), to test for trends in the long-term LPO redd count data set (Rieman and Myers 1997), as recommended in the Lake Pend Oreille Bull Trout Conservation Plan (PBTAT 1998). Data for the year 1995 were not used for any streams except the main stem Clark Fork River, Sullivan Springs, North Gold and Gold creeks in this analysis because poor water visibility due to high water conditions likely affected the accuracy of the counts in that year. In addition, we did not use the 1983 data point for Grouse Creek or the 1986 data points for Rattle and East Fork Lightning creeks because some segments of these streams that may have contained relatively substantial numbers of redds were not counted. We evaluated long-term trends in redd counts as the period between 1983 and present, excluding exceptions noted above. We evaluated short-term trends using data collected since 2001.

RESULTS

We completed Pend Oreille core area redd counts between October 13 and 24, 2011. A total of 815 bull trout redds were counted among all surveyed streams (Table 2). Six index streams counted consistently since 1983 accounted for 474 of the total redds (Table 2). Overall counts were below the previous ten year averages for total and index counts of 558 and 817 respectively, but represented an increase from the previous year's totals. Total counts included 37 bull trout redds from Caribou Creek, a Pack River tributary. This represents the first survey of bull trout spawning in this stream and a significant local population. In addition, 16 bull trout redds were counted in approximately 2.5 km of Grouse Creek downstream of the standard count reach boundary at the Flume Creek confluence and were included in the total and index counts in 2011.

Secondary counts in Trestle and East Fork Lightning creeks resulted in considerable increases in count totals. Follow up counts were conducted in these two locations after intitial counts were exceptionally low. In Trestle Creek secondary counts resulted in 78 additional redds counted and included in the total. In East Fork Lightning Creek 30 additional redds were counted and included in the total.

We detected significant positive trends in bull trout redd counts in both Porcupine Creek and Johnson Creek over the ten year period from 2002 to 2011(Table 3). Short-term negative trends were detected in the Clark Fork River and Pack River. Long-term significant trends were detected on the Clark Fork River, (negative), Granite, Gold, Johnson, and Uleda creeks, and collectively among all streams (all positive).Trend evaluations were largely consistent with the 2010 survey year although a significant positive trend in Uleda Creek was a new finding in 2011(Ryan and Jakubowski 2011b).

DISCUSSION

Numerous factors likely influence variations in estimated LPO adult bull trout abundance as measured by annual redd surveys. Clearly identifying direct impacts is difficult. However, some potential influential factors may be described from observations in 2011. For example, isolated incidents of decline in redd counts observed during the 2011 bull trout redd surveys may in some locations be associated with impaired passage conditions. Impaired passage conditions have been observed in Char Creek for several years. All recently observed redds in Char Creek were located below a large alluvial deposit that resulted from high flow events and have likely impacted counts. Ongoing adult upstream passage programs may also have impacted redd count totals in isolated locations such as the Clark Fork River spawning shelf and Twin Creek. As part of the passage program, bull trout are routinely collected in the Lower Clark Fork River in the vicinity of the Clark Fork River spawning shelf and Twin Creek confluence. Removed individuals, although important for upstream spawning populations, are likely reflected in redd count reductions and observed negative trends at these locations. It is recommended that redd count locations be critically reviewed annually and those with low value due to conditions such as those identified above be considered for removal from annual survey efforts.

Increased count totals following secondary counts in Trestle and East Fork Lightning creeks provided evidence standardized survey method remain highly variable. The accuracy of single counts conducted at standardized time periods was clearly low as secondary counts accounted for approximately 44% and 91%, of total counts in these two streams, respectively. Accuracy is likely impacted by both the individual surveyor and natural variation in spawning periods. Survey training courses are provided for new surveyors to reduce the variability among surveyors, but individual skills likely remain inconsistent. Standardized time periods are used to reduce variability among spawning periodicity, but remain insensitive to large fluctuation. Regardless, these results highlighted the need to be cautious in interpretation of bull trout redd surveys, especially within short time periods.

RECOMMENDATIONS

- Prioritize trend survey counts and discontinue routine surveys in location that offer little value due to accepted conditions of the location, such as the Clark Fork River spawning shelf and Twin Creek
- Investigate new survey locations when appropriate to record undocumented spawning activity (e.g. Caribou Creek)

Table 1. Survey streams for annual bull trout redd counts in tributaries to Lake Pend Oreille, Idaho.

Stream	Section Description (approximate length (km))
Caribou Cr	Between Caribou Creek road crossings at 1 km and 7 km (6.0)
Char Cr	Mouth to falls (1.2)
Clark Fork River	Spawning channel (N/A)
E. Fk. Lightning Cr[a]	Savage to Thunder Creek (5.0)
Gold Cr[a]	Mouth to 0.2 km upstream of W. Gold confluence (2.4)
Granite Cr	Mouth to road 278 crossing (6.4)
Grouse Cr[a]	Flume Creek to end of road 280 (2.4 km beyond gate) (6.5)
Johnson Cr[a]	Mouth to falls (1.5)
Lightning Cr	Rattle to Quartz (3.2)
Morris Cr	Mouth to trail 132 crossing (N/A)
N. Gold Cr[a]	Mouth to falls (1.2)
Pack River	Road 231 bridge near McCormick Cr to Falls located 0.4 km downstream of W. Branch (2.8)
Porcupine Cr	Mouth to S.Fk. (3.2)
Rattle Cr	Mouth to falls by upper bridge (5.7)
Savage Cr	Mouth to trail 61 crossing (2.0)
Strong Cr	Mouth to diversion barrier (N/A)
Sullivan Springs	Mouth upstream 0.4 km (0.4)
Trestle Cr[a]	1.6 km upstream of mouth to 0.5 km upstream of the road 275 switchback (10.4 km); 0.5 km upstream of road 275 switchback upstream to confluence with first southeast bank un-named tributary (0.5 km)
Twin Cr	Mouth to River Road (1.5)
Wellington Cr	Mouth to falls (0.5)

[a] Denotes “index” stream

Table 2. 2010 Bull trout redd counts from tributaries of Lake Pend Oreille, Clark Fork River, and Pend Oreille River, Idaho.

Stream(*Index)	Avg 1983-2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Clark Fork R.	8	7	8	1	0	3	2	0	1	0	0
Lightning Cr.	10	8	8	9	22	9	3	10	11[b]	0	20
EF Lightning Cr. *	50	58	38	77	50	51	34	38	85	26	64
Savage Cr.	7	15	7	15	7	25	0[b]	8	5	6	1
Char Cr.	11	8	7	14	15	20	1	5[e]	1[e]	4[e]	9[e]
Porcupine Cr.	10	0	5	10	14	8	8	8	15	11	13
Wellington Cr.	9	7	8	7	6	29	9	10	4[b]	7	6
Rattle Cr.	19	33	37	34	34	21	2	24	62[b]	43	65
Johnson Cr. *	19	31	0	32	45	28	32	40	47	57	54
Twin Cr.	9	8	3	6	7	11	0	4	0	0	1
Morris Cr.	1	7	1	1	3	16	0	6	6	9	0
Strong Cr.	2	0	--	0	--	--	--	7	6	2	11
Trestle Cr. [a] *	249	333	361	102[b]	174	395	145	183	279	188	178
Pack R.	22	22	24	31	53	44	16	11	4	0	1
Grouse Cr. *	37	42	45	28	77	55	38	31	51	27	116
Granite Cr.	32	57	101	149	132	166	104	52	106[c]	75[c]	129[c]
Sullivan Springs Cr.	16	15	12	14	15	28	17	7[c]	2[c]	9[c]	11[c]
North Gold Cr. *	29	24	21	56	34	30	28	17	28[c]	28[c]	6[c]
Gold Cr. *	112	203	126	167	200	235	179	73	107[c]	130[c]	56[c]
W. Gold Cr.	NA	--	--	--	--	4	0	7	5	4	0
M.F. East R.	NA	8[d]	21	20	48	71	34	36	25	22	28
Uleda Cr.	NA	4[d]	3	7	4	7	2	7[b]	16	6	9
N.F. East R.	NA	--	--	1	0	0	--	0	--	0	--
Caribou Creek	NA	--	--	--	--	--	--	--	--	--	37
Total 6 index streams	493	691	591	462	580	794	456	382	597	456	474
Total of all streams	611	890	836	781	940	1256	654	584	866	654	815

[a] Additional approx. 0.5 km reach immediately upstream of index reach on Trestle Creek added in 2001
[b] Impaired observation conditions (ice, high water, etc.)
[c] Abundant early spawning kokanee made identification of bull trout redds in lower reaches difficult
[d] Partial Count
[e] Barrier excluded bull trout from accessing typical spawning habitat

Table 3. Correlations between year and redd count (trends) for bull trout populations monitored from 1983 to 2011 in tributaries to Lake Pend Oreille, Idaho. The total number of years actually included for each evaluation is described by valid years. Tau b represents the direction and magnitude of observed trend.

	Period from 2002 to 2011		Period from 1983 to 2011	
Stream	Valid Years	Tau-b	Valid Years	Tau-b
Clark Fork	10	-0.58[a]	20	-0.54[a]
Lightning Creek	10	0.20	25	0.01
East Fork Lighting Creek	10	-0.09	28	0.02
Savage Creek	10	-0.43	24	0.02
Char Creek	10	-0.18	25	-0.09
Porcupine Creek	10	0.51[a]	25	0.09
Wellington Creek	10	-0.16	25	-0.08
Rattle Creek	10	0.27	25	0.26
Johnson Creek	10	0.67[a]	29	0.35[a]
Twin Creek	10	-0.41	25	-0.23
Morris Creek	10	0.00	13	0.19
Strong Creek	6	0.55	7	0.45
Trestle Creek	10	-0.07	29	0.01
Pack River	10	-0.56[a]	25	-0.25
Grouse Creek	10	0.02	29	0.12
Granite Creek	10	0.02	25	0.48[a]
Sullivan Springs	10	-0.27	24	0.01
North Gold Creek	10	-0.32	29	-0.21
Gold Creek	10	-0.42	29	0.20
West Gold Creek	6	-0.21	6	-0.21
Middle Fork East River	10	0.20	11	0.35
Uleda Creek	10	0.40	11	0.46[a]
North Fork East River	5	-0.63	5	-0.63
Index Streams	9	-0.37	28	0.08
All Streams	9	-0.31	28	0.27[a]

[a] *Denotes significance at* $\alpha \leq 0.05$

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Appendix A. Lake Pend Oreille Tributary Monitoring Location Maps

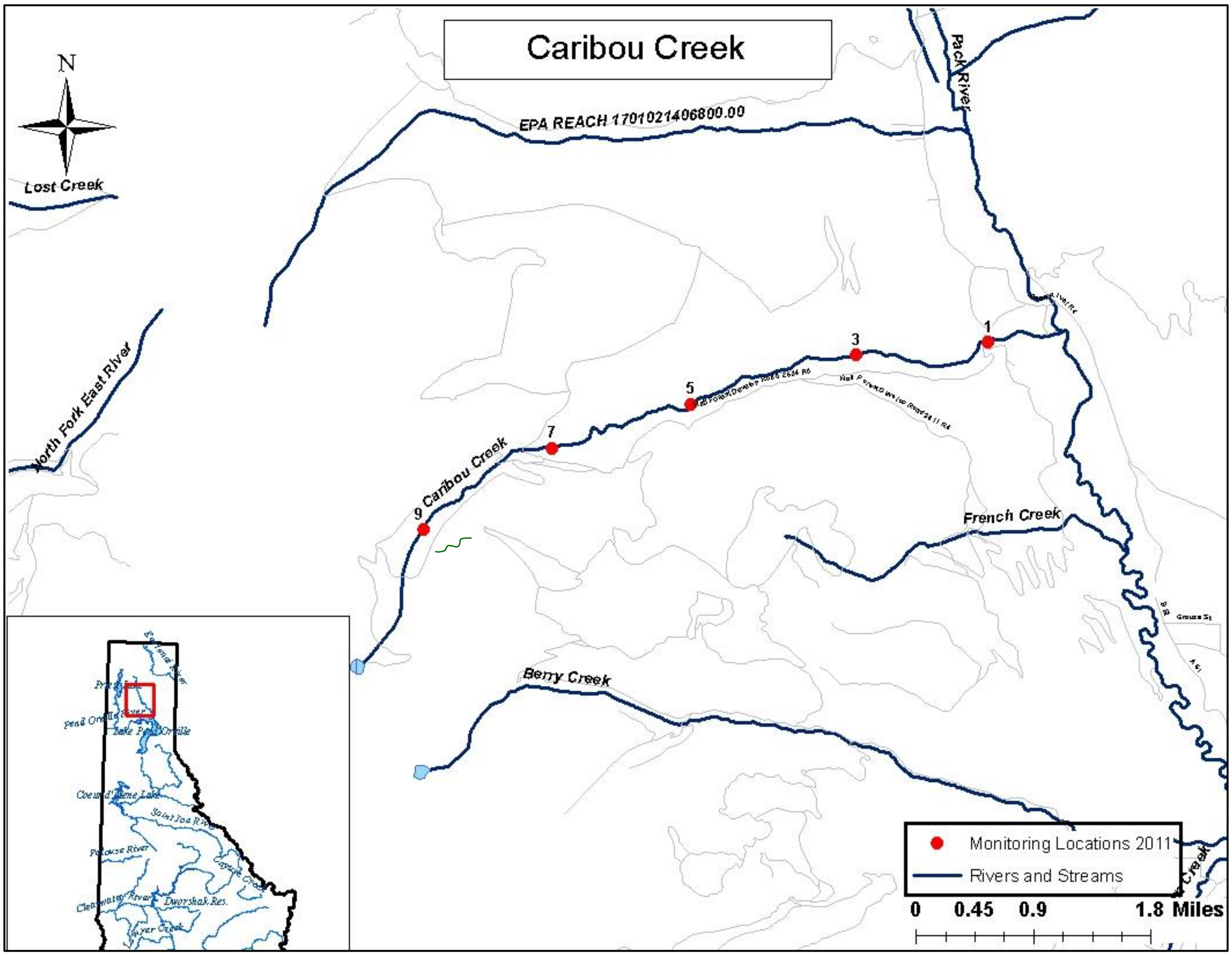

Figure A-1. 2011 tributary monitoring locations on Caribou Creek, Idaho, a tributary of the Pack River. Monitoring locations are numbered to correspond with approximate distance upstream (km) from the mouth.

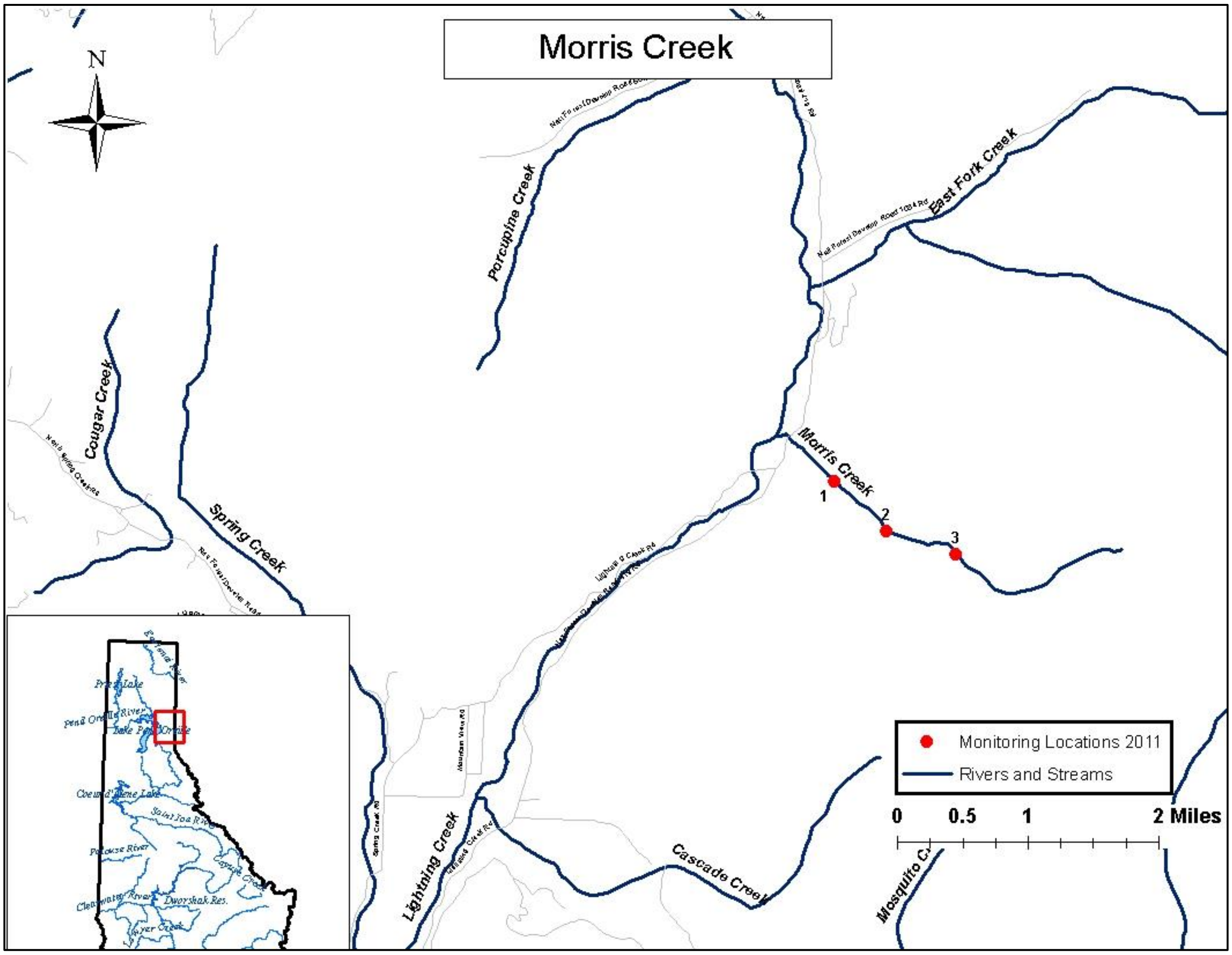

Figure A-2. 2011 tributary monitoring locations on Morris Creek, Idaho, a tributary of Lightning Creek. Monitoring locations are numbered to correspond with approximate distance upstream (km) from the mouth.

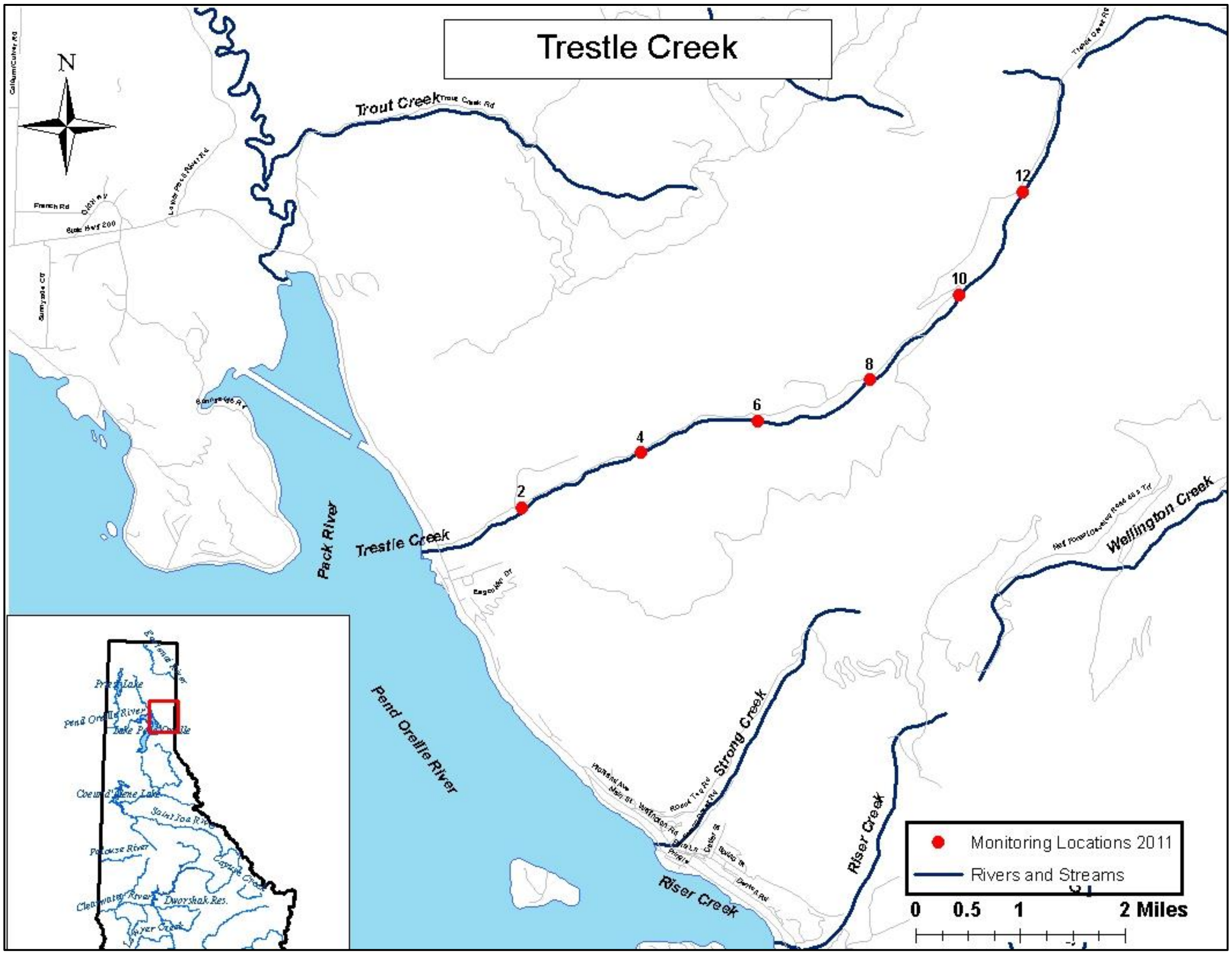

Figure A-3. 2011 tributary monitoring locations on Trestle Creek, Idaho, a tributary to Lake Pend Oreille. Monitoring locations are numbered to correspond with approximate distance upstream (km) from the mouth.

Appendix B. Lake Pend Oreille Tributary Monitoring Fish Species Distribution Maps

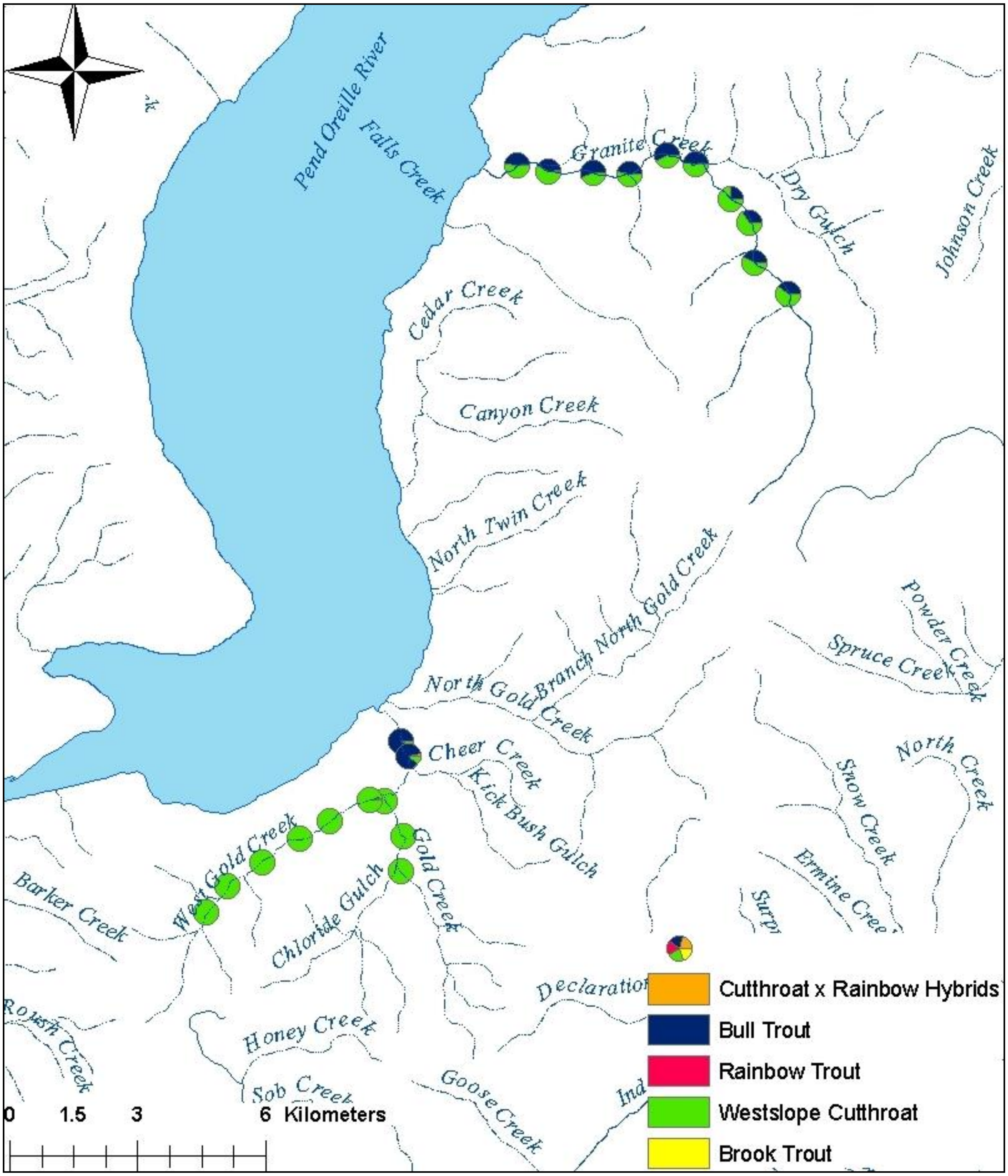

Figure B-1. Fish species distributions observed during 2009 tributary monitoring surveys of Granite Creek, Gold Creek and West Gold Creek, Idaho.

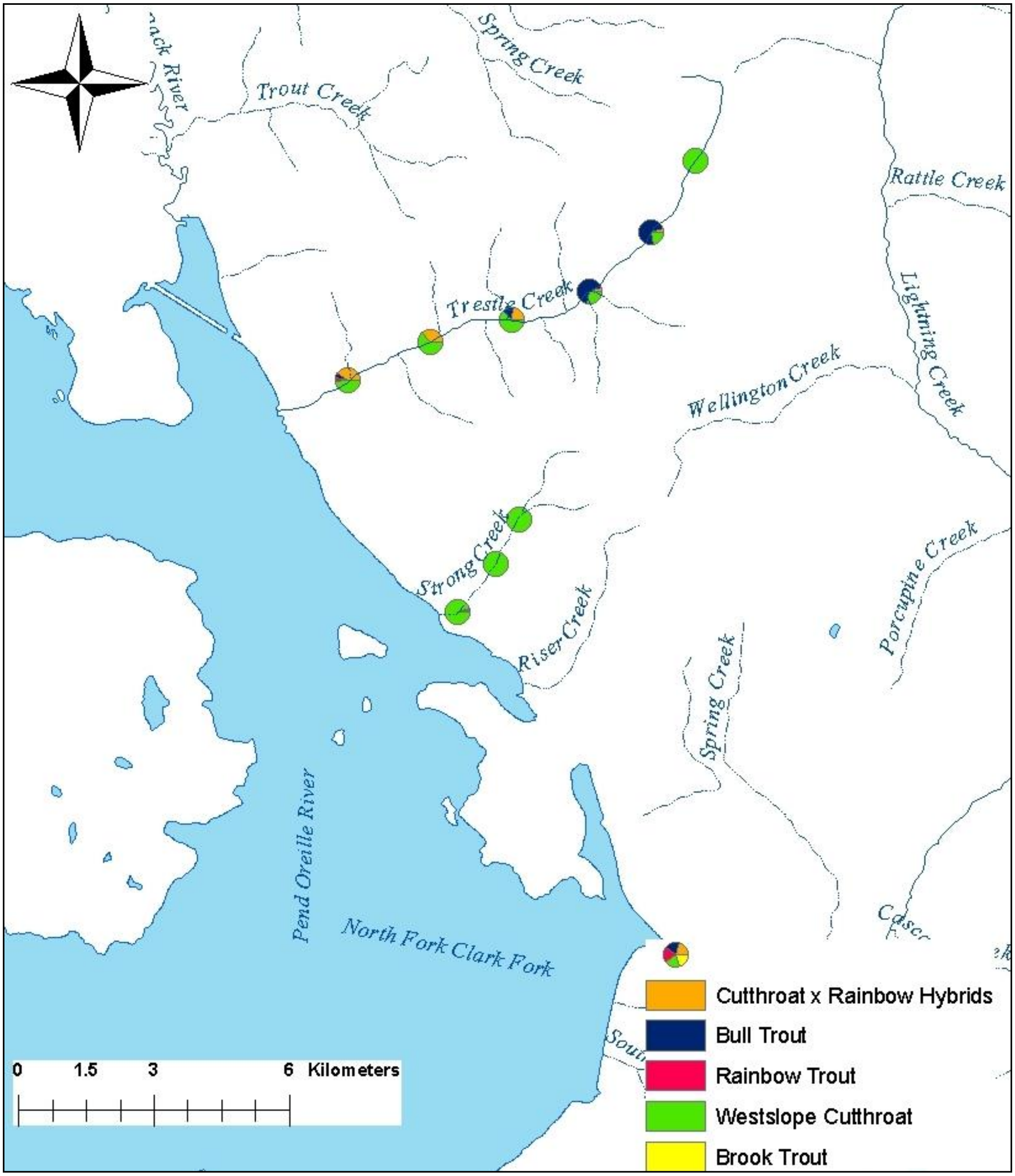

Figure B-2. Fish species distributions observed during 2009 Strong Creek, Idaho and 2011 Trestle Creek, Idaho tributary monitoring surveys.

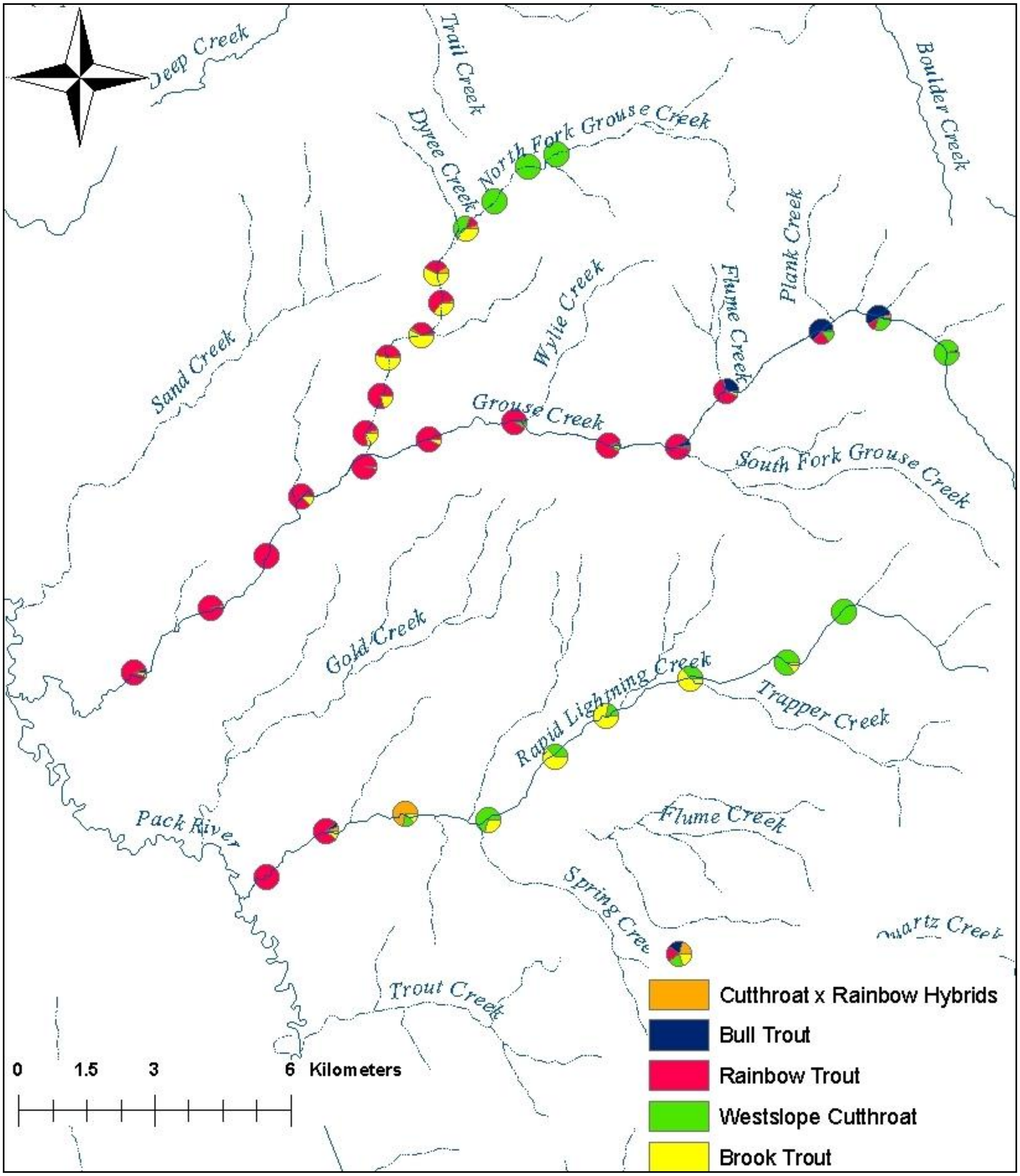

Figure B-3. Fish species distributions observed during 2010 tributary monitoring surveys of Grouse Creek, North Fork Grouse Creek, and Rapid Lightning Creek, Idaho.

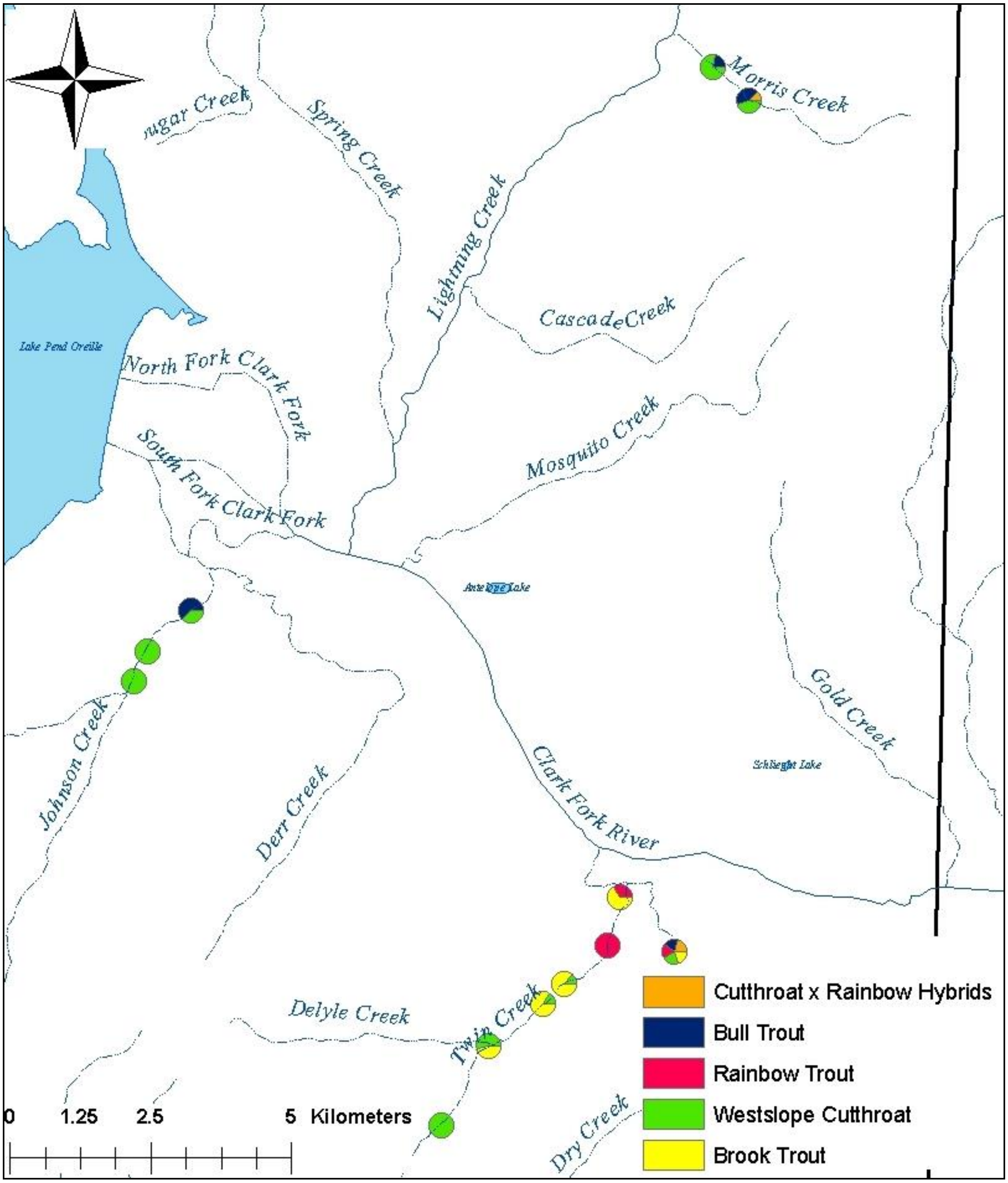

Figure B-4. Fish species distributions observed during 2009 Twin Creek and Johnson Creek, Idaho and 2011 Morris Creek, Idaho tributary monitoring surveys.

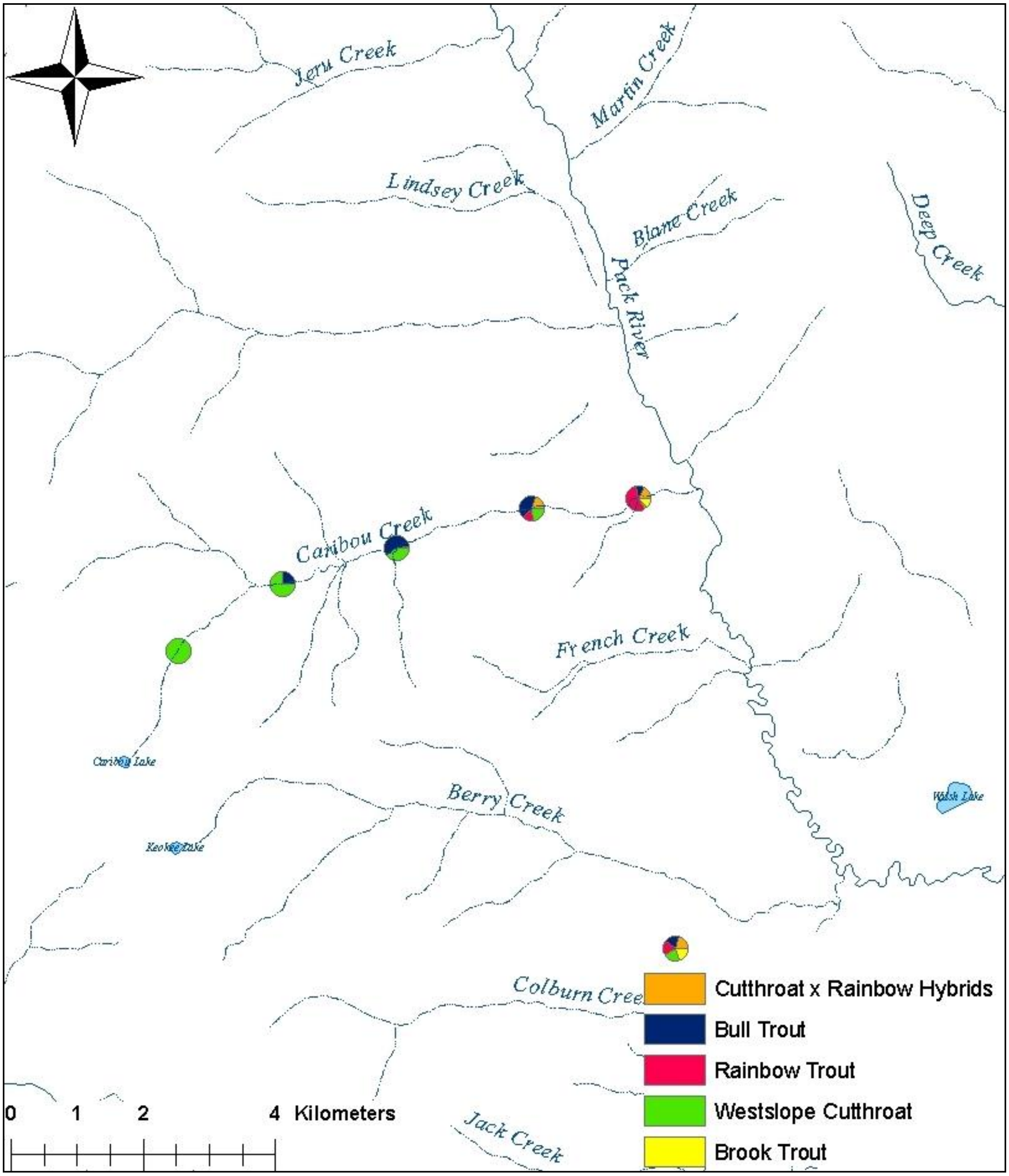

Figure B-5. Fish species distributions observed during 2011 tributary monitoring surveys on Caribou Creek, Idaho.