

# Arctic Grayling Monitoring Report 2013



*Tomellari*

*Emily Cayer*  
*Austin McCullough*



**Montana Fish,  
Wildlife & Parks**

**Dillon Field Office**

**January 1, 2014**

---

Submitted To:

Fluvial Arctic Grayling Workgroup  
U.S. Beaverhead-Deerlodge National Forest  
U.S. Bureau of Land Management  
Montana Chapter, American Fisheries Society  
Montana Council, Trout Unlimited  
U. S. Fish and Wildlife Service

## **Acknowledgements**

The following individuals and organizations contributed valuable assistance to Arctic grayling conservation efforts in Montana in 2013. From Montana Fish, Wildlife and Parks (FWP): Jim Olsen, Matt Jaeger, and Pat Clancey provided technical, program and fieldwork guidance. Scott Lula, Lucas Bateman, Ethan Lula, Brook Johnson, Travis Lohrenz, Tim Weiss, Christine Marozick, and Trevor Selch assisted with field work. Bruce Rich and Travis Horton reviewed reports, provided technical and administrative guidance and assisted with funding efforts. Karen Zackheim assisted with budget and funding efforts. Andy Brummond and Mike McLane provided technical support for water right and instream flow conservation efforts. Jay Pravecek and Chris Phillips assisted with egg-takes, and managed the Arctic grayling brood stock at the Yellowstone River Trout Hatchery. Ken Staigmiller and Marc Terrazas collected and analyzed tissue samples for fish health assessment. Mike Roberts and Russ Gates (Montana Department of Natural Resources Conservation) contributed water right and instream flow expertise to the Big Hole CCAA program. Kyle Tackett, Justin Morris, Dan Durham, Lindsay Walsey, and Trisha Cracraft (Natural Resource and Conservation Service) assisted conservation efforts by administrating an Environmental Quality Incentive Program with landowners in the upper Big Hole Valley, and assisting with grazing and vegetation monitoring associated with the Big Hole CCAA program. Jim Magee (U.S. Fish and Wildlife Service Partners for Fish and Wildlife Program) provided assistance with habitat improvement projects, and funding efforts. Jim Boyd (U.S. Fish and Wildlife Service Ecological Services) reviewed annual reports and Big Hole CCAA site-specific conservation plans. Paul Hutchinson (Bureau of Land Management) assisted with funding efforts. Jim Brammer and Darin Watschke (U.S. Forest Service) assisted with funding efforts. Carter Kruse and the crew of Turner Enterprises monitored the Green Hollow II brood lake and maintained a barrier and trap on Green Hollow Creek. We appreciate the efforts of the Big Hole Watershed Committee, The Ruby Watershed Council, Big Hole River Foundation, The Nature Conservancy, Avian Science Center, and Trout Unlimited (TU) for promoting conservation actions and supporting this program. We especially thank the Big Hole landowners that participated in Big Hole CCAA conservation efforts. We would like to thank all funding sources for support and contributions in 2013, which was provided by FWP, NRCS, TU, PPL Montana, BLM, USFWS (State Wildlife Grants), USFWS Partners for Fish and Wildlife Program and the Big Hole Watershed Committee.

# **Table of Contents**

Acknowledgements.....	i
Table of Contents.....	ii
Arctic Grayling in Montana	
I. Introduction.....	1
II. Legal Status of Arctic Grayling in Montana.....	1
III. Big Hole River Arctic Grayling Population.....	2
A. Introduction.....	2
B. Big Hole Watershed Habitat Monitoring.....	4
Stream Water Temperature.....	4
Methods.....	4
Results.....	5
Stream Flow Monitoring.....	7
Methods.....	7
Results.....	7
C. Recolonization Efforts.....	8
Introduction.....	8
Methods.....	8
Results.....	9
D. Big Hole Arctic Grayling Population Monitoring.....	11
Methods.....	11
Results.....	14
IV. Upper Ruby River Arctic Grayling Population.....	15
A. Introduction.....	15
B. Ruby Watershed Habitat Monitoring.....	16
Stream Temperature Monitoring.....	16
Methods.....	16
Results.....	17
Stream Flow Monitoring.....	19
Methods.....	19
Results.....	19
C. Upper Ruby River Arctic Grayling Population Monitoring.....	19
Methods.....	19
Results.....	21
V. Fluvial Arctic Grayling Brood Program.....	22
A. Introduction.....	22
B. Big Hole Gamete Collections.....	22
C. Axolotl Lake Fluvial Arctic Grayling Brood Reserve.....	22
Introduction.....	22
Methods.....	23
Results.....	23
D. Green Hollow II Fluvial Arctic Grayling Brood Reserve.....	23
VI. Literature Cited.....	24
VII. Appendices.....	26

Appendix II. All fish species captured by reach during Big Hole River surveys .....26  
Appendix II. All fish species captured by reach during Big Hole River trib. surveys. ....26

# **Arctic Grayling In Montana**

## **I. Introduction**

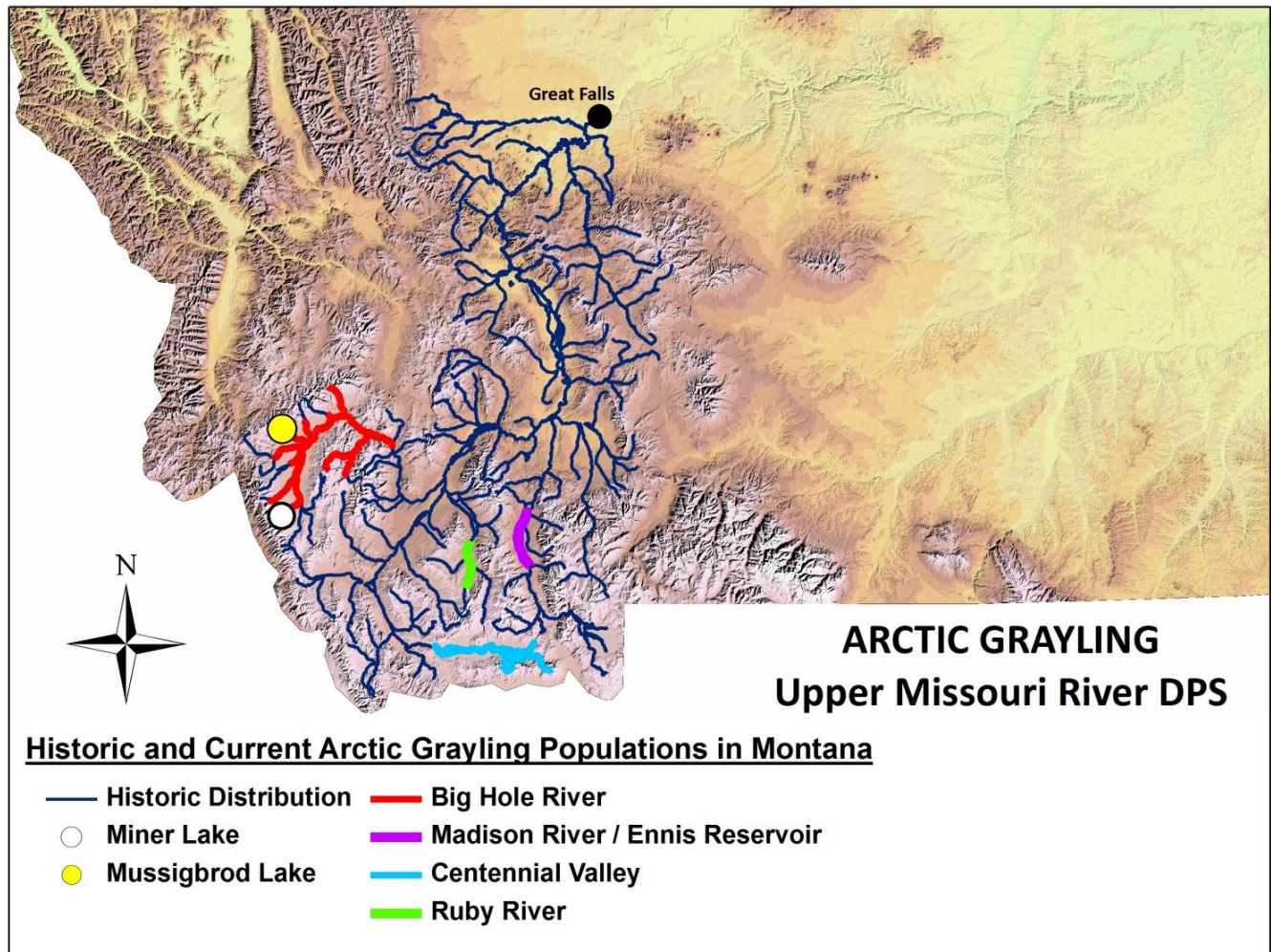
Arctic grayling *Thymallus arcticus* (grayling) in Montana exist at the southern extent of their range and are genetically distinct from grayling populations in Alaska and Canada (Kaya 1990, Petersen and Ardren 2009). Montana grayling populations exhibit both fluvial (stream dwelling) and adfluvial (lake dwelling) life history forms. Fluvial populations in Montana historically occupied waters in the Missouri River drainage upstream from Great Falls, Montana (Figure 1). Adfluvial populations historically were present in lakes in the Red Rock River watershed and the Big Hole River watershed (Figure 1). Currently, Montana grayling inhabit less than four percent of their historic range. Declines in native fluvial and adfluvial grayling populations in Montana over the past 30 years have led to numerous management, conservation and research actions.

## **II. Legal Status of Arctic Grayling in Montana**

Arctic grayling populations inhabiting historic waters in Montana are designated as a “Species of Special Concern” by Montana Fish, Wildlife & Parks (FWP), the Endangered Species Committee of the American Fisheries Society (AFS), the Montana Chapter of the American Fisheries Society (MCAFS), and the Montana Natural Heritage Program (Holten 1980, MNHP 2004). The United States Forest Service (USFS) and the Bureau of Land Management (BLM) classify fluvial grayling in Montana as a “Sensitive Species.”

In October 1991, the United States Fish and Wildlife Service (USFWS) received a petition to list fluvial grayling in the upper Missouri River system for protection under the Endangered Species Act (ESA). In 1994, the USFWS finding classified the distinct population segment (DPS) of fluvial grayling in the upper Missouri River system as a Candidate Species - warranted but precluded. This indicated that enough information was available to support a proposal to list the species as threatened or endangered; however, the listing action was precluded by species with greater need (USFWS 1994). In March 2004, the USFWS elevated the fluvial Arctic grayling DPS listing priority number (LPN) from a level nine to a level three (USFWS 2004). This is the highest priority level given to a DPS. The elevation in priority level was based on 1) the distribution of fluvial Arctic grayling represented only four percent of its historic range, and 2) monitoring surveys indicated a decline in fluvial Arctic grayling in the Big Hole River, Montana; a headwater river of the Missouri River. In May 2004, the USFWS received a petition for an emergency listing of fluvial Arctic grayling due to ongoing drought conditions and decreased population abundance. The USFWS announced their finding on the petition April 24, 2007, which removed fluvial Arctic grayling from the candidate species list because they could not be classified as a DPS as defined by the ESA (USFWS 2007). This ruling was challenged in November of 2007. In May 2009, the USFWS initiated a voluntary remand of the 2007 decision and published a notice of intent to conduct a new status review for Arctic grayling that may consider identifying a DPS that included fluvial and/or adfluvial life histories (USFWS 2009). In September 2010, the Federal Registrar (USFWS 2010) reported that fluvial and adfluvial grayling qualified as a ‘listable’ entity in accordance with the DPS Policy of the ESA. Genetic analysis (Peterson and Ardren 2009) of the five known native fluvial and adfluvial grayling populations (Figure 1) determined that both life history forms share recent evolutionary history, and genetic grouping was not segregated by life history type. The USFWS determined that a single DPS, known as the Missouri River DPS of Arctic grayling, was appropriate for Montana grayling. The existing and projected biological, environmental, and management conditions surrounding Arctic grayling were considered before determining the Missouri River DPS of grayling warranted listing as “threatened” or “endangered” under the ESA. The Missouri River DPS of grayling again received a LPN of three, and was precluded by higher priority listing actions. As part of a court settlement, the USFWS agreed to make final determinations on a variety of Candidate species, including Arctic grayling. The USFWS initiated an assessment in November 2013 and will either

remove Arctic grayling from the Candidate list or release a proposed rule to list Arctic grayling as either Threatened or Endangered by the end of September 2014.



**Figure 1.** Historic Arctic grayling distribution in Montana. Fluvial populations (blue) occupied the Missouri River drainage upstream of Great Falls, MT. Adfluvial populations (Red) occupied habitat in the Big Hole and Centennial watersheds.

### III. Big Hole River Arctic Grayling Population

#### A. Introduction

The Big Hole River is home to the last known native fluvial grayling population in the contiguous United States. Decline in the population’s abundance and distribution was first documented in the 1980s, resulting in increased efforts to understand population dynamics, identify critical habitats, and implement conservation projects to address limiting factors. These efforts have been directed primarily through the Arctic Grayling Recovery Program (AGRP) and the Candidate Conservation Agreement with Assurances for Fluvial Arctic Grayling in the Upper Big Hole River (Big Hole CCAA).

The AGRP was formed in 1989 after declines in the Big Hole River Arctic grayling population raised concerns among fishery managers and conservationists. The goals of the program are to: 1) address ecological factors limiting grayling populations, such as habitat quality and connectivity, population viability, and range-wide

distribution , 2) develop relationships that promote conservation actions, and 3) inform the general public of grayling conservation efforts and status. The AGRP is comprised of representatives from FWP, BLM, USFS, USFWS, MNHP, MCAFS, Montana State University, University of Montana, Montana Trout Unlimited (TU), PPL Montana, and the National Park Service.

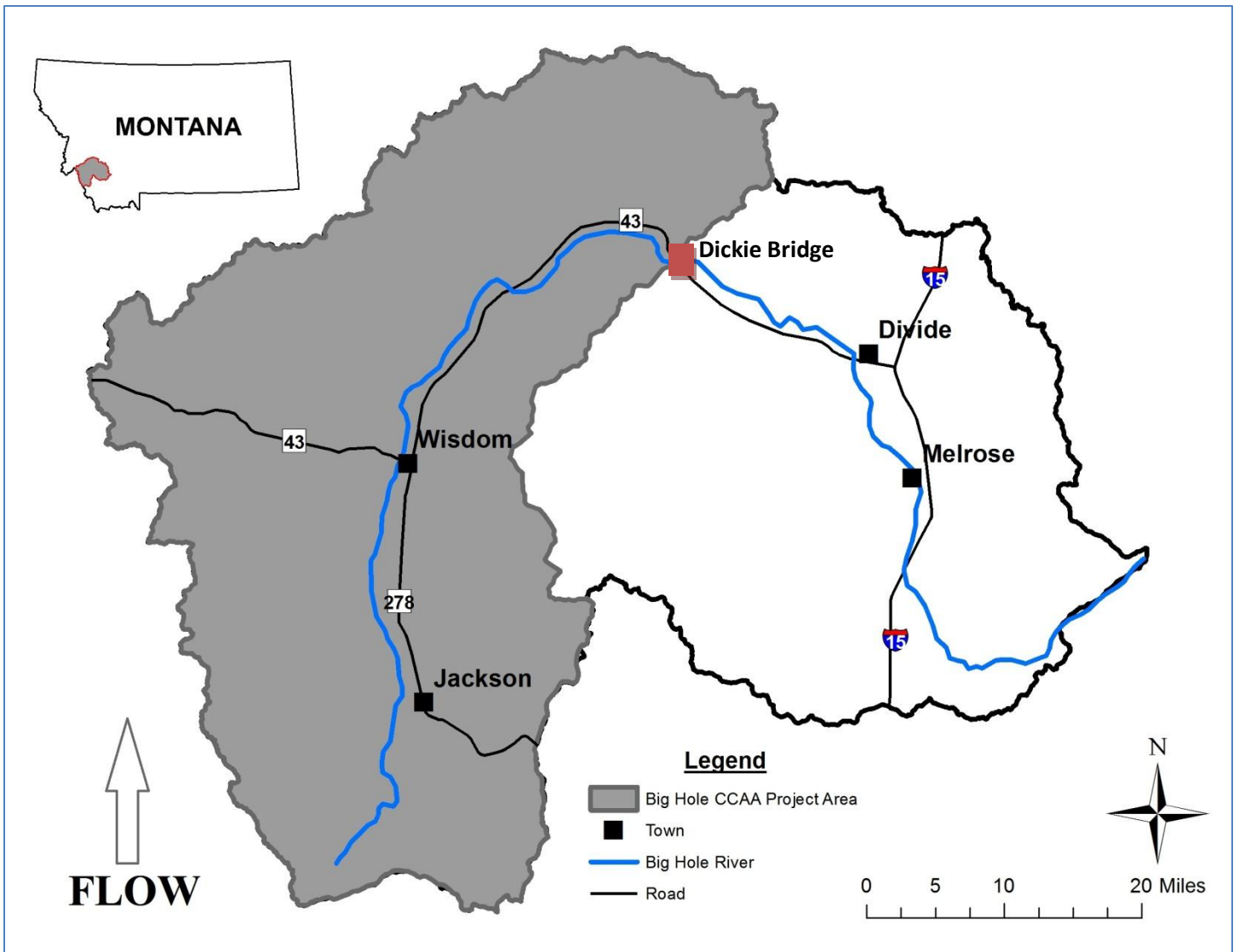
The Big Hole CCAA was developed to help alleviate private property concerns associated with the potential ESA listing of Montana grayling and to generate support from private landowners to improve habitat conditions for grayling throughout the Big Hole CCAA project area (project area; Lamothe and Magee 2007). The project area includes the Big Hole River watershed from Dickie Bridge upstream to the headwaters (Figure 2). Under this agreement the USFWS issued FWP an ESA section 10(a)(1)(A) Enhancement of Survival Permit, which gave FWP the authority to enroll non-federal landowners within the project area. Enrolled non-federal landowners (N = 30) are provided incidental take coverage and regulatory assurances once the non-federal landowner, FWP and the USFWS counter-sign the Certificate of Inclusion and a site-specific conservation plan for the enrolled property (Lamothe and Magee 2007). Site-specific conservation plans are developed for each enrolled landowner by an interdisciplinary technical team made up of individuals representing the Big Hole CCAA partnering agencies (FWP, DNRC, NRCS, and USFWS; hereafter, collectively referred to as the Agencies). Conservation measures outlined in the Big Hole CCAA document (FWP and USFWS 2006) are addressed by in each site-specific plan by implementing actions that:

- 1) Improve stream flows.
- 2) Improve and protect the function of riparian habitats.
- 3) Identify and reduce or eliminate entrainment threats to grayling.
- 4) Remove barriers to grayling migration.

Grayling conservation objectives initiated through the AGRP and the Big Hole CCAA within the Big Hole River watershed from January 1 through December 31, 2013 were to:

- 1) Develop and implement site-specific conservation plans on private properties enrolled in the Big Hole CCAA.
- 2) Promote and initiate projects through the Big Hole CCAA that address riparian habitat and stream channel function, fish passage, stream flow dynamics, and entrainment.
- 3) Develop and promote landowner relationships and continually educate the public and interest groups on the conservation needs and status of Montana grayling.
- 4) Monitor water temperature, instream flow, and habitat parameters related to habitat improvement projects within critical stream reaches for grayling in the Big Hole River watershed, and as required by the Big Hole CCAA.
- 5) Monitor abundance and distribution of grayling and native and sport fish species in the upper Big Hole River watershed.
- 6) Recolonize grayling into restored habitats in Rock Creek and the Upper Big Hole River using remote site incubators (RSIs).





**Figure 2.** The Big Hole CCAA project area within the Big Hole River watershed.

## **B . Big Hole River Watershed Habitat Monitoring**

### **Stream Water Temperature**

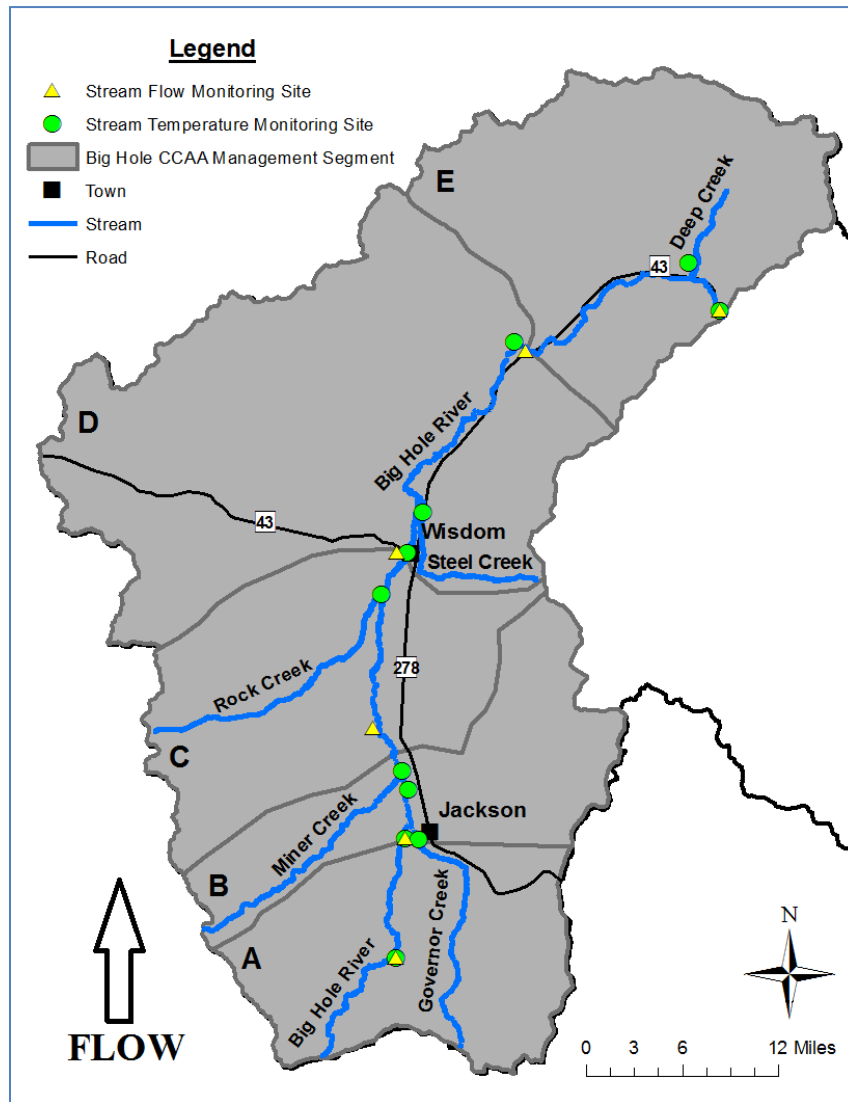
#### **Methods**

In 2013, FWP collected stream temperature data at 11 locations (six mainstem and five tributary) in the upper Big Hole watershed (Figure 3). Stream temperature data were collected at the upper boundary of the Big Hole CCAA project area and at one mainstem and one tributary location within each Big Hole CCAA management segment (A – E; Figure 3). Stream temperature data were collected in the Big Hole River at Saginaw Bridge, Miner Lakes Road, the confluence with Miner Creek, Wisdom Bridge, Mudd Creek Bridge, and Dickie Bridge. Big Hole River tributary sites included Governor Creek, Miner Creek, Rock Creek, Steel Creek, and Deep Creek.

Stream temperature data were recorded at 30-minute intervals from May 1 through October 1. Data were summarized as daily minimum, maximum and mean, maximum and mean for the period monitored (May 1 – October 1) and hours and days exceeding 70° and 77° Fahrenheit (Table 1). Seventy degrees Fahrenheit



represents the thermal stress threshold for salmonid species (Behkne 1991), and 77° Fahrenheit represents the upper incipient lethal temperature for Arctic grayling (Lohr et al. 1996).



**Figure 3.** Location of stream temperature monitoring sites (green circle), stream flow monitoring sites (yellow triangle) in the Big Hole CCAA project area.

## Results

The water temperature data logger was lost from the Big Hole River at Mudd Creek Bridge monitoring site and removed from the stream on July 13 at the Steel Creek monitoring site. The Big Hole River at Dickie Bridge maintained the highest mean seasonal temperature (59.0° Fahrenheit; Table 1) and Steel Creek reached the highest maximum seasonal temperature (79.0° Fahrenheit; Table 1). Governor Creek, Steel Creek, and the Big Hole River at Dickie Bridge monitoring sites exceeded the upper incipient lethal temperature for grayling (77° Fahrenheit; Table 1).

**Table 1.** Stream temperature monitoring sites in the Big Hole River watershed in 2013, and the seasonal mean and maximum temperature and cumulative hours exceeding 77° Fahrenheit for each monitoring site.

<b>Monitoring Site (Big Hole CCAA Management Segment)</b>	<b>Mean Seasonal Temperature (degrees Fahrenheit)</b>	<b>Maximum Seasonal Temperature (degrees Fahrenheit)</b>	<b>Cumulative Hours Exceeding 77° Fahrenheit</b>
Saginaw Bridge (upper project area boundary)	51.2	66.8	0
BHR CCAA (A)	53.9	70.5	0
Governor Creek (A)	56.8	78.7	12
BHR CCAA (B)	55.9	73.3	0
Miner Creek (B)	56.1	75.2	0
BHR CCAA (C)	58.6	76.0	0
Rock Creek (C)	56.8	69.8	0
BHR CCAA (D)	NA	NA	NA
Steel Creek (D)*	57.4	79.0	12
BHR CCAA (E)	59.0	77.5	10
Deep Creek (E)	56.0	74.2	0

\* Steel Creek water temperature data was summarized for the period May1 through July 13.

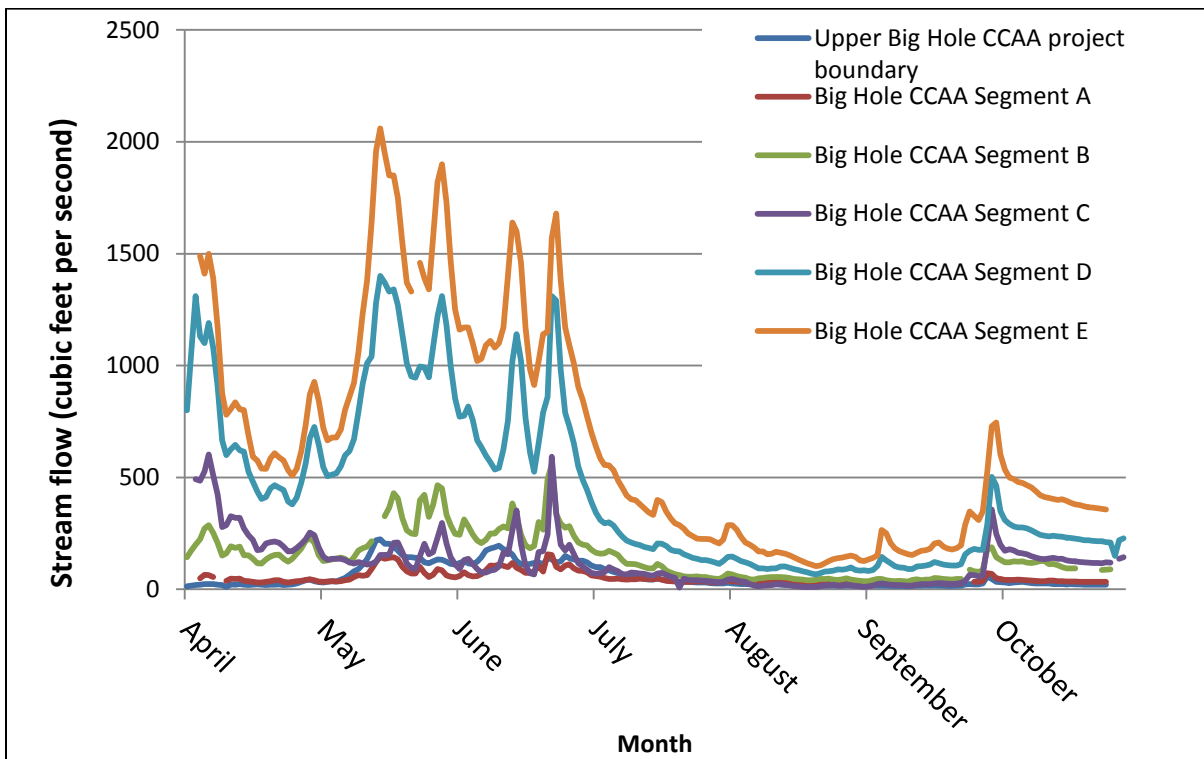
# Stream Flow Monitoring

## Methods

In 2013, the DNRC and U.S. Geological Survey (USGS) managed six real-time stream flow monitoring sites in the project area (Figure 3). Stream flow data was collected at the upper boundary of the project area (Saginaw Bridge) and at the lower boundary of each Big Hole CCAA management segment (A – E). Water stage height data was recorded in 15-minute intervals and reported online at [www.usgs.gov](http://www.usgs.gov). Big Hole CCAA managers depend on this network of stream flow data to implement stream flow conservation actions.

## Results

Snowpack and precipitation data were retrieved from the National Resource Conservation Service website ([www.nrcs.gov](http://www.nrcs.gov)) and based on the period of record, 1981-2010. The Big Hole basin snowpack was 89% of average for 2013. Spring precipitation (April – June) in the upper Big Hole basin was 92% of average. Below average snowpack and spring precipitation resulted in streamflows below Big Hole CCAA flow targets ranging from zero (Management Segment E) to 40 days (Management Segment C) during May and June. July and August precipitation in the upper Big Hole basin was 48% of average resulting in 4 (Management Segment E) to 67 days (Management Segment C) below CCAA targets between July and October. Precipitation and streamflow recovered dramatically in mid-September due to September-October precipitation that was 377% of average. To mitigate streamflows below the Big Hole CCAA flow targets, 11 landowners returned 260 cubic feet per second of irrigation and stock water to the Big Hole River and its tributaries.



**Figure 4.** 2013 Big Hole River stream flow data collected at real-time gaging stations at the upper Big Hole CCAA project area boundary (Saginaw Bridge), and the lower boundary of each Big Hole CCAA management reach (Miner Lakes Road, mouth of Miner Creek, Wisdom Bridge, Mudd Creek Bridge and Dickie Bridge).

## **C. Grayling Recolonization Efforts**

### **Introduction**

Historic grayling population data from the mid-1980's show that the upper Big Hole River and Governor Creek once supported between 1 and 8 grayling per mile, and Rock Creek (located upstream of Wisdom), historically held in excess of 50 grayling per mile. Because of degraded habitat and stream flow conditions, Arctic grayling have not been documented in these locations since the late 1980's. Conservation activities in recent years have been directed at improving habitat conditions in tributaries and on the mainstem Big Hole River in the upper portion of the basin. Since 2006, approximately 11 miles of riparian fence was installed, 4.5 miles of stream channel restoration was completed, 5 bridges replaced non-functioning culverts, 9 fish ladders were installed to improve fish passage, 11 irrigation improvement projects and 7 stock water systems were installed to increase instream flow, and riparian areas were treated for noxious weeds.

During pre-project planning, FWP proposed to assist grayling recolonization into Rock Creek if it did not occur naturally in three years (one generation). Monitoring efforts from 2006 – 2009 in Rock Creek to document grayling utilization following restoration included electrofishing, trapping, and tagging techniques, and resulted in the capture of only one grayling. In 2010, FWP initiated grayling recolonization efforts into Rock Creek (Figure 5).

Monitoring efforts from 2006- 2012 in the Upper Big Hole River and Governor Creek resulted in the capture of zero grayling, indicating that natural recolonization into these reaches had not occurred, or did so at low levels. As a result, FWP initiated a project to assist grayling recolonization into the Upper Big Hole River in 2013 to meet the CCAA goal of expanding grayling distribution within 5 years of initiating the CCAA program (Figure 5).

Grayling recolonization efforts in both locations include incubating gametes from the Big Hole fluvial brood stock using remote site incubators (RSI).

### **Methods**

A fluvial grayling brood population was developed in Axolotl Lake using gametes collected from the Big Hole River population. This brood was developed to preserve genetic diversity and provide a source for reintroduction/recolonization efforts. Grayling from the Axolotl Lake brood population were spawned in the spring and fertilized eggs were taken to the Yellowstone River Trout hatchery until eyed stage. Eyed-eggs were then transferred into RSI's installed downstream existing pin and plank diversions at two sites on Rock Creek, one site on Governor Creek, and two sites on the Big Hole River (Figure 5). The irrigation diversions assist to manage stream flows and create a backwater environment favorable to weak-swimming fry (Figure 5). The locations on Rock Creek and Governor Creek were chosen, in part, because they were the lowest points-of-diversion on the stream and minimized the risk of entraining RSI produced grayling into irrigation systems.

Remote site incubators were monitored daily to ensure operation and observe egg condition and development. Adjustments were made to incubators, as needed, to flush inlet pipes or adjust water levels. Emerged fry and their relative abundance and distribution were recorded.

On July 3, August 14, and September 24, electrofishing surveys were completed on 2.2 miles of irrigation ditch from five PODs on Rock Creek, Governor Creek and the Big Hole River to quantify entrainment of grayling into irrigation ditches associated with recolonization sites (Figure 5).

Population monitoring survey were completed on the Big Hole River CCAA management section A (9/25), Governor Creek (9/27), and Rock Creek (10/23) to quantify the number of grayling produced from RSIs and survived for at least 3 months (Figure 5).

Grayling captured during population monitoring and entrainment surveys were measured for total length (0.1 inches) and weight (0.01 lbs). Grayling greater than six inches in length were implanted with a visible-implant tag (VI tag).

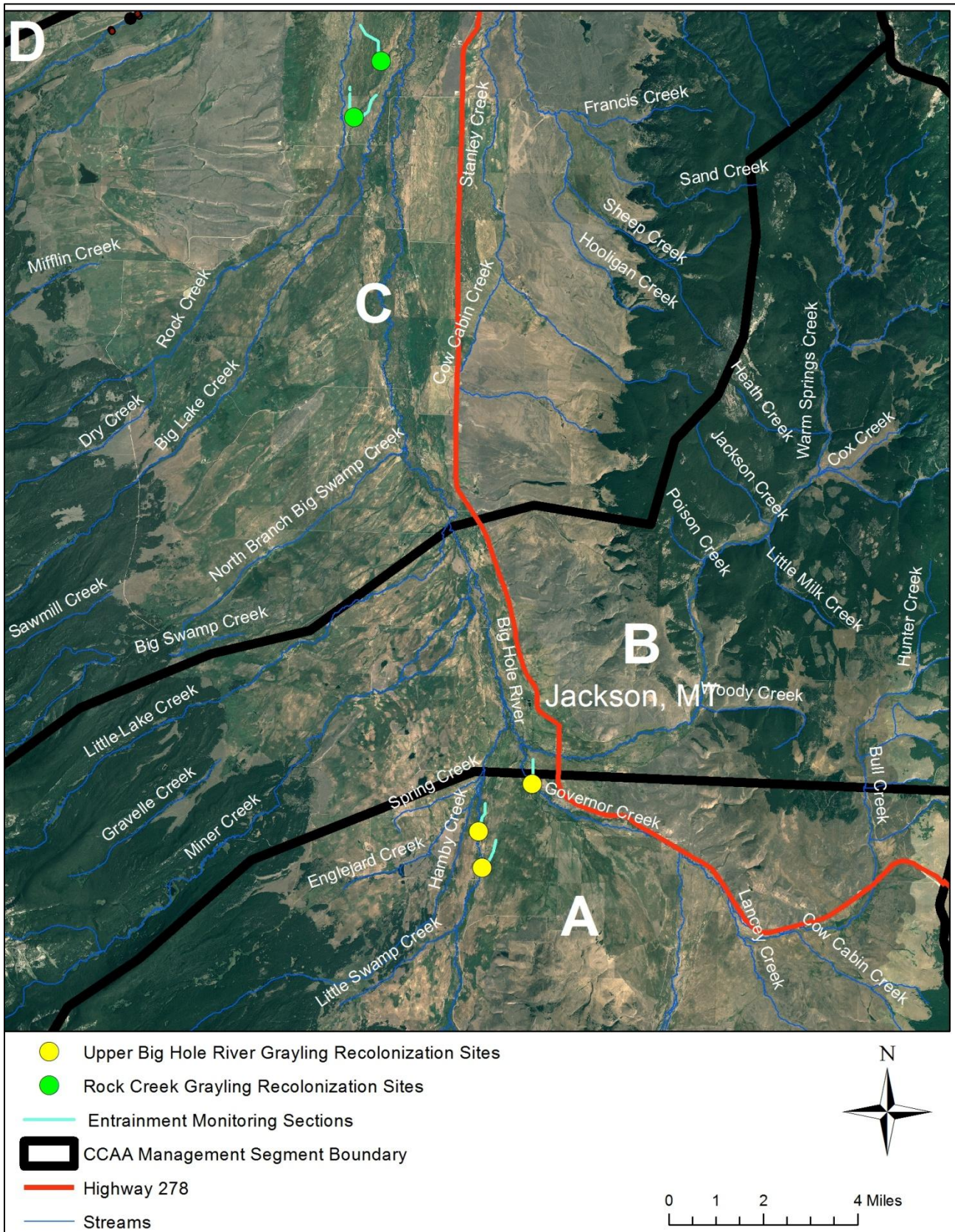
## **Results**

Grayling gametes were collected on May 21 at the Axolotl Lake grayling brood pond. Eggs collected from female grayling (N = 127) were fertilized by milt collected from male grayling (N = 127). Fertilized eggs were transported to the Yellowstone River Trout Hatchery and incubated until eye-up stage. On May 31, 105,000 eggs (50% eye-up) were transported to 20 RSIs at two locations on Rock Creek, 10 RSIs in Governor Creek, and five RSIs at each of the Big Hole River sites (Figure 5). Grayling fry were observed at each site. Initial emergence occurred on June 8 and all grayling fry had emerged by June 16.

On July 3, August 14, and September 24, electrofishing surveys were completed on 2.2 miles of irrigation ditch from five PODs on Rock Creek, Governor Creek and the Big Hole River to quantify entrainment of grayling into irrigation ditches associated with recolonization sites (Figure 5). Six grayling were captured in the Big Hole River ditch and returned to the Big Hole River.

Population monitoring surveys were completed on the Big Hole River (9/25), Governor Creek (9/27), and Rock Creek (10/23) to quantify the number of grayling produced from RSIs and survived for at least 3 months. No grayling were captured in the Big Hole River and Governor Creek reaches. A total of 13 grayling were captured within Rock Creek, including two YOY. Rock Creek recolonization efforts have resulted in an increased relative abundance of grayling in Rock Creek.





**Figure 5.** 2013 Remote site incubator (RSI) locations and entrapment survey reaches on the Upper Big Hole River, Governor Creek and Rock Creek.





**Figure 6.** Remote site incubators were positioned downstream of existing pin and plank diversion structure to alleviate high flow conditions and provide backwater areas for emerging fry.

## **D. Big Hole River Arctic Grayling Population Monitoring**

### **Methods**

In 2013, FWP completed fisheries surveys in the upper Big Hole watershed to meet objectives outlined by the AGRP and Big Hole CCAA. These objectives include assessing Arctic grayling population abundance, distribution, recruitment and age-class structure, and monitoring fisheries response to habitat improvement projects and Big Hole CCAA site-specific conservation actions.

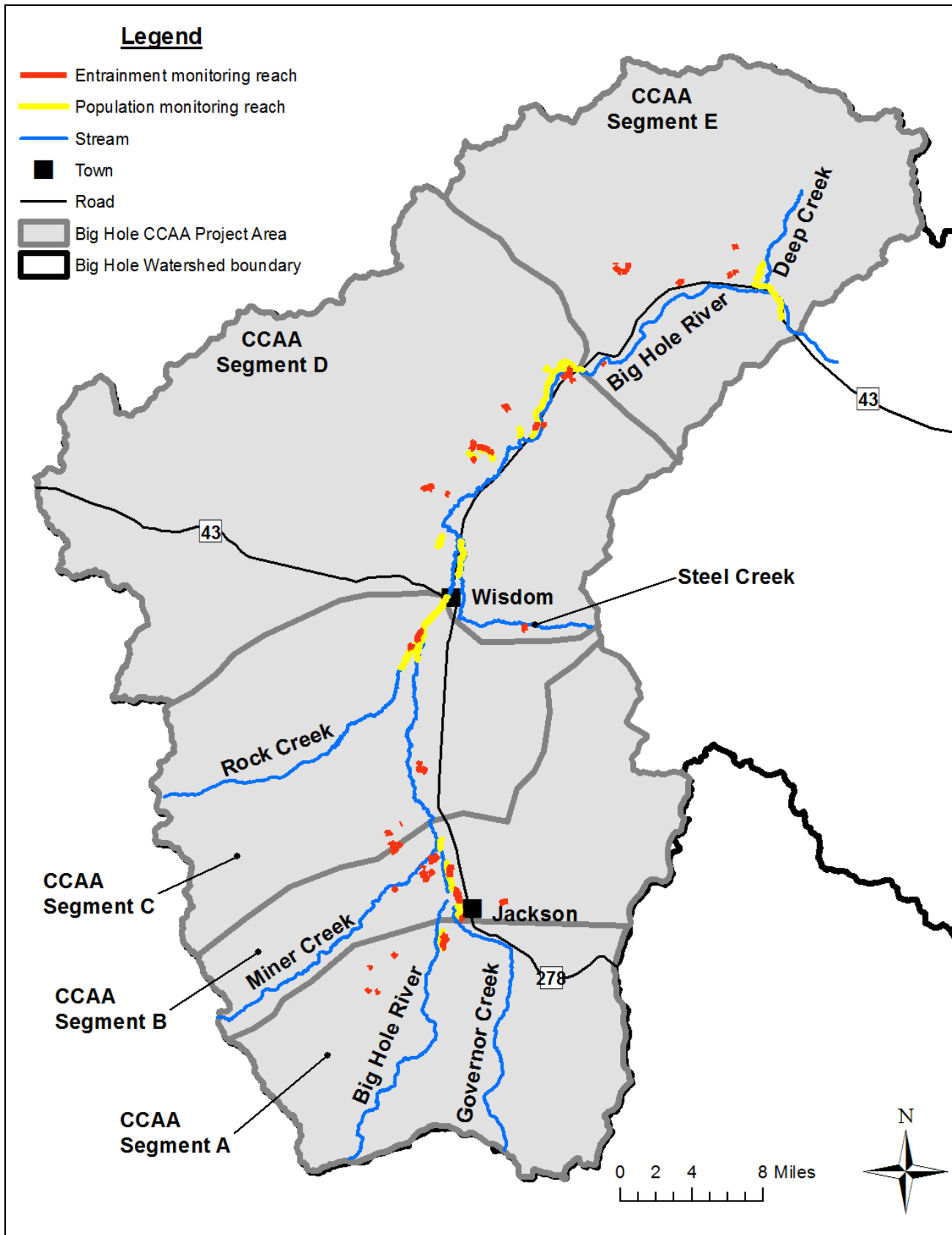
Drift boat or crawdad™ mounted mobile-anode equipment and backpack electrofishing units were used to conduct population monitoring surveys. Arctic grayling and native and sport fish species, including rainbow trout *Oncorhynchus mykiss*, brown trout *Salmo trutta*, brook trout *Salvelinus fontinalis* and burbot *Lota lota* were captured, anesthetized, and measured for total length ( $\pm 0.1$  in) and weight ( $\pm 0.01$  lb). Grayling greater than six inches in total length were tagged with a VI tag in the transparent tissue immediately posterior to the left eye. A genetic sample (fin clip) was taken from 59 YOY Arctic grayling for genetic analysis to estimate the number of reproducing individuals in 2013.

In 2013, FWP conducted population monitoring surveys on five Big Hole River reaches (19.3 miles) and 10 tributary reaches (14.7 miles) in the Big Hole watershed (Figure 7). As part of the Big Hole CCAA monitoring plan, one mainstem and one tributary reach in each Big Hole CCAA management segment (A – E) was sampled. Mainstem reaches were identified as Big Hole CCAA (A-E) and tributary reaches included: Governor Creek (A), Miner Creek (B), Rock Creek (C), Steel Creek (D) and Deep Creek (E). Additional tributary reaches included Swamp Creek, Plimpton Creek, Howell Creek, Pintlar Creek, and Squaw Creek.



Data collected during 2013 electrofishing surveys were summarized with Montana Fish, Wildlife & Parks Fisheries Information System. Catch-per-unit effort (CPUE; fish/mile) data were summarized for single-pass electrofishing effort for each sampling reach. CPUE data were used to track trends in relative abundance and spatial distribution. Grayling length data were summarized using a length-frequency histogram to describe the population age structure (Figure 9), and as CPUE for YOY (< 6.0 inches) and age 1+ (> 6.0 inches) Arctic grayling by sampling reach (Figure 11).

Electrofishing surveys were also conducted in irrigation ditches in the Big Hole River watershed to quantify grayling entrainment. In 2013, FWP surveyed 19.7 miles of irrigation ditch associated with 58 PODs (Figure 7). Arctic grayling captured in irrigation ditches were relocated to the nearest Big Hole River or tributary reach downstream of the irrigation ditch responsible for the entrainment (FWP and USFWS 2006).

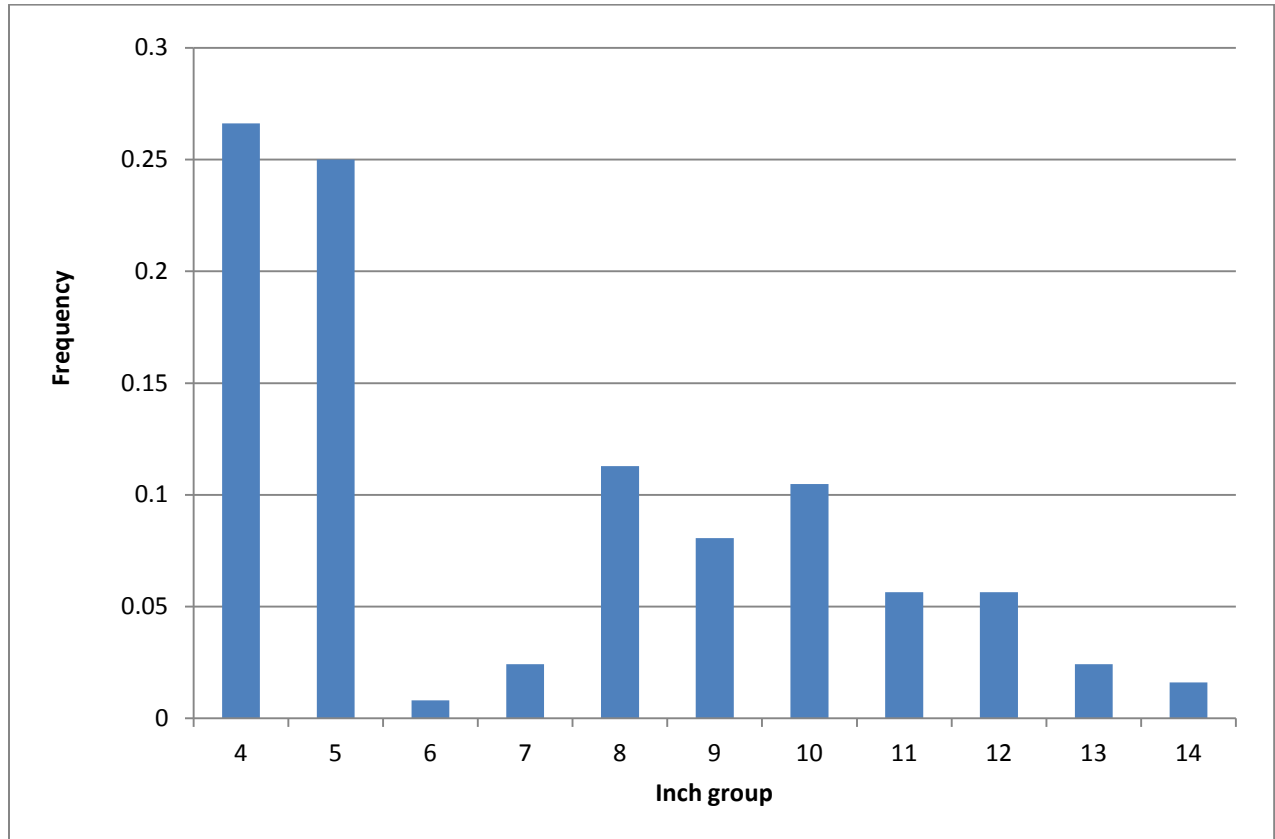


**Figure 7.** 2013 population monitoring and entrainment survey reaches completed in the Big Hole watershed.

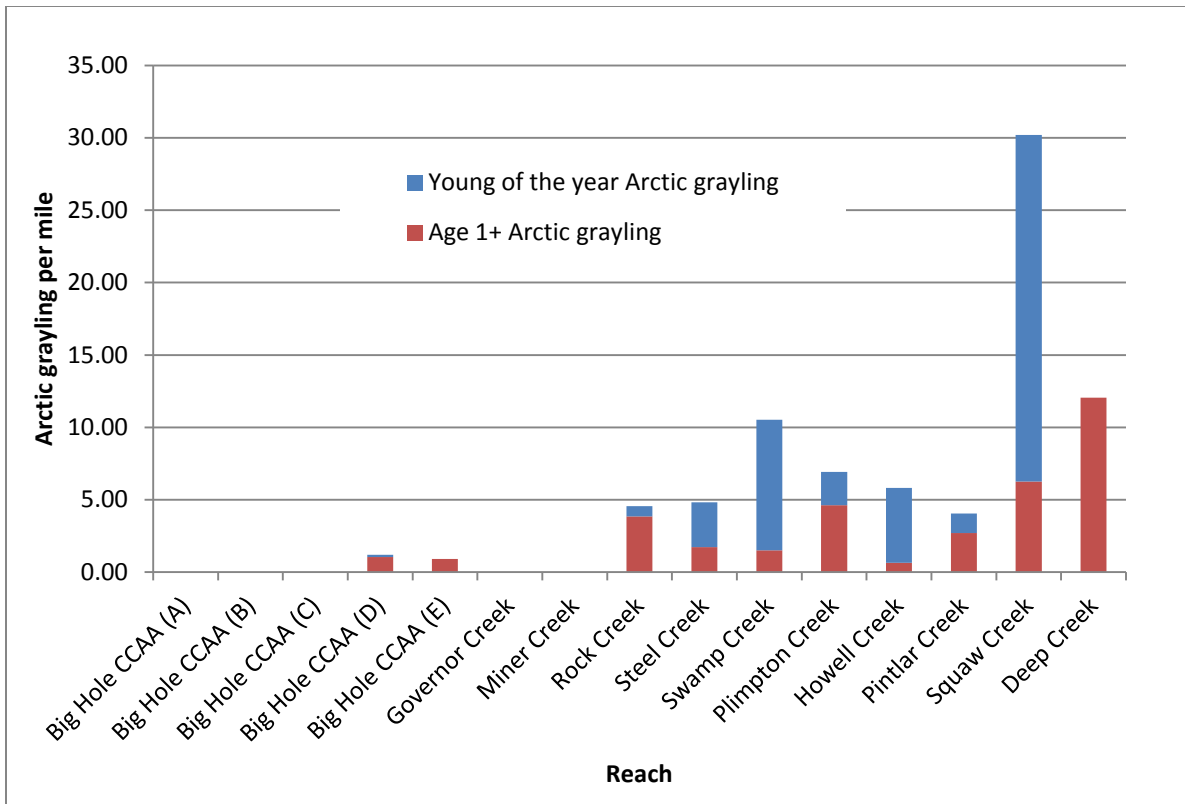
## Results

Population monitoring surveys resulted in the capture of 118 Arctic grayling. Half of the captured grayling were age-1 and older (N=59; >6 inches in length) and half were YOY (N=59; <6 inches in length; Figure 9). Despite greater effort in Big Hole River reaches (19.3 miles) than in tributary reaches (14.7 miles), a considerably higher number of grayling were captured in tributary reaches (N=108; Figure 11) than Big Hole River reaches (N=10; Figure 10). CPUE was lower in the Big Hole River reaches primarily due to unseasonably high water during population monitoring surveys (late September) (see Figure 4).

Entrainment monitoring surveys resulted in the capture of six grayling.



**Figure 9.** Length-frequency histogram for Arctic grayling captured during 2013 population monitoring and entrainment surveys in the upper Big Hole watershed (N = 124).



**Figure 10.** Young-of-the-year and age-1+ Arctic grayling captured per during 2013 population monitoring surveys.

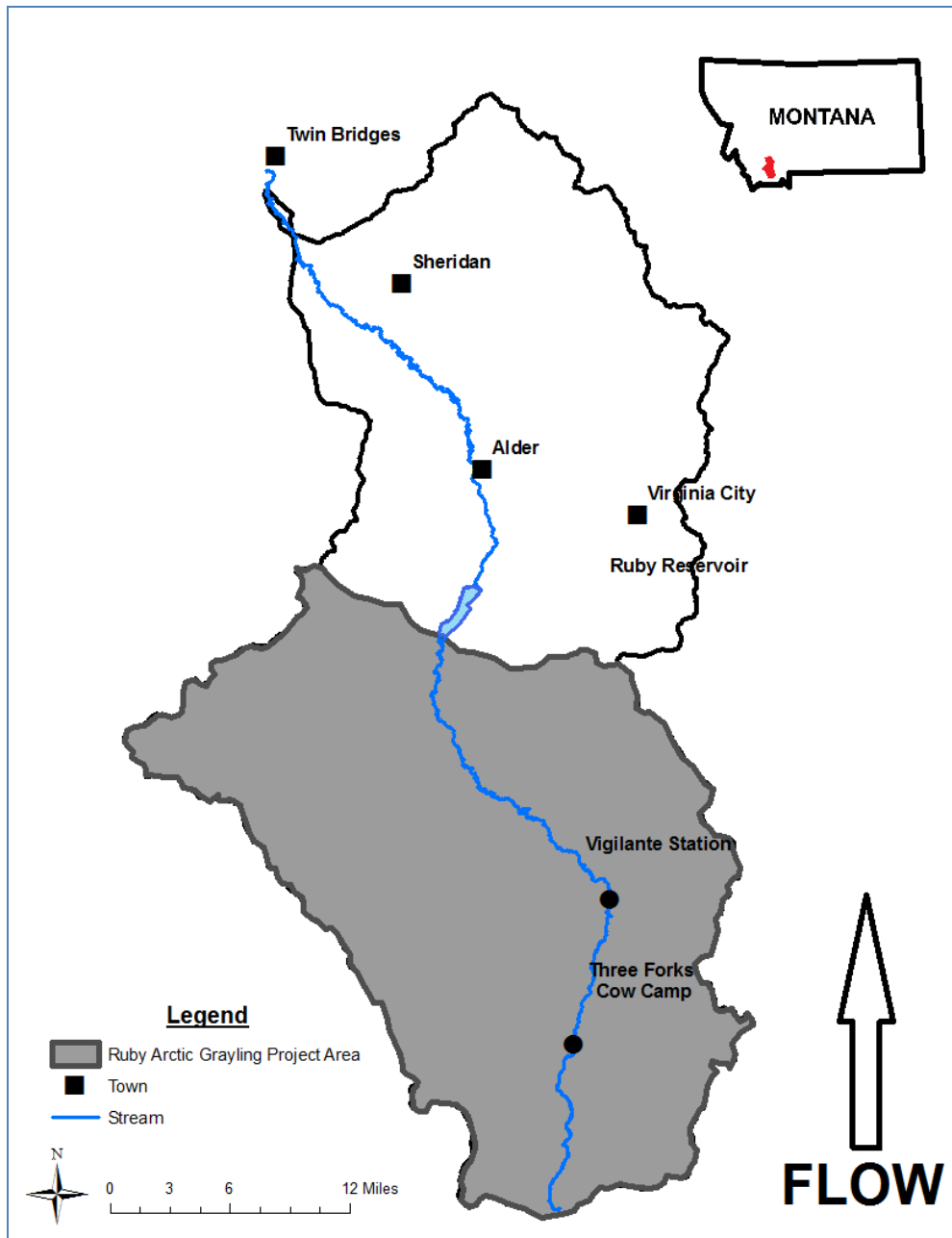
## IV. Upper Ruby River Arctic Grayling Population

### A. Introduction

One of the AGRP objectives is to establish fluvial grayling populations within the historic range (Fluvial Arctic Grayling Recovery Plan 1995). The Ruby River, upstream of Ruby Reservoir, was identified as suitable for fluvial grayling restoration due to its size, low gradient and relative low density of non-native salmonid species (Kaya 1992; Figure 11). Reintroduction efforts in the upper Ruby River began in 1997. Age 0, 1 and 2 hatchery reared grayling were stocked into the upper Ruby River from 1997 to 2005. In 2003, FWP began using remote site incubators (RSI) to supplement stocking efforts. From 2006 – 2008, grayling reintroduction efforts were supported solely by RSIs. Grayling eggs for Ruby River reintroduction efforts were taken from the Big Hole River Arctic grayling brood populations.

In 2009, FWP determined that the Ruby River grayling population had reached abundance, distribution and age-class structure thresholds that could potentially support a viable, self-sustaining population. As a result, 2008 was the final year of reintroductions using RSIs.

In 2013, population monitoring efforts evaluated abundance, distribution, age-class structure, and the occurrence of natural reproduction of the established population.



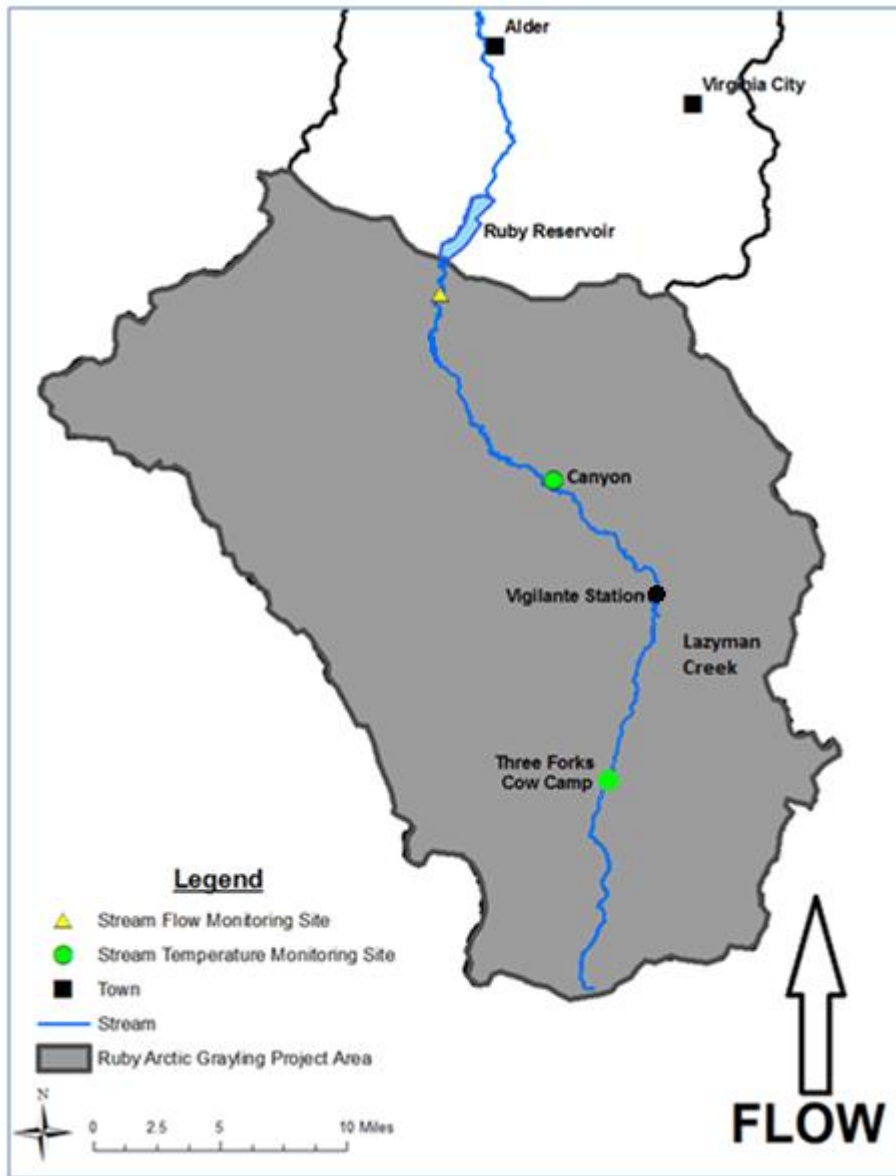
**Figure 11.** The Arctic grayling reintroduction area within the upper Ruby River watershed.

## **B. Ruby River Watershed Habitat Monitoring**

### **Stream Temperature Monitoring**

#### **Methods**

Water temperature data was collected at two locations (Canyon and Three Forks) in the upper Ruby River watershed to characterize stream water temperatures in the reintroduction area (Figure 12). Temperature loggers recorded data at 30-minute intervals and data were summarized as daily minimum, maximum and mean temperature, and hours and days exceeding 70° and 77° Fahrenheit. Seventy degrees Fahrenheit served as a thermal stress threshold for salmonid species (Behkne 1991), and 77° Fahrenheit represents the upper incipient lethal temperature for Arctic grayling (Lohr et al. 1996).



**Figure 12.** Location of stream temperature monitoring sites (green circle) and stream flow monitoring site (yellow triangle) in the upper Ruby grayling project area.

## Results

Seventy-seven degrees Fahrenheit was exceeded for one hour at each stream temperature monitoring site (Table 2). The Canyon monitoring site had the highest mean seasonal temperature (60.0°F) and Three Forks had the highest maximum temperature (77.5°F).

**Table 2.** 2013 upper Ruby watershed stream temperature monitoring sites summarized as the seasonal mean and maximum temperature and cumulative hours exceeding 77° Fahrenheit.

<b>Monitoring Site (Big Hole CCAA Management Segment)</b>	<b>Mean Seasonal Temperature (degrees Fahrenheit)</b>	<b>Maximum Seasonal Temperature (degrees Fahrenheit)</b>	<b>Cumulative Hours Exceeding 77° Fahrenheit</b>
Canyon	60.0	77.1	1
Three Forks	53.1	77.5	1



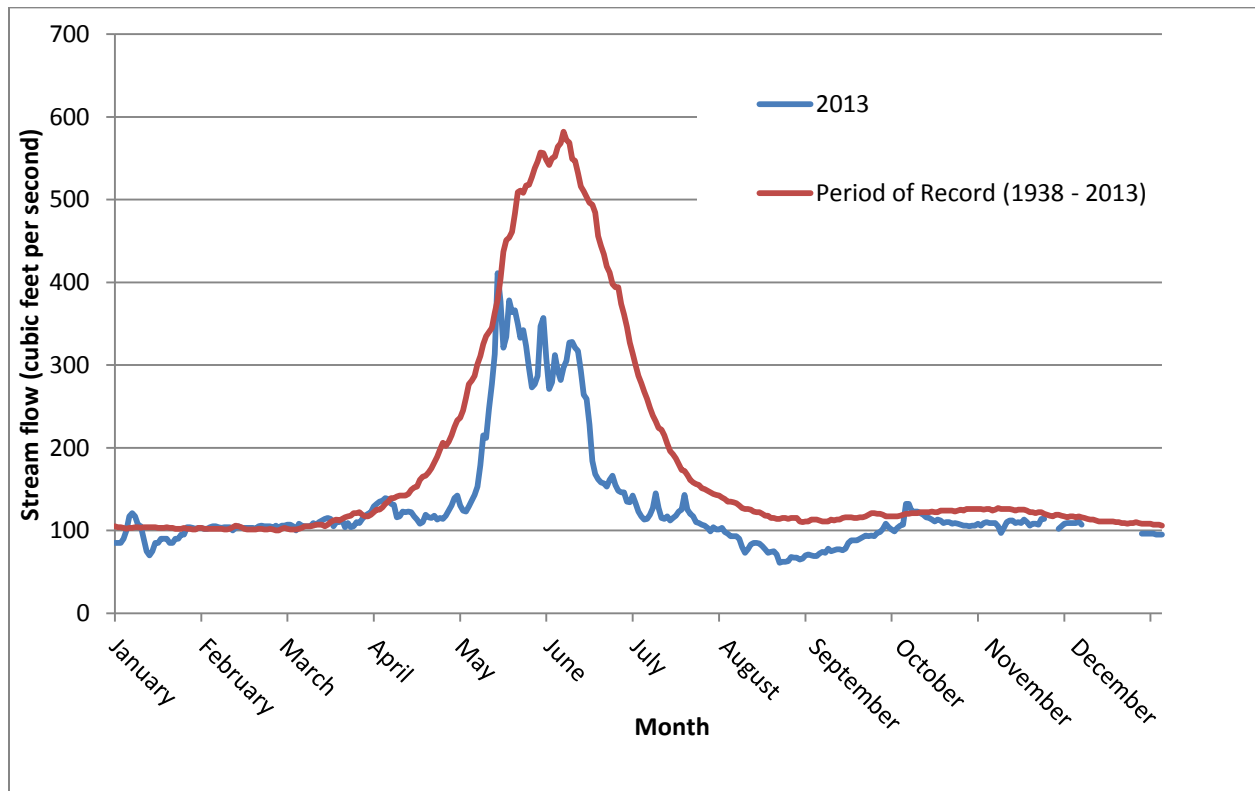
## Stream Flow Monitoring

### Methods

The USGS monitors stream flow in the upper Ruby River at a real-time gaging station directly upstream of the Ruby River Reservoir (Figure 12). Stream flow data are recorded at 15-minute intervals and reported online at [www.usgs.gov](http://www.usgs.gov).

### Results

The USGS continuous stream flow monitoring site upstream of Ruby Reservoir documented a peak mean daily flow of 411 cfs on May 14 (Figure 13).



**Figure 13.** 2013 Ruby River stream flow data recorded above the Ruby River Reservoir.

## Upper Ruby River Arctic Grayling Population Monitoring

### Methods

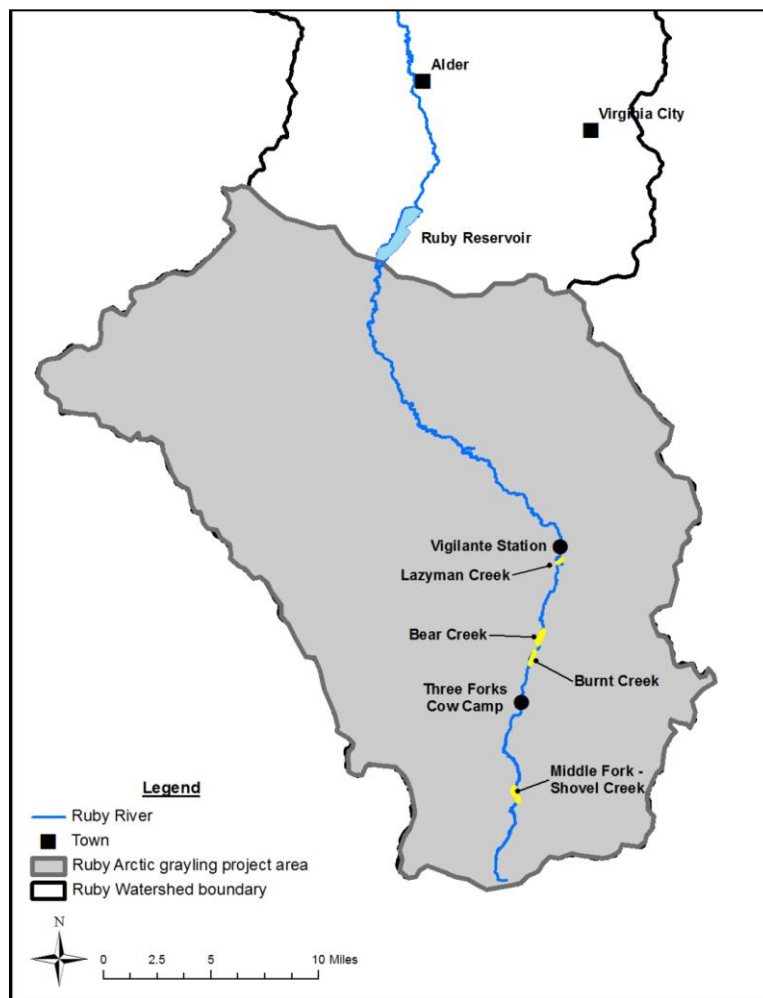
In 2013, FWP completed grayling population monitoring surveys in the upper Ruby watershed to assess abundance, distribution, age-class structure, and the occurrence of natural recruitment. Population monitoring surveys also documented relative abundance of other sport fish species.

Crawdad™ mounted mobile-anode equipment and backpack electrofishing units were used to conduct population monitoring surveys. Arctic grayling and native and sport fish species, including rainbow/cutthroat trout hybrids and brown trout were captured, anesthetized using MS-222, and measured for total length ( $\pm 0.1$

in) and weight ( $\pm 0.01$  lb). A fin clip was taken from all captured grayling for genetic analysis, and grayling greater than six inches in total length were tagged with a VI tag.

In 2013, FWP completed single pass electrofishing surveys on four reaches in the upper Ruby River watershed; two in the mainstem Ruby River, one in the Middle Fork of the Ruby River (Middle Fork), and one Lazyman Creek, a tributary to the Ruby River (Figure 15). Reaches included the Burnt Creek and Bear Creek reaches on the Ruby River, Shovel Creek on the Middle Fork, and the 2007 project reach on Lazyman Creek.

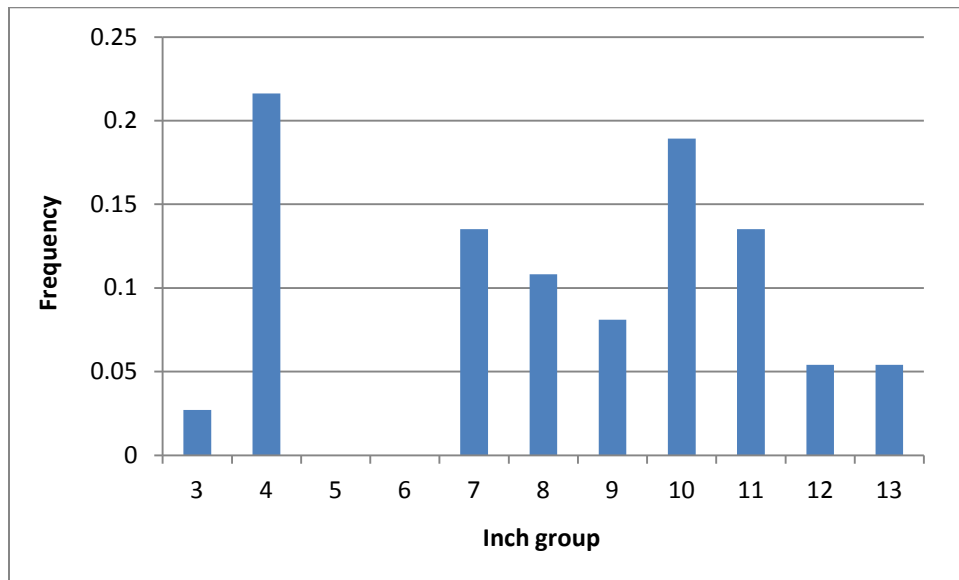
Data collected during 2013 electrofishing surveys were summarized with Montana Fish, Wildlife & Parks Fisheries Information System, and CPUE (fish/mile) estimates were completed for each survey reach. Data were used to track trends in population abundance, spatial distribution, and age-class structure. Grayling data were summarized using a length-frequency histogram to characterize population age structure and monitor the transition from an artificially produced population to a natural population (Figure 15), and CPUE (fish/mile) of YOY ( $< 6.0$  inches) and age 1+ ( $> 6.0$  inches) per reach (Table 3).



**Figure 14.** Montana Fish, Wildlife and Park’s 2013 population monitoring reaches in the upper Ruby River watershed.

## Results

Arctic grayling were captured in all population monitoring reaches, except Lazyman Creek. Distribution encompassed approximately 13 river-miles between the Bear Creek and Middle Fork – Shovel Creek sections. A total of 37 grayling were captured, of which nine were YOY. Presence of YOY verified that natural reproduction had occurred for the fifth consecutive year since supplementation efforts ended in 2008 (Figure 16). Young-of-the-year grayling were captured in Middle Fork – Shovel Creek and Bear Creek reaches (Table 3). Grayling relative abundance was summarized by reach as CPUE with the highest CPUE in the Middle Fork – Shovel Creek reach (Table 3).



**Figure 15.** Length-frequency histogram for Arctic grayling captured during 2013 population monitoring surveys in the upper Ruby River watershed ( N = 37).

**Table 3.** Results of Montana, Fish, Wildlife & Park’s 2013 upper Ruby watershed population monitoring survey results.

Reach	Distance	YOY	YOY/Mile	AGE 1+	AGE 1+/Mile	Total	Total AG/Mile
Middle Fork – Shovel Creek	1.13	1	0.88	3	2.65	4	3.54
Ruby River – Burnt Creek	1.14	0	0.00	8	7.02	8	7.02
Ruby River – Bear Creek	0.58	8	13.79	17	29.31	25	43.10
Lazyman Creek	0.13	0	0.00	0	0.00	0	0.00
Total	2.98	9	3.02	28	9.40	37	12.42

## **V. Big Hole River Arctic Grayling Brood Program**

### **A. Introduction**

A Big Hole River Arctic grayling brood population was developed in 1989. This brood was created to preserve the genetic integrity of fluvial grayling in Montana and to support reintroduction and recolonization efforts (Fluvial Arctic Grayling Recovery Plan 1995). The brood population was created using gametes collected from Big Hole River grayling. Currently, fluvial brood reserve populations are located at Axolotl Lake, and Green Hollow II Reservoir. The grayling brood populations in Axolotl Lake and Green Hollow II Reservoir provide a source for reintroduction or recolonization efforts within the grayling historic range in Montana. Since 1997, the brood populations have been used for reintroduction efforts in the upper Ruby River, North and South Fork of the Sun River, the lower Beaverhead River, the Missouri River headwaters near Three Forks, Montana, and to assist the recolonization of grayling into Rock Creek, Governor Creek, and the upper Big Hole River in the Big Hole watershed.

### **B. Big Hole Gamete Collections**

#### **Methods**

The grayling brood management plan outlines the need to maintain genetic diversity of brood populations by infusing gametes from wild Big Hole grayling every ten years (Leary 1991). In 2010, FWP began those efforts with the goal of collecting gametes from ten pairs (20 individuals) over three years. On April 16 and 30, FWP surveyed the North Fork monitoring section of the Big Hole River to determine grayling spawning activity, and capture grayling for gamete collection.

#### **Results**

Big Hole River grayling gamete collection efforts on the North Fork section of the Big Hole River resulted in the capture of 86 Arctic grayling; 36 males, 27 females, and 22 immature. Eggs were collected from 12 females, fertilized with 18 males, and transported to the YRT Hatchery. Progeny were cultivated in the hatchery and will be planted back into the brood reserve populations at Axolotl Lake and Green Hollow II Reservoir in 2014. The goal of collecting gametes from ten pairs (20 individuals) was met over a four-year period. These efforts will be completed again starting in 2020 to maintain the genetic diversity of the brood populations.

### **C. Axolotl Lake Arctic Grayling Brood Reserve**

#### **Introduction**

The Axolotl Lake brood reserve was started in 1989 and has been critical to grayling conservation efforts in Montana. Each spring FWP collects gametes from the brood reserves for reintroduction or recolonization efforts. The Axolotl brood population has been managed to maintain a balanced age structure and disease free status. Grayling (N = 500 – 1500) not used for reintroduction/recolonization efforts that were produced from the previous year's spawn are returned to Axolotl Lake to create an additional year class and maintain a balanced age structure. To ensure pathogens aren't imported to a new water body during reintroduction/recolonization efforts, annual fish health screening is completed for each brood population prior to transportation; no fish or eggs will be stocked in other waters or allowed into Axolotl Lake if tested positive. No pathogens have been found in the Axolotl grayling brood population. In 2013, fish health screening was conducted, gametes were collected for recolonization efforts in Rock Creek and the Upper Big Hole River, and an additional age class was stocked.

## **Methods**

On May 21, fyke trap and hook-and-line methods were used to capture grayling for gamete collection and pathogen testing. All captured grayling were marked with a temporary fin clip to produce a mark/recapture estimate, measured for total length ( $\pm 0.1$  in) and weight ( $\pm 0.01$  lb) and separated by sex. After eggs were collected and fertilized, grayling were held in a live car to recover and then released in the lake.

## **Results**

A total of 60 grayling were held after spawning for fish health screening. All grayling tested negative for pathogens. A total of 804 Arctic grayling were captured for gamete collection. Average length of captured grayling was 10.8 inches and average fecundity of spawned females was 1,058 eggs. A total of 134,320 eggs were collected from 127 females and fertilized by 127 males. Fertilized eggs were transported to YRT Hatchery and incubated to eye-up stage. On May 30, 105,000 eyed eggs (50% eye-up) were transported to Rock Creek and the Upper Big Hole and placed in RSIs. The remaining grayling were overwintered at YRT Hatchery, and will supplement the grayling brood populations in 2014.

On May 21, age-1 grayling ( $N = 500$ ) were stocked into the Axolotl Lake brood population to ensure the presence of multiple age-classes for future gamete collections. Stocked grayling were from 2012 Big Hole grayling gamete collections.

### **D. Green Hollow II Arctic Grayling Brood Reserve**

Green Hollow II Reservoir is located on Turner Enterprises property near Bozeman, Montana, and supports a grayling brood population derived from Big Hole grayling. The population serves as a genetic reserve for the Big Hole River population and provides gametes for reintroduction and recolonization efforts in Montana.

The Green Hollow II grayling brood population was not used to support reintroduction or recolonization efforts in 2013. As a result, fish health screening did not occur. No grayling were stocked into the brood population.

## VIII. Literature Cited

- Behnke, R.J. 1991. Aquatic conditions: Temperature niches. Page 130 in Stolz, J and Schnell, J., eds. The Wildlife Series: Trout. Stackpole Books, Harrisburg, PA.
- Fluvial Arctic Grayling Workgroup. 1995. Fluvial Arctic Grayling Recovery Plan.
- Holton, G.D. 1980. The riddle of existence: fishes of “special concern”. *Montana Outdoors* 11(1): 2-6.
- Kaya, C.M. 1990. Status report of fluvial Arctic grayling (*Thymallus arcticus*) in Montana. Prepared for Montana Fish, Wildlife & Parks, Helena, MT.
- Kaya, C.M. 1992. Restoration of Fluvial Arctic grayling to Montana streams: Assessment of reintroduction potential of streams in the native range, the upper Missouri River drainage above Great Falls. Prepared for Montana Chapter of the American Fisheries Society, Montana Fish, Wildlife and Parks, U.S. Fish and Wildlife Service, and the U.S. Forest Service.
- Lamothe, P.J, J.P. Magee 2007. Candidate Conservation Agreements with Assurances for Fluvial Arctic Grayling in the Upper Big Hole River. 2007 Annual monitoring report. Submitted to: Fluvial Arctic Grayling Workgroup. Montana Fish, Wildlife & Parks, Bozeman, MT.
- Leary, R. F. 1991. Establishment, Maintenance, and Use of a Genetic Reserve of Big Hole River Arctic Grayling. Brood management Plan
- Lohr, S. C., P.A. Byorth, C.M. Kaya, and W.P. Dwyer. 1996. High temperature tolerances of fluvial Arctic grayling and comparisons with summer water temperatures of the Big Hole River, Montana. *Transactions of the American Fisheries Society* 125:933-939.
- Montana Fish, Wildlife & Parks, Bozeman, Montana. Montana Department of Fish, Wildlife and Parks and the U.S. Fish and Wildlife Service. 2006. Candidate Conservation Agreement with Assurances for Fluvial Arctic Grayling in the Upper Big Hole River.
- Montana Natural Heritage Program. 2004. Montana Animal Species of Concern. Montana Natural Heritage Program and Montana Fish, Wildlife & Parks. Helena, MT.
- Petersen, D.P. and W.R. Ardren. 2009. Ancestry, population structure, and conservation genetics of Arctic grayling (*Thymallus arcticus*) in the upper Missouri River, USA. *Canadian Journal of Fish and Aquatic Science* 66: 1758-1774.
- U.S. Fish and Wildlife Service, Federal Register. 1994. Endangered and Threatened Wildlife and Plants; Finding on a petition to list the fluvial population of the Arctic grayling as endangered. *Federal Register* 59 (141): 37738-37741 (July 25, 1994).
- U.S. Fish and Wildlife Service, Federal Register. 2004. Endangered and Threatened Wildlife and Plants; Review of Species That Are Candidates or Proposed for Listing as Endangered or Threatened; Annual Notice of Findings on Resubmitted Petitions; Annual Description of Progress on Listing Actions Proposed Rules. *Federal Register* 69 (86): 24875-24904.
- U.S. Fish and Wildlife Service, Federal Register. 2007. Endangered and Threatened Wildlife and Plants; Revised 12-month finding for Upper Missouri River Distinct Population Segment of Fluvial Arctic Grayling. *Federal register* 72 (78): 20305-20314.

U.S. Fish and Wildlife Service, Federal Register. 2009. Endangered Threatened Wildlife and Plants; Status Review of Arctic Grayling (*Thymallus arcticus*) in the Upper Missouri River System. Federal Register 74 (207): 55524-55525.

U.S. Fish and Wildlife Service. Federal Register. 2010. Endangered and Threatened Wildlife and Plants; Revised 12-Month Finding to List the Upper Missouri River Distinct Population Segment of Arctic Grayling as Endangered or Threatened. Federal Register 75 (175): 54708-54753.



## IX. Appendix A

**Appendix I.** All fish species captured by reach during 2013 FWP population monitoring surveys in the mainstem Big Hole River.

Big Hole River Reach	Reach Length (Miles)	Arctic Grayling	Brook Trout	Rainbow Trout	Brown Trout	Burbot
Big Hole CCAA (A)	1.33	0	94	2	16	11
Big Hole CCAA (B)	2.51	0	45	3	266	0
Big Hole CCAA (C)	6.32	0	74	3	39	0
Big Hole CCAA (D)	5.83	7	10	6	8	0
Big Hole CCAA (E)	3.28	3	2	42	45	1
<b>Total</b>	<b>19.27</b>	<b>10</b>	<b>225</b>	<b>56</b>	<b>374</b>	<b>12</b>

**Appendix II.** All fish species captured by reach during 2013 FWP population monitoring surveys in Big Hole River tributaries.

Big Hole Tributary Reach	Reach Length (Miles)	Arctic Grayling	Brook Trout	Rainbow Trout	Brown Trout	Burbot
Governor Creek (A)	1.05	0	76	0	38	0
Miner Creek (B)	0.60	0	25	0	4	4
Rock Creek (C)	2.86	13	212	1	0	0
Steel Creek (D)	2.91	14	154	1	2	3
Swamp Creek	1.33	14	na	na	na	na
Plimpton Creek	1.30	9	na	na	na	na
Howell Creek	1.55	9	na	na	na	na
Pintlar Creek	0.74	3	na	na	na	na
Squaw Creek	0.93	29	na	na	na	na
Deep Creek (E)	1.41	17	25	103	49	7
<b>Total</b>	<b>14.71</b>	<b>108</b>	<b>492</b>	<b>105</b>	<b>93</b>	<b>14</b>