2011 Summer Steelhead Annual Report

Prepared by:

Rhonda Dasher
Kirk Truscott

Colville Tribes
Department of Fish & Wildlife
Anadromous Fish Division - Omak Office
23 Brooks Tracts Rd.
Omak, WA 98841
Phone: 509/422-7424
Fax: 509/422-7428

Prepared for:

Grant County Public Utility District

30 C St. S.W.
PO Box 878
Ephrata, WA 98823

Performance Period: January 1, 2011 to December 31, 2011

Table of Contents

List of Tables

List of Figures

Introduction

Upper Columbia summer steelhead populations have had a long history of decline resulting in protection under the Endangered Species Act (ESA) since 1997. Several reasons for this decline include overharvest, habitat degradation/alteration, hydro-system mortality and past hatchery practices.

The Okanogan steelhead population continues to be at high risk of extinction for abundance, productivity, spatial distribution and diversity. National Oceanic and Atmospheric Administration (NOAA) Fisheries 2008 Supplemental Comprehensive Analysis (SCA) identified the Okanogan River steelhead population at high risk for extinction. Natural origin returns (NOR) is currently 104 steelhead, compared to the recovery abundance target of 1,000). The SCA discuss the Okanogan population to be high risk relative to productivity (NOAA 2008). This was determined from a recruit/spawner value of 0.06 for brood years 1980-1999. Even more, the SCA identifies genetic diversity and spatial distribution as high risk, due to large hatchery influence of non-local stock (Wells stock) and spawner escapement limited to only two major tributaries (NOAA 2008).

In 2002, the Colville Tribe, with support from NOAA Fisheries and funding from the Pacific Coast Salmon Recovery Fund, initiated a locally-adapted pilot broodstock program in Omak Creek, a tributary to the Okanogan River Basin. Objectives were to determine if non-local hatchery steelhead released into the Okanogan River Basin would have an impact on the local population.

Beginning in 2007, Grant County Public Utility District (GPUD), through the Priest Rapids Project Settlement Agreement process began providing, in entirety, the operation and maintenance funding for implementation of a locally-adapted steelhead production program at Cassimer Bar Fish Hatchery (CBFH). Past production targets at CBFH were 20,000 yearling steelhead smolts for release in the Okanogan River Basin. The program was permitted under ESA through Section 10(a)(1)(A)(Permit 1412). In 2010, the Cassimer Bar Fish Hatchery was closed due to program failures and it was decided that the Grant PUD Hatchery Program component for the Okanogan Basin will be moved to Wells Fish Hatchery.

In conjunction with the Wells WDFW Steelhead HGMP Wells Project No. 2149 Grant PUD Hatchery Program components list Up to 100,000 (+-10%) smolts will be produced at Wells Hatchery for Grant PUD. Although discussions have occurred for many years related to a future BPA funded hatchery for the Okanogan River. If approved by the NOAAthen new permits and HGMP for the Okanogan Locally-Adapted Summer Steelhead program will need be developed.

Components of the current Scope of Work funded by GPUD include: 1) annual broodstock collection of up to 16 adults from Omak Creek; 2) transfer of broodstock from Omak Creek to Wells Fish Hatchery; 3) conduct spawning and egg incubation at Wells Fish Hatchery; 4) rear summer steelhead to approximately 18-20 fish per lb by release date; 5) annually tag up to 20,000 juvenile steelhead; 6) release of approximately 20,000 yearling steelhead smolts in the Okanogan River Basin; 7) maintain Wells Fish Hatchery and provide fish health treatments as prescribed by state fish pathologist; 8) evaluate survival of out-migrating steelhead smolts released from Omak Creek; 9) conduct snorkel surveys and estimate juvenile abundance in Omak Creek and up to three additional tributaries and 10) provide monthly and annual reports of the program.

Data and information included in this annual report for the period of January 1, 2011 - December 31, 2011 includes: 1) Brood year (BY) 2011 adult broodstock collection and adult enumeration for Omak Creek and Bonaparte Creek; 2) BY 2011 spawning and rearing; 3) BY 2010 rearing and release; 4) smolt -to- adult return (SAR) for completed brood years; 5) juvenile emigration monitoring; and 5) juvenile abundance estimates in Omak Creek and three additional tributaries to the Okanogan River.

Acknowledgements

We would like to acknowledge Grant County PUD, funding agency for the Summer Steelhead program. In addition, we would like to thank the Okanogan Basin Monitoring and Evaluation Program for contributing information regarding adult spawner abundance estimates and protocols for data collection. Data collection was completed by Ernest Timentwa and Oliver Pakootas. Spawning and rearing data was provided by Wells Hatchery.

Methods

Broodstock Collection

Traps were installed in Omak and Bonaparte creeks. Both traps have cod trigger fingers to reduce fish escapement. An aluminum cover prevents escapement and reduces fish stress. No changes were made to the traps or locations from 2010.

Traps are checked daily to remove debris and captured fish. Large numbers of fish require the trap to be checked multiple times a day to ensure fish health and safety. Fish are netted into a tank with MS-222 and sedated. Adult fish are measured (fork length, FL), sexed, scale sampled, DNA sampled, sampled for a Passive Integrated Transponder (PIT) and Coded-Wire Tags (CWT), Visual Implant Elastomer (VIE) tags, fin clips and any injuries or abnormalities.

Fish not destined for Wells broodstock are placed in a recovery tank and once recovered, returned to the creek above the weir. Fish taken for broodstock are transferred to a tank truck filled with tempered water. The transport tank is supplied with compressed oxygen and is supported with recirculation aerators to provide additional oxygen. Fish transported to Wells Hatchery are checked by the hatchery manager to determine ripeness.

After no fish have been observed in the trap for two weeks, the traps are removed and stored in a secure location for maintenance and repair prior to the next season.

Juvenile Emigration Monitoring

A five-foot rotary screw trap (RST) was installed at the mouth of Omak creek to collect juvenile fish. Omak Creek RST protocols follow developed procedures by Integrated Status and Effectiveness Monitoring Program (ISEMP). The trap is equipped with a live-box and a self-cleaning screen that helps remove medium to small debris from the live-box.

To minimize stress on fish and comply with limits and restrictions listed in the permit issued under the Kelt Reproductive Success Project (06-09-CRITFC49), when flows are too low (under 25 CFS) or too high (over 70 CFS), the cone is pulled until flows stabilize within the acceptable range. During peak migration the trap is checked multiple times a day to ensure fish health and properly operates.

All juvenile steelhead are measured to the nearest millimeter (mm), scales taken, DNA collected, and scanned for a PIT and code-wire tag. Fish are returned to a recovery tank supplied with compressed oxygen until recovered and then released downstream of the trap.

Spawning

In 2011, a shift from the Cassimer Bar Fish Hatchery (CBFH) to Wells Hatchery Complex (WHC) was needed due to poor survival rates from CBFH, anticipated CBFH facility upgrade costs, and to secure long-term access to hatchery facilities for summer steelhead during WHC modernization Fish collected for broodstock are held in a raceway at Wells Hatchery Complex until spawned. One female is fertilized with a primary and backup male if available. Post spawn, eggs and milt are combined at an incubation facility.

Females are lethally spawned and ovarian samples taken for virology tests. Males are live-spawned and are used multiple times for fertilization. After males have been used they are sacrificed for virology tests. All samples are sent to the Washington State Department of Fish and Wildlife Virology Lab in Olympia.

Rearing and Release

Eggs are fertilized and segregated into Heath trays for incubation. Heath stacks consist of eight trays per stack with a top tray not utilized for incubation. A steady flow of well water is passed through a degassing tower and filter into each stack. To provide artificial conditions vexar is used as a substitute for substrate in each tray.

Upon egg delivery each female is designated to one tray and water hardened in a solution of 100 ppm Iodophore for disinfection. Dead eggs are picked by hand and egg loss is enumerated. Fertile eggs are weighed and enumerated by weight for each tray. Once eggs reach the eyed-stage of development they are monitored daily and picked to remove unfertilized eggs. The number of eyed eggs and hatched eggs are documented.

Hatched alevins are transferred to a trough and are taught to feed with starter feed. Fry are sampled on a weekly basis to monitor growth and adjust feed frequency. Mortalities are collected daily and recorded. By June fish have reached parr stage and are transferred to outside ponds.

Pond released fish are PIT and or coded wire tagged. Fish destined for Omak Creek are inserted with both CWT and PIT tags. Additional fish for the Similkameen and Okanogan River are coded wire tagged and ad-clipped, so fish can be identified and used as harvest fish in the Okanogan.

Fish will achieve smolt size by March of the following year and at this time half the fish are taken to the St. Maries Acclimation Pond on Omak Creek and the remainder stay at the hatchery for release into the Okanogan and Similkameen. Acclimation fish at St. Maries are fed twice a week to maintain size. Random samples of 200 fish are taken weekly to determine growth rates and ensure fish meet size goals prior to release. Mortalities are picked daily.

To release fish screens are pulled at the outflow of the pond so fish can leave volitionally. Remaining fish on station are crowded, netted, weighed, scanned for PIT tags and loaded into transport trucks and direct released into Omak Creek just downstream of the acclimation pond.

Fish Abundance Surveys

The Okanogan Basin Monitoring and Evaluation Program (OBMEP) conduct snorkel surveys in the mainstem Okanogan and its tributaries to determine fish abundance. Habitat panel sites were determined, adapted from Hillman 2006, to determine fish population size and community structure at various sites in the Okanogan Basin. A random rotating panel design is used consistent with the Environmental Monitoring and Assessment Program (EMAP) adopted from the upper Columbia monitoring and evaluation program (Hillman 2004).

Juvenile Interrogation

Travel times from Omak Creek to Columbia River dams can be determined by an online database http://www.ptoccentral.org/dbaccess/InStrmDtctn/InStrmDtctn_query.html. Detections are filtered and separated by detection site to determine life history patterns. PIT tags can be used to determine juvenile survival and smolt to adult returns.

Results

Adult Collection

A weir located on Omak Creek approximately 1.61 km upstream from the confluence of the Okanogan River (rkm 51.5) and a temporary weir located on Bonaparte Creek approximately 0.03 km upstream from the confluence of the Okanogan River (rkm 91.25) was used to collect adult broodstock. Omak Creek and Bonaparte Creek weirs were installed on March 15, and 21, 2011, respectively. Operation of Bonaparte weir continued through May 30th and then removed, due to high water. Omak Creek weir was used for both summer steelhead broodstock and spring Chinook broodstock collection, and therefore, not removed until August 30, 2011.

A total of 58 adult steelheads were counted at the Omak Creek weir in 2011. Natural origin steelhead accounted for 48 of these fish. A similar proportion of males to females were found for both the natural and hatchery proportion of the Omak Creek stock in 2011 (Table 1). This data, extrapolated over the entire run, resulted in an estimated 85.7% of natural and 14.3% hatchery origin steelhead for Omak Creek (Table 1).

A total of five adult steelheads were trapped at Bonaparte Creek in 2011. This included four of natural origin and one hatchery origin steelhead (Table 2). This data, extrapolated over the entire run, resulted in an estimated 80.0% of natural and 20.0% hatchery origin steelhead for Bonaparte Creek (Table 2).

Broodstock Collection

In 2011 a total of fourteen steelheads were collected for broodstock from the Omak Creek and Bonaparte Creek weirs (Table 3). Broodstock collected in Omak and Bonaparte creeks included fourteen natural origin and zero hatchery origin steelhead for a natural origin composition of 100 percent (Table 3).

Broodstock Sex Ratio

Male to female sex ratio for brood year 2011 broodstock was similar to BYs 2004, 2005, and 2009, and represents a departure from the sex ratio observed in BY 2006, 2007 and 2008 (Table 3).

BY 2011 Run Timing for Omak and Bonaparte Creeks

2011 adult enumeration started off slow due to lingering cold weather and ice. Snowpack and precipitation levels were above average (see Table 3A, Figure 1, and Figure 2, OBMEP 2011 Spawning and Distribution Report). Water levels compromised adult weir panels during 2011which affected collection from May 6-June 1. Estimates of fish above the weir were computed using PIT tag data from the in-stream array.

BY 2011 Broodstock Survival

Broodstock survival collected in 2011 was 100 percent. This is consistent with broodstock survivals rates for 2003-2004 and 2006-2009 (Table 4).

BY 2011 Spawn and Early Rearing

A total of 55,678 green eggs were taken for the 2011 BY, resulting in 50,256 eye-eggs and 50,256 fry (Table 5). Green egg –to – eyed egg survival, eyed egg- to- fry survivals and fry-to-release was 90.3%, 90.3%, and 82.14%

respectively (Table 5). Juveniles were coded-wire tagged (100%) and PIT tagged (17,500 fish) at Wells Hatchery (Table 5).

BY 2010 Juvenile Rearing and Hatchery Survival

Rearing and Release

An estimated 12,290 fish were moved from the CBFH to St. Maries Acclimation pond for acclimation on 28 March, 2011. At release an average fork length size of 201.2 mm was measured (Table 7). No health issues were reported at either the hatchery or acclimation pond between January and final release in April.

An estimated 32,346 BY 2010 juvenile steelhead were released in to Omak Creek during the month of April 2010 (Table 7). Fish acclimated at St. Maries Acclimation Pond volitionally emigrated from the pond between April 16 and April 27, 2011. Juvenile steelheads reared at CBFH were direct released into Omak Creek immediately downstream from the St. Maries Acclimation Pond between 23 April, and 29 April, 2011.

Survival to Release

A combined survival for the acclimated and direct plant groups is reported (Table 8). Monthly survival and cumulative survival were high, remaining above 99 percent (Table 6).

Juvenile Emigration

A 5-foot rotary screw trap was installed in Omak Creek on 8 April, 2011 and removed on 30 June, 2011. Trap operation was sporadic throughout the trap period due to high flows.

In 2011, a total of 9,578 juvenile O. mykiss were trapped at the Omak Creek rotary screw trap. This included 1,686 of these natural origin fish (Table 10). Non-target species included bridge lip sucker (BLS) mountain whitefish (MWF) and eastern brook trout (EBT) (Table 10).

Due to the sporadic trap operation in 2011 trap efficiency trials were limited and subsequent expansions, to provide total estimated natural origin O. mykiss with a high confidence was not possible.

Multiple peak flows above 70 cfs caused the trap to be pulled in order to minimize fish mortality and trap damage. The trap operated for a total of 50 days out of the 84 days it was deployed. A production model by origin for O. mykiss has been determined (Figure 3).

2009 BY 2010 Release Detection and Travel Summary

In 2010 an estimated 32,346 locally adapted summer steelhead smolts were released into Omak Creek, at and below the St. Maries acclimation pond. An interrogation site near the mouth of Omak Creek detected fish leaving the creek. Detections indicate that more than 25 percent of the tags released in Omak Creek made it to Rocky Reach dam (Table 13). Mean travel times indicate that juvenile O. mykiss from Omak Creek travel to the ocean in 31 days (Table 12). Mean travel times were computed using DART Analysis Tools Query and returns information for juvenile releases and adult returns.

Juvenile Snorkel Abundance Estimates

In mid-August – early November, 2011, the Colville Tribe's Fish and Wildlife staff conducted snorkel surveys in 28 out of 34 water bodies in the US portion of the Okanogan River Basin. At six of the sites environmental conditions did not allow a survey to be completed. Due to extended run-off surveys were conducted later than past years.

Seventeen species of fish were observed among all sites in the US and BC. Three spine sticklebacks were the most abundant (N= 35,179) (Miller et al. 2011). O. mykiss were the second most abundant species observed

(N=1,523) and only 1.1 percent were greater than 300 mm (Miller et al. 2011). The highest densities of juvenile O. mykiss were in Omak Creek (6,255 fish/ha.) followed by Bonaparte Creek in the US (3,647 fish/ha.) (Table 11). Salmon Creek averaged 830 fish/ha (Miller et al. 2011).

Returning Adults in 2011

Locally adapted 2009 returning adults started over Bonneville around mid-July and continued in October. Final counts over Bonneville dam were 117 and 101 detected over McNary, Priest Rapids and Wells (Table 13). Mean travel time for adults to Rocky Rach (RRJ) was 23.5 days (Table 13).

Mean Travel Times for BY 2010 releases in Omak Creek For 2011

Mean travel time estimates for hatchery juvenile fish released from the acclimation pond at St. Maries and direct planted below the acclimation pond were obtained from the DART (Data Access Real Time) website using their analysis tools, developed by the Fisheries group at the University of Washington. Data from detections at dams are used to develop survival and detection probabilities (Table 15). Due to change in detection efficiencies between dams output data is subject to variability.

Survival Estimates and Detection Probabilities for BY 2010

Survival estimates for Omak Creek indicate a poor migration rate for 2010 (Table 14). These estimates were determined from a standard Cormack-Jolly-Seber model. Survival probabilities can be determined at each dam (Table 14). If no detections or low detections occur there may not be enough data to get an accurate survival or detection probability.

Analysis tools are new to DART and will be improved as more data is gathered. Currently, this gives a quick look at the juvenile and adult detections as well as detailed survival and detection probabilities for each tributary.

Smolt to Adult Return

Locally adapted smolts are stocked in Omak Creek. Prior to 2007, all fish were stocked above Mission Falls in Omak Creek near Stapaloop Creek. Smolt to adult returns indicates a poor juvenile survival for those years fish were stocked above Mission Falls. Adult returns for 2011 were estimated to be 0.73 percent to Wells Dam (Table 16). Two years of strong adult return rates are a positive sign that stocking below Mission Falls will have a higher juvenile survival and adult return rate.

References

Arterburn, John. 2007. Okanogan Basin Monitoring and Evaluation Program Field Manual; Redd Survey Methodology. Colville Confederated Tribes.

Colville Confederated Tribes. 2010. Hatchery and Genetic Monitoring Plan.

Dasher, Rhonda. Colville Confederated Tribes. 2007, revised 2011. Sampling Protocol for Adult and Juvenile Steelhead on Omak Creek.

Hatchery Scientific Review Group. 2009. Report to Congress on Columbia River. Basin Hatchery Reform.

Miller, Brian, Panther, J., Arterburn, J.. 2001. Confederated Tribes of the Colville Reservation, 2011 Okanogan BasinSteelhead Escapement and Spawning Distribution.

Narum, Shawn, R., Boe, S., Morgan, P., Powell. 2006. M. Small-Scale Genetic Structure and Variation in Steelhead of the Grande Ronde, Oregon, USA, Transactions of the American Fisheries Society 135:979-986.

National Oceanic and Atmospheric Administration. 2006. 50CFR Parts 223 and 224, Federal Register Volume 71, No. 3.

Pearsons, Todd. 2009. Monitoring and Evaluation Plan for Grant PUD's Salmon and Steelhead Supplementation Programs.

Priest Rapids Salmon and Steelhead Settlement Agreement. FERC Project 2114, 12/13/2005

Quantitative Consultants. 2010. Subbasin Integrated Status and Effectiveness Monitoring Project (ISEMP); Remote PIT Tagging Protocol.

Rayton, Michael. 2006. Okanogan Basin Monitoring and Evaluation Program; Rotary Screw trap Protocols. Colville Confederated Tribes.

Suzuki, D.T., Griffiths, A.J.F., Miller, J.H. and Lewontin, R.C.. 1989. An Introduction to Genetic Analysis 4th ed. W.H. Freeman Pp.704.

Appendix A

Table 1: Omak Creek adult steelhead enumeration by origin and year (2004-2011).

Watershed		Hatchery				Natural			
Okanogan River	Year	Male	Fem.	Total	%Hat.	Male	Fem.	Total	%Wild
	2004	63	33	96	90.6	8	2	10	9.4
	2005	83	62	145	98.0	0	3	3	2.0
	2006	21	76	97	92.4	2	6	8	7.6
	2007	39	15	54	69.2	15	9	24	30.8
	2008	39	15	54	69.2	15	9	24	30.8
	2009	22	9	31	66.0	12	4	16	34.0
	2010	25	16	41	19.9	111	54	165	80.1
	2011	5	3	8	14.3	20	28	48	85.7

Table 2: Bonaparte Creek adult steelhead enumeration by origin and year (2006-2011).

Watershed		Hatchery				Natural			
Okanogan River	Year	Male	Fem.	Total	%Hat.	Male	Fem.	Total	%Wild
	2006	10	0	10	83.3	2	0	2	16.7
	2007	140	0	140	85.9	23	0	23	14.1
	2008	13	0	13	50.0	13	0	13	50.0
	2009	16	8	24	72.7	6	3	9	27.3
	2010	45	0	45	58.4	32	0	32	41.6
	2011	1	0	1	20.0	2	2	4	80.0

Table 3: Steelhead broodstock collection summary for Omak creek and Bonaparte creek between the years of 2003 and 2011.

Watershed		Hat.	Wild	Total	%Hat.	%Wild	M:F Ratio
Okanogan River	Year	M:F	M:F	All	M:F	M:F	All
Omak Creek							
	2003	NA	NA	4	33.3	75.0	NA
	2004	4:7	4:1	16	68.8	31.3	1:1
	2005	NA	NA	19	85.2	15.8	1.11:1.0
	2006	NA	NA	11	72.7	27.3	0.27:1.0
	2007	0:7	4:1	12	58.3	41.7	0.50:1.0
	2008	1:0	3:4	8	8.3*	91.7*	2.0:1.0*
	2009	1:1	3:3	8	31.3*	68.8*	1.0:1.0*
	2010	1:1	7:7	16	17.6*	82.4*	1.0:1.0*
	2011	0:0	4:7	11	0.0*	100.0*	0.8:1.0*
Bonaparte Creek							
	2008	0:0	2:2	4			
	2009	1:2	3:2	8			
	2010	1:0	0:0	1			
	2011	0:0	2:1	5			

***** Bonaparte Creek brood stock was added to the locally adapted steelhead collection.

Table 3A: Okanogan basin precipitation levels for 2006-2011.

Watershed Year	March	April	May	Total
2006	0.81	0.89	1.35	3.05
2007	0.08	0.06	0.74	0.88
2008	0.73	0.19	0.18	1.10
2009	0.93	0.19	1.23	2.35
2010	0.52	1.21	3.05	4.78
2011	2.72	0.23	2.96	5.91
Ave. (1981-2010)	0.89	0.91	1.18	2.98

Table 4: Summer Steelhead broodstock collection and survival between the years of 2003 and 2011.

Watershed	Year	Collected	Spawned	% Survival
Okanogan River				
	2003	4	4	100.0
	2004	16	16	100.0
	2005	19	15	78.9
	2006	11	11	100.0
	2007	12	12	100.0
	2008	12	12	100.0
	2009	16	16	100.0
	2010	17	17	100.0
	2011	14	14	100.0

Table 5: Okanogan Basin Locally-adapted steelhead hatchery egg-take, fecundity and life stage survival between the years of 2004-2011.

Watershed Okanogan River	Year	Number Females	Total Green Eggs	Eggs/ Female	Total Eyed	Grn/Eyed Survival Percent	Total Fry	Eyed-Egg/Fry Survival	Total Released (smolt)	Fry/release Survival Percent	Grn/release Survival Percent
	2004	8	31,414	3927	24,260	77.2	21,500	88.6	13,232	61.5	42.1
	2005	9	32,038	3,560	25,206	78.7	21,452	85.1	19,862	92.6	62.0
	2006	8	36,345	4,543	33,221	91.4	30,895	93.0	27,219	88.1	74.9
	2007	8	43,327	5,416	42,439	98.0	41,447	97.7	32,915	79.4	76.0
	2008	4	19,868	4,967	17,938	90.3	16,771	93.5	15,505	92.5	78.0
	2009	8	33,112	4,139	31,815	96.1	30,505	95.9	23,618	78.0	71.9
	2010	8	39,539	4,942	36,174	91.5	33,748	93.3	32,333	95.8	81.8
	2011	8	55,678	6,960	50,256	90.3	50,256	90.3	41,285	82.14	74.1

Table 6: Monthly cumulative survival for BY 2010 UCR summer steelhead reared at Wells Hatchery, May-January 2011.

Watershed Okanogan River	Month	Total # of fish	Morts	Monthly Survival	Total % Survival
	May	50,256	NA	100.0	100.0
	June	50,256	4139	100.0	100.0
	July	46,117	2014	91.8	91.8
	August	44,103	554	95.6	87.8
	September	43,549	161	98.7	86.7
	October	43,388	89	99.6	86.6
	November	43,284	89	99.8	86.1
	December	43,226	58	99.9	86.0

Table 7: Hatchery summer steelhead stocking program from locally adapted broodstock in Omak Creek 2004 – 2011.

Watershed Okanogan River	Brood Year	Location	# Fish	Mean FL	# of PITs
	2004	Stapaloop Cr.	13,232	NA	13,232
	2005	Stapaloop Cr.	19,862	NA	19,867
	2006	St. Marys Accl.	9,898	153.8	19,772
	2006	Omak Cr.	9,874	153.8	0
	2006	Salmon Cr.	7,447	153.8	0
	2007	Ninemile Cr.	5,152	179.9	0
	2007	Antoine Cr.	2,856	179.9	0
	2007	Tunk Cr.	4,993	179.9	0
	2007	Omak Cr/Haley/Lobe	19,914	179.9	6,735
	2008	St. Marys Accl.	15,505	189.8	13,665
	2009	St. Marys Accl.	23,801	193.9	14,482
	2010	St. Marys Accl.	32,346	201.2	19,898
	2011	St. Marys Accl.	41,285	213.1	16,887

Table 8: Monthly cumulative survival for BY 2011 UCR summer steelhead reared at Cassimer Bar FH, May-January 2011.

Watershed Okanogan River	Month	Total # of fish	Morts	Monthly Survival	Total % Survival
	January	32,538	88	99.7	99.7
	February	32,482	56	99.8	99.6
	March	32,440	42	99.7	99.5
	April	32,346	94	99.7	99.2

Note: April mortality includes both Cassimer Bar Fish Hatchery and St. Mary's Acclimation pond.

Table 9: Average length (mm), weight (g) and CV for length of BY 20010 summer steelhead reared at Cassimer Bar FH and St. Maries Acclimation Pond, January-April 2011.

Watershed		Start Month			End Month		
Okanogan River	Month	Avg. Wt. (g)	Avg. FL (mm)	CV Length	Avg. Wt. (g)	Avg. FL (mm)	CV Length
	January	NA	NA	NA	137.1	28.1	17.0
	February	137.1	28.1	17.0	162.9	45.1	15.1
	March	162.9	45.1	15.1	170.2	53.8	11.0
	April[1]	170.2	53.8	11.0	180.0	65.0	18.5
	April[2]	170.2	53.8	11.0	179.0	68.0	22.9

[1] Cassimer Bar Fish Hatchery
[2] St. Mary's Acclimation Pond

Table 10: Summary of fish collected at the Rotary Screw Trap in Omak Creek between the years of 2006 and 2010. STHH = O. mykiss Hatchery, STHW = O. mykiss Wild, CHN = Chinook, WF = Mountian Whitefish, BLS = Bridgelip sucker, NPM = owNorthern Pike Minnow.

Watershed

Okanogan River

Year	STHH	STHW	Total	CHN	WF	BLS	EBT	NPM	Other	Total	Start	End	# Days
2006	457	85	542	3,103	0	0	0	0	0	3,103	5/1/06	6/2/06	32
2007	2,393	2,213	4,606	15	2	107	19	1	7	151	4/4/07	5/22/07	48
2008	178	5,012	5,190	2,031	15	387	13	5	64	2,515	4/14/08	5/24/08	40
2009	2,385	1,056	3,441	6	0	76	7	2	3	94	4/21/09	5/18/09	27
2010	2,955	297	3,252	8	0	30	9	0	11	58	4/15/10	6/30/10	76
2011	7,892	1,686	9,578	13	29	185	7	0	32	266	4/7/2011	6/30/2011	84

Table 11: Numbers of observed juvenile O. mykiss and observed density (fish/ha.) during snorkel surveys in the Okanogan Basin August- October 2010 (Miller et al. 2011).

Watershed Okanogan River	Site	Total	Density (Fish/ha.)
	Antoine Creek	49	1,942
	Bonaparte Creek	94	3,647
	Loup Loup Creek	48	1,267
	Ninemile Creek	NS	NA
	Okanogan River	30[1]	0.4[2]
	Omak Creek	349[1]	1,982[2]
	Salmon Creek	878[1]	8,30[2]
	Similkameen River	33[1]	10.2[2]

[1] Sum of juvenile) O. mykiss from multiple sites per creek.
[2]Average density of juvenile O. mykiss from multiple sites per creek.

Table 12. 2009 BY Mainstem detections and travel times for juvenile emigrants.

Mean Travel Time Estimates

Arithmetic mean travel time (in days):

	LMR	OMK	WEL	ENL	RRH	RIA	MCN	JDA	BON	TWX
REL	-0.62	519.71	5.79	1.12	16.26	19.00	28.91	37.62	28.78	31.57
LMR	-	****	****	****	****	****	****	****	26.06	****
OMK	-	-	****	****	7.73	****	****	****	****	****
WEL	-	-	-	****	29.89	****	****	****	****	****
ENL	-	-	-	-	****	****	****	****	****	****
RRH	-	-	-	-	-	1.29	10.67	14.28	14.29	16.25
RIA	-	-	-	-	-	-	****	****	14.29	****
MCN	-	-	-	-	-	-	-	3.06	4.46	6.36
JDA	-	-	-	-	-	-	-	-	1.62	3.22
BON	-	-	-	-	-	-	-	-	-	1.73
TWX	-	-	-	-	-	-	-	-	-	-

Standard Errors by reach:

	LMR	OMK	WEL	ENL	RRH	RIA	MCN	JDA	BON	TWX
REL	1.71	38.42	6.60	NA	0.17	3.73	1.00	2.94	0.26	0.78
LMR	-	****	****	****	****	****	****	****	NA	****
OMK	-	-	****	****	NA	****	****	****	****	****
WEL	-	-	-	****	NA	****	****	****	****	****

ENL	-	-	-	-	****	****	****	****	****	****
RRH	-	-	-	-	-	0.75	0.45	0.81	0.21	0.61
RIA	-	-	-	-	-	-	****	****	1.25	****
MCN	-	-	-	-	-	-	-	0.35	0.15	0.13
JDA	-	-	-	-	-	-	-	-	0.09	0.24
BON	-	-	-	-	-	-	-	-	-	0.03
TWX	-	-	-	-	-	-	-	-	-	-

Counts by reach:

	LMR	OMK	WEL	ENL	RRH	RIA	MCN	JDA	BON	TWX
REL	4	23	3	1	5059	6	413	256	1144	120
LMR	-	0	0	0	0	0	0	0	1	0
OMK	-	-	0	0	1	0	0	0	0	0
WEL	-	-	-	0	1	0	0	0	0	0
ENL	-	-	-	-	0	0	0	0	0	0
RRH	-	-	-	-	-	2	214	118	631	71
RIA	-	-	-	-	-	-	0	0	2	0
MCN	-	-	-	-	-	-	-	34	71	9
JDA	-	-	-	-	-	-	-	-	37	6
BON	-	-	-	-	-	-	-	-	-	40
TWX	-	-	-	-	-	-	-	-	-	-

Table 13. BY 2009 adult returns in 2011, Mean Travel Times and number of Detections

Mean Travel Time Estimates

Arithmetic mean travel time (in days):

	BON	MCN	PRD	RIA	RRH	WEL
REL	474.53	483.61	491.32	495.25	498.30	500.86
BON	-	9.06	16.78	21.68	23.56	26.32
MCN	-	-	7.62	12.36	14.39	17.16
PRD	-	-	-	4.31	6.44	9.23
RIA	-	-	-	-	2.09	4.87
RRH	-	-	-	-	-	2.75
WEL	-	-	-	-	-	-

Standard Errors by reach:

	BON	MCN	PRD	RIA	RRH	WEL
REL	1.49	1.67	1.54	1.44	1.54	1.51
BON	-	0.58	0.69	0.83	0.86	0.90
MCN	-	-	0.37	0.55	0.61	0.66
PRD	-	-	-	0.20	0.27	0.33
RIA	-	-	-	-	0.18	0.24
RRH	-	-	-	-	-	0.14
WEL	-	-	-	-	-	-

Counts by reach:

	BON	MCN	PRD	RIA	RRH	WEL
REL	117	101	101	93	100	101
BON	-	100	100	93	99	100
MCN	-	-	101	93	100	101
PRD	-	-	-	93	100	101
RIA	-	-	-	-	93	93
RRH	-	-	-	-	-	100
WEL	-	-	-	-	-	-

Table 14. BY 2010/2011 Release Survival estimates and detection probabilities by reach

Survival estimates and detection probabilities are determined using SURPH2 (Survival Under Proportional Hazards).

Cormack/Jolly-Seber Estimates
(Cormack 1964, Jolly 1965, Seber 1965)

Data: 20130121_3_2_H_2011___OMAKC__RED_2011_1358827680_1.data
SURPH data file: http://www.cbr.washington.edu/dart/dat/results/1358828128_surph.txt

Survival Probabilities

Period						
Population	1	2	3	4	5	Overall
1	0.9104 (0.0025)	0.8001 (0.0131)	0.6714 (0.0319)	1.4505 (0.1283)	0.3478 (0.0676)	0.2467 (0.0441)

Capture probabilities

| Occasion
Population	2 3 4 5 6
1	0.9618 (0.0021) 0.4438 (0.0082) 0.1059 (0.0056) 0.1592 (0.0126) 0.1407 (0.0256)

Product of final period survival/capture

Population |
---|---
1 | 0.0378 (0.0073)

Legend:

Main Fields:
OMK - Omak Creek Crump Weir
RRH - Rocky Reach Dam
MCN - McNary Dam
JDA - John Day Dam
BON - Bonneville Dam Complex

Final Field:
TWX - Estuary Towed Array Experiment

Periods:
1: Release-OMK
2: OMK-RRH
3: RRH-MCN
4: MCN-JDA
5: JDA-BON

Occasions:
2: OMK
3: RRH
4: MCN
5: JDA
6: BON

Note:

Survival estimates are generated from capture histories for each fish that are based on data downloaded from the PTAGIS database system. The particular data used for these estimates contain only last detections and therefore do not take into account the full detection history for a fish at a given site and may not account for errors in detection sequence recording. This may lead to minor over censoring of the data that in turn may lead to slightly higher standard errors in parameter estimates when compared to systems that use the full detections history of the fish.

Table 15. Mean travel times for BY2010 juveniles released in 2011 from acclimation pond and direct plant in Omak Creek.

Mean Travel Time Estimates

Harmonic mean travel time (in days):

| OMK RRH MCN JDA BON TWX

REL | 12.78 19.46 25.26 33.80 28.17 30.67
OMK | - 4.07 11.16 14.55 15.28 16.77
RRH | - - 6.76 9.36 10.06 11.45
MCN | - - - 3.14 3.97 5.75
JDA | - - - - 1.15 2.41
BON | - - - - - 1.56
TWX | - - - - - -

Standard Errors by reach:

| OMK RRH MCN JDA BON TWX

REL | 0.05 0.07 0.18 0.12 0.17 0.38
OMK | - 0.02 0.12 0.11 0.14 0.29
RRH | - - 0.10 0.11 0.13 0.26
MCN | - - - 0.11 0.09 0.28
JDA | - - - - 0.03 0.05
BON | - - - - - 0.01
TWX | - - - - - -

Counts by reach:

| OMK RRH MCN JDA BON TWX

REL | 17503 6462 1035 2257 692 186
OMK | - 6242 1003 2132 673 183
RRH | - - 488 967 320 87
MCN | - - - 220 88 29
JDA | - - - - 97 39
BON | - - - - - 26
TWX | - - - - - -

Harmonic mean travel time (in days):

| OMK RRH MCN JDA BON TWX

REL | 12.78 19.46 25.26 33.80 28.17 30.67
OMK | - 4.07 11.16 14.55 15.28 16.77
RRH | - - 6.76 9.36 10.06 11.45
MCN | - - - 3.14 3.97 5.75
JDA | - - - - 1.15 2.41
BON | - - - - - 1.56
TWX | - - - - - -

Standard Errors by reach:

| OMK RRH MCN JDA BON TWX

REL | 0.05 0.07 0.18 0.12 0.17 0.38
OMK | - 0.02 0.12 0.11 0.14 0.29
RRH | - - 0.10 0.11 0.13 0.26
MCN | - - - 0.11 0.09 0.28
JDA | - - - - 0.03 0.05
BON | - - - - - 0.01
TWX | - - - - - -

Counts by reach:

| OMK RRH MCN JDA BON TWX

REL | 17503 6462 1035 2257 692 186

OMK | - 6242 1003 2132 673 183
RRH | - - 488 967 320 87
MCN | - - - 220 88 29
JDA | - - - - 97 39
BON | - - - - - 26
TWX | - - - - - -

Table 16. Smolt to adult returns (SAR) and Hatchery Return Rate of Omak Creek locally-adapted steelhead back to Wells Dam for 2004 - 2012. Passive integrated transponder (PIT) detections were not corrected for tag loss, residuals or stray rate. *2011 based on two years of adult returns.

Rearing Facility	Release Year (RY)	Number of Broodstock (RY-1)	PIT smolts released	Adult Detections at Wells Dam	SAR (%)	#smolts per adult	HRR
Cassimer Bar Hatchery	2004	4	13,232	22	0.17%	3308	5.5
	2005	16	19,862	7	0.04%	1241	0.4
	2006	15	19,772	0	0.00%	1318	0.0
	2007	11	6,753	15	0.22%	614	1.4
	2008	12	13,665	0	0.00%	1139	0.0
	2009	8	14,482	8	0.06%	1810	1.0
	2010	8	19,898	112	0.56%	2487	14.0
Wells Fish Hatchery	2011*	16	16,887	124	0.73%	1055	7.8

Figure 1: Daily mean flow (cfs) in 2011 for Omak, Tunk, Bonaparte and Ninemile Creeks**.**

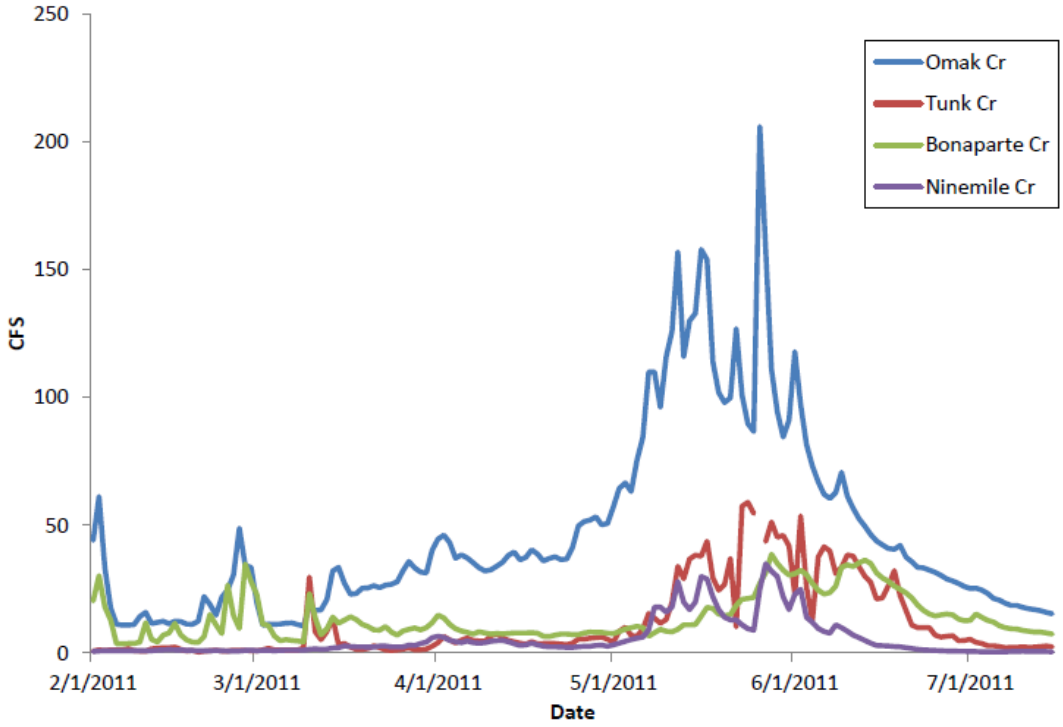

Figure 2. Run timing for Omak Creek 2006-2011 (2011, OBMEP Spawning and Distribution Report) 2011.

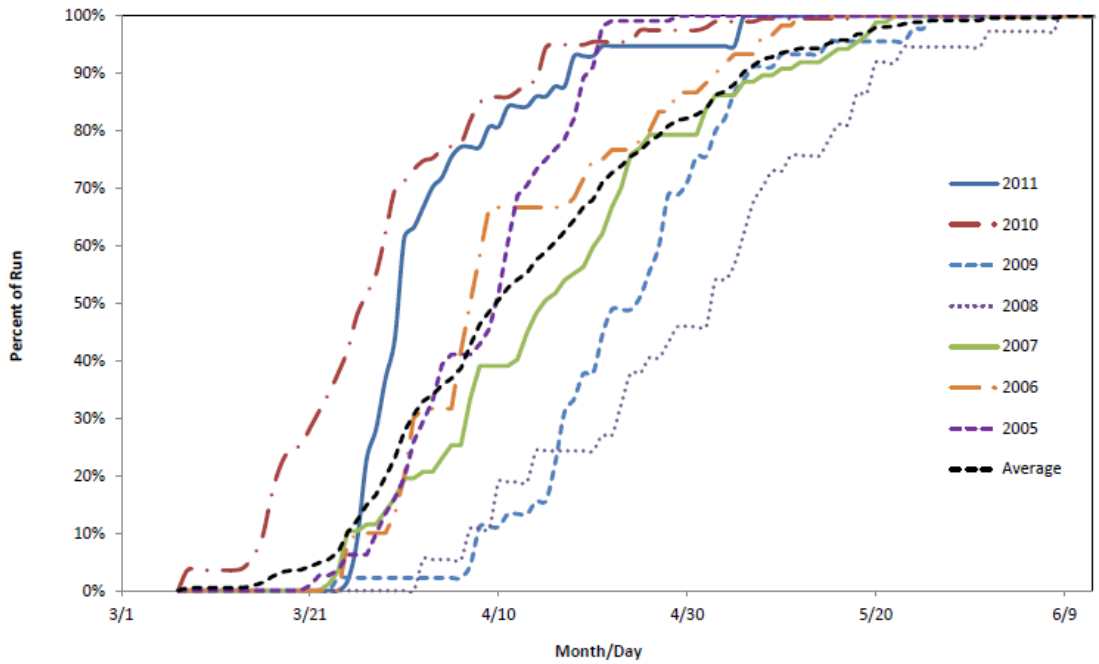

Figure 3: Total numbers of fish captured by origin at the Omak Creek Rotary Screw Trap for 2011.