Yakima Steelhead Viable Salmonid Population (VSP) Monitoring: Resident/Anadromous Interactions

Yakima Steelhead VSP Project

Annual Report 2011
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This report provides status and trend monitoring for the Upper Yakima steelhead population group. An additional focus of the work relates to resident/anadromous interactions studies associated with the Yakima Steelhead Viable Salmonid Population (VSP) Project. The VSP project was established through the Northwest Power Planning Council's fast track process (Skamania Workshops) in May 2010. The project (project # 201003000) is funded under two BPA contracts, one for the Yakama Nation and the other for the Washington Department of Fish and Wildlife (WDFW). The WDFW contract work focuses on the Upper Yakima Steelhead population while the YN contract has a much broader scope (e.g., MPG level). The current report was completed by the Washington Department of Fish and Wildlife in collaboration with the Yakama Nation.

Executive Summary

The National Marine Fisheries Service currently has jurisdiction over steelhead trout *Oncorhynchus mykiss* in the Mid-Columbia (Mid-Columbia Ecologically Significant Unit) due to their depressed abundance and 1996 federal listing as threatened under the Endangered Species Act (ESA). The ESA requires NMFS to develop a recovery plan that identifies actions necessary to restore Mid-Columbia steelhead to a sustainable level such that they longer require federal protection. In 2009, NMFS completed a recovery plan for Mid-Columbia steelhead. Concurrently, a recovery plan specific to the Yakima Distinct Population Segment (DPS) was developed locally and was adopted by NMFS and included as an appendix in their larger Mid-Columbia plan. The Yakima Basin steelhead recovery plan was developed to provide a roadmap for steelhead recovery in the Yakima. This project strives to conduct research that will support steelhead recovery in the Yakima Basin consistent with the objectives identified in the aforementioned recovery documents.

All findings in this report should be considered preliminary and subject to further revision unless they have been published in a peer-reviewed technical journal (i.e., see General Introduction).

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General Introduction

This report is intended to satisfy two concurrent needs: 1) to provide a contract deliverable from the Washington Department of Fish and Wildlife (WDFW) to the Bonneville Power Administration (BPA) reporting on important steelhead VSP metrics (abundance, productivity, diversity, and spatial structure) for upper Yakima steelhead status and trend monitoring, and 2) conduct research that will have broad scientific relevance. This work relies heavily on the infrastructure and staffing associated with the Yakima/Klickitat Fisheries Project (e.g., #199506325; #199506425; #199701325). Much of the background, staffing, methods, and index monitoring locations associated with the resident/anadromous interactions studies under the Yakima Steelhead VSP Project have been established through the YKFP and are described in annual topical reports and journal articles (appendix 1).

This project expands RM & E activities conducted by the co-managers in the Yakima Basin (Yakama Nation and Washington Department of Fish and Wildlife) to better evaluate VSP parameters (abundance, productivity, spatial structure, and diversity) for Yakima steelhead populations. It was developed to fill critical monitoring gaps identified in the 2009 Columbia Basin monitoring strategy review and the FCRPS Biological Opinion RPA review. Data from our research will be used to evaluate population status and trends, inform NOAA status reviews and implementation of the FCRPS Biological Opinion, and address critical uncertainties (e.g., the relationship between resident and anadromous life histories in the Upper Yakima and Naches populations), consistent with the NPCC Fish and Wildlife program, Columbia Basin research plan (uncertainties 3.1, 7.1 & 7.3), NOAA mid-Columbia steelhead recovery plan, and Fish Accords. The improved understanding of steelhead population performance produced by this project will directly inform efforts to recover steelhead populations in the Yakima Basin.

Acknowledgments

We would like to thank Bonneville Power Administration, particularly Sandra Fife, for administering funding for this work. We would also like to thank the staff associated with the Yakima/Klickitat Fisheries Project for providing the foundation for our project. Finally, we would like to thank the many people whom have served on the Ecological Interactions Team through the years that unknowingly collected much of the baseline data contributing to our study.

Chapter 1

Resident/anadromous *O. mykiss* interactions studies in the upper Yakima River, Washington

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Abstract

The steelhead trout *Oncorhynchus mykiss* exhibits perhaps the most diverse life history of any Pacific salmonid. Included in the diversity of this species is the variable expression of anadromous and resident life histories. The anadromous form may smolt and migrate to the ocean after one, two, or three years of freshwater residency and return to its natal stream after spending between one and three years in the ocean. In contrast, the resident life history form, also known as rainbow trout, spends its entire life in freshwater. Our understanding of this species is further complicated by the fact that both forms can interbreed and produce offspring of the opposite type. Federal mandates have required the development of recovery plans that will facilitate recovery of Mid-Columbia steelhead. A final draft of the Yakima Steelhead Recovery Plan was recently developed that addressed key uncertainties associated with steelhead recovery for the Yakima Major Population Group. One key uncertainty identified in that recovery document was the relationship between resident and anadromous life histories present in the Yakima Basin. The interplay between the resident and anadromous forms of *O. mykiss* deserves attention because it is poorly understood and there is a strong potential for the resident form to either contribute to, or to limit recovery of the anadromous form. The overarching objective of this research is to develop an understanding of resident/anadromous steelhead interactions and how this affects recovery of the anadromous steelhead population in the Upper Yakima Basin.

Introduction

The steelhead trout *Oncorhynchus mykiss* exhibits perhaps the most diverse life history of any Pacific salmonid. Included in the diversity of this species is the variable expression of anadromous and resident life histories. The anadromous form may smolt and migrate to the ocean after one, two, or three years of freshwater residency and return to its natal stream after spending between one and three years in the ocean. In contrast, the resident life history form, also known as rainbow trout, spends its entire life in freshwater. Our understanding of this species is further complicated by the fact that both forms can interbreed and produce offspring of the opposite type. While steelhead in the Yakima Basin (mid-Columbia evolutionary significant unit) are currently listed as threatened under the endangered species act (ESA; NMFS 1999), rainbow trout currently provide one of the best wild trout fisheries in Washington State (Krause 1991; Probasco 1994). Despite the fact that both forms can interbreed, they are managed separately. The anadromous form affords federal protection due to depressed abundance and poor adult returns. Management of the resident form is under the jurisdiction of the state and is managed as a popular sport fish in the Yakima River. Catch and release regulations for rainbow trout have been in effect for the main stem of the Yakima River (upstream from Roza Dam) since 1990 although rainbow trout in many tributaries to the Yakima River are open to lawful harvest under Washington State general harvest regulations (2 fish over 8 inches in length can be harvested daily). The flexibility in life history expression is thought to provide significant resiliency in unstable environments, although it substantially complicates our ability to manage them and further complicates the recovery of the anadromous form.

The Yakima Basin Sub-basin plan (Yakima Sub-basin Fish and Wildlife Planning Board 2004a) identified several key uncertainties and prioritized research needs consistent with steelhead recovery in the Yakima Basin. In 2009 a final draft of the Yakima Steelhead Recovery Plan was developed that addressed key uncertainties associated with steelhead recovery in the Yakima Major Population Group (MPG; Yakima Subbasin Fish and Wildlife Planning Board 2009). One key uncertainty identified is the relationship between resident and anadromous life histories present in the basin. This is particularly important in the Upper Yakima River because it supports a robust resident population (Temple et al. 2009) exhibiting some hatchery introgression (Campton and Johnston 1985) and the resident and anadromous forms are known to interbreed (Pearsons et al. 2007; Blankenship et al. 2009). The interplay between the resident and anadromous forms of *O. mykiss* deserves attention because it is poorly understood and there is a strong potential for the resident form to either contribute to, or to limit recovery of the anadromous form (Allendorf et al. 2001; Thrower et al. 2004). In addition, the interplay between the forms has the potential to confound evaluation of VSP parameters including population level productivity, spatial structure, and diversity of the anadromous form (Mobrand et al. 2005).

This report chapter is intended to provide annual progress updates for research primarily associated with Biological Objective 5 "Evaluate sympatric population dynamics and the effects on population viability between resident and anadromous forms of *O. mykiss*" as presented in the Yakima Steelhead VSP Project descriptive.

Methods

Study Area

The Yakima River Basin is a large river system that drains into the Columbia River near Richland, Washington. The upper Yakima River Basin, which is the subject of this paper, is located upstream of Roza Dam (Figure 1). Historically large numbers of salmon and steelhead returned to the upper Yakima Basin (Bonneville Power Administration 1996). Coho salmon were extirpated by the early 1980s and spring Chinook salmon have been severely depressed (Bosch 2004). Steelhead (mid-Columbia Evolutionarily Significant Unit) and bull trout are currently listed as threatened (National Marine Fisheries Service 1999; U.S. Fish and Wildlife Service 1998). Rainbow trout in the Yakima River provide one of the best wild trout fisheries in Washington (Krause 1991; Probasco 1994) and westslope cutthroat trout are present in many high elevation tributaries. Steelhead are known to utilize spawning habitats in both tributary and main stem areas in the upper Yakima Basin. Recent radio tracking studies conducted between the fall of 2002 and the spring of 2006 indicated that nearly 2/3 of the adult steelhead utilized a tributary for spawning (Karp et al. 2009) and the remaining fish are presumed to have spawned in the main stem Yakima River between Roza Dam and Easton Dam. Tributary spawning steelhead primarily used streams in the Teanaway, Swauk, Taneum, and lower Cle Elum River Basins, while a small number also are thought to have spawned in Umptanum, Cherry, Naneum, and Wilson Creeks (Karp et al. 2009; Figure 1). A permanent adult counting facility is located at Roza Dam that provides a complete adult census and estimate of run escapement.

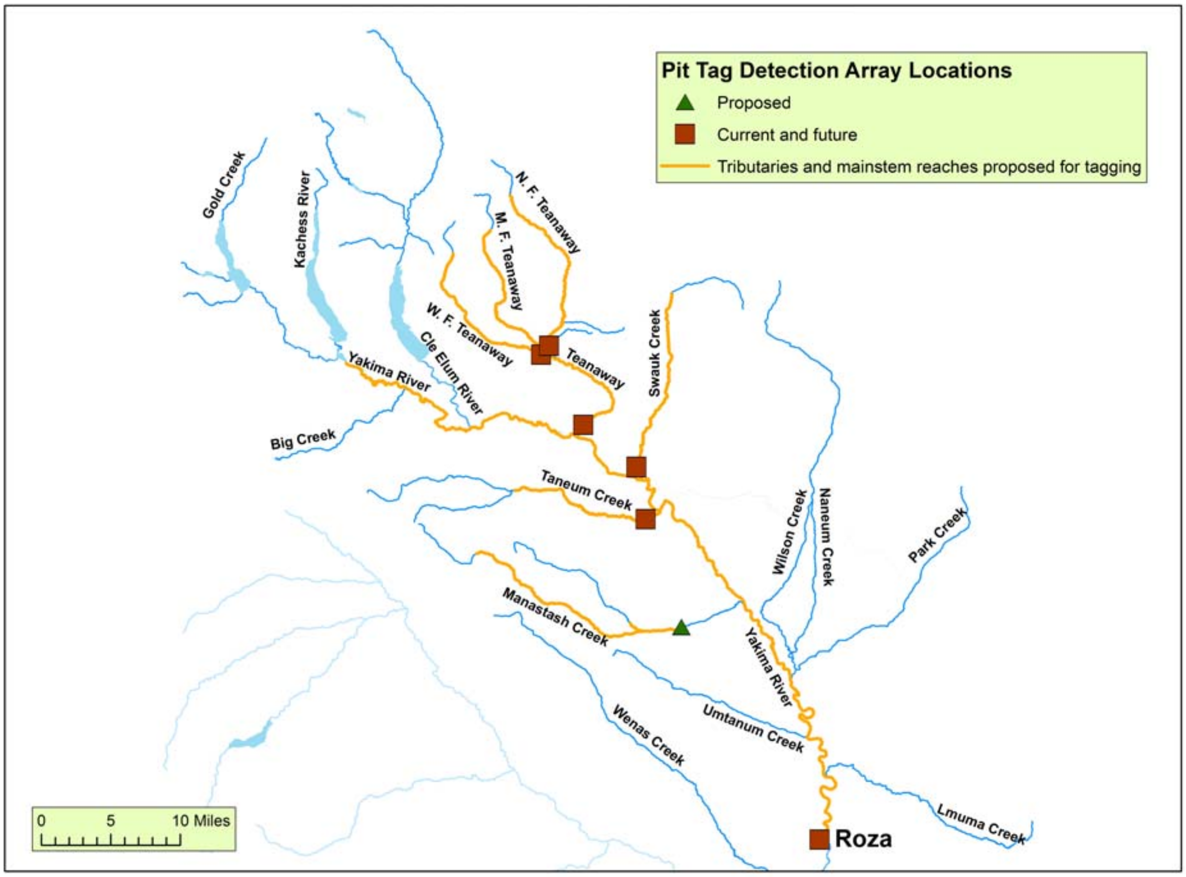

Figure 1. Map of the Yakima River Basin including PIT tag interrogation sites, proposed future interrogation sites, and streams targeted for *O. mykiss* tagging.

General approach

The work tasks associated with the resident/anadromous interactions studies under the VSP project were initially described in the Yakima Steelhead VSP Project Proposal. Since the project proposals are intended to provide a roadmap of work tasks intended to meet the study objectives, we will include much of the information here to provide context for the work.

Understanding how the resident form of *O. mykiss* acts as a source or a sink to recovery of the anadromous form in the Upper Yakima River will be a difficult task. However, recent advances in genetic evaluations and in tagging technology can be combined to provide a viable means to understanding the relationship. We proposed to install passive integrated transponder (PIT) tag detectors in important anadromous steelhead spawning tributaries as identified in Karp et al. (2009) which will be confirmed with the radio tracking component of the VSP project beginning in 2012. We installed PIT tag arrays at the mouth of Swauk creek, West Fork Teanaway and the North Fork Teanaway River (Figure 1). In addition, a PIT tag array was installed near the mouth of Taneum Creek in February 2010 (funded by the U. S. Bureau of Reclamation) and an array was installed in the mainstem Teanaway River by WDFW (Figure 1). We also participated in the installation of an AllFlex detection system at the mouth of Reecer

Creek and installed Allflex units at the mouths of Wilson and Umtanum creeks. Thus, the major tributaries in the upper Yakima Basin used by anadromous steelhead have PIT tag detection capability for both adults and juveniles. Approximately 50% of the anadromous spawning in the upper Yakima Basin occur in these streams (Karp et al. 2009), with the majority of tributary spawning occurring in the Teanaway Basin. Finally, an additional array in the mainstem Yakima River was installed at Roza Dam (rkm 205.9) and is now operational. The Roza array can be used to evaluate migration survival and timing through the upper Yakima mainstem, and will serve as the final point of detection of upper Yakima origin smolts prior to mixing with the other populations in the Yakima River migration corridor.

Recent tagging studies have identified some anadromous production occurring in our upper Yakima basin tributary streams. We began PIT tagging *O. mykiss* in the Teanaway basin in “control” and “treatment” sites in 2006 to evaluate *O. mykiss* growth in areas subjected to large supplementation origin salmon releases relative to areas that had no hatchery salmon released (project 199603501). We assumed we were tagging resident rainbow trout for growth evaluations, however in subsequent years, several of our tagged “trout” were detected at main stem Columbia River dams. Between 2006 and 2009, approximately 16% of tagged trout from the North Fork Teanaway, and 6% of tagged trout in each the Middle Fork Teanaway River, and Taneum creek were detected at downstream dams (raw detections not adjusted for detection efficiency). During the period 2002 to 2006, a total of 53, 15, and 17 radiotagged steelhead entered, and presumably spawned, in the North Fork Teanaway River, Middle Fork Teanaway River, and Taneum Creek, respectively (Karp et al. 2009). We are unclear if differential rates of anadromous production observed in those tributaries are correlated with anadromous use of them, or if some other factor is responsible (e.g. different abundance of *O. mykiss* with consistent low level rate of anadromous production from resident matings; differential movement rates to the main stem Yakima River that may favor residency; differential mortality). Interestingly, several of our returning steelhead adults tagged as rearing juveniles were never detected as migrating smolts and their first detections after initial tagging were as returning steelhead adults passing Bonneville Dam. Installation of permanent instream PIT tag arrays will provide us the ability to determine 1) the number of steelhead adults that spawn in each tributary, their movement and timing, and 2) the number of anadromous offspring produced in them via juvenile detections in subsequent years. Furthermore, it has been suggested that environmental conditions in the main stem Yakima River may favor a resident life history (Courter et al. 2009). Thus, it is plausible, yet currently unknown, if tributary origin steelhead parr move to rear in the Yakima River, and if so, if they residualize and exhibit a resident life history (perhaps due to environmental conditions favorable for residency.

One important objective of the PIT tagging component of this project will be to determine anadromous production from selected tributary streams. The large resident population will likely confound our ability to determine smolt production from these areas. However, tagging a large proportion of the population upstream from the PIT tag interrogation systems will provide estimates of the proportion of juveniles in each tributary population that are steelhead if the following critical data gaps can be addressed; 1) we can estimate and account for natural population turnover in each tributary, 2) we can account for the rate of anadromous production from resident crosses, and 3) we can account for the anadromous migrants (partitioned by age) passing interrogation sites.

We propose to PIT tag a minimum of 1000 rearing *O. mykiss* upstream from our PIT tag interrogation arrays in each tributary for a total of 5000 tags placed in tributaries. An additional

5000 will be placed in the main stem Yakima River. Five thousand tags has been recommended as a rough estimate of the number of anadromous fish that should be tagged to estimate life-stage survival rates by the Action Agencies (AA; referenced in Hillman 2004). One thousand tags per tributary is consistent with our experience of the number of fish that can feasibly be collected and tagged in individual tributaries given existing resources (fish in hand electrofishing sampling/collection by WDFW staff associated with project 199603501). Initially, 1000 *O. Mykiss* will be tagged in the Middle, West and North Forks of the Teanaway River, the main stem Teanaway River, Swauk Creek, and Manastash Creek, and Taneum Creek. Two thousand tags are currently contributed annually under 199603501 for monitoring trout growth as related to coho reintroduction and Chinook supplementation. Thus, 5000 tags will be available for the main stem Yakima River and 5000 for tributary streams as proposed by the AA. We will revise PIT tagging sample sizes as we refine our estimates of freshwater survival and establish estimates of the proportions of each life history type present in each stream. As data becomes available to estimate these critical parameters, rigorous estimates of minimum sample size requirements and detectable effect sizes will be used to determine the level of tagging effort necessary to estimate 1) proportion of anadromous vs. resident *O. mykiss* production from tributary streams, 2) the adult to adult survival and productivity of the anadromous form of *O. mykiss* in the upper Yakima population, and 3) differential anadromous contribution of resident matings in various tributaries. The total number of tags proposed to be released in each tributary will be adjusted to maximize detectable effects in important response variables (e.g. differences in survival and production between tributaries; differences in abundance attributed to habitat improvement actions) with minimum sampling effort required to achieve defined levels of statistical certainty.

Preliminary power analysis indicates the minimum detectable difference in the proportions of anadromous juveniles versus resident fish produced in the Middle Fork Teanaway River is approximately 1.7% in 2 years (a=0.05, B=0.1). We used the observed number of PIT tagged *O. mykiss* detected at some downstream interrogation station (migrant) divided by the total number of PIT tags deployed the previous year to generate an index of the proportion of steelhead versus resident fish production in the Middle Fork Teanaway River (we did not partition tags to correct for cohort structure, however, similar numbers of fish were tagged for 4 consecutive years). We subjected the data to the arcsine square root transformation to satisfy parametric test assumptions (ZAR 1999). We then used equation 8.23 as presented in ZAR (1999) to determine the minimum effect size we could detect given our sample data with a maximum Type I error rate established as 0.05, and maximum Type II error rate as 0.10 (Power = 0.90). The result from the computation was transformed back to a proportion following equation 13.6 in Zar (1999). The results we observed suggest we have adequate power to detect fairly small shifts in the life history proportions present in our tributary streams. However, we currently do not have adequate estimates of anadromous production because we cannot account for migration mortality prior to the first downstream interrogation point (Prosser Dam). Increasing the number of PIT tagged fish in various tributaries, and improving the network of detection arrays in the Yakima Basin will provide us the ability to estimate escapement, production accounting for life history types, and refine our ability identify bottlenecks hindering recovery. In addition, we will identify areas of major anadromous production and, perhaps, help us prioritize areas for recovery actions or that would benefit from protective measures to meet recovery goals. Thus, it appears that 1000 tagged fish per tributary will be sufficient to determine the proportion of anadromous juveniles present, and increasing the number of tributaries sampled will increase the aggregate tributary sample size to 5000 fish (and 5000 in the main stem) to determine freshwater migration and survival. If we assume 10000 upper Yakima fish are tagged, and 20% are anadromous, we would expect to detect 2000 smolts. If we apply a 1% SAR, we could expect to detect 20 tagged returning adults which equates to approximately 24% of the 10 year geometric mean number of adult returns. If we assume 40% of upper Yakima Fish are anadromous (which may not be unreasonable given most of our detections were far downstream in the main stem Columbia River), it is possible we will detect 40 returning tagged adults, or nearly 50% of the 10 year geometric mean run escapement.

Rearing juvenile abundance will be estimated in established tributary index monitoring sites following the protocols recommended in NOAA's Guidance for Monitoring Recovery of Pacific Northwest Salmon and Steelhead (Crawford and Rumsey 2009) and detailed by Temple and Pearsons (2006; 2007). Briefly, rearing juvenile abundance will be collected under existing collaborative projects (project 199603501) following the mark-recapture electrofishing methods detailed in Temple and Pearsons (2006; 2007). Previous data indicate Yakima tributary *O. mykiss* (albeit not partitioned by life history form) abundance exhibit a CV of 29% (Ham and Pearsons 2000) meeting the guidelines recommended in the NOAA guidance for monitoring juvenile steelhead populations (Crawford and Rumsey 2009). Although small effect sizes will be difficult to detect rapidly given our observed levels of natural variation, long-term aggregate (resident and anadromous juveniles combined) baseline abundance data are available in several upper Yakima tributaries that can be used in a future BACI analysis. A BACI analysis is recommended as a powerful statistical design used in effectiveness studies (Crawford and Rumsey 2009). Although no "treatment" is currently proposed, the data is available to evaluate the effectiveness of future actions should they occur.

Abundance estimates can be used in conjunction with movement and survival data to determine the abundance of each life history type produced in tributaries upstream from the PIT tag antennas. Rearing juvenile fish will be PIT-tagged; a genetic sample (e.g. fin clip) will be collected, and released unharmed near their point of capture. In addition, we will collect scale samples from 60 fish handled in each tributary and in main stem areas and determine their age in the lab by enumerating scale annuli (Jearld 1983). Sixty scales will provide an adequate sample to account for unreadable samples, and provide sufficient data to set constrictions in a mixture analysis of the length frequency distributions of trout in the upper Yakima River. The size at age estimated from the subset of aged fish will be used to populate a mixture analysis of the length frequency distributions of all fish, thus providing a method to assign age to unsampled fish in tributary or main stem areas (MacDonald and Pitcher 1979). We will use the R statistical software program (R development core team 2005) and the add-in package mixdist (Du 2002) to determine the proportion fish at age in the population to facilitate cohort tracking. Migrants will be monitored in subsequent years when detected at mainstem dams and will be assigned to brood year from the scale age data. Juvenile genetic samples will be banked for future analysis and will be analyzed if a sample becomes known to be anadromous (e.g. detections at main stem dams) or resident (e.g. recaptured in subsequent years in spawning condition). Fish of known origin (e.g. location and life history type) will have genetic samples processed and combined to the genetic baseline. In addition, the parentage of fish that have their life history form determined will be evaluated.

The PIT tag antenna arrays were installed and are operated as recommended by programs in other sub-basins facilitating data comparisons at the regional level (fast track project 201003400 in the Wenatchee; 2010017000 in the Salmon River Basin; ISEMP). We followed the guidance provided by QCinc. (2005) and install extended length PIT tag arrays with redundant antennas to maximize detection efficiency, and determine directionality. Following ISEMP's study design, at a minimum, we will obtain the ability to generate robust escapement and survival estimates for upper Yakima steelhead facilitating status and trend monitoring. Finally, interrogation data will be uploaded to PTAGIS and made available to other regional databases for use by all interested parties.

Population abundance estimates were generated for rearing O. mykiss (presumed rainbow trout) in upper Yakima Basin Tributary streams. The abundance and size structure of rainbow trout was estimated in18 sites in 6 streams during the summer when stream discharge was at or near base-flow conditions (July-August; Figure 2). Electrofishing was conducted during summer base-flow conditions to maximize sampling efficiency, and so that sampling conditions are similar between years. A backpack mounted electrofishing unit was used for mark-recapture sampling to estimate the abundance of rainbow trout. During sampling, all trout were captured, fork length and weight measured, inspected for general condition, and released. Notable comments such as visible injuries from hook scarring, parasites, or fish in abnormal condition were also recorded. A more detailed description of sampling protocols is presented in Temple and Pearsons (2007). Fish collection data was analyzed using computer software to estimate abundance and size information.

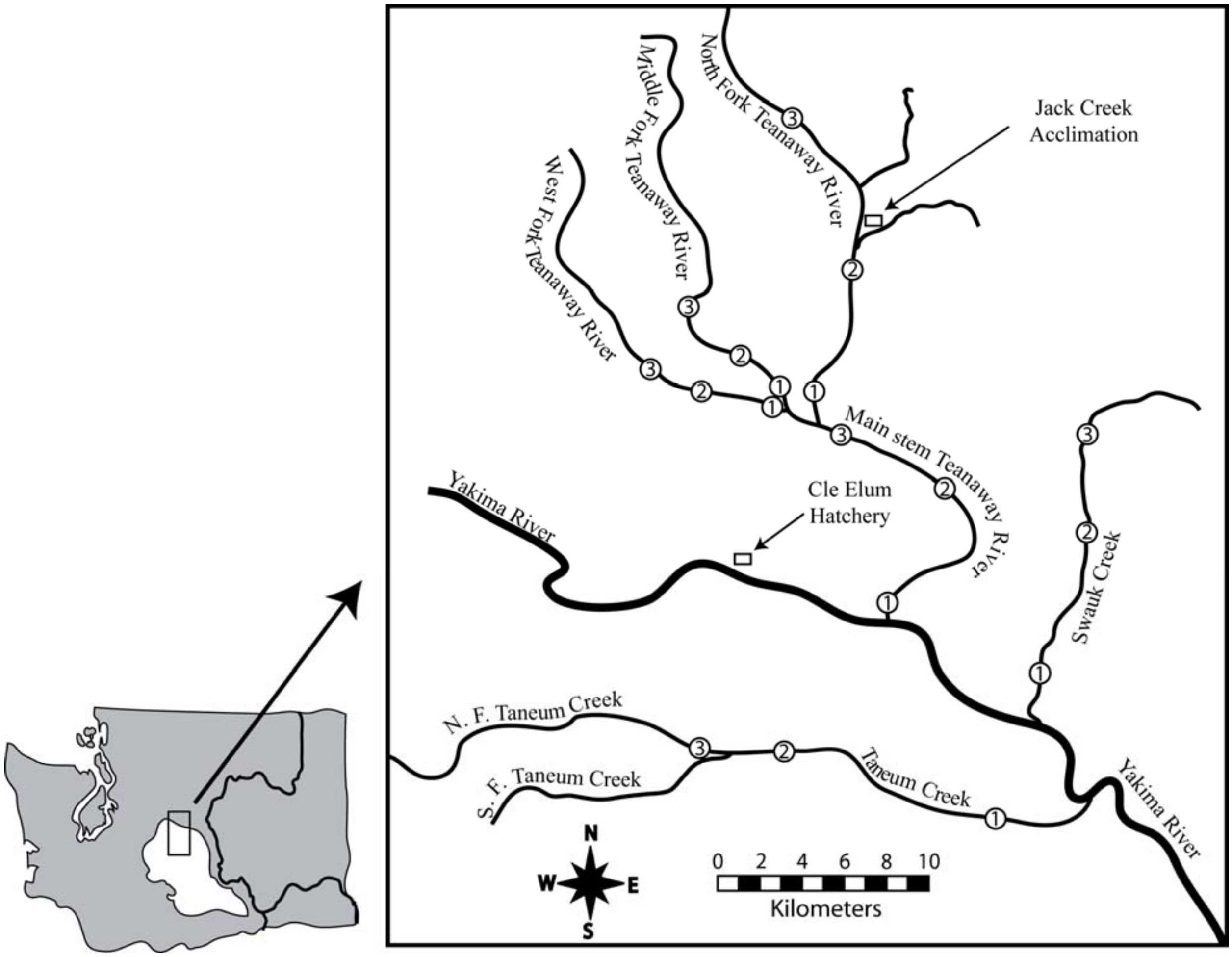

Figure 2. Map showing the relative location of tributary index monitoring sites.

Results

General approach

Since this is the first year of this project, we have no salient data to present at this time. We expect to begin collecting the first significant results during the winter adult migration in 2011-2012 and the spring smolt migration in 2012. This will be the period that we will have the first opportunity to detect radio tagged adults on our PIT tag interrogation sites, and the migration of *O. mykiss* parr that were PIT tagged in the upper Yakima. We did however, accomplish our tagging goals in 2011 and exceeded our goals for infrastructure development.

Our goal was to tag 10,000 *O. mykiss* parr in the upper Yakima during this contract period (2010-2011). Tags have succesfully been distributed the West Fork, Middle Fork, North

Fork, and Main stem Teanaway rivers, Swauk creek, Taneum Creek, and the main stem Yakima River (Table 1). Additional tags were distributed to the North, Middle, and West Fork Teanaway rivers under routine sampling associated with the YKFP, and in Taneum creek under the Coho interactions monitoring Program (Table 1; Figure 1). Additional tags were provided by WDFW and were distributed in Big Creek, Manastash Creek, and the Cle Elum River (Table 1; Figure 1). In addition, we submitted an additional proposal to obtain alternative funding to install a PIT tag interrogation station in Manastash Creek which has now been accepted and approved. This location will provide critical baseline data on the proportion of anadromous smolts produced from resident matings in an upper Yakima Tributary stream because there is currently (and historically) no anadromous passage in this creek. To date, 2 smolts that were tagged in Manastash creek during the winter 2010 as rearing *O. mykiss* parr were detected at main stem Columbia River Dams (2/1000 or 0.2%; 1 at Bonneville dam and 1 at John Day Dam) during the spring smolt migration in 2011.

Each parr captured that was tagged was genetically sampled. A small clip of fin tissue was collected and preserved in alcohol. The genetic material will be sent to the WDFW genetics lab in Olympia, Washington for storage. The annual genetic codes and numbers are presented in Table 1 for reference. PIT tagged fish that are detected at downstream locations and are presumed to be anadromous steelhead can have their genetic samples located and analyzed in future years. In FY2012, we will begin to analyze the backlog of adult samples collected at Roza dam. These samples will correspond to the brood year adults that may have produced migrants observed in recent years. Thus, we will have the opportunity to conduct a parentage analysis to determine which adults produced smolts. Migrants that do not assign to at least one anadromous parent will be presumed to have originated from resident parents.

Table 1. Number of *O. mykiss* tagged (at the time of this report) in each stream in the upper Yakima Basin, the projects that contributed PIT tags, and the associated genetic codes used in each stream for the year.

Stream	Number Tagged	Tag Source (project)	GSI codes
Middle Fork Teanaway	1500	Steelhead VSP& YKFP	11BZ
Main stem Teanaway River	1000	Steelhead VSP	11CA
North Fork Teanaway River	1500	Steelhead VSP&YKFP	11BX
West Fork Teanaway River	1500	Steelhead VSP&YKFP	11BY
Swauk Creek	1500	Steelhead VSP&YKFP	11CB
Taneum Creek	1000	YKFP-Coho	11CC
Manastash Creek	1000	WDFW-Science	10DP
Big Creek	256	WDFW-Science	11IJ
Cle Elum River	500	YKFP- NTTOC	11DS
Yakima River	1500	Steelhead VSP	11CE
Yakima River(below Roza Dam)	22	YKFP- NTTOC	11FF

We also collected scale samples from a subset of *O. mykiss* that were PIT tagged and that were genetically sampled. Main stem Yakima River scale samples collected in FY10 were remounted on gummed scale cards and were processed by the WDFW scale lab in Olympia, WA. The mean length at age for O. mykiss collected in the main stem Yakima River in the Fall of 2010 are presented in Table 2. The length frequency distribution of tributary rainbow trout indicated a strong age 1 component in most streams (figure 3). Generally age1 fish are the predominant age class subject to capture with our gear in our tributaries and are generally large enough to tag throughout the summer sampling period. We generally have poor capture efficiency for smaller young of the year fish until they grow of large enough size to overcome our gear bias (generally about 80mm fork length). Conversely, we rarely observe fish greater than age 4 in tributaries.

Table 2. Mean length (mm fork length) at age for *O. mykiss* observed in each sampling section (in order from downstream to upstream) in the main stem Yakima River in 2010. Age groupings that had no readable scales are identified with N/A.

Section	Age 1	Age 2	Age 3	Age 4	Age 5
Lower Canyon (LCYN)	232.7	265.5	394.5	408	405
Upper Canyon (UCYN)	231.1	268.4	358.0	389.7	377
Ellensburg (EBURG)	206	251.1	335.5	N/A	N/A
Thorp (THORP)	188.2	251.0	336.5	N/A	425
Cle Elum (CELUM)	207.4	293.7	355.5	386.2	440.0

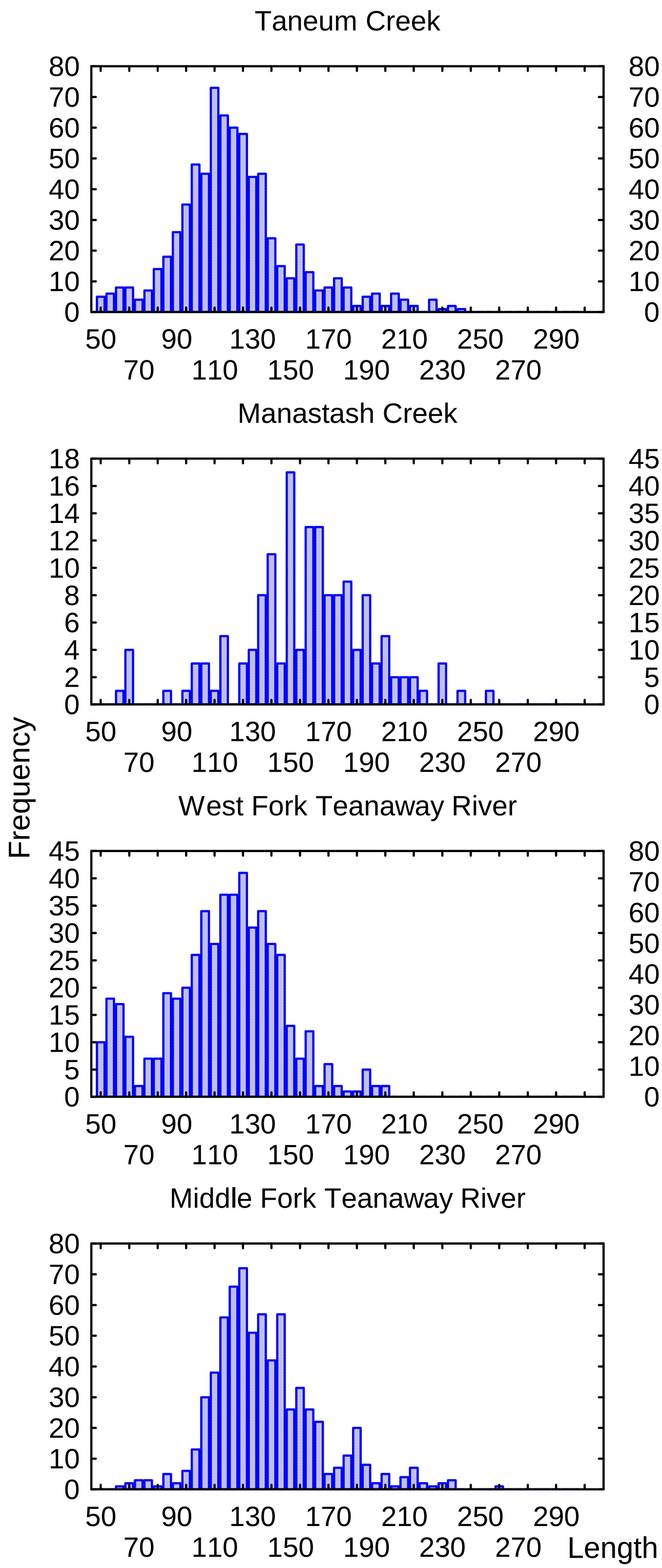

Figure 3. Length frequency distribution of *O. mykiss* in select tributary streams.

Population abundance estimates of rainbow trout in tributary streams revealed large amounts of spatial variation (Figure 4). Interestingly, the lowest abundance's were observed in the North Fork Teanaway and the Main stem Teanaway River. In a previous and preliminary analysis, we observed the highest rates of smolt production from these streams relative to others in the Yakima. We observed the highest density of rainbow trout in Swauk Creek and therefore expect to see a fair number of tagged migrants emigrate from the system during the smolt migration in 2012.

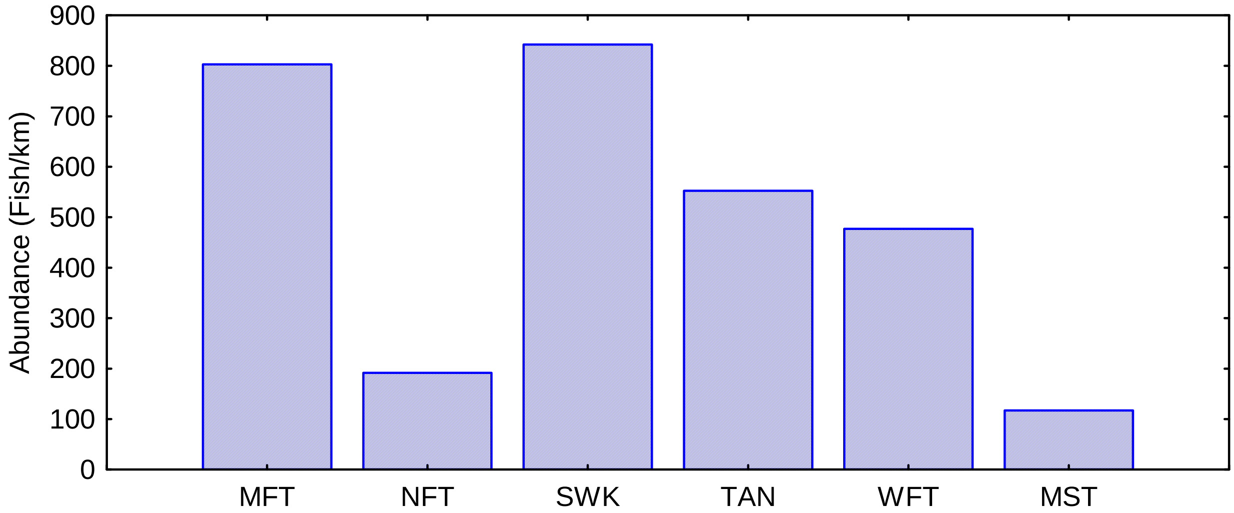

Figure 4. Population abundance of rainbow trout in the Middle Fork Teanaway River (MFT), North Fork Teanaway River (NFT), Swauk Creek (SWK), Taneum Creek (TAN), West Fork Teanaway River (WFT) , and the Main stem Teanaway River (MST).

An estimate of steelhead run escapement to the upper Yakima Basin for the 2010-2011 return was generated from Roza Dam counts. Approximately 346 steelhead passed upstream from Roza during this period with the peak migration occurring between March 2011 and May 2011. The majority of the run was composed of wild fish, although 9 hatchery fish were also detected at the Roza facility. We will attempt to generate an estimate of spawning escapement in future years as the radio telemetry component of the project gets under way providing us an estimate of pre-spawn mortality rates. Finally, we have observed a slow but steady increase in steelhead returns detected at Roza dam over the last decade relative to the decade in the 1990's (Figure 5). Although the adult abundance enumerated at Roza shows substantial improvement, the numbers have not met NOAA's 500 adult return target for recovery.

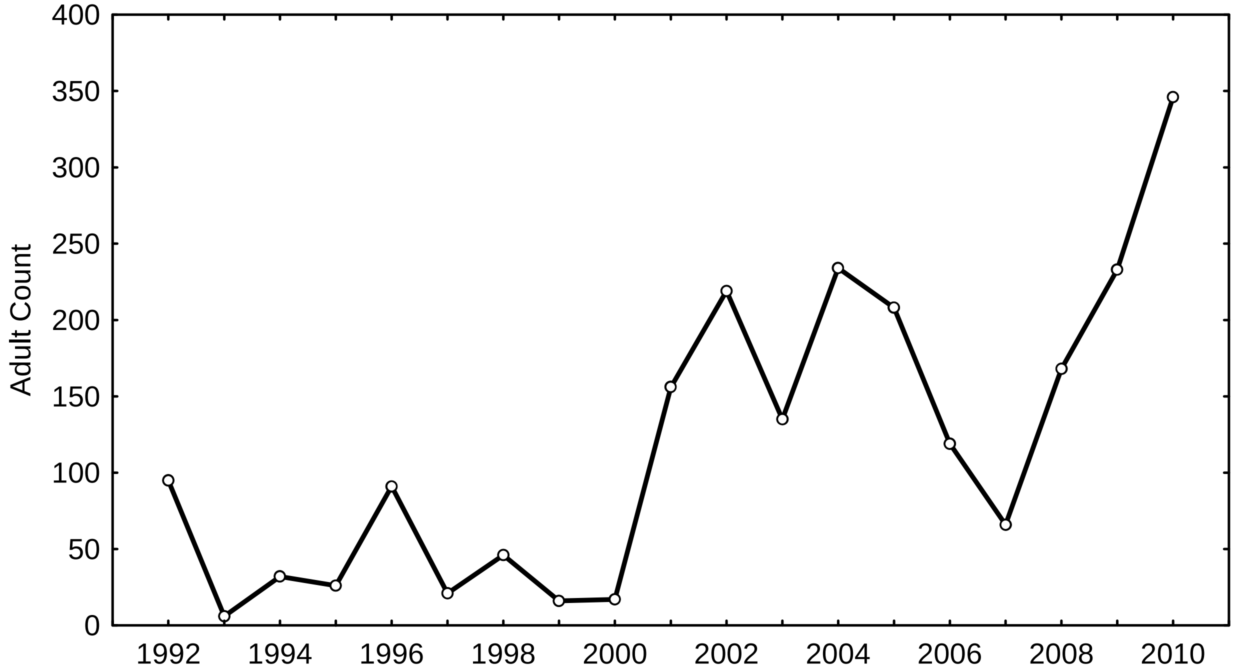

Figure 5. Annual steelhead adult returns as counted at Roza Dam.

Discussion

This report was intended to satisfy contractual reporting requirements for the first year of this project. However, this reporting deadline lies before the completion of the 2011 spring smolt outmigration, and the Adult spawning period. Thus, data are still being collected and analysis is premature at this point. As such, we used this opportunity to describe our accomplishments in the first year of our study and to reiterate the information presented in our project proposal. This will serve as a road map for reporting in future years.

We collected and tagged over 10,000 O. mykiss during this contract period. Previous information suggests that Yakima River Steelhead will smolt and migrate to the ocean primarily in their second year although we do observe smolts that are from 1 to 3 years old. We suspect that we will begin to observe significant numbers of our tagged *O. mykiss* that will be detected as smolts in the spring of 2012 and beyond. It will be at that point substantial and significant results will be obtained, and significant reporting will occur.

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