B O N N E V I L L E   P O W E R   A D M I N I S T R A T I O N

Yakama Reservation Watersheds Project

Annual Report 2005 - 2006 | August 2006 | DOE/BP-00025127-1

This Document should be cited as follows:

Rogers, Brandon, "Yakama Reservation Watersheds Project", 2005-2006 Annual Report, Project No. 199603501, 38 electronic pages, (BPA Report DOE/BP-00025127-1)

Bonneville Power Administration
P.O. Box 3621
Portland, OR 97208

This report was funded by the Bonneville Power Administration (BPA), U.S. Department of Energy, as part of BPA's program to protect, mitigate, and enhance fish and wildlife affected by the development and operation of hydroelectric facilities on the Columbia River and its tributaries. The views in this report are the author's and do not necessarily represent the views of BPA.

FY2006 ANNUAL REPORT

NOVEMBER 1ST 2005 THROUGH OCTOBER 1STST, 2006
YAKAMA RESERVATION WATERSHEDS PROJECT
BPA Project #1996-031-01-Contract #25127

Table of Contents

I. Introduction

Overview

In June of 2005, the Ahtanum Watershed Assesment, Toppenish Watershed and Satus Watershed Projects were combined into one project, named the Yakama Reservation Watersheds Project (YRWP.)
Since the last report in 2005, 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 begun new projects including a large riparian fencing project, experimental floodplain roughness projects using straw bales, and streamside revegetation at several locations along Ahtanum Toppenish and Satus Creeks.

II. Collect Data

A. Screw Traps

Ahtanum Creek

We monitored the steelhead outmigration in Ahtanum Creek through the use of a five foot rotary screw trap. The trap was deployed at river KM 5 upstream from the Goodman Rd. crossing. For the 2006 season, the trap was in place between December 1, 2005 and June 16, 2006. Cold weather and low flows prevented the cone from rotating until December 19th. The stream channel configuration has changed from previous years making the trap less efficient During the period of operation, the trap was checked daily in the mornings including most holidays and weekends. Heavy spring flooding in May forced us to lift the cone for a period of 12 days.

All Juvenile steelhead were anesthetized in MS-222 before being handled. They were then enumerated, measured and weighed. We inserted PIT tags into a sub-sample of the captured steelhead that measured greater than 100 mm to evaluate survival and migration timing. Scales (target # 100) were collected from steelhead individuals of varying sizes to use in conjunction with PIT tag data to assess survival by year class. We collected fin clips from steelhead smolts (target # 100) for use in DNA studies as well. After handling, we released steelhead juveniles 100 meters downstream. Physical data (water temperature, air temperature, and percent cloud cover) were recorded.

Results

We operated the Ahtanum Creek rotary screw trap for a 1 day period. During that time the trap was operating effectively (i.e., deployed and cone rotating for the entire 24 hour period) on 98 days (56% of operating time). Steelhead were captured on 49 of 174 days (28% of total operating days). Low flow sometimes prevented the cone from rotating. Clogging by debris is rarely a problem in Ahtanum Creek.
Fewer steelhead smolts were captured in 2006 (N=121) than in 2005 (N=534); however, a similar pattern in catches was observed (table 1). Although steelhead juveniles

consistently trickled into our trap in small numbers throughout the season beginning on December 14th, 2004 and ending on May 21st, 2005, the majority of our season's out-migrant catches were associated with a spike in discharge in May (Figure 1). Unfortunately, during this period, minor flooding made it unsafe to operate the screw trap consequently, a 12 day break in our continuous screw trapping schedule occurred. It is likely that we missed a significant number of outmigrating juveniles during this period. Our largest daily catches commonly occurred on downside of the flow spike. Similar to previous years, May 15th produced our largest daily catch of 13 smolts in 2006. Only four (3% of the total) steelhead mortalities were documented in 2006. Because of the lower current velocity at this site and lower debris load compared to our Satus Creek and Toppenish Creek sites, trap mortality rarely occurs at the Ahtanum Creek screw trap. We PIT tagged 115 juveniles in 2006.

The average length of captured fish increased at the end of the season, particularly during April and May when conditions for growth (i.e., temperature) were probably in an optimal range. Migration of older age 2 and 3 year old smolts during this period may account for the larger average size; however at this point, it is unknown. We hope ages derived from the scales collected will shed more light on the migration timing and survival of the different age classes. Mean fork length for all individual captured was larger in 2006 (185 mm) compared to the length (134 mm) of all steelhead captured in 2005.

To estimate the numbers of steelhead smolts migrating past our trap we periodically conducted efficiency tests (mark-recapture) by marking all or a sub-sample of the days catch with PIT tags and releasing the marked fish several hundred meters above our screw trap. In 2006, a total of 18 steelhead were released upstream for use in two separate efficiency tests. Out of all marked steelhead smolts, only 3 were recaptured at the trap. Minor adjustments in trap position and flow levels affect the efficiency of the trap operation. This produced at an overall efficiency of 16.6% compared to an efficiency of 34% in 2005. An extrapolation on our catch numbers suggest that approximately 720 steelhead juveniles migrated through the trap zone in 2006 while the trap was fishing. Due to the small sample size, small number of efficiency releases, and a

Table 1. Descriptive statistics for water temperatures at the Ahtanum Creek Screw Trap at RM 3 for the 2004-2005 season

Statistics	Nov	Dec	Jan	Feb	March	April	May	June	Overall
Monthly Catch	.	1	19	1	3	42	54	1	121
% of total	.	0.83%	15.70%	0.83%	2.48%	34.71%	44.63	0.83	100.00%
Max Fork Length	.	83	202	180	190	275.0	385	280.0	385
Min Fork Length	.	83	90	180	131	139.0	160	280.0	83
Mean Fork Length	.	83	154	180	166	187.1	193	280.0	183
Max Weight	.	5.6	82.4	53.4	70.3	192.2	122.8	.	192.2
Min Weight	.	5.6	7.4	53.4	24.9	35.5	42.5	.	5.6
Mean Weight	.	5.6	42.6	53.4	51.7	69.9	66.8	.	62.8
Mean Cond. Factor	.	0.979	1.069	.92	1.07	1.03	1.04	.	1.04
Number tagged	.	0	18	1	3	42	50	1	115
% monthly catch tagged	.	0.0%	94.7%	100.0%	100.0%	100.0%	92.6%	100.0%	95.0%

12 day interruption in our trapping schedule during the probable peak in outmigration; we have little confidence in this estimate. The number of steelhead smolts outmigrating through the trap zone was likely higher.
For the 95 steelhead that were PIT-tagged, we estimated a survival rate of 0.56 to Prosser Dam and 0.87 from Prosser Dam to McNary Dam for an overall survival rate to McNary Dam of 0.48 (48%) with a standard error of 0.19. This year's results appear to be a slight improvement from the survival rate to Prosser Dam in 2005.

Chinook

We captured only two chinook salmon in 2006 compared to the 58 chinook salmon smolts that we captured at the Ahtanum screw trap in 2005. We did not tag any of the Chinook salmon that we captured.

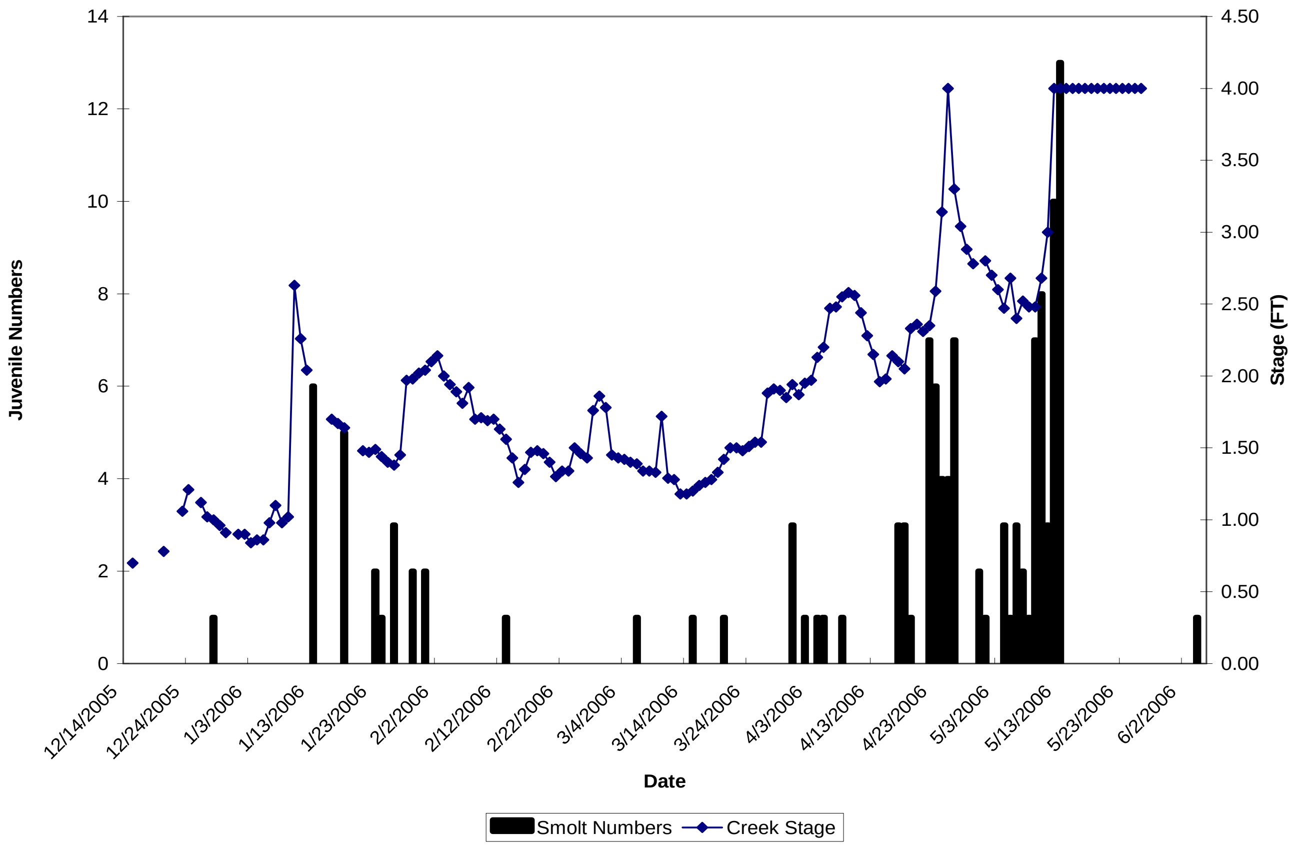

Figure 1. Number of steelhead smolts caught per day in the 2005-2006 out-migration period in the Ahtanum Creek Screw trap compared with river stage.

Satus Creek

We monitored the steelhead out-migration in Satus Creek through the use of a five foot rotary screw trap. The trap was deployed at river km 2 of Satus Creek, at the Satus Creek Wildlife Refuge. For the 2006 season, the trap was in place and operating between November 18, 2005 and June 14, 2006. The trap was operated continuously in all but the highest flows. As in Ahtanum Creek, the stream channel configuration has changed making our site less effective than past years, although an alternative location has been difficult to find. During the period of operation, the trap was checked daily in the mornings including holidays and weekends.

All Juvenile steelhead were anesthetized in MS-222 before being handled. They were then enumerated, measured and weighed. We inserted PIT tags into a sub-sample of the captured steelhead that measured greater than 100 mm to evaluate survival and migration timing. Scales were collected from 142 individuals of varying sizes to use in conjunction with PIT tag data to assess survival by year class. We collected fin clips from 100 steelhead smolts for use in DNA studies as well. After handling we released steelhead juveniles 100 meters downstream. Physical data (water temperature, air temperature, and percent cloud cover) were recorded.

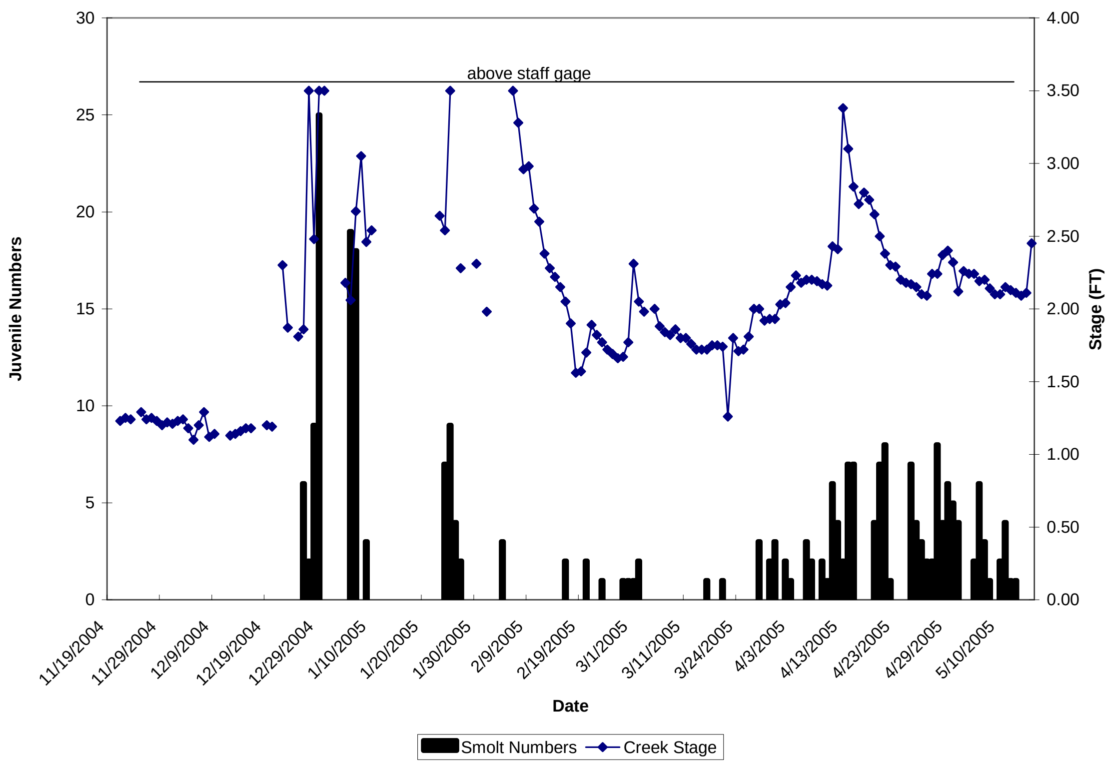

Figure 2. Daily steelhead captures compared with staff gage measurements in Satus Creek during the 2005-2006 out-migration season.

Results

We operated the Satus Creek rotary screw trap for a 199 day period. During that time the trap was operating efficiently (i.e., deployed and cone rotating for the entire 24 hour period) on 174 days (87% of the operating time). Steelhead juveniles were captured on 68 (34%) of the 199 operating days.

Between the dates of December, 27th and June 6th, 298 steelhead smolts were captured (table 2). The highest daily catch for the period of operation was on December 31st (N=25). Peaks in daily catches were associated with spikes in discharge occurring in January during a rain on snow event in the upper Satus Creek watershed and again at end of April (figure 2). Very few fish were captured outside of the periods when discharge spikes were occurring. Higher flow conditions improved our catches slightly over the 2005 season, although the current velocity at the trap location is relatively low and results in a slow rotation of the screw trap cone. Our redd count data, which is comparable and often higher than Toppenish Creek suggest that our catches at this location should be much higher. Additionally, our attempts at efficiency testing, which produced only one recapture, indicate that better positioning or an altogether new location may be needed in order to use this trap to obtain an out-migration estimate. Size (length and weight) jumped during the months of March, April, and May possibly reflecting a migration of age 2 and 3 juveniles or higher growth rates during the spring months due to more optimal water temperatures. Overall, 63 percent of the fish we aged were age one, 33 percent were age two, and 1 percent were age three.

For the 176 steelhead that were PIT-tagged, we estimated a survival rate of 0.85 to Prosser Dam and 0.81 from Prosser Dam to McNary Dam for an overall survival rate of 0.68 (68%) to McNary Dam with a standard error of 0.14. This year's results appear to be a substantial improvement from the survival rate to Prosser Dam in 2005.

Table 2. Monthly catch statistics for steelhead trout in Satus Creek at RM 1 for the 2005-2006 season.

Statistic	Nov	Dec	Jan	Feb	March	April	May	June	Overall
Monthly Catch	0	55	62	10	15	85	69	2	298
% of total	0%	18.5%	20.8%	3.4%	5.0%	28.5%	23.2%	0.7%	100%
Max Fork Length	.	183	145	140	180	195	192	158	195
Min Fork Length	.	76	73	78	89	92	46	147	76
Mean Fork Length	.	102.9	92.7	108.3	148.7	158.1	162.3	152.5	130.5
Max Weight	.	57.3	31.7	28.5	58.0	65.5	68.2	33.5	68.2
Min Weight	.	4.7	2.6	5.1	7.4	8.1	0.8	27.7	0.8
Mean Weight	.	11.1	9.2	13.4	32.8	40.7	34.6	30.6	26.5
Mean Cond.Factor	.	0.93	0.97	0.96	1.00	0.99	0.94	0.86	0.97
Number tagged	.	16	12	8	12	84	62	0	194.0
% monthly catch tagged	.	38.1%	19.4%	80.0%	80.0%	98.8%	89.9%	0.0%	68.1%

Toppenish Creek

We monitored the steelhead outmigration in Toppenish Creek through the use of a five foot rotary screw trap. The trap was deployed at river km 48 of Toppenish Creek, about

10 m downstream from the Wapato Irrigation Project's Unit 2 diversion dam. Yakama Nation Fisheries has operated a screw trap at this location since 2000. For the 2006 season, the trap was in place and operating between November 19, 2005 and June 14, 2006. The trap was operated continuously when flows were sufficiently low to make trap operation safe for technicians and migrating steelhead juveniles. During the period of operation the trap was checked daily in the mornings including most holidays and weekends. The rotation of the screw trap cone was often stopped by woody debris generated from beaver activity upstream. The trap was cleaned a second time before dark when clogging was problem, however; most of the beaver activity appeared to occur at night. In 2006 heavy precipitation and high flows for extended periods of time during the winter and spring made trap operation problematic.

All juvenile steelhead were anesthetized in MS-222 before being handled. They were then enumerated, measured and weighed. On several days when large catches occurred (>200) only a sub-sample were measured and weighed. We inserted PIT tags into a sub-sample of the captured steelhead that measured greater than 100 mm to evaluate survival and migration timing. Scales were collected from 80 individuals of varying sizes to use in conjunction with PIT tag data to assess survival by year class.
We collected fin clips from 64 steelhead smolts for use in DNA studies as well. After handling, we released steelhead juveniles 100 meters downstream below a check dam structure. Physical data (water temperature, air temperature, and percent cloud cover) were recorded.

Results

We operated the Toppenish Creek rotary screw trap for a 206 day period. Flow and debris flow conditions prevented operation of the screw trap for prolonged periods in January, April, and May 2006. Although the screw trap was in place, the cone was deployed for only 107 days (52%) during the operating period. The trap was deemed to be operating efficiently (i.e., deployed and cone rotating for entire 24 hour period) on 56 days (27% of the time). Steelhead juveniles were captured on 60 (56%) of the 107 operating days.

In addition to the target species steelhead trout (Oncorhynchus mykiss), redside shiners (Richardsonius balteatus), speckled (Rhinichthyus osculus) and longnose dace (R. cataractae), chiselmouth (Achrocheilus alutaceus), northern pikeminnow (Ptychocheilus oregonensis), suckers (Catostomus spp.), sculpin (Cottus spp.), goldfish (Carassius auratus), carp (Cyprinus carpio), bluegill (Lepomis macrochirus), pumpkinseed (Lepomis gibbosus), lamprey (Entoshpenus spp.) Black Bulhead (Ictulurus nebulosis) were captured in 2006 or have been captured in past years at the Toppenish Creek trap.

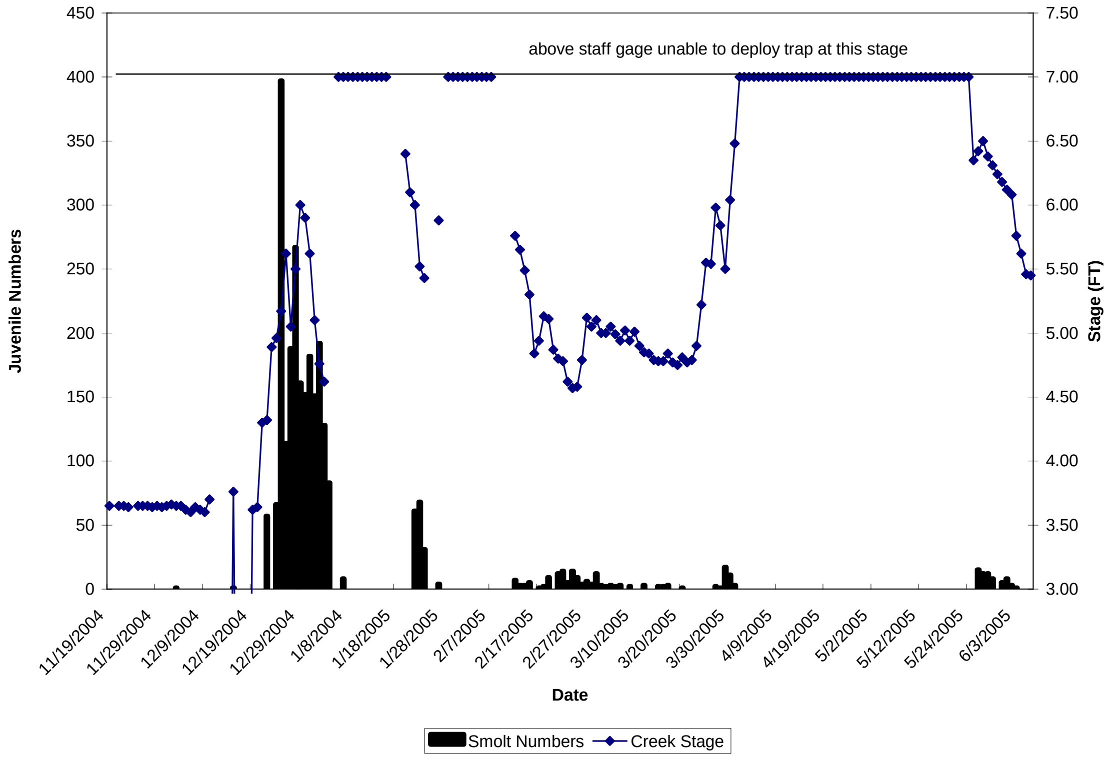

Figure 3. Steelhead juvenile catches compared with creek stage at the Toppenish screw trap.

2546 steelhead juveniles were captured during the season. Although steelhead parr were captured between the dates of 12-3-05 and 5-30-06, most individuals (91%) were captured in December and January as flows increased. The overall catch was roughly half of that caught in 2005. This likely reflected poor operating conditions rather than a change in outmigration because the trap could not be deployed during high flows when peak outmigration tends to occur. It is difficult to discuss outmigration patterns with the numerous breaks in our continuous trapping regime that occurred in 2006 due to high flows. Mortality was 10.7 percent (274 of 2546) in 2006 largely because of an event that occurred on 12-28-06 when 183 smolts were trapped in the screw trap cone with some debris. We refrained from operating the trap in high flows after that date.

Mean fork lengths were similar for each month in Toppenish Creek. The overall mean fork length was 105.8 mm. This is noticeably shorter than the mean fork length of captured smolts in 2005 (137 mm).

We pit tagged 685 steelhead parr in 2006. Thirty five (5%) of these were interrogated at the Prosser juvenile interrogation facility. This does not account for the operating efficiency of the facility. The mean travel time for tagged steelhead smolts was 99 days to migrate the 102 km between the trap and the Prosser facility. Taking into account detection efficiencies at Prosser and McNary Dams, we estimated a survival rate of 0.55 to Prosser Dam and 0.54 from Prosser Dam to McNary Dam for an overall survival rate to McNary Dam of 0.30 (30%) with a standard error of 0.05. The survival rate to Prosser Dam was substantially better in 2006 than in 2005, but the lower survival rate from Prosser Dam to McNary Dam compared to any other tag group cannot be expained at present. Even with this result, the overall survival rate to McNary Dam appears to have been better in 2006 than in the drought year of 2005.

To estimate the numbers of steelhead smolts migrating past our trap, we periodically conducted efficiency tests (i.e. mark-recapture) by marking all or a subset of the day's catch with PIT tags and releasing the marked fish several hundred meters above our screw trap. In 2006, a total of 176 PIT tagged steelhead juveniles were released above the trap. Out of all marked steelhead smolts, 17 were recaptured. Efficiency was expected to change with flows, repositioning, and debris amounts (resulting in trap clogging) in the water. We arrived at an overall efficiency of 9.6%. An extrapolation on our catch numbers suggests that approximately 26,359 juveniles migrated through our trap zone in 2006 when the trap was operating. However, this estimate is probably low because the trap was not deployed for substantial periods of time during peak flows when many fish were likely migrating through the trap zone.

Table 3. Number of steelhead captured per month Toppenish Creek.

Stat	Nov	Dec	Jan	Feb	March	April	May	June	Overall
Monthly Catch	0	1091	1221	88	79	3	64	0	2546
% of total	0.0%	42.9%	48.0%	3.5%	3.1%	0.1%	2.5%	0.0%	100.0%
Max Fork Length	.	200.0	185.0	196.0	196.0	159.0	197.0	.	200.0
Min Fork Length	.	60.0	57.0	62.0	2.4	80.0	118.0	.	57.0
Mean Fork Length	.	107.1	100.5	101.2	108.4	108.7	105.5	.	105.8
Max Weight	.	72.6	61.0	79.0	77.6	34.7	84.1	.	84.1
Min Weight	.	2.1	2.0	1.1	2.4	6.8	20.3	.	1.1
Mean Weight	.	12.8	11.5	13.0	14.6	108.7	47.3	.	13.7
Mean Cond.Factor	.	0.98	0.98	1.01	0.99	1.09	1.09	.	0.99
Number tagged	.	273	282	32	37	1	60	.	685
% monthly catch tagged	.	25.0%	23.1%	36.4%	46.8%	33.3%	93.8%	.	26.9%

B. Snorkeling

Ahtanum Creek

Snorkel surveys were conducted with three-person teams on 200-meter segments. Two surveyors moved upstream dividing the stream in half with each person enumerating the fish in just their half of the stream. The third person followed behind and recorded data. Steelhead / rainbow (were placed into either an Age 0 category for individuals that hatched in spring 2005 or an Age 1+ category for fish hatched in previous years. 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 meters^2). In the

Ahtanum at RM (river mile) 18.9 the Wapato Irrigation Project (WIP) diversion and the Ahtanum Irrigation District (AID) diversions are located in close proximity. Our segments were placed upstream and downstream from this complex. Ahtanum Creek is relatively wide at all three study segments requiring the use of two surveyors to effectively cover the entire width. However, many "blind spots" or areas obscured by rocks or exceedingly shallow areas probably contained fish that went unobserved and not tallied. Due to these limitations, numbers were likely underestimated. Surveys were repeated each month to assess the possible movement or shifts in distribution.

Table 4. snorkel survey rainbow/steelhead (*O. Mykiss*) numbers and densities at irrigation diversions in Ahtanum Creek

	Age 0 O. Mykiss	Age 0 O.Mykiss	Age 1 + O.Mykiss	Age 1 + O.Mykiss
Numbers	Above diversions	Below diversions	Above diversions	Below diversions
July	8	3	5	8
August	24	13	6	15
Densities (per 100 m²)				
July	0.39	0.13	0.24	0.35
August	1.16	0.56	0.29	0.65

Results

Chinook salmon snorkel surveys

We snorkeled a 1-mile segment in August to locate Chinook salmon adults or juveniles and discern whether this or nearby reaches are utilized by this species for spawning.

Toppenish Creek

To assess the effectiveness of established minimum instream flows on steelhead trout in the Toppenish Creek Basin, we snorkeled several segments situated upstream and downstream from one irrigation diversion on Toppenish Creek (Lateral) and one on the N. Fork of Simcoe Creek (Hoptowit). These sites were established in 2005.

Currently there is a minimum instream flow of 12 cfs (cubic feet per second) below the Lateral diversion dam located at RM (river mile) 44.2 (Figure 4). Before 2001, this irrigation ditch frequently dewatered the reach of Toppenish Creek immediately below the dam. After 2001, with the minimum instream flow of 10 cfs, approximately 2.3 miles of additional stream habitat below the diversion was watered and available for steelhead juveniles. Redds are typically observed in this reach during annual spawning ground surveys. The minimum instream flow requirement was increased from 10 cfs to 12 cfs in 2006. This resulted in some lengthening of the wetted reach, but Toppenish Creek continues to dry up for another two miles downstream atop its highly permeable alluvial fan whenever the flow past the Lateral Diversion remains below 15 cfs for an extended period.

We established two 100-meter snorkel segments upstream and downstream from the Lateral Diversion. We also established a 200-meter segment approximately 1.5 miles downstream from the Lateral Diversion intake directly upstream from the abandoned 3-Way diversion. 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. Toppenish Creek is relatively wide at all three study segments requiring the use of two surveyors to effectively cover the entire width. However, many "blind spots" or areas obscured by rocks or shallow areas probably contained fish that went unobserved and not tallied. Due to these limitations, numbers of steelhead, particularly age 0 juveniles, were likely underestimated. Steelhead/rainbow trout *(O. mykiss)* were placed into either an Age 0 category for individuals that hatched in the spring 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.

Densities of juvenile O. mykiss were slightly lower in 2006 than in 2005 at all the Toppenish Creek sites (Table 5). We arrived at an estimate of 4700 steelhead juveniles utilizing the 2.3 mile reach downstream from the Lateral Diversion. Average density for that reach during the season was 13.6 per 100 square meters. We estimated that 5900 juveniles used this reach in 2005.

Peak densities occurred on different dates for each Toppenish Creek site between August and October. Like 2005 the highest densities were observed at the 3-Way site, which is the farthest downstream. Desirable habitat conditions may account for these higher densities. Movement of fish into this reach from downstream (below Wesley Rd.; RM 41) sections as they begin to dry in June may also result in an accumulation of Age 0 parr at this site. It is unknown how successful juvenile steelhead are at avoiding stranding as stream reaches dry, but an earlier investigation in the Satus Creek watershed reported upstream movement of juvenile steelhead from drying stream reaches into perennial reaches. Densities of Age 0 steelhead were lowest at the segment upstream from the Lateral Diversion headgate. Several deep pools dominate this segment. It appears from our observations that Age 0 steelhead tend to avoid the deep pools (>1m) and prefer smaller pools. Larger Age 1+ rainbow/steelhead dominate the larger pools. Also as in 2005, the peak density in Age 0 steelhead smolts occurred in September. Densities of Age 0 fish may have decreased in October as the result of the dry reach watering up and allowing dispersal downstream. Densities of Age 0 steelhead par were higher downstream from the diversion than upstream, similar to what was observed in 2005. Although more suitable habitat quality for steelhead juveniles may exist in the downstream reach, accumulation of parr below the diversion may also account for higher numbers downstream. Unlike the 2005 season, when there was a small (<10 m) dry section immediately downstream from the diversion (between the diversion point and the screen bypass outlet) for several weeks, in 2006 flow was continuous past the diversion point. Despite the continuous flow, small Age 0 juveniles may find it difficult to migrate upstream past the check structures directly below the diversion. It may take several months before Age 0 parr attain a size that is capable of moving over the < 1 foot drops.

In 2005 snorkel surveys at these locations, there appeared to be a pattern of Age 1+ (smolt sized) steelhead parr densities increasing during the fall months. Although a slight increase was also seen in 2006, this pattern was less pronounced. However, flows were higher in 2006. In 2005 continuous surface flow past the seasonally dewatered section [that occurs each year between Wesley Rd.(RM 41) and Pom Pom Rd. (RM 38.9)] was not seen until December. In contrast, continuous flow past the dry reach occurred in September in 2006. This may have allowed all year classes of steelhead to disperse into downstream stream habitat resulting in less accumulation in the upstream section where our snorkel segments are located.

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. This diversion was modified with screens and a headgate in 2004. 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. A difference of 5.4 degrees C in the instantaneous maximum temperature was recorded by data loggers between a site at the confluence of the North Fork and South Forks of Simcoe Creek (RM 18.9) and a site at Simcoe Creek Rd (RM 15.3). 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. A size difference between Age 0 juveniles and older year classes (Age 1+) could still be observed at this location.

Densities of Age 0 steelhead were higher below the Hoptowit irrigation diversion than above it during all three monthly surveys. In contrast to 2005 when no age 0 steelhead parr were observed in this reach, Age 0 *O. mykiss* were present in 2006 in densities comparable to those observed at our Toppenish Creek site. Steelhead redds were observed upstream from our snorkel sites in 2006 unlike 2005 when the nearest steelhead redd was constructed below Simcoe Rd several miles downstream from our sites. 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 suggests that anadromous steelhead are the dominant component of the *O. mykiss* population in this portion of the Simcoe Creek watershed.

There was no noticeable difference in densities of Age 1+ steelhead parr between the site located upstream from the diversion and the segment located downstream from the diversion (Table 5). Densities of Age 1+ age classes of steelhead were substantially lower in 2006 than in 2005. This is probably due to a low (undetectable) 2005 Age 0 year class in this portion of Simcoe Creek.

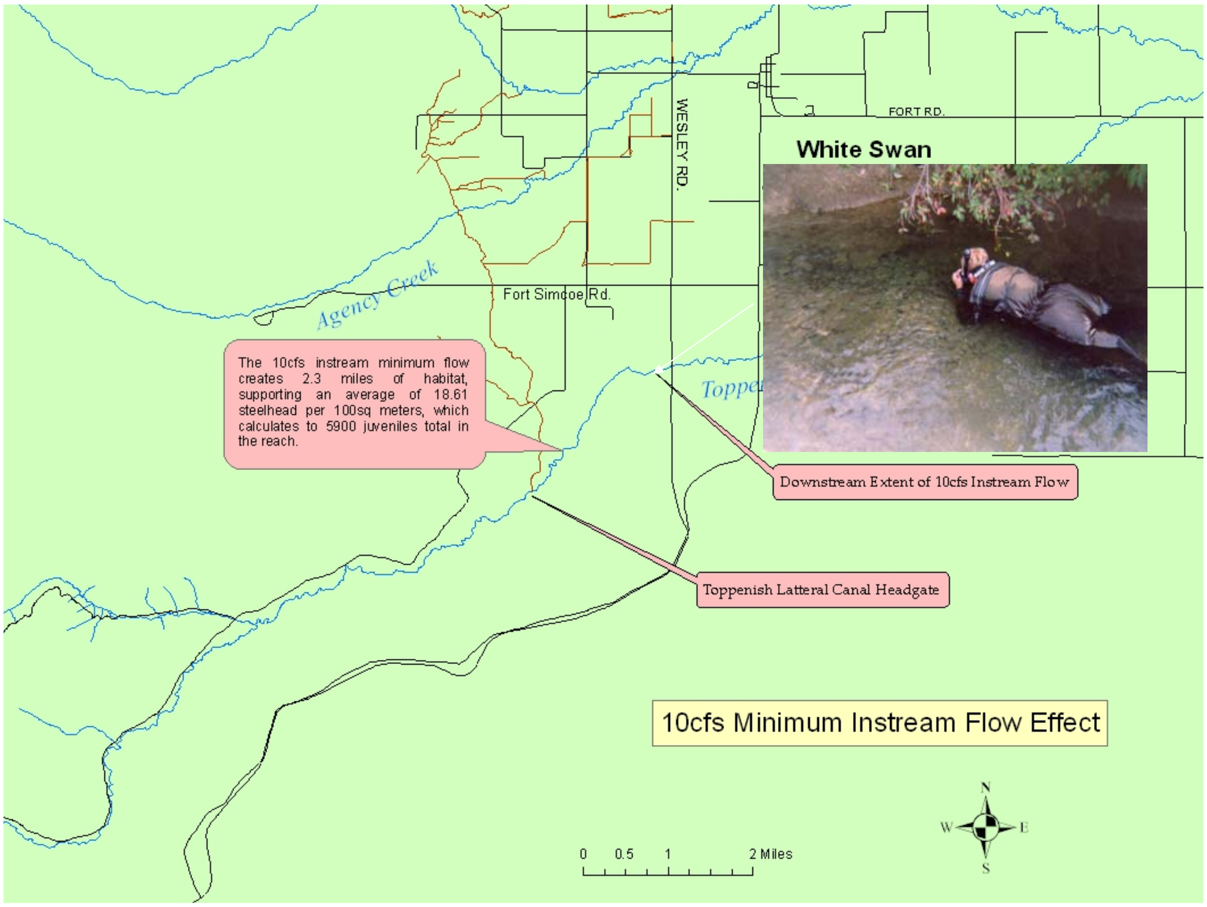

Figure 4. Map of 2005 and 2006 snorkel surveys at the Lateral Diversion.

Table 5. Snorkel survey rainbow/steelhead (*O. mykiss*) numbers and densities at irrigation diversions in Toppenish Creek (Lateral) and the North Fork of Simcoe Creek (Hoptowit) **2006**.

2006	Age 0	Age 0	Age 0	Age 0	Age 0	Age 1 +	Age 1 +	Age 1 +	Age 1 +	Age 1 +
Number	Above Lateral (100m)	Below Lateral (200m)	Above three way (200m)	Below Hoptowit (200m)	Above Hoptowit (200m)	Above Lateral (100m)	Below Lateral (200m)	Above Three Way (200m)	Below Hoptowit (200m)	Above Hoptowit (200m)
June	0	13	104	.	.	13	37	2	.	.
July	18	105	249	127	75	2	10	14	15	6
August	47	257	472	96	75	16	13	9	10	10
September	39	241	475	99	39	7	55	27	8	9
October	55	159	267	.	.	15	46	61	.	.
Density (per 100 m^2)										
June	0.00	0.80	5.92	.	.	1.77	2.28	0.11	.	.
July	2.45	6.46	14.16	18.41	10.81	0.27	0.62	0.80	2.17	0.86
August	6.40	15.81	26.85	13.91	10.81	2.18	0.80	0.51	1.45	1.44
September	5.31	14.82	27.02	14.35	14.35	0.95	3.38	1.54	1.16	1.30
October	7.49	9.78	15.19	.	.	2.04	2.83	3.47	.	.

Table 6. Snorkel survey rainbow/steelhead (*O. Mykiss*) numbers and densities at irrigation diversions in Toppenish Creek (Lateral) and the North Fork of Simcoe Creek (Hoptowit) **2005**.

2005	Age 0	Age 0	Age 0	Age 0	Age 0	Age 1 +	Age 1 +	Age 1 +	Age 1 +	Age 1 +
Number	Above Lateral (100m)	Below Lateral (100m)	Above three way (200m)	Below Hoptowit (200m)	Above Hoptowit (200m)	Above Lateral (100m)	Below Lateral (100m)	Above Three Way (200m)	Below Hoptowit (200m)	Above Hoptowit (200m)
June	70	163	235	0	0	37	12	0	21	45
July	85	97	404	0	0	5	7	5	22	23
August	136	212	572	0	0	47	39	25	30	23
September	70	111	394	0	0	23	59	95	32	43
October	75	49	300	.	.	38	102	98	.	.
Density (per 100 m^2)										
June	9.54	20.05	13.37	0.00	0.00	5.04	1.48	0.00	3.04	6.48
July	11.58	11.93	22.98	0.00	0.00	0.68	0.86	0.28	3.19	3.31
August	18.53	26.08	32.54	0.00	0.00	6.40	4.80	1.42	4.35	3.31
September	9.54	13.65	22.41	0.00	0.00	3.13	7.26	5.40	4.64	6.20
October	10.22	6.03	17.06	.	.	5.18	12.55	5.57	.	.

C. Stream Temperature

<u>Ahtanum Creek</u>

In 2006, we deployed nine Stowaway 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. 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, rootwads or other available permanent structures that could withstand high flow events. They were generally placed in pools or low flow channels that were less likely to dewater during the summer. We deployed the data loggers on 3-30-2006 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 a data logger in both the South Fork and North Fork of Ahtanum Creek near their confluence. The units were in place and continuously recording water temperatures at 48 minute intervals until we retrieved them on 10-10-2006. Two units were lost during a flood that occurred in May. The other eight data loggers recorded temperatures for the entire period.

Table 7. Descriptive statistics for water temperatures at 9 locations in the Ahtanum Creek watershed. Maximum Weekly Average 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 of the Ahtanum (0.5)	21.5 ºC	3.3 ºC	13.3ºC	10.6 ºC	8.5 ºC	17.2 ºC	20.3 ºC	**16.8 ºC**
North Fork of the Ahtanum (1.3)	21.8 ºC	2.5 ºC	13.1 ºC	10.7 ºC	8.4 ºC	18.4 ºC	21.0 ºC	**18.0 ºC**
AID Diversion (18.9)	24.8 ºC	3.1ºC	16.0 ºC	12.7 ºC	9.9 ºC	20.2 ºC	23.9 ºC	**19.8 ºC**
American Fruit Rd. (14)	24.1 ºC	3.3 ºC	15.5 ºC	12.9 ºC	10.5 ºC	20.4 ºC	23.3 ºC	**20.0 ºC**
42 nd Ave. (7.0)		Unit was lost during flood						
16 th Ave. (4.6)		Unit was lost during flood						
Above Bachelor Creek (3.2)	26.1 ºC	5.3 ºC	15.7 ºC	14.2 ºC	2.8 ºC	23.5 ºC	25.0ºC	**22.1 ºC**
Below Bachelor Creek (3.2)	26.4 ºC	4.8 ºC	16.6 ºC	14.7 ºC	12.7 ºC	23.8 ºC	25.3ºC	**22.7 ºC**
Ahtanum at the Mouth (0.5)	24.7 ºC	5.1 ºC	16.1 ºC	14.5 ºC	12.9 ºC	22.6 ºC	23.8 ºC	**21.7 ºC**

Results

Mean daily averages ranged from 10.6ºC in the South Fork of Ahtanum Creek above the confluences to 14.7 ºC above Bachelor Creek return (table 7). The highest instantaneous maximum of 26.4 ºC was recorded downstream of the Bachelor Creek return (RM 3.2). The lowest instantaneous maximum for the mainstem Ahtanum was recorded at American Fruit Road (24.1ºC). This site displayed the lowest water temperatures in 2005 as well.

We utilized the Maximum Weekly Average Temperature (MWATs; moving 7-day average of the daily mean water temperature) as an index to evaluate the suitability for salmonid use. MWATs were lowest at sites at the two forks of the Ahtanum as expected because they are farthest upstream. Water temperatures gradually increase downstream on the mainstem until peaking upstream from Goodman Rd. The highest MWAT (22.7ºC) was recorded below Bachelor Creek return at RM 3.2 in a reach that has relatively little shade and bank erosion problems as well as warmer return flows from Bachelor Creek which is essentially a return flow channel irrigated pasture. Water temperatures improve slightly several miles downstream at the USGS gage (MWAT: 21.7ºC) where the stream is well shaded and receives groundwater recharge.

Toppenish Creek

We used Onset Temperature data loggers to evaluate suitability of stream reaches for salmonids including ESA listed Steelhead trout. 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.

Temperature data loggers were placed in canisters and anchored with aircraft cable to trees, rootwads or other available permanent structures that could withstand high flow events. They were generally placed in pools or low flow channels that were less likely to dewater during the summer. We deployed ten data loggers in the mainstem of Toppenish Creek during spring at sites located between RM (river mile) 10.7 and 55.4. We also deployed seven data loggers in Simcoe Creek, one in Mill Creek, and two in Agency Creek. The units were in place and continuously recording water temperatures at 48 minute intervals until we retrieved them on 10-13-2006. Several units failed to record temperatures and one was placed at a site that dewatered for an extended period of time after (e.g., Toppenish Creek at Signal Peak Rd). Two loggers failed and one was lost during high flows. 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) as an index to evaluate suitability for salmonid use.

Table 8. Descriptive statistics for water temperatures at 11 locations in the mainstem Toppenish Creek. Maximum Weekly Average Temperature in bold text.

Location (river mile in parenthesis)	**Instantaneous Maximum**	**Instantaneous Minimum**	**Mean Daily Maximum**	**Mean Daily Average**	**Mean Daily Minimum**	**Maximum Daily Average**	**Maximum 7-Day Maximum**	**Maximum 7-Day Average**
Topp. at N. Fork confluence (54.4)	19.6 ºC	3.1 ºC	12.6 ºC	11.2 ºC	10.0 ºC	16.9 ºC	17.5 ºC	**15.9 ºC**
Topp. at swim hole (46.8)	22.7 ºC	3.9 ºC	14.9 ºC	13.0 ºC	11.4 ºC	20.3 ºC	22.1 ºC	**19.7 ºC**
Topp. above lateral (44.2)	24.3 ºC	4.0 ºC	16.0 ºC	13.9 ºC	12.1 ºC	21.5 ºC	23.6 ºC	**21.0 ºC**
Topp. below lateral (44.1)	Logger failed to record							
Topp. at Signal Peak Rd (40.2)	Dewatered on 6-22-06							
Topp. above Mud Lake Drain (31.5)	23.7 ºC	9.7 ºC	18.7 ºC	17.4 ºC	16.1 ºC	22.3 ºC	23.2 ºC	**21.6 ºC**
Topp. below Mud Lake Drain (31.4)	Logger failed							
Topp. at Unit 2 (26.5)	Logger lost in flood							
Topp. at Old Goldendale Rd (14.4)	26.1 ºC	7.5 ºC	18.3 ºC	16.9 ºC	15.7 ºC	23.6 ºC	24.5 ºC	**22.8 ºC**
Topp. below Hwy97 (10.7)	26.4 ºC	9.3 ºC	19.5 ºC	18.4 ºC	17.4 ºC	25.4 ºC	25.7 ºC	**24.5 ºC**
Mill Creek	17.4 ºC	6.8 ºC	14.0 ºC	12.7 ºC	11.5 ºC	15.9 ºC	16.6 ºC	**15.0 ºC**

Mean daily average temperatures in the mainstem Toppenish Creek ranged from 11.2ºC at the confluence of the North Fork of Toppenish with the mainstem at RM 54.4 to 18.4ºC below Hwy 97 at RM 10.7. The highest instantaneous maximum of 26.4ºC occurred at our farthest downstream site.

MWATs increased from the mouth upstream (Table 8). All sites in the irrigated reaches of the mainstem of Toppenish Creek had MWATs above 20 degrees C. The lowest site at RM 10.7 had the highest MWAT of 24.5º C, above the thermal maximum of 24.1º C. Sections of the creek dewatered downstream from Wesley Rd as they normally do during the summer. Our site at Signal Peak road (RM 40.2) began to dewater by the end of June similar to 2005, although flow was restored briefly in the beginning of July. 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.

Table 9. Descriptive statistics for 9 water temperature data loggers in the Simcoe Creek watershed. Maximum Weekly Average Temperature in bold text.

Location (river mile in parenthesis)	**Instantaneous Maximum**	**Instantaneous Minimum**	**Mean Daily Maximum**	**Mean Daily Average**	**Mean Daily Minimum**	**Maximum Daily Average**	**Maximum 7-Day Maximum**	**Maximum 7-Day Average**
N. Fork Simcoe (24.9)	17.8 ºC	3.3 ºC	11.3 ºC	9.7 ºC	8.3 ºC	15.8 ºC	17.2 ºC	**15.4 ºC**
Simcoe below Forks (18.9)	20.7 ºC	3.5 ºC	13.2 ºC	11.7 ºC	10.2 ºC	19.0 ºC	19.9 ºC	**18.3 ºC**
Simcoe at Simcoe Cr. Rd. (15.3)	26.1 ºC	3.7 ºC	16.6 ºC	13.1 ºC	10.4 ºC	20.9 ºC	25.0 ºC	**20.1 ºC**
Simcoe at towtnuk Rd. (12.7)	26.8 ºC	4.3 ºC	16.9 ºC	14.0 ºC	11.6 ºC	22.9 ºC	25.5 ºC	**21.8 ºC**
Above N White Swan Rd. (8.1)	19.6 ºC	5.6 ºC	14.7 ºC	12.6 ºC	10.7 ºC	17.5 ºC	18.8 ºC	**16.6 ºC**
Below N White Swan Rd. (8.1)	20.0 ºC	5.1 ºC	15.1 ºC	12.9 ºC	10.8 ºC	17.8 ºC	19.0 ºC	**16.8 ºC**
Barkes Rd (2.7)	22.9 ºC	5.8 ºC	16.4 ºC	14.8 ºC	13.2 ºC	20.9 ºC	22.4 ºC	**20.4 ºC**
Agency at Wesley Rd	15.8 ºC	6.0 ºC	13.3 ºC	11.6 ºC	10.2 ºC	13.3 ºC	15.4 ºC	**13.0 ºC**
Agency at Rd. 80	22.0 ºC	2.9 ºC	13.6 ºC	11.6 ºC	9.6 ºC	19.2 ºC	21.1 ºC	**18.7 ºC**

Mean daily average water temperatures in Simcoe Creek were generally lower than the mainstem of Toppenish Creek (table 9) ranging from 11.3ºC in the North Fork of Simcoe Creek in vicinity of Soda Springs at RM 24.9 (from the confluence with Toppenish Creek) to 16.4ºC at Brakes Rd. Temperatures in Simcoe Creek were relatively lower than 2005 when flows were critically low. Agency Creek at Wesley Rd was cool with stable flow through out the summer produced by large springs upstream from our site. Several miles upstream, Agency Creek, which had been dry since spring 2004, flowed contiuously for several months in 2006.

Like the mainstem Toppenish creek, MWATs in Simcoe Creek generally decreased from the mouth upstream, but at a greater rate per unit of distance than in the mainstem of Toppenish Creek. Flows decreased downstream from the confluences of the North Fork and South Fork of Simcoe Creek to North Simcoe Rd at RM 15.3. Several dry reaches are located downstream including our site at temperature site at Towtnuk Rd (RM 12.7), which exceeded 25ºC on June 20th and went dry shortly afterward. Flow resumes downstream where the cooler water of Agency Creek and several springs enter. This reach along the toe of the Toppenish Creek alluvial fan between the Agency Creek confluence (RM 9.5) and N. White Swan Rd. (RM 8.1) is adequately shaded and numerous beaver dams are present. Water from the return flow at North White Swan Rd raises the water temperature slightly (MWAT 0.2 degrees warmer downstream) during the warmest portion of the year.

Satus Creek

In 2006, we deployed 14 Onset Stowaway and Temp Pro data loggers in the lower reaches of 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, rootwads or other available permanent structures that could withstand high flow events. They were generally placed in pools or low flow channels that were less likely to dewater during the summer. We deployed the data loggers between 3-08-06 and 3-16-06 at sites located between river mile RM 3 and RM 44 (downstream from the falls). We also deployed a data logger in Kusshi Creek, Wilson Charley Creek, Dry Creek, and Logy Creek near their confluence with Satus Creek. The units were in place and continuously recording water temperatures at 48 minute intervals until we retrieved them on 10-10-2006. Two units were removed from the water and set on the bank by someone making temperatures during the months of August and September unusable. The units placed in Wilson Charley Creek and Kusshi Creek recorded temperatures until they went dry in late July and August. The other 11 data loggers recorded temperatures for the entire period.

Table 10. Descriptive statistics for water temperature at 10 locations in the Satus Creek watershed. Maximum weekly average temperature in bold text.

Location	Instantaneous Maximum	Instantaneous Minimum	Mean Daily Maximum	Mean Daily Average	Mean Daily Minimum	Maximum Daily Average	Maximum 7-Day Maximum	**Maximum 7-Day Average**
N. Satus Rd. (3.3)	24.4 ºC	3.3 ºC	16.3 ºC	15.2 ºC	14.0 ºC	22.6 ºC	23.4 ºC	**21.7 ºC**
Plank Rd (8.2)	Removed from water							
Below Dry Creek	Removed from water							
1st Crossing (12.4)	27.1 ºC	3.1ºC	16.7 ºC	14.4 ºC	12.2 ºC	23.4 ºC	26.0 ºC	**22.7 ºC**
Above Logy (16.7)	24.6 ºC	2.3 ºC	16.5 ºC	13.8 ºC	11.6 ºC	21.2 ºC	24.1 ºC	**20.7 ºC**
High Bridge (22.4)	25.6 ºC	1.2 ºC	15.2 ºC	12.7 ºC	10.6 ºC	22.2 ºC	24.8 ºC	**21.6 ºC**
4th Crossing (28.0)	24.5 ºC	2.1 ºC	14.8 ºC	12.4 ºC	10.3 ºC	21.5 ºC	23.6 ºC	**21.0 ºC**
County Line	25.2 ºC	2.3 ºC	14.8 ºC	11.6 ºC	9.1 ºC	20.4 ºC	24.1 ºC	**19.9 ºC**

(32)								
Wilson Charley (34)	23.6 ºC	2.2 ºC	13.6 ºC	10.8 ºC	8.6 ºC	19.0 ºC	22.8 ºC	**18.5 ºC**
Wooden bridge	21.8 ºC	0.9 ºC	12.1 ºC	9.7 ºC	7.8 ºC	17.9 ºC	21.0 ºC	**17.3 ºC**
Falls (44)	17.9 ºC	2.7 ºC	11.3 ºC	8.8 ºC	7.1 ºC	14.7 ºC	17.2 ºC	**14.3 ºC**
Logy Mouth	24.4 ºC	1.5 ºC	14.4 ºC	12.7 ºC	10.9 ºC	21.9 ºC	23.5 ºC	**21.2 ºC**
Dry Mouth	23.2 ºC	2.3 ºC	16.5 ºC	14.1 ºC	12.1 ºC	19.7 ºC	22.5 ºC	**19.2 ºC**
Kusshi Creek	Dry on 8/1/06							
Wilson Charley Creek	Dry on 7/27/06							

Results

Mean daily averages in Satus Creek ranged from 8.8º C downstream from falls (RM 44) to 15.2º C near the mouth (table 10). The instantaneos maximum of 27.1º C occurred at the 1st (Hwy 97) crossing site (RM 12.4) The maximum 7-day average of the daily maximum (MWMT) and average (MWAT) water temperature were used as an index to evaluate suitability for salmonids and other cold water biota along the course of the stream. The thermal maximum of 24.1 º C was exceeded by MWAT at several sites from county line at RM 32 to 1st crossing at RM 12.4. MWATs ranged from 14.3º C at the falls to 22.7º C at the 1st crossing site. 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.

D. Sediment Sampling

Ahtanum Creek

We collected substrate samples from the mainstem Ahtanum Creek using a core sampler. Samples were collected from three reaches (upper, middle, and lower). The upper reach is located below the confluence (RM 23.1) of the North and South forks of Ahtanum Creek. All samples in this reach were collected within one mile of the forks. The mid reach was located between American Fruit Road (RM 14.0) and the Wapato Irrigation Project (WIP) main diversion (RM 18.9). The lower reach was located between Goodman Rd (RM 3.0) and the confluence with the Yakima River. Three riffles within each reach were sampled during the survey. Riffles were selected based on the presence of inactive steelhead or coho redds (identified during spawning ground redd counts). Nearly all of our sites were located in pool tail outs in Ahtanum Creek. Four samples were collected at each riffle within a six meter radius of the Redd. A total of 36 core samples were collected and processed for Ahtanum Creek. All samples were obtained between October 1st and November 15th 2005. Samples were collected using a protocol developed for the Timber-Fish-Wildlife Ambient Monitoring Program (Schuett-Hames 1994). Samples were then processed using the volumetric method also outlined in Shuett-Hames (1994). Percent fine sediment was used to assess the suitability of the reaches for salmonid spawning because high percent fine levels can inhibit water exchange and increase salmonid embryo mortality (Chapman 1988).

Percent fine sediment (particles less than <0.85mm) was higher in the downstream reach (Figure 5). Percent fine sediment levels were similar for the middle study reach [American Fruit Rd (RM 14). to the AID diversion (RM 18.9)] and the upper study reach [below confluence of the North and South Forks(RM 23.1)] . The lower gradient of the lower 3 miles of Ahtanum Creek probably accounts for the higher fine sediment levels, although sediment inputs from irrigation drains and exposed stream banks with little riparian cover in some locations may also contribute to the relatively high levels of fine sediment below Goodman Rd.

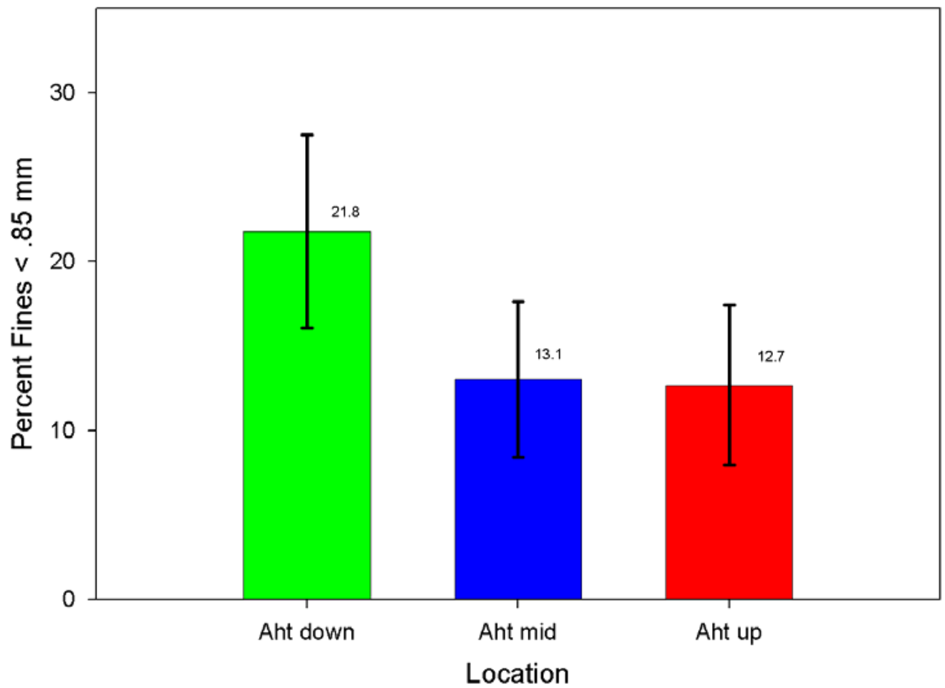

Figure 5. Percent fine sediment at 3 reaches of Ahtanum Creek (down, RM 3 to 0; mid, RM 18.9 to 14; and up, RM 23.1 to 22.1). Error bars = 95% confidence levels.

E. Spawning Surveys

Ahtanum Creek Steelhead

We conducted redd count spawning surveys in Ahtanum Creek in 2006 along the entire mainstem and four miles up both the South and North Forks. All redds were marked using a GPS with an accuracy of +/- 30ft. The relatively wet year of 2006 provided poor conditions (i.e., visibility and water clarity) for observing redds and spawning activity. Only one pass of our normal 3 pass schedule could be completed because of continuous high flow conditions and high turbidity. One redd was observed during that survey. (Three passes were completed in 2005 and 16 redds were observed during these surveys.) The low number of steelhead redds observed in 2006 probably greatly underestimates the level of steelhead spawning activity that actually occurred in Ahtanum Creek in 2006.

Ahtanum Creek Coho

In the fall of 2005, we conducted coho salmon spawning surveys in lower Ahtanum Creek using the same methodology as used for steelhead trout spawning surveys in the spring. A total of four passes were completed between 11-2-2005 and 11-25-2005 from Goodman Road at River Mile 2.8 to the confluence. Additionally, we completed a 5th pass between the 16th Ave. bridge (RM 4.6) and the mouth on 11-14-2006. During these surveys, we documented 11 redds and observed 17 live coho salmon. We collected the snout from one carcass that was identified as hatchery-orgin by the presence of a coded wire tag.

<u>Ahtanum Creek Chinook</u>

We performed a redd count survey for Chinook salmon on 2.8 mile reach of the North Fork of Ahtanum. We used the same methods that we use for steelhead trout surveys in the Ahtanum. No adult Chinook salmon or redds were observed.

<u>Ahtanum Creek Bull Trout</u>

Bull trout surveys were conducted in the South Fork of Ahtanum Creek within an index reach from RM 7.7 to RM 10.4. Four passes of this reach were made between September 5th, 2006 and October 6th, 2006. Four Redds were identified within the reach the three mile reach. Three of the four were identified on the 4th pass conducted on October 6th. Surveys are coordinated with the Washington Department of Fish and Wildlife, who survey the Middle and North Forks of Ahtanum Creek.

Table 11. AHTANUM WATERSHED - YAKAMA NATION STEELHEAD SPAWNING DATA, 2006

CREEK	REACH	*1st Pass* MILES	DATE	REDDS	LIVE	REACH TOTALS	REDDS PER MILE	LIVE OBS.
Ahtanum			3/21/2006					
Mainstem	Forks to AID Diversion	5.0		0		0	0.0	0
	AID to American Fruit Rd.	5.3		0		0	0.0	0
	American Fruit Rd. to 62nd Ave.	5.3		0		0	0.0	0
	62nd Ave. to 16th Ave.	4.2		1		1	0.2	0
	16th Ave. to Yakima R.	4.1		0		0	0.0	0
	TOTALS	23.9		1		1	0.0	0
North Fork	4 miles to confluence	4.0		0		0	0.0	0
						0		0
	TOTALS	4.0		0		0	0	0
South Fork	4 miles to confluence	4.0		0		0	0.0	0
	TOTALS	31.9		1	0			

<u>Toppenish Creek</u>

The Toppenish Creek watershed includes nearly 100 miles of anadromous fish bearing streams. We cover 78 miles of these waterways during our annual redd surveys. Redds of spawning adult steelhead are surveyed three times between March and the beginning of June. Streams were surveyed in a downstream direction, usually by a pair of surveyors. All redds were marked using a GPS with an accuracy of +/- 30ft.

Flows in Toppenish Creek contrasted greatly with those in 2005 which affected observed redd numbers and spatial distribution. Overall, flows were high, making it difficult and sometimes unsafe to survey. In addition, snow and unplowed roads in the headwaters made it impossible to access the upper reaches until June. We completed one pass of the upper Toppenish Creek reaches and 2 passes of the lower Toppenish reaches. We also completed two passes of Simcoe Creek and its major tributaries (i.e. North Fork Simcoe, South Fork Simcoe, Agency, and Whatum Creeks). We completed one pass of the North Fork of Toppenish Creek (confluence with mainstem Toppenish; RM 55.4) and two passes of Willy Dick Creek (confluence with the mainstem Toppenish.

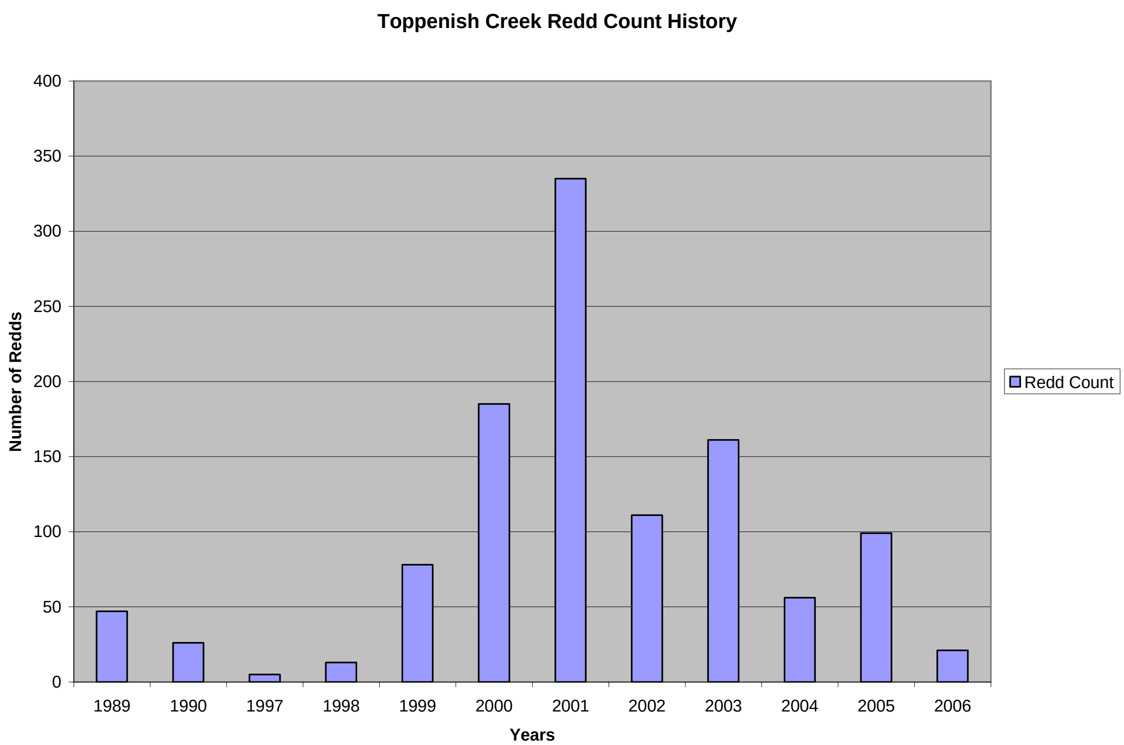

Figure 6. Redd count numbers in the entire Toppenish Creek basin between 1989 and 2006.

Successful completion of all three passes in 2006 would have accounted for more redds observed; however, because weather conditions prevented us from accessing the upper reaches our redd counts are a likely substantial underestimation of actual spawning activity in the Toppenish Creek watershed (Figure 6). In the lower reaches of Toppenish Creek (between Wiley Dick Creek and Yost Road), 5 redds were observed. This number is much lower than the 26 redds observed in 2005. Despite the lower redd count, our summer and fall snorkel surveys in performed in this reach in 2006 did not show a significant decrease in parr densities over our results from the 2005 season.   In all, the mainstem of Toppenish Creek and the North Fork of Toppenish produced only 33 percent of redds observed during 2006 redd count surveys within the entire Toppenish watershed compared to 91 percent of the redds observed during the 2005 season. In 2005, most redds (n=64) were observed in the upper reaches of Toppenish Creek above the confluence with Wiley Dick Creek. In 2006, only 2 redds could be located in this reach. Several factors probably account for this difference. The survey date was in early June, well after the peak in spawning activity had occurred. Also, because high flows can flatten redds making them difficult to identify, the high flow events that occurred in 2006 likely affected our ability to detect redds resulting in the low count. Additionally, steelhead may have successfully made it into some of the smaller tributaries and upstream from the limits of our survey segments. For example, Willy Dick Creek (a small tributary that enters Toppenish Creek at RM 48.5), which did not have adequate flows to facilitate movement of adult steelhead in 2005, had 4 redds observed within it in 2006.

We observed more spawning activity in 2006 within the Simcoe Creek watershed than what was observed in 2005. Higher flows probably attracted more fish and allowed passage over obstructions during the critical migration periods. Large beaver dam complexes are present in Simcoe Creek (particularly downstream of the confluence of the North and South Forks of Simcoe Creek) that may obstruct steelhead during low flows like the conditions that occurred in 2005. Redds (N=14) in the Simcoe Creek watershed were distributed between the confluence of Diamond Dick Creek and the North Fork of Simcoe (RM 22) and N. White Swan Road (RM 8.1). Good spawning and juvenile rearing habitat exist in this reach, although summer water temperatures can be high and flows low in the reach between Simcoe Creek Rd (RM 15.3) and the Towtnuk Road crossing (RM 12.7). Snorkel surveys performed in summer and fall of 2006 indicate that successful spawning occurred in the North Fork of Simcoe Creek. Agency Creek and Wahtum Creek, which can attract substantial numbers of spawning adults in good water years, produced 3 of the redds observed in 2006. All three redds were situated near the mouths of these tributaries.

Table 12. Number of Redds observed in the Toppenish Creek Watershed in 2006

Stream	From	To	Miles	3/14/06	3/23/06	3/28/06	3/29/06	4/27/06	5/23/06	6/02/06	6/05/06	total 06
Toppenish	upper most Toppenish	East Bank	3								0	
	NF Falls	NF confluence	4								0	
	East Bank	NF confluence	7								1	
	NF confluence	Wash out	4.5								1	
	Wash out	Willy Dick Cr	5			0			0			
	Willy Dick Cr	Olney Lateral	4.9			3			1			
	Lateral Canal	West Marion Drain Rd.	4.2			0			1			
	Yost Rd.	Shaker Church Rd.	4			0			0			
total						**3**			**2**		**2**	**7**
Simcoe	NF at 2nd crossing	Diamond Dick Cr	3.1		0					1		
	NF at Diamond Dick Cr	NF/SF confluence	3.4		0					0		
	SF 6 mile above mouth	3 mile above mouth	3.2		0					0		
	SF 3 mile above mouth	NF/SF confluence	3		0					0		
	NF/SF confluence	Simcoe Creek Rd.	3.6		3					0		
	Simcoe Creek Rd.	Towtnuk Rd.	3.1		2					0		
	Towtnuk Rd.	N. White Swan Rd.	2.8		1					0		
	N. White Swan Rd.	Stephenson Rd.	2.3		0					0		
total					**6**					**1**		**7**
Agency	Falls	Western Diversion.	4.5	0				0				
	Western Diversion.	confluence	4.4	2				0				
total				2				0				**2**
Wahtum	Yesmowit Rd.	confluence	3.6		1			0				
total					**1**			**0**				**1**
Willey Dick	Old logging site	confluence	4		0		2	2				
total					**0**		**2**	**2**				**4**
Total			**77.6**								**Total**	**21**

Satus Creek

We conducted redd counts in the Satus Creek watershed during between March and the beginning of June in 2006. The mainstem of Satus (from the impassible falls at RM (river mile) 44 to Rd. # 23 at RM 15.4), Logy Creek, Dry Creek, Kusshi Creek, Wilson Charley Creek, Shinando Creek, Bull Creek, and Mule Dry Creek are surveyed as well. All redds were marked using a GPS with an accuracy of +/- 30ft. Steelhead in Satus Creek have a protracted spawning season so passes are spread over a three month period from March 1 to the beginning of June.

In 2006, we completed two passes on the mainstem Satus, Dry, Mule Dry, Kusshi, Wilson Charley, and Logy Creeks. Conditions were usually good (i.e., clear water, good visibility) on both passes; however, flows were noticeably higher in 2006 than in 2005. In the entire watershed we documented 60 redds in 2006 (Table 13). In 2005, we observed 111 redds. It is unclear if our counts were lower in 2006 because conditions were less optimal for observing steelhead redds (and only 2 passes were completed) or if spawning activity was lower than 2005. We observed 28 redds (47 percent observed in total watershed) in the in the mainstem of Satus Creek. Logy Creek accounted for 11 redds and Dry Creek had 15. Low flows resulting from little snowpack and precipitation in 2005 had prevented steelhead from moving into other tributaries, but spawning adult steelhead utilized tributaries more effectively in 2006 than in 2005, because higher flows provided better access to these streams. Mule Dry, Kusshi and Wilson Charley creeks each had at least one redd

Table 13. Number of Redds observed in the Satus Creek Watershed in 2006

Creek	Stream Reach		Miles											Date	Total 06
	From	To		3/7	3/9	3/14	3/16	3/30	4/4	4/25	5/2	5/4	5/9	5/11	
SATUS	Falls	Wood Bridge	4.2	2							0				2
	Wood Bridge	County Line	4.4	1							6				7
	County Line	High Bridge	4	5							2				7
	High Bridge	Holwegner Ranch	4.8	0							4				4
	Holwegner Ranch	2nd Xing	3.9		0						5				5
	2nd Xing	1st Xing	3.5		0							0			0
	1st Xing	USGS Gage	2.8		2							0			2
	USGS Gage	Rd 23	4.3		1							0			1
total			**31.9**	**8**	**3**						**17**	**0**			**28**
LOGY	Falls	Spring Cr	3			0							0		0
	Spring Cr	S. C. Ford	1.5			0							0		0
	S. C. Ford	3rd Xing	6			8							0		8
	3rd Xing	Mouth	3.5			0							3		3
total			**14**			**8**							**3**		**11**
DRY	South Fk	Saddle	3.6					2						0	2
	Saddle	S-Turn	2.75					1						1	2
	S-Turn	Elbow Xing	3					0						0	0
	Elbow Xing	Seattle Cr	4.25					1						0	1
	Seattle Cr	Rd 75 bend	5.25					0						3	3
	Rd 75 bend	Pwr Line Ford	6.25					3	0					2	5
	Pwr Line Ford	SR97	1.75						0				1		1
	SR97	Mouth	1						0				1		1
total			**27.85**					**7**	**0**				**2**	**6**	**15**
W. CHARLEY	Forks	Twin Culverts	0.15	0							0				
	Twin Culverts	Big Culvert	1.2	0							0				
	Big Culvert	Mouth	0.55	2							0				
total			**1.9**	**2**							**0**				**2**
KUSSHI	Top (11th) Xing	Xing below washout	1.75		0						0				
	Xing below washout	2nd Crossing	0.85		1						0				
	2nd Crossing	Mouth	1.9		0						0				
total			**4.5**		**1**						**0**				**1**
BULL	Scout Camp	Mouth	1.4												**0**
SHINANDO	Ford	Mouth	0.5	**0**							**0**				**0**
MULE DRY															
	Lucy Canyon to Yakima Chief Rd		3.5				0			2					
	Yakima Chief Rd	Top of Enclosure	4.25				1			0					
	abv.Yakima Chief Rd						0			0					
	Top of Enclosure to Rd. 39		3.6				0			0					
			82.05				**1**			**2**					**3**
															60

1st pass (green)
2nd pass (yellow)

F. Monitoring Wells

The summer of 2000 marked the first attempts at maintaining flow in Toppenish Creek by restricting diversions into the Toppenish Lateral Canal upstream. From 2001 through 2004, a flow of 10 cfs has been maintained fairly consistently below the dam during the low-flow period. This minimum was raised to 12 cfs for the 2006 irrigation season. However, flow seeps out of the Toppenish Creek channel in the reach below the dam. Over the next 4 miles the creek can lose between 15 and 20 cfs. Even with 12 cfs flowing past the upstream diversion, the creek ceased flowing at the surface approximately 3 mi downstream from the dam, and began flowing again another 3 miles downstream during the summer of 2006. The 3-mile flowing reach below the dam supports large numbers of juvenile steelhead through the summer.

We monitor a network of 20 monitoring wells, most of them arranged in four north-south transects. The uppermost transect is just upstream from the beginning of the dry reach, and then next three transects are at 1 mile, 2 miles and 3 miles downstream. There are two more wells near the creek channel approximately 0.8 and 1.5 miles farther downstream, respectively. Groundwater levels in the dry reach, as measured at the monitoring wells, have been higher in summer since the instream flow mandate began.

In the drought summer of 2005, groundwater levels averaged 3 ft lower than in the summer of 2002, but were still higher than in summer 2000 at 14 of 19 sites. In 2006, with higher streamflow above the diversion dam, and a higher mandated instream flow below the dam, late-summer groundwater levels were higher at nearly all well sites compared to 2005.

At all four north-south transects, the groundwater surface elevation and land surface elevation both decline with increasing distance from Toppenish Creek. The maximum and minimum water surface elevations slope more steeply than the land surface at the two transects farthest upstream (3-Way Diversion and Dry-Logy Road). However, at the Signal Peak Rd and Pom Pom Rd transects downstream, groundwater elevation does not decline relative to the land elevation, although the groundwater surface still declines relative to sea level from south to north. This difference is explained by the increasing width of the alluvial fan with distance downstream, and a corresponding widening of the hyporheic zone. The Toppenish Creek channel has been held to the right (south) edge of its alluvial fan, and as the fan widens downstream, the hyporheic zone widens in a northward direction away from the channel, maintaining the groundwater surface close to the land surface.

Groundwater elevation rises at all locations in winter. The greatest summer-winter fluctuations are at the well farthest downstream near the Unit 2 crossing of Toppenish Creek. Fluctuations at this site are exacerbated by seasonal operation of the Unit 2 Canal, which is supplied mainly by return flows spilled into Toppenish and Simcoe creeks downstream. The smallest summer-winter fluctuations are closest to Toppenish Creek and some of its historic distributary channels north of the present creek.

Monitoring well data indicate that flow lost from the Toppenish Creek channel migrates mostly downgradient (northeast) beneath the surface of the alluvial fan, rather than downstream (east). This is also supported by the appearance of woody vegetation in an arc following the 1040-foot contour north and northeast of the Three-Way Diversion site and well away from the perennial channel. However, less than 5 cfs reappears in Toppenish and Simcoe creeks upstream from Mud Lake and Olney Flat drains, which enter the creeks below 850 ft elevation and mask any further upwelling. A square mile of woody vegetation in the visible upwelling zone around the 1040-foot contour may transpire 3 to 4 cfs in summer, assuming half of the reference cropland evapotranspiration rate published for the lower Toppenish Creek watershed (http://www.usbr.gov/pn/agrimet/monthlyet.html).

In late 2003, the Yakama Nation completed a project to reconnect Toppenish Creek with its floodplain in the vicinity of the Toppenish Lateral Canal just upstream from the reach with monitoring wells. With the upstream floodplain saturated longer each year, the intermittent reach of Toppenish Creek should benefit even more. Better year-round access to groundwater will promote growth of stabilizing riparian vegetation, which will in turn help the creek maintain summer surface flow. For the short term, higher subsurface water levels will help maintain pools in the intermittent reach to support juvenile steelhead over the summer. In addition to these local benefits, the increase in aquifer storage represented by the rising groundwater levels equates to an increase in base flows and thermal moderation in downgradient reaches of Toppenish and Simcoe creeks and their side channels. The YN has started monitoring groundwater in the vicinity of Marion Drain downstream, with an eye toward reducing the loss of groundwater to the drain instead of the creek. Project staff will continue to track long-term trends in groundwater levels.

III. Restoration Projects

A. Ahtanum Side Channel Reconnection

The project site is centered 21.5 stream miles above the mouth of Ahtanum Creek, and 3.1 stream miles below the confluence of the North and South forks of Ahtanum Creek. The action area is defined as that portion of the active stream channel and south floodplain within the north half of the south half of Section 15, T12N, R16E. The side channel contained in the action area is approximately 4,000 feet long. Direct impacts, including all ground disturbing activities, were limited to the proposed action area, while noise impacts were limited to an extent no more than half a mile from the site.

The surrounding land uses include irrigated agriculture and sparse residential housing. The land directly adjacent to the site has an orchard and highway embankment along the north bank, and irrigated pasture along with riparian shrubs and trees along the south bank.

Timeline and supervision:

Construction occured in September, 2006. All work was supervised by the design engineer and Yakama Nation Fisheries Program staff members.

Grade control construction:
One rock grade control structure was placed in Ahtanum Creek to provide adequate head to divert flow into the side channel. The control was constructed of large, angular rock with a maximum weight of 8,000 pounds, placed individually by a tracked excavator with a thumb attachment, standing outside the channel as much as possible. In plan view, the rock was arranged in a barb type alignment, with the top of the structure's grade set so that creek flow over the grade control was be directed toward the center of the channel. Some excavation of the channel and banks was necessary to seat individual rocks. The grade control spans the channel and is keyed far enough into the right bank to prevent erosion around the end of the key under flood conditions. The elevation of the grade control is the lowest at the apex of the "v", and slopes upwards 1.5 feet or more to the end of the key, as required to prevent erosion around the key.

Figure 7 Ahtanum Side Channel Project Intake.

Side channel intake construction:
A new intake (Figure 7) was constructed slightly upstream of the original point of divergence. At the original divergence point, the creek is entrenched. Relocation of the side channel intake to a point above this entrenchment minimized the amount of rock needed to divert water into the side channel. This intake is controlled to prevent the side channel from capturing the main flow of the creek in a flood event, and to allocate most of the creek's base flow to the main channel. Two methods of diversion were considered: a slot formed in the right key of the uppermost grade control, and a pipe buried in the key. To minimize risk of the side channel capturing flood flow, the pipe option was chosen. There is a greater chance of a pipe clogging with debris than an open slot, but placement of the pipe at a right angle to flow is expected to allow the vast majority of debris to sweep past the intake. A steel debris screen was fabricated to ensure that the

intake is not clogged with debris. Later, it may also be necessary to increase the capacity of the side channel where excessive deposition has occurred during prior flood events. Side channel restoration is especially valuable in this reach of Ahtanum Creek, where road construction and flood control have confined the floodplain, but where irrigation has less effect on summer stream flow (the largest diversions are downstream).

B. South Fork Simcoe Creek Road Obliteration and Stabilization
This project took place on a small tributary of the South Fork of Simcoe Creek. This tributary is fish bearing (rearing habitat) in its lower reach and an important input of good quality water to SF Simcoe Creek through mid summer. In winter the stream's discharge has been observed in excess of 10cfs.

In August, 2006 Project staff began a project that obliterated .25 miles of unnecessary logging road. The project also included removing an improperly placed culvert and stabilizing its alignment and several headcuts located downstream (Figure 8) of the road.

Figure 8. Headcut, SF Simcoe Creek Tributary, prior to road obliteration and stabilization.

Methods
A small, rubber tracked excavator was used to remove the failed culvert. The excavator then constructed a larger and more natural channel for the stream. The channel was then stabilized with large rock, in order to prevent additional headcutting above the road. Large rock was then used to stabilize several small headcuts downstream of the road.

The road alignment was then ripped with a 28" ripping implement and water bars were installed as needed. Finally, tank traps were excavated to permanently close the road.

C. Lincoln Meadow Road Relocation and Livestock Exclosure Fence

The forestry road that bisects Lincoln Meadow is approximately 2 ft above the existing grade of the meadow.

Figure 9. Road above surrounding grade, prior to construction.

The elevated road, combined with an improperly installed culvert and excessive grazing, has led to excessive downcutting of the watercourse draining the meadow. In the summer of 2006, YRWP staff moved ahead with a project that would first construct a livestock exclosure fence around the meadow and second remove the road bisecting the meadow.

Initially, the YRWP had proposed constructing an armored dip in the road, and adding grade control to the watercourse. During a site review with YN Forest Engineering, it was suggested that removing the road would be a much more comprehensive method of restoring the meadow. Permission was gained from various entities and we moved forward with the road removal plan. Removing the road, along with constructing a fence to exclude cattle from grazing the meadow will allow for complete restoration of Lincoln Meadow. The road relocation was engineered by the YN Forestry Roads Department with technical assistance from the YRWP and YN Water Resources.

Methods
During fence construction, staff used our ATV 4X4's and 6X6 to transport fencing supplies into the meadow. Project staff used 4 pt. barbed wire, 6 feet metal T posts and steel H-frames. The fence was constructed to National Resource Conservation Service specifications (Figure 10.)

Figure 10. Exclosure fence surrounding Lincoln Meadow.

The fence was constructed around the open part of the meadow with corner gates to allow animals to be herded out of the meadow if necessary. The total length of the completed fence is ¾ of a mile. During the road removal, a 10 ton dump truck was used to haul rock to the site. An excavator was used to remove the culvert and place rock for the grade control structure (Figure 11.) Large rock was used to construct the channel stabilization structure.

Figure 11. Grade control structure.

Conclusion
This project is a success. Project staff accomplished all of our initial objectives (road relocation, channel stabilization and livestock exclusion.) Lincoln Meadow is now ready for the second and final phase of this project, which will be the construction of grade control structures throughout the meadow. This is slated for summer, 2007.
Benefits of this project do/will include raising the water table in the meadow, delaying runoff, enhancing meadow habitat and decreasing sediment delivery to the Toppenish Creek Watershed.

D. Toppenish Ridge Stock Well and Pipeline
This project was implemented to assist in managing the migration of cattle from low elevations in the spring to higher elevations in the early summer. Prior to the project, upon cattle turnout on May 1st, cattle would quickly travel approximately 25 miles to the headwater meadows of Satus and Toppenish creeks. Livestock would immediately impact several important high elevation meadows, both by overgrazing and by creating hardened cattle trails. These impacts often left the meadows ripe for stream incision.

YRWP staff worked with Bureau of Indian Affairs Range Program and National Resource Conservation Service staff to initiate a project that would help alleviate this problem. This project has installed or repaired 14 miles of livestock pasturing fence, drilled two solar powered stock wells and constructed 3.6 miles of stock water pipeline.

Cattle loiter in the headwaters of Satus and Toppenish Creeks and do significant damage to those sensitive areas. In contrast with the former practice of cattle being turned loose in the early spring and quickly moving to their summer pasture area, bypassing large areas of good forage, this fence will allow cattle to be pastured on the north side of Toppenish ridge until late June or early July before allowing them to head to higher elevations.

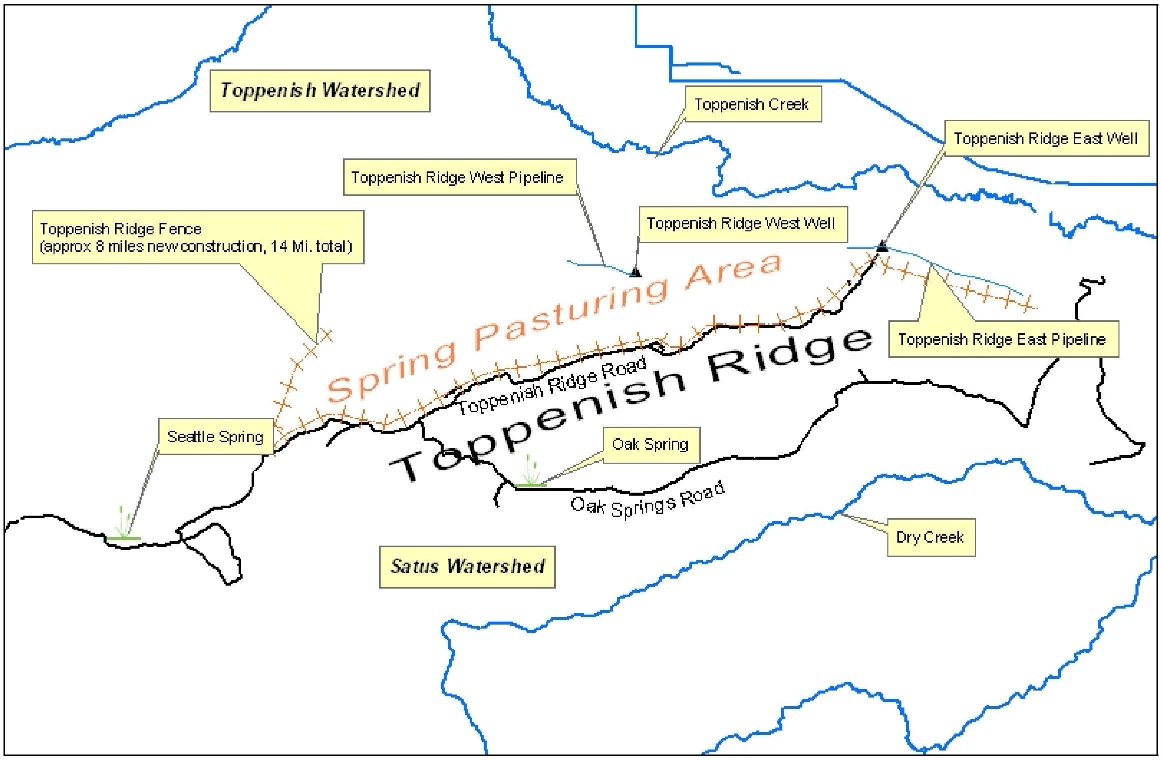

Figure 12. Map showing a spring pasturing area on the north side of Toppenish Ridge.

During this time, significant vegetation growth, actually an entire growth cycle, will occur in the higher elevation meadows allowing for much healthier riparian and wet meadow function.

The area labeled "Spring Pasturing Area" (Figure 12) will contain the cattle until mid June. This area is excellent for pasturing because it allows the cattle no contact with riparian areas. There is, however, a significant amount of feed in the area, and with the addition of the solar stock pumps, cattle can now be pastured here for a month or longer.

Conclusion

This project will function as it was intended, and is another significant step in restoring a healthy upper watershed that can supply summer flow to fish-bearing reaches downstream. There are possibilities for further development of this pasturing area if further grazing exclusion is deemed necessary.

E. Riparian Fencing and Revegetation

YRWP staff constructed and repaired a significant amount of riparian, meadow and range fencing in 2006. New construction included the Herke (.64mi), Rinker (.39mi), and Crosetto (1.1mi) property riparian fences and the Lincoln Meadow exclosure fence (1.1mi).

Figure 13. Cattle exclosure fence in Rentchler's Meadow.

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

IV Operations and Maintenance

A. Stock Wells

YRWP staff repair and maintain 33 solar powered stock pumps 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 to better meet multiple users needs while only using one stock pump.

B. Fencing

Staff maintained over 158 miles of range unit boundary fence, and 15 miles of riparian fence. 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.