FY2011 ANNUAL REPORT

MARCH 1, 2011 THROUGH FEBRUARY 29, 2012
YAKAMA RESERVATION WATERSHEDS PROJECT
BPA Project #1996-035-01-Contract #35636

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I. *Introduction*

A. Project Overview

In June of 2005, the Ahtanum Watershed Assessment, Toppenish Watershed and Satus Watershed Projects were combined into one project, named the Yakama Reservation Watersheds Project (YRWP). Since the last report in 2010, YRWP staff have continued several tasks including close monitoring of stream discharge and irrigation withdrawals, monitoring of juvenile steelhead and coho outmigration, steelhead spawning surveys, and analysis of irrigation extent and timing. We have also continued our restoration efforts in the three watersheds, completing a fish screen engineering design, three culvert removals and ford installations, construction of exclosure fences, bank stabilization and floodplain enhancement, and meadow restoration during the 2011 work season. Additionally, a reach assessment was conducted to identify future restoration projects on upper Toppenish Creek.

II. *Data Collection*

A. Smolt traps

Since 1999, we have utilized several five-foot diameter rotary screw traps to enumerate juvenile steelhead and analyze various aspects of steelhead outmigration (i.e. total outmigrant estimate, timing, outmigrant age structure, size, condition, outmigrant survival, smolt to adult returns, and adult-smolt productivity). We have deployed 3 traps (1 trap in Toppenish, 1 trap in Satus, and 1 in Ahtanum) for nearly 10 years. In Satus and Ahtanum the traps are located within several miles from the mouth. In Toppenish Creek, the trap is situated approximately 30 miles upstream on Toppenish Creek (however, this location is still below all the suitable spawning and rearing habitat in the stream). For the 2010-2011 season, we also deployed a second trap close to the mouth of Toppenish Creek that we intend to use to evaluate steelhead juvenile survival between the upper screw trap and the lower screw trap. This 30 mile "migration corridor" is impacted by intensive agriculture, the Wapato Irrigation Project and other water users and the influence of water use in this corridor on Juvenile and adult steelhead are unknown but conceivably negative. In addition to an instream PIT tag antenna at this location, the screw trap deployed at the mouth of Toppenish should provide information on survival and growth to begin to answer some of the questions about the role lower Toppenish plays in steelhead population dynamics.

The Rotary Screw Trap developed by E.G. Solutions in the late 1980s has been accepted as an effective device to capture and study out-migrating juvenile anadromous salmonids in Western North American rivers. Carson et. al. (1995) demonstrated that a one trap study using mark- recapture methods (similar to our technique) produced outmigration estimates that were comparable to a smolt weir that captured all smolts moving downstream when sample size was adequate. Other studies and reports have documented the effectiveness of this device in providing an estimate of outmigration (Rawding and Cochran 2007, Thedinga 1994). Now, most outmigration studies in the region rely on this device to estimate outmigration and study smolt demographics. The Yakama Nation obtained a rotary screw trap in 1997-- only several years after its development. This trap was deployed in Satus Creek. We deployed one in Toppenish Creek in 1999 and on in Ahtanum in 2000.

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 juveniles. 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 through-out the season. This affected the accuracy of 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 diligent attention to keeping the cone free of debris. This requires multiple visits to the traps during a 24 hour period and in some cases camping out at the trap and cleaning it periodically through-out the night. Our study and out-migrant estimates have improved since we have implemented this more rigorous maintenance schedule.

Methods

In 2011, we purchased a new screw trap from E.G. solutions for upper Toppenish Creek with funds from the Toppenish Biological Opinion Monitoring and Evaluation Project (BPA 1996035001). We purchased a trap with oversized pontoons to provide enough flotation for modifications we planned to make to make the screw trap safer to operate during high water events and at night. Modifications included: a new drive system for the debris wheel, a chain-hoist system to lift and secure the screw trap cone, and a platform at the front of the screw trap for cone cleaning.

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 are 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 (about 10 per day). We also collected fin clips from 100 individuals from Satus and 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 sub-sample (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 the efficiency (i.e. mark-recapture). Release site alternated between the right and left bank of the stream. Efficiency tests were performed 4 times per week

(Monday-Thursday) and release numbers and recaptures for the week were pooled. An evaluation between day and night releases was performed on several release groups to compare efficiency during the Recaptures and undersized fish were released 100 feet or more downstream from the screw trap. Physical data (water temperature, air temperature, and percent cloud cover) were recorded. The trap rotation rate (seconds per 1 revolution) was recorded to evaluate operating efficiency. A staff gage reading is obtained and used to compare timing with discharge.

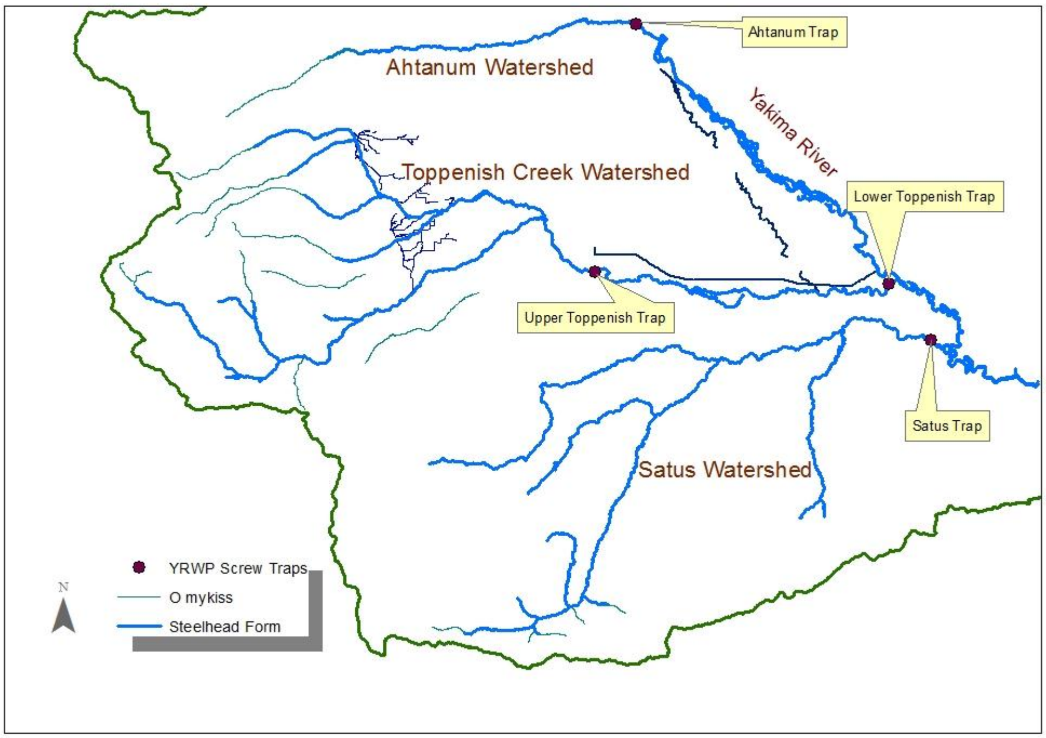

Figure 1 . Location of rotary screw traps operated by YRWP in Satus, Toppenish, and Ahtanum Creeks on the lower Yakima River.

Outmigration estimates for the season were obtained from each of the screw trapping sites with stratefied Petersen mark-recapture methods described in Volkhardt et. Al. (2007). The entire outmigration season from October through June were stratefied weekly. All *O. mykiss* over 80 mm were PIT tagged and released upstream from the trap on Monday through Thursday at the upper Toppenish screw trap where annual catches are high. At the other three traps (Lower Toppenish, Satus, and Ahtanum) where annual catches are low and sample sizes are often insuficient to obtain reliable estimates, efficiency releases are performed daily with all PIT tagged fish. Release sites were several-hundred meters upstream—which on these relatively small streams encompasses several riffles and pools—allowing for released fish to disperse but limiting mortallity between release site and trap. All fish are scanned for PIT tags and recaptures are attributed to their proper release group. On dates when the trap was not operating catches were interpolated using the mean of the previous three days and the following three days (Volkhardt et al. 2007). Estimates (and standard errors) are calculated using software created by Bjorkstedt (Darr V 2.02 R code, 2009) utilizing Darrochs (1961) statefied Petersen estimator. A one-trap study design was utilized.

Toppenish Creek

In 2009, Toppenish Creek was identified as the watershed in the Yakima basin where "fish in/fish out" population monitoring should be prioritized. The population in Toppenish Creek is one of the four (Satus, Toppenish, Naches, and Upper Yakima) recognized by NOAA for recovery purposes in the Yakima Basin. 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.

Upper Toppenish Screw trap

We have deployed and operated the screw trap located a river mile 26.5 below the Unit 2 diversion since 1999. This location was chosen because of its 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. 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 an upcoming three-year radiotracking study should lend additional support to our exclusion of this reach.

The upper Toppenish Creek trap was deployed during the first week of November in 2010 and remained in until mid-June 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 beyond those seen in previous years of screw trap operation. As a result on three occasions the trap was pulled for short periods of several hours to 48 hours due to movement of large debris jams and fear of stranding of 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 through-out the night and clean any debris from the cone or live-box. In 2011, YRWP personnel had to stay on-site over night at the upper Toppenish Trap for 40 nights. 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%.

For the 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. The percentage of the seasons catch that occurred following this event in Satus Creek was almost identical (71.5 %). Migration patterns and outmigrant demographics are often similar in these two streams. Mean length for the season was 104.68 mm which is similar to previous years, although a relatively higher percentage of steelhead juveniles were under 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 many of these smaller age 0 fish belonged to, 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). 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 annual reports (2008-2010).

Our primary goal in operating the screw trap is to obtain an 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 suggested a possible delineation of age 0 parr and age 1+ presmolt/smolt at 84 mm, although this length is much less than expected. Toppenish Creek has a protracted spawning season for steelhead and there is a wide variation of habitats within the watershed that produce different 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 during the next 2 years and therefore shouldn't be included with this cohort. Reducing the total estimate by 14.8% would give an estimate of 28,815. 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 very 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 lower in the watershed where the traps are located.

Table 1 Monthly steelhead catch statistics for the rotary screw trap in upper Toppenish Creek (RM 30) 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%

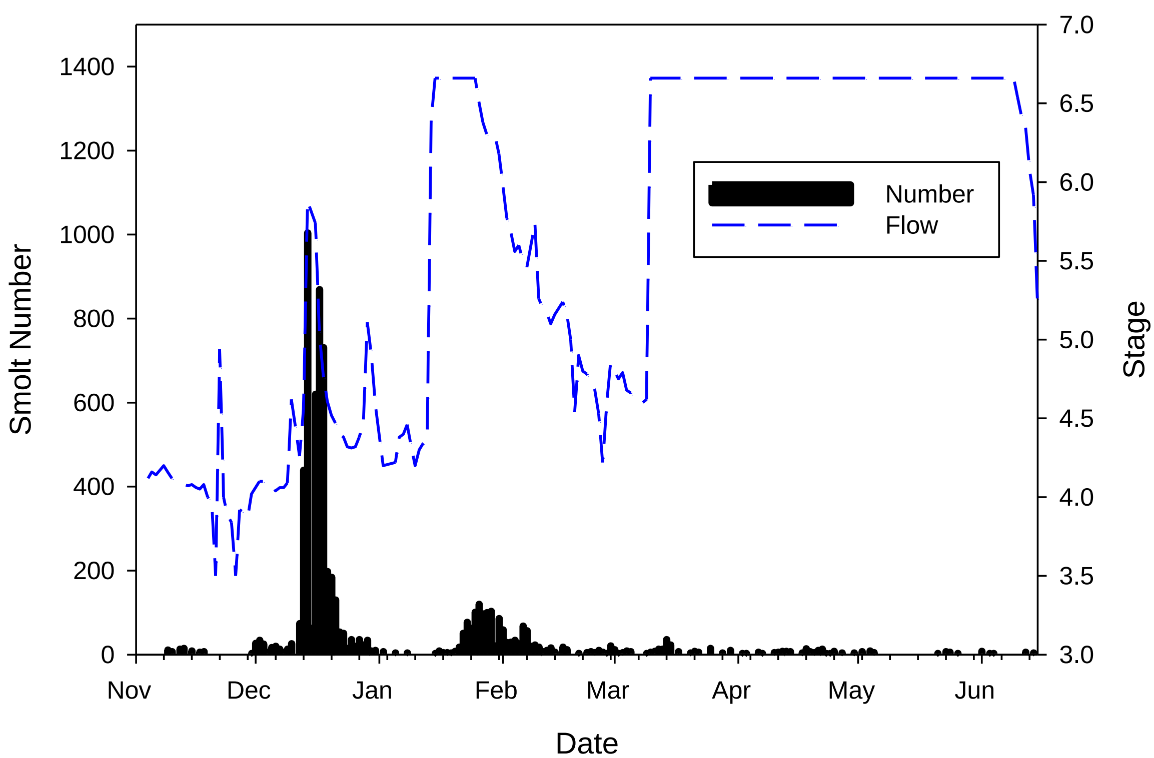

Figure 2. Number of steelhead juveniles captured per day (daily catch) compared with stream flow at the Upper Toppenish Creek screw trap.

Lower Toppenish Screw Trap

We deployed a second screw trap on Toppenish Creek in 2010 to evaluate timing and survival of steelhead smolts in the Lower part of Toppenish Creek. This portion of Toppenish Creek is situated on a rich plain that has been modified extensively primarily for agricultural purposes 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 aquatic 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 the 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.

In 2011, only 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 more ideal 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 April and 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 2012. Also in 2012, the trap data will supplement data collected by and instream PIT tag antenna at the same location. We hope to continue operation of the screw trap to test efficiency of the antennas and to collect information on winter growth.

Table 2 Monthly statistics for the 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%

Satus Creek

In 2011, we operated the screw trap at Satus Creek from the beginning of November through the end of June. During this time, trapping was only halted on several occasions due to high flows lasting less than 10 days. Steelhead Juveniles were not captured until mid-December in 2010. We continued to capture them until June 20th, 2011. Although the trap was deployed through the end of June we caught one *O. mykiss* juvenile beyond the 2nd. The majority of the seasons (71%; Table 3) catch occurred following the first peak in discharge in mid-December. This pattern is observed during most years that we have operated screw traps in all three tributaries. Although, the peak catch often lags behind Toppenish creek by a few days or longer due to a greater distance downstream from spawning and rearing habitat. Only 10.6% of the catch occurred during the spring months (March, April, May, and June). Juvenile size increased for later season migrants--which is typical. Survival is normally higher for these later migrants. Larger size and shorter travel times are important factors contributing to this.

Table 3 Monthly statistics for the Satus Creek Trap (RM 1) for the 2011 season.

Stat	Nov	Dec	Jan	Feb	March	April	May	June	Overall
Monthly Catch	.	476	95	25	9	28	31	2	666
% of total	.	71.5%	14.3%	3.75%	1.4%	4.2%	4.7%	0.3%	100.0%
Max Fork Length	.	167	218	255	158	178	188	130	255
Min Fork Length	.	67	72	64.00	81	65	111	103	64
Mean Fork Length	.	106.22	103.89	97.63	122.89	143.26	146.65	116.50	109.28
Max Weight	.	115.0	95.5	200.10	40.3	60.3	60.3	21.2	200.1
Min Weight	.	3.0	3.2	3.00	6.2	3.0	11.5	8.6	3.0
Mean Weight	.	13.27	12.99	16.31	21.48	31.93	31.54	14.90	15.08
Mean Cond.Factor	.	1.011	0.986	1.03	1.037	0.986	0.949	0.876	1.004
Number tagged	.	296	83	22	4	25	29	2	461.000
% monthly catch tagged	.	62.2%	87.4%	88.0%	44.4%	89.3%	93.5%	100.0%	69.2%
%of total	.		18.0%	4.8%	0.9%	5.4%	6.3%	0.4%	100.0%

Compared to the Screw Trap deployed in the upper Toppenish Creek , The Satus Creek trap has not captured enough smolts to produce estimates meeting proposed data standards (CV<30%) recommended in Crawford and Rumsey (2009) in years prior to 2011. For the 2011 season, however, we were able to obtain an estimate of out-migration (number of steelhead juveniles moving out of the spawning and rearing habitat to overwintering habitat in the Yakima River) at the Satus screw trap meeting those standards. We estimate 15772 (SE=3824; CV= 24.2%) juveniles migrated out of the Satus watershed in 2011. This estimate includes all sizes. A length-frequency histogram did not elucidate any obvious delineation points between year classes; however, 10.4% of the catch was under 84mm. Using the same cutoff length used in Toppenish would produce and estimate of 11,414. The number of small possible age-0 juveniles in the catch was higher during the 2011 season than others. A large 2010 year class an numerous high water events displacing parr were likely factors. Like Toppenish Creek, we feel that the resident *O. mykiss* contribution to this estimate this low in the Satus watershed is probably discountable for the same reasons (i.e, recaptures, smolt size, and summer high water temperature). We routinely capture chinook salmon parr at this screw trap that we believe originate in the upper Yakima or Natches watershed. In 2011, we captured chinook smolts. These individuals were tagged and DNA samples were collected.

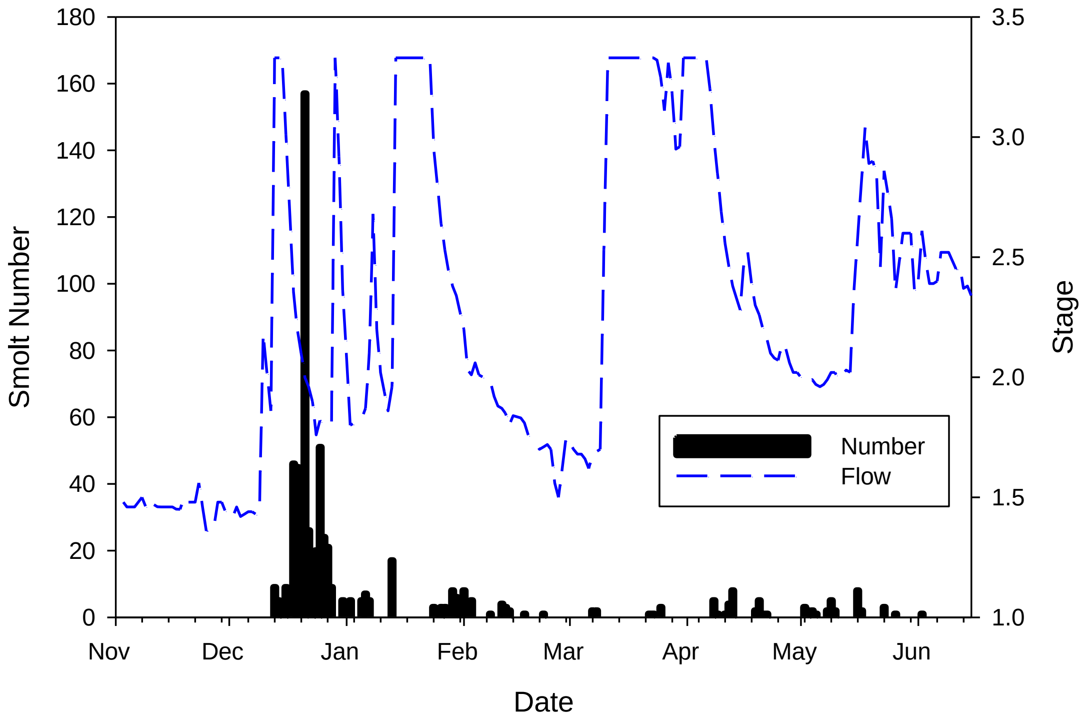

Figure 3. Number of steelhead juveniles captured per day (daily catch) compared with stream flow (stage) at the Satus Creek screw trap.

Ahtanum Creek

We have struggled to obtain useful outmigration information from Ahtanum Creek since the beginning of the 2007-2008 season when the landowner at the previous trapping location requested that we remove our trap from their property and we relocated the screw trap to LaSalle High School several hundred meters downstream. We have moved the trap several times on this property without increasing our catch numbers. Although we believe that smolt output is relatively low compared with Toppenish and Satus Creek, smolt trap efficiency and the resulting catch rate (n=20; Table 4) is too low for any meaningful analysis. Timing appears to follow a similar pattern as seen in Toppenish and Satus Creek. We routinely capture chinook salmon parr at this screw trap that we believe originate in the upper Yakima or Natches watershed. In 2011, we captured 24 chinook smolts these individuals were tagged and DNA samples were collected. An occasional coho salmon parr was captured in this trap as well during the season, the progeny of strays that spawn in the lower reaches of Ahtanum Creek.

Table 4 Monthly steelhead catch statistics for the Ahtanum Creek Trap (RM 3) for the 2011 season.

Stat	Nov	Dec	Jan	Feb	March	April	May	June	Overall
Monthly Catch	.	1	7	4	1	3	4	0	20
% of total	.	5.00%	35.00%	20.00%	5.00%	15.00%	20.00%	0.00%	100.00%
Max Fork Length	.	180	180	185	150	262	206	0	262
Min Fork Length	.	180.0	120.0	135.0	150.0	198.0	166.0	0.0	120.0
Mean Fork Length	.	180.0	156.6	152.5	150.0	239.3	183.5	0.0	174.4
Max Weight	.	59.0	55.1	64.3	35.4	189.9	78.0	0.0	189.9
Min Weight	.	59.0	18.7	21.1	35.4	69.7	45.3	0.0	18.7
Mean Weight	.	59.0	38.6	36.9	35.4	143.9	60.2	0.0	60.3
Mean Cond.Factor	.	1.01	1.01	0.97	1.05	0.99	0.97	0.00	0.99
Number tagged		1.00	7.00	4.00	1.00	3.00	4.00	0.00	20.00
% monthly catch tagged		100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	0.0%	100.0%

B. Snorkel Surveys

The Yakama Nation Fisheries Department have performed snorkel surveys since 2005 to evaluate steelhead parr density in Toppenish, Satus, and Ahtanum Creeks. These surveys have been developed as a index to monitor status and trends, to serve as an indicator of egg to parr survival, identify rearing distribution, and to evaluate differences between different habitats. Due to the inability to see small parr hidden in behind objects and those positioned in shallow water, snorkel surveys normally underestimate total abundance. They are, however, useful as an index to evaluate trends (if density doesn't have a substantial effect on behavior). For our survey plan, some reaches were located upstream and downstream from diversion structures and others were situated evenly through spawning and rearing habitat. Accessibility played a role in site selection because many portions of the stream are situated in steep canyon areas. Bridges and other man-made structures were avoided when possible. In the Satus watershed, where no irrigation diversion are present, sites were chosen at or near TFW (Timber Fish and Wildlife) stream habitat survey sites that were selected primarily in 1997 and 1998. We are considering using our snorkel surveys coupled with TFW or other protocol habitat surveys to evaluate aquatic habitat condition.

Methods

Snorkel Surveys generally followed procedures outlined in O'Neal (2007). Surveyors moved in an upstream direction from the bottom of a survey segment to the top. One person followed behind to record data. During the previous 6 years of monitoring steelhead parr in these tributaries, surveys were performed by the same three snorkelers providing some level of consistency in all years of this study. Enumerations were linked to a basic habitat type (pool or riffle). An additional surveyor was added to the roster this year. Steelhead / rainbow trout *(Oncorhynchus mykiss)* were placed into either an age 0 category; for individuals that hatched in the spring of that year, or an age 1+ category for those that likely hatched in previous years. Under most conditions, these two age classes of steelhead/rainbow trout were distinguishable through October, although variation in the size of individuals grew more pronounced as the season progressed. Age 1, 2, 3, etc. are probably not distinguishable from one another therefore we lumped them into an age 1+ category. We cannot visually distinguish between anadromous steelhead and resident rainbows at these life stages.

We measured 6 widths at the beginning of the season at each site to calculate a surface area of the survey reach to obtain densities of steelhead parr in number per 100 meters^2. Surveys were performed during the day after the sun appeared above the horizon and above the tree-line when possible-- normally between 9:00 AM and 3:00 PM. Although surveys are conducted monthly at the diversion comparison sites, we used the surveys completed in August to make comparisons between those sites and sites where surveys are only conducted annually. Paired t tests were utilized to compare monthly survey visits to sites above and below diversions.

Toppenish Creek

Toppenish Creek is a tributary of the Yakama River and is located on the Yakama Reservation in south central Washington. Toppenish Creek supports a population of ESA listed Mid-Columbia River steelhead *(Oncorhyncus mykiss)*. While habitat in the lower reaches of the stream is impacted by irrigation diversions and return flow drains, the upper part of watershed is fairly pristine. The uppermost diversion on Toppenish Creek is the Olney-Lateral Diversion located at river mile (RM) 44.3. Most of successful spawning and rearing of steelhead is believed to occur above the Olney- Lateral Diversion. Before 2001, the reach below the dam dewatered annually between July and September as result of irrigation withdrawals at the diversion. Minimum instream flows for the summer months have restored about 2.5 miles of additional spawning and rearing habitat below the Olney-Lateral Dam. Beyond about 2.5 miles, much of the surface flow is lost to the Toppenish Creek alluvial fan during the summer months, however since 2007; the upstream diversion has been manipulated during the summer months to provide continuous perennial flow of several cfs (2-8) through the dry reach. This creates a series of pools and a corridor that is available to migrating steelhead parr to avoid stranding and desiccation. Temperature increases gradually through a 6.5-mile reach divided by the Olney-Lateral Diversion as indicated by dataloggers positioned at approximately 1-mile intervals through these reaches. Between 2005 and 2010 our steelhead parr snorkel surveys were concentrated in this area.

During summer 2011, we expanded the number of sites snorkeled on Toppenish Creek in response to flooding events that appeared to have damaged steelhead redds. We hypothesized that these floods affected egg to smolt survival negatively and this would be reflected by low par density observed during summer snorkel surveys. These new sites are mostly in the upper part of the Toppenish mainstem. These sites are in addition to our normal index sites that we have surveyed since 2005.

We completed surveys at nine locations in the mainstem Toppenish Creek in 2011. At three of these site surveys were performed monthly. At the others, surveys were performed once during late July through August. The site at Wesley road was surveyed once in July, August, and October. The density of age 0 *O.mykiss* juveniles were lower at most sites in 2011, considerably lower than in 2010, which was appeared to be a good year for steelhead production (based on Prosser Dam counts, Toppenish redd counts, and 2010 snorkel surveys throughout the watershed. August densities ranged from 0 to 18.63 fish/100m^2. The highest density was observed at the site above Wesley Road (Table 5). Density at this site was 18.63 fish/100m^2. The next highest density observed was only a 1/3 of the highest site density (6.03 fish/100m^2) several miles upstream above the Olney-Lateral Diversion. It is unclear why density was so much higher at Wesley Road than the others. One characteristic of the stream morphology at this particular site is a complex braided channel configuration that dissipates flow and energy during flood events. Density was much lower at the sites higher in the watershed. One possible explanation for this pattern is redd destruction and fry displacement caused by a flood events (one event occurred at the end of March and a second higher event occurred on May 15th). The impact of the May 15th event was documented on identified steelhead redds during surveys conducted afterwards. Many identified redds were scoured out and extreme changes in stream morphology were noted. We hypothesized low survival for the 2011 steelhead age class in Toppenish Creek due to magnitude and timing of this flood. Redd damage and subsequent low summer parr density appeared to be most pronounced in reaches where channel is most confined by either canyon walls (e.g. site above the North Fork Toppenish) or dikes (three-way diversion site).

Age 1+ densities also appeared lower at most Toppenish Creek sites compared with other years. A higher density of age 1 steelhead was expected due to the large 2010 year class reaching this size.

Riparian vegetation has improved considerably during the past 5 years since minimal instream flows were implemented for this reach located between the old three way diversion and Signal Peak Road. Salmonid habitat quality continues to improve and could explain the steady increase in age 0 density since 2007 at our site above Wesley Road. It's location below a highly channelized reach also could explain higher relative density as juveniles could be swept downstream from reaches with little high water refuges to the Wesley Road reach that contains many of these refuges in the form of side channels and other off channel habitat. High water temperatures in this reach (>21° C) do not seem to affect summer survival by any level that would be detectable during snorkel survival. The red-band lineage of *O. mykiss* inhabits this portion of the Columbia basin and may be more tolerant of higher summer water temperatures than other populations used in temperature threshold studies.

Further downstream, spawning and rearing habitat quality declines. Although water temperatures do not increase and flows are perennial, channel complexity and spawning substrate are noticeably degraded. As a result density at our Pom Pom road and Shaker Church Road were lower in 2011 like most years, although *O. mykiss* are always present at these sites indicating that limited rearing potential exists.

The ongoing investigation at the Toppenish Olney-Lateral diversion comparing the density above the diversion with the density below the diversion indicated no difference in 2011 (t=1.6393; p=0.1997). No statistical difference has been observed since 2007 when instream flow minimums were increased to their current regime (figure 3). Prior to 2006, We concluded that low flows created impassable conditions for juveniles at the Olney-Lateral diversions resulting in an accumulation of steelhead parr below the diversion as juveniles were transported downstream through the screen bypass and were unable to move back upstream. This is a likely explanation for the higher densities downstream in 2005 and 2006. The 2007 annual report contains a more thorough discussion of this topic.

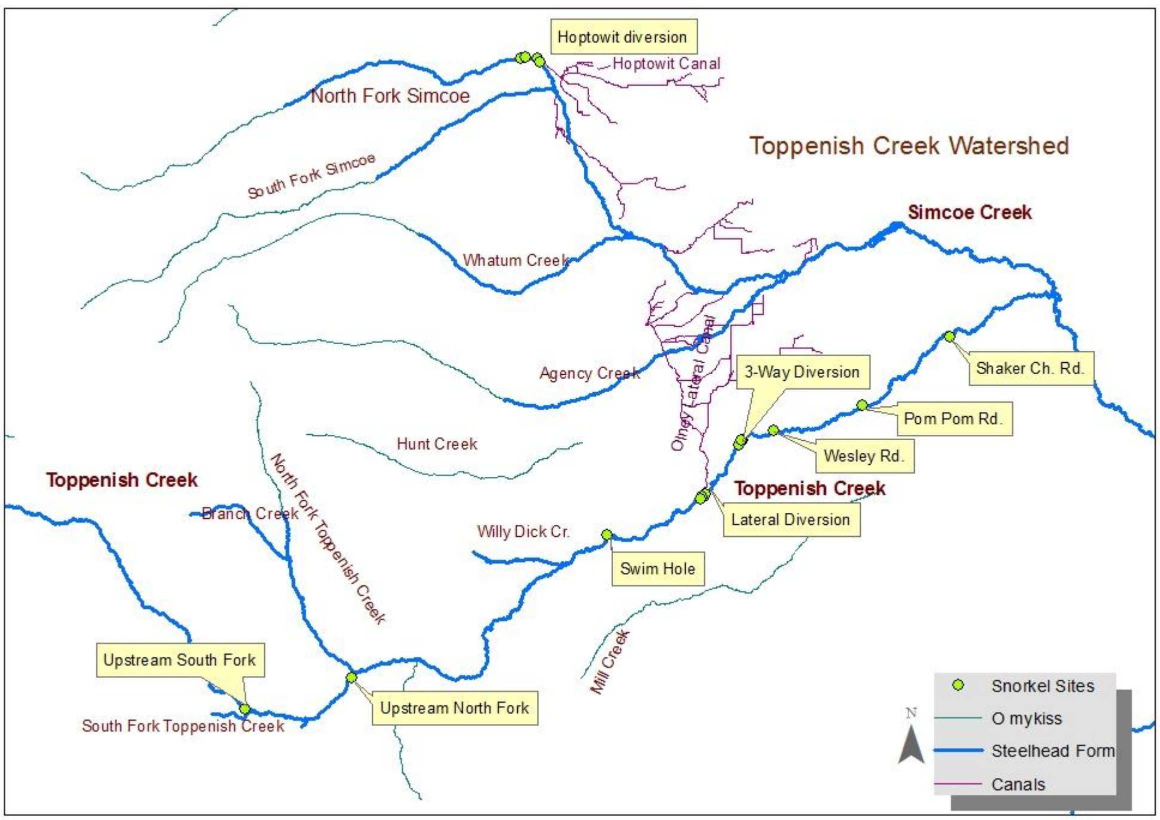

Figure 4. Snorkel site locations in the Toppenish Watershed.

Table 5. Toppenish wastershed sites *O. mykiss* age 0 number and density (fish/100m²)

Site	RM(river mile)	*O. mykiss* Age 0 Number	Age 0 Density	Age 1+ Number	Age 1+ Density
Toppenish Shaker Ch. Rd.	35.9	19	1.68	29	2.57
Toppenish Pom Pom Rd.	38.9	12	0.8	18	1.21
Toppenish Wesley Rd.	41.4	398	18.63	7	0.33
Toppenish 3-Way diversion	41.9	39	2.05	22	1.16
Toppenish Lat diversion dnst	44.2	41	2.91	18	1.07
Toppenish Lat diversion Upst.	44.2	104	6.03	41	2.45
Toppenish Swim Hole	46.6	62	3.02	60	2.98
Toppenish N. Fork Upst.	55.4	0	0	4	0.25
Toppenish S. Fork Upstr.	58.2	19	1.95	58	5.8
N.F. Simcoe Downstream. Hoptowit	32.7--18.9--0.7	63	8.75	31	4.31
N.F. Simcoe Upstream Hoptowit	32.7--18.9--0.8	69	7.55	47	5.44

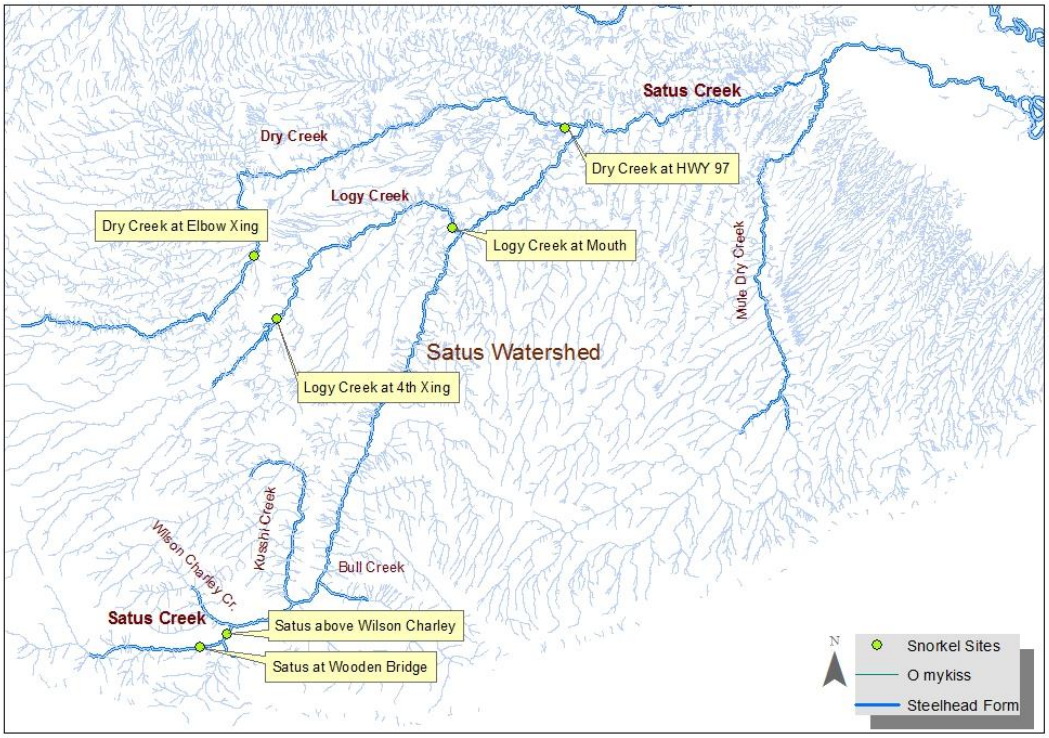

Figure 5. Snorkel site locations in the Satus Watershed

Table 6. A comparison of density (fish/100m²) of Age 0 and Age 1+ steelhead juveniles at the Olney-Lateral Diversion (RM 44) snorkel survey study site in 2005-2010.

	Age 0 Above Diversion	Age 0 Below Diversion	Age 0 Above Three way	Age 1 + Above Diversion	Age 1 + Below Diversion	Age 1 + Above Three way
2005						
June	9.54	20.05	13.37	5.04	1.48	0.00
July	11.58	11.93	22.98	0.68	0.86	0.28
August	18.53	26.08	32.54	6.40	4.80	1.42
September	9.54	13.65	22.41	3.13	7.26	5.40
October	10.22	6.03	17.06	5.18	12.55	5.57
2006						
June	0.00	0.80	5.92	1.77	2.28	0.11
July	2.45	6.46	14.16	0.27	0.62	0.80
August	6.40	15.81	26.85	2.18	0.80	0.51
September	5.31	14.82	27.02	0.95	3.38	1.54
October	7.49	9.78	15.19	2.04	2.83	3.47
2007						
June	8.11	11.24	3.58	1.91	1.19	0.00
July	12.89	2.62	0.26	0.36	0.95	0.00
August	11.93	8.56	6.20	3.58	1.84	0.63
September	12.17	9.51	8.25	4.18	2.14	1.58
October	8.23	12.13	14.56	2.63	2.79	3.15
2008						
June	1.97	3.27	2.73	8.41	5.65	0.53
July	6.44	6.96	5.31	4.65	2.02	0.63
August	8.05	9.45	9.20	9.43	6.48	3.68
September	11.28	9.93	10.41	8.00	4.70	2.94
October	na	na	na	na	na	na
2009						
June	na	Na	na	na	na	na
July	4.24	10.11	7.20	3.58	1.72	1.16
August	10.68	14.27	12.83	5.49	2.62	2.68
September	6.21	5.83	3.21	8.00	6.12	5.73
October	1.61	3.75	4.94	8.00	2.68	3.73
2010						
June	na	na	na	na	na	na
July	2.68	15.04	8.83	10.56	4.52	1.42
August	15.99	14.27	21.29	11.22	8.09	4.73
September	9.84	8.98	8.94	7.76	5.89	3.21
October	6.38	8.15	17.09	6.32	8.50	6.41
2011						
June	na	na	na	na	na	Na
July	8.77	6.78	0.79	6.44	2.56	0.05
August	6.03	2.91	2.05	2.45	1.07	1.16
September	5.85	4.93	1.79	4.12	3.03	1.21
October	5.13	5.83	1.58	1.19	0.42	1.10

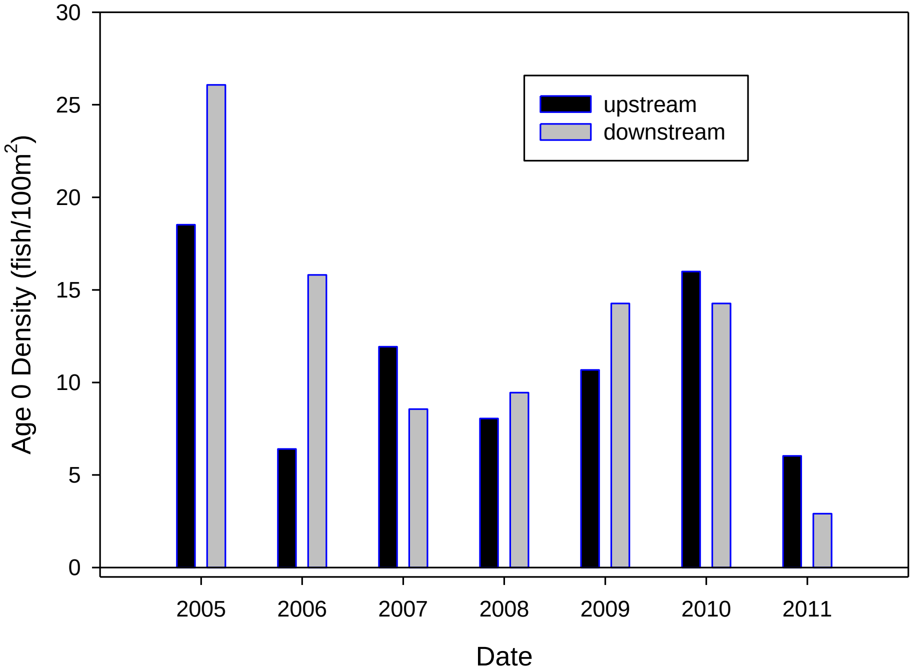

Figure 6. A comparison of steelhead Age 0 juveniles at locations upstream and downstream from the Olney-Lateral diversion in Toppenish Creek between 2005 and 2011.

Hoptowit Diversion at N. Fork of Simcoe Creek

We used the same methods utilized at the Toppenish Creek Lateral Diversion to monitor relative abundance above and below the Hoptowit Diversion located on the North Fork of Simcoe Creek less than one mile above the confluence with the South Fork at RM 19 of Simcoe creek. The diversion was modified with screens and a head-gate in 2004 to improve maintenance and fish passage. This diversion and three others downstream can withdraw a significant amount of water from Simcoe Creek, although diversion quantities have been reduced in recent years. Withdrawal affects water temperature downstream from the diversions, although the increase is gradual.
The segment lengths were 200 m and the width of this stream is relatively small so only one snorkel surveyor was needed. This portion of Simcoe Creek is well shaded affecting the visibility during snorkeling and making identification difficult at times. In the seven years of study, no salmonids other than *O. mykiss* were observed. A size difference between Age 0 juveniles and older year classes (Age 1+) could still be observed at this location.

No difference between densities of age 0 juvenile *O.mykiss* at the site upstream from the diversion or downstream was apparent in 2011 (t=1.3070; p= 0.28) (figure 4). Flow differences are typically minimal at the Hoptowit diversion since diversions at this location are curtailed during the summer, although passage above control structures appears difficult for small juveniles. Density at both upstream and downstream sites was the highest in 2011 since 2007 (figure 4) indicating that the Simcoe watershed may have fared better than the mainstem Toppenish during the floods in March and May. Gage data and redd count data seem to indicate that the magnitude of the flood and destruction to steelhead redds was less in the Simcoe watershed. Age 1 + density seems to be relatively consistent every year in the North Fork Simcoe creek.

Table 7. Number and density of steelhead parr upstream and downstream from the Hoptowit diversion on the North Fork of Simcoe Creek in 2011.

	Age 0 Below Hoptowit	Age 0 Above Hoptowit	Age 1 + Below Hoptowit	Age 1 + Above Hoptowit
June				
July	75	26	41	19
August	63	69	31	47
September	25	38	27	20
October	23	17	25	18
Densities (per 100 m²)				
June				
July	10.42	2.84	5.69	2.08
August	8.75	7.55	1.21	2.57
September	3.47	4.16	3.75	2.19
October	3.19	1.86	3.47	1.97

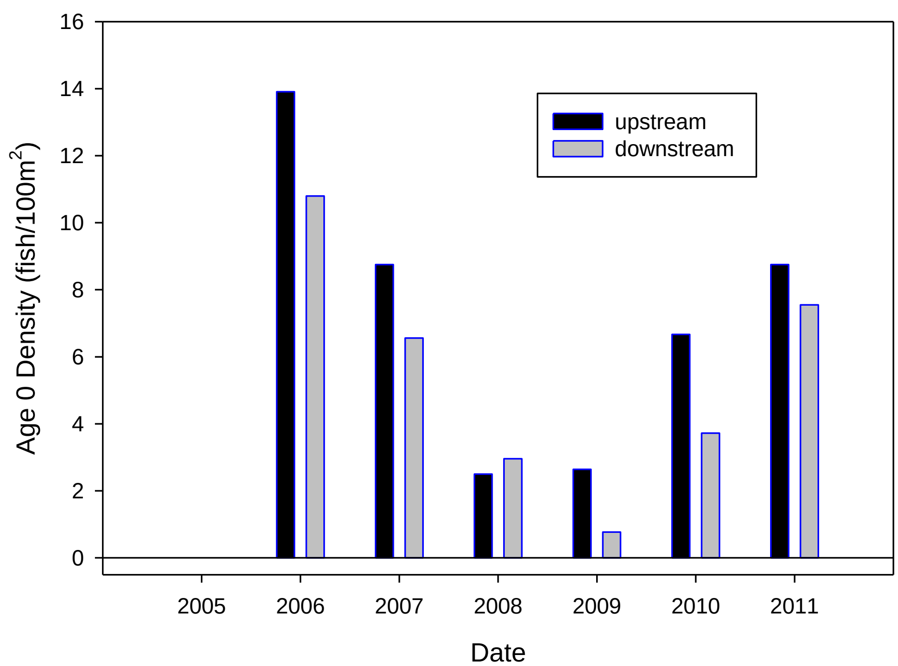

Figure 7. A comparison of steelhead Age 0 juveniles at locations upstream and downstream from the Hoptowit diversion in the North Fork Creek between 2005 and 2011 (0 age 0 *O. mykiss* were captured in 2005).

Ahtanum Creek Diversions

We conducted snorkel surveys upstream and downstream from a complex of diversion on Ahtanum in August of 2011. We utilized the same method as we used at diversions in the Toppenish Creek Watershed. Snorkel surveys were conducted with three person teams on 200 meter transects. In the Ahtanum, at RM (river mile) 18.9, the Wapato Irrigation Project (WIP) diversion and the Ahatnum Irrigation District (AID) diversions are located in close proximity (<1 mile) to one another. Our snorkel survey study sections were placed upstream and downstream from this complex. Ahtanum Creek is relatively wide at all three study transects requiring the use of two surveyors to effectively cover the entire width. However, many “blind spots” or areas obscured by rocks or exceeding shallow areas probably contained fish that went unobserved and tallied. Due to these limitations numbers were certainly underestimated.

More age 0 *O. mykiss* where observed below the diversion than above in 2011(Table 8). However, six years of annual surveys at these two sites indicate that there is no statistically significant difference in steelhead density upstream and downstream from the diversion (t=-1.9777; p=0.1049). The non-significant difference apparent (Figure 9) is probably best explained by better quality complex stream habitat located downstream from the diversions. There is a noticeable increase in canopy cover downstream from the diversion complex. Like previous years, we observed coho juveniles that were likely released as part of a Yakama Nation Fisheries reintroduction program. No other salmonid species have been observed at this location. Bull trout and cutthroat trout are present higher up in the watershed.

Table 8. snorkel survey rainbow/steelhead (*O. Mykiss*) numbers and densities at irrigation diversions in Ahtanum Creek

Numbers	Age 0 *O. Mykiss* Above diversions	Age 0 *O.Mykiss* Below diversions	Age 1 + *O.Mykiss* Above diversions	Age 1 + *O.Mykiss* Below diversions
August	29	72	8	15
Densities (per 100 m²)				
August	1.399	3.144	0.386	0.648

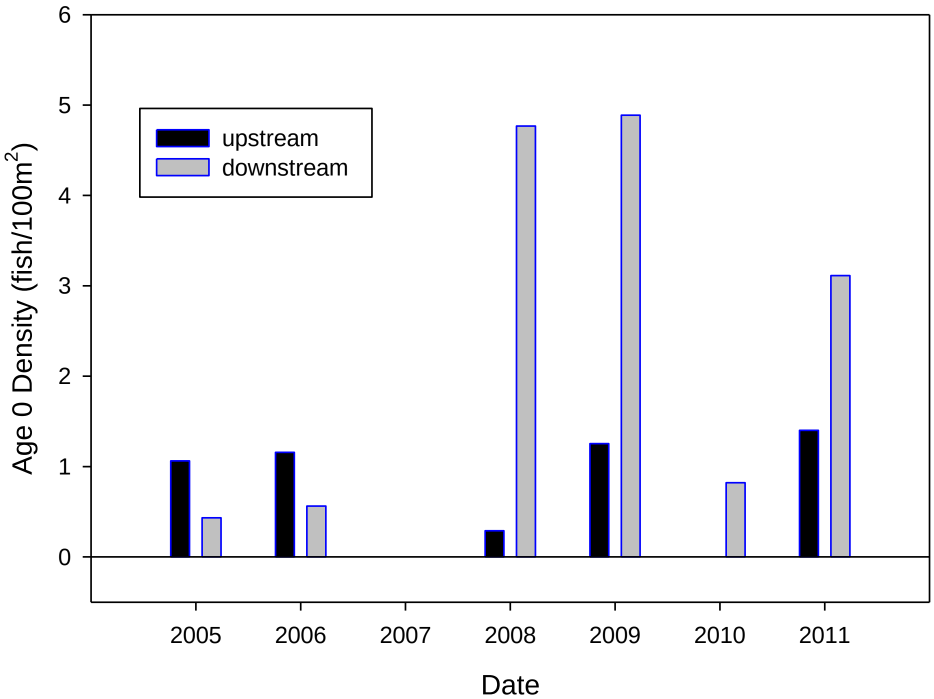

Figure 9. A comparison of steelhead Age 0 juveniles at locations upstream and downstream from the WIP/AID diversion complex in Ahtanum Creek between 2005 and 2011 (no survey was completed in 2007).

Satus Creek Tributaries

We conducted snorkel surveys at two locations Dry Creek and two locations on Logy Creek, both tributaries of Satus Creek. The purpose of these surveys was to identify rearing areas and compare Logy Creek, which has an abundant supply of cool water during the summer to Dry Creek, which typically has critical low flows. On each tributary one site was established less than 1 mile in distance from the mouth and a second sited was established upstream within spawning habitat. The upsteam site on Logy Creek was established at RM 9. An upstream site on Dry Creek (Elbow Crossing; RM 18) was situated near our Logy Creek site within 4 miles of where Dry Creek typically goes subsurface during the summer months. The downstream site on Dry Creek was located less than 1 mile from where Dry Creek regains continuous surface flow near the mouth of Dry Creek (HWY 97 crossing RM 1). The site on Logy Creek that was situated near the confluence was placed at approximately RM 0.3. Flows in this location are continuous and stable throughout the summer.

We established 200-meter snorkel segments at each site. Six widths from the wetted edge were measured along each segment and used to calculate the area and corresponding steelhead densities. Surveyors moved in an upstream direction from the bottom of a survey segment to the top. One person followed behind to record data. All three sites were surveyed on August 3rd 2011.

Like much of the lower Yakima watershed, Age 0 steelhead juvenile density was lower in 2011 than in 2010 at the two Dry Creek Sites. The highest densities of age 0 *O. mykiss* were recorded at the Dry Creek snorkel index sites in 2010. Densities were, however; slightly higher in 2011 than other years in Logy Creek (Table 10). The densities of age 1 juveniles was highest at all sites in both tributaries in 2011-as expected for the robust 2010 year class.

Among the sites Dry Creek at the elbow crossing had the highest density of both age 0 and age 1+ juvenile *O. mykiss* (Table 10).

Table 10. Number age 0 and Age 1 steelhead observed during snorkel surveys Dry Creek and Logy Creek in 2010

	Age 0	Age 0	Age 0	Age 0	Age 1 +	Age 1 +	Age 1 +	Age 1 +
	Dry Creek at the Elbow Crossing (200m)	Dry Creek below HWY 97 (200m)	Logy Creek at upper crossing (200m)	Logy above HWY 97 (200m)	Dry Creek at the Elbow Crossing (200m)	Dry Creek below HWY 97 (200m)	Logy Creek at upper crossing (200m)	Logy above HWY 97 (200m)
2007								
Number	129	121	45	.	49	30	15	.
Density	11.84	9.92	2.62	.	4.50	2.46	0.87	.
2008								
Number	151	71	49	32	131	48	10	59
Density	13.86	5.82	2.86	2.24	12.02	3.94	0.58	4.14
2009								
Number	25	159	34	22	62	12	34	4
Density	2.29	13.04	1.98	1.54	5.69	0.98	1.98	0.28
2010								
Number	521	692	47	32	148	47	9	14
Density	47.81	56.76	2.74	2.24	13.58	3.82	0.52	0.98
2011								
Number	313	97	54	47	234	145	52	23
Density	28.72	7.96	3.79	2.74	21.47	11.89	3.65	1.34

Upper Satus Creek

In 2011, we snorkeled two sites at the upper reaches of the steelhead spawning distribution in the mainstem Satus Creek. Both sites were located between the falls and the crossing of HWY 97. These sites were included to provide more complete coverage of the most productive spawning areas (based on redd distribution data) in the Satus watershed.

Steelhead (*O. mykiss*) density for age 0 and older age class was lower in 2011 than in 2010 -- similar to most surveyed reaches in the lower Yakima tributaries (Table 11). They were, however; higher than parts of the upper Toppenish watershed. Between the two sites more steelhead age 0 juveniles were observed at the lower site above Wilson Charley Creek and more older age class fish were seen at the upstream site.

Table 11. Number and density of steelhead parr at sites in upper Satus Creek above the Wilson Charley Creek confluence in 2011.

	Age 0 Satus above Wilson Charley Cr.	Age 0 Satus at Wooden Br.	Age 1 + Satus above Wilson Charley Cr.	Age 1 + Satus at Wooden Br.
2010				
Number	145	323	98	105
Densities (per 100 m²)	9.73	23.30	6.58	7.57
2011				
Number	133	90	22	66
Densities (per 100 m²)	8.92	6.49	1.48	4.76

C. Water Temperature Monitoring

We deployed data-loggers in the Ahtanum, Toppenish, and Satus watersheds to monitor water temperatures continuously during the warmer seasons when water temperatures can be a limiting factor for salmonid survival and growth. The Yakama Reservation Watersheds Project utilize this data to identify reaches where restoration projects would be most beneficial to salmonid populations and also to aid in management decisions that may effect water temperatures (i.e. management of irrigation diversions, riparian harvest, water withdrawals, etc.).

We deployed a total forty nine devices in the three watersheds (Figure 10). Data-loggers (Onset Optic Stowaways and Onset Water Temp Pro v2) were launched in spring 2011 and were programmed to collect water temperatures at 40 minute intervals. The units were encased in protective cages and secured to trees and roots using nylon coated aircraft cable. They were generally placed in pool tailouts that were less likely to dewater during the summer. Although some data-loggers were deployed in early March in 2010, we only used data during the period between April 15th and October 15th to calculate descriptive statistics to evaluate in-stream conditions for salmonids. Several data-loggers were left in place year round to monitor water temperatures during the peak migration and spawning periods for steelhead (i.e. winter and spring).

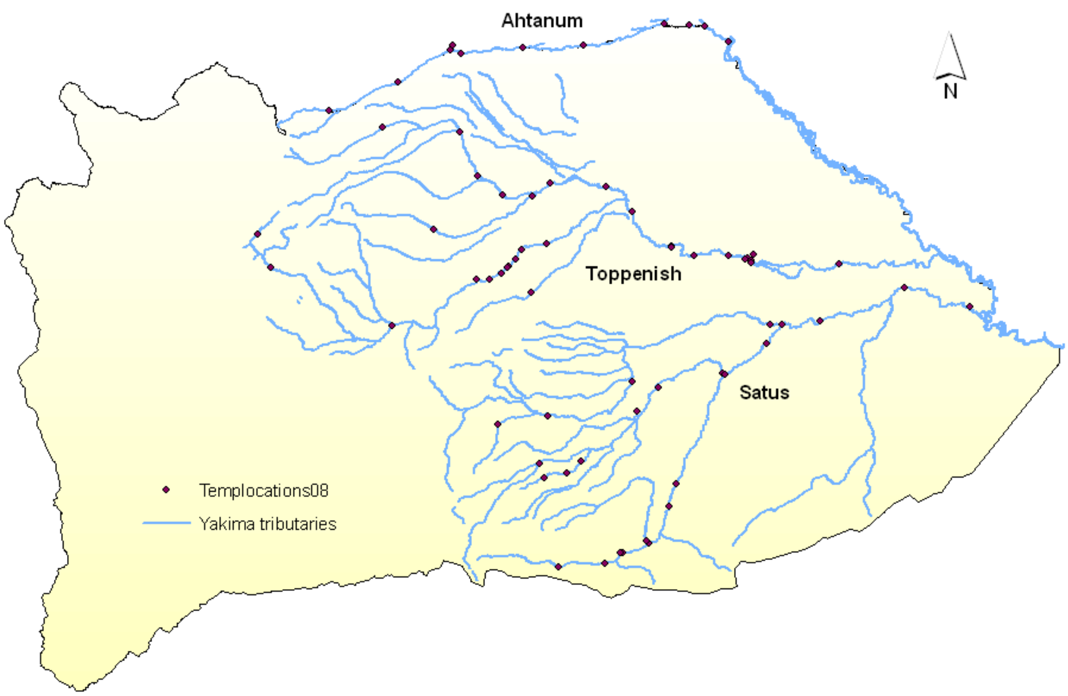

Figure 10. Locations of temperature monitoring stations established between 1997 and 2008 in the Yakima River watershed portion of the Yakama Reservation.

Ahtanum Creek

In 2011, we deployed nine temperature recording data-loggers in the Ahtanum Creek watershed to assess the suitability of water temperature for salmonids including ESA listed steelhead and other cold water species (i.e. westsolpe cutthroat trout, bull trout).

We deployed the data-loggers in February and March 2011 at sites located between river mile RM 0.5 (at the USGS gage) and RM 18.9 (Downstream from the Ahtanum Irrigation District (AID) Diversion). We also deployed three data-loggers in the South Fork and one in the North Fork of Ahtanum Creek near their confluence. The units were in place and continuously recording water temperatures at 40 minute intervals until we retrieved them in mid October. One unit, in the lower section of Ahtanum Creek, was lost during high discharge that occurred in March and May or was stolen. Seven data-loggers recorded temperatures for the entire period (Table 12).

Table12. Descriptive statistics for water temperatures at 8 locations in the Ahtanum Creek watershed for 2011. Maximum Weekly Maximum Temperature in bold text.

Location (river mile in parenthesis)	Instantaneous Maximum	Instantaneous Minimum	Mean Daily Maximum	Mean Daily Average	Mean Daily Minimum	Maximum Daily Average	**Maximum 7-Day Maximum**	Maximum 7-Day Average
South Fork Ahtanum at the DNR gate(11.4)	10.1ºC	3.4ºC	8.3ºC	7.0ºC	6.0ºC	8.8ºC	**9.9ºC**	8.7ºC
South Fork Ahtnaum at campground (8.7)	12.5ºC	4.1ºC	10.1ºC	8.4ºC	7.0ºC	10.6ºC	**12.4ºC**	10.5ºC
South Fork Ahtanum at Mouth(1.0)	17.2ºC	1.5ºC	11.2ºC	9.0ºC	7.2ºC	14.8ºC	**16.7ºC**	14.6ºC
North Fork Ahtanum at Mouth (1.3)	18.5ºC	0.6ºC	11.6ºC	9.2ºC	7.0ºC	15.8ºC	**18.3ºC**	15.7ºC
AID Diversion (18.9)	Lost Unit							
American Fruit Rd. (14.0)	21.8ºC	4.5ºC	15.3ºC	12.6ºC	10.3 ºC	18.2ºC	**21.4ºC**	17.9ºC
At 42nd Ave. (7.0)	20.7ºC	2.0ºC	11.7ºC	9.8ºC	7.9ºC	16.9ºC	**18.3ºC**	15.7ºC
At USGS Gauge (0.5)	21.7ºC	0.5ºC	11.0ºC	9.8ºC	8.7ºC	19.8ºC	**21.3ºC**	19.5ºC

Mean daily averages ranged from 7.0ºC in the South Fork of Ahtanum Creek several miles above the confluences to 12.6ºC at American Fruit Road (Table 12). The highest instantaneous maximum of 21.8ºC was also recorded at American Fruit Rd. (RM 14.0) in 2011.

We utilized the Maximum Weekly Maximum Temperature (MWMTs; moving 7-day average of the daily maximum water temperature) as an index to evaluate the suitability for salmonid habitat use. MWMTs were lowest at sites upstream on the South Fork of the Ahtanum as expected because they are farthest upstream and at higher elevation. In most years, water temperatures gradually increase downstream on the mainstem until peaking upstream at between 16th and 42nd Ave. where the greatest level of channel simplification has occurred on Ahtanum Creek. In 2011, the highest MWMT (21.4ºC) was recorded at American Fruit Rd. Water temperatures appeared to be slightly lower than 2010.

Toppenish Creek

We used Onset temperature data-loggers (Stowaways, Pro Temp 1 and Pro Temp 2) to evaluate suitability of stream reaches for salmonids including ESA listed steelhead, and westslope cutthroat that reside in Toppenish Creek. Most units were placed in the lower reaches of Toppenish and Simcoe Creeks where flows are heavily influenced by irrigated farm and range land through water withdrawals and return flow from the Wapato Irrigation Project (WIP) diversion from the Yakima River. Some data-loggers were, however, placed in the headwaters of Toppenish creek.

We deployed fifteen data-loggers in the mainstem of Toppenish Creek during spring 2011 at sites located between RM (river mile) 2.4 and 56. We also deployed six data-loggers in Simcoe Creek, one in Mill Creek, and two in Agency Creek. The units were in place and continuously recording water temperatures at 40 minute intervals until we retrieved them in mid-October 2011. Seven units failed to record temperatures due to battery failure; were lost due to high flows, beaver activity, or theft; or dewatered for an extended period. The other data loggers recorded temperatures for the entire period. We used the Maximum Weekly Average Temperature (MWAT, moving 7-day average of the daily mean water temperature) and the Maximum Weekly Maximum Temperature (MWMT, moving 7-day average of the daily maximum water temperature) as an index to evaluate suitability for salmonid habitat.

Mean daily average temperatures in the mainstem Toppenish Creek ranged from 11.1ºC at the swimming hole (RM 47.2) to 17.2ºC at the intersection of Highway 97 and Toppenish Creek (RM 10.7). The highest instantaneous maximum of 24.0ºC also occurred at the intersection of Highway 97 and Toppenish Creek as well as the highest MWMT (23.8ºC).

The section of Toppenish Creek located between mile 44 and 39 typically dewatered in the past. Beginning in 2001, minimum instream flows were gradually increased to a point where there is now perennial flow in Toppenish Creek, although it is uncertain if this will be the case during future drought years. In 2010 and 2011 dewatering on Toppenish Creek was not observed.

We continued to monitor the Toppenish Creek section in the vicinity of the Olney-Lateral Diversion at RM 44.2 in 2011. Thermographs were placed at relatively close intervals every 0.5 to 1.0 miles apart from the Deer Butte Rd. water hole (swim hole; RM 46.8) before Toppenish Creek emerges from the canyon downstream to Wesley Road (immediately above the Cleparty Diversion; RM 41.5). The Olney- Lateral Diversion intake is near the half-way point (Table 13).

Table 13 Descriptive statistics for water temperatures at 22 locations on Toppenish Creek and Simcoe Creek for 2011. Maximum Weekly Maximum Temperature in bold text.

Location (river mile in parenthesis)	Instantaneous Maximum	Instantaneous Minimum	Mean Daily Maximum	Mean Daily Average	Mean Daily Minimum	Maximum Daily Average	**Maximum 7-Day Maximum**	Maximum 7-Day Average
Topp. at N. Fork confluence (55.9)	16.8°C	1.1°C	10.5°C	8.8°C	7.5°C	14.1°C	**16.4°C**	13.9°C
Topp. at swim hole (47.2)	Dewatered							
1 mile below swim hole (45.9)	19.8°C	3.5°C	13.9°C	12.2°C	10.7°C	17.7°C	**19.6°C**	17.4°C
1 mile above lateral (45.1)	19.8°C	3.5°C	13.9°C	12.2°C	10.7°C	17.7°C	**19.6°C**	17.4°C
Topp. above lateral (44.2)	20.1°C	3.4°C	13.9°C	12.4°C	10.8°C	17.9°C	**19.9°C**	17.6°C
At three way (43.1)	20.7°C	3.2°C	14.7°C	12.9°C	11.3°C	18.3°C	**20.4°C**	18.1°C
At Cleparty (42.1)	Lost or Stolen							
Topp. At Shaker Church Rd. (36.1)	22.9°C	3.4°C	15.2°C	12.6°C	10.1°C	19.7°C	**22.3°C**	19.0°C
At Old Graves Property (33.9)	Dewatered							
Topp. below Mud Lake Drain (31.4)	Unit Failed							
Topp. at Unit 2 (26.5)	Dewatered							
Topp. at Lateral C (21.3)	Lost or Stolen							
Topp. Above Snake Creek(16)	23.5°C	6.4°C	12.1ºC	11.2ºC	10.4ºC	22.6ºC	**23.3ºC**	22.4ºC
Topp. below Hwy97 (10.7)	24.0ºC	7.6°C	18.1°C	17.2ºC	16.2ºC	23.3ºC	**23.8ºC**	23.1ºC
Topp. at Indian Church Rd. (2.4)	23.3ºC	8.7ºC	18.0ºC	16.5ºC	15.3ºC	20.9ºC	**22.9ºC**	20.6ºC
Mill Creek (8.7)	17.1ºC	3.0ºC	9.6ºC	8.5ºC	7.5ºC	15.7ºC	**16.4ºC**	14.9ºC
N. Fork Simcoe (24.9)	13.6°C	2.5°C	10.2ºC	9.1ºC	8.1ºC	12.9ºC	**13.4ºC**	12.6ºC
Simcoe below Forks (18.9)	20.2°C	3.4°C	12.8ºC	11.0ºC	9.3ºC	17.3ºC	**19.9ºC**	16.9ºC
Simcoe at Simcoe Cr. Rd. (15.3)	22.3°C	2.7°C	13.8ºC	11.1ºC	9.0ºC	18.2ºC	**21.9ºC**	17.9ºC
Above N White Swan Rd. (8.1)	Lost or Stolen							
Below N White Swan Rd. (8.1)	Lost or Stolen							
Barkes Rd (2.7)	18.4ºC	4.8ºC	13.4ºC	12.8ºC	12.2ºC	18.1ºC	**18.3ºC**	18.0ºC
Agency Creek Below Woodchoppers (8.9)	18.1ºC	3.0ºC	11.4ºC	9.8ºC	8.3ºC	16.4ºC	**17.8ºC**	15.9ºC
Agency Creek at Wesley (0.5)	19.0ºC	4.6ºC	12.3ºC	10.5ºC	9.2ºC	13.2ºC	**17.0ºC**	12.9°C

Satus Creek

In 2011, we deployed 19 Onset Stowaway and Hobo Temp Pro v2 data loggers in the Satus Creek watershed to assess the suitability of water temperature for salmonids including ESA listed steelhead and other cold water biota. Yakama Nation Fisheries have monitored water temperature in the Satus Creek basin since 1996. We intend to use this long term data to evaluate changes within the watershed that may affect water temperature (i.e., restoration projects, grazing practices, and timber harvest).

Temperature data-loggers were placed in canisters and anchored with aircraft cable to trees, root-wads or other available permanent structures that could withstand high flow events. They were generally placed in low flow channels that were less likely to dewater during the summer. We began deploying the data-loggers in February 2011 at sites in Satus Creek located between RM 1.2 and RM 44 (downstream from the falls that form the upper limit of the steelhead distribution in Satus Creek). We also deployed data loggers at three locations in Dry Creek, and Logy Creek from the falls downstream on each stream, which defines the upper extent of steelhead spawning and rearing habitat to their confluence with Satus Creek. Additionally, we deployed several data-loggers at headwater sites beyond the upper extent of steelhead spawning habitat. The units were in place and continuously recording water temperatures at 40 minute intervals until we retrieved them in mid-October. This provided a six month record of stream temperatures spanning the warmest part of the year and allows us to evaluate summer peak temperatures which a likely limiting factor to steelhead production in many parts of the watershed.

Mean daily averages in Satus Creek ranged from 7.1ºC downstream from falls (RM 44) to 14.0ºC at Plank Rd. (Table 14). Most mean daily averages were slightly lower than 2010. The greatest instantaneous maximum for the Satus Creek watershed was 25.2°C at the Plank Rd location (RM 7.4). The maximum 7-day average of the daily maximum (MWMT) and average (MWAT) water temperature were used as an index to evaluate suitability for salmonids and other cold water biota along the course of the stream.
Mean daily average water temperatures in the portion of Logy Creek available for anadromous species spawning ranged from 10.7º C to 11.2º C. The instantaneous maximum water temperature ranged from 17.0º C to 20.4º C. Water Temperatures in Logy Creek were probably suitable for steelhead trout during the warmer months along most of its length.

Table 14. Descriptive statistics for water temperature for 2011 at 19 locations in the Satus Creek watershed. Maximum weekly average temperature in bold text.

Location (river mile in parenthesis)	Instantaneous Maximum	Instantaneous Minimum	Mean Daily Maximum	Mean Daily Average	Mean Daily Minimum	Maximum Daily Average	**Maximum 7-Day Maximum**	Maximum 7-Day Average
Falls (44)	14.7ºC	1.0ºC	8.5ºC	7.1ºC	5.8ºC	12.9ºC	**14.2ºC**	12.6ºC
Wooden bridge (41.4)	17.1ºC	0.0ºC	8.8ºC	7.1ºC	5.7ºC	14.9ºC	**16.6ºC**	14.4ºC
Satus at Wilson Charley (39.5)	Unit Lost							
4th Crossing (34.1)	20.9ºC	1.0ºC	12.6ºC	10.5ºC	8.6ºC	18.7ºC	**20.3ºC**	18.2ºC
High Bridge (32.4)	22.5ºC	4.7ºC	16.1ºC	13.6ºC	11.5ºC	19.4ºC	**21.9ºC**	18.9ºC
Above Logy Creek (23.6)	21.8ºC	2.5ºC	15.0ºC	12.6 ºC	10.7ºC	19.0ºC	**21.0ºC**	18.7ºC
1st Crossing (20.2)	20.4ºC	1.6ºC	12.7ºC	11.2ºC	9.6ºC	18.6ºC	**20.0ºC**	18.3ºC
Below Dry Creek (18.7)	Unit Lost							
Plank Rd. (7.4)	25.2ºC	3.3ºC	15.7ºC	14.0ºC	12.3ºC	22.1ºC	**24.5ºC**	21.9ºC
N. Satus Rd. (1.2)	Unit Lost							
Logy at Falls(12.5)	malfunctioned							
Logy at Fourth Crossing (8.8)	17.0ºC	3.9 ºC	12.2 ºC	10.7ºC	9.1ºC	15.6ºC	**16.7ºC**	15.2ºC
Logy Mouth (0.5)	20.4ºC	1.6ºC	12.7ºC	11.2ºC	9.6ºC	18.6ºC	**20.0ºC**	18.3ºC
Dry Creek at Falls (25.7)	14.9ºC	0.7ºC	11.1ºC	9.3ºC	7.6ºC	12.0ºC	**13.9ºC**	11.3ºC
Dry Creek at Elbow Crossing (18.5)	19.6ºC	3.3ºC	14.3ºC	12.4ºC	10.9ºC	17.3ºC	**19.2ºC**	17.0ºC
Dry Creek at Mouth (1.2)	20.9ºC	7.1ºC	17.9ºC	15.3ºC	13.2ºC	18.4ºC	**20.5ºC**	18.2ºC
Section corner source (4.6)	9.0ºC	6.5ºC	8.5ºC	7.8ºC	7.5ºC	8.1ºC	**8.8ºC**	8.0ºC
Section corner mid crossing (2.7)	12.0ºC	4.6ºC	10.3ºC	8.4ºC	7.1ºC	9.5ºC	**11.3ºC**	9.3ºC
Section corner lower crossing (1.2)	13.2ºC	3.6ºC	11.1ºC	9.0ºC	7.2ºC	10.7ºC	**12.7ºC**	10.4ºC

The highest MWMT temperature (20.5ºC) in the Dry Creek watershed occurred at the mouth (RM 1.2).

D. Spawning Surveys

Steelhead Redd Counts

The Yakama Nation Fisheries Program staff have completed Redd count surveys (spawning surveys) for adult steelhead in lower Yakima river tributaries since 1988. 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. In each of the three tributaries that we survey (Satus, Toppenish, and Ahtanum), we attempt to perform a census of all available steelhead spawning habitat. The spawning distribution and spawning habitat have been delineated through the identification of barriers on the upstream limits; presence of suitable substrate, suitable width, depth, and gradient; and professional judgment of fisheries biologist. Several reaches, particularly 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 lack suitable spawning substrate.

Methods

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. Yakama Nation fisheries has attempted to various survey methods (ground, raft, aerial) 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. A three pass census count using the following technique is used. Two surveyors typically cover each 2 to 6 miles survey reach, walking in a downstream direction. In some smaller streams only one surveyor conducts the survey. Surveyors wear polarized glasses to aid in spotting redds. 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 non-adult steelhead *O. mykiss* observed in these watersheds during population surveys (i.e. redd counts, 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 will take care not to disturb spawning fish or possible staging pools when conducting spawner surveys. The survey should not be started until the sun breaks over the horizon to ensure that there is enough light to detect redds.

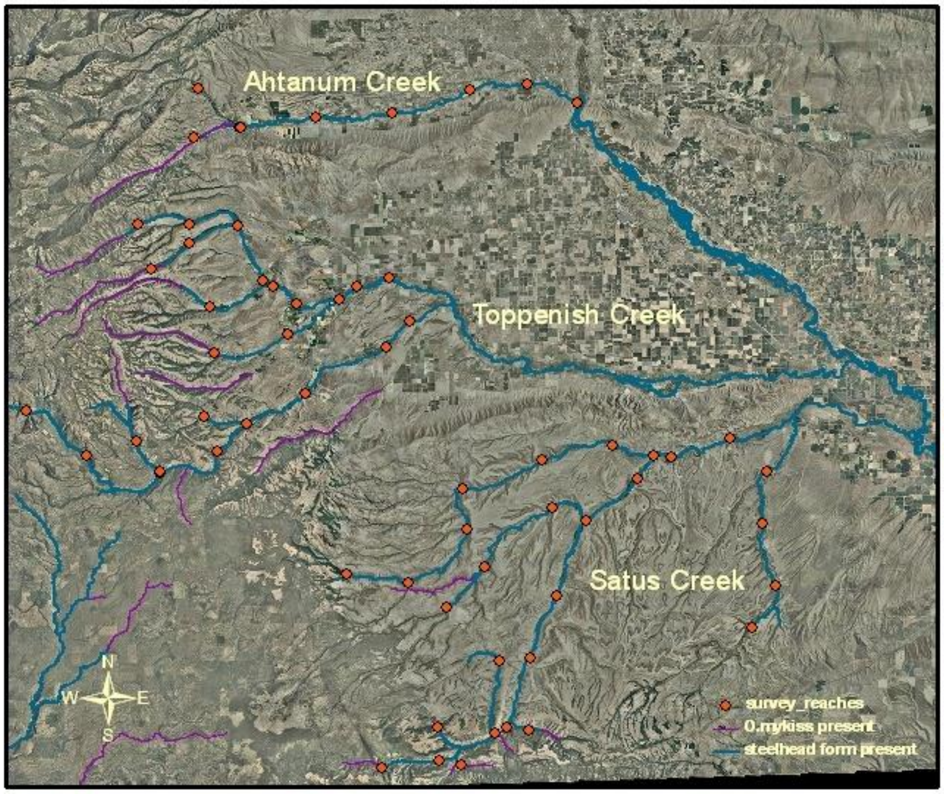

Figure 11. The beginning and end points for steelhead survey reaches in Satus, Toppenish, and Ahtanum Creek.

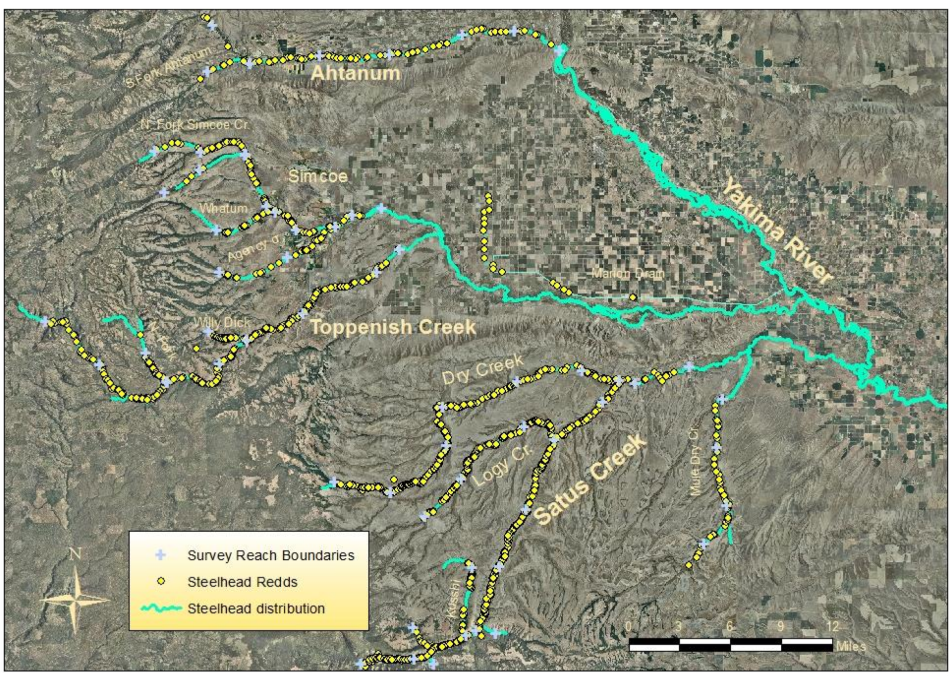

Figure 12. Location of Steelhead Redd in Satus Creek, Toppenish Creek, Ahtanum Creek, and Marion Drain 2001 to 2011.

Toppenish Creek

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 accessibility problems caused by spring snowpack and precipitation. In 2011, we were able to reach the upper portion of the Toppenish watershed beginning on March 28 for a 1st pass. The second pass was performed in April. 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.

For the year we identified a total of 100 redds, which is slightly lower than last year (n=105). Last year only one pass of the upper reaches of Toppenish Creek was completed at the end of the year. Seven Redds were identified in the reach upstream from the North Fork of Toppenish Creek in 2010 compared to 16 identified 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 result in a completion of all three passes in this stream. Due to these factors Simcoe Creek has been useful as an index reach to track trends in the watershed. Of the smaller tributaries of both the mainstem Toppenish and Simcoe Creeks, The North fork Toppenish Creek provides the best quality spawning habitat and rearing conditions, Although there is a barrier in the form of 12 foot + falls at about river mile four and channel simplification caused by proximate road placement. Ten redds were identified in 2011 compared to 13 in 2010. Three to four redds were seen in other small tributaries including Willey Dick, Agency and Whatum.

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 2.5 fish per redd for an estimate of spawning escapement of 250 adult steelhead for the watershed.

Table. 15	Number of steelhead redds in the Toppenish Creek watershed in 2011.			
	Upper Toppenish Watershed		**Distance miles**	**Number of Redds**
Toppenish	O Conner Creek (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)	Wiley Dick (48.5)	2.5	**5**
	Wiley Dick (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**
Willey Dick	old logging site (4)	Confluence (0)	**4**	**4**
	Simcoe Creek Watershed			
Simcoe	NF at 2nd crossing (6.5)	Diamond Dick (3.4)	3.1	**0**
	NF at Diamond Dick (3.4)	NF/SF confluence (0)	3.4	**10**
	SF 6 mile above confluence (6.2)	3 mile above confluence (3)	3.2	**0**
	SF 3 mile 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**

Lower Toppenish Creek

We conducted an aerial survey using a helicopter and following the protocol described in (Jones et. al. 2007). Three observers including the Pilot who has experience with aerial surveys were involved. 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 Marion Drain the water was more turbid with visibility of about 1 foot. This survey allowed us to evaluate the spawning habitat in a reach that is largely unwadeable and difficult 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 potential habitat until above Simcoe Creek

(RM 32). Few suitable riffles could were observed below this and most riffles that were observed were covered with thick vegetation that would make successful spawning difficult. The low gradient and absence gravel producing tributaries in the lower Toppenish Watershed appear to create a stream morphology not compatible with salmonid spawning. We plan to survey this reach again in 2012 to confirm our conclusion that the lower reach of Toppenish Creek serves mainly as a migration corridor and overwinter habitat for pre-smolts.

Toppenish Redd Life

Redd life (length of time redds remain visible during spawning ground surveys) surveys were conducted in Toppenish Creek between the beginning of March and June in Three reaches in the watershed (one reach on the mainstem 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 the upper Columbia area. In summary, a designated redd surveyor walked an index portion of the watershed. The surveyor walked this reach each week as conditions allowed. Each redd was examined and the condition of the redd assessed and placed into four categories (new, measurable, still measurable, still apparent and no longer apparent). Redds were flagged and each new redd was mapped and marked with a GPS. These weekly surveys were conducted for about 12 weeks between March 15th and June 1st. High flows made completion of weekly surveys too difficult for several weeks due to high water. Particularly in the mainstem Toppenish Creek, weekly redd life surveys had to be aborted due to high water. At the reach on the Simcoe Creek, few redds were identified. In the North Fork Toppenish Creek, flows and redd numbers (n=10) allowed us to calculate an average redd life of 10.7 days in that reach. This is substantially lower than redd life in the upper Satus reach in 2010 (n=30) and 2011 (n=27). Redds in this watershed appear to be more susceptible to the high flows in 2011. More frequent surveys would be ideal.

Surveyor accuracy study

We attempted to include a study to evaluate surveyor accuracy in during the 2011 Redd Count season. The methods used were adapted by those proposed for use by the Upper Columbia monitoring team in 2010 (Andrew Murdoch, unpublished protocol). In summary, two independent survey 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.

This method appears to be feasible logistically although some assumptions of mark-recapture techniques are violated. Only one redd was identified in our pilot study reaches and it was not re-sighted. The timing of these surveys around a high flow event affected its success. We will attempt these surveys again in 2012.

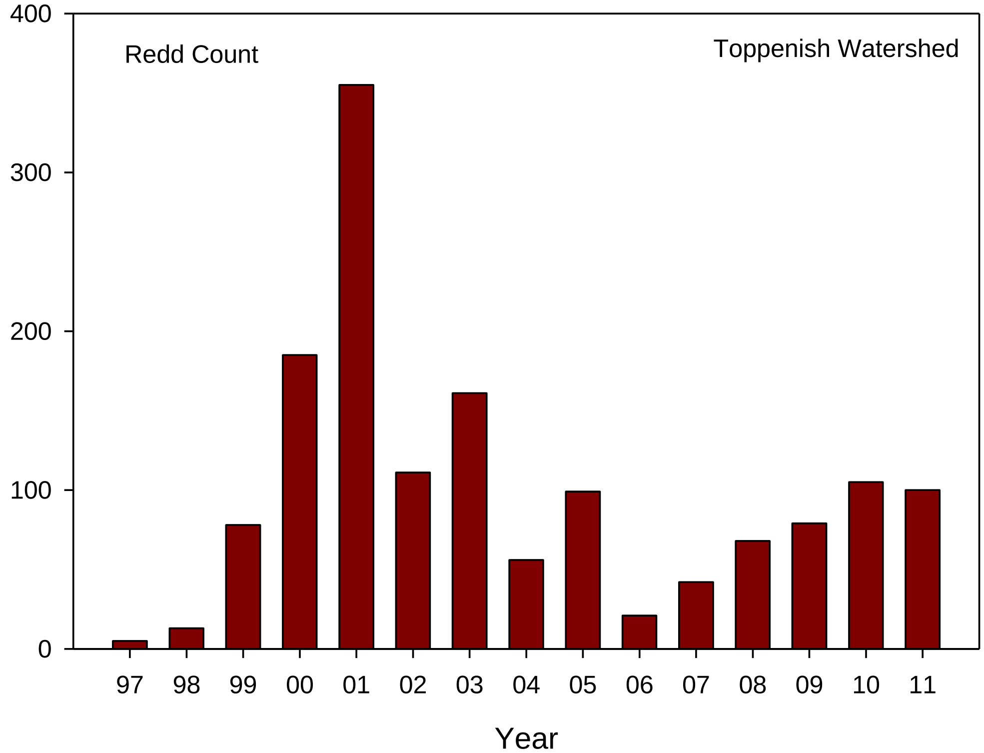

Figure 13. Number of steelhead redds per year in the Toppenish Creek watershed.

Satus Creek

Satus Creek has a record of three-pass census counts spanning 24 years beginning in 1988. Of the four populations in the Yakima basin, the Satus watershed has characteristics that are most conducive to the use of redd counts to quantify or index adult spawning abundance. Different climatic and topographic characteristics from nearby east slope cascade streams create a hydrograph where the peak discharge is almost always in mid-to-late winter before the steelhead spawning season. Although untested, accuracy (based on observed survey conditions) in this watershed seems to be relatively high when compared to most other watersheds in the Yakima Basin.

In 2011, a total of 293 redds were identified in all reaches surveyed (Table 16). This is lower than the 465 identified in 2010, although higher than the 10 year average. The number of Adults detected at Prosser Dam was also slightly lower in 2011 than in 2010. Unlike the other tributaries that we survey, High stream flows during the spring months do not interrupt surveys for more than a few days and all three passes are completed on schedule. The spawning season typically lasts from the end of February through early May. In 2011 surveys began during the first week of March and continued through the third week of May.

The distribution of steelhead redds was similar to other years with a large portion of steelhead redds located in the mainstem Satus Creek upstream from the confluence with Logy Creek. Downstream from this point only one redd was identified. The second largest producing spawning reach in the watershed was in Dry Creek upstream from the Elbow at RM 14 to 27. Logy Creek normally has fewer redds than Dry Creek, although it flows in this stream are perennial and consistently higher than in Dry. Other smaller tributaries (Mule Dry, Kusshi, and Wilson Charlie) had a total of 19 redd identified within them. Other tributaries such and Shinando Creek and Bull Creek had no redds identified and rarely do despite perennial flows and adequate habitat.

Table 16. Number of steelhead trout redds per reach in the Satus watershed in 2011. River miles are in parenthesis.

Stream	Start location, RM	End location, RM	Distance (miles)	# of Redds
SATUS	Falls (44.1)	Wood Bridge (40.8)	4.2	**40**
(3 passes)	Wood Bridge (40.8)	County Line (36.4)	4.4	**22**
	County Line (36.4)	High Bridge (32.4)	4	**27**
	High Bridge (32.4)	Holwegner(28.4)	4.8	**42**
	Holwegner (28.4)	2nd X-ing (23.7)	3.9	**24**
	2nd X-ing (23.7)	1st Xing (20.2)	3.5	**1**
	1st X-ing (20.2)	Gage (17.4)	2.8	**0**
	Gage (17.4)	Rd 23 (13.1)	4.3	**0**
Total			**31.9**	**156**
LOGY	Falls (14)	Spring Cr (11)	3	**12**
(3 passes)	Spring Cr (11)	S. C. Ford (9.5)	1.5	**10**
	S. C. Ford (9.5)	3rd Xing (3.5)	6	**11**
	3rd Xing (3.5)	Mouth (0.0)	3.5	**11**
Total			**14**	**44**
DRY	South Fk. (27.8)	Saddle (24)	3.6	**34**
(3 passes)	Saddle (24)	Elbow Xing (18.25)	5.75	**26**
	Elbow Xing (18.25)	Seattle Cr (14)	4.25	**7**
	Seattle Cr (14)	Rd 75 bend (8.75)	5.25	**3**
	Rd 75 bend (8.75)	Power Line Ford (2.5)	6.25	**3**
	Power Line Ford (2.5)	Mouth (0.0)	2.75	**1**
Total			**27.85**	**74**
W. CHARLEY	Forks (1.9)	Mouth (0.0)	**1.9**	**3**
KUSSHI	Top (11th) Xing (4.5)	Mouth (0.0)	**4.5**	**9**
SHINANDO	Ford (0.5)	Mouth (0.0)	**0.5**	**0**
MULE DRY	Yakima Chief Rd. (15.4)	Rd. 39 (4)	**11.4**	**7**
TOTAL			**92.05**	**293**

Satus Redd Life

We conducted several surveys to determine redd life (length of time redds remain visible during spawning ground surveys) on a portion of the Satus Creek in 2011 using the methodology described in Gallagher et. al. (2007). In summary, a designated redd surveyor walked an index portion of the upper Satus Watershed from the falls (RM 44.1) downstream to the old wooden bridge site (RM 40.8). The surveyor walked this reach each week as conditions allowed. Each redd was examined and the condition of the redd assessed and placed into four categories (new, measurable, still measurable, still apparent and no longer apparent). Redds were flagged and each new redd was mapped and marked with a GPS. These weekly surveys were conducted for 14 weeks between March 2nd and June 1st. Spawning appeared to have begun several weeks (end of February) before we initiated this study and ended in mid-May. In 2010, water temperatures began to exceed 4º C for part of the day beginning in early February downstream at the high bridge crossing. In 2011, water temperature was lower and was reflected by later spawning of adult steelhead. The peak in spawning activity occurred around the end of March-- several weeks later than 2010. The last redd in the watershed was identified on May 9th about a week later than the last redd identified in 2010. Redd numbers (N=40) were also lower in 2011 than 2010 (N=54) in this index reach. This reach often contains the highest number of redds in the Satus watershed. The average redd life in 2011 was 27.8 days. In 2010, average redd life in this reach was about 31 days --three days longer. The higher flows of 2011 had only a minimal effect on redd life. Periphyton growth also affects redd visibility and thus redd life, however, a difference in this factor was not noticed between the two years.

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 2.5 fish per redd for an estimate of spawning escapement of 732 adult steelhead for the watershed.

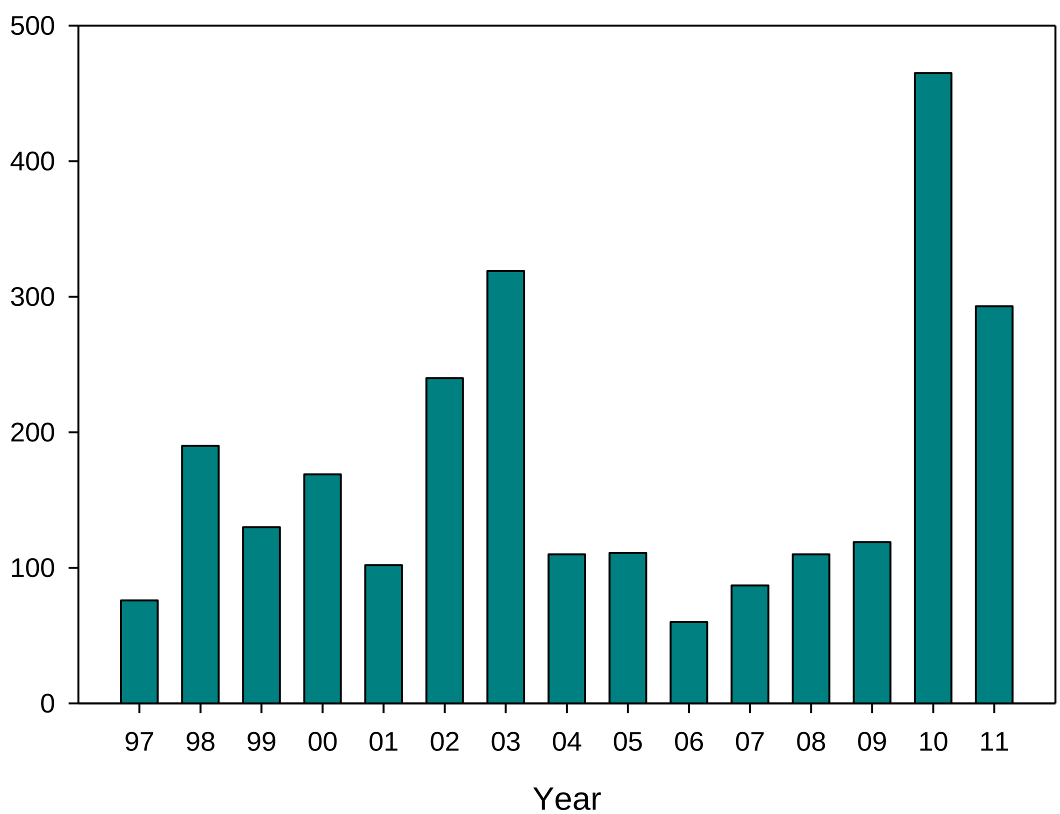

Figure 14. Number of Steelhead redds per year in the Satus Creek watershed.

Ahtanum Creek

The Ahtanum watershed was artificially lumped with the Naches population during the recovery planning process. It is unknown whether this population should be classified as a separate population. Due to prolonged high flows during the spring freshet in a confined channel, surveying Ahtanum Creek is difficult compared to the other two tributaries we survey. Turbidity in the lower stream also prevents effective spawning surveys. Due these factors as well as limited manpower, we are often only able to complete one pass before snowmelt accelerates in April. In 2011, despite consistent high spring discharge, we were able to complete one pass during the best possible conditions for this season. We counted a total of 28 redds. This is the largest number of redds seen in the watershed since annual surveys began in 2000. Nine redds were identified in the North and South Forks this year. The mainstem Ahtanum, and the lower reaches of the South and North Fork Ahtanum appears to provide the best spawning habitat in the watershed. We realize that spawning habitat likely extends above the four-mile beginning points for both the survey in the North Fork and South Fork; however, we currently lack the manpower and time to extend the survey boundaries further upstream. The relatively high number of redds seen in one pass in the Ahtanum watershed in 2011 indicate that a viable steelhead population may still exist in this watershed.

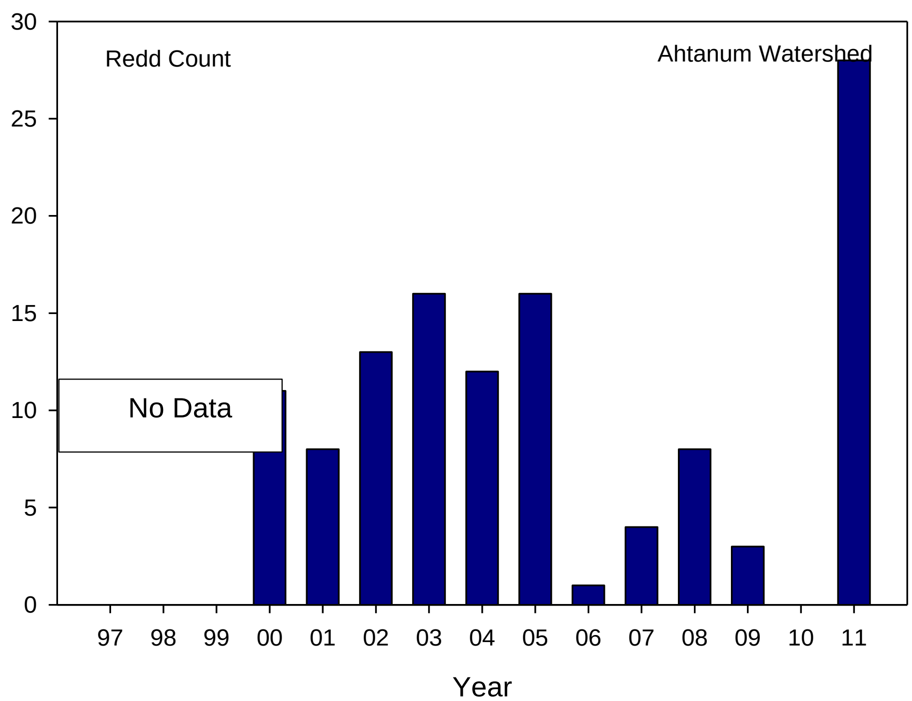

Figure 15. Number of Steelhead redds per year in the Ahtanum Watershed.

Table 17. Number of steelhead redds per reach in the Ahtanum watershed in 2011

Stream	Start location, RM	End location, RM	Distance (miles)	# of Redds
Ahtanum	North Fork Aht.(4)	North Fork Mouth(0)	4	**3**
(1 pass)	South Fork Aht. (4)	South Fork Mouth(0)	4	**6**
Mainstem	Confluence (23.1)	AID diversion (18.9)	4.2	**9**
	AID diversion (18.9)	Am Fruit Rd (14)	4.9	**8**
	Am Fruit Rd (14)	72n Ave. (8.6)	5.4	**0**
	72nd Ave. (8.6)	16 Ave. (4.6)	4	**2**
	16th Ave. (4.6)	mouth. (0)	4.6	**0**
Total			31.1	**28**

South Fork Ahtanum Bull Trout surveys

The Yakama Nation has performed Bull trout surveys in the South Fork Ahtanum Creek annually since 2002. Each year they are conducted in the South Fork of Ahtanum Creek within an index reach from approximately RM 7.7 to RM 10.4. This section borders the Yakama Reservation and includes a small section of Tract C. upstream from Reservation Creek. Surveys are conducted as part of a program to track the status and trends of this species with in the Yakima River watershed. Index reaches are situated in prime spawning reaches. In watersheds outside the South Fork Ahtanum, WDFW performs the surveys in cooperation with other agencies (e.g. USFWS, Joint Board, Yakama Nation, Yakima Basin Fish and Wildlife Recovery Board).

We perform these surveys using a protocol developed by WDFW (Eric Andersen; unpublished document-2011). Surveyor (s) walk upstream record, and flag redds during multiple passes. They are categorized as definite, probable, or possible. On the 3rd or last pass, GPS waypoints are collected. Live bull trout are documented during each pass as well. Only redds identified as probable or definite are included in the final count.

During our 2011 bull trout surveys we completed individual passes on Sept-9, Sept-20, and Oct- 4. We found a total of 4 redds during all passes. No live fish were documented in 2011. In the North Fork Ahtanum only one redd was identified and 11 were found in the Middle Fork (Eric Andersen; unpublished data). In the entire Ahtanum watershed, 16 redds were identified -- one less than in 2010.

III. RESTORATION PROJECTS

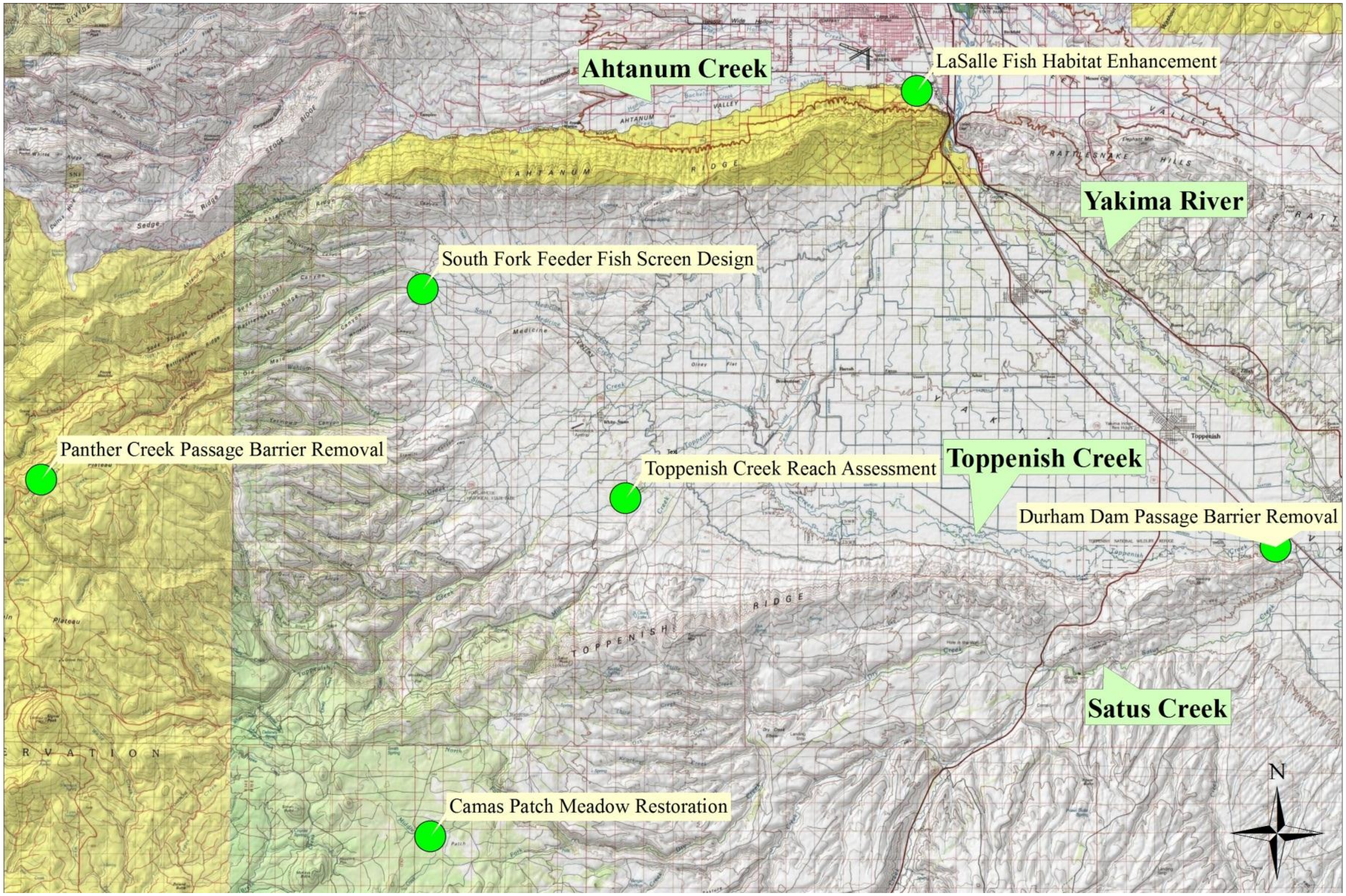

Figure 16. Location of YRWP 2011 restoration projects.

A. Camas Patch Meadow Restoration

Project overview

Camas Patch Meadows is a headwater meadow to Dry Creek and is considered a culturally sensitive meadow that is used by tribal members to dig roots and medicines. A road that bisects the meadow on the northern end of its boundary was identified as an impact to the natural hydrology of the meadow. This road was continually widened and eroded by vehicles using the road when wet, channelizing surface flow, and possibly affecting subsurface flow due to soil compaction (Figure 17). Additionally, a culvert located on the northwest corner of the meadow was also disrupting the natural hydrology of the meadow diverting flows around the meadow. 2011 restoration efforts included the following: 1) removing the culvert and installing a ford, 2) road closure and development of an alternate access route, 3) install buck and pole fences to prevent vehicles from continued use of the closed road, and 4) revegetating the decommissioned road. This project is part of an ongoing restoration action by YRWP. In 2006, YRWP had built and maintained fence over 6 miles of meadow at Camas Patch to exclude horses, cattle, and vehicles.

Figure 17. Camas patch meadow located left of picture and road that is widening and channelizing the meadows hydrology.

Methods

YRWP developed an old logging road located just north of the proposed road closure providing alternate access into and around the meadow (Figure 18 and 19). Though this road is still in close proximity of the meadow, this relocation should alleviate the impacts imposed on the meadow hydrology. This plan was approved and developed in accordance with BIA roads, YN Tribal staff and allotment owners. Road closure and the development of the alternate access route were completed July 13, 2011. Vehicle exclosure fences were also installed to prevent continued use of the closed road. Buck and pole fences were built to NRCS specifications and completed August 11, 2011 (Figure 19).

To further prevent the continued use of the closed road, the compacted soil was tilled using a small excavator. The road surface was revegetated using a meadow seed mix reflective of the current composition of the existing vegetation (Figure 20).

A culvert located at the northwest corner of the meadow complex forces surface runoff into localized channels causing downcutting downstream and decreasing meadow groundwater recharge. On June 5, 2011, YRWP completed the removal and installation of an armored rock ford to further enhance hydrologic connectivity. The armored ford was constructed at the proper angle and grading to allow crossing by most vehicles including trucks and logging equipment (Figure 21).

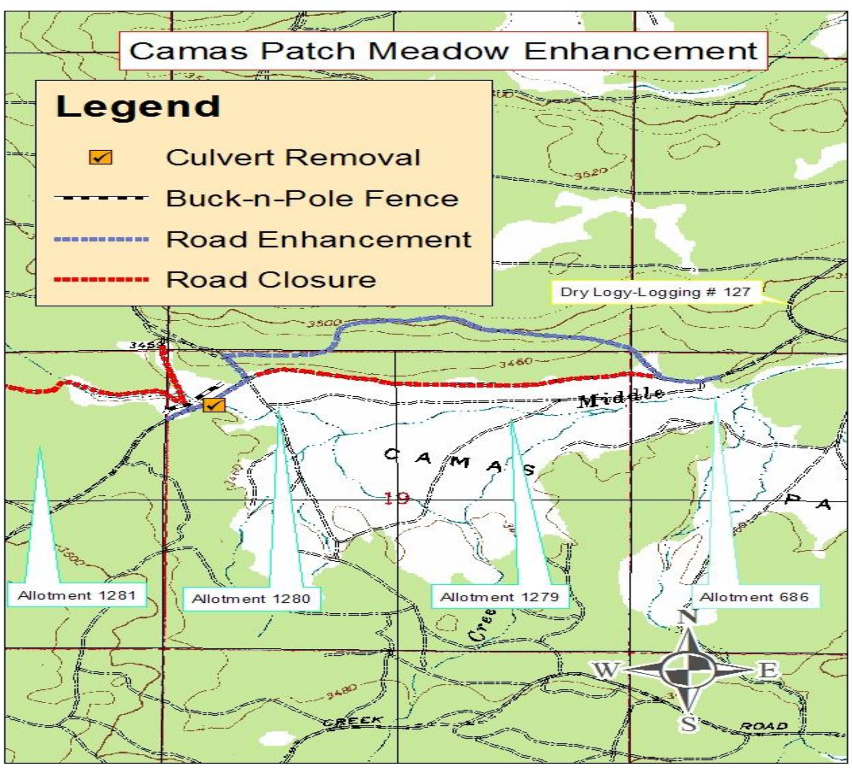

Figure 18. Camas patch road that was closed (red) and the old logging road that was developed (blue) to provide alternate access into and around the meadow.

Figure 19. Road closure and road development of alternate route. Also note vehicle exclosure fence to prevent continued use of closed road.

Figure 20. Revegetation of the decommission road surface.


Figure 21. Armored rock ford in place of culvert.

Conclusion

Three actions are proposed for 2012. Plans are to extend fence up to the newly improved road and around an adjacent meadow within the Camas Patch Meadow complex to exclude grazers. The meadow has been severely trampled by grazers and includes the main channel of Middle Fork Dry Creek. Incised ephemeral channels within the Camas Patch Meadow complex caused by overgrazing and other anthropogenic factors have contributed to low base flows in the upper Dry Creek watershed. An important spawning and rearing stream for Mid Columbia Steelhead Trout, Dry Creek is a tributary to Satus Creek which produces the highest Steelhead Redd counts of the Yakima River Basin. Plans are to install grade control structures within the incised channels of Camas Patch Meadow, so base flows will increase and provide higher water quality and quantity in areas of Dry Creek that are currently limiting.

B. Panther Creek Passage Barrier Removal

Project Overview

On August 6, 2011, YRWP completed the implementation of restoration actions at two road/stream interfaces on Panther Creek to improve stream function and facilitate fish movement (Figure 22). Sites within the Panther Creek watershed have seen degradation resulting from human activity (i.e. grazing, road building, and logging). These problems are most obvious at the site on Panther Creek where the Fort Simcoe Road # 80 transects T10N, R13E Section 13 and further downstream T10N, R13E Section 26. The Fort Simcoe Road # 80 crossing bisects an elongated wet meadow (Figure 23). At the culvert outlet, there was a scour pool and culvert drop height of about 1 foot. Westslope cutthroat trout congregated in the scour pool below, indicating that this crossing is likely a fish barrier. The channel is incised by about 1-3 feet downstream of the road and approximately 1-2 feet in areas upstream from the road. Small head cuts and stream bank erosion are apparent in the meadow. Further downstream, another scour pool is at the base of a culvert and drops between 0.5 and 1 foot. Although westslope cutthroat were collected during electrofishing surveys both downstream and upstream of these two stream crossings, fish passage may have been obstructed seasonally to adults and likely year round to smaller individuals. The culverts also obstructed bedload and large woody debris transport as indicated by its accumulation at the culvert inlets. By removing these two culverts, ESA listed steelhead will likely benefit from the improvement of stream function, a reduction in fine sediment, and an increase in base flows resulting from the restoration of natural wet meadow hydrology. Some wildlife and plant species may benefit as well.

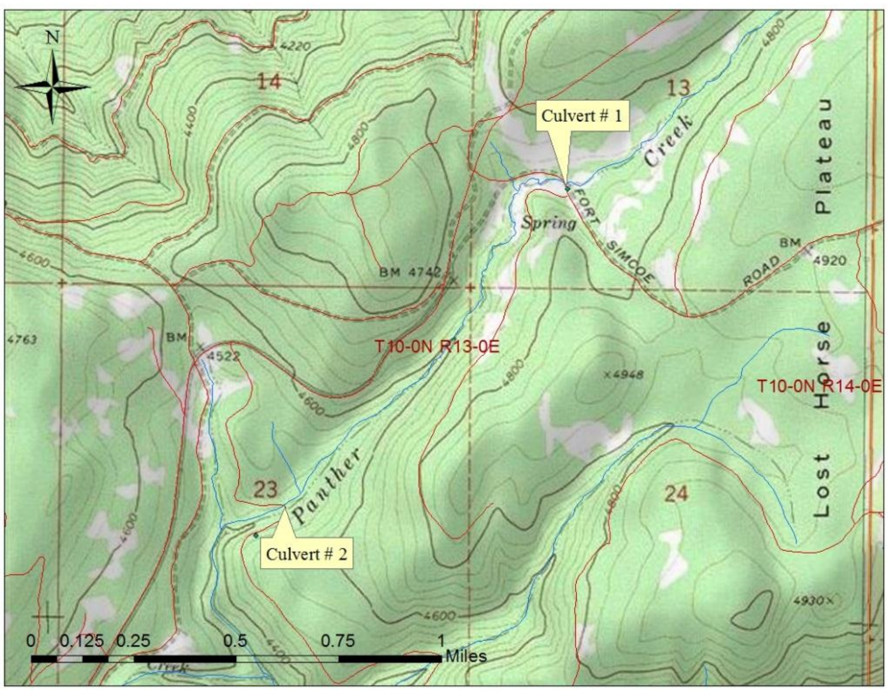

Figure 22. Location of restoration actions on Panther Creek.


Figure 23. Lower end of wet meadow located at the Fort Simcoe Road #80 crossing

Methods

Two culverts were identified as fish passage barriers and were removed and replaced by armored rock fords. Sites were re-vegetated using a grass seed mix representative of the existing composition of plant species. In addition to removing the two culverts, an exclosure fence was installed to exclude livestock grazing around the wet meadow present at the Fort Road #80 crossing. The upper half of Panther Creek flows though several small coniferous wet meadows that have seen notable encroachment by surrounding lodgepole pine stands and have been impacted by extensive livestock grazing.

Culvert #1 Fort Simcoe Rd stream crossing (T10N, R13E Section 13 SW ¼, SW ¼)

YRWP removed the culvert where Fort Simcoe Road crosses Panther Creek. In its place an armored rock ford was constructed at the proper angle and grading to allow crossing by most vehicles including trucks and logging equipment. Constructed riffle and inverted rock weirs were constructed below the crossing (between 5 and 50 feet downstream) with drops of less than 0.5 feet to allow fish passage for adults and larger juveniles from winter through early summer. The plunge pool was partially filled with gravel and woody debris was placed at the meander bend to encourage bank stability and reduce the potential for avulsion into and through the meadow. Equipment used for construction included a small excavator, a dump truck, a water truck, and road grader. The rock needed for the ford was available at the Lincoln Meadows rock quarry. Other road construction materials were obtained from the Yakama Nation at nearby quarries. Figure 24 and 25 shows before and after culvert #1 was removed.

Figure 24. Culvert # 1. Outfall of the culvert on the Rd. 80 crossing of Panther Creek

Figure 25. Culvert # 1. Armored rock ford replacing culvert on Rd. 80 crossing

Culvert #2 Panther Creek crossing (T10N, R13E Section 23 SE ¼, NW ¼)

YRWP removed the existing double culvert configuration (Figure 26) and replaced it with another armored rock ford (Figure 27). The construction was completed at an angle and grade approved for vehicle travel including trucks and logging equipment. Equipment used for construction included a small excavator, a dump truck, a water truck, and road grader. Areas of the stream channel disturbed during construction were stabilized with a combination of large wood, rock, and coir fabric similar to the final construction drawings.

Conclusion

Immediately after project implementation, a cutthroat trout was observed (and filmed) crossing the armored ford located at the Fort Simcoe Road #80 meadow crossing. Panther Creek is a headwater tributary of Toppenish Creek, which drains much of the north east corner of the Yakama Reservation. It begins at an elevation of 4950 and terminates about 4.5 miles downstream at its confluence with Toppenish creek (elev. 4000). Several small tributaries enter Panther Creek along its course including Pile-up Mosquito Creek, and an un-named perennial stream. Toppenish Creek provides important spawning and rearing habitat for Mid-Columbia ESU steelhead (*Oncorhynchus mykiss*), which are listed as threatened under the endangered species act. Spawning and rearing habitat for this species extends approximately up to the confluences of Panther Creek and Toppenish Creek in T10N. R13E Section 25 SW 1/4. YRWP staff are confident that this project will be a succes.

Figure 26. Culvert # 2. Outfall of double culvert configuration at lower Panther Creek

Figure 27. Culvert # 2. Armored rock ford replacing culvert on lower Panther Creek

C. Durham Dam Passage Barrier Removal

Project overview

The fish passage enhancement project is located at the Durham Diversion on Toppenish Creek, southeast of Toppenish, WA (Figure 28). The factors limiting fish passage and habitat degradation at the restoration site are the result of an obsolete irrigation diversion dam (Figure 29). During periods of heightened instream flows, the confines of the dam abutments create a hydraulic pressure gradient, limiting successful fish passage. Another result of the heightened hydraulics has been the creation of an extensive scour pool downstream of the dam which lacks roughness elements necessary for utilization by multiple life history stages of Mid Columbia River Steelhead. The upstream habitat adjacent to Toppenish Creek consists of wetland vegetation where, without the dams influence, a riparian corridor would exist. This factor has contributed to increased water temperatures, absence of fish refugia, a shift in primary macroinvertabrate production, and the absence of large woody debris/recruitment.

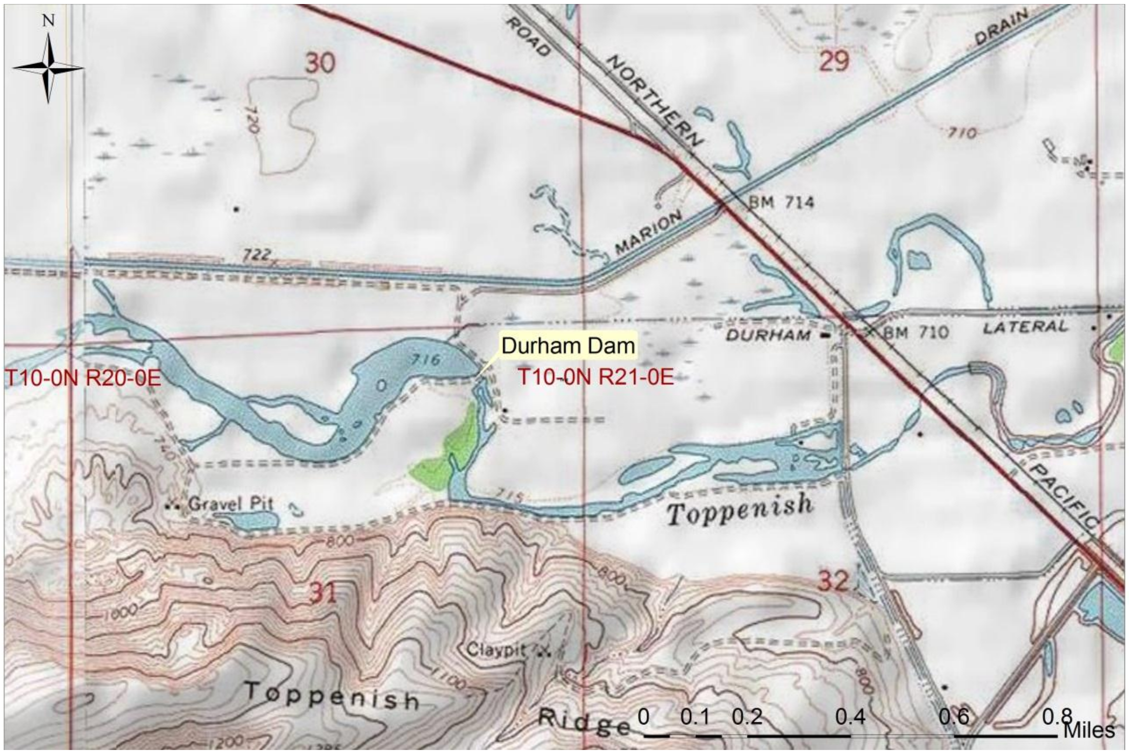

Figure 28. Location of Durham Dam on Toppenish Creek.


Figure 29. Obsolete Irrigation Diversion (Durham Dam) located on Toppenish Creek.

Methods

Removal of the diversion structure and portions of the roadway at the Durham Diversion Dam is the most effective method of achieving restoration goals of enhanced fish passage and restoration of natural channel and floodplain processes. A roughened channel/armored crossing will be put in place where the dam and road is removed. Large woody debris will be installed just downstream from the removed dam- extending downstream of the crossing to protect/stabilize the left bank and create a backwater rearing habitat. The riffle downstream of the pool will be extended upstream, and large woody debris will be anchored to areas along the right bank of the pool to increase channel roughness. These measures will promote forage and rearing habitat, while enhancing smolt, and adult fish migration. The engineering design and plan has been approved by all Yakama Nation DNR programs, Wapato Irrigation Project and land owners/allottees.

Conclusion

Project was abandoned August 18, 2011 due to a high water year (flows exceeded 60 cfs). Elevated flows hindered efficient site dewater (Figure 30 and 31). Project is postponed until 2012 (or to a time when flows are 40 cfs or less).

Figure 30. Failed coffer dam attempt using bulk bags.


Figure 31. Failed coffer dam attempt using bulk bags.

D. LaSalle High School Fish Habitat Improvement

Project Overview

YRWP staff completed a bank stabilization and floodplain restoration project in and adjacent to Ahtanum Creek (Figure 32) on November 1, 2011. Anthropogenic and natural factors had led to the rapid erosion of three stream meanders, a discontinuity between the floodplain and the stream, and a domination of non-native invasive vegetation within the project site. ESA listed species: Mid Columbia River Steelhead Trout and Bull Trout, Chinook, along with hatchery Coho; utilize Ahtanum Creek for multiple life history stages. The project site is located on LaSalle High School property which offers a unique educational outreach opportunity. These factors initiated a cooperative effort between the Yakama Nation, LaSalle High School, and North Yakima Conservation District to restore the site by creating fish & wildlife habitat, stabilizing the three eroding banks, creating two backwater channels and a swale, and re-planting the site with native plant species pursuant to project objectives.

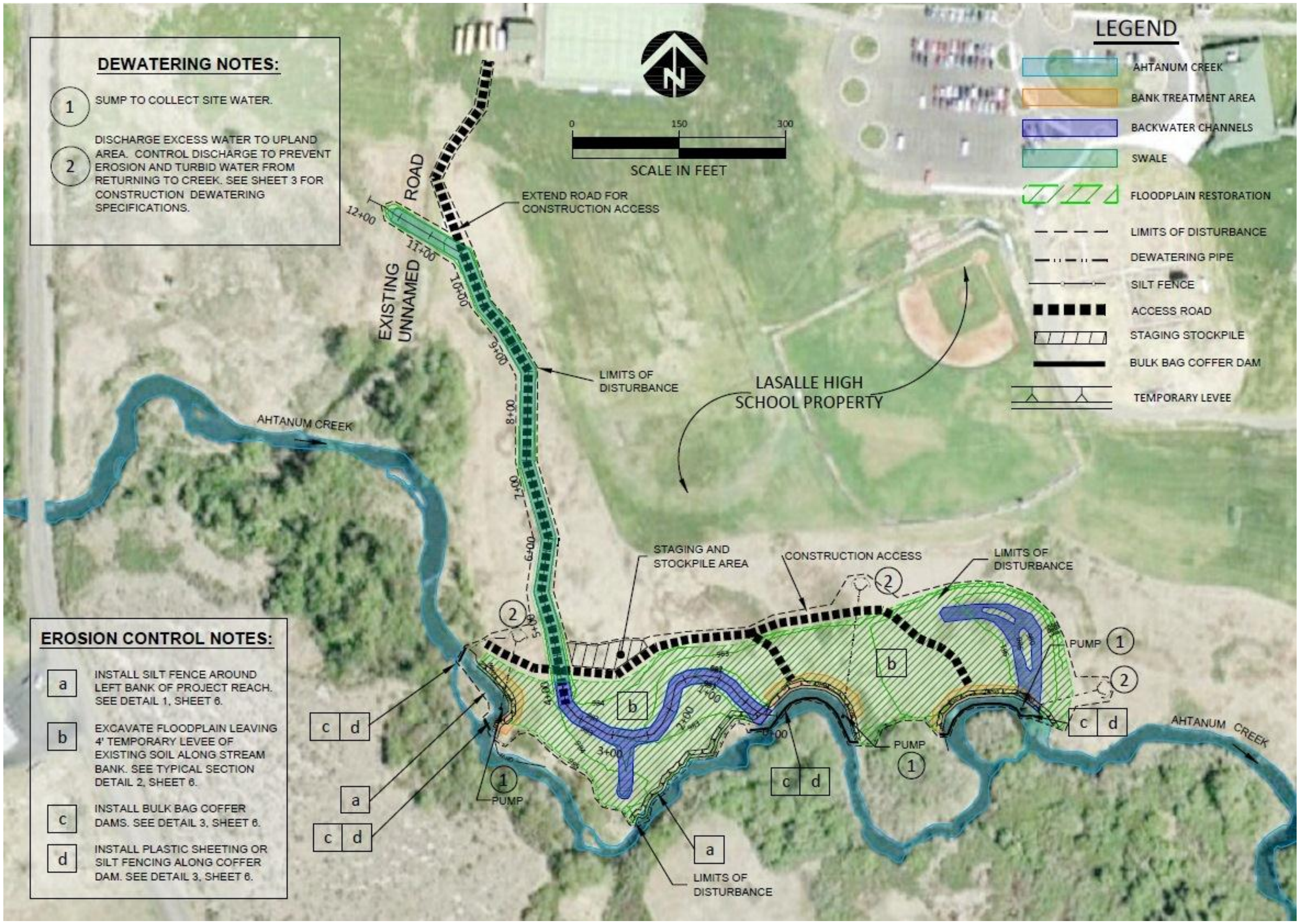

Figure 32. Bank stabilization and floodplain restoration project in and adjacent to Ahtanum Creek.

Methods

Bank stabilization features were installed at each of the three eroding meander bends (Figure 33). The bank stabilization features consist of a large woody debris toe with a fabric encapsulated soil (FES) lift above (Figures 34, 35, & 36). All woody materials installed were composed of Red Fir, which was harvested in 2011. Scour pools were excavated beneath the bank stabilization features to a depth of approximately 3 ft below existing grade to provide refuge fish habitat beneath the root wad component of the woody debris toes. Approximately 100 coyote willow cuttings were planted atop each of the root wad logs prior to replacing fill.

Figure 33. Site #2 during construction.

Approximately 8,500 cubic yards of soil was removed from the floodplain adjacent to Ahtanum Creek on the north bank to maximize water storage during elevated water events (Figure 37). Two backwater channels were placed in the new floodplain, and a swale from the upstream end of the property was excavated to convey overland flow to one of the backwater channels (Figure 38). The new floodplain and swale was re-vegetated with an upland grass seed mix and the new floodplain was also planted with shrubs and upland/riparian trees. Straw mulch was then placed over the disturbed soil to retain moisture, reduce erosion, and suppress weed growth. Biodegradable woven coir erosion control fabric was installed along the banks of backwater channels and within the backwater channels (in areas vulnerable to erosion). The backwater channels were also re-vegetated with native wetland seed. Large wood was installed along the backwater channel margins, on the new floodplain surface, and within the backwater channels to provide further erosion protection and fish and wildlife habitat (Figure 39). To improve access for student educational activities, two bridges were constructed by YRWP employees over the two backwater channels.


Figure 34. Site #1 post construction


Figure 35. Site #2 post construction


Figure 36. Site # 3 post construction


Figure 37. Excavated floodplain, floodplain wood, & backwater #2.


Figure 38. Constructed swale to convey overland flow.

Figure 39. Backwater #1: displaying re-vegetation, woody debris and erosion control measures.

Instream work areas were isolated and dewatered using bulk bag coffer dams and a dewatering pump (Figure 33). A Yakama Nation Fisheries Biologist was on sight during all in-stream work periods. Fish rescue efforts followed NMFS prescribed protocols. Several Chinook smolts and one Steelhead smolt were caught using seining and where necessary (undercut banks, streambed composition); electroshocking techniques were used to rescue fish. With each technique, three passes were completed after the last salmonid was captured. Length measurements were obtained from salmonid species and weights were obtained from salmonids captured at the downstream site, but unfortunately a balance was unavailable for the remaining 2 sites. Additionally, fin clip samples were removed from salmonid species for genetic analysis. Various other species were captured including: chiselmouth, pike minnow, sculpin spp., sucker, dace, shiner, ammocoete, and crayfish.

Conclusion

The three eroding banks on Ahtanum Creek have been armored to prevent further erosion. Critical refugia fish habitat was created by the bank stabilization features. During construction, a groundwater lens was discovered within the constructed backwater channels which will maintain optimal rearing temperatures within these habitats and the constructed grade within the backwaters will prevent fish stranding during periods of low flow. The swale that was installed at the site will convey overland flow to the upstream backwater channel and will prevent flooding during 100 year flood events. By reconnecting the floodplain, the channel will have an enhanced interaction with the floodplain during elevated flows which will allow for a more stable hydrograph. The wood that was added to the floodplain habitat will aid in dispersing the hydraulic energy during elevated flows and increase infiltration rates. The extensive re-vegetation of native plant species and planned weed control will allow for a healthy riparian corridor to develop in subsequent years. This will cause temperatures to be more stable, provide cover for fish, and increase wood recruitment, while providing wildlife habitat.

Figure 40. Sophmore LaSalle High School Science students learning about the project from contracted hydraulic engineer.

Figure 41. Example from site of re-vegetation efforts

E. Upper Toppenish Creek Reach Assessment

Project Overview

YRWP conducted a reach assessment on an 8.9 mile stretch of upper Toppenish Creek from Shaker Church Road to the Olney Lateral Diversion (Figure 42). This assessment evaluates physical and biological conditions affecting the viability of native salmonid species, specifically the Mid-Columbia Steelhead (*O. mykiss*) with the goal of identifying specific restoration activities to preserve and restore aquatic habitat and natural river processes (Figure 43). This project was completed February 29, 2012.

Methods

Existing data pertaining to prior studies, stream process, fish habitat and landowner use were reviewed. Two contractor staff walked Toppenish Creek along reaches which were accessible and had landowner consent. An overview of reach conditions and habitat enhancement opportunities were documented with field notes, photos and hand measurements of channel width and depth dimensions, gravel bar conditions and size of substrate. Gravel bar substrate sizes were documented using a Wolman pebble count method. Existing riparian vegetative composition was noted including species and locations with respect to the stream geometry. Location of data collection was documented through correlation to aerial photography, GPS waypoints and hand measurements (e.g. string machine). Field data was downloaded into and summarized in appropriate software (i.e. Excel, AutoCAD, GIS). A final report and supporting graphics was prepared to summarize the reach assessment and recommendations for habitat enhancement opportunities.

The final report includes three primary components:

1. Tributary Assessment – Watershed-scale characterization of first-order controls on river processes including geology and climate. Includes a Reach-Based Ecosystem Indicators Analysis.
2. Reach Assessment– Reach and Sub-Unit scale evaluation of current geomorphic and habitat conditions from river mile (RM) 36.0 at Shaker Church Road to RM 44.9 at the Olney diversion.
3. Project Identification – Presentation of restoration strategies applied at the reach and site scale.

Conclusion

Due to a time constraint, original plans to complete an analysis and decision matrix was not completed. The matrix was anticipated to include description of proposed enhancement for typical existing stream conditions, pros/cons, costs, risk, and planning level cost estimate. Conceptual level analysis and design was to evaluate performance, stability and risk of proposed habitat enhancement elements. If necessary, plans to include this portion of the assessment may be continued at a later date.

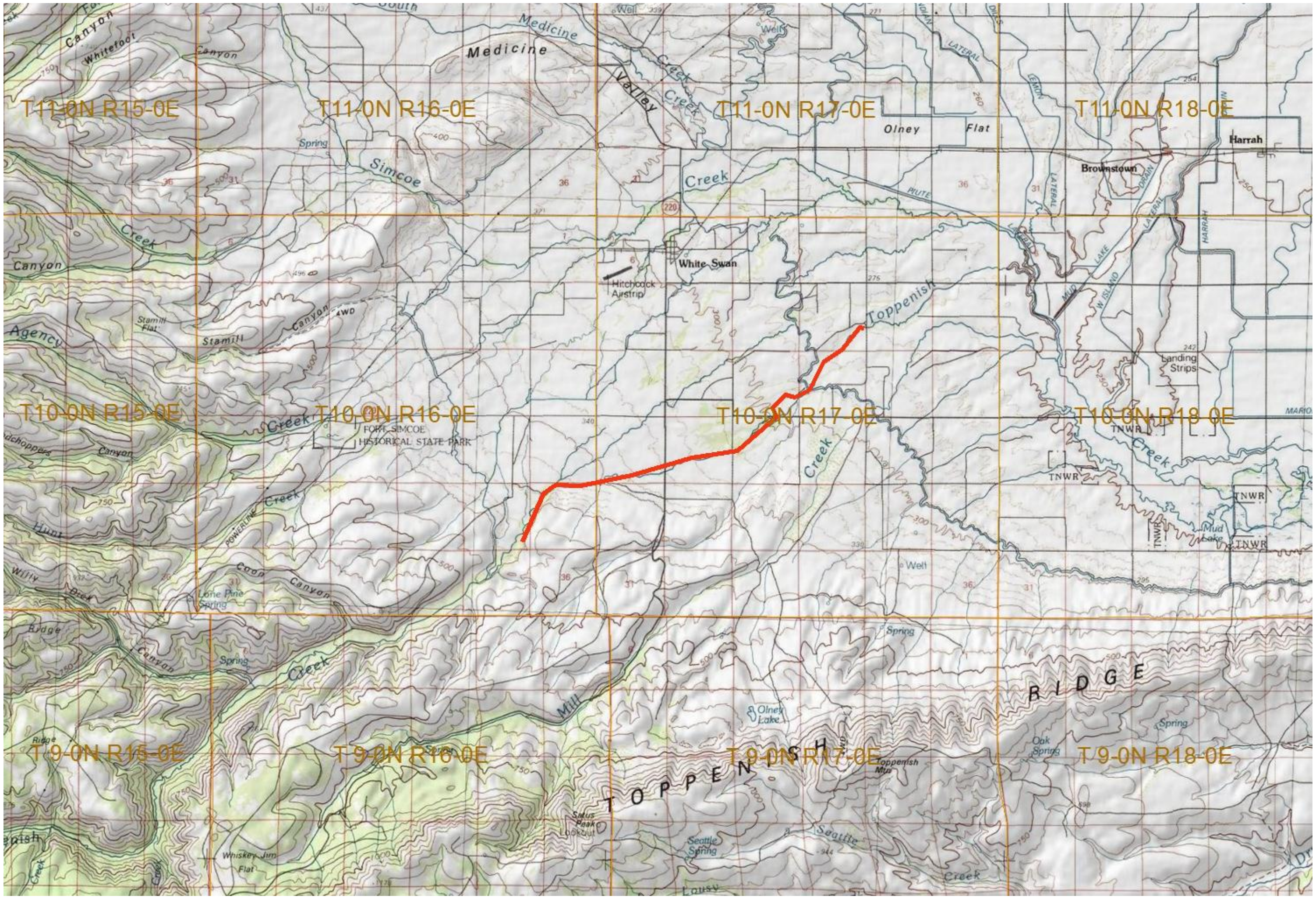

Figure 42. Upper Toppenish Creek Reach Assessment: 8.9 miles from the Olney Lateral Diversion to Shaker Church Road.

Figure 43. Habitat survey assessing reach conditions.

F. South Fork Feeder Ditch Fish Screen Design

Project Overview

The unscreened surface water diversion is located on South Fork Simcoe Creek (Figure 44). The diversion is characterized as a gravity diversion where flow is controlled by differences in elevation (Figure 45). Looking downstream, the gravity diversion intake is located on the right bank and flows near the streambank for about one mile. The ditch is used for watering livestock and flows through unshaded pasture. Installing a fish screen on the Feeder Ditch will prevent steelhead from using the ditch and becoming stranded during periods of high agricultural use or at low flows.

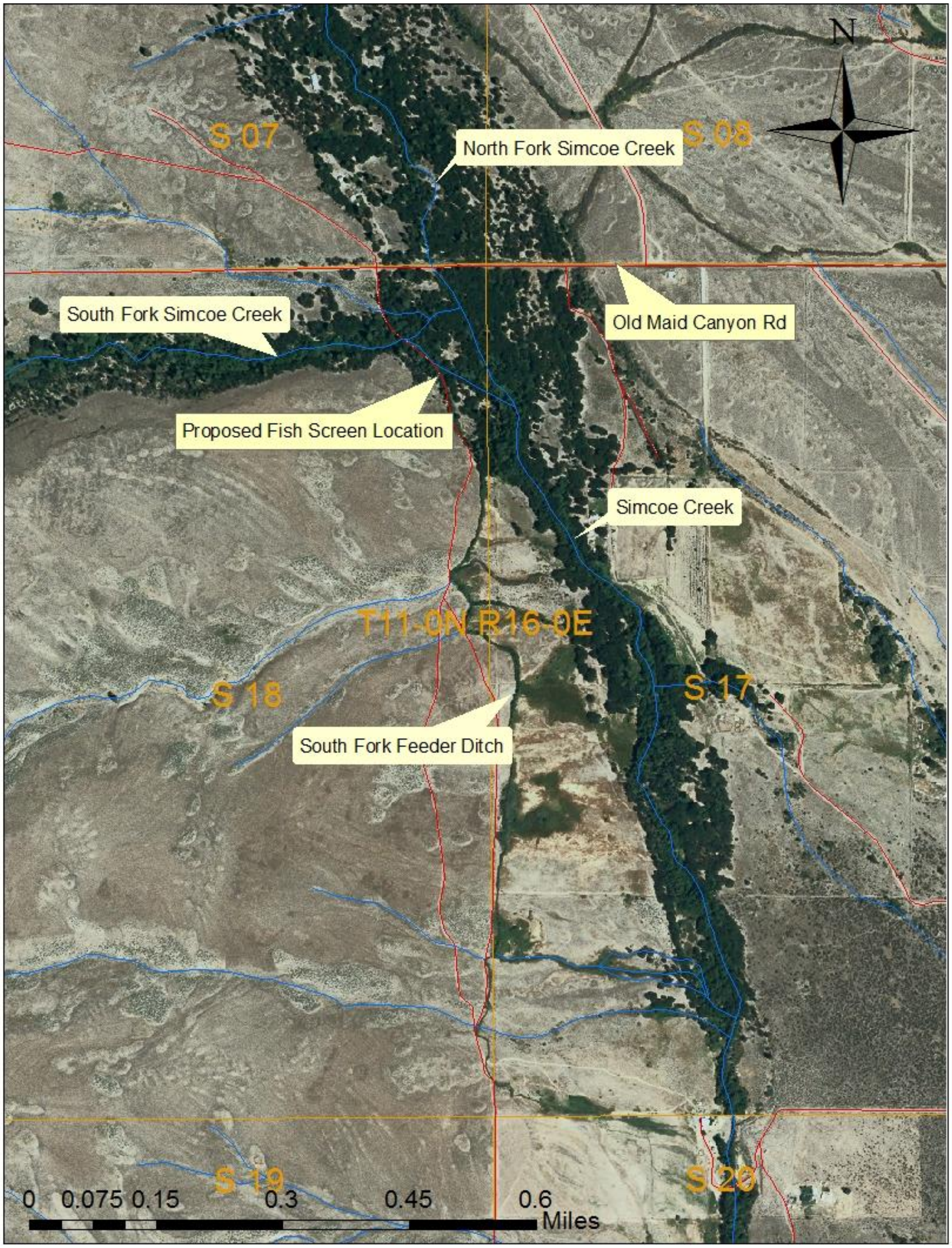

Figure 44. Unscreened surface water diversion is located on South Fork Simcoe Creek.

Figure 45. The Feeder Ditch is located on right looking downstream. Sandbagging at the diversion point is to maintain minimum in stream flow.

Methods

YRWP contracted work to develop an engineering design to install the fish screen. An engineering design was completed February 29, 2012. Assistance was requested from the Washington Department of Fish & Wildlife (WDFW) Technical Applications (TAPPS) Division in providing fish protection screening of the Feeder Ditch. WDFW's Capital Asset Management Program's (CAMP) Yakima Construction Shop (YCS) will fabricate and deliver a screen of standard designs that will be compliant with current state and federal fish protection criteria. The screen assembly will accommodate diversion rates appropriate for the site. The structure will include a submerged orifice weir with staff gages for measuring diversion flow and will be fitted with a protective cover to prevent damage or impaired operation from windblown debris. Operating procedures and a maintenance/parts manual will be provided with the screen. WDFW will provide replacement of any parts that fail for one year from the date of installation. TAPPS staff will continue to provide screening technical assistance in the placement and installation of this screen.

Conclusion

Over the last 20 years, YN Fisheries has evaluated and attempted to put fish screens on 5 unscreened diversions located within the Simcoe Creek Watershed. Currently all have been addressed but two: the South Fork Feeder ditch and Hubbard. Plans to install the Feeder Ditch fish screen is anticipated for 2012. However, due to complications with landowner approval, the screening of Hubbard ditch has been postponed and will be revisited at a later date.

IV. *Operations and Maintenance*

A. Stock Wells

YRWP staff repair and maintain 33 solar powered stock pumps (Figure 40) and 3 stock water pipelines in the Ahtanum and Toppenish Watersheds. These pumps and pipelines are used to provide stock water when YN minimum instream flow criteria mandate the cessation of irrigation. It is necessary to have many wells because there are many individual cattle operations, several of which may not always be served by a single well. Operating these wells has been a difficult task which we are still in the process of perfecting. Project staff anticipates constructing more stock pipelines that will be associated with the existing stock pumps. This will better meet multiple users' needs while only using one stock pump.

Figure 40. Stock pump and watering trough.

Routine maintenance of these facilities includes fixing a significant amount of broken PVC plumbing (often associated with cattle damage), replacing the electrical pieces of the pump's control systems as they wear out and upgrading the water troughs associated with the pumps.

Project staff have found that most of the infrastructure associated with the watering troughs (hoses, float switches, trough supports etc.) were too lightly built. Over the last year we have been working to upgrade this infrastructure with more rugged float switches, flexible PVC hoses instead of garden-type hoses, more sturdy stanchions for the troughs and gravel aprons around the troughs to prevent soil erosion.

In addition we have found it necessary to replace several of the protective fences surrounding the installations. The original fences were usually standard barbed wire and it has become apparent that a post and pole type fence is more appropriate for this application.

We have experienced relatively few problems with the solar arrays associated with the pumps. Several arrays have been upgraded to provide more power and thus more pumping capacity to units that experience high demand.

B. Fencing

As in past years, staff maintained over 158 miles of range unit boundary fence, 15 miles of riparian fence and 22 miles of meadow exclosure fence. The YRWP maintains range unit boundary fence in places where those fences keep cattle out of sensitive areas. Staff build and maintain riparian fencing. Some of the maintenance is done in cooperation with the Bureau of Indian Affairs' Range Program, however that program is chronically understaffed, and much of the work falls to the YRWP.

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