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

2005 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

February 6, 2006

Table of Contents

Table of Contents........2
List of Figures........3
List of Tables........4
Abstract........5
Introduction........6
Umatilla River Basin........10
    Methods........10
        Radio Telemetry........10
        PIT Tag Detection Array........10
    Results........12
        Radio Telemetry........12
        PIT Tag Detection Array........13
    Discussion........14
        Radio Telemetry........14
        PIT Tag Detection Array........16
    Plans for 2006........16
John Day River Basin (North Fork John Day River Sub-basin)........17
    Methods........17
        Radio Telemetry........17
        Abundance and Distribution........18
    Results........19
        Radio Telemetry........19
        Abundance and Distribution........20
        Discussion........21
    Plans for 2006........22
Acknowledgements........23
References........24

List of Figures

Figure 1. Map showing the locations of the screw trap in the Umatilla River and PIT tag detection array (UM1) in the North Fork Umatilla River…………………………….11

Figure 2. PIT tag detection array in the North Fork Umatilla River. 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..12

Figure 3. Number and timing of bull trout captured in a screw trap in the Umatilla River (rkm 143.5) during spring 2005………………………………………………………….13

Figure 4. Length frequency distribution of bull trout captured in a screw trap in the Umatilla River (rkm 143.5) in spring 2005. The length of one bull trout that was not measured, but was estimated to be about 220 mm FL, is not included…………………………..14

Figure 5. Number and timing of detections of PIT-tagged subadult bull trout at the PIT tag detection array near the mouth of the North Fork Umatilla River in 2005…………...14

Figure 6. Map showing the upper North Fork John Day River and relevant tributaries and landmarks………………………………………………………………………………..18

Figure 7. Tracking data for a fluvial adult bull trout (code 144) and apparent brook trout x bull trout hybrid (code 145) in the North Fork John Day River in 2005…………….20

List of Tables

Table 1. Date of release, radio tag code, fork length (FL), and capture and release location of a fluvial adult bull trout (code 144) and apparent brook trout x bull trout hybrid (code 145) in the North Fork John Day River in 2005……….………………………..19

Table 2. Redd counts in the North Fork John Day River (NFJD) and Baldy Creek in 2005. Sections 1, 2, and 3 in the NFJD were from the bridge at the North Fork John Day campground upstream to the mouth of Baldy Creek, from Baldy Creek upstream to the Peavy Cabin trailhead, and from the Peavy Cabin trailhead upstream to the headwaters…………………………………………………………………………...20

Abstract

The goal of U.S. Fish and Wildlife Service studies in the Umatilla and John Day river 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 2005, we focused on gaining a better understanding of the seasonal distribution and movement of subadult bull trout in the Umatilla River Basin and fluvial adult bull trout in the John Day River Basin. In the Umatilla Basin, we snorkeled the lower North Fork Umatilla River at night in winter and operated a screw trap near the mouth of the North Fork in spring to capture subadults for radio or passive integrated transponder (PIT) tagging. We also continued to track subadults radio tagged in 2004 and maintained a PIT tag detection array near the mouth of the North Fork. Two subadults radio tagged in the upper Umatilla River in November 2004 moved little in 2005. One moved from the pool where it was captured (river kilometer [rkm] 143.8) to a pool 50 m upstream in late January 2005 and remained there throughout the spring freshet and into late June, when it was last located. The other was located at its release site (rkm 143.2) about one month after being released, and its tag was subsequently found in June in a Forest Service rental cabin on a hill overlooking the release site. While snorkeling at night in winter, we observed only seven subadult-sized bull trout, estimating all to be too small to tag (<120 mm fork length). We captured 53 subadult-sized bull trout (<300 mm fork length) in the screw trap, with the catch peaking in late May. We PIT tagged 35 of these fish, but radio tagged none of them because all but one, which escaped the trap, were too small for our smallest radio tags. Twenty bull trout that were subadult-sized when tagged in the North Fork by researchers from Utah State University were detected at the PIT tag array. Peaks in detections occurred in June and October. In the John Day Basin, we angled in the upper North Fork John Day River and South Fork Desolation Creek in July and August to capture fluvial adults (≥300 mm fork length) for radio tagging. We also conducted spawning ground surveys in the North Fork and its tributary Baldy Creek to gather information on abundance and distribution, particularly of the fluvial adults we were targeting. We captured only three fluvial adult-sized fish while angling. Two appeared to be bull trout and one appeared to be a brook trout (*Salvelinus fontinalis*) x bull trout hybrid. We tagged one of the bull trout and the apparent hybrid. Both moved upstream onto the spawning grounds in late summer and began moving downstream in September-October. We were unable to document the movements of these fish after October because all of our scheduled flights through the end of the year were cancelled due to inclement weather. We counted only 17 redds in the North Fork John Day River and 10 redds in Baldy Creek (9 and 8, respectively, appeared to have been made by fluvial females based on their size). These results, along with our limited angling success in the North Fork, suggest fluvial adult bull trout abundance was 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, eventually 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 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 water 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 Recovery Unit chapters of the Draft Recovery Plan (U.S. Fish and Wildlife Service 2004a and 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 primarily within the upper Umatilla River and the North Fork to complete their life cycle (Sankovich et al. 2003; 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), suggesting they were either fluvial subadults or first-time maturing fluvial 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 have been human impacts to the upper basin due to development, agriculture, and forest management, the major impacts occurred in the lower basin where six irrigation dams and diversions were built, 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 2005, the conditions in the Umatilla Basin that held the potential to negatively impact bull trout remained unchanged. The population in the North Fork appeared to be relatively small and stable or declining based on redd counts and mark-recapture abundance estimates (P.M.S, unpublished data; Budy et al. 2004, 2005). 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. In 2004, we operated a downstream migrant trap in the North Fork in fall and snorkeled at night in the North Fork and upper Umatilla River in winter to capture subadults for radio tagging. We captured and tagged only two subadults, both of which did not move between the time they were released in November and the end of the year (Anglin et al. 2008). Our objective in 2005 was to continue to snorkel in winter and operate a downstream migrant trap near the mouth of the North Fork in spring to capture subadults for tagging and describe their seasonal movement and distribution.

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 in 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.

The John Day River Recovery Unit Team identified seven local populations of bull trout in the North Fork John Day River sub-basin: 1) upper North Fork John Day River (includes Crawfish, Baldy, Cunningham, Trail, Onion, and Crane creeks and the mainstem upstream from Granite Creek), 2) upper Granite Creek (includes Bull Run, Deep, and Boundary creeks), 3) Boulder Creek, 4) Clear/Lightning creeks above the Pete Mann ditch (includes Salmon Creek),

5) Clear Creek below the Pete Mann ditch (includes Lightning Creek below the ditch), 6) Desolation Creek (includes South Fork Desolation Creek below a barrier falls and North Fork Desolation Creek), and 7) South Fork Desolation Creek upstream from the barrier falls (U. S. Fish and Wildlife Service 2002). Leading up to our study, there were no reliable abundance estimates for these populations, 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 instream wood (Umatilla National Forest and Walla Walla National Forest 1997a and 1997 b 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 mainstem and its tributaries, or any coldwater refuges downstream, during summer. They might also form a thermal block to migration for individuals moving up or downstream.

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. We eventually will describe both fluvial adult and subadult migrations. Our objective in 2005 was to focus on adults and, primarily, on those utilizing the upper mainstem. A secondary objective was to conduct spawning ground surveys in the main stem and Baldy Creek to begin to gather information on adult abundance and distribution.

Umatilla River Basin

Methods

Radio Telemetry

During this reporting period, we continued to track two subadult bull trout radio tagged on the Umatilla River in November 2004 (Anglin et al. 2008). We used the methods described in Anglin et al. (2008) to track the fish and determine their locations.

We also used the methods described in Anglin et al. (2008) to continue to snorkel the North Fork Umatilla River at night in winter and attempt to locate and dip net subadult-sized bull trout for radio tagging. We had snorkeled the upper portion of the bull trout distribution in December 2004, so we focused our effort primarily downstream from there during January-March 2005.

In spring 2005, we transitioned from snorkeling to operating a 1.5-m diameter rotary screw trap in the Umatilla River to capture subadults for tagging. The trap was located about 500 m downstream from the mouth of the North Fork (Figure 1). It operated for 49 of 66 d from 18 April to 23 June. All captured fish except those that could be legally harvested were anesthetized in an aerated bath containing 50-70 mg/L tricaine methanesulfonate (MS-222) buffered with 120 mg/L sodium bicarbonate. We counted and measured the fork length of bull trout, Chinook salmon (*Oncorhynchus tshawytscha*), and steelhead or rainbow trout (*O. mykiss*), and also weighed most of the bull trout. Individuals of other species were counted.

We inserted 23-mm passive integrated transponder (PIT) tags into a sample of the bull trout ≥120 mm FL. The tags were inserted into the abdomen through an approximately 4-mm long incision made with a surgical blade. We performed no surgeries to implant radio tags in bull trout because we caught only one fish large enough to tag with our radio tags (described in Anglin et al. [2008]), and that fish was not in the trap when we returned the next morning to tag it. We did not tag the fish the day it was captured because our tags had a 12 hr on and 12 hr off duty cycle, and to conserve battery life, our protocol was to launch the appropriate number of tags at 0800 the day after we had captured fish of the appropriate size (>70 g or about 196 mm) rather than to launch tags each morning in hopes that such fish would be in the trap.

PIT Tag Detection Array

Bull trout movements out of the North Fork Umatilla River were also monitored using a

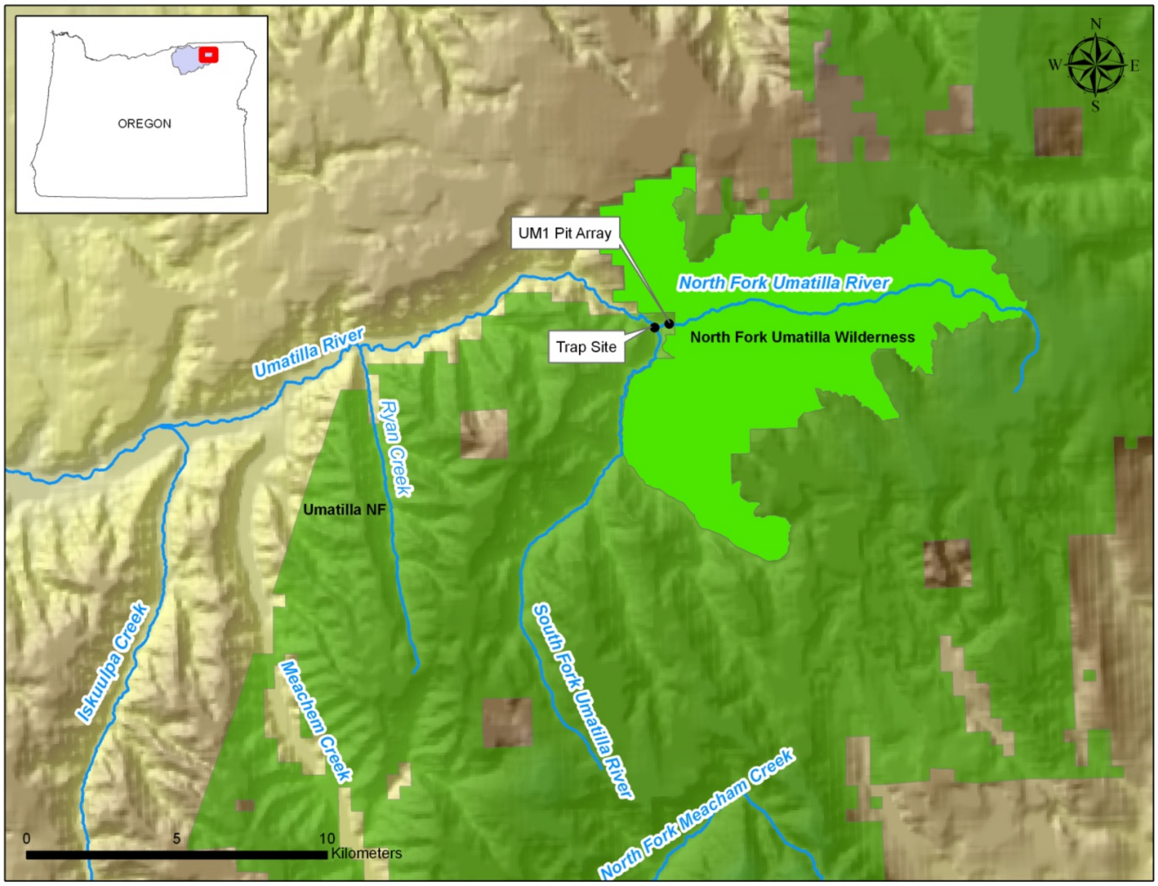

Figure 1. Map showing the locations of the screw trap in the Umatilla River and PIT tag detection array (UM1) in the North Fork Umatilla River.

PIT tag detection array near the mouth of the North Fork designated as UM1 (Figures 1 and 2). The PIT tag detection 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 was supplied with an on-site combination of solar panels, batteries, and a generator. Remote data upload was accomplished using satellite communications (Figure 2).

The PIT tag detection array enabled passive monitoring of the movement of bull trout that were PIT tagged in the North Fork in summer 2003-05 as part of an ongoing population assessment study (Budy et al. 2004, 2005). Subadults captured and PIT tagged at our screw trap 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 array were conducted to ensure reliable data collection and system operation. Antenna detection efficiency tests, as

Figure 2. PIT tag detection array in the North Fork Umatilla River. 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.

described in Anglin et al. (2008), were conducted periodically to estimate the proportion of the antenna field that consistently detected a PIT tag that passed through the apparent field.

Results

Radio Telemetry

The two subadult bull trout that were radio tagged in the upper Umatilla River in November 2004 moved little during the operational life of their tags. One (code 050) moved from the pool where it was captured (rkm 143.8) to a pool 50 m upstream in late January 2005 and remained there through 30 June 2005. On that date, we snorkeled to determine if the fish was alive and had retained its tag. We did not observe it, but it was evident it was alive and carrying its tag because it was at the head of the pool before we began snorkeling and at the tail of the pool after we had finished (we determined this by setting the radio receiver's gain to zero and using only a coaxial cable as an antenna). There were many larger *O. mykiss* and mountain whitefish (*Prosopium williamsoni*) moving around in the pool, and they may have obscured our view of the subadult. The subadult's tag apparently failed the week after we snorkeled, because we could not detect it while tracking on 6 July or thereafter.

The other tagged subadult (code 049) was located at its release site (rkm 143.2) about one month after being released. During seven subsequent tracking events extending into May, we either could not find it or could hear but not decode its tag's signal when in the vicinity of the release site. We eventually found the tag in June in a Forest Service rental cabin on a hill overlooking the release site.

We observed only seven bull trout while snorkeling the North Fork in January-March. All were located between Coyote and Woodward creeks and were too small to radio tag (100-

120 mm FL). We found no bull trout between the mouth of the North Fork and Coyote Creek.

The screw trap in the Umatilla River captured 53 bull trout, 295 Chinook salmon (fry, parr, and smolts), 1072 *O. mykiss*, 66 speckled dace (*Rhinichthys osculus*), 48 sculpin (*Cottus spp.*), and 2 adult and 4 larval Pacific lamprey (*Lampetra tridentata*). A rock crib anchoring one end of the trap's pulley system tipped over the day after the trap was installed, so the trap was pulled to shore and was not re-deployed until a week later, on 25 April. The first bull trout was captured the next day, but none were caught for six days thereafter. The bull trout catch peaked in late May, and the migration appeared to have ended by 10 June (Figure 3). On 23 June, the last day the trap operated, mid-day stream temperature at the trap site was 16^{o}C.

Trapped bull trout that were measured ranged from 102 to 180 mm FL and averaged 145 mm FL (Figure 4). The individual that was long enough to tag but was missing from the trap the next day was estimated to be about 220 mm FL. We PIT tagged 35 bull trout ranging from 122 to 180 mm FL and averaging 145 mm FL.

PIT Tag Detection Array

Twenty-three bull trout were detected at the PIT tag detection array in the lower North Fork Umatilla River in 2005. All had been tagged in the North Fork by researchers from Utah State University (USU). Three were the size of fluvial adults when tagged (471, 473, and 510 mm FL). The remainder were between 125 and 186 mm FL and were probably subadults when detected because they had not been detected previously passing downstream through the array. Two of these fish had been tagged in 2003, 6 in 2004, and 12 in 2005. Detections peaked during the months of June and October (Figure 5).

In 2003-05, 288 bull trout <300 mm FL (i.e., smaller than fluvial adult size) were tagged and released in the North Fork. The twenty fish that were likely subadults when detected at the array in 2005 represented 7% of these fish.

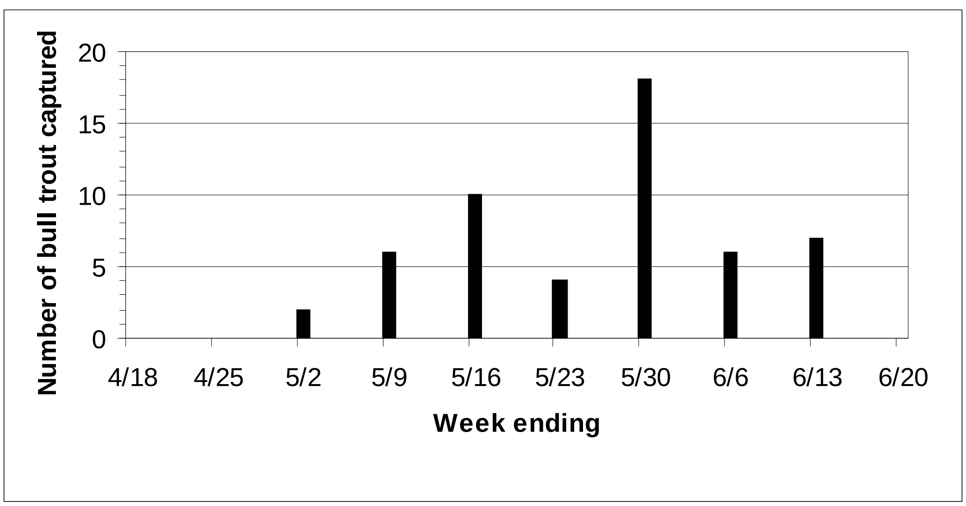

Figure 3. Number and timing of bull trout captured in a screw trap in the Umatilla River (rkm 143.5) in spring 2005.

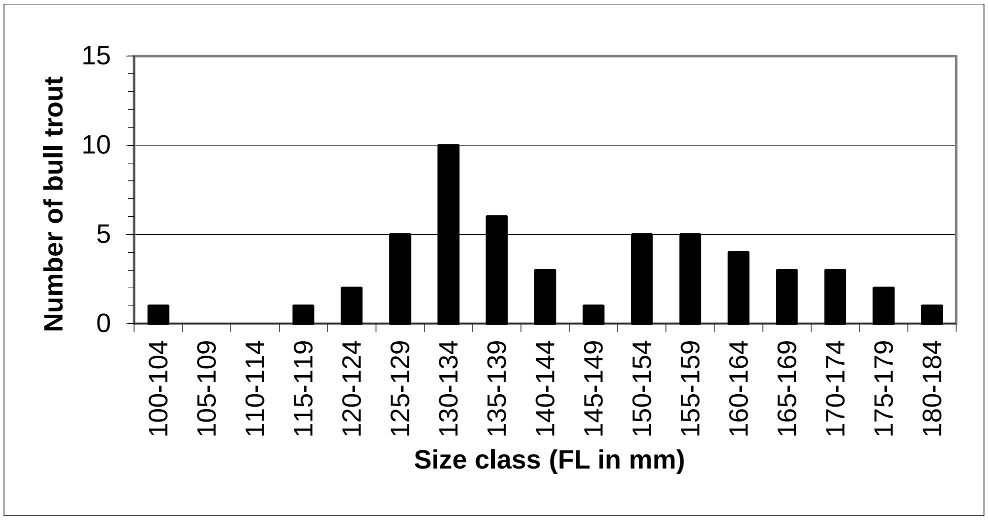

Figure 4. Length frequency distribution of bull trout captured in a screw trap in the Umatilla River (rkm 143.5) in spring 2005. The length of one bull trout that was not measured, but was estimated to be about 220 mm FL, is not included.

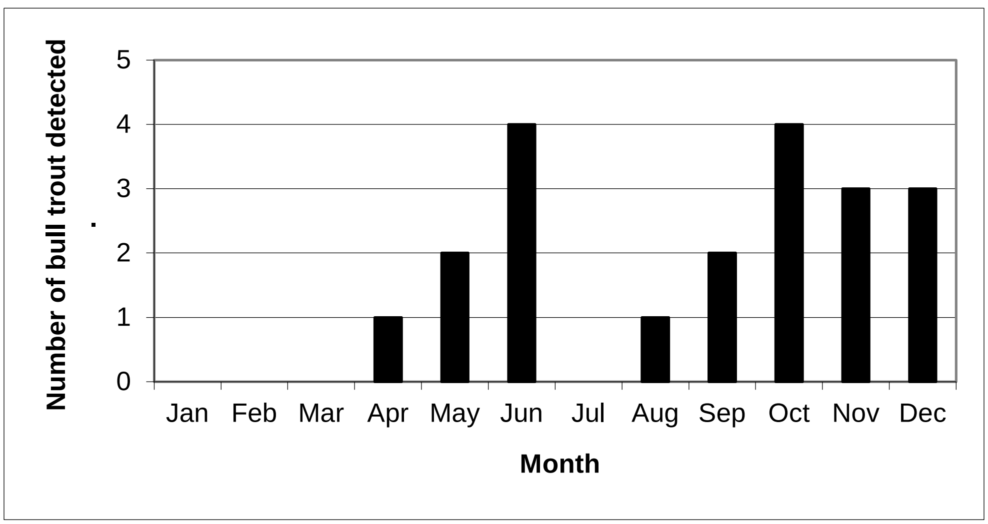

Figure 5. Number and timing of detections of PIT-tagged subadult bull trout at the PIT tag detection array near the mouth of the North Fork Umatilla River in 2005.

Discussion

Radio Telemetry

There were an estimated 1,976 (95% confidence limits of 1,375 and 4,190) bull trout 120-220 mm FL in the North Fork in summer 2004 (Budy et al. 2005). Our trap catch during the subsequent fall (Anglin et al. 2008) indicated few, if any, of those fish left the North Fork before we snorkeled it in winter. We observed only 11 juvenile or subadult-sized bull trout while snorkeling, however (7 during this reporting period and 4 during the previous one). Assuming the summer population estimate was not greatly positively biased, this indicates our snorkeling efficiency was quite low. We are uncertain why this would be the case. The slower, deeper-water habitats we focused on are preferred by bull trout in winter (Jakober et al. 1998), so our failure to find a larger number of fish should not have been due to our having snorkeled other habitat types less frequently. We also do not believe habitat complexity was an issue. There were some pools and runs that contained enough large woody debris to make it difficult to detect bull trout, but such sites were not numerous. Our impression of the remaining sites was that the habitat was not complex, and bull trout should have been noticeable if they were present. It is possible most of the bull trout had not emerged from concealment cover prior to the period when we snorkeled each night (from the onset of darkness to as late as 2300 hours), but this might not be likely given juvenile bull trout have been shown to emerge shortly after dusk (Muhlfeld et al. 2003).

Because we radio tagged only two subadult bull trout, there is little we can conclude at this time about subadult movements. None of the tagged fish migrated downstream into the lower Umatilla River. The single individual for which we had a good, long-term tracking record remained in the upper end of the Umatilla River and had a home range of approximately 50 m from November through June. It had a high fidelity to a single pool, where it was located for five consecutive months before its radio tag failed. The other fish, or its tag, likely was removed from the Umatilla River within two months after the date of release. Its lack of movement while in the river could indicate it had established an overwintering site or had died or lost its tag. We did not snorkel when the fish (or its tag) was known to be in the river to determine if it was alive and had retained its tag.

Our results from trapping in fall 2004 (when we caught no subadults) and spring 2005 suggest tagging in the spring and using smaller, shorter-lived radio tags to track the movement of subadults would be a reasonable option. We initially ruled this out because we were concerned shorter-lived tags would fail before subadults had to cease migrating downstream due to increasing water temperatures in the Umatilla River. However, if there are currently a relatively large number of subadults emigrating in May and early June, using tags with as little as one or two months of battery life would be informative because stream temperatures in the Umatilla River become too high for continued downstream migration in June or July each year (Confederated Tribes of the Umatilla Indian Reservation, unpublished data). With smaller tags we could reduce the minimum size for tagging, increase the sample size, and obtain a more representative sample. There are currently tags available that would allow us to track fish weighing 18 g (about 123 mm FL) for at least 52 days. Those tags could be used on all but the smallest subadults (see Figure 4). Larger tags could still be used on larger, earlier-migrating individuals.

Based on their size, most of the subadults trapped in the spring were likely migrating downstream for the first time. Older (larger) subadults that had exited the North Fork in prior years presumably were downstream from the trap site and not available for capture. Tracking the movement of older subadults would be beneficial because their behavior might differ from that of younger subadults. We will accomplish this in part by PIT tagging the smaller fish captured in the screw trap and monitoring their movement in subsequent years past the existing PIT tag detection array in the North Fork Umatilla River and an array that will be installed 15 km downstream from it at a county bridge currently being constructed. Additional, more detailed information on the movement of older subadults will be gained by coupling radio tagging with PIT tagging. Because it appears older subadults cannot be trapped at the site used in 2005, we will we have to modify our approach to capture them for tagging. Among the options are to move the trap to a location farther downstream in the system, fish a second trap downstream from the first, or use active techniques (e.g., angling, dip-netting). The last option would be preferable, especially if we were to target the bull trout in late summer and early fall when their distribution would be limited by high stream temperatures to the upper Umatilla River and any cold water refuges downstream. If we were to fish a single trap and move it downstream, we would risk capturing fewer fish and failing to characterize the movement of any subadults taking up residence upstream from the trap. We placed the screw trap close to the mouth of the North Fork in 2005 so the catch would be maximized and representative of fish exiting the North Fork. Fishing one trap near the North Fork and another downstream would be more costly in terms of equipment and person hours than actively capturing the subadults and is not possible with our current level of staffing. A potential additional problem with relying on one or more traps to capture older subadults is that we do not know whether the older subadults continue to migrate seasonally after their initial migration out of the North Fork. This could be the case, particularly if their distribution expands and contracts with changes in the amount of thermally suitable habitat; however, there may be individuals that leave the North Fork, find a suitable reach of stream in which to rear, and remain there until maturing. Such individuals would not be susceptible to being captured by a migrant trap.

PIT Tag Detection Array

The timing of downstream movement of subadult bull trout in the North Fork Umatilla in 2005, as indicated by detections at the PIT tag detection array, was similar to that seen in other systems, with peaks occurring in spring and fall and smaller numbers of fish continuing to move downstream during other months of the year (see, for example, the screw trapping data in Hemmingsen et al. 2001a; Muhlfeld and Marotz 2005; Downs et al. 2006). The low rate of detection (7%) of bull trout that were <300 mm FL when tagged in the North Fork suggests subadult production was low. Tagged fish that were not detected either were dead, had not yet initiated their downstream migration, had done so but had passed the PIT tag array undetected, or were resident fish. Future data collection at the detection array and through mark-recapture work conducted by USU researchers upstream from the array will be required to shed light on the fate of these fish.

Plans for 2006

In spring 2006, we will continue to operate a screw trap in the Umatilla River, just downstream from the mouth of the North Fork. We will outfit subadult bull trout with radio tags having battery lives ranging from about two to nine months, and PIT tag any in excess of those that are radio tagged. In late summer and early fall, we will capture larger, older subadults by angling or by snorkeling and dip-netting them at night and outfit them with nine-month tags. Radio-tagged fish will be tracked at least every other week during periods when they are actively migrating and monthly when they are not. We will continue to assist ODFW's district fish biologist in conducting spawning ground surveys on the North Fork Umatilla River.

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

Methods

Radio Telemetry

We used radio telemetry to monitor the movement of fluvial adult bull trout. Fish were captured for tagging by angling in the North Fork and its tributary South Fork Desolation Creek from 2 July to 22 August. We fished the North Fork from its headwaters downstream to rkm 160, about 2.5 km downstream from the North Fork John Day campgournd (Figure 6), so individuals destined for Trail, Onion, Baldy, and Crawfish creeks might be included in the sample. In South Fork Desolation Creek, we focused our effort on and near a pool at the base of a large falls at rkm 4. Six fluvial adults were observed by a diver in that pool, whereas few were seen scattered throughout the remainder of the stream in August 2003 (I. Tattam, Oregon State University, personal communication).

We carried our tagging equipment in a backpack as we fished and performed surgery as bull trout were captured. Our fish handling and surgical procedures generally followed those described by Sankovich et al. (2003); however, rather than holding fish in a live net in the stream before surgery, we placed them in a covered Rubbermaid tub containing aerated river water. We also used a cocktail straw to shield the hypodermic needle used to guide the radio tag antenna through the body wall, and inserted a PIT tag into the abdomen rather than the cheek of each fish. The 23-mm PIT tags we used (versus the 12-mm tags used by Sankovich et al.) could not be accommodated in the fish's cheek.

The radio tags (Lotek model MCFT-3FM) had a 12 hr on and 12 hr off duty cycle, 5 s burst rate, and warranty life of 755 d. They weighed 10 g in air and, based on length/weight relationships developed for other bull trout populations (Budy et al. 2004; P.M.S, unpublished data), were suitable for bull trout about 330 mm FL or longer at 3% of the host's weight.

We tracked the radio-tagged fish by vehicle, by foot, and air in roadless areas. Tracking occurred twice per month in summer and early fall when the bull trout were actively migrating. We had intended to track once per month in late fall and winter after the bull trout had arrived in wintering areas, however, all of our scheduled telemetry flights from November to January were cancelled due to bad weather. Fish positions during all tracking events 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.

Abundance and Distribution

We conducted spawning ground surveys on the North Fork John Day River and its tributary Baldy Creek twice during the September-October spawning period. The North Fork was surveyed from the bridge at the North Fork John Day campground upstream to a 10-m long cascade in the headwaters at about rkm 178. We believe this reach included all of the spawning habitat in the North Fork. Summer stream temperatures downstream from the bridge were likely too high to support bull trout, and we observed no bull trout or other fishes upstream from the

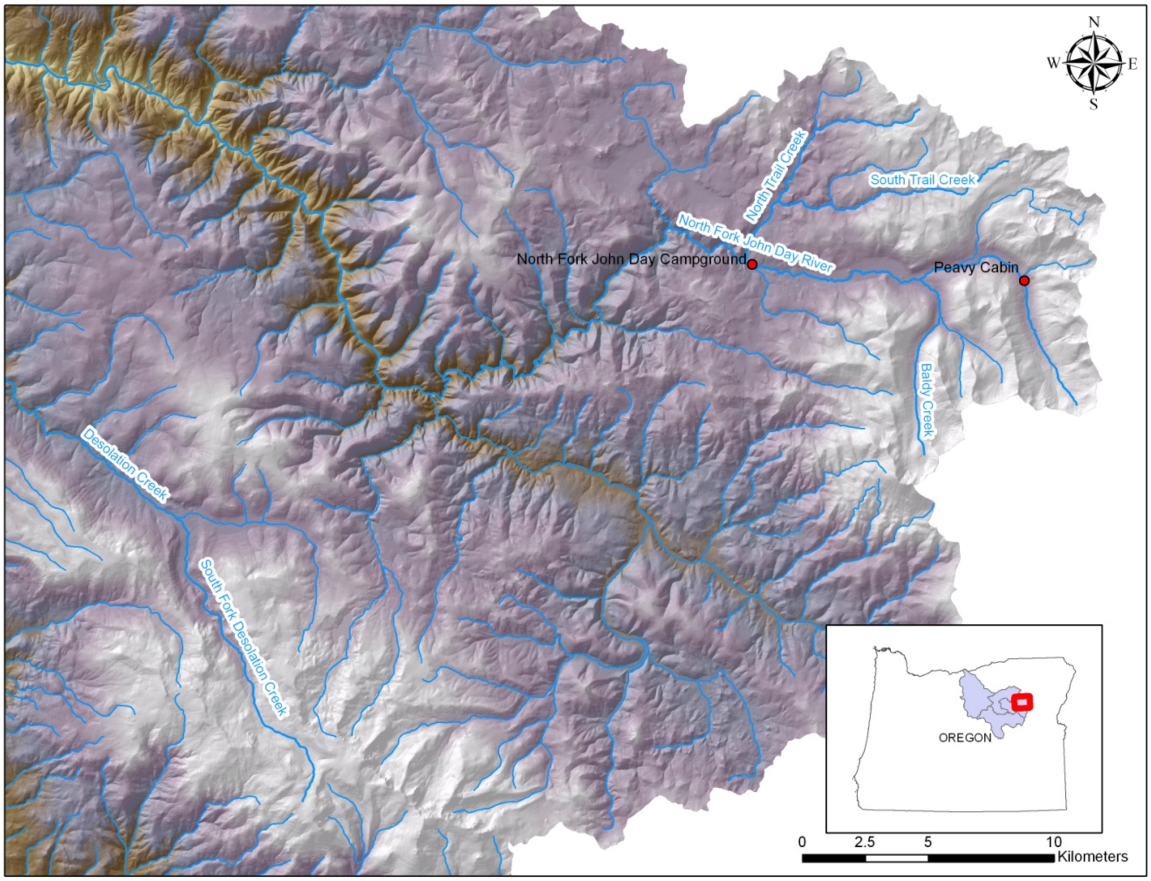

Figure 6. Map showing the upper North Fork John Day River and relevant tributaries and landmarks.

cascade while radio tracking on foot in September. Fish should have been visible if present upstream from the cascade because the habitat was not complex and there was little streamflow. We divided the survey reach into three sections, one from the bridge at the North Fork John Day Campground upstream to the mouth of Baldy Creek (Section 1), one from Baldy Creek upstream to Peavy Cabin trailhead (Section 2), and one from Peavy Cabin trailhead upstream to the cascade in the headwaters (Section 3). We surveyed Baldy Creek from its mouth upstream to rkm 5. This reach did not include all of the bull trout spawning habitat. It corresponded to a study section used by researchers from USU who conducted mark-recapture work in Baldy Creek in summer 2005. They will compare their estimate of adult bull trout abundance to the redd count. We split the survey reach into two sections, one extending from the mouth of Baldy Creek upstream 1.2 km to the beginning of ODFW's index area (Section 1), and the other encompassing the index area (Section 2).

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 the length and width of each redd and our impression of whether the redd was made by a fluvial or resident female based on its size and the size of the substrate. The length was measured from the upstream end of the pit to the downstream end of the pillow, and the width, at the widest part of the pillow. Personnel from ODFW conducted the last survey of Baldy Creek and measured only the width of redds. We subsequently classified the five redds they measured as belonging to fluvial or resident females if they were greater than or less than or equal to 50 cm wide, respectively. We based this criterion on data collected in the Little Minam River, which supports only resident bull trout (ODFW, unpublished data).

Results

Radio Telemetry

We caught only three fluvial adult-sized charr (two bull trout and one apparent brook trout [*Salvelinus fontinalis*] x bull trout hybrid) and observed only one other while angling. All four fish were located in the North Fork between the North Fork John Day campground and a point about 200 m upstream from the mouth of Baldy Creek. We did not observe or capture any fluvial adults in South Fork Desolation Creek during three outings, one each in early and mid July and early August. Of the three fish captured in the North Fork, two were outfitted with radio tags and one was released without being tagged because it was bleeding from the hook wound. The two tagged fish were 370 and 445 mm FL (Table 1), the former being the apparent hybrid. We also caught approximately 40 fish <300 mm FL in the North Fork. Most appeared to be brook trout x bull trout hybrids. Three apparent hybrids were caught just downstream from the North Fork John Day campground (i.e., downstream from the spawning grounds in the North Fork and Trail and Baldy creeks) and presumably were migratory individuals.

Table 1. Date of release, radio tag code, fork length (FL), and capture and release location of a fluvial adult bull trout (code 144) and apparent brook trout x bull trout hybrid (code 145) in the North Fork John Day River in 2005.

Date of Release	Tag code	FL(mm)	Rkm
7/2/05	145	370	162.9
7/6/05	144	445	170.6

Both of the tagged fish in the North Fork moved steadily upstream after being released, indicating they were in good condition following surgery. They arrived in the reach between the Peavy Cabin trailhead and the headwaters, where most of main stem spawning occurred, on or before 4 September (Figure 7). On 29 September, we observed one of the fish (code 144) exhibiting male behavior while paired with a female that was actively constructing a redd. We believe his radio tag's antenna had broken off because we had a clear view of him and could not see it. We nevertheless were able to track him from a vehicle as he slowly moved downstream out of the spawning grounds in October and early November. He was within 100 m upstream from the North Fork John Day campground and about to enter the North Fork John Day Wilderness Area when he was last located on 7 November.

The other tagged fish (code 145), the apparent brook trout x bull trout hybrid, was not observed again after being located upstream from the Peavy Cabin trailhead on 4 September

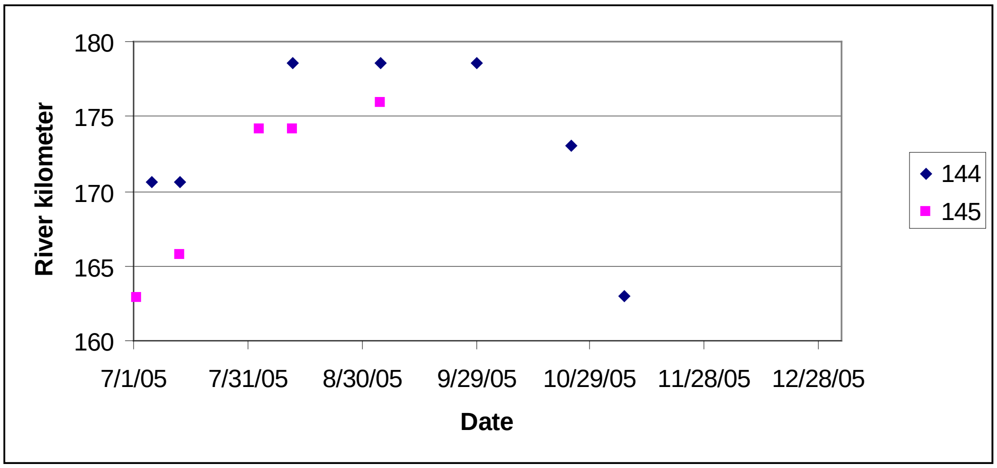

Figure 7. Tracking data for a fluvial adult bull trout (code 144) and apparent brook trout x bull trout hybrid (code 145) in the North Fork John Day River in 2005.

(Figure 7). We restricted our tracking to the reach between the North Fork John Day campground and the headwaters during the spawning period, so our failure to locate code 145 on 29 September probably indicated it had left the spawning grounds and moved downstream into the wilderness area between that date and the previous tracking event on 4 September. We were unable to confirm this because of our inability to conduct a telemetry flight during the remainder of the year.

Abundance and Distribution

During the spawning ground surveys, we counted 17 redds in the North Fork John Day River and 10 redds in Baldy Creek (Table 2). Most of the redds in the North Fork were located upstream from the trailhead at Peavy Cabin. None were downstream from the mouth of Baldy Creek. Based on redd and substrate sizes, we estimated nine redds in the North Fork and eight in Baldy Creek were made by fluvial females.

Table 2. Redd counts in the North Fork John Day River (NFJD) and Baldy Creek in 2005. Section descriptions are provided in the Methods section.

		New redds			
		Section			Total
Stream	Date	1	2	3	redds
NFJD	26-27 Sep	0	1	5	6
	17-19 Oct	0	4	7	11
					17
Baldy Cr	27 Sep	1	4		5
	27 Oct	3	2		5
					10

Discussion

As was the case for subadult bull trout in the Umatilla River Basin, there is little we can say currently about the migratory behavior of fluvial adult bull trout in the North Fork John Day River Sub-basin. The sample size is small, and the annual cycle of movement of the two radio-tagged fish has not been completed. Information collected on them and additional tagged fish during the spring-summer period as stream temperatures rise and flows subside will be key in gaining an understanding of factors restricting their movement and distribution.

Before we initiated this study, the bull trout population in the North Fork John Day River was thought to be relatively healthy. Our redd count and the difficulty we had in capturing fish for tagging indicate otherwise, as do the findings of researchers from USU who conducted mark-recapture work in the North Fork in summer 2005. Those researchers captured only three fluvial adult bull trout (which they defined as being >370 mm FL) while electrofishing a 12-km study area between the North Fork John Day Campground and Cunningham Creek. The abundance estimate based on re-sighting of marked fish while snorkeling was 9 (R. Al-Chokhachy, USU, personal communication). This estimate was imprecise and did not account for any fluvial adults that might have been upstream from the study area. Nevertheless, it is fairly consistent with the number of redds we attributed to fluvial females (9), and these two figures, coupled with the electrofishing and angling data, indicate the abundance of fluvial adults was extremely low.

The status of resident bull trout in the North Fork is difficult to assess based on the available information, but the evidence in general suggests they are not faring much better than their fluvial counterparts. Drawing inferences from the count of resident-sized redds is complicated by the presence of brook trout spawners in the North Fork, and 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 is a less relevant issue given we counted only eight resident-sized redds. Whether brook trout made none or all of them, the number belonging to bull trout would have been exceedingly small. Surveyor bias, on the other hand, could seriously undermine any attempt to infer the abundance of resident bull trout from the redd count. 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 and the stream in Hemmingsen et al.'s study both 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 associated with our redd count to be more in line with that evident in Hemmingsen et al.'s study.

The best evidence that resident bull trout in the North Fork are at risk comes from USU's mark-recapture work and from our experience while angling. The USU researchers estimated there were 699 bull trout between 120 and 370 mm FL in their study area (R. Al-Chokhachy, USU, personal communication). This figure alone is not very useful in assessing the status of resident bull trout because fish in this size class could have been resident or fluvial juveniles, fluvial subadults, or resident adults, and because much of the rearing habitat for bull trout is located upstream from the study area. However, when considered together with the estimate of the number of hybrids (349; R. Al-Chokhachy, USU, personal communication), it is evident hybridization with brook trout is a significant threat. This is supported by our observations while angling. We caught only hybrids and brook trout between Cunningham Creek and a point about 1.6 km downstream from the cascade we believe to be the upper limit of the bull trout distribution. Although we caught no brook trout upstream from that point, we continued to encounter hybrids (along with bull trout), suggesting brook trout may be present throughout the distribution of bull trout. In summer 2006, the USU study area will be extended upstream to the cascade (R. Al-Chokhachy, USU, personal communication). This will allow for a more rigorous evaluation of the abundance and distribution of bull trout, brook trout, and hybrids in the upper North Fork.

Plans for 2006

To increase our efficiency in capturing fluvial adult bull trout for radio tagging, we will operate a weir trap in the North Fork in spring and early summer 2006. The trap will be located downstream from the mouth of Baldy Creek so fish destined for that stream as well as the upper North Fork might be included in the sample. If we fail to capture a sufficient number of fish because high flows render the trap inoperable for extended periods, we will angle in summer to supplement the catch. Due to the low abundance of fluvial adults, we will tag no more than six individuals. This equates to less than 20% of the adult population in 2005, assuming there were two fluvial adults per redd that year. We will also tag any bull trout captured by investigators from ODFW operating screw traps in the North Fork, Middle Fork, and main stem John Day rivers, and seining in the John Day River below the town of Spray. We will track the fish tagged in 2005 and 2006 every other week during periods when they are actively migrating and monthly when they are not. The spawning ground surveys in the North Fork and Baldy Creek will be continued and we will expand our effort into other tributaries as time allows. Because many of the tributaries contain brook trout and fine granitic substrate, the primary focus will be on locating redds made by fluvial females to gain a better understanding of the distribution and abundance of fluvial adults in the drainage.

Acknowledgements

Funding for this study was provided by the U.S. Fish and Wildlife Service. We thank the personnel from the Oregon Department of Fish Wildlife's Northeast Oregon Fish Research and Development Section and Darren Gallion, Marshall Barrows, and Courtney Newlon of the U.S. Fish and Wildlife Service for their assistance in the field, and Oregon Department of Fish and Wildlife District Fish biologists Tim Bailey and Tim Unterwegner for supporting our work in their districts.

References

Anglin, D. R., D. G. Gallion, M. Barrows, C. Newlon, P. Sankovich, T. J. Kisaka, and H. Schaller. 2008. Bull trout distribution, movement and habitat use in the Walla Walla and Umatilla River basins, 2004 annual report. U. S. Fish and Wildlife Service, Columbia River Fisheries Program Office, Vancouver, Washington.

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.

Columbia-Blue Mountain Resource Conservation and Development Area. 2005. John Day Subbasin Revised Draft Plan. Northwest Power and Conservation Council, 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., S. Glutting, R. Hunt, D. Daniels, and B. Marotz. 2003. Winter diel habitat use and movement by subadult bull trout in the upper Flathead River, Montana. North American Journal of Fisheries Management 23:163-171.

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.

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. Chapter 9, John Day Recovery Unit, Oregon. 82 p. *In*: U. S. Fish and Wildlife Service, 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.

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.