# An Evaluation of Trout Movements in the Upper Smith River Basin

Final Report

Submitted to

Canyon Ranch –White Sulphur Springs, Mt.
Pat Barnes Missouri River Chapter of Trout Unlimited – Helena, Mt.
Missouri River Flyfishers – Great Falls, Mt.

Prepared by

Grant Grisak
Montana Fish, Wildlife & Parks
4600 Giant Springs Road
Great Falls, MT 59405

Montana Fish, Wildlife & Parks

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## Introduction

The interchange of game fish between the Missouri and Smith rivers has long been a subject of interest for Montana Fish, Wildlife & Parks (MFWP). Empirical information from the late 1980's indicates rainbow trout tagged in the Missouri River near Craig were harvested by anglers in the Smith River near the mouth of Hound Creek. The amount of interchange remains uncertain. In 2009, two brown trout implanted with radio transmitters in the Sun and Missouri rivers entered the Smith River and traveled 21 miles upstream where they entered Hound Creek and ultimately spawned at stream mile 10.2 and 4.4, respectively (Grisak et al. 2012). In 2009, FWP implanted 40 radio transmitters in rainbow trout, brown trout and walleye in the Missouri River between Ulm and Great Falls and two rainbow trout traveled 19 and 26 miles up the Smith River to spawn (Grisak 2009). A number of these trout and one walleye lingered in the lower reaches of the Smith River. Despite the low sample sizes over the past few years, a number of radio tagged fish from the Missouri and Sun rivers entered the Smith River to spawn, which raised further questions about the importance of the Smith River to the Missouri River trout life history. In the fall of 2009, Montana FWP expanded this study by partnering with three private entities (Canyon Ranch, Pat Barnes Missouri River Chapter of Trout Unlimited, Missouri River Flyfishers) to conduct a pilot study to investigate trout movements in the upper reaches of the Smith River. We hypothesized that rainbow trout and brown trout in the upper Smith River drainage were migratory and would move to spawning locations and then return to their pre spawn locations. We also hypothesized that rainbow trout and brown trout would migrate seasonally to avoid ice jams and low water flow in the winter and to avoid high water temperature and low water flow in the summer. We used radio telemetry to 1) evaluate gross movements of trout during critical times of the year to describe spawning movements and locations to, 2) identify habitat refuge sites during critical times of the year (summer, winter) and to 3) determine if trout from the upper reaches of the Smith River basin move into the Missouri River.

In 2003 the Canyon Ranch conducted extensive habitat improvements in the Smith River that included upgrading irrigation head structures and constructing or enhancing 74 habitat features between river mile 106.2 and 109.2. Here we relate fish movements to these habitat features to evaluate the relative importance of these structures to trout life history in the upper Smith River drainage.

## Methods

Radios were supplied by the Canyon Ranch (10), Missouri River Flyfishers (2), Pat Barnes Missouri River Chapter of Trout Unlimited (1), PPL Montana (2) and MFWP (6). We used Lotek model SR-11-25 (in air weight 9 g, 148 MHz) radios programmed to operate on 12h intervals beginning at 7:00 am MST. Radio burst rate was 1 cycle per 3 seconds (0.33 Hz) in order to differentiate Smith River radios with Missouri River radios (0.20 Hz). Radio service life was 769 days (guarantee 615 d). Radio surveillance in the remote sections of the Smith River was conducted using a Piper PA-18 Supercub airplane fitted with a four element Yagi antenna on

the wing strut. We also used a truck instrumented with a four element Yagi antenna that could be set at 90$^{o}$ positions to receive signals from the front, back, left and right side of the truck. In the truck and airplane we used a Lotek SRX 400 W5XG frequency/code scanning receiver. We stationed Lotek SRX 400 W7AS code logging receivers at Camp Baker, Eden Bridge and the mouth of the Smith River. Fish locations were identified using GPS and transcribed to the nearest 0.1 river mile.

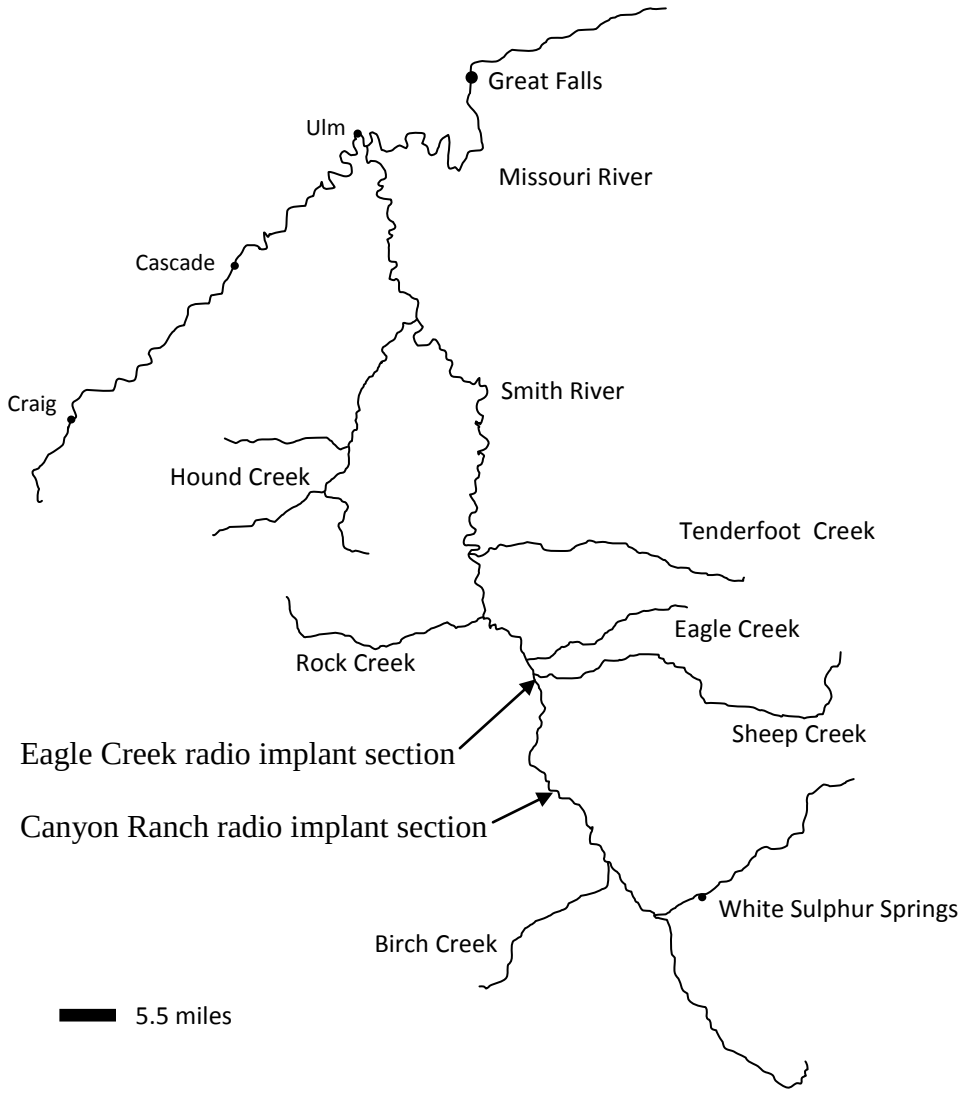



Figure 1. Map of the Smith River drainage with radio transmitter implant sections.

We captured trout using mobile anode electrofishing (smooth DC, 200V, 2A) on five occasions between 23 September and 9 November 2009 near the Eagle Creek section and at the Canyon Ranch section (Figure 1). Fish were randomly selected from the capture lots that measured

between 14 and 21 inches long to ensure they were sexually mature, young enough to spawn in the following two seasons, and large enough to carry the radio transmitter without negatively affecting their behavior (Brown et al. 1999). We surgically implanted radio transmitters in the abdomen of trout in a manner similar to the external antennae procedure described by Cooke and Bunt (2001).

We determined spawning dates and locations for each fish by evaluating movements during the spawning seasons for each species. For brown trout we assumed movements after September 1 were associated with spawning and for rainbow trout we assumed movements after March 15 were associated with spawning. Spawning locations were determined by documenting a fish's furthest movement during the spawning season and assuming it spawned in that area (Grisak 1999, Burrell et al. 2000, Hendersen et al. 2000, Pierce et al. 2009). Spawning dates were estimated using the median date of a fish's residency at a site (Downing et al. 2002).

We evaluated the mean distance fish traveled to spawning sites between species, between sexes and between the tagging locations. We also evaluated the total distance that fish traveled throughout the study between species, between sexes and between the tagging sections. Data were analyzed using Fishers F test to test for equality in variances, two sample T tests to test for differences in means, and Wilcoxon signed ranks non-parametric tests to test for differences in means. The significance level for all statistical tests was $P \leq 0.05$.

**Results**

In the Canyon Ranch section (rivermile [RM] 106.2-109.2) we implanted radios in 12 brown trout and 4 rainbow trout (Table 1). Mean length of brown trout was 18.8 (range 15.8-21.0) inches and mean weight was 2.3 (range 1.31-3.16) pounds. Mean length of rainbow trout was 18.7 (range 17.8-20.4) inches and mean weight was 2.21 (range 1.34-2.78) pounds. In the Eagle Creek section (RM 77.4-79.3) we implanted radios in 2 brown trout and 3 rainbow trout (Table 1). Mean length of brown trout was 16.9 (range 16.4-18.8) inches and mean weight was 1.87 (range 1.16-2.55) pounds. Mean length of rainbow trout was 14.6 (range 14.1-14.9) inches and mean weight was 1.06 (range 0.93-1.15) pounds. Mean surgery time for all fish was 2:01 (range 1:30-3:50). Mean body weight loading for all rainbow trout was 1.21% and for all brown trout was 0.88%.

During 2009-11 we made 20 flights totaling 50.2 hours at a cost of $5,795.50. The mean flight time was 2.45 hours (range 1.5-4.6) per flight. There were 399 relocations of radioed fish. The mean number of fish relocated per flight was 14 (range 2-20). Tracking radio tagged fish by airplane accounted for 76% of the relocations, followed by 10% by truck, 8% by remote ground stations, 5% by foot and <1% by boat. The mean number of days radios were monitored was 702 (range 338-811).

Table 1. Surgery statistics for rainbow trout and brown trout implanted with radio transmitters in the Smith River, 2009.

| Species | Frequency | Code | Length (in) | Weight (lbs) | Sex | Implant date | Location | Surgery time |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |
| RB | 148.720 | 110 | 14.9 | 1.11 | Female | 9/29/2009 | Smith River - Eagle Creek | 1:35 |
| RB | 148.720 | 111 | 14.1 | 0.93 | Female | 9/29/2009 | Smith River - Eagle Creek | 2:05 |
| RB | 148.720 | 113 | 14.7 | 1.15 | Female | 9/29/2009 | Smith River - Eagle Creek | 1:31 |
| LL | 148.720 | 112 | 16.4 | 1.63 | Female | 9/29/2009 | Smith River - Eagle Creek | 1:40 |
| LL | 148.720 | 75 | 14.9 | 1.16 | Female | 9/29/2009 | Smith River - Eagle Creek | |
| LL | 148.720 | 77 | 16.6 | 1.79 | Female | 10/19/2009 | Smith River – Canyon Ranch | |
| LL | 148.720 | 78 | 18.0 | 2.23 | Female | 10/19/2009 | Smith River – Canyon Ranch | |
| LL | 148.720 | 79 | 18.8 | 2.55 | Female | 10/19/2009 | Smith River – Canyon Ranch | |
| LL | 148.720 | 98 | 16.3 | 1.57 | Female | 9/23/2009 | Smith River – Canyon Ranch | |
| LL | 148.720 | 100 | 20.0 | 2.96 | Female | 9/23/2009 | Smith River - Canyon Ranch | 2:26 |
| LL | 148.720 | 101 | 19.8 | 2.51 | Male | 9/23/2009 | Smith River - Canyon Ranch | 3:50 |
| LL | 148.720 | 102 | 20.0 | 2.88 | Male | 9/23/2009 | Smith River - Canyon Ranch | 2:30 |
| LL | 148.720 | 103 | 21.0 | 3.08 | Male | 9/23/2009 | Smith River - Canyon Ranch | 1:37 |
| LL | 148.720 | 81 | 20.3 | 3.16 | Female | 10/19/2009 | Smith River - Canyon Ranch | |
| LL | 148.720 | 104 | 17.9 | 1.82 | Female | 11/9/2009 | Smith River - Canyon Ranch | 1:35 |
| LL | 148.720 | 108 | 19.4 | 2.42 | Female | 11/9/2009 | Smith River - Canyon Ranch | 2:30 |
| LL | 148.720 | 109 | 15.8 | 13.1 | Female | 11/9/2009 | Smith River - Canyon Ranch | 2:10 |
| RB | 148.720 | 88 | 15.4 | 1.34 | Female | 10/19/2009 | Smith River - Canyon Ranch | |
| RB | 148.720 | 105 | 20.4 | 2.78 | Female | 11/9/2009 | Smith River - Canyon Ranch | 1:30 |
| RB | 148.720 | 106 | 17.8 | 1.85 | Female | 11/9/2009 | Smith River - Canyon Ranch | 1:35 |
| RB | 148.720 | 107 | 18.0 | 2.01 | Female | 11/9/2009 | Smith River - Canyon Ranch | 1:50 |

The following is an account of each fish that we monitored;

**Brown trout 720-75** was tagged in the Smith River on 29 September 2009 at river mile 78.3 in the Eagle Creek section. It stayed in the same general location over the next nine months. Starting in September 2010 it progressively moved upstream to river mile 95.0. This fish was located 3 times river from 17 October to 25 January (2011) in a 0.5 mile reach of between river mile 94.5 and 95.0. We believed this fish spawned in the Smith River near confluence with the Soldier Lake outlet stream on November 7. In 2011 this fish stayed in the same general vicinity of the Fort Logan Bridge crossing of Highway 360 through May 6. During a flight on May 13, it was discovered 4 miles downstream near the Smith River Wildlife Management Area FAS. It stayed in this area through August 4$^{th}$ and was not contacted again. No judgments can be made about its behavior in 2011.

**Brown trout 720-77** was tagged in the Smith River on 19 October 2009 at river mile 108.5 (pool 16) in the Canyon Ranch section. It was never located again. We believe the radio may have malfunctioned.

**Brown trout 720-78** was tagged in the Smith River on 19 October 2009 at river mile 108.1 (pool 23) in the Canyon Ranch section. Over the next 654 days it was located 18 times in a 1.5 mile reach of river between river mile 107.5 and 109. The majority (61%) of the relocations were made at rivermile 108.5 (pool 15-16). No measurable movements were made during the 2010 spawning season so few judgments can be made about the behavior of this fish.

**Brown trout 720-79** was tagged in the Smith River on 19 October 2009 at river mile 108.7 (pool 10) in the Canyon Ranch section. From October 2009 through August 2010, this fish moved upstream and downstream within a 3.2 mile reach of river (rivermile 105.5-108.7). In October 2010, it moved upstream 3 miles to river mile 108.5 where it stayed for 4 days, then descended to rivermile 106.5. Again in November it moved upstream to rivermile 108.5 (pool 15-16) where we believe it spawned on November 21. During a flight on April 12, 2011, it was located 2 miles downstream. It stayed in a 1.5 mile reach (106-107.5) through August 4 when contact was lost.

**Brown trout 720-81** was tagged in the Smith River on 19 October 2009 at river mile 108.7 (pool 10) in the Canyon Ranch section. Over the next 654 days, this fish displayed subtle movements within a 1.5 mile reach of river (river mile 107.5-109). During the 2010 spawning season this fish moved 0.4 mile upstream to river mile 108.5 where we believe it spawned on November 15. No judgments can be made about its spawning behavior in 2011

**Brown trout 720-98** was tagged in the Smith River on 23 September 2009 at river mile 108.8 (pool 8). Over the next 754 days it moved upstream and downstream within a 2.7 mile reach (river mile 106.6-109.2) of river. In October 2009, this fish moved downstream 2.3 miles to river mile 106.5 where we believe it spawned on October 16. No movements were observed during the 2010 spawning season. In 2011 it made a downstream movement of 0.7 mile to river mile 180.5 where we believe it spawned on October 17.

**Brown trout 720-100** was tagged in the Smith River on 29 September 2009 at river mile 108.4 (pool 19) in the Canyon Ranch section. Over the next five months it progressively moved downstream 7.8 miles where it stayed at river mile 100.6 for a brief period in February 2010. In April it was discovered at river mile 105.5. In September it began moving upstream and traveled 3.0 miles and resided 0.1 mile upstream of where it was implanted. Based on positive upstream movements during the spawning season, we believed it spawned at river mile 108.5 (pool 16) on November 15. In 2011 this fish progressively moved downstream 2.5 miles to RM 106 where it resided for several days in mid May. In late May it moved upstream to river mile 106.5 (pool 68) where it stayed through December 13. It is possible this fish spawned near pool 68 in the fall of 2011.

**Brown trout 720-101** was tagged in the Smith River on 23 September 2009 at river mile 107.3 (pool 46) in the Canyon Ranch section. This fish displayed subtle movements within a 2.5 mile reach of river during an 811 day period. After the being tagged, it moved downstream 0.8 miles to river mile 106.5 where it stayed for several weeks. We believe this fish spawned in this area

on October 16. In 2010 this fish moved a short distance (0.8 mile) during the spawning season. We believe it spawned at river mile 108.5 (pool 15-16) on October 21. No judgments can be made about whether it spawned in 2011.

**Brown trout 720-102** was tagged in the Smith River on 23 September 2009 at river mile 106.7 (pool 63) in the Canyon Ranch section. Over the next few weeks, this fish was discovered upstream of the Buckingham Bridge. We are uncertain if it was in the Smith River at river mile 110.25, or 0.2 mile up Newlan Creek. We believe it spawned in one of these two areas on November 1. This fish progressively moved downstream 4.2 miles. In 2010 and 2011 it displayed subtle movements during each spawning season. We believe it spawned in 2010 at river mile 108.5 (pool 14-16) on November 15, and in 2011 at river mile 107.5 (pool 39) on November 13.

**Brown trout 720-103** was tagged in the Smith River on 23 September 2009 at river mile 108.8 (pool 8). We lost contact with this over the next 6 months until it was discovered 10.4 miles upstream at river mile 119.2 on 12 April. It stayed in the same area over the next two days after which contact was lost. On several occasion over the next 6 months we expanded the surveillance area in an effort to locate this fish. The expanded search involved 3 flights up the North Fork Smith River as far as Sutherlin Reservoir Dam (24.8 miles) and two flights up the South Fork Smith River as far as the Highway 89/12 intersection bridge (20.9 miles). During return flights down the South Fork River, we scanned the numerous tributaries both east and west of the river and did not detect any radio signals. The location of this fish remained uncertain until it was discovered at river mile 117 on April 20, 2011. It was located again on May 31 at river mile 116. Over a 2 year period this fish was intermittently located in a 3 mile reach between river mile 116 and 119. Despite numerous attempts to locate this fish both upstream and downstream of this area, we are uncertain about its behavior. Few judgments can be made about its behavior.

**Brown trout 720-104** was tagged in the Smith River on 9 November 2009 at river mile 106.5 (pool 68). Over a 707 day period, this fish made subtle movements within a 2 mile reach of river (rivermile 106-5-108.5). In 2010 this fish made discernible movements upstream and downstream during the spawning season. We believe it ultimately spawned at river mile 108.5 on November 29, 2010. In 2011, it moved upstream 0.9 mile during the spawning season. We believe it could have spawned at river mile 107.5 on October 17.

**Brown trout 720-108** was tagged in the Smith River on 9 November 2009 at river mile 107 (pool 55). Over the next 10 months it progressively moved upstream 1.7 miles (pool 11). In September 2010 it progressively moved 8.8 miles upstream to river mile 117.5 where we believed it spawned on November 15. In 2011 it stayed in the same general vicinity of river mile 117 through April.

**Brown trout 720-109** was tagged in the Smith River on 9 November 2009 at river mile 107 (pool 55). Over a 764 days period, this fish made subtle movements in a 2.5 mile reach of river (rivermile 106.5-109). There were no discernible movements made during three spawning seasons. No judgments can be made about its behavior.

**Brown trout 720-112** was tagged in the Smith River on 29 September 2009 in the Eagle Creek section at river mile 78.3. Over the next several days it moved downstream 4.7 miles and was located at river mile 83 on October 16. It's behavior suggest it was making a spawning run, but we lost contact with this fish during the peak of the 2009 spawning season. In April 2010 we regained contact with this fish near the location where it was tagged. In September it began a 1.7mile upstream migration and we believe it spawned at river mile 75.3 on November 29.In 2011, it made only subtle movements (0.9 mile) during the spawning season and we believe it may have spawned near river mile 75.1 near November 13.

**Rainbow trout 720-88** was tagged in the Smith River on 19 October 2009 at river mile 106.5 (pool 69) in the Canyon Ranch section. It stayed in the same general location over the next six months. On 12 April 2010 it was located at river mile 106. Within 5 days it moved 24.5 miles downstream in the Smith River and was recorded at the Camp Baker remote ground station on 17 April. During an airplane flight on June 6, it was discovered 10.5 miles up Sheep Creek. It descended Sheep Creek and was located at the mouth on 22 June. It was not located again. We believe it spawned at stream mile 10.6 in Sheep Creek on the median date of its residency which was May 13.

**Rainbow trout 720-105** was tagged in the Smith River on 9 November 2009 at river mile 106.5 (pool 68). In the spring of 2010 it moved upstream in the Smith River 1.3 miles and was located near the mouth of Newlan Creek, where we believed it spawned on April 15. By May 12, it had descended the river and was located at river mile 109. It stayed within a 1.5 mile reach of river over the next year. In the spring of 2011, it again moved upstream to river mile 109 where we believe it spawned on May 13. It descended the river and stayed with a 0.9 miles reach (river mile 106.6 to 107.5) for the remainder of the year.

**Rainbow trout 720-106** was tagged in the Smith River Canyon Ranch section on 9 November 2009 near river mile 108 (pool 29). It stayed in the same general vicinity through 12 May 2010 after which contact was lost. In 2010 FWP received numerous reports of pelicans in the upper Smith River basin. By September 2010, there were 4 radioed fish (including 720-106) that we had not relocated for several months. We assumed the radios in these fish malfunctioned, the fish had left the study area, or they had been removed from the study area by anglers or predators. On 2 September, we conducted a flight over the waterfowl nesting area on Canyon Ferry Reservoir and detected a signal from radio 720-106 in the NW ¼ of pond #3. On 10 September we launched a boat on nesting pond #3 and tracked radio 720-106 to island # 83 (Figure 2). We were unable to recover the radio as it was in 3 feet of water. The distance from island # 83 to the last known location of this fish on the Smith River was 25.1 miles (Figure 3). This finding revealed that pelicans from the Canyon Ferry nesting colony travel over the Big Belt Mountains to the Smith River and are able to forage on rainbow trout as long as 17.8 inches and weighing 1.85 pounds.

**Rainbow trout 720-107** was tagged in the Smith River on 9 November 2009 at river mile 108 (pool 29). Over the next year it made only subtle movements in a 0.8 mile reach of river. In 2011, this fish initially moved downstream in the Smith River approximately 3 miles to river mile 105.6 on April 20. During a flight on May 6 it was discovered in Newlan Creek 1.2 miles upstream from the mouth where we believe it spawned. By May 19 it had returned to the Smith

River and was located at river mile 107 where it stayed through the end of May. During a flight on September 21, it was located 45 miles downstream in the Smith River at river mile 62.9. It was located 2 more times in a 0.6 miles reach of river through December 13.

**Rainbow trout 720-110** was tagged in the Smith River on 29 September 2009 in the Eagle Creek section at river mile 78.0. It displayed subtle upstream and downstream movements within a 0.6 mile reach over the next 8 months. During a flight on 9 June it was discovered 23.6 miles downstream at river mile 55.0 near the Meagher/Cascade county line. We believed it spawned at river mile 55 on May 22. From June 2010 through December 2011 we made 15 relocations of this fish within a 1.7 mile reach of river. Between May 13 and May 19, 2011, this fish moved upstream 2.3 miles and we believe it spawned in 2011 at river mile 55.8 on May 19.

**Rainbow trout 720-111** was tagged in the Smith River on 29 September 2009 in the Eagle Creek section at river mile 78. It stayed in the same general vicinity (0.8 mile) over the next 6 months. In the spring of 2010 it moved downstream 6.6 miles to near the mouth of Rock Creek (river mile 72.0) where we believe it spawned on May 11. In October it moved upstream 0.5 mile to the mouth of Rock Creek and was located at that site 15 times through December 13, 2011.

**Rainbow trout 720-113** was tagged in the Smith River on 29 September 2009 in the Eagle Creek section near river mile 78.3. It stayed in the same general area over the next 30d. Six months later, on 12 May 2010, it was discovered 1.2 miles upstream and stayed in that area over the next 28 days until contact was lost. In 2010 FWP received numerous reports of pelicans in the upper Smith River basin. By September 2010, there were 4 radioed fish (including 720-113) that we had not collected relocation on for several months. We assumed the radios had malfunctioned, had been removed from the study area by anglers or predators, or the fish had left the study area. On 2 September we conducted a flight over the waterfowl nesting area on Canyon Ferry Reservoir and detected a signal from radio 720-113 in the NW ¼ of pond #3. On 10 September we launched a boat on nesting pond #3 and tracked radio 720-113 to island # 75 (Figure 2). We were able to recover the radio from about 6 inches of water. The distance from island # 75 to the last known location of this fish on the Smith River was 32.8 miles (Figure 3). This finding revealed that pelicans from the Canyon Ferry nesting colony travel over the Big Belt Mountains to the Smith River and are able to forage on rainbow trout as long as 14.7 inches and weighing 1.15 pounds.

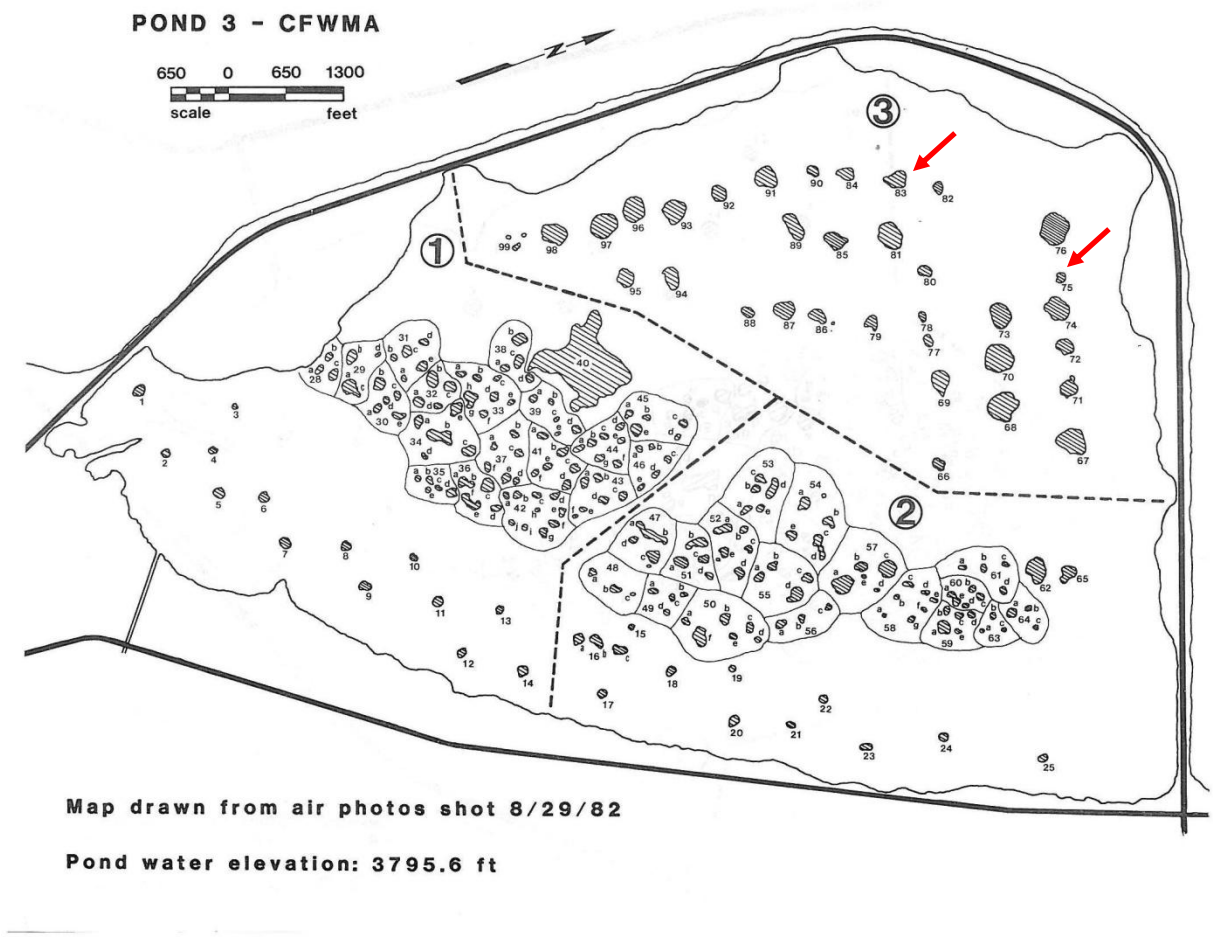



Figure 2. Map of waterfowl nesting pond #3 near Canyon Ferry Reservoir.

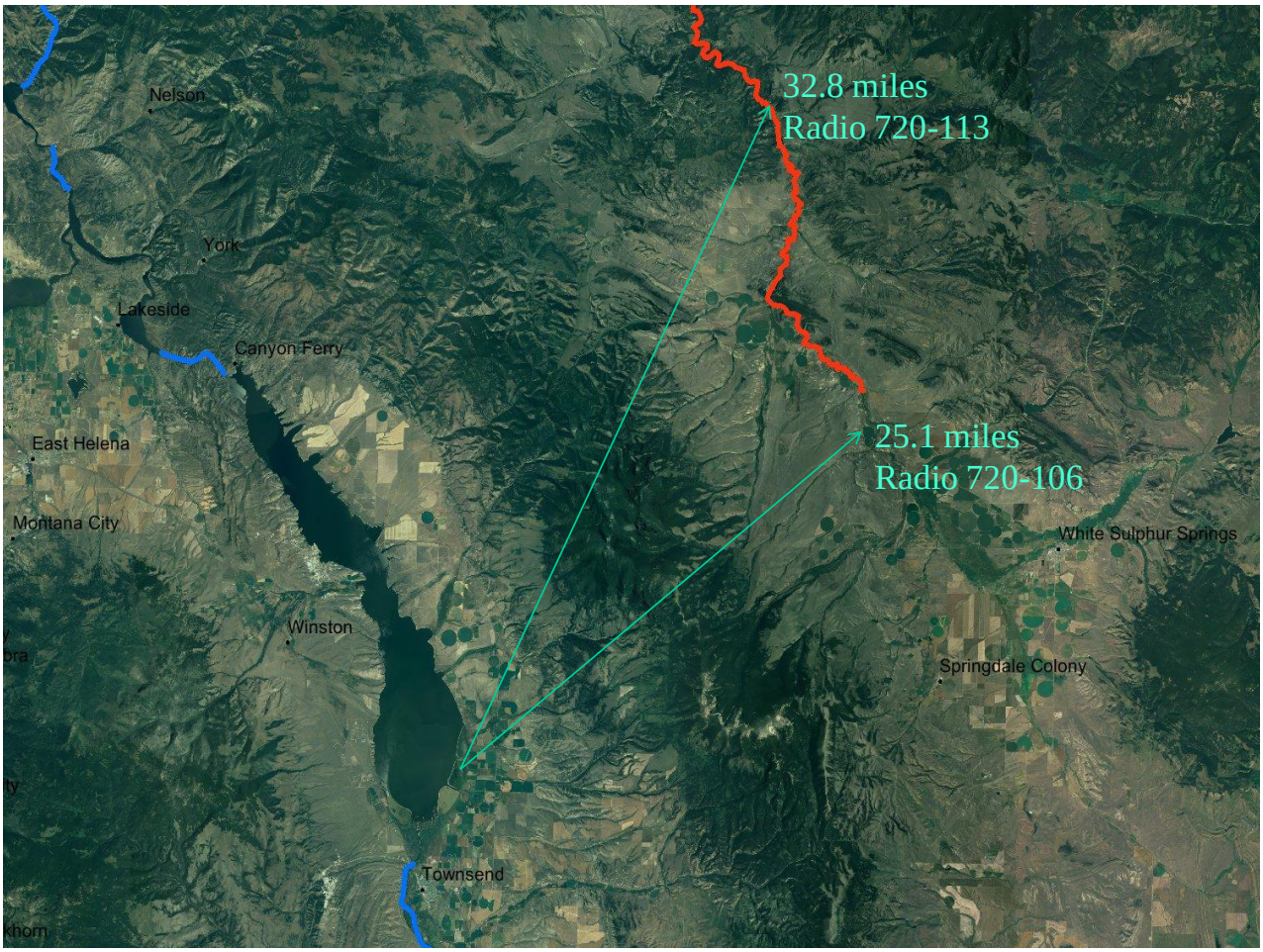



Figure 3. Aerial photo of upper Smith River drainage relative to Canyon Ferry waterfowl nesting pond #3 and distance birds traveled to forage on radioed trout.

Our results showed 20% of the trout from the Eagle Creek section and 57% of the trout from the Canyon Ranch section displayed resident behavior. Nearly half (43%) of the fish from the Canyon Ranch section moved away at some point during the study to spawn and only 14% returned and 29% reestablished in new home sites. The general behavior of fish that stayed (57%) in the 2.8 mile-long Canyon Ranch section included subtle movements between the deep water habitat features present in this section (Figure 4).

The mean total distance these fish traveled within this reach during the study period was 10.4 (range 3.7-17.4) miles for brown trout and 13.1 miles for rainbow trout. Brown trout that moved away from the Canyon Ranch section traveled a mean 5.4 (range 0.9-14.1) miles. Rainbow trout that moved away from the Canyon Ranch section to spawn traveled a mean 20.6 (range 5.5-35.7) miles to reach their destination. Rainbow trout that moved away from the Canyon Ranch section and established new home sites moved between 25.0 and 61.5 miles downstream.

Overall, 86% of the brown trout and 71% of the rainbow trout in this study displayed movements consistent with spawning. Brown trout spawned over a 44-day period between October 16 and November 29 (median November 13). Rainbow trout spawned over a 37-day period from April 25 to May 22 (median May 12). We determined 60% of rainbow trout spawned only once during the study and 40% displayed repeat spawning in consecutive years. For brown trout, 20% spawned during each of the 3 years, 30% spawned in 2 years (20% consecutive, 10% alternate), and 50% spawned only once during the study. The mean distance brown trout traveled to reach spawning sites was 3.29 miles (range 0.7-16.0). Rainbow trout traveled a mean 11.2 miles (range 1.5-35.7) to spawn.

In the Eagle Creek section, all of the rainbow trout moved out of this section and reestablished new home sites between 6.6 and 25.1 miles downstream. All of the brown trout from this section initially moved, both upstream and downstream, between 5.6 and 16.7 miles away and only one fish (720-112) returned to this section and remained throughout the study.

Analyses of fish spawning movements by species overall showed rainbow trout traveled significantly greater mean distances (11.2 miles, range 1.5-35.7) than brown trout (3.3 miles, 07.-16) to reach spawning locations (Wilcoxon $Z$=-2.4, $P$=0.015). Comparing the overall total miles traveled by species showed rainbow trout traveled significantly greater mean distances (32.6 miles, range 7.4-61.9) than did brown trout (14.5 miles, range 3.7-21.2) (Wilcoxon $Z$=-3.6, $P < 0.01$).

Analyses of the total miles fish traveled throughout the study according to the section in which fish were tagged showed rainbow trout from the Canyon Ranch section traveled significantly greater mean distance (11.5 miles, range 1.5-35.7) throughout the study than rainbow trout from the Eagle Creek section (10.8 miles, range 2.3-23.6) (Wilcoxon $Z$=-2.19, $P$=0.028).

Analyses of brown trout spawning movements according to the section in which fish were tagged showed brown trout from the Eagle Creek section traveled a greater mean distance (5.8 miles, range 0.9-16) to spawn than did those from the Canyon Ranch section (2.5 miles, range 0.7-8.8), but the differences were not significant (Wilcoxon $Z$=-1.21, $P$=0.23).

Analyses of the total miles brown trout traveled throughout the study showed those from the Eagle Creek section traveled a greater mean distance (20.3 miles, range 19.4-21.2) over the study period than those from the Canyon Ranch section (13.4 miles, range 3.7-19.7) (Wilcoxon $Z$=-3.06, $P$=0.002).

Analyses of fish spawning movements by sex showed female brown trout traveled further mean distances (3.9 miles, range 0.7-16) to spawn reach spawning sites than males (1.9 miles, range 0.8-3.6 ) (Wilcoxon $Z$=-2.26, $P$= 0.026). Male brown trout traveled slightly greater mean total miles (15.8 miles, range 12.0-19.7 ) throughout the study than females (14.3 miles, range 3.7-21.2) (Wilcoxon $Z$=-3.06, $P$=0.002).

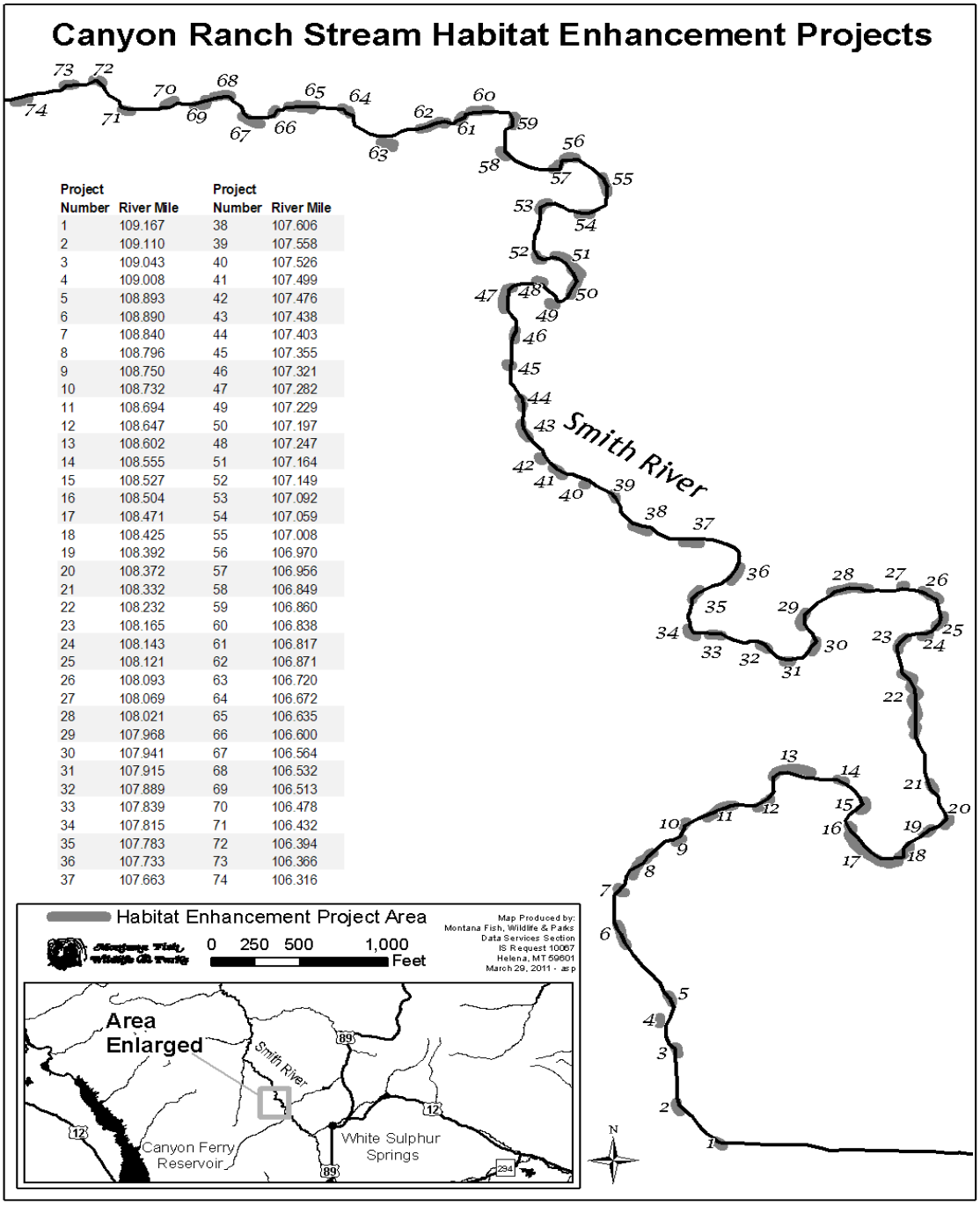
Four fish (19%) were prematurely removed from the study but nevertheless provided valuable information. Two (9%) of the fish in this study were removed from the study area by pelicans.

The radios from rainbow trout 720-106 and 720-113 were discovered at the pelican nesting area on Canyon Ferry Reservoir in September 2010. From the last known locations of these fish in the Smith River they were separated by 28.5 river miles which suggests pelicans from Canyon Ferry Reservoir forage over a broad range in the upper Smith River drainage. In 2010-11 MFWP staff received numerous reports of large flocks of pelicans in the floater section between Camp Baker and Eden Bridge. Rainbow trout 720-88 traveled the greatest distance (35.7 miles) of any fish in the study to reach a spawning location. After spawning in Sheep Creek, 10.5 miles upstream from the mouth, this fish returned to the Smith River and was detected at the Camp Baker remote receiver station a single time. It was not located again. We lost contact with brown trout 720-77 immediately after it was tagged. We assume the radio transmitter failed.

Throughout the study, radio tagged fish in the Canyon Ranch section were relocated at 22 (30%) of the 74 "pool" sites developed during the 2003 habitat enhancement project. Over half (61%) of the relocations came from three general pool areas (68, 39, 15) (Table 2). The highest number of relocations (31.3%) came from the area of pool 15. Pool areas 68 and 15 had the highest number of fish (11) use, followed by pool areas 18 and 39 (9 fish).

Table 2. Observations of radio tagged trout, river mile and approximate pool location, Canyon Ranch, Smith River, Montana.

| River Mile | Approximate pool number | # of observations | Rel % | | River Mile | Approximate pool number | # of observations | Rel % |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |
| 106.0 | --- | 6 | 3.1 | | 107.7 | 36 | 1 | 0.5 |
| 106.1 | --- | --- | --- | | 107.8 | 33 | --- | |
| 106.2 | --- | --- | --- | | 107.9 | 30 | 2 | 1.0 |
| 106.3 | 73 | --- | --- | | 108.0 | 27 | 6 | 3.1 |
| 106.4 | 70 | 1 | 0.5 | | 108.1 | 24 | 1 | 0.5 |
| 106.5 | 68 | 32 | 16.4 | | 108.2 | 22 | --- | --- |
| 106.6 | 65 | 5 | 2.6 | | 108.3 | 20 | 1 | 0.5 |
| 106.7 | 63 | 2 | 1.0 | | 108.4 | 18 | 9 | 4.6 |
| 106.8 | 59 | --- | --- | | 108.5 | 15 | 61 | 31.3 |
| 106.9 | 56 | 2 | 1.0 | | 108.6 | 12 | --- | --- |
| 107.0 | 54 | 8 | 4.1 | | 108.7 | 9 | 9 | 4.6 |
| 107.1 | 51 | --- | --- | | 108.8 | 8 | 2 | 1.0 |
| 107.2 | 49 | 1 | 0.5 | | 108.9 | 6 | 2 | 1.0 |
| 107.3 | 45 | 2 | 1.0 | | 109.0 | 4 | 9 | 4.6 |
| 107.4 | 42 | 3 | 1.5 | | 109.1 | 2 | --- | --- |
| 107.5 | 39 | 26 | 13.3 | | 109.2 | 1 | 3 | 1.5 |
| 107.6 | 38 | 1 | 0.5 | | | | | |




| Project Number | River Mile | Project Number | River Mile |
|---|---|---|---|
| 1 | 109.167 | 38 | 107.606 |
| 2 | 109.110 | 39 | 107.558 |
| 3 | 109.043 | 40 | 107.526 |
| 4 | 109.008 | 41 | 107.499 |
| 5 | 108.893 | 42 | 107.476 |
| 6 | 108.890 | 43 | 107.438 |
| 7 | 108.840 | 44 | 107.403 |
| 8 | 108.796 | 45 | 107.355 |
| 9 | 108.750 | 46 | 107.321 |
| 10 | 108.732 | 47 | 107.282 |
| 11 | 108.694 | 49 | 107.229 |
| 12 | 108.647 | 50 | 107.197 |
| 13 | 108.602 | 48 | 107.247 |
| 14 | 108.555 | 51 | 107.164 |
| 15 | 108.527 | 52 | 107.149 |
| 16 | 108.504 | 53 | 107.092 |
| 17 | 108.471 | 54 | 107.059 |
| 18 | 108.425 | 55 | 107.008 |
| 19 | 108.392 | 56 | 106.970 |
| 20 | 108.372 | 57 | 106.956 |
| 21 | 108.332 | 58 | 106.849 |
| 22 | 108.232 | 59 | 106.860 |
| 23 | 108.165 | 60 | 106.838 |
| 24 | 108.143 | 61 | 106.817 |
| 25 | 108.121 | 62 | 106.871 |
| 26 | 108.093 | 63 | 106.720 |
| 27 | 108.069 | 64 | 106.672 |
| 28 | 108.021 | 65 | 106.635 |
| 29 | 107.968 | 66 | 106.600 |
| 30 | 107.941 | 67 | 106.564 |
| 31 | 107.915 | 68 | 106.532 |
| 32 | 107.889 | 69 | 106.513 |
| 33 | 107.839 | 70 | 106.478 |
| 34 | 107.815 | 71 | 106.432 |
| 35 | 107.783 | 72 | 106.394 |
| 36 | 107.733 | 73 | 106.366 |
| 37 | 107.663 | 74 | 106.316 |

Figure 4. Habitat enhancement sites (pool number) and relative river mile reference for Canyon Ranch section of the Smith River, Montana.

## Discussion

Our hypothesis was that rainbow trout and brown trout in the upper Smith River drainage were migratory and would move to spawning areas and then return to their pre-spawn locations after spawning. The majority (80%) of trout from the Eagle Creek section established new home sites, and about one-third (29%) of the trout from the Canyon Ranch section established new home sites.

This study provided base line information about rainbow trout and brown trout behavior in the upper Smith River drainage. We could not demonstrate that fish from this reach of river were associated with the Missouri River, but this could have been an artifact of sample size. There is evidence that trout from the Missouri River use the Smith River for spawning. Grisak et al. (2012) reported rainbow trout from the Missouri River make extensive upstream spawning migrations into the Smith River and have been documented to spawn in the Tenderfoot Creek, Sheep Creek, Deep Creek. Missouri River rainbow trout migrated a mean 58.6 (range 22.1-88.5) miles up the Smith River to spawn. Missouri River brown trout have been documented to spawn in Hound Creek. Brown trout tagged in the Missouri River migrated a mean 25.7 (range 22.5-30.2) miles upstream in the Smith River to spawn.

The distance that upper Smith River brown trout and rainbow trout migrated was consistent with other reports. Burrell et al. (2000) reported that brown trout in the Chatooga River, North Carolina traveled a mean distance of 1.2 (0.12-4.75) miles to reach spawning sites. In this study we did not measure micro movements of brown trout. The fact that such a large proportion of brown trout stayed within the 2.8 mile reach Caynon Ranch section is consistent with micro movements of Chatooga River brown trout that ranged 27-76 meters during non spawning periods. Henderson et al. (2000) reported that rainbow trout in the Snake River, Idaho migrated between 3.17 and 3.97 miles to reach spawning sites, which is less than upper Smith River rainbow trout.

Our second hypothesis was that rainbow trout and brown trout would migrate seasonally to avoid ice jams and low water flow in the winter and to avoid high water temperature and low water in the summer. Harsh water temperature conditions in the upper Smith River drainage have been well documented. In 2006 and 2007 MFWP instituted time of day angling restrictions on the Smith River due to excessively high water temperature (Grisak et al. 2008). In 2006 water temperature in the upper Smith River was measured over $70^{o}$F in June, July and August. During these three months, there were 30 days when water temperature was 73 degrees or greater, and 8 of those 30 days had temperatures greater than 75 degrees. The maximum temperature recorded was $78.07^{o}$F, which occurred on July 22 and July 28. In compliance with department policy, MFWP recommended and subsequently implemented time-of-day angling restrictions for the entire Smith River from noon to midnight between July 31 and September 15. In 2007 the maximum temperature recorded in the upper Smith River was 81.02 degrees, which occurred on July 18. There were 48 days during June, July and August in which temperature was greater than 70 degrees. All 31 days of July had water temperature over 70 degrees, and 30 of those had temperatures over 73 degrees.

Although some fish in this study moved to establish new home sites, we did not document seasonal movements during winter or summer months. All fish that established new home sites did so only after spawning seasons. It is possible that critical habitat conditions during the study period did not reach levels that would affect fish behavior. Comparing the river flow and water temperature (measured at the Eagle Creek gage) from 1997-2009 to our study period (2010-2011) showed mean flow during the study period was 245% of the pre-study flow and maximum temperature was 76% of the pre study temperature. Higher mean flows and cooler water temperature likely influenced trout behavior during the study period and likely explains why we did not measure seasonal non-spawning movements.

During our study only two fish, both brown trout, from the Canyon Ranch section moved upstream to near the confluence of the North and South forks of the Smith River. It is possible that these fish were seeking refuge from ice and low flows in the winter months, because the South Fork Smith is thermally elevated from natural hot springs in the area. However, these fish did not display season movements away from these sites. Relocations of these two fish were sporadic despite considerable effort to locate them throughout the study, so making judgments about their behavior would be difficult.

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