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YAKAMA RESERVATION WATERSHEDS PROJECT
BPA Project #1996-035-01-Contract #35636

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I. Introduction

A. Project Overview
In June of 2005, the Ahtanum Watershed Assessment, Toppenish Watershed and Satus Watershed Projects were combined into one project, named the Yakama Reservation Watersheds Project (YRWP.) Since the last report in 2008, YRWP staff have continued several tasks including close monitoring of stream discharge and irrigation withdrawals, monitoring of juvenile steelhead and coho outmigration, steelhead spawning surveys and analysis of irrigation extent and timing. We have also continued our restoration efforts in the three watersheds, completing exclosure fences and a dam removal project during the 2009 work season.

II. Data Collection

A. Screw Traps

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

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 five years of data in hand to compare populations. On several occasions when large catches occurred (N > 200) only a random sub-sample were measured and weighed. We inserted PIT tags into a sub-sample of captured steelhead smolts over 100 mm in length. Fish were then released at least 100 meters downstream from the screw trap after data was collected. Some PIT tagged fish were released several hundred meters upstream from the trap to estimate the efficiency (i.e. mark-recapture). Our goal was to perform at least one efficiency test per week at each trap, although low capture rates sometimes prevented this. Physical data (water temperature, air temperature, and percent cloud cover) were recorded. The trap rotation rate (seconds per 1 revolution) was recorded to evaluate operating efficiency.

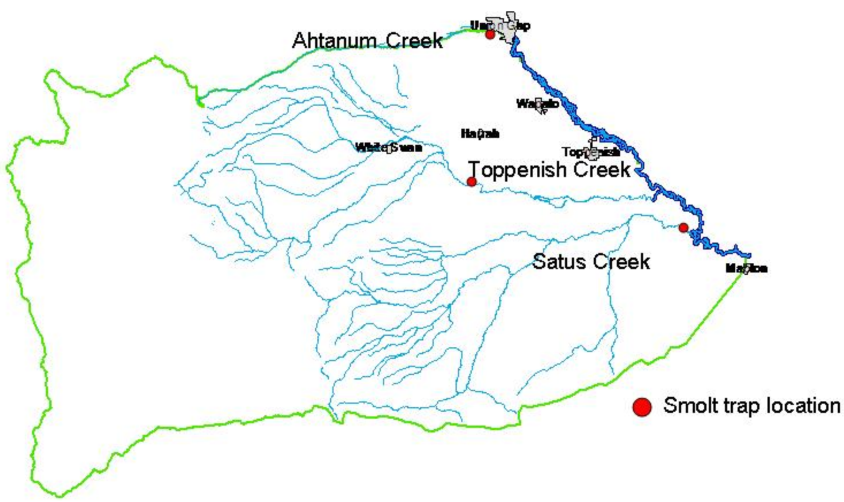

Figure 1. Map of smolt trap locations on Satus, Toppenish, and Ahtanum Creeks

Satus Creek

The screw trap on Satus creek was deployed at river mile (RM) 1 on December 2nd, 2008 and was operated continuously until June 16th 2009. The screw 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 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 87 % of the days (172) during the season. During the interval between visits to the trap, debris stopped the cone 20 % 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 2.04—10% lower than last season (2007-2008). The trap may not be rotating as easily due to wear and tear from several years with high flow events, however it is still functional.

During the 2008-2009 season a total of 415 steelhead juveniles were captured in the screw trap at Satus Creek. We implanted 322 PIT tags into captured fish. From the PIT tagged juveniles, 49 were released upstream for an efficiency test. None were recaptured. Last season an efficiency estimate of 7.4 percent was calculated. Although changes in capture efficiency between last year and this year are likely, the overall flow (indicated by average stage) and the average trap rotation rate differed less than 20% from the 2008-2009 season with conditions for recapture slightly less favorable. Using the 2007-2008 season efficiency, a rough outmigration estimate of 5608 steelhead smolts can be obtained. This number likely underestimates outmigration because the trap could not be effectively deployed during some of the peak flow events—the same events that can stimulate outmigration behavior in steelhead. Improvements to the channel (sand 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 36 mortalities tallied from the trap in the 2008-2009 season at the Satus trap—up from last year. However, many of these were decomposed beyond what would be expected during the 24 hour period interval between trap live box netting.

Table 1. Statistics for steelhead juvenile catches at the screw trap on Satus Creek for the 2008-2009 season.

Stat	Nov	Dec	Jan	Feb	March	April	May	June	Overall
Monthly Catch	.	2	122	12	92	58	128	1	415
% of total	.	0.5%	29.4%	2.9%	22.2%	14.0%	30.8%	0.2%	100.0%
Max Fork Length	.	120	183	126	176	191	176	160	191
Min Fork Length	.	116	70	94	80	129	106	160	70
Mean Fork Length	.	118.00	115.09	108.92	117.12	159.52	150.72	160.00	132.19
Max Weight	.	120.0	183.0	19.9	115.0	62.0	59.0	34.0	191.0
Min Weight	.	16.0	3.3	8.5	4.7	19.0	12.0	34.0	3.3
Mean Weight	.	17.95	115.09	12.99	18.28	40.71	35.34	34.00	25.72
Mean Cond.Factor	.	1.088	0.983	0.985	1.073	0.981	1.016	0.830	1.013
Number tagged	.	2	87	9	70	58	95	1	322
% monthly catch tagged	.	100.0%	71.3%	75.0%	76.1%	100.0%	74.2%	100.0%	77.6%
	.	0.3%	11.6%	1.2%	9.3%	7.7%	12.7%	0.1%	42.9%

Unlike the 2007-2008 season when the peak in daily catches occurred in December after an early winter storm caused a high flow event, the outmigration timing in 2008-2009 was dispersed throughout the season (Figure 2). May was the month with the largest catch in 2009. This is atypical for Satus and other lower Toppenish tributaries seen in previous years. Peak outmigrations typically occur around early winter flood events in January and February. The total trap catch was less compared to the 2008 season where 750 steelhead juveniles were captured. The trap was operated during a similar time period and was fishing effectively (deployed and rotating for entire interval between trap emptying) for 68 percent of that duration during the 2007-2008 period.

The mean fork length of juvenile steelhead increased during the spring months compared to the early months of December, January, and February (Table 1). Overall mean fork length (132.2 mm) was higher than 2008 (110.7 mm). This figure was influenced by fewer smolts migrating through the trap zone in December, unlike previous years. Smaller juveniles typically migrate through the trap zone in during the earlier months. Larger sized smolts migrated through the trap zone in March, April and May (3-month average; 142 mm). We collected scales from 101 individuals throughout the season. They will be aged in winter 2010.

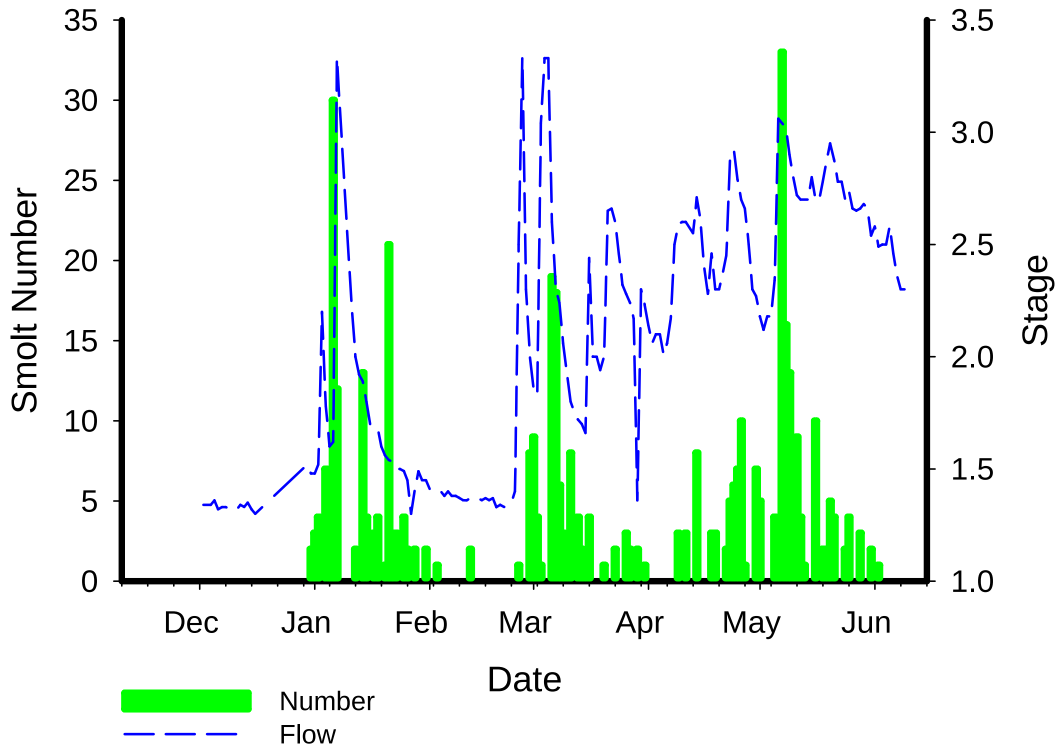

Figure 2. Number of smolts captured in the Satus Creek compared with stream stage during the 2008 and 2009 season.

<u>Toppenish Creek</u>

The screw trap on Toppenish creek was deployed at approximately river mile (RM) 23 on November 19th 2008 and was operated continuously until June 12, 2009. The screw trap was in place for a total of 205 days. High discharge and debris prevented operation of the screw trap for a period during the season, mostly in April. The trap could be deployed and operated for about 80% of the season. This is longer than the previous 3 seasons. In spring 2008 a prolonged high flow event prevented operation due to poor access, high debris loads and safety concerns for over 6 weeks in April and May (Figure 3). Similar prolonged high spring 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 166 days (80% of the operating period). The trap was operating efficiently (i.e. deployed and cone rotating for the entire 24 hour period) on 115 days or 56% of the season. Steelhead juveniles were captured on 69% of the 140 days when the trap was deployed.

We captured 2440 juvenile steelhead during the 2008-2009 season. This is higher than the 2007-2008 season when we captured 1681 steelhead juveniles. Out of captured individuals, we implanted PIT tags into 1178 smolts that were greater than 100 mm in length. Efficiency tests with PIT tagged steelhead indicate a higher trap efficiency rate (18.9%) than in the 2007-2008 season (16.2 %). An extrapolation on our catch numbers suggest that approximately 12,946 steelhead juveniles migrated through our trap zone during the 2008-2009 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 2009.

Table 2. Statistics for the steelhead juvenile catch at the screw trap at Toppenish Creek for the 2008-2009 season.

Stat	Nov	Dec	Jan	Feb	March	April	May	June	Overall
Monthly Catch	62	186	1391	35	365	308	54	39	2440
% of total	2.5%	7.6%	57.0%	1.4%	15.0%	12.6%	2.2%	1.6%	100.0%
Max Fork Length	176	265	236	185	190	236	197	234	265
Min Fork Length	98	85	60	73	60	76	92	97	60
Mean Fork Length	129.84	125.40	119.44	123.77	121.27	138.52	158.19	152.21	125.45
Max Weight	53.5	95	78.3	185	65	134	83	146	146
Min Weight	9.2	6.1	2.1	3.7	2.2	3	7	10	2.1
Mean Weight	23.15	20.46	18.22	21.06	19.12	28.55	41.25	39.92	21.55
Mean Cond.Factor	0.996	0.949	0.989	0.961	0.953	0.981	1.018	1.052	0.980
Number tagged	61.0	167.0	479.0	21.0	161.0	200.0	89.0	38.0	1178.0
% monthly catch tagged	98.39%	89.78%	34.44%	60.00%	44.11%	64.94%	164.81%	97.44%	48.28%
%of total	6.29%	17.22%	49.38%	2.16%	16.60%	20.62%	9.18%	3.92%	121.44%

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

Steelhead mortality was lower in 2009 (2.79 %) than in 2007 (5.35 %). Like previous years, large flood events and heavy debris loads were responsible for trapping mortalities. Although, based on the advanced stage of decomposition of some individuals, it is likely that a portion of the tallied mortalities were dead when they entered the trap.

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

Toppenish Screw Trap Migration Timing

Operation of the screw trap on Toppenish Creek has allowed us to analyze the timing of steelhead juvenile movement beyond their rearing habitat in the upper watershed. Some of the smolts that we PIT tagged at the Toppenish were detected downstream at the Chandler facility at Prosser Dam as well as the mainstem Columbia River dams. This has enabled us to determine how much time steelhead juveniles spend in the lower part of the Toppenish Creek and portion of the Yakima River between the confluence of Toppenish Creek and the Prosser detection facility.

Juveniles seem to undergo a gradual out migration that begins early in the fall as indicated by the increase in smolt size juveniles in snorkel surveys at the lower end of rearing habitat. Arrival at the screw trap begins in autumn and normally peaks in December or January. An exception was observed in 2005 when the peak occurred in April. Smolts also seem to spend an extended amount of time between the screw trap and the Prosser detection facility (Figure 5). Between 2005 and 2008 travel times between these two points have averaged from between 62 days and 111 days.

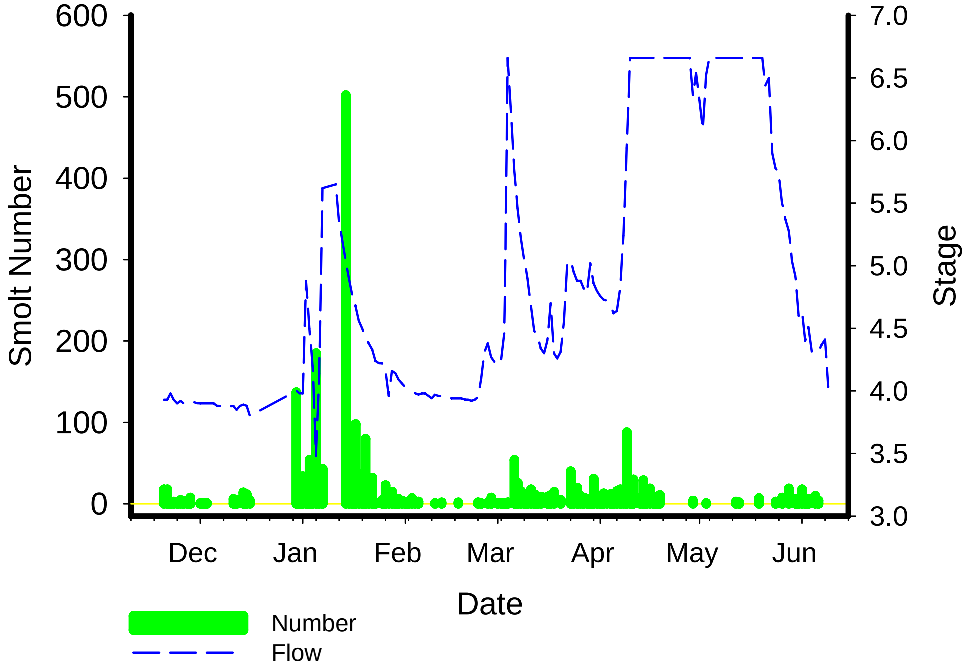

Figure 3. Steelhead juvenile catches compared to creek stage at the Toppenish Screw trap.

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

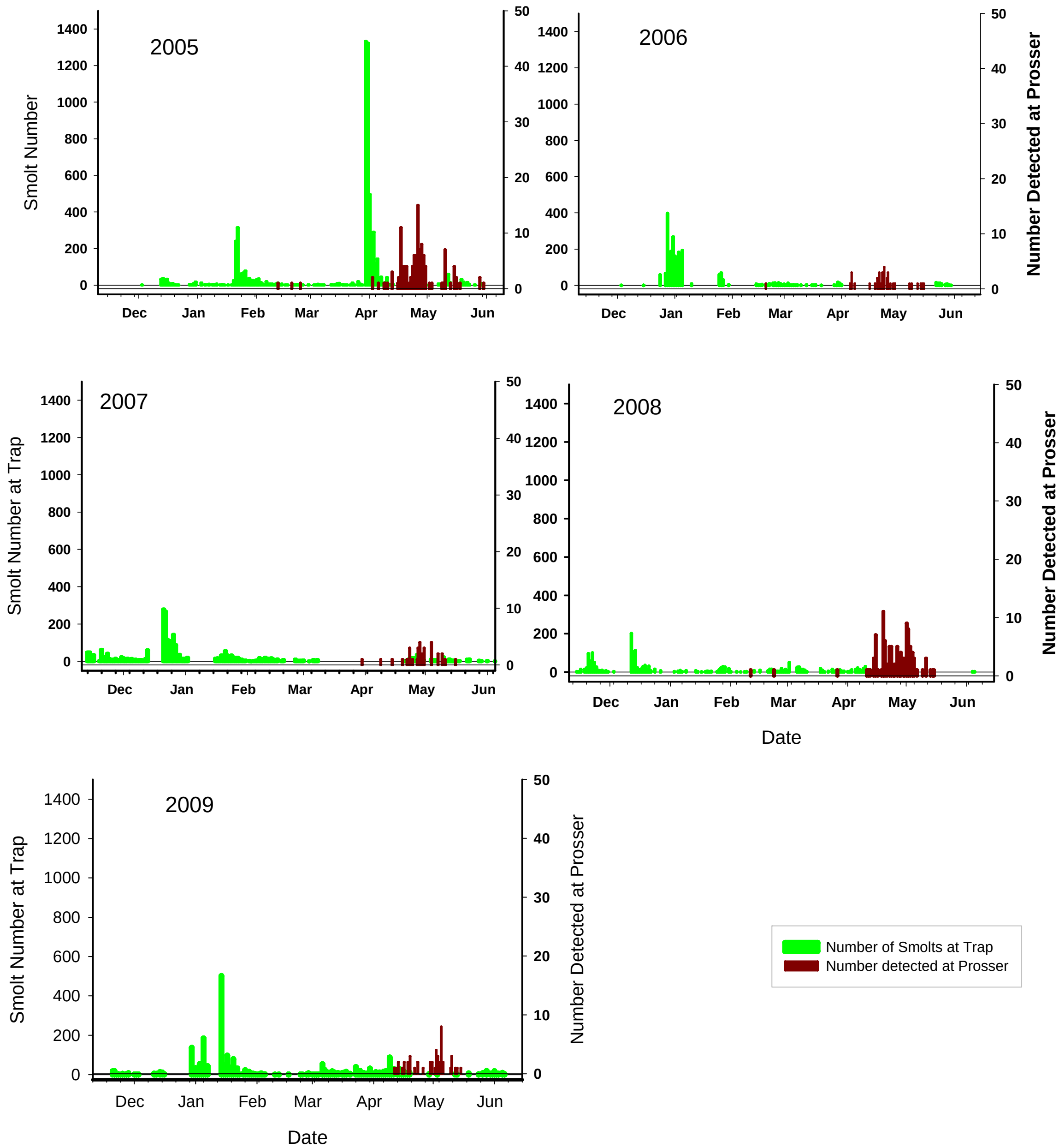

Figure 5. Timing of steelhead smolt trap captures at Toppenish Creek compared with detections of PIT tagged Toppenish Creek steelhead juveniles at the Prosser facility.

Ahtanum Creek

The screw trap on Ahtanum was deployed at river mile (RM) 2 on December 2nd , 2008 and was operated continuously until June 16th, 2008. The srcew trap was in place for a total of 179 days. On several occasions during the period of operation, the cone on the trap had to be lifted when discharge and in-stream debris levels were high to avoid clogging, damage to the trap, and harm to out-migrating juveniles.

Only 22 steelhead smolts were captured in 2009 (Table 3). Although higher than the 2006-2007 season when only 11 steelhead juveniles were captured, catches have been reduced from the previous years when several hundred smolts were captured during the season. It is probable that the screw trap is positioned in a much less efficient location than the previous seasons (before the 2006-2007 season). Similar to Satus Creek, the peak in outmigration in Ahtanum Creek occurred later in the year than norma when more than half of the captured juveniles outmigrated past the trap zone in May. The peak typically occurs in late December and January. Mean fork length for steelhead juveniles captured in the screw trap was 175mm. Ahtanum individuals are usually larger than those from Satus and Toppenish Creek. In addition to steelhead trout, 2 chinook salmon smolts were captured in the screw trap.

Table 3. Statistics for the screw trap catch at Ahtanum Creek for the 2008- 2009 season.

Stat	Nov	Dec	Jan	Feb	March	April	May	June	Overall
Monthly Catch	.	0	7	0	0	2	13	0	22
% of total	.	0.00%	31.82%	0.00%	0.00%	9.09%	59.09%	0.00%	100.00%
Max Fork Length	.	0	265	0	0	236	197	0	265
Min Fork Length	.	0.0	93.0	0.0	0.0	188.0	66.0	0.0	66.0
Mean Fork Length	.	0.0	166.0	0.0	0.0	212.0	174.8	0.0	175.4
Max Weight	.	0.0	216.0	0.0	0.0	141.0	81.0	0.0	216.0
Min Weight	.	0.0	7.3	0.0	0.0	72.0	3.0	0.0	3.0
Mean Weight	.	0.0	56.5	0.0	0.0	106.5	58.2	0.0	62.3
Mean Cond.Factor	.	0.00	0.85	0.00	0.00	1.08	1.01	0.00	0.96
Number tagged		0.00	5.00	0.00	0.00	2.00	10.00	0.00	17.00
% monthly catch tagged		0.0%	71.4%	0.0%	0.0%	100.0%	76.9%	0.0%	77.3%

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 of Age 0 fish throughout the summer rearing period. 2009 marked the 5th year of performing these surveys at the Toppenish and the Hoptowit diversions.

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 is believed to occur above the Olney- Lateral Diversion. Before 2001, the reach below the dam dewatered annually between July and September as result of irrigation withdrawals at the diversion. Minimum instream flows for the summer months have restored about 2.5 miles of additional spawning and rearing habitat below the Olney-Lateral Dam. Beyond about 2.5 miles, much of the surface flow is lost to the Toppenish Creek alluvial fan during the summer months, however since 2007; the upstream diversion has been manipulated during the summer months to provide continuous perennial flow of less than 1 cfs through the dry reach. This creates a series of pools and a corridor that is available to migrating steelhead parr to avoid stranding and desiccation.

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 (Figures 1-5). 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 both 2008 and 2009, an almost identical water management scheme as 2007 was employed for the Olney-Lateral (16 to 17 cfs maintained below the diversion).

Figure 1. Photo of the Olney- Lateral Diversion in the drought year of 2005 creating a passage barrier

Figure 2. Photo of the snorkel site upstream from the Three-Way Diversion.

Figure 3 Photo of our snorkel site downstream from The Olney-Lateral Diversion.

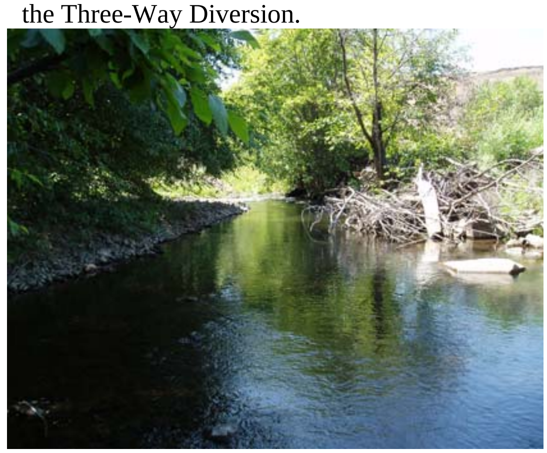

Figure 4. Photo of our snorkel site upstream from The Olney-Lateral Diversion

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 6).

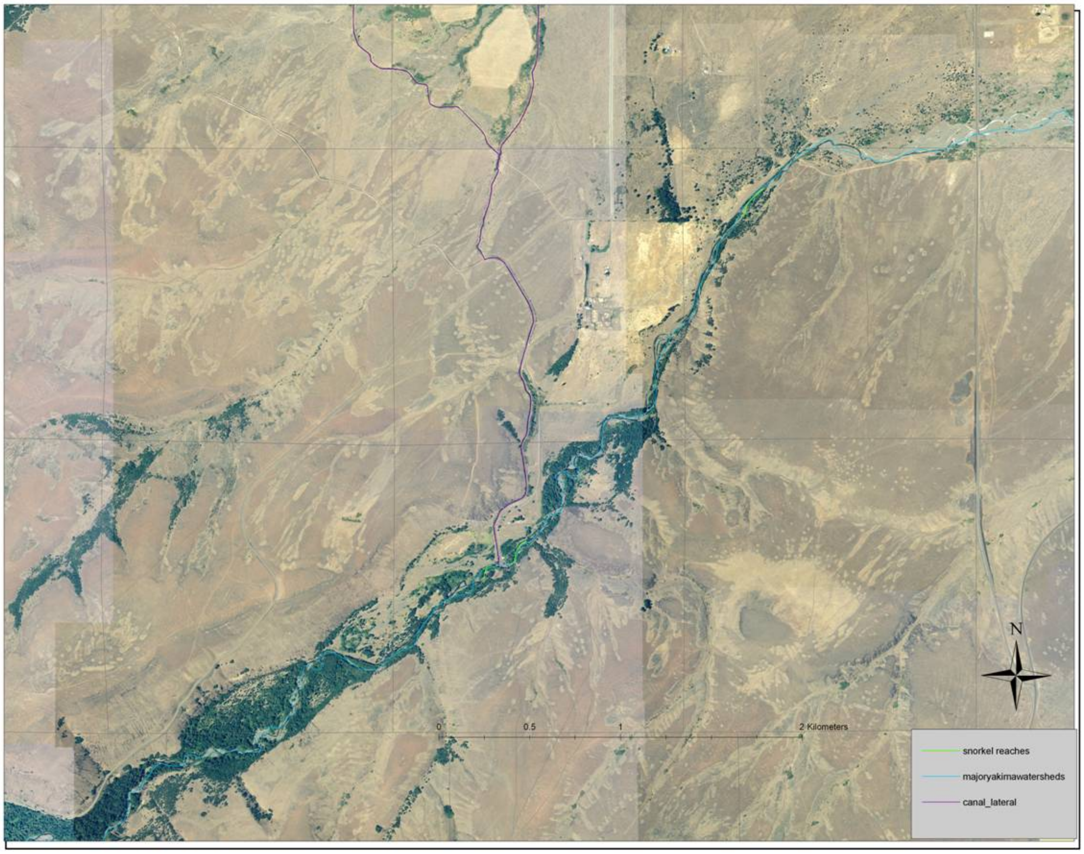

Figure 5. A map of Toppenish Creek centered on the Olney-Lateral Diversion point. Snorkel surveys sections were placed upstream and downstream from the diversion. The 2.5 mile diction located downstream (north east of the diversion) has provided rearing habitat for steelhead juveniles since 2001.

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 all years except 2006 (Table 1).

Table 1. Results from a series of Paired T-tests performed on steelhead Age 0 juveniles for years 2005-2009 on snorkel survey sites upstream and downstream of the Olney-Lateral Diversion.

	2005	2006	2007	2008	2009
T value	-1.4119	-2.8746	0.7224	-0.7319	-2.1400
P value	0.2308	0.0453	0.5100	0.5172	0.1219
Degrees of Freedom	4	4	4	3	3

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 (Figure 7). 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 making it difficult to ascertain a cause and effect relationship. 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.

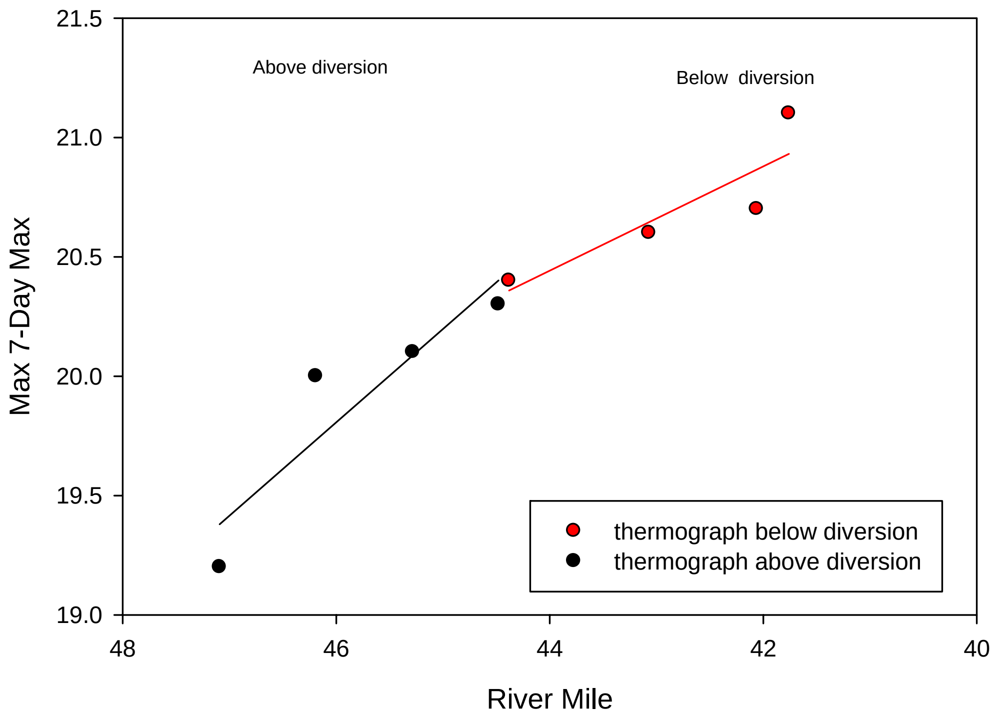

Figure 6. Maximum 7-day avege maximum water temperatures (MWMTs) collected using data-loggers at stations placed at approximately 1 mile intervals upstream and downstream from the Olney-Lateral diversion in 2007.

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 and 2009, summer withdrawals on the Olney-

Lateral were slightly higher because of increased stream flow. The flow below the diversion was similar in all three years. There were likely brief periods during which this particular stream reach was intermittent.

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 2. A comparison of density (fish/100m²) of Age 0 and Age 1+ steelhead juveniles at the Olney-Lateral Diversion (RM 44) snorkel survey study site in 2005, 2006, 2007, 2008 and 2009.

	Age 0 Above Diversion	Age 0 Below Diversion	Age 0 Above Three way	Age 1 + Above Diversion	Age 1 + Below Diversion	Age 1 + Above Three way
	2005					
June	9.54	20.05	13.37	5.04	1.48	0.00
July	11.58	11.93	22.98	0.68	0.86	0.28
August	18.53	26.08	32.54	6.40	4.80	1.42
September	9.54	13.65	22.41	3.13	7.26	5.40
October	10.22	6.03	17.06	5.18	12.55	5.57
	2006					
June	0.00	0.80	5.92	1.77	2.28	0.11
July	2.45	6.46	14.16	0.27	0.62	0.80
August	6.40	15.81	26.85	2.18	0.80	0.51
September	5.31	14.82	27.02	0.95	3.38	1.54
October	7.49	9.78	15.19	2.04	2.83	3.47
	2007					
June	8.11	11.24	3.58	1.91	1.19	0.00
July	12.89	2.62	0.26	0.36	0.95	0.00
August	11.93	8.56	6.20	3.58	1.84	0.63
September	12.17	9.51	8.25	4.18	2.14	1.58
October	8.23	12.13	14.56	2.63	2.79	3.15
	2008					
June	1.97	3.27	2.73	8.41	5.65	0.53
July	6.44	6.96	5.31	4.65	2.02	0.63
August	8.05	9.45	9.20	9.43	6.48	3.68
September	11.28	9.93	10.41	8.00	4.70	2.94
October	.	.	.	.	.	.
	2009					
June						
July	4.24	10.11	7.20	3.58	1.72	1.16
August	10.68	14.27	12.83	5.49	2.62	2.68
September	6.21	5.83	3.21	8.00	6.12	5.73
October	1.61	3.75	4.94	8.00	2.68	3.73

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 through 2009 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 through out the summer during the past 3 years.

In 2009, we observed increasing densities of Age 0 parr at Toppenish Creek sites through out the summer and into the fall (Table 2). 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. If we were to decrease the number of surveys performed to one annual survey at this location, we would probably survey these diversions in August or September when densities were at their greatest.

We observed increasing numbers of age 1 + juveniles (smolt size) from August through October in 2005 through 2008 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 2). In 2009, this pattern was observed again with peak Age 1+ densities occurring in September. They appeared to decline in October which could be the result of out-migrating smolts moving further downstream as thermal barriers in the hot low water reach begin to break down. In support of this theory, the screw trap that we operate at the Unit 2 diversion (RM 26.5) was deployed about 1 month earlier than normal in October 2009. We captured over 30 steelhead juveniles on the 1st day of operation and have continued to capture juveniles through October and early November. The trap is located in a reach that appears to be too warm to support summer rearing, so it is unlikely that many of the juveniles captured are resident fish.

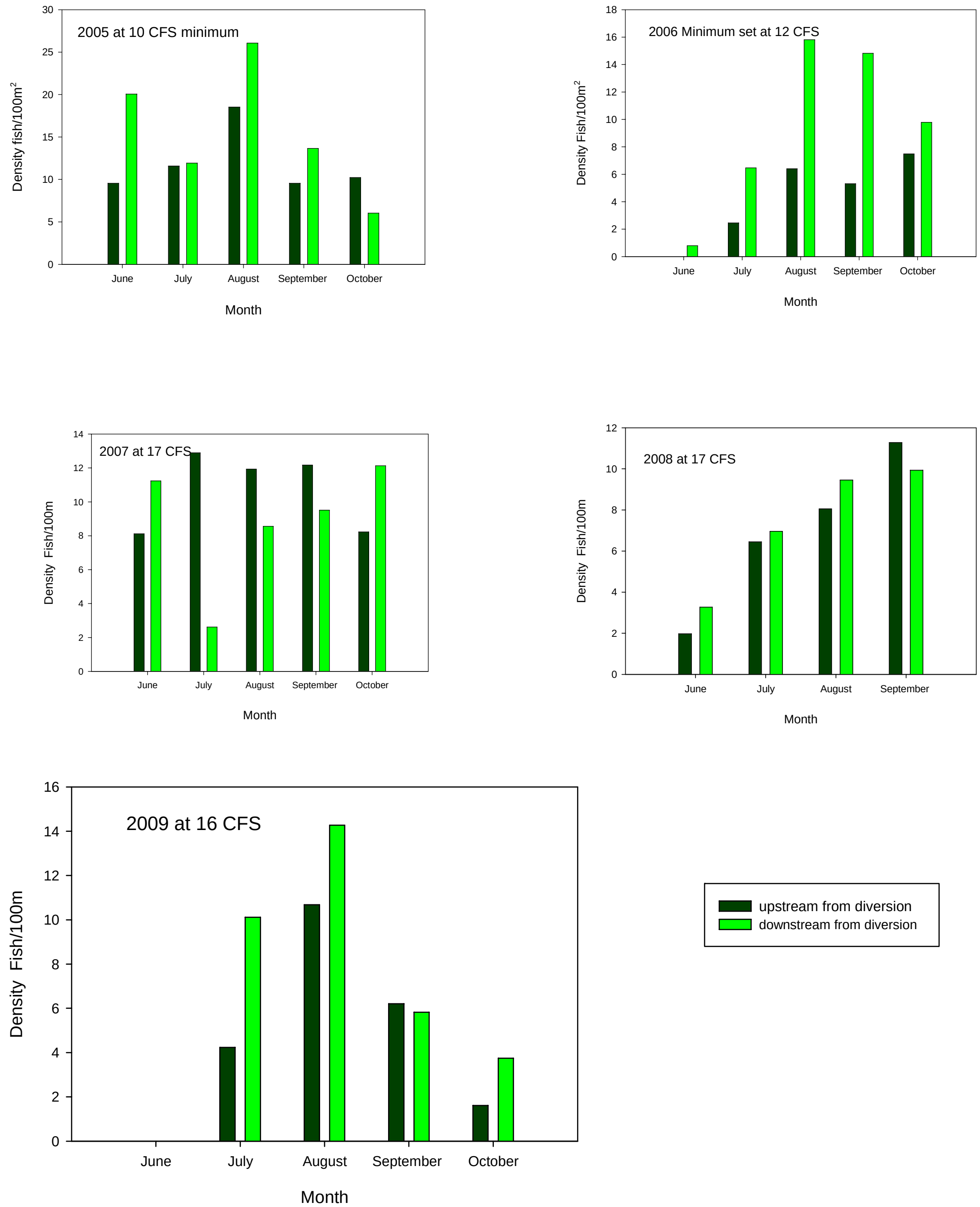

Figure 7. Comparison of Age 0 steelhead densities between 200 meter sites located upstream and downstream from the Olney-Lateral Diversion site in 2005-2009.

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 the five years of study, no salmonids other than O. mykiss were observed. A size difference between Age 0 juveniles and older year classes (Age 1+) could still be observed at this location.

Table 3. Number and density of steelhead parr upstream and downstream from the Hoptowit diversion on the North Fork of Simcoe Creek in 2009.

	Age 0 Below Hoptowit	Age 0 Above Hoptowit	Age 1 + Below Hoptowit	Age 1 + Above Hoptowit
June				
July	10	1	46	61
August	19	7	31	47
September	23	14	56	43
October	38	15	29	28
Densities (per 100 m²)				
June				
July	1.39	0.11	6.39	6.67
August	2.64	0.77	4.31	5.14
September	3.19	1.53	7.78	4.70
October	5.28	1.64	4.03	3.06

Densities of Age 0 steelhead were higher below the Hoptowit Irrigation Diversion than above it during the first three monthly surveys (Table). This is similar to the pattern observed in 2008. This year redds were located on both the upstream and downstream study sites. Although in close proximity to identified redds Similar lower numbers of Age 0 juveniles were observed compared to other years (i.e. 2006 and 2007). Numbers were similar to those seen in 2008. 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 2009 Age 0 parr densities were slightly higher than in 2008. In 2008, Age 0 parr densities in the North Fork of Simcoe Creek were lower than previous years (other than 2005). With the location of two steelhead redds—one on each site, higher densities were expected.

There was a slightly higher density of Age 1+ steelhead below the Hoptowit diversion (5.6 fish/100m²) than above it (4.9 100m²) in 2009. 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/100 m² --above compared to 4.4 fish/100m²--below). Overall, average densities of steelhead Age 1 + parr were similar in all years ranging from 3.8 to 8.1 fish/100 m². With the exception of 2006 where an average density as low as 1.2 fish/100 m² was recorded. 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.

<u>Ahtanum Creek Diversions</u>

We performed a snorkel survey at the main diversion complex on Ahtanum Creek to evaluate effects on steelhead juvenile abundance in August 2009. 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 (<1 mile) to one another. Our snorkel survey study sections were placed upstream and downstream from this complex. Ahtanum Creek is relatively wide at all three study transects requiring the use of two surveyors to effectively cover the entire width. However, many “blind spots” or areas obscured by rocks or exceeding shallow areas probably contained fish that went unobserved and tallied. Due to these limitations numbers were certainly underestimated. On the same day, we also performed a snorkel survey further upstream at the confluence of the North Fork and South Fork in a reach where steelhead redds is identified regularly.

The numbers of both Age 0 O. mykiss and Age 1’s were slightly higher in 2009 but comparable to the numbers observed in 2008. Over the last several years of performing snorkel surveys at this location, we almost always observe more O.mykiss juveniles below the diversions than above. This is probably due to the effect of juveniles migrating downstream and accumulating below the diversions. There also appears to be better habitat—particularly canopy cover at the site below diversions.

Like 2008, we also observed juvenile coho salmon at our site below the diversions. Several were also 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 4. snorkel survey rainbow/steelhead (*O. Mykiss*) numbers and densities at irrigation diversions in Ahtanum Creek

Numbers	Age 0 O. Mykiss Above diversions	Age 0 O.Mykiss Below diversions	Age 1 + O.Mykiss Above diversions	Age 1 + O.Mykiss Below diversions
August	26	113	16	47
Densities (per 100 m²)				
August	1.25	4.89	0.77	2.03

Satus Creek Tributaries

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 19th 2009.

In 2009, the highest density of age 0 steelhead (13.04 sthd/100m²) was observed at the Dry Creek site near the mouth. The highest density of Age 1+ steelhead was observed at the Dry Creek site further upstream at the elbow crossing. The lowest density of Age 0 and Age 1 + steelhead was seen at the Logy Creek site close to the mouth. The Dry Creek site below 97 had high numbers of juvenile steelhead considering its lower elevation low summer flows. Continuous water temperature measurements at this location do, however, 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 those sampled in 2007, 2008, and 2009, although those sampled appeared to have a good representation of different habitat types from deep pools, to riffles, to logjams.

Table 5. Number age 0 and Age 1 steelhead observed during snorkel surveys Dry Creek and Logy Creek in 2009

	Age 0	Age 0	Age 0	Age 0	Age 1 +	Age 1 +	Age 1 +	Age 1 +
	Dry Creek at the Elbow Crossing (200m)	Dry Creek below HWY 97 (200m)	Logy Creek at upper crossing (200m)	Logy above HWY 97 (200m)	Dry Creek at the Elbow Crossing (200m)	Dry Creek below HWY 97 (200m)	Logy Creek at upper crossing (200m)	Logy above HWY 97 (200m)
2007								
Nunber	129	121	45	.	49	30	15	.
Density	11.84	9.92	2.62	.	4.50	2.46	0.87	.
2008								
Nunber	151	71	49	32	131	48	10	59
Density	13.86	5.82	2.86	2.24	12.02	3.94	0.58	4.14
2009								
Number	25	159	34	22	62	12	34	4
Density	2.29	13.04	1.98	1.54	5.69	0.98	1.98	0.28

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

We deployed a total 61 devices in the three watersheds (Figure 1). Data-loggers (Onset Optic Stowaways and Onset Water Temp Pro v2) were launched in spring 2009 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 2009, 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).

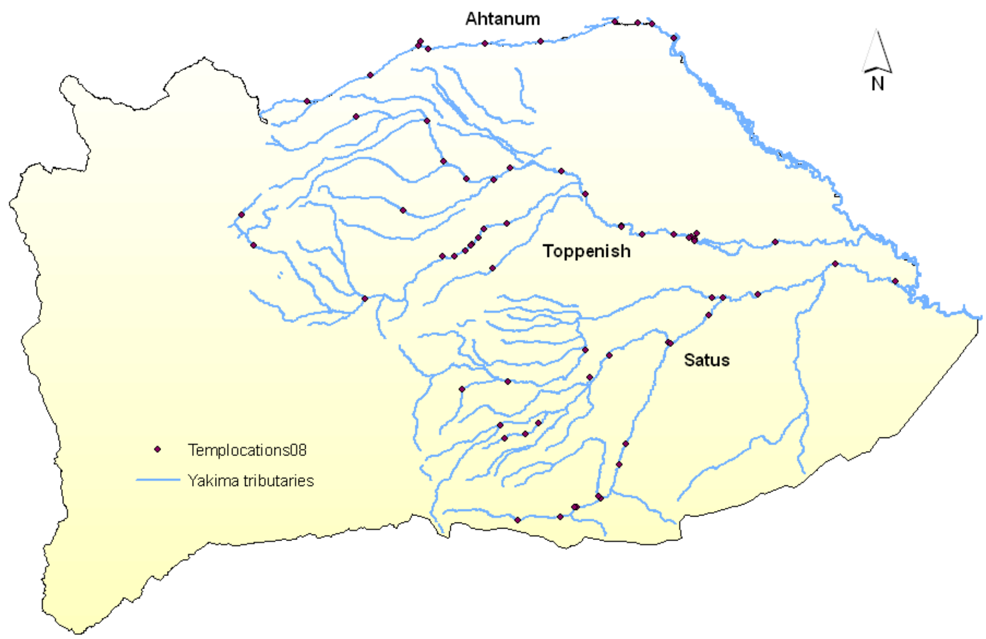

Figure 1. Locations of temperature monitoring stations in the Yakima River watershed portion of the Yakama Reservation.

Ahtanum Creek

In 2009, 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 2009 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 in mid October. One unit was lost during high discharge that occurred in April and May or was stolen. Two units malfunctioned. Seven data-loggers recorded temperatures for the entire period (Table 1).

Table 1. Descriptive statistics for water temperatures at 9 locations in the Ahtanum Creek watershed. Maximum Weekly Maximum Temperature in Bold.

Location (river mile in parenthesis)	Instantaneous Maximum	Instantaneous Minimum	Mean Daily Maximum	Mean Daily Average	Mean Daily Minimum	Maximum Daily Average	**Maximum 7-Day Maximum**	Maximum 7-Day Average
South Fork Ahtanum at the DNR gate (11.0)	malfunctioned							
South Fork Ahtnaum at campground (7.0)	15.3 ºC	1.2 ºC	9.9 ºC	8.0 ºC	6.5 ºC	12.6 ºC	**14.8 ºC**	12.2 ºC
South Fork of the Ahtanum (0.5)	22.2 ºC	1.8 ºC	14.1 ºC	11.1 ºC	8.6 ºC	18.4 ºC	**21.6 ºC**	18.0 ºC
North Fork of the Ahtanum (1.3)	22.8 ºC	1.7 ºC	14.0 ºC	11.3 ºC	8.8 ºC	19.6 ºC	**22.5 ºC**	19.2 ºC
Ahtanum below the Forks	Lost or stolen							
AID Diversion (18.9)	26.3 ºC	2.5 ºC	16.8 ºC	13.3 ºC	10.3 ºC	21.9 ºC	**25.8 ºC**	21.4 ºC
American Fruit Rd. (14.0)	malfunctioned							
42nd Ave. (7.0)	27.7 ºC	3.4 ºC	17.4 ºC	14.7 ºC	12.1 ºC	23.6 ºC	**27.2 ºC**	23.2 ºC
16th Ave	26.6 ºC	3.4 ºC	17.0 ºC	14.9 ºC	12.8 ºC	23.8 ºC	**26.4 ºC**	23.5 ºC
Ahtanum at the Mouth (0.5)	24.0 ºC	4.9 ºC	16.9 ºC	15.3 ºC	13.8 ºC	22.0 ºC	**23.7 ºC**	21.7 ºC

Mean daily averages ranged from 12.6ºC in the South Fork of Ahtanum Creek several miles above the confluences to 15.3 ºC at the mouth. (Table 1). The highest instantaneous maximum of 27.7 ºC was recorded at 42nd Ave. (RM 7). The lowest instantaneous maximum water temperature (24.0 ºC)in the mainstem Ahtanum was recorded at the mouth. This has been the case in other years as well. The lowest instantaneous maximum for the mainstem Ahtanum in 2007 was recorded at the mouth (24.1ºC). In 2008, the site with lowest instantaneous maximum was located several miles upstream at 16th Ave. Data for that site and our site at American Fruit Road was not available in 2009. 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 (27.2ºC) was recorded at 42nd Ave—2.6 degrees higher than the MWAT recorded for 2008. Through out the lower Yakima watershed high water temperatures where recorded due to hot dry weather at the end of July and beginning of August. Water temperatures improved slightly several miles downstream at 16th Ave (MWMT; 26.4ºC) 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 on the Yakima River floodplain. 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 in the mainstem Atanum Creek, although pockets of suitable water temperatures probably exist and serve as cool water refugia.

Toppenish Creek

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

We deployed 23 data-loggers in the mainstem of Toppenish Creek during spring 2008 at sites located between RM (river mile) 3 and 68. We also deployed seven data-loggers in Simcoe Creek, one in Panther Creek, one in Mill Creek, and two in Agency Creek. The units were in place and continuously recording water temperatures at 48 minute intervals until we retrieved them in mid October 2009. Five units failed to record temperatures due to battery failure or equipment malfunction. Three data loggers were lost due to high flows, beaver activity, or theft. One unit in Toppenish Creek dewatered for an extended period. Three units in Simcoe Creek dewatered producing unreliable data. The other data loggers recorded temperatures for the entire period. We used the Maximum Weekly Average Temperature (MWAT, moving 7-day average of the daily mean water temperature) and the Maximum Weekly Maximum Temperature (MWMT, moving 7-day average of the daily maximum water temperature) as an index to evaluate suitability for salmonid habitat.

Mean daily average temperatures in the mainstem Toppenish Creek ranged from 8.8ºC below the confluence of Panther Creek at RM 68 to 19.8ºC below Mud Lake Drain (RM 31.2). Excluding two sites (Toppenish Creek at Lateral C and Toppenish Creek the Cleparty diversion) which may have been affected by brief dewatering events by irrigation diversions, The highest instantaneous maximum of 27.2 ºC occurred at the Toppenish Creek site near the inlet of Snake Creek. Last year (2008), the highest temperatures were recorded at Campbell Rd. at the mid channel location (inst. Max; 28.8 ºC). This unit malfunctioned this year, however, the high was in 2009 was recorded in a similar location.

Table 2. Descriptive statistics for water temperatures at 24 locations in the mainstem Toppenish Creek. Maximum Weekly Maximum Temperature in bold text.

Location (river mile in parenthesis)	Instantaneous Maximum	Instantaneous Minimum	Mean Daily Maximum	Mean Daily Average	Mean Daily Minimum	Maximum Daily Average	**Maximum 7-Day Maximum**	Maximum 7-Day Average
Panther Creek at lower culvert (1.8)	13.7 ºC	0.4 ºC	9.9 ºC	8.1 ºC	6.5 ºC	12.0 ºC	**12.8 ºC**	11.9 ºC
Topp. at Panther Ck confluence (68)	15.3 ºC	0.9 ºC	10.8 ºC	8.8 ºC	6.9 ºC	13.0 ºC	**15.0 ºC**	12.7 ºC
Topp. at N. Fork confluence (54.4)	20.1 ºC	2.6 ºC	13.5 ºC	11.1 ºC	9.3 ºC	16.9 ºC	**19.7 ºC**	16.7 ºC

Topp. at swim hole (46.8)	malfunctioned							
1 mile below swim hole (45.9)	24.1 ºC	3.5 ºC	16.0 ºC	13.8 ºC	12.0 ºC	21.3 ºC	**23.8 ºC**	20.9 ºC
1 mile above lateral (45)	24.1 ºC	3.6 ºC	16.2 ºC	14.1 ºC	12.3 ºC	21.5 ºC	**23.8 ºC**	21.1 ºC
Topp. above lateral (44.2)	24.6 ºC	3.4 ºC	16.5 ºC	14.2 ºC	12.4 ºC	21.8 ºC	**24.3 ºC**	21.4 ºC
Above three way (42.8)	25.1 ºC	3.9 ºC	17.4 ºC	14.9 ºC	12.8 ºC	22.0 ºC	**24.8 ºC**	21.7 ºC
At three way (41.8)	26.0 ºC	3.8 ºC	17.5 ºC	14.8 ºC	12.7 ºC	22.2 ºC	**25.5 ºC**	21.9 ºC
Topp. At cleparty diversion (41.5)	31.2 ºC*	5.6 ºC	19.5 ºC	16.1 ºC	13.5 ºC	22.7 ºC	**26.4 ºC**	22.3 ºC
Topp at shaker church Rd. (35.9)	24.6 ºC	4.4 ºC	17.7 ºC	15.0 ºC	12.7 ºC	21.5 ºC	**24.1 ºC**	21.2 ºC
Topp at Graves Culvert (33.5)	Dewatered							
Topp. above Mud Lake Drain (31.5)	Malfunctioned							
Topp. below Mud Lake Drain (31.4)	25.2 ºC	13.7 ºC	21.1 ºC	19.8 ºC	18.4 ºC	23.9 ºC	**24.5 ºC**	23.4 ºC
Topp. at Unit 2 (26.5)	Malfunctioned							
Topp. at Lateral C (21.3)*	33.6 ºC*	7.1 ºC	19.6 ºC	18.2 ºC	16.9 ºC	24.1 ºC	**28.9 ºC**	23.4 ºC
Topp at Zimmerman's (21.2)	Malfunctioned							
Topp mid channel at Ashue Rd. (19.1)	Lost							
Topp at Campbell Rd. Mid channel (18.6)	Lost							
Topp before Snake Creek (18)	27.2 ºC	6.5 ºC	19.7 ºC	18.5 ºC	17.3 ºC	26.8 ºC	**27.0 ºC**	26.1 ºC
Topp. below Hwy97 (10.7)	Malfunctioned							
Toppenish at Indian Church Rd.	24.0 ºC	10.8 ºC	19.5 ºC	18.0 ºC	16.8 ºC	21.8 ºC	**23.4 ºC**	21.5 ºC
Mill Creek (10.4)	18.6 ºC	2.0 ºC	13.8 ºC	12.5 ºC	11.5 ºC	17.5 ºC	**18.1 ºC**	17.0 ºC
NFSimcoe (24.9)	17.4 ºC	2.1 ºC	11.5 ºC	9.8 ºC	8.3 ºC	15.7 ºC	**17.0 ºC**	15.4 ºC
Simcoe at N White Swan (8.1)	19.2 ºC	4.6 ºC	14.4 ºC	12.5 ºC	10.5 ºC	16.9 ºC	**18.7 ºC**	16.5 ºC
Simcoe at Barkes (2.7)	23.2 ºC	6.0 ºC	17.2 ºC	15.8 ºC	14.4 ºC	21.5 ºC	**22.6 ºC**	21.0 ºC
Agency at Woodchoppers	21.3 ºC	2.7 ºC	13.6 ºC	12.0 ºC	10.4 ºC	19.4 ºC	**20.8 ºC**	19.0 ºC

* Maximum water temperature affected brief spike in water temperature MWMT, MWAT not affected.

MWMTs generally increased from downstream towards the mouth (Table 2) with the exception of the site at Indian Church Road where water temperatures appear to be influenced by recharge on the floodplain and marion drain. The highest water temperatures (MWMT = 27.0 ºC) occurred in the reach near the Snake Creek inlet at RM 18. This excludes 2 sites (Toppenish Creek at Lateral C and Toppenish Creek the Cleparty diversion) that appeared to undergo brief moments of dewatering or warmwater discharge. For example the site at the cleparty diversion recorded a spike in water temperature lasting about 5 days and peaking on June 1st This could be due to changes in water withdrawals in this heavily irrigated reach of Toppenish Creek. These occurrences, although brief (2-5 days), could be highly detrimental to cold water aquatic life. 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 at Indian Church Rd. in the refuge where the MWMT was 23.4ºC. Water temperature appears to decrease slightly below HWY 97.

Sections of Toppenish Creek dewatered downstream from Wesley Rd as they normally do during the summer. However, only several short reaches (< 100 meters) went dry in 2009 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. In fact, our thermograph at the Shaker Church site displayed a MWMT similar to that seen about 10 miles upstream above the Olney-Lateral Diversion

We continued Toppenish Creek section near the Olney-Lateral Diversion at RM 44.2. Thermographs were placed every 0.5 to 1.0 miles apart from the Deer Butte Rd. water hole (swim hole; RM 46.8) before Toppenish Creek emerges from the canyon downstream to Wesley Road (Cleparty Diversion; RM 41.5). The Olney- Lateral Diversion intake is near the half-way point. Unfortunately, our upper most thermograph failed to download. The next one downstream (1 mile below swim hole) recorded a MWMT of 23.8ºC. At subsequent sites further downstream Maximum Weekly Maximum Temperatures (MWMT) increased by small increments (0-0.9 degrees C). At the furthest downstream site in this reach at the Cleparty diversion a MWMT of 26.4º was recorded—a 2.6 degrees increase over a 4.7 mile reach. Overall, MWMT increased this year compared with 2008. Flows downstream 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. Since the implementation of minimum instream flows in this reach, vegetation appears to have improved in the reach between Wesley and Signal Peak roads resulting from the nearly continuous flows.

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; 18.6ºC). The water temperature in 2008 at the same location was about 16.7—almost 2 degrees lower. *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.

Only three of our Simcoe Creek thermographs downloaded and produce reliable data in 2009. Most Units dewatered this year due to low flows and poor placement.

Satus Creek

In 2009, we deployed 24 Onset Stowaway and Hobo Temp Pro v2 data loggers in the Satus Creek watershed to assess the suitability of water temperature for salmonids including ESA listed steelhead and other cold water biota. Yakama Nation Fisheries have monitored water temperature in the Satus Creek basin since 1996. We intend to use this long term data to evaluate changes within the watershed that may affect water temperature (i.e., restoration projects, grazing practices, and timber harvest).

Temperature data-loggers were placed in canisters and anchored with aircraft cable to trees, root-wads or other available permanent structures that could withstand high flow events. They were generally placed in low flow channels that were less likely to dewater during the summer. We began deploying the data-loggers in early march 2009 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 downstream on each stream, which defines the upper extent of steelhead spawning and rearing habitat to their confluence with Satus Creek. Additionally, we deployed several data-loggers at headwater sites beyond the upper extent of steelhead spawning habitat. The units were in place and continuously recording water temperatures at 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 8.8ºC downstream from falls (RM 44) to 16.4ºC near the mouth (Table 3). The greatest instantaneous maximum (26.1 ºC) for the Satus Creek watershed occurred at the Plank Rd location (RM 7.4). Like other lower Yakima River Tributaries water temperatures were higher in 2009 than in 2008 for most of the Satus watershed. The maximum 7-day average of the daily maximum (MWMT) and average (MWAT) water temperature were used as an index to evaluate suitability for salmonids and other cold water biota along the course of the stream. MWMTs were higher in 2009 than in previous years. The highest (25.8º C) was recorded at the Satus Creek site at Plank Road. Last year (2008) the highest MWMT (24.0º C) occurred at the 1st crossing, which is typically the warmest location in the watershed. An examination of the past 14 years of Satus Creek water temperature data suggests that summer water temperatures were cooler in 2008 than in any other year since 1994. In the years spanning 1994 to 2007 and also 2009 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. Water temperature were well above optimal for much of the mainstem Satus Creek in 2009 probably affecting survival of steelhead parr. During the summer there are several reaches that dewater followed by areas of upwelling. These upwelling areas, as well as springs and tributary confluences (i.e., Dry Creek and Logy Creek) provide important rearing habitat for steelhead.

Table 3. 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)	23.2 ºC	6.3 ºC	17.6 ºC	16.4 ºC	15.2 ºC	21.6 ºC	**22.9 ºC**	21.5 ºC
Plank Rd (7.4)	26.1 ºC	0.6 ºC	18.7 ºC	16.3 ºC	13.9 ºC	24.4 ºC	**25.8 ºC**	24.1 ºC
Below Dry Creek (18.7)	Dewatered							
1st Crossing (20.2)	23.1 ºC	4.3 ºC	16.5 ºC	15.1 ºC	13.7 ºC	22.0 ºC	**22.8 ºC**	21.7 ºC
Above Logy (23.6)	22.5 ºC	4.3 ºC	17.0 ºC	15.1 ºC	13.5 ºC	21.1 ºC	**22.3 ºC**	20.9 ºC
High Bridge (32.4)	26.0 ºC	2.9 ºC	16.5 ºC	13.9 ºC	11.7 ºC	22.5 ºC	**25.3 ºC**	22.0 ºC
4th Crossing (34.1)	lost							
County Line (37)	25.6 ºC	2.7 ºC	15.8 ºC	12.4 ºC	9.6 ºC	21.3 ºC	**24.9 ºC**	20.7 ºC
Below Kusshi Creek	23.5 ºC	3.1 ºC	15.0 ºC	12.2 ºC	9.9 ºC	20.6 ºC	**23.0 ºC**	20.0 ºC
Wilson Charley (39.2)	22.2 ºC	2.5 ºC	13.8 ºC	11.0 ºC	8.8 ºC	18.9 ºC	**21.9 ºC**	18.4 ºC
Wooden bridge (40.8)	21.4 ºC	1.9 ºC	12.9 ºC	10.3 ºC	8.3 ºC	18.1 ºC	**20.9 ºC**	17.6 ºC
Below the Falls (44)	17.7 ºC	0.1 ºC	10.6 ºC	8.8 ºC	7.2 ºC	15.2 ºC	**17.2 ºC**	14.8 ºC
Satus at upper Lakebeds Rd. Crossing	Lost							
Logy at Mouth (0.5)	23.7 ºC	3.5 ºC	15.4 ºC	13.8 ºC	12.0 ºC	21.8 ºC	**23.4 ºC**	21.5 ºC
Logy at 4th crossing	malfunctioned							
Logy below the falls	18.5 ºC	1.5 ºC	12.0 ºC	10.2 ºC	8.2 ºC	16.5 ºC	**18.0 ºC**	16.2 ºC
Logy below confluences	13.7 ºC	3.1 ºC	10.1 ºC	8.9 ºC	7.7 ºC	12.3 ºC	**13.5 ºC**	12.2 ºC
Section Corner Spring at lower crossing	14.4 ºC	2.7 ºC	11.4 ºC	9.3 ºC	7.4 ºC	11.6 ºC	**13.6 ºC**	11.4 ºC
Section Corner Spring at mid crossing	13.1 ºC	4.0 ºC	10.7 ºC	8.7 ºC	7.3 ºC	10.1 ºC	**12.3 ºC**	10.0 ºC
Section Corner Spring at source	malfunctioned							
Dry Mouth (1.2)	21.7 ºC	4.4 ºC	17.4 ºC	15.0 ºC	13.0 ºC	19.4 ºC	**21.1 ºC**	19.0 ºC
Dry at Elbow Crossing (18.5)	21.9 ºC	3.4 ºC	15.8 ºC	13.7 ºC	12.2 ºC	19.1 ºC	**21.6 ºC**	18.8 ºC
Dry Below Falls	malfunctioned							
South Fork of Dry Creek	9.7 ºC	5.1 ºC	8.5 ºC	7.4 ºC	6.8 ºC	8.1 ºC	**9.4 ºC**	7.9 ºC

Mean daily water temperatures in the portion of Logy Creek available for anadromous species spawning ranged from 10.2 º C to 13.8 º C. The instantaneous maximum water temperature ranged from 13.7 º C to 23.7º C. Water Temperatures in Logy Creek were probably suitable for steelhead trout during the warmer months along most of its 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, 23.7 º C; MWMT, 23.4 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, displayed somewhat lower water temperatures (mean daily water temperatures; 13.7 º C to 15.0º C Inst. Max, 21.7ºC to 21.9ºC). The highest MWMT temperature (21.6ºC) 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 the 09 yearclass may be smaller than those seen in 07 and 08.

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 3). Water temperatures at these sites are cool and stable throughout the year (Inst. Maximums range from 9.7 º C to 14.4 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.

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 steelhead production.

Steelhead spawning ground surveys were performed on Ahtanum, Toppenish, and Satus Creeks in 2009. 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 2009. 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. We were able to complete all planned surveys on Satus Creek in 2009

<u>Methods</u>

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 as long as 21 years for some reaches. The methodology has changed little within that time period. One additional improvement that we have implemented since 2000 is the collection of GPS waypoints to pinpoint the most productive spawning reaches.

Two surveyors typically cover a 2 to 7 miles survey reach, walking in a downstream direction. Surveyors wear polarized glasses to aid in spotting redds. Each identified red is marked with a GPS with an accuracy of roughly +/- 30 feet. Redds are marked with fluorescent flagging to prevent counting redds identified on previous passes. Each redd is measured and its location in relation to the stream bank and thawlweg are recorded. The presence or absence of direct cover is also noted on data sheets. It is unlikely that resident rainbow trout redds (or redds from other redd building species) are mistaken for anadromous steelhead redds because of the small size of all non-adult steelhead O. mykiss observed in these watersheds during population surveys (i.e. redd counts, snorkel surveys). The number of live steelhead adults and carcasses are also recorded. When possible, the sex of live steelhead and carcasses is noted. Surveyors take care not to disturb spawning fish or possible staging pools when conducting spawner surveys.

<u>Toppenish Creek</u>

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 2009, a survey of the upper Toppenish Creek mainstem could not be completed due to a snowmelt runoff event until May. Road conditions rarely inhibit access to Simcoe Creek and its tributaries because much of the watershed is located in the valley, although high flows sometimes cause unfavorable conditions. On the lower 18 miles of habitat on Toppenish Creek access can be limited by high flows that can exceed 200 cfs for several weeks making spawning surveys dangerous. In 2009, we completed only two passes on the lower portion of the Toppenish Creek mainstem spawning habitat. We were able to complete two passes on Simcoe Creek.

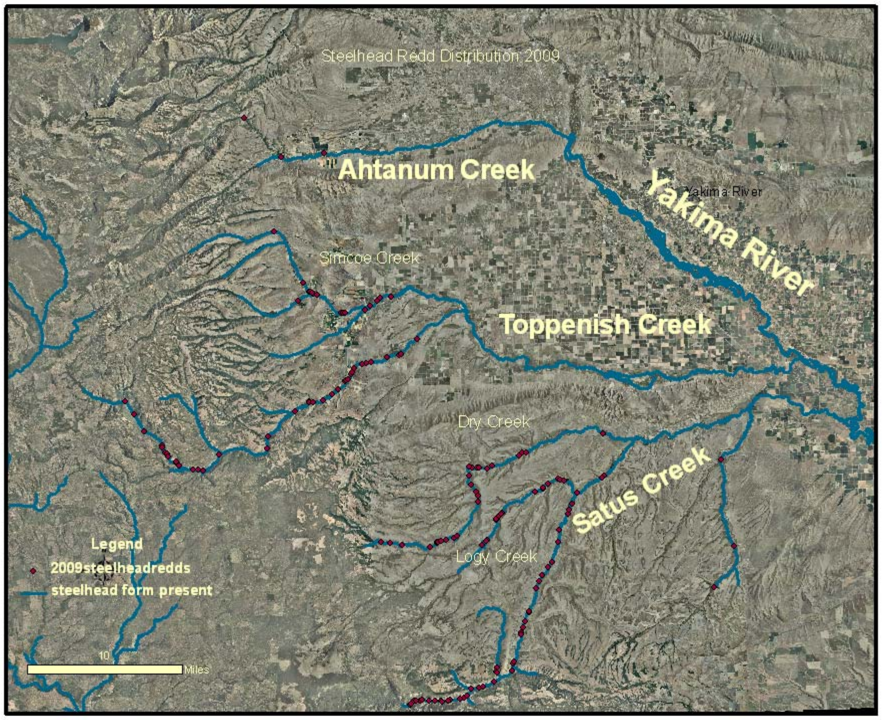

Figure 1. Location of Redds in Ahtanum, Satus, and Toppenish Creek in 2009 collected with handheld GPS units.

We identified more redds in 2009 (79) than we found in 2008 (68). This suggests an increasing trend in the steelhead population since a low point in 2006 with only 21 redds identified in the Toppenish Creek watershed. Survey effort was less and redd recognition conditions were probably slightly better in 2009 than in 2008. Despite the less than optimal conditions in 2008 we identified more redds than in the previous three years. It is likely that 79 redds for the Toppenish basin is a substantial underestimation of actual redds and steelhead spawning activity. The best spawning habitat in the Toppenish Creek watershed is probably located above the North Fork of Toppenish Creek (RM 55). However, this portion of the watershed is difficult to access during what is likely the peak spawning period (early April to Mid May). This year we were able to access the upper portion of Toppenish Creek during before the third week of May and we found 33 redds above the North Fork and in the North Fork. In previous years, only two redds were identified in the upper Toppenish Creek in 2006 and 14 were observed in 2007. Both of these surveys were conducted well after the peak spawning period. 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.

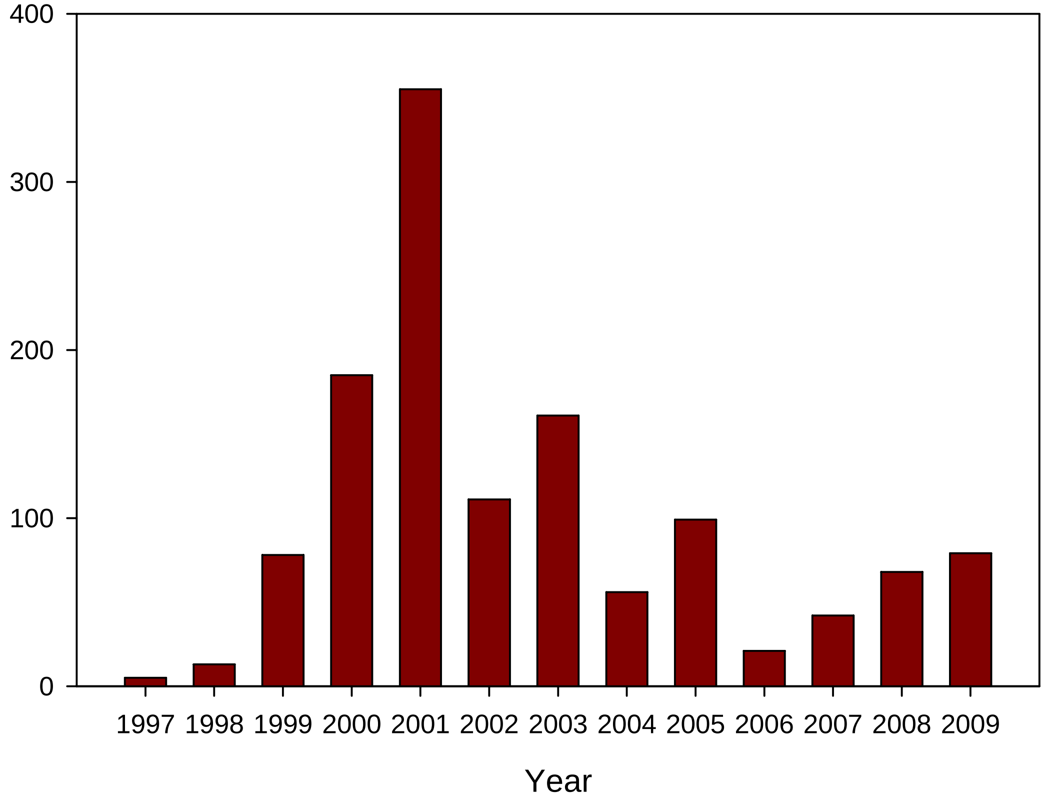

Figure 2. Number of Redds in the Toppenish Creek watershed for past 12 years.

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 2009; however, only one pass was completed due to a manpower shortage. We identified 18 redds in the Simcoe Creek watershed in 2009. More redds (N=26) were identified in the Simcoe Creek watershed in 2008. Only 10 steelhead redds were identified in 2006. The distribution of redds throughout the Simcoe Creek watershed was similar to that seen during the previous years (2006-2008). Redds were observed near the upper limits of the North Fork of Simcoe 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 habitat and redd numbers are often comparable to the North Fork of Simcoe Creek. One redd was identified in Whatum Creek this year—like 2008.

Table 1. Number of Steelhead redds per reach in the Toppenish Creek watershed in 2009.

Upper Toppenish Watershed	Distance miles	Number of Redds

Toppenish	O Conner Creek (65.7)	East Bank (62.4)	3	**3**
	East Bank (62.4)	NF confluence (55.4)	7	**14**
	NF confluence (55.4)	Wash out (53.5)	4.5	**2**
	Wash out (53.5)	Wiley Dick (48.5)	5	**2**
	Wiley Dick (48.5)	Olney Lateral (44.2)	4.9	**10**
	Olney Lateral (44.2)	Marion Drain Rd. (38)	4.2	**11**
	Marion Drain Rd. (38)	Shaker Church Rd. (35.9)	4	**3**
total			29.5	**61**
N. Fork Toppenish	NF Falls (4)	NF confluence (0)	4	**16**
Willey Dick	old logging site (4)	Confluence (0)	4	**0**
		Simcoe Creek Watershed		
Simcoe	NF at 2nd crossing (6.5)	Diamond Dick (3.4)	3.1	**0**
	NF at Diamond Dick (3.4)	NF/SF confluence (0)	3.4	**1**
	SF 6 mile above confluence (6.2)	3 mile above confluence (3)	3.2	**0**
	SF 3 mile above confluence (3)	NF/SF confluence (0)	3	**0**
	NF/SF confluence (18.9)	Simcoe Creek Rd. (15.3)	3.6	**1**
	Simcoe Creek Rd. (15.3)	Towtnuk Rd. (12.7)	3.1	**10**
	Towtnuk Rd. (12.7)	N. White Swan Rd. (8.1)	2.8	**3**
	N. White Swan Rd. (8.1)	Stephenson Rd. (5.9)	2.3	**1**
total			24.5	**16**
Agency	Falls (8.9)	Western Diversion. (4.4)	4.5	**0**
	Western Diversion. (4.4)	Confluence (0)	4.4	**1**
total			8.9	
Wahtum	Yesmowit Rd. (3.6)	Confluence (0)	3.6	**1**
Total			77.6	**79**

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 2009 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.

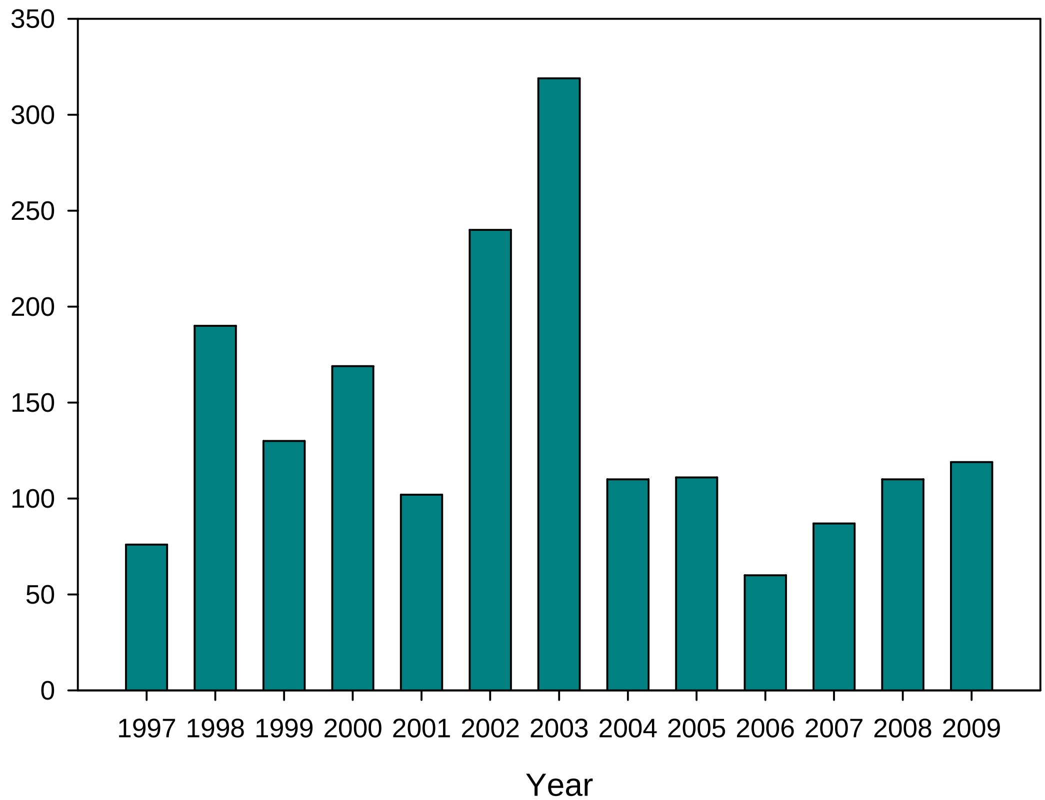

Figure 3. Number of Redds in the Satus Creek watershed for past 12 years

A total of 119 steelhead redds were identified in the Satus Creek watershed in 2009 compared to 110 in 2008. 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. 119 redds still falls below the 10-year average of 146 redds. The stream conditions this season were improved over those seen last year. 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 2009 to those observed 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 previous years (Figure 1). Slightly more redds were observed in the mainstem Satus, Dry and Logy Creeks in 2009. A significant increase in both steelhead redds and live adult steelhead was observed in the upper survey reach below the falls in the mainstem Satus Creek in 2009. Redd numbers were higher in Kusshi and Mule Dry 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. In 2009, we observed one Redd in Shinando Creek which rarely show activity from spawning steelhead. No redds were observed in Wilson Charley Creek in 2009.

Table 2. Number of steelhead trout redds per reach in the Satus watershed in 2009

Stream	Start location	End location	Distance (miles)	# of Redds
SATUS	Falls (44.1)	Wood Bridge (40.8)	4.2	**15**
(3 passes)	Wood Bridge (40.8)	County Line (36.4)	4.4	**7**
	County Line (36.4)	High Bridge (32.4)	4	**10**
	High Bridge (32.4)	Holwegner(28.4)	4.8	**9**
	Holwegner (28.4)	2nd X-ing (23.7)	3.9	**7**
	2nd X-ing (23.7)	1st Xing (20.2)	3.5	**9**
	1st X-ing (20.2)	Gage (17.4)	2.8	**0**
	Gage (17.4)	Rd 23 (13.1)	4.3	**0**
total			31.9	**57**
LOGY	Falls (14)	Spring Cr (11)	3	**1**
(3 passes)	Spring Cr (11)	S. C. Ford (9.5)	1.5	**3**
	S. C. Ford (9.5)	3rd Xing (3.5)	6	**11**
	3rd Xing (3.5)	Mouth (0.0)	3.5	**5**
total			14	**20**
DRY	South Fk. (27.8)	Saddle (24)	3.6	**6**
(3 passes)	Saddle (24)	Elbow Xing (18.25)	5.75	**6**
	Elbow Xing (18.25)	Seattle Cr (14)	4.25	**2**
	Seattle Cr (14)	Rd 75 bend (8.75)	5.25	**8**
	Rd 75 bend (8.75)	Power Line Ford (2.5)	6.25	**11**
	Power Line Ford (2.5)	Mouth (0.0)	2.75	**1**
total			27.85	**34**
W. CHARLEY	Forks (1.9)	Mouth (0.0)	1.9	**0**
KUSSHI	Top (11th) Xing (5.5)	Mouth (0.0)	4.5	**4**
SHINANDO	Ford (0.5)	Mouth (0.0)	0.5	**1**
MULE DRY	Yakima Chief Rd. (11.35)	Rd. 39	11.35	**3**
TOTAL			82.05	**119**

<u>Ahtanum Creek</u>

Conditions for spawning surveys were poor in 2009 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 April 8th, 2009. We documented a total of 3 redds during this survey. Two redds were located below the confluence of the North and South Forks of Ahtanum Creek. One redd was located in the North Fork Ahtanum Creel downstream from the USGS gage. Redd count surveys are probably not sufficient to evaluate changes in the steelhead population of Ahtanum Creek because of turbid high flow conditions during the peak of the spawning season (early April through mid May).

Table 3. Number of Steelhead Redds counted in the Ahtanum Creek watershed in 2009

Stream	Survey Reach	MILES	DATE	REDDS	LIVE
Ahtanum			**4/8/2009**		
Mainstem	Forks conf. To AID Diversion	5.0		2	0
	AID to American Fruit Rd.	5.3		0	0
	American Fruit Rd. to 62nd	5.3		0	0
	62nd to 16th	4.2		0	0
	16th to Yakima R.	4.1		0	0
	TOTALS	23.9			
North Fork	4 miles to confluence	4.0		1	0
	TOTALS	4.0		0	0
South Fork	4 miles to confluence	4.0		0	0
	TOTALS	**31.9**		**3**	**0**

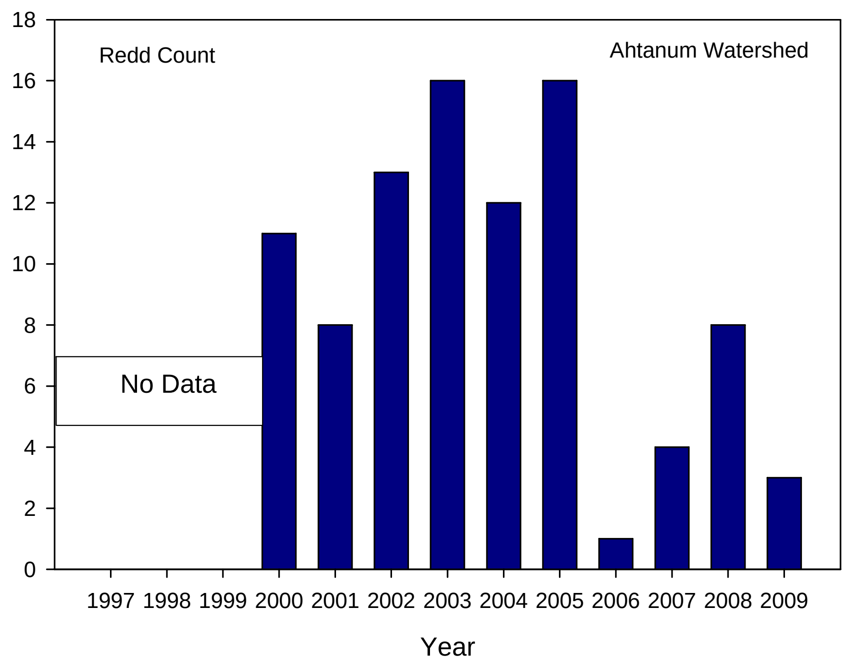

Figure 4. Number of steelhead redds in the Ahtanum Creek watershed for past 10 year

Coho Salmon

Coho Salmon spawn in the lower reaches of Ahtanum Creek each fall. Most of the coho observed spawning in the Ahtanum are strays from a reintroduction program headed by the Yakama Nation that has targeted tributaries of the upper Yakima River. The coho salmon reintroduction program began acclimating and releasing coho salmon in Ahtanum Creek in 2008. Some of these will likely begin returning next year. Yakama Nation Fisheries personnel have conducted Coho surveys in Ahtanum since 2001. Three passes were conducted in Ahtanum Creek during our fall 2008 coho salmon surveys between the mouth and the bridge at Goodman Rd. at RM 2.8. The methodology used was nearly identical to that used for steelhead spawning surveys. The first survey was performed on November 17th 2008, the 2nd was performed on November 25th 2008, and the third on December 1st 2008. A total of 9 coho redds and three live adult coho were identified in Ahtanum Creek in 2008. Most coho salmon redds were identified in Fulbright Park about 0.5 miles upstream from the mouth. Redd numbers were up from 2007 when only 5 coho redds were documented in this reach.

Bull Trout

A small population of bull trout resides in the headwaters of Ahtanum creek. Bull Trout redds were surveyed in September and October 2009. 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 six redds were identified during the three passes of our survey in 2009 (Figure 5). The first survey was conducted on September 3, 2009, with 3 redds located. During the second pass on September 16th 2009, 2 new redds were identified. During the third pass on October 3rd 2009, 1 redd was identified. In 2008, a total of three 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 redds because of their small size. Six live bull trout were also seen during the 1st pass.

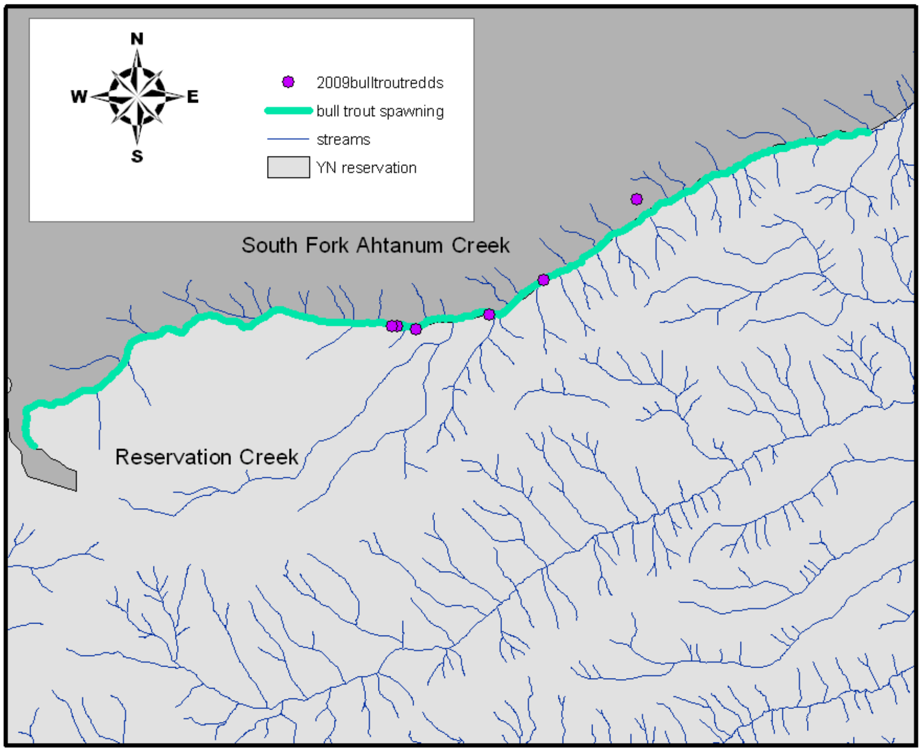

Figure 5. Locations of Bull Trout Redds in 2009 on the South Fork of Ahtanum Creek.

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.

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

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

A. Satus Creek Dam Removal

Background

Satus Dam, also known as the Shadduck dam was placed in Satus creek over half a century ago as a Wapato Irrigation Project (WIP) structure. It was used to divert water to supplement the irrigation water in the Satus District of WIP. The diversion has not been used by WIP for 20 years because WIP found other ways to supplement water to the lower end of the project. WIP intended to remove the dam, but unfortunately adequate funding to do so was limited.

The dam spans Satus Creek and has about a 2-ft drop with a fish ladder along the left side. The fish ladder would either be blocked by debris or man (poaching) and posed a fish passage barrier. The Yakama Nation Fisheries (YNF) wanted to remove the dam to improve fish passage for Mid Columbia ESU steelhead. Therefore YNF worked with YN personnel to develop a plan to breach the dam and improve fish habitat and fish migration.

1. Satus Dam

Project Description:

This project is located in the NW ¼, SW ¼, Township 9 North, Range 21 East, Section 7, on Tribal Trust Land. YNF obtained land owner permission to breach Satus dam. YNF proposes to remove the dam to a finished grade and abandon and remove the fish ladder. A roughened channel well replace the dam and provide fish passage, grade control stability and fish habitat.

The roughened channel concept was engineered by a professional engineer with experience in hydraulic engineering and geomorphology. The engineer performed a reach assessment of the area to locate any hazards like headcuts or areas primed for avulsion.

Once Satus dam is removed and the roughened channel is completed YNF staff will revegetate the site with riparian species appropriate for the area.

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. A tracked excavator was used to remove the concrete dam and fish ladder. The excavator also placed the rocks that formed the roughened channel.

During construction to mitigate for water quality project had to divert the stream out of the construction area. All heavy equipment that worked in or around the stream used hydraulic fluid for environment and water quality safety measures. Coffer dams were used to isolate the stream to the right channel during construction of the main channel. The construction channel had to be dewatered due to water seeping into area and making it difficult to design the roughened channel. Removal of the construction water was pumped into the existing ditch that ran adjacent to the dam.

The roughened channel was developed by using the cross section of the upstream and downstream of the dam. The channel was sized to match bank full channel capacity through the project reach. Channel roughness elements had protruding boulders which reduced the potential of supercritical flow conditions at the crest of the roughened channel and episode of a hydraulic jump. The roughened channel was designed to look like the natural stream system.

The flood plain roughness was achieved by placing large woody debris in the area that will cause recruitment of debris during high flows. Flood plain revegetation was accomplished using a stinger attachment which is used for planting at severely compacted sites, gravel bars along streams, and steep road cut and fill slopes. The stinger can plant 5 to 6 feet deep and accommodate various plant sizes, including one-gallon trees. It can pierce the ground and insert plants at a rate of five seedlings or cuttings per minute, providing rapid and efficient planting. All disturbed soil on the flood plain was hydroseeded with native vegetation.

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 breach a 65ft concrete dam that had about a 2-ft drop with a fish ladder along the left side. During low flows it would interfere with fish migration and it had been reported that the ladder would be blocked to allow poachers easy access to catch up-migrating steelhead. Breaching of this dam and the roughened channel improved migration up and downstream as well as fish habitat in this area.

Conclusion:

YRWP staff has successfully removed the first dam on the Yakama Reservation. Staff is confident that this project will allow easier access to key habitat for Mid Columbia ESU steelhead in the Upper Satus creek Watershed.

B. Ahtanum Creek Bank Stabilization

Project Description:

Flooding events have altered the course of Ahtanum Creek through the erosion of the south bank of Ahtanum Creek and the deposition of gravel bars, which is blocking a portion of the old channel. This has caused the stream to partially capture a farm service road on the south side of the Ahtanum Creek. Currently the stream is close to avulsing to the south which is not desirable in this instance. Our plan is to sufficiently roughen the areas primed for avulsion so that the stream stays in its current alignment. This will be done with engineered structures made of logs (large woody debris.) Using large woody debris will serve two purposes, stabilizing the bank and providing habitat for juvenile salmonids in the area.

In the spring of 2009, high spring run-off required a temporary plan to be immediately implemented to stabilize this bank on Ahtanum Creek. Ahtanum creek was attempting to reroute a new channel down the farm road. To prevent further degradation and erosion to this area large rock was put in to stabilize the bank and to keep the creek in it's original alignment.

Project Update:

An engineered plan for permanently stabilizing Ahtanum Creek at this location has been completed. This plan was used to apply for a Yakama Nation Watercode permit, JARPA, Cultural Resource Approval, and WDFW permit. All permits have been approved and project will commence in the summer of 2010. Project staff is currently working on contract for construction.

C. Renchtlers Meadow Fence Extension

YRWP staff constructed 4 miles of new meadow exclosure fence in 2009. New construction included an extension to Renchtlers Meadows.

Meadow exclosure fencing is done in order to allow vegetation to re-establish. The headwater of Renchtlers was never enclosed and was getting overgrazed by wild horses and cattle. YRWP staff received permission to enclose the headwaters of Renchtlers meadows and built the enclosure fence to NRCS specifications in the summer of 2009. This meadow will continue to be monitored by staff.

D. Lincoln Meadows Buck and Pole

Heavy snow fall has continued to disable the fence that encompasses Lincoln Meadows. Staff had to take a different approach in building a fence in this area that would stay intaked in heavy snow fall. Staff built a buck and pole fence in areas where snow was destroying the existing fence. This type of fence should withstand heavy snow fall and allow for less maintenance on the Lincoln Meadows fence line.

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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