

Rainbow Trout and Brown Trout Spawning Redd Survey and Fecundity
Analysis for the Missouri River –Holter Dam Tailwater Fishery

PPL-Montana MOTAC projects 003-08, 753-09, 757-10

Submitted to

PPL-Montana
336 Rainbow Dam
Great Falls, Mt. 59404

Prepared by

Grant Grisak
Montana Fish, Wildlife & Parks
4600 Giant Springs Road
Great Falls, Mt. 49505



January 2012

From 2007-2011 MFWP conducted comprehensive spawning studies of rainbow trout and brown trout in the Missouri River below Holter Dam. One segment of these studies involved investigating the abundance and distribution of spawning redds in the study area. These studies were funded by PPL-Montana MOTAC projects 003-08, 753-09, 757-10 as part of FERC license 2188.

The study area is located in central Montana and consists of a 26 mile reach of the Missouri River spanning from Holter Dam downstream to the Pelican Point Fishing Access Site (Figure 1). The principle tributaries are Little Prickly Pear Creek, Lyons Creek, Wolf Creek, Dearborn River, and Sheep Creek.

Methods

We counted spawning redds in the tributaries and the mainstem Missouri River to estimate the total amount of trout produced each year and to estimate the proportion of spawning in the mainstem Missouri River relative to the tributaries. Redd counts were conducted weekly by walking in index sections of the tributary streams starting on March 15 for rainbow trout and October 15 for brown trout. When few or no new redds were found in the index sections, we assumed that the peak of the spawn had occurred, then conducted an expanded basin-wide count within one week of the peak of the spawn. Redd counts on the Missouri and Dearborn rivers were conducted using a Bell OH-58 helicopter flying 250 meters above the water surface with the doors removed and two observers in the back seat wearing polarizing eyeglasses. At this flight altitude redds were clearly visible and marked with a GPS unit. Two-way communication reduced the likelihood of double counting redds in the center of the rivers, and allowed for instructing the pilot to hover or circle high use areas for recounts to increase accuracy.

We conducted flights in May and November 2007 to evaluate the spatial distribution of trout spawning areas in the Missouri River, and used the same protocol in 2008, 2009 and 2010 to count redds in the rivers. We used GPS to identify the sites for mapping purposes. We counted redds in the rivers within one week of the tributary surveys.

We used fixed boom boat electrofishing (smooth DC, 300 V, 4 A) to collect rainbow trout and brown trout from the Mountain Palace section for fecundity analyses. Fish were euthanized with a lethal dose of clove oil while in the field. Ovaries were removed in the laboratory within 12 hours, placed in a plastic bag, inventoried and frozen until counting.

Rainbow trout

In April 2007 we identified 21 sites in the Missouri River where rainbow trout redds were observed (Figure 2). The average distance between sites was 1.18 miles (range 0.24-2.80). Discharge of the Missouri River below Holter Dam was ~3,700 cfs on the day of the flight. In 2008 and 2009 high river flows (>5,000 cfs) and/or poor weather in late April and early May caused unfavorable conditions for counting rainbow trout redds in the Missouri River. In the spring of 2010 the water flow conditions (4,300 cfs) in the Missouri River were ideal for conducting aerial redd counts and we counted 1,644 redds

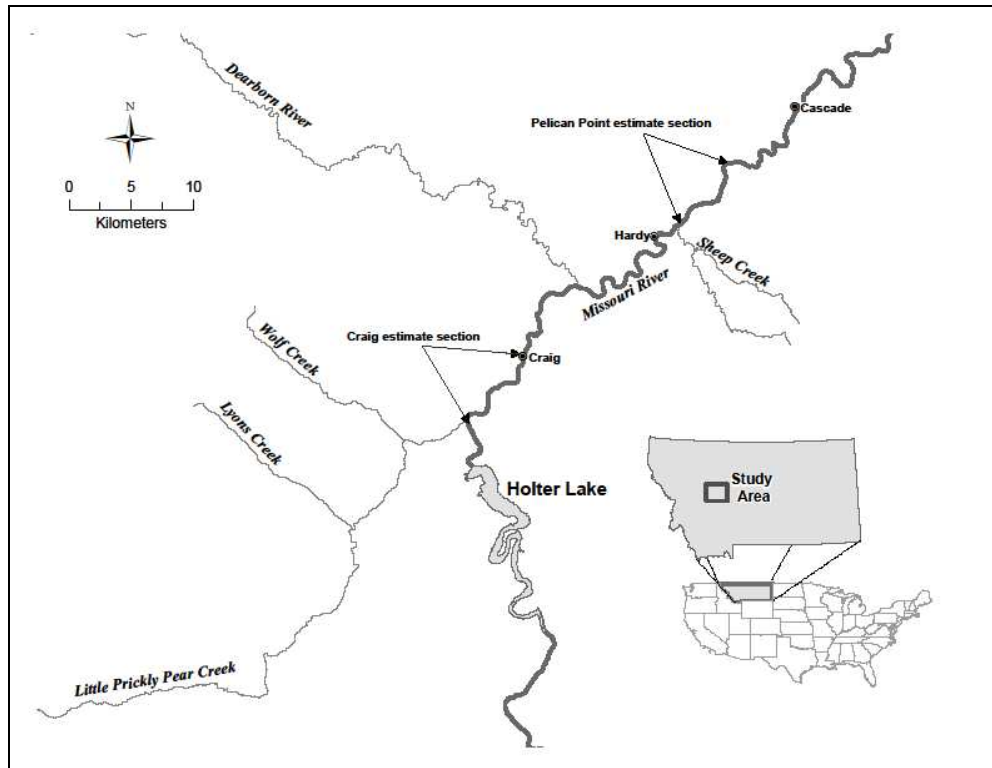


Figure 1. Missouri River – Holter Dam tailwater area.

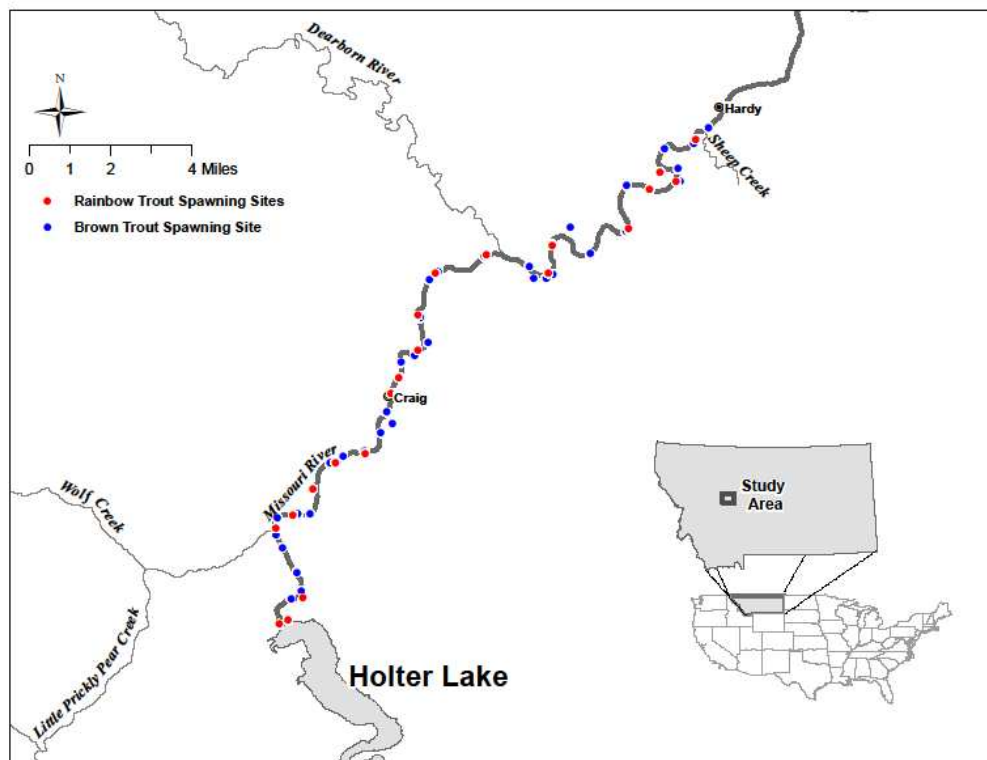


Figure 2. Spawning sites for rainbow trout and brown trout in the Missouri River below Holter Dam, 2007.

which represented 38% of the total redds we counted in 2010 (Table 1). We observed deep water rainbow trout redds at six locations, three of which were located close to where we observed deep water brown trout redds. The greatest number of deep water rainbow trout redds was 47 which occurred at RM 2.2, followed by 24 redds at RM 3.1, 11 redds at RM 8.9, 2 redds at RM 10.6, 2 redds at RM 11.5 and 6 redds at RM 14.2. Rainbow trout spawning redds were observed over a minimum of 76 miles of stream annually.

The annual mean number of rainbow trout redds we counted for the entire system was 4,071 (SE 378). Because we were unable to count redds on some streams during some years, we averaged the number of redds by stream over the 4 year period and estimated there were 6,185 rainbow trout redds for the entire system (Table 1). Little Prickly Pear Creek had 44-47% of the total annual redds we counted and the highest number of redds we counted (2,125) during one year. Wolf Creek had the highest density of redds for any one sampling period (186/mi) and the highest average density of redds (146/mi). The Dearborn River had the lowest average density of redds (33/mi) (Table 2).

The mean number of eggs for all rainbow trout was 1,627 (range 974-2,392). Rainbow trout egg numbers by 1 inch length group are listed in Table 3. Fish length or weight were not determining factors in the number of eggs per fish (linear regression, length $R^2=0.04$, $P=0.27$, weight $R^2=0.12$, $P=0.07$). The data showed that the longest fish had the most number of eggs, but there was not a predictable trend of diminishing egg numbers by 1 inch length group.

The average number of rainbow trout eggs spawned each year was 6.6 (range 3.2 to 10.8) million based on average annual redds counted and mean number of eggs per female.

Brown trout

In November 2007 we identified 37 different sites in the Missouri River where brown trout redds were observed (Figure 2). The average distance between brown trout spawning sites was 0.66 mile (range 0.17 to 1.45). Discharge of the Missouri River during this flight was ~3,200 cfs. The results of these flights determined that brown trout spawning sites in the Missouri River were distributed throughout the entire 26 mile reach. In November of 2008 flows (4,200 cfs) were suitable for aerial survey and we counted 644 brown trout redds in the Missouri River. We observed what we called “deep water” (> 6 feet deep) brown trout redds at RM 3.3, RM 8.8 and RM 9.0. In 2009, with similar flows (4,000 cfs) we counted 1,202 brown trout redds in the Missouri River (Table 4). In 2010 we counted 784 brown trout redds in the Missouri River.

The annual mean number of brown trout redds we counted over the entire system was 2,138 (SE 254). Because we were unable to count brown trout redds on some streams during some years, we averaged the number of redds by stream over the 4 year period and estimated there were 2,591 brown trout redds for the entire system (Table 4). Similar to rainbow trout, Little Prickly Pear Creek had the highest mean number of brown trout redds (930) and 36-66% of the total redds counted each year were in Little Prickly Pear

Creek. Wolf Creek had the highest average density of redds at 102/mile and the Dearborn River had the lowest average number of redds at 8/mile (Table 5). Brown trout spawning occurred over a minimum of 65.6 miles of stream annually. The Little Prickly Pear drainage had 36% of the mean annual brown trout redds.

The mean number of eggs for all brown trout was 2,145 (range 1,356-2,936). Brown trout egg numbers by 1 inch length group are listed in Table 6. The number of eggs per fish was correlated to length and weight (linear regression, length $R^2=0.49$, $P=0.001$, weight $R^2=0.53$, $P=0.0005$). The mean number of eggs per length group increased from smallest to largest except for the 20 inch length group, which had slightly fewer eggs than the 19 inch length group.

The average number of brown trout eggs spawned each year was 4.3 (range 3.5 to 5.6) million based on average annual redds counted and mean number of eggs per female.

Discussion

A number of previous spawning evaluations in the study area provided a baseline by which to compare our results. Past studies reported high (5,797) numbers of rainbow trout redds in the lower 42 miles of the Dearborn River (Leathe et al. 1988). The lower 20 mile section of that survey had 2,652 redds and corresponds roughly to the 19 mile-long section we evaluated in 2010 in which we counted 632 redds. In previous redd surveys by helicopter in the 34 mile reach of the Missouri River from Holter Dam to the town of Cascade fishery workers estimated 600 rainbow trout redds, and characterized this number as a probable “overestimate” (Leathe et al. 1988). In 2010 we counted 1,644 rainbow trout redds in the 26 mile reach between Holter Dam and Pelican Point FAS. A comprehensive evaluation of rainbow trout spawning in the Little Prickly Pear Creek drainage in 1998 (Grisak 1999) found 7,311 rainbow trout redds in 27.8 miles of stream. In our study, there was high variability in rainbow trout redds from year to year. The highest number in the Little Prickly Pear Creek drainage (27 miles) was 4,261 which occurred in 2007. Nevertheless, the 2007 count was 37% less than in 1998. In 2010, the number of redds in Wolf Creek (1,451) was considered high, but it was still 27% less than in 1998 (1,981). Comparing our results with past studies (Leathe et al. 1988, Grisak 1999) suggests rainbow trout in the Missouri River-Holter Dam tailwater system have had some change in spawning habits to favor more use of the Missouri River mainstem.

We consistently measured low numbers ($\bar{x}=153$) of brown trout redds in the lower 19 miles of the Dearborn River during aerial surveys. We made a few observations during these surveys. In November the Dearborn River is at base flow (~90cfs). It is a wide shallow river that offers little cover to large brown trout that are dependent on deep water (> 90 cm), instream structures or overhanging cover for concealment (Shuler et al. 1994, Dieterman et al. 2006). Brown trout spawning coincides with mountain whitefish (*Prosopium williamsoni*) spawning and each year we observed tens of thousands of mountain whitefish staging in the deep water zones of the Dearborn River. We believe the low use of the Dearborn River by spawning brown trout could be attributed to two factors. First, mountain whitefish could displace brown trout from the only available

cover in the Dearborn River (deep water), and could explain why more brown trout do not use it for spawning. Second, it is possible that the Dearborn River is lacking in groundwater inputs which limits brown trout spawning. Although this habitat feature is important for other fall spawning salmonids, there is evidence that it is not as important to brown trout (Hansen 1975, Witzel and MacCrimmon 1983, Essington et al. 1998). During our aerial surveys of the Dearborn River, we observed whitefish spawning at the upper end of the deep pools. Typically brown trout spawned at the lower end of deep pools, presumably to place eggs in areas where upwelling water would deliver oxygen to the eggs and remove nitrogen and carbon dioxide. Regardless of the reason, the Dearborn River has limited use for spawning brown trout.

Mainstem spawning sites for both rainbow and brown trout were not associated with any particular habitat feature such as side channels or edge of river (Henderson et al. 2000, Downing et al. 2001). We observed both species spawning on shallow riffles in mid channel, in side channels, along river banks and in deep water zones.

References

- Dieterman, D.J., W.C. Thorn, C. S. Anderson, and J. L. Weiss. 2006. Summer habitat associations of large brown trout in southeast Minnesota streams. Minnesota Department of Natural Resources Investigational Report 539.
- Essington, T.E., P.W. Sorensen, and D.G. Paron. 1998. High rate of redd superimposition by brook trout (*Salvelinus fontinalis*) and brown trout (*Salmo trutta*) in a Minnesota stream cannot be explained by habitat availability alone. Canadian Journal of Fisheries and Aquatic Science. Vol. 55, 2310-2316.
- Grisak, G. G. 1999. Missouri River rainbow trout spawning study, Missouri River young of the year trout investigations II and Montana statewide whirling disease investigations. Progress report. Montana Fish, Wildlife & Parks, Bozeman.
- Hansen, E.A. 1975. Some effects of groundwater on brown trout redds. Transactions of the American Fisheries Society. 1; 100-110.
- Leathe, S.A., W.J. Hill and A. Wipperman. 1988. North central Montana trout stream investigations. Job Progress Report, Federal Aid to Fish and Wildlife Restoration Act, Montana Project No. F-46-R-1, Job 1-g.
- Shuler, S., R.B. Nehring and K.D. Fausch. 1994. Diel habitat selection by brown trout in the Rio Grande River, Colorado, after placement of boulder structures. North American Journal of Fisheries Management 14:99-111.
- Witzel, L.D. and H.R. MacCrimmon. 1983. Redd-site selection by brook trout and brown trout in southwestern Ontario streams. Transactions of the American Fisheries Society. 112:760-771.

Table 1. Rainbow trout redds counted during the basin wide surveys in Missouri River and tributaries, 2007-10.

stream	Dist (mi)	2007	2008	2009	2010	Mean	Rel %
Missouri River	26.0	---	a	a	1644	1644	27
Dearborn River	19.0	---	a	a	632	632	10
Little Prickly Pear Creek	12.2	2125	1461	a	a	1793	29
Lyons Creek	7.0	847	897	a	386	710	12
Wolf Creek	7.8	1289	678	a	1451	1139	18
Sheep Creek	2.0	282	286	a	234	267	4
total		4543	3322		4347	6185	100

a- high turbid flows precluded counting redds

Table 2. Rainbow trout redd density (redds/mile) in Missouri River and tributaries 2007-10.

stream	Dist (mi)	07 Redds/mi	08 Redds/mi	09 redds/mi	10 redds/mi	Mean/mi
Missouri River	26.0	---	a	a	63	63
Dearborn River	19.0	---	a	a	33	33
Little Prickly Pear Creek	12.2	163	117	a	a	140
Lyons Creek	7.0	121	138	a	55	105
Wolf Creek	7.8	165	87	a	186	146
Sheep Creek	2.0	141	143	a	117	134

a- high turbid flows precluded counting redds

Table 3. Fecundity of rainbow trout by length group for the Missouri River, 2010.

length group	Mean eggs	eggs per fish										
15	1724	2168	1279									
16	1724	1711	1531	1929								
17	1421	1520	1227	1863	974	1198	1391	1581	1406	1475	1470	1529
18	1682	2464	1583	1490	1417	1588	1555	1726	1562	2151	1282	
19	2246	2100	2392									

Table 4. Brown trout redds counted during the basin wide surveys in Missouri River and tributaries, 2007-10.

stream	Dist (mi)	2007	2008	2009	2010	Mean	Rel%
Missouri	26.0	---	644	1202	784	877	34
Dearborn	19.0	---	137	169	---	153	6
Little Prickly Pear Creek	12.2	1111	973	990	647	930	36
Lyons Creek	3.0	81	249	b	42 c	124	5
Wolf Creek	3.4	390	269	362	---	340	13
Sheep Creek	2.0	114	129	b	258	167	6
total		1696	2401	2723	1731	2591	100

b- ice precluded counting redds

c- only 0.42 mile of stream was surveyed due to ice

Table 5. Brown trout redd density (redds/mile) in Missouri River and tributaries 2007-10.

stream	Dist (mi)	07 Redds/mi	08 Redds/mi	09 Redds/mi	10 Redds/mi	Mean/mi
Missouri River	26.0	---	24	46	30	33
Dearborn River	19.0	---	7	9	---	8
Little Prickly Pear Creek	12.2	91	79	81	53	76
Lyons Creek	3.0	27	83	---	100	70
Wolf Creek	3.4	115	84	106	---	102
Sheep Creek	2.0	57	61	---	129	82

Table 6. Fecundity of brown trout from Missouri River, 2010.

length group	Mean eggs	eggs per fish				
15	1431	1431				
16	1562	1452	1671			
17	---	---				
18	2002	1737	2018	2251		
19	2461	2052	2083	2343	2891	2936
20	2427	2104	2252	2392	2533	2852