U.S. Fish and Wildlife Service
Columbia River Fish and Wildlife Conservation Office

Brook Trout in the Walla Walla River Basin: Assessing the Conservation Risks to Bull Trout

2016-2019 Project Report

Marshall G. Barrows and Ryan C. Koch

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On the cover: An adult-sized Brook Trout captured in the East Big Spring Branch of the East Little Walla Walla River. Photograph by Marshall Barrows (FWS).

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Disclaimers

Brook Trout in the Walla Walla River Basin: Assessing the Conservation Risks to Bull Trout

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Abstract — The presence of self-sustaining populations of nonnative Brook Trout (*Salvelinus fontinalis*) in stream systems can potentially threaten the long-term persistence of Bull Trout (*Salvelinus confluentus*). A crucial component of the Bull Trout Recovery Plan involves identifying potential threats and improving our understanding of how those threats may affect the species. The potential for the nonnative Brook Trout population in the spring branches of the East Little Walla Walla River to expand to neighboring tributaries is a concern because further upstream expansion could threaten ESA-listed Bull Trout strongholds in the South Fork Walla Walla River and Mill Creek. When the Recovery Plan was finalized, information was lacking to accurately assess the conservation risks Brook Trout posed to Bull Trout in the Walla Walla River Basin. However, Recovery Action 4.3.1 specifically called for additional research into the distribution of Brook Trout in the spring branch tributaries and to evaluate the need for control. In 2016, the Columbia River Fish and Wildlife Conservation Office, initiated a study to gain a better understanding of Brook Trout distribution, gather spawning information, and monitor movements within the spring branch tributaries and to the mainstem Walla Walla River. Results from distribution sampling indicated that Brook Trout of multiple age classes were widely distributed throughout the East Big Spring Branch, however, Brook Trout were also found in portions of the West Big Spring Branch, the East Little Walla Walla River and the mainstem Walla Walla River at least seasonally. Of the 161 Brook Trout we PIT-tagged, the majority did not emigrate from the East Big Spring Branch. However, those that did (6.2%), primarily used the East Little Walla Walla River during the winter months as habitat linkages to connect with other habitat or to enter the mainstem Walla Walla River. Detection histories suggest six (3.7%) of the fish entered the mainstem Walla Walla River. Due to the limited nature of our tagging efforts, PIT-tagged fish represented the movements of an unknown, but likely much larger number of untagged individuals. PIT detection data also indicated that juvenile Chinook salmon (*Oncorhynchus tshawytscha*), adult steelhead (*Oncorhynchus mykiss*), Bull Trout, and large numbers of juvenile steelhead used the East Little Walla Walla River and the spring branch tributaries seasonally, primarily between the months of November and April, but fish were either sampled or detected in those areas during all seasons. Redd surveys were only conducted in a small portion (16%) of the East Big Spring Branch. The seven redds found only partially characterized spawning within the entire study area. In summary, this Brook Trout population demonstrates connectivity to the mainstem Walla Walla River, heightening the risk of colonizing nearby tributaries or expanding upstream into Bull Trout spawning and rearing habitat.

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Introduction

Introduced populations of Brook Trout have become widely established throughout the Pacific Northwest (Fuller et al. 1999; Dunham et al. 2002). The ability of Brook Trout to displace native salmonids has been well-documented (Meyer et al. 2006; Rieman et al. 2006) and likely due to multiple factors. Some of the main factors thought to contribute to their competitive success include rapid growth rates, early reproductive maturation and a wide tolerance of water temperatures when compared to many native salmonids (Gunkel et al. 2002; Meyer et al. 2006). In drainages where Brook Trout and Bull Trout cohabitate and compete for similar resources, Brook Trout not only regularly hold a competitive edge but also spawn in similar microhabitats in the fall leading to hybridization (Ratliff and Howell 1992: Fraley and Shepard 1989; Leary et al. 1993). The Bull Trout Recovery Plan (USFWS 2015a) identifies the presence of Brook Trout within Bull Trout Core Areas as a threat to the long-term persistence and eventual recovery of populations.

Historically, the Walla Walla River Basin was believed to be void of Brook Trout, but during habitat assessment and fish surveys in 2004, Brook Trout were observed and captured within multiple reaches of the East Big Spring Branch (EBSB) of the East Little Walla Walla River (ELWWR) on private property in the state of Oregon by the Confederated Tribes of the Umatilla Indian Reservation (Hoverson 2004; Mahoney et al. 2006). Multiple year classes were observed, indicating an established, self-sustaining population. However, surveys suggested the population was small and appeared to be localized within the EBSB (Hoverson 2004). In 2009, U. S. Fish and Wildlife Service (FWS) biologists captured an adult Brook Trout in a pond near the headwaters of the EBSB, rekindling multi-agency interest into further investigating the distribution of this invasive population. In August of 2011, the FWS coordinated a one-day multi-agency effort to coarsely describe Brook Trout distribution in the EBSB, the WBSB and the ELWWR via single pass electrofishing. After sampling 2.0, 0.4, and 0.2 rkms in the EBSB, West Big Spring Branch of the East Little Walla Walla River (WBSB), and the ELWWR, respectively, 36 total Brook Trout were captured (all within the EBSB). Brook Trout fork lengths ranged from 89 – 310 mm and averaged 207 mm (Barrows et al. 2023). This limited effort echoed results from Hoverson 2004, in that Brook Trout appeared to be confined to the EBSB. Despite its close proximity to the mainstem Walla Walla River (i.e., approximately 2.8 rkm) there had been no indications that Brook Trout from this population had dispersed beyond the EBSB and genetic work throughout the basin had yielded no results that indicated hybridization with Bull Trout. Nonetheless, the presence of Brook Trout in a tributary to the Walla Walla River remained an impending threat to Walla Walla River Basin Bull Trout.

When the Recovery Plan was finalized, crucial data were lacking to accurately assess the conservation risks Brook Trout posed to Bull Trout in the Walla Walla River Basin. However, Recovery Action 4.3.1 in the Mid-Columbia Recover Unit Implementation Plan (RUIP) specifically called for additional research into the distribution of Brook Trout in the spring branch tributaries and to evaluate the need for control (USFWS 2015b). In 2016, the Columbia River Fish and Wildlife Conservation Office, with assistance from the Walla Walla Watershed Council, the Washington Department of Fish and Wildlife, and the Oregon Department of Fish and Wildlife, initiated a study to gain a better understanding of Brook Trout distribution, gather spawning information, and monitor movements within the spring branch tributaries and to the mainstem Walla Walla River.

Study Area

Three streams were included in our study, the ELWWR, WBSB and EBSB. The ELWWR begins as one of the distributary branches from the Little Walla Walla River (Figure 1). The Little Walla Walla River originates within the city limits of Milton-Freewater, Oregon where a portion of the Walla Walla River (WWR) streamflows are diverted primarily for irrigation purposes at the Little Walla Walla River Diversion (WWR rkm 76.3). After approximately 2.5 rkm, the Little Walla Walla River is distributed into multiple irrigation channels. One channel, the West Crockett Branch, continues to flow North through town until it becomes known as the East Little Walla Walla River (ELWWR) near Cobb Road (ELWWR rkm 9.4). For this study, the upper boundary of our study area was established where Ferndale Road crosses the ELWWR. Six rkm of the ELWWR from Ferndale Road downstream to its confluence with the mainstem Walla Walla River (WWR rkm 62.1) were included in the study. The WBSB is a small spring branch tributary that originates from a wetland area near Ferndale Road and flows primarily north for 2.4 rkm before its confluence with the ELWWR (ELWWR rkm 3.7). The EBSB is the larger of the two spring branch tributaries and initiates from a pond located east of Highway 11 and flows northwest through farmland before entering the ELWWR (ELWWR rkm 2.0), approximately 1.1 rkm north of the Oregon/Washington state line.

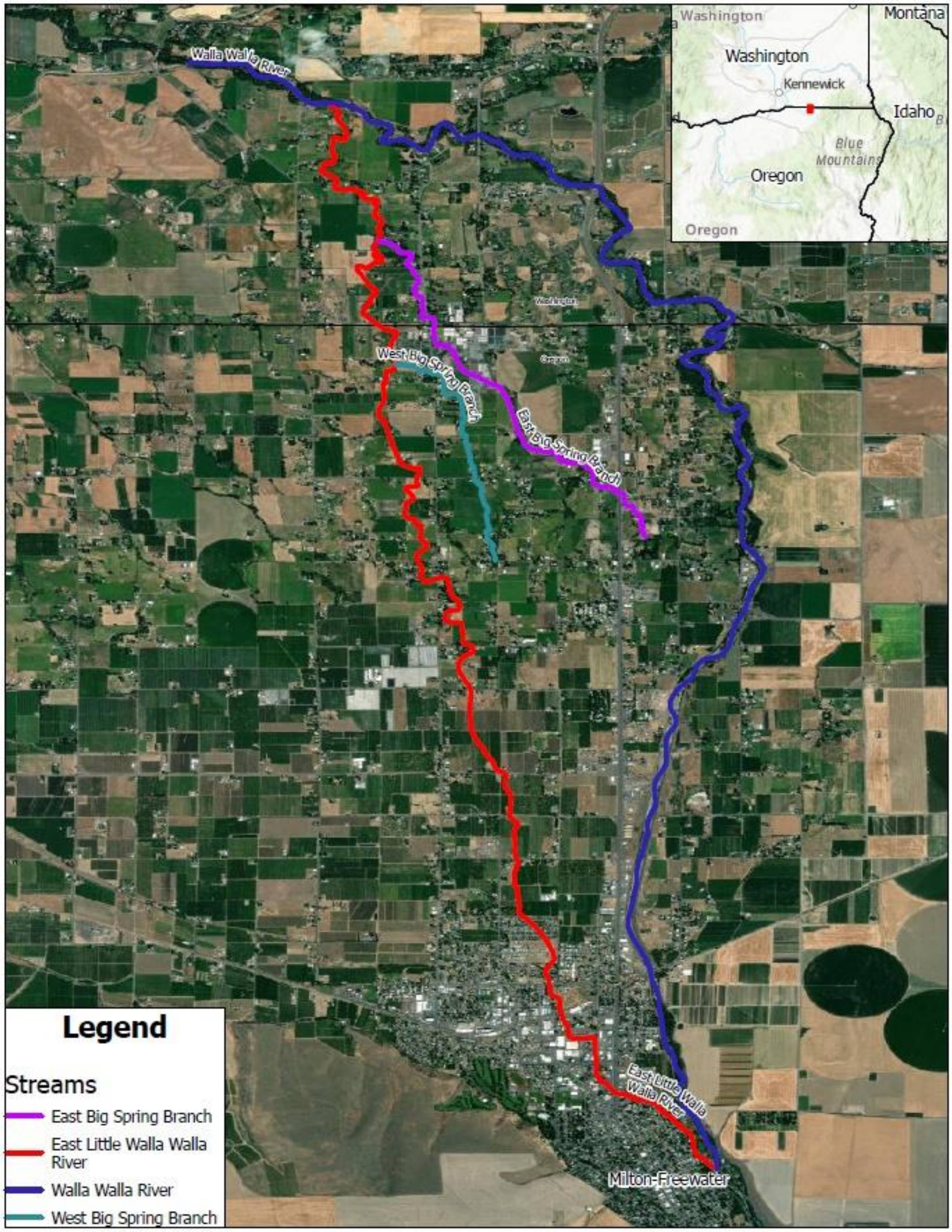

Figure 1. Study area map showing the Little Walla Walla River Diversion, the East Little Walla Walla River, and the West and East Big Spring Branches of the East Little Walla Walla River.

The entire study area was located on private land. Online tax lot maps for Umatilla County in Oregon and Whitman County in Washington were used to identify landowners that owned property that bounded stream reaches in the study area. With assistance from the Oregon Department of Fish and Wildlife, Washington Department of Fish and Wildlife and Walla Walla River Watershed Council staff, we secured access to sample a total of over 3.7 rkm of stream habitat from 21 landowners throughout the study area (Figure 2).

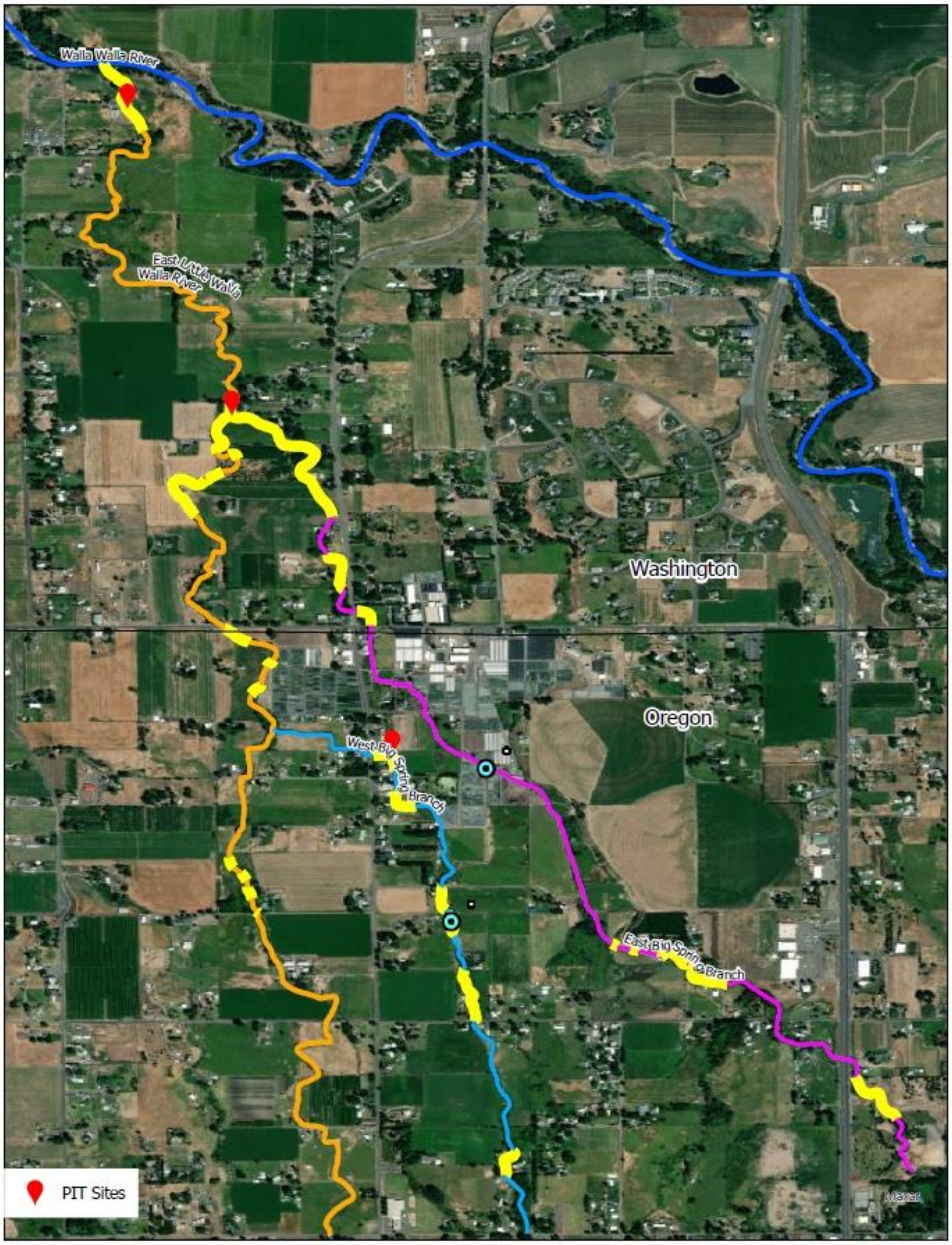

Figure 2. Study area map showing sampling reaches on the East Little Walla Walla River, and the West and East Big Spring Branches of the East Little Walla Walla River.

Methods

Field crews used electrofishing to sample in the EBSB, WBSB and the ELWWR to gain a better understanding of Brook Trout distribution. Brook Trout were tagged with Passive Integrated Transponder (PIT) tags for subsequent detection. PIT detection sites were established at strategic locations within the study area, fish movements were monitored and redd surveys were conducted. Details of these activities are hereafter described.

Distribution

Electrofishing surveys were conducted to describe the current Brook Trout distribution in the EBSB, WBSB and ELWWR. Since all streams in the study area were located on private land, the level of access acquired influenced the design and implementation of the surveys. Not all portions of the stream within each stream section were sampled primarily due to excessive blackberry growth or deep silt substrate.

Experienced personnel used a Smith-Root model LR-24 shocker to sample accessible stream reaches from downstream to the upstream boundary without blocknets when water temperatures did not exceed 18 ℃. Single-pass electrofishing without blocknets has been demonstrated to be an effective and efficient tool for collecting fish distribution data in small streams (Batemen et al. 2005; Reid et al. 2008; Hudson et al. 2010; Silver et al. 2010). All fish captured were enumerated and identified to species. All species other than Brook Trout were immediately released near the capture site. Following capture, Brook Trout were immediately anesthetized for tagging in a river water bath containing a concentration of 40 mg/L of AQUI-S®20E in accordance with INAD #11-741. Once anesthetized, Brook Trout were measured to the nearest mm (fork length) and weighed to the nearest 0.1 g. Length-frequency distributions were summarized for all Brook Trout captured during this study (i.e., during distribution sampling and targeted tagging efforts). Age classes were identified from the length-frequency histograms.

Movement

Brook Trout were captured and PIT-tagged to establish and maintain a tagged population for subsequent detection (Figures 2 and 3). Reaches where high densities of Brook Trout were captured during the 2011 sampling effort were targeted (Barrows et al. 2023). Stream reaches were sampled in the same manner as distribution surveys (*see Distribution Methods section*). In addition, the upstream end of an unscreened irrigation canal was electrofished and a small irrigation pond at the Walla Walla Nursery was sampled via angling. To monitor movement of PIT-tagged individuals, we established PIT detection antennas in strategic locations to passively detect Brook Trout as they moved past various points within the study area (Figure 2). Recapture data from subsequent sampling efforts were analyzed to identify movements of individuals. Established PIT detection sites throughout the Walla Walla River Basin were monitored for PIT-tagged Brook Trout detections as well.

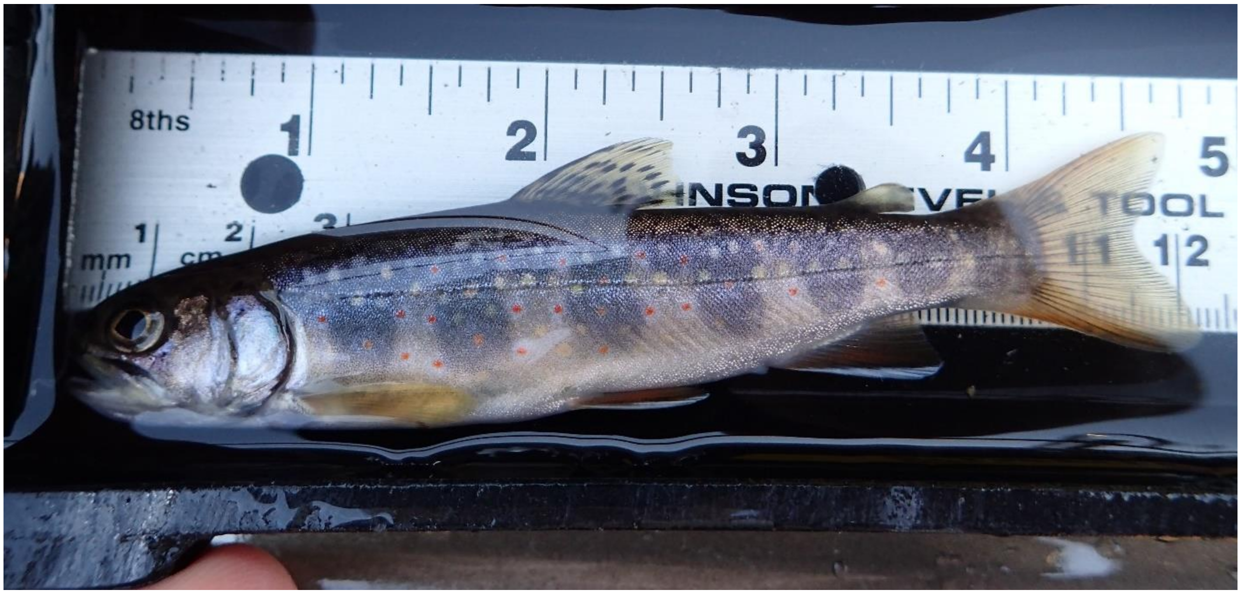

Figure 3. Brook Trout captured via electrofishing in the East Big Spring Branch. The fish was PIT-tagged and released to help establish a population of tagged fish for subsequent detection.

Tagging

Once anesthetized with AQUI-S®20E, all previously untagged Brook Trout exceeding 120 mm in length received a 23 mm long PIT tag that was inserted subcutaneously at the abdomen through a shallow 3-mm incision made with a surgical scalpel slightly off the mid-line and anterior to the pelvic girdle (Barrows et al. 2014). Fish that did not exceed 120 mm in length received a 12 mm PIT tag via a syringe in the abdominal cavity. Following surgery, the Brook Trout were recovered from anesthesia to an upright swimming position in an aerated bath of river water and released in an area of reduced water velocity near the capture site.

PIT Detection Sites

Three PIT detection arrays were established and operated at strategic locations throughout the study area to passively monitor Brook Trout presence and movement between the EBSB, WBSB, ELWWR and the mainstem Walla Walla River (Figure 2). Use of the ELWWR and the spring branch tributaries by PIT-tagged Chinook salmon, steelhead and Bull Trout was monitored as well. Each site was powered by a Destron Fearing 1001M multiplexing transceiver and 120 volt AC was provided by partnering property owners. We also checked other nearby PIT detection sites in the mainstem Walla Walla River for Brook Trout detections.

<u>East Big Spring Branch PIT Detection Site</u>

A PIT detection site was established at the mouth of the EBSB where it enters the ELWWR. This array became operational on June 23, 2016 and consisted of two pass-through antennas constructed from 2” PVC and passively detected PIT-tagged fish as they exited or entered the EBSB (Figure 4). This site also had two antennas that monitored the ELWWR slightly upstream of the EBSB confluence. Monitoring at this site ended on July 31, 2019.


Figure 4. PIT detection site at the confluence of the East Big Spring Branch and the East Little Walla Walla River (ELWWR rkm 2.0). Two antennas monitored the mouth of the East Big Spring Branch (left) and two antennas monitored the mainstem East Little Walla Walla River just upstream from the confluence (right).

West Big Spring Branch PIT Detection Site

A PIT detection site was established near the mouth of the WBSB near where it enters the ELWWR on July 27, 2016. This array consisted of two pass through antennas constructed from 2" PVC and passively detected PIT-tagged fish as they exited or entered the WBSB until monitoring ended on July 31, 2019 (Figure 5).

Figure 5. PIT detection site in the West Big Spring Branch near its confluence with the East Little Walla Walla River.

East Little Walla Walla River PIT Detection Site

An additional PIT detection site was established near the confluence of the ELWWR and the mainstem Walla Walla River (Figure 6). This array became operational on June 24, 2016 and passively detected PIT-tagged Brook Trout as they emigrated to the Walla Walla River. A secondary benefit of this array was that it monitored the seasonal use of the ELWWR by other PIT-tagged salmonids (i.e., steelhead, spring Chinook, Bull Trout) that were tagged elsewhere in the basin. Monitoring at this site ended on July 31, 2019.

Figure 6. PIT detection site in the East Little Walla Walla River West Big Spring Branch near its confluence with the East Little Walla Walla River.

Mainstem Walla Walla River PIT Detection Sites

The Columbia Basin PIT tag Information System (PTAGIS) was checked regularly for Brook Trout detections. Particular attention was paid to mainstem Walla Walla River PIT detection sites at Burlingame Diversion Dam (rkm 61) and Nursery Bridge Dam (rkm 74) as these two sites are nearest downstream and upstream to the confluence of the ELWWR.

Spawning

Prior to this study, no information regarding potential Brook Trout spawning grounds in this system existed. However, we encountered sexually mature individuals in spawning colors while sampling the Walla Walla Nursery reach in the EBSB on November 20, 2018. We conducted a single Brook Trout redd survey the following day on November 21, 2018 to confirm spawning and to coarsely estimate the abundance of spawning Brook Trout within the reach. Experienced surveyors began at the downstream end of the reach (rkm 1.3) and walked upstream for 642 m to the upstream end of the reach. A 150 m portion of a diversion canal at the head of the reach was also surveyed for redds. Redds encountered during surveys were enumerated and classified as either occupied or unoccupied.

Results

Distribution

We conducted Brook Trout distribution surveys from August 1 – 4, 2016 in 24 reaches of varying length within the study area. In total, we sampled 7 reaches totaling 1.1 rkm (19%) of the 6.0 rkm portion of the ELWWR within the study area (Table 1). We also sampled 11 reaches totaling 1.94 rkm (49%) and 6 reaches totaling 0.67 rkm (28%) of the EBSB and WBSB, respectively.

Table 1. Stream portions sampled during Brook Trout distribution surveys from August 1 – 4, 2016.

Stream Name	Sampled Portion (rkm)	Stream length (rkm)	Proportion of Stream Sampled (%)
East Little Walla Walla R.	1.1	6.0	19%
East Big Spring Branch	1.9	4.0	49%
West Big Spring Branch	0.7	2.4	28%

No Brook Trout were found during distribution surveys within sampled reaches in the ELWWR. However, one Brook Trout (100 mm FL) was captured in the WBSB approximately 1.1 rkm upstream from its confluence with the ELWWR (Figure 7). No Brook Trout were encountered within the first 570 m of the EBSB upstream of its confluence with the ELWWR, but two Brook Trout were captured approximately 800 m upstream from the confluence and in each of the remaining upstream reaches that were sampled in the EBSB (Table 2). The highest number of Brook Trout encountered during distribution surveys was within reach EBSB-16, a 557m reach flowing through the Walla Walla Nursery property where 36 fish were captured between rkm 1.35 and rkm 1.9. Bridgelip Sucker (*Catostomus columbianus*), Three-spine Stickleback (*Gasterosteus aculeatus*), Redside Shiner (*Richarsonius balteatus*), Dace .spp, Sculpin .spp, Mountain Whitefish (*Prosopium williamsoni*), Western Brook Lamprey (*Lampetra richardsoni*), Chinook Salmon (*Oncorhynchus tshawytscha*) and Steelhead/Rainbow Trout (*Oncorhynchus mykiss*) were among the incidental captures.

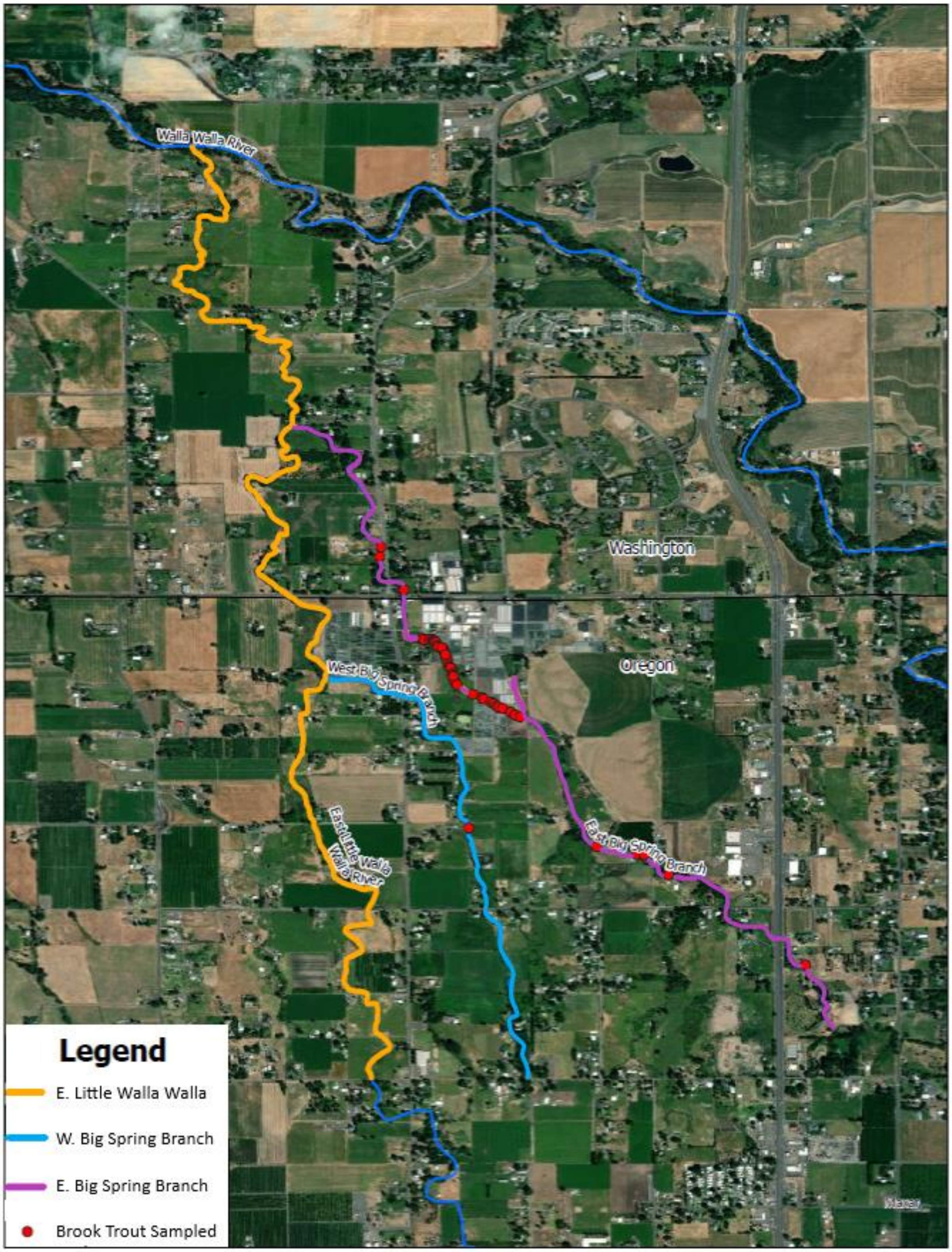

Figure 7. Locations of Brook Trout sampled during distribution surveys conducted in the East Little Walla Walla River, the East Big Spring Branch, and the West Big Spring Branch from August 1 – 4, 2016 near Milton-Freewater, Oregon.

Table 2. Reaches sampled during distribution surveys from August 1 – 4, 2016. The start and end rkms for each reach, the actual meters of stream sampled within each reach and the number of Brook Trout captured within each reach are provided.

Stream Name	Reach #	Reach Start (rkm)	Reach End (rkm)	Habitat Sampled within Reach (m)	Brook Trout Sampled
East Little Walla Walla R.	ELWWR (1)	0.00	0.30	300	0
East Little Walla Walla R.	ELWWR (2)	1.94	1.99	51	0
East Little Walla Walla R.	ELWWR (3)	1.99	2.14	148	0
East Little Walla Walla R.	ELWWR (4)	2.14	2.37	111	0
East Little Walla Walla R.	ELWWR (5)	2.37	2.61	244	0
East Little Walla Walla R.	ELWWR (6)	3.17	3.64	154	0
East Little Walla Walla R.	ELWWR (7)	4.21	4.44	119	0
Totals				**1127 m**	**0**
East Big Spring Branch	EBSB (8)	0.00	0.19	185	0
East Big Spring Branch	EBSB (9)	0.19	0.26	79	0
East Big Spring Branch	EBSB (10)	0.26	0.42	158	0
East Big Spring Branch	EBSB (11)	0.42	0.57	145	0
East Big Spring Branch	EBSB (12)	0.72	0.88	161	2
East Big Spring Branch	EBSB (13)	1.01	1.09	77	1
East Big Spring Branch	EBSB (14)	1.26	1.35	85	1
East Big Spring Branch	EBSB (15)	1.35	1.90	557	36
East Big Spring Branch	EBSB (16)	2.57	2.81	135	3
East Big Spring Branch	EBSB (17)	2.81	2.96	148	1
East Big Spring Branch	EBSB (18)	3.56	3.77	210	1
Totals				**1940 m**	45
West Big Spring Branch	WBSB (19)	0.32	0.42	102	0
West Big Spring Branch	WBSB (20)	0.50	0.60	101	0
West Big Spring Branch	WBSB (21)	0.97	1.06	86	0
West Big Spring Branch	WBSB (22)	1.09	1.16	77	1
West Big Spring Branch	WBSB (23)	1.32	1.52	201	0
West Big Spring Branch	WBSB (24)	2.05	2.15	102	0
Totals				**669 m**	**1**

In total, 46 Brook Trout were captured during distribution surveys. Fork lengths ranged from 78 – 238 mm and averaged 148 mm. Length frequency analysis indicated the presence of at least three distinct age classes (Figure 8). The smaller group of fish (< 135 mm) were likely less than one year old. Fish from 135 mm to 215 mm were likely between one year and 2 years old, and the largest of the fish captured (> 225 mm) may have been older than 2 years.

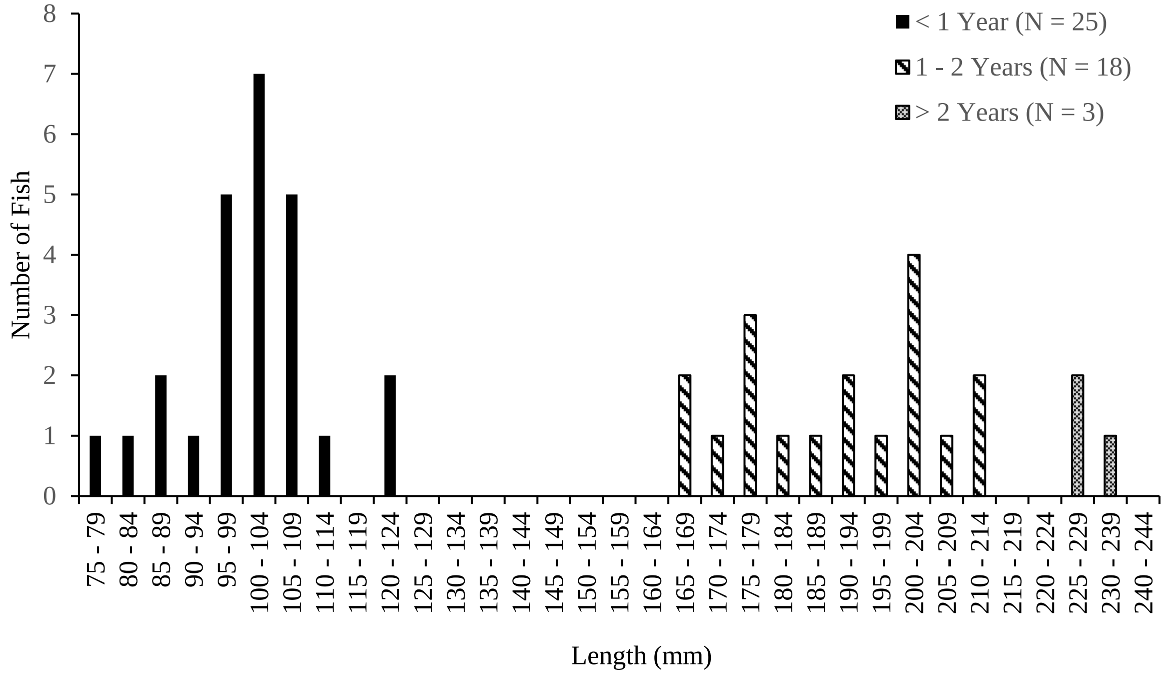

Figure 8. Length frequency of Brook Trout captured during distribution surveys in the East Little Walla Walla River, the East Big Spring Branch and the West Big Spring Branch from August 1 – 4, 2016.

Movement

Tagging

During distribution surveys in August 2016, the 45 Brook Trout captured in the EBSB were PIT-tagged for subsequent detection. On September 20, 2016 and September 21, 2016, we electrofished reaches of the EBSB where high densities of Brook Trout were encountered during distribution surveys. These reaches included a 642 m reach near the Walla Walla Nursery beginning 1.3 rkm upstream from its confluence with the ELWWR where 29 Brook Trout were captured. Five of these fish had been previously tagged and 24 new PIT tags were deployed. Near the upstream end of this reach, there was an unscreened diversion ditch where we captured and PIT-tagged six more Brook Trout (Figure 20). We also captured one additional Brook Trout in the Nursery's small irrigation diversion pond. Two additional Brook Trout were captured in a 210 m reach of the EBSB beginning approximately 3.6 rkm from the ELWWR confluence. One of these fish had been previously tagged and one received a PIT tag. In total, 38 Brook Trout were captured during September 2016, of which 6 were previously PIT-tagged and 32 received PIT tags and were released. Fork lengths ranged from 81 – 235 mm and averaged 143.7 mm. Length frequency analysis indicated the three age classes that were present during August were also represented during September (Figure 9).

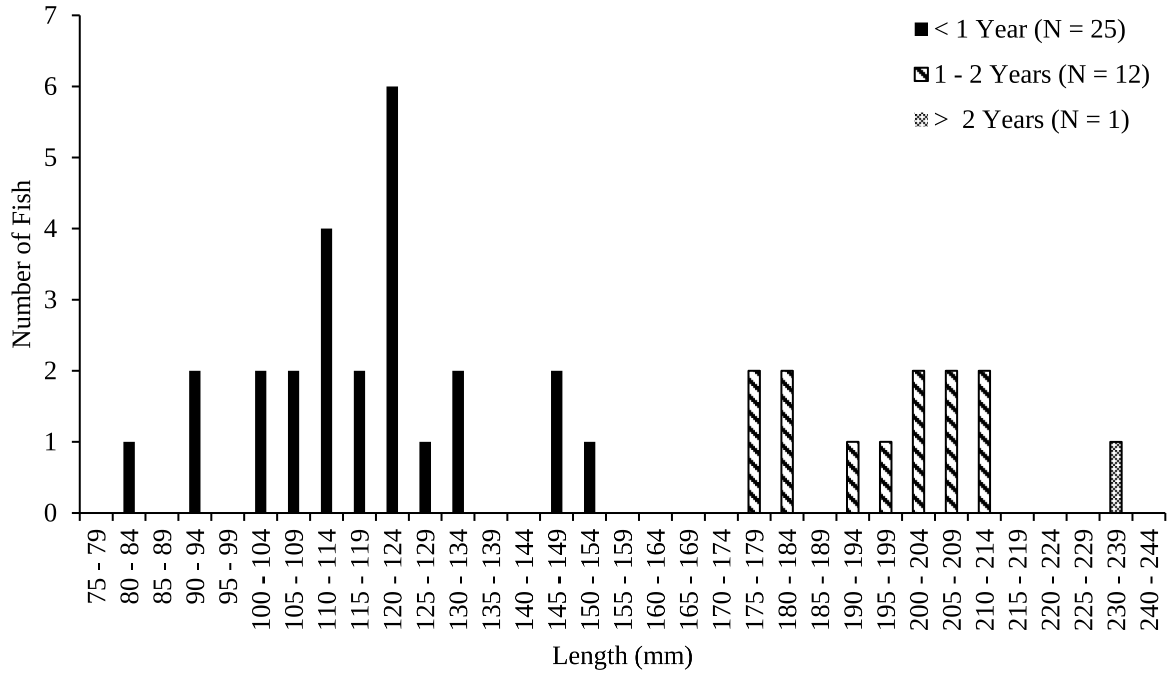

Figure 9. Length frequency of Brook Trout captured in the East Big Spring Branch from September 20 – 21, 2016.

On June 19, 2018, we electrofished the 642 m Walla Walla Nursery reach of the EBSB and PIT-tagged 23 additional Brook Trout to maintain a tagged population for subsequent detection. The following day (June 20, 2018) we repeated this effort in the same reach and captured 37 individuals, 4 of which had been PIT-tagged the previous day. In total, we PIT-tagged and released 56 individual Brook Trout in June 2018, that ranged in length from 68 to 277 mm and averaged 135.3 mm. Length frequency analysis suggests the possibility of four age classes in the sample (Figure 10).

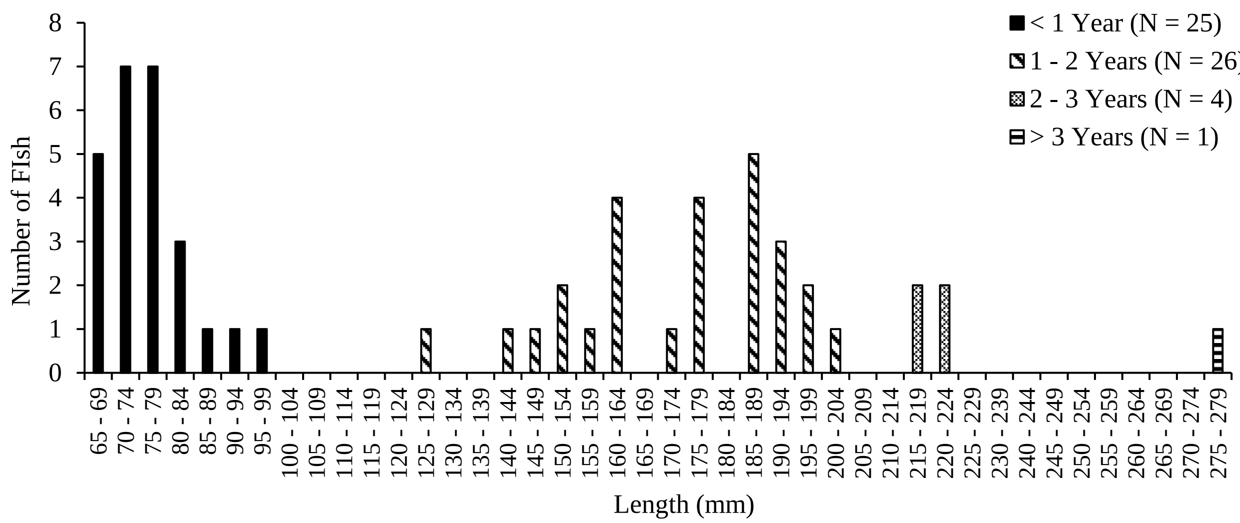

Figure 10. Length frequency of Brook Trout captured in the East Big Spring Branch from June 19 – 20, 2018.

The final tagging effort of this project was conducted on November 20, 2018 in the 642m Walla Walla Nursery reach of the EBSB. Thirty-three Brook Trout were captured, most of which were of the smallest size class (Figure 11). Most of the larger fish and a portion of the smaller individuals exhibited spawning colors. Five of the 33 fish were previously tagged, so we PIT-tagged and released 28 individuals. Overall, 161 Brook Trout were PIT-tagged and released from 2016 through 2018 (Table 3).

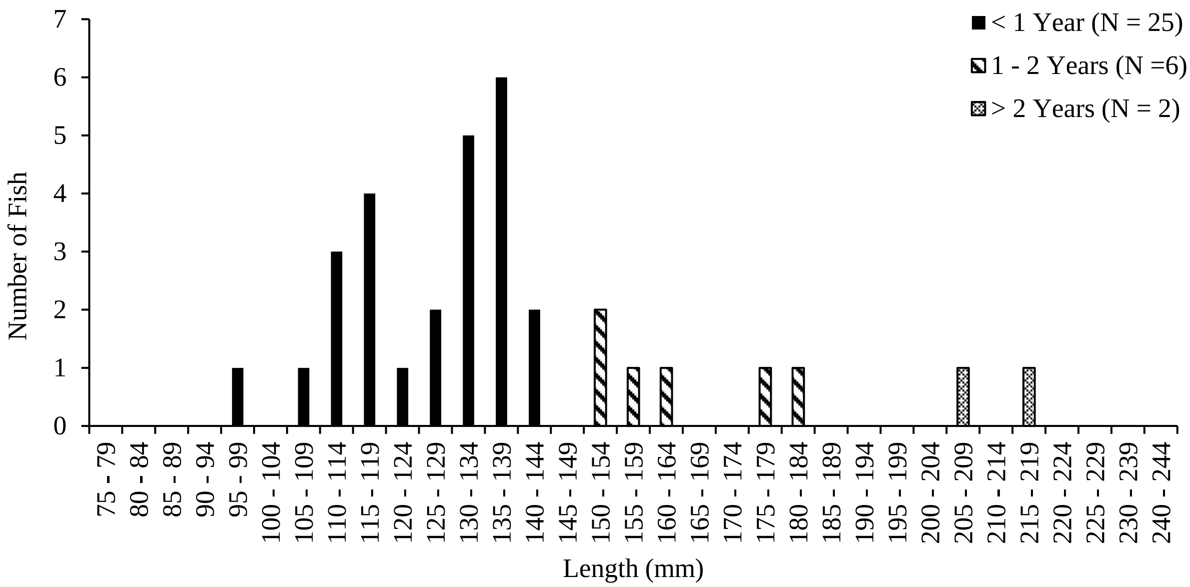

Figure 11. Length frequency of Brook Trout captured in the East Big Spring Branch on November 20, 2018.

Table 3. Summary of PIT-tagged Brook Trout from 2016 through 2018.

Year	Month	Stream	# PIT-tagged
2016	August 1 - 4	East Little Walla Walla River	0
	August 1 - 4	East Big Spring Branch	45
	September 20 - 21	East Big Spring Branch	32
		2016 Total	**77**
2018	June 19	East Big Spring Branch	23
	June 20	East Big Spring Branch	33
	November 20	East Big Spring Branch	28
		2018 Total	**84**
		Project Total	**161**

PIT Detection Arrays

Brook Trout were the main focus of this study, but PIT-tagged Chinook Salmon, steelhead and Bull Trout were also detected. Table 4 is a summary of PIT-tagged salmonids detected at sites within the study area from 2016 through 2019. One additional Brook Trout was detected on multiple PIT antennas at the Burlingame Diversion Dam in the mainstem Walla Walla River. Detection histories for all Brook Trout detected at PIT detection sites from 2016 through 2019 are provided in Table 5.

Table 4. Summary of individual PIT-tagged salmonids detected at PIT sites located near the mouths of the East Little Walla Walla River (ELWWR), the East Big Spring Branch (EBSB), and the West Big Spring Branch (WBSB) from 2016 through 2019.

PIT Site	Species	Life Stage	Hatchery/Wild	# of Individuals
ELWWR	Brook Trout	Unknown	Wild	5
	Spring Chinook	Juvenile	Wild	4
	Spring Chinook	Juvenile	Hatchery	1
	Steelhead	Juvenile	Wild	229
	Steelhead	Adult	Hatchery	1
	Bull Trout	Adult	Wild	1
EBSB	Brook Trout	Unknown	Wild	7
	Spring Chinook	Juvenile	Wild	3
	Steelhead	Juvenile	Wild	139
	Bull Trout	Adult	Wild	1
WBSB	Brook Trout	Unknown	Wild	2
	Steelhead	Juvenile	Wild	4

Table 5. Comprehensive detection histories for individual PIT-tagged Brook Trout detected at PIT sites located near the mouths of the East Little Walla Walla River (ELWWR), the East Big Spring Branch (EBSB), the West Big Spring Branch (WBSB), and at Burlingame Dam from 2016 through 2019.

PIT Tag Code	Size at Tagging (FL)	Date Released (*) or Detected	Location Released (*) or Detected
3D9.1C2DC019CC	**104 mm**	**8/3/2016***	**W. W. Nursery Reach (EBSB - rkm 1.3)***
		2/16/2018	E. Big Spring Branch Mouth PIT
3D9.1C2DC06AC3	**107 mm**	**8/3/2016***	**W. W. Nursery Reach (EBSB - rkm 1.3)***
		1/9/2017	W. Big Spring Branch Mouth PIT
3D9.1BF1FDC5B0	**121 mm**	**8/3/2016***	**W. W. Nursery Reach (EBSB - rkm 1.3)***
		1/20/2017	W. Big Spring Branch Mouth PIT
3D9.1BF1FD920F	**191 mm**	**9/20/2016***	**W. W. Nursery Reach (EBSB - rkm 1.3)***
		2/12/2017	E. Big Spring Branch Mouth PIT
		2/16/2017	E. Little Walla Walla Mouth PIT
		2/23/2017	E. Little Walla Walla Mouth PIT
3D9.1C2DC03F7D	**111 mm**	**9/20/2016***	**W. W. Nursery Reach (EBSB - rkm 1.3)***
		10/7/2016	E. Big Spring Branch Mouth PIT
		10/7/2016	E. Little Walla Walla Mouth PIT
3D9.1C2DC04D58	**102 mm**	**9/20/2016***	**W. W. Nursery Reach (EBSB - rkm 1.3)***
		12/20/2016	E. Big Spring Branch Mouth PIT
		12/21/2016	E. Little Walla Walla Mouth PIT
3D9.1C2DC146BD	**109 mm**	**9/20/2016***	**W. W. Nursery Reach (EBSB - rkm 1.3)***
		10/23/2018	E. Big Spring Branch Mouth PIT
		10/23/2018	E. Little Walla Walla Mouth PIT
3D9.1C2DC146BD	**118 mm**	**9/20/2016***	**W. W. Nursery Reach (EBSB - rkm 1.3)***
		3/15/2018	E. Big Spring Branch Mouth PIT
3D9.1BF1FCAEE4	**197 mm**	**6/19/2018***	**W. W. Nursery Reach (EBSB - rkm 1.3)***
		11/20/2018	Burlingame Canal Intake (W.W. River - rkm 61)
		11/22/2018	Burlingame Canal Intake (W.W. River - rkm 61)
		11/23/2018	Burlingame Canal Exit (W.W. River - rkm 61)
		1/18/2019	Burlingame Dam Ladder (W.W. River - rkm 61)
3D9.1BF1FCA304	**176 mm**	**6/20/2018***	**W. W. Nursery Reach (EBSB - rkm 1.3)***
		11/4/2018	E. Big Spring Branch Mouth PIT
		11/4/2018	E. Little Walla Walla Mouth PIT

East Big Spring Branch PIT Detection Site

Seven individual PIT-tagged Brook Trout were detected while exiting the EBSB at the ELWWR confluence primarily during the fall, winter and early spring months (i.e., October – March) from 2016 through 2018 (Figure 12). Two additional Brook Trout were subsequently detected moving into the WBSB in January of 2017, suggesting they exited the EBSB and avoided detection sometime between their release date (August 3, 2016) and January 2017 (*see West Big Spring Branch PIT Detection Site Results*). No Brook Trout were documented reentering the EBSB after initially exiting the stream. A Bull Trout that was PIT-tagged in the mainstem Walla Walla River on September 21, 2016 was detected entering the EBSB from the ELWWR on January 7, 2017 before returning to the ELWWR and moving upstream on January 10, 2017. In addition, a total of 143 juvenile steelhead and 3 Chinook Salmon were detected at this site. These fish were PIT-tagged in the Walla Walla River and Mill Creek (tributary to the Walla Walla River) by the Confederated Tribes of the Umatilla Indian Reservation as part of their ongoing smolt monitoring efforts. Initial detections of steelhead occurred primarily between November and May, generally peaking in December, and occasionally continuing into June and July. Of the 143 juvenile steelhead detected at this site, 122 individuals were detected on the antennas monitoring the mouth of the EBSB (Figure 13). Thirty of the 143 PIT-tagged steelhead were detected on the antennas monitoring the ELWWR just upstream from the confluence (Figure 14). Some individuals, including the Bull Trout and one of the Brook Trout, were detected on both sets of antennas (Figures 12 and 14).

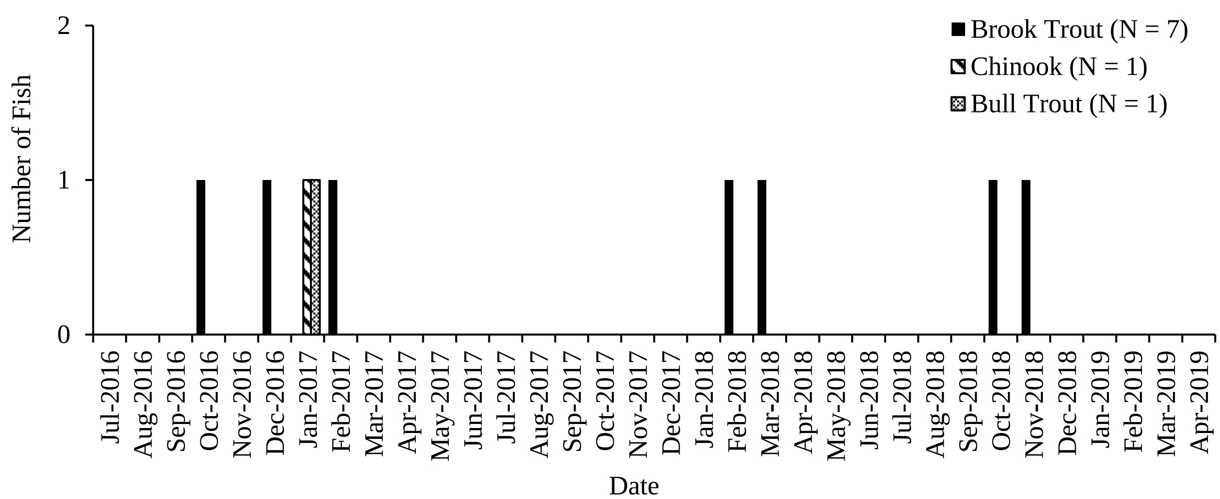

Figure 12. Initial detections of individual PIT-tagged Brook Trout, Chinook, and Bull Trout at antennas monitoring the mouth of the East Big Spring Branch.

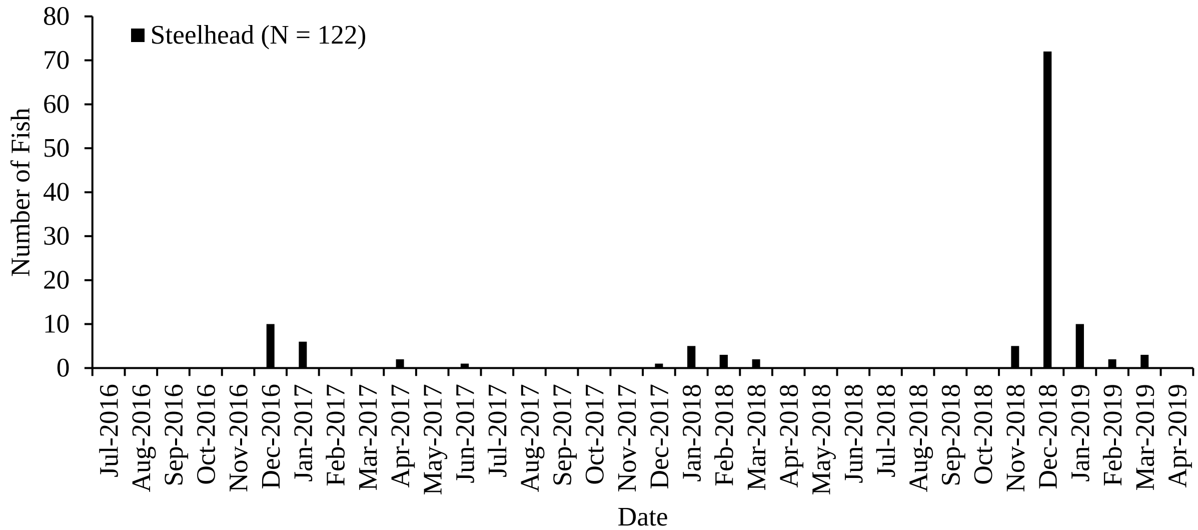

Figure 13. Initial detections of individual PIT-tagged steelhead at antennas monitoring the mouth of the East Big Spring Branch.

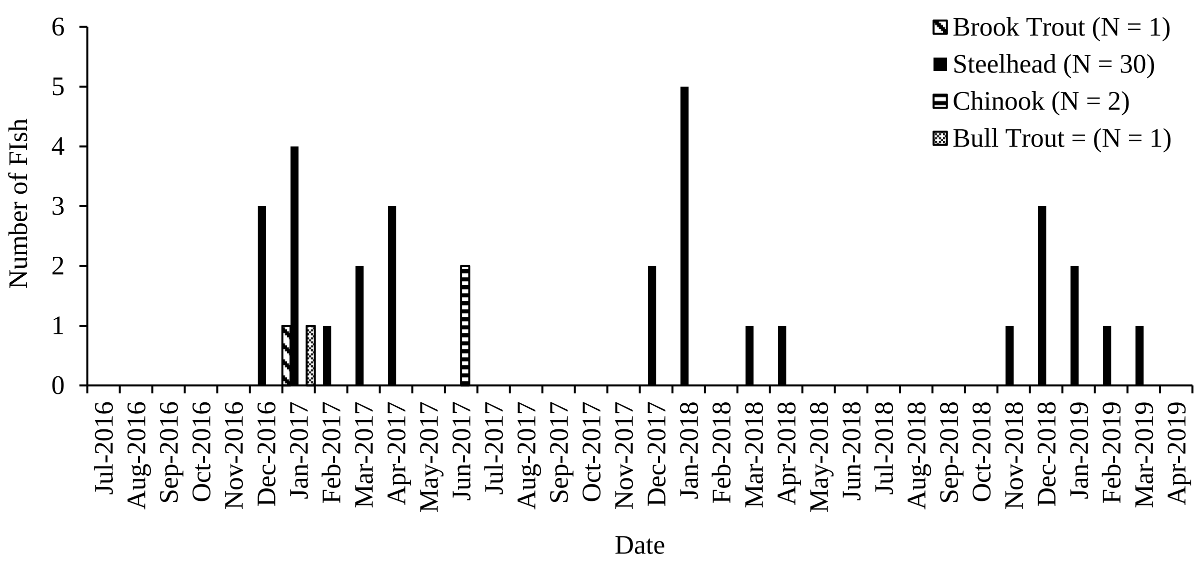

Figure 14. Initial detections of individual PIT-tagged Brook Trout, steelhead, Chinook, and Bull Trout at antennas monitoring the East Little Walla Walla River just upstream of the East Big Spring Branch confluence.

West Big Spring Branch PIT Detection Site

Very few PIT-tagged fish were detected at the PIT antenna located near the mouth of the WBSB. However, two PIT-tagged Brook Trout that were originally tagged in the EBSB during August 2016 were detected moving upstream of the site in January 2017 and were not subsequently detected (Figure 15) . In addition, four PIT-tagged steelhead that were originally tagged in the mainstem Walla Walla River were detected at the WBSB site in December, February and March. This site was regularly subject to ambient electromagnetic interference resulting from nearby pumps, equipment or other forms of electrical "noise" that effected detection efficiency. Detections at this site should be considered minimums, because an unknown number of PIT-tagged fish may have passed undetected during periods of inefficient operation.

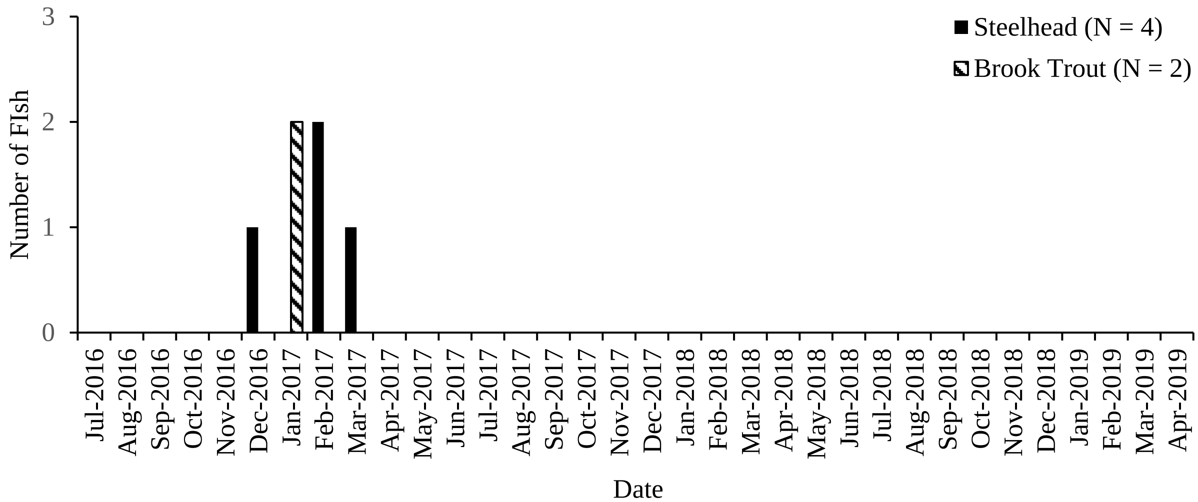

Figure 15. Initial detections of individual PIT-tagged Brook Trout and steelhead at the PIT site located near the mouth of the West Big Spring Branch.

<u>East Little Walla Walla River PIT Detection Site</u>

Five individual PIT-tagged Brook Trout were detected moving downstream past the PIT detection site just upstream from the mouth of the ELWWR from 2016 to 2018. These fish moved rapidly downstream after leaving the EBSB and usually entered the mainstem Walla Walla River within the same day (Table 5). Brook Trout were detected at this site during the months of October, December, February and April (Figure 16). No Brook Trout were documented reentering the ELWWR after initially exiting to the ELWWR. The Bull Trout noted above that was tagged in the Walla Walla River and detected at the EBSB site was also detected returning to the mainstem Walla Walla River on January 11, 2017 (Figure 16). In addition, a total of 229 individual PIT-tagged juvenile steelhead, 5 Chinook Salmon and 1 adult steelhead were detected at the ELWWR PIT site (Figures 16 and 17). Initial detections of steelhead at this site occurred between November and April, usually peaking in December. Detection histories indicated that while some individuals appear to have spent only a few weeks within the ELWWR system, others likely reared within the ELWWR and the spring branch tributaries for a year or more before exiting the system.

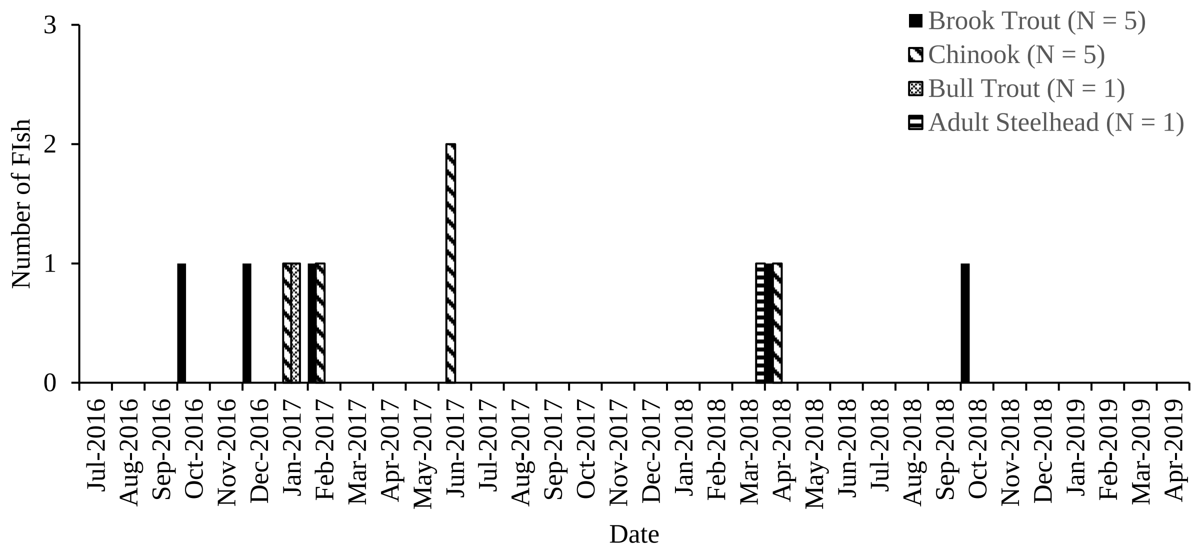

Figure 16. Initial detections of individual PIT-tagged Brook Trout, Chinook, Bull Trout and adult steelhead at the PIT site located near the mouth of the East Little Walla Walla River.

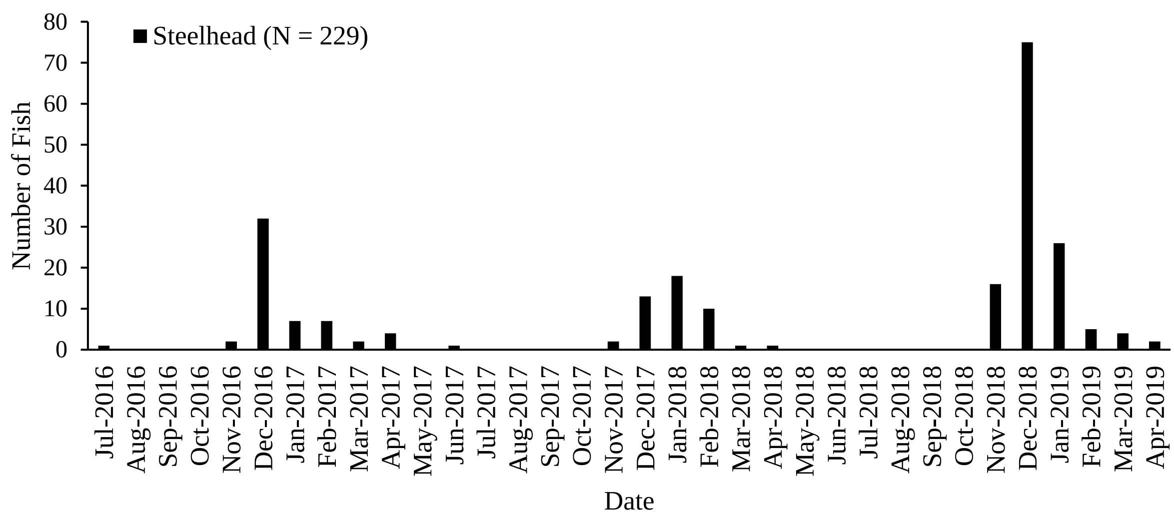

Figure 17. Initial detections of individual PIT-tagged juvenile steelhead at the PIT site located near the mouth of the East Little Walla Walla River.

Mainstem Walla Walla River PIT Detection Sites

Only one of the Brook Trout we PIT-tagged (PIT ID: 3D9.1BF1FCAEE4) was detected on established PIT antennas in the mainstem Walla Walla River. This fish was 197 mm in length when originally tagged in the Walla Walla Nursery reach of the EBSB, approximately 1.3 rkm upstream from its confluence with the ELWWR on June 19, 2018 (Figure 18). This Brook Trout was not detected at the EBSB or the ELWWR PIT detection sites prior to being detected entering the Burlingame Dam canal at the intake on November 20, 2018. Subsequent detections indicated the fish remained in the canal before exiting through the bypass channel back to the mainstem Walla Walla on November 23, 2018 (Figure 19). The fish appeared to have resided in the Walla

Walla River downstream of Burlingame Dam prior to being briefly detected entering the downstream entrance of the adult fish ladder at Burlingame Dam on January 18, 2019. The detection history suggests this fish remained in the Walla Walla River downstream of Burlingame Dam.

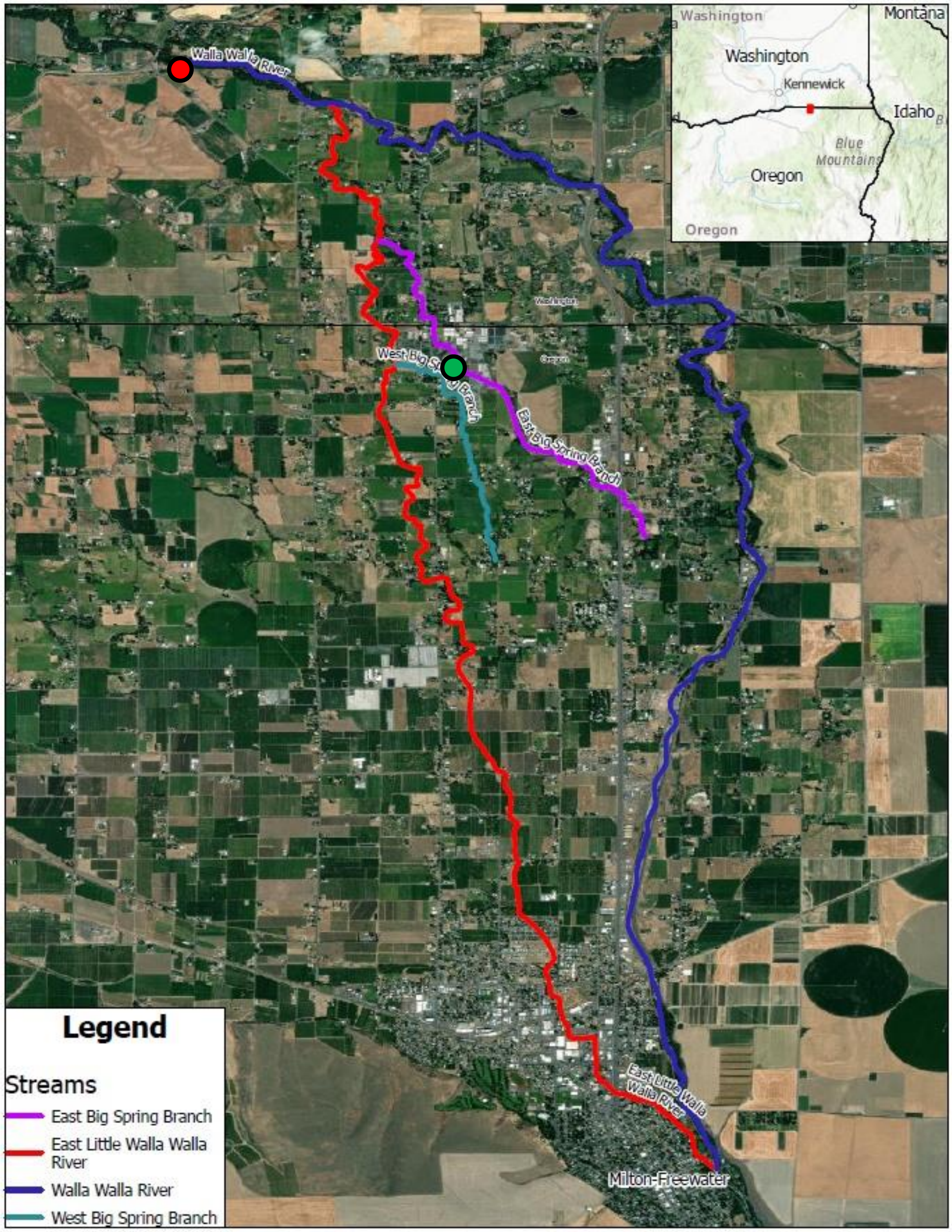

Figure 18. Study area map showing where a Brook Trout (PIT ID: 3D9.1BF1FCAEE4) was tagged (green symbol) in the East Big Spring Branch and where it was subsequently detected in the mainstem Walla Walla River at Burlingame Dam (red symbol) near College Place, Washington.

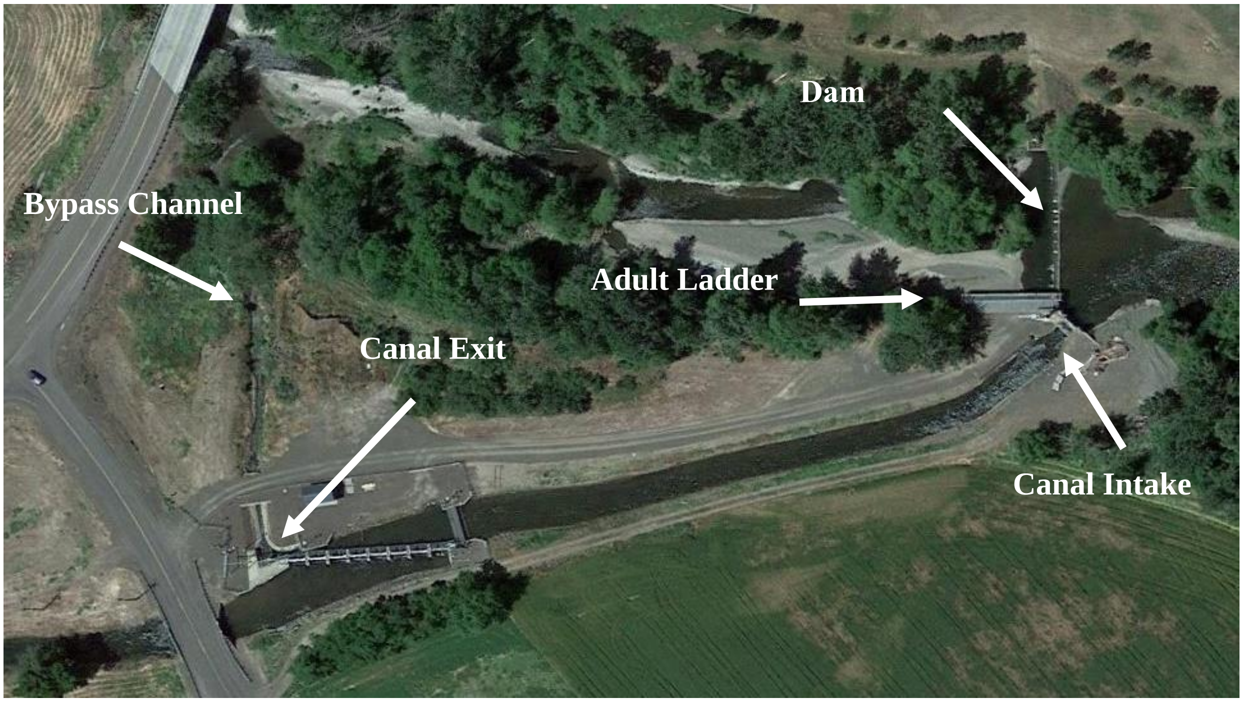

Figure 19. Aerial photo of Burlingame Dam (rkm 61) on the Walla Walla River near Milton-Freewater, Oregon. The diversion dam, canal intake, canal exit, fish bypass channel and adult fish ladder are indicated. (Photo derived from Google Earth Pro, Imagery Date: 6/13/2019).

Spawning

On November 21, 2018, we conducted a single Brook Trout redd survey in the 642 m Walla Walla Nursery reach of the EBSB beginning at rkm 1.3 (Figure 20). We encountered several areas of disturbed gravel throughout the reach. However, only five were determined to be unoccupied Brook Trout redds. In addition, we conducted a redd survey in the 150 m diversion canal near the head of the Walla Walla Nursery reach where we had captured Brook Trout earlier in the study. Similar to the other reach, there were areas of disturbed gravel in the stream margins, but only two unoccupied redds were identified within the canal.

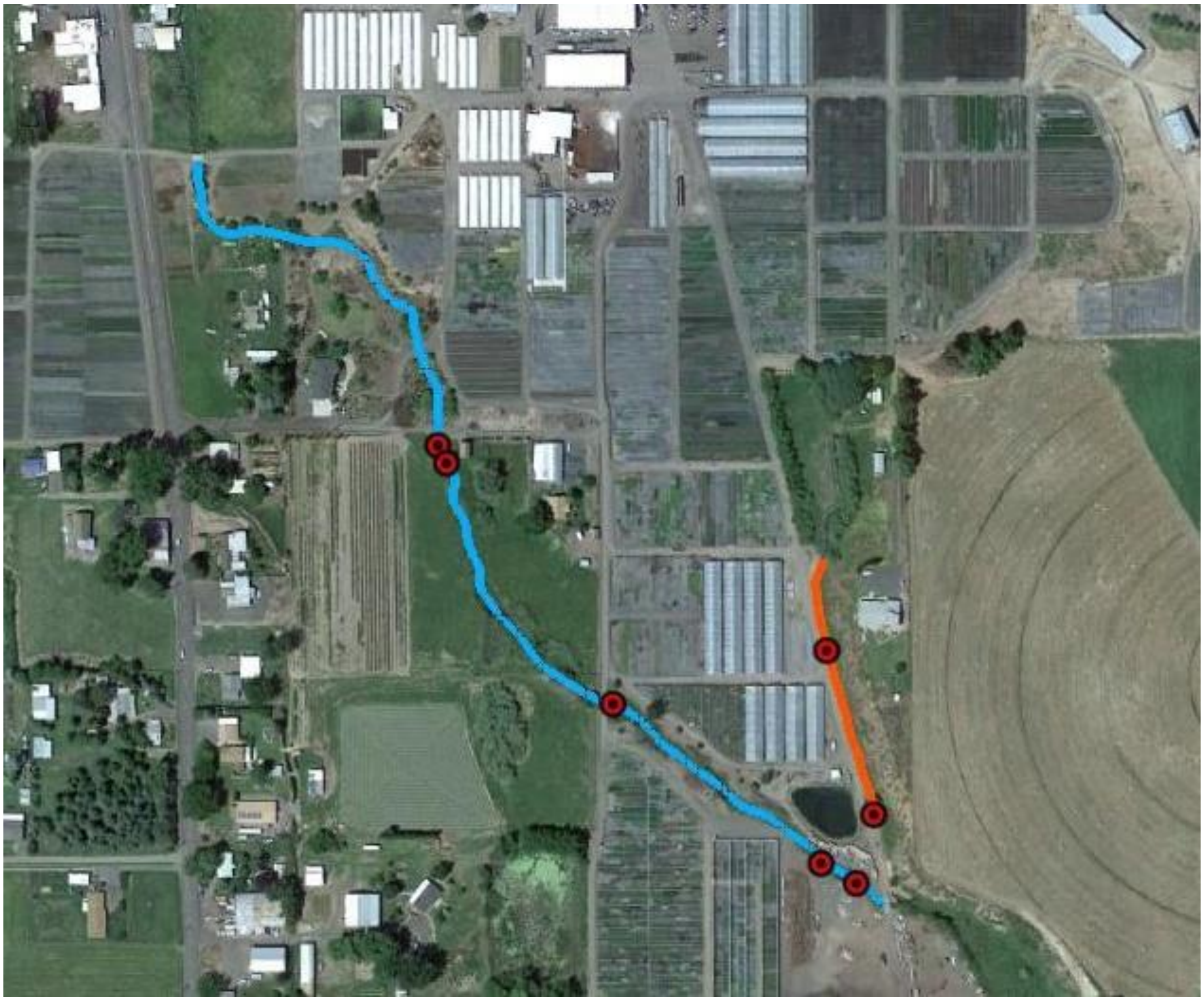

Figure 20. Aerial photo of the Walla Walla Nursery reach beginning at rkm of the East Big Spring Branch (blue) and the diversion canal (orange) where redd surveys were conducted on November 21, 2018 near Milton-Freewater, Oregon. Brook Trout redds are indicated by red symbols. (Photo derived from Google Earth Pro, Imagery Date: 6/13/2019).

Discussion

Effective management of Bull Trout in the Walla Walla River Basin requires a sufficient knowledge of current and potential threats. Despite not meeting the criteria to be categorized as a primary threat to Walla Walla River Basin Bull Trout at the time the Mid-Columbia RUIP was written, the authors included recovery actions that called for continued research into this potential threat and to evaluate the need for control (USFWS 2015b).

Information about Brook Trout biology is abundant. However, there is a lack of understanding of the invasion process and mechanisms involved when introduced to non-native systems (Adams et al. 2002). A Brook Trout invasion can be viewed as a cycle that can progress either continuously or intermittently and be influenced by different factors over varying time scales (Vermeij 1996; Adams et al. 2002). To date, there has been no evidence of hybridization between Brook Trout and Bull Trout in the Walla Walla River Basin, and expansion of the ELWWR Brook Trout population seems to be slow or stalled. However, population expansion and upstream invasion may progress at any time, possibly in response to a changing climate or catastrophic event. To more accurately characterize the threat that Brook Trout pose to Bull Trout populations in the Walla Walla River Basin, it was essential that we gained a better understanding of their distribution, gathered spawning information, and monitored their movements within the spring branch tributaries and the mainstem Walla Walla River. Prior to implementing our multifaceted approach to investigating this Brook Trout population, very little information on these topics existed.

Limited access to streams in the study area prohibited us from utilizing a systematic, spatially balanced sampling method for Brook Trout distribution surveys. However, by sampling all stream reaches where access was granted, we were able to gain an improved understanding of Brook Trout distribution within the study area during August. We confirmed that Brook Trout of multiple age classes were widely distributed throughout the EBSB from 0.8 rkm upstream of its confluence with the ELWWR upstream to the headwater reaches. Brook Trout in the EBSB were a well-established, locally reproducing population that had expanded throughout much of the available stream habitat. However, sampling in the WBSB revealed a much different situation. Only a single juvenile Brook Trout was captured within the 0.67 rkm (28%) portion of the WBSB that we sampled. It was apparent that despite being present, Brook Trout were at much lower densities and not widely distributed throughout the WBSB when sampling was conducted in August 2016. However, we know from PIT detection data that two Brook Trout tagged in the EBSB moved into the WBSB in January 2017. Similarly, no Brook Trout were captured during distribution surveys in the ELWWR in August 2016, but PIT detections confirmed that Brook Trout either entered or were detected within the ELWWR during all months from October through April. These data suggest Brook Trout distribution throughout the study area may differ seasonally. Overall, the vast majority of the population appears to occupy the EBSB, but contrary to prior knowledge, Brook Trout can also be found in the WBSB and some fish occupy portions of the ELWWR and the mainstem Walla Walla River at least seasonally.

Brook Trout captured during this study ranged from 68 – 277 mm (FL) and appeared to be primarily from two age groups (i.e., < 1 year; 1-2 years) but larger individuals may have been from older age groups. Our within-year length-frequency data suggests Brook Trout in the two youngest age classes (< 1 year and 1-2 year) exhibit rapid growth during the summer months in the EBSB. This is consistent with findings from other Brook Trout studies (Hoxmeier and Dieterman 2013; B. Davis, personal communication, 2022). Age class data was not essential to this study, but it confirms the presence of an established, locally reproducing Brook Trout population. Otolith or scale analysis may provide more accurate age information than length-frequency analysis during future efforts.

The only upstream movements by PIT-tagged Brook Trout recorded at PIT detection sites within the study area were the two individuals that moved from the EBSB to enter the WBSB in January 2017. These fish likely moved into the WBSB after spawning elsewhere in the system. However, a Brook Trout that was originally tagged at rkm 2.75 in the EBSB on August 3, 2016 was recaptured on September 21, 2016 after moving upstream approximately 1 rkm to the upstream limit of the EBSB. Although this fish was only 101 mm (FL) at the time, it exhibited spawning colors and its movement pattern was consistent with upstream spawning movements reported in other Brook Trout studies (Gowan and Fausch 2011).

Although the majority of our Brook Trout did not emigrate from the EBSB after being PIT-tagged, those that did used the ELWWR as a migratory corridor to connect with habitat in the WBSB and to enter the mainstem Walla Walla River. Most Brook Trout that moved downstream, including into the mainstem Walla Walla River, did so during the winter months, possibly seeking downstream habitat to recuperate following spawning. However, some fish left the EBSB and entered the Walla Walla River prior to the Fall spawning season. These fish may have been en route to unknown spawning grounds, or simply seeking additional foraging habitat.

The total population size and the proportion that received PIT tags during this study are unknown. However, the percentage of tagged individuals was likely small due to the limited nature of the tagging effort. Consequently, the movements observed by each tagged fish undoubtedly represented the movements of a much larger number of untagged individuals. For example, detection histories indicate six (3.7%) of the 161 Brook Trout PIT-tagged during the course of this study moved to the mainstem Walla Walla River. If our limited tagging efforts resulted in five percent or less of the total population being PIT-tagged, then over 119 total Brook Trout may have moved to the mainstem Walla Walla River from 2016 to 2019.

None of the PIT-tagged Brook Trout that were detected while entering the mainstem Walla Walla River at the lower ELWWR PIT antenna, or the fish detected at Burlingame Dam were subsequently detected returning to the study area and their ultimate fate is unknown. However, there was no indication that they reentered the ELWWR. Alternatively, they may have remained in the mainstem, entered a nearby tributary, or died.

Prior to this study, little was known about the seasonal use of the ELWWR and the spring branch tributaries by ESA listed salmonids. Data from PIT detection sites confirmed that juvenile Chinook Salmon, adult steelhead, Bull Trout, and large numbers of juvenile steelhead used the ELWWR and the EBSB seasonally. Salmonids were detected primarily between the months of November and April, but they were either sampled or detected during all seasons. The groundwater-fed streams provide temporally critical thermal refuge habitat for juvenile fish to shelter from inclement seasonal conditions in the winter (i.e., cold), spring (i.e., high flows and turbidity) or summer (i.e., overly warm). Appendix A compares temperature data collected at our PIT detection sites near the mouths of each study area tributary to correlating temperatures recorded in the mainstem Walla Walla River. These graphical comparisons clearly show notably cooler (i.e., favorable) temperature conditions in the ELWWR and the spring branch tributaries beginning in early June and continuing through the beginning of October. The graphical comparisons also show the availability of warmer water refuges throughout the winter months in the ELWWR and the spring branch tributaries. It was unknown what proportions of the total Bull Trout, Chinook Salmon and steelhead populations were PIT-tagged at the time, but the fish we detected likely represented a much larger number of untagged fish of each species that used the study area. Although this was not the main focus of our study, these observations highlight the importance of managing (e.g., habitat restoration, fish screens, etc.) the ELWWR system as off-channel habitat for ESA listed salmonids.

Our study confirmed that Walla Walla Basin Bull Trout and Brook Trout from the ELWWR spring branch population occupied the same overwintering, foraging and migration (OFM) habitat both spatially and temporally while in direct competition for resources. Similarly, Chinook Salmon and steelhead seasonally occupied the same habitat as Brook Trout within the study area and may also compete for habitat and resources.

We not only captured Brook Trout within an unscreened irrigation canal that diverts water near the upstream end of the Walla Walla Nursery property on the EBSB, but we also identified probable redds in it. In addition, the canal likely discharges to the mainstem Walla Walla River at some unknown location, possibly providing another route for Brook Trout to enter the mainstem. Since the Brook Trout that was eventually detected at Burlingame Dam in the mainstem Walla Walla River was not detected migrating through the EBSB or ELWWR at PIT antennas, it is plausible that the fish may have accessed the mainstem through this unscreened and unmonitored canal. Installation of a fish screen at the head of this canal should be considered.

Spawning information associated with this Brook Trout population did not exist prior to this study. This investigatory effort was intended to gather some initial information to inform future, more thorough surveys if warranted. Due to the small size of prospective spawners, we found it difficult to locate and identify definitive redds. However, seven probable redds and multiple possible test digs indicated spawning activity within the surveyed reach. Two of the seven probable Brook Trout redds were located in the gravel margins of the unscreened nursery diversion ditch near the upstream end of the survey area. A comparison between length frequencies of fish captured during sampling in June 2018 and November 2018 suggested many individuals in the larger/older size classes (i.e., > 1 year) were no longer in the surveyed reach in November. This may indicate the larger/older component of the spawning population moved from the reach to a different area to spawn, possibly contributing to the low redd count. Surveys were not conducted in the ELWWR or the WBSB, and only 16% of the EBSB was surveyed for redds. Redd surveys confirmed spawning within the Walla Walla Nursery reach, but the limited scope only partially characterized Brook Trout spawning throughout the study area.

Management Implications

Effective management and the eventual recovery of Bull Trout depends largely on identifying threats, improving our understanding of how those threats potentially affect the species, and then using that information to design, fund, prioritize and implement conservation actions to address those threats (USFWS 2015a). The most important findings resulting from this study are that Brook Trout are not confined to the EBSB as previously believed, they move throughout the ELWWR via migratory corridors, and some individuals move out to the mainstem Walla Walla River. Gowan and Fausch (2011) also found that Brook Trout movement is more common and can occur over greater distances than previous studies had determined. These movement patterns and confirmed connectivity to the mainstem Walla Walla River heighten the risk of the population expanding its distribution and colonizing additional habitat in nearby tributaries (e.g., Mill, Yellowhawk, Garrison, Dry, and Russel creeks). The Recovery Plan also indicates the potential for Brook Trout to continue increasing their range (an upward shift in elevation) due to the effects from climate change. Another risk associated with the presence of this population is that they are a ready source for "bucket biologists" to spread them to other reaches within the Walla Walla Basin. To date, there has been no indication of hybridization between Brook Trout and Bull Trout within the Walla Walla River Basin. However, if Brook Trout were to expand into the South Fork Walla Walla River or Mill Creek, the impacts could be devastating to one of the region's few remaining Bull Trout strongholds and the effects would likely be irreversible and possibly undermine past, current and future recovery efforts. Successful Brook Trout removal projects have occurred, but usually only in very narrow, short streams with simple habitat (Shepard et al. 2014). Other efforts have used nondiscriminatory chemical treatments (i.e., rotenone) to eradicate invasive salmonids (Lintermans and Raadik 2001). However, a less intrusive, novel approach for eradication has been recently developed. This biological control strategy involves producing male Brook Trout with two Y-chromosomes which are then released into the targeted population, resulting in all male offspring, so eventually the population becomes skewed toward a single sex, leading to extirpation (Poirier et al. 2020). If future management actions call for Brook Trout eradication, we would recommend considering the Trojan Y Chromosome technique due to the presence of ESA listed salmonids in the ELWWR and the spring branch tributaries.

Future Plans

We recommend that future research be implemented to more thoroughly describe the spatial distribution of Brook Trout within the ELWWR and the spring branch system. Since Brook Trout moved into the mainstem Walla Walla River, we believe it would be reasonable to design a study using systematic eDNA sampling to investigate whether the population has spread to other nearby tributaries. The tributaries that are closest to the mouth of the ELWWR are Mill, Yellowhawk, Garrison, Dry, Cottonwood, Russel, and Calwell creeks. Following such an effort, we recommend that a Brook Trout eradication feasibility assessment be conducted.

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Appendix A

Temperature Data for Spring Branch Tributaries of the East Little Walla Walla River

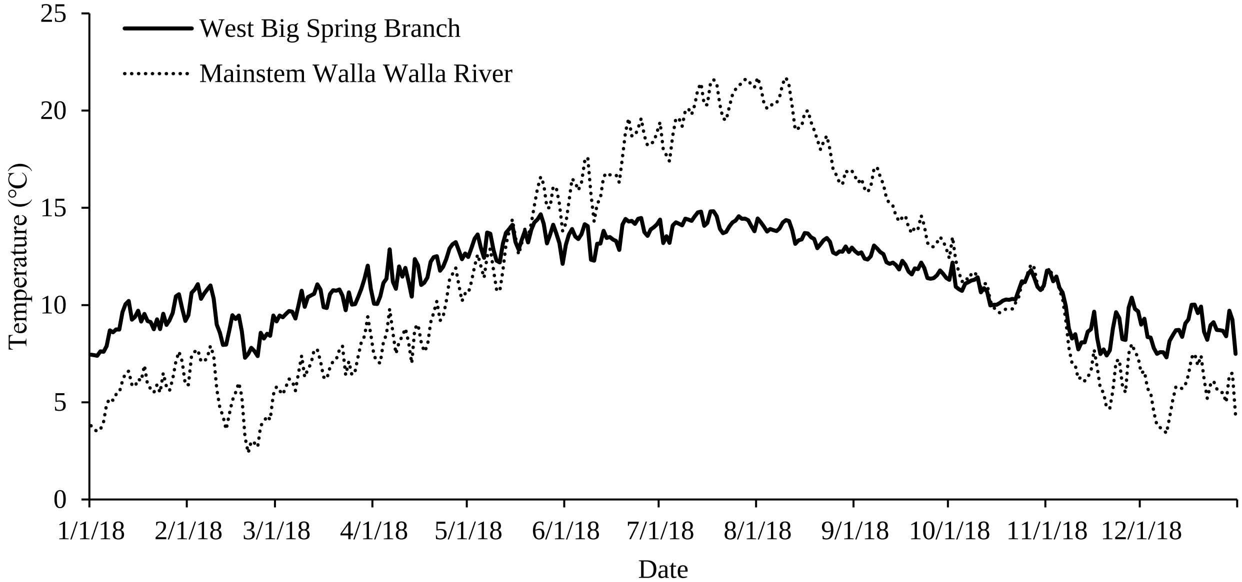

Figure 21. Water temperatures recorded during 2018 at the mouth of the West Big Spring Branch (black) and in the mainstem Walla Walla River at the Washington Department of Ecology Streamflow Monitoring Station at Beet Rd (rkm 60.8). (https://apps.ecology.wa.gov/)

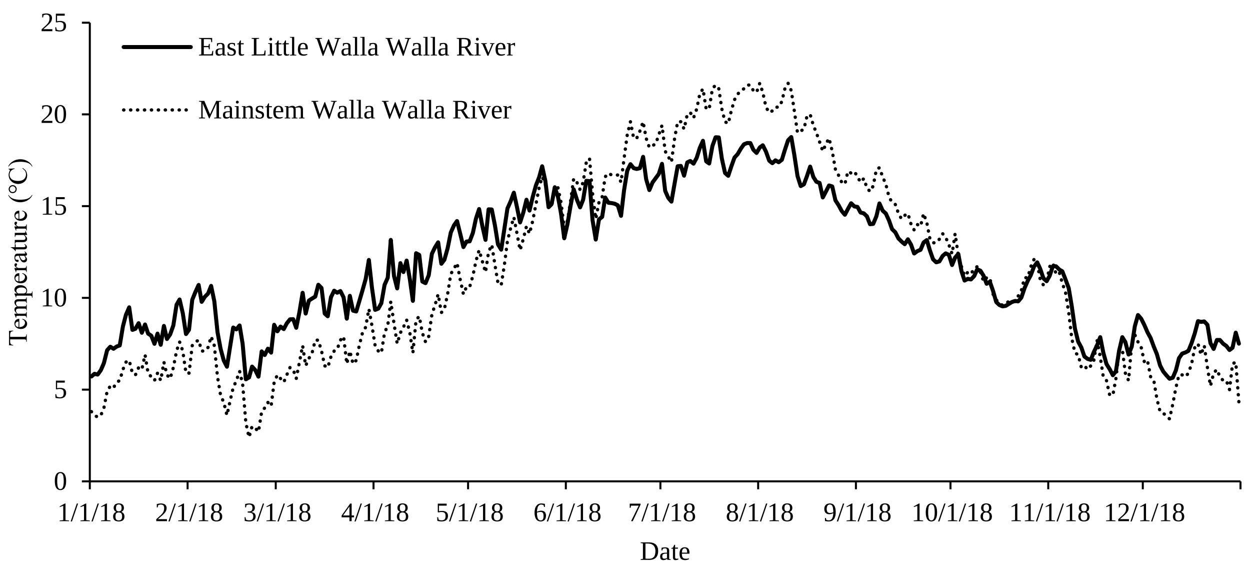

Figure 22. Water temperatures recorded during 2018 at the mouth of the East Little Walla Walla River (black) and in the mainstem Walla Walla River at the Washington Department of Ecology Streamflow Monitoring Station at Beet Rd (rkm 60.8). (https://apps.ecology.wa.gov/)

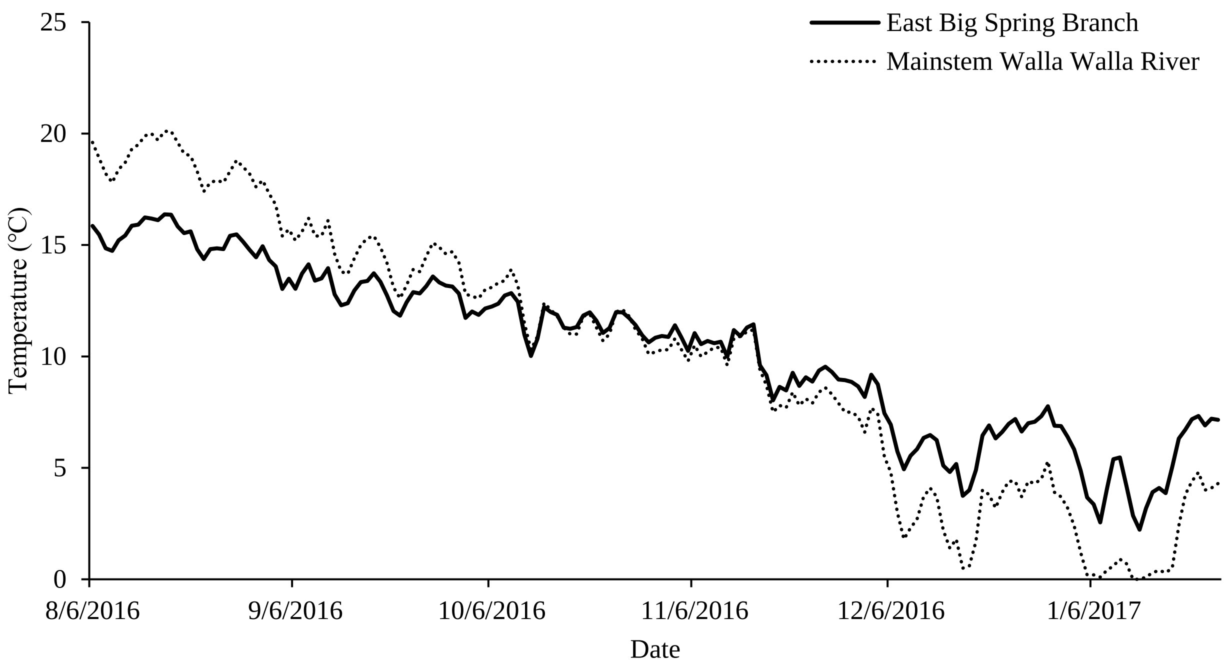

Figure 23. Water temperatures recorded from August 6, 2016 through January 25, 2016 at the mouth of the East Big Spring Branch (black) and in the mainstem Walla Walla River at the Washington Department of Ecology Streamflow Monitoring Station at Beet Rd (rkm 60.8). (https://apps.ecology.wa.gov/)

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