

U.S. Fish and Wildlife Service

**Bull Trout Spawning Ground Surveys in the Entiat
River Basin 2022: Annual Report for Study 6, USFWS
Subpermit MCFWCO-22**



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On the cover: Photograph of SCA intern Dylan Meek identifying a Bull Trout Redd in the Entiat River. USFWS photograph by Flora Gibbs.

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Section A: 2022 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 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 2022 in order to continue monitoring this at-risk population.

A2. Methods and Study Area

In 2022 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 ESRI's Field Maps and Survey123 applications.

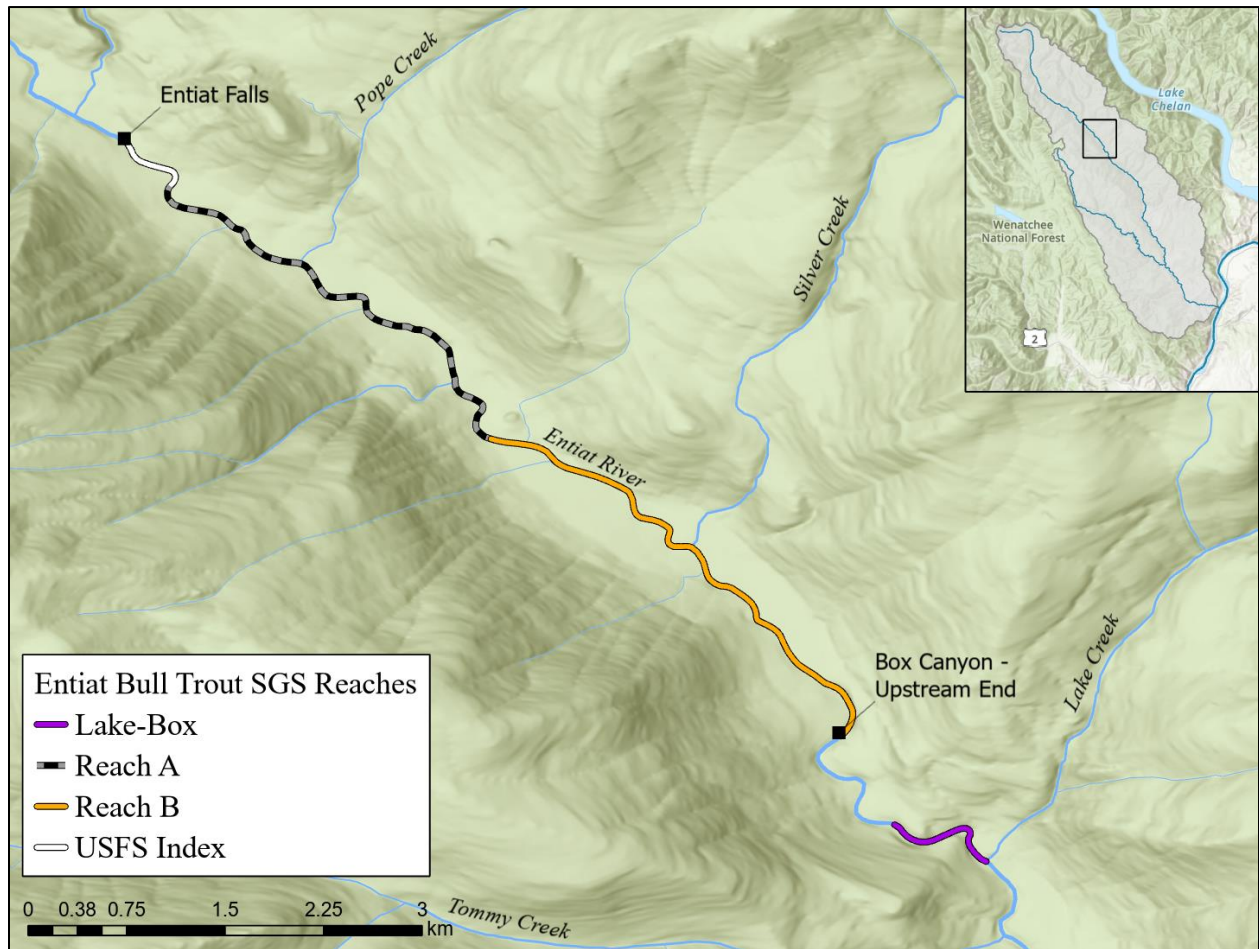


Figure A1. Bull Trout Spawning Ground Survey Reaches in the Mainstem Entiat River. Displayed reaches represent all documented Bull Trout spawning habitat in the mainstem Entiat River. The Lake-Box reach was not surveyed in 2022 due to hazardous access conditions.

A3. Results

The three reaches upstream of Box Canyon were each surveyed five times between September 14 and October 21, 2022. During surveys, 19 Bull Trout redds and 19 migratory adult Bull Trout ≥ 450 mm were observed (Table A1, Figure A2). The majority of these redds ($n=10$) were located in the tail of a single pool in the USFS Index Reach. Six of the ten redds in this pool were superimposed on by other Bull Trout redds.

In addition to the observed adult Bull Trout and Bull Trout redds, one Chinook Salmon redd was documented in Reach B on October 7. Multiple superimposed Brook Trout Redds were also measured in Reach B between October 7 and the final survey on October 21 (Appendix Table B1).

Table A1. Bull Trout Redds and Migratory Adult Bull Trout (>450 mm) Identified During Bull Trout Redd Surveys in the Entiat River, 2022.

Reach	Date	Mean Temperature (°C)	Adult Bull Trout	New Bull Trout Redds
USFS Index	09/14/22	11.0	3	0
USFS Index	09/27/22	9.0	6	5
USFS Index	10/04/22	8.1	3	2
USFS Index	10/12/22	7.0	0	4
USFS Index	10/20/22	6.2	0	0
Reach A	09/14/22	11.8	0	0
Reach A	09/27/22	9.4	1	0
Reach A	10/04/22	9.6	2	4
Reach A	10/12/22	8.4	2	3
Reach A	10/20/22	6.8	0	0
Reach B	09/12/22	12.4	0	0
Reach B	09/26/22	10.1	1	0
Reach B	10/07/22	9.4	0	0
Reach B	10/14/22	7.9	1	0
Reach B	10/21/22	6.6	0	1
Total			19	19

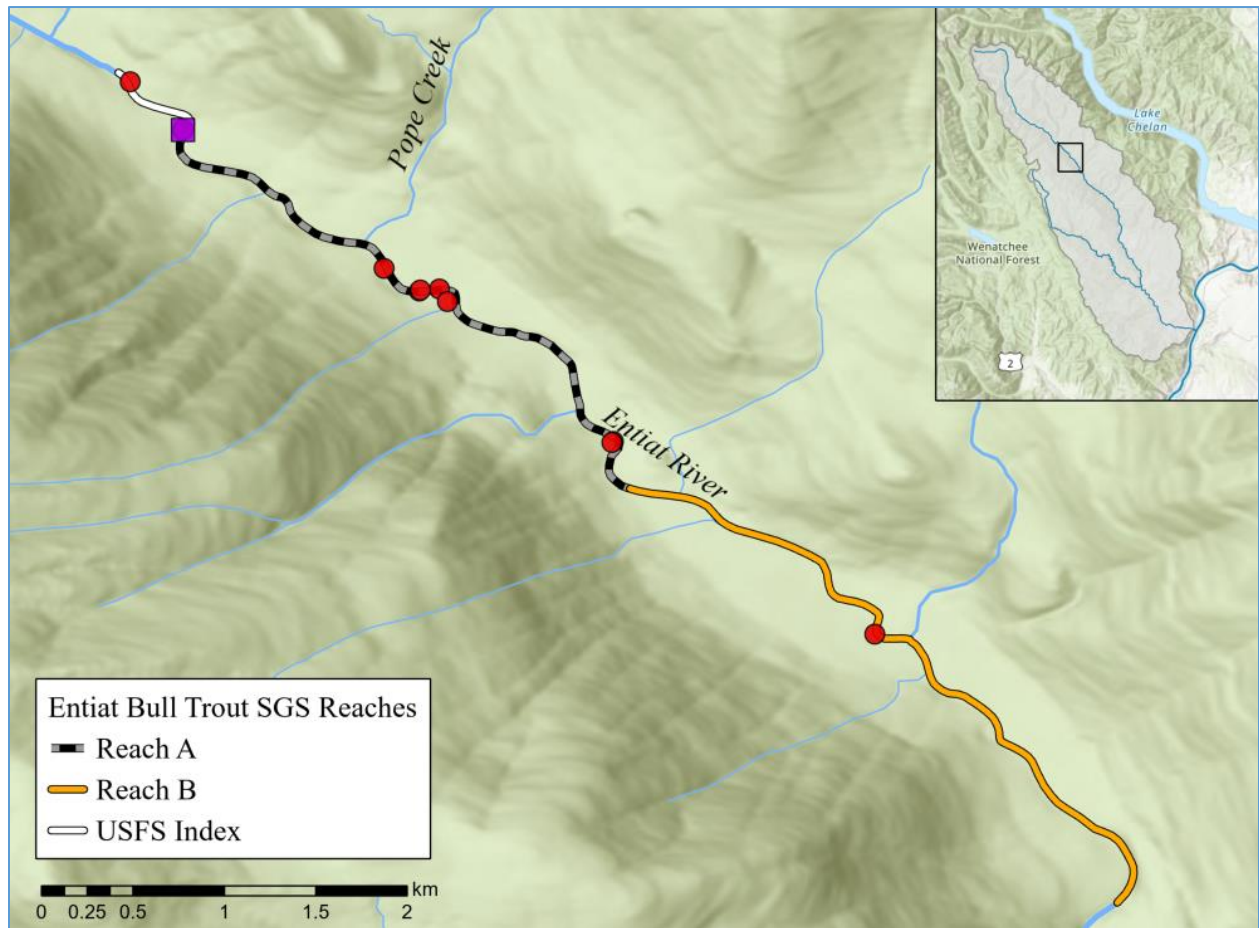


Figure A2. Bull Trout Redds Documented During 2022 Entiat River Bull Trout Spawning Ground Surveys. Red circles indicate individual Bull Trout redd locations. The purple square indicates the location of multiple, superimposed Bull Trout redds.

A4. Discussion

The 19 Bull Trout redds found in the Entiat River upstream of Box Canyon in 2022 is a decrease from the 30 to 32 redds documented in 2020 and 2021 respectively, which were 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. The number of redds documented in 2022 is still 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 B2). The number of Bull Trout redds observed in 2022 is also 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 in 2022 is still above recent average Entiat River Bull Trout spawning levels, although it is a decrease from those recorded in 2020 and 2021. It should also be noted that 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.

Also of note in 2022 were the high degrees of Bull Trout redd aggregation and intraspecific redd superimposition. Over 52% of the Bull Trout redds in the Entiat River were located in a <40 m² gravel bed in the USFS Index Reach, and over 31% of all documented Bull Trout redds were subject to intraspecific superimposition. These are the largest amounts of redd aggregation and superimposition documented in the Entiat River (unpublished USFWS data). Redd aggregation can increase the chance of catastrophic events severely impacting a salmonid population (Tentelier and Piou 2011), and superimposition can lead to decreases in egg survival and emergence rates (Essington et al. 1998, Weeber et al. 2010, Dudley 2019); although, the effects of intraspecific redd superimposition on many *Salvelinus* species, including Bull Trout, are poorly understood (Weeber et al. 2010, Gortázar et al. 2012). Redd aggregation and superimposition can be caused by factors including spawning ground temperature increases and decreases in spawning substrate availability (Blanchfield and Ridgway 2005, Tentelier and Piou 2011). Both of these factors are considered threats in the Entiat River (Nelson 2014, USFWS 2015). Due to the potential impacts of continued redd aggregation and superimposition, we suggest further monitoring of superimposition rates and potential causes and the consideration of local spawning habitat restoration or expansion actions if spawning habitat availability is determined to be a contributing factor.

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: Appendix

Table B1. Location and Measurement Data from Redds Identified During 2022 Bull Trout Redd Surveys in the Entiat River Basin. BLT= Bull Trout, BRK=Brook Trout, CHN=Chinook Salmon.

Reach	Date	Species	Length (m)	Width (m)	Latitude	Longitude	Field Comments
USFS Index	09/27/22	BLT	2.90	0.63	47.984779	-120.575292	
USFS Index	09/27/22	BLT	2.80	0.96	47.982407	-120.572702	Superimposed by nearby BLT redd
USFS Index	09/27/22	BLT	2.35	0.84	47.982409	-120.572695	Superimposed by nearby BLT redd
USFS Index	09/27/22	BLT	2.90	1.10	47.982426	-120.572691	Superimposed by nearby BLT redd
USFS Index	09/27/22	BLT	3.20	0.96	47.982427	-120.572696	Superimposed by nearby BLT redd
USFS Index	10/04/22	BLT	2.40	1.50	47.982399	-120.572720	Superimposed by nearby BLT redd
USFS Index	10/12/22	BLT	1.44	0.97	47.982431	-120.572694	
USFS Index	10/04/22	BLT	2.25	0.75	47.982429	-120.572688	
USFS Index	10/12/22	BLT	2.16	0.90	47.982408	-120.572706	
USFS Index	10/12/22	BLT	2.20	1.00	47.982404	-120.572710	Superimposed by nearby BLT redd
USFS Index	10/12/22	BLT	1.50	1.11	47.982422	-120.572703	
Reach A	10/04/22	BLT	2.50	1.10	47.975601	-120.562816	
Reach A	10/04/22	BLT	2.18	1.50	47.974497	-120.561091	
Reach A	10/04/22	BLT	3.00	1.40	47.974605	-120.560112	
Reach A	10/04/22	BLT	3.10	1.25	47.967119	-120.551555	
Reach A	10/12/22	BLT	1.50	0.57	47.967069	-120.551619	
Reach A	10/12/22	BLT	0.92	0.57	47.974552	-120.561045	
Reach A	10/12/22	BLT	3.56	0.80	47.973970	-120.559700	
Reach B	09/26/22	CHN	6.00	2.00	47.954546	-120.535466	
Reach B	10/07/22	BRK	NA	NA	47.957787	-120.539254	
Reach B	10/07/22	BRK	NA	NA	47.954852	-120.535957	
Reach B	10/07/22	BRK	NA	NA	47.954682	-120.535919	Cluster of ≥ 4 BRK redds
Reach B	10/14/22	BRK	0.60	0.50	47.961225	-120.541532	

Reach B	10/14/22	BRK	0.90	0.50	47.961222	-120.541525	
Reach B	10/14/22	BRK	0.60	0.40	47.961217	-120.541519	
Reach B	10/20/22	BLT	1.40	0.83	47.957661	-120.538709	
Reach B	10/14/22	BRK	2.00	9.00	47.955147	-120.536589	Cluster of ≥ 4 BRK redds
Reach B	10/21/22	BRK	0.55	0.30	47.960004	-120.540948	Cluster of ≥ 7 BRK redds
Reach B	10/21/22	BRK	0.70	0.30	47.957828	-120.539252	
Reach B	10/21/22	BRK	3.00	0.80	47.957920	-120.539222	Cluster of ≥ 4 BRK redds
Reach B	10/21/22	BRK	0.35	0.35	47.955185	-120.536557	

Table B2. Annual Bull Trout Redd Counts per Reach 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	Entiat River Total Redds
2004	NA	20	20	7	47
2005	NA	18	16	16	50
2006 ^a	NA	6	12	3	21
2007 ^a	NA	1	7	4	12
2008 ^a	13	2	4	2	21^b
2009 ^a	2	2	9	4	17^b
2010 ^a	1	0	4	2	7^b
2011 ^a	7	0	2	0	9^b
2012	2	4	3	4	13^b
2013	6	9	7	2	24^b
2014	NA	NA	NA	NA	NA
2015	NA	NA	NA	NA	NA
2016	NA	1	6	7	14
2017	NA	1	2	4	7
2018	NA	5	4	5	14
2019	NA	3	7	6	16
2020	NA	4	12	14	30
2021	NA	7	10	13	32

^a Year when passage upstream of Box Canyon was obstructed by a log barrier

^b Total includes Lake-Box Canyon reach

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