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FY2010ANNUAL REPORT

OCTOBER 1, 2009 THROUGH DECEMBER 31, 2010
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 2009, 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 exclosure fences, bank stabilization, fish screen installation and meadow restoration during the 2010 work season.

II. *Data Collection*

A. Smolt Traps

We monitored steelhead juvenile out migration (abundance, timing, and survival) in Toppenish Creek, Satus Creek, and Ahtanum Creek using three 5 foot diameter rotary screw traps each situated below all known steelhead spawning habitat in each respective tributary (Figure 1). Traps were operated between mid November and the first week of June each year. Flow is often to low at other times (i.e. June- October) of the year making operation during this period.

<u>Methods</u>

All juvenile steelhead were anesthetized in MS-222 before being handled. They were then enumerated, measured (mm), and weighed (g). Scales were collected on 100 individuals. We also collected fin clips from 100 individuals from Satus and Toppenish Creek. These samples were sent to CRITFC for DNA analysis. They now have six years of data in hand to compare populations. On several occasions when large catches occurred (N > 200) only a random sub-sample were measured and weighed. We inserted PIT tags into a sub-sample of captured steelhead smolts over 100 mm in length. Fish were then released at least 100 meters downstream from the screw trap after data was collected. Some PIT tagged fish were released several hundred meters upstream from the trap to estimate the efficiency (i.e. mark-recapture). Our goal was to perform at least one efficiency test per week at each trap, although low capture rates sometimes prevented this. 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.

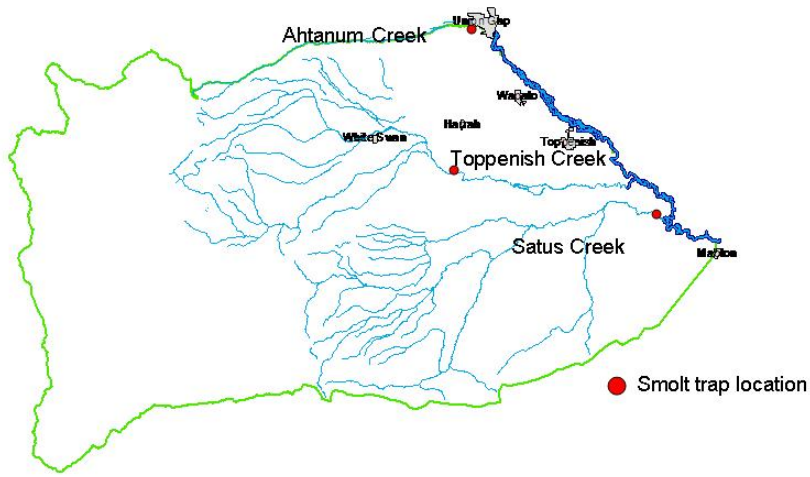

Figure 1. Map of smolt trap locations on Satus, Toppenish, and Ahtanum Creeks

Satus Creek

The screw trap on Satus creek was deployed at river mile (RM) 1 on December 1st, 2009 and was operated continuously until June 29th 2010. The screw trap was in place for a total of 212 days. On several occasions during the period of operation, the cone on the trap had to be lifted when discharge and instream debris levels were high to avoid clogging, damage to the trap, and harm to out-migrating juveniles. Conditions for operation were suitable at this site for 92 % of the days (195) during the season. During the interval between visits to the trap, debris stopped the cone 17.5 % of the time. Steelhead smolts were captured on 62 days during the season (38% of operating days).

The mean rotation time for the screw trap was 16.47 seconds per rotation. The mean staff gage reading was 2.05—almost identical (2.04) to last season (2007-2008). The trap may not be rotating as easily due to wear and tear from several years with high flow events, however it is still functional.

During the 2009-2010 season a total of 120 steelhead juveniles were captured in the screw trap at Satus Creek. We implanted 91 PIT tags into captured fish. From the PIT tagged juveniles, 68 were released upstream for an efficiency test. Only one was recaptured producing a very rough efficiency estimate of 1.47 percent. A rough outmigration estimate of 8160 steelhead smolts can be obtained; however, basing an outmigration estimate on only one recaptured individual is probably not a statistically valid approach. This number likely underestimates outmigration because the trap could not be effectively deployed during some of the peak flow events—the same events that can stimulate outmigration behavior in steelhead. Improvements to the channel (sand bags, weir panels, or more permanent structures) may be helpful to increase the efficiency to greater than 10% to get a good out-migration estimate at this location. There were 0 mortalities tallied from the trap in the 2009-2010 season at the Satus trap—down from last year.

Table 1. Statistics for the steelhead juvenile catch at the screw trap at Satus Creek for the 2009-2010 season.

Stat	Nov	Dec	Jan	Feb	March	April	May	June	Overall
Monthly Catch	.	37	9	4	33	32	5	0	120
% of total	.	30.8%	7.5%	3.3%	27.5%	26.7%	4.2%	0.0%	100.0%
Max Fork Length	.	158	108	150	179	176	160	.	179
Min Fork Length	.	77	74	94	85	94	71	.	74
Mean Fork Length	.	115.73	95.78	123.00	143.15	142.15	119.80	.	129.21
Max Weight	.	158.0	108.0	28.0	60.0	176.0	38.0	.	179.0
Min Weight	.	5.0	3.0	6.6	8.0	94.0	4.0	.	3.0
Mean Weight	.	16.70	95.78	18.40	34.09	142.15	22.00	.	24.86
Mean Cond.Factor	.	0.984	0.814	0.902	1.290	1.022	1.027	.	1.068
Number tagged	.	27	1	3	30	31	3	0	93
% monthly catch tagged	.	73.0%	11.1%	75.0%	90.9%	96.9%	60.0%	0.0%	77.5%
%of total	.	3.6%	0.1%	0.4%	4.0%	4.1%	0.4%	0.0%	12.4%

In 2010, the peak outmigration occurred in December. Peak outmigrations typically occur around early winter flood events in January and February. The total trap catch (n=120) was less than 2009 (n=415) and in the 2008 season where 750 steelhead juveniles were captured. The trap was operated during a similar time period and was fishing more effectively (deployed and rotating for entire interval between trap emptying) than the previous years on record so trap operations were probably not the reason for a lower catch. An early migration before deployment may have been possible.

The mean fork length of juvenile steelhead increased during the spring months compared to the early months of December, January, and February (Table 1). Overall mean fork length (129.2 mm) was higher than 2008 (110.7 mm) but similar to last year (132.0 mm). This figure was influenced by fewer smolts migrating through the trap zone in December, unlike previous years. Smaller juveniles typically migrate through the trap zone during the earlier months. Larger sized smolts migrated through the trap zone in March, April and May (3-month average; 135 mm). We collected scales from 34 individuals throughout the season. They will be aged in winter 2011.

Toppenish Creek

The rotary screw trap on Toppenish creek was deployed at approximately river mile (RM) 23 on October 19th 2009 and was operated continuously until the end of June, 2010. The screw trap was in place for a total of 253 days. High discharge and debris prevented operation of the screw trap for a period during the season, mostly in April. The trap could be deployed and operated for about 83% of the season. This is longer than the previous 4 seasons. High flows routinely force us to halt operation of our screw trap for extended periods interfering with our ability to obtain a suitable population estimate. The timing of high flows after the outmigration appeared to have dwindled in 2010, allowed us to interpolate data during the times the trap was pulled and obtain a more reliable estimate than the previous 4 years. Although the trap was in place, the cone was deployed for 166 days (83% of the operating period). The trap was operating efficiently (i.e. deployed and cone rotating for the entire 24 hour period) on 162 days or 64% of the season. Steelhead juveniles were captured on 69% of the 140 days when the trap was deployed.

By the end of the 2010 season we captured a total of 4208 in the Toppenish Creek screw trap (table 2). Our catch this year was the highest since the drought year of 2005 when we captured a total of 5750. The peak month was December with 2407 or 57% of the total annual catch. The peak out-migration was associated with the first spike in discharge of the season (figure 2) During the last 6 years of operation peak out-migration has occurred in December or January in all but 1—2005 when an abnormally dry autumn and winter did not produce enough runoff to facilitate migrant transport through the dry reach in Toppenish Creek. There is often a minor spike that occurs in the spring after a period little movement during February in many years.

During the 2009-2010 season, we trapped for a longer period of time in Toppenish Creek. We deployed the trap the 3rd week of October and did not recover it until the end of June. The catch was notable in October with 1.5%; however, in June only 7 fish were captured and most of those were caught at the beginning of the month. We plan on deploying earlier.

Table 2. Catch statistics at the Toppenish Creek trap in the 2009-2010 season

Stat	Oct	Nov	Dec	Jan	Feb	March	April	May	June	Overall
Monthly Catch	65	543	2407	578	68	258	203	79	7	4208
% of total	1.5%	12.9%	57.2%	13.7%	1.6%	6.1%	4.8%	1.9%	0.2%	100.0%
Max Fork Length	189	192	210	199	185	208	212	200	185	212
Min Fork Length	70	56	59	52	65	60	75	80	87	52
Mean Fork Length	130.23	115.86	112.27	105.09	114.72	125.50	141.26	138.87	158.00	116.02
Max Weight	76	70	90	79	55	84	93	51	70	93
Min Weight	4	1	2	2	3	2	4	4	7	1
Mean Weight	24.85	16.80	15.71	13.20	17.41	22.46	31.14	28.38	44.86	17.76
Mean Cond.Factor	0.984	0.979	1.014	1.015	0.990	1.007	0.993	0.986	1.041	1.004
Number tagged	36.0	268.0	394.0	171.0	47.0	177.0	199.5	63.0	5.0	1256.0
% monthly catch	55.38%	49.36%	16.37%	29.58%	69.12%	68.60%	98.30%	79.75%	71.43%	29.85%

Mean fork lengths increased during the spring months of April and May – a typical pattern seen in previous years and at other trap locations (Table 2). Mean fork length (125.45 mm) for 2008-2009 was higher than the three previous seasons (range: 105.8 – 116.2), but lower than the 2004-2005 season (137.00 mm). During dryer years, outmigration appears to be delayed and smolts move through the trapping area at a larger size. It also appears that during years when high flows occur early in the season (i.e. November and December) a large number of small (<100mm) probable age 0 steelhead juveniles get flushed downstream out of their normal summer rearing areas located upstream from our trap location. It is unknown what becomes of these early migrants and it is unknown how these differences in the flow regime affect the overall survival of steelhead smolts in the Toppenish population.

In 2009-2010 season, we captured 1 chinook salmon smolt in the Toppenish Creek trap. We can only speculate where this individual originated. We also captured one in 2008. In addition to the target species steelhead trout (Oncorhynchus mykiss); redside shiners (Richardsonius balteatus), speckled (Rhinichthyus osculus) and longnose dace (R. cataractae), chiselmouth (Achrocheilus alutaceus), northern pikeminnow (Ptychocheilus oregonensis), suckers (Catostomus spp.), sculpin (Cottus spp.), goldfish (Carassius auratus), carp (Cyprinus carpio), bluegill (Lepomis macrochirus), pumpkinseed (Lepomis gibbosus), lamprey (Entoshpenus spp.) black bulhead (Ictulurus nebulosis) were captured in 2010 or have been captured in past years at the Toppenish Creek trap.

Out-migration Estimates in Toppenish Creek 2005-2010

One of the primary objectives of operating our screw traps are to obtain out-migration estimates or the number of juveniles moving past the screw trap on the way to mature in the ocean. Out-migration estimates from a fixed location such as the Unit 2 screw trap at River Mile 30 provide an index of evaluating the status and trends in freshwater productivity (the number of juvenile steelhead that recruit to the smolt life history stage and begin out-migrating to the Ocean). Beginning in the 2010-2011 season, with better redd count data indexing adult spawner abundance, we will be able to produce estimates of the number of smolts produced per redd (smolts / redd) for the entire watershed and this will allow us to assess steelhead survival trends during the early life history stage (i.e. egg, allevin, parr, pre-smolt) in the context of spawning and rearing habitat restoration efforts in the Toppenish watershed.

A good out migration estimate requires continual operation of the rotary screw trap during the entire season due to the clumped distribution of our catch. For example in 2005, about 25% of our annual catch occurred in one day. Therefore, interpolation from operating days to non-operating days that could occur under a more even catch distribution would be imprecise. Flow conditions and debris loading during the frequent winter and spring flood events have resulted in periods of discontinued trapping in most years at our Unit 2 Toppenish trapping location (Table 3). Safety has played a role in the decision not to operate the trap during flood events, but also concern over high smolt mortality levels that are experienced due to impingement on debris. We have attempted several remedies in the past 10 years including designating someone to clean the trap at the end of the work-day and designing racks placed in front of the cone to block debris. Neither of these attempts was successful. We have determined that making staff available at night to operate the trap during high flows will produce the best results despite the added cost. Many smolt trapping programs around the basin have adopted this approach.

Methods

Trap operation methods are outlined at the beginning of this section. We utilized a one-trap mark-recapture method described in Volkhardt (2007). The marked (PIT tagged individuals were released upstream several hundred meters about once per week. All fish captured in the screw trap were scanned for tags. Later, tag ID's were checked to confirm that the tagged fish were part of the prior efficiency release. We used a Darrochs (1961) stratified Petersen estimator (Darr 2.2 code for R software) to obtain out migration estimates (Bjorkstedt 2005, 2009). All sizes were included in the estimate, although it is likely that some of the smaller individuals were too small to out-migrate that particular year. It is likely that these fish succumb to high temperatures (or other mortality pressures) during the summer. A length-frequency relationship did not indicate that the catch could be separated into year classes based on size.

Over the last six years of operation, we have produced reliable estimates in only 2 of those years. In 2005, the Toppenish basin experienced a drought resulting in manageable flows on Toppenish Creek for almost the entire (95%) season. We estimated smolt out-put of 34,748 for the season. In 2009, we estimated a higher smolt out-put of 45,849. During the 2009 season, the highest discharge occurred at the end of the season after smolt migration had tapered off. Thus, we did not believe that we missed any significant spikes in migration, so we interpolated data during these brief breaks in our trapping schedule by calculating an average of the previous three days and the following three days. In contrast, during the previous four years (2006-2009) the out-migration estimates calculated likely did not reflect the true migration past the trap because of extended breaks in the screw trapping deployment that occurred during periods closer to the beginning of the season when large number migrate beyond the spawning and rearing grounds upstream from our screw trap location.

Table 3. Catch, trap operation statistics, and outmigration estimates for the Toppenish Creek Unit 2 screw trap at River Mile 30

Year	Number of days trap operated (migration Season)	Annual Catch	Number of smolts released upstream for mark-recapture study (pooled)	Average (pooled) efficiency (capture probability)	out-migration estimate for period deployed *	Number of days trap out of operation because of high flows, ice, etc	Percent of migration season included in estimate
2005	179	5750	311	16.72%	**34748** SE 6163	12	93%
2006	206	2546	176	9.66%	31830 SE 10039	100	51%
2007	201	2383	100	13.00%	18402 SE 5860	67	66%
2008	217	1681	191	16.23%	14480 SE 4887	77	65%
2009	202	2418	191	16.75%	19710 SE 7139	45	77%
2010	233	4546	375	11.2%	**45849** SE 10001	35++	85% (100 %)

*outmigration estimate includes all sizes and does not include periods when the smolt trap is out of operation due to high flows. Darroch's (1961) Stratified Peterson estimator; Darr 2.0.2 Statistical application for R software (Bjorkstedt 2005). ++ catch estimated as an average of catch from 3 days before and after period of trap cessation.

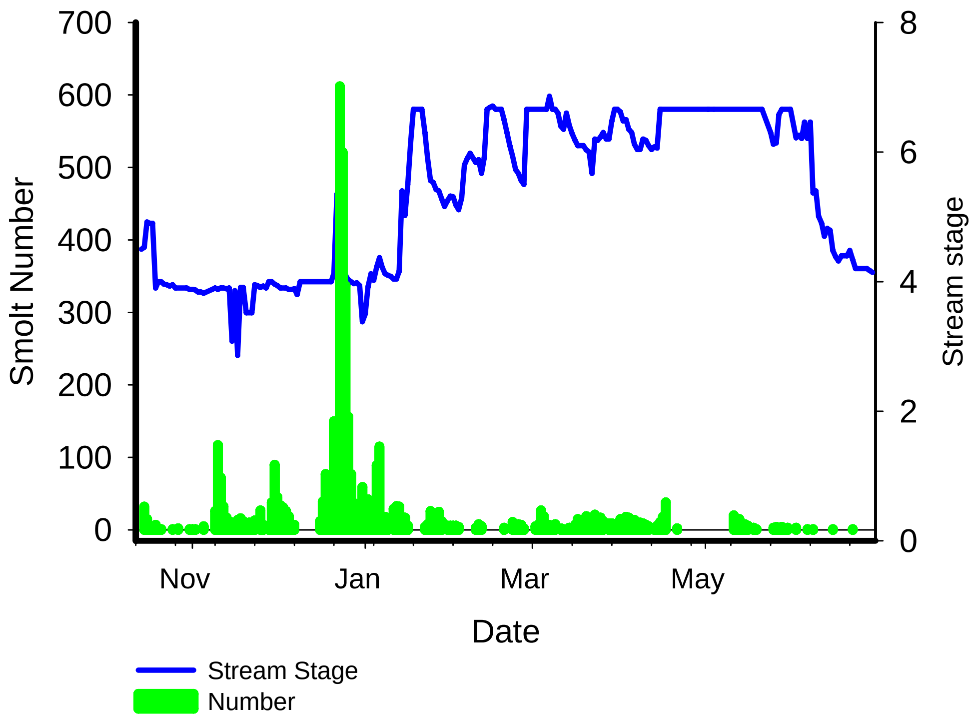

Figure 2. Steelhead juvenile catches compared to creek stage at the Toppenish Smolt trap.

Ahtanum Creek

The screw trap on Ahtanum was deployed at river mile (RM) 2 on December 29th, 2009 and was operated continuously until June 29th, 2010. The screw trap was in place for a total of 179 days. On several occasions during the period of operation, the cone on the trap had to be lifted when discharge and in-stream debris levels were high to avoid clogging, damage to the trap, and harm to out-migrating juveniles.

Only 23 steelhead smolts were captured in 2010--one more than last year (Table 3). Although higher than the 2007-2008 season when only 11 steelhead juveniles were captured, catches have been reduced from the previous years (2004-2006) when several hundred smolts were captured during the season. Although we relocated the trap after last season, it is probable that the screw trap is still positioned in a much less efficient location than the previous seasons (before the 2006-2007 season). Similar to Satus Creek, the peak in out-migration in Ahtanum Creek occurred later in the year than normal when most of the captured juveniles out-migrated past the trap zone in May. The peak typically occurs in late December and January. Mean fork length for steelhead juveniles captured in the screw trap was 110mm—smaller than most years.

Table 4. Statistics for the smolt trap catch at Ahtanum Creek for the 2009- 2010 season.

Stat	Nov	Dec	Jan	Feb	March	April	May	June	Overall
Monthly Catch	.	0	2	0	0	0	21	0	23
% of total	.	0	8.70%	0.00%	0.00%	0.00%	91.30%	0.00%	100.00%
Max Fork Length	.	..	114	.	.	.	220	.	220
Min Fork Length	.	.	105.0	.	.	.	151.0	.	105.0
Mean Fork Length	.	.	109.5	.	.	.	177.7	.	109.5
Max Weight	.	.	15.0	.	.	.	102.0	.	220.0
Min Weight	.	.	11.0	.	.	.	39.0	.	11.0
Mean Weight	.	.	13.0	.	.	.	60.6	.	56.0
Mean Cond.Factor	.		0.98	.	.	.	1.08	.	1.07
Number tagged	.	0.00	2.00	0.00	0.00	0.00	19.00	0.00	21.00
% monthly catch tagged	.	0.0%	100.0%	0.0%	0.0%	0.0%	90.5%	0.0%	91.3%

B. Snorkel Surveys

We conducted snorkel surveys in Satus, Toppenish, and Ahtanum watersheds to compare densities between index sites and to evaluate trends in parr densities in the productive spawning and rearing areas of these watersheds. Since it is impossible to observe parr in very shallow water, true densities are likely underestimated. Therefore, the following is a discussion of relative density rather than the true density of parr in these index reaches.

Methods

We established snorkel segments 200 meters in length to incorporate a variety of habitat types into the segment (Figure 3). Sites were chosen in the Ahtanum and Toppenish watersheds upstream and downstream from irrigation diversions to assess the possible effects of water withdrawal as well as the irrigation complex infrastructure (i.e. diversion dam or check structures, screen bypass). 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 in 1997 and 1998.

Surveyors moved in an upstream direction from the bottom of a survey segment to the top. One person followed behind to record data. Methods were similar to those described in the AFS salmonid field protocols handbook (O'Neal. 2007). During the last 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). 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. 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 to obtain densities of steelhead parr in number per 100 meters^2.

Toppenish Creek Olney-Lateral Diversion

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 *(Oncorhynchus mykiss)*. Habitat in the lower reaches of the stream is impacted by irrigation diversions and return flow drains. 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

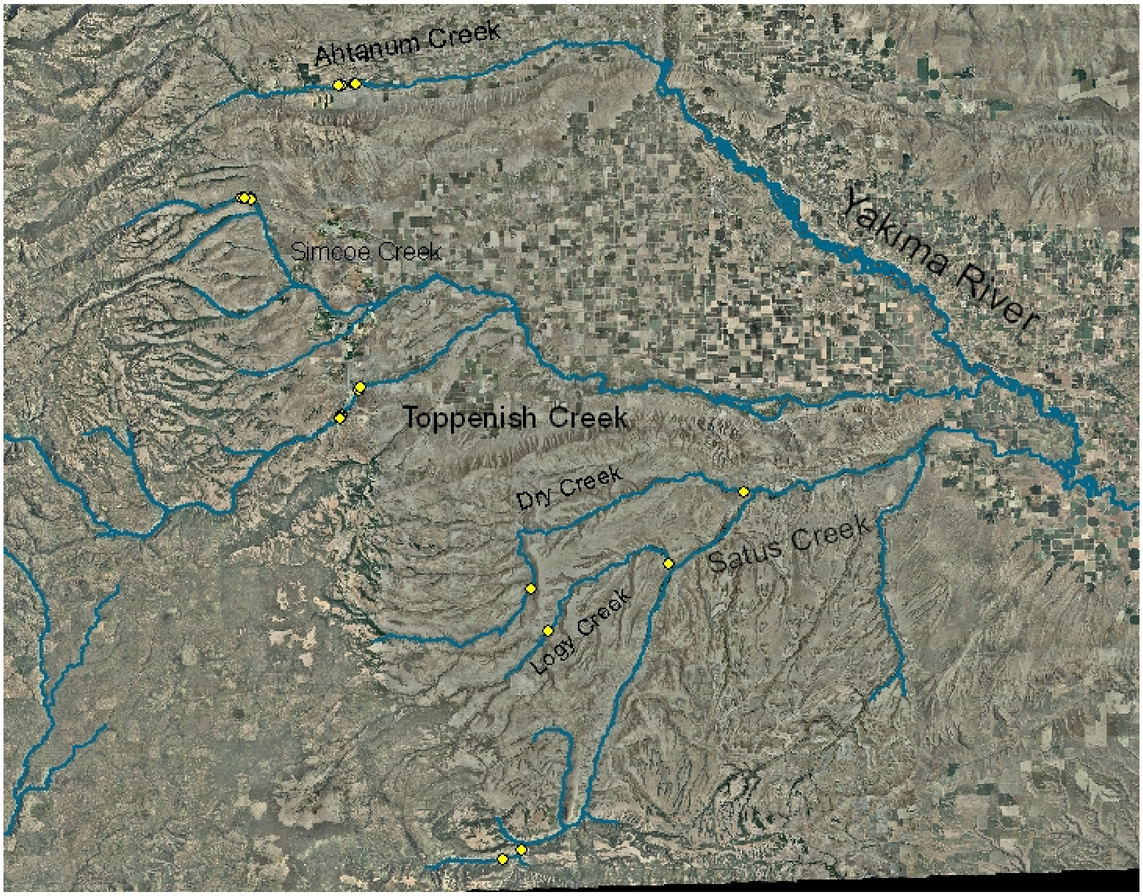

Figure 3. Location of 200m snorkel index sites completed in 2010

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.

At our Toppenish Creek snorkel sites we regularly visited three sites in the vicinity of the Olney Lateral diversion (the first diversion site after the stream exits the canyon and enters the alluvial fan). The uppermost site was situated directly above the diversion structure. Two sites were located below the Olney-Lateral Diversion. One was directly below the check structures and another was located about 1 mile downstream where effects of water withdrawal (e.g. higher water temperature) were expected to be seen. Surveys were repeated each month from July to October to assess the possible movement or shifts in spatial and temporal distribution.

The peak density of age 0 steelhead parr occurred in August. Peak densities have occurred in either August or September at nearly every site during all years of this study (Table 1). By late summer, O. mykiss juveniles have reached a size where avoiding detection by hiding in the interstices between cobbles and boulders has become more difficult. In addition, low flows and higher water temperatures may encourage juveniles to congregate in and below pools where detection is more likely by snorkel surveyors. Hypothetically, steelhead juvenile density should be greatest after hatching and swim up but decrease steadily through the summer as individuals succumb to the natural sources of mortality. However, this pattern has not been observed during six years of monitoring Toppenish Creek parr density. In addition to the phenomenon of detection likelihood increasing with size, we have hypothesized that the diversion check structures and fish screen bypass system continually funnel age 0 juveniles downstream throughout the season resulting in an accumulation of age 0 parr in the reaches below the diversion. This could also partly explain the pattern of increasing density through August or September in our data set in most years. At some point (probably before age 1) the juvenile attain a size that permits them to migrate back upstream beyond the diversion check structures—that are about 1 foot in drop.

A more detailed discussion of the influence of water management at the Olney-Lateral diversion can be found in the 2009 YRWP annual report.

Relative density of age 0 juvenile appears to have increased slightly in 2010 compared with the previous year. Higher densities were observed in 2005 and 2006 (Table 5). Redd numbers also increased in this reach in 2010 probably contributing the increase in parr density.

Table 5. 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	.	.	.	.	.	.
	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

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 six 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.

Table 6. Number and density of steelhead parr upstream and downstream from the Hoptowit diversion on the North Fork of Simcoe Creek in 2010.

	Age 0 Below Hoptowit	Age 0 Above Hoptowit	Age 1 + Below Hoptowit	Age 1 + Above Hoptowit
June				
July	40	6	26	19
August	48	34	21	26
September	43	54	29	22
October	44	13	15	6
Densities (per 100 m²)				
June				
July	5.56	0.66	3.61	2.08
August	6.67	3.72	2.92	2.84
September	5.97	5.91	4.03	2.41
October	6.11	1.42	2.08	0.66

The density of O. mykiss age 0 juveniles was usually lower than densities seen in the sites on the mainstem Toppenish Creek. They rarely exceeded 10 fish/100 m² in any year and never exceeded 7 fish/100 m² for either age category in 2010. Less variation was observed for both age 0 and age 1 juveniles in the six years of surveying this site than seen at the mainstem Toppenish sites.

<u>Ahtanum Creek Diversions</u>

We performed a snorkel survey at the main diversion complex on Ahtanum Creek to evaluate effects on steelhead juvenile abundance in August 2010. 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.

Over the last several years of performing snorkel surveys at this location, we almost always observe more O.mykiss juveniles below the diversions than above. This is probably due to the effect of juveniles migrating downstream and accumulating below the diversions as appears to also happen in the Toppenish Creek watershed. There also appears to be better habitat—particularly canopy cover at the site below diversions. Densities of O. mykiss were very low at both sites (none were observed above the diversion). Like 2008 and 2009 we observed coho juveniles that were likely released as part of a Yakama Nation Fisheries reintroduction program.

Table 7. 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	0	19	22	22
Densities (per 100 m²)				
August	0.0000	0.8218	1.0618	0.9516

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 site 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 18th 2010.

We expected that the higher stable continuous flows in Logy Creek would accommodate higher densities of rearing O.mykiss than Dry Creek, which becomes intermittent for several miles at the lower end. However, since 2007, densities of rearing age 0 parr were consistently higher at the Dry Creek sites than the Logy Creek sites. This difference was most pronounced in 2010 where the highest densities of O mykiss (47.81 and 56.76 fish/100m²) in six years of snorkel surveys in the lower Yakima River tributaries were observed at the two Dry Creek sites (Table 8). All sites both Logy and Dry Creeks appeared to provide complex habitat (e.g. pools, riffles, side channels, etc.) and despite lower flows in the Dry Creek sites, water temperatures were similar at the sites and within a suitable range for steelhead juvenile rearing. Groundwater exchange in a valley bottom dominated by course alluvium appears to moderate water temperatures in Dry Creek. Whereas, the Logy Creek stream channel contains extensive reaches of exposed bedrock, likely affecting water temperature and macroinvertebrate production.

Table 8. 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								
Nunber	129	121	45	.	49	30	15	.
Density	11.84	9.92	2.62	.	4.50	2.46	0.87	.
2008								
Nunber	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

Upper Satus Creek

In 2010 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.

At our upper site at the wooden bridge we observed 23.2 age 0 parr per 100m². This site was located downstream from a 4 mile reach where redd densities were particularly high in 2010 (n=60). We expected available rearing habitat to be nearly saturated as a result. Densities in 2010 were comparable to other productive rearing areas in the lower Yakima tributaries like the Toppenish Creek sites at the Olney-Lateral diversion. In comparison, parr density at this site was only half of density observed in Dry Creek in 2010. Fewer age 0 steelhead juveniles (9.73 fish/100m²) were observed at our site several miles downstream where the channel is simplified by being constrained between two roads (HWY 97 and old Lakebeds Rd.). Fewer redds were also observed in this reach during 2010 redd count surveys.

Table 9. Number and density of steelhead parr at sites in upper Satus Creek above the Wilson Charley Creek confluence in 2010.

	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.
Number	145	323	98	105
Densities (per 100 m²)	9.73	23.30	6.58	7.57

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 59 devices in the three watersheds (Figure 4). Data-loggers (Onset Optic Stowaways and Onset Water Temp Pro v2) were launched in spring 2010 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).

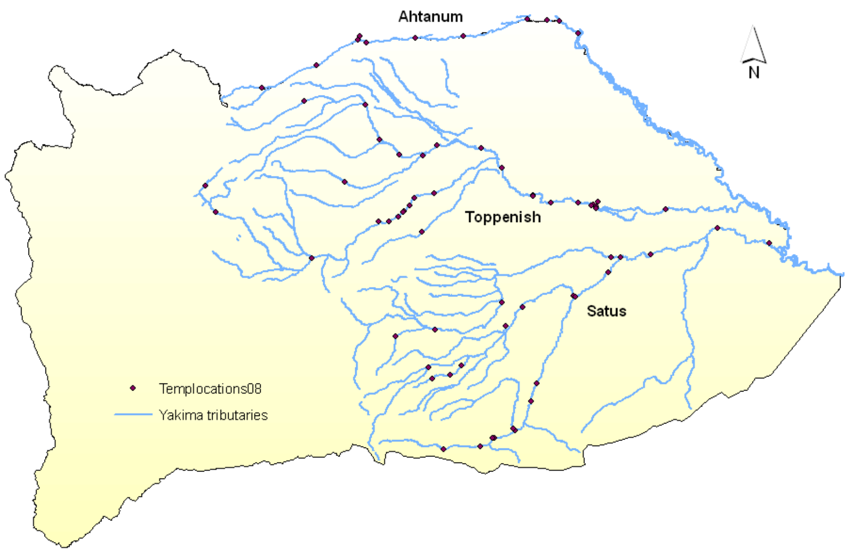

Figure 4. Locations of temperature monitoring stations established between 1997 and 2008 in the Yakima River watershed portion of the Yakama Reservation.

Ahtanum Creek

In 2010, 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 2010 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. Three units, all in the lower section of Ahtanum Creek, were lost during high discharge that occurred in April and May or was stolen. Two units malfunctioned. Six data-loggers recorded temperatures for the entire period (Table 10).

Table 10. Descriptive statistics for water temperatures at 9 locations in the Ahtanum Creek watershed. Temperature record is from April 15th through October 5th. Maximum Weekly Maximum Temperature in Bold.

Location (river mile in parenthesis)	Instantaneous Maximum ºC	Instantaneous Minimum ºC	Mean Daily Maximum ºC	Mean Daily Average ºC	Mean Daily Minimum ºC	Maximum Daily Average ºC	**Maximum 7-Day Maximum ºC**	Maximum 7-Day Average ºC
South Fork Ahtanum at the DNR gate (11.0)	10.6	3.4	8.6	7.3	6.2	9.4	**10.4**	8.8
South Fork Ahtnaum at campground (7.0)	13.8	4.1	10.7	8.8	7.4	11.5	**13.2**	10.8
South Fork of the Ahtanum at mouth (0.5)	19.7	3.8	13.1	10.5	8.4	16.4	**19.1**	15.4
North Fork of the Ahtanum (1.3)	Dewatered in July for 3 wks							
AID Diversion (18.9)	23.4	3.0	15.4	12.2	9.5	19.1	**22.5**	18.1
American Fruit Rd. (14.0)	23.0	3.9	15.7	13.2	10.8	19.8	**22.2**	18.9
42nd Ave. (7.0)	Lost or stolen							
16th Ave	Lost or stolen							
Ahtanum at the Mouth (0.5)	Lost or stolen							

Mean daily averages ranged from 8.6ºC in the South Fork of Ahtanum Creek several miles above the confluences to 15.7ºC at American Fruit Road (Table 10). We were unable to collect temperature data from the lower reach of Ahtanum Creek were higher temperatures typically occur. The highest instantaneous maximum of 23.4 ºC was recorded at AID Diversion (RM 18.9) in 2010.

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 2010, the highest MWMT (22.5ºC) was recorded upstream from the AID diversion. However, data could not be obtained from the lower part of Ahtanum Creek where the highest water temperatures often occur. Water temperatures appeared to be slightly lower than 2009.

<u>Toppenish Creek</u>

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 20 data-loggers in the mainstem of Toppenish Creek during spring 2010 at sites located between RM (river mile) 3 and 68. We also deployed seven data-loggers in Simcoe Creek, one in Panther Creek, one in Mill Creek, and two in Agency Creek. The units were in place and continuously recording water temperatures at 48 minute intervals until we retrieved them in mid October 2010. Five 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. Three units in Simcoe Creek dewatered producing unreliable data. 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 8.2ºC below the confluence of Panther Creek at RM 68 to 19.1ºC at the middle channel of Toppenish Creek at Campbell Road (RM 18.6). The highest instantaneous maximum of 26.8ºC also occurred at this Toppenish Creek site as well as the highest MWMT (26.1ºC). This site also had the highest water temperature in 2008. In 2009, data from this site was unavailable, but the highest MWMT occurred a short distance downstream at River Mile 18 on the South Channel of Toppenish near the Snake Creek inlet. Water temperature at this site was only 0.9 degrees lower (MWMT; 25.2ºC) than the maximum observed at Campbell Rd. The section of Toppenish creek where the stream splits into multiple channels appears to have the highest water temperatures during the summer. Substrate type and an overall lack of riparian vegetation in this reach probably influences water temperature as well. Infiltration in this reach may also result in lower water temperatures downstream. Water temperature appears to decrease slightly below HWY 97 possibly the result of ground water recharge in the lower reach.

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, dewatering on Toppenish Creek was not observed. Downstream between Wesley Rd. (RM 41.5) and the mouth, conditions are considered unfavorable overall for steelhead rearing during the summer due to the high water temperatures. However, areas of upwelling from Pom Pom Rd. (RM 38.9) downstream to Shaker Church Rd. (RM 35.9) provide thermal refuge for rearing steelhead parr which was confirmed during snorkel surveys conducted in 2009. In fact, our thermograph at the Shaker Church site displayed a MWMT similar to that seen about 8 miles upstream above the Old Three way diversion site. Water temperature does, however, increase a short ways downstream near the mouth of Simcoe Creek (graves culvert; 23.6ºC)

Table 11. Descriptive statistics for water temperatures at 24 locations in the mainstem Toppenish Creek. 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
Panther Creek at lower culvert (1.8)	13.5	1.9	9.4	7.5	5.7	11.1	**12.5**	10.5
Topp. at Panther Ck confluence (68)	13.8	3.0	9.9	8.2	8.2	11.2	**12.7**	10.7
Topp. at N. Fork confluence (54.4)	18.2	3.2	12.4	10.3	8.7	15	**17.5**	14.7
Topp. at swim hole (46.8)	20.3	4.2	14.1	12.4	10.9	18.2	**19.9**	17.8
1 mile below swim hole (45.9)	21.2	4.2	14.6	12.7	11.1	18.8	**20.7**	18.3
1 mile above lateral (45)	21.5	4.3	14.8	12.9	11.3	18.6	**21**	18.6
Topp. above lateral (44.2)	21.8	4.4	15.0	13.1	11.5	19.3	**21.4**	18.9
Above three way (42.8) *	23.2	8.6	17.7	15.3	13.3	20.0	**22.7**	19.4
At three way (41.8)	23.9	8.7	18.2	15.5	13.5	20.4	**23.4**	19.8
Topp. At cleparty diversion (41.5)	25.3	8.5	18.8	15.7	13.4	21.0	**24.7**	20.3
Topp at shaker church Rd. (35.9)	23.7	8.3	18.6	15.7	13.2	20.1	**22.8**	19.5
Topp at Graves Culvert (33.5)	24	9.6	18.7	17.1	15.6	22.9	**23.6**	22.2
Topp. above Mud Lake Drain (31.5)	lost or stolen							
Topp. below Mud Lake Drain (31.4)	dewatered							
Topp. at Unit 2 (26.5)	22.9	7.6	16.3	15.7	15.3	22.0	**22.5**	21.6
Topp. at Lateral C (21.3)*	Stolen							
Topp at Zimmerman's (21.2)	dewatered							
Topp at Campbell Rd. Mid channel (18.6)	26.8	9.7	20.7	19.1	17.5	24.5	**26.1**	23.9
Topp before Snake Creek (18)	25.6	8.9	18.5	17.6	16.6	24.3	**25.2**	24.0
Topp. below Hwy97 (10.7)	25.3	10.6	19.8	19.0	18.3	24.4	**24.4**	23.3
Toppenish at Indian Church Rd.	malfunctioned							
NFSimcoe (24.9)	15.8	3.1	11.0	9.4	8.0	14.1	**15.2**	13.6
Simcoe below Forks (18.9)	18.5	3.6	12.7	11.4	10.1	17.3	**18.0**	16.7
Simcoe at Simcoe Cr. Rd. (15.3)	24.5	4.3	16.1	13.1	10.8	19.9	**23.7**	19.3
Simcoe at N White Swan (8.1)	19.8	5.4	14.8	12.8	10.9	17.1	**18.6**	16.1
Simcoe at Barkes (2.7)	22.3	6.2	16.5	15.2	13.8	20.9	**21.5**	20.0
Simcoe below olney flat (0.2)	22.1	12.0	17.8	17.1	16.4	21.1	**20.6**	12.9

We continued to monitor the Toppenish Creek section in the vicinity of the Olney-Lateral Diversion at RM 44.2 in 2010. 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. At subsequent sites further downstream Maximum Weekly Maximum Temperatures (MWMT) increased by small increments (0-0.9 degrees C). At the furthest downstream site in this reach at the Cleparty diversion a MWMT of 24.7 ºC was recorded in 2010. In 2010 a MWMT of 26.4º was a recorded — indicating cooler water temperature in 2010. Overall, MWMT's decreased this year compared with 2009. Flows downstream at the three-way often measure higher than at our discharge site below the Olney-Lateral Diversion about 2.3 miles upstream. Downstream from the three-way, surface flow decreases rapidly as it sinks into the alluvial fan. In this short section of Toppenish Creek, we normally observe the greatest increase in water temperature in the alluvial fan reach of Toppenish Creek. The sparse vegetative cover between the Three-Way Diversion and Wesley Road probably contributes to the temperature increase as well. Since the implementation of minimum instream flows, vegetation appears to have improved in the reach between Wesley and Signal Peak roads resulting from the nearly perennial flows. During snorkel surveys we have documented some of the highest densities of rearing steelhead parr at our index site at the Cleparty diversion indicating that steelhead parr can cope with the sub-optimal temperatures for short periods. Although, we have witnessed them congregating below gravel bars where slightly cooler water is emerging.

Satus Creek

In 2010, we deployed 24 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 2010 at sites in Satus Creek located between RM 1.2 and RM 44.1 (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 8.4ºC downstream from falls (RM 44) to 16.3ºC near the mouth (Table 12). Most mean daily averages were slightly lower than 2009. The greatest instantaneous maximum for the Satus Creek watershed typically occurs at the Plank Rd location (RM 7.4). However, this year that location dewatered so the highest (25.4 ºC) was observed upstream on Satus below the Dry Creek confluence.
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. MWMTs were higher in 2009 than in 2010. The highest in 2010, (25.8º C) was recorded at the Satus Creek site at the site below the dry creek confluence. Water temperatures were well above optimal for much of the mainstem Satus Creek in 2009 probably affecting survival of steelhead parr. During the summer there are several reaches that dewater followed by areas of upwelling. These upwelling areas, as well as springs and tributary confluences (i.e., Dry Creek and Logy Creek) provide important rearing habitat for steelhead.

Mean daily water temperatures in the portion of Logy Creek available for anadromous species spawning ranged from 8.4º C to 13.3º C. The instantaneous maximum water temperature ranged from 15.6º C to 21.8º C. Water Temperatures in Logy Creek were probably suitable for steelhead trout during the warmer months along most of its length. These deep pools may provide thermal refuges during the short periods when water temperatures exceeded threshold temperatures for cool water biota.

The highest MWMT temperature (20.8ºC) in the Dry Creek watershed occurred at the mouth (RM 1.2). Some intermittent pools in this reach hold steelhead parr until flow returns in late fall. Water returns to surface at our station upstream from HWY 97 near the mouth. This water is perennial providing a suitable reach for steelhead rearing (confirmed through snorkel surveys). The lower 1.5 miles of Dry Creek is probably the largest thermal refugia for cold water species in the lower Satus and lower Dry Creek portion of the watershed.

Table 12. Descriptive statistics for water temperature at 20 locations in the Satus Creek watershed. Maximum weekly average temperature in bold text.

Location	Instantaneous MaximumºC	Instantaneous MinimumºC	Mean Daily MaximumºC	Mean Daily AverageºC	Mean Daily MinimumºC	Maximum Daily AverageºC	**Maximum 7-Day MaximumºC**	Maximum 7-Day AverageºC
Satus Longhouse Rd. (1.2)	23.5	9.6	17.4	16.3	15.2	21.6	**22.2**	20.7
Plank Rd (7.4)	dewatered							
Below Dry Creek (18.7)	25.4	6.2	17.8	15.1	12.9	21.9	**24.7**	21.2
1st Crossing (20.2)	24.2	5.8	17.0	14.8	12.7	21.5	**23.5**	20.8
Above Logy (23.6)	22.5	6.1	16.8	14.7	12.9	20.0	**20.9**	19.3
High Bridge (32.4)	23.4	3.6	15.7	13.2	11.2	20.2	**22.9**	19.7
4th Crossing (34.1)	21.8	3.3	15.0	12.8	10.8	19.7	**21.5**	19.3
County Line (37)	malfunctioned							
Wilson Charley (39.2)	21.5	4.3	14.8	12.9	11.3	19.0	**21.0**	18.6
Wooden bridge (40.8)	18.9	2.6	12.1	9.7	7.7	15.7	**18.4**	15.1
Below the Falls (44)	15.6	2.6	10.1	8.4	6.9	13.4	**15.0**	12.7
Logy at Mouth (0.5)	21.8	4.7	14.9	13.3	11.7	19.9	**21.2**	19.2
Logy at 4th crossing	malfunctioned							
Logy below the falls	17.3	2.5	11.7	9.9	8.2	14.9	**16.4**	14.3
Section Corner Spring at lower crossing	malfunctioned							
Section Corner Spring at mid crossing	12.1	5.6	10.5	8.8	7.5	9.8	**11.6**	9.5
Section Corner Spring at source	9.1	5.9	8.5	7.8	7.5	8.2	**9.0**	8.1
Dry Mouth (1.2)	21.2	7.4	17.4	14.9	12.9	18.7	**20.8**	18.2
Dry at Elbow Crossing (18.5)	20.2	5.7	15.0	13.1	11.6	17.7	**19.7**	17.3
Dry Below Falls	15.9	4.1	12.0	10.0	8.1	13.0	**14.6**	12.0

D. Spawning Surveys

Steelhead

The Yakama Reservation encompasses a large portion of the Yakima River basin steelhead Major Population Group (MPG) spawning and rearing habitat. We conduct spawning ground surveys in Yakima basin tributaries to evaluate trends in steelhead production.

Steelhead spawning ground surveys were performed on Toppenish, and Satus Creeks in 2010. Spawner surveys are often used as an index of spawning escapement for anadromous salmonid species. Completing three passes between mid March and the end of May is our goal; however, manpower constraints, access, and survey conditions (i.e. turbidity, discharge) often limit the number of successful passes, particularly in Ahtanum and Toppenish Creeks. Manpower shortages, resulting from increased restoration and project maintenance demands, injuries, and staff reduction limited our success in completing surveys in 2010. We focused efforts on the Satus Creek watershed in an attempt to maintain our 22 year record of complete three pass redd count surveys in the entire Satus watershed. We were able to complete all planned surveys on Satus Creek.

Methods

The Yakama Nation Fisheries Program has conducted spawning ground surveys for steelhead trout on tributaries to the Yakima River (Ahtanum, Satus and Toppenish Creeks) within Yakama Reservation for as long as 22 years for some reaches. The methodology has changed little within that time period. One additional improvement that we have implemented since 2000 is the collection of GPS waypoints to identify and describe the most productive spawning reaches.

Two surveyors typically cover a 2 to 7 miles survey reach, walking in a downstream direction. Surveyors wear polarized glasses to aid in spotting redds. Each identified redd is marked with a GPS with an accuracy of roughly +/- 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 thalweg 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. Very few carcasses are ever observed in these watersheds likely due to the robust populations of scavengers (i.e. bears, otters) on the Yakama Reservation. Surveyors take care not to disturb spawning fish or possible staging pools when conducting spawner surveys.

Toppenish Creek

The Toppenish Creek watershed includes nearly 100 miles of anadromous fish bearing stream habitat. We cover 78 miles of these waterways during our annual redd counts. Like Ahtanum Creek and other east slope cascade streams with headwaters reaching to elevations above 5000 feet, a long protracted snowmelt flood pulse often causes unfavorable survey conditions for several weeks in March and April. In addition, the forest roads in the upper Toppenish Creek watershed are typically not cleared of snow unless it is located on or near an active logging unit or a major arterial road.

In years with normal or above normal snowpack in the headwaters, the upper 18 miles of surveyable steelhead spawning habitat are typically inaccessible until the beginning of May or later. In 2010, a survey of the upper Toppenish Creek mainstem could not be completed due to a snowmelt runoff event until May. Road conditions rarely inhibit access to Simcoe Creek and its tributaries because much of the watershed is located in the valley, although high flows sometimes cause unfavorable conditions. On the lower 18 miles of habitat on Toppenish Creek access can be limited by high flows that can exceed 200 cfs for several weeks making spawning surveys dangerous.

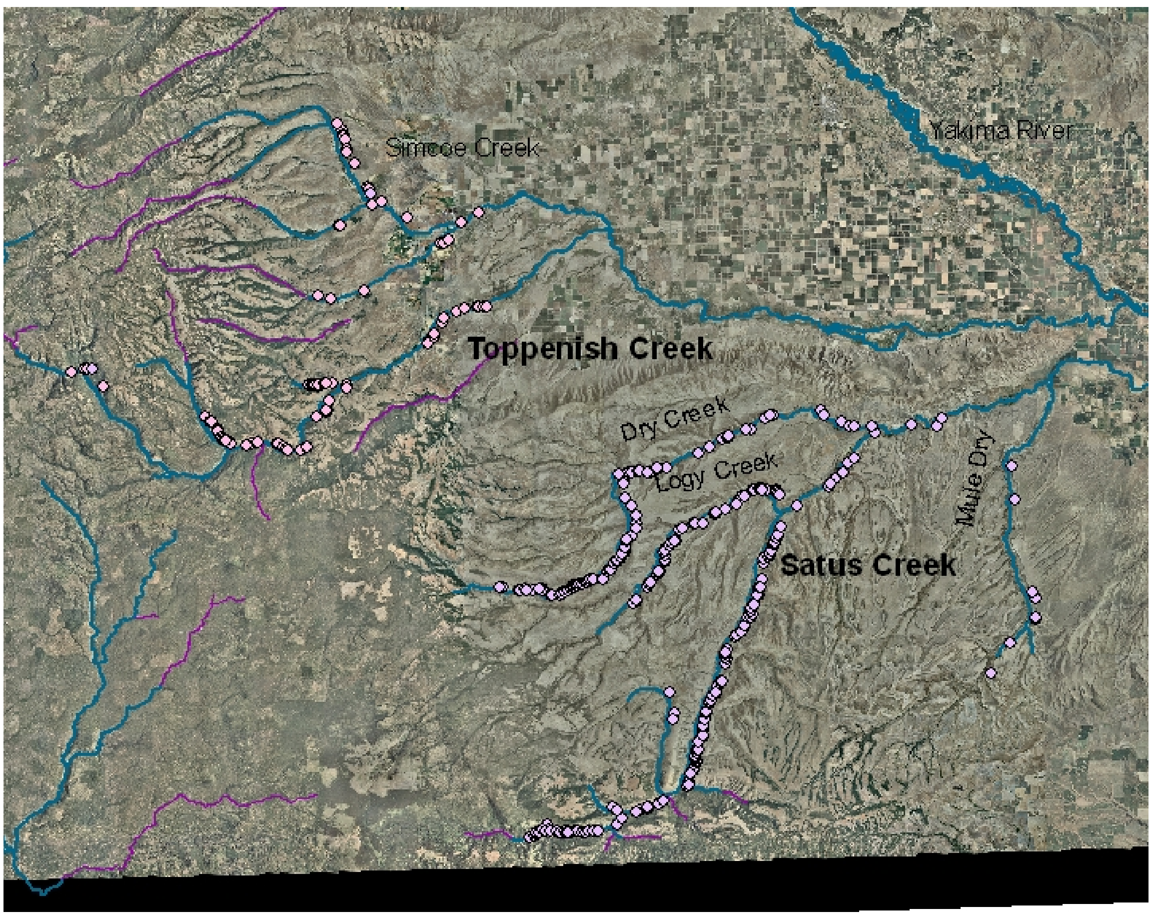

Figure 5. Location of Redds in Ahtanum, Satus, and Toppenish Creek in 2010 collected with handheld GPS units.

We identified more redds in 2010 (n=105) than we found in 2009 (n=79). This suggests an increasing trend in the steelhead population since a low point in 2006 with only 21 redds identified in the Toppenish Creek watershed. We expected a large number of redds in all Yakima basin tributaries because of higher than average adult steelhead returns (n=6814) at the adult detection facility in Prosser. Survey effort and redd recognition conditions were similar from 2006 through 2010. It is likely that the number of redds for the Toppenish basin is a substantial underestimation of actual redds and steelhead spawning activity because of the unfavorable conditions for identifying redds. The best spawning habitat in the Toppenish Creek watershed is probably located above the North Fork of Toppenish Creek (RM 55; personal observation). However, this portion of the watershed is the most difficult to access during what is likely the peak spawning period (early April to Mid May). This year we were able to access the upper portion of Toppenish Creek during the last week of May and we found 20 redds above the North Fork and in the North Fork compared with 33 identified in 2009. In 2006, only two redds were identified in the upper Toppenish Creek. In that particular year, the survey was conducted well after the peak spawning period--in a year with low redd counts throughout the basin. In 2005, when access and visibility conditions were optimal due to drought conditions and a meager snowpack 60 percent of redds in the Toppenish Creek watershed were found in the upper 18 miles of Toppenish Creek.

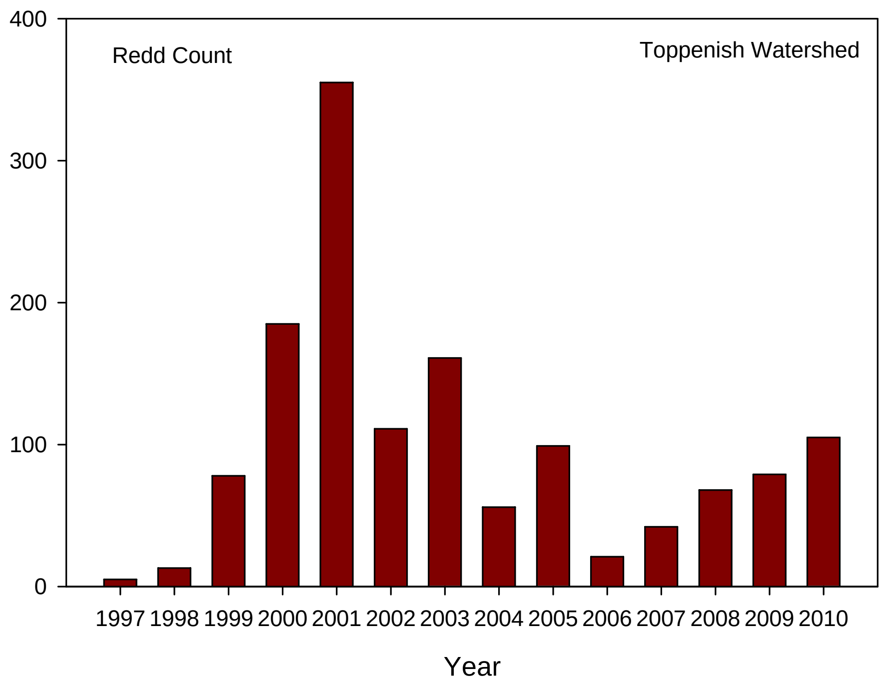

Figure 6. Number of steelhead redds in the Toppenish Creek watershed between 1997 and 2010 documented during three passes of redd count surveys.

The Simcoe Creek sub-watershed is better suited to multi-year comparison of spawning escapement compared to the mainstem Toppenish for several reasons including 1.) lower peak flows, 2.) early spring access 3.) lower turbidity during spring thaw. Three passes in the Simcoe watershed were possible in 2010. We identified 30 redds in the Simcoe Creek watershed in 2010— more than 2009 when 18 redds were identified. Redd numbers were similar to 2008 when 29 were identified in the Simcoe Creek watershed. Although more redds, indicative of spawning activity, was seen in 2010 than the previous six years, the large return of adult steelhead that was seen at Prosser dam was not apparent in Simcoe Creek like it was in most of the Satus Creek watershed where redd number increased four-fold. The distribution of redds throughout the Simcoe Creek watershed was similar to that seen during the previous four years (2006-2009). One redd was observed in the North Fork of Simcoe Creek where redds and adult steelhead are typically observed. This contrasts with the 2005 season where obstructions and low flows blocked passage of adult steelhead above the narrows (RM 12.5) and all 9 redds (in the Simcoe watershed) were located below that area where habitat and summer water temperatures are less optimal. This year, two redds were observed in the South Fork of Simcoe near the mouth, where habitat seems comparable to the North Fork of Simcoe Creek. Only a couple of redds have ever been identified in this stream and these are the first in six years.

More redds were identified in some of the smaller tributaries of Simcoe and Toppenish such as Wahtum Creek (n=5), Agency Creek (n=3), and Willy Dick Creek (n=14) than we document in most years. The number of Redds identified in the North Fork of Toppenish (n=13) was slightly less than we observed in 2009 when 16 redds were observed in this stream. The North Fork of Toppenish Creek is more accessible to surveyors than the mainstem Toppenish Creek upstream from the confluence, thus three passes are typically possible in this stream making it a good index reach like the Simcoe watershed for comparing redd abundance between years. In 2010, we completed one pass of the South Fork Toppenish Creek and did not find any redds. This stream has only been surveyed once in the past with the same results as 2010. Although flows appear to be adequate for adult steelhead migration and redd construction, there are several characteristics of the South Fork Toppenish watershed that would likely discourage its use by Toppenish steelhead. These include: falls near the mouth with an (approximate) eight foot drop, a bedrock chute situated directly above the falls, multiple one to five foot drop cascades throughout the watershed created by bedrock and log jams, a steep gradient, above optimal substrate size relative to mainstem Toppenish Creek. Although no definitive passage barrier was identified, the upper portions of the watershed are inhabited only by cutthroat trout (YN unpublished electrofishing data) indicating a possible cumulative effect of all the partial barriers below. It is possible that steelhead may occasionally spawn in the lower sections of this stream, but so far none have been documented. Therefore, we will probably not include the South Fork Toppenish with our regular survey reaches, but may conduct surveys in this reach over future years periodically as time permits.

Table 13. Number of Steelhead redds per reach in the Toppenish Creek watershed in 2010.

Upper Toppenish Watershed	Distance miles	Number of Redds

Toppenish	O Conner Creek (65.7)	East Bank (62.4)	3	**7**
	East Bank (62.4)	NF confluence (55.4)	7	**0**
	NF confluence (55.4)	Wash out (53.5)	4.5	**11**
	Wash out (53.5)	Wiley Dick (48.5)	5	**9**
	Wiley Dick (48.5)	Olney Lateral (44.2)	4.9	**8**
	Olney Lateral (44.2)	Marion Drain Rd. (38)	4.2	**13**
	Marion Drain Rd. (38)	Shaker Church Rd. (35.9)	4	**0**
Total			29.5	**48** **0**
N. Fork Toppenish	NF Falls (4)	NF confluence (0)	4	**13**
Willey Dick	old logging site (4)	Confluence (0)	4	**14**
		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	**1**
	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	**2**
	NF/SF confluence (18.9)	Simcoe Creek Rd. (15.3)	3.6	**15**
	Simcoe Creek Rd. (15.3)	Towtnuk Rd. (12.7)	3.1	**2**
	Towtnuk Rd. (12.7)	N. White Swan Rd. (8.1)	2.8	**1**
	N. White Swan Rd. (8.1)	Stephenson Rd. (5.9)	2.3	**1**
Total			24.5	**22**
Agency	Falls (8.9)	Western Diversion. (4.4)	4.5	**3**
	Western Diversion. (4.4)	Confluence (0)	4.4	**0**
Total			8.9	**3**
Wahtum	Yesmowit Rd. (3.6)	Confluence (0)	3.6	**5**
Total			77.6	**105**

Satus Creek

Compared to other watersheds in the Yakima River Basin the conditions are most favorable and consistent in the Satus for conducting steelhead spawning surveys from season to season. This is mostly due to its lower elevation and often lesser snowpack compared with other nearby watersheds (i.e. Toppenish and Ahtanum). The tributaries of Satus Creek arise in geographically distinct areas with differing elevations, precipitation levels and patterns, relatively large distances between the headwater locations (an exception is the Satus mainstem and Logy Creek where both streams have a source in the large Lakebeds meadow complex). This results in an asynchronous runoff pattern compared to Toppenish Creek where the mainstem and many tributaries arise from a similar geographic area (Lost Horse Plateau). The survey conditions in the Satus watershed also recover quickly (i.e. several days) from periods of high runoff – unlike the

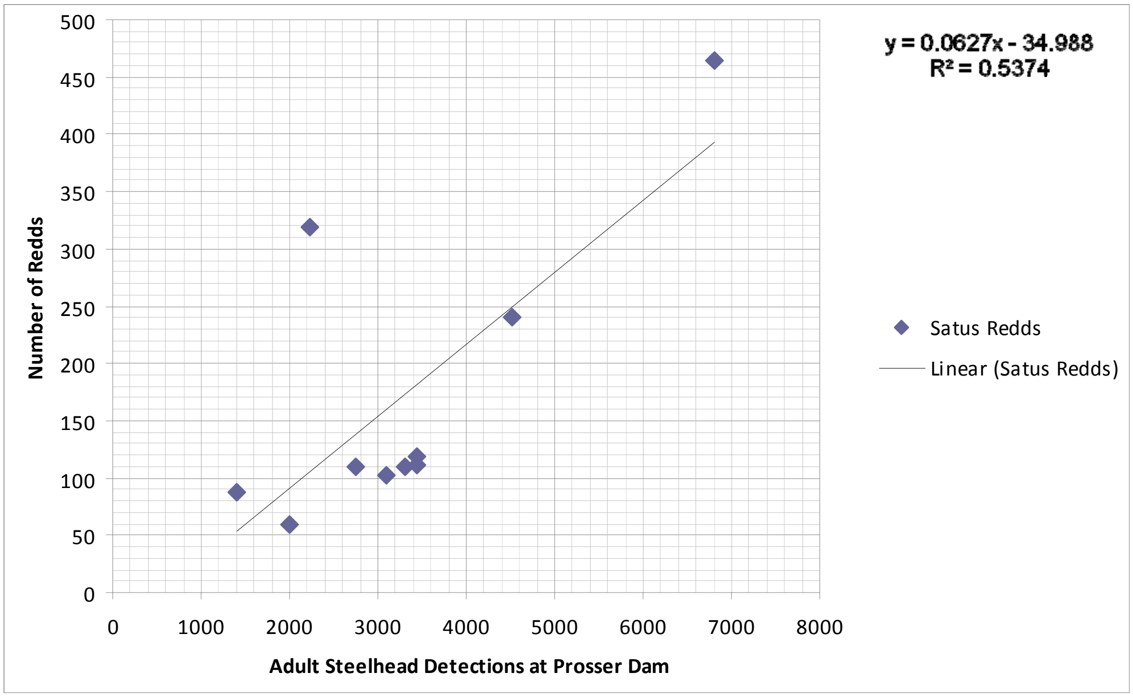

Figure 7. Linear relationship between the number of redds counted in Satus Creek and adult detections at Prosser Dam on the Yakima River (conglomerate of the Satus, Toppenish, Naches, and Upper Yakima DPS) for the past 10 years.

Toppenish and Ahtanum watersheds which can be unwadeable for weeks at a time. Due to runoff patterns in the Satus Creek watershed, YN Fisheries staff are typically able to complete all three passes on the mainstem of Satus Creek, Dry Creek, and Logy Creek. In 2010 like most years, only two passes could be completed on Mule Dry Creek, Wilson Charley Creek and Kusshi Creek before low flows make fish passage unlikely.

A total of 465 steelhead redds were identified in the Satus Creek watershed in 2010 nearly 4 times the number of redds observed in 2009 when 119 were identified. It is likely that these counts reflect a trend of increasing steelhead spawning activity in the Satus watershed starting at a low point of 60 redds in 2006. Our total of 465 redds exceeds the 10-year average of 146 redds by over three times. It is the largest number of redds identified in the watershed since redd counts since they began in 1988. The second highest occurred in 1988 when 445 were identified. Survey conditions were similar in 2010 to those observed in 2006, 2007, and 2009—slightly higher at times, but recovering quickly. Survey conditions were more difficult in 2008 than in other years due to an above normal snow-pack in the watershed, particularly the upper Satus reach. During 2008, significant snow melt occurred into late May and early June. This made our third pass of the upper 4 miles ineffective where Satus Creek is confined to a small canyon.

Despite the minor problems experienced that year, redd counts still seem to be a decent index of spawning activity (figure 7).

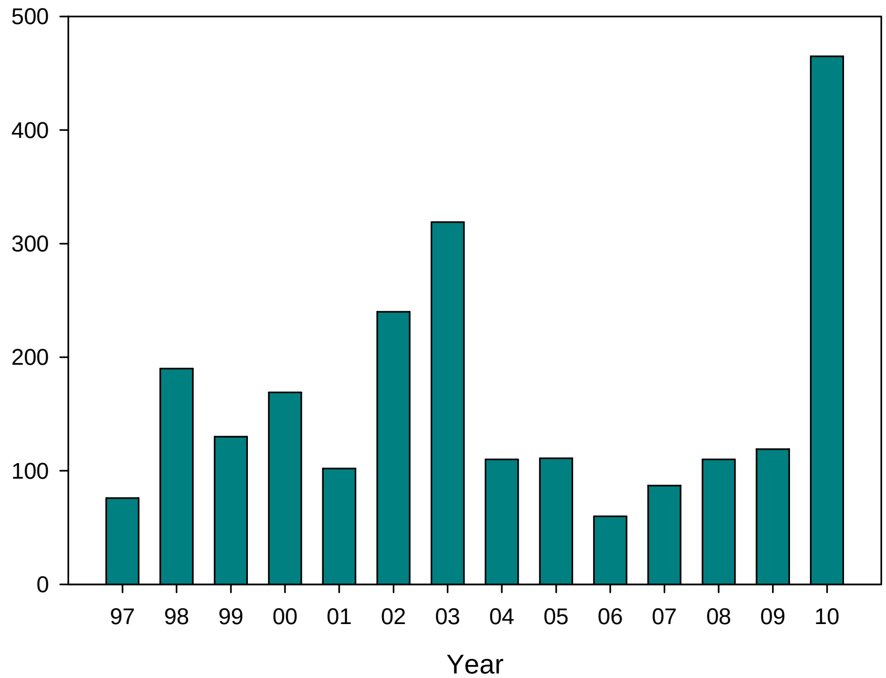

Figure 8. Number of steelhead redds in the Satus Creek watershed for 1997-2010 documented during three passes of all suitable spawning habitat.

The distribution of redds within the Satus watershed was similar to what was observed in previous years (Figure 8) with more redds in all reaches. No redds were observed in Shinando Creek this year where one was seen in 2009. Dry Creek was particularly well represented in the Satus redd count surveys with 153 redds, over twice the number seen in Logy Creek (n=72). The highest density of redds (13.9 redds per mile) were identified in the Dry Creek survey reach between the saddle (RM 24) and the Elbow Road Crossing (RM 18.5). The spawning success of steelhead in this particular reach was confirmed by a high density (47.8 fish/100m²) of age 0 parr identified during August snorkel surveys. This density which was exceeded only at our site near the mouth of Dry Creek (56.7 fish/100m²) which we have identified as a thermal refuge for rearing steelhead parr and thus a location where they congregate in considerable numbers.

Table 14. Number of steelhead trout redds per reach in the Satus watershed in 2010

Stream	Start location, RM	End location, RM	Distance (miles)	# of Redds
SATUS	Falls (44.1)	Wood Bridge (40.8)	4.2	**54**

(3 passes)	Wood Bridge (40.8)	County Line (36.4)	4.4	**31**
	County Line (36.4)	High Bridge (32.4)	4	**39**
	High Bridge (32.4)	Holwegner(28.4)	4.8	**31**
	Holwegner (28.4)	2nd X-ing (23.7)	3.9	**47**
	2nd X-ing (23.7)	1st Xing (20.2)	3.5	**10**
	1st X-ing (20.2)	Gage (17.4)	2.8	**5**
	Gage (17.4)	Rd 23 (13.1)	4.3	**7**
Total			31.9	**224**
LOGY	Falls (14)	Spring Cr (11)	3	**11**
(3 passes)	Spring Cr (11)	S. C. Ford (9.5)	1.5	**10**
	S. C. Ford (9.5)	3rd Xing (3.5)	6	**30**
	3rd Xing (3.5)	Mouth (0.0)	3.5	**21**
Total			14	**72**
DRY	South Fk. (27.8)	Saddle (24)	3.6	**22**
(3 passes)	Saddle (24)	Elbow Xing (18.25)	5.75	**80**
	Elbow Xing (18.25)	Seattle Cr (14)	4.25	**11**
	Seattle Cr (14)	Rd 75 bend (8.75)	5.25	**14**
	Rd 75 bend (8.75)	Power Line Ford (2.5)	6.25	**16**
	Power Line Ford (2.5)	Mouth (0.0)	2.75	**10**
Total			27.85	**153**
W. CHARLEY	Forks (1.9)	Mouth (0.0)	1.9	**2**
KUSSHI	Top (11th) Xing (5.5)	Mouth (0.0)	4.5	**3**
SHINANDO	Ford (0.5)	Mouth (0.0)	0.5	**0**
MULE DRY	Yakima Chief Rd. (11.35)	Rd. 39	11.35	**11**
TOTAL			82.05	**465**

Redd Life Pilot Study

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 2010 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 12 weeks between March 15th 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 highbridge crossing.

In the reach surveyed, redds were identifiable from 2 to 8 weeks and the average redd life was 31 days. This is similar for reported redd lives (22.4-40.7 days) of winter steelhead in California and Oregon (Gallagher 2007). Flow appeared to affect redd recognition more than any other factor. Into May and June, periphyton growth became more noticeable and impacted redd recognition more. There were eight cases of redds being superimposed on one-another and this factor could affect the redd count data-set, although, in many cases these multiple redds were apparent with distinct pits and tailspill.

In conclusion, a more accurate redd count of Satus would entail bi-weekly surveys due to a small portion of redds that are visible for only two weeks.

Ahtanum Creek

Conditions for spawning surveys were poor in 2010 because of turbidity and high flows for much of April and May. We were unable to survey this stream before flows made it unwadeable.

Coho Salmon

Coho Salmon spawn in the lower reaches of Ahtanum Creek each fall (November through early December). Most of the coho observed spawning in the Ahtanum are strays from a reintroduction program headed by the Yakama Nation that has targeted tributaries of the upper Yakima River. The coho salmon reintroduction program began acclimating and releasing coho salmon in Ahtanum Creek in 2008. Some of these will likely begin returning next year. Yakama Nation Fisheries personnel have conducted Coho surveys in Ahtanum since 2001. Three passes were conducted in Ahtanum Creek during our fall 2009 coho salmon surveys between the mouth and the bridge at Goodman Rd. at RM 2.8. The methodology used was nearly identical to that used for steelhead spawning surveys. The first survey was performed on November 4th 2009, the 2nd was performed on November 18th 2009, and the third on December 3rd 2009. A total of 8 coho redds and 28 live adult coho were identified in during surveys in Ahtanum Creek in 2009. Most coho salmon redds were identified in Fulbright Park about 0.5 miles upstream from the mouth. Redd numbers were similar to 2008 when 9 coho redds were documented in this reach.

Bull Trout

A small population of bull trout resides in the headwaters of Ahtanum creek. Bull Trout redds were surveyed in September and October 2010. Surveyors walk a 4 mile section of the South Fork of Ahtanum Creek in an upstream direction. This reach represents the most suitable bull trout habitat in the South Fork of Ahtanum Creek. A method developed by Washington Department of Fish and Wildlife (WDFW) was employed.

Only two redds were identified during the three passes of our survey in 2010. The first survey was conducted on September 9th 2010, with 2 redds located. One adult resident bull trout was seen working a redd. During the following passes on September 16th and October 7th, no new bull trout redds were observed We typically identify less than five bull trout redds each year in the reach that we survey, although recognition is difficult when searching for redds constructed by fish typically less than 250 millimeters long. We likely miss some redds because of their small size. In other parts of the Yakima Basin bull trout redd counts were up (Eric Andersen; WDFW, personal communication).

III. RESTORATION PROJECTS

A. Ahtanum Creek Bank Stabilization

Project overview

Flooding events have altered the course of Ahtanum Creek through the erosion of the south bank of Ahtanum Creek and the deposition of gravel bars, which is blocking a portion of the old channel. This has caused the stream to partially capture a farm service road on the south side of the Ahtanum Creek. Stream discharge increasingly flows along the farm road which parallels the creek through fields for a distance of about 550 feet before returning to the creek. Low to moderate flood events have eroded the road 2 to 2.5 feet in depth and eroded the stream bank at the point of flow return back to the stream. Thus, the stream is actively forming an avulsion along the road and once established will provide the most hydraulically efficient path from stream flows possibly becoming the main channel (See Figure 9)

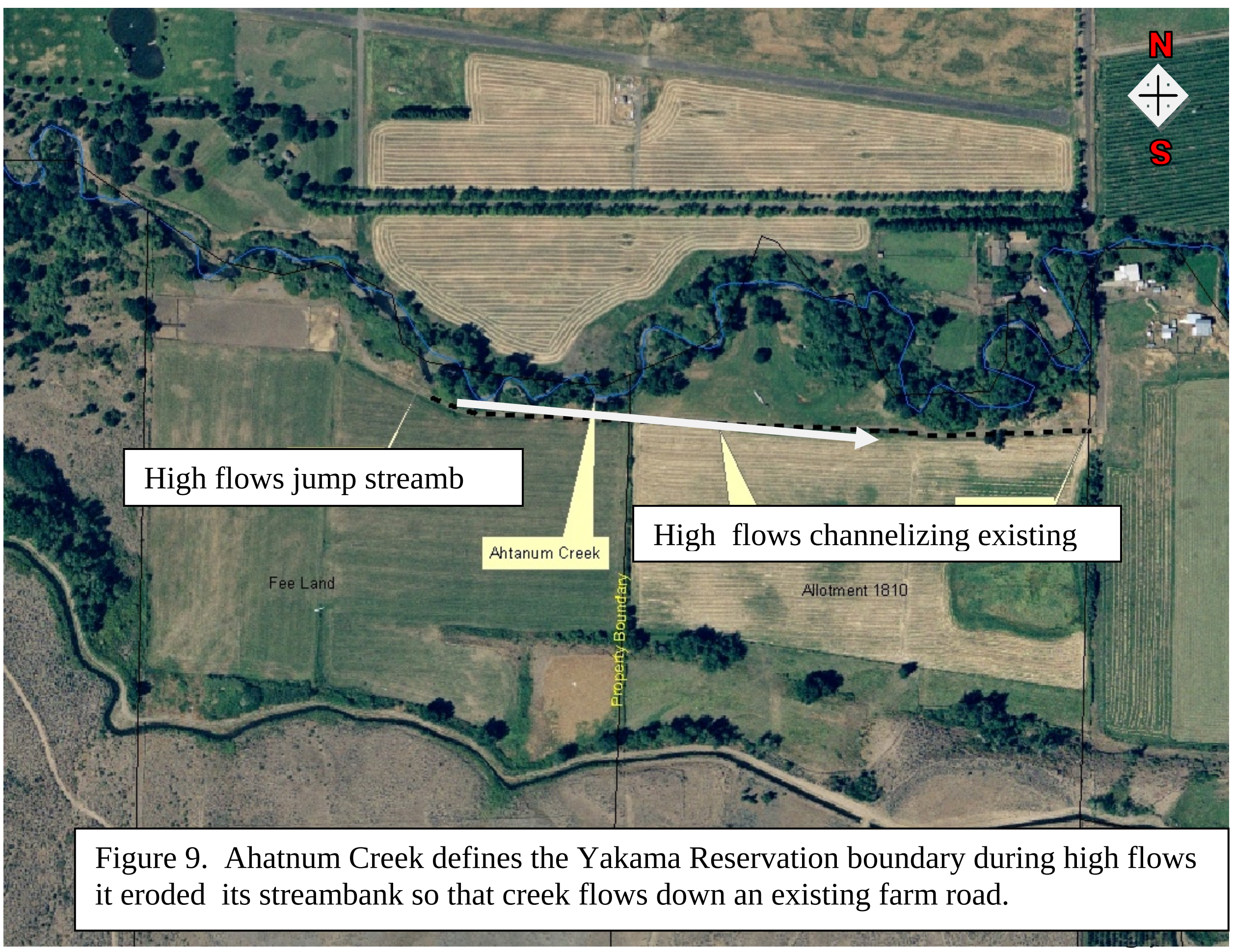

Figure 9. Ahatnum Creek defines the Yakama Reservation boundary during high flows it eroded its streambank so that creek flows down an existing farm road.

Method

This project would reconstruct the riparian corridor and stream bank by construction of a vegetated timber crib. The crib was constructed with large woody debris (LWD) with root wads extending into the stream, wood slash was used behind the face of the crib to retain stream gravels placed within the depth of the crib (See figure 10.)

Figure 10. Where Ahtanum Creek used to access farming road during high flows. Bank stabilized to keep creek in original channel.

Three foot diameter boulders was cabled to the top logs of the crib for ballast. Riparian vegetation was placed in the crib and extended beyond the face of the crib above OHW (Ordinary High Water) . The riparian corridor was rehabilitated using vertical log snags to hold LWD placed on the flood plain to restore riparian corridor hydraulic roughness and planting of native riparian vegetation. An existing side channel was enhanced with slash and overhanging vegetation for off channel rearing habitat. This project was protecting against lateral erosion sourcing fine sediments into the stream and avulsion of the creek along approximately 550 feet of farm road through an adjacent field.

Conclusion

This project has served the dual purpose of avoiding an unwatend avulsion and created a significant amount of LWD habitat in Ahtanum Creek.. YRWP staff are confident that this project will be a success.

B. Smartlowit Screen Installation

For the past seven years Yakama Nation fisheries staff has been working on developing a plan to put fish screens on unscreened private irrigations ditches in Simcoe Creek Watershed. Simcoe Creek has endangered Steelhead that spawns and rears in its watershed. Currently, there are 3 unscreened diversions located in the Simcoe Creek called Smartlowit, South Fork Feeder and Hubbard diversions. These diversions have the flow to cause outmigrating Steelhead to get stranded on farmland.

In 2007 Yakama Reservation Watershed Project (YRWP) staff started to work with a private irrigator on accepting the concept of screening his irrigation ditch, which is called the Smartlowit diversion. The first attempt was to try an infiltration gallery on his property. The infiltration gallery didn't work due to hitting bedrock.

After the failure of the infiltration gallery YRWP staff looked at two fish screens for the Smartlowit diversion one a farmers fish screen (see figure 11) and a 4 CFS Rotary Wiper W/Guard fish screen (see figure 12).

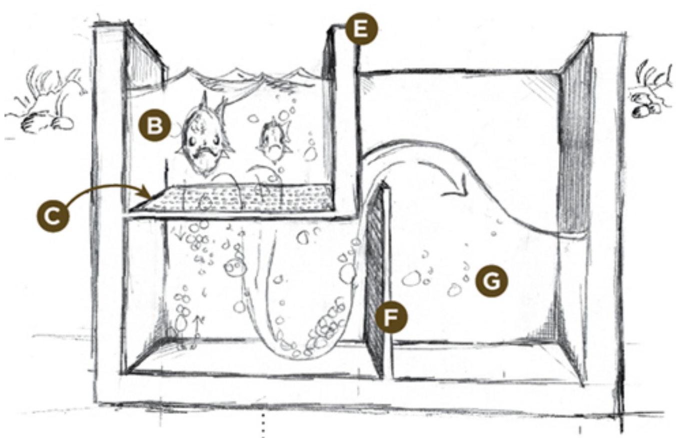

Figure 11. Farmers Fish screen

Figure 12. 4 CFS Rotary Wiper W/Guard Fish Screen.

After meeting with Engineers, YN Tribal staff and Landowner it was decided to install the 4 CFS Rotary Wiper W/ Guard fish screen. This alternative was chosen because of the flow and debris load.

Figure 13. Spring of 2010 Smartlowit Unscreened irrigation diversion off of Simcoe Creek.

Figure 14. Winter of 2010 4 CFS Rotary Wiper W/ Guard fish Screen installed.

The 4 CFS Rotary fish screen will be ready to operate in the spring of 2011. YN Watercode and YRWP staff will participate in operating and maintaining this fish screen.

Also, YRWP are looking at alternatives for the other two unscreened diversions on Simcoe Creek and have these installed by winter of 2011.

C. Lincoln Meadows Restoration Project

Project Overview

Lincoln Meadows is a headwater meadow to Toppenish Creek. YRWP staff has worked on Lincoln Meadows in the past on fencing the meadow for cattle exclusion and removing a road that bisected the meadow. During this phase of restoration a culvert was removed and the road was ripped and seeded. The culvert placed in the middle of the meadow is believed to have caused the severe headcut above and below the meadow. Damages to the meadow were also caused by overgrazing and physical trampling of the bed and banks of the meadow. This causes spring runoff to degrade the channel through lateral and vertical channel expansion. Keeping the cattle off the meadow was effective, but the headcut never stabilized. YRWP staff wanted to take a more effective look at bringing the water table back up and restoring the meadows natural hydrology.

Methods

In collaboration with engineers, YN Tribal staff and BIA roads an engineer plan was developed to restore the meadow back to its original grade. Due to the increase of runoff caused by logging activity, bare ground conditions within the meadow and segements of existing channel that is higher than the valley bottom the plan was to fill the channel bottom with compact fill.

From the top of the meadow to the bottom of the meadow which is approximately 1,830 feet. The channel was filled to grade with large rock in certain places and then compacted with gravel and soil (See figure 15). Then the banks were constructed and stabilized using fabric lifts composed of gravel and soil materials. After the completion of the construction the area was seeded with natural vegetation. Once the hydrology of the meadow is restored it is expected that native sedge communities will dominate the site.

Figure 15. Lincoln meadows channel filled with compact soil and gravel.

Conclusion

This is YN first attempt to stabilize a meadow using this methodology. YRWP staff is excited and confident to examine the results of this meadow in the summer of 2011.

D. Camas Patch Meadows

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. Currently, a road runs perpendicular to the meadow changing the natural hydrology of the meadow. The road is driven on by vehicles when it is wet causing the road to widen and channelize (see figure16). The road is draining the natural hydrology of the meadow cutting flow off from the meadow.

Figure 16. Camas patch meadow located left of picture and road that is widening and channelizing the meadows hydrology.

Method

Originally, the plan was to place geotextile and gravel on the road, but YRWP looked at a different option. An old logging road that is no longer in use is located north of the eroded road and meadow (See Figure 17). This road gives access above and below the Camas patch meadow and is away from the hydrology of the meadow. YRWP staff approached BIA roads, YN Tribal staff and allotment owners to develop this option which was agreed upon.

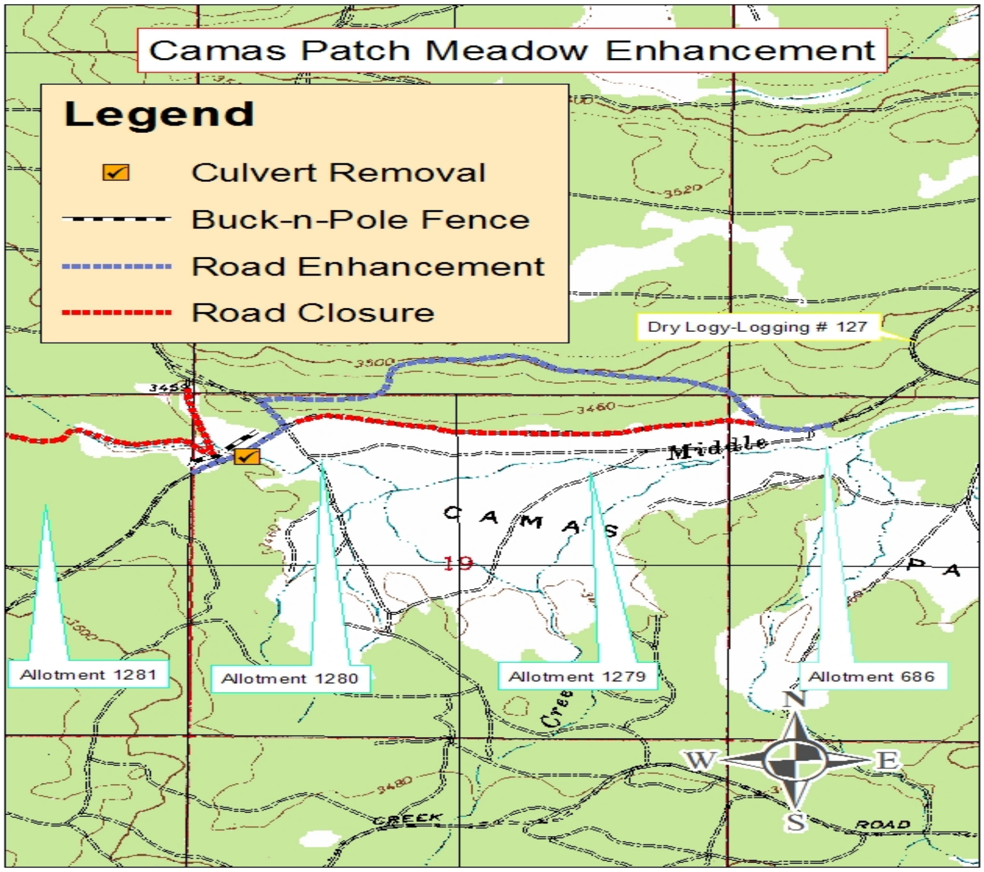

Figure 17. Camas patch road that will be closed is in the red and the road that will be developed is in the blue.

Conclusion

The new road was developed, but unfortunately bad weather prevented this project to be completed. The contractor will complete the work once weather permits.

IV. Operations and Maintenance

A. Stock Wells

YRWP staff repair and maintain 33 solar powered stock pumps (Figure 26) 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 18. 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 16.5 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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