2010

Annual Report

Colville Tribes

Fish & Wildlife Department

Okanogan Basin Monitoring & Evaluation Program

BPA Project # 2003-022-00

2010 Annual Report

Colville Tribes
Fish & Wildlife Department
Anadromous Fish Division

Okanogan Basin Monitoring & Evaluation Program

March 1, 2010 – February 28, 2011
CCT Project # 3158
BPA Project # 2003-022-00
Contract # 46597

Prepared by

Brian F. Miller, Jennifer L. Panther, and John E. Arterburn

Funded by

U.S. Department of Energy
Bonneville Power Administration
Division of Fish and Wildlife
PO Box 3621
Portland, OR 97208-3621

August 2011

Acknowledgements

We would like to thank Mary Davisson, Edward Berrigan, Tatum Gunn, Oly Zacherle, Vertis Campbell, Rhonda Dasher, Dennis Papa, Darin Hathaway, Tatiana Kozlova, Skyeler Folks, Jamie Squakin, and Lindsay George for their help in collecting, entering, and compiling field data for this report. Thanks also to Summit Environmental, LGL Limited, Environmental Trust of the Colville Tribes, Okanagan Nation Alliance, Environment Canada, Canada Department of Fisheries and Oceans, Washington State Department of Ecology, Washington Department of Fish and Wildlife, and the USGS for their collaboration on projects and data collection efforts.

We would also like to extend our appreciation to the many private landowners who have provided land access and enabled us to collect data within the Okanogan Basin.

Funding for the Okanogan Basin Monitoring and Evaluation Program is provided by Bonneville Power Administration (BPA).

Summary

The Colville Tribes Anadromous Fisheries Department began designing the Okanogan Basin Monitoring and Evaluation Program (OBMEP) in the spring of 2004 to provide essential information on habitat conditions and fish populations. The collected data has greatly expanded the level of knowledge being used in planning efforts and for fisheries management in the Okanogan River basin. Information related to the status and trends for all salmon and steelhead within the Okanogan River basin requires long-term vision and commitment to provide answers about population level action effectiveness.

The Okanogan Basin Monitoring and Evaluation Program draws from the existing strategies (ISAB, Action Agencies/NOAA Fisheries, and WSRFB), guidance from the Monitoring Strategy for the Upper Columbia Basin (Hillman 2006), and was called for in the Upper Columbia salmon Recovery Plan along with the Okanogan River Basin sub-basin plan. The OBMEP approach addresses questions specifically related to the Endangered Species Act for Upper Columbia River steelhead. This project is designed to monitor key components of the ecosystem related to anadromous salmonids including biological, physical habitat, and water quality parameters, plus serving to develop baseline research where data are currently unavailable.

2010 was marked as another productive year through completion of work elements related to collection of habitat, temperature, spring spawner, adult enumeration, and smolt production data. We catalogued, archived, analyzed, and reported on these data. Additional cooperative efforts resulted in redd and carcass data collection for summer/fall Chinook, real-time temperature and stream discharge data collection, and international coordination with agencies in Canada. Data and reports are available through the Okanogan Basin Monitoring and Evaluation Program website, located at:

http://cctobmep.com/obmep.php

Table of Contents

Attachments

Background

Beginning in 2002, the Upper Columbia Regional Technical Team (RTT) attempted to standardize and improve monitoring by developing the Monitoring Strategy for the Upper Columbia Basin (Hillman 2006). A proposal for funding the Okanogan River portion of this strategy was submitted to the Northwest Power and Conservation Council (NPCC) and received a high priority rating from both the Columbia Basin Fish and Wildlife managers and the Independent Scientific Review Panel (ISRP). Funding for this project was approved in 2003. The Colville Tribes' Anadromous Fisheries Division began implementing this project in the spring of 2004 to provide essential information on habitat threats and fish population viability. The collected data has already greatly expanded the level of knowledge being used in planning efforts and for fisheries management in the Okanogan basin. Information related to status and trends for all salmon and steelhead within the Okanogan River basin requires a long-term vision and commitment to provide answers about population level actions and effectiveness.

The Okanogan Basin Monitoring and Evaluation Program (OBMEP) draws from the existing strategies (ISAB, Action Agencies/NOAA Fisheries, Integrated Status and Effectiveness Monitoring Project (ISEMP), Pacific Northwest Aquatic Monitoring Partnership (PNAMP), and Columbia System-wide Monitoring and Evaluation Project (CSMEP)) and outlines an approach for addressing questions specifically related to anadromous fish management and recovery in the Upper Columbia and more specifically the Okanogan River basins. Therefore, OBMEP is specifically designed to monitor key components of the ecosystem including biological, physical habitat, and water quality parameters. This program also establishes baseline information where data are currently unavailable thus allowing future status and trend analyses to occur.

The primary project goals of OBMEP include: (1) determining if there is a meaningful biological change at the population scale for summer/fall Chinook, spring Chinook, sockeye, and steelhead in the Okanogan basin; (2) if meaningful change in selected physical habitat parameters are occurring over time; (3) if selected water quality parameters are changing in mainstem and tributary locations; (4) if change is occurring in VSP parameter from the cumulative habitat restoration actions occurring throughout the Okanogan basin; and (5) administering contracts and ensure that this effort continues in a scientifically sound manner that is closely coordinated across the Okanogan River basin, geo-political boundaries, upper Columbia ESU, Columbia River basin, and Pacific Northwest region.

Program Methods

As adapted from Hillman (2006), OBMEP developed a set of specific protocols to allow standardized data collection in a thorough and scientific manner. Snorkel surveys for fish, water quality monitoring, macroinvertebrate sampling, and physical habitat condition sampling are conducted at sites selected using a random spatially balanced rotating panel design (EMAP sites). These EMAP sites were monitored throughout the Okanogan River sub-basin from March 2010 through February 2011. Migrating adult and emigrating juvenile fish are monitored at fixed sites, through adult weir traps, juvenile rotary screw traps, and underwater video systems. Steelhead redd surveys are conducted using a census approach.

Protocols were developed specifically for OBMEP. The current versions of these protocols can be viewed at the program's web site. This report is a synopsis of all data collections and reporting efforts conducted under OBMEP for contract year 2010. Additional information relative to specific data collection activities, or links to previous year's reports can be found at:

http://cctobmep.com/obmep_publications.php

Technical reports or updates completed this year are included in the appendices that follow this report.

Project Objectives

Work Element A: Produce Pisces Status Reports

All periodic status reports were completed on time.

Work Element B: Produce (Annual) Progress Report

Each year, OBMEP produces an annual progress report. Several additional documents were completed as end products for specific deliverables. Some of these reports and conclusions are included in this document under the specific work elements or as attachments to this document.

Work Element C: Produce Environmental Compliance Documentation

Permit applications were developed and submitted primarily for operation and collection of fish at our rotary screw trap. All permits were procured before active trapping began. The permits obtained and issuing agencies are as follows:

Title of Permit	Permit #	Issuing Agency
NOAA Section 10 Permit	#16122	NOAA Fisheries
Hydraulic Project Approval (HPA)	#121497-1	WDFW
Scientific Collection Permit	#10-400	WDFW
Bridge Attachment Permit	#7687D	WSDOT
Shoreline Exemption	#1040	City of Okanogan
Floodplain Development Permit	#FDP 05-12	City of Okanogan

In addition to the above permits, OBMEP staff worked with BPA to develop compliance with the HIP-BiOp for all other activities.

Work Element D: Develop RM&E Methods and Designs – Revise Protocols

OBMEP frequently updates protocols in order to reflect any additions, changes, or refinements to methodology. In 2010, the habitat data collection protocol was updated to include modifications and improvements to previous methods. Updated protocols, along with previous versions, are posted to the program website.

Work Element E: Monitoring Changes in Standing Crop of Fish and Invertebrates at EMAP Sites

Snorkel Surveys

The Colville Tribes' Fish and Wildlife Department conducted snorkel surveys in established EMAP sites throughout the Okanogan basin as part of the Okanogan Basin Monitoring and Evaluation Program. A total of 47 out of 51 sites were snorkeled in Washington and British Columbia. Two sites were dewatered, one was inaccessible due to complete canopy closure of poison ivy, and access was denied by the landowner of another site. Surveys were conducted from mid-August through early October, 2010.

Tributaries were snorkeled by the same observers as in 2009, and three out of the five snorkelers who snorkeled the mainstem Okanogan and Similkameen rivers in 2009 also snorkeled in 2010. All observers were trained in fish observation techniques and species identification prior to snorkeling. Time was spent before snorkeling to ensure estimates of size classes were consistent within and among observers.

Twenty-one species of fish were observed among all sites in the US and Canadian portions of the Okanogan and Similkameen basins. All fish species had been observed previously in at least one of the last 5 years. The most abundant species of fish observed were steelhead (*Oncorhynchus mykiss*; N=2,622), followed by smallmouth bass (*Micropterus dolomieu*; N=2,207) and northern pikeminnow (*Ptychocheilus oregonensis*; N=959). Only 0.4% of steelhead, 3.4% of smallmouth bass, and 2.5% of northern pikeminnow were >300 mm in length.

Juvenile rainbow trout and steelhead (both *Oncorhynchus mykiss*) were observed throughout the US and Canadian portions of the Okanogan and Similkameen basins. The highest densities were observed in McClean Creek (9,540 fish/ha) in British Columbia and Tonasket Creek (9,017 fish/ha) in Washington. Four sites were sampled on Salmon Creek, and densities among these sites ranged from 2,044 to 2,862 fish/ha. One site below the anadromous barrier on Omak Creek had a density of 2,091 fish/ha, comparable to sites on Salmon Creek. In contrast, density of juvenile *O. mykiss* at four sites above the anadromous barrier ranged from 84 to 1,308 fish/ha. No juvenile *O. mykiss* were observed in Antoine, Ninemile, and Siwash Creeks in the US or at Testalinden, Ellis, Haynes, and Reed Creeks in British Columbia. Observed densities of juvenile *O. mykiss* for all streams and rivers are shown below in Table 1.

Washington Tributaries	Juvenile *O. mykiss* (N)	Observed Density (fish/ha)
Antoine Creek	0	0
Bonaparte Creek	179	5,761
Loup Loup Creek	6	201
Ninemile Creek	0†	0†
Okanogan River	20*	0.5*
Omak Creek	349*	838*
Salmon Creek	878*	2,384*
Similkameen River	79*	12*
Siwash Creek	0	0
Tonasket Creek	199	9,017
Tunk Creek	83	2,315

British Columbia Tributaries	Juvenile *O. mykiss* (N)	Observed Density (fish/ha)
Ellis Creek	0	0
Haynes Creek	0	0
Inkaneep Creek	226	3,433
McLean Creek	323	9,540
Okanogan River	25*	3.7*
Park Rill Creek	4	3
Reed Creek	0	0
Shingle Creek	64*	682*
Shuttleworth Creek	5	102
Testalinden Creek	0	0
Vaseux Creek	563	2,325

Table 1. Numbers of fish observed during snorkel surveys and average observed density of fish.
*Indicates an average of multiple snorkel reaches on creek.
†The one of the two sites on Ninemile Creek was not snorkeled due to complete poison ivy canopy closure; therefore, this average value is likely underestimated for 2010.

Macroinvertebrate Sampling

In 2010, macroinvertebrate sampling was expanded to cover all tributaries and the mainstem-Okanogan, within both Washington and British Columbia. As additional years of data collection continue, macroinvertebrate composition will be compared to standing crop of fish, to help further describe population structures.

Macroinvertebrate data collected in 2010 from the Washington portion of the Okanogan Basin is presented in the Hilsenhoff Biotic Index (Hilsenhoff 1987), EPT Richness, and Taxa Richness. Laboratory work and species identification was performed by EcoAnalysts, INC. (Moscow, ID). Index keys are show below in Table 2 and 3 for reference.

Biotic Index	Water Quality	Degree of Organic Pollution
0.00 - 3.50	Excellent	No apparent organic pollution
3.51 - 4.50	Very good	Possible slight organic pollution
4.51 - 5.50	Good	Some organic pollution
5.51 - 6.50	Fair	Fairly significant organic pollution
6.51 - 7.50	Fairly poor	Significant organic pollution
7.51 - 8.50	Poor	Very significant organic pollution
8.51 - 10.00	Very poor	Severe organic pollution

Table 2. Hilsenhoff Biotic Index (1987)

	Excellent	Good	Fair	Poor
EPT Richness	>10	6-10.	2-5.	0-1.
Taxa Richness	>30	21-30.	11-20.	0-10.

Table 3. EPT and Taxa Richness index key (adopted from USGS).

Stream	Date of collection	OBMEP site	Organisms (N)	HBI	Taxa Richness	EPT Richness
Omak Cr.	9/14/10	19	100	4.80	15	9
Omak Cr.	9/16/10	361	296	4.40	20	14
Omak Cr.	9/20/10	366	116	2.76	19	16
Omak Cr.	9/21/10	48	104	3.50	20	14
Omak Cr.	9/27/10	12	247	3.61	22	11
Loup Loup Cr.	9/27/10	421	270	4.55	12	6
Bonaparte Cr.	9/28/10	388	76	4.68	11	6
Upper Tonasket Cr.	9/30/10	568	115	4.43	22	7
Antoine Cr.	10/4/10	592	114	4.66	22	10
Salmon Cr.	10/6/10	552	203	3.64	20	13
Salmon Cr.	10/8/10	376	334	3.89	22	15
Salmon Cr.	10/14/10	297	328	3.95	13	11
Salmon Cr.	10/11/10	36	158	3.85	19	13
Nine Mile Cr.	10/12/10	587	40	6.46	12	3
Okanogan River	10/20/10	74	21	4.57	5	1
Okanogan River	10/21/10	549	20	4.35	6	1

Table 4. Brief summary of macroinvertebrate data from 2010 sampling.

Work Element F: Okanogan River Summer Chinook and Steelhead Smolt Trapping

The Colville Tribes' Fish and Wildlife Department continued enumerating juvenile salmonids using rotary screw traps in 2010. Anadromous forms of *Oncorhynchus* with verified natural production in the Okanogan basin were targeted for this study, including Chinook (*O. tshawytscha*), sockeye (*O. nerka*), and summer steelhead (*O. mykiss*). Two rotary screw traps were deployed on the Okanogan River from the Highway 20 Bridge in Okanogan, WA. Traps were operated between 30 March and 23 July 2010. An 8-foot trap was used to sample the main channel of the river for the duration of the study and a 5-foot trap was used to sample lower velocity water near the west bank when discharge levels exceeded 5,000 cfs.

Chinook salmon were the most abundant species of fish trapped in 2010, followed by sockeye and steelhead. The naturally produced Chinook sub yearling catch totaled 25,111. Throughout the season, a total of 3,367 were marked and released above the trap to determine trap efficiency. A total of 46 were recaptured. The wild sub yearling Chinook out-migrant estimate based on the Peterson Formula rendered 1,799,514 fish. In addition to the sub yearling Chinook, 8 wild yearling Chinook were also captured. Based on the Peterson Formula and cumulative efficiency based on upstream hatchery releases (513,003) and downstream captures at the screw trap (4,609), we estimated 1,001 wild yearling Chinook out-migrants.

Also caught were 19,380 juvenile sockeye. Data on sockeye emigration was forwarded to Chelan County PUD on a daily basis to help in spill timing at Rocky Reach Dam. Due to the narrow window of timing in which sockeye out-migrate in the Okanogan and low trap efficiencies, determining a reliable population estimate was unfeasible.

A total of 1,880 hatchery steelhead were captured at the rotary screw trap in 2010, from the total 100,592 released at upstream locations. Additionally, 87 wild juvenile steelhead were also captured. Using the hatchery releases as a mark-recapture group, the Peterson Formula estimated 4,705 wild steelhead out-migrants. Scale and DNA samples were collected from natural origin steelhead for analysis by WDFW.

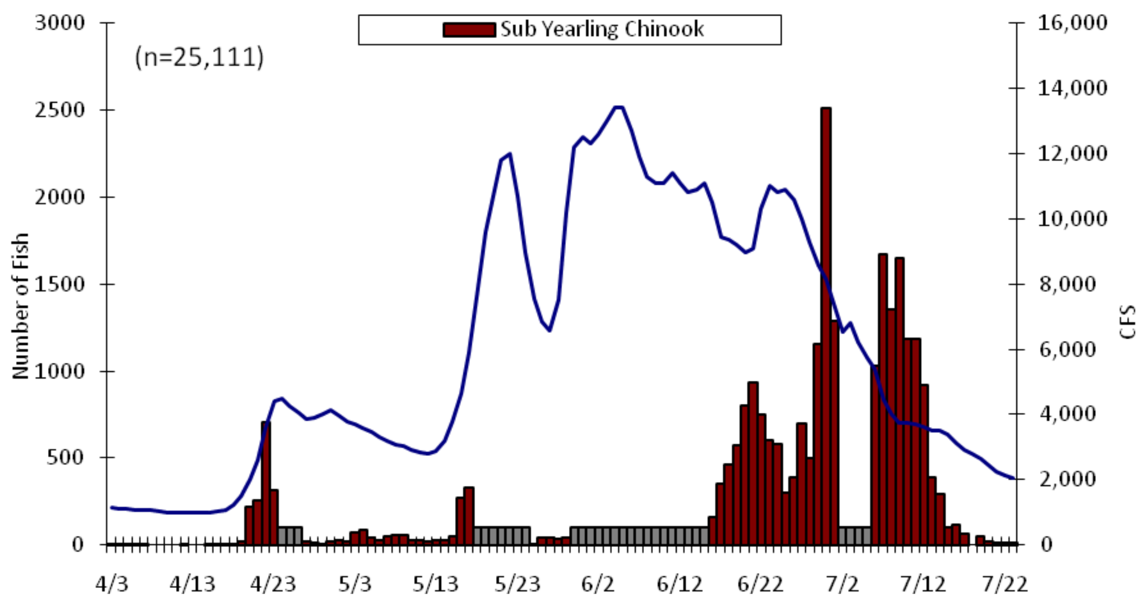

Figure 1. 2010 sub yearling Chinook outmigration timing.

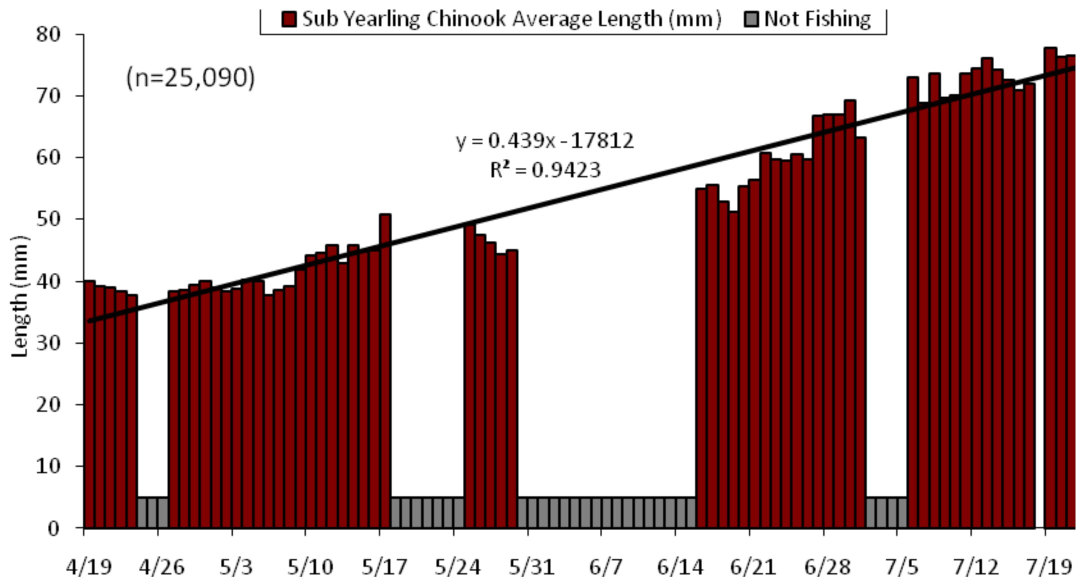

Figure 2. 2010 sub yearling Chinook length distribution.

Work Element G: Enumerate Adult Returns to the Okanogan River Basin

Underwater Video Monitoring

OBMEP used underwater video to collect data on the run timing and abundance of adult salmonids passing into the British Columbia portion of the Okanagan River Basin. These data are used to determine basin-wide distributions, status and trends of adult returns, and origin. Additionally, three video systems were installed on tributaries within the Okanogan Basin: Salmon, Antoine, and Ninemile Creeks.

In 2010, the recording equipment at Zosel Dam was upgraded with new equipment with larger storage capacity for electronic data (6 terabytes). However, due to the large number of returning adult sockeye, it took much longer to review these data with limited staff. In November, an equipment failure resulted in the loss of approximately 69 days (August 25 through October 31) of video from the right bank ladder. Fortunately, the data loss occurred at the end of the run (Figure 3). However, a complete set of data was collected for the left bank ladder.

We used linear regression to model the relationship of fish passage between the left bank (LB) and right bank (RB) ladders. Data were log-transformed prior to analysis to conform to the assumption of normality. There was a significant linear relationship ($P<0.001$) between fish observed in camera 5 (LB) and cameras 4 (RB; r^2 =0.89, df=48) and camera 6 (LB) and camera 3

(RB; r^2 =0.82, df=48). From this model, we estimated a mean of 2304 (95% CI=1604 - 3315) sockeye were missed during equipment failure. No fish were estimated for camera 2 (RB) because it was likely dewatered for the majority of time and only 3 fish were observed in the corresponding camera 7 (LB).

The first sockeye observed at Wells Dam on the Columbia River was on June 12 and the peak was July 8 (22,989). Sockeye moved quickly from the Columbia River through the Okanogan River because the first sockeye observed at Zosel Dam was on June 14 and the peak was on July 16 (34,793). Adding the fish that were estimated during equipment failure to the observed 205,998 resulted in a total of 208,302 sockeye in 2011 (Figure 3).

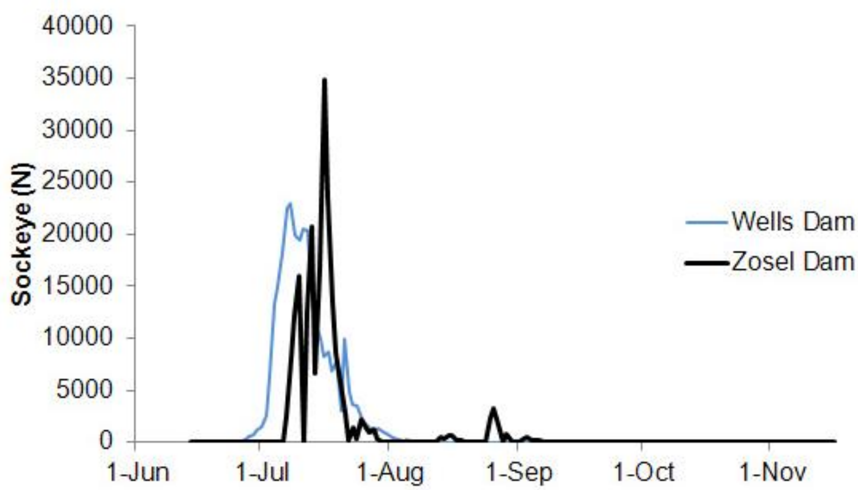

Figure 3. Daily sockeye passing Zosel Dam (black line) in 2010. Blue line shows the sockeye run at Wells Dam for comparison.

The majority (92%) of sockeye passed from July 7 through July 31 and the last fish (3) were observed November 16th. Fish favored passing through the left bank ladder, which received 64.6% compared to 35.4% of fish passing through the right bank ladder. Passage occurred primarily between the hours 0400 and 1200, with 67% of fish passing during these hours (Figure 4).

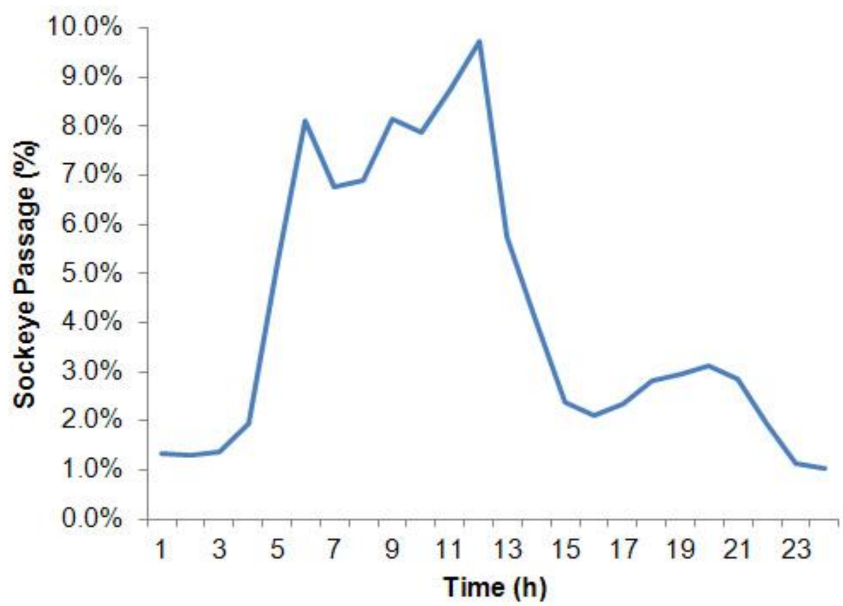

Figure 4. Hourly passage of sockeye at Zosel Dam in 2010.

Temperature appeared to be a major factor influencing migration timing. The very close distance (8 days) between the peak of fish numbers at Wells Dam (July 8) and the peak at Zosel Dam (July 16th) shows fish were able to move quickly through the system without being delayed by a high temperature barrier (~21.0 °C), which can form at the mouth of the Okanogan River (Hyatt et al. 2003). The number of fish per day was log-transformed prior to analysis to conform to the assumption of normality, and linear regression was used to model the relationship between temperature and the number of fish per day at Zosel Dam. A significant (P=0.016) inverse relationship existed between temperature and the number of fish passing Zosel Dam (Figure 5) from July 7-31, showing that when minimum temperatures exceeded 23.3 °C, fish decreased or ceased in migrating.

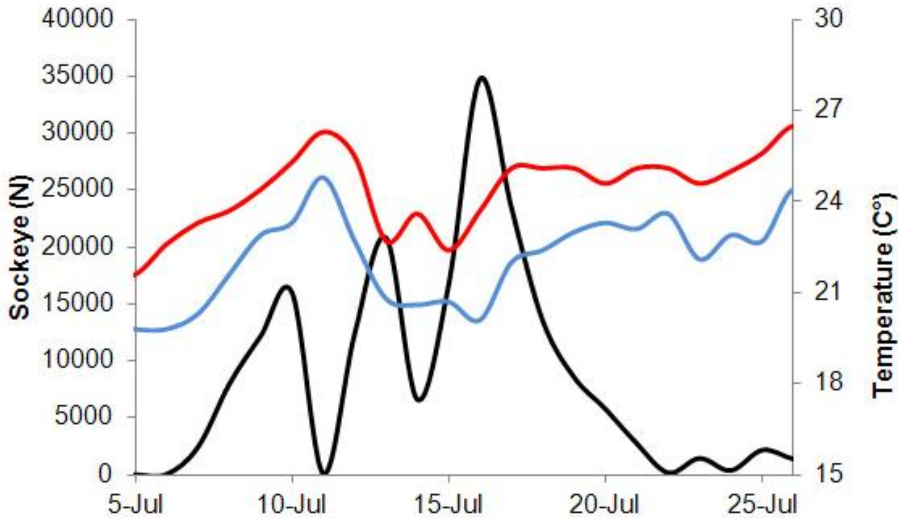

Figure 5. Black line is sockeye passage, blue line is minimum water temperature, and red line is maximum water temperature at Zosel Dam in 2010.

Adult Chinook salmon were observed at Zosel Dam from July 8 through October 24 in 2010. A total of 245 Chinook were observed (Figure 6). However, data for approximately 69 days were lost for the right bank ladder when the equipment failed. Due to the low number of Chinook observed over a long period of time, it was not possible to estimate how many fish were missed with a strong degree of certainty. However, if the proportions of sockeye observed in the LB (64.6%) versus the RB (35.5%) ladder are the same for Chinook, then an estimated 127 Chinook may have passed unobserved, which would have resulted in a total of 359 Chinook. The number of Chinook that passed Zosel Dam is a relatively small proportion of the total run over Wells Dam (less than 1%).

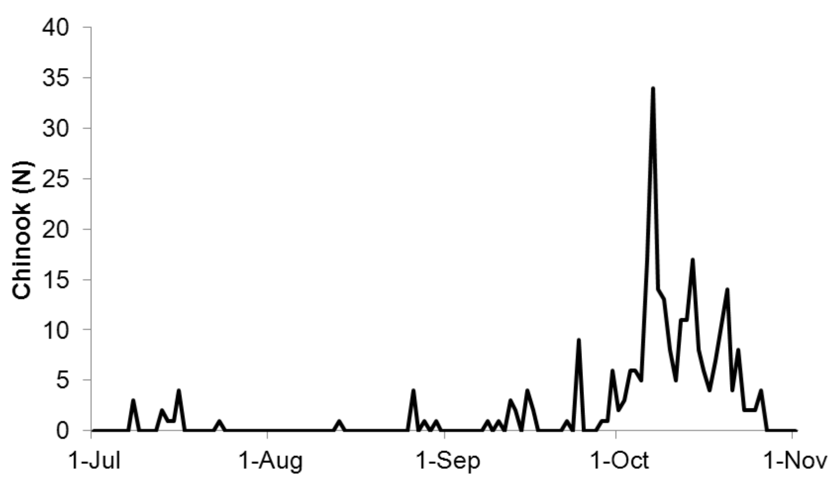

Figure 6. Chinook passage at Zosel Dam in 2010.

Steelhead were observed at Zosel Dam on February 23 through May 28, 2010, peaking on March 31 (29 fish; Figure 7). A total of 450 fish were observed, with 127 (28%) having intact adipose fins. On Salmon Creek, a total of 93 fish were observed, with 16 (17.2%) having intact adipose fins. Eighteen (18) steelhead were observed above the video weir on Ninemile Creek, with 22.2% (4) having intact adipose fins. No steelhead were observed passing the video weir in Antoine Creek. A detailed analysis on summer steelhead escapement can be found in the 2010 Steelhead Escapement and Spawning Distribution Report (Appendix 1).

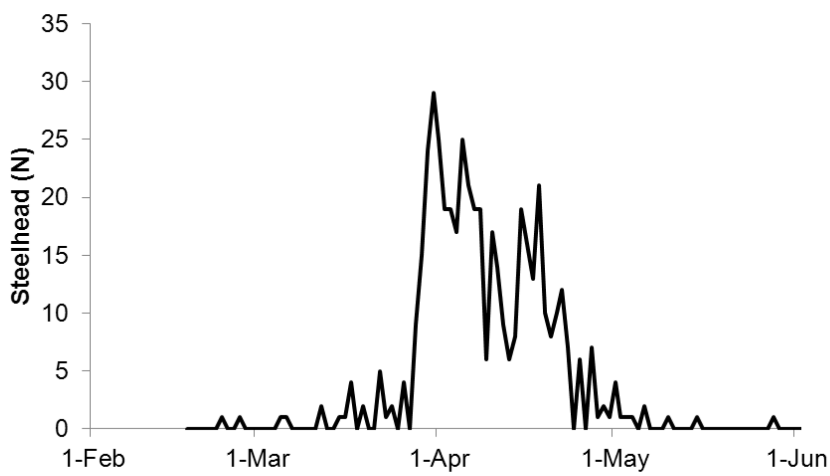

Figure 7. Steelhead passage at Zosel Dam in 2010.

A complete description of the apparatus and methodology for video sampling at Zosel Dam can be found at:

http://cctobmep.com/media/files/VideoManual070312FinalMR.pdf

Historic results from all years of operation are posted to the Columbia River DART website:

http://www.cbr.washington.edu/dart/adult.html

Steelhead Redd Surveys

Summer steelhead (*Oncorhynchus mykiss*) spawning distribution and abundance estimates were determined throughout the Okanogan basin in 2010 using redd surveys, adult weir traps, and video enumeration. We estimated that between 3,236 and 3,596 summer steelhead spawned in the Okanogan River basin, estimating that 630 and 853 were of natural origin. Objectively determining wild origin was complicated by the unknown number of adipose-present hatchery steelhead released into the Okanogan River, the presence of adfluvial rainbow trout, and the inability to validate origin when observing steelhead on redds. In 2010, new fisheries regulations requiring the harvest of all steelhead with clipped adipose fins likely contributed to higher percentages of ad-present spawners. Escapement into British Columbia was estimated at 377 steelhead with 29.7% observed with adipose fins at the video station at Zosel Dam, five miles south of the Canadian border. However, the spatial distribution of spawning in the Canadian portion of the Okanogan basin remains largely unknown. The highest densities of steelhead redds continue to be in the lower Similkameen River and downstream of Zosel Dam on the Okanogan River.

Due to above-average runoff in 2010, tributaries to the Okanogan River were more readily accessible to adult steelhead. Approximately 37% of steelhead that spawned within the United States utilized tributary habitats, which was higher than in previous years. The abundance of steelhead that spawned in tributary habitats may help to increase future years' returns of natural origin steelhead. Annual collection of steelhead spawning data continues to provide a comprehensive depiction of spawning distribution and minimum escapement trends within the Okanogan River basin.

The data on steelhead spawning distribution can be viewed on our web site at:

http://cctobmep.com/media/files/2010_okanogan_sth_surveys.pdf

The complete 2010 steelhead spawning report is attached as Appendix 1.

Work Element H: Monitor Threats to Salmonid Habitats at up to 50 Sites Annually

Currently, the Colville Tribes are the only organization collecting comprehensive fish habitat data throughout the Okanogan Basin, in both Washington and British Columbia. Cooperation includes the sharing of monitoring responsibilities between the Colville Tribes and the Okanagan Nation Alliance (ONA), adjusting or changing sampling methods to comport with standardized protocols, and adhering to strict statistical design criteria.

Physical habitat data is collected annually at 50 EMAP sites (25 panel, 25 rotating panel) consistent with protocols developed by the Colville Tribes. Thirty-four sites were located in the Washington State portion of the Okanogan Basin by the Colville Tribes and 16 sites were located in the British Columbia portion of the Okanagan Basin by the ONA. Of the 50 total EMAP sites, 6 were not sampled, due to either climatic or landowner restrictions.

Physical habitat data are collected in electronic format on Trimble GPS data loggers. Information collected pertains to: the presence and composition of large woody debris, riparian vegetation structure, canopy cover, human disturbance, substrate composition, stream channel habitat types (pool, riffle, glide, etc.), and channel morphology. All data are compiled on the OBMEP server located at the Colville Tribes', Fish and Wildlife office in Omak, WA. Specific information requests can be directed to the Colville Tribes, Fish and Wildlife Department, Anadromous Fish Division, 25B Mission Road, Omak, WA 98841, (509) 422-7424.

Past and present habitat data are being analyzed with the use of the Ecosystem Diagnosis and Treatment (EDT). The EDT approach integrates site specific information with larger spatial scales and broader ecological processes. Methods were developed by ICF International to examine the potential of habitat in the Okanogan River to support spring Chinook salmon and steelhead. The EDT process provides a framework for the evaluation of habitat data collected within the Okanogan River basin; the production version of EDT3 is due for release in 2011 and includes software and tools that will be used to conduct ecosystem status and trend analysis.

Reports related to habitat data can be downloaded at:

http://cctobmep.com/obmep_publications.php

Work Element I: Fill Data Gaps Related to Water Quality and Quantity Needed to Evaluate Status and Trend

Water Quality

Water quality readings were collected at 24 locations within the Okanogan basin. Procedures were modeled after the Department of Ecology's water quality protocols. Specific metrics included conductivity, dissolved oxygen, pH, turbidity, ammonia, nitrates, and total dissolved gas. Data were collected once monthly, unless site conditions did not allow. During the winter months, many small streams and the Okanogan River were frequently iced over; therefore, no readings were taken. Additionally, water quality data were not collected if a streambed was dry. Specific water quality data requests can be directed to the Colville Tribes', Fish and Wildlife Department, Anadromous Fish Division, 25B Mission Rd., Omak, WA 98841, (509) 422-7424.

Water Temperature and Discharge

Water temperature is largely accepted as the largest limiting factor for steelhead recovery in the Okanogan River. In order to monitor water temperatures, OBMEP began deploying Onset® temperature data loggers in streams at all annual and panel tributary sites in May of 2005. Data was again collected in 2010 at all EMAP sites located in the U.S. and Canadian portions of the Okanogan Basin. Temperature data are compiled on the OBMEP server located at the Colville Tribes, Fish and Wildlife office in Omak, WA. Specific information requests can be directed to the Colville Tribes', Fish and Wildlife Department, Anadromous Fish Division, 25B Mission Rd., Omak, WA 98841, (509) 422-7424.

Real time temperature data are collected at three sites on the Okanogan River in the United States at Oroville, Malott and Tonasket by the US Geological Service under contract with the Colville Tribes. An additional site is located on Ninemile Creek. Data have been assimilated into on-going data collection activities within the USGS web sites. These data are available on the internet to provide easy access to the public and other agencies. Data links for sites on the Okanogan River:

Mallot:http://waterdata.usgs.gov/wa/nwis/dv?referred_module=sw&dd_cd=01%2C02%2C05%2C05%2C05&format=gif&p

Tonasket: http://waterdata.usgs.gov/wa/nwis/uv?12445000

Oroville: http://waterdat.usgs.gov/wa/nwis/dv/?siteno=12439500&agencycd=USGS

Ninemile Creek: http://nwis.waterdata.usgs.gov/nwis/uv?12438900

The Okanogan River watershed, especially the Canadian portion, has several tributaries with unknown discharge or temperature regimes. OBMEP continues to pursue cooperative agreements between the Okanagan Nation Alliance, the Ministry of Environment, Environment Canada, and the Colville Tribes to address these data gaps for Inkaneep, Vaseux, and Shuttleworth creeks.

To view data go to:

http://scitech.pyr.ec.gc.ca/waterweb/disclaimerB.asp

1. In the “View all Real Time Stations within” window, select British Columbia and choose Order By: Station name.
2. Scroll down the page and click “I accept”.
3. Scroll through the station list and select the station:
    a. INKANEEP CREEK NEAR THE MOUTH (08NM200)
    b. VASEUX CREEK NEAR THE MOUTH (08NM246)
    c. SHUTTLEWORTH CREEK AT THE MOUTH (08NM149)

Work Element J: Manage Projects: Produce Necessary Documents, Estimates, and Contracts plus Direct Office Expenses

Completed

Work Element L: Project Coordination and Public Outreach

OBMEP biologists coordinated directly with other entities performing M&E related activities throughout the region to ensure compatibility with other regional M&E and salmon recovery efforts. On-going coordination with other monitoring practitioners is critical to the success of OBMEP's ability to collect useful data that can be easily assimilated to larger spatial scales.

We developed OBMEP under a regional M&E scheme involving coordination with multiple entities through both the Columbia System-wide Monitoring and Evaluation Project (CSMEP) and the Pacific Northwest Aquatic Monitoring Partnership (PNAMP) to ensure that our project is compatible with efforts spanning the entire Pacific Northwest. Continued coordination with these entities will be necessary as region wide M&E efforts continue to evolve.

At the scale of the Upper Columbia ESU, OBMEP biologists regularly contributed to monthly meetings of the Upper Columbia Regional Technical Team (RTT) and monitoring and data management subcommittees. Data have been shared at these meetings along with field protocols and strategies for field sampling, data archiving, manipulation, and analysis. Ongoing coordination within the Upper Columbia Salmon Recovery Board process is essential to make sure data can be scaled up for ESU related recovery analysis to measure progress toward recovery of listed salmonid stocks.

Within the Okanogan River sub-basin, we have international coordination responsibilities with Canadian entities. To facilitate these relationships we have contracted with Okanagan Nation Alliance and host regular quarterly meetings. Additional meetings are occasionally attended with other agencies and groups that collect monitoring data or have a need or use for the data we are collecting. Regular updates are provided annually at the Bilateral Okanogan Basin Technical Working Group meeting and Lake Osoyoos Board of Control, Fisheries Advisory Group.

In addition to providing local groups and agencies with information and updates, many OBMEP survey sites fall within areas of private ownership. Therefore, landowners must be contacted (public outreach) and access granted before field crews can conduct surveys. Biologists and field staff working under OBMEP have made many contacts with landowners throughout the Okanogan basin to gain access to EMAP sampling sites, redd survey sites, and to keep the landowners updated. Most contacts have been positive and access to perform work under this contract would be impossible without cooperation from local landowners.

Work Element M: Support of OBMEP Website and Workshop/ Conference Attendance

Workshop and Conference Attendance

OBMEP staff are frequently involved in local and regional meetings, conferences, and workshops. In addition to attendance, data collected by the program are commonly requested to be presented at these events, which are used for both informative and management decisions.

Some of the forums which OBMEP staff contributed in 2010 included:

- Columbia Cascade Regional Fisheries Enhancement Group
- Upper Columbia Regional Technical Team
- Okanogan Irrigation District board meetings
- Enloe Dam relicensing meetings
- Regional Fisheries Enhancement Group Advisory Board and Coalition

- PNAMP Habitat Metric meetings
- HCP Hatchery Oversight Technical Team Conference
- Lake Osoyoos Board of Control Fisheries Advisory meeting
- PNAMP Steering Committee
- NPCC Categorical Review Workshop
- Okanogan River Watershed Action Team meetings
- 2010 Adaptive Management Science Conference
- PIT-tag conference, Skamania, WA

Website

The primary purpose of the OBMEP website is to disseminate summary data and results in the form of reports. In 2010, Disuatel-Hege Communications was enlisted to redesign the OBMEP website and host it on one of their web servers. Their hosting services will ensure greater security for the website and more technical assistance for maintaining the site. Content from the old website was updated and new content was added to the new site. The new site has been streamlined making it very intuitive to use, with a modern look and feel consistent with the Colville Tribes' main website. The publications page is the primary location from which results and summary data within reports are disseminated. Publications have been simply organized by report type specific to a type of project or organization. A news feed has been added to the main page and will allow us to post updates on current projects or new work to be done under OBMEP. The new URL is: **www.cctobmep.com**

Work Element N: Manage, Maintain, and Expand the OBMEP Database

At the end of the 2006 contract year, OBMEP began using an Access® database developed by Summit Environmental Consultants Ltd to archive data. They also developed protocols for transferring data collected on Trimble® handheld data loggers, data forms and the Internet into the database. From 2006 to 2010, much of the data in the database were entered without performing full audits on the data. Therefore, in 2010, a full-scale audit was conducted on existing data in the database. All snorkel data were double-checked with original paper data sheets. Habitat data were collected electronically, so it was not possible to check any original datasheets. However, outliers were examined to determine if they were real or if they were the result of typos (i.e. misplaced decimals). Video, screw trap, adult trap, water quality, and temperature data were audited as well. Data that were identified as missing were added, typos were fixed, identified errors were resolved, and all changes were documented in metadata documents. All duplicate entries of any data type were removed. In the future, much of the auditing that was performed in 2010 will be done by the biologists responsible for collecting the data prior to uploading the data into the database.

In 2010, several training sessions on using templates for the database were conducted before the various data types were collected. The training especially focused on common mistakes that were made in previous years when entering data. Templates on the newer Trimble GEO XT's were modified to include new data types that were being collected and to decrease the chances of making mistakes that were made in previous years.

An upgrade to the database infrastructure is planned for 2011. Meetings and conversations were held in 2010 to determine the specifics of the new infrastructure that will house the OBMEP database at the Colville Tribes Fish and Wildlife Department office in Omak, WA. The database software will be converted from Microsoft Access® 2003 to Microsoft SQL Server 2008. Additionally, the current hardware (MPC database server) will be replaced with a new HP server, which will be made accessible over the web via a new HP web server. Providing access over the web will allow a greater flexibility in the number of people that can access the database over the web. It will also ensure a greater degree of security to the Tribes' network than is currently available under the existing remote access connections.

Work Element O: Analyze Collected and Historical Data on Habitat, Biological, and Water Quality Parameters

Conducted periodically throughout the contract period.

Conclusions

The Okanogan Basin Monitoring and Evaluation Program completed another year of data collection, coordination, and reporting in 2010. All tasks were completed on time and within budget. Among the most requested data have been the annual spring spawning numbers; therefore, this report will continue to be produced on an annual basis. Data from other sampling events will be analyzed in a timely fashion and made available at request from other agencies. Technical documents will continue to be posted on the OBMEP and BPA web sites for public access. Access to OBMEP data will also be handled through the Upper Columbia Salmon Recovery Board data steward, Integrated Status and Effectiveness Monitoring Project (ISEMP) through the STEM Databank, the Columbia Basin Fish and Wildlife Authorities state of the resource report, Fish Passage Center, US Geologic Survey, and the Columbia River Data Access in Real Time (DART), Stream-net, or by contacting OBMEP staff directly.

OBMEP continues to progress by using the latest technologies and scientific knowledge. The video monitoring project has been expanded to include multiple tributaries and time saving methodologies. We are also testing methods to monitor water levels in tributaries in order to improve the accuracy and efficiency of water temperature monitoring. In late 2010, OBMEP worked in conjunction with WDFW to implement a basin-wide PIT tag detection project, which expanded our capabilities of monitoring steelhead utilization of the mainstem Okanogan and tributaries. These PIT tag arrays were located in the lower extent of tributaries to the Okanogan River and provide detailed data on individual fish movements, population migration timing, and tributary spawning distribution. We are comparing data from the PIT tag antennas with redd survey, weir trap, and video data to help further refine steelhead spawning distribution estimates within the basin. In 2011, this program will be expanded to cover all tributaries utilized by anadromous fish as well as multiple sites on the mainstem Okanogan and Similkameen Rivers.

Improved methods to collect and analyze habitat data are being applied in order maintain standardization throughout the upper Columbia, while maintaining consistency with our existing datasets. In order to holistically characterize the suitability of habitat within the Okanogan basin for steelhead utilization, our data is being analyzed through the EDT3 model. This new technology incorporates discrete habitat metrics, historically analyzed on an individual basis, into a comprehensive approach. As these efforts mature, the OBMEP staff hopes to contribute to improved data collection and status and trend monitoring throughout the entire Columbia River basin, while in turn, adapting from other projects developments.

References

Hillman, T. W. 2006. Monitoring strategy for the Upper Columbia Basin. Second Draft Report for the Upper Columbia Salmon Recovery Board, Bonneville Power Administration, and National Marine Fisheries Service.

Hilsenhoff, W. L. 1987. An improved biotic index of organic stream pollution. The Great Lakes Entomologist 20:31-39.

Karr, J.R., and E.W. Chu. 1998. Restoring Life in Running Waters: Better Biological Monitoring. Island Press. 1-55963-674-2. 220pp.

Miller, B.F., Panther, J.L., and J.E. Arterburn. 2011. 2010 Okanogan Basin Steelhead Escapement and Spawning Distribution. BPA project #200302200. Colville Confederated Tribes Fish and Wildlife Department, Nespelem, WA.

Schwartz, J. 2010. Habitat Status and Trends, Diagnosis and Treatment of the Okanogan Ecosystem through Time. Executive summary submitted to the Colville Confederated Tribes Fish and Wildlife Department, Nespelem, WA.

Appendix 1.

Colville Tribes, Fish & Wildlife Department

2010 Okanogan Basin Steelhead Escapement and Spawning Distribution

Brian F. Miller, Jennifer L. Panther, and John E. Arterburn

Prepared for the Bonneville Power Administration,
Division of Fish and Wildlife, BPA Project # 200302200
Document # CCT/AF-2011-1

March 2011

2010 Okanogan Basin Steelhead Escapement and Spawning Distribution

Prepared by:

Brian F. Miller
Jennifer L. Panther
John E. Arterburn

Colville Tribes
Department of Fish & Wildlife
Anadromous Fish Division - Omak Office
25B Mission Road
Omak, WA 98841
Phone: 509/422-7424
Fax: 509/422-7443

Prepared for:

U.S. Department of Energy
Bonneville Power Administration
Division of Fish and Wildlife
P.O. Box 3621
Portland, OR 97208-3621

Performance Period: March 1, 2010 – February 28, 2012

BPA Project # 200302200

http://www.bpa.gov/

Acknowledgements

We would like to thank the following people for help in collecting or compiling information used in this report: Rhonda Dasher, Rocky Timentwa, Oliver Pakootas, Teddy Cohen, Mary Davisson, Darin Hathaway, Edward Berrigan, Tim Erb, Dennis Papa, Chris Fisher, Charlie Snow, Charles Frady, Tatiana Kozlova, and Skyeler Folks. Thanks to the individuals involved with administrating this contract especially David Roberts, Loni Seymour, Mickie Allen, and Colette Adolph. Thanks to the Bonneville Power Administration for funding the Okanogan Basin Monitoring and Evaluation Program (BPA project number 20032200).

Abstract

Summer steelhead (*Oncorhynchus mykiss*) spawning distribution and abundance estimates were determined throughout the Okanogan basin in 2010 using redd surveys, adult weir traps, and video enumeration. We estimated that between 3,236 and 3,596 summer steelhead spawned in the Okanogan River basin, estimating that 630 and 853 were of natural origin. Objectively determining wild origin was complicated by the unknown number of adipose-present hatchery steelhead released into the Okanogan River, the presence of adfluvial rainbow trout, and the inability to validate origin when observing steelhead on redds. In 2010, new fisheries regulations requiring the harvest of all steelhead with clipped adipose fins likely contributed to higher percentages of ad-present spawners. Escapement into Canada was estimated at 377 steelhead with 29.7% observed with adipose fins at the video station at Zosel Dam, five miles south of the Canadian border. However, the spatial distribution of spawning in the Canadian portion of the Okanogan basin remains largely unknown. The highest densities of steelhead redds continue to be in the lower Similkameen River and downstream of Zosel Dam on the Okanogan River.

Due to above-average runoff in 2010, tributaries to the Okanogan River were more readily accessible to adult steelhead. Approximately 37% of steelhead that spawned within the United States utilized tributary habitats, which was higher than in previous years. The abundance of steelhead that spawned in tributary habitats may help to increase future years' returns of natural origin steelhead. Annual collection of steelhead spawning data continues to provide a comprehensive depiction of spawning distribution and minimum escapement trends within the Okanogan River basin.

Contents

Introduction

Summer steelhead are listed as threatened in the Upper Columbia Evolutionarily Significant Unit (ESU) under the Endangered Species Act (ESA). To recover this ESU requires that all four populations (Wenatchee, Methow, Entitat, and Okanogan) meet minimum adult abundance thresholds, have positive population growth rates, and each population must be widely distributed within respective basins. Within the Okanogan River basin, the Okanogan Basin Monitoring and Evaluation Program (OBMEP), monitors adult abundance attributes. Since 2004, OBMEP developed protocols derived from the Upper Columbia Strategy (Hillman 2004) that called for a complete census of all spawning. Preliminary methodologies for implementing redd surveys were developed in 2005 (Arterburn et al. 2004), and these methods were later revised in 2007 (Arterburn et al. 2007c).

In addition to redd surveys, adult weir traps and underwater video counting was incorporated in order to improve escapement estimates, reduce project costs, and coordinate with other on-going data collection efforts. Weir traps have been operated on Omak Creek since 2001, Bonaparte Creek since 2006, and Inkameep Creek since 2007. These weir traps provided supplemental biological data, such as length, weight, sex, mark/tags, origin, and age that are also used to evaluate adult steelhead returns. Underwater video enumeration allows adult steelhead to be counted at fixed locations, such as Zosel Dam since 2006, and Ninemile, Antoine, and Salmon Creek since 2008. We also expanded the use of PIT tag data, especially related to summer steelhead escapement north of Lake Osoyoos, and stable isotope data, to partition adfluvial rainbow trout from anadromous steelhead.

This document builds upon preceding information and previous year's data and reports can be accessed at www.cctobmep.com. An extensive literature review of historic spawning information related to the Okanogan River basin can be found in Arterburn et al. (2005). A census of all mainstem habitats was conducted within the U.S. in 2005 and identified several large areas that contained no redds due to unsuitable spawning habitat. Eliminating these areas from future surveys reduced program costs, and it is assumed there was minimal loss of any relevant data. Recommendations from the 2005 surveys helped define the actual reaches that would be surveyed from 2006 through 2010.

Methods

The Okanogan River basin flows from the northern headwaters near Vernon, BC to the confluence with the Columbia River near Brewster, WA (Figure 1). We conducted a census count of all summer steelhead spawning downstream of anadromous fish migration barriers in the mainstem and all accessible tributaries of the Okanogan and Similkameen River drainages within the United States (Arterburn et al. 2007a, Walsh and Long 2006). We used adult weir traps and underwater video enumeration at locations where habitat is extensive or difficult for surveys to be performed on foot. Redd surveys were used to cover all remaining spawning habitat.

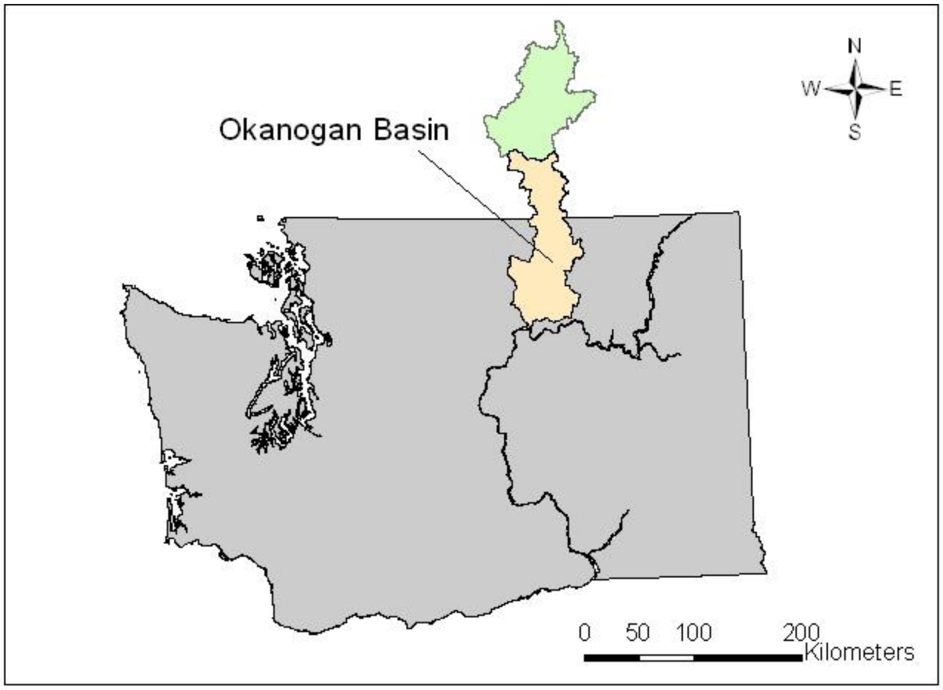

Figure 1. The extent of historic habitat in the Okanogan River basin accessible to anadromous fish.

At weir traps, we used protocols developed for the collection of locally adapted broodstock (Dasher 2011). Weir traps were located at Omak Creek, Bonaparte Creek, and Inkameep Creek in 2010. The Omak Creek trap was located approximately 1.6 km upstream of the confluence with the Okanogan River (Figure 2). This trap was a semi-permanent design that has remained operational under all discharges since 2005. The Bonaparte Creek picket weir trap has been installed seasonally each year since 2006 (Figure 3); the Inkameep Trap has been operational since 2007. At each trap, fish species was identified, weight (g) and length (mm) recorded, sex determined, tags or marks identified, and biosamples taken as needed for DNA analysis and aging. Fish were either placed up stream of the weir, taken for broodstock, removed and relocated.

Underwater video data were collected following procedures as described in Nash (2007). Video counting facilities were located at Zosel Dam, where year around data have been collected since 2006 (Figure 4). Seasonal video systems were installed in Ninemile and Antoine Creeks, near their confluence with the Okanogan River. A seasonal video monitoring station was also installed in Salmon Creek, at the Okanogan Irrigation District's diversion at rkm 7.2. Above this point, most of the land is privately owned and access for a complete redd survey would be unattainable.

Figure 2. Semi-permanent floating weir trap located on Omak Creek.

Figure 3. Seasonal picket weir trap located on Bonaparte Creek.

Figure 4. Photographs of Zosel Dam west bank video chute array prior to (left) and during deployment.

Summer steelhead were enumerated in all remaining spawning habitats following the OBMEP redd survey protocol (Arterburn et al. 2007C). Designated mainstem and tributary survey reaches are listed in Table 1. The area of the Okanogan River downstream from Chiliwist Creek is inundated by the Columbia River (Wells Pool/Lake Pateros), and therefore, lacks appropriate velocity and substrate needed for summer steelhead to spawn. Consequently, this lower reach (~ 15 miles) of the Okanogan River was excluded from surveys.

The Okanogan River was divided into seven survey reaches, based on access points, and the Similkameen River was surveyed as two reaches. We used data (discharge, air and water temperature, local knowledge of fish movements) collected from previous years to determine when to begin surveys on the mainstem. Mainstem surveys were conducted from rafts and on foot in a downstream progression. All island sections or other mainstem areas that could not be floated due to limited access and/or obstacles (e.g. wood debris, braided channels, and diversions) were surveyed on foot. Raft surveys were conducted by a minimum of two people using 10' Skookum ®Steelheader model catarafts (Redman, Oregon). Small tributaries were surveyed on foot, walking upstream. Each reach within the mainstem Okanogan and Similkameen River was surveyed up to three times between March 19 and May 12, 2010. Tributaries were surveyed one to four times, beginning April 9 and ending May 27.

Geographic positions of redds were collected with a Trimble GeoExplorer XT GPS unit and downloaded into GPS Pathfinder® after every survey. The GIS data were reviewed and differentially corrected. To avoid recounting, redds were marked by flagging tied to bushes or trees adjacent to the area where they were observed. Individual flags were marked with the survey date, direction, and distance from the redd(s), consecutive flag number, total number of redds represented by the flag, and surveyor initials. Incomplete redds or test pits were not flagged or counted. The color of the flagging was changed for each survey.

Table 1. Designated redd survey reaches in the United States, used by OBMEP in 2010.

Redd Survey Reaches	Location Description	Reach length(km)
Similkameen - S1/S2	Similkameen/Okanogan Confluence (0) to Enloe Dam (14.6)	14.6
Okanogan - O1	Okanogan River south Loup Loup Creek (26.7) to Salmon Creek (41.4)	14.7
Okanogan - O2	Okanogan River at Salmon Creek (41.4) to the office (52.3)	10.9
Okanogan - O3	Okanogan River at the office (52.3) to Riverside (66.1)	13.8
Okanogan - O4	Okanogan River at Riverside (66.1) to Janis Bridge (84.6)	18.5
Okanogan - O5	Okanogan River at Janis Bridge (84.6) to Tonasket Park (91.4)	6.8
Okanogan - O6	Okanogan River at Horseshoe Lake (112.4) to confluence with Similkameen River (119.5)	7.1
Okanogan - O7	Okanogan River at confluence (119.5) to Zosel Dam (127.0)	7.5
Tunk Creek	Tunk Creek at Okanogan River confluence (0) to high water mark (0.2)	0.2
Bonaparte Creek	Bonaparte Creek/Okanogan River confluence (0) to Bonaparte Falls (1.6)	1.6
Ninemile Creek	Ninemile Creek from Okanogan River confluence (0) to video weir (0.7)	0.7
Tonasket Creek	Tonasket Creek/Okanogan River confluence (0) to Tonasket Falls (3.5)	3.5
Antoine Creek	Antoine Creek/Okanogan River confluence (0) to video weir (1.3)	1.3
Loup Loup Creek	Loup Loup Creek/Okanogan River confluence to Loup Loup Creek diversion (2.3)	2.3
Wild Horse Sp Creek	Wild Horse Spring Creek/Okanogan River Confluence to barrier (1.1)	1.1
Omak Creek	Omak Creek/Okanogan River Confluence (0) to Omak Creek trap site (2.0)	2.0
Salmon Creek	Salmon Creek confluence with the Okanogan (0) to OID diversion (7.2)	7.2

We employed the method currently used by Washington Department of Fish and Wildlife (WDFW) in the Upper Columbia Basin to extrapolate escapement estimates using the sex ratio of broodstock collected randomly over the run at Wells Dam (Andrew Murdoch, WDFW, pers. comm.). For example, if the sex ratio of a random sample of the run was 1.5:1.0 males to female, the expansion factor for the run would be 2.5 fish per redd (FPR). All escapement calculations using sex ratio multipliers assume that each female will produce only one redd. This method is used for all supplemented stocks within the Upper Columbia Basin. Sex ratio data was used to provide estimates of total spawner escapement for the population, tributary, and mainstem reaches.

Population estimates within several sub-watersheds incorporated sex ratio data generated from adult weir traps. Total redd estimates, in combination with spawner escapement where data exists (Omak Creek, Bonaparte Creek, and Inkaneep Creek weir traps; Zosel Dam, Antoine Creek, Salmon Creek, Ninemile Creek video counts), were summed to estimate total escapement within sub-watersheds. Sex ratio was determined by counting and sexing a sample of adult fish at Wells Dam, and all fish collected at Inkaneep, Omak, and Bonaparte Creek traps. The ratio of males to females was used representatively for the streams where fish were trapped. Values derived from Wells Dam data were applied to mainstem reaches. The sex ratio from the Omak Creek trap was applied to medium-sized tributaries in the United States and the sex ratio from the Bonaparte Creek trap was applied to similarly sized small streams.

Results and Discussion

Sex Ratio

A sample of 1,264 summer steelhead including 671 males and 593 females were sexed at Wells Dam in 2010 by Washington Department of Fish and Wildlife personnel (Charles Frady, WDFW, pers. comm.). Wells Dam data resulted in a sex ratio of 1.13 males per female or 2.13 FPR.

In 2010, 212 summer steelhead were enumerated at the Omak Creek trap (140 males; 72 females) and a ratio of 1.9 males for each female was observed, yielding 2.9 FPR. Sixty-seven summer steelhead (46 males; 21 females) were collected at Bonaparte Creek, resulting in a FPR multiplier of 3.2 steelhead per redd. For tributaries to the Okanogan where sex ratio data were not available (i.e. Salmon, Tunk, Ninemile, Loup Loup, Antoine Creeks), a surrogate value was used from similarly sized creeks. The value from Omak Creek was applied to Salmon Creek (2.9 FPR); the observed 3.2 FPR value from Bonaparte Creek was applied to the remaining small tributaries to the Okanogan.

Percent-Wild

The WDFW estimated the number of wild summer steelhead that escaped above Wells Dam was 1,834 or 8.2% of the total escapement in 2010. This value was based upon ad-present steelhead counts, PIT tags, coded wire tags, scale analysis, harvest, broodstock collection, and stray rates estimated for Wells Hatchery (Charles Frady, WDFW, pers. comm.). The proportion of wild fish assumed to be bound for the Okanogan River was 352 or 9.1% of the total escapement assumed to be bound for the Okanogan River. This percentage was applied to all mainstem Okanogan reaches to estimate the likely number of wild spawners.

The percent of wild summer steelhead estimated as returning to tributary weir traps was determined by the presence of an intact adipose fin, PIT tag, and coded wire tag information. The number of natural origin steelhead returning to Omak Creek was 80.7% (171 out of 212 total fish). Twenty-eight wild fish were captured in the Bonaparte Creek trap out of 67 total fish; therefore, 41.8% were considered wild.

Video weirs were also used on three tributaries and the mainstem Okanogan in order to determine percent-wild estimates. On Salmon Creek, 17.2% of passing fish were documented as ad-present and 22.2% for Ninemile Creek. No adult steelhead were observed in the Antoine Creek video weir. At Zosel Dam, 127 out of 450 summer steelhead (28%) were documented having intact adipose fins. A percent-wild value of 40.5% was used for Tunk Creek where no specific data were collected. This value was derived by averaging the four monitored tributary locations (Omak, Bonaparte, Salmon, and Ninemile Creeks). The most conservative percent wild estimates (17.2%) were used for Wild Horse Spring Creek, Loup Loup Creek, and Tonasket Creek because wild steelhead production in these streams is rare based upon a lack of year round discharge. We felt more confident using 17.2% for these systems based on observations of adipose fins during redd surveys and the fact that these creeks have not been regularly accessible to steelhead in previous years (insufficient flows for adult passage).

Okanogan and Similkameen River Mainstem

Water clarity remained acceptable to conduct redd surveys during the majority of mainstem surveys on the Okanogan and Similkameen Rivers in 2010. However, two sharp increases in discharge on the Similkameen River occurred at the end of April and the end of May (Figure 5), which resulted in reduced visibility. A total of four mainstem surveys could not be effectively conducted: one survey on Reach O2, one on Reach S1, and two on Reach S2. Estimates of potential missed redd counts for these surveys were calculated based on the proportion of redds observed across the first, second, and third round of surveys within 2011.

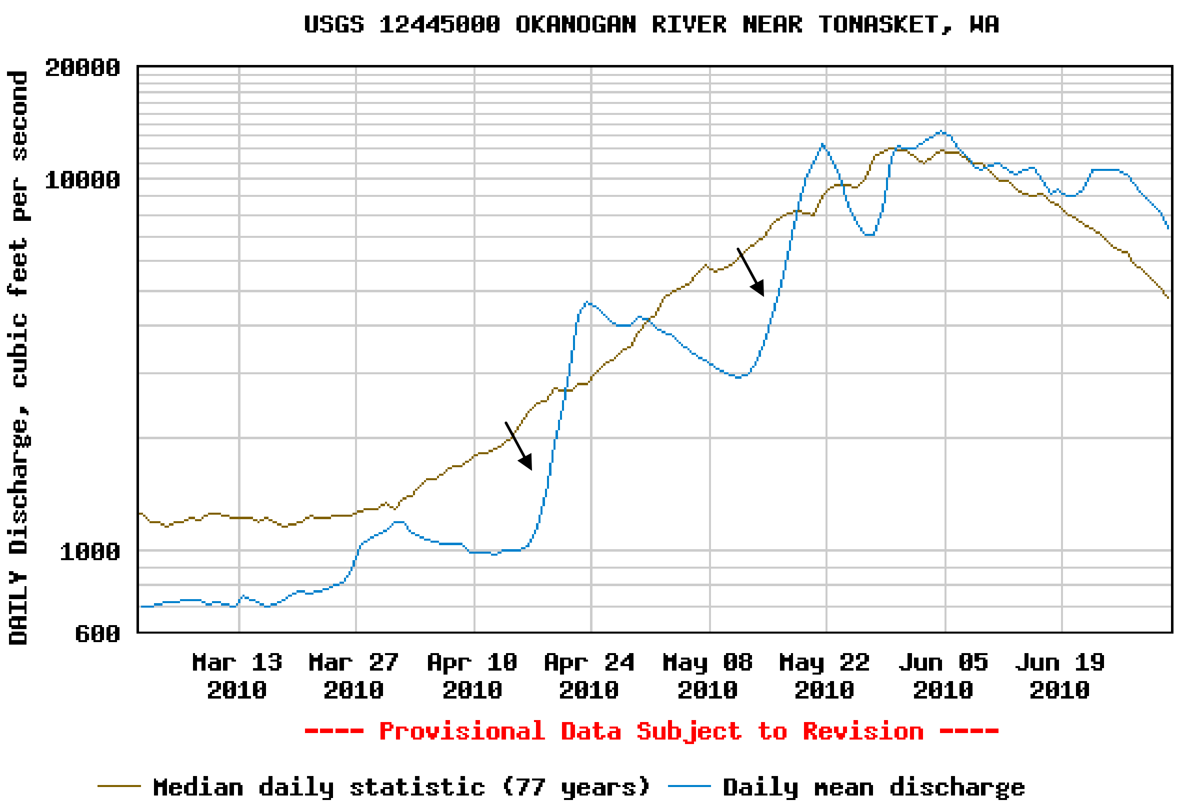

Figure 5. Discharge of Okanogan River as measured at Tonasket, WA for the period from March to June, 2010 compared to the 77-year historic average (www.usgs.gov). Arrows indicate sharp increase in discharge that reduced water visibility.

The lower-most reach on the Okanogan River (O1) was surveyed April 5, April 16, and May 11 (Figure 6). A total of 20 steelhead redds were documented (19 during the second survey and 1 during the third survey). Using the mainstem value of 2.13 FPR, 43 steelhead were estimated to be utilizing this reach. A 9.1% wild rate applied to this value would suggest 4 spawners were of natural origin. Redds were documented in several new locations from previous years. No redds were observed on the mid-channel bar downstream of the Malott bridge, which had been frequently utilized in previous years.

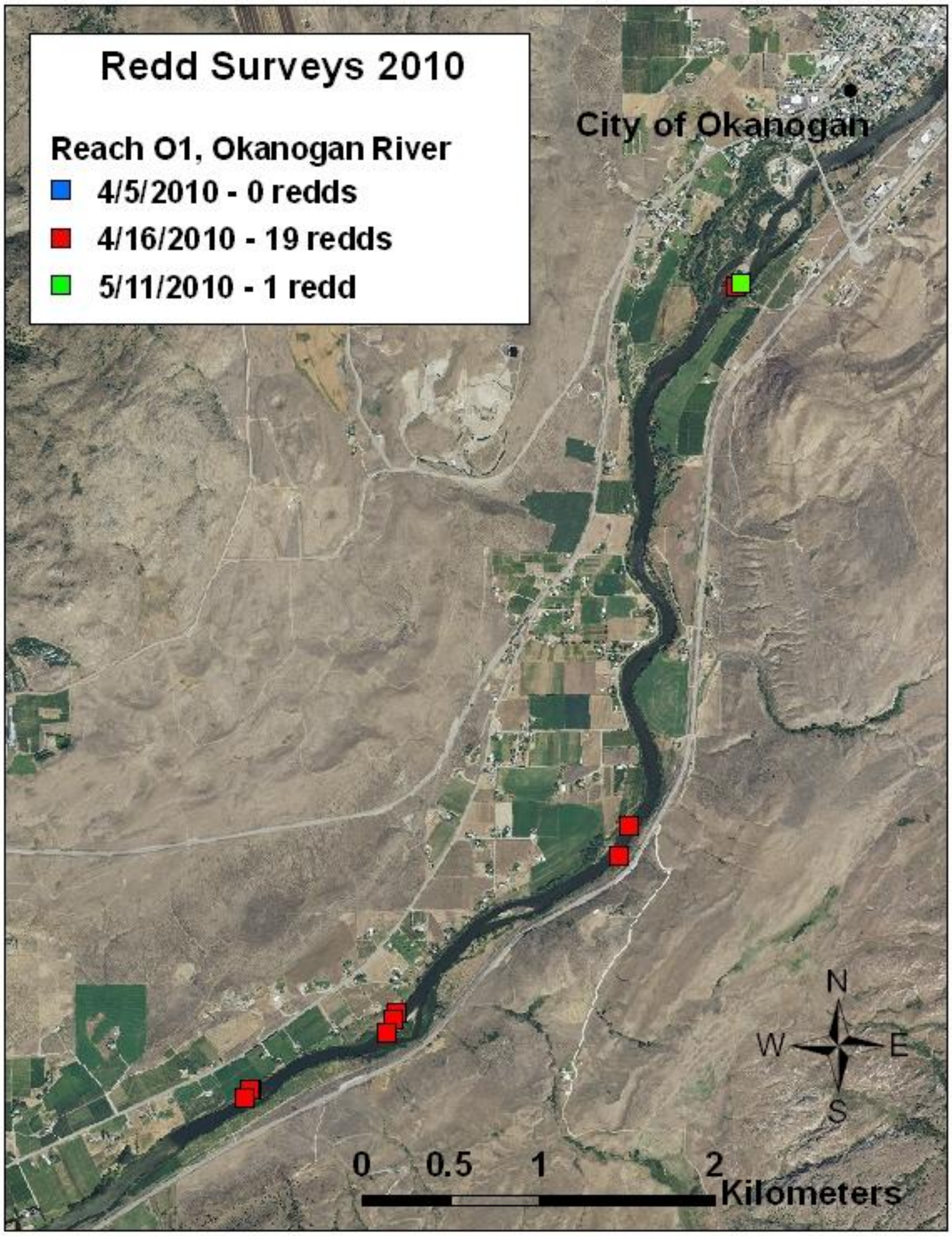

Figure 6. Redd distribution observed in 2010 for Okanogan River reach O1 from the confluence of Salmon Creek downstream to south of Loup Loup Creek.

The first survey of Okanogan River reach O2 was conducted on March 19 and 27 redds were observed (Figure 7). The second survey occurred April 6 and 15 additional redds were documented. A final survey could not be conducted due to increasing discharge and limitations in water visibility. However, we conservatively estimated 6 redds may have been missed on the final survey. The value of 2.13 FPR rendered 102 steelhead that likely spawned in this reach, 9 of which may have been of wild origin. Steelhead redds were documented in areas where spawning frequently occurred in previous years, including immediately downstream of Omak Creek, below the downtown Omak bridge, and in the vicinity of the braided channel near Shellrock Point.

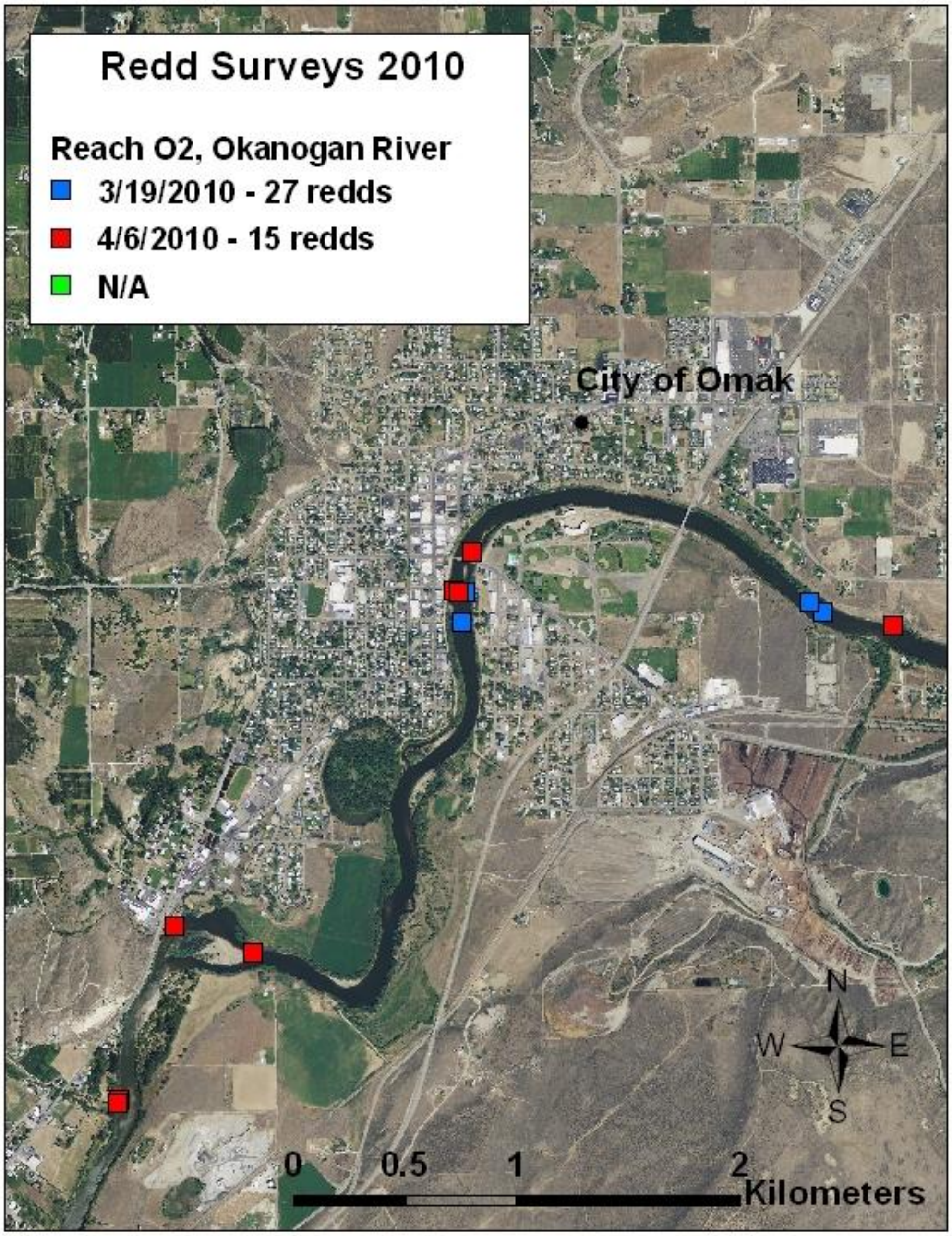

Figure 7. Redd distribution observed in 2010 for Okanogan River reach O2 from the confluence of Omak Creek in Omak, WA downstream to Salmon Creek. Estimated redds from third survey not included on map.

Okanogan River Reach O3 was surveyed on March 23, April 7, and May 12. A total of 18 redds were identified (Figure 8) representing an estimated 38 steelhead spawners, 3 of natural origin. Availability of suitable spawning gravel is minimal within Reach O3. Fine sediments and low water velocities dominate much of this reach, which may account for the continued low abundance of spawning steelhead.

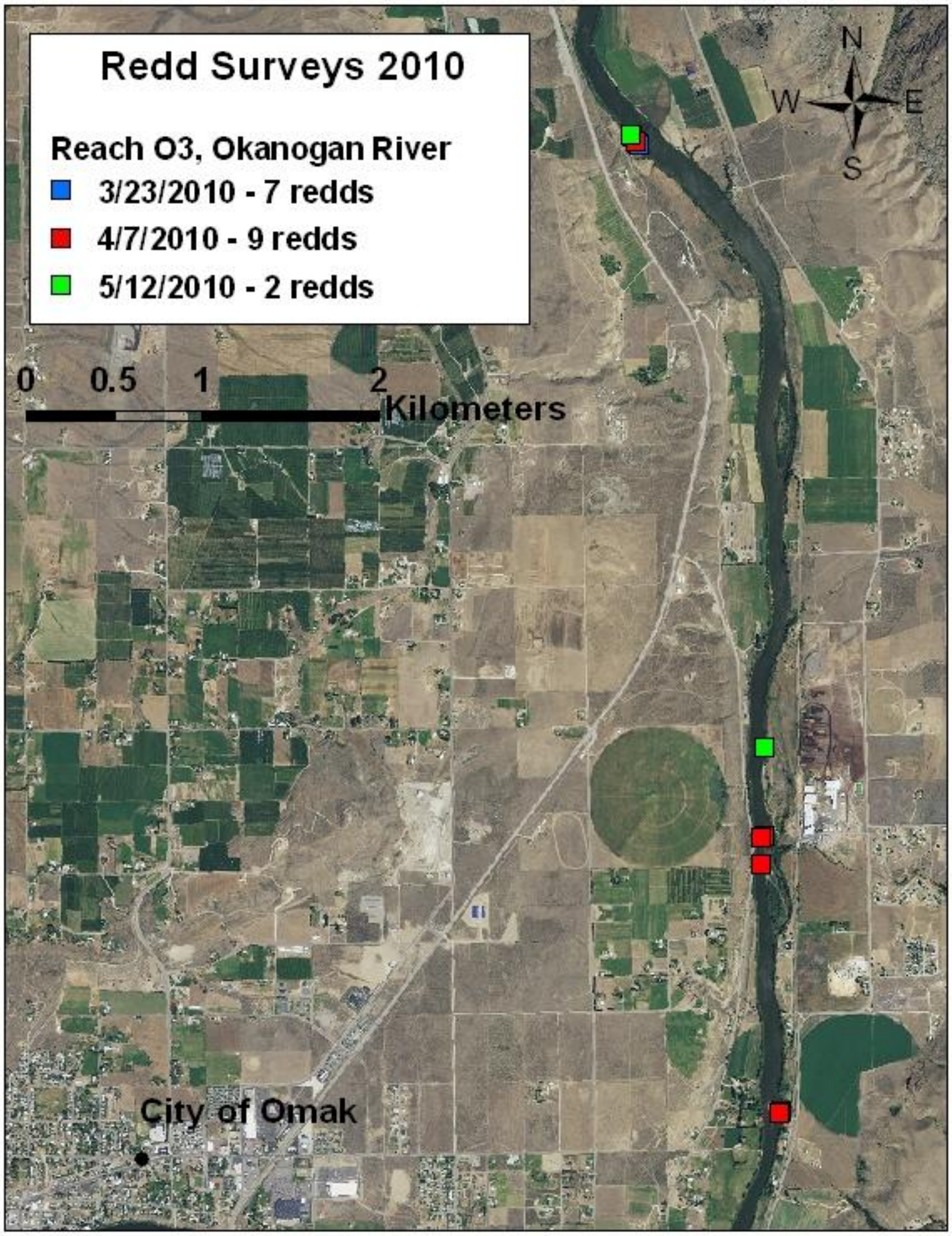

Figure 8. Redd distribution observed in 2010 for Okanogan River reach O3 from the town of Riverside, WA downstream to the confluence with Omak Creek in Omak, WA.

Okanogan River reach O4 was surveyed on March 22, April 9, and May 10 (Figure 9). Only 5 redds were observed on the second survey. Visibility was reduced to 0.9 m during the third survey, but the majority of commonly used spawning areas remained visible; however, no new redds were located. These 5 redds were expanded to represent 11 total adult steelhead. The number of redds observed in 2010 was the lowest observed count within this reach (previous years range: 11-58 redds).

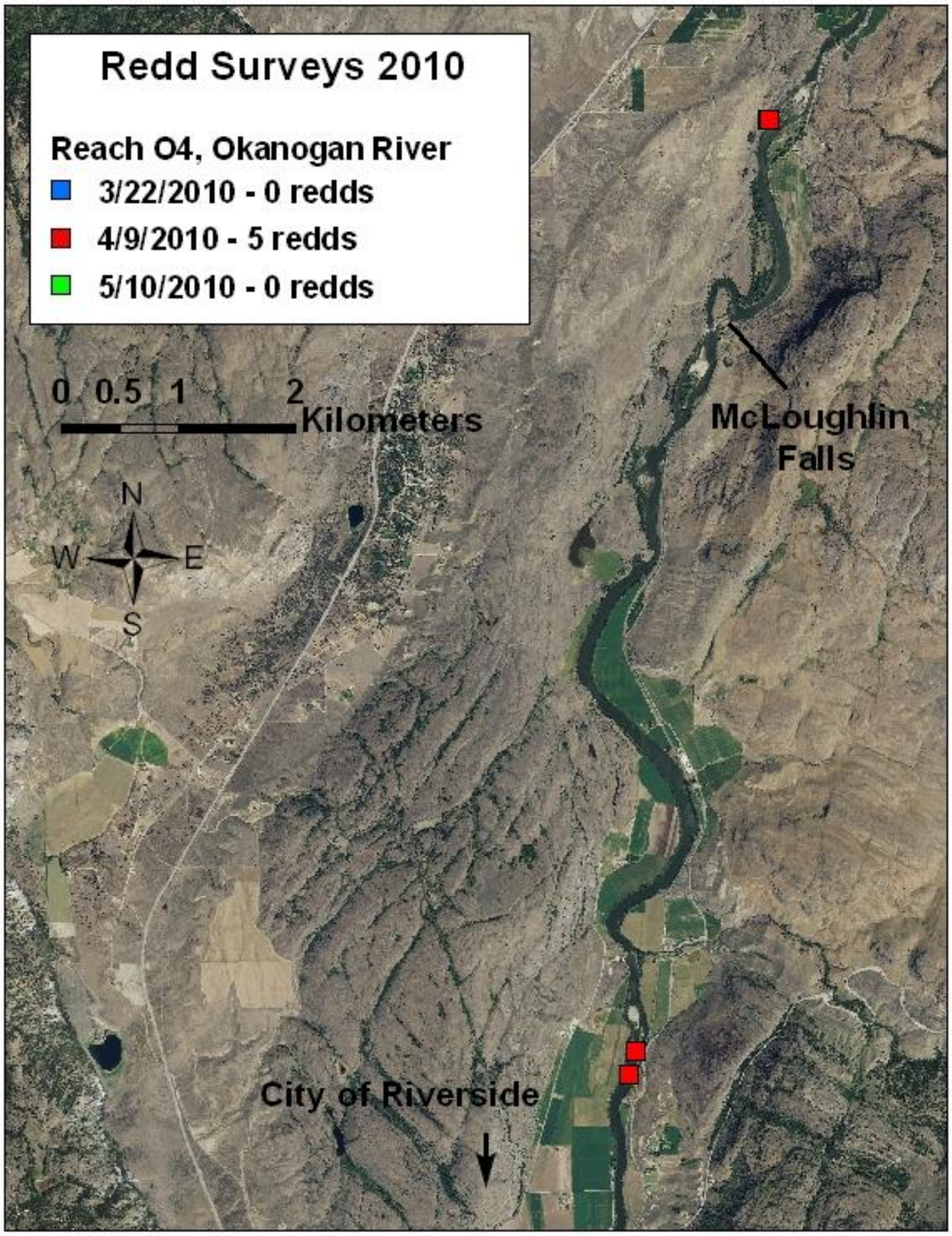

Figure 9. Redd distribution observed in 2010 for Okanogan River reach O4 from Janis Bridge downstream to the town of Riverside, WA.

Okanogan River Reach O5 was surveyed on March 24, April 12, and May 8. A total of 99 redds were identified across three surveys (Figure 10). The number of redds observed in 2010 was the highest frequency recorded (previous range was 5-63 redds from 2005-2009). An estimated 211 spawners used this reach, based on the value of 2.13 FPR. A 9.1% wild rate rendered 19 wild steelhead. The highest frequency of redds were documented downstream of Tonasket, in sections of braided channel.

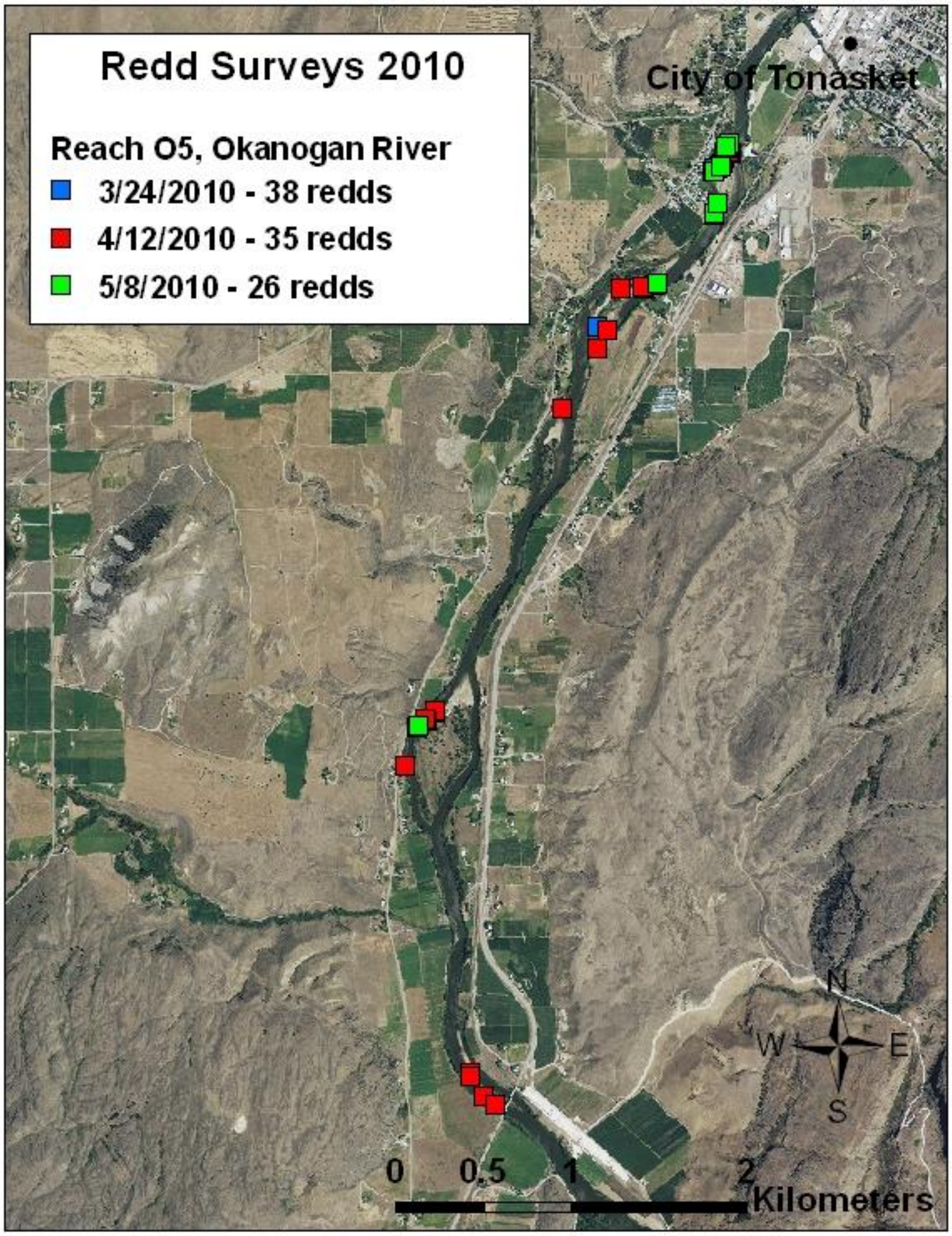

Figure 10. Okanogan River redd distribution observed in 2010 within reach O5 from the Chief Tonasket Park located in the town of Tonasket, WA downstream to the Highway 97 Bridge at Janis, WA.

Surveys were conducted on Reach O6 on April 5, April 14, and May 9. A total of 40 redds were observed over the course of the three surveys (Figure 11). No redds were identified in this reach in both 2008 and 2009; however, prior surveys had identified 3-19 redds within this reach. A total of 85 steelhead spawners, 8 wild, were attributed to the 40 redds. The number of redds documented in 2010 was the highest count for this reach in the past 6 years of surveys.

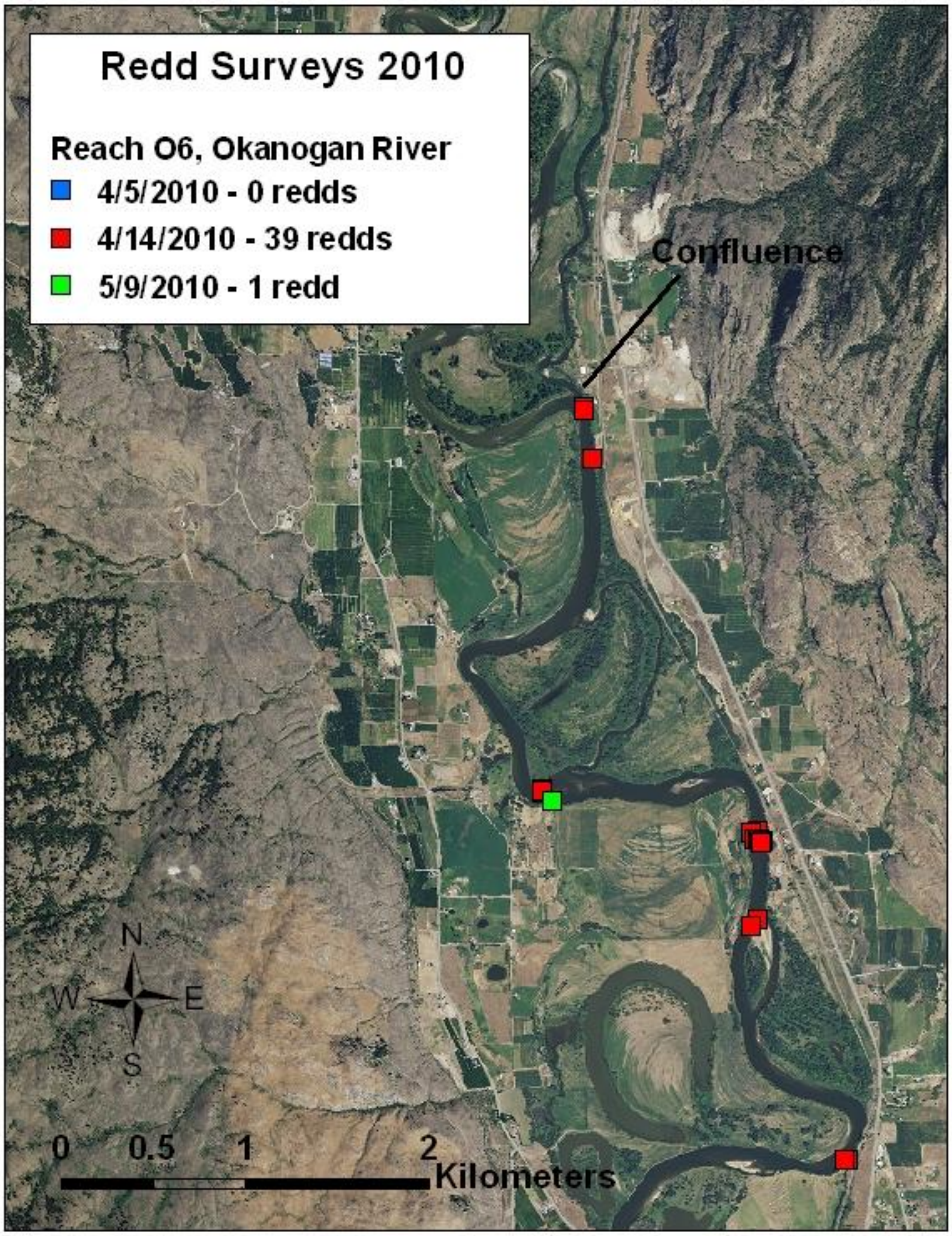

Figure 11. Redd distribution observed in 2010 within reach O6, from the confluence of the Okanogan and Similkameen Rivers to Horseshoe Lake.

Okanogan River Reach O7 was surveyed three times in 2010, a total of 393 summer steelhead redds were identified. On March 31, 97 redds were identified, 254 redds on April 19, and 42 redds on May 9. The majority of redds were observed downstream of Zosel Dam, but above Driscoll Island (Figure 12). The number of redds observed in 2010 was the second highest number recorded within this reach (previous range of 141-249 from 2005-2008, 524 redds in 2009). Using 2.13 FPR provided a total estimate of 837 steelhead spawning within this reach. The mainstem value of 9.1% wild represented 76 of those fish as ad-present spawners. As in previous years, much of the spawning activity was focused on ridges of gravel created by summer/fall Chinook downstream of Zosel Dam.

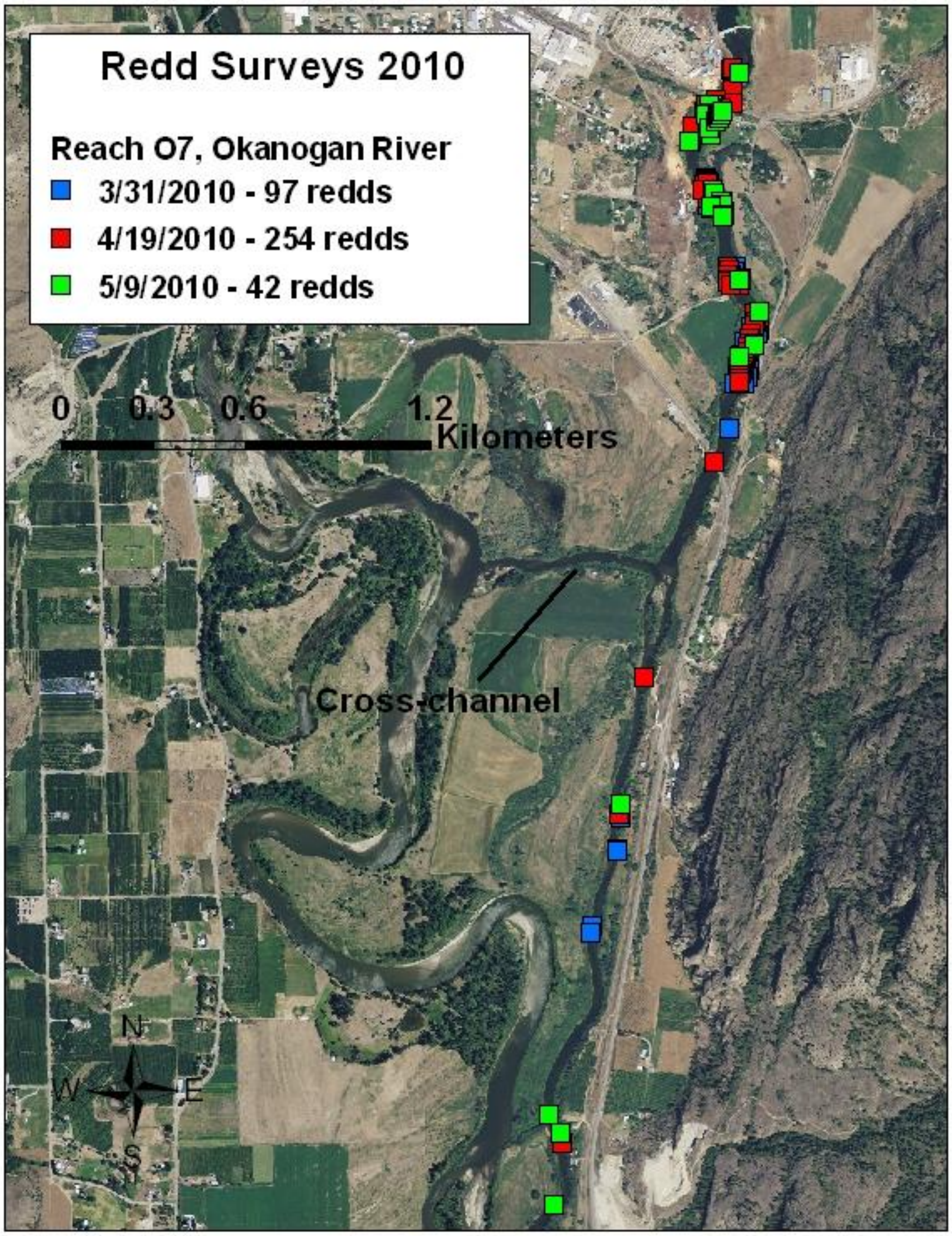

Figure 12. Redd distribution observed in 2010 for Okanogan River reach O7 which extends from Zosel Dam downstream to the confluence with the Similkameen River.

Similkameen River Reach S1 was surveyed two times in 2010. A total of 46 redds were documented on the first survey and 73 redds on the second (Figure 13). A third survey was not conducted due to unfavorable water visibility. We conservatively estimated that 18 redds were likely missed on the final survey. This value was calculated from the proportion of redds created on other reaches during 2010. Based on the estimated redd count, 292 steelhead may have spawned in this reach, 27 of those being ad-present.

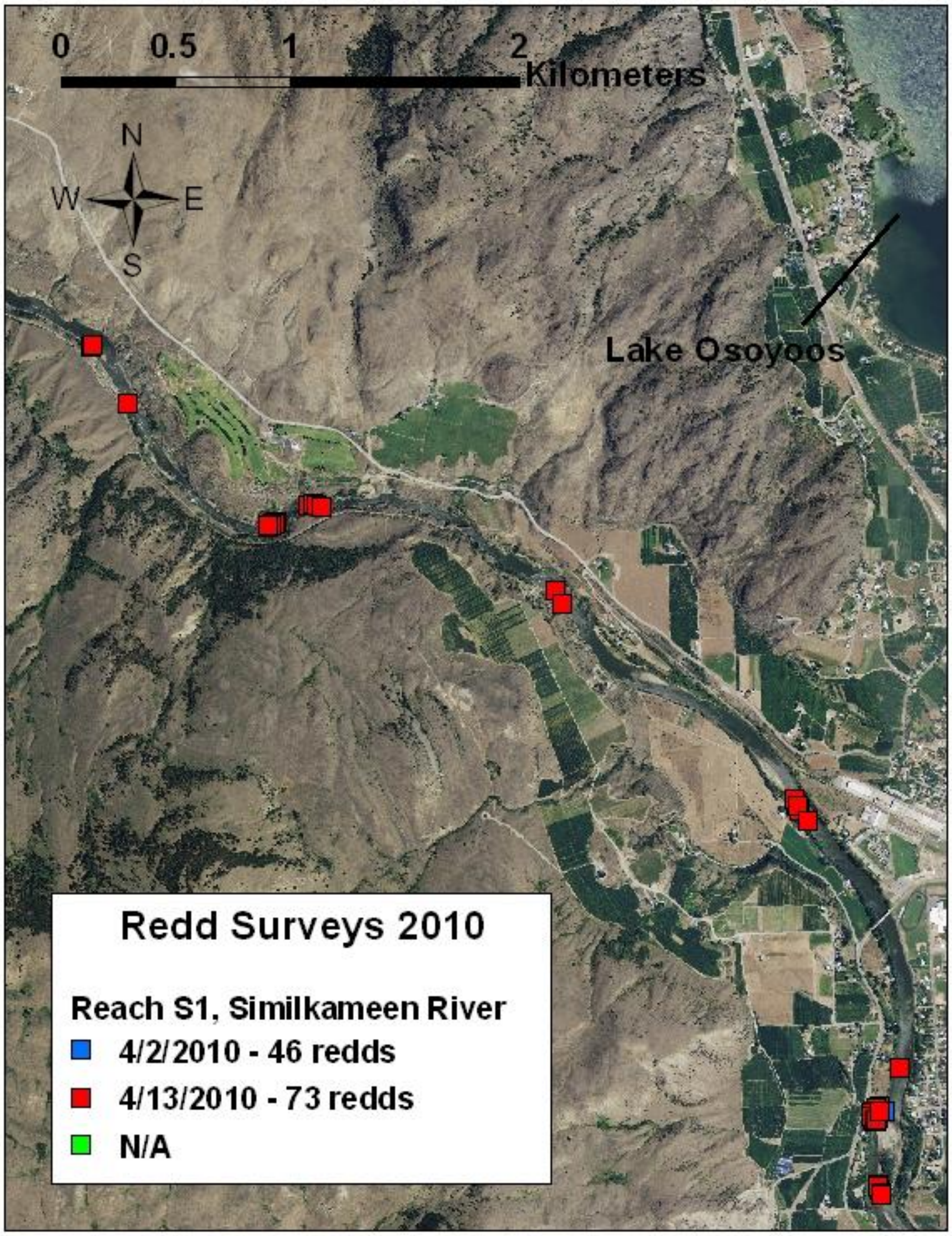

Figure 13. Redd distribution observed in 2010 for Similkameen River reach S1, from first and second survey pass only. Reach S1 extends from the base of Enloe Dam downstream to the water treatment plant in Oroville, WA.

Water visibility allowed observers to conduct only one successful survey on Similkameen River Reach S2. Twenty-six redds were documented on the first survey, which occurred on March 30 (Figure 14). Based on proportions of redds observed from multiple passes in 2010 on other reaches, an estimated 66 and 12 redds may have been missed on the second and third survey, respectively. From the estimated redd count, 222 steelhead may have spawned in this reach. Twenty of these may have been wild, based upon the 9.1% mainstem wild percentage.

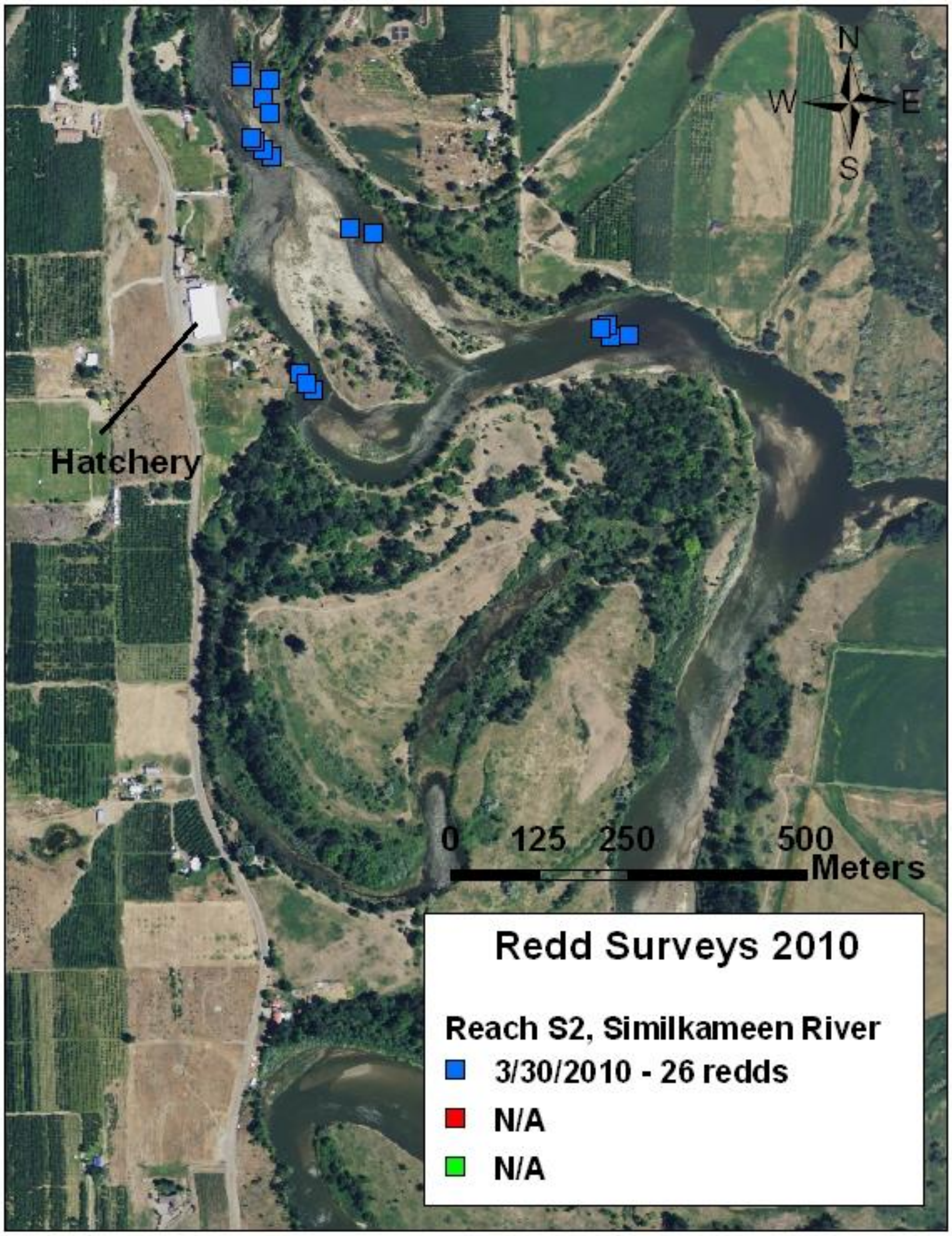

Figure 14. Redd distribution observed in 2010 for Similkameen River reach S2, first round of surveys only. Reach S2 extends from the end of Reach S1 to the confluence with the Okanogan River. Any redds observed within the cross-channel are considered a part of S2.

Tributary redd surveys in the Okanogan River basin

Tributary surveys began as soon as water clarity allowed or landowner access was granted. Steelhead redd surveys within tributary habitats were conducted beginning on April 9 through May 27. The upstream extent of each survey was limited by either a natural fish passage barrier or access to private land, as described in Arterburn et al. (2007a). Above-normal precipitation (Table 2) and discharge (Figure 15) in 2010 allowed adult steelhead to access many of the tributaries, including those which are frequently inaccessible due to low flows.

Table 2. Precipitation totals measured by the National Weather Service at the Omak airport. http://www.crh.noaa.gov/

Month	Precipitation in 2010 (inches)	Precipitation in 2009 (inches)	Precipitation in 2008 (inches)	Precipitation in 2007 (inches)	Precipitation in 2006 (inches)	Avg Precip (70 yr mean)
March	0.52	0.93	0.73	0.08	0.81	1.00
April	1.21	0.19	0.19	0.06	0.89	1.11
May	3.05	1.23	0.18	0.74	1.35	1.08
Total	4.78	2.35	1.10	0.88	3.05	3.19

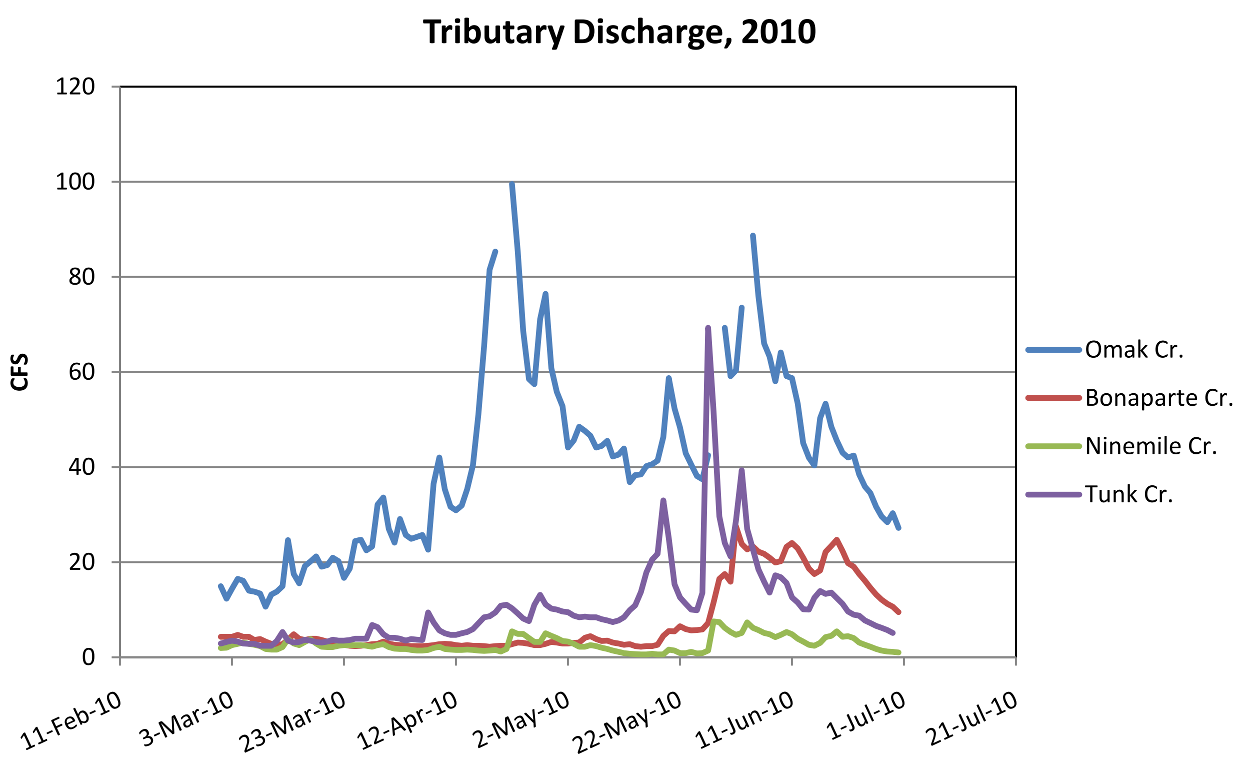

Figure 15. Discharge from March through June of 2010 for four tributary streams known to produce summer steelhead in the Okanogan basin. https://fortress.wa.gov/

Ninemile Creek

The lower 0.7 km of Ninemile Creek was surveyed on May 7 and a total of 9 redds were observed (Figure 16). Additionally, the video counting array documented 14 ad-clipped and 4 ad-present adult steelhead passing above this point. Steelhead were observed passing the video array beginning on April 3 through May 5. A value of 3.2 FPR provided an estimate of 29 steelhead spawning below the video weir. The total number of steelhead that spawned in Ninemile Creek in 2010 was 47 with 10 likely of natural origin.

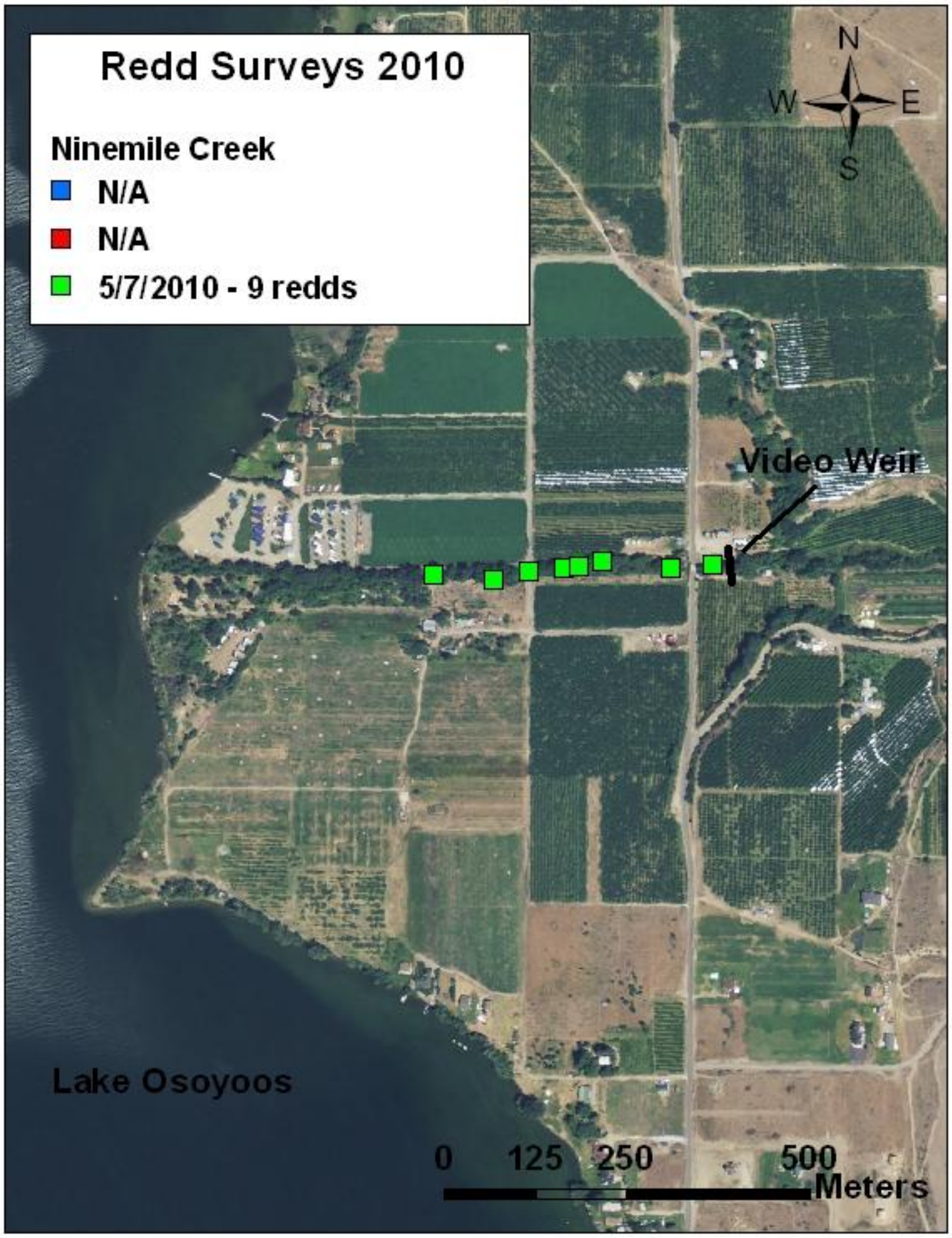

Figure 16. Redd distribution observed in 2010 for Ninemile Creek, extending from the mouth at Lake Osoyoos to the video weir.

Tonasket Creek

Steelhead redd surveys were conducted on Tonasket Creek on May 19. Past summer steelhead spawner escapement estimates for this creek were 8 in 2006, 17 in 2007, and zero in 2008 and 2009. During most years, Tonasket Creek flows intermittently during the spring and dries up by mid-summer in the lower most 3 km. However, sufficient flows existed in 2010 to allow for steelhead passage and 8 redds were documented (Figure 17). The value of 3.2 FPR provided an estimate of 26 steelhead for 2010; a percent-wild value of 17.2% rendered 5 of those as wild. The three redds created in the lower section were desiccated shortly after the spring runoff.

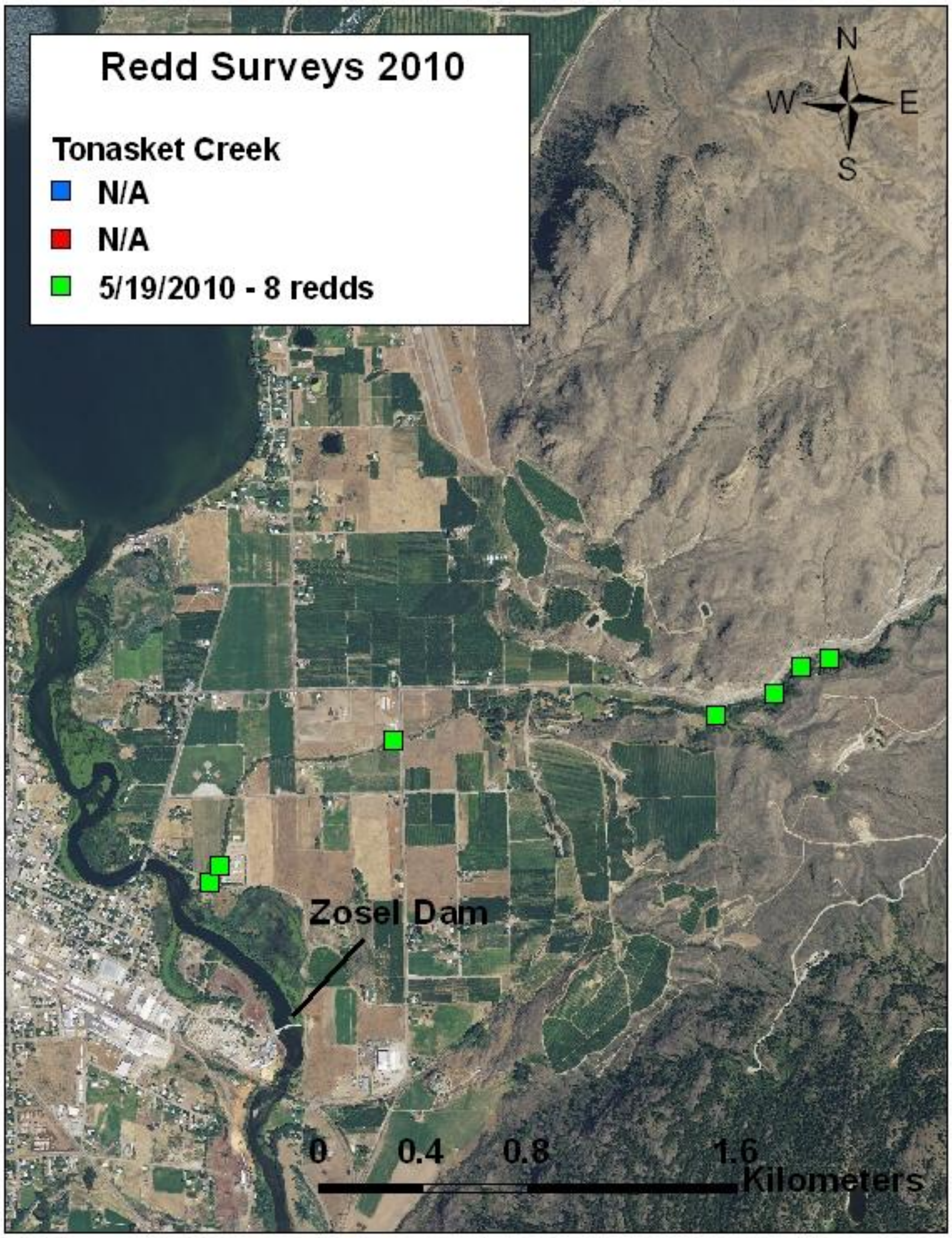

Figure 17. Redd distribution observed in 2010 for Tonasket Creek, from the confluence with the Okanogan River upstream to the anadromous barrier.

Wild Horse Spring Creek

Wild Horse Spring Creek was surveyed April 14 and May 6, 2010 and a total of 87 redds were observed (Figure 18). A total of 278 steelhead, 48 of those considered of natural-origin, were estimated to have spawned in this creek in 2010 based on 3.2 FPR and a 17.2% wild rate. In 2006, the first three redds were observed by OBMEP field crews and subsequently verified by WDFW staff. Again in 2007, steelhead redds were observed within the 1.1 km of available habitat. However, no summer steelhead redds were observed in 2008 or 2009 due to very low flows during the spawning period.

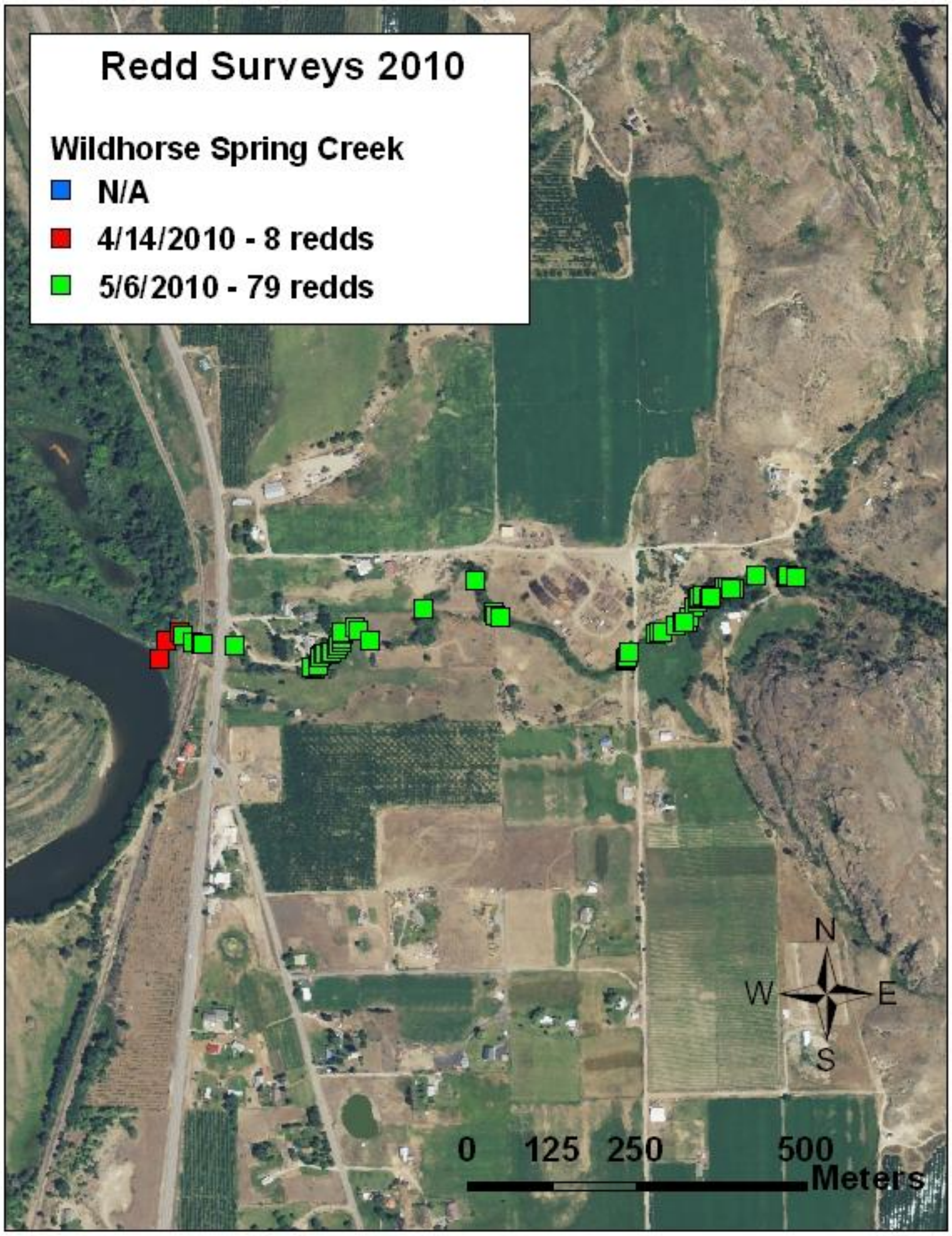

Figure 18. Redd distribution observed in 2010 for Wild Horse Spring Creek from the confluence with the Okanogan River upstream to the anadromous barrier.

The majority of redds on Wild Horse Spring Creek were documented in a recently rehabilitated section of creek, immediately upstream (east) of Hwy 97. The stream channel rehabilitation created more habitat complexity, added spawning substrate, reestablished stream channel, and stabilized banks through riparian shrub plantings along approximately 300 meters of creek. However, discharge decreased to zero by mid-summer and most redds were dessicated. In 2011, a flow reestablishment study may identify potential for perennial flow to a greater portion of the creek (Keith Kistler, CCT Biologist, pers. comm.).

Antoine Creek

Antoine Creek flows perennially; however, minimal discharge at the mouth of the creek may have limited access of adult steelhead throughout the 2010 spawning season. When the stream was surveyed on May 4, no summer steelhead or redds were observed from the confluence with the Okanogan River to the video weir. Additionally, no adult steelhead were documented passing through the video weir in 2010.

Although escapement was also zero in 2008 and 2009, snorkel surveys have identified multiple year-classes of both brook trout and *O. mykiss,* indicating that rearing conditions exist (Kistler et al. 2006, Kistler and Arterburn 2007). To accelerate the reestablishment of summer steelhead in Antoine Creek, approximately 3,000 juvenile steelhead were released during April of 2008 (Fisher 2008). However, a relatively large delta at the confluence of Antoine Creek makes access difficult for anadromous steelhead, consideration should be given to increasing flow and improving adult steelhead access during typical flow conditions.

Bonaparte Creek

An adult weir trap was installed on Bonaparte Creek in 2010. Sixty-seven summer steelhead (46 males; 21 females) were collected at the Bonaparte Creek weir (Table 3). Run timing at the Bonaparte Creek weir appeared to be earlier than that of previous years (Figure 19).

Redd surveys downstream of the Bonaparte Creek trap were conducted on May 4 and May 27. A total of 14 steelhead redds were observed (Figure 20). Based upon the value of 3.2 FPR generated from adult steelhead collected at the weir trap, an estimated 45 summer steelhead spawned downstream. The percent-wild value, calculated at the trap site and applied to downstream redds, provided an estimate of 19 wild fish that spawned downstream of the weir.

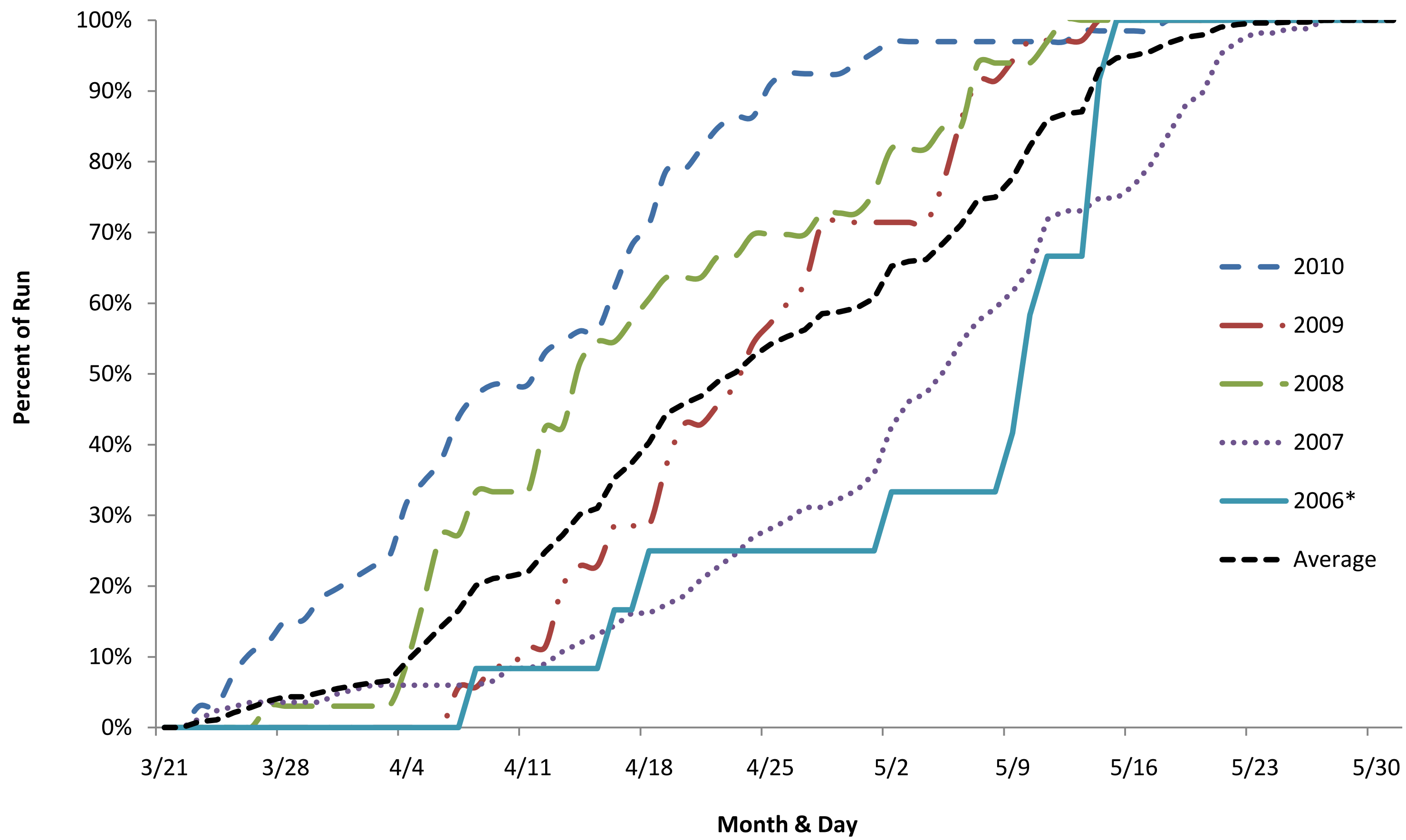

Figure 19. Run timing of summer steelhead at the Bonaparte Creek trap, 2006-2010. *The 2006 trap was only operated for part of the season.

Table 3. Proportions and totals of male, female, and wild summer steelhead at the Bonaparte Creek weir trap in 2010.

Bonaparte Creek Adult Weir Trap, 2010	Total (N)	Wild (N)	Percent-Wild (%)
Total	67	28	41.8%
Males	46	17	37.0%
Females	21	11	52.4%

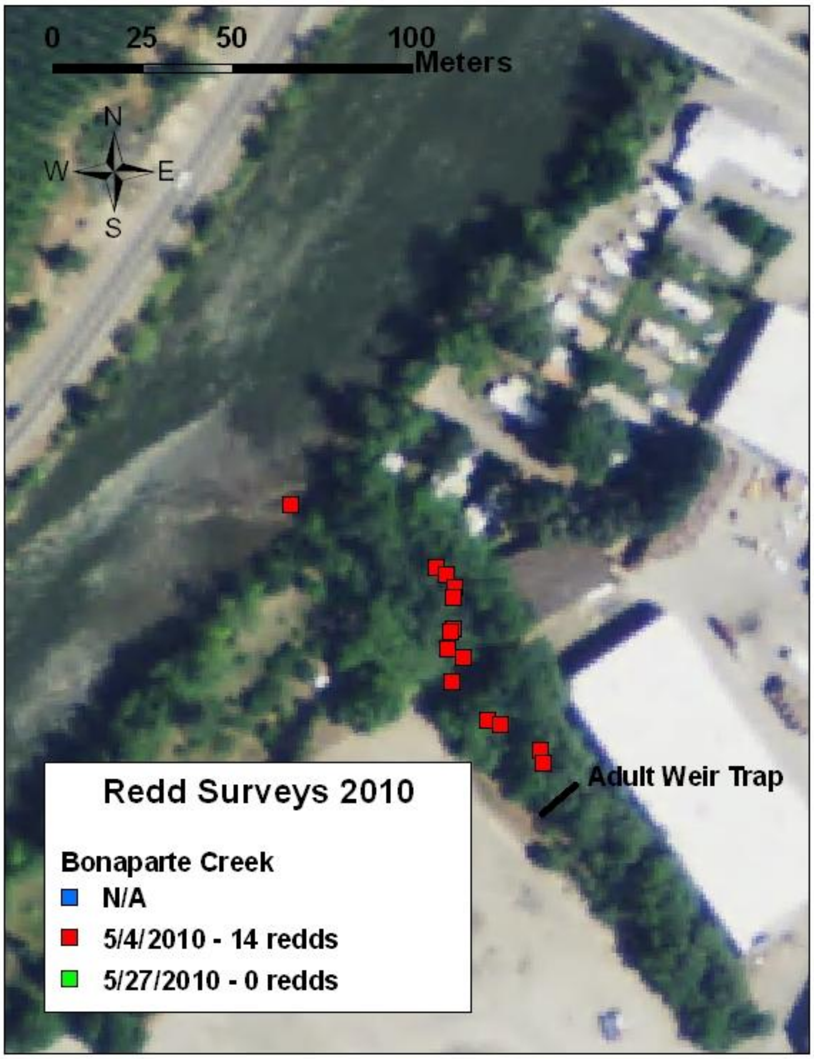

Figure 20. Distribution of redds observed in Bonaparte Creek during 2010 from the confluence with the Okanogan River upstream to the Bonaparte weir trap.

Tunk Creek

On April 9, two redds were identified immediately upstream of the Tunk Creek confluence with the Okanogan River. An additional 32 were identified on May 6 (Figure 21). Using a value of 3.2 FPR provided an estimate of 109 steelhead that spawned in Tunk Creek. Previous escapement estimates for Tunk Creek were 7 in 2005, 2 in 2006, unknown in 2007, 2 in 2008, and ten in 2009. However, 2009 and 2010 were the only two years that the entire creek was surveyed, up to the anadromous barrier.

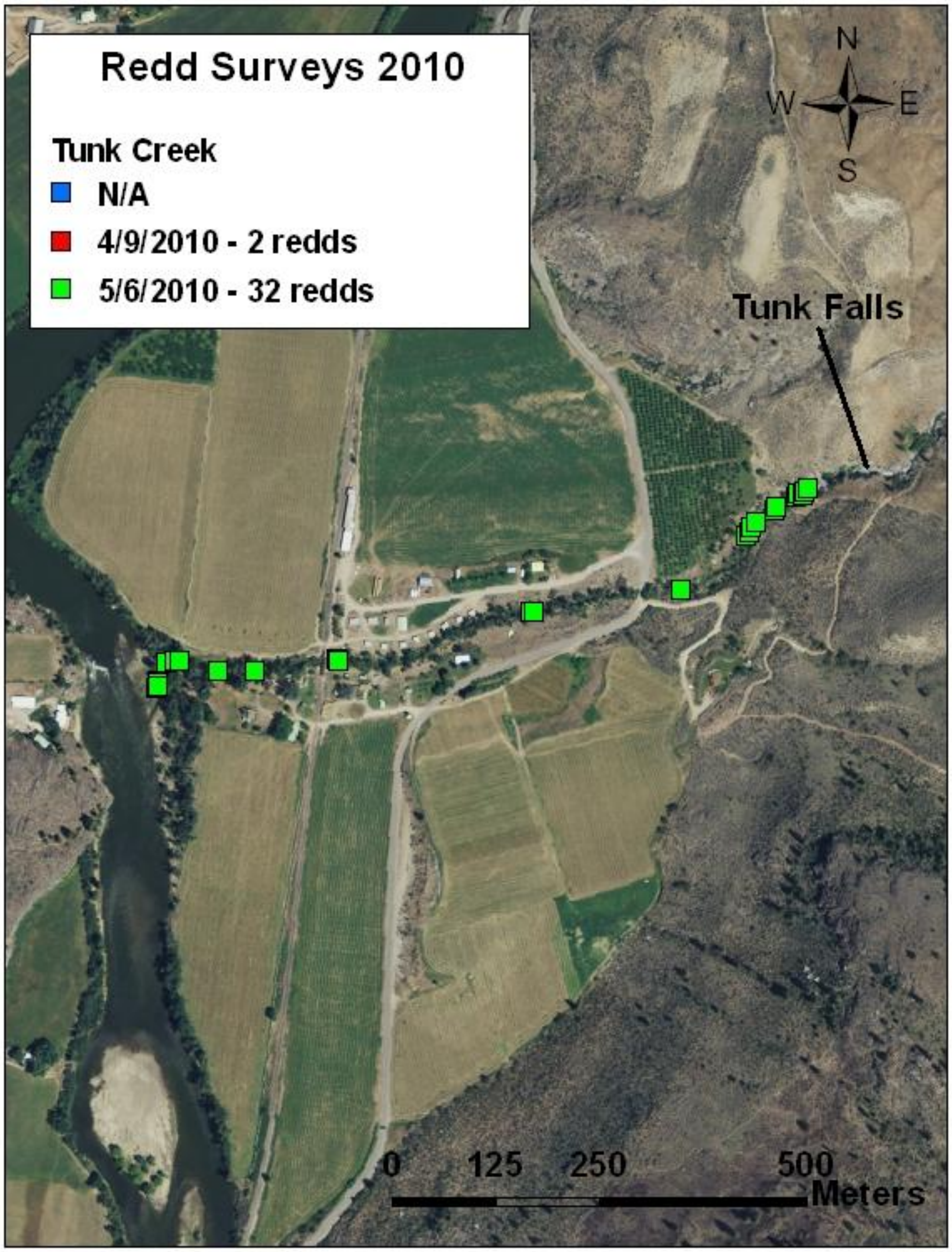

Figure 21. The distribution of redds observed in Tunk Creek during 2010, from the confluence with the Okanogan River upstream to Tunk Falls (anadromous barrier).

Wanacut Creek

No adult steelhead or redds were observed in Wanacut Creek in 2010. Although sufficient flows existed to allow the water to reach the Okanogan River, several small potential barriers may have deterred steelhead from entering this creek.

Omak Creek

In 2010, we estimated that a total of 273 adult steelhead spawned in Omak Creek; the highest number recorded since data were first collected in 2001 (Figure 22). The highest proportion of wild steelhead was also recorded at the weir trap, with over 80% of all steelhead being of natural origin (Table 4). At the adult weir trap, 140 male and 72 female steelhead were sexed, rendering a sex ratio of 1.9 M:F (2.9 FPR). The run timing at the Omak Creek weir appeared to be earliest since 2005 (Figure 23).

Table 4. Proportions and totals of male, female, and wild summer steelhead passed above the Omak Creek trap in 2010.

Omak Creek Adult Weir Trap, 2010	Total (N)	Wild (N)	Percent-Wild (%)
Total	212	171	80.7%
Males	140	113	80.7%
Females	72	58	80.6%

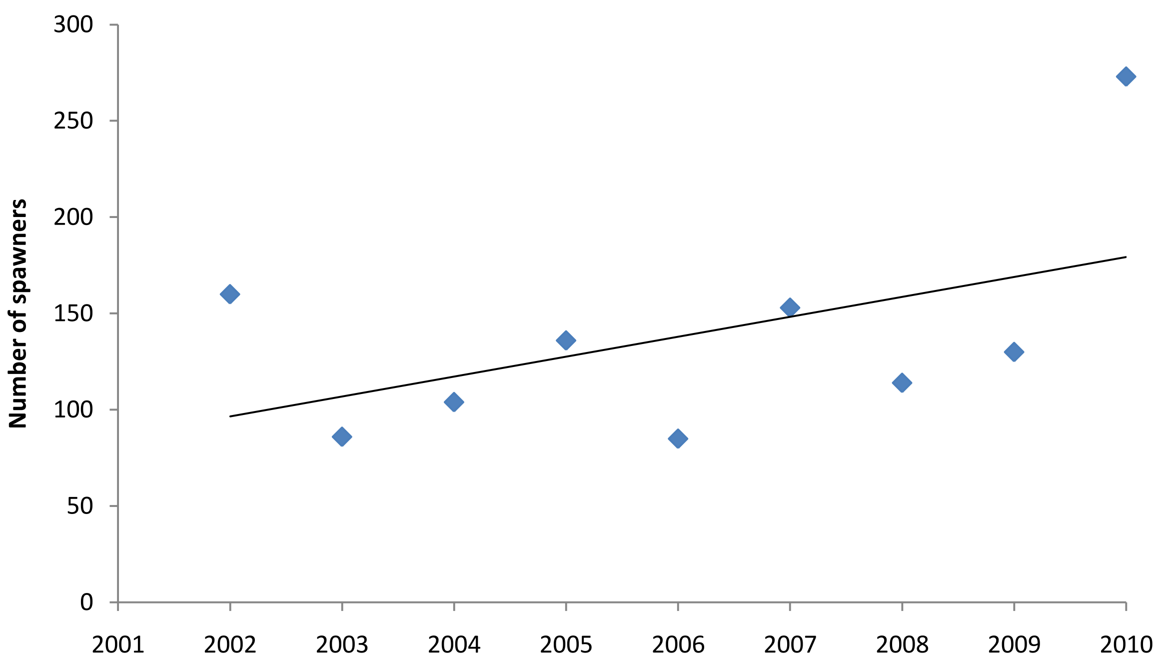

Figure 22. Total number of summer steelhead estimated to have spawned in Omak Creek, 2002 to 2010.

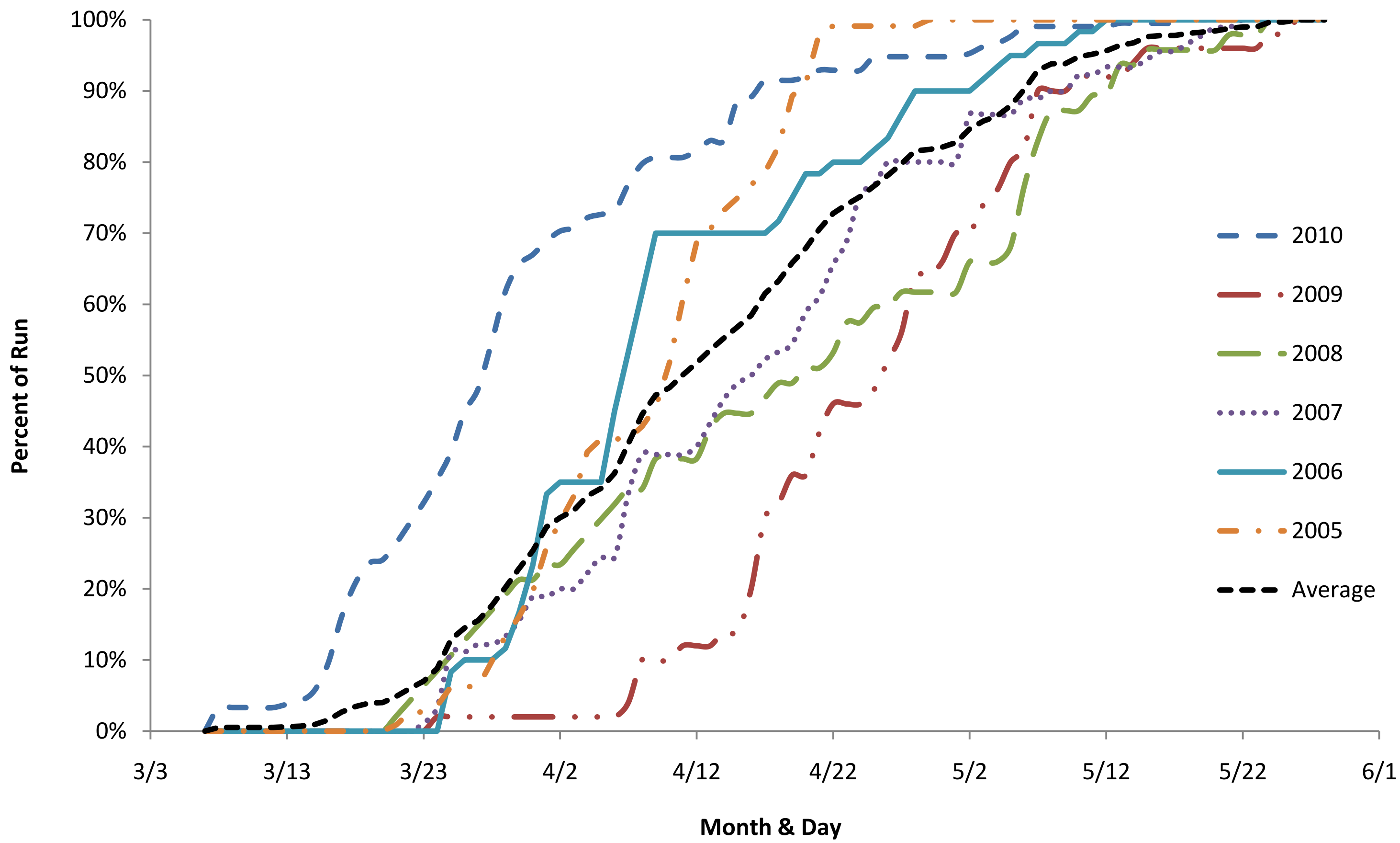

Figure 23. Run timing of summer steelhead at the Omak Creek trap, 2005-2010.

Redd surveys identified 21 redds below the Omak Creek weir trap (Figure 24). Only one redd survey was conducted in 2010 because discharge levels were not conducive to survey spawning activity until May when most of the spawning was considered complete. Using the 2.9 FPR from the weir trap, an estimated 61 steelhead likely spawned between the mouth of Omak Creek and the trap. Eight redds were constructed immediately downstream of the weir trap, possibly suggesting trap avoidance behavior. However, trap avoidance appeared to be less prevalent than in previous years, based on trap modifications made in 2009 (Rhonda Dasher, Colville Tribes Biologist, pers. comm.).

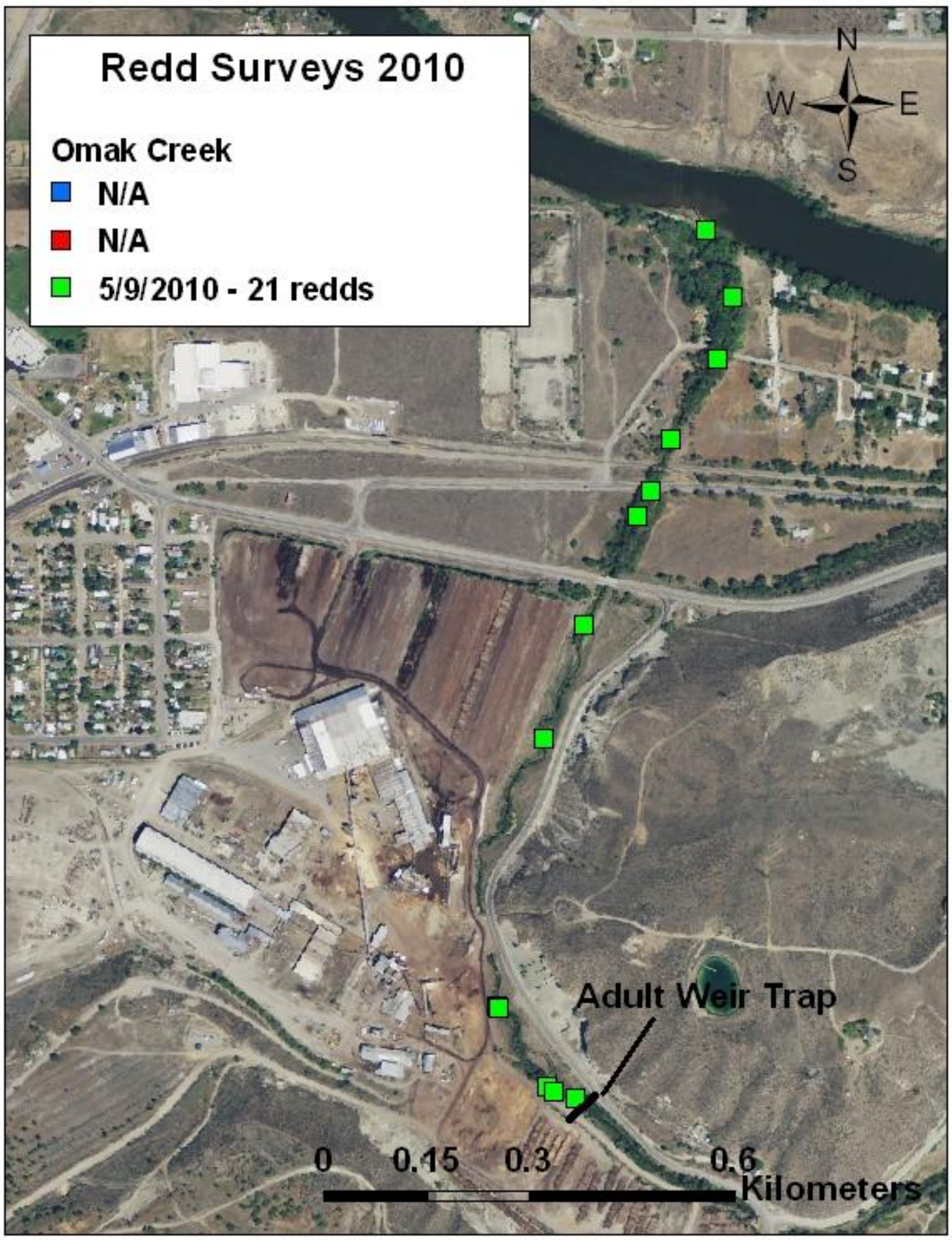

Figure 24. Map of summer steelhead redds observed below the Omak Creek trap during the spring of 2010.

Salmon Creek

Since the early 1900's, Salmon Creek has been entirely diverted for irrigation usage. The resulting dry stream channel extends from the Okanogan Irrigation District (OID) diversion dam (7.2 km) to the confluence with the Okanogan River. Occasionally, uncontrolled spills occurred downstream of the OID diversion dam. These spills typically occur in mid-May to June, which is after summer steelhead have already spawned. Passage flows were evaluated during a controlled release of 22 cfs from April 1 through April 14, 2003. During this two week period, six steelhead redds were constructed within the lower reach of Salmon Creek (Fisher and Arterburn 2003). These passage evaluation studies helped establish a long-term water lease that provides sufficient water both for adult and smolt passage.

In 2010, 1,200 ac/ft of water was provided for a short migration window, primarily for summer steelhead (Chris Fisher, Colville Tribes, pers. comm.). The potential for adult steelhead to access Salmon Creek from the mainstem Okanogan began on March 28. Additionally, above average rainfall in May increased the amount of runoff that came down Salmon Creek in May and June but it is unknown to what extent this could have negatively impacted developing steelhead eggs (Figure 25).

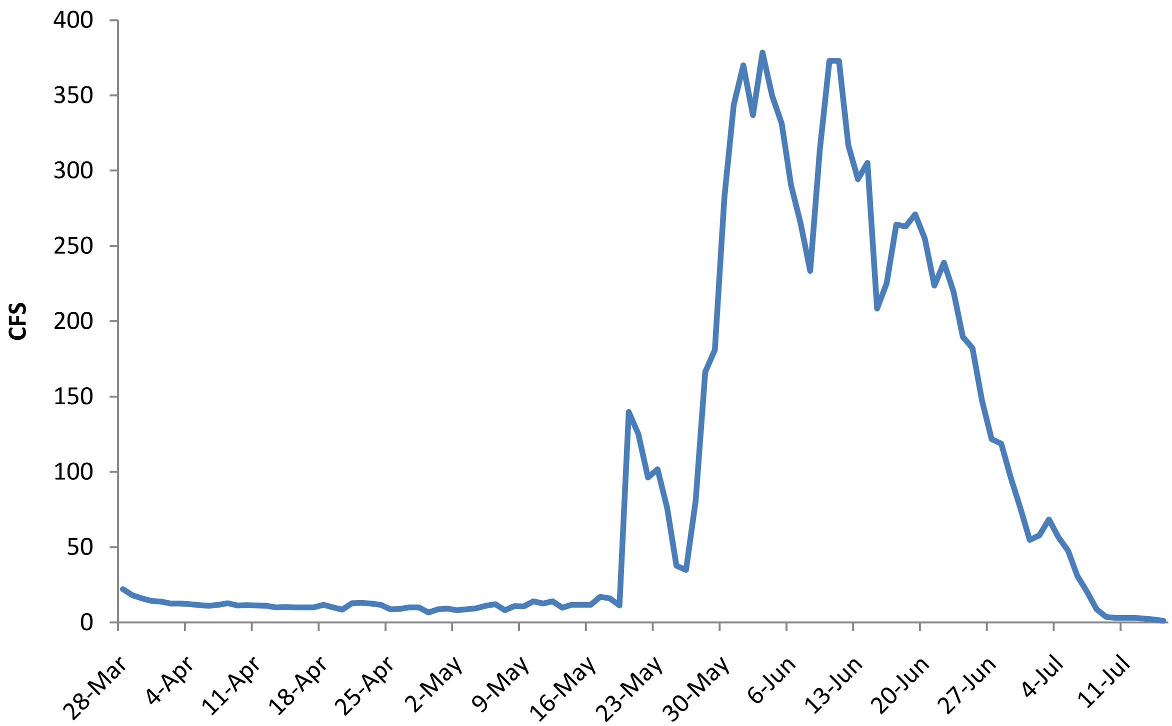

Figure 25. Release of water from Salmon Creek (2010) to allow steelhead passage.

A specialized underwater video apparatus was installed into the fish ladder of the OID diversion dam in 2010 (Figure 26). A total of 103 adult steelhead passed upstream through the video chamber, 16 had intact adipose fins, and 6 could not be identified as ad-clipped or ad-present. Ten steelhead passed downstream within a short timeframe; consequently, these were subtracted from the total up-stream passage value, rendering a total of 93 that likely spawned upstream of the OID diversion.

Table 5. Adult steelhead enumerated at the video weir on Salmon Creek during 2010.

Salmon Creek Video Observations

	Up	Down	Total Up
Ad-clipped	81	10	71
Ad-present	16	0	16
Unknown	6	0	6
Total	103	10	93

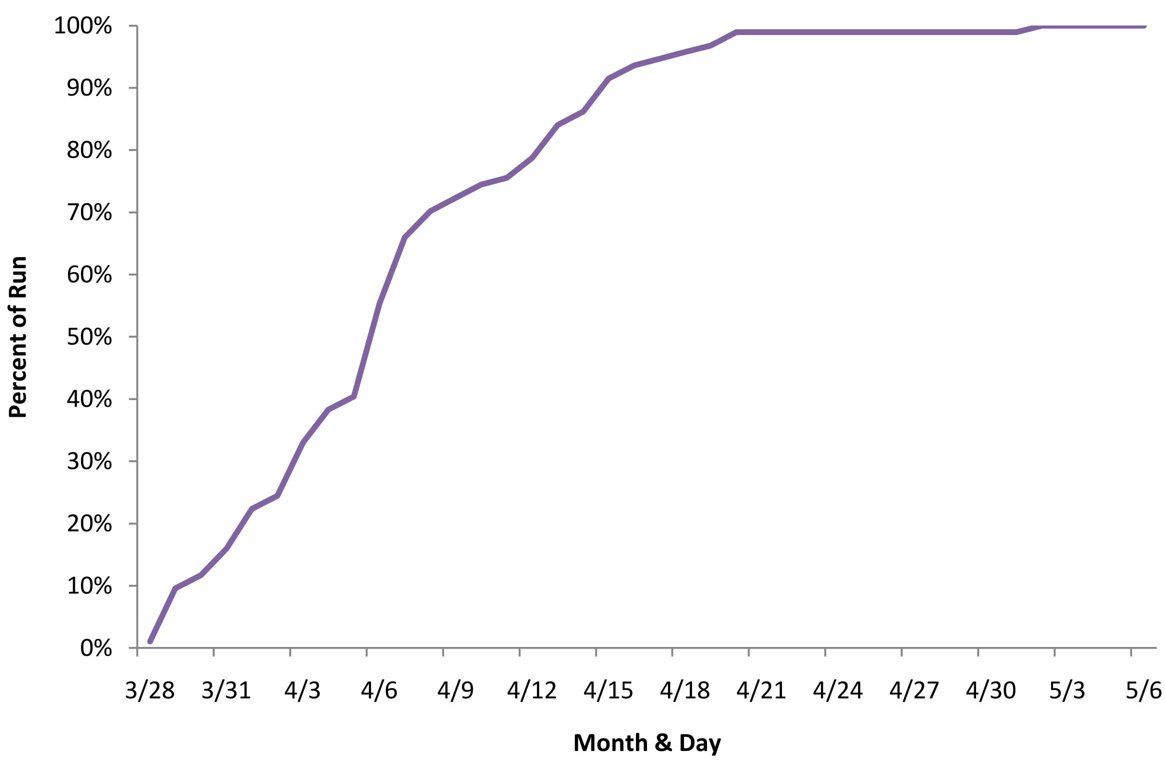

Figure 26. Run timing of summer steelhead at the Salmon Creek video weir, 2010. March 28 represented the first day of access to the mouth of the creek, and the first steelhead was observed on video less than 24 hrs later.

A total of 74 steelhead redds were observed in the lower 7.2 km of Salmon Creek (Figure 27). Using a FPR value of 2.9 (from Omak Creek) rendered 215 spawners below the diversion. Ad-present fish made up 17.2% of the fish observed in the video weir. This was applied to the redd count downstream of the video weir, which rendered 37 ad-present steelhead spawning downstream.

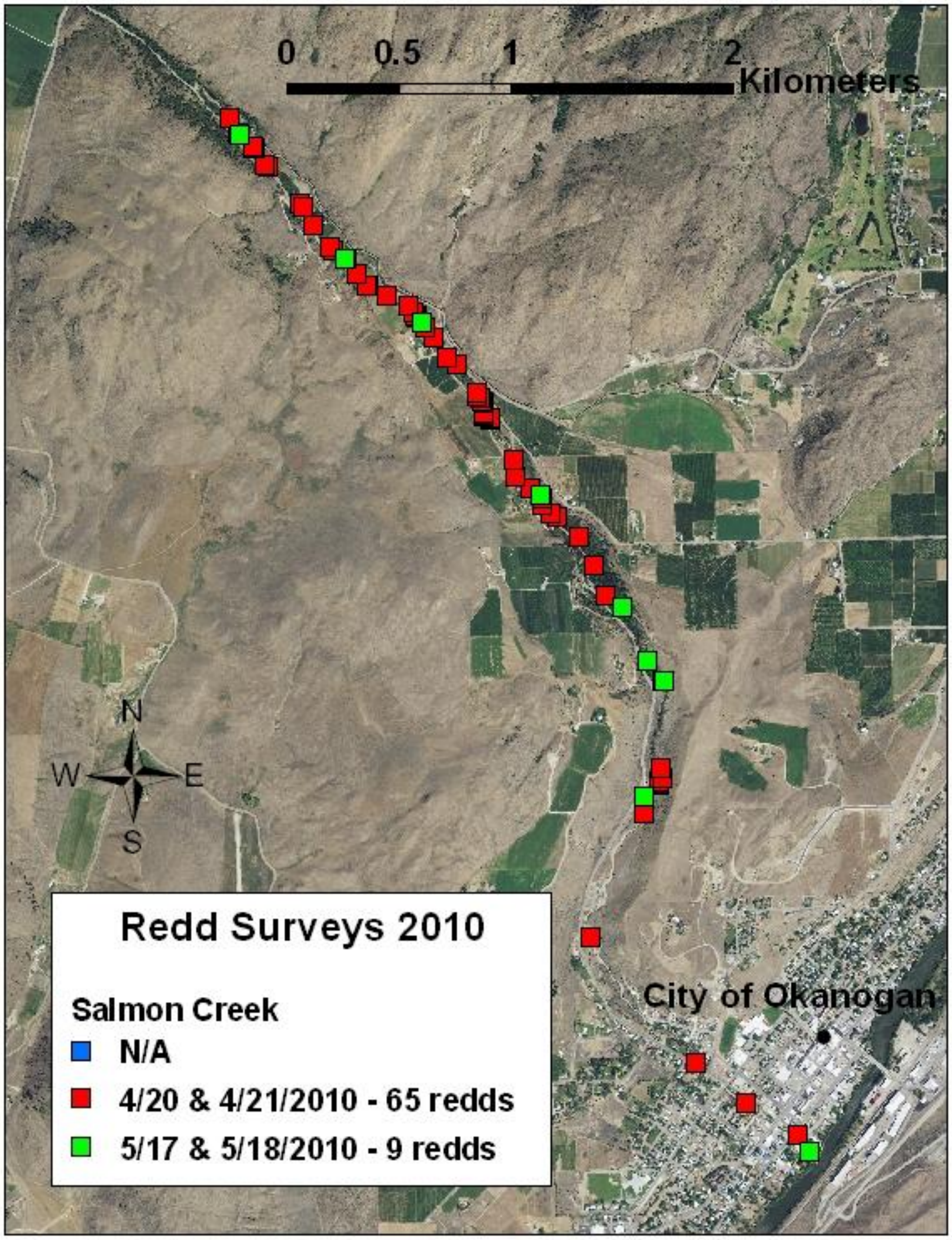

Figure 27. Map of summer steelhead redds observed below the Salmon Creek trap during the spring of 2010.

Loup Loup Creek

Low stream flows on Loup Loup Creek constrained fish passage in the previous two years, primarily due to an impediment (culvert) located at rkm 0.1. However, adequate flows allowed steelhead access into Loup Loup Creek and passage above the culvert in 2010. A total of 39 redds were documented from April 16 through May 18 (Figure 28). One section of Loup Loup creek was not surveyed due to denial of access from land owners. A value of 3.2 FPR provided an estimate of 125 steelhead in Loup Loup Creek, with 22 being of natural origin. Past surveys have estimated that 12 summer steelhead spawned in this creek in 2006, 18 in 2007, and zero in 2008 and 2009.

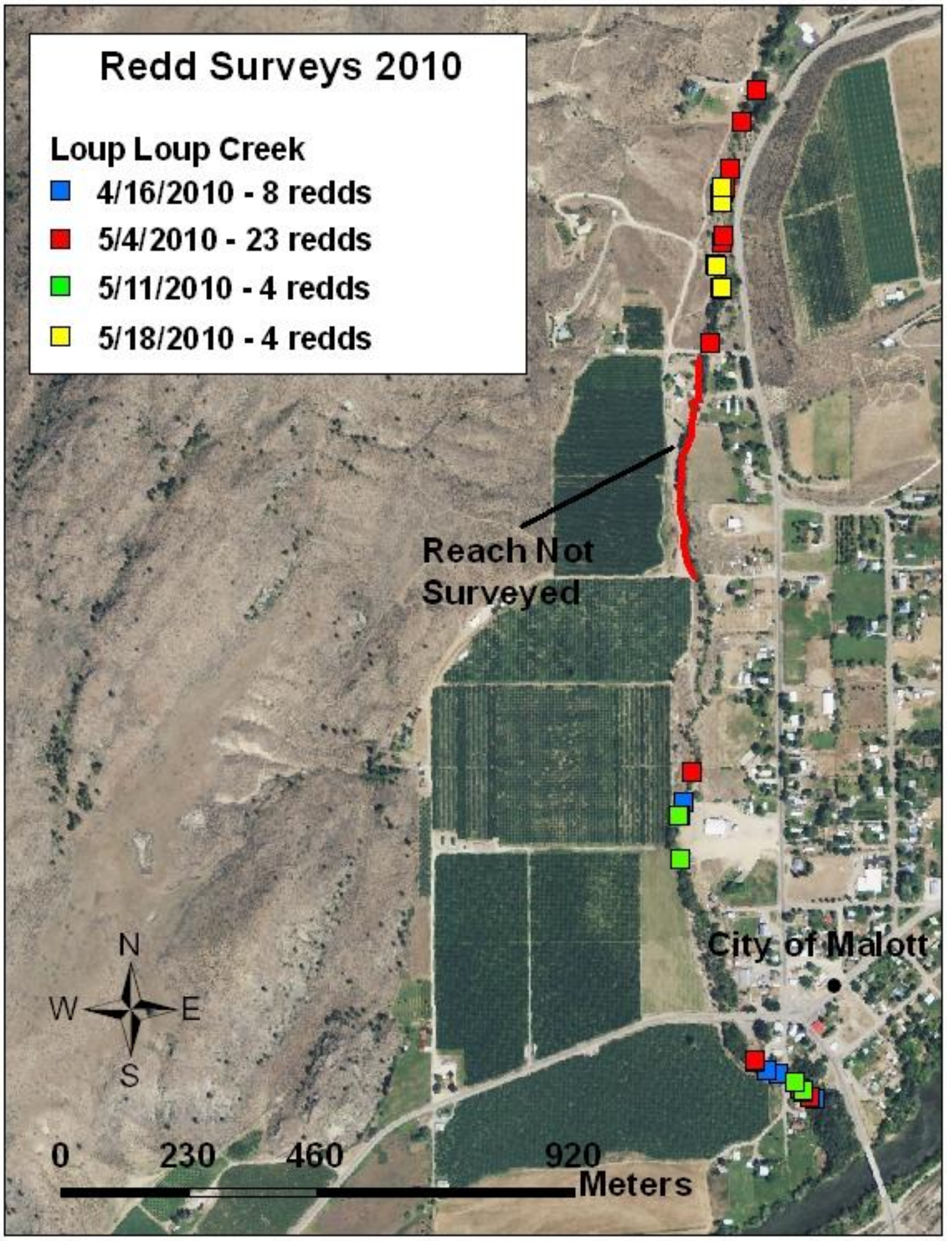

Figure 28. Map of summer steelhead redds observed in Loup Loup Creek, from the confluence with the Okanogan River to the irrigation diversion (barrier), during the spring of 2010. One section of the creek was not surveyed due to access related issues.

Escapement into Canada

During 2010, 450 summer steelhead were counted passing Zosel Dam (Table 6). In order to determine the number of steelhead unaccounted for in Lake Osoyoos, the estimated number of spawners that entered Ninemile (47 steelhead) and Tonasket (26 steelhead) Creeks were subtracted from the total number counted at Zosel Dam. These two creeks are located upriver of Zosel Dam, but south of the international border. Therefore, 377 summer steelhead may have passed into habitats beyond Lake Osoyoos.

A total of 127 ad-present summer steelhead were observed at the Zosel Dam video station. The estimated number entering Ninemile (10 ad-present steelhead) and Tonasket (5 ad-present steelhead) Creeks were subtracted from the total, resulting in an estimate of 112 ad-present summer steelhead. Of the total number of summer steelhead unaccounted for in Lake Osoyoos, 29.7% were observed with intact adipose fins.

Table 6. The number of adult summer steelhead that passed Zosel Dam by month for the 2010 spawner cohort, July 2009 to June 2010.

Zosel Dam Video Counts

Month	Ad-Clipped	Ad-Present	Total
July	0	0	0
August	0	0	0
September	0	0	0
October	0	0	0
November	0	0	0
December	0	0	0
January	0	0	0
February	0	2	2
March	76	22	98
April	244	96	342
May	3	7	8
June	0	0	0
Total	**323**	**127**	**450**

An adult weir trap was operated on Inkameep Creek by the Okanagan Nation Alliance in 2010. A total of 77 *O. mykiss* were captured, seven of which had clipped adipose fins. Of the captured fish, 46 were females, 26 were males, and 5 individuals were unidentifiable. The mean fork length ± SD of all fish captured was 49.0 ± 10.0 cm. The mean fork length for females was 48.7 ± 9.0 cm and 51.4 ± 9.4 cm for males. In order to differentiate between anadromous and resident individuals, fin samples from 62 fish were sent for stable isotope analysis (carbon $\delta^{13}C$ and nitrogen $\delta^{15}N$). Of the 62 samples analyzed, 4 were determined to be anadromous steelhead and 57 were resident rainbow trout. Six out of the 7 adipose clipped fish were sent for the analysis. Four were determined to be anadromous and 1 likely not anadromous. The analysis from one sample was inconclusive and will be re-run; however, it is possible that it was anadromous because the sample was from an adipose clipped fish.

Six steelhead were detected on a PIT tag array in the mainstem Okanagan River (site OKC), upstream of Lake Osoyoos (Table 7). The percent of returning steelhead that received PIT tags at or prior to passing

Wells Dam from 15 Jun 2009 to 14 Jun 2010 was 14.2% (3,588/25,211) (Charles Frady, WDFW, pers. comm.). Assuming that the 6 tagged steelhead detected at OKC were a representative subsample of the total population, an estimated 42 steelhead may have passed this location.

Table 7. PIT tagged steelhead that were detected at PIT tag array, site OKC, from July 2009 to June 2010.

Tag ID	Initial Tagging Information			Detection at OKC		
	Tag Date	**Tag Site**	**Organization**	**Rear Type**	**Obs. Site**	**Obs. Date**
3D9.1C2D1BF50D	7/16/2009 9:32	PRDLD1	WDFW	U	OKC	3/20/2010 4:04
3D9.1C2D290535	7/16/2009 9:32	PRDLD1	WDFW	U	OKC	3/24/2010 3:55
3D9.1C2D3C6B45	7/13/2009 12:00	WEL	WDFW	H	OKC	5/2/2010 8:54
3D9.1C2D09B18E	7/28/2009 12:00	BONAFF	CRITFC	U	OKC	5/6/2010 8:49
3D9.1C2D1C771D	7/16/2009 9:32	PRDLD1	WDFW	U	OKC	5/6/2010 23:12
3D9.1C2D1C1D31	7/16/2009 9:32	PRDLD1	WDFW	U	OKC	5/12/2010 18:05

Bringing it all together

In the United States, summer steelhead are currently listed as “threatened” under the Endangered Species Act in the Upper Columbia River Evolutionary Significant Unit. Detailed percent-wild information for 2010 is provided in this document and every attempt has been made to ensure that these estimates are as accurate as possible. However, these data should be used with caution as it is difficult to define natal origin through visual observation alone (i.e. intact adipose fin). Mean values presented in this document represent our best scientific estimate from available information, but should not be considered absolute. Thus, high and low estimates are also provided to represent a full range of potential scenarios. A summary of the best available counts and estimates for each reach or sub-watershed throughout the Okanogan River basin are presented in Table 8.

The total escapement estimate for Okanogan River summer steelhead spawners in 2010, based on redd surveys, weir traps, and video data, was likely between 3,236 and 3,596 (Table 9). Since 2005, the Okanogan summer steelhead population has been growing at a rate of 424 steelhead per year (Figure 29). For 2010, WDFW estimated maximum spawner escapement into the Okanogan River basin at 3,920 summer steelhead (Charles Frady, WDFW, pers. comm.). The WDFW estimate was derived from Wells Dam passage counts modified by harvest information and divided into individual river basin through the use of radio telemetry data (English et al. 2001, 2003).

The WDFW escapement estimate for 2010 was 352 steelhead; OBMEP estimated that between 630 and 853 ad-present steelhead likely spawned within the Okanogan River basin in 2010 (Table 10). The wide range in our estimate of wild steelhead was directly linked to uncertainty in the actual origin of ad-present steelhead. Additionally, inconsistent percentages of ad-present steelhead that utilized individual tributaries (i.e. 80.7% wild for Omak Creek vs. 17.2% for Salmon Creek) complicated percent-wild calculations from redd counts where we had no means of determining local counts. Since 2005, the Okanogan River population of wild steelhead has been increasing by almost 89 steelhead per year (Figure 30).

Table 8. Redd counts and spawner counts for each sub-watershed or counting location along with the estimated number of wild summer steelhead represented by each in 2010. The grand total for the entire Okanogan River population is presented with subtotals for tributary and mainstem habitat types in the United States and Canada. Values with an asterisk (*) contain a partial estimated redd count.

Distribution of Steelhead Spawning in the Okanogan Basin, 2010

Category	Description/location	Total Spawners	Redd Count	# Wild
US Mainstem	Reach O1	43	20	4
US Mainstem	Reach O2	102	48*	9
US Mainstem	Reach O3	38	18	3
US Mainstem	Reach O4	11	5	1
US Mainstem	Reach O5	211	99	19
US Mainstem	Reach O6	85	40	8
US Mainstem	Reach O7	837	393	76
US Mainstem	Reach S1	292	137*	27
US Mainstem	Reach S2	222	104*	20
US Tributary	Loup Loup Creek	125	39	22
US Tributary	Salmon Creek - Above Diversion	93	n/a	16
US Tributary	Salmon Creek - Below Diversion	215	74	37
US Tributary	Omak Creek - Above Weir Trap	212	n/a	171
US Tributary	Omak Creek - Below Weir Trap	61	21	49
US Tributary	Wanacut Creek	0	0	0
US Tributary	Tunk Creek	109	34	44
US Tributary	Bonaparte Creek - Above Weir Trap	67	n/a	28
US Tributary	Bonaparte Creek - Below Weir Trap	45	14	19
US Tributary	Antoine Creek - Above Video Weir	0	n/a	0
US Tributary	Antoine Creek - Below Video Weir	0	0	0
US Tributary	Wild Horse Spring Creek	278	87	48
Zosel Dam	**Observed Passing Zosel Dam**	**450**	**n/a**	**127**
US Tributary	Tonasket Creek	26	8	5
US Tributary	Ninemile Creek - Above Video Weir	18	n/a	4
US Tributary	Ninemile Creek - Below Video Weir	29	9	6
Subtotals	**Adult escapement into US mainstem**	**1,841**	**864**	**167**
Subtotals	**Adult escapement into US tributaries**	**1,278**	**n/a**	**449**
Subtotals	**Adult escapement into CDN**	**377**	**n/d**	**112**
Grand total		**3,496**		**728**

Table 9. Total escapement of summer steelhead for the Okanogan River since 2005 including combined hatchery and natural-origin summer steelhead estimates. In 2005 and 2006, only low and high estimates were provided so a simple arithmetic mean was computed for both years. The OBMEP estimate for 2007 was based on estimated mainstem data.

Okanogan River summer steelhead spawner population trend data				
Year	**WDFW escapement estimate**	**OBMEP spawner survey estimate**		
		Low	Mean	High
2005	2,233	1,147	1,315	1,482
2006	1,602	779	855	930
2007	1,921	1,234	1,266*	1,280
2008	1,755	1,341	1,386	1,436
2009	2,211	2,020	2,133	2,198
2010	3,920	3,236	3,496	3,596

* Estimated mainstem reach data rather than empirical data as in other years.

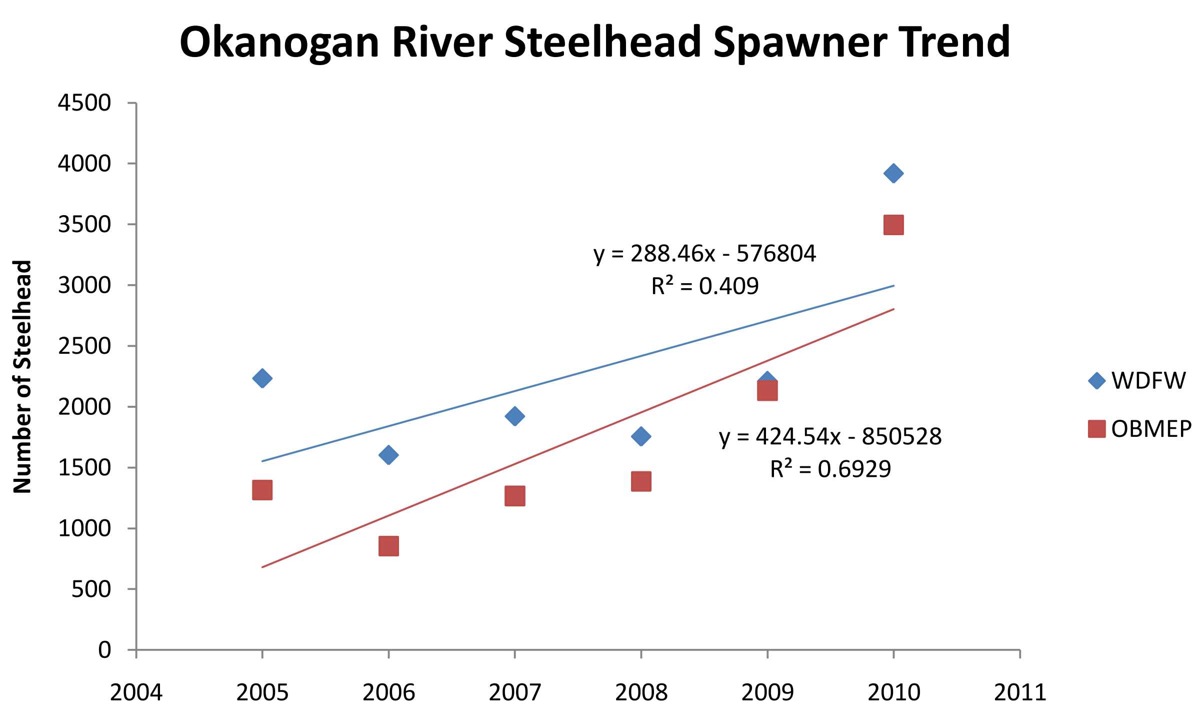

Figure 29. Trends in Okanogan River steelhead spawners, 2005-2010.

Table 10. Natural origin summer steelhead estimates for the Okanogan River since 2005. The estimates in 2005 and 2006 were calculated by multiplying the average wild percent for the Okanogan River. In 2006 and 2007 various sources data were used, such as trap, video, PIT tags, and coded wire tags were used to develop data for Table 6 at the sub-watershed scale. The OBMEP estimate for 2007 is based on estimated mainstem reach data.

Okanogan River wild summer steelhead spawner population trend data				
Year	**WDFW escapement estimate**	**OBMEP spawner survey estimate**		
		Low	Mean	High
2005	153	143	164	185
2006	130	127	139	151
2007	110	148	152*	155
2008	227	213	225	266
2009	202	178	212	241
2010	352	630	728	853

* Estimated mainstem reach data rather than empirical data as in other years.

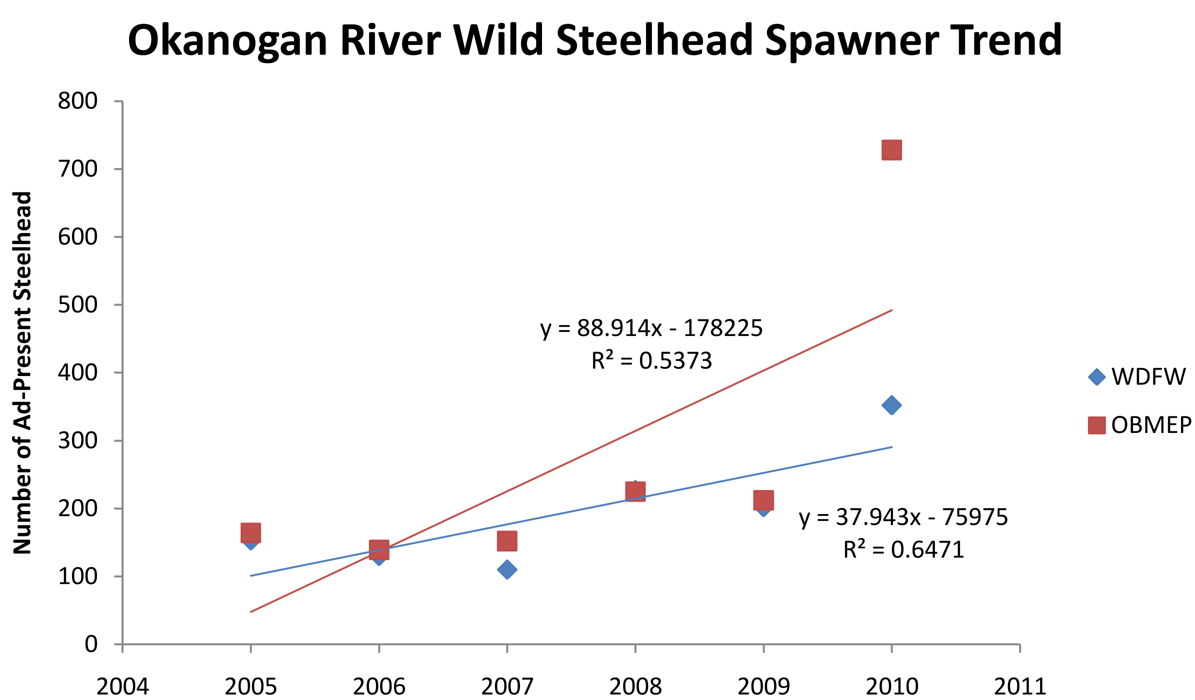

Figure 30. Trends in Okanogan River ad-present steelhead spawners, 2005-2010.

Conclusions

Results from steelhead adult enumeration efforts in the Okanogan basin indicate that more steelhead returned to the Okanogan River than in previous years' surveys, since 2005. Spawning is common throughout the mainstem Okanogan River and was most heavily focused below Zosel Dam and lower Similkameen Rivers. It is highly likely that distribution of spawning is largely influenced by stocking location because juvenile hatchery steelhead were scatter-planted in Omak and Salmon Creek, as well as the Similkameen River acclimation site. Steelhead redds were commonly observed near these stocking locations, as well as near Chinook redd mounds and mid-channel islands.

Annual variations of environmental factors can profoundly impact redd distributions in small tributaries to Okanogan River. Changes in spawner distributions within tributaries are primarily driven by four factors:

1) Discharge and elevation of the Okanogan River;
2) Discharge of the tributary streams;
3) Timing of runoff that alters the shape of the hydrograph, and;
4) Stocking location of hatchery smolts.

The first three items are largely based upon natural environmental conditions, which can be altered dramatically by such things as water releases from dams, irrigation withdrawals, and climate change. Years such as 2006, 2008, and 2009 clearly show how low tributary discharge can dramatically alter spawning location and reduce the number of steelhead utilizing small tributary streams. Habitat alterations at the mouths of key spawning tributaries can improve access, provided that sufficient discharge is available. In 2010, water availability in the Okanogan River basin was above normal; subsequently, a much larger proportion of steelhead spawned in tributaries than were documented in previous years. Approximately 37% of steelhead were estimated to have spawned in tributaries to the Okanogan in 2010. Summer steelhead that spawn in tributary habitats of the Okanogan River basin are more likely to find suitable environmental conditions and rearing habitats than those spawning in mainstem habitats.

Spring spawner data provide a depiction of steelhead spawning distribution and an estimate of minimum spawner abundance; however, determining the origin of returning adults is less objective. Accurate and reliable determination of origin is critical for tracking recovery of Upper Columbia summer steelhead within the Okanogan River basin. However, hatchery activities that do not mark all fish in an easily identifiable way complicate determining origin. It is difficult to conclude if increasing trends in wild fish are a result of more natural production or fewer summer steelhead being marked with an adipose fin clip. In 2010, new angling regulations required the retention of all steelhead caught with a clipped adipose fin (up to 4 fish). The benefits of these regulations may be reduced when not all hatchery fish are properly marked. Evaluation of natural production would be improved in the future by ensuring that all hatchery summer steelhead are marked by the removal of the adipose fin.

In 2011 and 2012, PIT tag arrays will be installed at the downstream extent of most tributaries throughout the Okanogan River basin. Additionally, returning adults will be implanted with PIT tags at mid-Columbia PUD facilities. Once the Okanogan basin-wide PIT tag array is in place, interrogation of PIT tagged adult steelhead will allow further examination of age, sex, and origin within each sub-watershed. PIT tag interrogations will also help to validate redd survey observations.

Literature Cited

Arterburn, J.E., and K. Kistler 2006. 2006 Okanogan Basin Steelhead Spawning Surveys. 2006 Report for Bonneville Power Administration project #200302200. Colville Confederated Tribes Fish and Wildlife Department. Nespelem, WA. http://nrd.colvilletribes.com/obmep/pdfs/2006%20steelhead%20 spawning%20Final.pdf

Arterburn, J.E., K. Kistler and C. Fisher 2007a. Anadromous Fish Passage Barriers in the Okanogan Basin. Report# CCT/AF-2007-1 for the Colville Tribes. Colville Confederated Tribes Fish and Wildlife Department. Nespelem, WA. http://nrd.colvilletribes.com/obmep/pdfs/Barriers%20to%20anadromous%20fish%20in%20the%20Okanogan%20 River.pdf

Arterburn, J., K. Kistler, C. Fisher and M. Rayton. 2007b. Okanogan Basin Spring Spawner Report for 2007. Confederated Tribes of the Colville Reservation Fish & Wildlife Department; Omak,WA. http://nrd.colvilletribes.com/obmep/pdfs/2007steelheadspawningFinal_000.pdf

Arterburn, J.E., K. Kistler and P. Wagner 2007c. Okanogan Basin Monitoring and Evaluation Program Field Manual Redd Survey Methodology Final Draft March 7, 2007. Colville Confederated Tribes Fish and Wildlife Department. Nespelem, WA. http://nrd.colvilletribes.com/obmep/pdfs/Redd%20survey%20 protocol.pdf

Arterburn, J.E., K. Kistler and R. Dasher 2005. 2005 Okanogan Basin Steelhead Spawning Ground Surveys. 2005 Report for Bonneville Power Administration project #200302200. Colville Confederated Tribes Fish and Wildlife Department. Nespelem, WA. http://nrd.colvilletribes.com/obmep/pdfs/Final%202005%20steelhead%20 spawning.pdf

Arterburn, J. E., and Fisher C. J. 2003. Steelhead surveys in Omak Creek. 2003 Annual Report for Bonneville Power Administration project #2000-001-00 and NOAA Fisheries – Pacific Coastal Salmon Recovery Fund, November 2003. Colville Confederated Tribes Fish and Wildlife Department. Nespelem, WA.

Arterburn, J. E., and Fisher C. J. 2004. Okanogan River Tributary Survey. Colville Tribes Fish and Wildlife Department-Internal Report May & June 2004, Omak, WA.

Arterburn, J. E., and Fisher C. J. 2005. Steelhead surveys in Omak Creek. 2004 Annual Report for Bonneville Power Administration project #2000-001-00 and NOAA Fisheries – Pacific Coastal Salmon Recovery Fund, April 2005. Colville Confederated Tribes Fish and Wildlife Department. Nespelem, WA.

Arterburn, J. E., and Miller B. F. 2009. Spring Spawner estimates for the Okanogan River Basin (2008). Colville Confederated Tribes Fish and Wildlife Department. Nespelem, WA. http://nrd.colvilletribes.com/ obmep/pdfs/200902272008springspawnerFINAL.pdf

Dasher, R. E. 2011. Protocol for sampling summer steelhead adults and juveniles 2011. Confederted Tribes of the Colville Reservation, Fish and Wildlife Department Omak, WA.

English, K., C. Sliwinski, B. Nass, and J. Stevenson. 2001. Assessment of adult steelhead migration through the Mid-Columbia River using radio-telemetry techniques, 1999-2000.

English, K., C. Sliwinski, B. Nass, and J. Stevenson. 2003. Assessment of adult steelhead migration through the Mid-Columbia River using radio-telemetry techniques, 2001-2002.

Fisher, C. J., and J. E. Arterburn. 2003. Steelhead surveys in Omak Creek. 2002 Annual Report for Bonneville Power Administration project #2000-001-00 April 2003. Colville Confederated Tribes Fish and Wildlife Department. Nespelem, WA.

Hillman, T. W. 2004. Monitoring strategy for the Upper Columbia Basin. Prepared for: Upper Columbia Regional Technical Team, Upper Columbia Salmon Recovery Board, Wenatchee, Washington.

Kistler, K., and J. Arterburn 2007. 2006 Okanogan Basin Snorkel Surveys. BPA project #200302200. Colville Confederated Tribes Fish and Wildlife Department. Nespelem, WA.

Kistler, K., J. Arterburn, and M. Rayton. 2006. 2005 Okanogan Basin Snorkel Surveys. BPA project #200302200. Colville Confederated Tribes Fish and Wildlife Department. Nespelem, WA. http://nrd.colvilletribes.com/obmep/pdfs/Final%202005%20snorkel%20report%20_2_.pdf

Long, K., M. Squakin, and C. Louie 2006. Steelhead spawner enumeration in the Okanogan Mainstem and tributaries: Inkaneep, Vaseux and Shuttleworth creeks-2006. Prepared by the Okanagan Nation Alliance Fisheries Department, Westbank, BC. http://nrd.colvilletribes.com/obmep/pdfs/Steelhead%20Redd%20Survey%20in%20Canada%202006.pdf

Nash, B. L. 2007. Fish enumeration using underwater video imagery Operational Manual. Colville Confederated Tribes Fish and Wildlife Department. Nespelem, WA.

Smith A. K. 1973. Development and application of spawning velocity and depth criteria for Oregon salmonids. Transactions of the American Fisheries Society 102:312-316

Walsh, M. and K. Long. 2006. Survey of barriers to anadromous fish migration in the Canadian Okanagan sub basin. Prepared by the Okanagan Nation Alliance Fisheries Department, Westbank, BC.

WSRFB (Washington Salmon Recovery Funding Board). 2003. Draft 5/16/2003 monitoring and evaluation strategy for habitat restoration and acquisition projects. Washington Salmon Recovery Funding Board, Olympia, WA. Web link: http://www.iac.wa.gov/srfb/docs.htm

WDFW, 2009. 2008-2009 Upper Columbia River Steelhead Fishery Summary. Prepared for NOAA Fisheries. Washington Department of Fish and Wildlife, Olympia, WA.