U.S. Fish & Wildlife Service

2005 Entiat River Bull Trout Spawning Ground Surveys

U.S. Fish and Wildlife Service
Mid-Columbia River Fishery Resource Office
Leavenworth, WA 98826

2005 Entiat River Bull Trout Spawning Ground Surveys

Supplemental Report
Entiat River Bull Trout Radio-telemetry Project

FONS Project # 2003-011

Mark C. Nelson and R.D. Nelle
Fish Biologists

U.S. Fish and Wildlife Service
Mid-Columbia River Fishery Resource Office
7501 Icicle Road
Leavenworth, WA 98826

January 24, 2007

Disclaimer

The mention of trade names or commercial products in this report does not constitute endorsement or recommendation for use by the federal government.

The correct citation for this report is:

Nelson, M.C. and R.D. Nelle. 2007. 2005 Entiat River Bull Trout Spawning Ground Surveys. U.S. Fish and Wildlife Service, Leavenworth WA.

2005 ENTIAT RIVER BULL TROUT SPAWNING GROUND SURVEYS

Mark C. Nelson and R.D. Nelle

Final Report

U.S. Fish and Wildlife Service
Mid-Columbia River Fishery Resource Office
7501 Icicle Rd.
Leavenworth, WA 98826

Abstract. - In 2005, the Mid-Columbia River Fishery Resource Office (MCRFRO) conducted bull trout spawning ground surveys in the upper Entiat River. Radio-telemetry indicated that adult fluvial bull trout were staging on the spawning grounds downstream of the USFS index reach and that the extended surveys first conducted in 2004 were again warranted. Thirty-four bull trout redds were recorded by MCRFRO in Reaches A and B, and 16 redds were observed by USFS in the index reach, for a total of 50 redds. One spent female spring Chinook salmon and 8 spring Chinook salmon redds were also observed, the first documented spawning in the Entiat River upstream of Box Canyon and Fish Tail Falls (rkm 47.0). These observations indicate that Entiat Falls (rkm 54.5) should be considered the upper limit of anadromy in the Entiat River. Bull trout redds averaged 1.2 m^2 (1.6 m long x 0.7 m wide) and were oblong in shape (2.3 L/W ratio). Spring Chinook salmon redds averaged 7.0 m^2 (3.4 m long x 2.0 m wide) and more oval or circular in shape (1.7 L/W ratio). Five "redds" were intermediate in size and shape and were considered incomplete salmon redds and were not counted. We recommend that dimensions of all redds be recorded during spawning ground surveys in the Upper Columbia Recovery Unit and a reference database be developed to improve species identification of redds in areas where multiple salmonid species concurrently spawn.

Table of Contents

List of Tables

List of Figures

On the cover: A pair of fluvial bull trout on redd. USFWS photograph by M. Nelson.

Introduction

In 2005, the Mid-Columbia River Fishery Resource Office (MCRFRO) conducted bull trout spawning ground surveys in the upper Entiat River as part of a multi-year radio-telemetry study of fluvial bull trout. Radio tagged adult bull trout were tracked to this area during the study and spawning ground surveys were initiated by MCRFRO in 2004. Spawning surveys are also conducted by the U.S. Forest Service in the upper Entiat River, but are restricted to a 0.4 km index reach downstream of Entiat Falls (rkm 54.5) (USFS 2005).

Methods

Two reaches were surveyed (Figure 1). Reach A started at rkm 54.1 (downstream of USGS gage pool and the lower limit of USFS index reach) and ended at rkm 51.2 (Tommy Road Bridge). Reach B started at rkm 51.2 (Tommy Road Bridge) and ended at rkm 47.3 (upstream of Fish Tail Falls at Box Canyon). Two surveyors walked the river in the downstream direction and identified, counted, flagged and recorded the location of redds. All redds were measured and photographed and live bull trout were counted. Water temperatures (°C) were recorded using glass thermometers (± 1 degree of accuracy). During the surveys, radio-tagged bull trout were tracked with a Lotek SRX-400 receiver. Locations of tagged bull trout and redds were recorded with a Garmin model GPSmap76 unit.

Redds were classified as complete (definite) or incomplete. Length and width of redds (pit and tailspill) and pit depths were measured (± 0.01 m) with a graduated wading rod. Redd measurements were taken only after redd was complete or fish were not present. Redd shape was approximated by the ratio L/W and area was calculated as L x W. There are no established criteria for distinguishing between redds of different salmonid species, so we used the presence of live fish, size of redd, shape of redd, and subjective experience of the surveyors to judge the species of complete redds in the field.

Results

Surveys were conducted from September 9 to October 27, 2005. Water temperatures ranged from 8.5 - 11.5 °C during September and from 4.0 – 7.0 °C during October (Table 1).

Fourteen live adult bull trout and 1 live adult spring Chinook salmon were observed, and 34 bull trout redds, 8 spring Chinook salmon redds, and 5 redds of undetermined species were counted in 2005 (Table 2). Sixteen bull trout redds were located in Reach A and 18 were in Reach B (Figures 2 and 3). Three spring Chinook salmon redds were found in

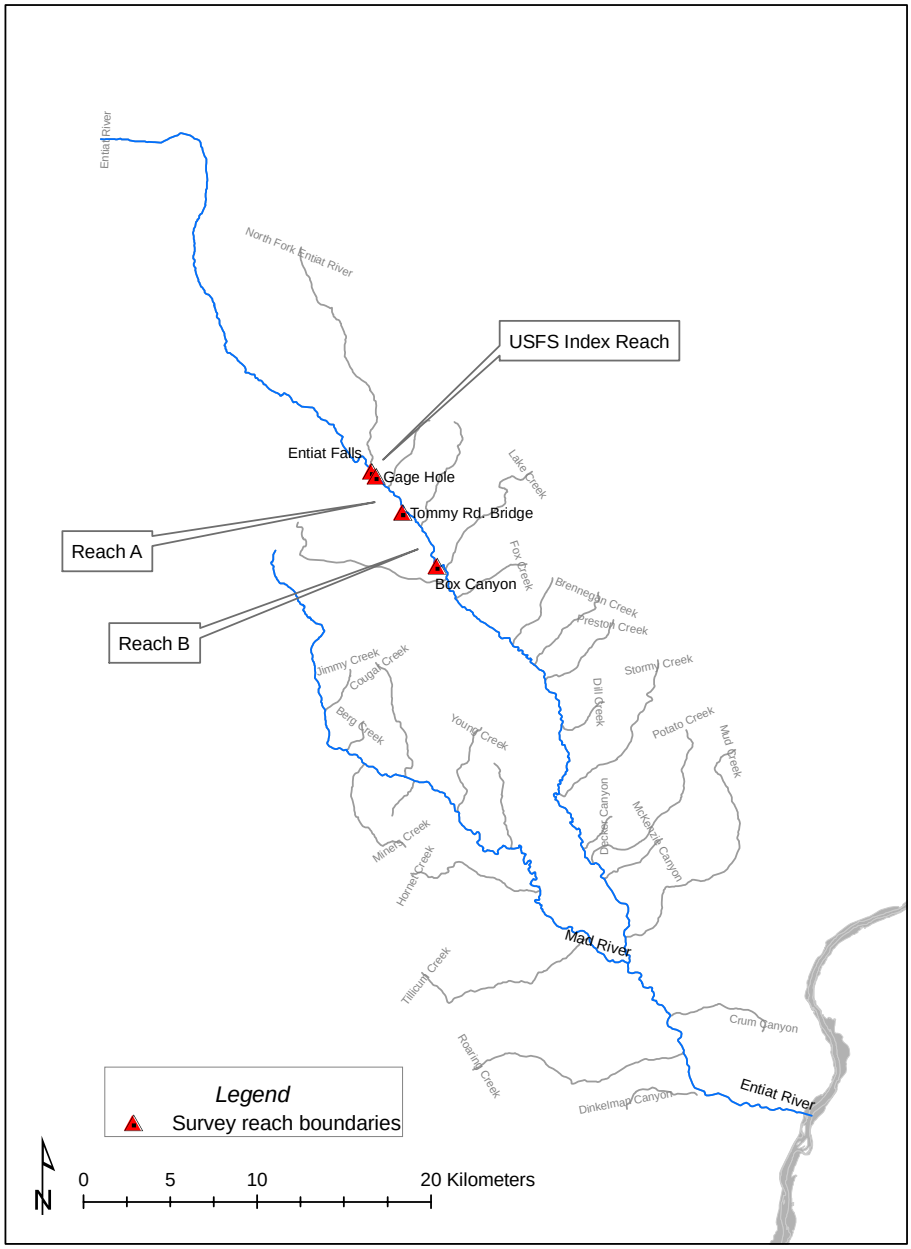

Figure 1. Map of the Entiat River showing bull trout spawning ground reaches surveyed by MCRFRO and USFS.

Table 1. Entiat River water temperatures during spawning ground surveys in 2005.

Date	Reach	Start Temp °C	Start Time	End Temp °C	End Time
9/9/05	A	8.5	10:35	10.5	15:00
9/12/05	B	8.5	10:30	11.5	14:50
9/29/05	A	10.0	10:50	11.5	15:20
10/05/05	B	6.0	11:38	6.5	14:52
10/11/05	A	6.0	11:15	7.0	14:25
10/24/05	B	6.5	11:12	n/a	14:15
10/27/05	A	4.0	12:12	4.0	14:40

Table 2. Number of redds of bull trout, spring Chinook salmon, and undetermined species observed in the Upper Entiat River, September 9 - October 27, 2005.

Reach	Date	Observers	# BT redds	cumulative # BT redds	# bull trout	# SCS redds	# undeterm. *sp* redds
A	9/09/05	MN,DC	1	1	3	0	0
	9/29/05	MN,DC	11	12	7	3	5
	10/11/05	MN,BK	4	16	0	0	0
	10/27/05	MN,BK	0	16	0	0	0
B	9/12/05	RN,BK	1	1	3	3	0
	10/05/05	MN,BK	13	14	1	2	0
	10/24/05	MN,BK	4	18	0	0	0
Totals			34		14	8	5

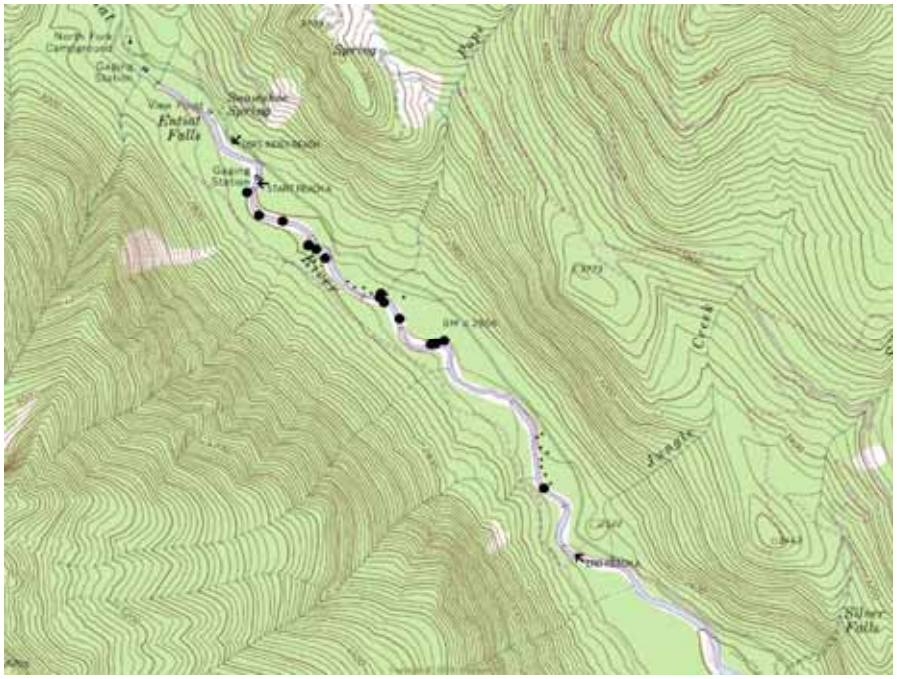

Figure 2. Location of bull trout redds in Reach A in 2005.

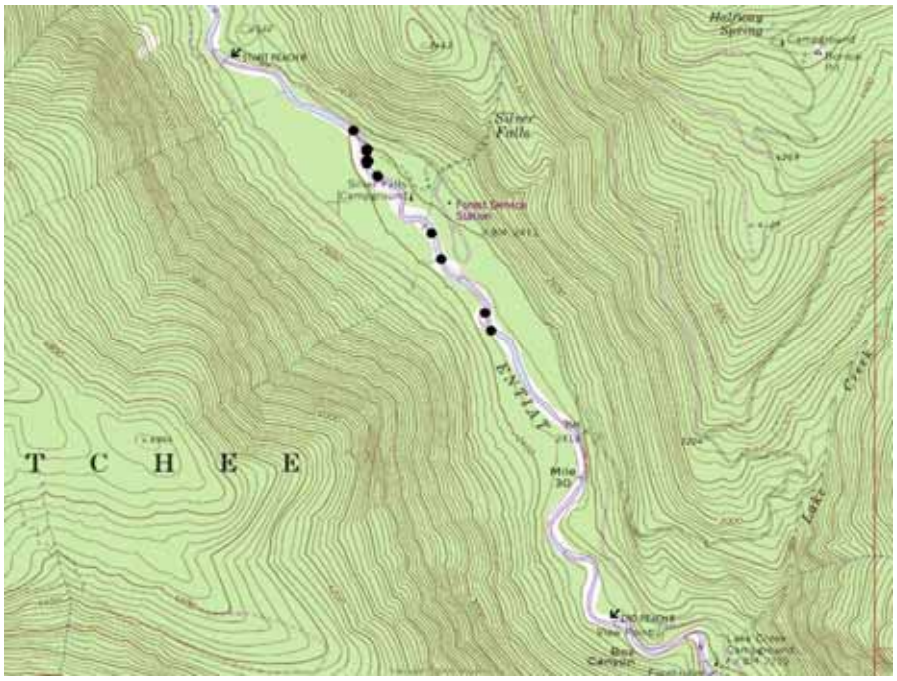

Figure 3. Location of bull trout redds in Reach B in 2005.

Reach A and 5 were in Reach B (Figures 4 and 5). The latitude and longitude coordinates of all redds of both species are recorded in Appendix Table A1.

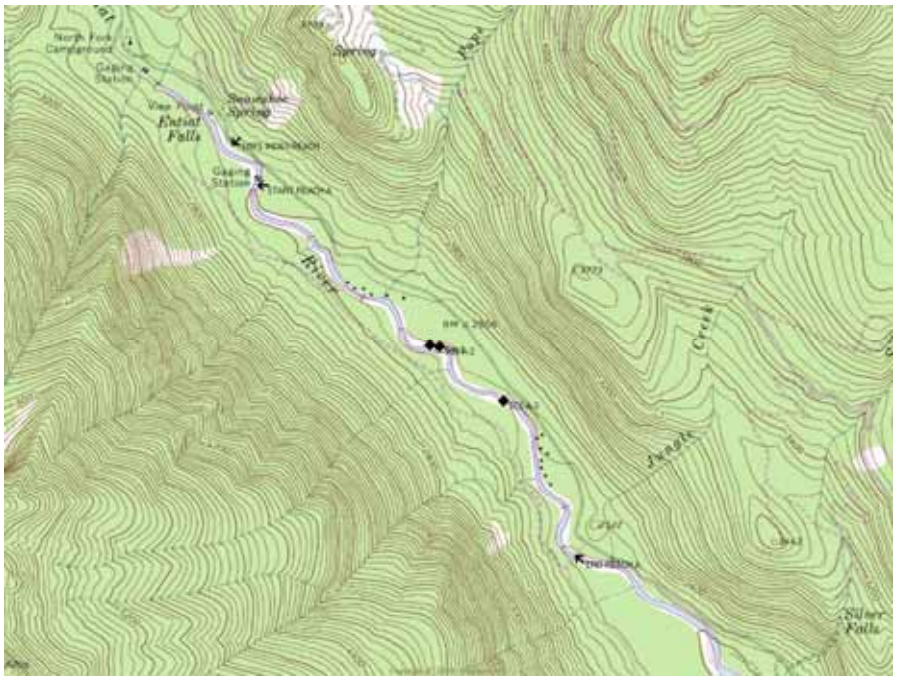

Figure 4. Location of spring Chinook salmon redds in Reach A in 2005.

Figure 5. Location of spring Chinook redds in Reach B in 2005.

One spent female spring Chinook salmon carcass was recovered near Silver Falls Campground during habitat surveys; no eggs remained in the carcass and spawning was judged 100% successful (Mike Ward, Terraqua, per. comm.). Analysis of scale annuli indicated it was a 4 year old hatchery fish (Charles Hamstreet, USFWS, per. comm.).

Bull trout redds were smaller in size and more oblong in shape than spring Chinook salmon redds (Figures 6 and 7, Tables 4 and 5). The area of bull trout redds averaged 1.2 m^2 (range 0.5 m^2 - 3.45 m^2), while spring Chinook redds averaged 7.0 m^2 (range 3.75 m^2 - 11.5 m^2). On average, bull trout redds were 2.3 times longer than wide (L/W range 1.5 – 3.8), while spring Chinook redds were 1.7 times longer than wide (L/W range 1.1 to 2.2). The 5 redds of undetermined species were variable in area, but most were circular in shape (Table 6). In the field, 3 of these redds were classified as complete (U1, U4, U5), but only one of these (U4) would fit in the observed range of size and shape of bull trout redds. Two redds classified as incomplete (U2, U3) were small and circular, with an average area of 0.6 m^2 and average L/W ratio of 0.9.

Figure 6. Photograph of typical bull trout redd in the upper Entiat River in 2005.

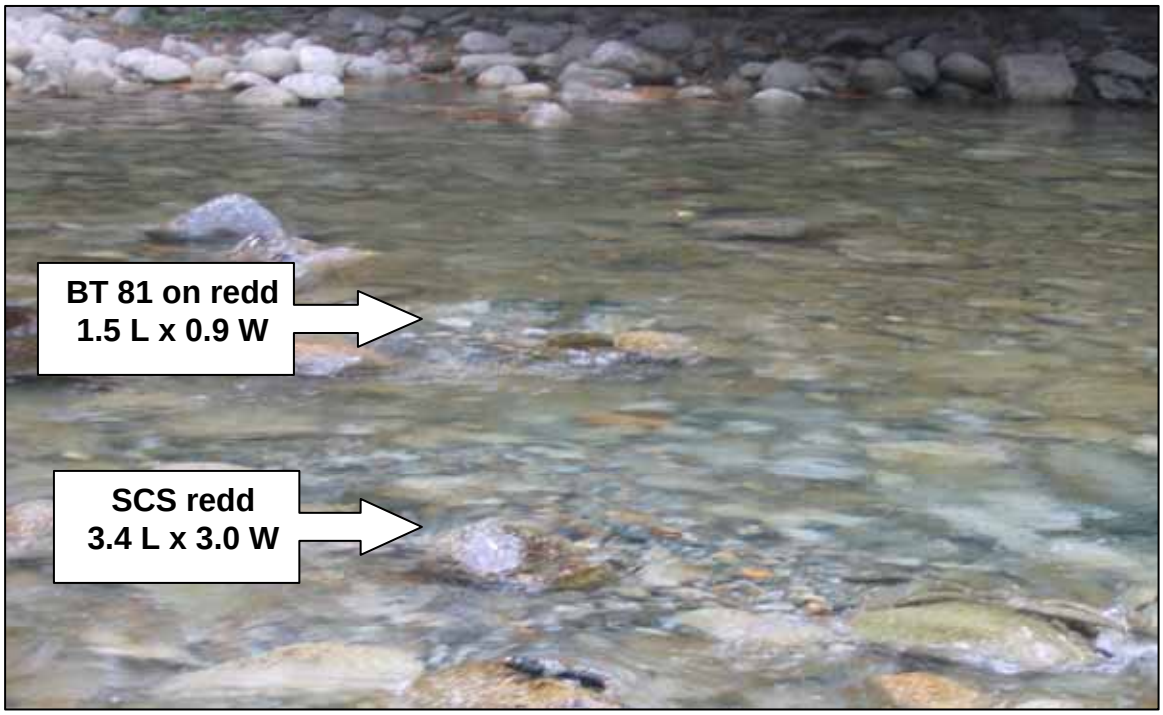

Figure 7. Photograph of a bull trout redd and a spring Chinook redd observed in Reach A on September 29, 2005. Note radio-tagged bull trout (code 81) present on the bull trout redd.

Table 3. Dimensions of redds judged as bull trout in the Upper Entiat River in 2005.

Redd name	Length (m)	Width (m)	Area (m^2)	Ratio L/W	Depth of pit (m)
A1	1.5	0.4	0.6	3.8	0.36
A3	1.1	0.6	0.66	1.8	0.35
A4*(♀♂)	1.5	1.0	1.5	1.5	0.35
A5	1.7	0.9	1.53	1.9	0.25
A6	1.5	0.9	1.35	1.7	0.3
A7*(♀♂♂)	2.2	0.9	1.98	2.4	0.42
A8	1.5	0.8	1.2	1.9	0.55
A9	3.0	0.8	2.4	3.8	0.29
A10	1.5	0.7	1.05	2.1	0.34
A11	2.0	0.7	1.4	2.9	0.3
A12	2.0	0.7	1.4	2.9	0.35
A13*(♀)	1.5	0.9	1.35	1.7	0.4
A14	1.5	0.9	1.35	1.7	0.3
A15	1.1	0.7	0.77	1.6	0.2
A16	2.3	1.5	3.45	1.5	0.28
A17	1.5	0.6	0.9	2.5	0.23
B4	nr**	nr**	-	-	nr**
B5	1.3	0.6	0.78	2.2	0.25
B6	1.5	0.7	1.05	2.1	0.26
B7	1.5	0.8	1.2	1.9	0.24
B8	1.9	0.6	1.14	3.2	0.2
B9	1.3	0.5	0.65	2.6	0.3
B10	1.0	0.5	0.5	2.0	0.24
B11	1.5	0.6	0.9	2.5	0.24
B12	1.5	0.5	0.75	3.0	0.28
B13	1.0	0.5	0.5	2.0	0.24
B14	1.6	0.5	0.8	3.2	0.3
B15	1.6	0.5	0.8	3.2	0.28
B16	1.6	0.8	1.28	2.0	0.3
B17	1.9	1.1	2.09	1.7	0.3
B18	1.5	0.5	0.75	3.0	0.4
B19	1.5	0.8	1.2	1.9	0.38
B20	1.5	0.9	1.35	1.7	0.4
B21	1.5	0.7	1.05	2.1	0.35
Mean	1.6	0.7	1.2	2.3	0.31

** bull trout present on redd, ** not recorded*

Table 4. Dimensions of redds judged as spring Chinook salmon during bull trout spawning ground surveys in the Upper Entiat River in 2005.

Redd name	Total length (m)	Width (m)	Area (m^2)	Ratio L/W	Pit depth (m)
SCS-A-1	3.4	3.0	10.2	1.1	0.5
SCS-A-2	4.2	2.0	8.4	2.1	0.3
SCS-A-3	2.5	1.5	3.75	1.7	0.5
SCS-B-4	5.0	2.3	11.5	2.2	0.45
SCS-B-5*(♀)	4.0	2.0	8	2.0	0.4
SCS-B-6	2.9	2.3	6.67	1.3	0.35
SCS-B-7	2.5	1.5	3.75	1.7	0.3
SCS-B-8	2.5	1.5	3.75	1.7	0.4
Mean	3.4	2.0	7.0	1.7	0.4

* spring Chinook salmon present on redd

Table 5. Dimensions of redds of undetermined species observed during bull trout spawning ground surveys in the upper Entiat River in 2005.

Redd name	Total length (m)	Width (m)	Area (m^2)	Ratio L/W	Depth of pit (m)
U1	1.5	1.5	2.25	1.0	0.29
U2	0.8	0.8	0.64	1.0	0.3
U3	0.7	0.8	0.56	0.9	0.39
U4	2.5	1.2	3	2.1	0.36
U5	1.5	1.4	2.1	1.1	0.26

Discussion

In 2005, we found 6 fewer bull trout redds in Reaches A and B than we did in 2004. However, in 2005 the USFS counted 9 more bull trout redds in their index reach than in 2004 (USFS 2005), and the total number of redds in the upper Entiat River between Box Canyon and Entiat Falls increased from 47 in 2004 to 50 in 2005 (Table 7).

Table 6. Total bull trout redds observed during USFS and MCRFRO spawning ground surveys in the upper Entiat River, 2002 - 2005.

Reach	Agency	rkms	Length	2002	2003	2004	2005
Index	USFS	54.1-54.5	0.4 km	7	5	7	16
A and B	MCRFRO	47.3-54.1	7.2 km	*	*	40	34
Totals			7.6 km	--	--	47	50

** Bull trout spawning ground surveys not conducted in Reaches A and B in these years*

Fish Tail Falls at Box Canyon (rkm 47.0) has long been considered the upper limit of distribution of anadromous fish in the Entiat River (USFWS 1950, Mullan et al. 1992), although during a snorkel survey in 1989 one adult Chinook salmon was observed upstream of Fish Tail Falls (Brown 1992). The redds we observed during our surveys are the first documented occurrence of spawning activity by spring Chinook salmon upstream of Fish Tail Falls. Our observations indicate that Entiat Falls (rkm 54.5) should be considered the upper limit of anadromy in the Entiat River.

The presence of salmon and bull trout together on the same spawning grounds made species identification of redds more challenging. We were able to differentiate most redds of bull trout and spring Chinook salmon by the presence of live fish, size of redds, shape of redds, and the subjective experience of the surveyors, but not enough information was available to confidently identify 5 redds to species. All 5 of these redds were found in a cluster at one location in reach A, near one definite bull trout redd and 1 definite spring Chinook salmon redd. In the field, 2 of these redds were considered incomplete and 3 were considered complete redds, but the circular shape suggests most were incomplete salmon redds. One could perhaps have been retroactively classified as a bull trout, but at this point we do not want to change our field assessments. We decided on the conservative approach and to not erroneously inflate the number of redds of either species, so all 5 were designated undetermined and incomplete redds.

Recommendations

Spawning ground surveyors rely on several factors to identify the species of redds they observe, and in some cases, the observer uses subjective experience to make the final identification. To improve the accuracy of species identification of redds and formalize the procedure, we recommend that measurements of redds and observations on substrate size, water velocity, redd position, or other characteristics are recorded during spawning ground surveys. While we recognize that there is overlap in size and shape of redds of different species, a reference database of redd characteristics of known salmonid species should be developed for the Upper Columbia Recovery Unit. This database may be useful as a guide to improve species identification of redds in areas where multiple salmonid species concurrently spawn.

References

Brown, L.G. 1992. Draft management guide for the bull trout *Salvelinus confluentus* (Suckley) on the Wenatchee National Forest. March 1992. Washington Department of Wildlife, Wenatchee, WA.

Hamstreet, C. 2005. USFWS, Mid-Columbia River Fishery Resource Office. Personal communication.

Mullan, J., K. Williams, G. Rhodus, T. Hillman, and J. McIntyre. 1992. Production and Habitats in Mid-Columbia River Tributary Streams. U.S. and Wildlife Service Monograph I. 489 pp.

USFS 2005. 2005 Bull trout spawning survey of Mad River. Prepared by Phil Archibald and Emily Johnson, U.S. Forest Service, Entiat Ranger District.

USFWS 1950. Survey of the Columbia River and its tributaries- part IV: Area III Washington streams from the Klickitat and Snake Rivers to Grand Coulee Dam. Special Scientific Report-Fisheries No. 37. Washington D.C. September 1950.

Ward, M. 2005. Terraqua Consulting. Personal communication.

Appendix

Table A1. Latitude and longitude coordinates of all redds of bull trout and spring Chinook salmon observed in the upper Entiat River in 2005.

Species[1]	Redd Name	Date	Latitude	Longitude
BT	A1	9-Sep-05	47.9792690	-120.5689135
BT	A3	29-Sep-05	47.9817051	-120.5731388
BT	A4	29-Sep-05	47.9806595	-120.5723154
BT	A5	29-Sep-05	47.9803680	-120.5707111
BT	A6	29-Sep-05	47.9792500	-120.5689790
BT	A7	29-Sep-05	47.9790775	-120.5684011
BT	A8	29-Sep-05	47.9786498	-120.5678113
BT	A9	29-Sep-05	47.9769927	-120.5639755
BT	A10	29-Sep-05	47.9765776	-120.5637806
BT	A11	29-Sep-05	47.9765705	-120.5637380
BT	A12	29-Sep-05	47.9758146	-120.5626958
BT	A13	29-Sep-05	47.9745788	-120.5605313
BT	A14	11-Oct-05	47.9768132	-120.5640722
BT	A15	11-Oct-05	47.9750755	-120.5599052
BT	A16	11-Oct-05	47.9747485	-120.5596133
BT	A17	11-Oct-05	47.9678560	-120.5527246
BT	B4	12-Sep-05	47.9522093	-120.5330377
BT	B5	5-Oct-05	47.9606455	-120.5409155
BT	B6	5-Oct-05	47.9606474	-120.5409332
BT	B7	5-Oct-05	47.9605505	-120.5409916
BT	B8	5-Oct-05	47.9600791	-120.5410014
BT	B9	5-Oct-05	47.9601611	-120.5409155
BT	B10	5-Oct-05	47.9601087	-120.5409123
BT	B11	5-Oct-05	47.9600460	-120.5408697
BT	B12	5-Oct-05	47.9600715	-120.5408620
BT	B13	5-Oct-05	47.9599360	-120.5409347
BT	B14	5-Oct-05	47.9529810	-120.5327877
BT	B15	5-Oct-05	47.9529861	-120.5327801
BT	B16	5-Oct-05	47.9521571	-120.5323672
BT	B17	5-Oct-05	47.9521457	-120.5323526
BT	B18	24-Oct-05	47.9614792	-120.5419836
BT	B19	24-Oct-05	47.9593600	-120.5401852
BT	B20	24-Oct-05	47.9593800	-120.5402213
BT	B21	24-Oct-05	47.9567074	-120.5364821
SCS	SCS-A-1	9-Sep-05	47.9746092	-120.5605924
SCS	SCS-A-2	29-Sep-05	47.9745371	-120.5599284
SCS	SCS-A-3	29-Sep-05	47.9720203	-120.5555253
SCS	SCS-B-4	12-Sep-05	47.9621950	-120.5432739
SCS	SCS-B-5	12-Sep-05	47.9614886	-120.5420123
SCS	SCS-B-6	12-Sep-05	47.9548027	-120.5355299
SCS	SCS-B-7	5-Oct-05	47.9555022	-120.5358430
SCS	SCS-B-8	5-Oct-05	47.9595131	-120.5403165

[1]*Note: BT- bull trout; SCS- spring Chinook salmon*

U. S. Fish and Wildlife Service
Mid-Columbia River Fishery Resource Office
7501 Icicle Road
Leavenworth, WA

January 2007