

**2007 Bull Trout Redd Monitoring
in the Wallowa Mountains**

**Prepared by: Gretchen Sausen
U.S. Fish and Wildlife Service
La Grande Field Office
May 2008**



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ABSTRACT

Bull trout were listed as threatened under the Endangered Species Act in 1998 due to declining populations. The U. S. Fish and Wildlife Service (Service) recommends monitoring populations in subbasins where little is known including the Grande Ronde and Imnaha subbasins. Spawning survey data is important for determining relative abundance and distribution trends in bull trout populations. The Bull Trout Redd Monitoring in the Wallowa Mountains report summarizes the 2007 bull trout spawning data collected in the Wallowa Mountains of NE Oregon and compares this with past years' data. Bull trout spawning surveys have been conducted on similar index areas for selected Grande Ronde and Imnaha River streams from 1999 to 2007. Surveys were conducted by the Oregon Department of Fish and Wildlife (ODFW), U.S. Forest Service (the Forest), Service, Nez Perce Tribe (NPT), National Marine Fisheries Service (NMFS), Anderson Perry, fisheries consultants, and volunteers. Objectives of the survey included; locate bull trout spawning areas, determine redd characteristics, determine bull trout timing of spawning, collect spawning density data, determine and compare the spatial distribution of redds along the Lostine River in 2005 through 2007 and over time use this data to assess local bull trout population trends and the long-term recovery of bull trout. Timing of spawning, total redds, redd sizes, and redd locations are documented in the report. The local bull trout populations were relatively stable for the survey period. The Imnaha population is one of the strongholds within the Imnaha Subbasin. The Lostine River and Bear Creek contain brook trout and hybridization may be occurring.

ACKNOWLEDGMENTS

The Service has, for the past four years, provided staff time necessary for the coordination, implementation, and analysis and report summarization of this project. Prior to Service support of this project, the Wallowa-Whitman National Forest, Wallowa Mountains Office (WMO) had secured previous years' funding and support, and was responsible for the coordination, implementation, and analysis and report summarization.

This project would not have been possible without the dedication, hard work, funding, and assistance provided by all the partners. The WMO provided an invaluable service in 2005 through 2007, providing a horse/mule packer to pack us in and out of the Upper Imnaha to conduct our annual spawning survey in that drainage. We had contracted this service in past years.

I would like to thank the partners in 1999 - 2007 which included; the WMO, ODFW, NPT, the Service, NOAA, and Anderson Perry and Associates (Anderson Perry), consultants, and volunteers. Special thanks to the people who walked the streams (including surveys conducted in 1999-2007), helped with scheduling surveys and surveyors, provided access to private property, assisted in mapping, or summarized the data. These included: Gary Miller, Brad Smith, Alan Miller, Ken Bronec, Peter Cleary, Marisa Meyer, Everett Leach, Jeff Nehls, Maria Shepherd, Cindy Sloan, Rick Christian, Michelle Cregger, Jeff Yanke, Ian Wilson, Jake Kimbro, Jamie McClure, Dave Bright, Suzanne Nostrant, Shivonne Nesbit, John Stephenson, Keith Paul, Max Hoffman, Andrew McClay, Mary Hawkins, Don Hair, Dana McCosky, Dave Kwasniewski, Ari Martinez, Rachel Rounds, Tiffany Tumelson, Greg Silver, Jennifer Lord, Jody Delavan, Lynne Price, Mac Huff, Tim Whitesel, Paul Sankovich, Dana Orrick, Jim Harbeck, Sue Womack, Jennifer Poirier, Tim Plawman, Darren Gallion, Paul Wilson, Al Hemmingsen, Levi Pinkham, Pete McHugh, Shane Vatland, Megan Lucas, Troy Baker, John Brunzell, Phil Howell, Ed Bowles, Susanna Allen, Brad Lovatt, Erin Hanson, Mark Robertson, Debbie Barkow, Dale Hanson, Krischele Hampton, Pat Kinery, Susan Lindstedt, Erin Barry, Dwayne Shotton, Jason Haubelt, Rochelle Rusczyk, Vince Tranquilly, Jon Rombach, Patrick Vichit, and Patrick Bishop.

INTRODUCTION

Bull trout were listed as threatened under the Endangered Species Act in 1998 due to declining populations. The Service recommends monitoring populations in subbasins where little is known including the Grande Ronde and Imnaha subbasins (USFWS 2002). Spawning survey data is important for determining relative abundance and distribution trends in bull trout populations. A minimum of 15 years is needed for determining bull trout population trends (Maxwell 1999). Bull Trout redd counts (spawning surveys) have been conducted annually on the Wallowa Valley, Hells Canyon National Recreation Areas (HCNRA), and Eagle Cap districts of the Forest and along some sections of private property of the Lostine River by the Service, ODFW, the Forest, NPT, contractors, and volunteers for the past seven to eight years.

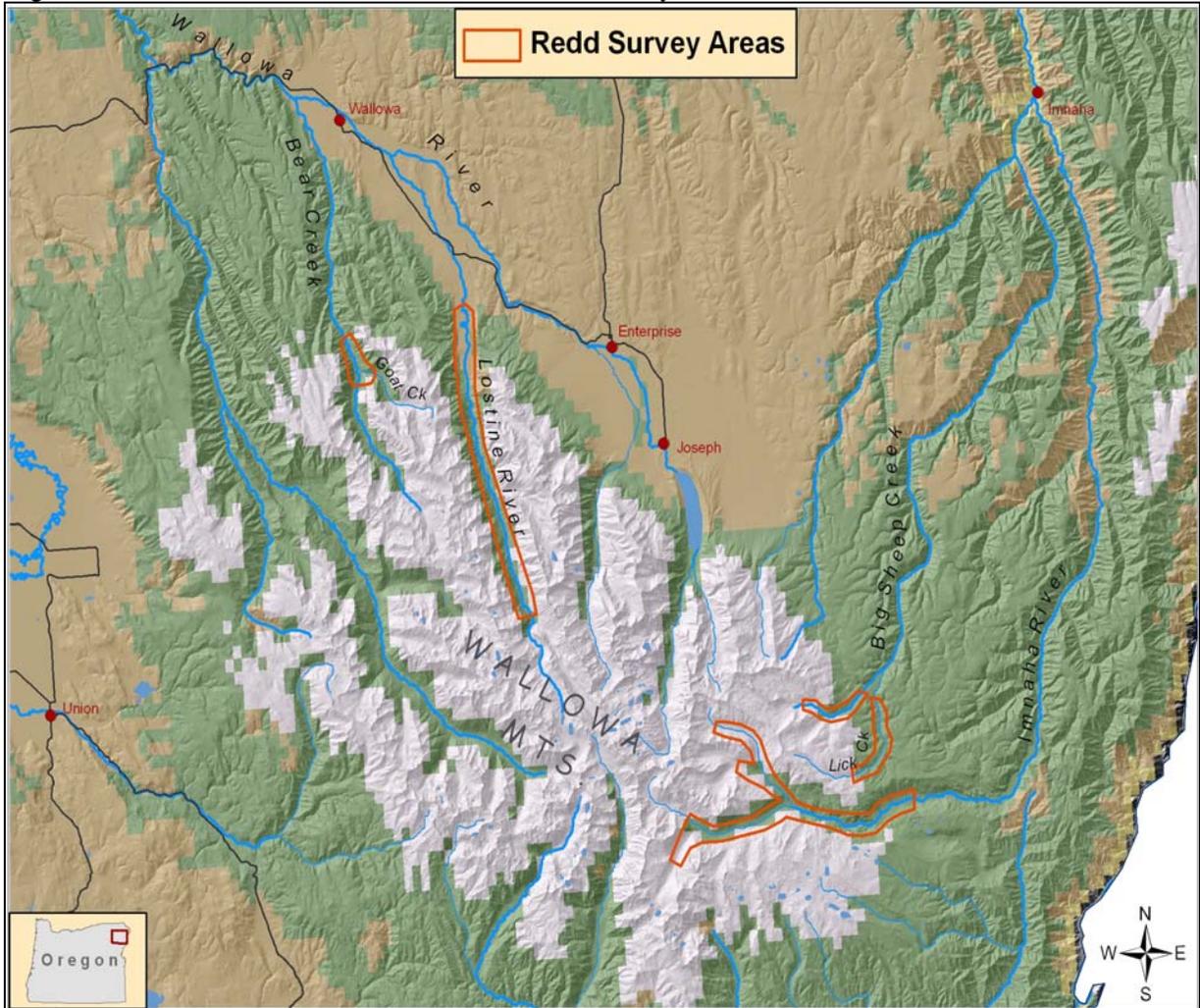
Objectives of the bull trout spawning surveys included:

- Locate bull trout spawning areas.
- Determine redd characteristics.
- Determine bull trout timing of spawning.
- Collect spawning density data.
- Map the location of the bull trout spawning reaches.
- Determine and compare the spatial distribution of redds along the Lostine River in 2005 through 2007. Collect first year UTM spatial redd data on Big Sheep, Lick Creek, and Middle Imnaha.
- Access population trends for local bull trout populations.
- Use this information for the long-term recovery of bull trout.

LOCATION

The Service and several partners conducted bull trout spawning surveys in 2007 on selected streams in the Grande Ronde and Imnaha Sub-Basins. Stream systems surveyed in 2007 for bull trout redds included; the Lostine River, Bear and Goat Creeks, the Imnaha River, Big Sheep Creek and Lick Creek (Figure 1).

Figure 1. Wallowa Mountain Bull Trout Redd Survey Areas.



METHODS

Spawning surveys for bull trout require as many as ten to twelve people in one day (for complete surveys on large rivers) to complete the surveys during the spawning time. As mentioned above, this project would not be possible without the cooperative effort of partners. Surveyors walk the rivers through the selected “index areas” to locate the bull trout redds.

This project is part of a larger effort in NE Oregon and SE Washington that is occurring at the same time (September – October). Due to the lack of available experienced surveyors to conduct these river surveys, over the years, we have had to increase our survey days on the accessible sections of the Lostine and Imnaha Rivers to 2 days (conducting half of the survey length one day and the other half the following day). Surveys were conducted twice (mid and late bull trout spawning season) on the Lostine River, Big Sheep Creek, Lick Creek, Middle Imnaha (Blue Hole to Indian Crossing) and Bear and Goat Creeks. One-time surveys were conducted late in the spawning season in 2007, on the Upper Imnaha River and tributaries, due to access and funding limitations. Refer to Appendix B, Table 1 comparing survey data and survey frequency for 1999-2007 bull trout spawning surveys on selected Grande Ronde and Imnaha River streams. Total redd numbers are all redds documented, and not necessarily comparable river miles (refer to Appendix B, Table 2a-2d for comparable reaches and redd counts for those sections).

The survey protocol (in addition to repeat surveys, or one-time late surveys where feasible) included; 1) visit to known bull trout redd and review of survey form prior to redd count survey, 2) experienced bull trout redd count surveyor(s) paired with inexperienced surveyor (on the job training), 3) bull trout redds measured, data recorded, and redds flagged during survey, and 4) all stream flagging removed post surveys.

Data recorded during the bull trout spawning surveys included; 1) date of survey, 2) stream location, 3) size of redds, 4) visibility of redds, 5) number of redds, and 6) approximate number and sizes of bull trout observed during surveys. In past years, reach locations (upstream and downstream boundary UTM coordinates) were documented. In 2007, in addition to the above, bull trout redd UTM locations on the Lostine River, Big Sheep Creek, Lick Creek, and Middle Imnaha within the “index areas” also were documented.

Information collected during our bull trout spawning surveys is compiled by the Service and made available to other agencies (i.e., this report).

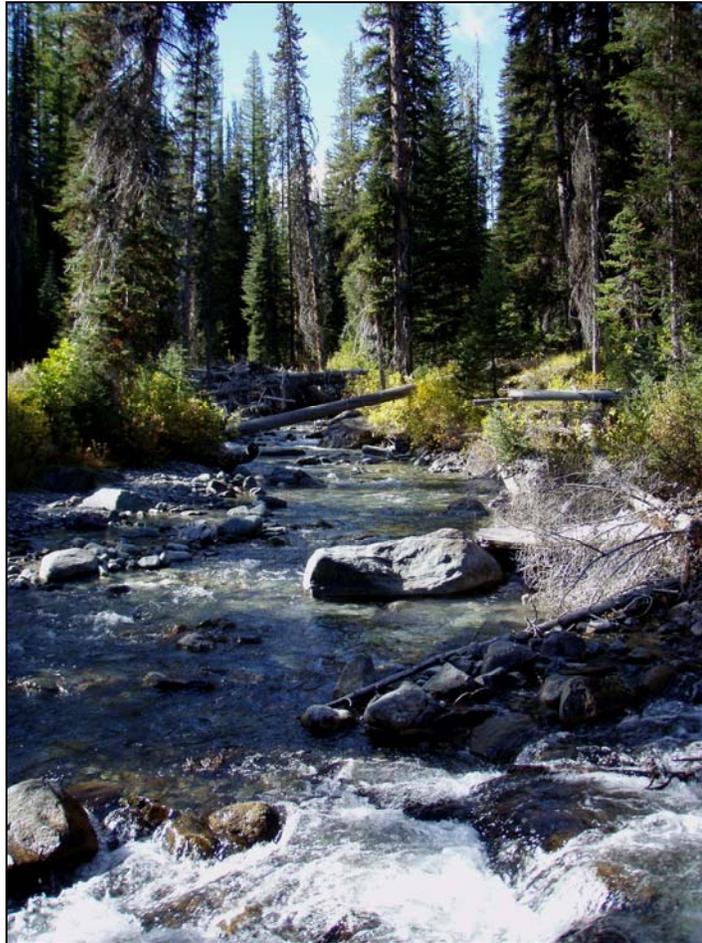


Suzanne Anderson (National Marine Fisheries Service) assisting with Bear Creek Survey in 2007.

RESULTS

Location of Bull Trout Spawning Habitat Areas Surveyed

Bull trout spawning surveys have been conducted on similar index areas for selected Grande Ronde and Imnaha River streams from 1999 to 2007. From 1999 to 2007 bull trout spawning areas have been established (in particular, the Lostine and Imnaha Rivers) for these streams. Redd characteristics have been measured on these streams. The Middle Imnaha (Imnaha River from the fish weir below Gumboot confluence to Indian Crossing) was not surveyed in 2005 through 2007, (this area was surveyed in 1999 to 2004 and is considered bull trout spawning habitat). This portion of known bull trout spawning habitat on the Imnaha was not surveyed for the past three years, because of limited funding, a lack of experienced surveyors and a minimal number of redds documented in this area in past years. Bear Creek and Goat Creek were surveyed as in past years but the survey area of Bear Creek and Goat Creek increased (1.9-3.8 total miles between 1999-2006 versus 7.2 in 2007) and the survey frequency increased (generally once from 1999-2006 and twice in 2007).



Middle Fork Imnaha near the confluence with N.F. Imnaha, 2008

Timing of Bull Trout Spawning

Bull trout timing of spawning for our surveyed streams in general is approximately September 1 through October 15, and as early as August 15 in the Imnaha River system. The Lostine River has been very consistent or predictable (with commencement of spawning documented in 2006 as early as the first week in September), and Imnaha (being a much larger system) has been less predictable. (The above information is based on documentation during bull trout spawning surveys and chinook surveys where bull trout were spawning).

We are not exactly certain of when spawning commences and ends within the Upper Imnaha (within the mainstem, North Fork, South Fork, and Cliff Creek [a resident tributary]). We have questions as to what time of the year, dependent on annual flows, bull trout pass over the falls. Some years we have seen fluvial size bull trout spawning in the South Fork Imnaha in mid-late Sept/early October and in recent years we have not. ODFW observed large fluvial bull trout spawning in South Fork Imnaha in mid August 2005 (B.Knox, ODFW, pers. comm., 2005). ODFW has observed fluvial bull trout spawning as early as mid August (during chinook surveys) below the Imnaha falls and as late as early October (during our bull trout surveys) in several years (B. Smith, ODFW, pers. comm., 2005). We need more years of observation and survey data to understand bull trout spawning and adult movement in the Imnaha Sub-Basin, and Big Sheep and Bear Creek Watersheds.



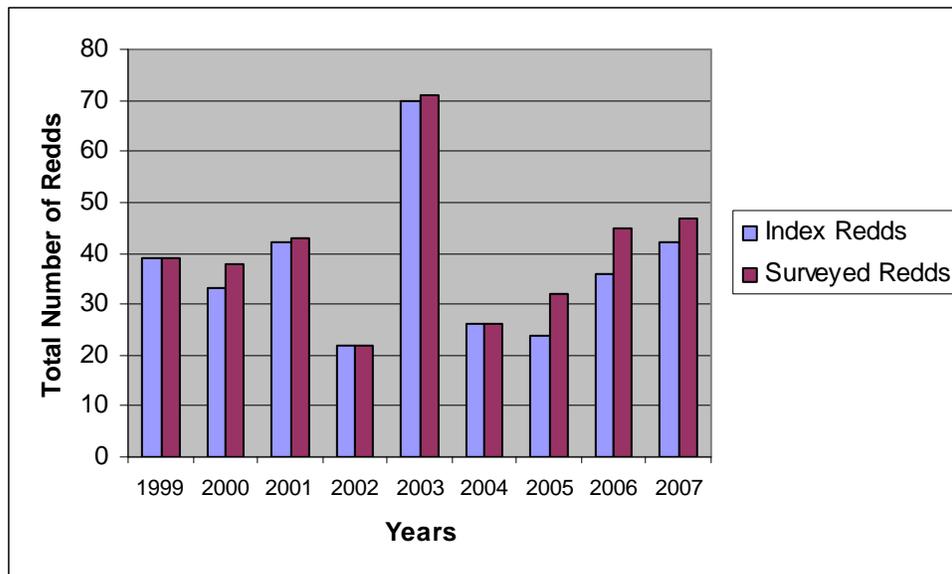
Bull Trout Spawning Trio on Redd, Lostine River (Photo courtesy of U.S.F.S.).

Total Number of Bull Trout Redds

Lostine River

Refer to Appendix B, Table 3a and 3b for bull trout redd count summary data for 2007. Forty-seven total bull trout redds for 10.1 miles of survey (including Pole Bridge to Six Mile Bridge) were documented in 2007 on the Lostine River. Pole Bridge to Six Mile Bridge section has not been surveyed every year. The following data for the Lostine River compares consistently surveyed index areas on the Lostine River (8.5 miles) from 1999 to 2007 excluding the Pole Bridge to Six Mile section (Figure 2). The Lostine River had a low of 22 redds in 2002 to a high of 70 redds in 2003. There has been an increasing trend in redd numbers since 2004, although numbers have not reached the 2003 totals. The nine year average from 1999 to 2007 for the Lostine River is 37 redds. Redds in 2003 for the Lostine River totaled 70, which is almost double the 9-year average. Total redd numbers (in the 8.5 miles of comparable index areas) on the Lostine ranged from 22-70 redds within the 8- year period (not consecutively). The highest bull trout redd numbers (“the bread and butter”) within the Lostine River has consistently been observed and recorded in the headwaters, from Shady Campground to Bowman [approximately River Mile (RM) 24.5 to RM 22]. In 2007, the densities were greatest in the uppermost reach (Shady to French Camp) which is upstream of the chinook spawning index areas. Surveyors also observed more suitable spawning gravels available to bull trout in the Shady to French Camp reach than in past years.

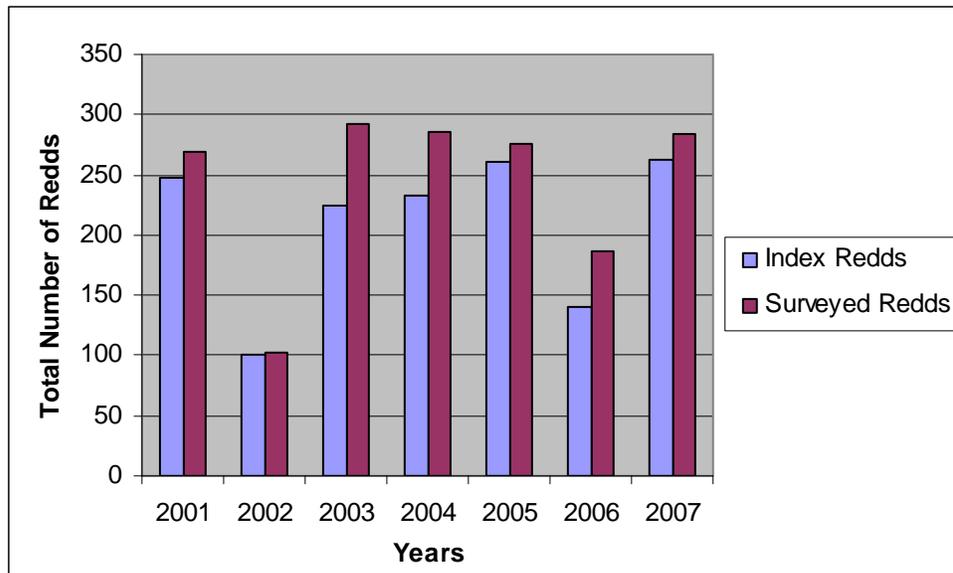
Figure 2. Comparison of bull trout surveyed redds and index redds (comparable miles) documented from 1999 to 2007 on the Lostine River.



Innaha River

Two hundred and eighty four total bull trout redds for 19.4 miles of survey were documented in 2007 on the Innaha River (from Indian Crossing to Blue Hole and upstream). Indian Crossing to Blue Hole was surveyed twice (mid to late spawning season) and upstream areas were surveyed once (mid spawning season) in 2007. The following data for the Innaha River compares consistently surveyed index areas on the Innaha River (17.5 miles) from 2001 to 2007 (Figure 3). The seven-year average from 2001 to 2007 was 210 redds for the Innaha River system. Total redd numbers on the Innaha ranged from 101-262 within the 7-year period. The highest bull trout redd counts for the Innaha River from 2001 to 2007 was recorded in the Upper Innaha from Blue Hole to Cliff Creek, including Upper Innaha tributaries. In 2006 and 2007, there was a significant shift in documented spawning distribution from past years. In 2006 and 2007, the majority of the spawning bull trout were located from the Innaha falls to Indian Crossing, whereas, in past years the distribution had higher numbers above the Blue Hole (two miles upstream of Indian Crossing), as well as in the upper tributary streams (S.F. and N.F. Innaha).

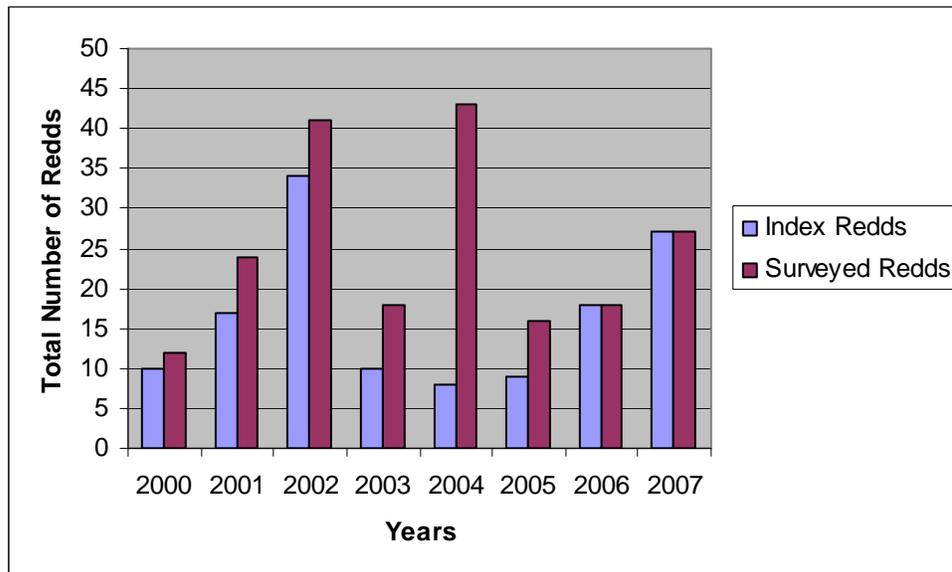
Figure 3. Comparison of bull trout surveyed redds and index redds (comparable miles) documented from 2001 to 2007 on the Innaha River.



Big Sheep Creek

Twenty seven total bull trout redds for 8.6 miles of survey were documented in 2007 on Big Sheep Creek and Lick Creek. These areas were surveyed twice in 2007, mid to late spawning season. The following data for Big Sheep Creek compares consistently surveyed index areas on Big Sheep and Lick Creek (7.6 miles) from 2000 to 2007 (Figure 4). The eight-year average from 2000 to 2007 was 17 for the Big Sheep system. Total redd numbers within the Big Sheep system ranged from 8-34 within the 8-year period. Redd surveys for bull trout in the Big Sheep system have been limited in miles of survey (8.4 to 14.1 miles from 2000 to 2007) and in frequency, (2000-2001 surveys were conducted once late season, and in 2002, 2003, 2005-2007 surveys were conducted twice, mid and late season). In 2004, the survey was conducted once late season for Big Sheep and twice, mid and late season for Lick Creek.

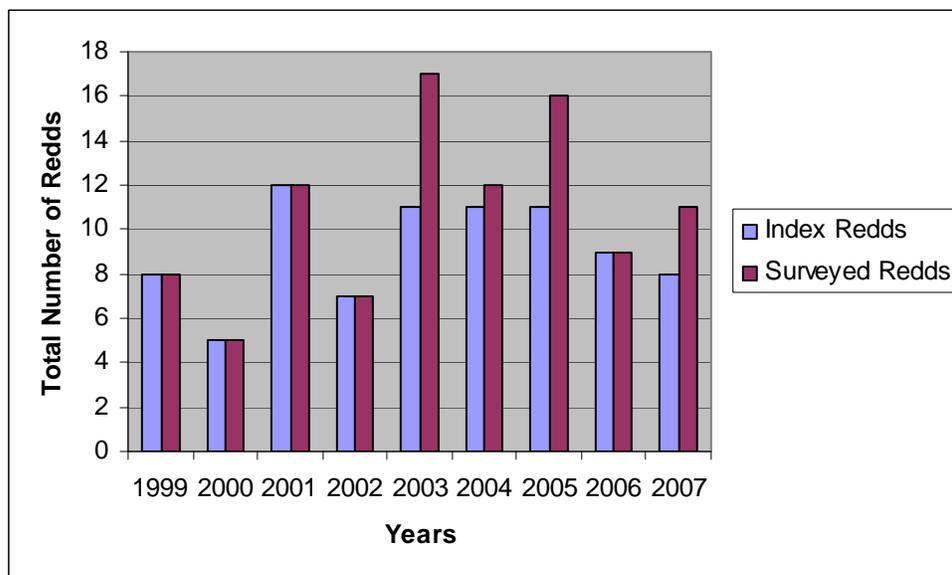
Figure 4. Comparison of bull trout surveyed redds and index redds (comparable miles) documented from 2000 to 2007 on Big Sheep and Lick Creeks.



Bear Creek

Eleven total bull trout redds for 7.2 miles of survey were documented in 2007 on Bear Creek (including Goat Creek). The index area was surveyed twice in 2007 (different from previous years), and once in the expanded survey section Wilderness boundary to upstream Little Bear confluence (4 miles) mid spawning season. The following data for Bear Creek compares consistently surveyed index areas on Bear Creek and Goat Creek (1.9 miles) from 1999 to 2007 (Figure 5). Redd counts on Bear Creek and Goat Creek had a low of 5 redds in 2000 to a high of 12 total redds in 2001, and decreasing to 8 redds in 2007. The nine-year average from 1999 to 2007 is 9 redds for Bear and Goat Creeks. Bear Creek/Goat Creek spawning data collected from 1999 to 2006 is restricted in scope due to access and funding limitations, and 2007 was expanded to help identify total spawning area for bull trout in Bear and Goat Creeks. The highest bull trout redd counts for the survey sections on Bear/Goat Creeks have been recorded in Goat Creek (mouth to waterfall, RM 0 to RM 0.9).

Figure 5. Comparison of bull trout surveyed redds and index redds (comparable miles) documented from 1999 to 2007 on Bear Creek (including Goat Creek).



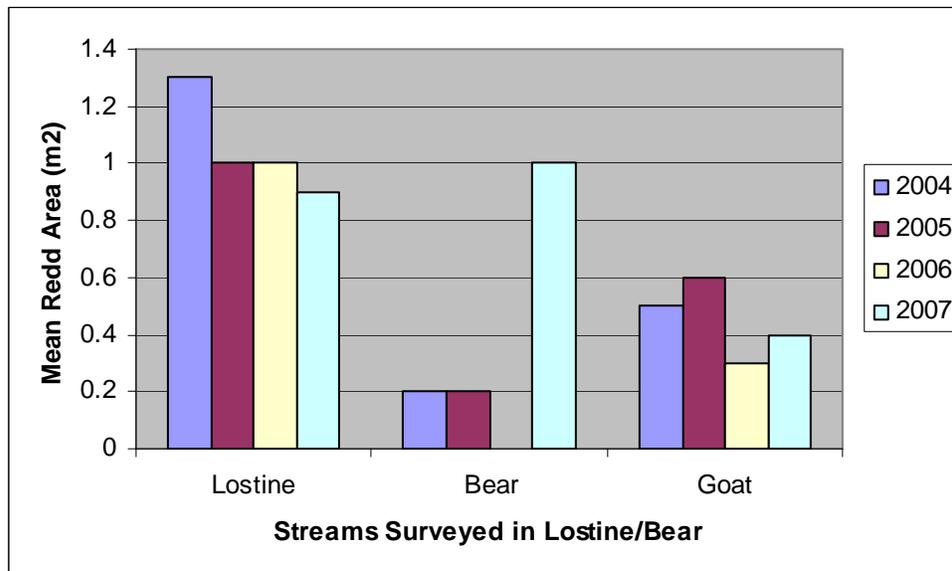
Sizes of Bull Trout Redds

Bull trout redds were measured using the same methodology in 2004 through 2007 and comparison of bull trout redd sizes (mean redd area (m²)) for these years is illustrated in Figures 6 and 7 below. There is a relationship between size of female salmonid and size of redd; large fish make large redds (Bjornn and Reiser 1991, and P. Sankovich, Service, pers. comm., 2006). In addition, length/frequency distributions of mature resident bull trout and mature fluvial bull trout do not overlap, therefore, there is little overlap in size of redds (P. Sankovich, pers. comm., 2006).

Lostine/Bear/Goat

Figure 6 compares bull trout redd sizes for the Lostine River, Bear Creek, and Goat Creek in 2004-2007. Mean redd area (m^2) ranged from 0.9-1.3 for the Lostine, 0.3-0.6 for Goat Creek, and 0.2-1.0 for Bear Creek. The Bear Creek sample area was expanded in miles surveyed in 2007 (in past years the redd area was smaller and more typical of resident redds, in 2007 the redd area was larger and more typical of fluvial size bull trout redds). Brook trout are thought to be abundant in Bear Creek (due to historical stocking in the headwater lakes). Bull trout redds were not observed or documented in Bear Creek within the index area in 2006. The Lostine River contains brook trout, but for most survey years, we have not observed brook trout spawning with bull trout, nor have we observed brook trout spawning. Currently, genetic sampling of bull trout/brook trout has not occurred on Bear Creek to help determine magnitude of hybridization. Goat Creek was limited in available spawning habitat, but it appears to be the best available spawning habitat for fluvial fish in the Bear/Goat Creek system during drought years. (Several miles of upper Bear Creek were dry due to low snowpack and summer drought conditions). It appears from the data in 2004-2007 that the redds in Goat Creek were a combination of resident and fluvial fish, as the redd sizes were midway between the Bear Creek (resident size) and the Lostine (fluvial size) (except for the fluvial size redds in Bear Creek in 2007. Two bull trout that were observed occupying a redd on Goat Creek in 2004 were <12 inches (<300 ml) and were on a redd that had an area of 0.3 m^2 , therefore this size of redd is resident (related to the fish size). More years of data collection on these streams should help us better understand the resident and fluvial life histories of bull trout in this area, relative to fish and redd sizes.

Figure 6. Comparison of bull trout redd sizes [mean redd area (m^2)] for Lostine River, Bear, and Goat Creeks sampled during bull trout spawning surveys, 2004-2007.

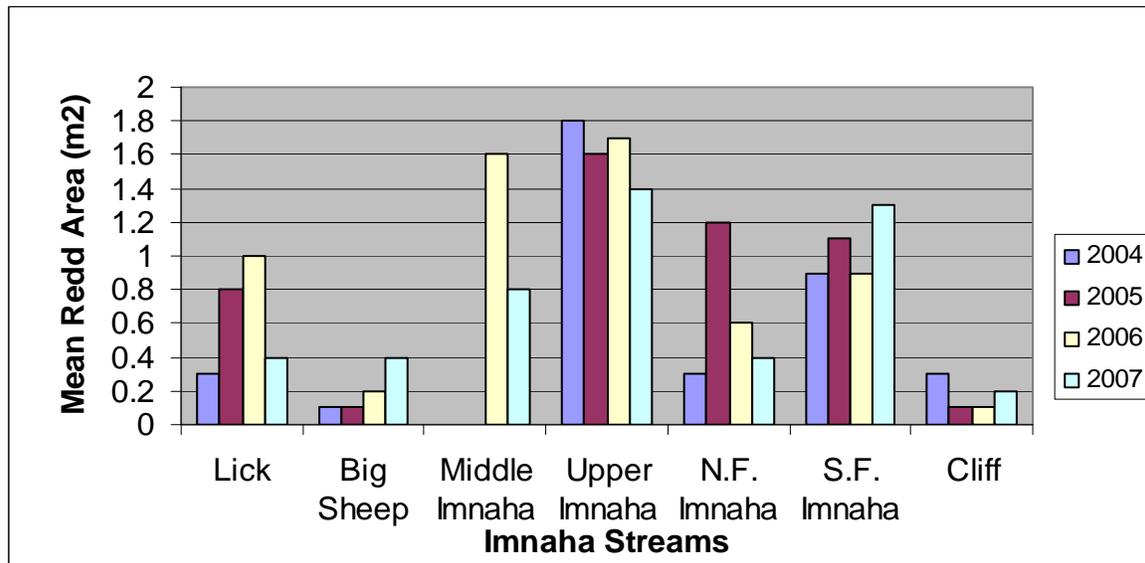


Footnote: Bull trout redds were not observed in the index area of Bear Creek in 2006.

Imnaha and Big Sheep

Figure 7 compares bull trout redd sizes for the sampled streams in the Imnaha system in years 2004-2007. Mean redd area (m²) ranged from 0.3-0.8 for Lick Creek, 0.1-0.4 for Big Sheep, 1.4-1.8 for Upper Imnaha, 0.3-1.2 for N.F. Imnaha, 0.9-1.3 for S.F. Imnaha, and 0.1-0.3 for Cliff Creek. Middle Imnaha had only two redds observed in 2005 and three redds in 2004. In 2006 and 2007, Middle Imnaha had a large distribution of redds in this survey area (sample size = 18 for both years) compared to past years. Middle Imnaha in 2004 and 2006 had primarily fluvial size redds with resident redds documented in 2005 and a mix of fluvial and resident redds in 2007. Cliff Creek is a known resident system with a waterfall near the mouth. The survey on Cliff Creek in 2004 included a large fluvial size redd near the confluence with the S.F. Imnaha and therefore the mean redd size was higher than in 2005 and 2006 when no fluvial redds were observed in Cliff Creek below the waterfall. Lick Creek and Imnaha had an overlap of bull trout and chinook redds, which may make differentiation between the two sometimes difficult. Lick Creek data in 2004-2006 appeared to be a combination of resident and fluvial redds (with more resident redds documented), Big Sheep was resident redds all years, and Upper Imnaha and S.F. Imnaha contained a majority of fluvial redds. North Fork Imnaha appears to have had more resident redds in 2004, more fluvial size redds in 2005, and a mix of fluvial and resident in 2006. Cliff Creek is a known resident system with a mean redd size of 0.2 m² in 2007. Mean redd size was greater, a size of 0.3 m² in 2004 as a result of a fluvial redd near the mouth and potential superimposition of redds above the barrier. 2007 mean redd size included a few larger redds below the falls (near the mouth) which are presumed to be fluvial redds.

Figure 7. Comparison of bull trout redd sizes [mean redd area (m²)] for sampled streams in the Imnaha Subbasin, 2004-2007.

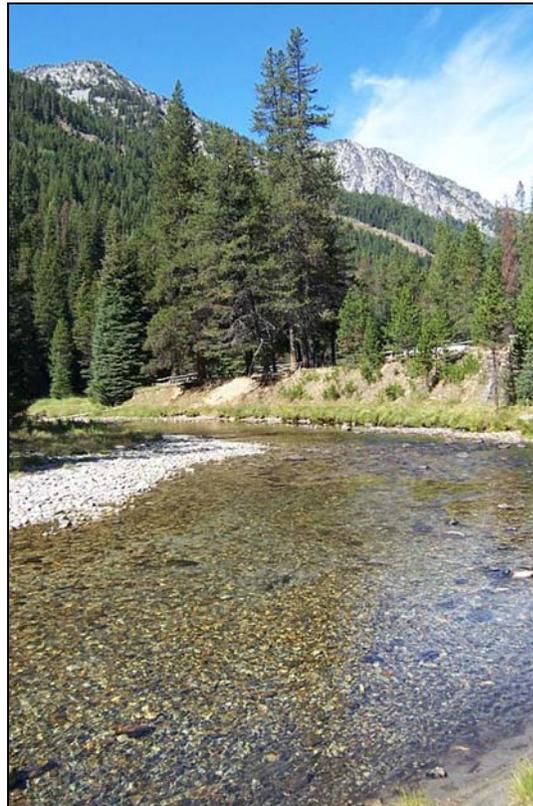


Refer to Tables 4a and 4b in Appendix B for additional information on 2007 bull trout redd characteristics.

Bull Trout Redd Distribution on the Lostine River

The bull trout spawning survey on the Lostine River in years 2005 through 2007 included collection of UTM coordinate data on the spatial distribution of the 2005 through 2007 bull trout redds observed along the Lostine River (Figure 8). Bull trout redds on the Lostine River (as well as in other surveyed streams) were often arranged in complexes (several redds in close proximity to each other) as shown in Figure 8. Redds were primarily located in the French Camp to Shady Falls and Bowman to French Camp reaches along the Lostine River in both 2005 and 2006; and mainly in the French Camp to Shady Falls reach in 2007 and several miles (approximately 10 miles) downstream of these reaches at the Six Mile Bridge to Pole Bridge reach. High site fidelity is documented by the overlapping of bull trout redds from 2005-2007, especially in the upper reaches of the Lostine River (Figure 8).

Sections of the Lostine River not surveyed due to insufficient spawning gravels (boulder and cobble dominated substrate) and difficult access include; Bowman to Walla Walla (approximately 2.2 miles) and Williamson to Pole Bridge (approximately 3.5 miles). Downstream of Westside Ditch on the Lostine River (approximately 9 miles) is private property that is not surveyed due to lack of bull trout spawning gravels, higher stream temperatures, and low flows associated with irrigation withdrawal.



Downstream view of the Lostine River near Turkey Flat, within the French Camp to Bowman, bull trout spawning area. Photo courtesy of the USFS.

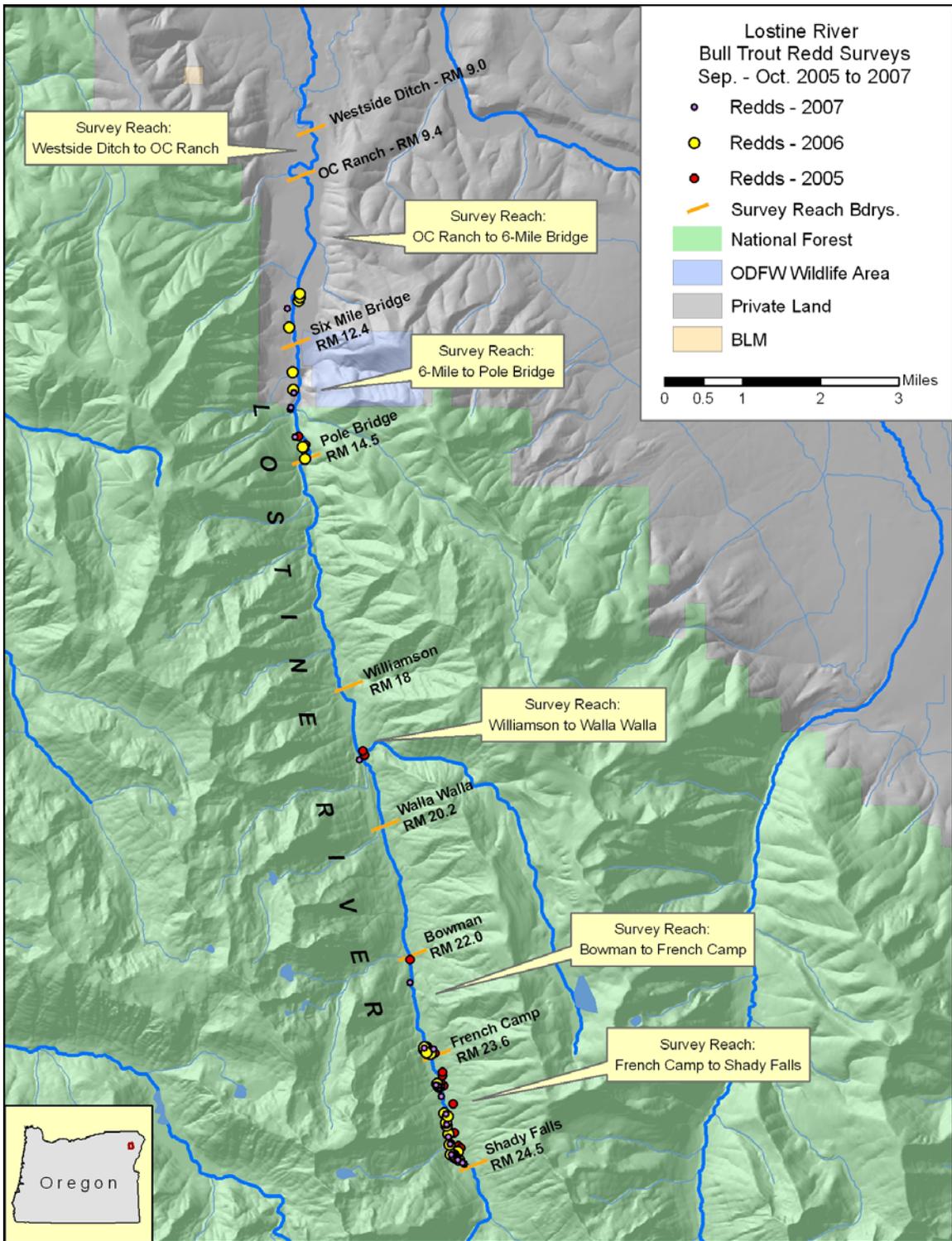


Figure 8. Map of the Lostine River showing bull trout redd survey reaches and bull trout redd locations in years 2005 through 2007.

DISCUSSION

A combination of low flows (due to drought conditions) and severe streambed scour activity in spring of 2006 and 2007 created limited available habitat for spawning bull trout in the fall of 2006 and 2007. This is noted by the author as most evident in the Lostine/Bear and Imnaha systems. During drought conditions, as in 2006 and 2007, Bear Creek had limited spawning habitat for fluvial bull trout due to subbing out of flows. It is assumed that there is habitat upstream of the index area above subbing flows for resident bull trout. In 2007, surveyors noted a chinook redd (obvious because of the huge size and large substrate) in lower Goat Creek which was probably a result of extremely low flows and warm temperatures in Bear Creek in 2007. Several side channels on the Imnaha were no longer flowing in 2006 and 2007, and this was evident as well during the chinook surveys on these streams. This would likely have an effect on densities and distribution of redds for both bull trout and chinook species in these systems.



Bear Creek upstream of surveyed bull trout reaches in 2007. Several miles of dry streambed due to drought conditions limits fluvial bull trout distribution.

The Imnaha in 2006 and 2007 had a large distribution of bull trout redds that extended further downstream than in past years (Blue Hole to Indian Crossing, a two mile section); which may be due to limited passage of fluvial bull trout at the falls and potential bull trout/chinook interactions that are not well understood. As mentioned in the 2006 report, additional research on timing in the Imnaha and especially passage above and below the falls would be beneficial in our understanding of bull trout in this system.

The upper reach of Big Sheep Creek (1.0 mile upstream of the canal) had extremely high sediment loads as compared to past surveys. No redds were documented but resident bull trout were observed. A rain cell in July 2007 created several “gully washers” along upper Big Sheep Watershed that created this high sediment load in upper Big Sheep.

Hopefully, over time, this material will wash out to provide clean spawning gravels for the resident bull trout in this reach.



Upper Big Sheep Watershed, views of gullies formed during a rain storm in July 2007 that contributed to high sediment loads in upper Big Sheep (within the 1.0 mile upstream of canal, upper survey reach of Big Sheep Creek).

For 2007, the Bear Creek survey was experimental in design and included more miles upstream and was conducted twice (for the index area and once for the additional experimental miles). This experimental survey in 2007 gave us a better understanding of the total bull trout spawning habitat available in this system during drought stream conditions and the timing of spawning. The additional miles of survey did not give us many more redds. It appears that Goat Creek, with its cold water and limited available spawning substrate, is the “bread and butter” of spawning habitat for both fluvial and resident bull trout in the upper Bear Creek system. It is assumed that there is additional resident bull trout spawning habitat several miles upstream from our survey location that was not surveyed due to logistics.

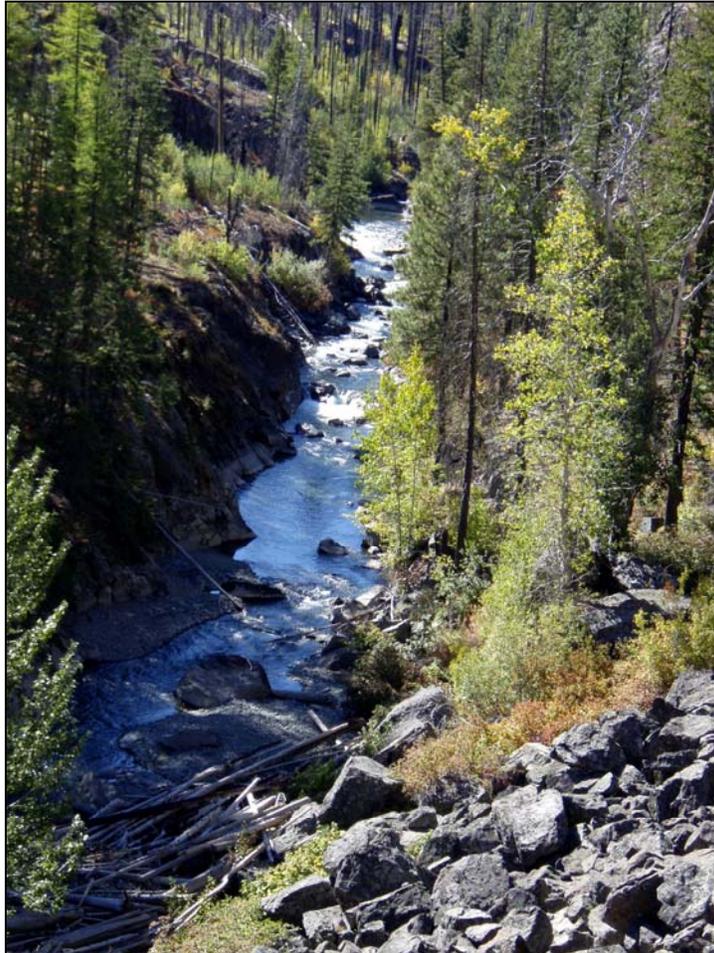
Overall, future needs for this project include continued funding and support from all involved parties for conducting and reporting bull trout redd counts in the Wallowa Mountains. We need at least 15 years (consecutive years) of bull trout redd data for trend data (Maxwell 1999) and for bull trout recovery data needs. Caution must be exercised in using the above bull trout spawning data for adult population trends until we have a complete 15 years of data.

CONCLUSION

The local bull trout populations appear to be relatively stable for the survey period (1999-2007); although, a minimum of 15 years is needed to determine population trends.

The Imnaha population is one of the strongholds within the Imnaha Subbasin as it has multiple age classes, contains fluvial fish, has an anadromous prey base, has connectivity with the Snake River, and bull trout are distributed throughout the habitat. Primary spawning activity on the Imnaha River has been documented to occur in the headwaters which lie within wilderness. Both fluvial and resident life history forms are present. The Imnaha River is rated at low risk of extinction, and Big Sheep is rated “of special concern” (Buchanan et al. 1997).

The Lostine River is considered a moderately-strong population within the Grande Ronde Subbasin. Our results are consistent with Buchanan et al. (1997). Lostine River and Bear Creek contain brook trout and the degree of hybridization is unknown. Limited redd count data is available on Bear Creek and this portion of the Lostine River/Bear Creek local population has been listed as a special concern by Ratliff and Howell (1992). Future genetic analysis of bull trout and brook trout is recommended to help determine the significance of this threat.



Imnaha River view from trail to spawning area, 2007



Bull Trout spawning pair on the Upper Imnaha , 2007

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APPENDIX A – PHOTOS TAKEN AT SURVEY LOCATIONS



Log jam on the Imnaha River upstream of the Blue Hole, 2006. (Photo courtesy of Nez Perce Tribe).



Same log jam as in above photo, this photo taken in 2007.



Upper North Fork Imnaha River, Bull Trout Spawning Survey Area, 2007.



Middle Fork Imnaha, view downstream to confluence with North Fork Imnaha, 2007.



Fluvial bull trout pair on redd downstream of the Lower Imnaha Falls, Imnaha River, 2006 (Photo courtesy of the Nez Perce Tribe).



Rainbow trout found dead along Bear Creek. It's eyes were bigger than it's mouth, 2007! (Photo courtesy of the Nez Perce Tribe).



Cliff Creek waterfall, resident bull trout population above falls, 2006.
(Photo courtesy of Nez Perce Tribe).



Middle Imnaha Falls, survey begins here and bull trout surveyors work downstream, 2007.



Headwaters of North Fork Imnaha. Begin uppermost reach here, where trail crosses stream. View upstream, 2007.

APPENDIX B – TABLES

Table 1 – Bull Trout Spawning Surveys and Survey Frequencies for selected Grande Ronde River and Imnaha River Streams, 1999-2007

Stream	Year	Dates	Survey	Total	Total	Total
			Frequency	Redds	Miles	Redds/Mile
Lostine River	1999	9/16,9/23,10/12	3 Times	39	9.75	4.0
	2000	9/21,9/28,10/12	3 Times	38	13.74	2.8
	2001	9/17-18,10/11-12	Twice	43	14.4	3.0
	2002	9/23-24,10/7-8	Twice	22	10.7	2.1
	2003	9/23-24,10/6-7	Twice	71	10.5	6.8
	2004	9/14-15,10/5-6	Twice	26	8.5	3.1
	2005	9/15, 9/21-22, 10/3-10/4	Twice, and 3 Times in Turkey Flat	32	10.5	3.0
	2006	9/14, 9/20-21, 10/2-10/4	Twice, and 3 Times in Turkey Flat and Shady Campground areas	45	10.5	4.3
	2007	9/19-9/20, 10/3-10/4	Twice	47	10.1	4.7
Bear Creek (including Goat Cr)	1999	9/7,9/22	Once Bear, Twice Goat	6	1.8	3.3
	2000	10/18	Once	5	1.8	2.8
	2001	10/16	Once	12	2.3	5.2
	2002	10/15	Once	7	2.3	3.0
	2003	10/16	Once	17	3.8	4.5
	2004	10/1	Once	11	2.3	4.8
	2005	10/11	Once	16	2.8	5.7
	2006	10/10	Once	9	1.9	4.7
	2007	9/17, 10/9	Twice, Exploratory (more reaches than past years)	11.0	7.2	1.5

Table 1 (Continued)– Bull Trout Spawning Surveys and Survey Frequencies for selected Grande Ronde River and Imnaha River Streams, 1999-2007

Stream	Year	Dates	Survey Frequency	Total Redds	Total Miles	Total Redds/Mile
Imnaha River	1999	9/20,28,10/11	Middle = Thrice	14	15.2	0.9
(excluding Big Sheep)	2000	9/20,22,25,26,27,10/11	Upper = Once, Middle = Twice	92	29.1	3.2
	2001	9/20,21,10/1,2,3,9,10	Upper = Once, Middle = Twice	291	31.3	9.3
	2002	9/25,26,9/30,10/1-2,10/10-11	Upper = Once, Middle = Twice	113	30.5	3.7
	2003	9/25-26,9/29-30,10/1,10/8-9	Upper = Once, Middle = Twice	266	31.6	8.4
	2004	9/15-9/16,9-27,28,29,10/7-8	Upper = Once, Middle = Twice	293	31.5	9.3
Middle=Blue Hole to Indian	2005	9/26-28, 10/7	Once Upper and Middle	276	19.4	14.2
2005-2006	2006	9/25-28,10/5	Upper = Once, Middle = Twice	186	19.4	9.6
	2007	9/24-27, 10/5	Upper = Once, Middle = Twice	284	19.4	14.6

Table 1 (Continued)– Bull Trout Spawning Surveys and Survey Frequencies for selected Grande Ronde River and Imnaha River Streams, 1999-2007

Stream	Year	Dates	Survey Frequency	Total Redds	Total Miles	Total Redds/Mile
Big Sheep	1999	9/21,29,30,10/18,19	Once	20	14.2	1.4
[(including Lick, and Salt).	2000	10/13-10/16	Once	12	8.4	1.4
	2001	10/14,10/17	Once	24	8.4	2.9
Salt Cr. not surveyed post 2003,	2002	9/30,10/1,10/14-15	Twice	41	9.3	4.4
and Upper Big	2003	9/22,10/14	Twice	18	9.3	1.9
	2004	9/20,9/28-9/29,9/30,10/4,10/19	Once Big Sheep, Twice Lick	43	14.1	3.0
Sheep exploratory in 2004].	2005	9/19-20, 10/6	Twice	16	8.6	1.9
	2006	9/19, 10/4	Twice	18	7.6	2.4
	2007	9/21, 10/2	Twice	27	8.6	3.1

Table 2a–Bull Trout Spawning Surveys for the Lostine River Comparing 1999 to 2007 Surveys

Stream	Years								
	1999	2000	2001	2002	2003	2004	2005	2006	2007
Lostine			Redds	Surveyed					
Reaches (miles surveyed)									
Lundquist Bridge to OC Ranch (2.8)	1	0	2	3	3	5	0	5	4
Williamson to Walla Walla (2.2 miles)	0	2	1	0	6	1	3	0	2
Bowman to French Camp (1.6 miles)	18	19	16	11	18	3	9	9	5
French Camp to Shady Falls (1.5)	20	12.0	23	8	43	17	12	22	31
Lostine Total Redds (Comparable Reaches)	39	33	42	22	70	26	24	36	42
Lostine Total Miles of Comparable Stream	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1
Lostine Redds/Mile Comparable Stream	4.6	3.9	4.9	2.6	8.2	3.1	2.8	4.2	5.2
Total Redds For Year	39	38.0	43.0	22.0	71.0	26.0	32.0	45	47
Total Miles Surveyed For Year	9.8	13.7	14.4	10.7	10.5	8.5	10.5	10.5	10.1
Total Redds/Mile For Year	4.0	2.8	3.0	2.1	6.8	3.1	3.0	4.3	4.6

Notes: The Lostine was surveyed three times in 1999 and 2000. Survey years 2001-2007, the Lostine was surveyed twice, (except Shady Campground and Turkey Flat areas were surveyed three times in 2005 and 2006). Dates of Lostine bull trout spawning surveys generally commenced as early as the second or third week in September and the last survey was conducted in the first or second week in October.

Table 2b – Bull Trout Spawning Surveys for Bear and Goat Creeks Comparing 1999 – 2007 Surveys

Stream	Survey Years								
	1999	2000	2001	2002	2003	2004	2005	2006	2007
Bear Creek			Redds	Surveyed					
Reaches (miles surveyed)									
Bear: Goat Confluence to Wilderness Boundary (1 mile)	0	2	3	1	2	3	5	0	1
Goat Creek: Mouth to Falls (0.9)	8	3	9	6	9	8	6	9	7
Bear (and Goat) Total Redds (Comparable Reaches)	8	5	12	7	11	11	11	9	8
Bear Creek Total Miles of Comparable Stream	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9
Bear Creek Redds/Mile Comparable Stream	4.2	2.6	6.3	3.7	5.8	5.8	5.8	4.7	4.2
Total Redds For Year	8	5	12	7	17	12	16	9	11
Total Miles Surveyed For Year	1.9	1.9	2.3	2.3	3.8	2.3	2.8	1.9	7.2
Total Redds/Mile For Year	4.2	2.6	5.2	3.0	4.5	5.2	5.7	4.7	1.5

Notes: These surveys were conducted once from 1999-2006, usually late in the spawning season, the first or second week in October [except in 1999, surveys were conducted in September (on 9/7 and 9/22)]. In 2007, the surveys included several additional “experimental” miles and were conducted twice in the spawning season, once in mid September and once in early October.

Table 2c – Bull Trout Spawning Surveys for the Imnaha River Comparing 2001 – 2007 Surveys

Stream	Years						
	2001	2002	2003	2004	2005	2006	2007
Imnaha River	Redds	Surveyed					
Reaches (miles surveyed)							
South Fork Imnaha and tributaries:							
Cliff Creek, mouth to 2.5 miles (2.5 miles)	96	22	57	65	61	17	93
South Fork Imnaha, NF to Soldier (1.5 miles)	6	7	14	12	44	9	30
South Fork Imnaha, Soldier to Cliff (3.1 miles)	33	18	37	29	55	26	37
North Fork Imnaha:							
North Fork, above Middle Fork (4.1 miles)	49	18	40	68	39	18	30
North Fork, below Middle Fork to mouth (2.1 miles)	2	8	15	9	21	6	7
Middle Fork, mouth to falls (0.8 miles)	12	0	12	6	24	7	17
Imnaha River:							
Imnaha River, NF to Falls (0.6 miles)	0	3	5	1	2	3	2
Imnaha River, Falls to lower falls (0.8 miles)	41	18	35	40	13	37	28
Imnaha River, Blue Hole to Indian Crossing (2.0 miles)	8	7	9	3	2	18	18
Imnaha Total Redds (Comparable Reaches)	247	101	224	233	261	141	262
Imnaha Total Miles of Comparable Stream	17.5	17.5	17.5	17.5	17.5	17.5	17.5
Imnaha Redds/Mile Comparable Stream	14.1	5.8	12.8	13.3	14.9	8.1	15.0
Total Redds For Year	269	103	293	286	276	186	284
Total Miles Surveyed For Year	19.4	18.3	42.8	41.2	19.4	19.4	19.4
Total Redds/Mile For Year	13.9	5.6	6.8	6.9	14.2	9.6	14.6

Notes: All reaches except Blue Hole to Indian were surveyed once in 2001 to 2007. The Blue Hole to Indian Crossing reach was surveyed twice, in mid September and October from 2001-2007, except in 2005 it was surveyed once.

Table 2d – Bull Trout Spawning Surveys for Big Sheep and Lick Creek Comparing 2000 – 2007 Surveys

Stream	Survey Years							
	2000	2001	2002	2003	2004	2005	2006	2007
Big Sheep Creek (including Lick Creek)		Redds	Surveyed					
Reaches (miles surveyed)								
Big Sheep, canal to 39 rd. (1.9 miles)	2	6	17	2	3	5	6	12
Lick Creek, Meadow to 39 rd. (1.5 miles)	0	6	3	0	1	3	5	3
Lick Creek, 39 rd. to Quartz Creek (4.2 miles)	8	5	14	8	4	1	7	12
Big Sheep Total Redds (Comparable Reaches)	10	17	34	10	8	9	18	27
Big Sheep Creek Total Miles of Comparable Stream	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6
Big Sheep Creek Redds/Mile Comparable Stream	1.3	2.2	4.5	1.3	1.1	1.2	2.4	4.6
Total Redds For Year	12	24	41	18	43	16	18	27
Total Miles Surveyed For Year	8.4	8.4	9.3	9.3	14.1	8.6	7.6	8.6
Total Redds/Mile For Year	1.4	2.9	4.4	1.9	3.0	1.9	2.4	3.1

Notes: Survey frequency varied by year, surveys were conducted once in mid to late October in years 2000 and 2001 for both Big Sheep and Lick Creek, and surveys were conducted twice, once in September and once in October in years 2002-2007, except for Big Sheep which was surveyed once in 2004.

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Imnaha Basin Stream Reach, Section	Date(s)	Kilometers Surveyed	Miles Surveyed	Occ	Redds			Per km	Per Mile	Total But obs	Bull Trout Observed (mm)			
					Unocc	Total					<6"(150mm)	<12" (~300mm)	<18"(450mm)	>18"(450mm)
Upper Imnaha System														
South Fork Tributaries														
Cliff Cr., mouth to 3.6 km	25-Sep	4.0	2.5	11.0	82.0	93.0	23.3	37.2	27.0	0.0	21.0	6.0	0.0	
South Fork Tributaries Total		4.0	2.5	11.0	82.0	93.0	23.3	37.2	27.0	0.0	21.0	6.0	0.0	
North Fork														
Middle Fork., mouth to falls	25-Sep	1.3	0.8	2.0	15.0	17.0	13.1	21.0	8.0	0.0	6.0	1.0	1.0	
N. Fk., above M. Fk. (reach 3-7) 8.0	24-Sep	6.6	4.1	5.0	25.0	30.0	4.5	7.3	8.0	0.0	4.0	2.0	2.0	
N. Fk., below M. Fk. (reach 1-2)	9/25, 9/26	3.4	2.1	0.0	7.0	7.0	2.1	3.3	1.0	0.0	1.0	0.0	0.0	
North Fork Total		11.3	7.0	7.0	47.0	54.0	4.8	7.7	17.0	0.0	11.0	3.0	3.0	
South Fork														
S. Fk., North Fork to Soldier Cr.	24-Sep	2.4	1.5	1.0	29.0	30.0	12.5	20.1	6.0	0.0	5.0	0.0	1.0	
S. Fk., Soldier to Cliff Cr.	9/24, 9/25	5.0	3.1	3.0	34.0	37.0	7.4	11.9	6.0	3.0	3.0	0.0	0.0	
South Fork Total		7.4	4.6	4.0	63.0	67.0	9.1	14.6	12.0	3.0	8.0	0.0	1.0	
Upper Imnaha														
Upper Imnaha (Falls to North Fork)	26-Sep	1.0	0.6	0.0	2.0	2.0	2.0	3.2	3.0	0.0	0.0	1.0	2.0	
Upper Imnaha Falls to lower falls	26-Sep	1.3	0.8	8.0	20.0	28.0	21.5	34.7	22.0	0.0	2.0	10.0	10.0	
Falls downstream .67 mi. to beg. of gorge	26-Sep	1.1	0.7	4.0	4.0	8.0	7.3	11.7	11.0	0.0	0.0	8.0	3.0	
Lower end of gorge to next gorge (.25 mi)	26-Sep	0.4	0.2	0.0	3.0	3.0	7.5	12.1	0.0	0.0	0.0	0.0	0.0	
Canyon above slide to canyon just above slide	26-Sep	1.5	0.9	2.0	9.0	11.0	7.3	11.8	3.0	0.0	2.0	1.0	0.0	
Upper Imnaha Total		5.3	3.3	14.0	38.0	52.0	9.8	15.8	39.0	0.0	4.0	20.0	15.0	
Upper Imnaha System Total		28.0	17.4	36.0	230.0	266.0	9.5	15.3	95.0	3.0	44.0	29.0	19.0	
Imnaha Basin Total (Page 2)		17.1	10.6	1.0	44.0	45.0	2.6	4.2	56.0	27.0	29.0	0.0	0.0	
Imnaha Basin Total Pages 1 & 2)		45.1	28.0	37.0	274.0	311.0	6.9	11.1	151.0	30.0	73.0	29.0	19.0	

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Imnaha Basin Stream Reach, Section	Date(s)	Kilometers Surveyed	Miles Surveyed	Occ	Redds			Per km	Per Mile	Total But obs	Bull Trout Observed (mm)			
					Unocc	Total					<6"(150mm)	<12" (~300mm)	<18"(450mm)	>18"(450mm)
Middle Imnaha														
Blue Hole to Indian Crossing	27-Sep	3.2	2.0	1.0	11.0	12.0	3.8	6.0	2.0	1.0	1.0	0.0	0.0	
Blue Hole to Indian Crossing	5-Oct			0.0	6.0	6.0	1.9	3.0	0.0	0.0	0.0	0.0	0.0	
Middle Imnaha Total		3.2	2.0	1.0	17.0	18.0	5.6	9.1	2.0	1.0	1.0	0.0	0.0	
Big Sheep System														
Big Sheep, 1.0 mile Upstream Canal to Canal	21-Sep	1.6	1.0	0.0	0.0	0.0	0.0	0.0	7.0	2.0	5.0	0.0	0.0	
Big Sheep, 1.0 mile Upstream Canal to Canal	2-Oct			0.0	0.0	0.0	0.0	0.0	2.0	2.0	0.0	0.0	0.0	
Big Sheep, Canal to Rd. 39	21-Sep	3.1	1.9	0.0	7.0	7.0	2.3	3.6	22.0	7.0	15.0	0.0	0.0	
Big Sheep, Canal to Rd. 39	2-Oct			0.0	5.0	5.0	1.6	2.6	7.0	2.0	5.0	0.0	0.0	
Lick Cr. Meadow to 39 rd.	21-Sep	2.4	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Lick Cr. Meadow to 39 rd.	2-Oct			0.0	3.0	3.0	1.3	2.0	16.0	13.0	3.0	0.0	0.0	
Lick Cr. 39 Rd. to Quartz Cr.	21-Sep	6.8	4.2	0.0	7.0	7.0	1.0	1.7	0.0	0.0	0.0	0.0	0.0	
Lick Cr. 39 Rd. to Quartz Cr.	2-Oct			0.0	5.0	5.0	0.7	1.2	0.0	0.0	0.0	0.0	0.0	
Big Sheep System Total		13.9	8.6	0.0	27.0	27.0	1.9	3.1	54.0	26.0	28.0	0.0	0.0	
Imnaha Basin Total (Page 1)		28.0	17.4	36.0	230.0	266.0	9.5	15.3	95.0	3.0	44.0	29.0	19.0	
Imnaha Basin Total (Page 2)		17.1	10.6	1.0	44.0	45.0	2.6	4.2	56.0	27.0	29.0	0.0	0.0	
Imnaha Basin Total Pages 1 & 2)		45.1	28.0	37.0	274.0	311.0	6.9	11.1	151.0	30.0	73.0	29.0	19.0	

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Grande Ronde Basin Stream Reach, Section	Date(s)	Kilometers Surveyed	Miles Surveyed	Occ	Redds			Per km	Per Mile	Total But obs	Bull Trout Observed (mm)			
					Unocc	Total					<6"(150mm)	<12" (~300mm)	<18"(450mm)	>18"(450mm)
Bear Creek														
Goat Cr (Mouth to Falls)	17-Sep	1.4	0.9	2.0	3.0	5.0	3.5	5.6	3.0	0.0	2.0	1.0	0.0	
Goat Cr (Mouth to Falls)	9-Oct			1.0	1.0	2.0	1.4	1.5	1.0	0.0	1.0	0.0	0.0	
Bear Creek (Standley Trail to USFS Cabin)	17-Sep	1.4	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Bear Creek (Standley Trail to USFS Cabin)	9-Oct			0.0	1.0	1.0	0.7	0.8	0.0	0.0	0.0	0.0	0.0	
Bear Creek (USFS Cabin to Goat Creek)	17-Sep	0.8	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Bear Creek (USFS Cabin to Goat Creek)	9-Oct			0.0	1.0	1.0	1.2	2.5	0.0	0.0	0.0	0.0	0.0	
Bear Creek (Goat Creek to Wilderness Boundary)	17-Sep	1.4	0.9	0.0	1.0	1.0	0.7	1.1	0.0	0.0	0.0	0.0	0.0	
Bear Creek (Goat Creek to Wilderness Boundary)	9-Oct			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Bear Creek (Wilderness Boundary to Trail Bridge)	17-Sep	4.8	3.0	0.0	1.0	1.0	0.2	0.3	2.0	1.0	1.0	0.0	0.0	
Bear Creek (Trail Bridge to Rd. Bridge Upstream L.Bear)	17-Sep	1.6	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Bear Creek Totals		11.6	7.2	3.0	8.0	11.0	0.9	1.5	6.0	1.0	4.0	1.0	0.0	
Lostine River														
Lundquist Bridge to OC Ranch	9/19, 9/20	4.4	2.8	0.0	4.0	4.0	0.9	1.5	0.0	0.0	0.0	0.0	0.0	
Lundquist Bridge to OC Ranch	10/3, 10/8			0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	0.0	2.0	
Pole Bridge to 6 Mile Bridge	19-Sep	3.2	2.0	1.0	4.0	5.0	1.6	2.5	1.0	0.0	1.0	0.0	0.0	
Pole Bridge to 6 Mile Bridge	3-Oct			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Williamson to Walla Walla	20-Sep	3.5	2.2	1.0	1.0	2.0	0.6	0.9	1.0	1.0	0.0	0.0	0.0	
Williamson to Walla Walla	11-Oct			0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	1.0	0.0	
Bowman to French Camp	19-Sep	2.6	1.6	0.0	2.0	2.0	0.8	1.3	7.0	0.0	0.0	3.0	4.0	
Bowman to French Camp	3-Oct			0.0	3.0	3.0	1.2	0.7	0.0	0.0	0.0	0.0	0.0	
French Camp to Shady Falls	19-Sep	2.4	1.5	1.0	24.0	25.0	10.4	16.7	17.0	0.0	9.0	7.0	1.0	
French Camp to Shady Falls	3-Oct			0.0	6.0	6.0	2.5	1.7	6.0	4.0	2.0	0.0	0.0	
Lostine River Total		16.2	10.1	3.0	44.0	47.0	2.9	4.7	35.0	5.0	12.0	11.0	7.0	
Grande Ronde Basin Total														

**Table 4a –
Summary of Measured Bull Trout Redds, Grande Ronde River Basin
Lostine River, Bear Creek, and Goat Creek 2007**

Stream	n*1		Length (M)	Width (M)	Area (m2)	Length/Width ratio
Lostine	47	mean	1.3	0.7	0.9	2.0
		sd	0.6	0.2	0.6	0.9
		max	2.4	1.1	2.4	4.7
		min	0.2	0.3	0.1	0.5
Bear Creek	4	mean	1.1	0.8	1.0	1.6
		sd	0.1	0.2	0.1	0.8
		max	1.7	1.3	2.2	2.3
		min	0.7	0.3	0.3	1.2
Goat Creek	7	mean	0.9	0.4	0.4	2.3
		sd	0.3	0.2	0.3	0.9
		max	1.3	0.9	0.9	3.2
		min	0.6	0.2	0.2	1.2

Footnote 1: n = number of redds observed and measured (sample size).

Table 4b – Summary of Measured Bull Trout Redds, Imnaha River Basin 2007

Stream	n*1		Length (M)	Width (M)	Area (m2)	Length/Width ratio
Lick Creek	15	mean	0.8	0.4	0.4	1.8
		sd	0.3	0.1	0.3	0.6
		max	1.6	0.7	0.8	3.2
		min	0.3	0.2	0.1	1
Big Sheep Creek	12	mean	0.8	0.4	0.4	2.0
		sd	0.3	0.2	0.3	0.5
		max	1.3	0.7	0.8	3.2
		min	0.4	0.2	0.1	1.3
Middle Imnaha	18	mean	1.1	0.7	0.8	1.6
		sd	0.3	0.2	0.4	0.4
		max	1.8	1.1	1.8	2.0
		min	0.4	0.4	0.2	0.7
Upper Imnaha	52	mean	1.4	0.8	1.4	2.4
		sd	0.8	0.5	1.8	4.2
		max	4.0*	2.0	8	32
		min	0.2	0.1	0.1	0.7
N.F. Imnaha	54	mean	0.9	0.4	0.4	2.1
		sd	0.4	0.2	0.3	0.7
		max	2.0	1.2	1.4	4.0
		min	0.2	0.1	0.0	0.9
S.F. Imnaha	67	mean	1.5	0.7	1.3	2.2
		sd	0.7	0.4	1.5	0.7
		max	3.8	2.9	11.0	4.9
		min	0.4	0.1	0.1	0.9
Cliff Creek	93	mean	0.5	0.3	0.2	1.8
		sd	0.2	0.1	0.1	0.5
		max	1.2	0.6	0.8	3.3
		min	0.1	0.1	0.0	0.9

Footnote 1: n = number of redds observed and measured (sample size).

Footnote 2: Some of the larger redds measured could be multiple redds, as in one location, at least ten bull trout were paired up in a redd area.