ANNUAL REPORT

ABUNDANCE AND DISTRIBUTION OF ADULT AND JUVENILE STEELHEAD (*ONCORHYNCHUS MYKISS)* IN TOPPENISH CREEK

JULY 1, 2010 THROUGH JUNE 30, 2011
YAKAMA RESERVATION WATERSHEDS PROJECT
TOPPENISH BIOP. MONITORING AND EVALUATION
BPA Project #1996-035-01-Contract # 48418

TABLE OF CONTENTS

Abstract

We attempted to obtain precise estimates of adult steelhead spawner abundance and juvenile outmigrant abundance. Census redd counts (three passes) were performed along all 76 miles of documented steelhead spawning habitat. In addition, one aerial survey using a helicopter was completed on the lower (unwadeable, 36 mile long) section of Toppenish Creek. 100 Redds were found and expanded to an estimate of 250 adult spawners in the watershed. Two rotary screw traps were deployed on Toppenish Creek to estimate steelhead juvenile out-migration from Toppenish Creek spawning habitat and to evaluate survival to the mouth and downstream through the series of detection facilities on the Yakima and mainstem Columbia. An estimated 33,820 (SE=2292; CV=6.7%) steelhead juveniles migrated off the spawning and rearing grounds and past the rotary screw trap located at river mile 26.5 on Toppenish Creek. At the second screw trap located at the mouth of Toppenish Creek, we captured 14 juvenile steelhead.

Introduction

The Yakima Reservation Watersheds Project (1996-035-01) is a combination of former BPA funded projects the earliest of which began in 1996 to restore the steelhead population in Satus, Toppenish, and Ahtanum creeks, the three lower steelhead producing tributaries of the Yakima River. All three of these watersheds are located on the Yakama Reservation. In March 1999, the Middle Columbia River Steelhead Distinct Population Segment was listed as threatened under the Endangered Species Act (ESA). Four populations (Satus, Toppenish, Naches, and Upper Yakima) are recognized by NOAA's National Marine Fisheries Service for recovery purposes in the Yakima Basin and comprise the Yakima MPG (Major Population Group) (Yakima Fish and Wildlife Recovery Board 2009).

Monitoring the steelhead population in Toppenish Creek has proved to be difficult in many years. Adult steelhead are counted as they migrate up the Yakima River at Prosser Dam in the town of Prosser. These counts using mostly video cameras at the fish ladders (as well as a Denil fish ladder and trap used for biological sampling) are are believed to produce a fairly accurate adult migrant count for the Yakima MPG. Another counting facility (Roza) is located on the Yakima River farther upstream above the Naches River provides a direct count of adult steelhead migrating upstream of the boundary delineating the Upper Yakima Population. No counting facilities are present for the Naches, Toppenish, or Satus Creek populations. Spawner surveys provide an index of adult escapement on these Yakima River tributaries. Spawner surveys including a redd count have been performed in Toppenish Creek since 1997. The accuracy of these counts varies from year to year and is dependant on snowpack and stream conditions during the spawning season. The poor accessibility of the upper section of the watershed has been the greatest obstacle to completing a redd survey that captures the entire spawning season.

In 2009, Toppenish Creek was identified as the watershed in the Yakima basin where "fish in/fish out" population monitoring should be prioritized. We strengthened our Toppenish Creek screw trapping program beginning in the 2010-2011 season to meet the objective of accurately quantifying "fish out" or the number of steelhead juveniles migrating out of the Toppenish creek spawning grounds with a data standard (CV, coefficient of variation < 30%) adhering to recommendations in Crawford and Rumsey (2009). Better equipment and more manpower obtained with additional BPA funding (1996-035-01 BIOP M&E Toppenish Creek) were required to meet this objective. We attempted to use census redd counts and develop expansions to obtain the adult abundance or "fish in" estimates.

Precise estimates of juvenile steelhead abundance and adult spawner abundance are the primary objectives of this study. It is anticipated that this project will span multiple generations allowing us to quantify freshwater productivity. Smolt-per-spawner and/or smolt-per-redd estimates will be provided in future years after several years of data become available, along with estimates of downstream survival and Smolt-to-adult returns (SAR). Information on life history characteristics such as migration timing and spawning behavior will also be provided by this study as will some abundance and life history information for non-target fish species.

Study Area

Toppenish Creek is located in south central Washington and the entire watershed is situated within the boundary of the Yakama Reservation. Toppenish Creek is a major tributary of the Yakima River comprising 10% of the total Yakima River watershed at an area of 622 mi^2. The headwaters of Toppenish Creek are located on Lost Horse Plateau at a maximum elevation of 5200 feet. Simcoe Creek, the main tributary of Toppenish Creek, joins at river mile 32 (about the halfway point). The forks of Simcoe Creek and its main tributaries Agency and Wahtum creeks also arise from Lost Horse Plateau, but at a slightly lower elevation. Toppenish Creek enters the Yakima River about 7 miles south east of the town of Toppenish, Washington at river mile 80 at an elevation of 650 feet. Along its approximately 70-mile length, stream morphology and watershed topography changes substantially. Through most of the upper third of its length, Toppenish Creek flows through a remote forested canyon. Most of the upper Toppenish Watershed is tribal trust land managed for timber production and cultural resources. The middle third of Toppenish is dominated by an alluvial fan. This area is managed for multiple uses including livestock grazing and some agriculture. Irrigation withdrawals begin in this region of the watershed. The lower portion of Toppenish Creek is heavily influenced by agriculture with a variety of crops grown (e.g. corn, wheat, hops, mint, and grapes). Flows and water quality are altered drastically by irrigation withdrawals, spills and return flows in the lower portion of Toppenish Creek. Much of the land adjacent to the lower third of the creek is devoted to waterfowl production and hunting. The USFWS Toppenish Creek Wildlife Refuge, Yakama Nation wildlife areas, and a number of private duck clubs provide a substantial amount of off-channel wetland habitat (managed to attract waterfowl) on the lower 30 miles of Toppenish Creek.

The hydrograph of Toppenish Creek is similar to other streams on the east slopes of the Cascade Range. Peak flows typically occur in early to mid-spring resulting from snowmelt, although rain-on-snow events during winter can cause substantial floods—sometimes the peak flow for the season. Flows decrease rapidly during late spring and early summer as the snow pack is depleted. Flows (and closely-related water temperature) are probably the limiting factor for steelhead production in portions of the Toppenish and Simcoe watersheds. Irrigation spills and return flows in the lower portions of Toppenish Creek stream flow are not believed to be beneficial to salmonids because of their temperature, suspended solids, and the potential homing issues raised by flows originating from outside the Toppenish watershed.

Fish species that are known to reside in the Toppenish Creek watershed include: steelhead/rainbow trout (*Oncorhynchus mykiss*), Coho Salmon (*O. kisutch*), chinook salmon (*O. tshawytscha*), westslope cutthroat trout (*O. clarki*), redside shiners (*Richardsonius balteatus*), speckled (*Rhinichthyus osculus*) and longnose dace (*R. cataractae*), chiselmouth (*Achrocheilus alutaceus*), northern pikeminnow (*Ptychocheilus oregonensis*), suckers (*Catostomus* spp.), sculpin (*Cottus* spp.), goldfish (*Carassius auratus*), carp (*Cyprinus carpio*), bluegill (*Lepomis macrochirus*), pumpkinseed (*L. gibbosus*), lamprey (*Entosphenus* spp.), black bulhead (*Ictalurus nebulosis*), and threespine stickleback (*Gasterosteus aculeatus*).

Due to its cultural importance to the Yakama people, its listing status as threatened under the ESA, and the opportunity to increase the size of the population using stream and landscape restoration techniques, the steelhead is the target species for restoration and population monitoring in the Toppenish basin. Other native fish species as well as many wildlife and plant species are assumed to also benefit from these actions.

Methods

<u>Juvenile Out-migration</u>

Upper Toppenish Screw Trap

The upper Toppenish screw trap was deployed at the beginning of the outmigration season in late autumn and fished for the entire steelhead outmigration season ending in June.

We deployed and operated the 5-foot-diameter screw trap (designed and constructed by EG Solutions) located at river mile 26.5 below the Unit 2 diversion each year since 1999. This location was chosen because of its favorable site characteristics (stream morphology facilitating good trap efficiency and groundwater recharge allowing us to operate through the winter months) and position several miles below all recognized spawning and rearing habitat that begins upstream at about river mile 35.5 below Shaker Church Road on the mainstem Toppenish Creek, and above RM 5.5 on Simcoe Creek. Mill Creek, which was identified as a minor spawning population in the Yakima Steelhead recovery plan (although, at this time there is no recent evidence of steelhead spawning activity), is located about 4.5 miles upstream from this site. No viable tributaries enter Toppenish Creek below the Mill Creek confluence and much of the runoff from the north is captured by Marion Drain, which parallels Toppenish Creek for 19 miles beginning at the trap site. Aerial, watercraft, and limited foot surveys below our trap site indicate that habitat and successful spawning activity in the reach below the upper screw trap is unlikely. Additional planned aerial spawning surveys and a three-year radio-tracking study should lend additional support to our exclusion of this reach.

Lower Toppenish Screw Trap

We deployed a second screw trap on Toppenish Creek in 2010 to evaluate out-migration timing and survival of steelhead smolts in the lower part of Toppenish Creek. This portion of Toppenish Creek is situated on the historical Yakima River floodplain, which has been modified extensively for agricultural purposes and transportation over the last 150 years. There is a complex irrigation system of canals and drains (WIP, Wapato Irrigation Project) that significantly influences flow, temperature, and other hydrologic characteristics of the lower Toppenish watershed. Another prominent feature of this part of the watershed are numerous controlled wetlands that were developed for producing, attracting and providing refuge to waterfowl species (and other migratory birds). It isn't clear what role these wetlands play to migrating adult and juvenile steelhead. We hope to ascertain the impact of these wetlands through several ongoing studies including this PIT-tagging study for juveniles and also the radio tracking study for adults. Like the upper trap, the lower trap and its target organisms were protected by lifting the cone during periods of high flows and debris loading.

Trapping and tagging Procedures

In many years we have not been able to obtain reliable estimates due to high flows that often occur in winter and spring. The heavy debris loads associated with these high-flow events have the potential to clog the screw trap cone and impinge and kill out-migrating juvenile fish. During normal to high flow years between 1999 and 2009, we were forced to temporarily halt operation of the trap to avoid trap mortality numerous times throughout the season. This affected our study and estimates negatively because studies to obtain outmigration estimates require or at least benefit from continuous operation. In 2010, we found that we could operate the trap during high water events and minimize trapping mortality through multiple visits to the traps during a 24 hour period and in some cases camping out at the trap and cleaning it periodically throughout the night. Our study and out-migrant estimates have improved since we have combined continuous fishing with rigorous maintenance. The trap was operated continuously in all but the highest flows. During the period of operation the trap was checked daily in the mornings including holidays and weekends, even during low and moderate flows.

Our screw trapping protocol was similar at all four of the screw traps that we operate (upper Toppenish, lower Toppenish, Ahtanum, and Satus). Each trap was visited at least once a day usually between 6:30 AM and 11:00 AM. Fish were netted out, identified and target fish were held in 5-gallon buckets. Aeration using battery operated pumps was applied if needed. All juvenile steelhead were anesthetized in MS-222 before being handled. They were then enumerated, measured (mm), and weighed (g). Scales were collected on 300 individuals per season and location (up to 10 per day). We also collected fin clips from 100 individuals from Toppenish Creek. These samples were sent to CRITFC for DNA analysis to be used in several ongoing studies. On several occasions when large catches occurred (N > 300) only a random sub-sample (first 100) were measured and weighed to prevent us from exceeding the guidelines in our NOAA Section 10 permit. We inserted PIT tags into a subsample (first 100) of captured steelhead smolts over 80 mm in length. PIT tagged fish were released several hundred meters upstream from the trap to estimate trap efficiency (i.e. mark-recapture). The upstream release site alternated between the right and left banks of the stream. Efficiency releases were made 4 times per week (Monday-Thursday) and release numbers and recaptures for the week were pooled. Day and night releases were compared for several efficiency release groups. We set a target of 4000 steelhead juveniles to PIT tag and attempted to space our tagging effort throughout the season so the total out-migration was represented appropriately. Due to variable seasonal catches, there is no clear formula to achieve this and the target number tagged per day had to be adjusted several times during the season; however, we still ended the season short of PIT tags.

Scales were collected from 300 individuals of varying sizes to use in conjunction with PIT tag data to assess survival by year class. We collected fin clips from 100 steelhead smolts for use in DNA studies as well. DNA samples are analyzed by CRITFC for their steelhead kelt reconditioning study. After handling we released steelhead juveniles, along with all recaptures and undersized fish 100 meters downstream below a check dam structure. Physical data (water temperature, air temperature, and percent cloud cover) were recorded. The trap rotation rate (seconds per revolution) was recorded to evaluate operating efficiency.

Juvenile out-migration estimate

We utilized a Petersen's stratified capture-recapture model to estimate juvenile steelhead outmigrant abundance.

The assumptions of this model are:

1) The population is closed;
2) All fish have an equal probability of capture in the first period;
3) Marking does not affect catchability;
4) The fish do not lose their marks; and
5) All recovered marks are reported (Volkhardt et al. 2007)

Due to changes in factors shown to affect trap efficiency (i.e. stream flow, temperature, increasing smolt size) that occur as out-migration season progresses, we stratified our estimate temporally by week. Darr 2.02 software for R utilizing Darroch's (1961) maximum likelihood estimator for stratified data was used to obtain an estimate and its associated variance (Bjorkstedt 2005 and 2009). A one-trap study design was used. Since at least 5 recaptures are typically necessary to converge, Darr 2.02 incorporates an algorithm that automatically pools adjacent strata as needed. We enabled this algorithm because many strata outside the peak migration period had fewer than five recaptures.

Adult Abundance

Although they are labor-intensive and subject to variable environmental conditions (flow, turbidity, temperature), redd counts currently provide the best index of adult spawner abundance in the lower Yakima River tributaries. The spawning distribution and spawning habitat have been delineated through the identification of barriers at the upstream limits, presence of suitable substrate, suitable width, depth, and gradient, and professional judgment of a fisheries biologist. Several reaches in the Toppenish watershed contain marginal habitat. Each year since 2010, one or more of these marginal reaches are randomly selected to be surveyed. We also conduct an aerial survey of the lower portion of Toppenish Creek (below Shaker Church Road) once a year. No redds have been detected in the lower portions of these tributaries during the aerial surveys or during wading and rafting surveys conducted in the past. In most cases these portions of the tributaries are located on the historical Yakima River floodplain and appear to lack suitable spawning substrate.

Census Redd Counts

In each lower Yakima River tributary (Satus, Toppenish, and Ahtanum), we attempt to perform a census survey on all recognized spawning habitat in each tributary. The Yakama Nation Fisheries Program has attempted to various survey methods (ground, raft and aerial) in some areas outside of these recognized spawning reaches but have not documented any redds. The procedure for conducting steelhead redd counts has not changed significantly during past 24 years that the Yakama Nation has performed them. For each of three passes, two surveyors typically cover each 2 to 6-mile survey reach, walking downstream. In some smaller streams only one surveyor conducts the survey. Surveyors wear polarized glasses to aid in spotting redds, and generally begin after the sun breaks over the horizon. Each identified redd is marked with a GPS with an accuracy of +/- 30 feet. Redds are marked with fluorescent flagging to prevent counting redds identified on previous passes. Each redd is measured and its location in relation to the stream bank and thawlweg are recorded. The presence or absence of direct cover is also noted on data sheets. It is unlikely that resident rainbow trout redds (or redds from other redd building species) are mistaken for anadromous steelhead redds because of the small size of all resident *O. mykiss* observed in these watersheds during redd counts and snorkel surveys. The number of live steelhead adults and carcasses are also recorded. When possible, the sex of live steelhead and carcasses is noted. Surveyors are careful not to disturb spawning fish or possible staging pools when conducting spawner surveys.

Redd Count Expansion

Several methods were considered to convert our redd counts to estimates of adult spawner abundance. We hoped to calculate redd life (length of time redds remain visible during spawning ground surveys) and use an area under the curve (AUC) technique to account for redds that were constructed and became unidentifiable in between surveys (Gallager et. al 2007). We also attempted mark-resight surveys to gauge surveyor accuracy. Although, not incorporated into an estimate of adult abundance, these studies provide some insight into spawn timing and the accuracy of redd counts as tool to index adult spawner abundance.

Redd life surveys were conducted in Toppenish Creek between the beginning of March and June in three reaches in the watershed (one reach on the mainstem of Toppenish Creek, one on the North Fork of Toppenish Creek, and one on Simcoe Creek). Reaches with suitable habitat were included. The surveys were performed weekly using techniques outlined in Gallagher et al. (2007) and developed in upper Columbia River watersheds. In summary, a designated redd surveyor walked an index portion of the watershed each week as conditions allowed. Each redd was examined and the condition of the redd was assessed and placed into four categories (new and measurable, not new but still measurable, still apparent but no longer measurable, and no longer apparent). Redds were flagged and each new redd was mapped and marked with a GPS.

We attempted to include a study to evaluate surveyor accuracy during the 2011 spawning season. Our methods were adapted by those proposed for use by the Upper Columbia monitoring team in 2010 (Andrew Murdoch, WDFW unpublished protocol). In summary, two independent surveys were performed (a mark survey followed immediately by a re-sight survey).   GPS coordinates and notes (including sketched maps) were compared at the end of the survey to determine if redds identified during the second re-sight survey are re-sights or "new sights".

To translate our census count into an estimate of steelhead abundance we utilized the method outlined in Gallagher et al. (2007). The cumulative redd count was multiplied by the standard 2.5 fish per redd used for Washington streams for an estimate of spawning escapement. Other expansion coefficients were also considered.

Results and Discussion

Juvenile Out-migration

The upper Toppenish Creek trap was deployed during the first week of November in 2010 and remained in until mid-June in 2011 when it was retrieved for repairs. Juvenile *O. mykiss* were captured throughout this period, but catch rates were low at the beginning and end of the season indicating that little of the outmigration season was missed. Above-normal precipitation and snowpack in 2011 resulted in several runoff events that were beyond those seen in previous years of screw trap operation. As a result on three occasions, the trap was removed for short periods of several hours to 48 hours due to movement of large debris jams and the possibility of stranding operators at the screw trap site. However, during most of the frequent high water events during 2011, we managed to keep the trap operating by maintaining staff onsite though the night to continuously remove debris from the screw trap. During periods of high flow and high catches, staff would stay onsite at the upper Toppenish screw trap in a trailer and check the trap every two hours throughout the night and clean any debris from the cone or live-box. In 2011, YRWP personnel had to stay on-site overnight at the upper Toppenish trap for 40 nights mostly between mid December and mid-March. This practice improved trap efficiency and reduced mortality. Overall (average) trap efficiency for the 2011 outmigration season was 21.8% and juvenile *O.mykiss* mortality for the season was 0.48%. We did not find a significant difference in efficiency between steelhead released during the day and those released after dark ($p > 0.05$); however, overall recapture rates were low during these trials. We will likely continue these day/night comparisons in the future.

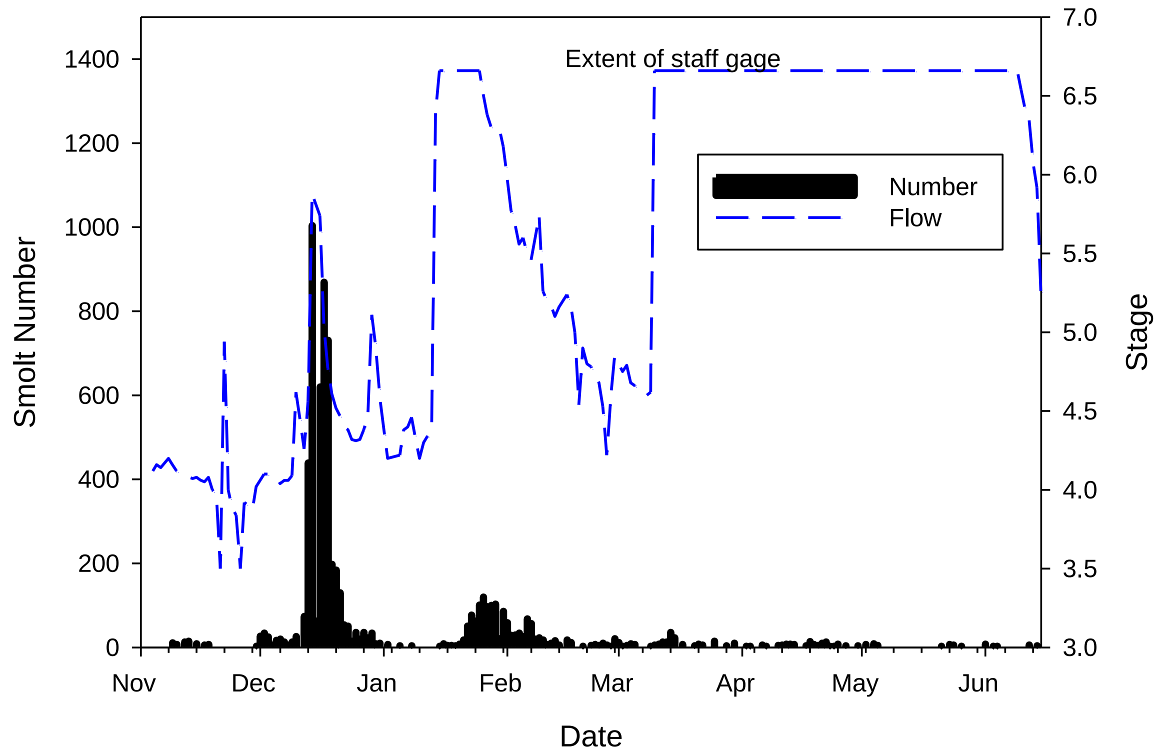

Figure 2. Number of steelhead juveniles captured per day (daily catch) compared with stream flow at the Upper Toppenish Creek screw trap in 2011. This illustrates a typical outmigration pattern for Toppenish Creek with the peak occurring from mid-December to mid-January.

For the entire MY 2011 season, most of outmigrants (71.6 %) were captured in December when the first winter storm of the season increased flows significantly above late-fall base flows (Figure 2). The percentage of the season's catch that followed this event at our screw trap in Satus Creek was almost identical (71.5 %). Migration patterns and out-migrant demographics are often similar in these two streams. Mean fork length for the season was 104.68 mm which is similar to previous years, although a relatively higher percentage of steelhead juveniles were less than 80 mm in 2011 (11.9 %). These individuals are likely age-0 parr that were swept downstream during the flood events of late 2010 and early 2011. The 2010 year class, which comprised much of this smaller group, was particularly large.

Monthly catches decreased steadily through the season with less than 7% of the annual catch occurring during the spring period (March-June). However, at the nearest PIT tag detection site on the Yakima River at Prosser dam (RM 48), migrants typically do not show up until the end of April through May. A more thorough discussion of timing can be found in previous YRWP annual reports (2008-2010).

Our primary goal in operating the screw trap is to estimate of the number of steelhead juveniles migrating out of the spawning and rearing habitat of upper Toppenish Creek and into the over-wintering habitat on lower Toppenish Creek (outmigration estimate). In 2011, our estimate of total outmigrating juveniles was 33,820 (SE=2292; CV=6.7%). A length-frequency histogram weakly suggested a possible delineation of age 0 parr and age 1+ presmolt/smolt at 84 mm, although this length is less than expected (Figure 3). Toppenish Creek has a protracted spawning season for steelhead and there is a wide variation of habitats within the watershed that produce different incubation times and growth rates. Regardless, if 84 mm is a viable delineation point between the two age classes, then 14.8% of the catch were age 0 and should out-migrate later and therefore shouldn't be included with this cohort. Reducing the total estimate by 14.8% would give an estimate of 28,815. It is possible that some of these smaller parr do outmigrate just as it is also possible that some of the larger juveniles included in this estimate will attempt to stay in the watershed and out-migrate in subsequent years as 2- or 3–year-olds. For the purpose of monitoring trends in juvenile out-migration, using the estimate of all juveniles captured at the trap is probably prudent assuming that no substantial differences in age composition or migratory behavior exist between years.

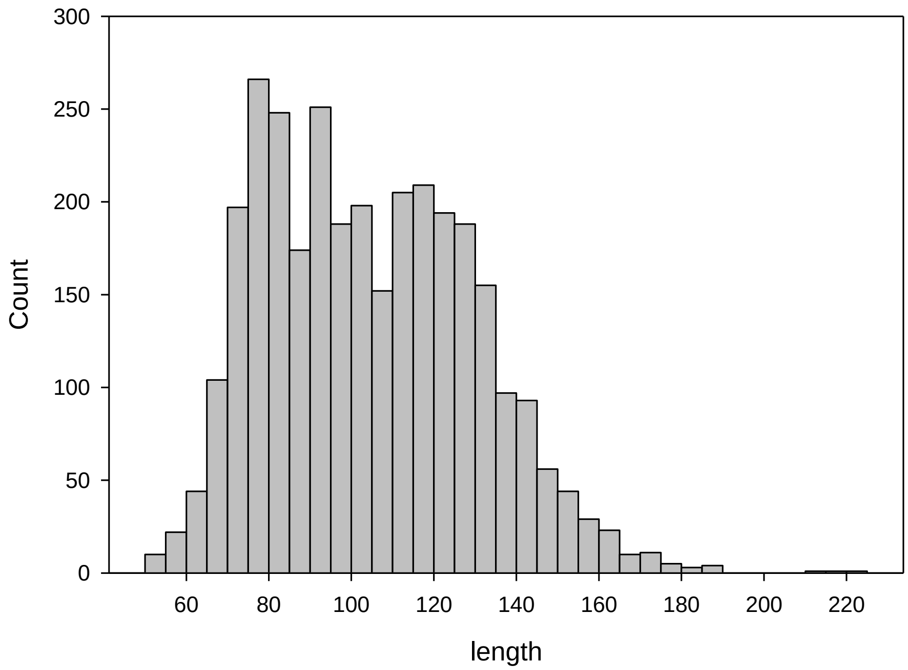

Figure 3. Length-frequency distribution for measured juvenile steelhead (*O.mykiss*) captured in the upper Toppenish Creek screw trap between November and June 2011.

Although these estimates do not differentiate between residents and anadromous steelhead smolts, we have concluded that the number of residents moving through this portion of Toppenish creek is small and possibly discountable. That assumption is based on documentation of very few recaptured *O.mykiss* that were not previously released upstream as part of an efficiency test and recaptured within a few days. With a more robust resident population we would expect periodic recaptures of residents that were PIT tagged earlier in the season or in other years. These non-efficiency recaptures are more commonplace in watersheds where resident populations are present at the trapping location. Another indicator of resident *O.mykiss* absence is the rarity of individuals larger than 200 mm in the season catch. These larger individuals are however, sometimes seen miles upstream during summer snorkel surveys. High summer temperatures may prevent the resident population from establishing themselves lower in the watershed where the traps are located. In our similar screw trap on Ahtanum Creek, we frequently catch *O. mykiss* larger than 200 mm, despite a slower rotation of the trap cone. This suggests that trap avoidance by larger fish of the Toppenish trap is not the reason for their absence. Large *O.mykiss* are also rare in the Satus Creek screw trap.

Lower Toppenish Screw Trap

In 2011, we operated a second screw trap at a new location near the mouth. At the lower Toppenish Creek Trap, 14 juvenile steelhead were captured at this site indicating that the trap location and site stream morphology was less than ideal. However, we could not locate a better site near the mouth of Toppenish Creek. Like our other sites on the Yakima River floodplain, morphology and low gradient make screw trapping a challenge. It is impossible to obtain estimates of outmigration with such a low sample size. Timing is also unclear for the same reason; however, outmigration through this location appears to occur throughout the season (December through June). Most PIT-tagged juveniles are detected at the first detection facility at Prosser Dam in late April through mid May. We hope to increase the efficiency of this trap by using weir panels to direct more flow and fish into the screw trap in future years. Since December 2012, the trap data supplement data collected by an instream PIT tag antenna at the same location. We hope to continue operation of the screw trap to test efficiency of these antennas in detecting outmigrating smolts and to recapture juveniles tagged upstream to collect information on winter growth.

Adult Abundance

The 2011 spawning season on Toppenish Creek marked the first year with expanded funding allowing us to boost manpower and obtain needed equipment to access and survey the upper part of the Toppenish watershed. As described in many of our previous annual reports, we have had difficulty reaching the upper portion of this watershed in most years due to spring snowpack and precipitation. In 2011, we were able to reach the upper portion of the Toppenish watershed beginning on March 28 for a first pass. This portion of Toppenish Creek would have been inaccessible without a UTV fitted with snowtracks and snowshoes for surveyors. The second pass was performed in April. By that time, much of the snow in the upper watershed had melted but the UTV and snowshoes were still necessary to access the uppermost site. We were prevented from completing a third pass until the beginning of June by high flows caused by snowmelt in the highest regions of the watershed. We were, despite an above-normal year for precipitation and snowpack in the eastern Washington Cascades, able to complete our three-pass census survey as planned.

Table. 1 Number of steelhead redds identified in the Toppenish Creek watershed between March and June 2011.

Stream	**Upper Toppenish Watershed** Survey reach access point (river miles in parentheses)		**Distance miles**	**Number of Redds**
Toppenish	O Conner Cr (65.7)	East Bank (61.1)	4.6	**5**
	East Bank (61.1)	NF confluence (55.4)	5.7	**11**
	NF confluence (55.4)	Wash out (50.9)	4.5	**13**
	Wash out (50.9)	Willy Dick Cr (48.5)	2.5	**5**
	Willy Dick Cr (48.5)	Olney Lateral (44.2)	4.3	**17**
	Olney Lateral (44.2)	Pom Pom rd. (38.9)	5.3	**6**
	Pom Pom Rd. (38.9)	Shaker Church Rd. (35.9)	3	**0**
Total			**29.9**	**57**
N. Fork Toppenish	NF Falls (4)	NF confluence (0)	**4**	**10**

Willy Dick	old logging site (4)	Confluence (0)	**4**	**4**

	Simcoe Creek Watershed			
	Survey reach access point (river miles in parentheses)			
Simcoe	NF at 2nd crossing (6.5)	Diamond Dick (3.4)	3.1	**0**
	NF at Diamond Dick Cr (3.4)	NF/SF confluence (0)	3.4	**10**
	SF 6 miles above confluence (6.2)	3 miles above confluence (3)	3.2	**0**
	SF 3 miles above confluence (3)	NF/SF confluence (0)	3	**0**
	NF/SF confluence (18.9)	Simcoe Creek Rd. (15.3)	3.6	**6**
	Simcoe Creek Rd. (15.3)	Wesley Rd. (10.1)	5.2	**4**
	Wesley Rd. (10.1)	N. White Swan Rd. (8.1)	2.0	**0**
	N. White Swan Rd. (8.1)	Stephenson Rd. (5.9)	2.2	**1**
Total			**25.7**	**21**
Agency	Falls (8.9)	Western Diversion. (4.4)	4.5	**3**
	Western Diversion. (4.4)	Confluence (0)	4.4	**1**
Total			**8.9**	**4**
Wahtum	Yesmowit Rd. (3.6)	Confluence (0)	**3.6**	**4**

Total			76.1	**100**

For the year we identified a total of 100 redds, which is slightly lower than 2010 (n=105). In 2010, only one pass of the upper reaches of Toppenish Creek was completed at the end of the year due to high flows and poor accessibility, and only 7 redds were identified upstream from the North Fork of Toppenish Creek in 2010 compared to 16 redds in 2011. Redd counts in Simcoe Creek were similar in 2010 and 2011 (n=22 and n=21 respectively). Lower flows and better access in Simcoe Creek typically facilitates completion of all three passes in this stream, making Simcoe Creek useful as an index reach to track trends in the watershed. Of the smaller tributaries to Toppenish and Simcoe Creeks, North Fork Toppenish Creek provides the best quality spawning habitat and rearing conditions, although there is a falls at least 12 feet high near river mile 4 and channel simplification caused by proximate road placement. Ten redds were identified in 2011 compared to 13 in 2010. Three to 4 redds were seen in other small tributaries including Willy Dick, Agency, and Wahtum creeks.

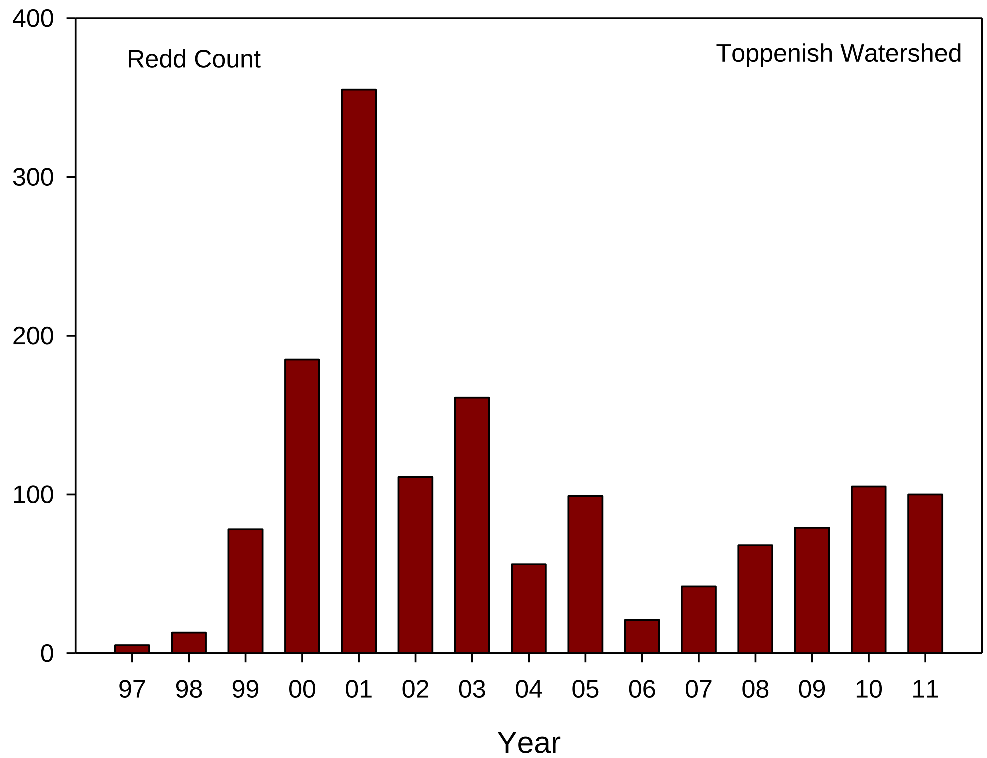

Figure 4. Number of steelhead redds per year in the Toppenish Creek watershed from 1997 to 2011. The years 2001 and 2005 had especially low flow creating ideal survey conditions but affecting redd distribution.

We used a helicopter to survey the lower portion of the Toppenish watershed, following the protocol described in Jones et al. (2007). We used three observers including the pilot, who has experience with aerial redd surveys. The survey was completed on May 13th between the mouth of Toppenish Creek and Shaker Church Road (RM 35.9). No redds or live fish were identified during the survey. The water was fairly clear but high upstream from the confluence with Marion Drain near the mouth. Downstream from the Marion Drain intersection, the water was more turbid with visibility of about 1 foot. Completion of this survey allowed us to evaluate the spawning habitat in a reach that is largely unwadeable and hazardous to float in a canoe, raft, or other watercraft. The spawning potential of the reach appears to be low. Although Hockersmith et. al. (1995) reported spawning during their radiotracking study as low as river mile 22; we didn't observe any potential spawning habitat until above Simcoe Creek (RM 32). Few suitable riffles were observed below this point and most riffles that were observed were covered with thick aquatic vegetation indicating high fine sediment levels that would inhibit spawning. The low gradient and absence of gravel-producing tributaries in the lower Toppenish watershed appear to create stream morphology not compatible with salmonid spawning. We plan to survey this reach again in 2012 and 2013 to confirm our conclusion that the lower reach of Toppenish Creek serves mainly as a migration corridor and as overwintering habitat for steelhead pre-smolts.

Surveyor Accuracy

Our method of assessing accuracy appears to be feasible logistically although some assumptions of mark-recapture techniques are violated. During 2011 surveys on the mainstem Toppenish and Simcoe Creek, only one redd was identified that was not re-sighted. The timing of these surveys around a high flow event affected the method's success. We completed these surveys towards the end of the spawning season after a major runoff event occurred in May and probably scoured most of the redds, making them unidentifiable.

Redd Count Expansion

The cumulative redd count was multiplied by 2.5 fish per redd for an estimate of spawning escapement of 250 adult steelhead for the watershed. The 2.5 fish per redd expansion used for our estimate is similar to those obtained through studies of other Middle-Columbia steelhead populations in Oregon ranging from 2.1 to 2.6 fish per redd (Poxon et. al 2011). Another method to estimate adult abundance for Toppenish Creek commonly used by Yakima basin managers is to disaggregate the total adult steelhead count at Prosser by the proportion of radio-tagged steelhead (from Prosser) returning to the Toppenish Creek watershed (11%) during a radio-telemetry study that spanned 1989-1992 (Hockersmith 1995). With 6197 adult steelhead counted at Prosser between July 1, 2010 and June 30, 2011, we estimate a return of 682 Toppenish steelhead. A 3-year radio-telemetry study began in 2011, which should provide further insight into tributary escapement. The redd count expansion method likely underestimates steelhead spawning escapement due to scouring of redds during high water events in between surveys. However, it should be taken into consideration that redds wiped out during floods will probably not produce viable offspring.

References

Bjorkstedt (2005 and 2009). Darroch's (1961) Petersen Estimator (Darr v 2.02 R code) available at http://swfsc.noaa.gov/textblock.aspx?Division=FED&id=3346 .

Carlson, S. R., L. G. Coggins and C.O. Swanton. 1998. A simple stratified design for smolt mark-recapture estimation for salmon smolt abundance. Alaska Fishery Research Bulletin 5(2): 88-102.

Crawford, B., and S. Rumsey. 2009. Guidance for monitoring recovery of salmon and steelhead. NOAA Fisheries Service. North West Region.

Gallagher, S.P., P.K. Hahn, and D.H. Johnson. 2007. Redd Counts. Pages 197-231 *in* D.H.Johnson, B.M. Shrier, J.S. O'Neal, J. A. Knutzen, X Augerot, T.A. O'Neil, and T. N. Pearsons. 2007. Salmonid field protocols handbook: techniques for assessing status and trends in salmon and trout populations. American Fisheries Society, Bethesda Maryland.

Gallagher, S.P.,D.W. Wright, B.W. Collins, and P.B. Adams. 2010. A Regional Approach for monitoring Salmonid Status and Trends: Results of a Pilot Study in Coastal Mendocino County, California. North American Journal of Fisheries Management 30:1075-1085.

Gallagher, S.P., P.B. Adams, D.W. Wright, and Barry Collins. 2010. Performance of Spawner Survey Techniques at Low Abundance Levels. North American Journal of Fisheries Management 30:1086-1097.

Hilborn, R, B.G. Bue, S. Sharr. 1999. Estimating spawning escapement from periodic counts: a comparison of methods. Canadian Journal of Fisheries and Aquatic Sciences 56:888-896.

Hockersmith, E., J. Vella, L. Stuehrenberg, R.N. Iwamoto, and G. Swan. 1995. Yakima River radio-telemetry study: steelhead, 1989-93, Bonneville Power Administration, Portland, Oregon.

Jezorek, I G, J.H. Petersen. 2005. Monitoring and assessment of juvenile steelhead in the Toppenish Creek National Wildlife Refuge, Science Support Project 2003. Prepared for the USFWS TCNWR. USGS, Western Fisheries Research Center, Cook, WA 41pp.

Jones III, E. L, S. Heinl, and K. Pahlke. 2007. Aerial Counts. Pages 197-231 *in* D.H.Johnson, B.M. Shrier, J.S. O'Neal, J. A. Knutzen, X Augerot, T.A. O'Neil, and T. N. Pearsons. 2007. Salmonid field protocols handbook: techniques for assessing status and trends in salmon and trout populations. American Fisheries Society, Bethesda Maryland.

Poxon, B. D., D. M. Faber, J. R. Ruzycki, R. W. Carmichael. 2011. Abundance, Productivity, and Life History of Fifteenmile Creek Steelhead. Project No. 2010-35-01, Contract No. 54132, the Bonneville Power Administration, Portland, Oregon

Rawding, D. and P. Cochran. 2007. Wind River Winter and Summer Steelhead Adult and Smolt Population Estimates from Trapping Data, 2006. Project No. 199801900, Contract No. 19617, the Bonneville Power Administration, Portland, Oregon

Susac, G. L., S. E. Jacobs. 1999. Evaluation of spawning ground surveys for indexing the abundance of winter steelhead in Oregon coastal basins. Oregon Department of Fish and Wildlife Federal Aid in Sport Fish Restoration Program: F-145-R-08.

Terraqua, Inc. 2009. A Field Manual of Scientific Protocols for Downstream Migrant Trapping within the Upper Columbia Monitoring Strategy. BPA, ISEMP. (.pdf)

Terraqua, Inc. 2009. A Field Manual of Scientific Protocols for Steelhead Redd Surveys within the Upper Columbia Monitoring Strategy. BPA, ISEMP. (.pdf)

Thedinga, J.F. 1994. Determination of salmonid smolt yield with rotary screw traps in the Situk River, Alaska, to predict the effects of glacial flooding. North American Journal of Fisheries Management 14: 837-851.

Volkhardt, G.C., S.L. Johnson, B.A. Miller, T.E. Nichelson, and D.E. Seiler. 2007. Rotary Screw Traps and Inclined Plane Traps. Pages 235-266 *in* D.H. Johnson, B.M. Shrier, J.S. O'Neal, J. A. Knutzen, X Augerot, J.S. O'Neil, and T. N. Pearsons. 2007. Salmonid field protocols handbook: techniques for assessing status and trends in salmon and trout populations. American Fisheries Society, Bethesda Maryland.

Yakima Basin Fish and Wildlife Recovery Board. 2009. Yakima Steelhead Recovery Plan. Yakima, WA. http://www.ybfwrb.org/Recovery.html

Yakima Basin Fish and Wildlife Recovery Board. 2009. Final Draft: VSP Section, Yakima Steelhead, Research, Monitoring, and Evaluation Plan. Yakima, WA. http://www.ybfwrb.org/Library/SteelheadRME/YakimaSteelheadVSPMonitoringPlan.pdf

APPENDIX A. ADDITIONAL TABLES AND FIGURES

Table A-1. Steelhead juvenile catch and mark-recapture data stratified weekly for the upper Toppenish creek screw trap for the MY 2011 season. Recaptures for each week are adjusted using PIT tag codes to exclude fish tagged in previous seasons and to assign fish to appropriate release group (e.g. fish in the trap recapture week i +1 column were recaptured the week following the week they were released above the trap)

statistical week (i)	Dates	Trap Catch (week i)	Upstream Release (week i)	Trap Recapture (week i)	Trap Recapture (week i + 1)	Trap Recapture (week i + 2)
Week 1	11/1 --11/7	3	0	0	0	0
Week 2	11/8--11/14	52	16	1	0	0
Week 3	11/15--11/21	24	3	1	0	0
Week 4	11/22--11/28	0	0	0	0	0
Week 5	11/29--12/5	112	70	16	0	0
Week 6	12/6--12/12	162	71	13	0	0
Week 7	12/13--12/19	3924	449	129	6	1
Week 8	12/20--12/26	490	302	98	0	0
Week 9	12/27--1/2	126	92	20	0	0
Week 10	1/3--1/9	27	18	4	0	0
Week 11	1/10--1/16	15	0	0	0	0
Week 12	1/17--1/23	168	0	0	0	0
Week 13	1/24--1/30	605	293	35	0	0
Week 14	1/31--2/6	332	144	15	0	0
Week 15	2/7--2/13	151	99	10	0	0
Week 16	2/14--2/20	42	26	3	0	0
Week 17	2/21--2/26	33	15	4	0	0
Week 18	2/27--3/5	60	14	5	0	0
Week 19	3/6--3/12	33	5	1	0	0
Week 20	3/13--3/19	84	0	0	0	0
Week 21	3/20--3/26	35	0	0	0	0
Week 22	3/27--4/2	17	0	0	0	0
Week 23	4/3--4/9	12	0	0	0	0
Week 24	4/10--4/16	34	0	0	0	0
Week 25	4/17--4/23	56	15	1	0	0
Week 26	4/24--4/30	19	12	0	0	0
Week 27	5/1--5/7	22	19	0	0	0
Week 28	5/8--5/15	3	2	0	0	0
Week 29	5/16--5/22	7	4	0	0	0
Week 30	5/23--5/29	18	12	0	0	0
Week 31	5/30--6/5	17	16	0	0	0
Week 32	6/6--6/12	6	6	0	0	0
Week 33	6/13--6/19	9	8	0	0	0

Table A-2. Monthly steelhead catch statistics for the rotary screw trap in upper Toppenish Creek (RM 26.5) for the 2011 season.

Stat	Nov	Dec	Jan	Feb	March	April	May	June	Overall
Monthly Catch	82	4797	915	496	202	124	50	32	6698
% of total	1.2%	71.6%	13.7%	7.4%	3.0%	1.9%	0.7%	0.5%	100.0%
Max Fork Length	158	218	222	179	189	195	190	188	222
Min Fork Length	69	51	52	52	58	70	72	80	51
Mean Fork Length	111.71	104.54	100.75	101.28	114.89	115.26	114.86	128.03	104.68
Max Weight	42	103	109.2	54.5	66.4	65	63	69.6	109.2
Min Weight	3	1	1.3	2.2	1.6	3	3.8	4.4	1
Mean Weight	14.59	12.85	11.91	12.59	17.59	18.36	17.49	24.86	13.20
Mean Cond.Factor	0.951	0.972	0.999	1.033	0.993	0.998	0.976	1.008	0.987
Number tagged	43.0	1746.0	670.0	342.0	171.0	112.0	46.0	31.0	3155.0
% monthly catch tagged	52.44%	36.40%	73.22%	68.95%	84.65%	90.32%	92.00%	96.88%	47.10%
%of total	1.36%	55.34%	21.24%	10.84%	5.42%	3.55%	1.46%	0.98%	100.00%

Table A-3. Monthly steelhead catch statistics for the screw trap at lower Toppenish Creek (RM 1) for the 2011 season.

Stat	Nov	Dec	Jan	Feb	March	April	May	June	Overall
Monthly Catch	0	1	3	2	1	1	6	0	14
% of total	0.0%	7.1%	21.4%	14.3%	7.1%	7.1%	42.9%	0.0%	100.0%
Max Fork Length	.	112	113	103	175	180	220	.	220
Min Fork Length	.	112	65	100	175	180	170	.	65
Mean Fork Length	.	112.00	87.33	101.50	175.00	180.00	186.17	.	146.36
Max Weight	.	14	14	10.5	53	40.3	96.6	.	220
Min Weight	.	14	2.8	10	53	40.3	50	.	65
Mean Weight	.	14.00	7.43	10.25	53.00	40.30	65.18	.	146.36
Mean Cond.Factor	.	0.996	0.970	1.050	0.989	0.691	0.996	.	0.970
Number tagged	.	1.0	2.0	2.0	0.0	1.0	6.0	.	11.0
% monthly catch tagged	.	99.65%	66.67%	100.00%	0.00%	100.00%	100.00%	.	78.57%
%of total	.	9.06%	18.18%	18.18%	0.00%	9.09%	54.55%	.	100.00%

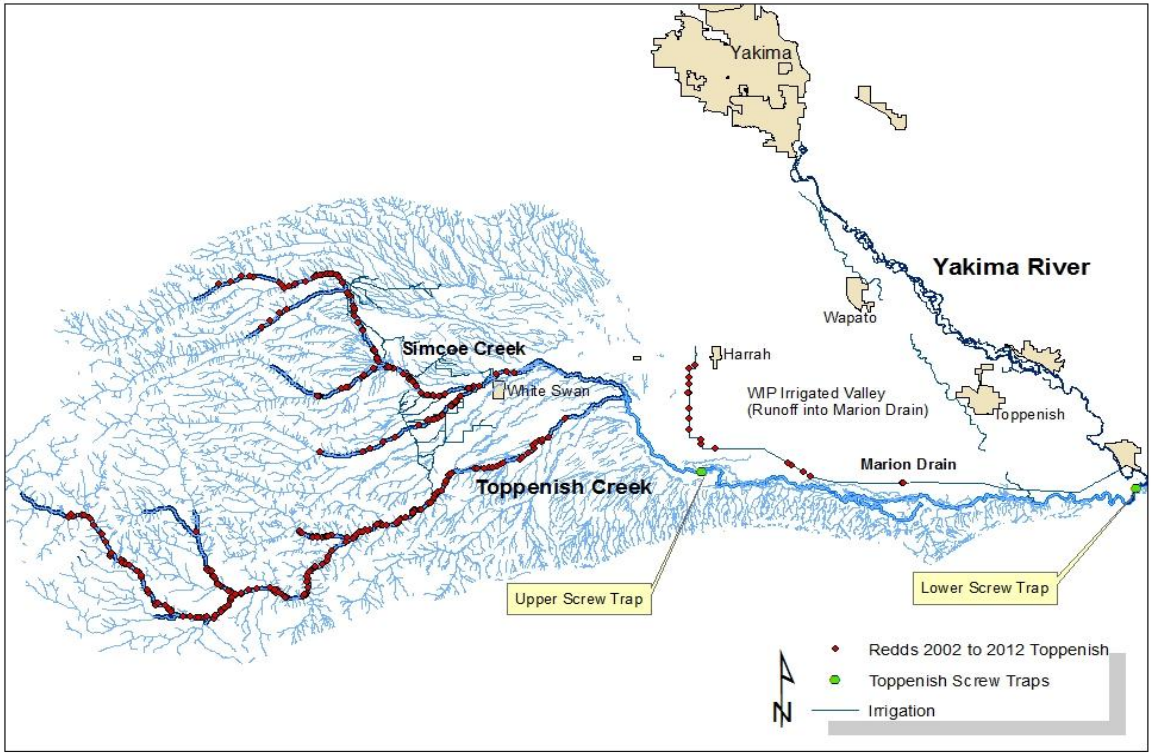

Figure A-1. Map of the study area including screw trap location, steelhead distribution, and steelhead redd GPS locations,

Figure A-2. Photograph of the 5-foot rotary screw trap at the upper Toppenish location (RM 26.5) including modifications.

Figure A-3. Aerial photograph of the upper Toppenish creek screw trap location, downstream from the Unit 2 irrigation diversion.