Bull Trout Distribution, Movements and Habitat Use in the Umatilla and John Day River Basins

2007 Annual Progress Report

Prepared by:

Paul M. Sankovich
Donald R. Anglin

Department of the Interior
U.S. Fish and Wildlife Service
Columbia River Fisheries Program Office
1211 SE Cardinal Court, Suite 100
Vancouver, WA 98683

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Table of Contents

List of Figures

List of Tables

Abstract

The goal of the U.S. Fish and Wildlife Service's studies in the Umatilla and John Day basins is to provide information that can be used to develop recovery actions for bull trout (*Salvelinus confluentus*) listed as threatened under the Endangered Species Act. In 2007, we focused on gaining a better understanding of the seasonal distribution and movement of subadult bull trout in the Umatilla Basin and of fluvial adult bull trout in the John Day Basin. In the Umatilla Basin, we continued to track one subadult that had been outfitted with a 293-d tag in August 2006, and operated a screw trap in spring and snorkeled at night in late summer and fall in the upper Umatilla River to capture additional subadults for radio or passive integrated transponder (PIT) tagging. We also maintained one PIT tag detection array in the North Fork Umatilla River near its mouth (UM1), and another 15 km downstream in the Umatilla River (UM2; installed in August). Although our primary focus was on subadults, we radio and PIT tagged two fluvial adult-sized bull trout captured at Three Mile Falls Dam (rkm 6) in spring to fill in gaps in our knowledge of fluvial adult movements. We radio tagged 36 of 55 bull trout captured in the screw trap, and PIT tagged 13 of them. We observed only two subadults while snorkeling at night and failed to capture both of them. The subadult tagged in 2006 moved downstream in stages. It remained at its release site in the Umatilla River near the mouth of the North Fork (rkm 143) from early August through mid-September 2006. It then moved downstream to rkm 137 between mid-September and mid-November 2006 and downstream to Cayuse (rkm 110) between mid-November 2006 and March 2007. It was last located in Cayuse in July 2007. Of the 36 radio tagged bull trout captured at the screw trap, 20 moved downstream 3.2 to 35.5 km (mean = 13.7 km), six remained near the release site, and seven were never located during the lives of their 45- or 96-d tags. The fish that moved downstream reached their lowermost location in a maximum of 3 to 46 d. All were distributed upstream from Cayuse. One of the bull trout tagged at Three Mile Falls Dam reached the upper Umatilla River (rkm 122) within 19 d of its release, but its tag was shortly thereafter located in a trailer park in Pendleton (rkm 90), indicating it had either been poached or legally harvested by a tribal member. The other bull trout tagged at Three Mile Falls Dam was last observed 6 km downstream from the mouth of McKay Creek (rkm 76) in mid-June, when stream temperatures in the Umatilla River upstream from McKay Creek (an unnatural cold water input) may have been unsuitable for continued upstream migration. Nine and five bull trout that were subadult sized when tagged in the North Fork by researchers from Utah State University were detected at UM1 and UM2, respectively. The detections at UM1 occurred in April, May, June, and August. The detections at UM2 occurred in September and October and included three of the fish that passed UM1 in April-August. In the John Day Basin, we continued to track three fluvial adult bull trout and three apparent brook trout (*Salvelinus fontinalis*) x bull trout hybrids that had been radio tagged in the upper North Fork John Day River in 2005 and 2006, and we operated a weir trap in the upper North Fork in summer to capture additional fish for tagging. We also conducted spawning ground surveys in the North Fork and its tributaries Baldy and South Fork Desolation creeks to gather information on abundance and distribution. No bull trout or apparent hybrids were captured in the weir trap. Only one of the fish tagged in 2005-06 moved extensively during the life of its tag. It was an apparent hybrid that migrated between the spawning grounds in the North Fork and wintering sites approximately 70 km downstream in successive years, with no apparent impediments to its movement. Based on the evidence collected in 2007, the remaining tagged fish either lost their tags or died on the spawning grounds or as they began to migrate downstream from them in 2006. During the spawning

ground surveys, we counted three redds in the North Fork John Day River (one of which appeared to have been made by a fluvial female based on its size), and no redds in Baldy and South Fork Desolation creeks. These results, along with the weir trap count, indicate fluvial adult bull trout abundance was exceedingly low.

Introduction

Bull trout (*Salvelinus confluentus*) were officially listed as a Threatened Species under the Endangered Species Act (ESA) in 1998. The U.S. Fish and Wildlife Service (FWS) subsequently issued a Draft Recovery Plan (U.S. Fish and Wildlife Service 2002) which included chapters for the John Day Recovery Unit (Chapter 9) and the Umatilla-Walla Walla Recovery Unit (Chapter 10). The two chapters were updated in 2004 (U.S. Fish and Wildlife Service 2004a, 2004b), and are the current guide for recovery actions in the Umatilla and John Day basins. The goal of bull trout recovery planning by the FWS is to describe courses of action necessary for the ultimate delisting of this species, and to ensure the long-term persistence of self-sustaining, complex interacting groups of bull trout distributed across the species' native range (U.S. Fish and Wildlife Service 2004a, 2004b).

Bull trout are native to the Umatilla and John Day basins, and they exhibit two different life history strategies in those systems. Fluvial bull trout spawn in headwater streams and juveniles rear in these streams for one to four years before migrating downstream as subadults to larger mainstem areas, and possibly to the Columbia River, where they grow and mature, returning to the tributary stream to spawn (Fraley and Shepard 1989). Downstream migration of subadults generally occurs during the spring, although it can occur throughout the year (Hemmingsen et. al. 2001a, 2002). These migratory forms occur in areas where conditions allow for movement from upper watershed spawning streams to larger downstream waters that contain greater foraging opportunities (Dunham and Rieman 1999). Stream-resident bull trout also occur in the two basins, and they complete their entire life cycle in the tributary streams where they spawn and rear. Resident and migratory forms of bull trout may be found living together for portions of their life cycle, but it is unknown if they can give rise to one another (Rieman and McIntyre 1993). Bull trout size is variable depending on life history strategy. Resident adult bull trout tend to be smaller than fluvial adult bull trout (Goetz 1989). Under appropriate conditions, bull trout regularly live to 10 years, and under exceptional circumstances, reach ages in excess of 20 years. They normally reach sexual maturity in four to seven years (Fraley and Shepard 1989; McPhail and Baxter 1996).

When compared to other North American salmonids, bull trout have more specific habitat requirements. The habitat components that shape bull trout distribution and abundance include water temperature, cover, channel form and stability, valley form, spawning and rearing substrates, and migratory corridors (U.S. Fish and Wildlife Service 1998). Throughout their lives, bull trout require complex forms of cover, including large woody debris, undercut banks, boulders, and pools (Fraley and Shepard 1989; Watson and Hillman 1997). Juveniles and adults frequently inhabit side channels, stream margins, and pools with suitable cover (Sexauer and James 1997). McPhail and Baxter (1996) reported that newly emerged fry are secretive and hide in gravel along stream edges and in side channels. They also reported that juveniles are found in pools, riffles, and runs where they maintain focal sites near the bottom, and that they are strongly associated with instream cover, particularly overhead cover. Bull trout have been observed over-wintering in deep beaver ponds or pools containing large woody debris (Jakober et al. 1998). Habitat degradation and fragmentation (Fraley and Shepard 1989), barriers to migration (Rieman and McIntyre 1995), and reduced instream flows have all contributed to the decline in bull trout populations in the Columbia River Basin.

In summary, bull trout need adequate stream flows and temperatures and the corresponding habitat for each of the different life history functions at specific times of the year in order to persist. Habitat conditions must be adequate to provide spawning, rearing, and migration opportunities, cover, forage, seasonal movement, and over-wintering refuges.

The goal of FWS studies in the Umatilla and John Day basins is to develop information and analyses to assist in assessing the relative merit of potential action strategies in making progress towards meeting the requirements outlined in the Umatilla-Walla Walla and John Day Day Recovery Unit chapters of the Draft Recovery Plan (U.S. Fish and Wildlife Service 2004a, 2004b) for the recovery and delisting of bull trout. Specifically, FWS studies were designed to address the following recovery plan objectives:

- Restore and maintain suitable habitat conditions for all bull trout life history stages and strategies, and

- Conserve genetic diversity and provide opportunity for genetic exchange.

The habitat objective should be accomplished through a series of steps designed to restore and maintain suitable habitat conditions for all bull trout life history stages and strategies. The first step should consist of defining the physical conditions that comprise suitable bull trout habitat. The second step should be application of these habitat "criteria" to current conditions to determine the extent of the relevant stream that currently provides suitable habitat. The third step should consist of determination of the changes required to improve habitat in areas indicated in the recovery plan that do not currently provide suitable conditions. The fourth step should consist of implementing changes to restore and maintain suitable habitat conditions for all bull trout life history stages and strategies.

The genetic diversity objective should be accomplished by maintaining connectivity among local populations of bull trout to facilitate gene flow and genetic diversity. As the recovery plan discusses, connectivity consists of maintaining the fluvial component of each local population which includes providing conditions that allow fluvial adults to effectively move between spawning and wintering areas, and ensuring that movement of both fluvial adult and subadult bull trout can occur, at least seasonally, between local populations within each core area in the recovery unit. This includes establishing the physical conditions necessary for up- and down-stream fish passage, and providing a continuum of suitable physical habitat to ensure the persistence of fluvial life stages and provide the opportunity for genetic interchange between local populations within each core area.

The approach FWS used to plan studies in the two basins consisted of the following steps:

- Identify information needed to assess if criteria for recovery objectives are being achieved;

- To that end, design and implement studies to describe bull trout distribution, movement, and seasonal habitat use patterns;

- Use this information and results from these studies to assist in guiding actions that will make progress towards bull trout recovery.

We previously described what was known about the abundance, distribution, and migratory patterns of bull trout and potentially limiting physical conditions in the Umatilla Basin when we initiated our study there in 2004 (Anglin et al. 2008). To summarize, at that time, the only viable population of bull trout appeared to occur in the North Fork Umatilla River, and it appeared to be relatively small. Telemetry studies had shown fluvial adult bull trout did not migrate extensively, remaining within the upper Umatilla River and the North Fork to complete their life cycle (Sankovich et al. 2003, 2004; Oregon Department of Fish and Wildlife [ODFW], unpublished report). Little was known about the movement and seasonal distribution of subadults, but the available evidence suggested they also were not prone to undertake extensive migrations. Five bull trout had been captured in a ladder at Three Mile Falls Dam in the lower Umatilla River at river kilometer (rkm) 6 between 1995 and 2004. These fish were 254 to 330 mm in fork length (FL), indicating they were either subadults or first-time maturing adults when captured. Thus, assuming these fish originated in the Umatilla Basin, it appeared at least a small number of subadults produced there continued to migrate to and use the lower Umatilla and Columbia rivers. Although there were human impacts to the upper basin due to development, agriculture, and forest management, the major impacts occurred in the lower basin where there were six irrigation dams and diversions, and sections of the river were sometimes dewatered seasonally. All but one of the diversion dams had ladders, but the ladders were designed for passage of salmon and steelhead, and it was not known if bull trout could negotiate them.

Between 2004 and 2007, the conditions in the Umatilla Basin that held the potential to negatively impact bull trout remained relatively unchanged. The population in the North Fork appeared to be small and stable or declining based on mark-recapture abundance estimates and redd counts (Budy et al. 2004, 2005, 2006; P.M.S. unpublished data). Because fluvial adult bull trout migrations had been studied previously and subadult migrations remained largely un-described, we chose to focus on the latter when we began our study in the basin. Through 2006, we used a combination of trapping, snorkeling, telemetry, and a fixed passive integrated transponder (PIT) tag detection site to determine the subadult population was small and individuals exiting the North Fork (i.e., individuals migrating as subadults for the first time) remained within the upper 40 km of the Umatilla River during their first summer in the Umatilla River (Anglin et al. 2008; Sankovich and Anglin 2006, 2007). We observed no individuals utilizing the heavily impacted lower river. As a result, we were unable to describe the timing of use, seasonal distribution, and movement of subadults in the lower river and determine how subadults might be negatively affected by conditions there. Because of the small size of the subadult population, our sample size was small each year, and we potentially had not fully described the migratory behavior and distribution of subadult bull trout in the basin. Our objective in 2007, therefore, was to continue to study the subadults.

Bull trout in the John Day Basin inhabit the Middle Fork, North Fork, and upper John Day River drainages. When we initiated our study in the basin in 2005, we chose to focus on bull trout from the North Fork. Few migratory individuals remained in the Middle Fork system and those in the upper John Day River and its tributaries had been studied extensively by ODFW from 1997 to 2001. There were no reliable abundance estimates for bull trout populations in the

North Fork John Day Sub-basin, but because much of the upper main stem flows through a wilderness area, local biologists suspected its bull trout population, in particular, was relatively healthy. Fluvial bull trout were believed to persist only among the upper North Fork John Day, upper Granite Creek, and Desolation Creek local populations (U. S. Fish and Wildlife Service 2002), and there was evidence indicating their abundance in the latter two local populations was extremely low (P. Howell, U. S. Forest Service [USFS], personal communication; P.M.S., unpublished data). Little information was available on the migratory patterns of these bull trout. Based on observations of two radio-tagged subadults and the incidental capture of fluvial adults by steelhead anglers, it was evident the overwintering area extended downstream into the lower North Fork and John Day River (Hemmingsen et al. 2001a; T. Unterwegner, ODFW, personal communication). The telemetry data also showed subadult migrations could be extensive, with one individual traveling at least 220 km between its winter and summer rearing sites (Hemmingsen et al. 2001a).

There are no dams on the North Fork John Day River and water withdrawals from it are limited to the lower 24 km, where several irrigation pumps are operated. In all but extreme drought years (e.g., 1977), the lower river has sufficient flow to provide fish passage during the irrigation season (T. Unterwegner, ODFW, personal communication). The Pete Mann Ditch is the only other significant water diversion in the sub-basin. It traverses a number of tributaries to Clear Creek and diverts varying portions of their flow into the Powder River Basin. Because fluvial bull trout are no longer present in the Clear Creek system, the Pete Mann Ditch currently has the potential to impact only resident bull trout and their localized movements.

The major factor limiting the distribution and movement of bull trout in the North Fork John Day River sub-basin appears to be high summer stream temperatures (Columbia-Blue Mountain Resource Conservation and Development Area 2005). The high stream temperatures are attributed to a lack of streamside shade, increases in fine sediments, altered hydrologic patterns, losses of pool habitat, and low amounts of in-stream wood (Umatilla National Forest and Walla Walla National Forest 1997a and 1997b cited in Columbia-Blue Mountain Resource Conservation and Development Area 2005). These conditions are a product of past and, to a lesser extent, continuing forest management practices (e.g., logging and fire suppression), grazing, placer and dredge mining, and road construction (Columbia-Blue Mountain Resource Conservation and Development Area 2005). The lower sub-basin's semi-arid climate and loss of forest canopy due to extensive wildfires might also be important naturally-occurring contributing factors. The elevated stream temperatures presumably force bull trout to seek out and remain in colder headwater reaches of the main stem and its tributaries, or any coldwater refuges downstream, during summer. They might also form a thermal block to migration for individuals that fail to ascend the river system in a timely manner.

Although high summer stream temperatures have been proposed as the major factor limiting bull trout in the North Fork John Day River Sub-basin (Columbia-Blue Mountain Resource Conservation and Development Area 2005), a more detailed description of the migratory behavior of the sub-basin's bull trout is needed to support this contention and determine where thermal barriers or other factors might be restricting the movement and distribution of those fish. Information on both fluvial adult and subadult migrations was limited when we initiated work in the North Fork John Day River in 2005, but we elected to begin by studying the adults. While angling in the North Fork in 2005 and operating an upstream migrant trap there in summer 2006 to capture fish for radio tagging, we captured only eight large-bodied (>300 mm FL) char, three of which appeared to be brook trout (*Salvelinus fontinalis*) x bull trout hybrids rather than pure bull trout (Sankovich and Anglin 2006, 2007). We tagged seven of these fish, including the apparent hybrids. All remained in the upper 79 km of the 180 km-long North Fork throughout the lives of their two-year tags. Given the small size of the sample, our primary objective in 2007 was to continue to study the migratory behavior of adult bull trout, as well as that of any apparent hybrids that might be captured, since information on their movement would be informative in terms both their interactions with bull trout and impediments to movement. A secondary objective was to conduct spawning ground surveys in the main stem and its tributaries Baldy and South Fork Desolation creeks to gather information on adult abundance and distribution.

Umatilla River Basin

Methods

Radio Telemetry

Two subadults tagged in 2006 (Sankovich and Anglin 2007) remained at large with operable tags in 2007, so we continued to track them until their tags failed. These fish were outfitted with 293-d tags in August 2006.

To capture additional subadults for tagging, we operated a 1.5-m diameter rotary screw trap in the Umatilla River just below the mouth of the North Fork (Figure 1). The trap operated for 56 of 60 d from 25 April to 23 June 2007. Captured individuals of most non-target species were simply counted and released. Steelhead and rainbow trout (*Oncorhynchus mykiss*) were also assigned to 50-mm size categories (e.g., 0-49 mm, 50-99 mm) based on visual estimation of their fork lengths. All bull trout were anesthetized in an aerated bath containing 50-70 mg/L tricaine methanesulfonate (MS-222) buffered with 120 mg/L sodium bicarbonate. They were then weighed (nearest 0.1 g), measured (nearest 1 mm), and PIT or radio tagged. The PIT tags were 23 mm long and were inserted into the abdomen through an approximately 4-mm long incision made with a surgical blade anterior to the pelvic girdle and slightly off the mid-line. Our radio tagging methods followed those described by Sankovich (2003) and Anglin et al. (2008). We used three sizes of tags manufactured by Lotek Wireless Fish and Wildlife Monitoring. The model NTC-M-3 tags weighed 0.55 g, had an 8 s burst rate, and a warranty life of 45 d. The model NTC-3-2 tags weighed 1.2 g, had a 9.5 s burst rate, and a warranty life of 96 d. The model NTC-4-2-L tags weighed 2.1 g, had a 12 s burst rate, a 12 h on and 12 h off duty cycle, and a warranty life of 293 d. Based on a length/weight relationship developed for bull trout in the North Fork Umatilla River (Budy et al. 2004), we estimated the respective tag models would be suitable for individuals as short as 126, 164, and 197 mm FL at 3% of the host's weight. For the fish that were tagged, the tags actually averaged 2.1% and ranged from 1.5 to 2.7% of the host's weight. We chose to exceed Winter's (1996) "2% rule" in some cases because Winter (1996) offered no justification for it, and Brown et al. (1999) subsequently showed transmitters weighing up to 12% of a fish's weight had no effect on swimming

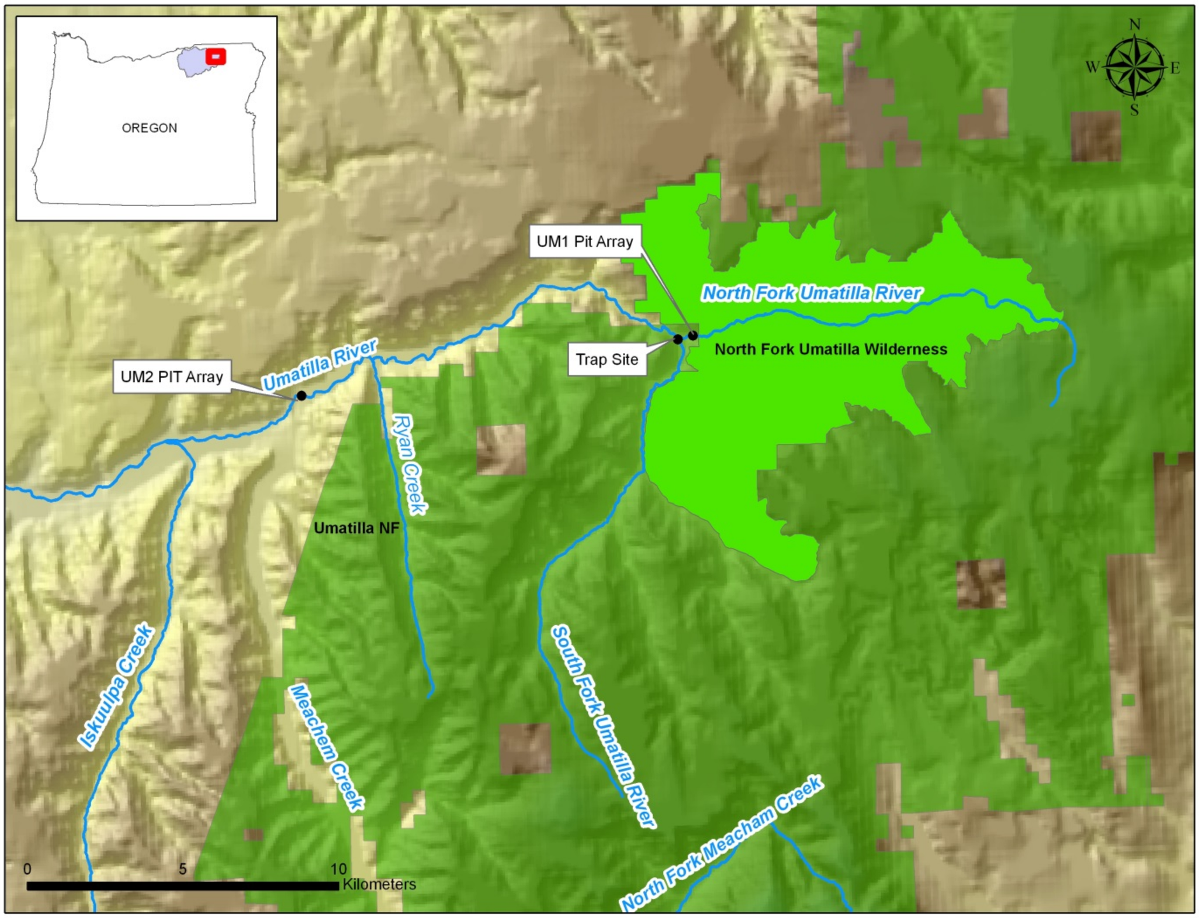

Figure 1**.** Map of the Umatilla River Basin showing the location of the screw trap and two PIT tag detection arrays.

performance. Also, Jakober et al. (1998) found the distance moved by radio-tagged bull trout did not differ between fish with transmitter weights less or greater than 2% of body weight. We released the tagged fish in the North Fork Umatilla River about 150 m upstream from its mouth.

The near absence of larger, older subadult bull trout in the trap catch in 2007 and prior years indicated most of them were remaining below the trap site to rear after emigrating from the North Fork as younger fish; therefore, on several occasions from August to October, we also angled or used a dip net while snorkeling at night to attempt to capture larger subadults and include them in the sample of radio-tagged fish. We focused our effort upstream from rkm 135 on the Umatilla River. Bull trout probably are restricted to that area during summer due to elevated temperatures in the river downstream (P.M.S., unpublished data). We targeted fish that were large enough to accommodate our heaviest tags ($\geq$197 mm FL) but were less than 250 mm FL, which appears to be a reasonable, approximate upper length limit for subadult bull trout in northeast Oregon streams in late summer and fall (P.M.S., unpublished data).

We also PIT and radio tagged two bull trout captured in spring in a trap operated by biologists from the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) in the east bank ladder at Three Mile Falls Dam (rkm 6.4; Figure 2). These fish were 385 and 325 mm FL and were probably fluvial adults. Although our focus was on subadults, we tagged these fish because doing so provided a unique opportunity to broaden our understanding of fluvial adult movements. Only five bull trout had been trapped at Three Mile Falls Dam prior to 2007, and none had been radio tagged to follow their progress up the Umatilla River. In addition, during past telemetry studies, no fluvial adults had been documented below rkm 63 on the Umatilla River. Tagging the two fish at Three Mile Falls Dam would allow us to determine if they would successfully negotiate the diversion dams and fish passage facilities in the lower river, become stranded in or below de-watered reaches that might develop as the irrigation season progressed, be negatively influenced by McKay Creek's plume (i.e., remain in it until stream temperatures in the Umatilla River, outside the plume, became unsuitable for continued upstream migration), or return to the Columbia River, from which they presumably came, to overwinter—all questions that had yet to be answered for fluvial adults.

We outfitted the larger individual with a Lotek model MCFT-3FM radio tag that had a 5 s burst rate, 12 h on and 12 h off duty cycle, and warranty life of 755 d. The tag weighed 10 g in

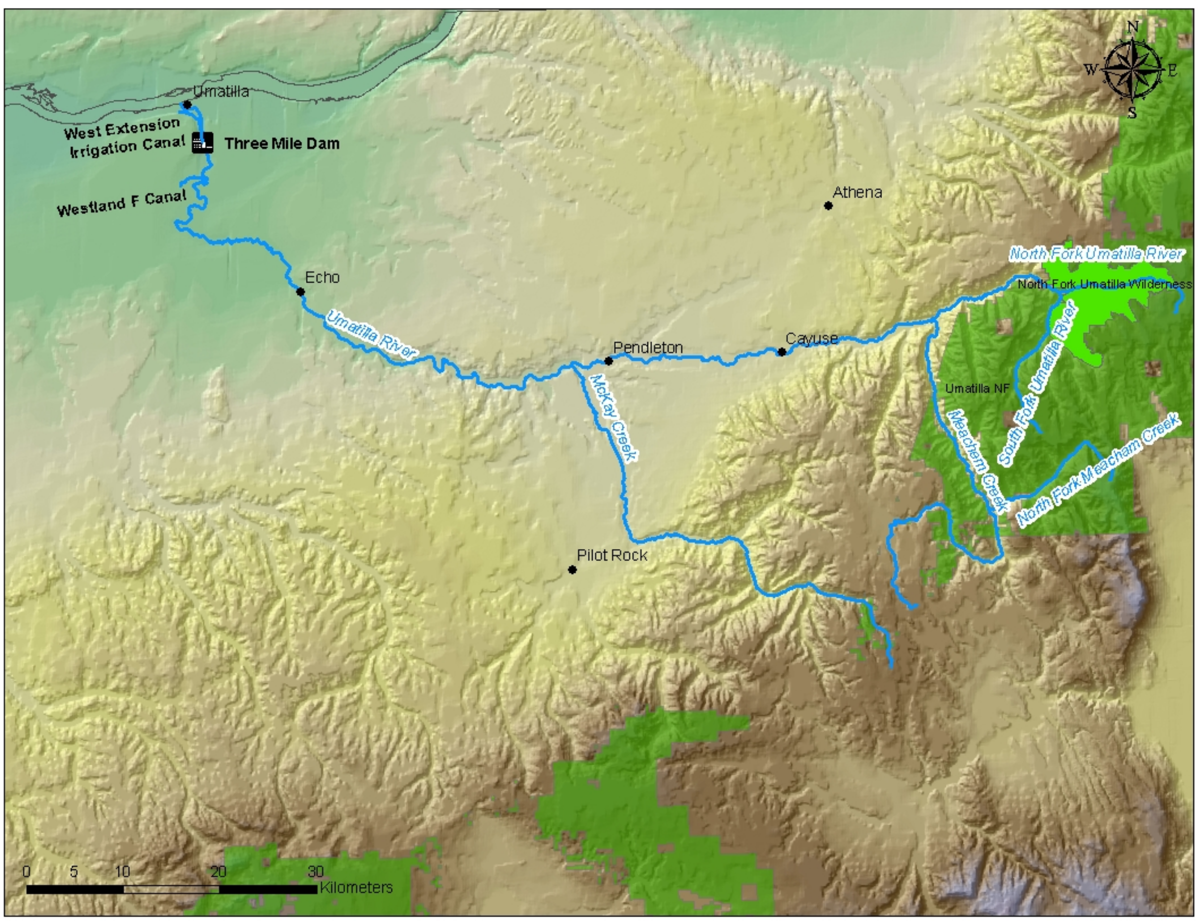

Figure 2. Map of the Umatilla River basin showing the location of Three Mile Falls Dam.

air and was 1.5% of the host's weight. The smaller individual was outfitted with a Lotek model NTC-4-2-L tag that had a 12 s burst rate, 12 h on and 12 h off duty cycle, and warranty life of 293 d. The tag weighed 2.1 g in air and was 0.6% of the host's weight. The procedures we used to implant the radio and PIT tags were the same as those described above for tagging subadult bull trout. We collected duplicate fin tissue samples from the tagged fish for subsequent genetic analyses, to determine if each individual originated in- or outside the Umatilla Basin. The samples were stored in vials in 95% ethanol. Both of the fish were released just upstream from Three Mile Falls Dam on the day of tagging after they had recovered from the anesthesia. They had been held in the trap at Three Mile Falls Dam for a day prior to being tagged and released.

We tracked the radio-tagged fish by road and by foot and airplane in areas not accessible by road. We were unable to conduct winter telemetry flights until March due to mechanical problems with our pilot's plane or poor weather conditions when flights were scheduled. We tracked at least weekly in spring and early summer, before stream temperatures increased to a point where continued downstream migration was unlikely, and once per month from August through November. During tracking, fish positions were recorded using a GPS unit. The coordinates were later entered into a mapping program (MAPTECH's Terrain Navigator) to determine the location, in river kilometers, of each individual.

<u>PIT Tag Detection Arrays</u>

Bull trout movements were also monitored using two PIT tag detection arrays, one near the mouth of the North Fork (UM1) and another at rkm 129 on the Umatilla River (UM2), just upstream from the intake to the Imeques acclimation facility (Figures 3 and 4). The UM1 array was brought on-line in October 2004. We installed the UM2 site on 2 August 2007. Each array consisted of a full duplex interrogation system (Destron Fearing FS1001A), an antenna array custom built for this application, and a laptop computer equipped with Minimon software (Pacific States Marine Fisheries Commission). Power at the UM1 site was supplied with a combination of solar panels, batteries, and a generator. Remote data upload was accomplished using satellite communications (Figure 3). The UM2 site was powered through a hard wire connection. Data collected there were downloaded manually.

The PIT tag detection arrays enabled passive monitoring of the movement of bull trout that were PIT tagged in the North Fork in summer 2003-07 as part of an ongoing population assessment study (Budy et al. 2004, 2005, 2006, 2007). Subadults captured and PIT tagged at our screw trap in spring and early summer 2005-07 were also available for detection. The relatively efficient passive monitoring using PIT tag detection arrays together with the ongoing comprehensive tagging effort is an important part of our goal to better understand migratory bull trout life history, and the temporal and spatial aspects of their distribution and movements.

Routine inspection and maintenance of the PIT tag detection arrays were conducted to ensure reliable data collection and system operation. Antenna detection efficiency tests were conducted periodically to estimate the proportion of the antenna field that consistently detected a PIT tag that passed through the apparent field. Methods used to conduct efficiency tests were described in Anglin et al. (2008).

Figure 3. PIT tag detection array in the North Fork Umatilla River (UM1). On the left is the shed that houses the electronics, computer, and generator. Solar panels and satellite dish are visible on the roof. On the right the antenna array can be seen mounted to a bridge.

Figure 4. PIT tag detection array in the Umatilla River at rkm 128 (UM2).

Results

<u>Radio Telemetry</u>

Of the two radio-tagged fish remaining from 2006, one (code 117) was located about 4 km up the North Fork Umatilla River during the first telemetry flight of the year in March, where it had been observed the previous fall (Figure 5; Appendix Table A1). This fish was initially tagged and released in the Umatilla River just downstream from the mouth of the North Fork and may have been a small adult rather than subadult at the time. It was 298 mm FL and, based on visual inspection of its internal organs during the surgical procedure, appeared to have maturing testes. We did not decode a signal from this fish's tag throughout the remainder of 2007. We

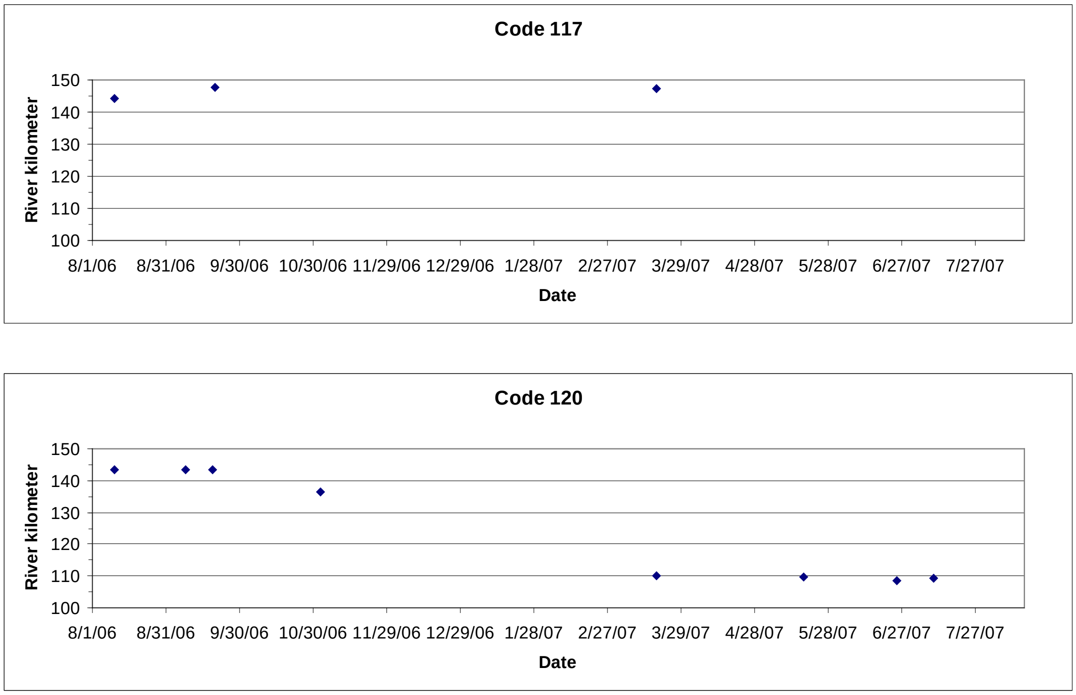

Figure 5. Tracking data for bull trout radio tagged on the Umatilla River in August 2006. River kilometers are continuous from the mouth of the Umatilla River into the North Fork Umatilla River. The North Fork enters the Umatilla River at rkm 144.

did, however, continue to receive signals from a tag in its last known location during flights through October.

The other fish (120), which had been tagged and released about 700 m downstream from the mouth of the North Fork (rkm 143) in August 2006 and had last been observed at rkm 137 in November, was located at rkm 110 (Cayuse) in March (Figure 5; Appendix Table A1). It remained in that area through 10 July when its tag's signal was last detected (Figure 5; Appendix Table A1). During the week leading up to 10 July, stream temperatures recorded at Cayuse peaked daily at 23 to 25^{o}C and averaged 20^{o}C (CTUIR, unpublished data). We were unable to visually observe this fish to determine if it had died or perhaps located a cold water refuge.

The screw trap in the Umatilla River captured 55 bull trout, 940 *O. mykiss* (one of which was an adult steelhead), 508 juvenile Chinook salmon (*O. tshawytscha*), 85 speckled dace (*Rhinichthys osculus*), 26 sculpin (*Cottus spp.*), and 4 larval and 2 adult Pacific lamprey (*Lampetra tridentata*). The bull trout were captured throughout the trapping period (Figure 6). They ranged from 128 to 182 mm and averaged 156 mm in fork length (Figure 7). We radio tagged 36 of them. The minimum, maximum, and average fork lengths of these fish were the same as for the group trapped. Twenty-six of the radio-tagged fish were outfitted with 45-d tags and 10 with 96-d tags (Table 1). Three of the radio-tagged fish were recovered together in the screw trap as mortalities two days after their release (Table 1). There were no internal injuries evident from the surgical procedure. The tags from these fish were re-used in other subadults.

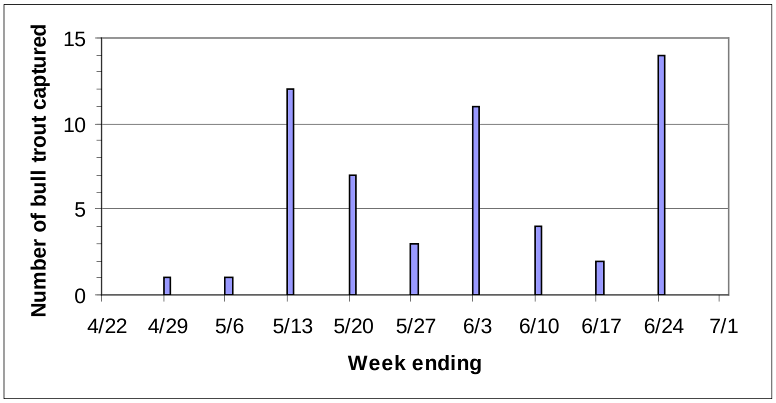

Figure 6. Number and timing of bull trout captured in a screw trap in the Umatilla River (rkm 144) in spring and early summer 2007.

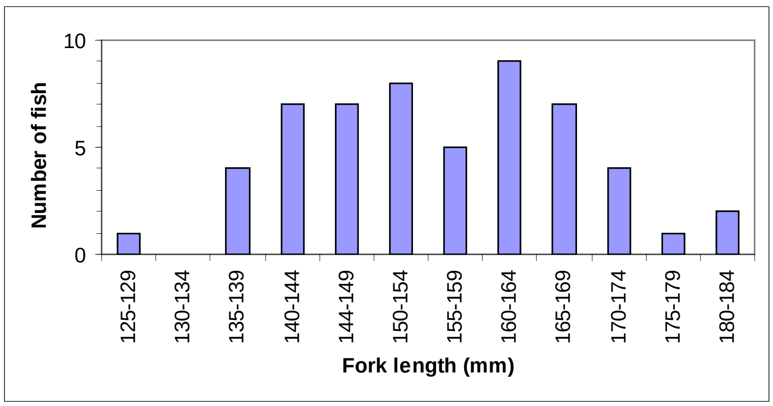

Figure 7. Length frequency distribution of bull trout captured in a screw trap in the Umatilla River (rkm 144) in spring and early summer 2007.

We PIT tagged an additional 12 subadults. Their fork lengths ranged from 140 to 165 mm and averaged 152 mm (Table 1). One of the PIT-tagged fish was recovered in the screw trap as a mortality along with the aforementioned radio-tagged fish and, like them, had suffered no internal injuries.

Of the subadults radio tagged at the screw trap, 20 moved downstream an appreciable distance (at least 3 km), 6 remained near the release site, and 7 were never located following their release. The distance between the release site and lowermost observation of fish that moved downstream ranged from 3.2 to 35.5 km and averaged 13.7 km (Figures 8, 9, and 10; Appendix Table A1). These fish were distributed between rkm 109 (Cayuse) and 141 and took a maximum of 3 to 46 d to reach their lowermost location. Only two tagged subadults that migrated downstream later moved upstream. One (code 165) was at rkm 137 on 14 May and rkm 138 on 17 June. Stream temperatures measured by a thermograph at rkm 132 ranged from 11 to 15^{o}C and averaged 12^{o}C on 17 June (CTUIR, unpublished data), so this fish's upstream movement probably was not due to unsuitably warm temperatures at its former location. The other fish (152) was at rkm 109 on 25 June and at rkm 110 on 6 August. On the latter date, when

Table 1. Date of tagging, radio tag code and model, PIT tag code, and length and weight of bull trout captured in a screw trap and at Three Mile Falls Dam (TMFD) in the Umatilla River in 2007.

Date	Radio tag code	Tag model	PIT tag code	FL (mm)	WT (g)	Capture location
4/29/07	126	MCFT-3FM	3D9.1BF1FC832D	385	656.0	TMFD
5/3/07	176	NTC-4-2L	3D9.1BF1B2F5EC	325	331.0	TMFD
5/3/07	156	NTC-M-3		146	34.1	screw trap
5/7/07	158	NTC-M-3		152	35.6	screw trap
5/7/07	159	NTC-M-3		162	43.4	screw trap
5/8/07	160	NTC-M-3		160	35.6	screw trap
5/8/07	161	NTC-M-3		161	25.6	screw trap
5/8/07	162	NTC-M-3		162	26.4	screw trap
5/9/07	163	NTC-M-3		156	44.6	screw trap
5/9/07	164	NTC-M-3		144	35.2	screw trap
5/9/07	165	NTC-M-3		140	27.1	screw trap
5/9/07	166	NTC-M-3		135	34.5	screw trap
5/10/07	167	NTC-M-3		128	21.4	screw trap
5/10/07	168	NTC-M-3		150	35.7	screw trap
5/12/07	169	NTC-M-3		144	31.4	screw trap
5/14/07	170	NTC-M-3		154	38.6	screw trap
5/14/07	172	NTC-M-3		141	32.0	screw trap
5/14/07	173	NTC-M-3		152	38.4	screw trap
5/19/07	174	NTC-M-3		162	39.2	screw trap
5/19/07	171	NTC-M-3		149	36.0	screw trap
5/19/07	175	NTC-M-3		158	38.6	screw trap
5/19/07			3D9.1BF1B2AA24	154	40.3	screw trap
5/23/07			3D9.1BF1FD19BE	159	40.1	screw trap
5/23/07			3D9.1BF1B2EA8E	145	29.7	screw trap
5/25/07			3D9.1BF1FC8325	145	32.5	screw trap
5/29/07			3D9.1BF1B29168	149	33.6	screw trap
5/29/07			3D9.1BF1FC9F0D	158	41.9	screw trap
5/29/07			3D9.1BF1B293A2	157	40.5	screw trap
5/29/07			3D9.1BF1B29F37	141	29.3	screw trap
5/29/07			3D9.1BF1B29CE6[b]	148	30.4	screw trap
6/1/07			3D9.1BF1B29371	162	44.0	screw trap
6/6/07	188	NTC-M-3		144	28.7	screw trap
6/6/07	189	NTC-M-3		151	34.3	screw trap
6/6/07	147	NTC-3-2		164	44.2	screw trap
6/6/07	190	NTC-M-3		135	24.8	screw trap
6/7/07	148	NTC-3-2		173	53.6	screw trap
6/7/07	149	NTC-3-2		170	47.9	screw trap
6/7/07	150	NTC-3-2		175	53.3	screw trap
6/7/07	151	NTC-3-2		164	41.9	screw trap
6/13/07	152	NTC-3-2		182	65.3	screw trap
6/15/07	153	NTC-3-2		168	45.1	screw trap
6/19/07	154[a]	NTC-3-2		170	52.3	screw trap
6/19/07	155	NTC-3-2		181	63.3	screw trap
6/19/07	191[a]	NTC-M-3		174	52.0	screw trap
6/19/07	192[a]	NTC-M-3		165	42.7	screw trap
6/19/07			3D9.1BF1B2F971	165	42.4	screw trap
6/19/07			3D9.1BF1B2F1E8	147	32.9	screw trap
6/19/07			3D9.1BF1B29CDF	140	28.2	screw trap
6/23/07	191	NTC-M-3		164	46.2	screw trap
6/23/07	192	NTC-M-3		165	45.6	screw trap
6/23/07	154	NTC-3-2		162	49.3	screw trap

[a]These fish were recovered as mortalities in the screw trap two days after being released. Their radio tags were subsequently used in other fish.

[b]This fish was a recapture, PIT tagged in the North Fork Umatilla River in 2006.

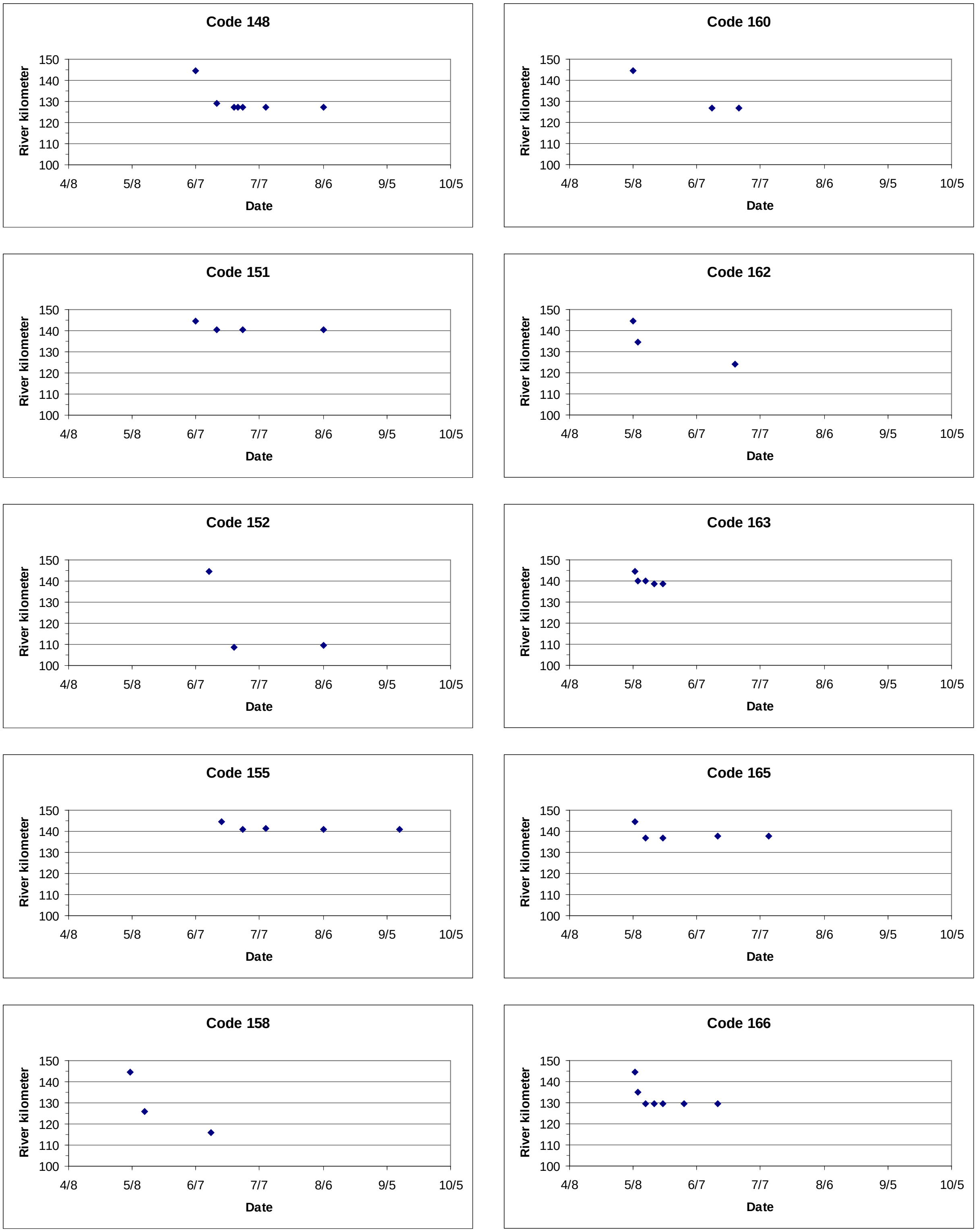

Figure 8. Tracking data for radio-tagged subadult bull trout that moved downstream following their release in the North Fork Umatilla River in spring and early summer 2007. River kilometers are continuous from the mouth of the Umatilla River into the North Fork Umatilla River. The North Fork enters the Umatilla River at rkm 144.

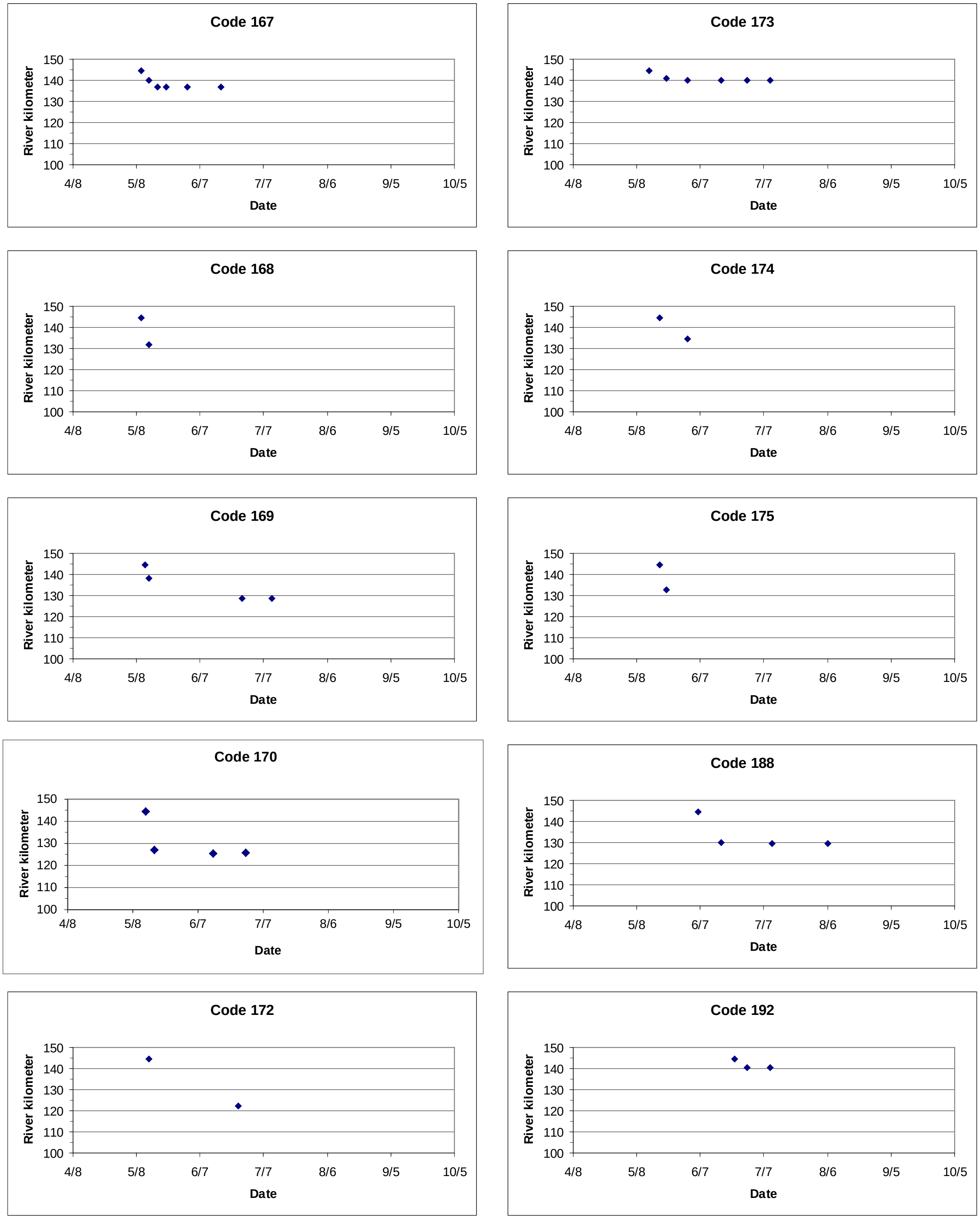

Figure 8 (continued). Tracking data for radio-tagged subadult bull trout that moved downstream following their release in the North Fork Umatilla River in spring and early summer 2007. River kilometers are continuous from the mouth of the Umatilla River into the North Fork Umatilla River. The North Fork enters the Umatilla River at rkm 144.

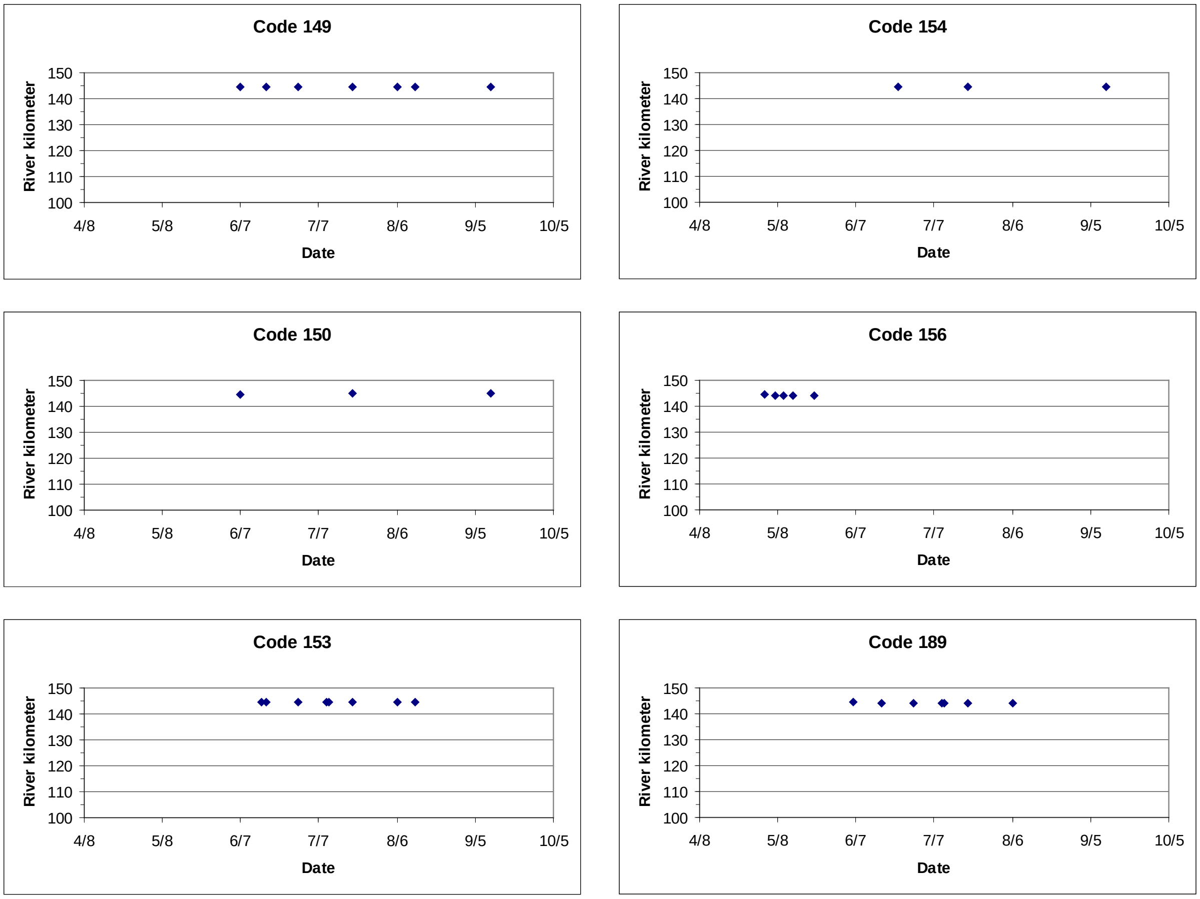

Figure 9. Tracking data for radio-tagged subadult bull trout that moved little following their release in the North Fork Umatilla River in spring and early summer 2007. River kilometers are continuous from the mouth of the Umatilla River into the North Fork Umatilla River. The North Fork enters the Umatilla River at rkm 144.

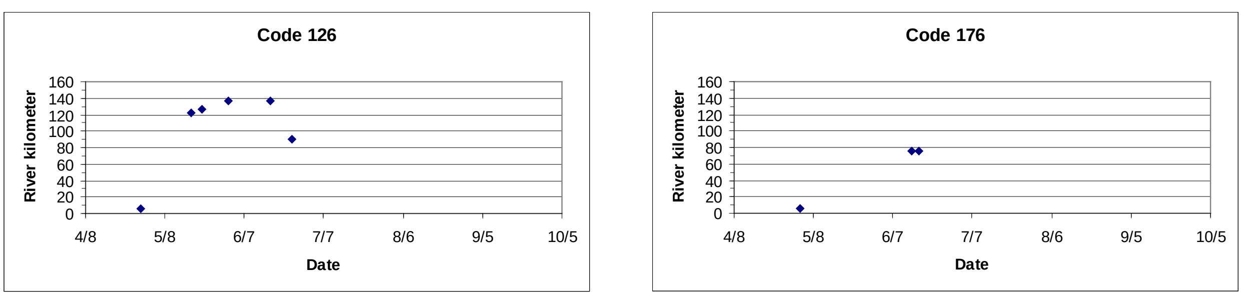

Figure 10. Tracking data for bull trout captured and radio tagged at Three Mile Falls Dam on the Umatilla River in spring 2007.

this fish was last located, stream temperatures at rkm 109 ranged from 17 to 23^{o}C, averaged 20^{o}C (CTUIR, unpublished data), and were likely marginal for survival, if not lethal, so its upstream movement may have been driven by temperature. Three other fish (148, 169, and 188) were located in a section of river where stream temperatures at the time appeared to be unsuitably high. These fish were between Meacham Creek (rkm 127) and rkm 130 on 10 and 11 July, when stream temperatures at rkm 128 ranged from 17 to 24^{o}C and averaged 20^{o}C (CTUIR, unpublished data). The tag from one of these fish (148) was later recovered from the streambed in the area where it had been located on 10 July. We attempted to visually observe the other two fish but were unsuccessful. A number of cold water refuges occur in the areas where these fish were located (Contor et al. 1995), so it is possible they were not exposed to the high temperatures recorded at the temperature monitoring site. Among the subadults that remained near the release site were four (149, 150, 153, and 154) that moved upstream after being tagged and released (Appendix Table A1). Their upstream movements were limited to 200-500 m and were not as extensive as those of some of the subadults tagged in 2006.

While angling and snorkeling in the Umatilla River in August-October, we captured no larger subadult bull trout. We observed two while snorkeling, but failed to net them.

Both of the bull trout captured and tagged at Three Mile Falls Dam continued moving up the Umatilla River after being released. We were unable to effectively track their early movements because our pilot's plane was inoperable and much of the river downstream from Gibbon (rkm 127) could not be tracked effectively by road. It was evident, nevertheless, that at least one of the fish (126) had no difficulty negotiating the lower river. It had migrated upstream 116 km to rkm 122 by 18 May (19 d post-release; Figure 10; Appendix Table A1) when it was first located during a telemetry flight. It continued upstream to rkm 137 and remained there between 1 and 17 June. On 25 June, it was found 47 km downstream in Pendleton (rkm 90) during a flight. We subsequently tracked on foot that day to pin-point its location and determined it was in a trailer park, indicating it may have been poached or legally harvested by a CTUIR tribal member.

The other fish (176) was first located during a telemetry flight on 14 June (45 d post-release). On that date, it was about 6 km downstream from the mouth of McKay Creek (rkm 76; Figure 10; Appendix Table A1) near Barnhart. We tracked by road on 17 June to determine its precise location and found it was at rkm 75.6 in a stream section flowing through private land. We subsequently obtained permission to access the land and returned there on 19 June intending to snorkel the river to determine if this fish was alive; however, we could not detect a signal from its tag at that site or in the Umatilla upstream to the headwaters in areas that could be tracked by road. Six days later, on 25 June, we conducted a telemetry flight over the Umatilla River, but were still unable to locate this fish. At the time of the flight, we believed a weir at the mouth of McKay Creek blocked access to larger fish, so we did not track McKay Creek. We learned afterward, however, that there were holes in the weir through which larger fish might pass. On 5 July, therefore, we tracked McKay Creek by road. We failed to locate this fish then and during several aerial and ground tracking events along the Umatilla River and McKay Creek throughout the remainder of the year. Data collected at fixed telemetry sites on the Umatilla River below Barnhart and at the PIT tag array in the North Fork Umatilla River indicated this fish did not move downstream into the lower river or upstream into the North Fork Umatilla River. It is possible this fish had been unable to continue migrating upstream out of McKay Creek's plume when it was located near Barnhart on 17 June. During the preceding week, stream temperatures in the Umatilla River just above the mouth of McKay Creek peaked at 21 to 24^{o}C and averaged

19°C (CTUIR, unpublished data). Stream temperatures near the fish's location during this period were much cooler, peaking at 15 to 17°C and averaging 13°C (CTUIR, unpublished data).

PIT Tag Detection Arrays

The PIT tag detection array in the North Fork Umatilla River (UM1) detected 11 bull trout that had been tagged and released in the North Fork by researchers from Utah State University (USU) (Table 2). One of these fish was tagged in 2005, eight were tagged in 2006, and two were tagged in 2007. None had been detected previously. The two fish tagged in 2007 were fluvial adult sized (380 and 531 mm FL) at tagging in July. They moved downstream past UM1 in mid-August, presumably before the spawning period began. The remaining fish were smaller (124 -206 mm FL) when tagged and presumably were subadults when detected. These smaller fish passed the array in April, May, June, and August, with the peak occurring in May (Figure 11). They represented less than one percent of the juvenile-sized bull trout that had been tagged in the North Fork in 2003-07 (n=461). To date, only 41 (9%) of 461 fish that were juvenile sized when tagged in the North Fork have been detected at UM1.

While operating the screw trap in the Umatilla River, we PIT tagged and released 13 subadult bull trout in the North Fork about 100 m upstream from UM1. Seven of these fish (53%) were detected, all on the day of their release. One was recaptured in the screw trap without being detected at the array. The remainder may also have passed the array undetected, or they may have failed to return downstream after being released, as did 23% of the radio-tagged fish.

Table 2. Tagging data, detection histories, and elapsed time between detections for bull trout PIT-tagged and released in the North Fork Umatilla River in 2003-07 and detected at PIT tag detection arrays in the North Fork Umatilla (UM1) and Umatilla (UM2) rivers in 2007.

			Date of detection		Elapsed time between detections (d)	
Tag ID	Date tagged	Length at tagging (mm)	UM1	UM2	Tagging to UM1	UM1 to UM2
3D9.1BF1B2EEA7	07/25/05	127	04/11/07	10/15/07	625	187
3D9.1BF1B29CE6	07/13/06	156	05/29/07	09/28/07	320	122
3D9.1BF1B2EC09	07/24/06	129	06/04/07		316	
3D9.1BF1B2B2B0	07/25/06	152	05/08/07		287	
3D9.1BF1B2F7F2	07/25/06	124	05/17/07		296	
3D9.1BF1B2A875	08/02/06	166	04/12/07		253	
3D9.1BF1B2B664	08/02/06	190	04/11/07		252	
3D9.1BF1B2ECCB	08/02/06	130	05/14/07		285	
3D9.1BF1B2D981	08/04/06	206	08/12/07	10/19/07	373	68
3D9.1BF1FD04A7	07/17/07	201		10/21/07		
3D9.1BF1FDAA22	07/19/07	380	08/17/07		29	
3D9.1BF1B2A979	07/19/07	531	08/15/07	10/20/07	27	66
3D9.1BF1B2B3A4	07/19/07	195		10/20/07		
3D9.1BF1B2A626	07/20/07	445		11/12/07		

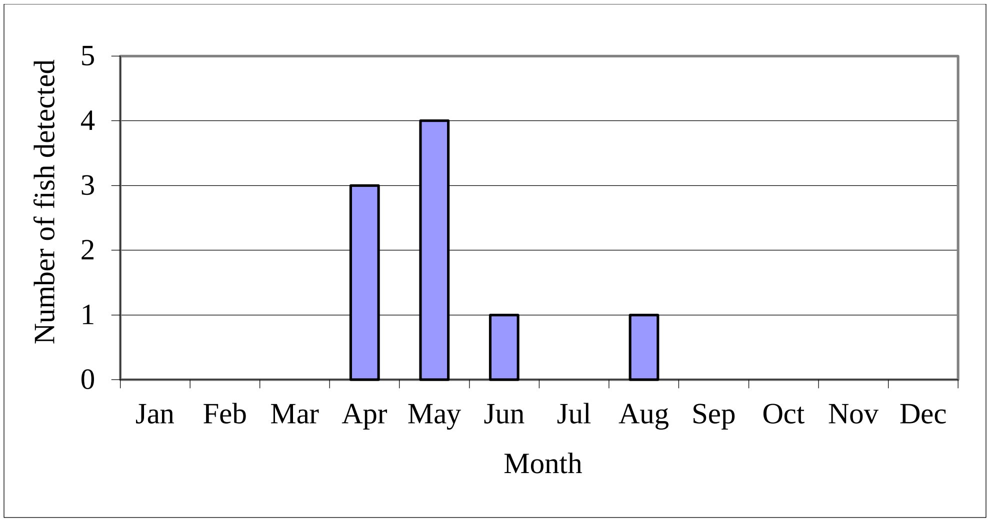

Figure 11. Number and timing of detections of PIT-tagged bull trout at a PIT tag detection array in the North Fork Umatilla River (UM1) in 2007. Data for bull trout that were fluvial adult sized when tagged are not included.

Seven tagged bull trout were detected at the array in the Umatilla River near Imeques (UM2) after it was installed in August (Table 2). Two were fluvial adult sized (445 and 531 mm FL) when tagged in the North Fork in July 2007. One of these was detected at UM1 in August and 15 km downstream at UM2 in October. The other passed UM1 undetected and arrived at UM2 in November. Five fish that were juvenile sized when tagged (127-206 mm FL) were detected at UM2 after it was installed in August (Figure 12). One was tagged in 2005 and two each were tagged in 2006 and 2007. The fish tagged in 2005 was detected at UM1 in April and at UM2 in October. The two fish tagged in 2006 were detected at UM1 in May and August and at UM2 in September and October, respectively. Neither of the two smaller fish tagged in 2007 and detected at UM2 had been detected previously at UM1.

Discussion

<u>Radio Telemetry</u>

The subadult bull trout we radio tagged in spring behaved similarly to spring-tagged subadults in the Flathead River system and Mill Creek (Walla Walla River Basin, Washington) with respect to their patterns of movement (upstream, downstream, or sedentary; Muhlfeld and Marotz 2005; P. Howell, USFS, personal communication). The fish in the Flathead River system were collected by electrofishing, so their direction of movement, if any, prior to capture was not known. Those in the Umatilla River and Mill Creek were caught in downstream migrant traps; therefore, the upstream or lack of movement by some individuals indicates they were moving locally rather than undertaking a directed downstream migration when trapped. This type of behavior was observed previously among subadult-sized bull trout in Mill Creek that were recaptured one or more times in a season after having been released downstream from a screw trap (P.M.S., unpublished data). Researchers attempting to estimate the efficiency of

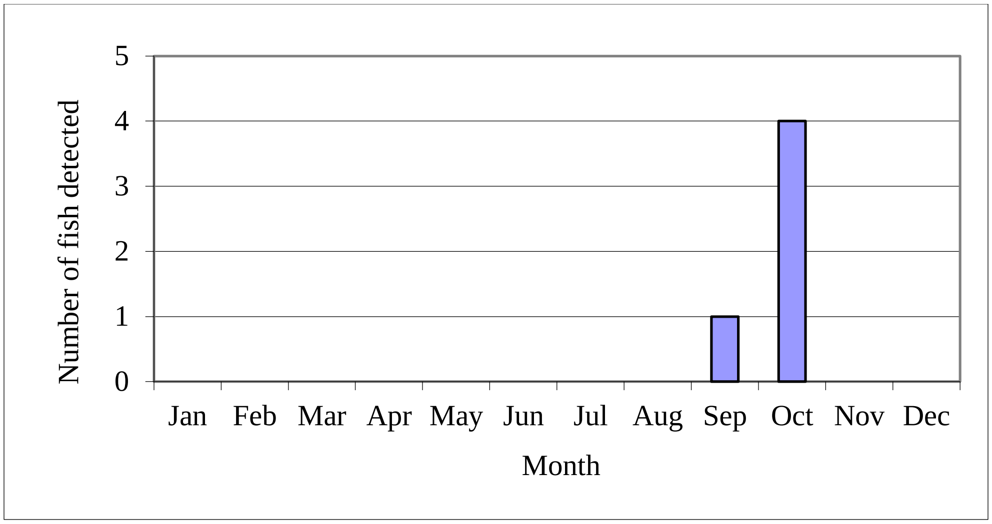

Figure 12. Number and timing of detections of PIT-tagged bull trout at a PIT tag detection array in the Umatilla River (UM2) in 2007. Data for bull trout that were fluvial adult sized when tagged are not included.

downstream traps by releasing captured subadult-sized bull trout upstream from them should be aware of the potential for those fish to fail to return downstream. Failure to account for this type of behavior could result in efficiency and migrant abundance estimates that are negatively and positively biased, respectively.

The spring-tagged subadults in the Umatilla River moved similar distances to those in Mill Creek (P. Howell, USFS, personnel communication) and far less extensively than those in the Flathead River system (Muhlfeld and Marotz 2005). The relatively short migrations of our study fish could have been a result of low subadult density in the upper Umatilla River. The North Fork Umatilla River bull trout population is small (Budy et al. 2004, 2005, 2006), so subadults currently might not have to migrate far to find unoccupied rearing sites. Another factor might have been the unsuitably high summer stream temperatures that have existed for many years in all but the upper portion of the Umatilla River. Those conditions perhaps have selected against farther migrating individuals. There is support for this idea in that conditions in Mill Creek are similar, whereas the Flathead River system contains extensive interconnected summer rearing areas.

Our description of subadult migrations has been limited thus far primarily to the initial movements relatively small, presumably younger, individuals make upon exiting the North Fork. We have yet to adequately describe what these fish do leading up to the time they reach maturity and return to the North Fork Umatilla River to spawn. The limited information we have collected on larger (older) radio-tagged subdults (n=3) has shown they may remain at a single site from fall through early summer (Anglin et al. 2008) or begin to move downstream as stream temperatures decrease in the fall (Sankovich and Anglin 2007). Data collected at the two PIT tag detection arrays also showed some individuals migrated downstream in stages (Table 2). Using a combination of radio telemetry and PIT tag detection arrays, we will more fully describe subadult migrations in the future.

Assuming the two bull trout trapped at Three Mile Falls Dam in 2007 originated in the Umatilla Basin, they provided evidence that some of the basin's bull trout continue to migrate through the heavily impacted lower Umatilla River and utilize the Columbia River. Based on the lengths of the seven bull trout trapped at the dam since 1995 (250-385 mm FL), these fish likely were subadults when they emigrated from the Umatilla River. We have failed so far to document this type of behavior, probably because it is expressed infrequently and a relatively small number of subadults have been radio tagged. The two fish we tagged at the dam in 2007 probably had reached maturity given their size (325 and 385 mm FL). Neither made it to the spawning grounds, although one presumably could have had it not been harvested. The other appeared to have been trapped in McKay Creek's plume. We lost track of this fish soon after locating it there, so we were unable to determine its ultimate fate. Nevertheless, we assume its chances of spawning successfully were negatively affected by the plume's presence. At best, this fish's upstream migration would have been delayed for two or more months until stream temperatures in the Umatilla River upstream from McKay Creek dropped. At worst, this fish would have been delayed and potentially exposed to inhospitable, if not intolerable, stream temperatures within the plume as summer progressed. The water entering the Umatilla River from McKay Creek is unnaturally cool because of hypolimnetic water releases from McKay Reservoir. If managers wish to avoid potential bull trout losses associated with McKay Creek's plume, steps will have to be taken to alter how those water releases are made and establish a more natural temperature regime in McKay Creek below the reservoir.

PIT Tag Detection Arrays

The timing of downstream movement of subadult bull trout in the North Fork Umatilla in 2007, as indicated by PIT tag detections at UM1, was somewhat atypical of that in previous years and in other systems (Sankovich and Anglin 2006, 2007; Hemmingsen et al. 2001a, 2001b; Muhlfeld and Marotz 2005; Downs et al. 2006); however, the number of detections was small (n=9). The peak in migration occurred in spring, as is typical, but only one individual was detected throughout the remainder of the year. Subadult production appeared to have been low in 2007, as in prior years, based on detection rates of fish that were juvenile sized when PIT tagged and released in the North Fork. It was probably not as low as indicated, however, because the antennas at UM1 were not 100% efficient. A test we ran by releasing PIT-tagged fish upstream from the antennas showed they were at least 53% efficient. Detections of fish tagged by USU researchers in the North Fork and known to have passed UM1 based on their detection at UM2, indicated the antennas were 57% efficient (four of seven such fish were detected at UM1; Table 2). We will install new antennas at UM1 in 2008 to improve detection efficiency there.

The UM2 site was not operational until August. Still, as noted above, we were able to document staged downstream movement by some subadults (n=3) exiting the North Fork. These fish emigrated from the North Fork in spring and summer and moved past UM2 in fall. Stream temperatures at and downstream from UM2 are unsuitable for bull trout in summer (P.M.S., unpublished data). Through continued monitoring at this site, we will determine how prevalent movement by subadults into the seasonally inhospitable area is, and whether subadults residing there when stream temperatures are suitable return upstream as they become unsuitable.

Plans for 2008

In spring and early summer 2008, we will continue to operate a screw trap in the Umatilla River, just downstream from the mouth of the North Fork. We will radio tag up to 30 subadult bull trout with tags having two to twelve month lives, and PIT tag any other subadults that are captured if they are 120 mm FL or longer. In late summer and early fall, we will capture larger, older subadults by angling or by snorkeling and dip-netting them and outfit them with twelve month radio tags. We will continue to operate and maintain the UM1 and UM2 PIT tag detection arrays and will install more efficient antennas at UM1. A patch analysis (USFWS 2008) of the Umatilla River Basin will be conducted to determine if any catchments there constitute a patch, and if so, to identify them. We will collect water temperature data at relevant locations to support this analysis and to aid in interpreting the movements of radio- and PIT-tagged bull trout in the basin. Finally, we will continue to assist ODFW's district fish biologist in conducting spawning ground surveys on the North Fork Umatilla River.

John Day Basin (North Fork John Day Sub-basin)

Methods

Radio Telemetry

We used telemetry to monitor the movement of fluvial adult bull trout. Six fish radio tagged in 2005 and 2006 (Sankovich and Anglin 2006, 2007), including three individuals that appeared to be brook trout x bull trout hybrids, were still at large with functioning tags during this reporting period (Table 3), so we continued to track their movement. We operated a weir trap in the North Fork John Day River about 30 m downstream from the mouth of Baldy Creek (Figure 13) from 12 June to 12 August 2007 to capture additional fish for tagging.

We tracked the tagged fish by foot, road, and air. Fish positions were recorded using a GPS unit. The coordinates were later entered into a mapping program (MAPTECH's Terrain

Table 3. Date of tagging, radio tag code, fork length (FL), and weight (WT) of fluvial adult bull trout and apparent brook trout x bull trout hybrids tagged on the North Fork John Day River in 2005 and 2006 and at large with functioning tags in 2007.

Date	Tag code	FL (mm)	WT (g)	Comments
7/2/2005	145	370[a]		apparent hybrid
7/11/2006	129	424	806	
7/12/2006	130	420	775	
7/12/2006	128	420	837	female
7/16/2006	127	442	902	apparent hybrid
7/16/2006	125	455	944	apparent hybrid

[a] This fish was recaptured in a weir trap on 16 July 2006. It weighed 716 g and was 403 mm FL at the time.

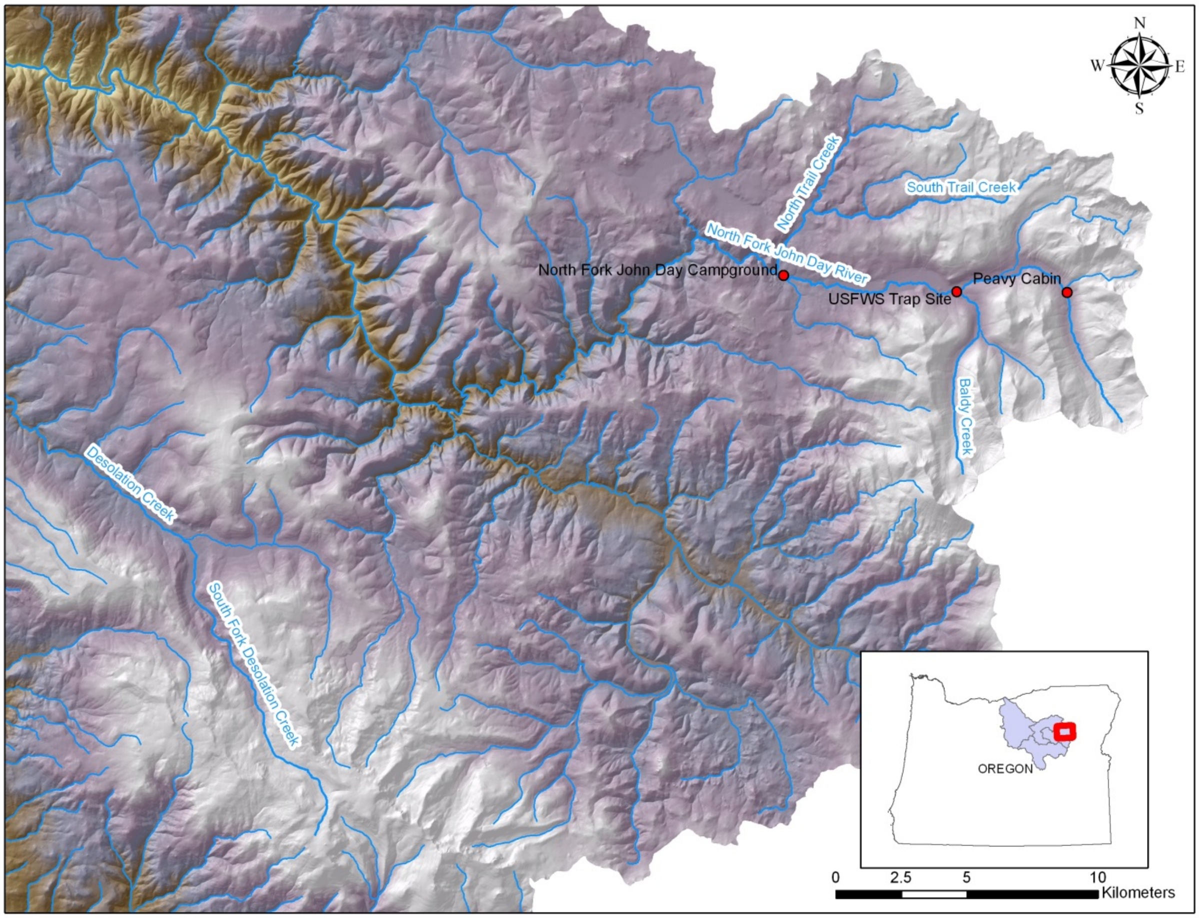

Figure 13. Map showing the location of the North Fork John Day River, the FWS weir trap site, and relevant tributaries and landmarks.

Navigator) to determine the location, in river kilometers, of each individual.

Abundance and Distribution

We conducted spawning grounds surveys on the North Fork John Day River three times during September-October. Baldy Creek was surveyed once each in September and October, and South Fork Desolation Creek was surveyed once in October. The North Fork was surveyed from the mouth of Baldy Creek upstream to a 10-m long cascade in the headwaters at about rkm 178. We believe this reach included all of the spawning habitat. We observed no bull trout or other fishes upstream from the cascade while radio-tracking on foot, and no redds were observed downstream from Baldy Creek in prior years. There were two survey sections in the North Fork, one (Section 1) extending from the mouth of Baldy Creek upstream to Peavy Cabin, and another (Section 2) extending from Peavy Cabin upstream to the 10-m long cascade. Baldy Creek was surveyed from its mouth upstream 5 km. This reach did not include all of the bull trout spawning habitat. It included an ODFW index area (Section 2; from the first trail crossing to the third) and the reach of stream below it to the mouth (Section 1). South Fork Desolation Creek was surveyed from USFS road number 45 (1.6 km upstream from the mouth) upstream approximately 4 km to a falls that appeared to be a significant obstacle to fish passage, but may not have been be totally impassable under high flows.

When conducting the spawning ground surveys, we flagged redds with surveyor's tape as they were discovered and gave them a unique number that was written on the flagging along with the date. We also recorded this information in a notebook along with our impression of whether the redd was made by a fluvial or resident female based on its size and the size of the substrate.

Results

Radio Telemetry

During the previous reporting period, we were unable to obtain a flight in December to determine where the radio-tagged fish were overwintering. The last tracking event in 2006 occurred on 20 October. On that date, two fish (codes 125 and 127) were found in the section of the upper North Fork that is accessible by road, at rkm 174 and 166, respectively (Sankovich and Anglin 2007). The remaining fish were not located.

The first aerial telemetry survey in 2007 did not occur until 19 March because our pilot's plane was inoperable for an extended period and several scheduled flights were cancelled due to inclement weather. From the tracking data collected on 19 March and subsequent surveys, it was evident only one fish (145), an apparent hybrid, traveled an extensive distance downstream from the spawning grounds to overwinter (Figure 14; Appendix Table A2). This fish overwintered within 2 km of the site where it spent the winter of 2005-06. It remained at its winter location at least through 20 April, when its tag's signal was last detected. It presumably did not return to the spawning grounds in 2007 because it was not captured in our weir trap.

Three tagged fish (125, 127, and 130) appeared to have died or shed their tags prior to winter 2006-07. Two of these fish (125 and 127) migrated upstream after being tagged and had

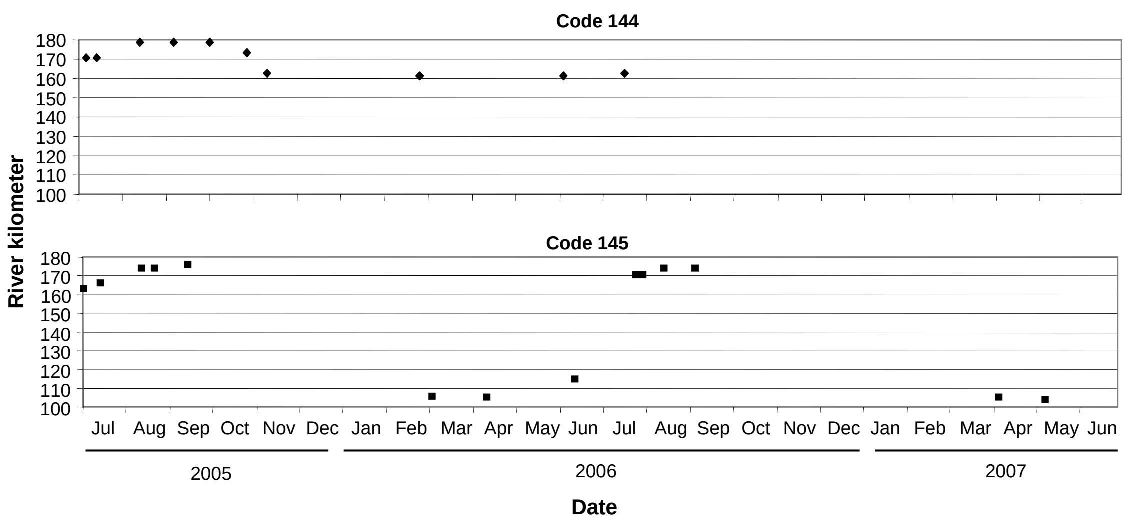

Figure 14. Tracking data for a bull trout (code 144) and an apparent brook trout x bull trout hybrid (code 145) radio-tagged on the North Fork John Day River in July 2005.

begun to return downstream in October (Figure 15 and Appendix Table A2). We continued to find them at their October locations through the spring and eventually determined their tags were buried in the streambed. The third fish (130) ascended Baldy Creek, where it (or its tag) remained after being detected in August 2006 (Figure 15; Appendix Table A2). There was a large gap in the tracking data for this fish because we did not track Baldy Creek between August 2006 and September 2007. We were tracking the North Fork during that time and, because we were not locating 130 there, assumed it was still in Baldy Creek. In September, we hiked into Baldy Creek to confirm whether 130 was dead or had lost its tag and found its tag in a log jam out of the water.

The two remaining tagged fish (128 and 129) were never found in 2007. They were last observed in the headwaters in late August 2006 (Figure 15; Appendix Table A2). We conducted telemetry surveys along the entire North Fork, the John Day River from its mouth to a point 16 km upstream from its confluence with the North Fork, and the Columbia River near the mouth of the John Day River to try to locate these fish.

We captured no bull trout or apparent hybrids in the weir trap in the North Fork, so no additional fish were radio tagged in 2007. Eleven adult Chinook salmon (three females and eight

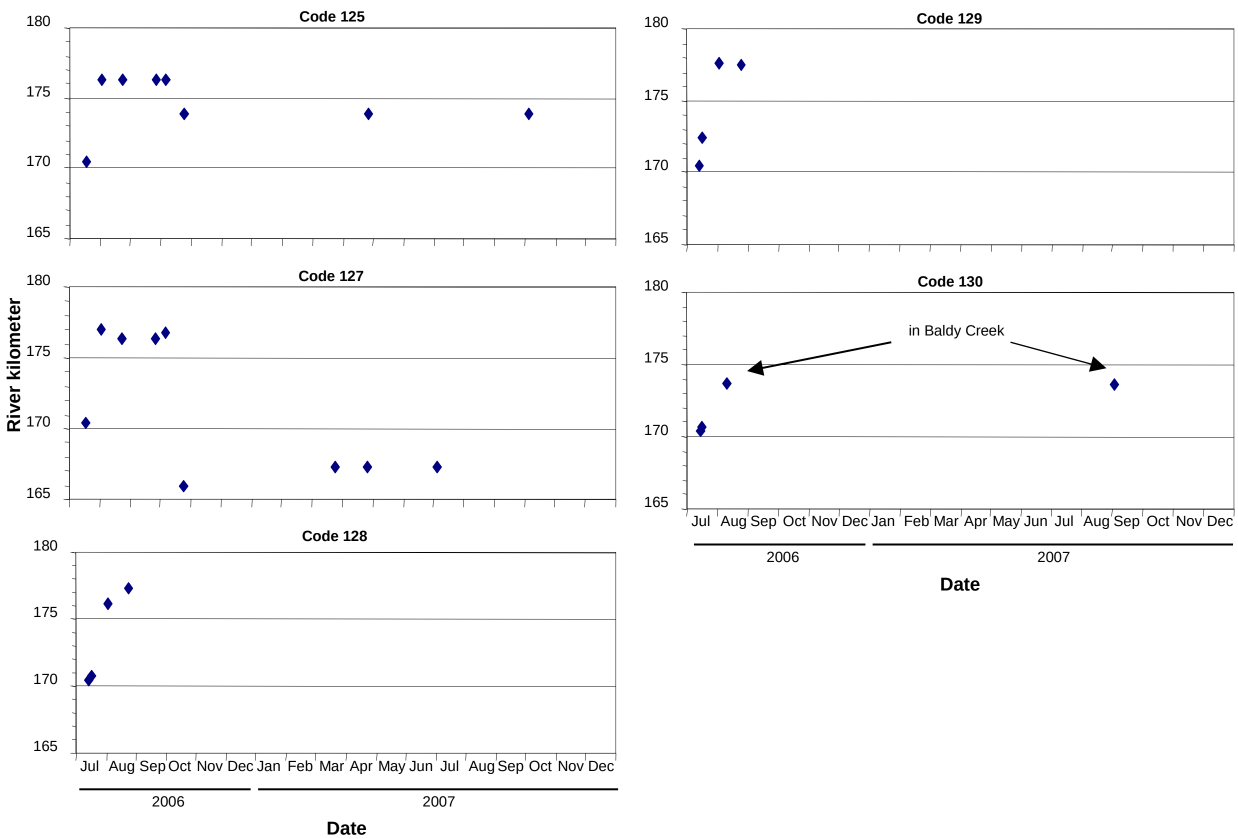

Figure 15. Tracking data for bull trout (codes 128, 129, and 130) and apparent brook trout x bull trout hybrids (codes 125 and 127) radio-tagged on the North Fork John Day River in July 2006.

males) were captured incidentally in the trap. We snorkeled regularly to determine if bull trout were being held up by the weir or if holes had developed in it, but found neither to be the case.

Abundance and Distribution

During the spawning ground surveys, we counted three redds in the North Fork John Day River (Table 4). All were upstream from Peavy Cabin. Based on their size and the size of the substrate, we estimated two were made by resident females and one was made by a fluvial female. The latter redd was observed by Chinook salmon spawning ground surveyors on 11 September (T. Schultz, ODFW, personal communication) prior to our discovering it on 25 September. A large, fluvial female bull trout was present at the redd on 11 September. We observed two other bull trout during the surveys in the North Fork that may have been fluvial adults. They were about 350 mm FL and were together, but were not involved in spawning and were not near a redd at the time. In Baldy Creek and South Fork Desolation Creek, we found no redds (Table 4).

Table 4. Redd counts in the North Fork John Day River (NFJD), Baldy Creek, and South Fork Desolation Creek in 2007. Section descriptions are provided in the Methods section.

		New Redds		
Stream	Date	Section 1	Section 2	Total redds
NFJD	25 Sep	0	3	3
	16 Oct		0	0
	28 Oct		0	0
				3
Baldy Cr	27 Sep	0	0	0
	18 Oct		0	0
				0
SFD	2 Oct	0		0

Discussion

Based on our results from angling in 2005 (three fish captured; Sankovich and Anglin 2006), trapping in 2006 (Sankovich and Anglin 2007) and 2007 (six and no fish captured, respectively), and the spawning ground surveys in 2005-07 (three to 17 redds counted; Sankovich and Anglin 2006, 2007, herein), it is evident the abundance of fluvial adult bull trout in the North Fork John Day River and Baldy Creek is extremely low. There also appears to be a low abundance, if not absence, of fluvial adults in South Fork Desolation Creek based on the redd counts there in 2006 and 2007 (none each year; Sankovich and Anglin 2007, herein). This finding is consistent with results from snorkeling surveys conducted in South Fork Desolation Creek in August 2003 (I. Tattam, Oregon State University, personal communication). Our telemetry data are too limited to determine if there are any passage problems in the migratory corridor that might be contributing to the low abundance of fluvial adults. No bull trout have yet been tracked through an annual cycle of movement. One apparent hybrid has been, and there appeared to be no impediments to its movement within the upper 79 km of the North Fork. Information collected on additional tagged fish will be required to gain an understanding of any factors restricting the movement and distribution of fluvial adults.

Our count of resident redds in the North Fork and Baldy Creek was probably not an accurate reflection of the abundance of resident adult bull trout in those streams. Drawing inferences from the count of resident-sized redds is complicated by the presence of brook trout spawners in the North Fork and Baldy Creek, and by the potential for the count to have been negatively biased, as is often the case when dealing with resident redds (Hemmingsen et al. 2001b; Starcevich et al. 2005). The presence of brook trout spawners is a less relevant issue given we counted only two resident-sized redds. Whether brook trout made all or none of them, the number belonging to bull trout would have been exceedingly small. Surveyor bias, on the other hand, could have been a significant problem. Hemmingsen et al. (2001b) counted only 21 redds in a stream supporting an estimated 885 mature resident bull trout. Starcevich et al. (2005) found surveyor bias to be less substantial in another stream, but it was still high, with 45% of the redds made by resident bull trout going undetected. Although the magnitude of any bias in our count is unknown, it is worth noting the North Fork, Baldy Creek, and the stream in Hemmingsen et al.'s study contain large amounts of fine granitic substrate, unlike the stream in Starcevich et al.'s study (P.M.S., personal observation). Small redds built in fine granitic substrate are difficult to detect. Therefore, we might expect any bias in our count to be more in line with that evident in Hemmingsen et al.'s study. This appears to be a reasonable expectation given researchers from USU estimated there were approximately two thousand bull trout >120 mm FL in the North Fork and Baldy Creek in 2006 (Budy et al. 2007), and a large portion of these fish presumably were resident adults, yet we counted only one redd we believed to have been made by a resident female that year.

Plans for 2008

Given the low abundance of fluvial bull trout in the North Fork John Day River system, we will limit our effort in 2008 to radio tagging any bull trout captured incidentally by personnel from ODFW operating screw traps and seining in the lower North Fork, lower Middle Fork John Day River, and John Day River. Tracking fish captured at these locations would allow us to expand our knowledge of the seasonal movement and distribution of bull trout in the John Day Basin. Only two bull trout (the subadults noted in the Introduction) have been radio tagged at these sites in the past. Because it is important to continue to monitor the status of bull trout, particularly fluvial individuals, in the North Fork John Day Sub-basin, we will also conduct spawning ground surveys in the North Fork and its tributaries Baldy Creek and South Fork Desolation Creek.

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References

Anglin, D. R., D. G. Gallion, M. Barrows, C. Newlon, P. Sankovich, T. J. Kisaka, and H. Schaller. 2008. Bull trout distribution, movements, and habitat use in the Walla Walla and Umatilla River basins. 2004 Annual Report. Department of Interior, U.S. Fish and Wildlife Service, Vancouver, Washington.

Brown, R. S., S. J. Cooke, W. G. Anderson, and R. S. McKinley. 1999. Evidence to challenge the “2% Rule” for biotelemetry. North American Journal of Fisheries Management 19: 867-871.

Budy, P., R. Al-Chokhachy, and G. P. Thiede. 2004. Bull trout population assessment and life-history characteristics in association with habitat quality and land use: a template for recovery planning. Annual Progress Report for 2003. USGS Utah Cooperative Fish and Wildlife Research Unit, Utah State University, Logan, Utah.

Budy, P., R. Al-Chokhachy, K. Homel, and G. P. Thiede. 2005. Bull trout population assessment in northeastern Oregon: a template for recovery planning. Annual Progress Report for 2004. USGS Utah Cooperative Fish and Wildlife Research Unit, Utah State University, Logan, Utah.

Budy, P., R. Al-Chokhachy, K. Homel, and G. P. Thiede. 2006. Bull trout population assessment in northeastern Oregon: a template for recovery planning. Annual Progress Report for 2005. USGS Utah Cooperative Fish and Wildlife Research Unit, Utah State University, Logan, Utah.

Budy, P., R. Al-Chokhachy, and G. P. Thiede. 2007. Bull trout population assessment in northeastern Oregon: a template for recovery planning. Annual Progress Report for 2006. USGS Utah Cooperative Fish and Wildlife Research Unit, Utah State University, Logan, Utah.

Columbia-Blue Mountain Resource Conservation and Development Area. 2005. John Day Subbasin Revised Draft Plan. Northwest Power and Conservation Council, Portland, Oregon.

Contor, C. R., E. Hoverson, and P. Kissner. 1995. Umatilla Basin natural production monitoring and evaluation. Annual Progress Report 1993-1994. Bonneville Power Administration, Portland, Oregon.

Downs, C. C, D. Horan, E. Morgan-Harris, and R. Jakubowski. 2006. Spawning demographics and juvenile dispersal of an adfluvial bull trout population in Trestle, Creek, Idaho. North American Journal of Fisheries Management 26:190-200.

Dunham, J. B., and B. E. Rieman. 1999. Metapopulation structure of bull trout: Influences of physical, biotic, and geometrical landscape characteristics. Ecological Applications. 9: 642-655.

Fraley, J. J., and B. B. Shepard. 1989. Life history, ecology and population status of migratory bull trout (Salvelinus confluentus) in the Flathead Lake and River system, Montana. Northwest Science 63:133-143.

Goetz, F. 1989. Biology of the bull trout. United States Department of Agriculture, Forest Service, Willamette National Forest, literature review, Eugene, Oregon.

Hemmingsen, A. R., S. L. Gunckel, P. M. Sankovich, and P. J. Howell. 2001a. Bull trout life history, genetics, habitat needs, and limiting factors in central and northeast Oregon, 2000 Annual Report. Bonneville Power Administration, Portland, Oregon.

Hemmingsen, A. R., S. L. Gunckel, and P. J. Howell. 2001b. Bull trout life history, genetics, habitat needs, and limiting factors in central and northeast Oregon, 1999 Annual Report. Bonneville Power Administration, Portland, Oregon.

Hemmingsen, A. R., S. L. Gunckel, P. M. Sankovich, and P. J. Howell. 2002. Bull trout life history, genetics, habitat needs, and limiting factors in central and northeast Oregon, 2001 Annual Report. Bonneville Power Administration, Portland, Oregon.

Jakober, M. J., T. E. McMahon, R. F. Thurow, and C. G. Clancy. 1998. Role of stream ice on fall and winter movements and habitat use by bull trout and cutthroat trout in Montana headwater streams. Transactions of the American Fisheries Society 127:223-235.

McPhail, J. D., and J. Baxter. 1996. A Review of bull trout (*Salvelinus confluentus*) life-history and habitat use in relation to compensation and improvement opportunities. Fisheries Management Report No. 104. Department of Zoology, U.B.C., Vancouver, B.C.

Muhlfeld, C. C., and B. Marotz. 2005. Seasonal movement and habitat use by subadult bull trout in the upper Flathead River system, Montana. North American Journal of Fisheries Management 25:797-810.

Rieman, B. E., and J. D. McIntyre. 1993. Demographic and habitat requirements for conservation of bull trout. United States Department of Agriculture, Forest Service, Intermountain Research Station, General Technical Report INT-302, Ogden, Utah.

Rieman, B. E., and J. D. McIntyre. 1995. Occurrence of bull trout in naturally fragmented habitat patches of varied size. Transactions of the American Fisheries Society. 124:285-296.

Sankovich, P. M., S. L. Gunckel, A. R. Hemmingsen, I. A. Tattam, and P. J. Howell. 2003. Migratory patterns, structure, abundance, and status of bull trout populations from subbasins in the Columbia Plateau, 2002 Annual Report. Bonneville Power Administration, Portland, Oregon.

Sankovich, P. M., S. J. Starcevich, A. R. Hemmingsen, S. L. Gunckel, and P. J. Howell. 2004. Migratory patterns, structure, abundance, and status of bull trout populations from subbasins in the Columbia Plateau, 2003 Annual Report. Bonneville Power Administration, Portland, Oregon.

Sankovich, P. M., and D. R. Anglin. 2006. Bull trout movement, distribution, and habitat use in the Umatilla and John Day River Basins, 2005 annual report. U. S. Fish and Wildlife Service, Columbia River Fisheries Program Office, Vancouver, Washington.

Sankovich, P. M., and D. R. Anglin. 2007. Bull trout movement, distribution, and habitat use in the Umatilla and John Day River Basins, 2006 annual report. U. S. Fish and Wildlife Service, Columbia River Fisheries Program Office, Vancouver, Washington.

Sexauer, H. M., and P. W. James. 1997. Microhabitat use by juvenile bull trout in four streams located in the eastern Cascades, Washington. Pp. 361-370 in Friends of the Bull Trout Conference Proceedings (Mackay, W.C., M.K. Brewin, and M. Monita, eds.). Bull Trout Task Force (Alberta), c/o Trout Unlimited Canada, Calgary, AB.

Starcevich, S. J., S. Jacobs, and P. J. Howell. 2005. Migratory patterns, structure, abundance, and status of bull trout populations from subbasins in the Columbia Plateau and Blue Mountain Provinces, 2004 Annual Report. Bonneville Power Administration, Portland, Oregon.

U. S. Fish and Wildlife Service. 1998. Klamath River and Columbia River bull trout population segments: status summary. Prepared by the Service's bull trout listing team.

U. S. Fish and Wildlife Service. 2002. Bull Trout (*Salvelinus confluentus*) Draft Recovery Plan, Portland, Oregon.

U. S. Fish and Wildlife Service. 2004a. Unpublished revised draft. Chapter 9, John Day Recovery Unit, Oregon. 164 p. January 14, 2004.

U. S. Fish and Wildlife Service. 2004b. Unpublished revised draft. Chapter 10, Umatilla-Walla Walla Recovery Unit, Oregon and Washington. 160 p. May 10, 2004.

U. S. Fish and Wildlife Service. 2008. Bull Trout Recovery Monitoring and Evaluation Guidance. Report prepared for the U.S. Fish and Wildlife Service by the Bull Trout Recovery and Monitoring Technical Group (RMEG). Portland, Oregon. 74 pp.

Watson, G., and T. W. Hillman. 1997. Factors affecting the distribution and abundance of bull trout: an investigation at hierarchical scales. North American Journal of Fisheries Management 17:237–252.

Winter, J. 1996. Advances in underwater biotelemetry. Pages 555-590 *in* B. R. Murphy and D. W. Willis, editors. Fisheries Techniques, Second Edition. American Fisheries Society, Bethesda, Maryland.

Appendix Table A1. Locations of radio-tagged subadult bull trout in the Umatilla and North Fork Umatilla rivers during tracking events from August 2006 to September 2007. River kilometers are continuous from the mouth of the Umatilla River into the North Fork. The North Fork enters the Umatilla River at river kilometer 144.2. River kilometers in italics indicate the fish had died or shed its tag.

	Radio tag code																		
Date	117	120	126	147	148	149	150	151	152	153	154	155	156	158	159	160	161	162	163
8/10/06	144.1	143.5																	
9/8/06		143.5																	
9/19/06	147.7	143.5																	
11/2/06		136.6																	
3/19/07	147.5	110.2																	
4/29/07			6.4																
5/3/07													144.3						
5/7/07													144.2	144.3	144.3				
5/8/07																144.3	144.3	144.3	
5/9/07																			144.3
5/10/07													144.2					134.5	139.8
5/12/07																			
5/14/07													144.0	125.8					139.8
5/18/07			121.8																138.7
5/19/07																			
5/22/07			127.1										144.2						138.7
6/1/07			137.1																
6/6/07				144.3															
6/7/07					144.3	144.3	144.3	144.3											
6/13/07									144.3										
6/14/07														115.8		126.8			
6/15/07										144.3									
6/17/07			137.1		128.9	144.3		140.5		144.3									
6/19/07												144.3							
6/23/07											144.3								
6/25/07		108.6	*90.1*		127.1				108.8									124.1	
6/27/07					127.1											126.6			
6/29/07					127.1	144.3		140.5		144.3		141.1							
7/10/07		109.2			127.1					144.3		141.4							
7/11/07										144.5									
7/20/07						144.5	144.8			144.5	144.6								
8/6/07					*127.1*	144.5		140.5	109.6	144.5		141.1							
8/13/07						144.5				144.5									
9/11/07						144.5	144.8				144.6	141.1							

Appendix Table A1 (continued).

	Radio tag code																	
Date	164	165	166	167	168	169	170	171	172	173	174	175	176	188	189	190	191	192
8/10/06																		
9/8/06																		
9/19/06																		
11/2/06																		
3/19/07																		
4/29/07																		
5/3/07													6.4					
5/7/07																		
5/8/07																		
5/9/07	144.3	144.3	144.3															
5/10/07			135.0	144.3	144.3													
5/12/07						144.3												
5/14/07		136.8	129.4	140.0	131.6	138.1	144.3		144.3	144.3								
5/18/07			129.4	136.6			127.0											
5/19/07								144.3			144.3	144.3						
5/22/07		136.8	129.4	136.8						140.9		132.7						
6/1/07			129.4	136.8						140.0	134.5							
6/6/07														144.3	144.3	144.3		
6/7/07																		
6/13/07																		
6/14/07							125.3						75.9					
6/15/07																		
6/17/07		137.9	129.4	136.8						140.0			75.6	129.8	144.2			
6/19/07																		
6/23/07																	144.3	144.3
6/25/07									122.1									
6/27/07						128.6												
6/29/07							125.7			140.0					144.2			140.5
7/10/07										140.0					144.2			140.5
7/11/07		137.9				128.6								129.7	144.2			
7/20/07															144.2			
8/6/07														129.7	144.2			
8/13/07																		
9/11/07																		

Appendix Table A2. Locations of radio-tagged bull trout and apparent brook trout x bull trout hybrids (codes 125, 127, and 145) in the North Fork John Day River and Baldy Creek during tracking events from July 2005 to November 2007. River kilometers are continuous from the mouth of the North Fork into Baldy Creek (tag code 130) or the upper main stem (the remaining tag codes). Baldy Creek enters the North Fork at river kilometer 170. River kilometers in italics indicate the fish had died or shed its tag.

	Radio tag code						
Date	125	127	128	129	130	144	145
7/2/05							162.9
7/6/05						170.6	
7/13/05						170.6	165.7
8/3/05							174.2
8/12/05						178.6	174.2
9/4/05						178.6	176.0
9/29/05						178.5	
10/17/05							
10/24/05						173.1	
11/7/05						163.0	
2/20/06						161.1	105.2
3/30/06							105.0
5/30/06						161.1	114.9
7/11/06				170.4		*162.5*	170.2
7/12/06			170.4		170.4		
7/14/06			170.7	172.5	170.7		
7/16/06	170.4	170.4					170.4
7/31/06	176.3	177.0	176.2	177.6			173.6
8/8/06					173.7		
8/21/06	176.3	176.3	177.3	177.5			173.6
9/22/06	176.3	176.3					
10/2/06	176.3	176.8					
10/20/06	173.9	165.9					
3/19/07		167.3					104.6
4/20/07	173.9	167.3					103.6
6/28/07		*167.3*					
9/27/07	*173.9*						
11/03/07					*173.7*		