

Rainbow Trout and Brown Trout Movements Between
the Missouri River, Sun River and Smith River, Montana

PPL-Montana MOTAC projects 021-08, 771-09, 771-10, 771-11

Submitted to

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

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Introduction

From 2008-2011 Montana Fish, Wildlife & Parks (MFWP) conducted studies to evaluate rainbow trout and brown trout behavior in the Missouri River near Great Falls and the level of interaction these fish have between the Missouri, Sun and Smith rivers. These studies were funded by PPL-Montana MOTAC projects 021-08, 771-09, 771-10, 771-11 as part of FERC license 2188.

Segments of all three rivers are considered good habitat for trout. The Missouri River segment includes the upper 30 miles of river from Holter Dam to Cascade. In the Sun River, the upper 39.2 miles from Diversion Dam downstream to the Crown Butte Canal headgate is considered good trout habitat. In the Smith River, the upper 98.9 miles from the North and South forks confluence downstream to Eden Bridge is considered good trout habitat. Although trout are present in the lower reaches of these rivers, those areas would not be considered good trout habitat due to low gradient channel, high turbidity, high water temperatures and predominantly sand and silt substrate. The purpose of this study was to 1) determine the importance of these segments of rivers to the overall trout populations, 2) determine the interconnectivity of these three rivers, and 3) generalize the behavior of trout found in these sections of river.

Study Area

The study area is located in central Montana and consists of an 89 mile reach of the Missouri River spanning from Holter Dam downstream to the Black Eagle Dam, a 20 mile reach of the lower Sun River and all 121 miles of the Smith River (Figure 1).

Methods

To evaluate trout movements and behavior we surgically implanted radio transmitters in trout from the lower portions of the Missouri, Sun and Smith rivers using the procedure described by Cooke and Bunt (2001). Radios were Lotek model SR-11-18 (in air weight 9.7g), SR-11-25 (in air weight 9.9g) and SR-11-35 (in air weight 11.5g). Radio-tagged fish were detected using a 4 element Yagi antenna with a mobile radio-telemetry receiver (Lotek SRX 400 W5) and a truck, jet boat, or airplane. Stationary radio receivers (Lotek SRX 400 W7AS) were positioned on the Missouri River at the mouths of the Sun River, Smith River, Sheep Creek, Dearborn River, Little Prickly Pear Creek, and the Craig Bridge and on the Smith River at Eden Bridge and the mouth of Sheep Creek. Stationary radio receivers positioned at creek mouths provided precise dates and times when fish passed by these locations. We used a river mile reference system that assumes Holter Dam is river mile 0.0 and measurements continue downstream to Black Eagle Dam (Table 1). In the Smith and Sun rivers, the river mile reference started at the mouth and continued upstream (Table 2). All fish locations were recorded to the nearest 0.1 mile.

Given the large spatial scale of our study area and the difficulty associated with determining exact spawning sites, we estimated spawning locations and times by documenting a fish's furthest movement during the spawning season and assuming it spawned in the area at that time (Grisak 1999, Burrell et al. 2000, Hendersen et al. 2000, Pierce et al. 2009). For fish that had extended stays in one area, we used the median date of its residency to estimate spawning date.

The mean distances that fish traveled between the three river sections were compared using single factor analysis of variance (ANOVA). Student's t tests were used to determine if the mean distance traveled by males and females was significantly different. The level of significance for all statistical tests was 0.05.

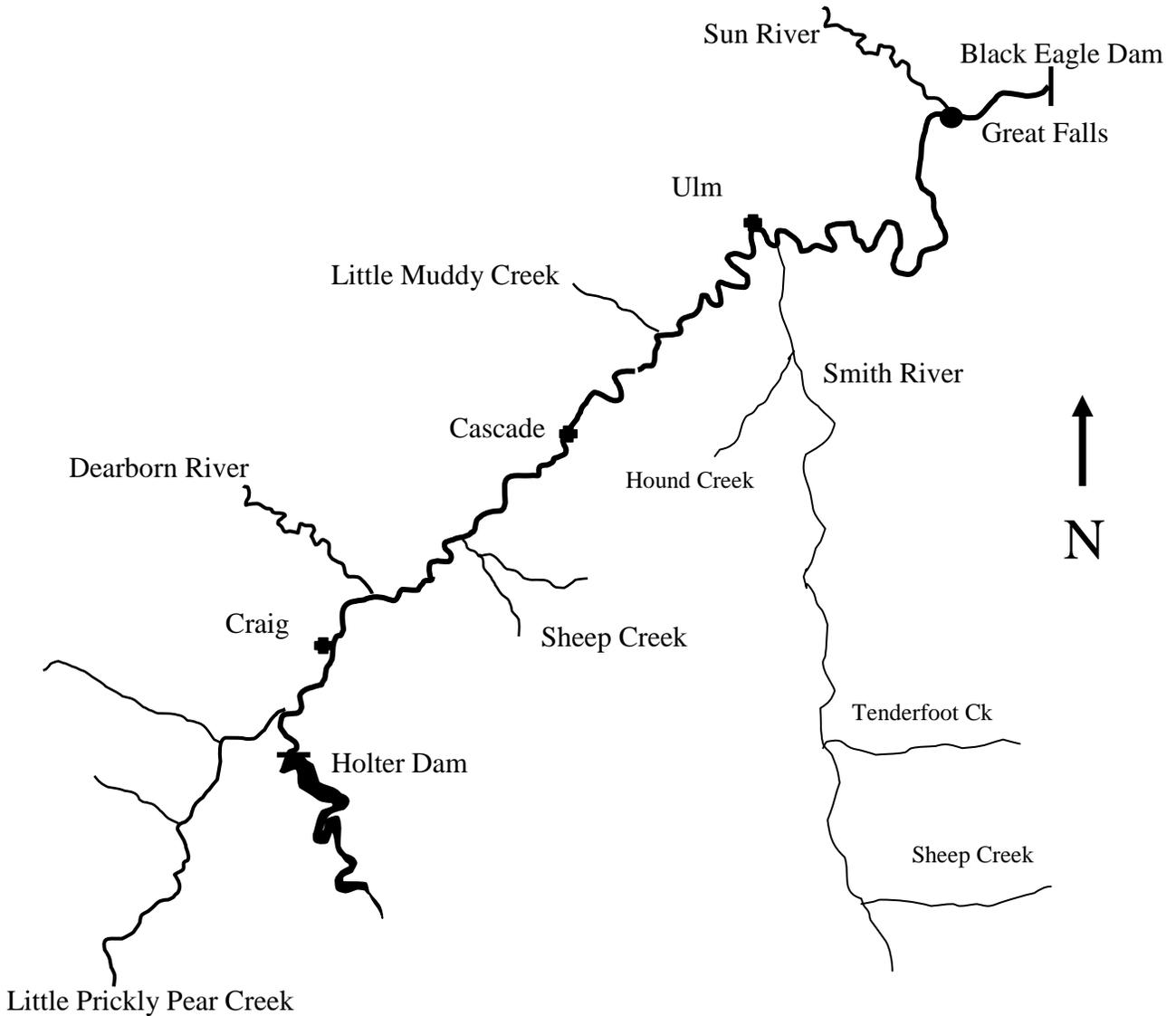


Figure 1. Map of the study area showing the Missouri River, Sun River, Smith River and associated tributaries, Montana.

Table 1. Landmarks and associated river miles in the Missouri River between Holter Dam and Black Eagle Dam.

Landmark	River mile	Landmark	River mile
Holter Dam	0.0	End of Pelican Point electrofishing sxn	28.3
BLM Campground	0.3	Tintinger Slough	29.5
Wolf Creek Bridge	2.4	Mouth of Antelope Creek	30.6
Mouth of Little Prickly Pear Creek	2.7	Cascade Bridge	34.4
Inlet of Billings Slough	5.0	City of Cascade FAS	35.4
Inlet of Sterling Slough	6.9	Wing Dam	36.5
Mouth of Sterling Slough	7.4	Mouth of Bird Creek	41.4
Craig Bridge	7.9	Mouth of Little Muddy Creek	43.3
Jackson Rock	9.3	Castner Coulee	51.0
I-15 Bridge	10.3	Dunes FAS	53.1
Mouth of Stickney Creek	11.2	Ulm Bridge	56.4
Stickney FAS	11.7	Mouth of Smith River	58.1
Mouth of Dearborn River	13.5	Zahara Golf Course point	61.7
Mid Canon FAS	15.0	USGS Gaging station 06078200	66.8
Mouth of Andy Creek	17.7	Woodland Estates point	69.2
Devils Kitchen FAS	18.3	Big Bend FAS	75.0
Hardy Bridge	22.0	KMON Radio Towers	79.3
Prewett Creek FAS	22.3	Sand Coulee Creek	81.2
Chestnut Valley irrigation intake	22.4	White Bear Island	82.0
Mouth of Sheep Creek	22.7	Mouth of Sun River	84.7
Mouth Hardy Creek	24.2	Central West Bridge	85.7
Pelican Point FAS	26.2	Black Eagle Dam	88.5

Table 2. Landmarks and associated river miles in the Smith River.

Landmark	River mile	Landmark	River mile
Smith River mouth	0.0	Two Creek	62.4
First bridge on Eden route	3.6	Tenderfoot Creek	65.7
Truly Bridge FAS	9.4	Rock Creek	72.4
Mortag FAS	19.2	Spring Creek	77.4
Eden Bridge	22.4	Eagle Creek	80.0
Hound Creek	24.1	Sheep Creek	81.2
Deep Creek	42.4	Camas Creek	92.3
Trout Creek	49.7	Canyon Ranch	109.0
Bear Gulch	52.1	Newlan Creek	110.0
Cascade/Meagher county line	57.1	North and South forks confluence	121.2

We surgically implanted radio transmitter tags in 23 rainbow trout and 20 brown trout (Table 3). We radio tagged 18 female and 5 male rainbow trout. Mean length of females was 17.2 inches (range 13.3-19.5) and mean weight was 1.9 pounds (range 1.4-2.5). Mean length of males was 15.5 inches (range 15.0-16.2) and mean weight was 1.3 pounds (range 1.2-1.5). Mean body weight loading from radio transmitters implanted in rainbow trout was 1.4% (range 0.9-1.8).

We radio tagged 9 female and 11 male brown trout. Mean length of females was 19.3 inches long (range 15.5-23.5) and mean weight was 2.5 pounds (range 1.1-3.8). Mean length of males was 19.9 inches (range 11.2-22.4) and mean weight was 2.6 pounds (range 0.49-3.95). Mean body weight loading from radio transmitters implanted in brown trout was 1.2% (range 0.6-5.1).

Results – fish movements

The following is an account of movements and behaviors exhibited by radio tagged trout;

Rainbow trout 720-71 was captured by hoop net in the Smith River 1.0 mile upstream from the mouth on April 22, 2009 and was surgically implanted with a radio transmitter. It measured 18.1 inches long and weighed 1.7 pounds and was positively identified as a female during the surgery. This fish stayed in the same general area near the mouth of the Smith River through May 28. It began a steady upstream migration in early June and ultimately resided in the large deep swirl pool at the Riverdale subdivision (RM 49.6) on July 1. Over the next 39 days it moved downstream and was detected by the remote receiver at the mouth of the Smith River on August 10. It was located 2.2 miles upstream of the Ulm Bride on September 18 where it spent most of the winter of 2009-10. The first location of this fish in 2010 was on April 20 at RM 51.2 near Castner Coulee. Twenty-five days later it was harvested by an angler 6.8 miles downstream near the mouth of the Smith River. Few judgments can be made about the movements of this fish.

Rainbow trout 720-70 was captured by hoop net in the Smith River 1.0 mile upstream from the mouth on April 22, 2009 and was surgically implanted with a radio transmitter. It measured 15.1 inches long and weighed 1.3 pounds and was positively identified as a male during the surgery. Within 7 days of being tagged, this fish moved to the Missouri River and was located 8 times over a 315 day period in a 4 mile reach of river, upstream and downstream, of the Smith River mouth. No judgments can be made about its behavior.

Rainbow trout 720-72 was captured by hoop net in the Smith River 1.0 mile upstream from the mouth on April 22, 2009 and was surgically implanted with a radio transmitter. It measured 15.0 inches long and weighed 1.19 pounds and was positively identified as a male during the surgery. This fish made short distance movements in the lower 1 mile reach of the Smith River over the next 589 days. No judgments can be made about its behavior.

Rainbow trout 720-73 was captured by hoop net in the Smith River 1.0 mile upstream from the mouth on April 22, 2009 and was surgically implanted with a radio transmitter. It measured 15.4 inches long and weighed 1.17 pounds and was positively identified as a male during the surgery. Over the next 13 days this fish was located 4 times in the lower 1 mile reach of the Smith River. It was never seen again after May 6, 2009. No judgments can be made about its behavior.

Table 3. Meristics and radio transmitter tag implant location for rainbow trout and brown trout from the Missouri, Sun and Smith rivers, Montana, 2008-2011.

Spp	Fish ID	Length	Weight	Sex	Tag date	Tag location	River mile	Radio life	Travel miles
RB	720-71	18.1	1.7	F	4/22/09	Smith River near mouth	1	388	24.1
RB	720-70	15.1	1.3	M	4/22/09	Smith River near mouth	1	315	9.5
RB	720-72	15.0	1.2	M	4/22/09	Smith River near mouth	1	589	2.1
RB	720-73	15.4	1.2	M	4/22/09	Smith River near mouth	1	14	1
RB	720-52	19.5	2.5	F	4/7/11	Smith River near Truly Bridge	9.4	167	135.2
RB	890-12	13.3	1.4	F	8/26/08	Smith River near Truly Bridge	9	289	24.8
RB	890-13	13.5	1.7	F	8/26/08	Smith River US of Eden Bridge	22.6	---	---
RB	720-8	16.7	1.8	F	3/23/11	Missouri R. at Smith Mouth	58.1	69	86.1
RB	720-9	18.6	2.3	F	3/23/11	Missouri R. at Smith Mouth	58.1	38	6.9
RB	720-85	17.8		F	3/24/09	Missouri R. Lord Ranch pt.	61.5	527	188.9
RB	720-83	17.2	1.8	F	3/28/10	Missouri R. Lord Ranch pt.	61.5	542	116.1
RB	890-20	17.2	1.4	F	3/25/08	Missouri R. Lord Ranch pt.	61.5	---	---
RB	720-32	18.6	2.2	F	3/26/10	Missouri R. Lord Ranch pt.	61.5	496	151.6
RB	720-55	16.8	1.9	F	3/25/11	Missouri R. Lord Ranch pt.	61.5	138	88.4
RB	720-56	17.5	2.0	F	3/25/11	Missouri R. Lord Ranch pt.	61.5	180	177.1
RB	720-57	15.9	1.6	F	3/25/11	Missouri R. Lord Ranch pt.	61.5	83	99.4
RB	720-82	16.2	1.5	M	3/26/09	Missouri R. at Zahara	63.9	463	101.8
RB	720-84	17.4		F	3/26/09	Missouri R. at Zahara	63.9	616	117.9
RB	890-18	16.8	1.5	F	3/27/08	Missouri R. at Zahara	63.9	443	50.3
RB	720-86	18.7	2.2	F	3/26/09	Missouri R. at Woodland	65.1	77	70.2
RB	720-30A	17.3	2.0	F	3/30/09	Sun River @ 6th St. Bridge	0.7	610	8.7
RB	720-31	16.0	1.2	M	3/30/09	Sun River @ 6th St. Bridge	0.7	610	3.4
RB	720-96	18.0	2.1	F	4/13/09	Sun River @ 6th St. Bridge	0.7	10	0.7
LL	720-71A	20.5	3.2	F	3/28/11	Smith River near Mouth	0.5	48	40.1
LL	720-74	15.8	1.1	F	4/22/09	Smith River near Mouth	1	589	29.7
LL	720-50	21.7	2.9	M	4/7/11	Smith River at 1st Bridge	3.6	131	3.4
LL	720-53	15.5	3.8	F	4/7/11	Smith River near Truly Bridge	9.4	131	39.3
LL	720-54	11.2	0.5	M	4/7/11	Smith River near Truly Bridge	9.4	131	1.7
LL	890-14	16.4	2.8	F	8/29/08	Smith River US of Eden Bridge	22.3	449	85.9
LL	720-113A	22.0	4.0	M	3/23/11	Missouri R. at Smith Mouth	58.1	---	---
LL	890-16	19.5	2.3	M	3/25/08	Missouri R. DS of Smith R.	60.3	443	153.8
LL	890-19	20.8	2.4	M	3/25/08	Missouri R. Lord Ranch pt.	61.5	443	127
LL	720-89	19.8	2.3	F	3/24/09	Missouri R. Lord Ranch pt.	61.5	465	76.7
LL	720-80	17.1	1.4	M	3/24/09	Missouri R. Lord Ranch pt.	61.5	751	39
LL	890-17	21.4	2.7	M	3/27/08	Missouri R. at Zahara	63.9	441	85.1
LL	720-87	22.4	3.4	M	3/26/09	Missouri R. at Zahara	63.9	525	130.4
LL	720-95	20.5	2.8	M	4/10/09	Sun River @ 6th St. Bridge	0.7	734	192.5
LL	720-91	22.2	3.1	F	4/2/09	Sun River @ 6th St. Bridge	0.7	748	63.8
LL	720-94	19.5	2.2	F	4/10/09	Sun River @ 6th St. Bridge	0.7	600	85.4
LL	720-97	20.3	1.1	F	4/13/09	Sun River @ 6th St. Bridge	0.7	567	11.7
LL	720-99	23.5		F	4/17/09	Sun River @ 6th St. Bridge	0.7	528	375
LL	720-98	21.6	3.2	M	4/17/09	Sun River @ 6th St. Bridge	0.7	2	10.4
LL	890-11	20.2	3.1	M	3/21/08	Sun River @ Beacon Club	0.9	593	205

Rainbow trout 720-52 was captured by mobile anode electrofishing in the Smith River at the Truly Bridge FAS (RM 9.4) on April 7, 2011 and was surgically implanted with a radio transmitter. It measured 19.5 inches long and weighed 2.49 pounds and was positively identified as a female during the surgery. Within 29 days, this fish was located 66.6 miles upstream in the Smith River residing in the FWP Eagle Creek electrofishing section near the Rocking C's Ranch. Over the next 13 days this fish moved downstream 10.4 miles, then upstream 2.4 miles. We believe it spawned in the Smith River near RM 76 on May 6. It progressively moved downstream traveling as rapidly as 5.3 miles per day until it reached the mouth of the Smith River on June 10. During a flight on September 21 we detected a mortality code from this transmitter in the Missouri River at RM 66.7 which suggests the fish was dead.

Rainbow trout 890-12 was captured by angling in the Smith River at the Truly Bridge FAS (RM 9.4) on August 26, 2008 and was surgically implanted with a radio transmitter. It measured 13.3 inches long and was positively identified as a female during the surgery. This fish stayed in the same general vicinity over the winter of 2008-09, and was located slightly (0.5 mile) upstream on May 1 and 12, 2009. On May 26 it was detected by the remote receiver at Eden Bridge. By June 11, it had returned to within 0.2 mile of its original location in May. Based on migratory movements during the 2009 spawning season, we believe this fish may have spawned in the Smith River at RM 22 near May 26. The fact that it returned to within 0.2 mile of its pre-spawn location suggests some site fidelity.

Rainbow trout 890-13 was captured by angling in the Smith River upstream of the Eden Bridge FAS (RM 22.6) on August 26, 2008 and was surgically implanted with a radio transmitter. It measured 13.5 inches long and was positively identified as a female during the surgery. Fourteen days later the radio was recovered from an osprey nest located near the Ulm Bridge FAS by linemen from Northwestern Energy. No judgments can be made about its behavior.

Rainbow trout 720-8 was captured by hoop net in the Missouri River at the mouth of the Smith River on March 23, 2011 and was surgically implanted with a radio transmitter. It measured 16.7 inches long and weighed 1.75 pounds and was positively identified as a female during the surgery. Over the next 50 days this fish moved upstream in the Smith River ultimately stopping at river mile 48.3 on May 13. By May 29, it moved 26 miles downstream and was detected by the remote receiver station located at Eden Bridge. Two days later it was located 11.8 miles downstream at the Truly Bridge FAS. Based on migratory movements during the 2011 spawning season, we believe this fish spawned in the Smith River at RM 48.3 near May 13. During its post spawn migration it traveled an average of 2.1 miles per day.

Rainbow trout 720-9 was captured by hoop net in the Missouri River at the mouth of the Smith River on March 23, 2011 and was surgically implanted with a radio transmitter. It measured 18.6 inches long and weighed 2.27 pounds and was positively identified as a female during the surgery. Twice this fish was located 6.9 miles downstream in the Missouri River over a 38 day period. It was never located again.

Rainbow trout 720-85 was captured by hoop net in the Missouri River near the lower portion of Lord Ranch point (RM 61.5) on March 24, 2009 and was surgically implanted with a radio

transmitter. It measured 17.8 inches long and weighed 1.81 pounds and was positively identified as a female during the surgery. Between April 2 and April 6 this fish moved 11.9 miles upstream near the Dunes FAS. Within 5 days it returned to the mouth of the Smith River where it stayed for 17 days. On May 1 this fish was recorded by the remote receiver station at the Smith River mouth and on the same day it was located 2 miles upstream in the Smith River during a flight. It returned to the mouth of the Smith River on May 4, and by May 7 it was located during a flight 27.1 miles upstream in the Missouri River near Tintinger Slough. It again returned to the mouth of the Smith River on May 12 and stayed there for 2 days. On May 14 it was recorded by the remote receiver station at the mouth of the Smith River and on the same day it was located 3 miles upstream in the Smith River during a flight. Two days later, on May 16 it was located 29.6 miles downstream in the Missouri River and was recorded by the remote receiver station at the mouth of the Sun River, having traveled at a rate of 1.2 miles per hour. On May 19 it returned to the mouth of the Smith River. On June 4 it was located at the Wing Dam where it stayed for 18 days. On July 1 this fish moved downstream 16.1 miles near the Dunes FAS. Over the next 428 days, this fish was located 8 times in a 1.5 mile reach of river between the Dunes FAS and Castner Coulee. In 2009, over a 206 day period, this fish traveled 188.9 miles. This fish entered the Smith River on May 1 and May 14 and traveled 2 and 3 miles upstream, respectively. Although this migration behavior is consistent with spawning, there is virtually no suitable trout spawning habitat in the lower 3 miles of the Smith River because it is almost exclusively mud and sand substrate. However, on May 7 this fish made a long distance migration in the Missouri River and resided near Tintinger Slough for several days, where there is an abundance of gravel suitable for trout spawning. On this basis, we believe this fish spawned in the Missouri River near Tintinger Slough (RM 31) near May 7.

Rainbow trout 720-83 was captured by hoop net in the Missouri River near the lower portion of Lord Ranch point (RM 61.5) on March 28, 2010 and was surgically implanted with a radio transmitter. It measured 17.2 inches long and weighed 1.7 pounds and was positively identified as a female during the surgery. Over the next 22 days it was located 3 times in a 6.7 mile reach of river between the mouth of the Smith River and Woodland Estates. It began an upstream migration on April 21 and entered the Dearborn River on May 14. It returned to the mouth of the Dearborn River on May 29. Eight days later it was located at the mouth of the Smith River where it stayed in a 2.3 mile reach of river through July 30. In April 2010 this fish was located at RM 71.5 near Buckshot Island. It stayed in this area through September 21, 2010 when contact was lost. This fish displayed migratory behavior in 2009 and we believe it spawned in the Dearborn River on the median date (May 20) of its residency in the Dearborn River.

Rainbow trout 890-20 was captured by hoop net in the Missouri River near the lower portion of Lord Ranch point (RM 61.5) on March 25, 2008 and was surgically implanted with a radio transmitter. It measured 17.2 inches long and weighed 1.38 pounds and was positively identified as a female during the surgery. It was never located again. We believe the radio transmitter malfunctioned.

Rainbow trout 720-32 was captured by hoop net in the Missouri River near the lower portion of Lord Ranch point (RM 61.5) on March 26, 2010 and was surgically implanted with a radio transmitter. It measured 18.6 inches long and weighed 2.22 pounds and was positively identified as a female during the surgery. On April 1 it entered the Smith River and began an upstream

migration. During a flight on April 22, it was located 7 miles upstream (RM 29.3) of Eden Bridge near the Ken McKamey Ranch Bridge. During a flight on May 12 it was located in Tenderfoot Creek 1.8 miles upstream from the mouth where we believe it spawned. Three days later (May 15) it was recorded by the remote receiver station at the mouth of the Smith River. It entered the Missouri River and resided near the USGS Ulm gage station (RM 66.3) for the remainder of the year. On March 25, 2011, this fish was captured in a hoop net at RM 61.5, which was nearly the exact location it was captured one year earlier. An inspection of the fish revealed the surgical incision was perfectly healed and the fish appeared to be in good health. Throughout 2011 it stayed in a 2 mile reach of river near this capture location. This fish traveled 146.8 miles in 75 days. In a 72 hour period from May 12 to May 15 it traveled 67.5 miles (rate 0.94 mph). This fish also showed site fidelity by returning to its capture location.

Rainbow trout 720-55 was captured by hoop net in the Missouri River near the lower portion of Lord Ranch point (RM 61.5) on March 25, 2011 and was surgically implanted with a radio transmitter. It measured 16.8 inches long and weighed 1.89 pounds and was positively identified as a female during the surgery. It entered the Smith River on April 28 and progressively moved upstream reaching the mouth of Deep Creek (RM 42.5) on May 13. It stayed at the mouth of Deep Creek through May 19, and then began a downstream descent passing through the Eden Bridge remote receiver station on May 28. It passed through the remote receiver station at the mouth of the Smith River on June 20. Unusual radio performance caused fishery workers to suspect the radio was not in the water. During a tracking run by boat on August 10, we detected a mortality code from this transmitter at RM 58.1 which suggests the fish was dead. The radio was discovered approximately 30 feet from the edge of the Missouri River bank in a dense growth of cottonwood trees across from the Smith River confluence. Slight abrasions on the radio antennae suggest it may have been killed by a raptor. In 87 days this fish traveled 91.8 miles. We believe this fish spawned in Deep Creek near the mouth on the median date (May 16) of its presence at Deep Creek.

Rainbow trout 720-56 was captured by hoop net in the Missouri River near the lower portion of Lord Ranch point (RM 61.5) on March 25, 2011 and was surgically implanted with a radio transmitter. It measured 17.5 inches long and weighed 1.96 pounds and was positively identified as a female during the surgery. Within 3 days it moved upstream in the Missouri River and stayed at the mouth of the Smith River for 8 days before migrating into the Smith River. It progressively migrated upstream 72.5 miles reaching the mouth of Rock Creek on April 30. During a trans-basin flight between Tenderfoot Creek and Eagle Creek on May 6, we discovered this fish 5.4 miles up Sheep Creek. We located it again on May 13 at stream mile (SM) 9.5, on May 19 at SM 12.5, then on May 31 at SM 16.5 near the mouth of Moose Creek. This fish descended Sheep Creek and the Smith River and was detected at the remote receiver station at Eden Bridge on June 28. During a flight on September 21 it was located in the Smith River 4.3 miles upstream from the mouth. In 180 days this fish traveled 177.1 miles. We believe it spawned near the confluence of Moose Creek with Sheep Creek on the median date (May 25) of its residency.

Rainbow trout 720-57 was captured by hoop net in the Missouri River near the lower portion of Lord Ranch point (RM 61.5) on March 25, 2011 and was surgically implanted with a radio transmitter. It measured 15.9 inches long and weighed 1.44 pounds and was positively identified

as a female during the surgery. It moved upstream to the mouth of the Smith River where it resided for 5 days. It progressively moved 48 miles upstream in the Missouri River to the island complex downstream of Jackson Rock (RM 10.1) where we believe it spawned. On June 15, it was located once again at the mouth of the Smith River. Based on migratory movements in 2011, we believe this fish spawned in the Missouri River near RM 10.1 on May 18. Returning to the mouth of the Smith River shows some fidelity for its pre-spawn location. This fish traveled 119.6 miles in 83 days.

Rainbow trout 720-82 was captured by hoop net in the Missouri River near the Zahara Golf Course (RM 63.9) on March 26, 2009 and was surgically implanted with a radio transmitter. It measured 16.2 inches long and weighed 1.45 pounds and was positively identified as a male during the surgery. It moved upstream to the mouth of the Smith River on April 12. On April 13 it entered the Smith River and traveled 22.1 miles upstream where it stayed at Eden Bridge for 2 days (April 22-23). It moved back to the mouth of the Smith River on May 1. On May 2 it began a second migration into the Smith River and was located at the Mortag PLFA (RM 19.1) on May 7. Over the next 7 days it descended the river and resided near the Truly Bridge for 3 days, then returned to the Missouri River (RM 58.1). Between June 11 and October 16 it moved progressively downstream 13.6 miles where it spent the winter near Buckshot Island (RM 71.7). In April 2010 it was in the same location and remained there through July 2. Based on migratory behavior in 2009 we believe this fish spawned near RM 22.1 on April 22-23 and again on May 2 at RM 19.1. Its return to the Missouri River after spawning suggests some element of site fidelity. In 2009 this fish traveled 101.8 miles in 204 days.

Male rainbow trout have been documented as having polygamous spawning behavior. Male rainbow trout have been observed spawning in multiple locations over a 13d period in Lyons Creek, a tributary to the Missouri River (Grisak 1999).

Rainbow trout 720-84 was captured by hoop net in the Missouri River near the Zahara Golf Course (RM 63.9) on March 26, 2009 and was surgically implanted with a radio transmitter. It measured 17.4 inches long and weighed 1.52 pounds and was positively identified as a female during the surgery. Within 10 days this fish began an upstream migration in the Missouri River. On April 21 it was recorded by the remote receiver station at the mouth of the Dearborn River where it stayed for three days. It entered the Dearborn River on April 23 and was located during a flight on May 12 at river mile 5. It stayed within a 1 mile reach of the Dearborn River between RM 5 and RM 6 through June 11. On June 16 it was recorded at the Dearborn River mouth by the remote receiver station where it stayed for 2 days. It progressively moved downstream in the Missouri River between June 18 and June 30 where it was recorded at the mouth of the Smith River. In September it moved downstream 10.9 miles and resided near Woodland Estates (RM 69) throughout the winter. In March 2010 we located this fish at RM 76.5. We made 10 relocations of this fish in the same general vicinity through December 2, 2010. Four of these relocations were made in April–May and there was no evidence of a spawning attempt in 2010. Based on migratory movements in 2009, we determined this fish spawned in the Dearborn River at RM 5 near May 12. It also returned to the lower portions of the Missouri River near its pre spawn location. Over a 176 day period this fish traveled 117.9 miles. In a 24 hour period (April 21 to April 22) it traveled 12 miles upstream from Sheep Creek to the mouth of the Dearborn River.

Rainbow trout 890-18 was captured by hoop net in the Missouri River near the Zahara Golf Course (RM 63.9) on March 27, 2008 and was surgically implanted with a radio transmitter. It measured 16.8 inches long and weighed 1.60 pounds and was positively identified as a female during the surgery. Throughout 2008 it stayed in the same general area of the Smith River mouth. In February 2009 it moved downstream 26.6 miles and was detected by the remote receiver station at the Sun River mouth. Ten days later it was detected at by the remote receiver station at the mouth of the Smith River. In May it moved downstream 11 miles and stayed in a 1.5 mile reach of the Missouri River through June 11. No judgments can be made about the behavior of this fish.

Rainbow trout 720-86 was captured by hoop net in the Missouri River near the Zahara Golf Course (RM 63.9) on March 26, 2009 and was surgically implanted with a radio transmitter. It measured 18.7 inches long and weighed 2.17 pounds and was positively identified as a female during the surgery. Over the next 28 days it progressively moved upstream 41.1 miles to the mouth of Sheep Creek where it stayed through June 6. During a flight on June 11 it was located 29.1 miles downstream at the Dunes FAS. It moved upstream 1 mile on July 1 and stayed within a 1.1 mile reach of river throughout the remainder of the year. In 2010 this fish stayed within a 0.8 mile reach of the Missouri River near Castner Coulee. Based on migratory movements in 2009, we believe this fish spawned in the Missouri River near the Sheep Creek/Missouri River confluence near May 16. After spawning it returned to the lower portion of the study area. In a 77 day period this fish traveled 70.2 miles.

Rainbow trout 720-30A was captured by trap net in the Sun River near the 6th Street Bridge on March 30, 2009 and was surgically implanted with a radio transmitter. It measured 17.3 inches long and weighed 2.01 pounds and was positively identified as a female during the surgery. This fish moved to the mouth of the Sun River on March 31 and stayed in the same general vicinity for the next 56 days. During a surveillance trip by truck on October 16, we located this fish at RM 87.1 near the Montana Refining Company at Great Falls. It stayed in the same general vicinity through November 30, 2010. No judgments can be made about the behavior of this fish.

Rainbow trout 720-31 was captured by trap net in the Sun River near the 6th Street Bridge on March 30, 2009 and was surgically implanted with a radio transmitter. It measured 16.0 inches long and weighed 1.15 pounds and was positively identified as a male during the surgery. Over the next 610 days this fish moved into the Missouri River and stayed in a 1 mile reach of river between the BNSF railroad bridge at Broadwater Bay and the mouth of the Sun River. No judgments can be made about the behavior of this fish.

Rainbow trout 720-96 was captured by trap net in the Sun River near the 6th Street Bridge on April 13, 2009 and was surgically implanted with a radio transmitter. It measured 18.0 inches long and weighed 2.06 pounds and was positively identified as a female during the surgery. Within 5 days of being tagged, this fish moved to the mouth of the Sun River and stayed in this location for 5 days. It was never located again. No judgments can be made about the behavior of this fish.

Brown trout 720-71A was captured by hoop net in the Smith River 0.5 mile upstream from the mouth on March 28, 2011 and was surgically implanted with a radio transmitter. It measured 20.5 inches long and weighed 3.24 pounds and was positively identified as a female during the surgery. Over the next 48 days this fish progressively traveled upstream in the Missouri River ultimately reaching the Devils Kitchen FAS on May 15. It was not located again. No judgments can be made about the behavior of this fish. It traveled 40.1 miles in 48 days.

Brown trout 720-74 was captured by hoop net in the Smith River 0.5 mile upstream from the mouth on April 22, 2009 and was surgically implanted with a radio transmitter. It measured 15.8 inches long and weighed 1.09 pounds and was positively identified as a female during the surgery. This fish moved to the Missouri River and was located during a flight on May 1 upstream of the mouth of the Smith River (RM 57.4). It progressively moved upstream 27.4 miles over the next 56 days and resided near Tintinger Slough. It stayed in this area for the remainder of the year. We believe it spawned in the area of Tintinger Slough (RM 30) on the median date (Nov 8) of its residency in this area (October 16 to December 2). In 2010, it was located 16 times in a 1.2 mile reach of river near Tintinger Slough. We suspect it could have spawned in this area again.

Brown trout 720-50 was captured by hoop net in the Smith River 3.6 miles upstream from the mouth on April 7, 2011 and was surgically implanted with a radio transmitter. It measured 21.7 inches long and weighed 2.92 pounds and was positively identified as a male during the surgery. Over the next 131 days it was located 6 times and had traveled upstream 3.1 miles. During a surveillance track by truck on August 16, we detected a mortality code from this transmitter at RM 18.0 which suggests the fish was dead. After gaining permission from a landowner, we recovered this radio from a sand bar on the east bank of the Smith River at RM 18. The radio was buried in 6 inches of sand and has presumably been buried by the high flows in the Smith River in June of 2011. No judgments can be made about its behavior.

Brown trout 720-53 was captured by mobile anode electrofishing in the Smith River near the Truly Bridge FAS (RM 9.4) on April 7, 2011 and was surgically implanted with a radio transmitter. It measured 15.5 inches long and weighed 1.13 pounds and was positively identified as a female during the surgery. Over the next 22 days this fish moved downstream and was detected by the remote receiver station at the mouth of the Smith River. Five days later (May 30) it was located 9.6 miles upstream near Truly Bridge FAS and it stayed in this area through May 31. During a surveillance track by truck on August 16, we detected a mortality code from this transmitter at RM 23.0 which suggests the fish was dead. The transmitter was recovered from a deep pool upstream of Eden Bridge on September 8. No judgments can be made about the behavior of this fish or why it died.

Brown trout 720-54 was captured by mobile anode electrofishing in the Smith River near the Truly Bridge FAS (RM 9.4) on April 7, 2011 and was surgically implanted with a radio transmitter. It measured 11.2 inches long and weighed 0.49 pounds and was positively identified as a male during the surgery. The fish stayed in the same general vicinity of Truly Bridge FAS over the next 52 days. On August 16, we detected a mortality code from this transmitter at RM 9.4 which suggests the fish was dead. The radio was not recovered. No judgments can be made about the behavior of this fish.

Brown trout 890-14 was captured by angling in the Smith River near the Eden Bridge (RM 22.3) on August 29, 2008 and was surgically implanted with a radio transmitter. It measured 16.4 inches long and was positively identified as a female during the surgery. This fish was located 9 times over the next 286 days (through June 11, 2009) and it stayed in a 2 mile reach of river upstream and downstream of the Eden Bridge. Contact with this fish was lost for 100 days until it was detected by the remote receiver station at Sheep Creek in the Missouri River on September 19, 2009. Over the next 5 days this fish moved upstream in the Missouri River 21.3 miles eventually reaching the mouth of Little Prickly Pear Creek on September 24. It stayed at the mouth of Little Prickly Pear Creek through November 21 until contact was lost. There were no records of this fish moving into the creek. This fish traveled 56.6 miles between the Smith and Missouri Rivers in 8 days. It then traveled 16 miles upstream in the Missouri River over a 4 day period. We suspect that we tagged this fish in the Smith River during its spawning run in 2008 and that it likely spawned in the Smith River near RM 22.5 in early December. Based on migratory movements in 2009, we believe this fish spawned in the Missouri River near RM 2.7 near October 28.

Brown trout 720-113A was captured by hoop net in the Missouri River near the mouth of the Smith River (RM 58.1) on March 23, 2011 and was surgically implanted with a radio transmitter. It measured 22.0 inches long and weighed 3.95 pounds and was positively identified as a male during the surgery. It was never located again. No judgments can be made about the behavior of this fish.

Brown trout 890-16 was captured by hoop net in the Missouri River near the lower portion of Lord Ranch point (RM 61.5) on March 25, 2008 and was surgically implanted with a radio transmitter. It measured 19.5 inches long and weighed 2.29 pounds and was positively identified as a male during the surgery. Contact with this fish was lost for 114 days until it was located 58.3 miles upstream near the Wolf Creek Bridge on July 17. On August 31 it was detected at the remote receiver station at Little Prickly Pear Creek where it stayed through October 3. On October 20, it was located 4.3 miles up Little Prickly Pear Creek. The next day (Oct 22) it was located at SM 5.0. On October 23 and 24 it was located at SM 1.5 and SM 0 in Little Prickly Pear Creek, respectively. The next day it was detected by the remote receiver station at the Dearborn River, and then contact was lost for the remainder of 2008. This fish was next located 48 miles downstream on January 21, 2009 at RM 61.5, approximately 1.2 mile from its tagging location. It was located 5 times in 2009 in a 13 mile reach of river between Big Bend FAS (RM 74.5) and Lord Ranch point (RM 61.5). Based on migratory behavior in 2008 we determined this fish spawned in Little Prickly Pear Creek on October 22 at SM 5. This fish was able to ascend the creek 5 miles, spawn and return to the Missouri River in as few as 5 days. This fish traveled 153.8 miles in 443 days. This fish also showed fidelity by returning to its tagging location.

Brown trout 890-19 was captured by hoop net in the Missouri River near the lower portion of Lord Ranch point (RM 61.5) on March 25, 2008 and was surgically implanted with a radio transmitter. It measured 19.0 inches long and weighed 2.38 pounds and was positively identified as a male during the surgery. Contact with this fish was lost for nearly 1 year until it was located 5.5 miles downstream from its original tagging location on February 4, 2009. In 2009 it moved upstream 43.9 miles and reached the Prewett Creek FAS on May 1. It was located in this area 4

times through June 11, and then contact was lost. This fish traveled travel 50 miles over a 127 day period. No other judgments can be made about the behavior of this fish.

Brown trout 720-89 was captured by hoop net in the Missouri River near the lower portion of Lord Ranch point (RM 61.5) on March 24, 2009 and was surgically implanted with a radio transmitter. It measured 19.8 inches long and weighed 2.31 pounds and was positively identified as a female during the surgery. Over the next 99 days this fish stayed within a 4 mile reach of river between Lord Ranch point and Zahara Golf Course. On July 15 it was detected by the remote receiver at the mouth of the Smith River and stayed in this area through October 18. On October 23 it was detected by the remote receiver at Eden Bridge. Contact with this fish was lost until January 29, 2010 when it was inadvertently discovered 3.8 miles up Hound Creek during a return surveillance flight from the Smith River. Over the next 33 days this fish was located 2 times in a 0.5 mile reach of Hound Creek between SM 3.3 and 3.8. We believe this fish spawned in Hound Creek in 2009 near SM 3.8. In mid March it began a downstream migration and on March 24 it was detected by the remote receiver station at the mouth of the Smith River where it stayed for 2 days. On April 16 it was located 3.6 miles upstream in the Missouri River near the Monty Kuka house. It stayed in this area through May 12. During a surveillance trip by boat on July 2, this fish was located downstream of Castner Coulee at RM 51.5. It was never located again. Based on migratory movements in 2009, this fish likely spawned in Hound Creek near SM 3.8. Over a 465 day period this fish traveled 76.7 miles.

Brown trout 720-80 was captured by hoop net in the Missouri River near the lower portion of Lord Ranch point (RM 61.5) on March 24, 2009 and was surgically implanted with a radio transmitter. It measured 17.1 inches long and weighed 1.44 pounds and was positively identified as a male during the surgery. Within 12 days of being tagged, this fish was located 28.5 miles upstream near the Cascade Bridge. Over the next 13 days it progressively moved upstream 9 miles to the mouth of Sheep Creek. Over the next 180 days this fish was located 8 times in a 1.1 mile reach of river near the mouth of Sheep Creek. Given its location during the fall of 2009, we believe it spawned near October 16 at RM 23, approximately 1 mile downstream of the mouth of Sheep Creek. We regained contact with this fish on February 23, 2010, in the same location. It remained at the mouth of Sheep Creek throughout 2010. We made 11 contacts of this fish throughout 2010. It is possible this fish could have spawned in this area in 2010. In 2011, we located it 1.5 miles upstream near the Prewett Creek FAS. It was not located again. This fish traveled 39 miles in 751 days.

Brown trout 890-17 was captured by hoop net in the Missouri River near the Zahara Golf Course (RM 63.9) on March 27, 2008 and was surgically implanted with a radio transmitter. It measured 21.4 inches long and weighed 2.68 pounds and was positively identified as a male during the surgery. Contact with this fish was lost until it was detected by the remote receiver located at the mouth of Sheep Creek on September 21. It stayed at the mouth of Sheep Creek for 32 days. It was located within 0.5 mile of its tagging location on January 12, 2009. It stayed at its tagging site through February 17. On June 11 it was located 5.5 miles downstream of its tagging site at Woodland Estates subdivision (RM 69.5). Based on migratory movements in the fall of 2009, we believe this fish spawned near Sheep Creek (RM 24) near October 11. This fish displayed site fidelity by returning to its tagging location. This fish traveled 85.1 miles in 441 days.

Brown trout 720-87 was captured by hoop net in the Missouri River near the Zahara Golf Course (RM 63.9) on March 26, 2009 and was surgically implanted with a radio transmitter. It measured 22.4 inches long and weighed 3.36 pounds and was positively identified as a male during the surgery. After tagging, this fish moved downstream 7.6 miles to Buckshot Island. In April it began an upstream migration and progressively moved 69 miles reaching the Wolf Creek Bridge on September 18, 2009. It moved downstream to the Craig Bridge where it stayed 30 days. On November 10 it was located at the mouth of the Dearborn River, presumably spawning. It stayed in the same general vicinity throughout the remainder of the year. We regained contact with this fish near the Riverdale subdivision (RM 49.5) during a flight on February 23, 2010. We located this fish 11 times between February 23 and September 2 in a 3.8 mile reach of river between the Dunes FAS and Riverdale subdivision. It was not located again after September 2, 2010. Based on migratory movements in 2009, we believe this fish spawned near the mouth of the Dearborn River (RM 13.5) on November 10. This fish traveled 130.4 miles in 525 days.

Brown trout 720-95 was captured by trap net in the Sun River near the 6th Street Bridge on April 10, 2009 and was surgically implanted with a radio transmitter. It measured 20.5 inches long and weighed 2.82 pounds and was positively identified as a male during the surgery. Eight days after this fish was tagged it was detected at the remote receiver station at the mouth of the Smith River. It progressively moved 36.7 miles upstream in the Missouri River to the Mountain Palace FAS. It stayed in this area for 99 days, and then descended the Missouri River where it reached the mouth of the Sun River on October 16. It spent the winter of 2009-10 at the mouth of the Sun River. We regained contact with this fish at the mouth of the Sun River on April 23, 2010. It began a 63.6 mile upstream migration in the Missouri River and ultimately reached the Mountain Palace FAS on May 13. It stayed in a 0.9 mile reach of river near the Mountain Palace FAS over the next 573 days. In the fall of 2009 this fish displayed migratory behavior consistent with spawning in that it traveled 63 miles downstream from the Mountain Palace FAS to the mouth of the Sun River. Although it is possible this fish spawned in the lower reaches of the Missouri River, we cannot conclusively determine if it spawned. For two years in a row, this fish displayed summer site fidelity by making upstream migrations to the Mountain Palace area arriving between May 13 and June 11. It also returned to within 0.6 mile of its tagging location in the fall of 2009. Overall this fish traveled 192.5 miles over 734 days.

Brown trout 720-91 was captured by trap net in the Sun River near the 6th Street Bridge on April 2, 2009 and was surgically implanted with a radio transmitter. It measured 22.2 inches long and weighed 3.09 pounds and was positively identified as a female during the surgery. This fish moved to the Missouri River on May 27 and stayed near the Sun River confluence through July 12. It was detected by the remote receiver station at the mouth of the Smith River on July 14, then by the receiver at Eden Bridge on July 17. Contact with this fish was lost until January 29, 2010 when it was inadvertently discovered 10.2 miles up Hound Creek during a return surveillance flight from the Smith River. Over the next 446 days this fish was located 6 times in a 1.3 mile reach of Hound Creek between SM 8.9 and 10.2. We believe this fish spawned in Hound Creek in 2009 near SM 10. During its spawning migration in 2009, this fish traveled 49 miles in 5 days.

Brown trout 720-94 was captured by trap net in the Sun River near the 6th Street Bridge on April 10, 2009 and was surgically implanted with a radio transmitter. It measured 19.5 inches long and

weighed 2.2 pounds and was positively identified as a female during the surgery. The next location of this fish was made 3 days later when it was detected by the remote receiver at the mouth of the Smith River. It continued a progressive upstream movement in the Missouri River reaching the Craig Bridge on April 30. On June 6 it was detected at the base of Holter Dam and stayed in a 0.1 mile reach throughout the remainder of 2009. In 2010 it was located in the same general vicinity below Holter Dam and moved within a 0.1 mile reach until contact was lost on December 1, 2010. This fish was able to travel 77.4 miles in 20 days. During a 24 hour period from April 21-22, it traveled 9.5 miles from Sheep Creek to Mid Canon FAS. It is possible this fish spawned in the Missouri River mainstem below Holter Dam. Previous spawning surveys in the area showed brown trout spawning occurs at many locations in the Missouri River, including directly below Holter Dam (Grisak 2012).

Brown trout 720-97 was captured by trap net in the Sun River near the 6th Street Bridge on April 13, 2009 and was surgically implanted with a radio transmitter. It measured 20.3 inches long and weighed 2.81 pounds and was positively identified as a female during the surgery. Contact with this fish was lost until it was discovered on September 18 11.4 miles away from its tag location in the Missouri River upstream of Big Bend FAS (RM 74). Contact was lost again for 5 months until it was located at Broadwater Bay (RM 85.2). It was located in this area 7 times through November 1, 2010. No judgments can be made about its behavior.

Brown trout 720-99 was captured by trap net in the Sun River near the 6th Street Bridge on April 17, 2009 and was surgically implanted with a radio transmitter. It measured 23.5 inches long and weighed 3.76 pounds and was positively identified as a female during the surgery. Within three days this fish moved to the Missouri River. It progressively moved 60.7 miles upstream in the Missouri River over a 16d period and ultimately reached the mouth of Sheep Creek. It was detected at the remote receiver station at Sheep Creek for 12 consecutive days through May 20. Three days later (May 23) it was detected by the remote receiver station at the mouth of the Sun River. It stayed at the mouth of the Sun River for two days, and then was detected at the mouth of the Smith River on May 29. It moved 34 miles upstream in the Missouri River to the mouth of Sheep Creek. It was located in this area 126 times between May 9 and September 30. We regained contact with this fish on March 3, 2010 at the mouth of Bird Creek (RM 41.5). It progressively moved downstream and reached the mouth of the Sun River on April 20, 2010. It stayed in this area through June 30. On July 7 it was detected by the remote receiver station at the mouth of Sheep Creek, 60.7 miles upstream. It stayed at the mouth of Sheep Creek through September 28 where it was detected for 82 consecutive days by the remote receiver. On September 29 it was located at the mouth of the Smith River, and then on September 30 it was located at the mouth of the Sun River. This fish traveled 60.7 miles in 48 hours at the rate of 1.26 miles per hour.

Over a 528 day period, this fish traveled a total of 374.9 miles. It made 6 trips between the mouth of the Sun River and Sheep Creek (Table 4). The shortest amount of time required to travel this distance was 2.5 days. Although this fish made multiple long distance movements, few judgments can be made about its spawning habits. It is not likely this fish spawned near the mouth of the Sun River in the fall of 2009 and 2010.

Table 4. Movement patterns between the Sun River and Sheep Creek for brown trout 720-99, Missouri River Montana, 2009-10.

Trip	Depart	Arrive	Days
Sun to Sheep	April 20, 2009: 1129 am	May 9, 2009: 647 pm	19.3
Sheep to Sun	May 20, 2009: 129 pm	May 23, 2009: 736 pm	3.3
Sun to Sheep	May 24, 2009: 1240 pm	June 3, 2009: 408 am	10.1
Sheep to Sun	September 30, 2009: 330 pm	April 20, 2010: 316 am	202.5
Sun to Sheep	June 30, 2010: 546 am	July 7, 2010: 121 am	7.2
Sheep to Sun	Sept 28, 2010: 1104 am	Sept 30, 2010: 1008 am	2.5

Brown trout 720-98 was captured by trap net in the Sun River near the 6th Street Bridge on Friday April 17, 2009 and was surgically implanted with a radio transmitter. It measured 21.6 inches long and weighed 3.21 pounds and was positively identified as a male during the surgery. This fish was harvested by a 13 year old female angler on Sunday April 19, 2009 in the Missouri River at the Big Bend FAS. In less than 48 hours after the surgical procedure this fish had moved into the Missouri River and traveled a total distance of 10.4 miles upstream, was attracted to bait and caught by an angler. The angler reported observing surgical staples in the abdomen of the fish, but no other abnormalities.

Brown trout 890-11 was captured by trap net in the Sun River near the Beacon Night Club on March 21, 2008 and was surgically implanted with a radio transmitter. It measured 20.2 inches long and weighed 3.06 pounds and was positively identified as a male during the surgery. We lost contact with this fish until July 17 when it was located 82.9 miles upstream in the Missouri River at the mouth of Little Prickly Pear Creek. Over the next 49 days this fish moved several times downstream and upstream between the Dearborn River mouth and Little Prickly Pear Creek mouth. It entered Little Prickly Pear Creek on October 20 and traveled upstream and downstream in a 2 mile reach between SM 5.2 and 7.3. It reached SM 7.3 on November 7 and stayed there for several days where we believe it spawned. It moved downstream 2.4 miles on November 25 where it stayed for 24 days. On December 19 it moved upstream 2 miles and resided at SM 6.9 through May 12, 2009. On July 6, 2009 it returned to the Missouri River and stayed at the mouth of Little Prickly Pear Creek through October 19. It began a progressive downstream migration in the Missouri River and was detected at the remote receiver station at Craig on November 3. On November 4, this fish left the detection range of the remote receiver at Craig at 12:10 am, and it was detected at the Sheep Creek remote receiver station at 6:43 pm. This fish was able to travel 16 miles in 18 hours and 33 minutes. The very next day it was detected by the remote receiver station at Sheep Creek 16 miles downstream. It was never located again. The range of this fish included the Sun River, Missouri River and Little Prickly Pear Creek. It displayed long distance movements between the Sun River and Little Prickly Pear Creek. It displayed sporadic upstream and downstream movements in both the Missouri River and Little Prickly Pear Creek. It overwintered in Little Prickly Pear Creek.

Results - summary

We made 1,579 relocations during the study. Remote receiver stations accounted for 70% of the relocation data, followed by 15% by airplane, 12% by truck, 2% by boat, <1% by trap net, <1% by hoop net and <1% by anglers. From 2008-2011 we made 39 radio tracking flights totaling 100.1 hours. The mean duration per flight was 2.6 (range 1.2 – 4.6) hours.

Rainbow trout

Radio transmitters implanted in rainbow trout were tracked over a mean 317 days (range 10-616). Overall 48% of the radio tagged rainbow trout displayed behavior consistent with spawning. Fish tagged in the Missouri River had the highest percentage (69%) of spawners followed by fish tagged in the Smith River (29%). None of the rainbow trout tagged in the Sun River displayed spawning behavior.

The mean date for rainbow trout spawning was May 13 (range April 25-May 26). For rainbow trout that spawned in the Smith River drainage the mean spawning date was May 13. For rainbow trout that spawned in the Missouri River drainage the mean spawn date was May 14. In addition to mainstem spawning in the Missouri and Smith rivers, rainbow trout spawned in Tenderfoot Creek, Sheep Creek (smith drainage), Deep Creek and the Dearborn River. Rainbow trout spawning was proportioned 62% in the Smith River drainage and 38% in the Missouri River drainage.

The mean distance that all radio tagged rainbow trout traveled throughout the study was 69.7 (1.0-188.9) miles. Rainbow trout tagged in the Missouri River traveled further distances than fish from the other two rivers (ANOVA $F(2,21)=9.39$, $P=0.001$). Females traveled further distances than males ($t(9)=2.43$, $P=0.03$). Females traveled a mean 84.2 (range 0.7-188.9) miles and males traveled a mean 23.6 (range 1.0-117.8) miles.

After spawning, 100% of the tagged rainbow trout displayed site fidelity by returning to the study area. Overall, rainbow trout returned to within 7.6 (range 0.1-13.8) miles of their tag location and 23% of the spawners returned to within 1.2 miles of their tag location.

We made some generalizations about rainbow trout behavior in these river sections. The fidelity of rainbow trout to our study area indicates the lower portions of these rivers support resident populations that are dependent on the upper reaches of the Smith and Missouri rivers, and are capable of self sustaining. Rainbow trout tagged in the Missouri River used both the Smith River and Missouri River for spawning. We cannot explain why none of the radio-tagged rainbow trout traveled upstream in the Sun River, or why no rainbow trout used the Sun River for spawning. This could be an artifact of sample size. Rainbow trout spawning was slightly later than has been reported in other studies. In our study the peak of the rainbow trout spawn was May 13 which is approximately 19 days later than the Little Prickly Pear Creek drainage of the Missouri River (Grisak 1999). Rainbow trout were capable of traveling up to 91.9 miles one way to reach spawning locations as evidenced by fish 720-56. This fish was also traveled 25.5 miles upstream in 5 days. Overall, 30% of the fish in this study traveled more than 100 miles.

Brown trout

The radio transmitters implanted in brown trout were tracked over a mean 437 days (range 2-751). Overall 50% of the radio tagged brown trout displayed behavior consistent with spawning. Fish tagged in the Missouri River had the highest percentage (71%) of spawners followed by fish tagged in the Sun River (57%), then fish tagged in the Smith River (17%).

The mean date for all brown trout spawning was October 28 (range October 11-November 10). The mean spawning date for brown trout in the Smith River drainage was October 26 and in the Missouri River drainage it was November 1. In addition to mainstream spawning in the Smith River and Missouri River, brown trout also spawned in Hound Creek and Little Prickly Pear Creek. Three brown trout spawned near the mouths of Sheep Creek (720-80, 720-99) and the Dearborn River (720-87). We were uncertain if these fish entered the tributaries because they were not detected by the antennae that covered the tributary. Spawning was proportioned 67% in the Smith River drainage and 33% in the Missouri River drainage.

The mean distance that brown trout traveled throughout the study was 92.4 (range 1.7-375) miles. The mean distance fish traveled between the three rivers was not significantly different (ANOVA $F(2,19)=2.03$, $P=0.15$). Males traveled slightly greater distances than females, but the difference was not significant ($t(14) = -0.12$, $P=0.91$). Females traveled a mean 89.7 (range 11.7-375.0) miles and males traveled a mean 94.8 (range 1-117.8) miles.

A small proportion (20%) of the brown trout that spawned overwintered in their spawning tributaries (Hound, Little Prickly Pear) and returned to the Missouri River between March 24 and July 6. Overall, 67% of the spawners used the Smith River and 33% of the spawners used the Missouri River for spawning.

After spawning, 40% of the radio tagged brown trout displayed fidelity by returning to the study area. On average, brown trout spawners returned to within 7.9 (range 1.2-14.4) miles of their tag location and 25% of the spawners returned to within 1.2 miles of their tag location.

The fidelity of brown trout to the study area indicates that approximately 40% of the population is resident that is dependent on the upper reaches of the Smith and Missouri rivers for spawning. Brown trout tagged in the Sun River spawned in the Smith and Missouri rivers. It is unexplainable why none of the radio tagged brown trout traveled upstream in the Sun River, or why no tagged fish used the Sun River for spawning. This could be an artifact of sample size. Brown trout were able to travel as much as 90.2 miles one way to reach eventual spawning habitat as evidenced by fish 890-11 and 35% of all brown trout traveled more than 100 miles.

Radio telemetry proved to be a valuable tool in describing trout behavior. For example, rainbow trout 720-32 was captured by hoop net at RM 61.5 in the Missouri River in 2009. This fish was captured by hoop net in the same location almost exactly one year prior. If a passive tagging method such as Floy T-bar tags had been used to mark this fish we would have assumed it spent the whole year in this section of river. However, monitoring by radio telemetry showed this fish traveled up the Smith River to Tenderfoot Creek in 2009, spawned, and then returned to its pre-spawn location. Brown trout 890-16 showed very similar behavior.

Throughout the study, only 2 (5%) tagged fish were harvested by anglers. Brown trout 720-98 traveled 10.4 miles within 48 hours of being implanted with a radio transmitter and was harvested by a bait angler in the Missouri River. This behavior suggests the radio transmitter implant procedure had little effect on the fish's behavior or desire to feed. Rainbow trout 720-71 was harvested nearly 1 mile from its implant location near the mouth of the Smith River.

Calculations of radio battery life showed 35% of the radios in rainbow trout and 25% of the radios in brown trout had sufficient battery life to capture movements during 2 spawning seasons, but none of the fish we monitored showed repeat spawning in consecutive years. Brown trout 720-95 showed long distance movements during the 2009 and 2010 spawning seasons, but these were downstream movements that placed the fish near the mouth of the Sun River during the brown trout spawning period. The behavior of this fish was consistent with spawning, but the spawning location was not probable.

Overall, the lower portions of these three rivers support a vibrant population of resident rainbow trout and brown trout that are dependent on the upper reaches of the Missouri and Smith rivers for their life cycle.

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