

U.S. Fish and Wildlife Service

**Bull Trout Spawning Ground Surveys in the Entiat  
River Basin 2021: Annual Report for Study 6, USFWS  
Subpermit MCFWCO-21**

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Authored by:

Jose A. Vazquez and R.D. Nelle

U.S. Fish and Wildlife Service  
Mid-Columbia Fish and Wildlife Conservation Office  
Leavenworth, WA 98826

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*On the cover: Photograph of MCFWCO Biological Science Technician Jake Blakely Measuring a Bull Trout Redd in the Entiat River. USFWS photograph by Meg Euclide.*

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## **Section A: 2021 Entiat River Bull Trout Spawning Ground Surveys**

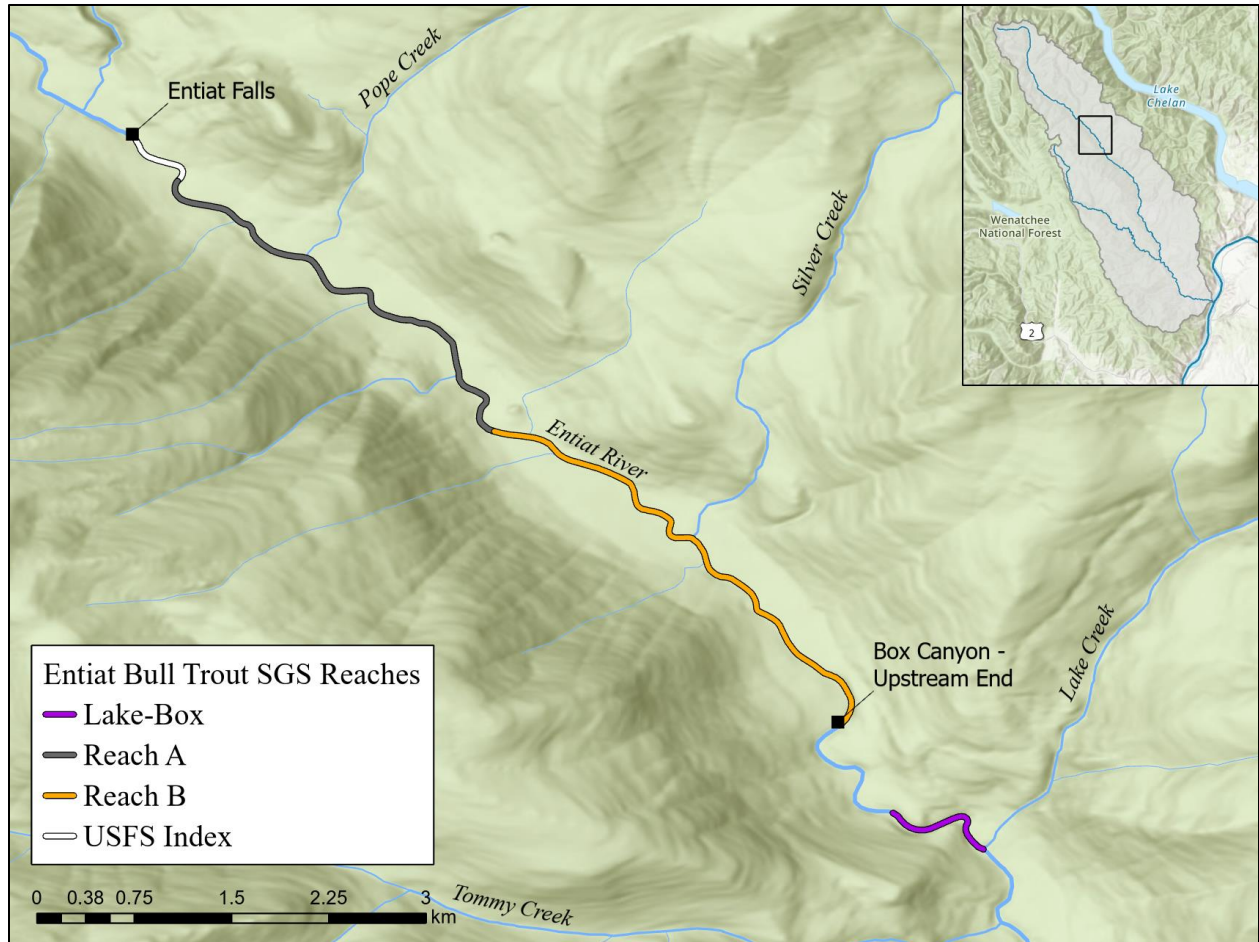
### **A1. Introduction**

One of two migratory Bull Trout populations in the Entiat River Basin, the Entiat River Bull Trout population spawns in the mainstem Entiat River between Entiat Falls (rkm 54.5) and the mouth of Lake Creek (rkm 46.5, Nelson et al. 2014). There are several severe threats to this population including habitat modification, competition with introduced Brook Trout, illegal fishing, climate change, and passage impediments at Box Canyon (rkm 47.0), an intermittent flow barrier that was obstructed by logs between 2006 and 2011 (Nelson 2014, USFWS 2015, Vazquez and Nelle 2020). Excluding 2014-2015 when surveys were suspended due to fire related closures, annual spawning ground surveys have been conducted by the MCFWCO since 2004 in the majority of mainstem Entiat River Bull Trout spawning habitat to assess local spawning activity and monitor the health of the Entiat River Bull Trout population. MCFWCO Entiat River Bull Trout spawning ground surveys were performed in 2021 in order to continue monitoring this at-risk population.

### **A2. Methods and Study Area**

In 2021 we surveyed three reaches in the mainstem Entiat River between Box Canyon and Entiat Falls that comprise the majority of the spawning habitat used by the Entiat River Bull Trout population (Nelson et al. 2008). A short fourth reach that includes the portions of Box Canyon upstream of the Lake Creek confluence (rkm 46.5-47.0) represents the remaining documented Bull Trout spawning habitat in the mainstem Entiat River (Figure A1). This reach was surveyed between 2008 and 2013 but not since, because access into and through Box Canyon has several hazards and is physically challenging.

All surveys were performed by at least two trained staff members. Consecutive surveys at each reach were separated by two weeks or less. During surveys, redds were identified as areas of disturbed substrate containing discernable pit and tailspill features. Redds were differentiated between species based on morphology, timing, and spawning adult identification. At all identified redds, measurements and photographs were taken, GPS coordinates were recorded, and present adult Bull Trout were counted. Water temperatures were taken with a handheld thermometer at the beginning and end of surveys. All data was recorded on iPads using the TouchGIS application and ESRI's Survey123 application.



**Figure A1.** Bull Trout Spawning Ground Survey Reaches in the Mainstem Entiat River. Displayed reaches represent all documented Bull Trout spawning habitat in the mainstem Entiat River. The Lake-Box reach was not surveyed in 2021 due to hazardous access conditions.

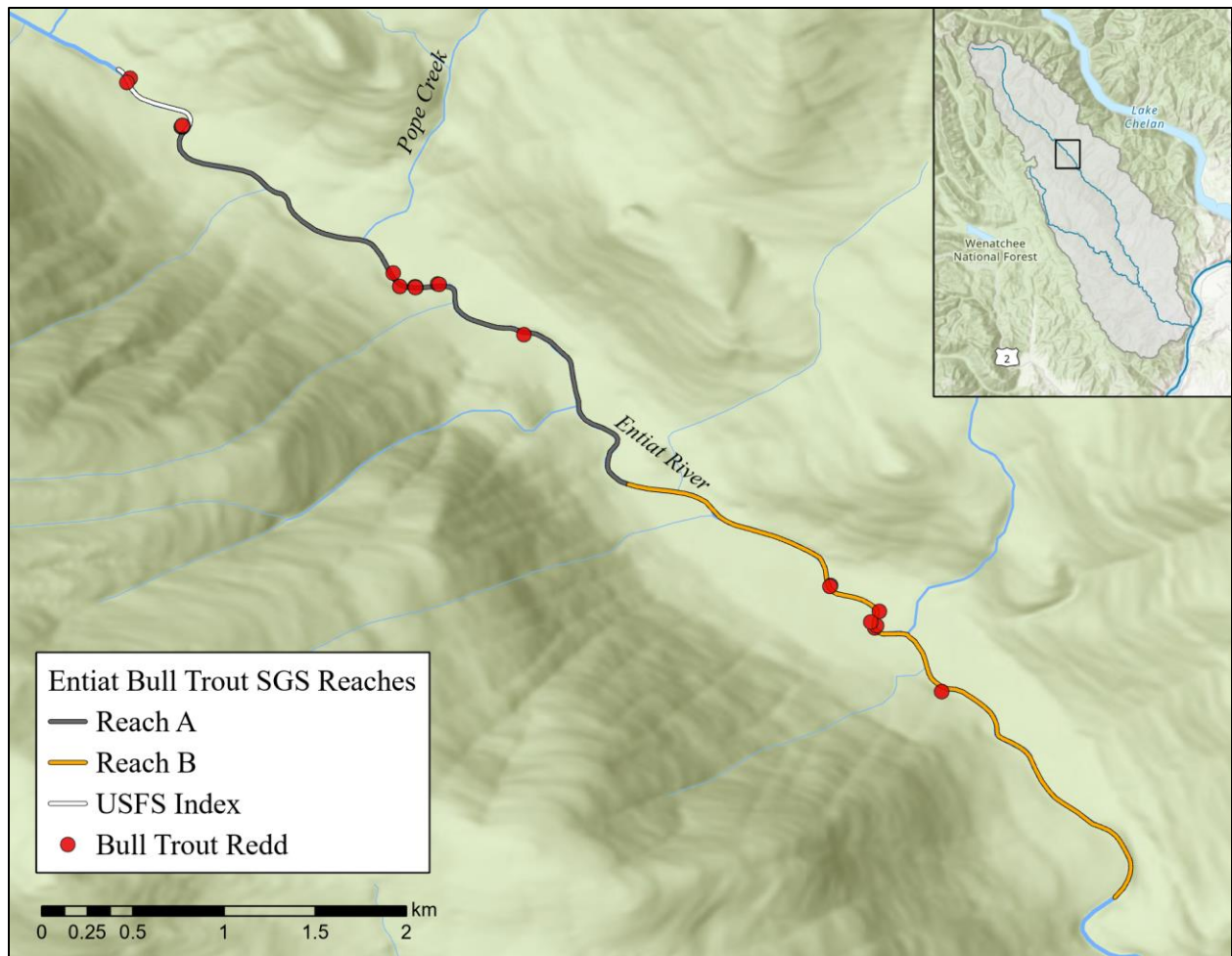
### A3. Results

The three reaches upstream of Box Canyon were each surveyed five to six times between September 14 and October 21, 2021. During surveys, 32 Bull Trout redds and thirteen adult Bull Trout  $\geq 450$  mm were observed (Table A1, Figure A2). In addition to the observed adult Bull Trout and Bull Trout redds, three Chinook Salmon redds, two adult spring Chinook Salmon, and four Chinook Salmon carcasses were documented in Reach B between September 14 and September 21. Seventeen Brook Trout redds were observed during the final survey in Reach B on October 21 (Appendix Table C1).

**Table A1.** Bull Trout Redds and Adult Bull Trout (>450 mm) Identified During Bull Trout Redd Surveys in the Entiat River, 2021.

Reach	Date	Mean Temperature (°C)	Adult Bull Trout	New Bull Trout Redds
USFS Index	09/17/21	7.8	0	2
USFS Index	09/23/21	10.0	9	2
USFS Index	09/27/21	10.9	2	5
USFS Index	10/06/21	6.5	1	4
USFS Index	10/13/21	4.6	1	1
USFS Index	10/19/21	4.7	0	1
Reach A	09/17/21	8.1	0	0
Reach A	09/27/21	10.8	0	5
Reach A	10/06/21	6.9	0	4
Reach A	10/13/21	5.1	0	1
Reach A	10/19/21	5.0	0	0
Reach B	09/14/21	10.4	0	0
Reach B	09/21/21	9.2	0	1
Reach B	10/04/21	7.1	0	5
Reach B	10/15/21	5.1	0	1
Reach B	10/21/21	5.2	0	0
<b>Total</b>			<b>13</b>	<b>32</b>





**Figure A2.** Locations of Bull Trout Redds Documented During 2021 Entiat River Bull Trout Spawning Ground Surveys.

#### A4. Discussion

The 32 Bull Trout redds found in the Entiat River upstream of Box Canyon in 2021 represent the largest number of Bull Trout redds documented in the entire mainstem Entiat River since the log obstruction that was present between 2006 and 2011 first formed. Additionally, following the 30 redds identified in 2020, this is second consecutive year that  $\geq 30$  Bull Trout redds were documented upstream of Box Canyon, which is a significant increase from other post-obstruction surveys. The  $\geq 30$  Bull Trout redds documented in 2020 and 2021 are over three standard deviations above the mean number of redds documented upstream of Box Canyon between 2006 and 2019 (mean=11.2 redds, SD=4.9, n=11, Appendix Table C2). The number of Bull Trout redds observed in both 2020 and 2021 are also greater than two standard deviations above the mean number of redds documented between 2008 and 2013, when redd surveys included the Box Canyon reach (mean=15.2 redds, SD=6.7, n=6). This data indicates that the spawning activity documented between 2020 and 2021 likely represents a high point in recent Entiat River Bull Trout spawning levels. Despite large relative numbers of recorded Bull Trout redds in 2020 and 2021, observed spawning activity upstream of Box Canyon has still not returned to the pre-obstruction levels documented in 2004 and 2005, when 47 and 50 redds were counted

respectively. Continued monitoring of the Entiat River Bull Trout population is necessary to assess future spawning activity and population trends.

#### **A5. Future Activities**

Spawning surveys are the best tool we currently have to monitor the Entiat River Bull Trout population, and we therefore recommend continuing surveys of this at-risk population.

#### **A6. References**

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## **Section B: 2021 Mad River Bull Trout Spawning Ground Surveys**

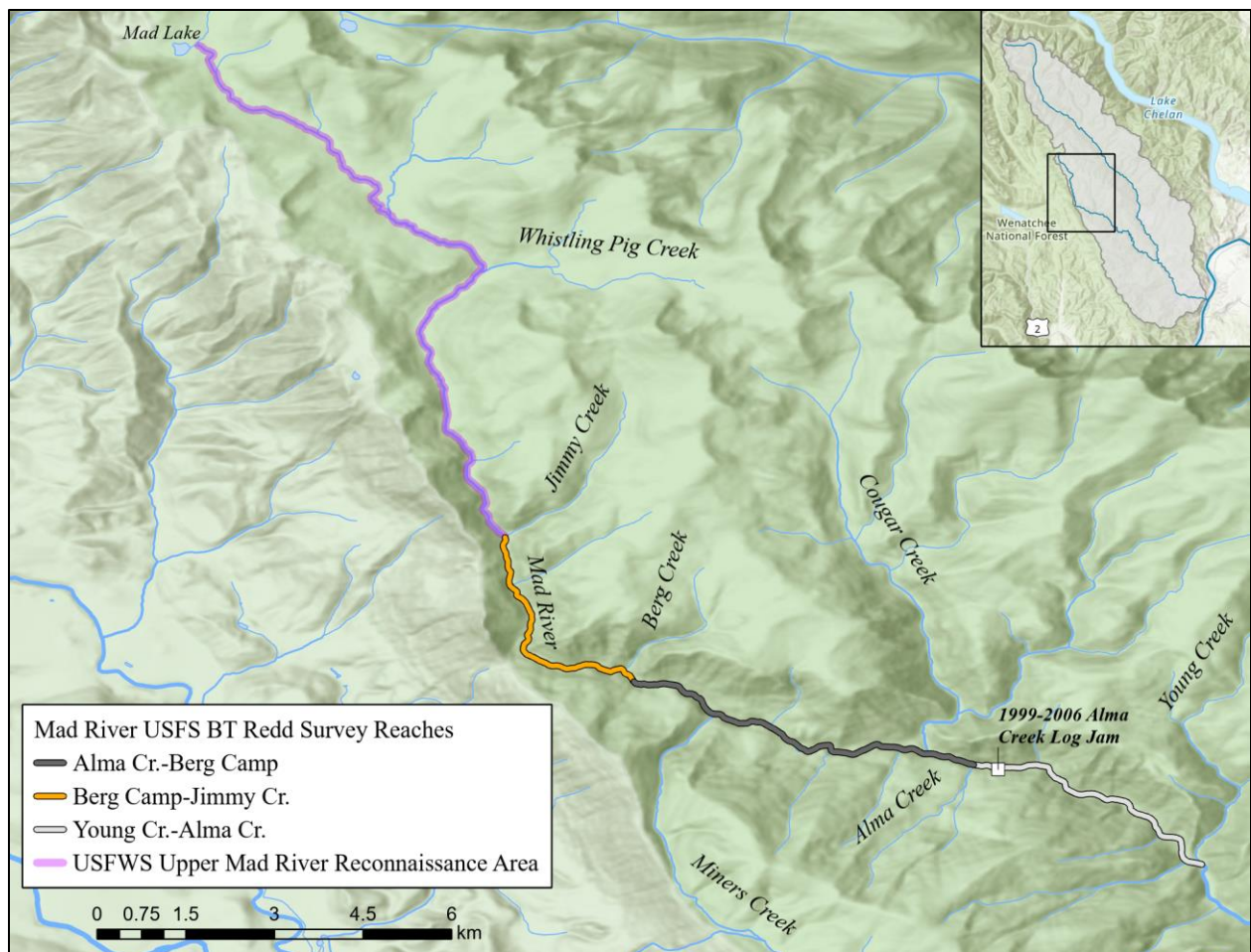
### **B1. Introduction**

The USFS Entiat Ranger District surveyed all known Bull Trout spawning habitat in the mainstem Mad River from 1989 until 2011 but discontinued further surveys due to funding and staff limitations (Mayfield per. comm. 2019). During these surveys, the USFS documented a log jam at rkm 22.8, near the Mad River's confluence with Alma Creek that prevented access to the majority of Bull Trout spawning habitat in the Mad River between 1999 and 2006 and could negatively impact Bull Trout populations if it reaggregates (Archibald and Johnson 2007). The USFS also identified a decreasing trend in Mad River Bull Trout redds between 2006 and their final surveys in 2011 (Willard 2011). After the cessation of the USFS surveys, the 2018 Cougar Creek Fire burned the majority of the Mad River drainage (WADNR 2018) and had an unknown impact on the local Bull Trout population. In order to assess the current status of the Mad River Bull Trout population, the MCFWCO began resurveying the USFS reaches in 2019. These surveys found that Bull Trout were still present and spawning in the Mad River; however, further surveys were required to draw accurate population status conclusions. The MCFWCO continued Bull Trout redd surveys in the USFS Mad River reaches during 2020 and 2021 in order to collect further data that could be used to assess the status of the Mad River Bull Trout population following the Cougar Creek Fire and identify local threats, including new migration barriers. During 2021, the MCFWCO also performed reconnaissance surveys in the Mad River upstream of the USFS reaches to determine if any Bull Trout spawning occurred in headwater areas where Bull Trout DNA was found during 2018 eDNA surveys.

### **B2. Methods and Study Area**

Bi-weekly Bull Trout redd surveys in the Mad River occurred within three reaches established by the USFS between the Young Creek confluence (rkm 19.5) and the Jimmy Creek confluence (rkm 31.5, Figure B1). Due to variable trail and stream conditions resulting from the Cougar Creek Fire, the three USFS reaches were surveyed in shortened segments that could be completed in a single day. A single segment comprising the lower 1 rkm of the Young Creek-Alma Creek reach (rkm 19.5-20.5) was not surveyed in 2021 due to logistical constraints and the absence of redds in this area during recent and historic redd surveys (Archibald and Johnson 2007, Vazquez 2020). Reconnaissance surveys were performed once in all areas between the Jimmy Creek confluence (rkm 31.5) and a location approximately one kilometer downstream of Mad Lake (rkm 43.4). In order to maximize the probability of detecting active Bull Trout spawning, reconnaissance surveys occurred during peak Mad River Bull Trout spawning activity as identified during spawning ground surveys in the USFS reaches.

All surveys were performed by at least two trained staff members. During surveys, redds were identified as areas of disturbed substrate containing discernable pit and tailspill features. At all identified redds, measurements and photographs were taken, GPS coordinates were recorded, and present adult Bull Trout were counted. Water temperatures were taken with a handheld thermometer at the beginning and end of surveys. All data was recorded on iPads using the TouchGIS application and ESRI's Survey123 application.



**Figure B1.** Areas of the Mad River Surveyed for Bull Trout Redds by USFWS in 2021 Including the USFS Reaches and the Upper Mad River Upstream of the Jimmy Creek Confluence.

### B3. Results

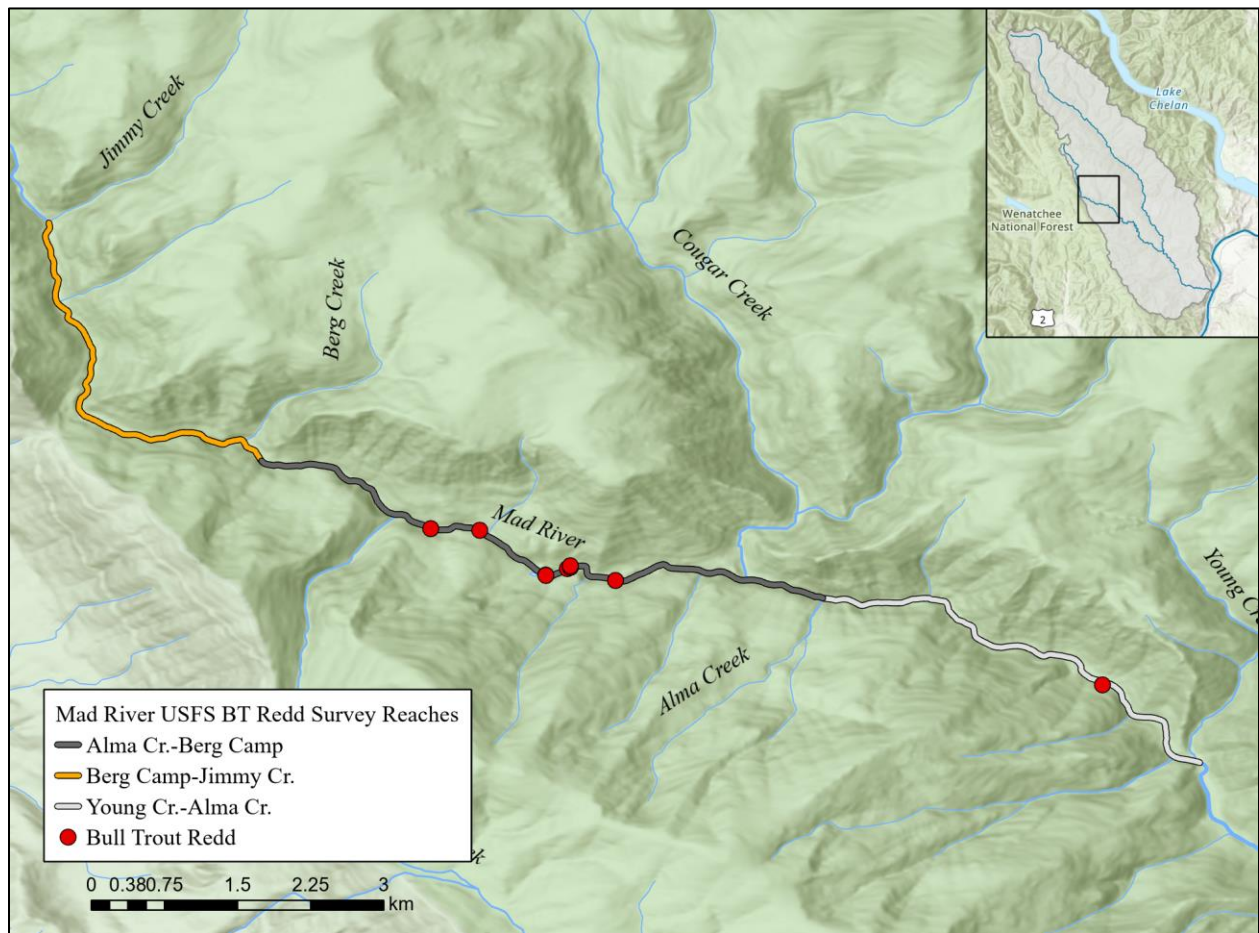
All surveyed areas within the USFS Mad River reaches (rkm 20.5-31.5) were visited at least three times between September 10 and October 14, 2021 (Appendix Table C4). Reconnaissance surveys occurred between September 21 and 27, 2021 during the period of peak Mad River Bull Trout spawning activity.

A total of nine Bull Trout redds and three adult Bull Trout were identified during 2021 surveys in the USFS reaches (Table B1, Figure B2). Six of these redds were greater than one meter in length, indicating they were likely created by migratory Bull Trout (Nelson and Sulak 2013). The majority of the redds were found upstream of the Alma Creek logjam (rkm 22.8) in the area between the Cougar Creek confluence (rkm 23.8) and the Miners Creek confluence (rkm 26.5). No redds or migratory Bull Trout were identified upstream of the Miners Creek confluence. Bull Trout redds and adult Bull Trout were also not found during reconnaissance surveys upstream of the USFS reaches.

**Table B1.** Bull Trout Redds and Adult Bull Trout >300 mm Identified During 2021 Bull Trout Redd Surveys in USFS Reaches Between rkm 20.5 and rkm 31.5 in the Mad River.

USFS Reach	Surveyed Area (rkm)	First Survey Date	Final Survey Date	Adult Bull Trout	Bull Trout Redds
Young Cr. to Alma Cr.*	20.5 - 23.2	9/15/2021	10/14/2021	0	1
Alma Cr. To Berg Camp	23.2 - 27.8	9/13/2021	10/7/2021	3	8
Berg Camp to Jimmy Cr.	27.8 - 31.5	9/10/2021	10/8/2021	0	0
<b>Total</b>				<b>3</b>	<b>9</b>

\* rkm 19.5-20.5 was not surveyed in 2021



**Figure B2.** Locations of Bull Trout Redds Documented During 2021 USFWS Mad River Bull Trout Spawning Ground Surveys. No redds were found upstream of the Jimmy Creek confluence during reconnaissance surveys.

#### **B4. Discussion**

The 2021 Mad River Bull Trout spawning ground survey results indicated that Bull Trout are continuing to spawn in their historic spawning habitat in the Mad River following the 2018

Cougar Creek Fire; although, the number of redds identified and the amount of habitat used by migratory Bull Trout declined relative to past survey years.

The nine Bull Trout redds identified in 2021 represent a decrease from the 17 and 16 redds identified in 2019 and 2020 respectively and are greater than one standard deviation below the pre-Alma Creek obstruction average of 20.1 redds (std=9.3, n=9, Appendix Table C3). This decline represents a single year of observations, thus trend conclusion cannot be inferred from the data. However, the 2021 count represents a notable decrease within a small population, and future surveys are needed to monitor potential future declines. It should also be noted that, due to their small size and cryptic appearance, our surveys may have undercounted the number of resident redds in surveyed reaches (Dunham et al. 2001, Al-Chokhachy et al. 2005). This implies that actual Bull Trout spawning levels may have been greater than our data indicates. A decrease in migratory spawning activity, however, is still a concern due to potential resulting declines in diversity and absolute abundance (Brenkman and Corbett 2005, Al-Chokhachy and Budy 2008).

The presence of migratory Bull Trout redds upstream of the historic location of the Alma Creek logjam (rkm 22.8) indicated that a significant migration barrier was likely not present at this location in 2021. Unfortunately, the absence of Bull Trout redds from areas upstream of the Miners Creek confluence (rkm 26.7), where multiple migratory-sized redds were documented during past USFS and USFWS surveys (Archibald and Johnson 2007, Vazquez 2021), indicates that new obstructions may be present upstream of this area. Surveyors noted that several new or recently enlarged log jams and debris falls related to the Cougar Creek fire were present upstream of the Miners Creek confluence during 2021 surveys. It is possible that one or more of these features is obstructing Bull Trout movement and limiting spawning habitat access. Loss of connectivity within spawning and rearing habitat can reduce spawning success rates, inhibit gene flow, reduce total juvenile carrying capacity within the stream system, and increase the threat of extirpation due climate change or short-term disturbances (Pess et al. 2008, Meeuwig et al. 2010, Falke et al. 2015, Brenkman et al. 2019). Further research is needed to assess Bull Trout movements and future spawning activity upstream of the Miners Creek confluence and to evaluate the impacts of any present obstructions on the Mad River Bull Trout population.

No Bull Trout redds or adult Bull Trout were found during reconnaissance surveys performed upstream of the USFS reaches. Areas upstream of the USFS reaches were only surveyed once, so, while migratory Bull Trout spawning in this area was unlikely if passage was obstructed in downstream reaches, it is possible that undocumented spawning occurred in this region in 2021, especially if spawning was performed by small resident Bull Trout. Multiple resident-sized Bull Trout were identified during 2021 night snorkel surveys performed within the area where reconnaissance surveys occurred, indicating that successful, unidentified resident Bull Trout spawning may be occurring in the Mad River upstream of the Jimmy Creek confluence (Vazquez in press). Resident Bull Trout spawning ground surveys are logistically challenging and often inaccurate (Al-Chokhachy et al. 2005, Howell and Sankovich 2012), so we do not recommend performing resident redd surveys in the Upper Mad River. However, if migratory Bull Trout spawning is documented upstream of the Miners Creek area, future surveys should be performed to assess migratory spawning activity upstream of the Jimmy Creek confluence.

## **B5. Future Activities**

Due to the low number of redds documented in 2021 and prior MCFWCO Mad River Bull Trout redd surveys, further redd surveys in the Mad River USFS reaches are needed to assess future Mad River Bull Trout spawning activity and monitor the impacts of the Cougar Creek Fire and any migration barriers that may develop in the future. We recommend performing annual or periodic redd surveys in Mad River spawning and rearing habitat as resources allow.

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## Section C: Appendix

**Table C1.** Location and Measurement Data from Redds Identified During 2021 Bull Trout Redd Surveys in the Entiat River Basin.

River	Reach	Survey Date	ID Number	Species	Length (m)	Width (m)	Latitude	Longitude
Entiat	Reach A	9/23/2021	18	Bull Trout	2.55	1.50	47.982379	-120.572770
Entiat	Reach A	9/23/2021	19	Bull Trout	1.62	1.20	47.982419	-120.572743
Entiat	Reach A	9/27/2021	37	Bull Trout	1.70	0.90	47.974496	-120.561215
Entiat	Reach A	9/27/2021	39	Bull Trout	1.80	1.10	47.974487	-120.561211
Entiat	Reach A	9/27/2021	41	Bull Trout	2.05	1.20	47.974651	-120.560142
Entiat	Reach A	9/27/2021	42	Bull Trout	2.40	0.90	47.974631	-120.560066
Entiat	Reach A	9/27/2021	43	Bull Trout	3.20	1.30	47.972157	-120.555896
Entiat	Reach A	10/6/2021	56	Bull Trout	1.32	0.55	47.974528	-120.562009
Entiat	Reach A	10/6/2021	57	Bull Trout	1.78	0.86	47.974511	-120.561228
Entiat	Reach A	10/6/2021	58	Bull Trout	1.90	0.80	47.974514	-120.561269
Entiat	Reach A	10/6/2021	59	Bull Trout	1.53	0.89	47.974475	-120.561238
Entiat	Reach A	10/13/2021	65	Bull Trout	2.08	0.75	47.975190	-120.562330
Entiat	Reach B	9/14/2021	10	Chinook Salmon	9.80	2.10	47.953144	-120.532702
Entiat	Reach B	9/14/2021	8	Chinook Salmon	5.50	3.00	47.954586	-120.535344
Entiat	Reach B	9/14/2021	9	Chinook Salmon	8.40	1.20	47.954485	-120.533649
Entiat	Reach B	9/21/2021	16	Bull Trout	1.83	1.21	47.957730	-120.538613
Entiat	Reach B	10/4/2021	44	Bull Trout	2.10	1.20	47.959817	-120.540792
Entiat	Reach B	10/4/2021	45	Bull Trout	1.15	0.70	47.959772	-120.540824
Entiat	Reach B	10/4/2021	46	Bull Trout	1.00	0.40	47.958542	-120.538391
Entiat	Reach B	10/4/2021	48	Bull Trout	0.90	0.40	47.957834	-120.538525
Entiat	Reach B	10/4/2021	49	Bull Trout	2.95	1.00	47.954596	-120.535320
Entiat	Reach B	10/15/2021	67	Bull Trout	1.20	0.71	47.958017	-120.538810
Entiat	Reach B	10/21/2021	70	Brook Trout	0.59	0.18	47.961263	-120.541425
Entiat	Reach B	10/21/2021	71	Brook Trout	0.40	0.25	47.961156	-120.541159

River	Reach	Survey Date	ID Number	Species	Length (m)	Width (m)	Latitude	Longitude
Entiat	Reach B	10/21/2021	72	Brook Trout	0.42	0.18	47.958313	-120.538712
Entiat	Reach B	10/21/2021	73	Brook Trout	0.50	0.18	47.958240	-120.538714
Entiat	Reach B	10/21/2021	74	Brook Trout	0.44	0.30	47.958212	-120.538714
Entiat	Reach B	10/21/2021	75	Brook Trout	0.20	0.10	47.958177	-120.538697
Entiat	Reach B	10/21/2021	76	Brook Trout	0.18	0.12	47.957950	-120.539237
Entiat	Reach B	10/21/2021	77	Brook Trout	0.20	0.13	47.957950	-120.539237
Entiat	Reach B	10/21/2021	78	Brook Trout	0.23	0.14	47.958042	-120.539157
Entiat	Reach B	10/21/2021	79	Brook Trout	0.16	0.13	47.958181	-120.539184
Entiat	Reach B	10/21/2021	80	Brook Trout	0.24	0.15	47.958228	-120.539057
Entiat	Reach B	10/21/2021	82	Brook Trout	0.20	0.16	47.955233	-120.536531
Entiat	Reach B	10/21/2021	84	Brook Trout	0.21	0.10	47.954797	-120.535864
Entiat	Reach B	10/21/2021	85	Brook Trout	0.20	0.30	47.954825	-120.535773
Entiat	Reach B	10/21/2021	86	Brook Trout	0.44	0.14	47.949682	-120.530079
Entiat	Reach B	10/21/2021	87	Brook Trout	0.30	0.11	47.949572	-120.529940
Entiat	Reach B	10/21/2021	88	Brook Trout	0.40	0.20	47.949435	-120.529843
Entiat	USFS Index	9/17/2021	13	Bull Trout	4.26	1.08	47.982396	-120.572696
Entiat	USFS Index	9/17/2021	24	Bull Trout	1.68	1.00	47.982388	-120.572693
Entiat	USFS Index	9/27/2021	26	Bull Trout	1.35	0.70	47.984772	-120.575292
Entiat	USFS Index	9/27/2021	28	Bull Trout	1.65	0.95	47.982455	-120.572723
Entiat	USFS Index	9/27/2021	29	Bull Trout	1.79	0.75	47.982451	-120.572700
Entiat	USFS Index	9/27/2021	30	Bull Trout	2.10	1.00	47.982441	-120.572688
Entiat	USFS Index	9/27/2021	32	Bull Trout	2.40	1.65	47.982397	-120.572703
Entiat	USFS Index	10/6/2021	50	Bull Trout	1.45	0.75	47.982447	-120.572695
Entiat	USFS Index	10/6/2021	51	Bull Trout	2.10	0.75	47.982446	-120.572685
Entiat	USFS Index	10/6/2021	52	Bull Trout	1.70	1.08	47.982441	-120.572700
Entiat	USFS Index	10/6/2021	53	Bull Trout	1.40	0.71	47.982432	-120.572701
Entiat	USFS Index	10/13/2021	61	Bull Trout	1.65	1.00	47.982445	-120.572715
Entiat	USFS Index	10/19/2021	69	Bull Trout	1.35	0.55	47.984569	-120.575449

River	Reach	Survey Date	ID Number	Species	Length (m)	Width (m)	Latitude	Longitude
Mad	Alma-Berg	9/20/2021	10	Bull Trout	0.45	0.38	47.827009	-120.552407
Mad	Alma-Berg	9/20/2021	12	Bull Trout	1.30	0.70	47.828357	-120.556567
Mad	Alma-Berg	9/20/2021	13	Bull Trout	0.75	0.45	47.828092	-120.556844
Mad	Alma-Berg	10/5/2021	15	Bull Trout	1.10	0.50	47.828212	-120.556565
Mad	Alma-Berg	10/5/2021	16	Bull Trout	1.10	0.60	47.827505	-120.558842
Mad	Alma-Berg	10/5/2021	17	Bull Trout	0.95	0.45	47.827472	-120.558825
Mad	Alma-Berg	10/5/2021	18	Bull Trout	1.00	0.45	47.831627	-120.564912
Mad	Alma-Berg	10/5/2021	19	Bull Trout	0.75	0.40	47.831775	-120.569424
Mad	Young-Alma	9/15/2021	8	Bull Trout	1.08	0.60	47.817393	-120.507552

**Table C2.** Annual Bull Trout Redd Counts from Past Bull Trout Spawning Ground Surveys in the Mainstem Entiat River

Year	Lake-Box Redds	Reach B Redds	Reach A Redds	USFS Index Redd	<b>Entiat River Total Redds</b>
2004	NA	20	20	7	<b>47</b>
2005	NA	18	16	16	<b>50</b>
2006 <sup>a</sup>	NA	6	12	3	<b>21</b>
2007 <sup>a</sup>	NA	1	7	4	<b>12</b>
2008 <sup>a</sup>	13	2	4	2	<b>21<sup>b</sup></b>
2009 <sup>a</sup>	2	2	9	4	<b>17<sup>b</sup></b>
2010 <sup>a</sup>	1	0	4	2	<b>7<sup>b</sup></b>
2011 <sup>a</sup>	7	0	2	0	<b>9<sup>b</sup></b>
2012	2	4	3	4	<b>13<sup>b</sup></b>
2013	6	9	7	2	<b>24<sup>b</sup></b>
2014	NA	NA	NA	NA	<b>NA</b>
2015	NA	NA	NA	NA	<b>NA</b>
2016	NA	1	6	7	<b>14</b>
2017	NA	1	2	4	<b>7</b>
2018	NA	5	4	5	<b>14</b>
2019	NA	3	7	6	<b>16</b>
2020	NA	4	12	14	<b>30</b>

<sup>a</sup> Year when passage upstream of Box Canyon was obstructed by a log barrier

<sup>b</sup> Total includes Lake-Box Canyon reach

**Table C3.** Annual Bull Trout Redd Counts from Past USFS and USFWS Bull Trout Spawning Ground Surveys in the Mad River.

Year	Surveying Agency	Young to Alma Redds	Alma to Berg Redds	Berg to Jimmy Redds	<b>Total Mad River Redds</b>
1993	USFS	0	7	3	<b>10</b>
1994	USFS	0	13	4	<b>17</b>
1995	USFS	7	7	2	<b>16</b>
1996	USFS	2	19	2	<b>23</b>
1997	NA	NA	NA	NA	<b>NA</b>
1998	USFS	4	35	4	<b>43</b>
1999 <sup>a</sup>	USFS	30	0	0	<b>30</b>
2000 <sup>a</sup>	USFS	45	0	0	<b>45</b>
2001 <sup>a</sup>	USFS	34	0	0	<b>34</b>
2002 <sup>a</sup>	USFS	26	0	0	<b>26</b>
2003 <sup>a</sup>	USFS	52	0	0	<b>52</b>
2004 <sup>a</sup>	USFS	37	0	0	<b>37</b>
2005 <sup>a</sup>	USFS	36	1	0	<b>37</b>
2006 <sup>a</sup>	USFS	1	6	0	<b>7</b>
2007	USFS	2	16	11	<b>29</b>
2008	USFS	2	5	2	<b>9</b>
2009	USFS	1	3	3	<b>7</b>
2010	USFS	4	2	0	<b>6</b>
2011	USFS	0	10	0	<b>10</b>
2012	NA	NA	NA	NA	<b>NA</b>
2013	NA	NA	NA	NA	<b>NA</b>
2014	NA	NA	NA	NA	<b>NA</b>
2015	NA	NA	NA	NA	<b>NA</b>
2016	NA	NA	NA	NA	<b>NA</b>
2017	NA	NA	NA	NA	<b>NA</b>
2018	NA	NA	NA	NA	<b>NA</b>
2019	USFWS	0	10	7	<b>17</b>
2020	USFWS	3	11	2	<b>16</b>

<sup>a</sup> Years when the Alma Creek log jam obstructed passage to upstream spawning areas

**Table C4.** Trip Information from Mad River Redd Surveys and Reconnaissance Surveys.

Date	Survey Category	Segment Name	Start Latitude	Start Longitude	End Latitude	End Longitude	Mean Temp (°C)	Adult Bull Trout	Bull Trout Redds
9/7/2021	USFS Reaches	Cougar-Miners	47.832400	-120.570730	47.827150	-120.551050	9.5	2	0
9/10/2021	USFS Reaches	Miners-Ford	47.841197	-120.598888	47.832400	-120.570730	9.1	0	0
9/13/2021	USFS Reaches	Cougar Canyon	47.827150	-120.551050	47.824860	-120.529980	8.8	0	0
9/15/2021	USFS Reaches	Young-Alma Falls	47.824980	-120.527170	47.816720	-120.505910	9.6	0	1
9/16/2021	USFS Reaches	Ford-Jimmy	47.859880	-120.604560	47.841197	-120.598888	4.9	0	0
9/20/2021	USFS Reaches	Cougar-Miners	47.832400	-120.570730	47.827150	-120.551050	6.5	1	3
9/21/2021	Recon Survey	Jimmy-Lost	47.841197	-120.598888	47.886548	-120.616338	3.9	0	0
9/22/2021	Recon Survey	Meadow-Lake	47.915498	-120.627977	47.925430	-120.644380	5.2	0	0
9/23/2021	USFS Reaches	Miners-Ford	47.841197	-120.598888	47.832400	-120.570730	6.6	0	0
9/24/2021	Recon Survey	Lost-Meadow	47.886548	-120.616338	47.906740	-120.618620	4.1	0	0
9/28/2021	Recon Survey	Meadow	47.906740	-120.618620	47.915498	-120.627977	4.4	0	0
9/29/2021	USFS Reaches	Cougar Canyon	47.827150	-120.551050	47.824860	-120.529980	6.3	0	0
9/30/2021	USFS Reaches	Ford-Jimmy	47.859880	-120.604560	47.841197	-120.598888	5.7	0	0
10/1/2021	USFS Reaches	Young-Alma Falls	47.824980	-120.527170	47.816720	-120.505910	5.8	0	0
10/5/2021	USFS Reaches	Cougar-Miners	47.832400	-120.570730	47.827150	-120.551050	6.9	0	5
10/7/2021	USFS Reaches	Miners-Ford	47.841197	-120.598888	47.832400	-120.570730	3.3	0	0
10/8/2021	USFS Reaches	Ford-Jimmy	47.859880	-120.604560	47.841197	-120.598888	1.7	0	0
10/14/2021	USFS Reaches	Young-Alma Falls	47.824980	-120.527170	47.816720	-120.505910	3.5	0	0
10/18/2021	USFS Reaches	Cougar Canyon	47.827150	-120.551050	47.824860	-120.529980	4.0	0	0

**U. S. Fish and Wildlife Service  
Mid-Columbia Fish and Wildlife Conservation Office  
7501 Icicle Road  
Leavenworth, WA**



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