Document ID #P110317
Report covers work performed under BPA contract #35636
Report was completed under BPA contract #40083

FY2008 ANNUAL REPORT

FEBRUARY 1ST 2008 THROUGH SEPTEMBER 30TH, 2008
YAKAMA RESERVATION WATERSHEDS PROJECT
BPA Project #1996-035-01-Contract #35636

Table of Contents

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 2007, 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 several exclosure fences and a culvert removal project during the 2008 work season.

II. Collect Data

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. 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.

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 four 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.

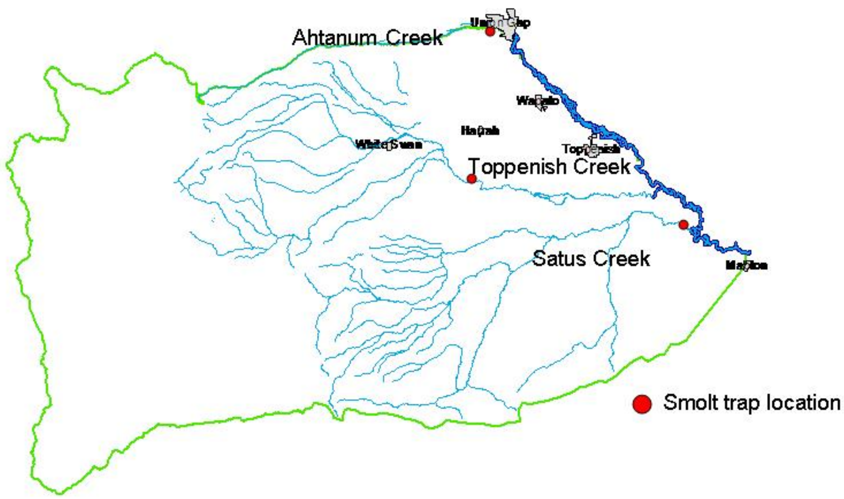


Figure1. Map of smolt trap locations on Satus, Toppenish, and Ahtanum Creeks

<u>Satus Creek</u>

The screw trap on Satus creek was deployed at river mile (RM) 1 on November 28th, 2007 and was operated continuously until June 17th 2008.   The screw trap was in place for a total of 202 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 82 % of the days (165) during the season. During the interval between visits to the trap, debris stopped the cone 14 % 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 2.27—slightly higher than last year. The trap may not be rotating as easily due to wear and tear from two years with high flow events.

During the 2007-2008 season a total of 750 steelhead juveniles were captured in the screw trap at Satus Creek. We implanted 392 PIT tags into captured fish.   From the PIT tagged juveniles, 148 were released upstream for an efficiency test.   Eleven of these were recaptured.   An average efficiency of 7.43% can be calculated from these results. We obtained a rough outmigration estimate of 10,091 steelhead smolts. This number a likely underestimate 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 bag weir 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 only two mortalities tallied in the 2007-2008 season.

Satus Creek Screw-trap Catch 2007-2008 Monthly Descriptive Statistics

Stat	Nov	Dec	Jan	Feb	March	April	May	June	Overall
Monthly Catch	.	642	43	31	5	21	9	0	751
% of total	.	85.6%	5.7%	4.1%	0.7%	2.8%	1.2%	0.0%	100.1%
Max Fork Length	.	177	135	157.00	180	190	184	0	190
Min Fork Length	.	70	64	65.00	116	129	123	0	64
Mean Fork Length	.	109.08	101.70	107.61	139.00	139.00	150.44	0.00	110.67
Max Weight	.	94	22.5	39.00	63.5	63.5	64.4	0	94
Min Weight	.	0	4.3	4	2.7	3.2	24.1	0	2.7
Mean Weight	.	14.67	11.18	13.85	30.84	38.94	35.79	0.00	15.51
Mean Cond.Factor	.	1.059	1.002	0.999	1.037	0.999	1.041	0.000	1.051
Number tagged	.	334.0	14.0	12.0	5.0	21.0	6.0	0.0	392.0
% monthly catch tagged	.	52.0%	32.6%	38.7%	100.0%	100.0%	66.7%	0.0%	52.2%

The peak in daily catches occurred in December after an early winter storm caused a high flow event. Numbers captured in the trap waned in January than increased in early March and remained consistent through that month and then decreased again in April. Catches more than doubled compared to the 2007 season where only 301 steelhead juveniles were captured, although efficiency tests indicate that many out-migrating steelhead smolts can still avoid our trap.

The mean fork length of juvenile steelhead increased during the spring months compared to the early months of December, January, and February. Overall mean fork length (110.67 mm) was higher than 2007 (102.2 mm). This figure was influenced by a large number of smaller juveniles migrating through the trap zone in December. Larger sized smolts migrated through the trap zone in March, April and May (3-month average; 152 mm). We collected scales from 101 individuals. They will be aged in winter 2008.

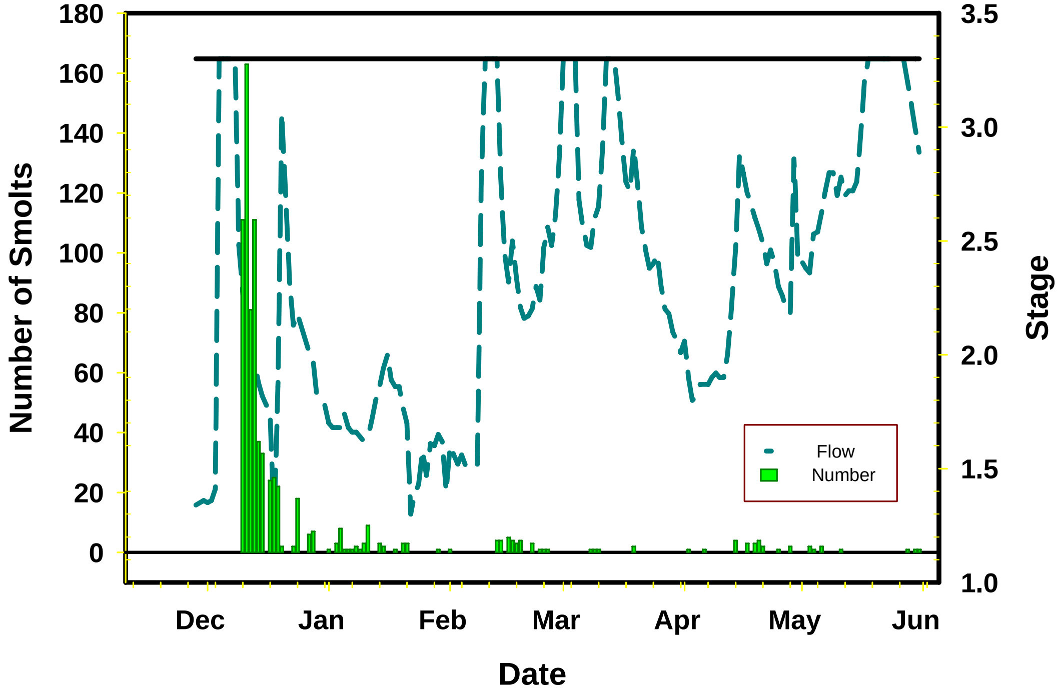


Figure2. Number of smolts captured in the Satus Creek compared with stream stage in 2007 and 2008.

<u>Toppenish Creek</u>

The screw trap on Toppenish creek was deployed at approximately river mile (RM) 23 on November 14th 2007 and was operated continuously until June 17, 2008. The screw trap was in place for a total of 217 days. High discharge and debris prevented operation of the screw trap for a prolonged 51 day period from April through early June. Similar prolonged high flow events occurred during the 2006-2007 season and the 2005-2006 season. Operation of the screw trap was also halted during several other intervals of high flow in December, January, and February. Although the trap was in place, the cone was deployed for only 140 days (65% of the operating period). The trap was operating efficiently (i.e. deployed and cone rotating for the entire 24 hour period) on 90 days or 41 % of the time. Steelhead juveniles were captured on 99 days (71 %) out of the 140 days when the trap was deployed.

We captured 1681 juvenile steelhead during the 2007-2008 season. This is lower than the 2006-2007 season when we captured 2384 steelhead juveniles. Out of captured individuals, we implanted PIT tags into 970 smolts that were greater than 100 mm in length. Efficiency tests with PIT tagged steelhead indicate a higher trap efficiency rate (16.23%) than in the 2006-2007 season (13.82 %). An extrapolation on our catch numbers suggest that approximately 10,357 steelhead juveniles migrated through our trap zone during the 2007-2008 season. However, this is only a rough estimate and is certainly low because of the long intervals when the trap could not be deployed due to high flows. Years of smolt trap data from three locations in the Yakima River basin indicate that steelhead outmigration peaks following peaks in the hydrograph. Unfortunately, we are often unable to trap during this period because of concerns for staff safety, trap damage, and steelhead mortality events. It is difficult to discuss outmigration estimates and patterns with the numerous breaks in the continuous trapping regime that occurred in 2008.

Table 1. Smolt trap statistics for the Toppenish Creek.

Stat	Nov	Dec	Jan	Feb	March	April	May	June	Overall
Monthly Catch	421	600	156	123	231	146	0	4	1681
% of total	25.0%	35.7%	9.3%	7.3%	13.7%	8.7%	. 0.00%	0.2%	100.0%
Max Fork Length	232	199	308	170	214	224	.	173	308
Min Fork Length	74	58	72	70	0	82	.	154	0
Mean Fork Length	124.83	114.94	119.20	107.18	122.13	137.46	.	165.75	116.02
Max Weight	125.3	81.4	129.1	50.5	90.9	102.3	.	55.1	129.1
Min Weight	4.1	2	0	3.2	0	5.4	.	35.2	0
Mean Weight	20.52	11.99	18.43	13.68	21.05	28.50	.	48.65	17.78
Mean Cond.Factor	0.938	0.970	1.010	0.985	0.981	0.994	.	1.059	0.970
Number tagged	342.0	279.0	71.0	50.0	109.0	115.0	.	4.0	970.0
% monthly catch tagged	81.24%	46.50%	45.51%	40.65%	47.19%	78.77%	0.00%.	100.00%	57.70%
%of total	35.26%	28.76%	7.32%	5.15%	11.24%	11.86%	0.00%	0.41%	100.00%

Mean fork lengths increased during the spring months of April and May – a typical pattern seen in previous years and at other trap locations. Mean fork length (116.02 mm) for 2007-2008 was higher than the 2006-2007 season (106.0 mm), but lower than the 2004-2005 season (137.00 mm). It 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.

Steelhead mortality was higher in 2007 (5.35 %) than in 2007 (1.76 %) but lower than 2006 (10.76 %). Like previous years, large flood events and heavy debris loads were responsible for trapping mortalities.

In spring 2008 we captured 1 chinook salmon smolt in the Toppenish Creek trap. We can only speculate where this individual originated. 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 2008 or have been captured in past years at the Toppenish Creek trap.

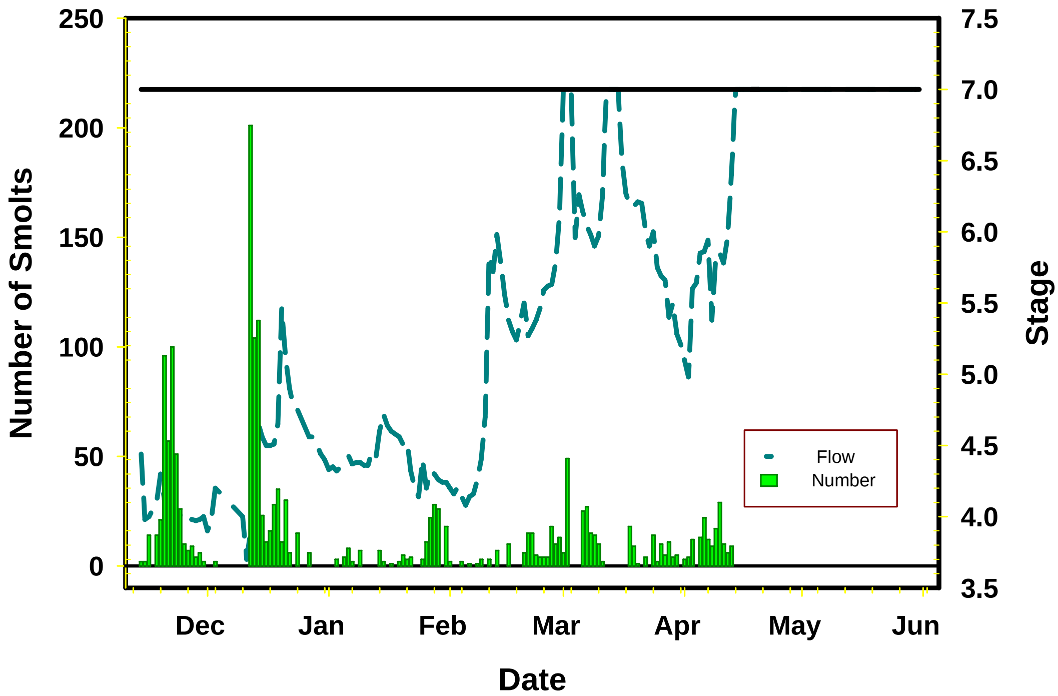


Figure3. Steelhead juvenile catches compared to creek stage at the Toppenish Screw trap.

Ahtanum Creek

The screw trap on Satus creek was deployed at river mile (RM) 2 on December 3, 2007 and was operated continuously until June 17, 2008. The srcew trap was in place for a total of 197 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 60 steelhead smolts were captured in 2008 (Table 2). This is higher than the 2006-2007 season when only 11 steelhead juveniles were captured. However, the 2008 catch was lower than the previous three years. The peak in outmigration in Ahtanum Creek occurred in December when 2/3 of the captured juveniles outmigrated past the trap zone -- similar to both Toppenish Creek and Satus Creek. Mean fork length for steelhead juveniles captured in the screw trap was 127.2 mm. In addition to steelhead trout, 2 chinook salmon smolts were captured in the screw trap.

Table2. Descriptive statistics for the 2007-2008 screw trap season in Ahtanum Creek.

Stat	Nov	Dec	Jan	Feb	March	April	May	June	Overall
Monthly Catch	.	40	0	2	1	10	3	4	60
% of total	.	66.67%	0.00%	3.33%	1.67%	16.67%	5.00%	6.67%	100.00%
Max Fork Length	.	156	.	106	125	168	159	176	176
Min Fork Length	.	85.0	.	106.0	125.0	119.0	138.0	119.0	85.0
Mean Fork Length	.	118.3	.	106.0	125.0	149.9	151.0	151.0	127.2
Max Weight	.	37.2	.	12.3	21.3	47.6	39.0	53.1	53.1
Min Weight	.	6.9	.	12.3	21.3	17.2	26.9	31.4	6.9
Mean Weight	.	18.0	.	12.3	21.3	33.8	34.7	38.6	22.7
Mean Cond.Factor	.	1.03	.	1.03	1.09	0.99	1.00	1.04	1.04
Number tagged		36.00	.	1.00	1.00	9.00	3.00	4.00	54.00
% monthly catch tagged		90.0%	0.00%	50.0%	100.0%	90.0%	100.0%	100.0%	90.0%

Figure 4. The five foot diameter screw trap deployed at Toppenish Creek.

B. Snorkeling

We conducted snorkel surveys in Satus, Toppenish, and Ahtanum watersheds to monitor steelhead parr and compare densities between sites located upstream and downstream from irrigation diversions. We also used surveys to compare steelhead parr density between streams, assess distribution of different salmonid species, and visually evaluate growth.

Methods

We established three snorkel segments 200 meters in length upstream and downstream from the diversion to compare steelhead density. At our Toppenish Creek study site we also established a segment approximately 1.2 miles downstream from the diversion intake directly upstream from the abandoned Three-Way Diversion (river mile (RM) 41.8).

Surveyors moved in an upstream direction from the bottom of a survey segment to the top. One person followed behind to record data. 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. Unfortunately, we can not visually distinguish between anadromous steelhead and resident rainbows at these life stages. Surveys were repeated each month from June to October to assess the possible movement or shifts in spatial and temporal distribution. 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.

<u>Toppenish Creek Olney-Lateral Diversion</u>

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)*. 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 occurs 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. 2008 was the 4th year that we monitored steelhead populations at this site.

Flow and water temperature are two interrelated environmental factors that limit steelhead production in the lower reaches of Toppenish Creek. The Olney-Lateral

Diversion is situated at the bottom of the Toppenish Creek Canyon. Surface flow decreases as Toppenish Creek crosses the alluvial fan. Prior to 2001, the Olney-Lateral Diversion captured nearly all of the surface flow in Toppenish Creek during the late summer months. Minimum summer instream flows below the Olney-Lateral Diversion were set by the Yakama Nation Water Code Administration each year of this study. Irrigation diversions were regulated to accommodate the flow prescribed below. In 2001-2005, a minimum flow of 10 cfs was prescribed below the Olney-Lateral Diversion for the months of July through September. A 10 cfs minimum flow provides about 2.5 miles of rearing habitat. In 2006, the prescribed minimum was increased to 12 cfs. A flow of about 17 cfs was maintained below the diversion in 2007 to provide continuous surface flow through the reach between 2.5 miles and 4.5 miles downstream from the diversion—a segment that typically dewaters during the summer at a lower flow. In 2008, the same water management scheme as 2007 was employed for the Olney-Lateral (about 17 cfs maintained below the diversion).

Figure5. photo of the Olney- Lateral Diversion in the drought year of 2005 creating a passage barrier

Figure6. photo of the snorkel site upstream from the Three-Way Diversion.

Figure7. Photo of our snorkel site downstream from The Olney-Lateral Diversion.

Figure8. Photo of our snorkel site upstream from The Olney-Lateral Diversion

Temperature increases steadily through the 6.5-mile reach divided by the Olney-Lateral Diversion. Maximum weekly (7-day average) maximum water temperatures (MWMT) did not increase at a faster rate downstream from the diversion in 2007 (Figure).

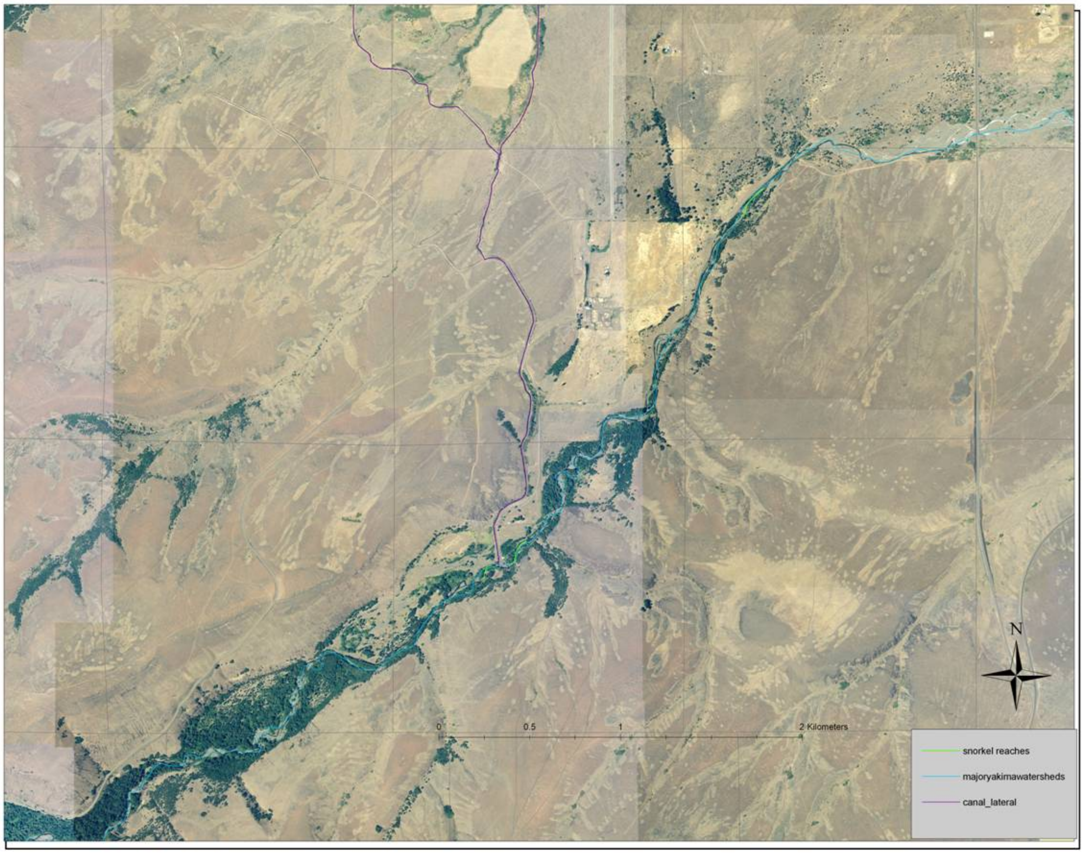


Figure9. A map of Toppenish Creek centered on the Olney-Lateral Diversion point. Snorkel surveys sections were placed upstream and downstream from the diversion. The 2.5 mile diction located downstream (north east of the diversion) has provided rearing habitat for steelhead juveniles since 2001.

During all four years snorkel surveys, we did not see lower densities of age 0 steelhead juveniles below the Olney-Lateral Diversion, nor did we observe a decreasing trend in age 0 density through the season. We found no difference in age 0 juvenile steelhead densities between the upstream and downstream sites in 2005 ($t=-0.9521$; $p=0.369$), 2006 ($t=-1.685$; $p=0.130$), 2007 ($t=0.945$; $p=0.373$), or 2008 ($t=-0.1890$; $p=0.856$). In 2006, there appeared to be a greater density of steelhead parr observed at our site below the Olney-Lateral Diversion in the months of August and September when steelhead Age 0 densities where more than twice as high during that period. We expected to see a decline in density of age 0 steelhead at all of our sites between June and October due to normal mortality. A steeper decline in density below the diversion might have reflected reduced survival because of inadequate flow or artificially high water temperature. Unfortunately, there are many other factors that influence the densities of steelhead parr that we observe during snorkel surveys. One example of a factor that influences the effectiveness of snorkel surveys to quantify steelhead juvenile density is development and size of the juveniles. As juveniles mature and grow they are more likely to be observed by surveyors later in the season when they move away from the shallow interstices between cobble and into areas such as pool and below gravel bars where they can be more readily seen.

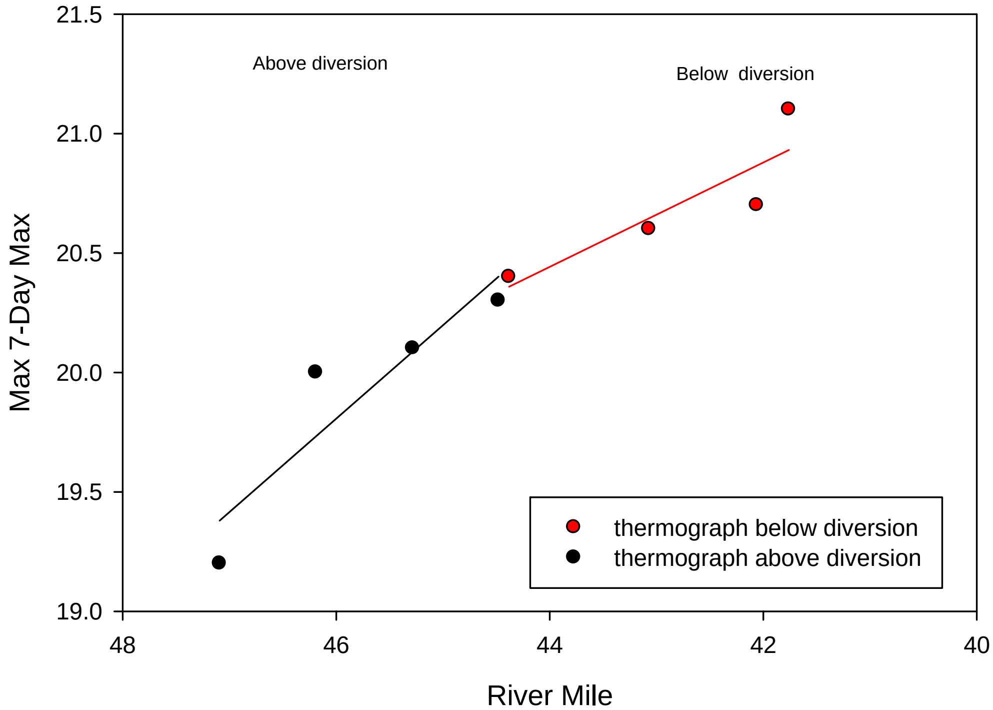


Figure10. Maximum 7-day avege maximum water temperatures (MWMTs) collected using data-loggers at stations placed at approximately 1 mile intervals upstream and downstream from the Olney-Lateral diversion in 2007.

The difference in discharge between survey sites upstream and downstream of the diversion may not have been enough to affect the densities of age 0 steelhead particularly in 2007 when withdrawal at the Olney-Lateral Diversion was limited to less than 2 cfs for most of the summer months. In 2008, summer withdrawals on the Olney-Lateral were slightly higher because of increased streamflow. The flow below the diversion was similar in 2008 to 2007 and possibly higher.

Results may have also been influenced by an “accumulation effect” where age 0 steelhead juveniles drift downstream and collect below the diversion structures (which are impassible to small fry—particularly in 2005 when a dry barrier formed directly below the Olney-Lateral Diversion. Hubble (1992) documented the gradual downstream movement of tagged steelhead juveniles in Satus Creek through the summer. Downstream dispersal is also constrained by the low flow reach below Wesley Road (RM 41.8). This “accumulation effect” appeared to be more evident in 2005 and 2006 when the low flow reach was completely dry for several weeks or longer during the summer months.

Table 3. A comparison of density of Age 0 and Age 1+ steelhead juveniles at the Olney-Lateral Diversion (RM 44) snorkel survey study site in 2005, 2006, 2007, and 2008.

	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	**.**	**.**	**.**	**.**	**.**	**.**

more water was diverted for irrigation and a temporary dry reach occurred several miles downstream from the Olney-Lateral Diversion. In the drought year of 2005, a small dry reach also occurred immediately downstream from the Olney-Lateral Diversion, before the screen bypass pipe. Upstream movement of all age classes was likely obstructed. In 2007 and 2008 continuous or nearly continuous flow was present along the entire length of Toppenish Creek, including the reach that went dry in previous years (between Signal Peak Road and Wesley Road). This may have encouraged more steelhead parr to drift downstream preventing the accumulation of steelhead parr in the 2.5 mile reach downstream from the diversion where two of our sites were situated (Below Diversion and Above Three-Way). We are unsure if stream habitat condition in this low flow reach, particularly water temperature is conducive to steelhead survival and development. Juveniles were observed there throughout the summer in 2007.

In 2008, we observed increasing densities of Age 0 parr at Toppenish Creek sites throughout the summer and into the fall. The highest density was observed during our September survey. We did not observe this pattern during previous years when peak Age

0 densities often occurred in late summer (i.e. August). We believe that the relatively low numbers of Age 0 year class steelhead seen early in the year results from their ability to avoid detection by utilizing the interstices in the rocks and that densities, are in reality, greater during this period.

We observed increasing numbers of age 1 + juveniles (smolt size) from August through October in 2005 through 2007 indicating that gradual downstream pre-outmigration (dispersal to the lower regions of Toppenish Creek that are inhospitable to steelhead survival during the summer) may occur during this time of year (Table 1). Although in 2008, this pattern was less pronounced with peak Age 1+ densities occurring in August instead of September. We were unable to complete our October survey because of increased turbidity caused as fish screen maintenance on Olney-Lateral began mid-way through our snorkel survey. Weather and schedule conflicts prevented us from completing this survey at a later date in October.

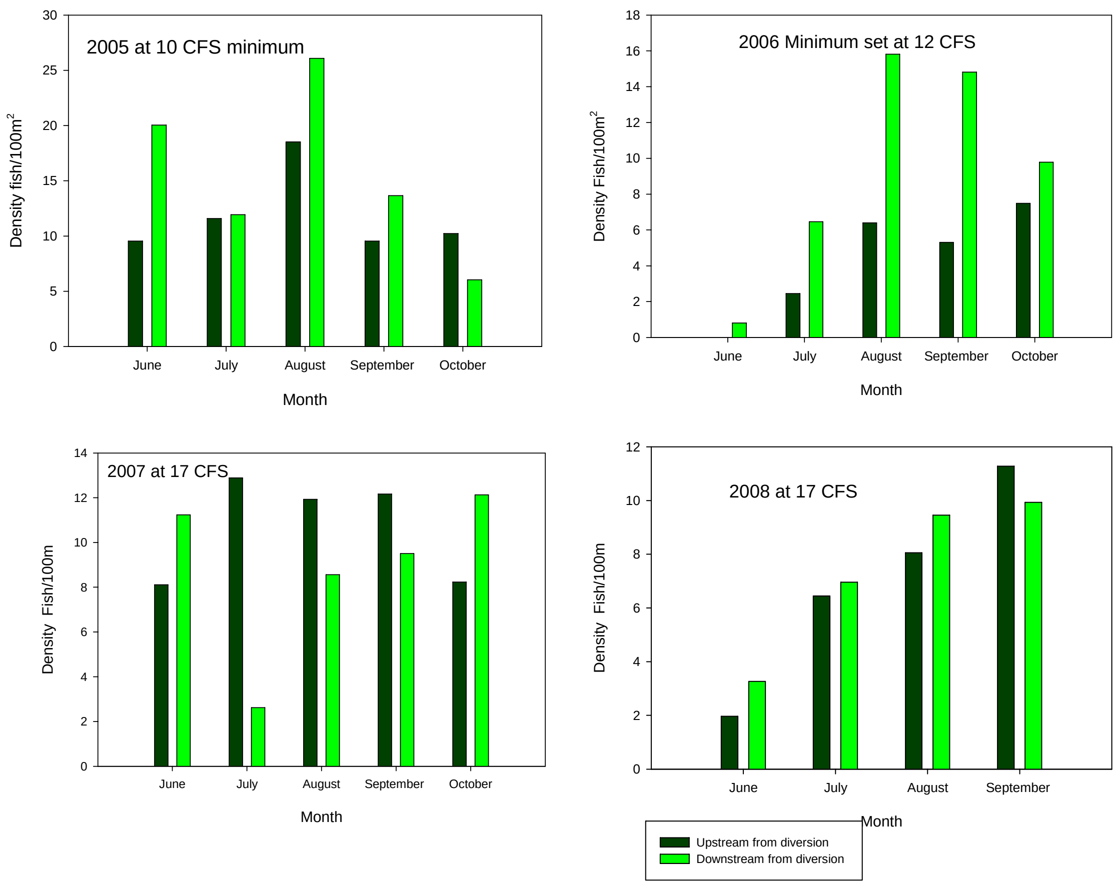


Figure11. Comparison of Age 0 steelhead densities between 200 meter sites located upstream and downstream from the Olney-Lateral Diversion site in 2005, 2006, 2007, and 2008.

Hoptowit Diversion at N. Fork of Simcoe Creek

We used the same method 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 length was 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 three 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.

Table4. Number and density of steelhead parr upstream and downstream from the Hoptowit diversion on the North Fork of Simcoe Creek in 2008.

	Age 0	Age 0	Age 1 +	Age 1 +
	Below Hoptowit	Above Hoptowit	Below Hoptowit	Above Hoptowit
June	10	1	103	22
July	19	5	43	58
August	18	27	43	35
September	8	9	44	44
October	30	24	45	33
Densities (per 100 m²)				
June	1.39	0.11	14.31	2.41
July	2.64	0.55	5.97	6.35
August	2.50	2.95	5.97	3.83
September	1.11	0.98	6.11	4.81
October	4.17	2.63	6.25	3.61

Densities of Age 0 steelhead were higher below the Hoptowit Irrigation Diversion than above it during the first three monthly surveys (Table 4). In October 2007, density was higher above the diversion. A redd located less than 100 m downstream of the snorkel site may have for the higher number of age 0 steelhead below the diversion, particularly in the June survey, before fry had a chance to disperse. In 2005, no age 0 steelhead parr were observed in this reach. Large beaver dam complexes below the confluence of the North and South Fork of Simcoe Creek would likely prevent upstream movement of any fry into our study reach at the low flows occurring in 2005. The absence of Age 0 *O. mykiss* in 2005 from our snorkel survey observations support or theory that anadromous steelhead are the dominant component of the *O. mykiss* population in this portion of the Simcoe Creek watershed. Age 0 *O. mykiss* were present in 2006 in densities comparable to those observed at our Toppenish Creek site. In 2007, densities of age 0 steelhead were lower at both sites but comparable to the densities seen at our Toppenish Creek study site. In 2008, Age 0 parr densities in the North Fork of Simcoe Creek were lower than previous years (other than 2005). Mean density was higher (2.36 fish/100m²) below the diversion than above the diversion (1.44 fish/100m²) in 2008. With the location of two steelhead redds within 100 feet of our downstream site and two steelhead redds within the boundary of our upstream site we expected higher densities at both locations.

There was no noticeable difference in densities of Age 1+ steelhead parr between the site located upstream from the diversion and the segment located downstream from the diversion (Table 4). Densities of Age 1+ age classes of steelhead were substantially lower in 2006 than in 2005. This is probably due to a low (undetectable) 2005 Age 0 year class in this portion of Simcoe Creek. They appeared to rebound in 2007 because of the stronger 2006 year class compared to the weak 2005 year class. In 2008, Age 1+ densities were similar to 2007 and like age 0 parr, Age 1+ densities were slightly higher below the diversion than above (7.2 fish/100m²--above, compared to 4.4 fish/100m²--below).

Ahtanum Creek Diversions

We performed two sets of snorkel surveys at the main diversion complex on Ahtanum Creek to evaluate effects on steelhead juvenile abundance. 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. Two surveyors moved upstream dividing the stream in half with each person enumerating the fish in just their half of the stream. Under most conditions these two classes of steelhead/rainbow trout were distinguishable. Six stream widths were measured at each site to estimate the area (in 100 meters²). 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 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. Surveys were first conducted in July and then repeated in August to assess the possible movement or shifts in distribution.

The density of O. mykiss juveniles increased in August at locations upstream and downstream from the irrigation diversions (Table 5). The most striking increase occurred in age 0’s at the site below the diversions in August when 104 age 0 parr were observed. This is more than 10 times more than the number of individuals observed the previous month. It is unclear why such a large increase between the months of July and August in steelhead density was observed by surveyors both above and below the diversions. The density of age 0 juveniles was higher below the irrigation diversions (mean=2.75 fish / 100m²) than above (mean=1.45 fish / 100m²). Better quality habitat for steelhead fry below the diversions may partially explain this difference. In addition, like we have theorized at our Toppenish watershed sites, smaller steelhead juveniles may be more apt to avoid observation early in their development due to their size and differential behavior compared to older individuals. There did not appear to be a notable difference in densities of age 1 + juvenile O. mykiss. During our 2008 surveys, we also observed juvenile coho salmon at our site below the diversions. None were seen at our site above the diversion. These fish were probably hatchery releases from earlier in the year (Todd Newsome, YN Fisheries –personal communication).

Table 5. 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
July	0	17	14	5
August	6	110	25	36
Densities (per 100 m²)				
July	0.00	0.74	0.68	0.22
August	0.29	4.76	1.21	1.56

South Fork Ahtanum

We conducted snorkel surveys in the South Fork Ahtanum on August 21st 2008 to confirm the presence of bull trout staging in this reach prior to spawning. We also attempted to identify the upper extent of O. mykiss distribution and document their relative abundance in comparison to other salmonids like westslope cutthroat trout. We surveyed three 100 meter sections. We observed O. mykiss at the lower site on the South Fork Ahtanum. At the middle reach site we did not identify any O.mykiss, although it is difficult to distinguish juvenile O. mykiss from cutthroat in turbulent swift water like the South Fork Ahtanum Creek. We observed the highest density of cutthroat trout at the middle reach (n= 16). Only three were observed at our upstream site located 0.5 miles upstream from the mouth of Reservation Creek. Bull trout were observed at the middle section and the upper section. At both locations 2 adult bull trout were observed in pairs, possibly staging to spawn, which typically begins in September in the South Fork Ahtanum Creek.

Table 6. Number and density of salmonids captured in the South Fork Ahtanum Creek

Year class	Age 0 O.	Age 1+ O.	cutthroat	bull trout

	mykiss	mykiss		
Site 1 (downstream) near the cattle guard				
# sthd	0	11	3	0
Relative Density (sthd/100m²)	0	2.22	0.61	0
Site 2 at the (middle) at lower end of BT survey index reach				
# sthd	0	0	16	2
Relative Density (sthd/100m²)	0	0	3.28	0.41
Site 3 (upstream) at upper end of BT survey				
# sthd	0	0	3	2
Relative Density (sthd/100m²)	0	0	0.89	0.60

<u>Satus Creek Tributaries</u>

We conducted snorkel surveys at two locations on 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 of August 10th 2008.

The highest density of age 0 steelhead (13.86 sthd/100m²) was observed at the Dry Creek site near the Elbow Crossing. The highest density of Age 1+ steelhead was observed at this site as well. The lowest density of Age 0 and Age 1 + steelhead was seen at the Logy Creek site. The Dry Creek site below 97 had relatively high numbers of juvenile steelhead considering its lower elevation low summer flows. Although continuous water temperature measurements at this location indicate that water temperatures remain within a suitable range for rearing steelhead. Steelhead juveniles were also observed in other intermittent reaches of dry creek including isolated pools through early autumn 2007. Logy creek may have better rearing areas than the one sampled in 2007 and 2008.

Table 7. Number age 0 and Age 1 steelhead observed during snorkel surveys Dry Creek and Logy Creek in 2008

	Age 0	Age 0	Age 0	Age 0	Age 1 +	Age 1 +	Age 1 +	Age 1 +
Number	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

C. Stream Temperature

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 affect water temperatures (i.e. management of irrigation diversions, riparian harvest, water withdrawals).

We deployed a total 61 devices in the three watersheds (Figure12). Data-loggers (Onset Optic Stowaways and Onset Water Temp Pro v2) were launched in spring 2008 and were programmed to collect water temperatures at 48 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 pools or low flow channels that were less likely to dewater during the summer. Although some data-loggers were deployed in early March in 2008, 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 are left in place year round to monitor water temperatures during the peak migration and spawning periods for steelhead (i.e. winter and spring).

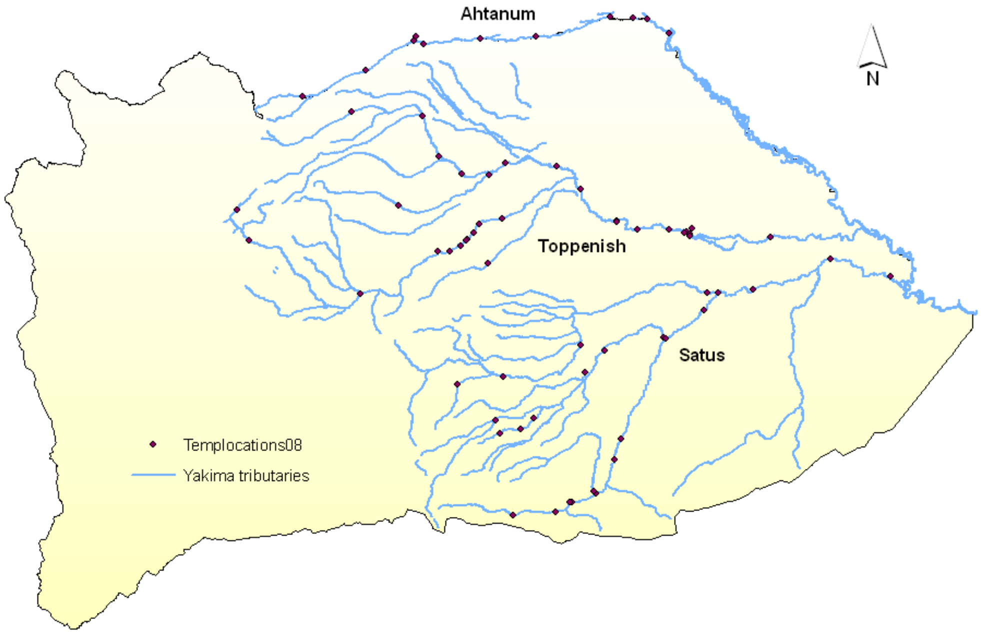


Figure 12. Locations of temperature monitoring stations in the Yakima River watershed portion of the Yakama Reservation.

Ahtanum Creek

In 2008, 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 March 2008 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 48 minute intervals until we retrieved them on October 13th 2008. Several units were lost during high discharge that occurred in April and May or were stolen. Seven data-loggers recorded temperatures for the entire period.

Table 8. Descriptive statistics for water temperatures at 9 locations in the Ahtanum Creek watershed. Maximum Weekly Maximum Temperature in Bold.

Location (river	Instantaneous	Instantaneous	Mean	Mean Daily	Mean	Maximum	**Maximum**	Maximum

mile in parenthesis)	Maximum	Minimum	Daily Maximum	Average	Daily Minimum	Daily Average	**7-Day Maximum**	7-Day Average
South Fork Ahtanum at the DNR gate (11.0)	11.2	2.4	8.6	7.3	6.2	10.1	**10.6**	9.5
South Fork Ahtnaum at campground (7.0)	14.1	1.0	9.3	7.4	6.0	11.9	**13.2**	11.2
South Fork of the Ahtanum (0.5)	21.1	0.7	13.6	10.6	8.2	17.6	**19.8**	16.5
North Fork of the Ahtanum (1.3)	21.6	0.3	13.5	10.8	8.4	18.7	**20.4**	17.6
AID Diversion (18.9)	25.1	1.1	15.8	12.6	9.8	20.8	**23.7**	19.6
American Fruit Rd. (14.0)	Lost or Stolen							
42nd Ave. (7.0)	25.9	3.0	16.8	14.1	11.6	22.4	**24.6**	21.1
16th Ave	24.9	3.0	14.7	13.5	12.2	22.1	**23.6**	21.1
Ahtanum at the Mouth (0.5)	Lost or Stolen							

Mean daily averages ranged from 7.3ºC in the South Fork of Ahtanum Creek several miles above the confluences to 14.1 ºC at 42nd Ave. (Table 8). The highest instantaneous maximum of 24.9 ºC was recorded at 42nd Ave. (RM 7). The lowest instantaneous maximum water temperature for 2008 was recorded at 16th Ave. in 2008. The lowest instantaneous maximum for the mainstem Ahtanum in 2007 was recorded at the mouth (24.1ºC). Data for that site and our site at American Fruit Road was not available in 2008. The site at American Fruit Road displayed the lowest water temperatures in 2005 and 2006. Low flows occurred at the sites below the AID and WIP diversions in early July affecting the water temperature.

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 at the two forks of the Ahtanum as expected because they are farthest upstream and at higher elevation. Water temperatures gradually increase downstream on the mainstem until peaking upstream at 42nd Ave. The highest MWMT (24.6ºC) was recorded at 42nd Ave. Water temperatures improved slightly several miles downstream at 16th Ave (MWMT; 23.6ºC) where the stream is well shaded and receives groundwater recharge, although urban development in the reach between 42nd Ave. and 16th Ave. probably affects the hydrology and thus the water temperature regime. Typically, water temperatures drop a little further at the mouth of Ahtanum Creek where increasing flow indicates groundwater recharge. Our data-logger could not be found at that location this year. All sites in the mainstem Ahtanum Creek have MWMTs above 21 ºC indicating that temperature may be a potential limiting factor for cold water fish species.

Toppenish Creek

We used Onset temperature data-loggers 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 2008 at sites located between RM (river mile) 10.7 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 2008. Two units failed to record temperatures or had battery failure. Five data loggers were lost due to high flows, beaver activity, or theft. 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 8.8ºC below the confluence of Panther Creek at RM 68 to 19.2ºC at Campbell Road (RM 18.6). The highest instantaneous maximum of 28.8 ºC occurred at the mid-channel Toppenish Creek Ashue Road site. Last year (2007), the highest temperatures were recorded below Mud Lake drain (inst. Max; 33.0 ºC). This year water temperatures (including the instantaneous maximum, and MWMTs) were notably much lower at this location (inst. Max; 20.8 ºC). This statistic was also lower than the instantaneous maximum recorded upstream from the Mud Lake Drain outflow (21.5ºC) indicating slightly lower water coming from the drain at times. This is not typical. No abnormal spikes in water temperature were recorded this year at that location like what was seen in 2007. In 2006, water temperatures at the Mud Lake Drain were moderate (inst. Max; 23.7 ºC) compared to other sites on the mainstem of Toppenish Creek as expected since it is located near the longitudinal midpoint of the stream.

Table 9. 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)	14.0	3.4	9.0	7.6	6.2	11.9	**12.7**	10.9
Topp. at Panther Ck confluence (68)	13.7	3.5	10.4	8.8	7.2	12.0	**13.3**	11.3
Topp. at N. Fork confluence (54.4)	17.9	4.7	13.8	11.6	9.9	15.3	**17.2**	14.7
Topp. at swim hole (46.8)	20.6	2.8	14.3	12.5	10.9	18.6	**19.8**	17.9
1 mile below swim hole (45.9)	21.4	6.7	17.0	15.0	13.3	19.2	**20.6**	18.5
1 mile above lateral (45)	21.9	7.0	17.5	15.4	13.7	19.6	**21.1**	18.9
Topp. above lateral (44.2)	22.3	3.0	15.3	13.3	11.6	19.7	**21.5**	19.0

Topp. below lateral (44.1)	22.4	3.0	15.5	13.3	11.5	19.9	**21.6**	19.1
Above three way (42.8)	23.0	7.0	18.5	16.0	13.9	20.1	**22.2**	19.3
At three way (41.8)	Lost or Stolen							
Topp. At cleparty diversion (41.5)	Lost or Stolen							
Topp. below Signal Peak Rd.(40.2)	Lost or Stolen							
Topp. above Mud Lake Drain (31.5)	21.5	5.3	16.2	15.1	13.9	20.4	**20.9**	19.7
Topp. below Mud Lake Drain (31.4)	20.8	5.3	16.2	15.4	14.7	20.6	**20.4**	20.0
Topp. at Unit 2 (26.5)	23.2	5.8	17.2	16.0	15.0	22.4	**22.6**	21.6
Topp. at Lateral C (21.3)	23.3	6.1	17.1	16.1	15.1	22.3	**22.5**	21.6
Topp at Zimmerman's (21.2)	Lost or Stolen							
Topp mid channel at Ashue Rd. (19.1)	28.8	12.5	19.8	19.0	18.3	25.6	**26.6**	23.7
Topp at Campbell Rd. N. channel (18.6)	27.3	7.8	20.8	18.9	17.1	25.6	**26.1**	24.1
Topp at Campbell Rd. Mid channel (18.6)	27.6	8.0	20.6	19.2	17.7	26.0	**26.6**	24.9
Topp before Snake Creek (18)	26.1	8.3	19.7	18.8	18.0	24.9	**25.2**	23.8
Snake Creek (4.4)	25.8	8.3	19.6	18.9	18.1	24.9	**24.9**	23.8
Topp. below Hwy97 (10.7)	24.3	8.0	17.8	17.1	16.6	23.1	**23.2**	22.3
Mill Creek (10.4)	16.7	4.4	12.4	11.2	10.2	16.3	**16.2**	15.5

MWMTs generally increased from the mouth upstream (Table 9). The highest water temperatures occurred in the reach near Ashue and Campbell Roads where the stream disperses into three different channels. All sites in the irrigated reaches of the mainstem of Toppenish Creek had MWATs above 20 degrees C and MWMTs above 24 ºC with the exception of the downstream site below HWY 97 in the refuge where the MWMT was 22.3ºC. Water temperature at this location was also about 0.9 degrees cooler than in 2007.

Sections of Toppenish Creek dewatered downstream from Wesley Rd as they normally do during the summer. However, only several short reaches went dry in 2008 for brief periods of time as water withdrawals from the Olney-Lateral diversion were reduced substantially during the summer. Downstream from the dewatered section starting at Wesley Rd., to 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) could provide thermal refuge for rearing steelhead parr.

We deployed five thermographs in a section of Toppenish Creek where a large restoration project (Mid-Toppenish Project) to raise the stream channel and direct flow into several side-channels was completed in 2006. We expect this project to increase shallow groundwater storage and flow and in turn enhance thermal refuges where this cooler water returns to the main channel. Several impoundments were also created by this project where water temperatures were expected to increase. An overall greater variability in water temperatures in this section of Toppenish Creek is likely. Higher groundwater levels is expected to eventually increase vegetation and with it stream channel shading which should have a positive influence on water temperatures. The results from temperature monitoring in 2008 indicate water temperatures through sites on the Mid Toppenish Project were too high for salmonids during the summer months (MWMTs ranged from 24.9 ºC to 26.6 ºC). Flow does increases and temperature decreases further downstream at the refuge below HWY 97 (Table 9). The emergence of cooler groundwater could explain this decrease in water temperature.

Like 2007, in 2008 we focused our efforts on the Toppenish Creek section near the Lateral Diversion at RM 44.2. Thermographs were placed every 0.5 to 1.0 miles apart from the water hole (swim hole; RM 46.8) before Toppenish Creek emerges from the canyon downstream to Wesley Road (Cleparty Diversion; RM 41.5). The Olney- Lateral Diversion intake is near the half-way point. Unfortunately, this year a number of data-loggers in this area did not turn up when we retrieved them in October so a thorough analysis of this reach is not possible.

Water temperatures (MWAT) increased during the first mile by 0.8 degrees. An increase of 0.6 degrees was noted at the next site downstream (Toppenish Creek 1-mile above diversion). After that point, increases of < 0.2 degrees were observed at following stations until the three-way location (RM 41.9). Only a slight increase in water temperature was observed from our site directly above the Olney-Lateral Diversion to the one directly below. Flows at the three-way often measure higher than at our discharge site below the Olney-Lateral Diversion about 2.3 miles upstream. Below the three-way, surface flow decreases rapidly as it sinks into the alluvial fan. Consequently, water temperature continues to increases in this section. The sparse vegetative cover between the Three-Way Diversion and Wesley Road probably contributes to the temperature increase as well. Withdrawals at the Olney- Lateral Diversion were lower (< 10% of the stream flow) in 2007 and 2008 than in previous years during the summer months probably resulting in little direct impact to water temperatures by water withdrawal.

Mill Creek has summer flows below one cfs; however, water temperatures at the second crossing Mill Creek Canyon site remained cool through-out the summer (Inst. Max; 16.7ºC). *O. mykiss* were seen residing in the pool where the thermograph was deployed several times during the summer when the unit was checked. Water temperatures were in an optimal range for these individuals despite low flows. Low flows may have still affected productivity and obstructed movement of these trout.

Table 10. Descriptive statistics for 9 water temperature data loggers in the Simcoe 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
N. Fork Simcoe (24.9)	16.4	1.9	11.2	9.5	8.0	14.8	**15.6**	14.1
Simcoe below Forks (18.9)	19.0	2.0	13.0	11.6	10.1	17.9	**18.1**	17.0
Simcoe at Simcoe Cr. Rd. (15.3)	25.5	2.6	17.0	13.6	10.9	21.3	**24.4**	20.1
Simcoe at towtnuk Rd. (12.7)	malfunctioned							
Above N White Swan Rd. (8.1)	19.0	4.8	14.6	12.6	10.7	16.7	**18.5**	16.4
Below N White Swan Rd. (8.1)	Lost or stolen							
Barkes Rd (2.7)	21.7	6.3	16.2	14.7	13.3	20.1	**21.2**	19.4
Agency at Wesley Rd	14.6	6.1	12.8	11.2	9.9	12.8	**14.2**	12.6
Agency below falls	malfunctioned							

Two of our Simcoe Creek thermographs were lost, stolen, or failed to download data in 2008. Five out of seven of our mainstem Simcoe Creek thermographs recorded data properly. Mean daily average water temperatures in Simcoe Creek were generally lower than the mainstem of Toppenish Creek (table 10) ranging from 9.5ºC at the North Fork Simcoe site (RM 24.9 –from the mouth of Simcoe Creek) to 17.0ºC at Simcoe Creek Road (RM 12.7). Temperatures in Simcoe Creek were lower than 2006 when flows were comparable. Last year (2007) most of our data-loggers on Simcoe Creek were stolen or malfunctioned making comparisons difficult. Agency Creek at Wesley Rd. was cool with stable flow through out the summer produced by large springs upstream from our station near the Jeldwin facility in White Swan. This site often has the lowest water temperatures in the agricultural valley on the Yakama Reservation.

Like the mainstem Toppenish Creek, MWATs and MWMTs in Simcoe Creek generally decreased from the mouth upstream. Little flow exists in Simcoe Creek between Simcoe Creek Road and Wesley Road during the summer, thus water temperatures are often high at Simcoe Creek Rd. and Towtnuk Rd. Flow resumes downstream where the cooler water of Agency Creek and several springs enter. This reach along the toe of the Toppenish Creek alluvial fan between the Agency Creek confluence (RM 9.5) and N. White Swan Rd. (RM 8.1) is adequately shaded and numerous beaver dams are present. Due to groundwater recharge and spring creek water, water temperatures are often favorable for salmonids in this reach and downstream, probably beyond Stevenson Rd. At Barkes Road (RM 2.7) water temperatures (MWMT) once again were above 21 ºC and no longer optimal for cold water biota—although our snorkel survey observations have indicated that Yakama Basin *O. mykiss* can survive when daily maximum water temperatures exceed 21 ºC for short periods.

Satus Creek

In 2008, we deployed 25 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 on March 4th 2008 at sites in Satus Creek located between RM 1.2 and RM 44.1 (downstream from the falls). We also deployed data loggers at three locations in Dry Creek, and Logy Creek from the falls 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 48 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.

Mean daily averages in Satus Creek ranged from 9.2ºC downstream from falls (RM 44) to 15.2ºC near the mouth (Table 11). The greatest instantaneous maximum (25.4 ºC) for the Satus Creek watershed occurred at the HWY 97 1st crossing (RM 20.2). In 2007, a higher instantaneous maximum water temperature of 26.4ºC occurred 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. Last year in 2007, the thermal maximum of 24.1º C was exceeded by MWMT at several sites from High Bridge (RM 32.4) to the Plank Road crossing at RM 7.4 (Table 11). This year (2008) the highest MWMT (24.0 º C) occurred at the 1st crossing, which is typically the warmest location in the watershed. MWATs ranged from 14.6º C at the falls to 22.4º C at the Plank Road crossing and MWMTs ranged from 16.6 º C to 24.0 º C (figure 13). Water temperatures in the mainstem Satus Creek were apparently cooler this year than in 2007. An examination of the past 14 years of Satus Creek water temperature data suggests that summer water temperatures seemed to be cooler in 2008 than in any other year since 1994. In the years spanning 1994 to 2007 at least one of our sites had a MWMT above 24.1 º C. A record snow pack that melted later in the season may have been partially responsible for this decrease in 2008. However, late summer rearing conditions were still marginal (Inst. Max and MWMTs exceeding 21 º C) in some locations. 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.

Table 11. Descriptive statistics for water temperature at 10 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)	24.3	6.8	17.5	16.3	15.0	22.3	**23.2**	21.4
Plank Rd (7.4)	24.3	5.3	16.3	14.6	12.9	23.4	**23.5**	22.4
Below Dry Creek (18.7)	23.6	4.4	17.2	14.7	12.5	20.4	**23.1**	19.6
1st Crossing (20.2)	25.4	4.2	17.0	14.6	12.5	22.1	**24**	21.1
Above Logy (23.6)	23.1	2.8	15.9	13.3	11.3	20.3	**22.1**	19.6
High Bridge (32.4)	malfunctioned							
4th Crossing (34.1)	22.7	2.1	14.6	12.4	10.5	20.3	**21.3**	19.2
County Line (37)	21.1	2.1	14.5	11.8	9.5	18.2	**20.5**	17.8
Below Kusshi Creek	Lost or stolen							
Wilson Charley (39.2)	21.3	1.9	13.1	10.3	8.1	17.6	**20.0**	16.5
Wooden bridge (40.8)	20.0	1.8	12.3	9.8	7.8	16.9	**18.8**	15.9
Below the Falls (44)	16.7	2.1	10.6	8.7	7.1	14.3	**15.6**	13.4
Satus at upper Lakebeds Rd. Crossing	malfunctioned							
Logy at Mouth (0.5)	22.2	3.5	14.7	13.1	11.5	20.3	**21.0**	19.4
Logy at 4th crossing	19.2	2.5	12.6	11.0	9.4	17.4	**18.2**	16.6
Logy below the falls	17.2	1.4	11.6	9.8	8.0	15.4	**16.4**	14.6
Logy below confluences								
Section Corner Spring at lower crossing	15.6	4.9	11.7	9.6	7.8	11.8	**13.9**	11.1
Section Corner Spring at mid crossing	14.0	5.6	10.7	8.9	7.5	10.3	**12.5**	9.7
Section Corner Spring at source	9.5	7.2	8.7	8.0	7.7	8.3	**9.2**	8.2
Dry Mouth (1.2)	20.4	4.6	16.2	14.7	13.2	17.9	**19.3**	17.5
Dry at Elbow Crossing (18.5)	20.3	3.3	15.2	13.2	11.7	17.8	**19.6**	17.3
Dry Below Falls	16.0	4.2	12.2	10.3	8.4	13.7	**15.5**	13.1
South Fork of Dry Creek	10.2	6.2	8.5	7.5	6.9	8.3	**9.6**	7.9

Mean daily water temperatures in Logy Creek ranged from 9.8 º C to 13.1 º C. The instantaneous maximum water temperature ranged from 17.2 º C to 22.2 º C. Water Temperatures in Logy Creek were probably suitable for steelhead trout during the warmer months along its entire length. The only site in this tributary where water temperatures exceeded 21 º C and considered sub-optimal for steelhead rearing occurred at the mouth of Logy Creek (Inst. Max, 22.2 º C; MWMT, 21.0 º C). Much of this stream is suitable for steelhead rearing and upper half had temperatures that are continuously suitable and near optimal for steelhead production. Deep pools are present in the lower portion of Logy Creek approaching the confluence with Satus Creek. These deep pools may provide thermal refuges during the short periods when water temperatures exceeded threshold temperatures for cool water biota. Snorkel surveys conducted at the mouth of Logy Creek in early August confirmed the presence of healthy appearing steelhead juveniles.

Dry Creek, on the other hand, had suitable water temperatures at all the sites that we monitored (mean daily water temperatures; 12.2 º C to 16.2 º C Inst. Max, 16.0 º C to 20.4 º C). The highest MWMT temperature in the Dry Creek watershed occurred at the Elbow Crossing (RM 18.5). Approximately four miles downstream, there is an extended reach of Dry Creek (nearly 12 miles) where the stream becomes intermittent and many steelhead parr become stranded in pools and succumb to desiccation or localized high water temperatures. Some intermittent pools hold steelhead par until flow returns in late fall. Water returns to surface at our station upstream from HWY 97 near the mouth. This water is perennial and cool 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. If steelhead populations in the Satus Creek watershed are limited by water temperatures, then we could predict a healthy outmigration of 07 yearclass steelhead smolts this year and possibly 08 yearclass steelhead juveniles next year if water temperatures aren't significantly higher in summer 2009.

Some of the upper reaches of Dry Creek and most of the upper reaches of Logy Creek receive water from numerous springs resulting from relatively cool water temperatures in the upper reaches of Logy Creek, Section Corner Creek, and the South Fork of Dry Creek (Table 11). Water temperatures at these sites are cool and stable throughout the year (Inst. Maximums range from 9.5 º C to 15.6 º C) and could provide habitat for warm water intolerant species like cutthroat trout, bull trout or tailed frog. However, these species appear to be absent from these headwater streams. Brook trout are the only fish species present in the upper reaches of Satus Creek, Logy Creek and Dry Creek.

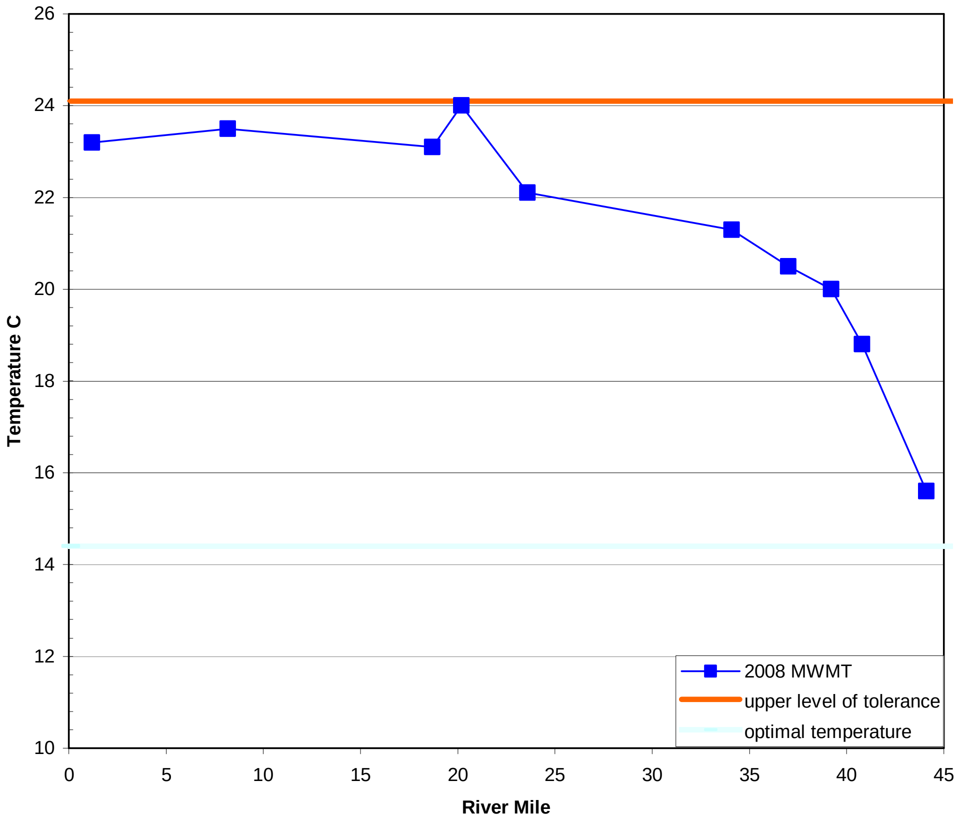


Figure 13. Maximum Weekly Maximum Water Temperatures (7-day moving average of the daily maximum water temperature) at 10 locations in the Satus Creek water between the confluence with the Yakima River and the upper extent of steelhead migration.

D. Spawning Surveys

Steelhead

The Yakama Reservation encompasses a large portion Yakima River basin steelhead spawning and rearing habitat. We conduct spawning ground surveys in Yakima basin tributaries to evaluate trends in spawning activity.

Steelhead spawning ground surveys were performed on Ahtanum, Toppenish, and Satus Creeks. 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 2008. We focused efforts on the Satus Creek watershed in an attempt to maintain our 20 year record of complete three pass redd count surveys in the entire Satus watershed.

Figure 14. Steelhead Spawning in 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) Yakama Reservation for between 8 and 20 years. 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 pinpoint the most productive spawning reaches.

Figure 15. Spawning ground survey in progress in Satus Creek.

Two surveyors typically cover each 2 to 6 miles survey reach, walking in a downstream direction. Surveyors wear polarized glasses to aid in spotting redds. Each identified red 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 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. 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 2008, a survey of the upper Toppenish Creek mainstem could not be completed due to a snowmelt runoff event that lasted through 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. In 2008, we managed to complete only one pass on the lower portion of the Toppenish Creek mainstem spawning habitat. Although conditions may have been conducive to completing at least 2 passes on Simcoe Creek, we could only complete one pass on the entire Simcoe Creek sub-watershed because of lack of manpower.

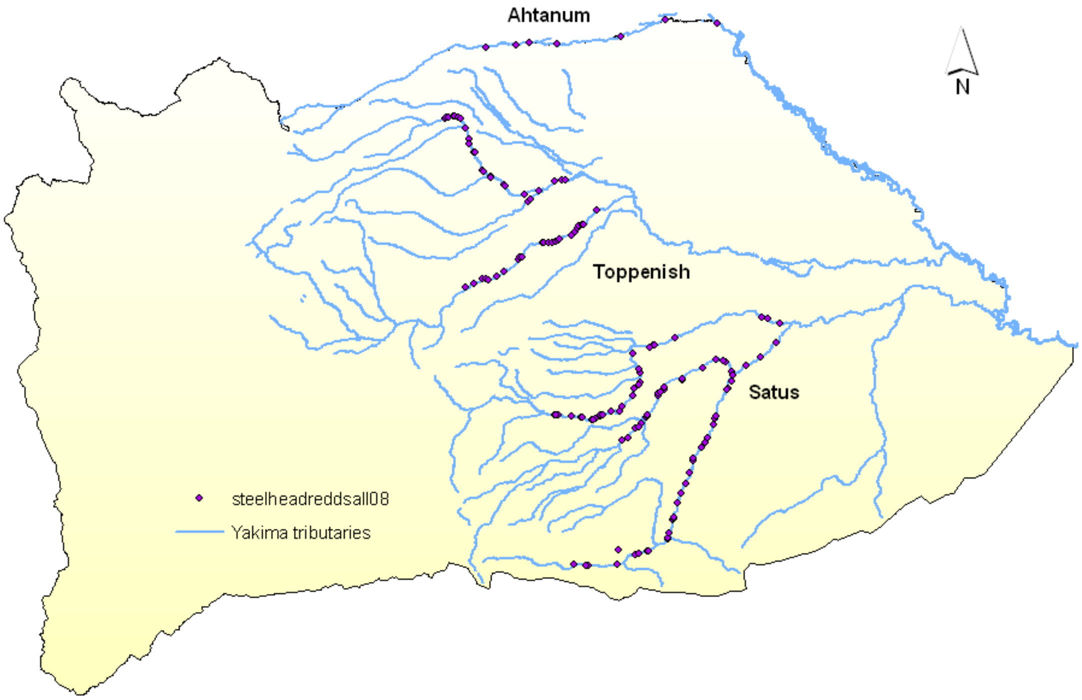


Figure16. Location of Redds in Ahtanum, Satus, and Toppenish Creek in 2008 collected with handheld GPS units.

We identified more redds in 2008 (68) than we found in 2007 (42). This indicates an increasing trend since a low point in 2006 with only 21 redds identified in the entire Toppenish Creek watershed. Survey effort was less and redd recognition conditions were worse in 2008 than in the previous two years (2006 and 2007). Despite the less than optimal conditions in 2008 we identified more redds than in the previous two years. It is likely that 68 redds for the Toppenish basin is a substantial underestimation of actual redds and steelhead spawning activity—even more of an underestimation than normal. Only two redds were identified in the upper Toppenish Creek in 2006 and 14 were observed in 2007. 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.

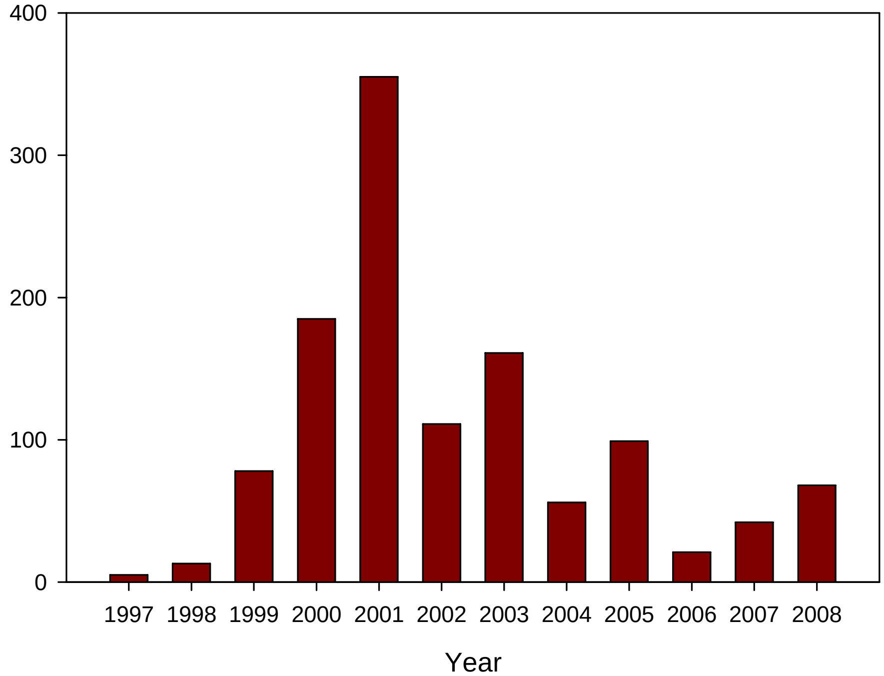


Figure 17. Number of Redds in the Toppenish Creek watershed for past 10 year

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 2008, however only one pass was completed due to a manpower shortage. We identified 26 redds in the Simcoe Creek watershed Seventeen redds were identified in the Simcoe Creek watershed in 2007. Only 10 steelhead redds were identified in 2006. The distribution of redds throughout the Simcoe Creek watershed was similar to that of 2006, and 2007. Redds were observed near the upper limits of the North Fork of Simcoe Creek, and Agency Creek. 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 were located below that area where habitat and summer water temperatures are less optimal. Surprisingly, no redds were observed in the South Fork of Simcoe, where redd numbers are often comparable to the North Fork of Simcoe Creek. One redd was identified in Whatum Creek this year. No redds were identified in this stream in 2007.

Table 12. Number of Steelhead redds per reach in the Toppenish Creek watershed in 2008.

	Upper Toppenish Watershed		Distance miles	Number of Redds
Toppenish	O Conner Creek (65.7)	East Bank (62.4)	3	**0**
	East Bank (62.4)	NF confluence (55.4)	7	**0**
	NF confluence (55.4)	Wash out (53.5)	4.5	**0**

	Wash out (53.5)	Wiley Dick (48.5)	5	**6**
	Wiley Dick (48.5)	Olney Lateral (44.2)	4.9	**9**
	Olney Lateral (44.2)	Marion Drain Rd. (38)	4.2	**12**
	Marion Drain Rd. (38)	Shaker Church Rd. (35.9)	4	**11**
total			29.5	**38**
N. Fork Toppenish	NF Falls (4)	NF confluence (0)	4	**0**
Willey Dick	old logging site (4)	Confluence (0)	4	**1**
		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	**7**
	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	**7**
	Simcoe Creek Rd. (15.3)	Towtnuk Rd. (12.7)	3.1	**6**
	Towtnuk Rd. (12.7)	N. White Swan Rd. (8.1)	2.8	**2**
	N. White Swan Rd. (8.1)	Stephenson Rd. (5.9)	2.3	**4**
total			24.5	**26**
Agency	Falls (8.9)	Western Diversion. (4.4)	4.5	**0**
	Western Diversion. (4.4)	Confluence (0)	4.4	**2**
total			8.9	**2**
Wahtum	Yesmowit Rd. (3.6)	Confluence (0)	3.6	**1**
Total			77.6	**68**

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 survey conditions in the Satus watershed also recover quickly (i.e. several days) from periods of high runoff – unlike the Toppenish and Ahtanum watersheds which can be un-wade-able 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 2008 like most years, only one pass could be completed on Mule Dry and two on both Wilson Charley and Kusshi Creek before low flows make fish passage unlikely.

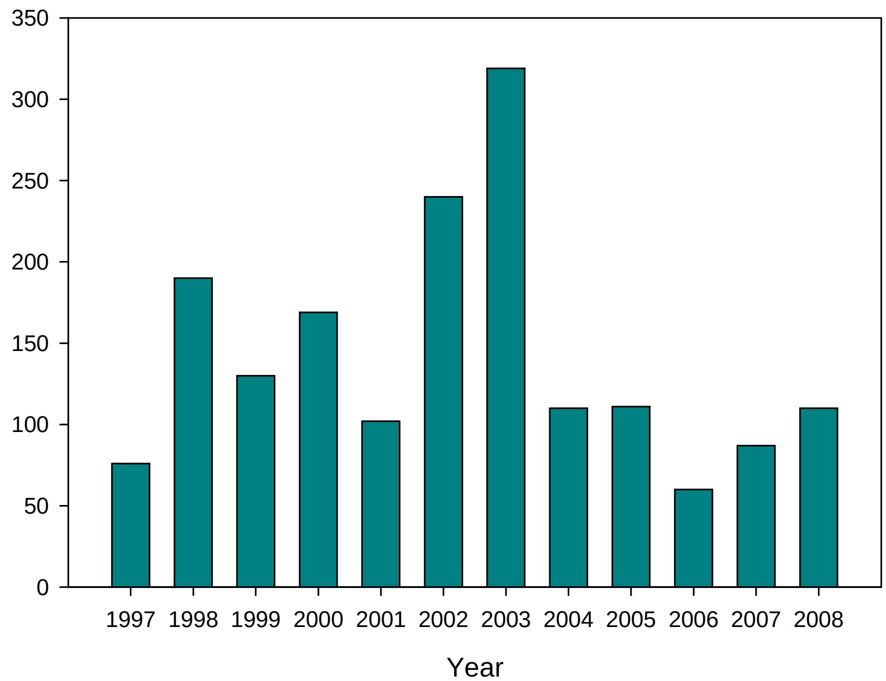


Figure18. Number of Redds in the Satus Creek watershed for past 10 year

110 steelhead redds were identified in the Satus Creek watershed in 2008 compared to 87 in 2007. 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. 110 redds still falls below the 10-year average of 146 redds. 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. 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. Survey conditions were similar in 2006 and 2007—slightly higher at times, but recovering quickly.

The distribution of redds within the Satus watershed was similar to what was observed in 2006 and 2007. More redds were observed in the mainstem Satus, Dry and Logy Creeks in 2007. Redd numbers were similar in Wilson Charley Creek and Kusshi Creeks. No redds observed in Mule Dry Creek in 2008 because the stream was probably impassable to migrating adult steelhead for a significant portion of the season due to low flows. When flows were adequate in March a large log-jam that formed at the mouth of Mule Dry Creek may have obstructed passage. We often survey this creek early in the season. We typically do not return after the lower portion of the stream goes dry, although adult steelhead may stage in some of Mule Dry Creeks deeper holes and begin spawning at a later date.

Table 13. Number of steelhead trout redds per reach in the Satus watershed in 2007

Stream	Start location	End location	Distance (miles)	# of Redds
SATUS	Falls (44.1)	Wood Bridge (40.8)	4.2	**4**
(3 passes)	Wood Bridge (40.8)	County Line (36.4)	4.4	**7**
	County Line (36.4)	High Bridge (32.4)	4	**15**
	High Bridge (32.4)	Holwegner(28.4)	4.8	**8**
	Holwegner (28.4)	2nd X-ing (23.7)	3.9	**8**
	2nd X-ing (23.7)	1st Xing (20.2)	3.5	**3**
	1st X-ing (20.2)	Gage (17.4)	2.8	**1**
	Gage (17.4)	Rd 23 (13.1)	4.3	**0**
total			31.9	**46**
LOGY	Falls (14)	Spring Cr (11)	3	**6**
(3 passes)	Spring Cr (11)	S. C. Ford (9.5)	1.5	**4**
	S. C. Ford (9.5)	3rd Xing (3.5)	6	**10**
	3rd Xing (3.5)	Mouth (0.0)	3.5	**5**
total			14	**25**
DRY	South Fk. (27.8)	Saddle (24)	3.6	**8**
(3 passes)	Saddle (24)	Elbow Xing (18.25)	5.75	**17**
	Elbow Xing (18.25)	Seattle Cr (14)	4.25	**4**
	Seattle Cr (14)	Rd 75 bend (8.75)	5.25	**6**
	Rd 75 bend (8.75)	Power Line Ford (2.5)	6.25	**0**
	Power Line Ford (2.5)	Mouth (0.0)	2.75	**3**
total			27.85	**38**
W. CHARLEY	Forks (1.9)	Mouth (0.0)	1.9	**1**
KUSSHI	Top (11th) Xing (5.5)	Mouth (0.0)	4.5	**0**
SHINANDO	Ford (0.5)	Mouth (0.0)	0.5	**0**
MULE DRY	Yakima Chief Rd. (11.35)	Rd. 39	11.35	**0**
TOTAL			82.05	**110**

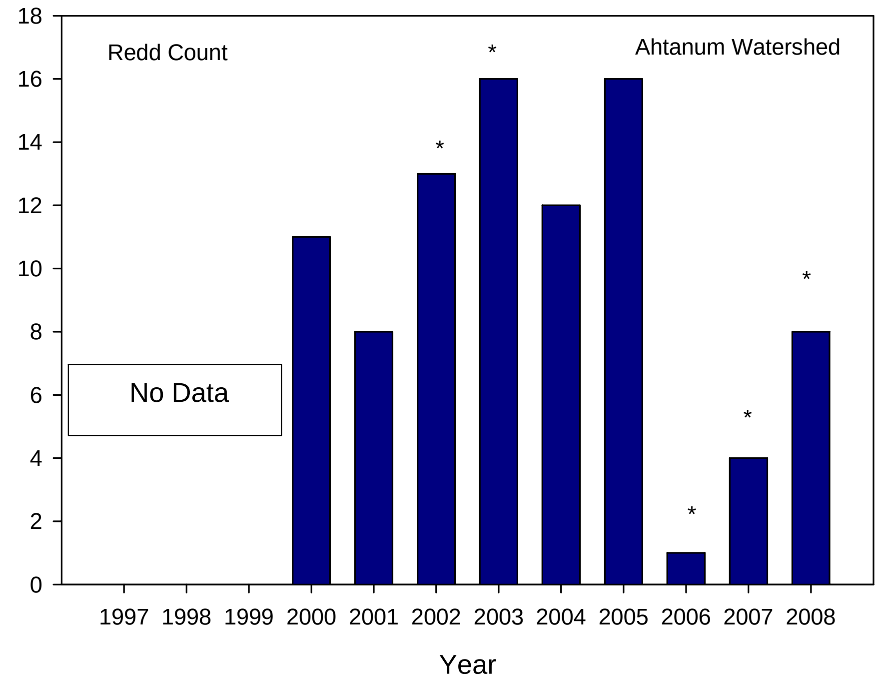
Ahtanum Creek

Conditions for spawning surveys were poor in 2008 because of turbidity and high flows for much of April and May. We were able to complete one pass of the entire mainstem Ahtanum Creek as well as the lower reaches of the South and North Forks of Ahtanum. The survey was completed on March 21st 2008. We documented a total of 8 redds during this survey. Half of the steelhead redds were observed in the reach between the confluences of the North and South Fork Ahtanum Creeks and the AID (Ahtanum Irrigation District) Diversion. The other 4 were spread out downstream between the AID diversion and mouth. We observed 1 live adult steelhead below 62nd Ave.

Table 14. Nunber of Steelhead Redds counted in the Ahtanum Creek watershed in 2008

Stream	Survey Reach	MILES	DATE	REDDS	LIVE
Ahtanum			**3-20 to 3-21**		
Mainstem	Forks conf. To AID Diversion	5.0		4	

	AID to American Fruit Rd.	5.3	1	
	American Fruit Rd. to 62nd	5.3	2	
	62nd to 16th	4.2	0	1
	16th to Yakima R.	4.1	1	
	TOTALS	23.9	8	
North Fork	4 miles to confluence	4.0	0	
	TOTALS	4.0	0	
South Fork	4 miles to confluence	4.0	0	
	TOTALS	**31.9**	**8**	**1**



*= years when partial surveys were conducted

Figure 19. Number of Redds in the Ahtanum Creek watershed for past 10 year

Coho Salmon

Coho Salmon spawn in the lower reaches of Ahtanum Creek each fall. Many of these are strays from the coho salmon reintroduction program. Yakama Nation Fisheries personnel have conducted Coho surveys in Ahtanum since 2001. Three passes were conducted in Ahtanum Creek during our fall 2007 coho salmon surveys between the mouth and the bridge at Goodman Rd. at RM 2.8. The first survey was performed on October 25th 2007, the 2nd was performed on November 8th 2007, and the third on November 16th 2007. A total of five coho redds and three live adult coho were identified in Ahtanum Creek in 2007. Most Coho salmon redds were identified in Fulbright Park about 0.5 miles upstream from the mouth. Redd numbers were down from 2006, when 7 redds were identified. The largest number of Coho redds was observed in fall 2004 when 26 redds were identified in Ahtanum Creek. Forty-one live adult coho salmon were observed that year and 7 carcasses were observed. The carcasses were scanned for coded wire tags. All possessed a wire tag indicating they were hatchery progeny.

Bull Trout

A small population of bull trout resides in the headwaters of Ahtanum creek. Bull Trout redds were surveyed in September and October 2008. 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.

A total of three redds were identified during the three passes of our survey in 2008. The first survey was conducted on September 15th 2008, with 2 redds were located. During the second pass on September 25th 2008 no new redds were identified. During the third pass on October 3rd 2008, 1 redd was identified. In 2007, a total of five redds were identified in our survey reach. We typically identify less than five bull trout redd 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 of the redds because of their small size. The other surveyed portions of the Yakima basin also had fewer bull trout redds identified than usual (Eric Anderson—WDFW; personal communication).

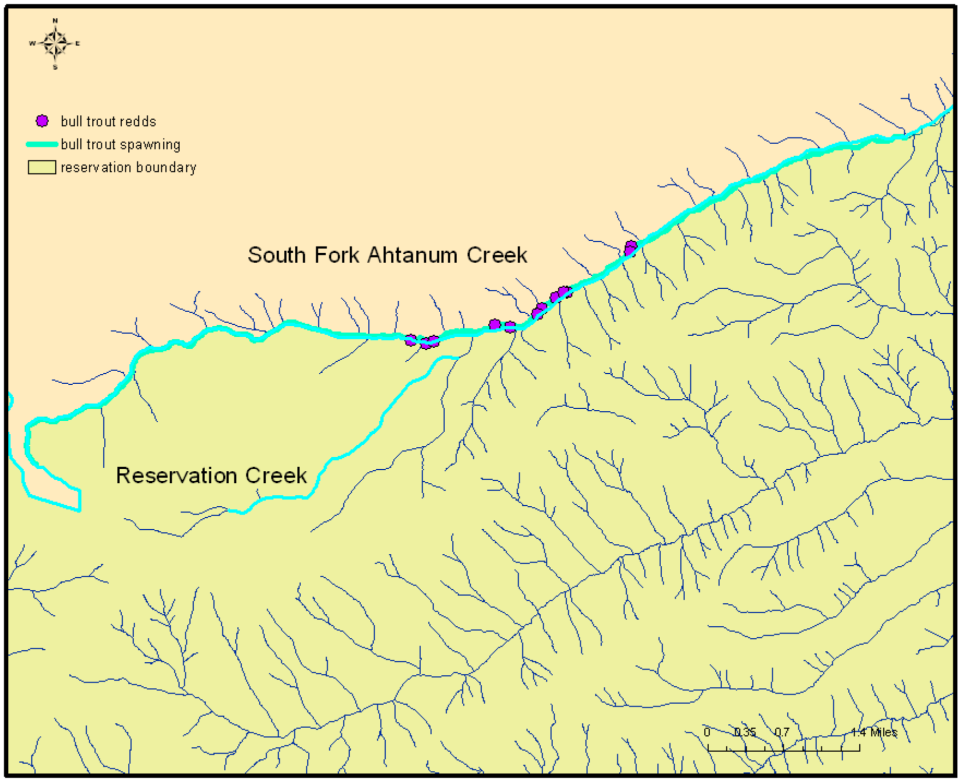


Figure 20. Locations of Bull Trout Redds from 2005 through 2008 on the South Fork of Ahtanum Creek

E. Starvation Flats Aquifer Monitoring

Starvation Flats Monitoring Wells

Starvation Flats is an open area within the forested region of the Yakama Reservation. It is located in the upper north east portion of the North Fork of Dry Creek. Seasonally wet meadow habitat is located in areas within Starvation Flats. In 2007, YRWP staff constructed a fence around the northwest portion of starvation flats. Grade control structures to arrest or reverse channel degradation in the meadow gullies are currently being considered by YRWP and other tribal programs. We would expect these restoration activities to expand the groundwater holding capacity of the starvation flats aquifer, increase the retention of water and slow the release of water during the spring snowmelt and runoff. This could ultimately improve summer rearing conditions for steelhead trout in Dry Creek where low summer flows likely limit production.

We periodically monitored (approximately bi-monthly) ground water depths below the

Table 15. Measurements in feet below the surface taken at eight test wells in Starvation Flats

Date	A	B	C	D	E	F	G	H
8/10/2007	16.77	.	4.46	10.65	8.43	12.11	12.2	8.9
8/23/2007	17.19	6.67	4.66	11.06	8.74	12.82	12.29	9.26
9/6/2007	17.29	7.02	4.96	11.37	9.01	13.42	12.52	9.64
9/13/2007	17.44	7.15	5.03	11.6	9.19	13.72	12.6	9.82
9/20/2007	17.37	7.25	5.1	11.78	9.29	14.05	12.73	9.92
9/26/2007	17.46	7.45	5.36	11.93	9.46	14.42	12.91	10.29
10/11/2007	17.41	7.67	5.67	12.44	9.72	14.98	13.12	10.78
10/25/2007	17.67	7.92	6.12	12.76	10.21	15.81	13.27	11.53
11/7/2007	17.79	8.05	6.42	13.21	10.5	16.31	13.28	12.04
5/20/2008	1.41	3.05	2.04	7.51	5.27	6.39	9.92	5.51
7/24/2008	5.23	5.24	3.69	8.12	7.1	9.76	10.63	7.53
8/4/2008	7.44	5.7	3.92	7.84	7.4	10.31	10.86	7.86
8/12/2008	10.81	5.88	4.04	9.34	7.62	10.7	11.06	8.08
9/2/2008	15.78	6.43	4.44	10.41	8.19	11.74	11.56	8.91
9/23/2008	16.14	6.85	4.84	11.01	8.7	12.72	11.86	9.53

surface at eight test wells that were placed throughout the Starvation flats area. Water levels dropped between 2.4 and 14.7 feet between May and the end of September in 2008. Water levels dropped even further as the year progressed in fall 2007. The lowest aquifer levels were measured on November 11, 2007. Water levels ranged from 6.4 to 17.8 feet below the surface during this time. Snow pack began accumulating at the beginning of December, ending and eventually reversing the drop in water levels. At the end of 2008 we intend to deploy hobo water depth data-loggers to monitor well levels through the winter and spring months when access to starvation flats is difficult.

III. Restoration Projects

Seattle Springs Exclosure Fence Proposal

Background

In September 2007, Fisheries staff were approached about helping to address some of the problems occurring at Seattle Springs due to overgrazing. Because of the traditional importance of the spring, cultural resources staff were also interested in an active management program. Several specialists from many programs conducted site visits and discussed potential avenues to address overgrazing, weed invasion and the reduced wetland area of the spring. This proposal was developed in response to these requests.

Purpose
During the various site reviews and related discussions through email, several needs have been communicated regarding the construction of the proposed exclosure fence. Roughly and in no particular order, those needs are the following: a fence that excludes cattle and horses but allows deer and elk to cross, a fence that allows access to the area either by means of a walk-in gate or a cattle guard that allows vehicles to enter, exclosure of the bulk of the sensitive are surrounding Seattle Springs and a fence constructed in an aesthetically pleasing manner.

YN Fisheries and Wildlife staff feel that it is possible to build a fence that will mostly fit those needs.

Proposal
We proposed building a buck and pole type fence similar to the one in figure 1.

Figure 21. Buck and Pole Fence - Ahtanum Creek

Timeline and supervision:
Construction of the fence occurred in during the summer of 2008. All work was supervised by the YRWP's field supervisor.

Fence Alignment Details:
Significant work was put into determining the best and most efficient alignment for this fence. There was one spring with an associated watercourse in the vicinity of the proposed fence, and both were included in the exclosure.

Methods:
This fence was built to National Resource Conservation Service specifications, peeled poles were assembled into A-Frames or bucks and poles were then attached to the bucks creating rails. Poles were harvested from areas where Lodgepole pine were encroaching on wet meadow areas. Materials were brought to the jobsite using a pickup truck or a 6x6 ATV at remote sites.

Conclusions:
The YRWP has constructed several similar fences in the last few years. The exclosure fence in Rentchler's Meadow is a good example and a reasonable replicate as well. Rentchler's Meadow was similar to Seattle Springs in that the floodplain had been grazed excessively. YRWP staff constructed a fence in much the same manner as the one in Seattle Springs with the exception that the Rentchler's Meadow exclosure fence was built with barbed wire. The results were immediate and very positive; we quickly saw an explosion of vegetation during the fist summer. The second summer we actually saw standing water persist in the meadow until late August. Previous to the exclosure fence, standing water had disappeared by late June. Because of these observations, and because YN Vegetation Management will be actively controlling noxious weeds, we feel that we'll see similar results in Seattle Springs.

B. Graves Property Culvert Removal

Project Description:
Yakama Nation Fisheries (YNF) proposes to remove a 6ft diameter culvert and the concrete fill material associated with it. The culvert is located on Toppenish Creek near the confluence of Toppenish and Simcoe Creeks, approximately ½ mile west of Brownstown Rd. The culvert is on property recently acquired by the Yakama Nation. After construction, the adjacent stream will be stabilized as needed; the likely method would be large rock grade control

structures.

Figure 22. Graves culvert and headwall.

The project will be engineered by a professional engineer with experience in hydraulic engineering and geomorphology. An engineer will perform a reach assessment of the area adjacent the culverts and locate any hazards like headcuts or areas primed for avulsion. Project will include any work needed to address any hazards found adjacent the culvert in question.

After the culvert and concrete is removed, YNF staff will revegetate the site with riparian species appropriate for the site. The stream adjacent the culvert site will be stabilized using grade control structures made of large rocks.

Methods:
Rock for this project was staged onsite prior to beginning the work. Rock was delivered by side-dump semi truck and placed in piles according to size. Careful measurements were taken to assure the proper quantity and quality of rock was

delivered.

Figure 23. Large rock stockpile prior to project initiation.

A tracked excavator was used to remove the concrete debris and the culvert. The excavator also placed the rocks that formed the grade control.

Figure 24. Excavator constructing grade controls.

Benefits of Project / Discussion:
The target species for this project is Mid Columbia ESU steelhead. These fish are listed as Threatened under the Endangered Species Act. The objective of this project was to remove a 6-foot-diameter culvert at a farm crossing of Toppenish Creek. The culvert was grossly undersized, with a watershed area of more than 200 square miles upstream, and had been observed to block passage to adult steelhead due to the outlet velocity of the culvert, which exceeded the burst swimming speed of an adult steelhead at a stream discharge of 300 cfs, within the normal range of flows during the migration period. In some years, we believe this culvert delayed upmigration for as much as ¼ of the spawning season. Even worse, the medium to high flow events favored by steelhead for upmigration are the very flow events that created the velocity barrier at the outlet of the culvert. These were missing their best opportunities for moving through the Toppenish Creek system and maintaining optimal distribution and spawning/rearing density. Adult steelhead have been observed jumping onto the concrete fill material surrounding the culvert and we felt that some fish were injured or predated in addition to being impeded. The culvert crossing had been breached a number of times by high flows, scattering crossing fill downstream. The resulting gaps in the crossing have been refilled after each event with demolition debris.

Conclusion:
YRWP staff are confident that this project will meet its goal of allowing unfettered fish passage to the entire upper watershed of Toppenish Creek.

C. Satus Dam Removal Engineering

Project Description:

This project will remove an abandoned low-head irrigation dam located in the lower reach of Satus Creek at river mile 10.4. Currently, the dam's fish passage facility congregates all of the adult upmigrants on one side of the stream and forces them to pass through a ladder system that is often plugged with debris.

The project will improve downstream migration of steelhead trout and allow upstream movement of juvenile steelhead trout so they can access more desirable summer rearing habitat. The project will result in the increase in abundance of viable steelhead spawning redds in the reaches above the dam. The project will eliminate the delay of adult steelhead trout below the dam that are currently vulnerable to predation and poaching. The project will ultimately result in more steelhead spawning redds in the reaches above the dam, and an increase in the abundance and productivity of the Satus Creek steelhead population.

Project Update:
To date YRWP staff have completed several portions of the project. In July of 2008 the engineered plans for the project were completed. The plans call for the dam to be partially removed, with the footing being left in the stream. The removal of the dam will

create a elevation difference of about 4ft. To stabilize the stream and not allow the elevation differential to create a headcut, the plans call for the installation of a constructed riffle. Constructed riffles are a newer technology, but one that the engineering firm has significant experience with. When the riffle is completed, it does not appear to be artificial, and provides totally unimpeded fish passage.

With the plans we were able to haul all of the rock needed for the project to the site. This was completed in September of 2008, and about 800cy of rock is now staged and prepared for construction.

Our plan for the summer is 2009 is to wait until Satus Creek has reached summer low flow, and then begin construction. We intend to contract for construction in May of 2009.

D. Camas Patch Exclosure Fence

Project Description:

The Camas Patch fence encloses 1291 acres and protects a wet meadow (Camas Patch Meadow) that is at the head of the Dry Creek Watershed. Camas Patch Meadow has been significantly impacted by overgrazing, both by cattle and wild horses. The fence was built to protect the most sensitive areas of the meadow. The fence was completed in September of 2008(Figure 25.)

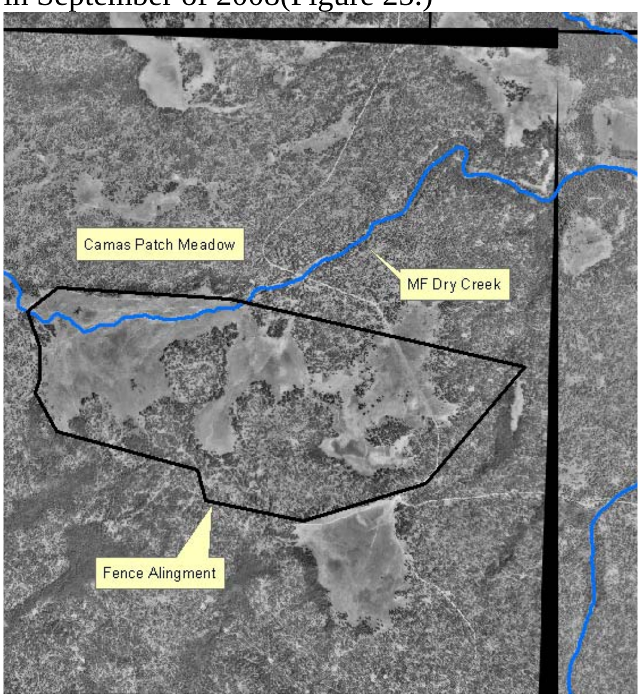


Figure 25. Camas Patch Meadow and viscinity.

Methods:

This fence was built to National Resource Conservation Service specifications, 5 strand barbed wire, line posts every 600ft, H braces every ¼ mile, steel pipe was set in a 28”x12” block of concrete, rock jacks were constructed of galvanized field wire and pressure treated lumber. When available, barbed wire was attached to live trees using several 2x4's for spacers. Brushing of the alignment by hand tools (chainsaws) was allowed however no ground disturbance was permitted. Materials were brought to the jobsite using a pickup truck or a 6x6 ATV at remote sites. Two 12'cattle guards were repaired as they had filled in with soil and were no longer functioning.

Fence Alignment Details:
Significant work was put into determining the best and most efficient alignment for this fence. There was one watercourse (MF Dry Creek) in the vicinity of the proposed fence with a total stream length of .3 mile. Our goal for this project was first to protect the meadow and second to protect as much stream as possible. Because of this, significant distances of the MF Dry Creek were left out of the exclosure, however most of the stream not in the exclosure is in areas with good riparian vegetation and thus not at immediate risk of excessive grazing. Project staff will continue to monitor the exclosure and the riparian area around the exclosure to determine if additional protection is required.

E. Riparian Fencing and Revegetation
YRWP staff constructed 6.2 miles of new meadow exclosure fence in 2008. New construction included the Camas Patch Meadow exclosure fence (Figure 25.)

Meadow exclosure fencing is done in order to allow vegetation to re-establish. Once this has been completed, staff begin restoration of hydrologic function. This usually involves constructing grade control structures in the watercourse that drains the meadow to reestablish groundwater storage capacity and slow the rate of runoff.

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 anticipate 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 26. 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 PCV 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. Much of this maintenance focuses on the boundary fences surrounding the Logy Creek range units that are leased by the project. 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.

Project staff constructed 6 miles of new meadow exclosure fence in the Starvation Flats area. Most of the range unit fencing is located along the perimeter of the Project's leased range units. The riparian fence is distributed as follows: 8.5 mile in the Ahtanum Watershed, 2 miles in the Toppenish Watershed and 5 miles in the Satus Watershed. Maintenance of both riparian and range unit fencing is necessary because in some cases range unit fencing is actually being used to create an exclosure (cattle on the outside) of the entire range unit. This is the case with the entire Logy Creek watershed (100 sq mi), where the range unit fence prohibits any grazing. Logy Creek and its tributaries are the major source of summer flow for Satus Creek.

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