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Steelhead Spawning Ground Surveys on the Entiat River, 2015.

Kenneth Poczekaj and R.D. Nelle

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

***On the cover**: Two steelhead on a redd in the Entiat River.*

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Authored by

Kenneth Poczekaj
R.D. Nelle

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

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Abstract— The Mid-Columbia River Fishery Resource Office conducted steelhead, *O. mykiss gairdneri,* spawning ground surveys on the Entiat River. Surveys took place from late February to mid-June 2015. A total of 163 redds were observed during the spring 2015 spawning period with peak of spawning occurring during April.

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Introduction

Study Area

The Entiat River watershed originates from 11 glaciers and snowfields in the Cascade Mountains and flows southeast approximately 69 km to join the Columbia River at river kilometer (rkm) 778 (CCCD 2004, Mullan et al. 1992). The Entiat watershed is bordered by the Entiat Mountains to the southwest and the Chelan Mountains to the northeast and drains approximately 1,085 km^2. The topography is steep with unstable erodible soils and vegetation types varying from semi-arid shrub steppe near the confluence with the Columbia River to temperate forests and alpine meadows in the headwaters.

Past glacial activity has shaped the Entiat River valley by creating a U-shaped valley upstream of terminal moraine at rkm 26.1 and V shaped valley downstream (Mullan et al. 1992). The present upstream limit to anadromy is at Entiat Falls (rkm 54.4) (Figure 1).

The Entiat River watershed supports eight salmonid species including spring and summer Chinook Salmon *Oncorhynchus tshawytscha*, steelhead and resident rainbow trout *O. mykiss gairdneri,* Sockeye Salmon *O. nerka,* Westslope Cutthroat Trout *O. clarki lewisi,* Coho Salmon *O. kisutch*, Mountain Whitefish *Prosopium williamsoni,* Bull Trout *Salvelinus confluentus,* and introduced Eastern Brook Trout *S. fontinalis*. Other fish species include, Chiselmouth *Acrocheilus alutaceus,* Northern Pikeminnow *Ptychocheilus oregonensis,* Largescale Sucker *Catostomus macrocheilus,* Bridgelip Sucker *C. columbianus,* Speckled Dace *Rhinichthys osculus,* Longnose Dace *R. cataractae,* Redside Shiner *Richardsonius balteatus,* sculpin *Cottus spp*., Three-Spined Stickleback *Gasterosteus aculeatus* and Pacific Lamprey *Entosphenus tridentatus*. (Mullan et al 1992, CCCD 2004,).

Methods

Surveys to count steelhead redds were conducted using methods outlined for the Mid Colombia River Fisheries Resource Office (Nelle and Moberg 2008). The main-stem Entiat River was surveyed from Fox Creek Campground (rkm 45) to the Entiat information kiosk (rkm 1.1) (Figure 1). The survey area was divided into four reaches based on river access points and distances that could be surveyed in a work day (Figure 1, Table 1). A two person crew each using a 10'cataraft conducted redd surveys while moving downstream. Surveyors walked areas that were inaccessible or unsafe to raft. Steelhead redd surveys began on February 23, 2015 and continued until our cutoff date of June 15, 2015. All four reaches were surveyed on a weekly basis as long as the weather and stream conditions permitted.

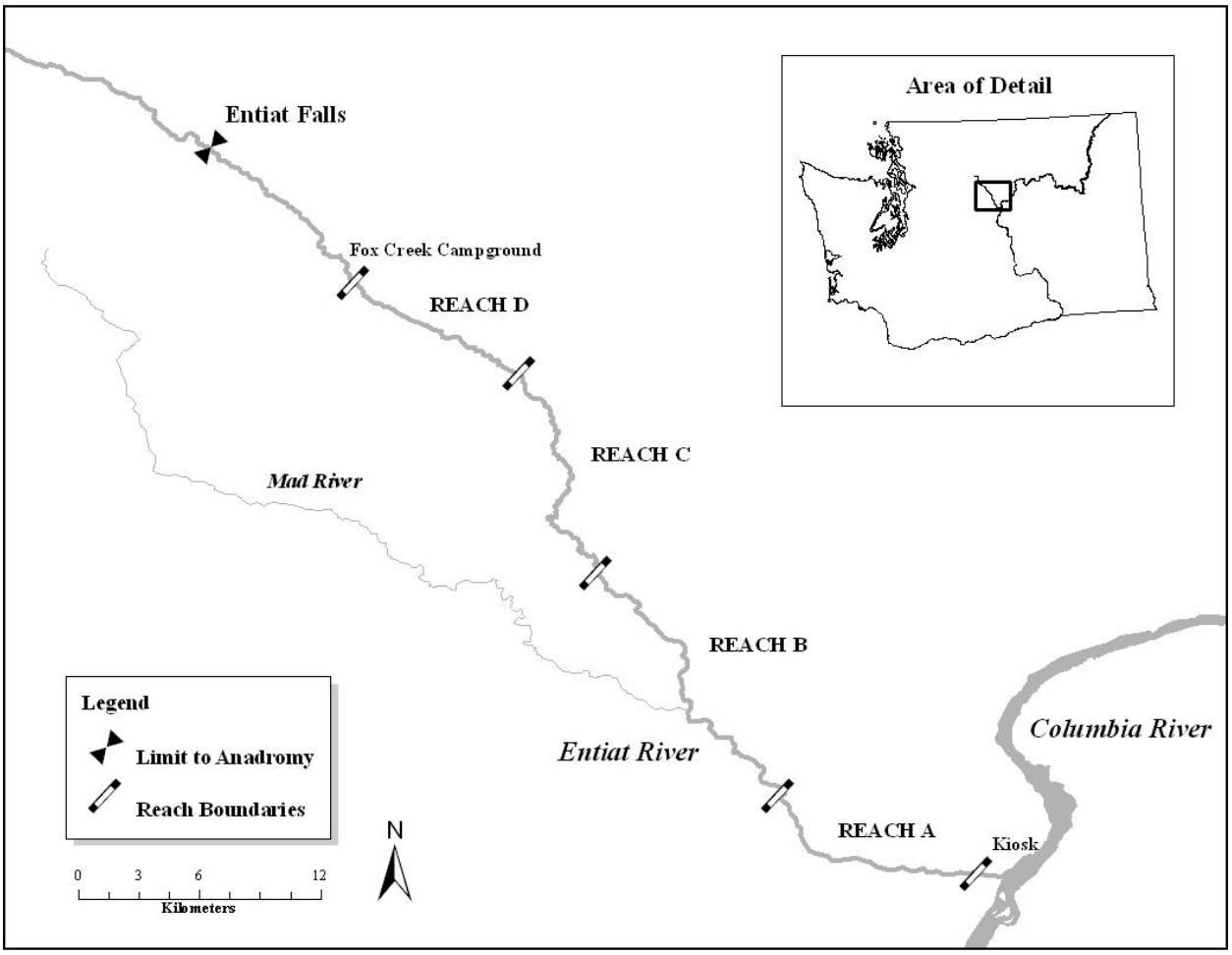

Figure 1: The four reaches of steelhead redd surveys on the Entiat River, 2015.

Table 1: Steelhead spawning ground reaches on the Entiat River in 2015.

Reach	Start (Landmark)	End	Length (km)
D	rkm 45.0 (Fox Cr. Campground)	rkm 37.7	7.3
C	rkm 37.7 (Brief Bridge)	rkm 25.9	11.8
B	rkm 25.9 (McKenzie Diversion)	rkm 10.6	15.3
A	rkm 10.6 (Entiat NFH)	rkm 1.1	9.5

Three separate methods were used to describe water clarity. First, we continued to use a Secchi disk method of calculating lateral water visibility that we first used in 2011. This technique uses a weighted Secchi disk attached to a cord 1.5m in length and a fifty meter measuring tape. The downstream surveyor rests the Secchi disk on the river bed at a depth of 0.5m with the face oriented parallel to the water surface. A second observer wades upstream unreeling the measuring tape until the disk's color patterns are no longer discernible. The distance is then recorded (Figure 2). The second method categorizes water clarity by visual estimation. Water clarity is recorded as 1-3 with 1 being very clear and 3 being too turbid to see through by the observers. A category 3 determination precludes the survey for the day. Finally, water samples were taken to measure stream turbidity by light scatter due to suspended particles. In the office samples were transferred into clear glass vials, placed in a Hach 2100P Portable Turbid meter, and measurements in nephelometric turbidity units (NTUs) were recorded. All three water visibility measurements were recorded at the start and end of each survey. Weather conditions were recorded at the beginning of each survey. Changes in weather conditions taking place throughout the duration of the survey were recorded. Water temperatures were recorded at the beginning and end of each survey reach. Temperatures were taken with calibrated thermometers accurate to +/- 0.07°C. Redds were measured and marked using flagging tape marked with the date observed, location in the stream, and its corresponding redd number. A GPS coordinate was then taken using a Garmin GPSmap 78s device.

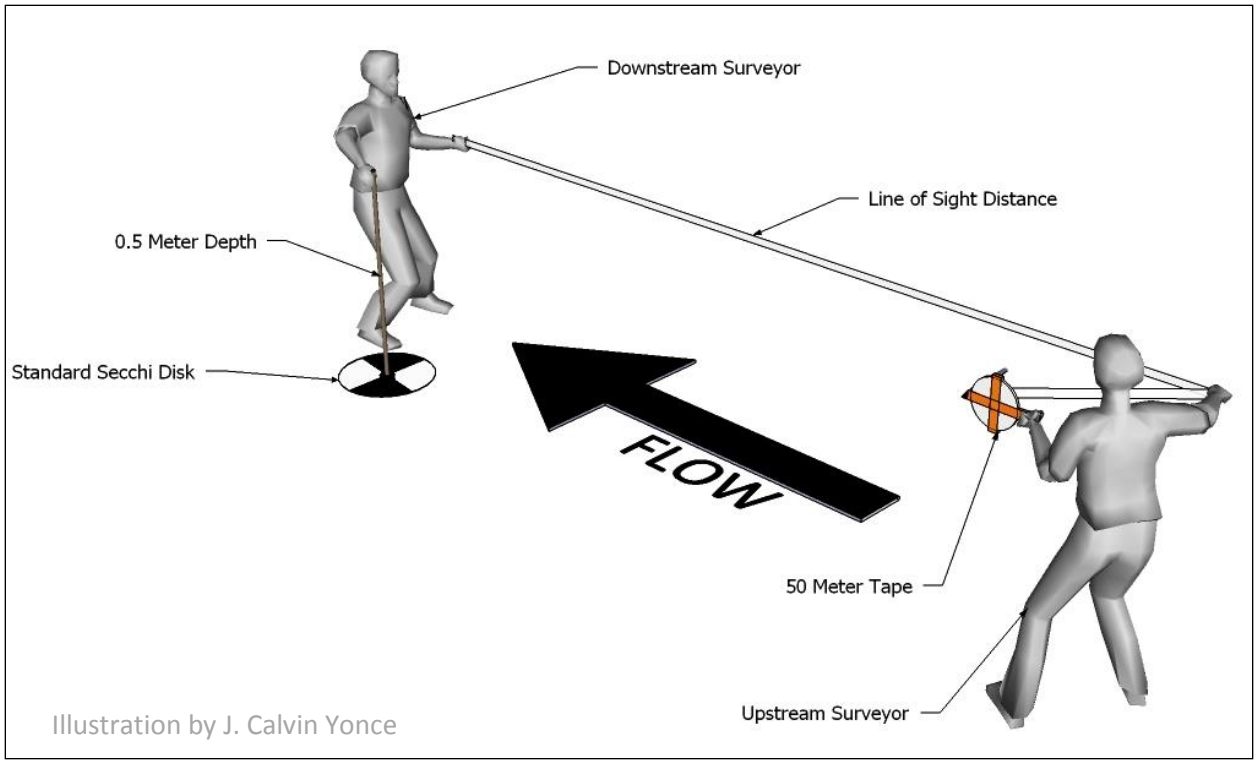

Figure 2: Lateral Secchi disk visibility measurement.

Results

During the survey season water temperatures ranged from 1.5°C to 11.5° C. Turbidity averaged 2.63 NTU, lateral Secchi disk visibility readings averaged 7.09 meters, water clarity averaged 1.33 (Table 2). Average turbidity was greatest in Reach B, and turbidity was generally lower farther upstream. Lateral Secchi disk readings averaged higher in reach C and lower in reach D (Table 2).

Table 2: Ranges and means of temperature, Secchi disk lateral visibility, turbidity, and water clarity of the Entiat River during steelhead redd surveys, 2015.

	Ranges (mean)			
Reach	**Temp °C**	**Secchi Disk (m)**	**Turbidity (NTU)**	**Water Clarity**
A	1.50 – 11.50 (6.6)	2.30 – 9.30 (7.2)	0.74 – 6.83 (2.55)	1 – 2.5 (1.2)
B	2.50 – 10.75 (6.4)	4.80 – 9.20 (7.1)	1.40 – 5.32 (2.92)	1 – 2.5 (1.3)
C	1.85 – 8.75 (6.5)	5.40 – 9.25 (7.8)	1.05 – 5.31 (2.66)	1 – 2.5 (1.2)
D	4.00 – 9.25 (6.7)	3.80 – 8.20 (6.3)	0.90 – 4.05 (2.41)	1 – 2.5 (1.5)
All Reaches	1.50 – 11.50 (6.5)	2.30 – 9.30 (7.1)	0.74 – 6.83 (2.60)	1 – 2.5 (1.3)

A total of 163 redds were counted during 2015 (Table 3). The first redd was observed on February 23 in Reach A when mean water temperature was 1.5°C. Sixty-six percent (108/163) of observed steelhead redds were constructed in April, with a peak of forty-one new redds the week beginning Monday, April 6. The mean temperature during this peak spawning week was 6.0°C. Reach C had the greatest number of redds in any reach with 73 (45% of all observed redds) (Table 4). Redds were generally distributed throughout the river with higher concentrations of redds in areas with large areas of suitable gravel (Figures 3-6). Similar to previous years, the majority of new redds (80% in 2015) were observed during April and May (Figure 7).

Table 3: The numbers of new steelhead redds counted each week and cumulative totals in the survey reaches on the Entiat River, 2015.

Number of steelhead redds

Monday Date	A		B		C		D		All Reaches	
	New	Total	New	Total	New	Total	New	Total	New	Total
02/23/15	1	1	0	0	0	0	-	-	1	1
03/02/15	5	6	1	1	0	0	-	-	6	7
03/09/15	1	7	2	3	2	2	1	1	6	13
03/16/15	0	7	-	-	1	3	-	-	1	14
03/23/15	5	12	1	4	1	4	1	2	8	22
03/30/15	2	14	0	4	1	5	1	3	4	26
04/06/15	6	20	16	20	19	24	-	-	41	67
04/13/15	2	22	6	26	22	46	8	11	38	105
04/20/15	0	22	1	27	9	55	7	18	17	122
04/27/15	0	22	2	29	5	60	5	23	12	134
05/04/15	0	22	4	33	6	66	4	27	14	148
05/11/15	-	-	1	34	6	72	1	28	8	156
05/18/15	-	-	-	-	-	-	-	-	-	-
05/25/15	-	-	-	-	1	73	0	28	1	157
06/01/15	1	23	0	34	5	78	0	28	6	163
06/08/15	-	-	0	34	0	78	0	28	0	163
06/15/15	0	23	-	-	-	-	-	-	0	163

Note: Cells containing "-" indicate a survey was not conducted in that reach during the survey week.

Table 4: The total number of steelhead redds by reach on the Entiat River from 2006 to 2015.

	Reach				
Year	**A**	**B**	**C**	**D**	**Total**
2006	38	26	34	13	111
2007	40	7	14	3	64
2008	93	84	31	14	222
2009	128	37	27	8	200
2010	87	33	52	17	189
2011	55	73	51	26	205
2012	29	20	28	0	77
2013	34	59	37	11	141
2014	27	56	30	13	126
2015	23	34	78	28	163

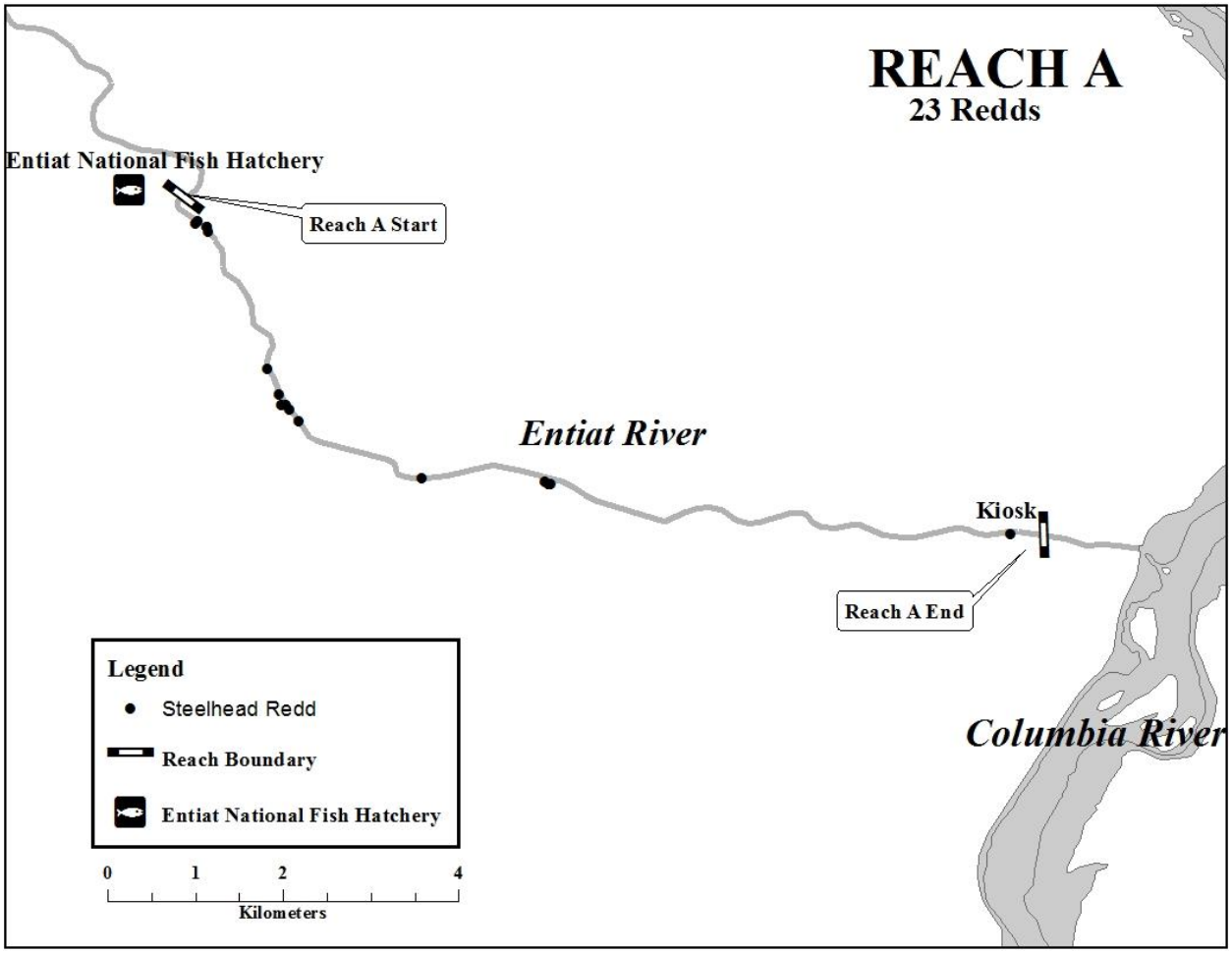

Figure 3: Location of steelhead redds in reach A, 2015.

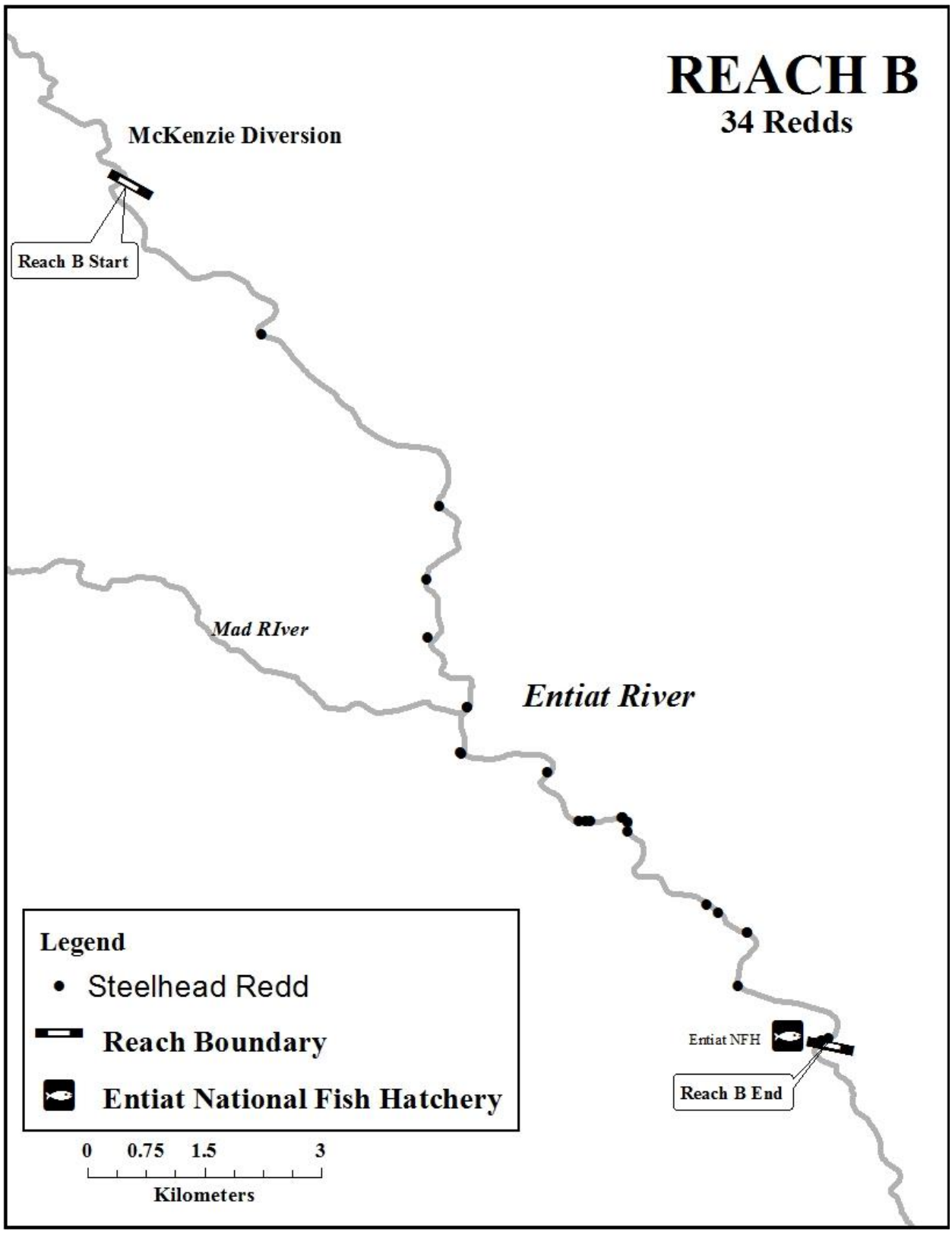

Figure 4: Location of steelhead redds in reach B, 2015.

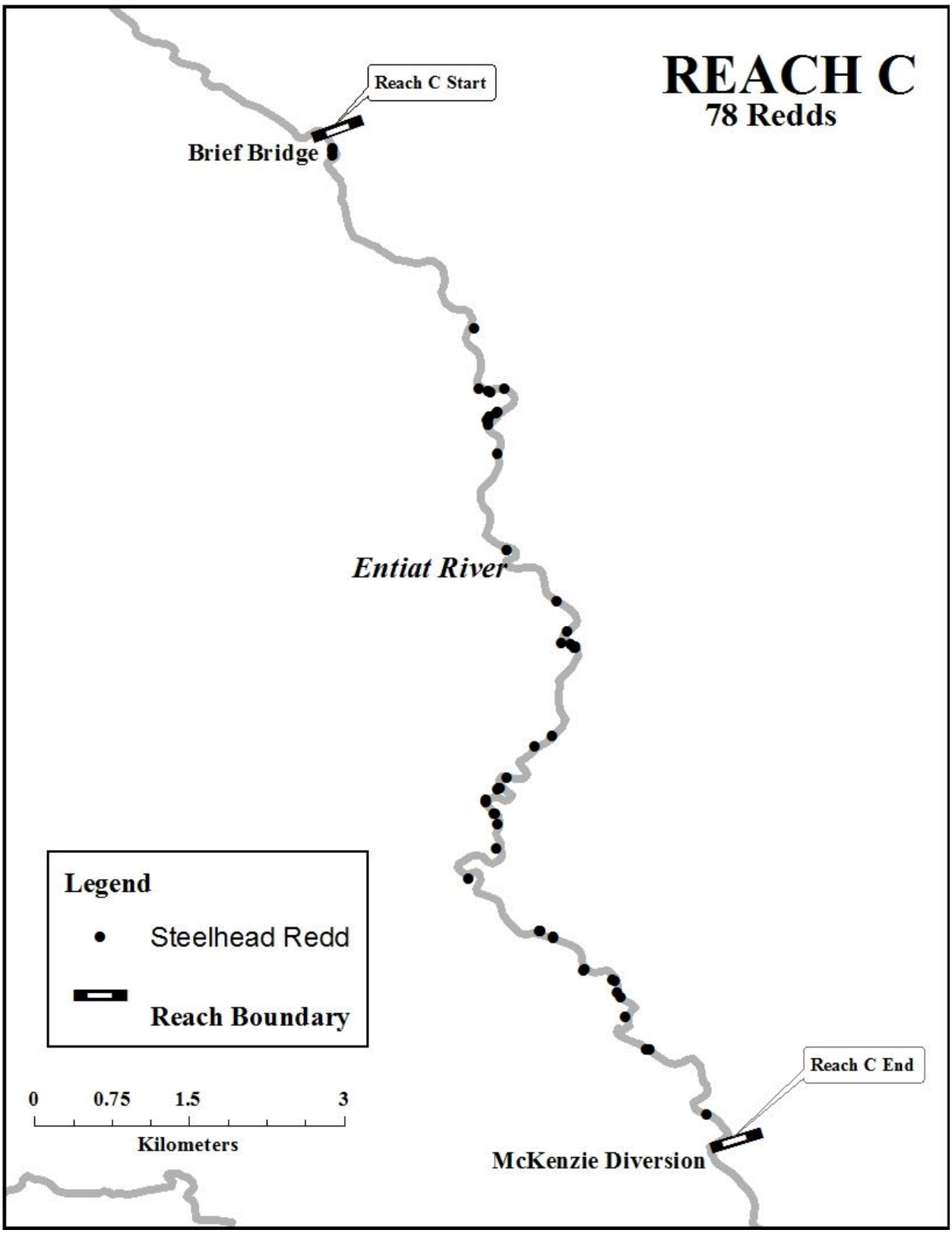

Figure 5: Location of steelhead redds in reach C, 2015.

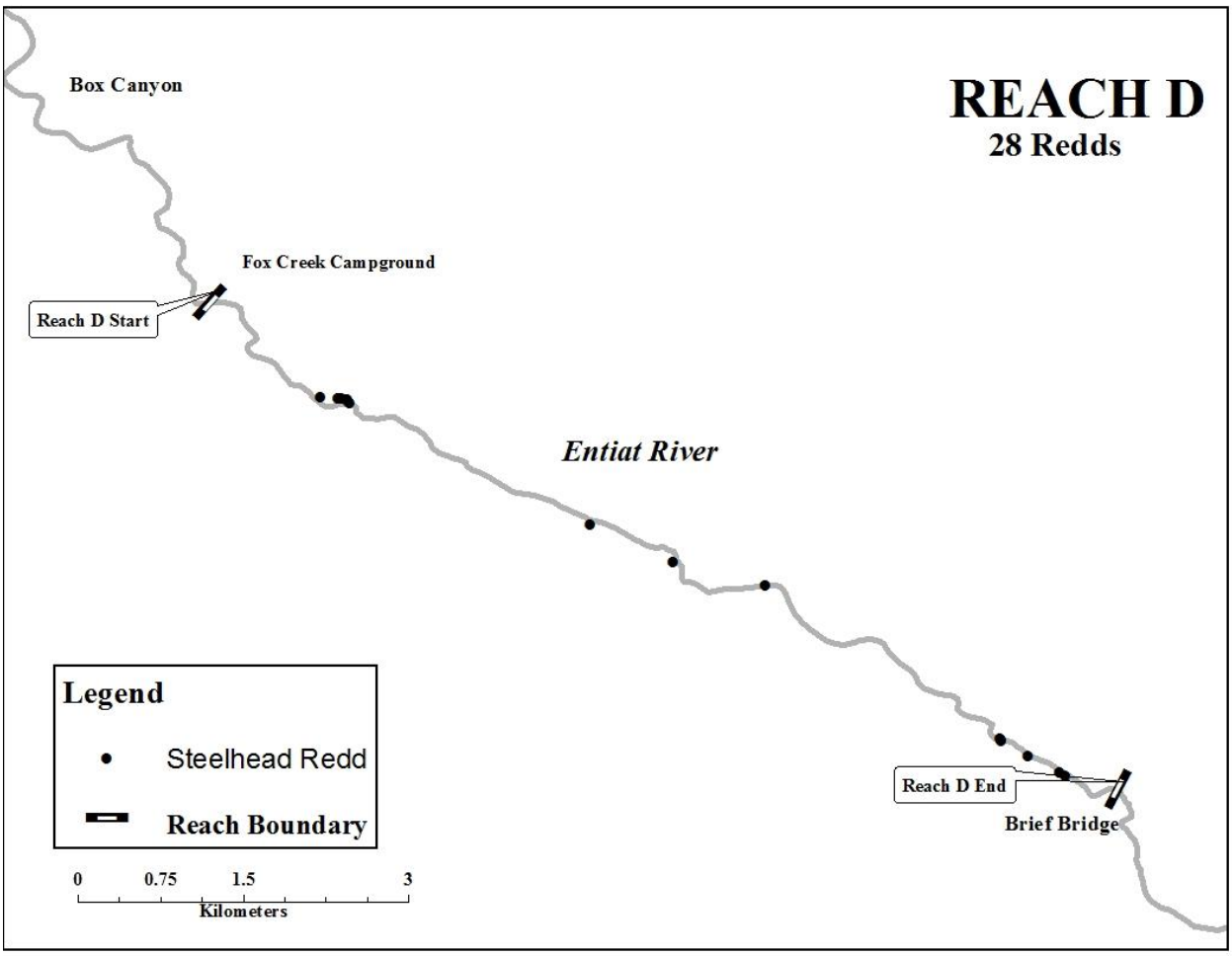

Figure 6: Location of steelhead redds in reach D, 2015.

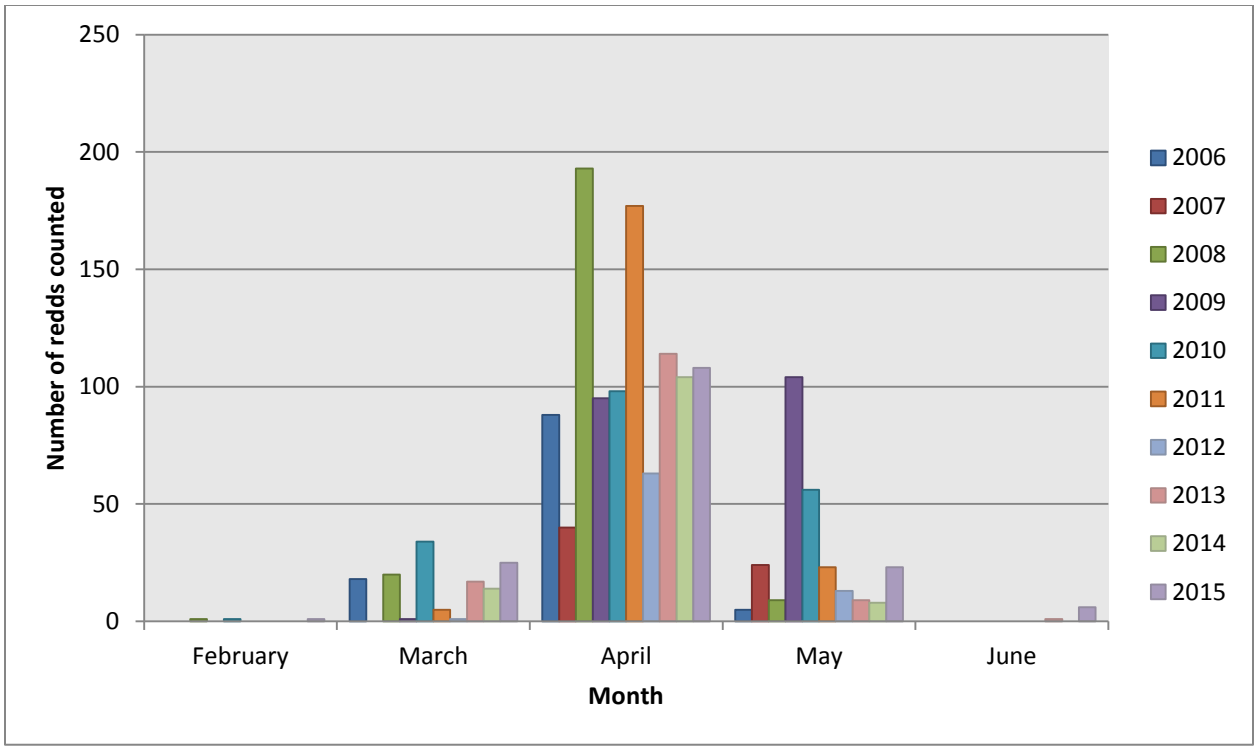

Figure 7: The numbers of steelhead redds observed by month in the Entiat River from 2006 to 2015.

Discussion

Steelhead spawning ground surveys on the Entiat River were conducted within the required time frame. Surveys were initiated in mid-February; however, we were unable to achieve a zero count in reaches A and D. We were unable to determine the onset of the spawning season with the first redd being seen in reach A on February 23rd this year during our first survey. The greatest number of new redds were seen in the week beginning Monday, April 6th (Table 3). River flows increased during the week of May 18th and conditions included greater turbidity and water depth making it more difficult for observers to see redds. Increased flow also causes evidence of redds to be erased more quickly. These factors likely decreased the total numbers of redds observed at that time (Table 3). The peak of spawning activity was well defined between the weeks of April 6th and April 13th. Despite a week of no surveying due to high discharge (week of May 18th), we were still able to establish an estimated end of spawning, the week of June 8th. Redds were detected later than most years, possibly due to a low discharge year with water conditions returning to levels clear enough to conduct surveys the first two week of June.

Literature Cited

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