Monitoring the Use of the Mainstem Columbia River by Bull Trout from the Walla Walla Basin

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Abstract

Bull trout distribution, abundance and habitat quality have declined range wide and several local extirpations have been documented. As a result, the Columbia River Distinct Population Segment of bull trout was listed as threatened under the Endangered Species Act in June 1998. Mainstem Snake and Columbia River dams have the potential to impact migratory bull trout. Little is known about use of the Columbia River by bull trout from the Walla Walla Basin and the need for further research is identified in the U.S. Fish and Wildlife Service Draft Recovery Plan. A full stream width passive integrated transponder (PIT) array was maintained in the lower Walla Walla River and used to monitor use of the Columbia River by bull trout from the Walla Walla Basin from October 2007 through September 2008. We PIT tagged 158 bull trout in the Walla Walla Basin during the year, including a significant number lower in the Basin near the Burlingame Diversion facility. Additional bull trout tagged by other agencies in Mill Creek (tributary to the Walla Walla River), the South Fork Walla Walla River, and the Touchet River were also available for detection. Six PIT tagged bull trout were detected moving through the lower Walla Walla River toward the Columbia River from November 2007 through January 2008. Additional PIT tagged bull trout may have passed the array undetected when detection efficiencies were relatively low. Since only a small proportion of Walla Walla Basin bull trout are PIT tagged, these six detections likely represent some larger number of bull trout exhibiting a similar pattern of movement. In addition, a Walla Walla Basin bull trout from the Touchet River was detected in the juvenile fish bypass at John Day Dam on the Columbia River.

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Introduction

Bull trout distribution, abundance, and habitat quality have declined range wide and several local extirpations have been documented. As described in Gallion and Anglin (2009), the Columbia River Distinct Population Segment (DPS) of bull trout was listed as threatened under the Endangered Species Act in June 1998 (63 FR 31647). Declines in bull trout distribution and abundance are the results of the combined effects of habitat degradation and fragmentation, blockage of migratory corridors, poor water quality, entrainment into irrigation diversion canals, and the effects of introduced nonnative species (U.S. Fish and Wildlife Service 2002a).

Mainstem Snake and Columbia River dams have the potential to impact migratory bull trout. It is not known if adequate conditions for bull trout passage are present at the mainstem dams, but elsewhere, dams have created barriers to migration and isolated previously connected populations (Nerass and Spruell 2000). Dams and associated reservoirs also alter the natural hydrograph (U.S. Fish and Wildlife Service 1998) and riverine habitat used by migratory bull trout. Reservoirs create warm water habitats that not only are unfavorable to bull trout, but also provide favorable conditions for exotic predators and competitors (Harza 2000). In addition to possible passage delays at mainstem dams, bull trout also have the potential to be entrained into the turbines which may result in injury or mortality (Skarr et al. 1996).

In 2002, the U.S. Fish and Wildlife Service (FWS) issued a draft Recovery Plan for the Umatilla-Walla Walla Recovery Unit (U.S. Fish and Wildlife Service 2002b) which described conditions within the Unit, defined recovery criteria, and identified recovery actions. The Umatilla-Walla Walla Recovery Unit is one of 22 Recovery Units in the Columbia River DPS. The FWS Recovery Plan identifies three Core Areas within the Umatilla-Walla Walla Recovery Unit; the Umatilla River Core Area, the Walla Walla River Core Area, and the Touchet River Core Area. In addition, the Yakima and Tucannon Core Areas are also within close proximity to the Walla Walla Basin Core Areas. The Columbia River between the Umatilla Core Area and the Walla Walla and Touchet Core Areas is identified as an area of research need due to uncertainty about its current or potential use by bull trout as rearing, overwintering, and migration habitat. Within the Walla Walla River Core Area, both Upper Mill Creek and Upper Walla Walla River local populations are known to support migratory fish, but until recently, it was unknown if these migratory bull trout used the Columbia or Snake rivers. The U.S. Army Corps of Engineers funded the FWS in 2005 to install and operate a passive integrated transponder (PIT) detection array at Oasis Road Bridge (ORB) on the Walla Walla River (rkm 10). No bull trout were detected at this array in 2005 or 2006, and one PIT tagged bull trout was detected at the array moving toward the Columbia River in January 2007. In addition to the single detection, it is also possible that additional PIT tagged bull trout passed the array undetected when detection efficiency was low. Our goals during 2008 were to maintain the ORB PIT detection array and to continue to PIT tag migratory bull trout, with a focus on lower Basin areas to increase the number of tagged fish that would potentially move out of the Walla Walla Basin and into the mainstem Columbia River (i.e. McNary Pool). Further defining the timing and level of use of the Columbia River is the first step to assess the potential impacts mainstem dams and reservoirs may have on migratory bull trout. In addition, if observations of migratory bull trout from the Walla Walla Basin using the Columbia River continue, their presence at upstream and downstream hydro projects should be investigated.

The objectives of this project during the reporting period were to:

1. Determine the number of PIT tagged bull trout from the Walla Walla Basin that enter the Columbia River.

2. Determine when PIT tagged bull trout from the Walla Walla Basin enter and return from the Columbia River.

Background

Migratory bull trout make up a portion of the total bull trout populations in most Core Areas, including the Core Areas in the Walla Walla Basin. Bull trout migrations have been studied in the Walla Walla Basin using radio telemetry (Mahoney 2003, Mendel et al. 2003, Mahoney et al. 2006, Anglin et al. 2008a) and PIT tag detection arrays (Anglin et al. 2008a, Anglin et al. 2008b, Gallion and Anglin 2009, Anglin et al. 2009). Mahoney et al. (2006) investigated movements of adult bull trout in the Walla Walla River, and results indicated overwintering migratory adult bull trout moved downstream from October through December, and the lower limit of the winter distribution was near the Oregon (OR)/Washington (WA) state line. Studies in Mill Creek by Hemmingsen et al. (2002) investigated movements of adult bull trout, and Weeber et al. (2007) investigated movements of subadult bull trout. Neither study found evidence of bull trout emigrating from Mill Creek. Limitations of these and other radio telemetry studies include relatively small numbers of tagged individuals, and radio tag life spans that are relatively short (e.g. <2 years). In comparison, PIT tags can be used to monitor movements of large numbers of bull trout for long time periods. In addition, relatively small bull trout can be PIT tagged because of the small tag size (12 mm, 23 mm) and light weight (~0.10 g, ~0.62 g). PIT tags remain active for the life of the fish, the implantation procedure is less invasive, and PIT tags are less expensive than radio tags, which allows a larger proportion of the population to be marked for a given cost.

Current and past research projects, including this project, have resulted in a significant number of PIT tagged bull trout in the Walla Walla Basin (Table 1). Tagging data were queried from the Columbia Basin PIT Tag Information System (PTAGIS) database for all agencies except the U.S. Geological Survey-Utah Cooperative Fish and Wildlife Research Unit (USGS-USU) which were taken from Budy et al. (2003, 2004, 2005, 2006, 2007, 2008). PIT tagged fish from these groups that have not been lost to mortality are available for detection at the ORB detection array, although it is not possible to estimate the proportion of the total that may be long range migrants.

Table 1. Number of bull trout PIT tagged in the Walla Walla Basin by reporting year (October 1 through September 30) and agency.

Year	USGS-USU	USFS[a]	ODFW[b]	FWS	CTUIR[c]	WDFW[d]	Total
2001			68			25	93
2002	211		140			11	362
2003	468		67			41	576
2004	410		67		9	55	541
2005	417		618		3	39	1077
2006	221	1220	2	11	2	37	1493
2007	374	1079		11	23	18	1505

[a]-U.S. Forest Service
[b]-Oregon Department of Fish and Wildlife
[c]-Confederated Tribes of the Umatilla Indian Reservation
[d]-Washington Department of Fish and Wildlife

Between 2002 and 2007, the FWS installed several PIT detection arrays in the Walla Walla Basin to determine the temporal and spatial aspects of bull trout movement, distribution, and connectivity between local populations (Anglin et al. 2008a, 2008b). The eight detection arrays (Figure 1) installed in mid- and upper-basin areas (Harris Park, Bear Creek, Nursery Bridge, Kiwanis Camp, Bennington Diversion, Division Ladder, Yellowhawk Creek, and Yellowhawk Creek 2) allowed us to determine distribution and movements of migratory bull trout that originate in headwater spawning and early rearing areas (upper South Fork Walla Walla River, upper Mill Creek). The next step in our research was to determine distribution and movements for longer range migrants that may have been using the lower Walla Walla River and Columbia River. In 2005, we installed the ORB PIT detection array 10.1 rkm upstream from the mouth of the Walla Walla River (Gallion and Anglin 2009) to examine movement into or out of the Columbia River. In 2007 we installed the Burlingame PIT detection (Figure 1) array to determine distribution and movements between the upstream arrays and the ORB array, and to acquire better definition of those movements. A total of 27 PIT tagged bull trout were detected at the new Burlingame detection array in 2007, and an additional 12 bull trout were captured and PIT tagged at this location. These results suggested that a significant number of bull trout were continuing their migration into the lower Walla Walla River. The first evidence of bull trout using the Columbia River was a bull trout detection at ORB on January 31, 2007 (Anglin et al. 2009). However, only this single bull trout was detected. Considering these results, we installed a new PIT detection array during 2008 in the ladder at Lowden Diversion Dam (Figure 1) to determine the relative number of PIT tagged bull trout that continued their migration downstream from Burlingame. Our goal was to determine the fate of migratory bull trout that move downstream as far as Burlingame, but do not appear to continue on to the mouth of the Walla Walla River past the detection array at ORB, or into the Columbia River.

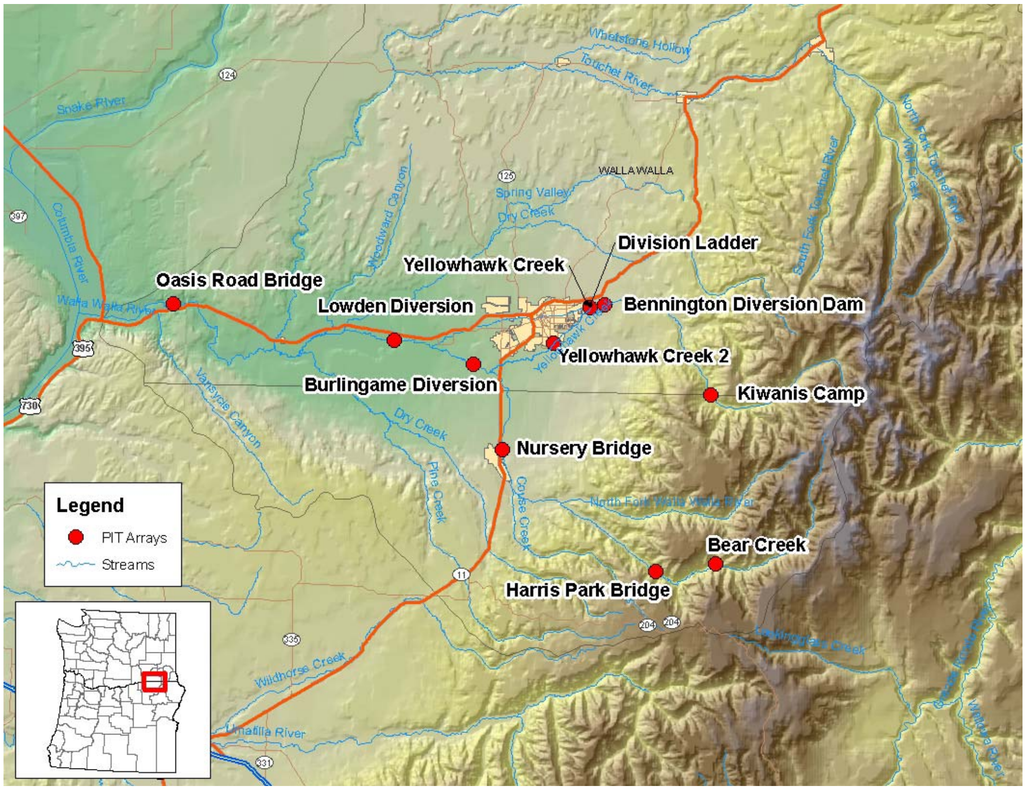

Figure 1. Locations of PIT detection arrays in the Walla Walla Basin.

Methods

PIT Detection Array Operation and Maintenance

Monitoring use of the Columbia River by Walla Walla Basin bull trout continued during the reporting period. The FWS continued operation and maintenance of the PIT tag detection array at Oasis Road Bridge in the lower Walla Walla River (Figure 1). The site configuration consisted of a pass through (PT) detection array comprised of six individual antennas. The PT antennas detect most PIT tagged fish when they pass through the inner space of the antenna structure (Figure 2). The floating design of our PT antennas maximizes the proportion of the water column monitored, but it is susceptible to damage from high flows and debris accumulation. Installation and testing of a second pass over (PO) detection array was conducted in 2007 but the results were not satisfactory and the pass over array was disconnected (Anglin et al. 2009). Routine maintenance and removal of debris from the site was conducted when stream conditions allowed access to the antennas.

Data from the multiplexors that control the PT antennas and record detections into a buffer were also recorded on a portable computer at the site, and regularly uploaded to the regional PTAGIS database using remote communications. To improve reliability of communications at the site, we discontinued using a satellite modem and began using a Wi-Fi wireless local area network for internet access on December 10, 2007. Routine inspection and maintenance of the antenna arrays were conducted when streamflows allowed to repair broken antennas and cables, and to remove debris from the antennas.

Figure 2. Oasis Road Bridge pass through (PT) PIT detection array near the confluence of the Walla Walla River and Columbia River.

Detection Efficiency - Physical

Detection efficiency calculations for the PT PIT detection array based on physical factors (e.g. streamflow) and antenna performance were described in the 2005/2006 Annual Report for this project (Gallion and Anglin 2009). These calculations included two factors:

- Site functionality status, and
- Individual antenna and overall PT array efficiency.

<u>Site Functionality</u> – The site is comprised of six, separate antennas. Antennas can cease to operate efficiently for several reasons including; blown out by high flows, leakage and short circuit, antenna cable broken or chewed off, power supply, and tuning. In addition, if the power supply to the site is down, none of the antennas will operate. All of these factors determine the proportion of time that the site was partially or fully functional.

<u>Individual Antenna and Overall Site Efficiency</u> – Physical detection efficiency is affected by two, primary factors; streamflow magnitude, and the coverage of the electromagnetic field within and/or around each PT antenna. High streamflows depress the antennas and cause water to flow

over the tops and around the bank antennas. Fish that pass in these areas may not be detected. Coverage of the electromagnetic field for the PT antennas was discussed in Gallion and Anglin (2009), and Anglin et al. (2009), and was nearly always 100% within the pass through area of the antennas. Individual antenna efficiency tests were not conducted in 2008 as they had been from 2005-2007. We assumed, based on repetitive measurements conducted from 2005-2007, that antenna performance was 100%, or coverage was complete within each individual antenna (i.e. there were no holes).

We used the same method in 2008 that was described in Gallion and Anglin (2009), and Anglin et al. (2009) for physical efficiency estimates. This method was based on site functionality, streamflow magnitude, and antenna efficiency. Evaluation of the following variables on a daily basis provided the data for efficiency estimates:

- Site functionality was determined (using remote communications) by identifying individual antennas in the array that were missing or broken. In addition, the multiplexor creates interrogation files that provide diagnostics for each of the antennas. These diagnostics establish the operational status of the antennas and contribute to efficiency estimates.
- Average daily stage at USGS gage #14018500 on the Walla Walla River near Touchet was used to estimate stage height at the array.
- Cross sectional area of the stream at the array was calculated based on stage height.
- The percent coverage of the water column was calculated for each antenna.
- The physical detection efficiency (percent of the stream cross section monitored) of the array (all antennas) was calculated.

These data were combined and averaged for monthly estimates of antenna functionality and efficiency, and monthly physical detection efficiency for the entire array.

Detection Efficiency - Biological

We considered using PIT tagged bull trout to estimate biological detection efficiency directly for the array, but abundance was too low to obtain sufficient numbers of fish. We considered conducting efficiency tests with Chinook salmon or summer steelhead smolts in 2007, and we concluded that the disparity between outmigrant anadromous fish behavior with 12 mm PIT tags and bull trout behavior with 23 mm PIT tags was too great to be of much value. However, we decided a reasonable compromise might consist of using summer steelhead yearlings with 23 mm PIT tags rather than 12 mm PIT tags. After discussing the idea with the CTUIR, we concluded that the tests could be conducted, and we coordinated with the Tribe for 14 PIT tagged yearling steelhead release groups between April 3 and May 29, 2008. PIT tagged steelhead were released approximately 150 m upstream from the ORB detection array. Biological detection efficiencies were calculated by dividing the number of fish detected by the number of fish released for each release group. Efficiencies were then averaged for three streamflow ranges representing lower flows (445-618 cfs), intermediate flows (1070-1230 cfs), and higher flows (1460-1680 cfs) to determine if there was a streamflow-related pattern for biological detection efficiency similar to what we have observed for physical detection efficiency. Streamflows in the lower range represent conditions when the antennas are near the water surface, and physical detection efficiency should be near 100%. Thus, we would expect biological detection efficiency to be the highest. As streamflow increased, we anticipated reductions in both physical and biological efficiencies.

Bull Trout Sampling/PIT Tagging

Our goal continued to be focused on sampling and PIT tagging bull trout that were likely to migrate downstream, through the Walla Walla Basin and into the Columbia River. Radio telemetry and PIT detections initially indicated that bull trout downstream dispersals occurred primarily during the spring with some additional activity during the fall. After examining the most recent PIT detection data and fish sampling data, we determined that fall dispersals may be as significant as spring dispersals. Considering that sampling efficiency during the fall is much higher than during the spring (i.e. lower streamflows), we substantially increased our sampling effort from October through December. Sampling was conducted from October through December 2007, and March through September 2008 in mid- to lower-Basin areas. In addition, we assisted with a salvage operation at the Burlingame Diversion facility in January 2008.

Hook and line sampling was conducted primarily in pools from approximately rkm 82, upstream from Nursery Bridge, to rkm 60 near the Burlingame Diversion facility on the Walla Walla River, and from rkm 18 near Bennington Diversion Dam on Mill Creek to rkm 17 at the confluence with Yellowhawk Creek. Hook and line sampling was also conducted in upper Yellowhawk Creek. See Figures 1 and 3 for locations.

Fyke nets were deployed in the fish bypass return channel at the Little Walla Walla Diversion facility (rkm 76) upstream from Nursery Bridge, and at the fish bypass return channel at the Burlingame Diversion facility (rkm 60) on the Walla Walla River. A fyke net was also deployed below the head gate at the upper end of Yellowhawk Creek. See Figures 1 and 3 for locations. Fyke nets were typically deployed for continuous 24-hour periods while in the field, and checked each morning and evening.

Other fish sampling efforts in the Basin (Figure 3) resulted in additional PIT tagged bull trout. The CTUIR operated a screw trap in the Walla Walla River near rkm 79 just upstream from Milton-Freewater, OR. This effort was conducted primarily for Chinook salmon and steelhead, but when bull trout of sufficient size were captured, they were PIT tagged. The USFS operated a screw trap, primarily for bull trout, in upper Mill Creek, USGS-USU electro-seined for bull trout in the upper South Fork Walla Walla River, and WDFW operated a screw trap and adult trap in the Touchet River near Dayton, WA for multiple species. Bull trout tagged during these efforts were tagged with both 12 mm and 23 mm PIT tags.

Captured bull trout were anesthetized with MS-222 (tricaine methanesulfonate), scanned for PIT tags, and measured. A 23 mm PIT tag was applied to all untagged bull trout of sufficient size (>120 mm). We tested a new body location for the PIT tag during sampling this year. We previously inserted the PIT tag into the body cavity through a 3-4 mm incision made with a scalpel. Our goal was to eliminate the invasive nature of opening up the body cavity. An incision was made with a scalpel that was just deep enough to pierce the skin. The PIT tag was then inserted in a subcutaneous position. Fish were recovered for 30 minutes and released on site. All other species were enumerated and released. No sampling was conducted when water temperatures exceeded 18^{o}C.

Figure 3. Bull trout PIT tagging locations in the Walla Walla Basin.

PIT Detections

Detections of PIT tagged fish at ORB were recorded on the laptop computer at the site and uploaded daily along with detection array operational data via a wireless internet connection to the PTAGIS database. Bull trout detections were compared to streamflow and water temperature for the relevant time period. Detections of PIT tagged Chinook and steelhead were summarized by month. In addition to being detected at the ORB PIT array, PIT tagged bull trout have the potential to be detected at mainstem Columbia or Snake river dams. The PTAGIS database was regularly queried for detections of Walla Walla Basin bull trout in the fish ladders and juvenile bypass systems at Bonneville, The Dalles, John Day, McNary, and Priest Rapids dams on the Columbia River, and Ice Harbor Dam on the Snake River.

Results and Discussion

PIT Detection Array Operation and Maintenance

The ORB PIT detection array was partially or fully operational for the majority of time between October 2007 and September 2008. Site visits every other week were sufficient to control debris on the array except during high spring flows. Remote access to the site via satellite modem and wireless internet provided operational data from the multiplexor that allowed us to determine that all six antennas were present and not damaged for the entire year.

Intermittent power outages affected site functionality between January and April 2008. The change between satellite communications and wireless internet communications required different equipment components that exceeded the power supply. The power outages caused the site to be down a total of 7% of the time over this four month period. A second thermoelectric generator was available at the site, so we started the unit to supply additional power until we could examine the site configuration and determine if it could be changed so operation on one generator could be resumed. The effect of the power outages on site detection efficiency is discussed in the following section.

River discharge and the corresponding stage height exceeded the monitoring height of the array at times from December 2007 through June 2008. The effect of higher discharges on site efficiency are discussed further in the following section.

Detection Efficiency - Physical

Individual antenna performance and the overall monthly physical detection efficiency of the ORB detection array are shown in Table 2. As discussed previously, based on repetitive measurements conducted from 2005-2007, antenna performance was assumed to be 100% when antennas were present and not damaged.

Overall array detection efficiency based on site functionality, streamflow magnitude, and antenna efficiency ranged from 77% to 99% during 2008 (Table 2). All six antennas remained intact, but detection efficiency never reached 100% because there is a small space in between antennas where fish can pass undetected. Detection efficiency was less than 99% when stream stage exceeded the monitoring height of antennas and when there were occasional power outages at the site. Following is a monthly summary of the factors that affected physical detection efficiency and reduced it to less than 99%:

<u>December 2007</u> – Two brief spikes in stream stage and discharge reduced efficiency to 97%.
<u>January 2008</u> – One five day spike in stream stage and discharge, and power outages for a total of 20 hours, reduced efficiency to 95%.
<u>February 2008</u> – Streamflow exceeded the height of the array for approximately three quarters of the month, and power outages for a total of 57 hours reduced efficiency to 81%.
<u>March 2008</u> – Streamflow exceeded the height of the array for approximately two thirds of the month, and power outages for a total of 35 hours reduced efficiency to 86%.

April 2008 – Streamflow exceeded the height of the array for approximately one third of the month, and power outages for a total of 100 hours reduced efficiency to 81%.
May 2008 – Streamflow exceeded the height of the array for the entire month, resulting in the lowest physical detection efficiency of the year at 77%.
June 2008 – Streamflow exceeded the height of the array for 60% of the month, reducing efficiency to 89%.

Detection efficiency may have been less than the values reported in Table 2 because of the random and unknown effect of debris accumulation between site visits. The accumulation of debris may have caused the antennas to "sink" due to the increased resistance from the debris in the current, thereby reducing the proportion of the water column monitored.

Table 2. Percent area monitored for individual antennas and average monthly percent physical detection efficiency at the ORB PIT detection array.

	Antenna						Detection Efficiency
Date	1	2	3	4	5	6	(%)
October 2007	100%	100%	100%	100%	100%	100%	99
November 2007	100%	100%	100%	100%	100%	100%	99
December 2007#	100%	100%	100%	100%	100%	100%	97
January 2008*#	100%	100%	100%	100%	100%	100%	95
February 2008*#	100%	100%	100%	100%	100%	100%	81
March 2008*#	100%	100%	100%	100%	100%	100%	86
April 2008*#	100%	100%	100%	100%	100%	100%	81
May 2008#	100%	100%	100%	100%	100%	100%	77
June 2008#	100%	100%	100%	100%	100%	100%	89
July 2008	100%	100%	100%	100%	100%	100%	99
August 2008	100%	100%	100%	100%	100%	100%	99
September 2008	100%	100%	100%	100%	100%	100%	99

*The site was intermittently off line for ~7% of the time during these months due to power outages.
#Stream stage height exceeded the monitoring height of the array at times.

Detection Efficiency - Biological

A total of 164 steelhead were released on 14 days from April 3 through May 29, 2008 upstream from the ORB detection array. Of those, 82 were detected, resulting in an overall biological detection efficiency of 50% (Table 3). Biological detection efficiency decreased with increasing streamflow as expected, at least partly because our physical detection efficiency also decreased with increasing streamflow. Power outages occurred on two of the four days that fish were released during the low streamflow period (April 10, 11). These outages affected both physical and biological efficiency. Using only the two days when no problems occurred, biological detection efficiency would have been 87% and physical detection efficiency would have been 98%. Although the pattern of decreasing detection efficiency as a function of increasing streamflow was similar for both biological and physical efficiency, the reduction was much greater for biological efficiency, particularly at the highest streamflows tested. This outcome may have been a result of steelhead migratory behavior. Outmigrant anadromous fish including steelhead, typically use the upper portion of the water column on their downstream migration. Physical efficiency during the high flow period indicated that approximately three quarters (77%) of the water column was monitored. At higher flows, water velocity increases and the antennas become depressed in the water column. Also, debris load typically increases as streamflow increases. These two factors may have caused the antennas to "sink", reducing the proportion of the water column monitored. It is likely that the majority of steelhead passed over the top of the array under these higher flows. Since bull trout are bottom-oriented, including during their downstream dispersals, we expect that the biological detection efficiency would have been higher had we been able to conduct the efficiency tests with bull trout.

Table 3. Biological detection efficiencies estimated from 14 PIT tagged yearling steelhead release groups for three different streamflow conditions at the ORB PIT detection array**.** Physical detection efficiencies are also shown for the release dates and streamflow conditions.

Release Date	Streamflow (cfs)	# Released (N=164)	# Detected (N=82)	Biological Detection Efficiency	Physical Detection Efficiency
April 3	445	10	9	90%	98%
April 10*	571	9	6	67%	42%
April 24	590	20	17	85%	98%
April 11*	618	10	6	60%	76%
	$\overline{X}$=556	Sum=49	Sum=38	**77.6%**	$\overline{X}$=78.5%
April 17	1070	10	6	60%	88%
May 13	1120	15	6	40%	87%
May 14	1190	14	7	50%	85%
April 29	1230	10	8	80%	83%
	$\overline{X}$=1152	Sum=49	Sum=27	**55.1%**	$\overline{X}$=85.8%
May 9	1460	14	3	21%	78%
April 16	1490	10	2	20%	77%
April 30	1520	15	4	27%	77%
May 27	1630	10	1	10%	79%
May 8	1660	11	5	45%	74%
May 29	1680	6	2	33%	77%
	$\overline{X}$=1573	Sum=66	Sum=17	**25.8%**	$\overline{X}$=77.0%

*Power outages reduced physical detection efficiency, and possibly biological detection efficiency

Bull Trout Sampling/PIT Tagging

We captured and PIT tagged a total of 158 bull trout during the year (Table 4). Hook and line sampling was the most productive, yielding 134 bull trout. Fyke net sampling produced a total of 21 bull trout. Although hook and line sampling was the most efficient method, fyke nets allow us to sample areas that are difficult for hook and line sampling, and the nets fish without our continuous presence. An additional three bull trout were captured and PIT tagged during a salvage operation at the Burlingame Diversion facility. Bull trout fork length ranged from 102 mm to 589 mm, with a mean length of 253 mm. Sampling during the fall and early winter, from October through January, produced 73 bull trout (46% of the total), and sampling during the spring and late summer, from April through late August, produced 85 bull trout (54% of the total). Subadult bull trout (<300 mm) were captured during both time periods and were presumably dispersing downstream to rearing areas. Adult bull trout (>300 mm) captured during the late summer and fall time periods, were moving downstream to overwintering areas. Adults captured during the spring, were moving upstream to spawning areas in the South Fork Walla Walla River or Mill Creek.

Table 4. Bull trout captured and PIT tagged in the Walla Walla Basin between October 2007 and September 2008. Refer to Figure 1 for locations.

	Little Walla Walla Diversion	**Nursery Bridge Dam**	**Burlingame Diversion**	**Joe West Bridge**	**Harris Park Bridge**	**Mill Creek Complex**	**Yellowhawk Creek**	**Total**
Oct-07	10	2	0	0	0	1	1	**14**
Nov-07	21	2	25	1	0	3	2	**54**
Dec-07	0	0	2	0	0	0	0	**2**
Jan-08	0	0	3	0	0	0	0	**3**
Feb-08	0	0	0	0	0	0	0	**0**
Mar-08	0	0	0	0	0	0	0	**0**
Apr-08	5	0	0	0	0	1	0	**6**
May-08	0	0	0	0	0	1	0	**1**
Jun-08	9	0	0	0	0	0	1	**10**
Jul-08	30	28	0	0	2	4	0	**64**
Aug-08	4	0	0	0	0	0	0	**4**
Sep-08	0	0	0	0	0	0	0	**0**
TOTAL	**79**	**32**	**30**	**1**	**2**	**10**	**4**	**158**

The results of our sampling efforts increased from 12 bull trout last year to 158 bull trout this year. The large increase in our catch was the result of an extended sampling season, and our increased knowledge of the spatial and temporal distribution of migratory bull trout over the course of the year. Unlike 2007, water temperatures during 2008 remained below 18^{o}C for at least part of the day during the summer, which allowed us to sample during July and August. In addition, our life history work in the Walla Walla Basin over the last five years, along with the network of PIT detection arrays that we installed throughout the Basin during the same time period, has improved our understanding of subadult and adult movement and dispersal patterns. This was the primary factor that resulted in our increased sampling effort and success during the fall and early winter time period.

In addition to our sampling effort, a total of 39 bull trout were captured and PIT tagged by the CTUIR in their screw trap near Milton-Freewater, OR at rkm 82 (Figure 3). Other researchers captured and PIT tagged an additional 1,528 bull trout during 2008 in upper basin areas (Table 5). These bull trout will also be available for detection at the ORB PIT detection array, although the proportion that are migratory is unknown.

Table 5. Total number of bull trout PIT tagged by other agencies in headwater areas of the Walla Walla Basin between October 2007 and September 2008.

Agency	Location	PIT Tagged Bull Trout
USFS	Upper Mill Creek	813
USGS-USU	South Fork Walla Walla River	603
WDFW	Touchet River near Dayton, WA	112
Total		**1528**

PIT Detections

For the second consecutive year of this study, bull trout from the Walla Walla Basin were detected moving through the lower Walla Walla River toward the Columbia River. Six PIT tagged bull trout were detected at the ORB PIT array from November 17, 2007 through January 7, 2008 (Table 6). Of the six fish detected, one was tagged in the in the South Fork Walla Walla River, one was tagged in Lower Mill Creek and four were tagged in the Walla Walla River.

The bull trout tagged in the South Fork Walla Walla River (SFWW) shows the typical pattern of the migratory life history form (Table 6). This fish was tagged in the SFWW spawning/early rearing area, and spent approximately 16 months rearing in the same area before it moved downstream. During the typical fall dispersal time period (October-December), this fish moved from the SFWW to the mouth of the Walla Walla River past the ORB PIT array (January 7, 2008). The next four bull trout in Table 6 (three subadults, one adult) were PIT tagged in mid-Basin areas at the Burlingame Diversion and Nursery Bridge, and subsequently detected at ORB moving toward the Columbia River. The last bull trout detected at ORB is listed in Table 6 as an adult. Although we use a fork length of 300 mm to separate subadults and adults, this is not a definitive criteria. It is a general guideline. This fish could have been a subadult moving downstream to rear, or an adult moving downstream to overwinter. This was the second bull trout known to have originated in Mill Creek and subsequently moved out of the Walla Walla Basin to the Columbia River. This fish moved down Yellowhawk Creek to the Walla Walla River rather than using the Mill Creek corridor. Mill Creek streamflows were less than 50 cfs for most of November 2007, and passage conditions in Mill Creek were poor. This fish moved approximately 74 rkm in 16 days (4.6 rkm/day), a much faster rate than the Mill Creek subadult bull trout that was detected at ORB earlier in 2007 (Anglin et al. 2009).

Water temperatures during the time period when these bull trout were moving down the mainstem Walla Walla River towards ORB were suitable, ranging from 8^{o}C to slightly above 0^{o}C (Figure 4). Discharge in the mainstem Walla Walla River was at base flow in early November, followed by an increase to about 150 cfs on November 14 (Figure 4). Fish passage in the Walla Walla River is severely impaired at base flow, and most of the downstream movement of these PIT tagged bull trout likely occurred after the increase in discharge on

November 14. We have observed movement patterns in the past that suggested low fall streamflows (i.e. base flow) inhibited movement, and as soon as streamflows increased, detections at downstream arrays occurred. The detection histories in Table 6 suggest this may have happened during fall 2007.

The ORB PIT detection array recorded 889 detections of Chinook salmon and 1,744 detections of summer steelhead. Steelhead and Chinook salmon were detected from November 2007 through September 2008. The majority of the detections occurred in April (68%) and May (26%). The large numbers of steelhead and Chinook salmon detections during April and May corresponded with releases of hatchery steelhead and Chinook salmon smolts (PTAGIS).

Table 6. Tagging and detection history details for PIT tagged bull trout detected at the ORB PIT detection array in 2008.

Adult/Subadult (length)	**Date Tagged (*)/ Detected**	**Elapsed Time (days)**	**Location Tagged (*)/ Detected**
Subadult	7/06/2006*	N/A	South Fork Walla Walla (SFWW) *
(170 mm)	10/27/2007	478	SFWW Bear Creek (rkm 105)
	10/31/2007	4	SFWW Harris Park (rkm 97)
	1/07/2008	68	Oasis Road Bridge (rkm 10)
Subadult	11/07/2007*	N/A	Nursery Bridge (rkm 74)*
(285 mm)	11/17/2007	10	Burlingame Diversion (rkm 60)
	12/18/2007	31	Oasis Road Bridge (rkm 10)
Subadult	11/08/2007*	N/A	Burlingame Diversion (rkm 60)*
(285 mm)	11/21/2007	13	Oasis Road Bridge (rkm 10)
Subadult	11/27/2007*	N/A	Burlingame Diversion (rkm 60)*
(285 mm)	12/19/2007	22	Oasis Road Bridge (rkm 10)
Adult	11/08/2007*	N/A	Burlingame Diversion (rkm 60)*
(315 mm)	12/02/2007	24	Oasis Road Bridge (rkm 10)
Adult	10/25/2007*	N/A	Bennington Diversion Dam Mill Creek (rkm 19)*
(300 mm)			
	11/01/2007	7	Bennington Diversion Dam Mill Creek (rkm 19)
	11/04/2007	3	Upper Yellowhawk Creek(rkm 14)
	11/04/2007	0	Middle Yellowhawk Creek #2 (rkm 8)
	11/07/2007	3	Burlingame Diversion (rkm 60)
	11/10/2007	3	Burlingame Diversion (rkm 60)
	11/17/2007	7	Oasis Road Bridge (rkm 10)

* Initial tagging date and location

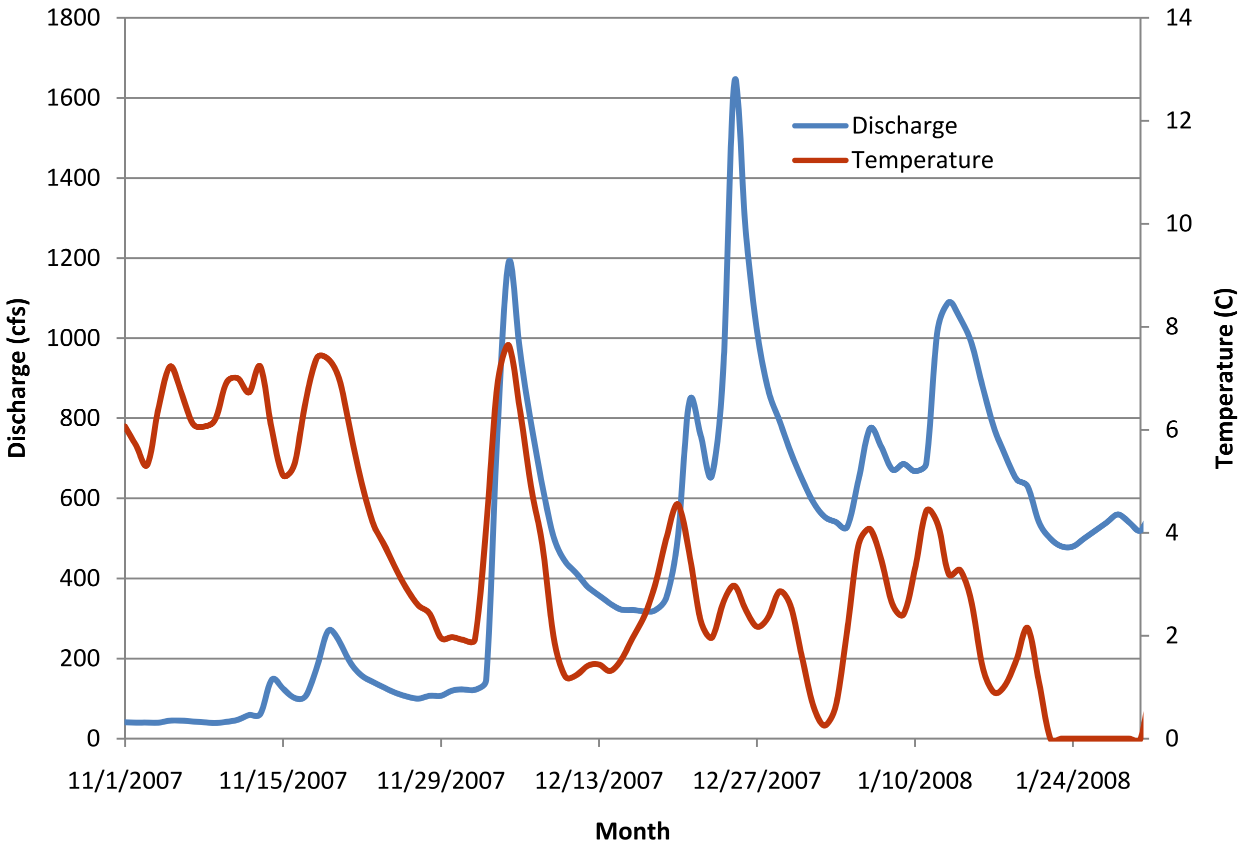

Figure 4. Walla Walla River average daily discharge from USGS gage #14018500 on the Walla Walla River near Touchet, and Walla Walla River average daily water temperature from the FWS thermograph at the ORB PIT detection array.

Bull trout PIT tagged in the Walla Walla Basin that subsequently move into the Columbia River have the potential to be detected at mainstem Columbia or Snake River dams. One bull trout that was originally tagged on April 24, 2008 in the Touchet River was detected on May 12, 2008 at the John Day Dam juvenile fish bypass PIT array (Table 7). This subadult bull trout moved 87 rkm down the Touchet River to the Walla Walla River, 35 rkm down the Walla Walla River to the Columbia River, 36.4 rkm down the Columbia to McNary Dam, and 122.9 rkm down the Columbia to John Day Dam, for a total distance of 281.3 rkm. The corresponding rate of movement was 15.6 rkm/day. This bull trout was not detected at the ORB detection array. Streamflows in the Walla Walla River during this time period reduced the physical detection efficiency of the ORB array. In addition, there were nearly four days during April when the site was down because of power outages. This bull trout also passed McNary Dam without being detected. Spring spill at the Columbia River mainstem hydro projects typically starts about April 10. If this fish passed McNary Dam via the turbines or via spill, it would not have been detected.

Table 7. Tagging and detection history details for the PIT tagged bull trout detected at the John Day Dam Juvenile Bypass PIT detection array in 2008.

Adult/Subadult (length)	Date Tagged (*)/ Detected	Elapsed Time (days)	Location Tagged (*)/ Detected
Subadult (155 mm)	04-24-08*	N/A	Touchet River (rkm 87) Dayton Pond*
	05-12-08	18	Columbia River (rkm 347) John Day Dam Juvenile Bypass

Future Plans

During 2009 we plan to continue monitoring and evaluating performance of the ORB PIT detection array. We will also continue to calculate detection efficiency. Physical detection efficiency data based on physical parameters including site functionality and stream stage height will be collected and efficiency will be estimated on a monthly basis. We will continue to refine and focus sampling sites under fall, winter, and spring flow conditions to increase our catch of migratory bull trout in mid- and lower-basin areas. We will continue fyke net and hook and line sampling. We will also continue to coordinate with the CTUIR on their screw trap sampling for an additional source of PIT tagged bull trout. We plan to coordinate with the CTUIR for another series of PIT tagged steelhead releases using 23 mm PIT tags. These tests provide useful information, particularly at low flows when the majority of the river is monitored. We will also continue to monitor Columbia and Snake river dams for mainstem detections of PIT tagged Walla Walla Basin bull trout.

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