2006 OKANOGAN BASIN STEELHEAD SPAWNING GROUND SURVEYS

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Abstract

Until 2005, summer steelhead redd surveys had not been conducted in the Okanogan River Basin with the exception of 4-years of data in Omak Creek. In 2006, we uncovered new information related to summer steelhead spawning in the Okanogan River basin. First, we were able to estimate escapement into Canada for the first time in 2006 because of the installation of a video counting system at Zosel dam in 2005. Second, we documented spawning areas in four new tributaries; Tonasket, Antoine, Wild Horse Spring, and Loup-loup Creeks. Finally, we added new information related to up-stream barriers for Tonasket, Nine-mile, Wild Horse Spring, and Whistler Canyon creeks. Snow-packs and water supply was near to above normal in 2006, compared to well below normal in 2005. The peak of spawning occurred between the begin and middle of April, and did not appear to progress in any sort of unified pattern although we did see earlier spawning occurring in the Similkameen River when compared to the Okanogan River. The Distribution of redds in 2006 was considerably different compared to 2005 along the main-stem and especially in the area downstream of Zosel dam because certain habitats were dewatered early in the spawning season. In the United States we observed 306 redds in the main-stem habitats of the Similkameen and Okanogan Rivers and 52 redds were observed in the tributaries. We estimated that between 254 and 278 of the 298 summer steelhead that passed Zosel dam were destined for spawning areas inside of Canada and 51% of these fish had adipose fins intact. Redds were observed in the greatest concentration in or near down-welling areas with sufficient water velocities to kept 1” to 3” gravels clear of fine sediments. Primary spawning areas in 2006 included: the Similkameen River, the Okanogan River below Zosel Dam, McAllister Rapids downstream of Tunk Creek, downstream of Bonaparte Creek and along Omak Creek. Additional years of data will help further refine this information and provide a clearer picture of the status of summer steelhead spawning in the Okanogan River basin and allow for trend analysis in the future.

Introduction

This is the second year of steelhead redd surveys conducted by the Colville Tribes in the Okanogan Basin. Last years report contained an extensive literature review of historic spawning information related to the Okanogan River basin (Arterburn et al. 2005). Last years report can be accessed through our web-site at: http://nrd.colvilletribes.com/obmep/Reports.htm and this year’s document built upon last year’s information.

The Okanogan Basin Monitoring and Evaluation Project (OBMEP) was created in March of 2004 to establish a basin wide monitoring program for anadromous fish in the Okanogan River basin and is funded by the Bonneville Power Administration (BPA project # 200302200), OBMEP fills data gaps particularly associated with endangered summer steelhead through implementation of scientifically rigorous long-term status and trend monitoring of habitat, water quality, and biological indicators. OBMEP uses protocols derived from the Upper Columbia Strategy (Hillman 2004) that calls for a complete redd census, if possible, or an annual count of the numbers of redds within already-established index areas, or in reaches selected using randomly selected EMAP design. Following the Upper Columbia Strategies guidance maintains coordination and compatibility with other monitoring and evaluation efforts in the Upper Columbia ESU (Figure 1).

In 2004, we conducted a complete census of all main-stem habitats within the U.S. for the first time and identified several large areas that contained no redds and also are unlikely to ever have suitable habitat for spawning to occur. By eliminating these areas from future surveys reduces cost without the loss of any biologically important data. A few other areas such as Tunk and Nine-mile creeks have limited access due to a lack of land owner permission but these data would be similarly impacted regardless of the monitoring design used. Historic redd survey data collected by the Colville Tribes also provided important information used to establish reference reaches on Omak Creek. Collectively several recommendations were made and in 2005 that we applied in 2006.

Methods

Steelhead redd surveys were conducted in the Okanogan River drainage in all accessible tributaries and along the main-stem of the Okanogan and Similkameen Rivers downstream of known anadromous fish barriers (Arterburn and Fisher 2004, Walsh and Long 2006). Surveys were conducted up to three times during the spawning period on the main-stem Okanogan and Similkameen Rivers, from March 27-April 28. Single surveys of tributary habitats were conducted starting on June 1 and ending July 14. Designated main-stem and tributary survey reaches have been defined and can be viewed in Table 1. These reaches encompassed all spawning habitat currently available in the United States portion of the Okanogan River basin and a majority of the annual and rotating panel EMAP habitat sites (Figure 2). In Omak Creek, one-time surveys were conducted at already-established index areas, one extending 2 km upstream from the mouth of Omak Creek, the other between the lower-end of OBMEP site 19 upstream to Mission Falls. Above Mission Falls, reaches were surveyed using the downstream extent of the randomly selected EMAP sites upstream for 1 km. The Colville Tribes collaborated with effectiveness monitoring efforts related to passage improvement at Mission Falls completed last fall. The Colville Tribes fish and Wildlife Department surveyed the entire reach from the upstream extent of Mission Falls to the crossing at Haley Creek Road to determine if any summer steelhead had spawned above the falls in 2006. This effort encompassed 3 EMAP sites that were originally planned for monitoring by the OBMEP crews.

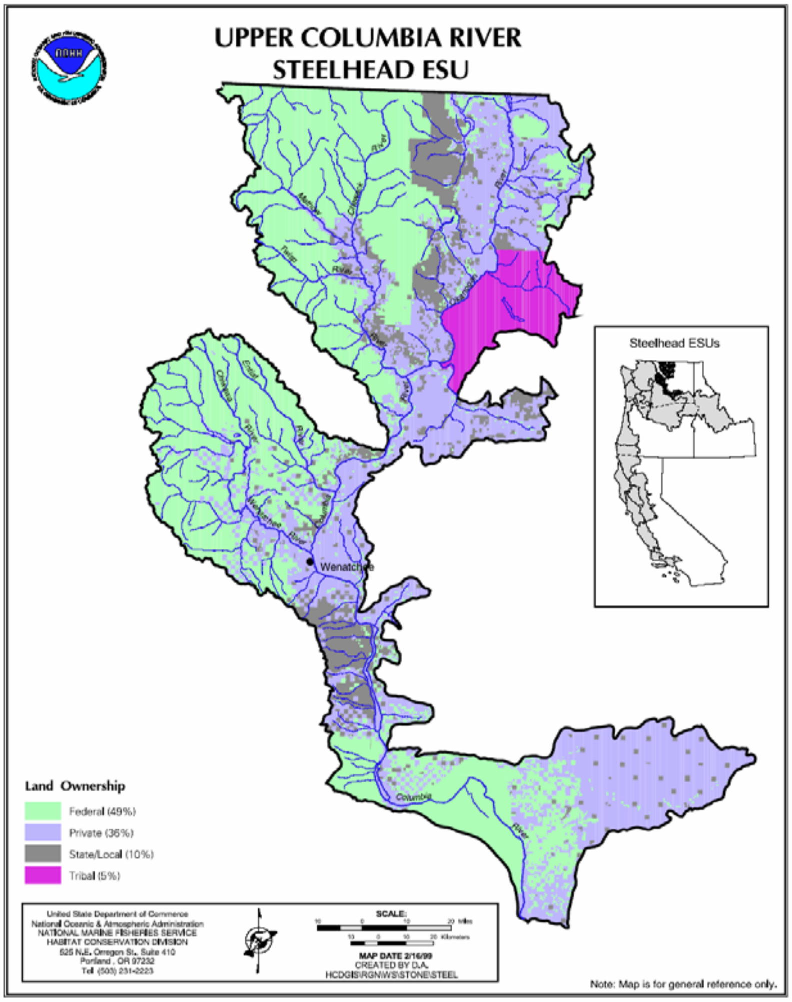

Figure 1: The Upper Columbia River summer steelhead Evolutionarily Significant Unit showing land ownership. *Map courtesy of NMFS-HCD* (http://www.nwr.noaa.gov/reference/frn/1997/62FR43937.pdf).

Steelhead spawning areas were surveyed by foot in the tributaries or from rafts along main-stem reaches. All surveys were conducted and redds were verified by at least two trained staff. Main-stem surveys were conducted by rafts except all island sections or areas that could not be floated due to limited access and/or obstacles (e.g. Wood debris, braided channels, and diversions) were surveyed by foot. The watershed was divided into reaches to allow for ease of access and provide reference points regarding distribution maps (see Table 1). Raft surveys were conducted using a minimum of two people in two 1-man, 10’ Skookum steelheader model catarafts.

On the Okanogan River, we surveyed reaches from below Zosel Dam to the Washington Department of Fish and Wildlife (WDFW) area located at the confluence with Chilliwist Creek. The area of the Okanogan below Chilliwist is subject to inundation from the Columbia River (Well’s Pool) and therefore lacks the appropriate flow and substrate needed for summer steelhead to spawn. The Similkameen River was surveyed from below Enloe Dam to the confluence with the Okanogan River.

Table 1. 2006 Redd survey Reaches

2006 Redd Survey Reaches		Reach length(km)
S1	Similkameen/Okanogan Conflunce(0) to Enloe Dam (14.6)	14.6
O1	Okanogan River south of Chiliwist creek(23.7) to Loup Loup creek(26.7)	3.0
O2	Okanogan River at Salmon creek(41.4) to the Office(52.3)	10.9
O3	Okanogan River at the office(52.3) to Riverside(66.1)	13.8
O4	Okanogan River at Riverside(66.1) to Janis Bridge(84.6)	18.5
O5	Okanogan River at Janis bridge(84.6) to Tonasket park(91.4)	6.8
O6	Okanogan River at horse shoe lake(112.4) to Confluence with Similkameen(119.5)	7.1
O7	Okanogan River at confluence(119.5) to Zoesel dam(127.0)	7.5
TU1	Tunk cr @Okanogan river Confluence (0) to High water mark (0.2)	0.2
B1	Bonaparte creek/Okanogan river confluence (0) to water fall barrier (1.6)	1.6
N1	Ninemile creek from Okanogan River confluence(0) to Eder land (1.7) Maximum potential (4.3 km)	1.7
TO1	Tonasket Creek/Okanogan River Confluence(0) to Tonasket Falls (3.5)	3.5
A1	Antoine Creek/Okanogan River Confluence(0) to Antoine Barrier (1.3)	1.3
L1	Loup Loup Creek/Okanogan River Confluence to Loup Loup Falls(3.3)	3.3
WS1	Wildhorse Spring Creek/Okanogan River Confluence to Barrier(1.1)	1.1
WC1	Whistler Cache Creek/Okanogan River Confluence to Barrier (0.7)	0.7
OM1	Omak creek/Okanogan River Confluence(0) to Omak Lake Rd. Bridge(2.0)	2
OM2	Emap site 19 Lower(5.3) to Mission Falls (9.0)	3.7
OM48	Emap site 48 Lower(23.1) to River Kilometer (24.1)	1
OM334	Emap site 334 Lower (31.3) to River Kilometer (32.3)	1
OM3	Above mission falls(10.8) to Haley Creek Road(18.9)	8.1

Redds were marked by GPS and surveyor flagging tied to bushes or trees on the stream-bank adjacent to the area were redds were observed. Each flag was marked with the date, coordinate, and distance from the redd, consecutive flag number, total number of redds represented by the flag, and surveyor initials, this same information was captured electronically by entering it into a Trimble Geoexplorer XT data logger. The color of the flagging was changed for each survey. Incomplete redds or test pits were not flagged and not counted. On subsequent surveys, all redds were counted and every attempt made to locate all flags from previous surveys. We noted missing flags by a gap in the numbering sequence. If a flag was found to be missing, the surveyor re-flagged redds based on the previously collected GPS location and information. Re-flagged redds were not counted as new redds.

US OBMEP sites

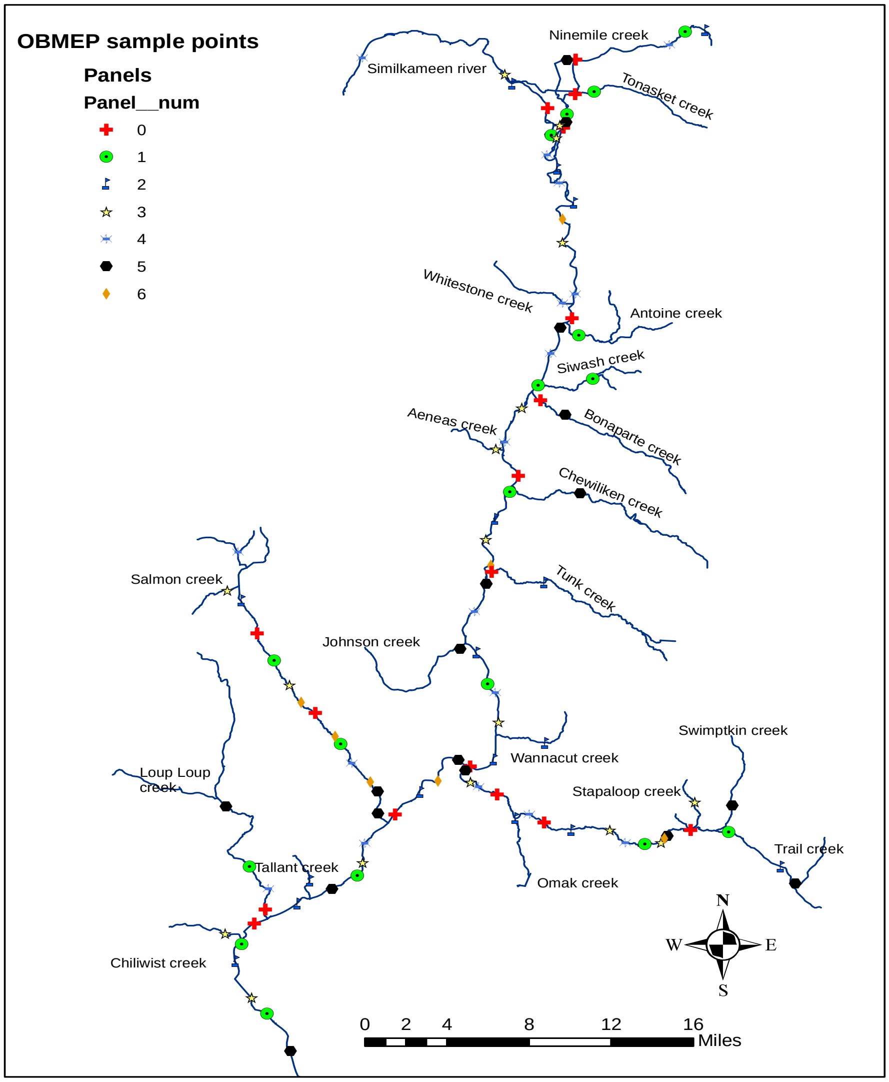

Figure 2: Probabilistic sampling design was used to select EMAP sites from a sampling universe that included all accessible habitats for anadromous fish in the United States Portion of The Okanogan River Watershed. Annual sites (Panel 0) are sampled annually and panel sites (1-5) are sampled once every 5 years on a rotating basis and panel 6 represents sites used as alternates if original sites are inaccessible.

GPS data and other information collected during field surveys were recorded on Trimble units and downloaded into GPS Pathfinder Office® after every survey. The GIS data were reviewed and spatially corrected to accurately display coordinates in a map format. Escapement calculations were made for each sub-population and the entire watershed. Several methods for calculating spawning escapement exist, such as the number of redds times a "fish-per-redd" estimate. WSRFB (2003) uses 2.2 Chinook per redd, assuming one redd per female. For steelhead, they assume 1.23 redds per female. A more accurate method currently used by WDFW in the Upper Columbia Basin is based on the sex ratio of broodstock (not recovered carcasses) collected randomly over the run (A. Murdoch, personal communication, WDFW). For example, if the sex ratio of a random sample of the run is 1.5:1.0, the expansion factor for the run would be, 2.5 fish/redd. This method is used for all supplemented stocks within the Upper Columbia Basin. We used the more accurate method and calculated escapement using the sex ratio generated from the Omak Creek weir in addition to using the sex ratio calculated from fish collected at Well's dam. Both the total number of redds and spawning escapement were reported to the nearest whole number.

Total redd estimates, in combination with spawner escapement where data exists (Omak Creek), can be used to estimate total escapement with a high level of accuracy. Tributaries where landowner permission could not be granted, represents a more difficult problem. The only way to expand estimates to the entire creek is to multiply the density of redds per km of stream in the sampled area by the remaining length of stream accessible by summer steelhead; this method was only needed for Nine-mile, Tunk and Omak Creeks. Sex ratio data can be used to provide estimates of total spawner escapement for the reach, watershed or sub-watershed. The sex ratio was determined by counting all adult fish returning to the Omak Creek weir and comparing the ratio of males to females and assuming that each female will produce one redd we will also use the sex ratio estimate derived by WDFW at Wells Dam as it is unknown which ratio truly represents the Okanogan River population best. Using both methods allowed us to report a range of estimates within which we believe the true value lays rather than attempting to express an exact value that is unlikely to be true.

Results

Sex ratios

All fish collected at the Omak Creek trap where fish could be handled and sex determined resulted in 63 summer steelhead being sexed with 43 fish identified as females and 20 identified as male. This makes a 0.47: 1 male to female ratio and a sex ratio as observed at the Omak Creek Trap of 1.47. At Wells Dam 839 summer steelhead were sampled in 2006, 327 males and 517 females were identified by Washington Department of Fish and Wildlife personnel (Charley Snow-personal communications) This results in a ratio of 0.64:1 males per female or a sex ratio of 1.64.

Okanogan and Similkameen River Main-stem

The Okanogan River was divided into seven segments based on access points and the Similkameen River was surveyed in one segment. All reaches were located upstream of the Wells' pool influence that is commonly agreed to be at the confluence of Chiliwist Creek and the Okanogan River. We used data collected in 2005 as reference for main-stem reach survey timing. In 2005, when flows on the main-stem exceeded 3,000 CFS, visibility was too poor to continue with main-stem redd surveys (Arterburn et al. 2005).

Therefore, we began surveying on March 27th and finished on April 24th when flow reached roughly 3,000 CFS and visibility compromised our ability to do more main-stem surveys (Figure 3). We completed three surveys on each main-stem reach with the exception of our final survey of the S1 reach.

Tributary habitats were originally planned for surveys during the first week of June. However, wet weather and abundant snow pack required us to delay several surveys on the larger tributaries until such time as lower discharge and water clarity allowed us to get into the creeks. Visibility in some small tributaries allowed surveys to be conducted as scheduled but most of the larger tributaries did not get surveyed until the first week in July.

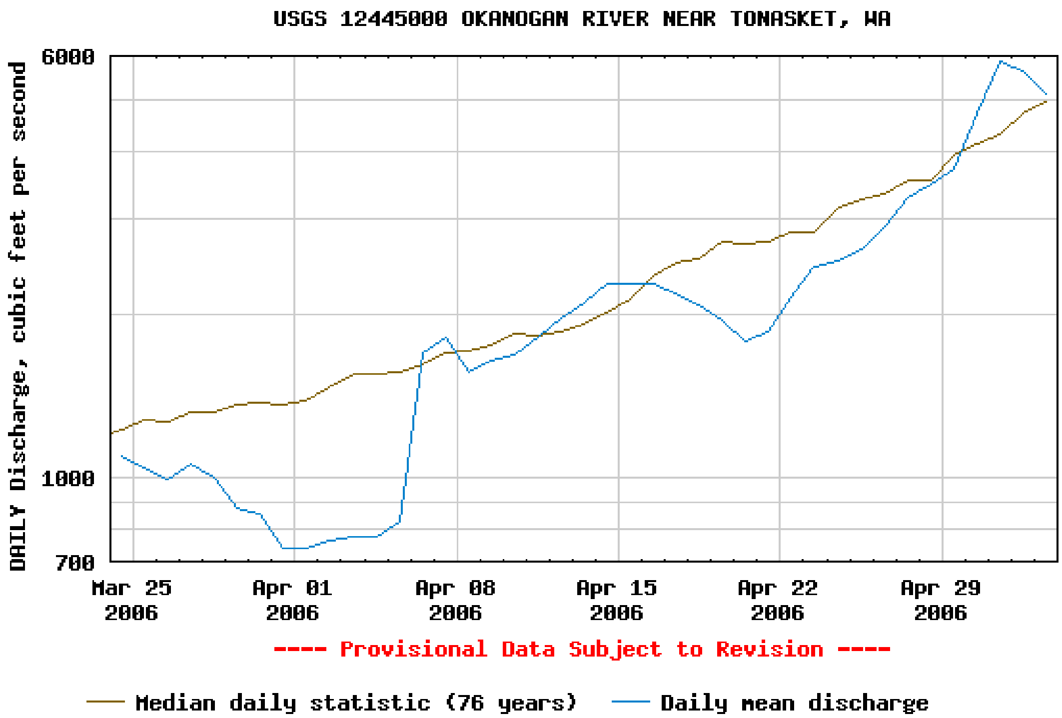

Figure 3: Discharge of Okanogan River as measured at Tonasket, WA for the period from March 24th to May 3, 2006 compared to the 76-year historic average (http://waterdata.usgs.gov/wa/nwis/uv?12445000).

The lower most reach on the Okanogan River (O1) was surveyed on: 3/28/06, 4/06/06, and 4/20/06, however, no steelhead redds were observed. In 2005, most redds were observed around a large, mid-channel gravel bar located a short distance downstream of the confluence with Loup-loup Creek.

Okanogan River Reach O2 was surveyed on: 3/27/06, 3 redds were observed; 4/06/06, 0 new redds and 4/20/06, 1 additional redd was observed. A total of 4 steelhead redds were identified in 2006. These redds were observed around the Highway 155 bridge located in Omak, WA and the Island at Shellrock Point (Figure 4). We calculated that conservatively the number of spawners using this reach was between 6 and 7 summer steelhead representing a density of 0.37 steelhead redds per kilometer.

Reach O2-2006

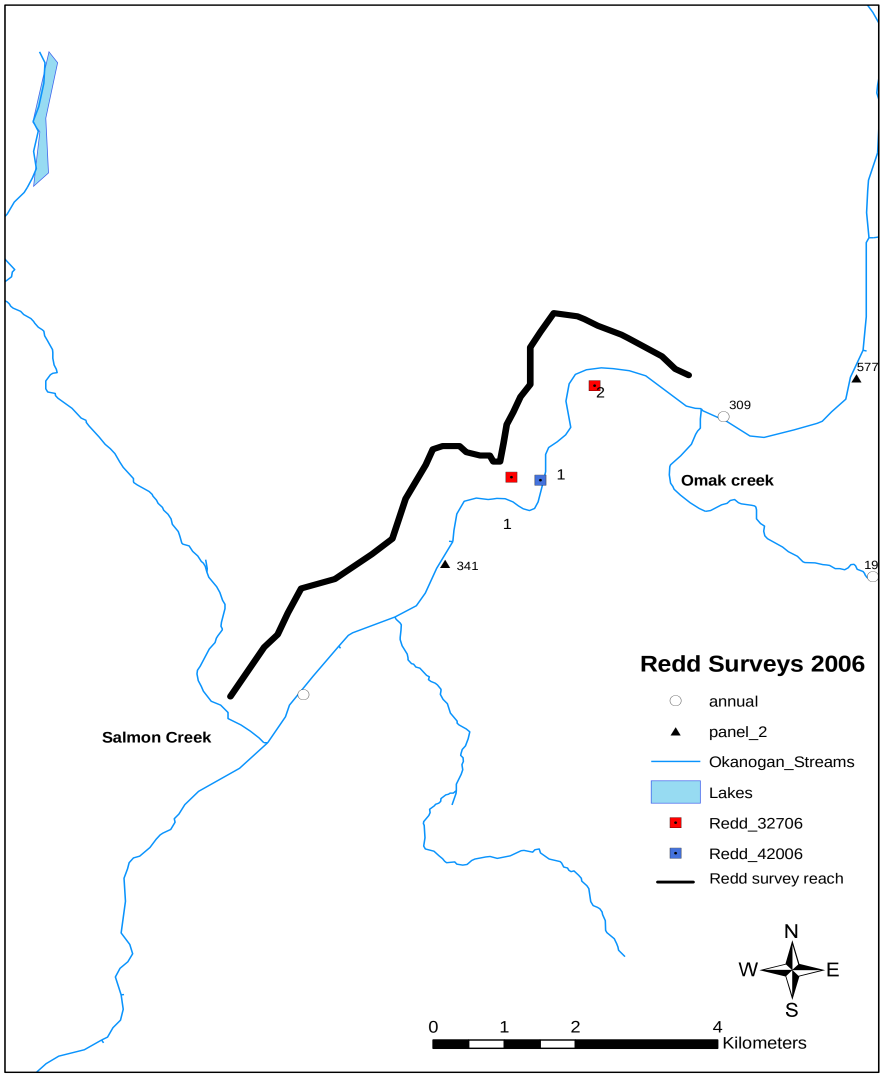

Figure 4: Redd distribution observed in 2006 for Okanogan River reach O2 from the Colville Confederated Tribes Fish and Wildlife office in Omak to Salmon Creek.

Okanogan River Reach O3 was surveyed on: 3/29/06, when 2 redds observed, other surveys were conducted on 4/07/06 and 4/25/06 when no new redds were observed. A total of 2 steelhead redds were identified. These redds were observed in the middle of the survey reach (Figure 5). We calculated that the number of spawning summer steelhead represented by these redds was 3 regardless of which sex ratio was used. The density of steelhead redds in this reach was 0.14 redds per kilometer.

Okanogan River Reach O4 was surveyed on: 3/31/06, 0 redds observed; 4/11/06, 2 redds identified, and 4/21/06, when 9 additional redds were seen. A total of 11 steelhead redds were identified. The bulk of the steelhead redds were observed within the braided channel below McAllister rapids near the confluence with Tunk Creek (Figure 6). We calculated that conservatively the number of spawners using this reach was between 13 and 15 summer steelhead representing a density of 0.59 steelhead redds/km.

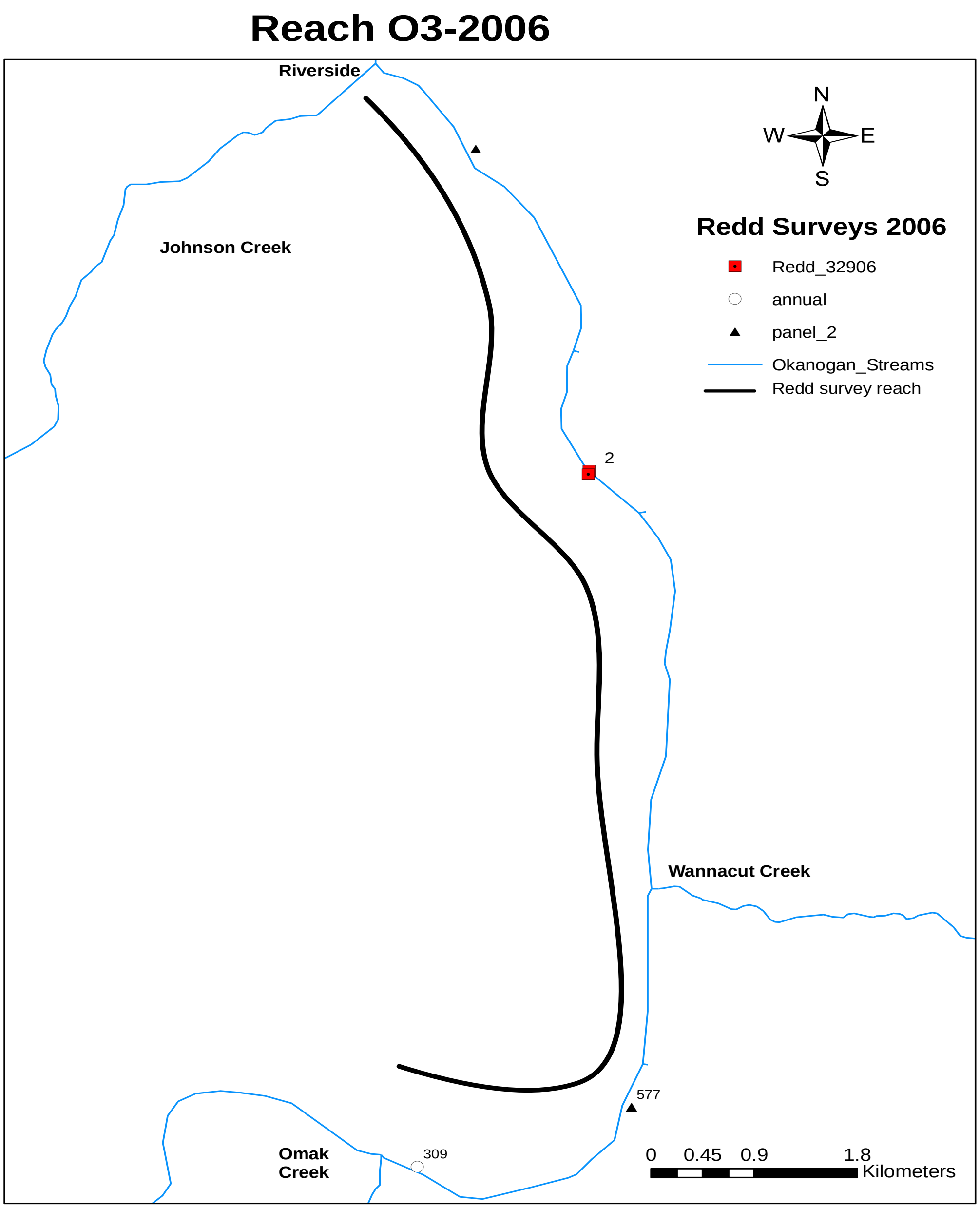

Figure 5: Redd distribution observed in 2006 for Okanogan River reach O3 from the town of Riverside, WA to the Colville Confederated Tribes Fish and Wildlife office in Omak.

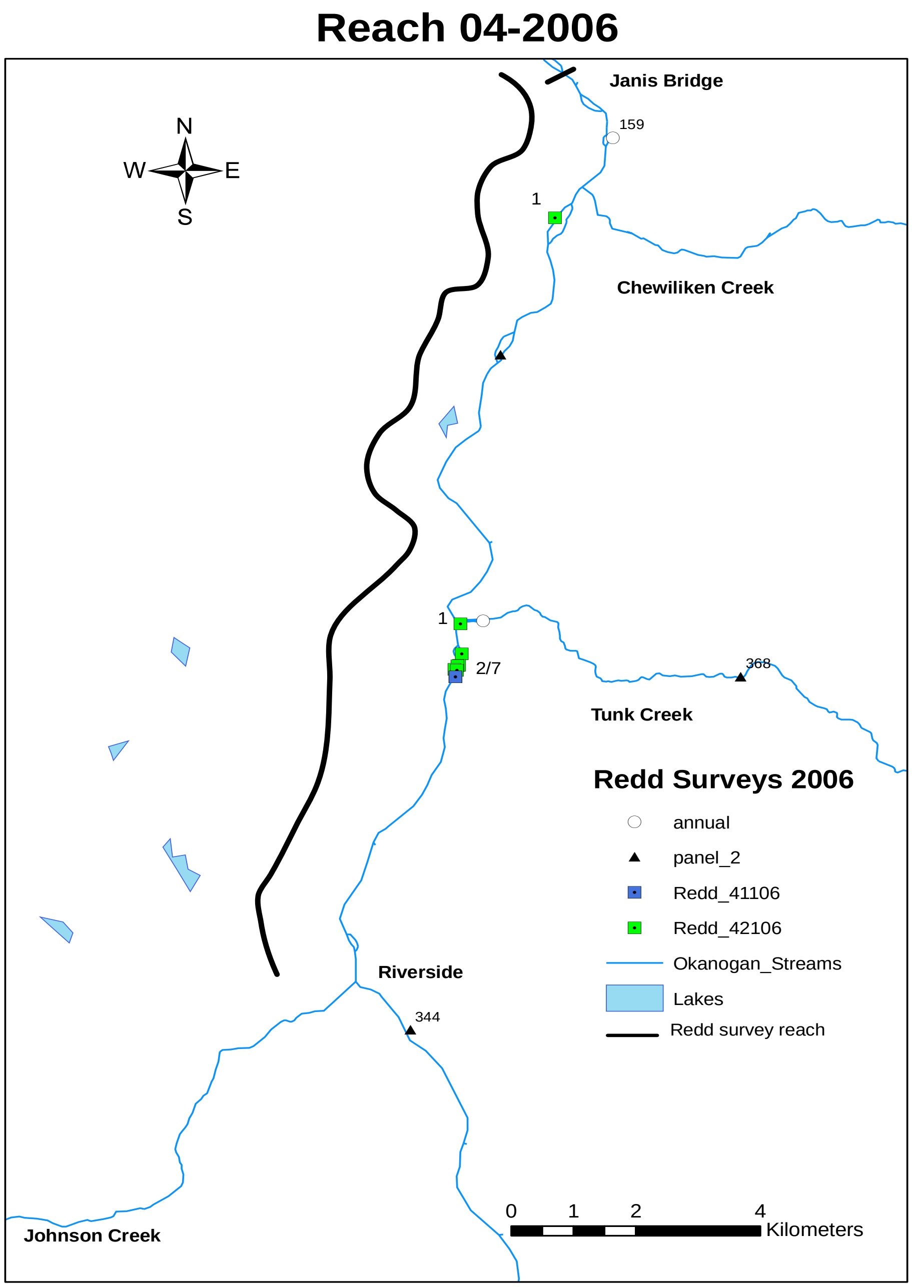

Figure 6 Redd distribution observed in 2006 for Okanogan River reach O4 from Janis Bridge to the town of Riverside, WA.

Okanogan River Reach O5 was surveyed on: 3/30/06, 10 redds were observed; 4/10/06, 21 new redds were indicated; and 4/18/06 when an additional 8 redds were seen. A total of 39 redds were identified within this reach during 2006 (Figure 7). Most of the steelhead redds were observed in areas with side channels and islands. We calculated that conservatively the number of spawners using this reach was between 57 and 64 summer steelhead representing a density of 5.74 steelhead redds per kilometer.

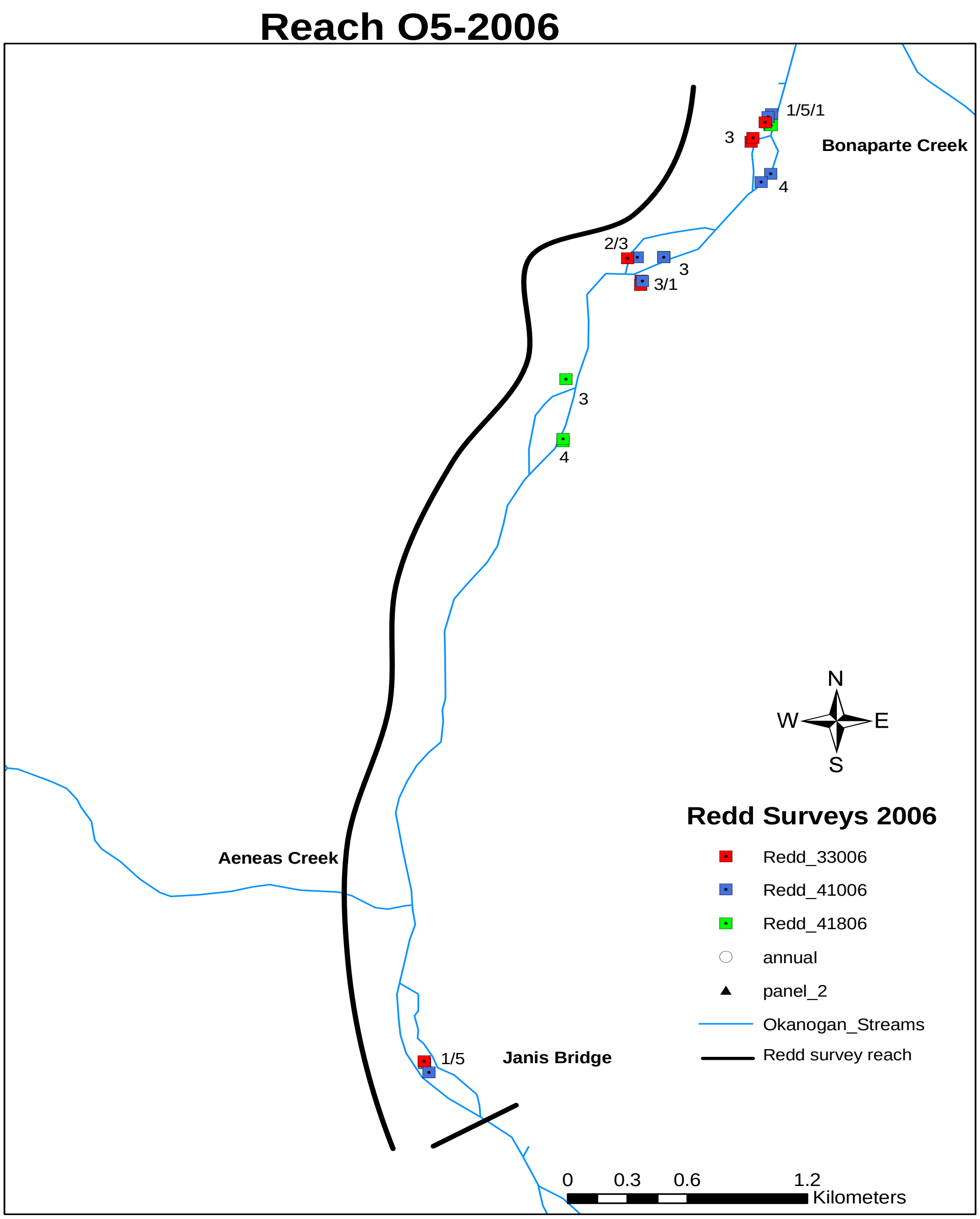

Figure 7: Okanogan River redd distribution observed in 2006 Reach O5 from the Chief Tonasket Park near the confluence with Bonaparte Creek to the Highway 97 Bridge at Janis, WA.

Okanogan River Reach O6 was surveyed on: 4/03/06, 1 redd was observed subsequent redd surveys on 4/18/06 and 4/24/06 did not detect any new redds. A total of one steelhead redd was located near the confluence of the Okanogan and Similkameen Rivers (Figure 8). We calculated that this redd represents 2 summer steelhead or a density of 0.14 steelhead redds/km.

Reach 06-2006

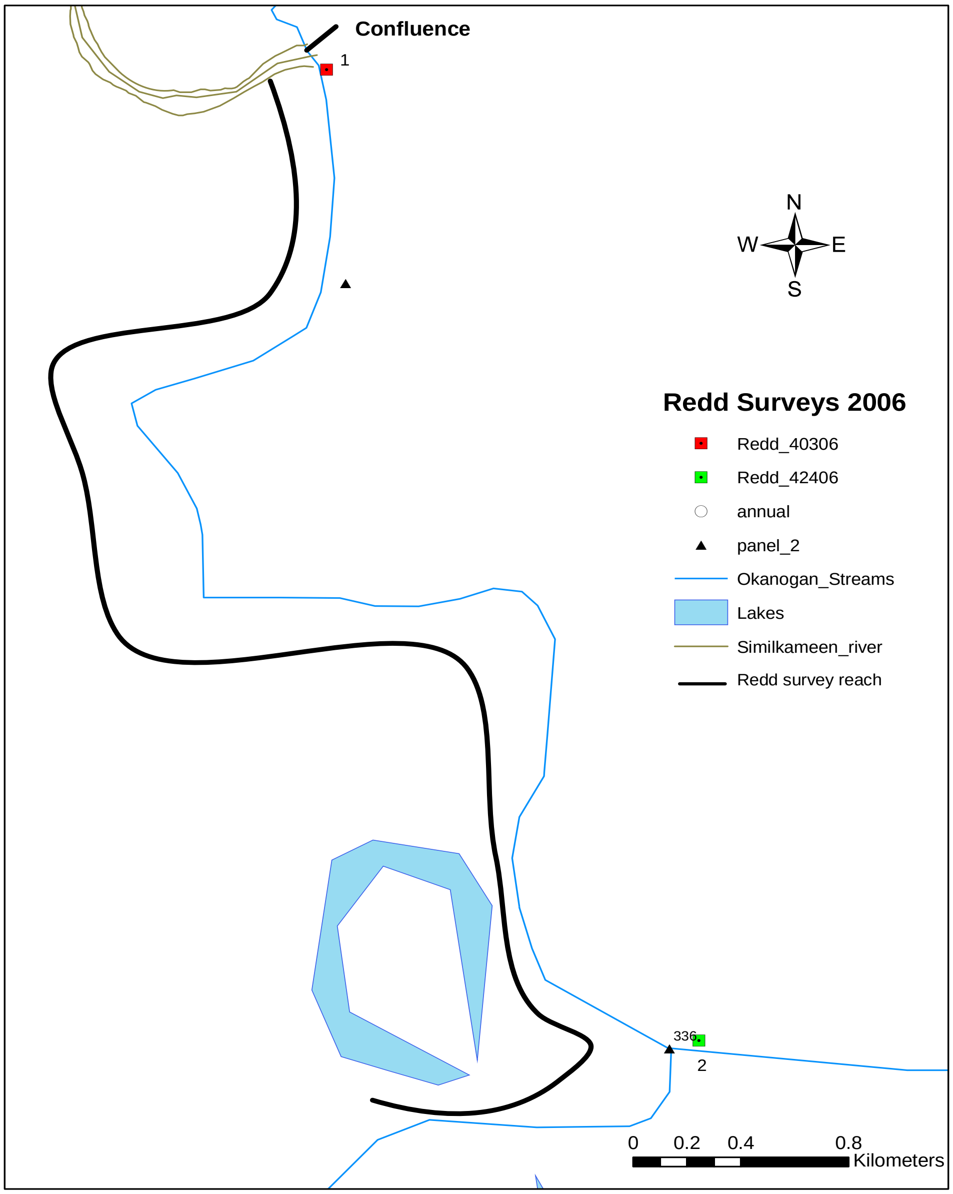

Figure 8: Okanogan River redd distribution observed in 2006 Reach O6 from the confluence of the Similkameen and Okanogan River to Horseshoe Lake.

Okanogan River Reach O7 was surveyed on: 4/05/06, 19 redds; 4/10/06, 5 redds; and 4/19/06, 127 redds. A total of 151 redds were identified. A majority of redds were observed between Zosel Dam and the cross channel in 2006 (Figure 9). During peak spawning, numerous steelhead were observed constructing or near redds. We calculated that conservatively the number of spawning steelhead using this reach was between 222 and 248. We calculated the density of steelhead redds in this reach to be 20.1 per km.

Reach 07/S1-2006

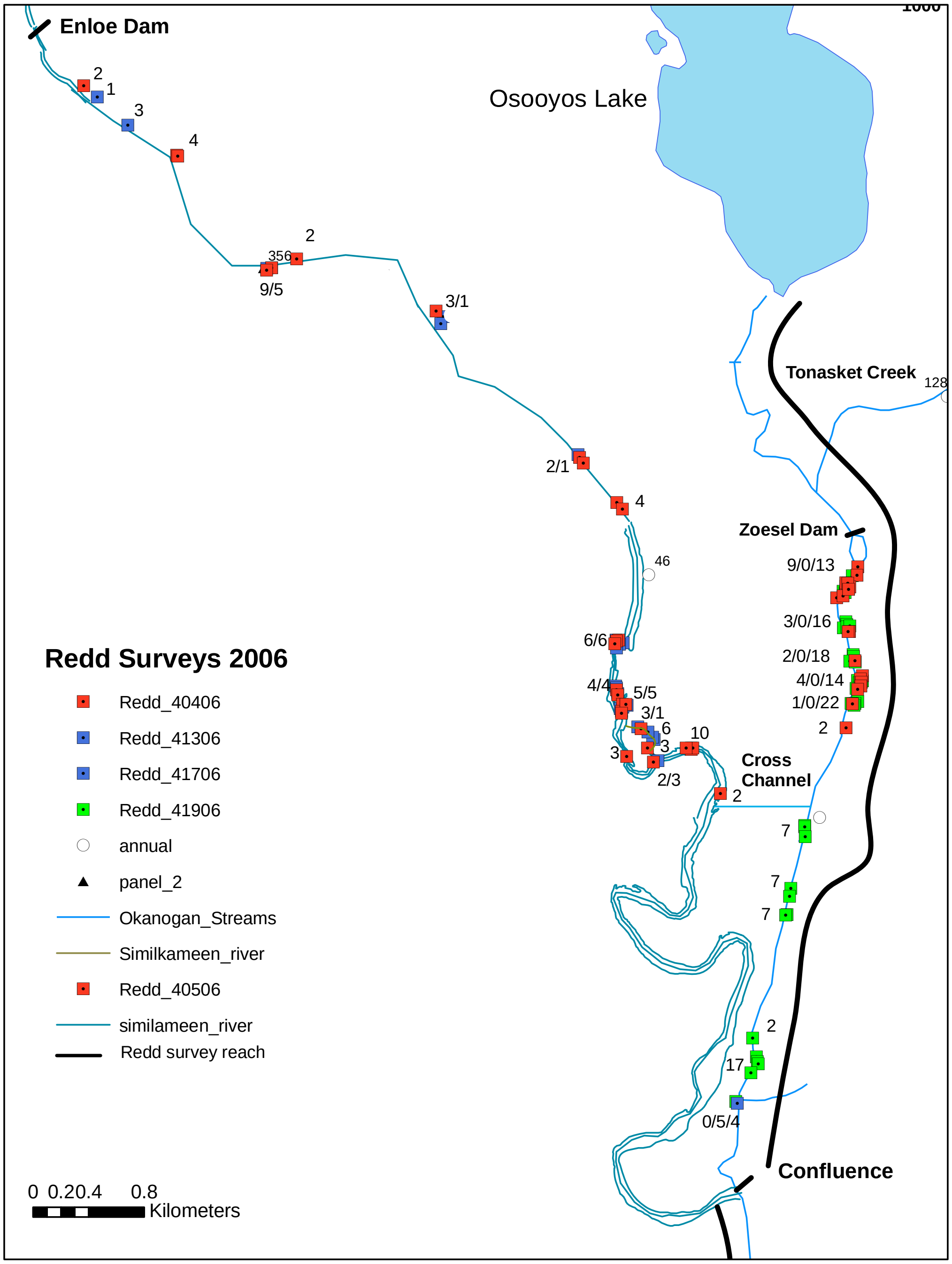

Figure 9: Redd distribution observed in 2006 for Okanogan River Reach O7 and Similkameen River Reach S1. Reach O7 extends from Zosel Dam downstream to the confluence with the Similkameen River. Reach S1 extends from Enloe Dam downstream to the confluence with the Okanogan River.

Similkameen River Reach S1 was surveyed on 4/04/06 when 62 redds were observed and again on 4/17/06 when another 36 redds were observed. The final survey of this reach was cancels due to high flows and poor visibility. A total of 98 steelhead redds were identified within this reach during 2006. Steelhead redds were found mostly in the reach below the bridge crossing near Oroville, WA but upstream of the cross-channel (Figure 9). We conservatively calculated that the number of spawning steelhead that used this reach was between 144 and 161 which represents a density of 6.71 steelhead redds per kilometer.

United States Tributaries to the Okanogan River

Each tributary of the Okanogan River represents a unique data set therefore the results of each tributary are described individually.

The lack of access has been an on-going problem on Nine-mile Creek. No exhaustive survey of fish passage barriers has ever been possible due to uncooperative landowners. However, OBMEP and other crews from the Colville Tribes Fish and Wildlife Department have slowly documented barriers to migration within this watershed. As of the writing of this document we have verified that anadromous fish have access to a minimum of 1.7 km and a maximum of 4.3 km of spawning and rearing habitat. Several barriers were discovered this year between river kilometer 4.3 and 9.1 by OBMEP field crews. Several surveys below river kilometer 1.7 have uncovered only a single impedance to passage at approximately river kilometer 1.3 that could be a major obstacle during low water years such as 2005. Extrapolating redd surveys is limited to the maximum habitat available but this evaluation is subject to change as additional habitat information is gained. A total of 9 redds were identified on 6/05/06 within the lower 1.7 km accessible to survey crews but no summer steelhead were observed (Figure 10). We estimate a range of possible escapements for Nine-mile Creek to be between a minimum of 13 to a maximum of 37 summer steelhead and representing a density of 5.29 redds/km.

Tonasket Creek had good flows throughout the steelhead spawning season in 2006. The barrier to upstream migration has been located at river kilometer 3.5 were a natural falls exists (Arterburn and Fisher 2004). A total of 5 redds were observed during our survey of this reach on 6/05/06 (Figure 10). We also observed 1 adipose clipped and fully spent steelhead carcass. We calculated the escapement for Tonasket Creek to be between 7 and 8 summer steelhead representing a density of 1.43 redds per kilometer.

In 2006, we surveyed two additional small tributaries to the Okanogan River because they had good steady discharge during the summer steelhead spawning period and had never been surveyed before. One tributary enters the Okanogan River near Eyhot Island and is called Whistler Cache Creek (Figure 11). However, high gradient and culvert barriers within the first half kilometer apparently keep summer steelhead from using this stream that historically represented about 0.7 km of habitat for anadromous fish. The other tributary is Wildhorse Spring Creek. This creek had been inaccessible in recent years due to a large beaver dam located near the confluence with the Okanogan River. However, high flows in 2006 blew out this obstruction and steelhead along with their redds were observed by OBMEP crews during main-stem surveys on 4/24/06 below the highway 97 crossing. An additional survey was conducted on 6/01/06 above the highway 97 crossing to the upstream barriers (Figure 11). Within the 1.1 km of available habitat 3 redds were observed representing between 4 and 5 summer steelhead and a density of 2.72 redds/km.

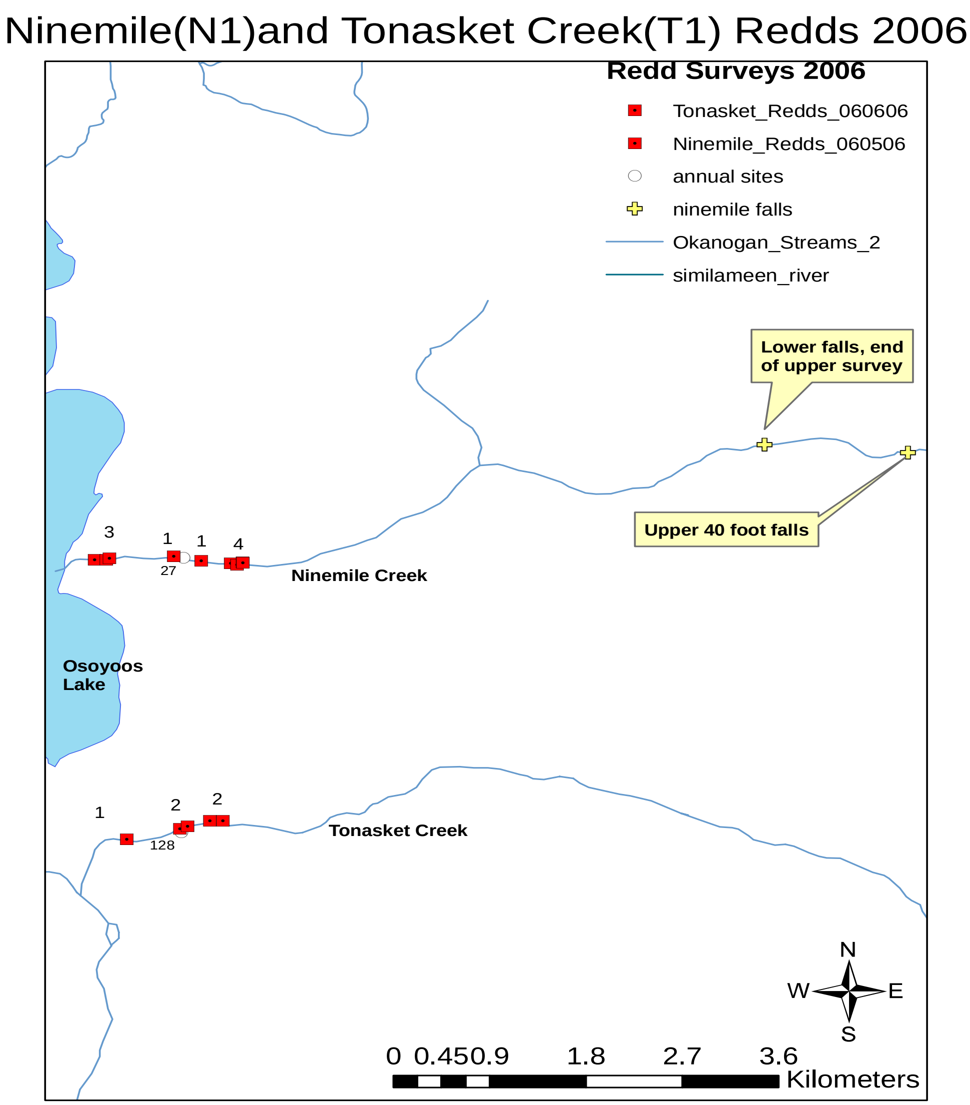

Figure 10: Redd distribution observed in 2006 for Nine-mile and Tonasket Creek in the accessible lower portions of each creek.

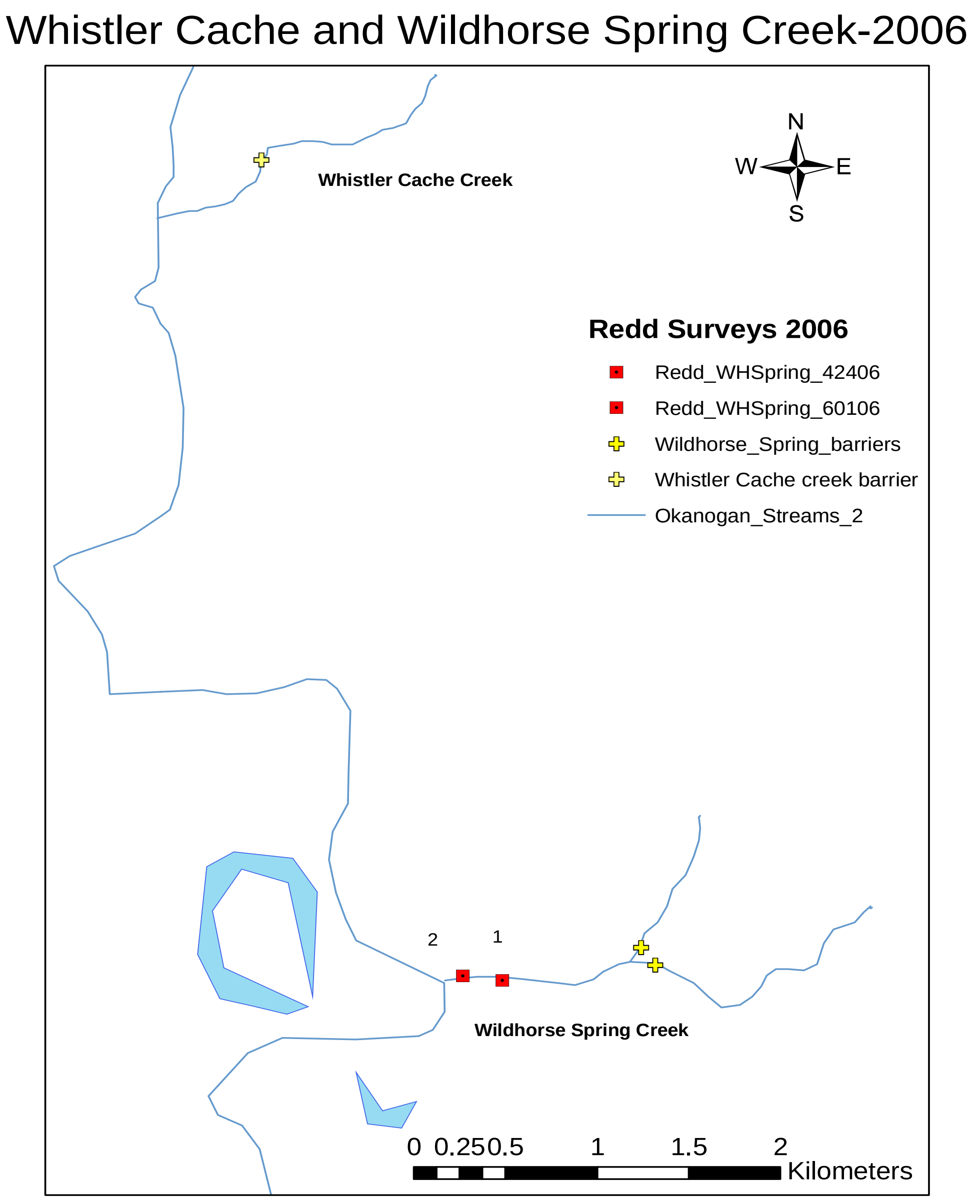

Figure 11: Whistler Cache Creek and Wildhorse Spring Creek Redd Surveys 2006.

Antoine Creek had good flow late in the steelhead spawning season in 2006. The barrier to upstream migration has been located at river kilometer 1.3 were a bedrock feature and irrigation diversion exists (Arterburn and Fisher 2004). A total of 2 redds were observed during our survey of this reach on 7/05/06 (Figure 12). We calculated the escapement for Antoine Creek to be 3 summer steelhead, representing a density of 1.54 redds/km.

Antoine Creek-2006

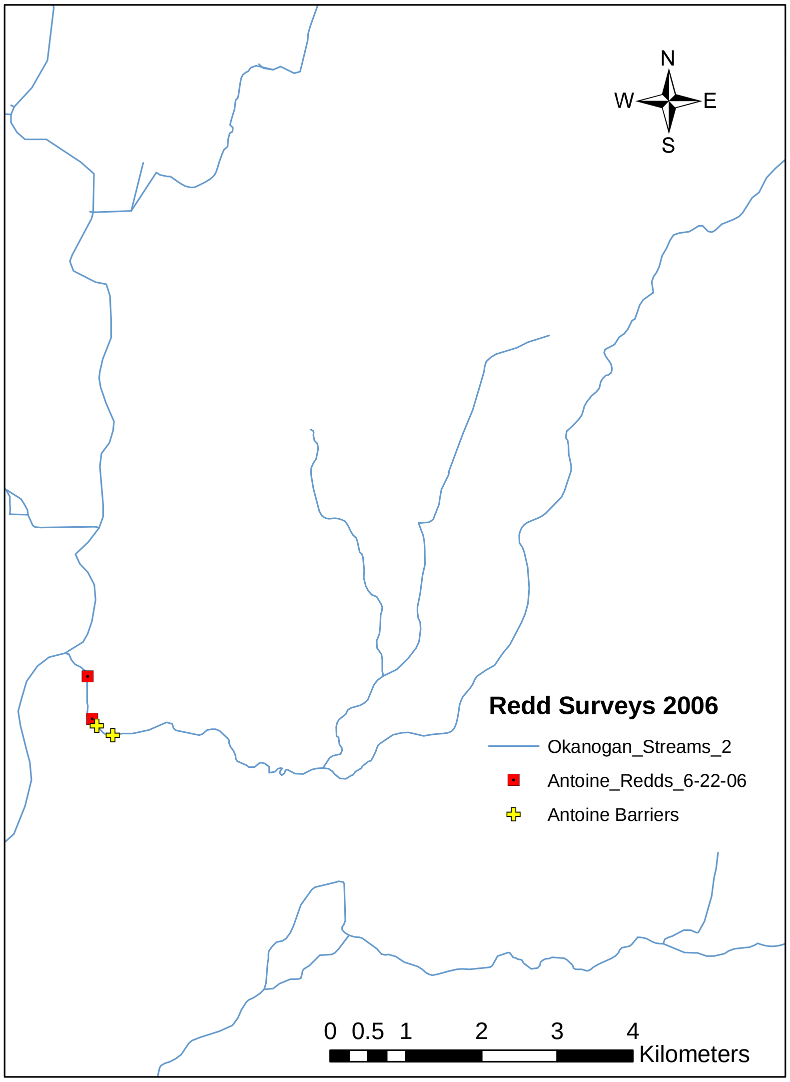

Figure 12: Redds observed and natural barriers on Antoine Creek representing 1.3 km of habitat available to anadromous fish.

The only access on Tunk Creek was within the high water mark of the Okanogan River channel therefore we conducted foot surveys in conjunction with main-stem raft surveys for Reach O3. The high water mark along the Okanogan River provides access to the lower 0.2 km, however only 1.0 km of habitat exists in Tunk Creek below the historic natural barrier of Keystone Falls. We observed only 1 redd in Tunk Creek (Figure 6) on 4/21/06 in the lower 0.2 km. Expanding these data to include the full 1 km results in the estimated density of 5.0 redds per km. This was used to estimate an escapement for Tunk Creek of between 2 and 7 summer steelhead in 2006.

In 2006, several counting mechanisms were in place on Bonaparte Creek. A picket weir trap was installed 4/7/06 and 12 steelhead were trapped and passed up-stream including 2-females and 10-males for a sex ratio of 6.0. An experimental video weir was also installed on 3/16/06 but only observed 6 summer steelhead that could be positively identified and was only operational on a limited basis. The entire length of usable anadromous fish habitat on Bonaparte Creek, from the confluence with the Okanogan River to Bonaparte Falls, was surveyed on 7/14/06. Poor visibility was the main reason why crews could not get into the stream sooner. Our redd census documented 3 redds and resulted in a possible escapement range of between 12 (count at the picket weir) and 18 summer steelhead using the sex ratio for Bonaparte Creek (Figure 13). Bonaparte Creek had a density of 1.88 summer steelhead per kilometer. We observed 4 summer steelhead with adipose fins at the picket weir (33%) and 67% of the steelhead observed at the video weir had adipose fins.

Bonaparte Creek Redds-2006

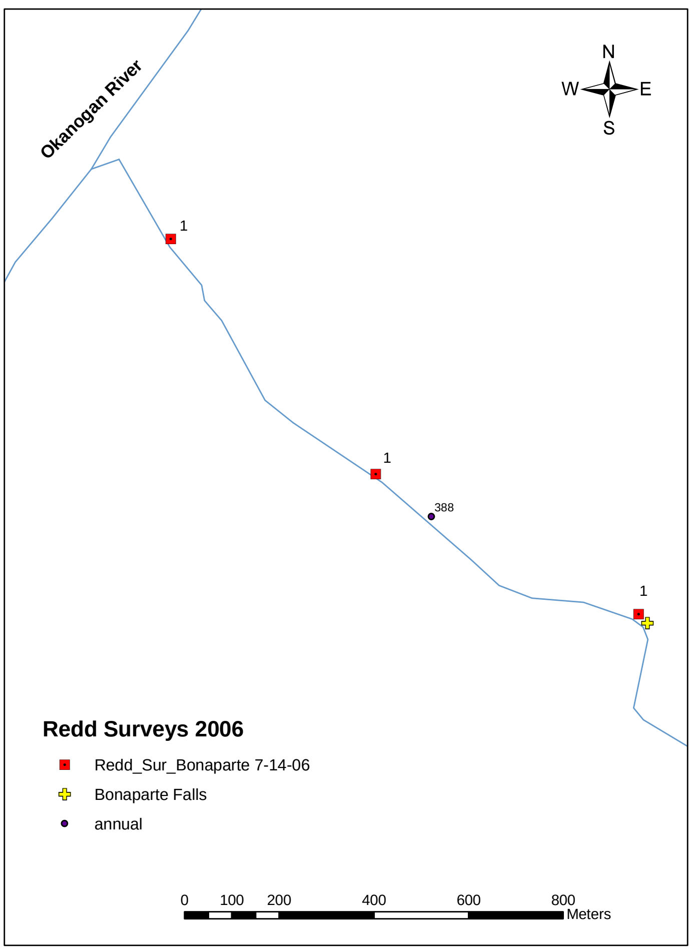

Figure 13: The distribution of redds observed in Bonaparte Creek during 2006 from the confluence with the Okanogan River upstream to Bonaparte Falls.

Omak Creek has a weir/trap installed at river km 1.5 to collect all fish migrating upstream. The Colville Tribes released 63 summer steelhead above the weir out of a total of 77 that were trapped. A total of 5 redds were observed below the trap on 6/26/06 and 21 redds were observed above the trap on 6/27/06 (Figure 14). The distance from the confluence with the Okanogan River upstream to Mission Falls represents 9.0 km of available habitat; surveys were conducted over a total of 5.7 km (63%). Using the observed total of 21 redds, the remaining portions of Omak Creek was calculated to have contained 8 additional redds. This brings the calculated total of 34 redds for the entire 9 km reach. We surveyed 10.1 km above Mission Falls between 6/28/06 and 7/8/06 but did not observe a single steelhead redd. By using the total number of summer steelhead collected at the trap and redd estimates below the trap we calculated the possible range of escapement into Omak Creek at between 84 and 85 steelhead. Only five summer steelhead with adipose fins were observed in Omak Creek (7.9%). Redd densities were 3.33 redds/km below the trap and 3.68 redds/km above the weir to Mission Falls with no redds above Mission Falls.

Loup-loup Creek was surveyed for redds on 6/30/06 because good flows estimated at between 20 and 60 CFS existed during most of the summer steelhead spawning period. Historically, this creek has had little discharge that reached the Okanogan River due to irrigation diversions and water storage within this watershed. Additionally, a perched culvert at approximately river kilometer 0.1 keeps, most fish, in most years from accessing the 3.3 km of the habitat that historically was accessible to anadromous fish. Summer steelhead were observed above the culvert in 2006 and 8 redds were identified during our surveys (Figure 15). We calculated that this represents between 12 and 13 summer steelhead that migrated past the lower culvert barrier. It is highly likely that more steelhead would utilize Loup-loup Creek if passage flows were provided in most years and passage at the downstream culverts was improved.

In 2006, a video counting station was operational at Zosel Dam. A minimum of 298 summer steelhead passed this location. Of these, 51% had adipose fins that were intact and the majority of steelhead passed during the month of April. Based on our redd surveys we can calculate that a minimum of between 254 and 278 summer steelhead were destined for spawning areas within Canada. Redd surveys conducted by the Okanagan Nation Alliance (ONA) were conducted between 4/04/06 and 6/26/06 and a picket weir trap was installed on Inkaneep Creek. Preliminary results indicate that redds were observed in all creeks surveyed below McIntyre Dam with the highest abundance being observed in Inkaneep and Vaseux Creeks with main-stem habitats only containing a minor number of redds (Figure 16). Our best estimate from these efforts indicates that we have discovered the spawning location for only approximately 31% of the steelhead that passed above Zosel Dam.

Omak Creek Redd Surveys 2006

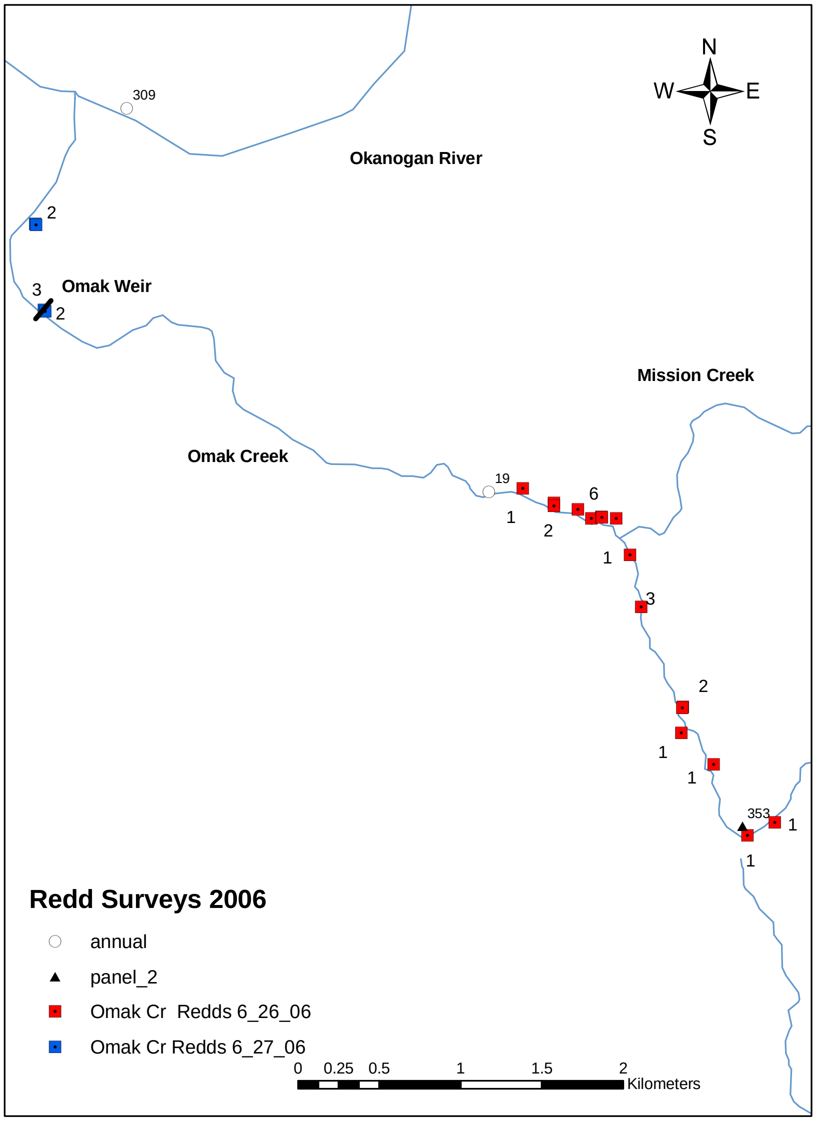

Figure 14: Observed Omak Creek redd distribution in 2006. The lower reach extended from the confluence with the Okanogan River upstream to the bridge on Omak Lake Rd (rkm 2.0), the center reach from Moomaw's fence upstream to Mission Falls (rkm 5.3 to 9.0) and the upper reach not shown extended from above Mission Falls (rkm 10.75) to Haley Creek Rd (rkm 18.9) and also included 1 km reaches up-stream of EMAP habitat sites number 48 and 334 but no redds were detected above Mission Falls.

Loup Loup(L1) 2006

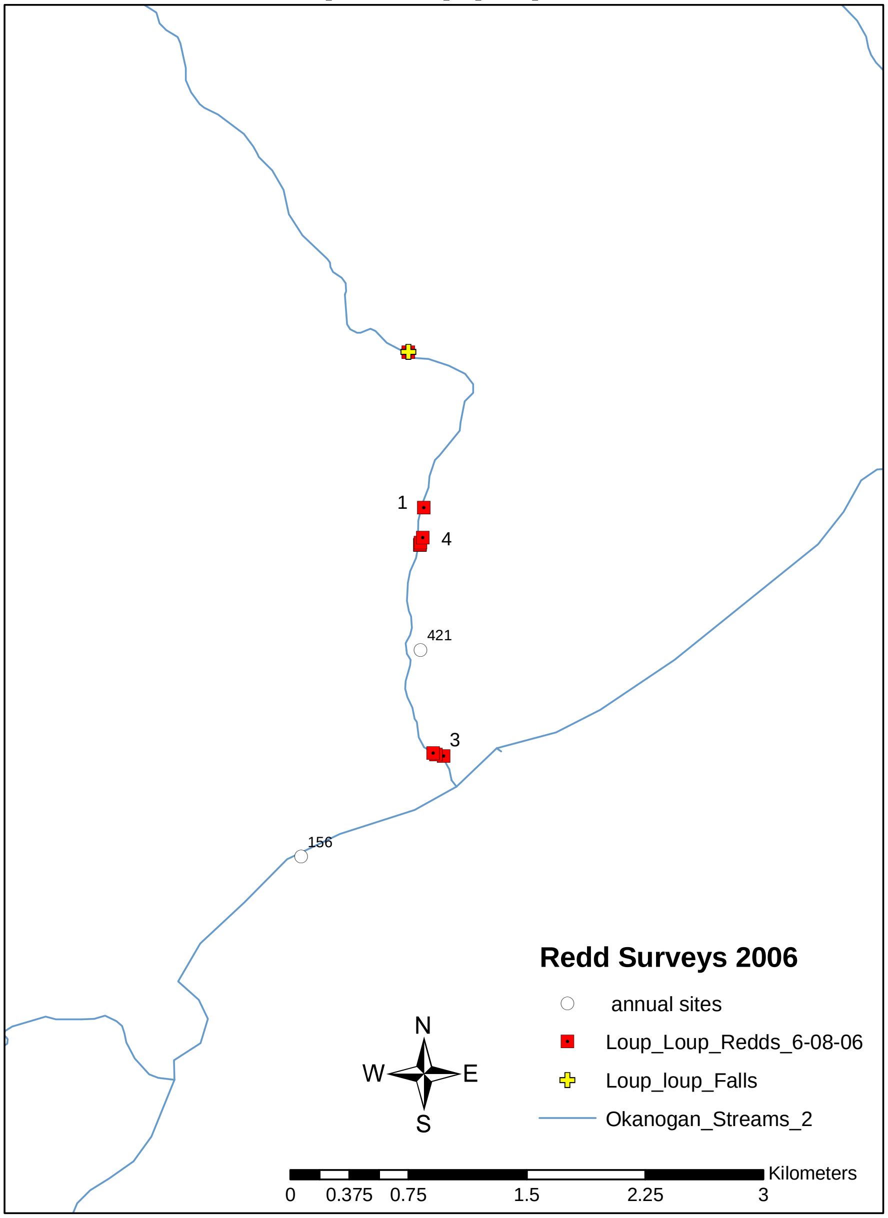

Figure 15: The location of summer steelhead redds observed on Loup-loup Creek in 2006 and the natural falls that represents the natural upstream limits for anadromous fish.

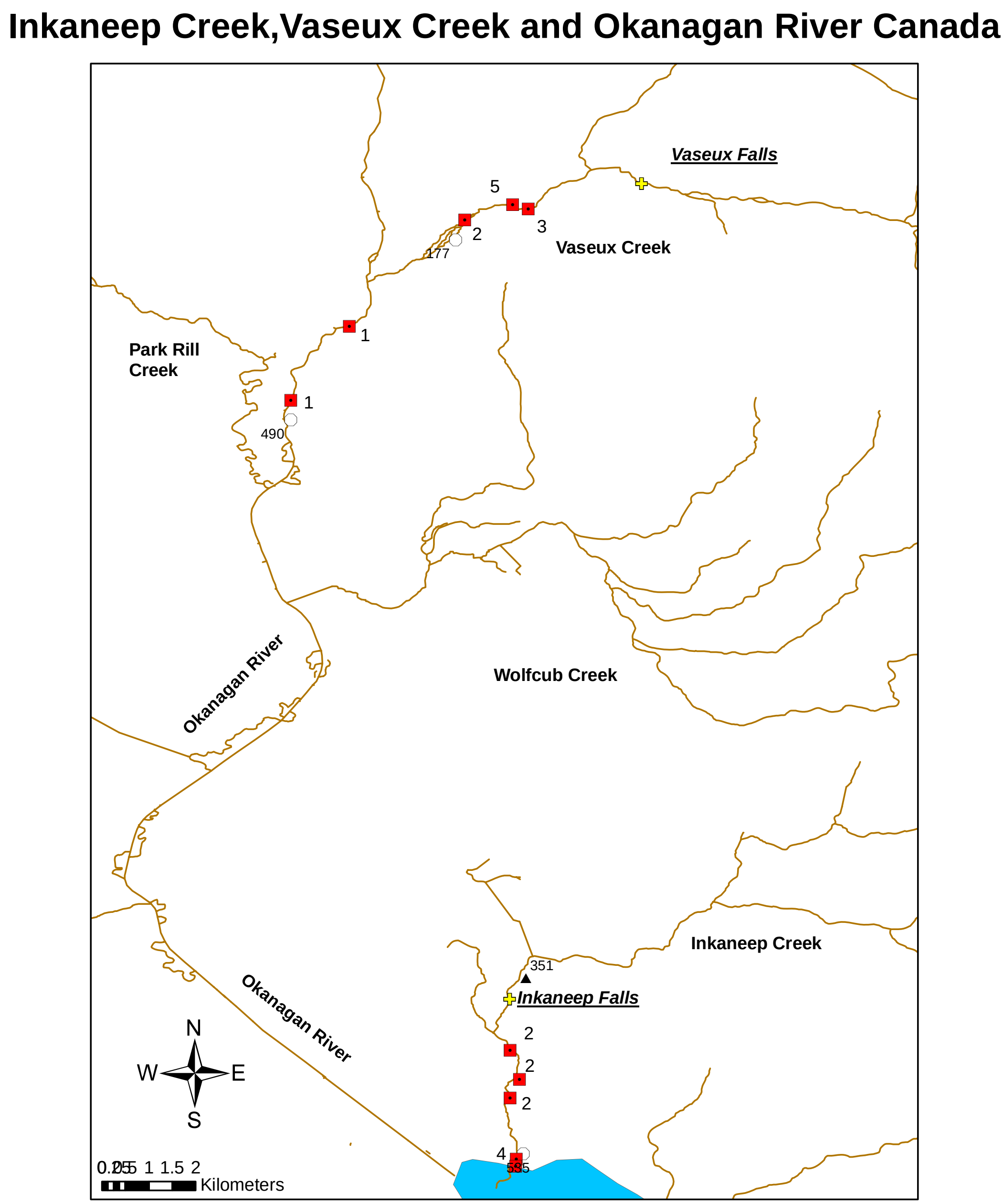

Figure 16: Steelhead redds observed by the Okanagan Nation Alliance in Canada as part of OBMEP below McIntyre Dam in the spring of 2006.

Discussion

Similarities with the 2005 redd survey data include; main-stem redd distribution that were highest in the upstream reaches of the Okanogan and Similkameen Rivers as a result of focused hatchery releases into this area. High quality spawning gravels are also common in this area. Other high density spawning areas in both years included the island section near Tonasket, Janis Rapids, and McAlister Rapids were braided channels and increased water velocities maintain clean gravels (1 to 3 inch) preferred by summer steelhead (Smith 1973). Where habitats were conducive, steelhead built redds in close proximity to one another, especially in pool tail-out areas and at the heads of mid-channel islands. Future habitat improvement efforts should key on providing and sustaining more sites that support a gravel substrate that can be kept clear of fine sediments. Improving the abundance and quality of gravel areas in the Okanogan River basin would improve egg to fry production for both Chinook and steelhead.

Water availability in the Okanogan River basin approximated normal or slightly above but the last above normal water year was 10 years ago in 1997 (Figure 3). Many of the small tributaries had considerable material accumulated within the channel making for some dramatic channel forming events. Many tributaries had flow and much of this flow was uncontrolled on the tributary streams like Salmon, Loup-loup, Antoine, Whistler Cache, and Tonasket Creeks. Abundant sediments delivered into the main-stem reaches of the Okanogan and Similkameen Rivers reduced visibility within the plume of the tributary streams. For example, snow pack and water flow in the Loup-loup Creek drainage was 111% of the 20 year average (*Washington Water Supply Outlook Report).* Loup-loup Creek was estimated to be flowing between 20-60 CFS during our main-stem survey period and contributing a high level of sediment and turbidity to the Okanogan River.

Poor visibility may have reduced the number of redds detected or sedimentation may have caused main-stem habitats near tributaries to be less desirable to steelhead looking for a place to spawn. Overall, areas that were within the discharge plume as identified by areas of increased turbidity did not appear to be utilized in 2006 at the same rate as they were utilized by summer steelhead in 2005. For example, in 2005, many more redds were observed within Reach O2 of the Okanogan River when compared to surveys in 2006 (Arterburn et al. 2005). This year during the month of April, Omak Creek was flowing at an average of 157 CFS with an instantaneous maximum flow of 269 CFS (Figure 17). Omak Creek was contributing a lot of sediment to the Okanogan River during our survey period impairing visibility in reach 02 from the confluence all the way downstream to Shellrock Point.

Reach O7 was impacted by both high and low flows released from Zosel dam (Figure 18). Flows between the cross channel and the confluence with the Similkameen River were eliminated when discharge was reduced to below 200 cubic feet per second (CFS) and this occurred between the dates of 3/30/06 and 4/04/06. Last year, this section of the O7 reach contained the highest density of summer steelhead redds (Arterburn et al. 2005). Several redds had been constructed within this reach during this timeframe with most of them located between the Zosel Dam outlet and the cross channel. By 4/6/06 flows had been increased to 1,240 CFS and many of the previously built redds were likely scoured. Traditionally, flows in this reach of the Okanogan River are between 400 and 800 CFS. The impacts from these highly fluctuating flows are hard to predict but it did result in a substantial change in the distribution of summer steelhead redds between 2005 and 2006.

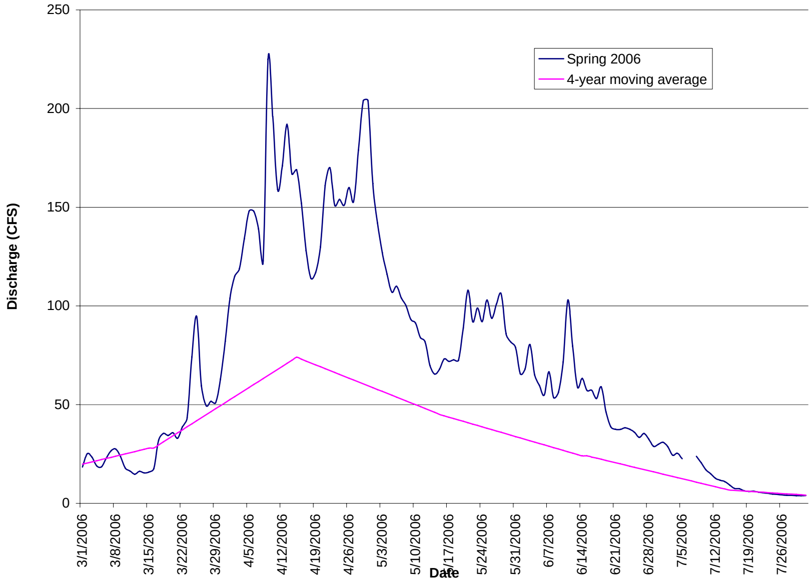

Figure 17. March through July discharge for Omak Creek in 2006 compared to 4-year moving average from data collected by DOE below Mission Falls. https://fortress.wa.gov/ecy/wrx/wrx/flows/station.asp?sta=49C100

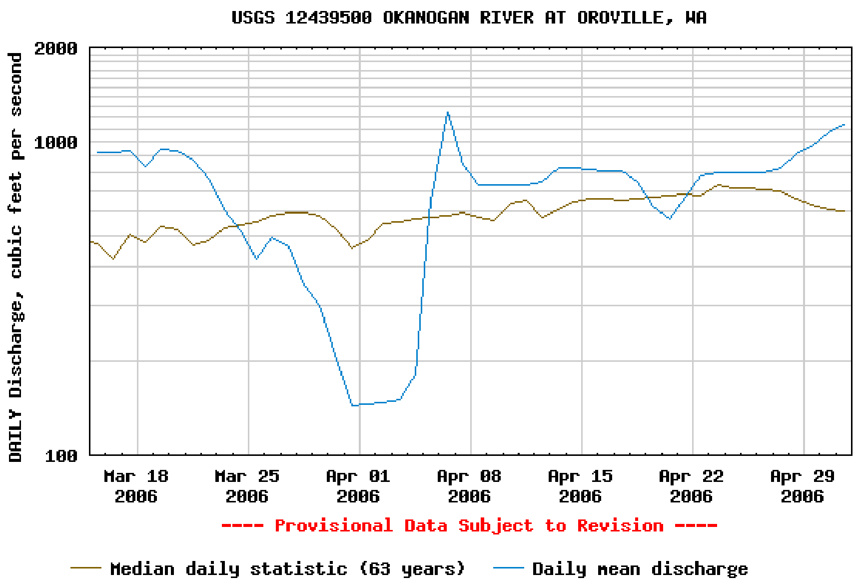

Figure 18: Discharge of Okanogan River as measured at Tonasket, WA for the period from March 15th to May 1, 2006 compared to the 63-year historic average (http://waterdata.usgs.gov/wa/nwis/uv?1243950).

The Omak Creek drainage was extremely dry during the winter of 2005 and this made redd survey results much different than in previous years (Figure 17). The distribution of summer steelhead redds in 2006 was more consistent with past years surveys (Arterburn et al. 2005, Arterburn and Fisher 2005, Arterburn and Fisher 2004, Fisher and Arterburn 2003) Dividing the known escapement by the sex ratio, one would expect to observe 43 redds above the trap but only 29 were counted. This could have resulted from high flows making redds hard to detect, the length of time between redd creation and the survey making redds hard to detect, pre-spawn mortality of females after being pasted above the weir, or because fish passed above Mission Falls.

Data collected in 2005 and recommendation that were made helped us considerably in 2006. The run timing and flows under which we could sample were much better understood. However, data collected in 2005 was more typical of a low water year and resulted in unrealistic expectations for how early we could conduct tributary surveys. Each tributary is different and as a result one specific timeframe is not likely to allow all the redd surveys to proceed on schedule. In future years, it would be useful not to attempt tributary redd surveys prior to June 1st and be realistic that in some years surveys may not be possible to complete until after the first week in July. Future studies to identify the rate that redd detection is impaired would enhance the accuracy and interpretation of redd surveys that are delayed due to above normal precipitation.

Conclusions

The total escapement for the Okanogan River was estimated at between 779 and 930 summer steelhead spawners (Table 2). Our spawner estimates are very consistent with WDFW estimates derived from Wells Dam passage counts and modified using creel survey information. WDFW estimated total spawner escapement into the Okanogan River Basin at 811 summer steelhead (Bob Jateff-personal communications).

Table 2.- Total redds and corresponding number of summer steelhead for the Okanogan River basin in 2006.

2006 Redd Surveys

Dates when data were collected	Location	Total Redds Observed (#)	Total Redds Expanded (#)	Mean Density (Redds/km)	Steelhead[1,4] (Max. #)	Steelhead[2,3] (Min. #)
3/27/06-4/21/06	Main-stem	306		3.72	514	450
4/24/06-7/8/06	Tributaries	52	82	2.72	138	76
10/05-6/06	Escapement into Canada[5]				278	253
2006 Okanogan River Spawner Estimate				**3.53**	**930**	**779**
2005 Okanogan River Spawner Estimate				**4.50**	**1482**	**1147**

1-Calculated using a sex ratio of 1.68,based on observations at Well's Dam
2-Calculated using a sex ratio of 1.47, based on observations at the Omak Creek weir
3-The minimum number of steelhead is based on a sex ratio of 1.47 and only the number of redds observed
4-Maximum steelhead is based on sex ratio of 1.68 and expanded number of redds were applicable
5-Estimated as the number passing Zosel dam less fish accounted for in Nine-mile and Tonasket Creeks

Our surveys indicate that main-stem spawning is common for summer steelhead although it is hypothesized that fish spawning in the tributaries habitats are more likely to find suitable rearing habitat. However, more information on life history adaptations and survival are needed to quantify recruitment and test theses hypotheses. Additional research into spawning and production in the Canadian portion of the drainage is needed to fully evaluate the Okanogan River Basin. Continued redd surveys on an annual basis will allow for evaluation of trends and changes in the distribution of important spawning areas over time.

These data clearly show that redd surveys throughout the Okanogan River Basin are possible in both tributary and main-stem habitats and the distribution of spawning can be effectively quantified plus changes detected using these methodologies. Baseline information for spawning habitat distribution, spawn timing, and spawner escapement have been determined but additional years of data are necessary to refine this information and allow for trend analysis.

Literature Cited

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.

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.

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.

Smith A. K. 1973. Development and application of spawning velocity and depth criteria for Oregan 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