Arctic Grayling Monitoring Report
2012

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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 Category One 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 2) 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.

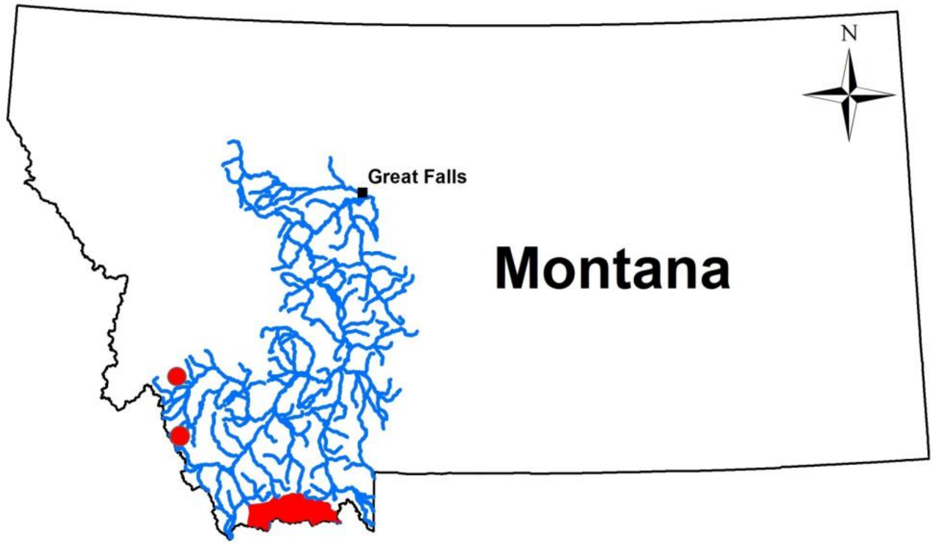

Figure 1. Historic Arctic grayling distribution in Montana. Fluvial populations (blue) occupied the Missouri River drainage upstream of Great Falls, MT. Adfluvial populations (Red) occupied habitat in the Big Hole and Centennial watersheds.

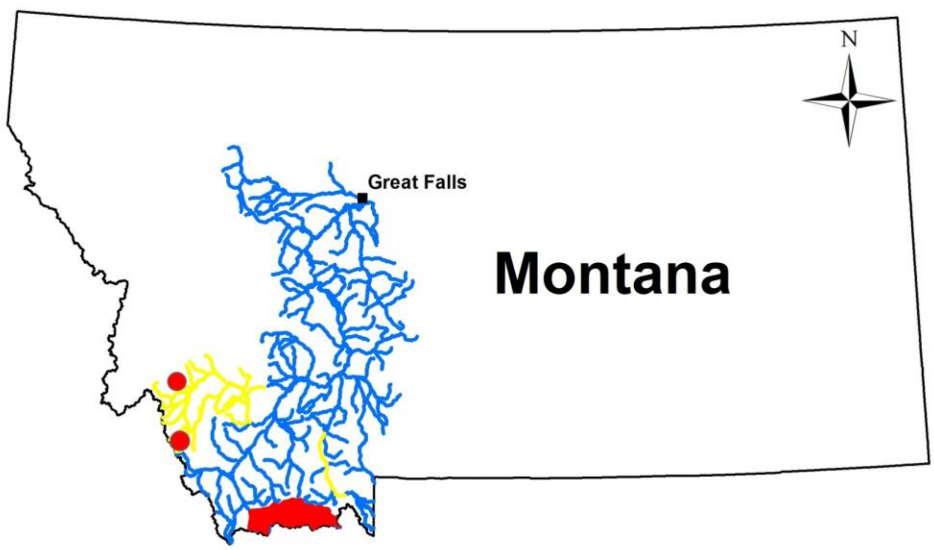

Figure 2. Present distribution of the five known Montana Arctic grayling populations. Fluvial populations delineated in yellow and adfluvial populations in red.

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 populations abundance and distribution was first documented in the1980s, 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), Pennsylvania Power and Light 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 et. al 2007). The project area includes the Big Hole River watershed from Dickie Bridge upstream to the headwaters (Figure 3). 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 = 33) 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 et al. 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, 2012 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 using remote site incubators (RSIs).

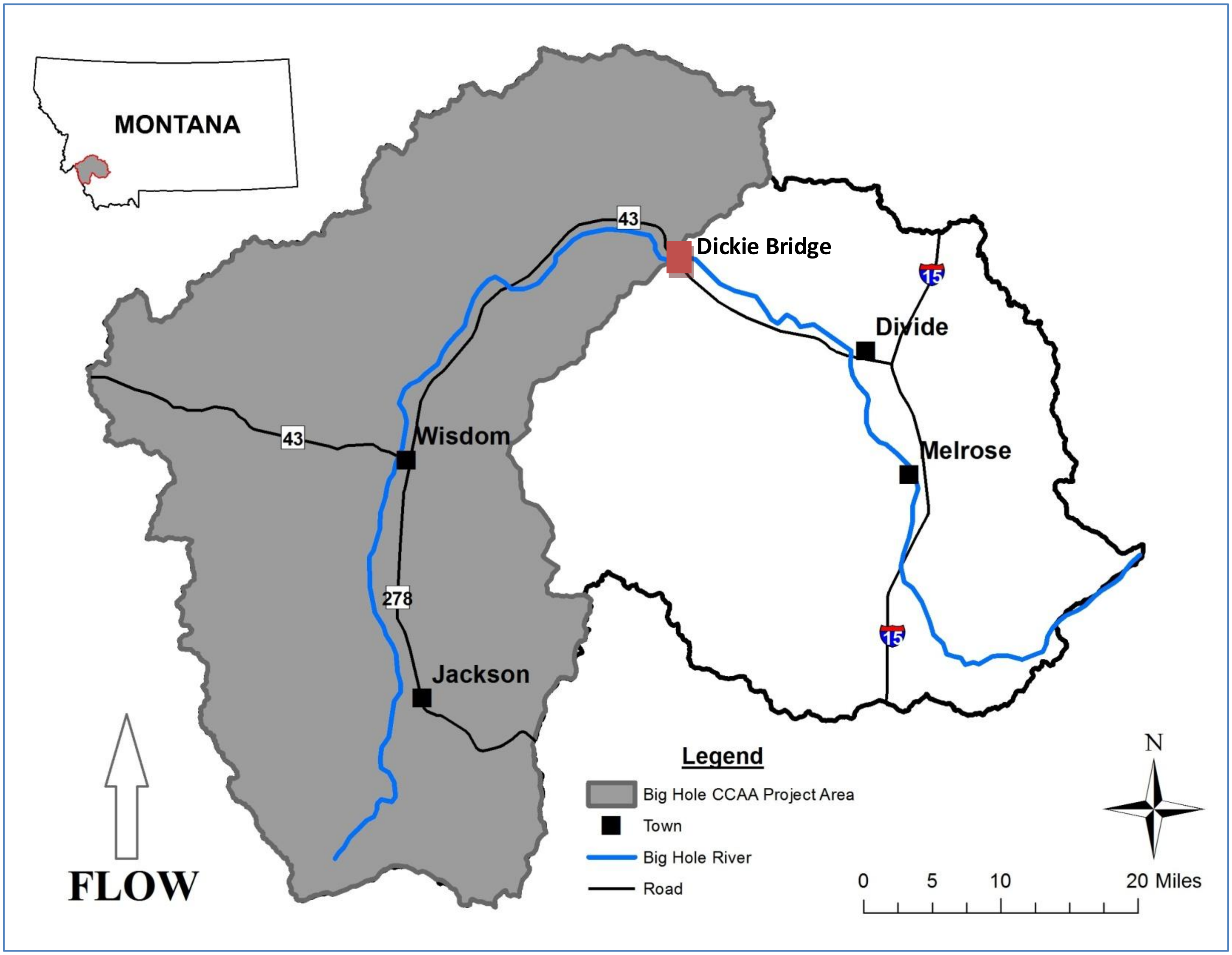

Figure 3. The Big Hole CCAA project area within the Big Hole River watershed.

B . Big Hole River Watershed Habitat Monitoring

Stream Water Temperature

Methods

In 2012, FWP collected stream temperature data at 11 locations (six mainstem and five tributary) in the upper Big Hole watershed (Figure 4). Stream temperature data was 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 4). Stream temperature data was 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 31. Data were summarized as daily minimum, maximum and mean, maximum and mean for the period monitored (May 1 – October 31) and hours and days exceeding 70º and 77º Fahrenheit (Table 1). Seventy degrees Fahrenheit represents the thermal stress threshold for salmonid species (Behkne 1991), and 77º Fahrenheit represents the upper incipient lethal temperature for Arctic grayling (Lohr et al. 1996).

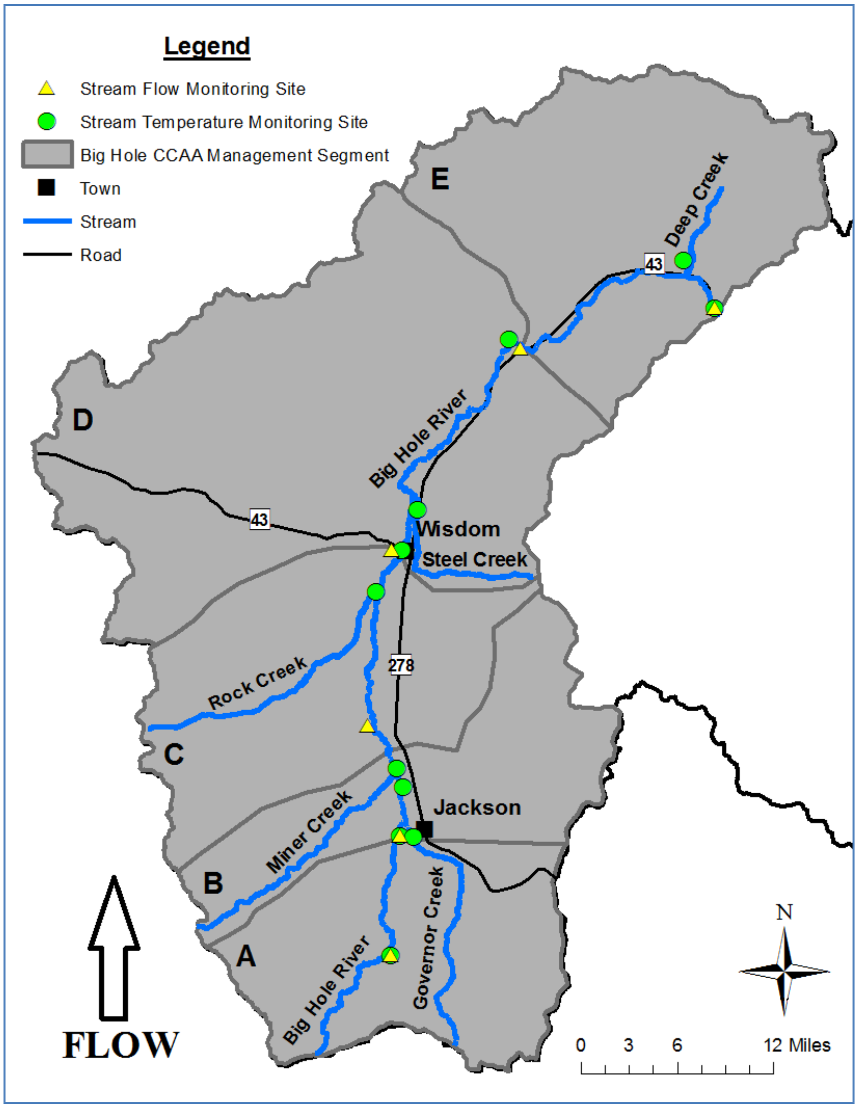

Figure 4. Location of stream temperature monitoring sites (green circle), stream flow monitoring sites (yellow triangle) in the Big Hole CCAA project area.

Results

The Big Hole River at Wisdom Bridge maintained the highest mean seasonal temperature (55.2° Fahrenheit; Table 1) and Steel Creek reached the highest maximum seasonal temperature (77.2° Fahrenheit; Table 1). Steel Creek was the only monitoring site to exceed the upper incipient lethal temperature for grayling (77° Fahrenheit; Table 1).

Table 1. **Stream temperature monitoring sites in the Big Hole River watershed in 2012, and the seasonal mean and maximum temperature and cumulative hours exceeding 77º Fahrenheit for each monitoring site.**

Monitoring Site (Big Hole CCAA Management Segment)	Mean Seasonal Temperature (degrees Fahrenheit)	Maximum Seasonal Temperature (degrees Fahrenheit)	Cumulative Hours Exceeding 77º Fahrenheit
Saginaw Bridge (upper project area boundary)	48.8	67.7	0
BHR CCAA (A)	51.2	70.3	0
Governor Creek (A)	53.4	76.6	0
BHR CCAA (B)	51.6	66.0	0
Miner Creek (B)	52.8	75.7	0
BHR CCAA (C)	55.2	75.2	0
Rock Creek (C)	53.4	72.9	0
BHR CCAA (D)	55.0	76.6	0
Steel Creek (D)	54.9	77.2	2
BHR CCAA (E)	54.7	75.6	0
Deep Creek (E)	52.1	73.0	0

Stream Flow Monitoring

Methods

In 2012, the DNRC and U.S. Geological Survey (USGS) managed six real-time stream flow monitoring sites in the project area (Figure 4). 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. 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) and based on the period of record, 1971-2000. The upper Big Hole basin snowpack was 92% of average for 2012. Spring precipitation (April – June) in the upper Big Hole basin was 80% of average. Below average snowpack and spring precipitation resulted in streamflows below Big Hole CCAA flow targets during the last 10 days of June. Summer precipitation (July – October) in the upper Big Hole basin was 82% of average. Due to these conditions, summer streamflows in the Big Hole CCAA project area fell below established target levels. To mitigate streamflows below the Big Hole CCAA flow targets, 11 landowners enrolled in the Big Hole CCAA (and one non-enrolled landowner) returned over 170 cubic feet per second of irrigation water back to the Big Hole River and its tributaries to instantaneously supplement stream flows.

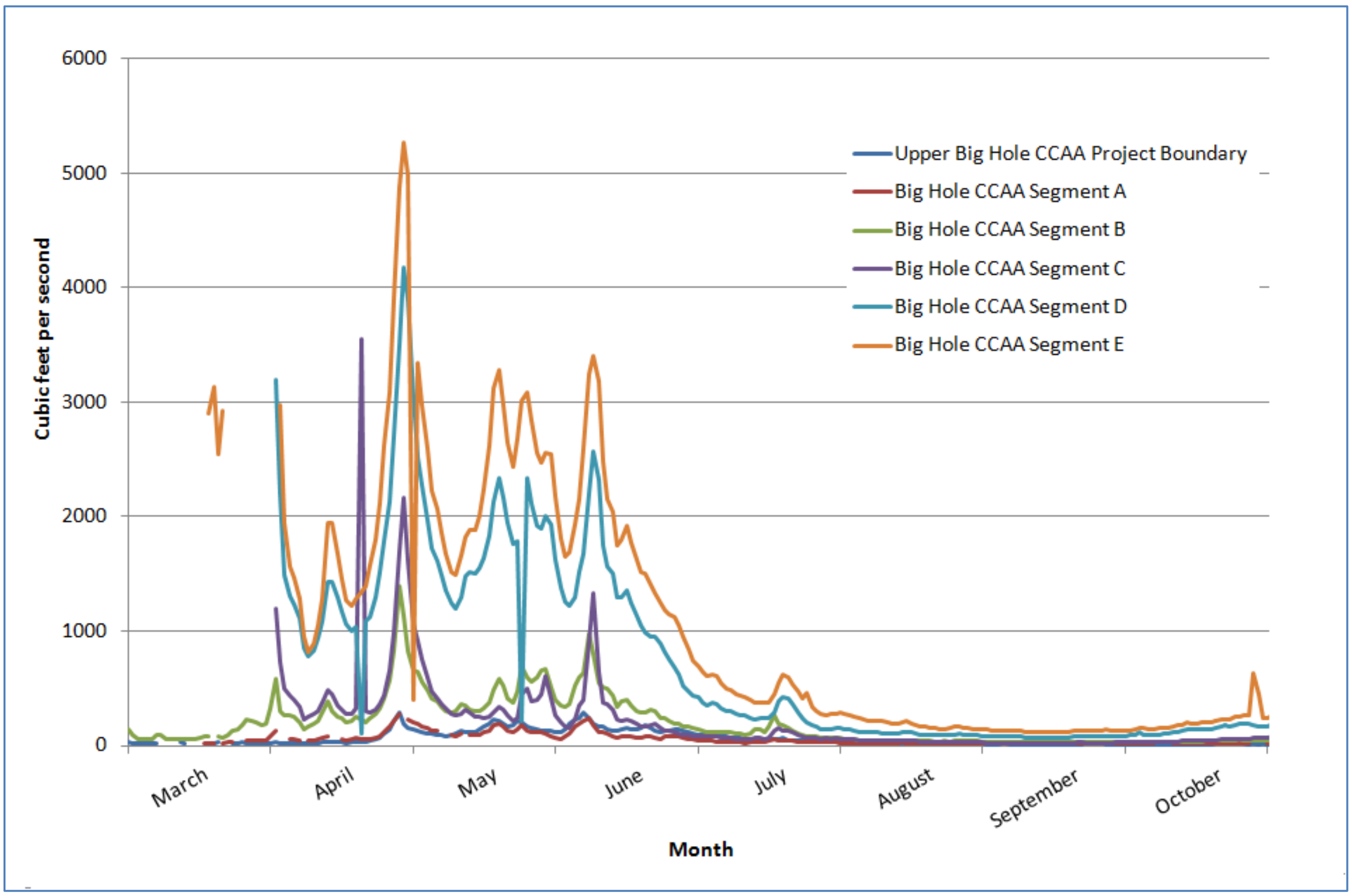

Figure 5. 2012 Big Hole River stream flow data collected at real-time gaging stations at the upper Big Hole CCAA project area boundary (Saginaw Bridge), and the lower boundary of each Big Hole CCAA management reach (Miner Lakes Road, mouth of Miner Creek, Wisdom Bridge, Mudd Creek Bridge and Dickie Bridge).

E. Rock Creek Recolonization

Introduction

Rock Creek is a tributary to the Big Hole River located upstream of the town of Wisdom (Figure 6). Rock Creek historically held relatively high numbers of grayling (Figure 7) and is considered an important tributary to the Big Hole grayling population. Electrofishing surveys in the 1970s and 1980s documented abundance in excess of 50 individuals per mile (Figure 7).

A nearby irrigation system was altered in the late 1980s causing Rock Creek to flow into an irrigation ditch, eliminating connectivity between Rock Creek and the Big Hole River. Soon after, grayling abundance declined (Figure 7). In 2006, a project was completed that reactivated a historic Rock Creek channel to restore connectivity between Rock Creek and the Big Hole River. In addition, 2.5 miles of existing channel was restored to reference condition by increasing pool quality and frequency, stabilizing and sloping streambanks, and revegetating streambanks using sod mats and planting natives willow species. A riparian fence was constructed and approximately five miles of stream was excluded from livestock grazing for five years (2006 – 2011).

Monitoring efforts from 2007 – 2009 to document grayling utilization of Rock Creek following restoration included electrofishing, trapping, and tagging techniques, and resulted in the capture of only one grayling. During pre-project planning, FWP proposed to assist grayling recolonization into Rock Creek if it did not occur naturally in three years (one generation). In 2010, FWP initiated grayling recolonization efforts into Rock Creek by incubating gametes from the Big Hole fluvial brood stock using remote site incubators (RSI).

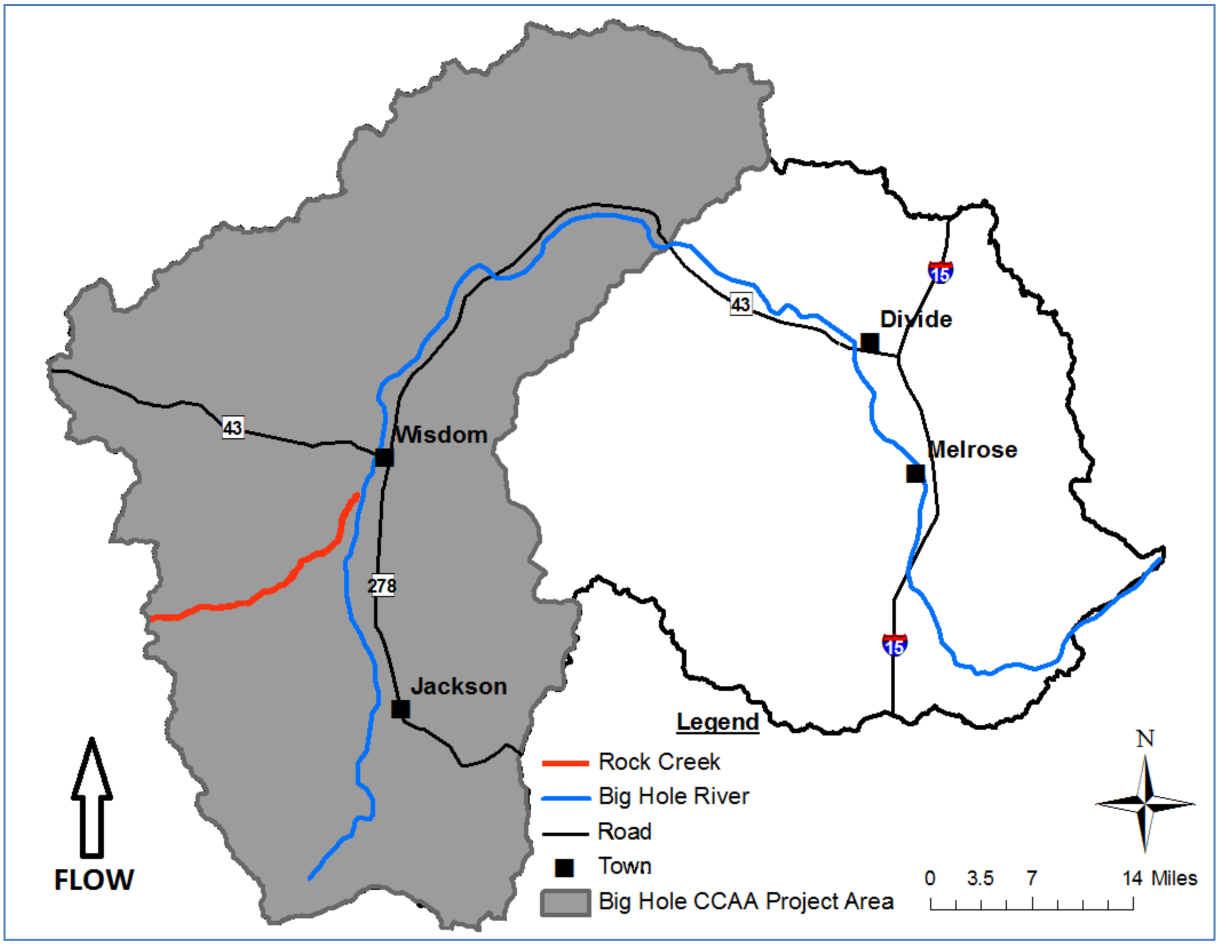

Figure 6. Rock Creek location within the Big Hole River watershed.

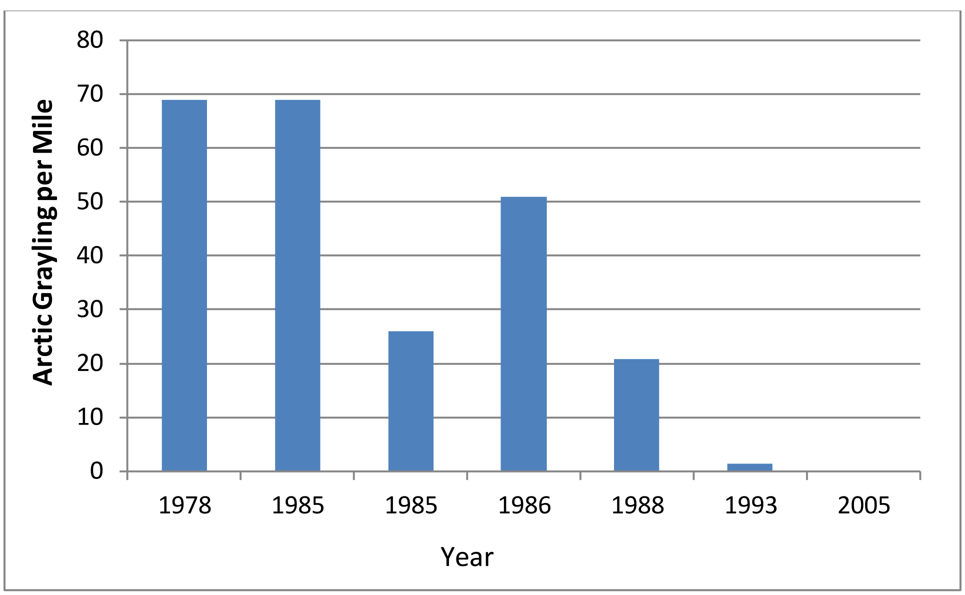

Figure 7. Arctic grayling population monitoring surveys in Rock Creek prior to the reconnection/habitat enhancement project completed in 2006.

Methods

A fluvial grayling brood population in Axolotl Lake was developed 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 of two existing pin and plank diversions. The irrigation diversions assist to manage stream flows and create a backwater environment favorable to weak-swimming fry (Figure 9). The two locations were chosen, in part, because they were the lowest points-of-diversion on Rock Creek 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 5, 12, and 26, electrofishing surveys were completed on 2.4 miles of irrigation ditch from five PODs on Rock Creek and the Big Hole River to quantify entrainment of grayling individuals into irrigation ditches (Figure 8).

On October 17 and 18, a population monitoring survey was completed on Rock Creek to quantify the number of grayling produced from RSIs and survived for at least 3 months. The survey was completed on the lower 2.9 miles of Rock Creek, downstream of each RSI site (Figure 8).

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 (VI) tag.

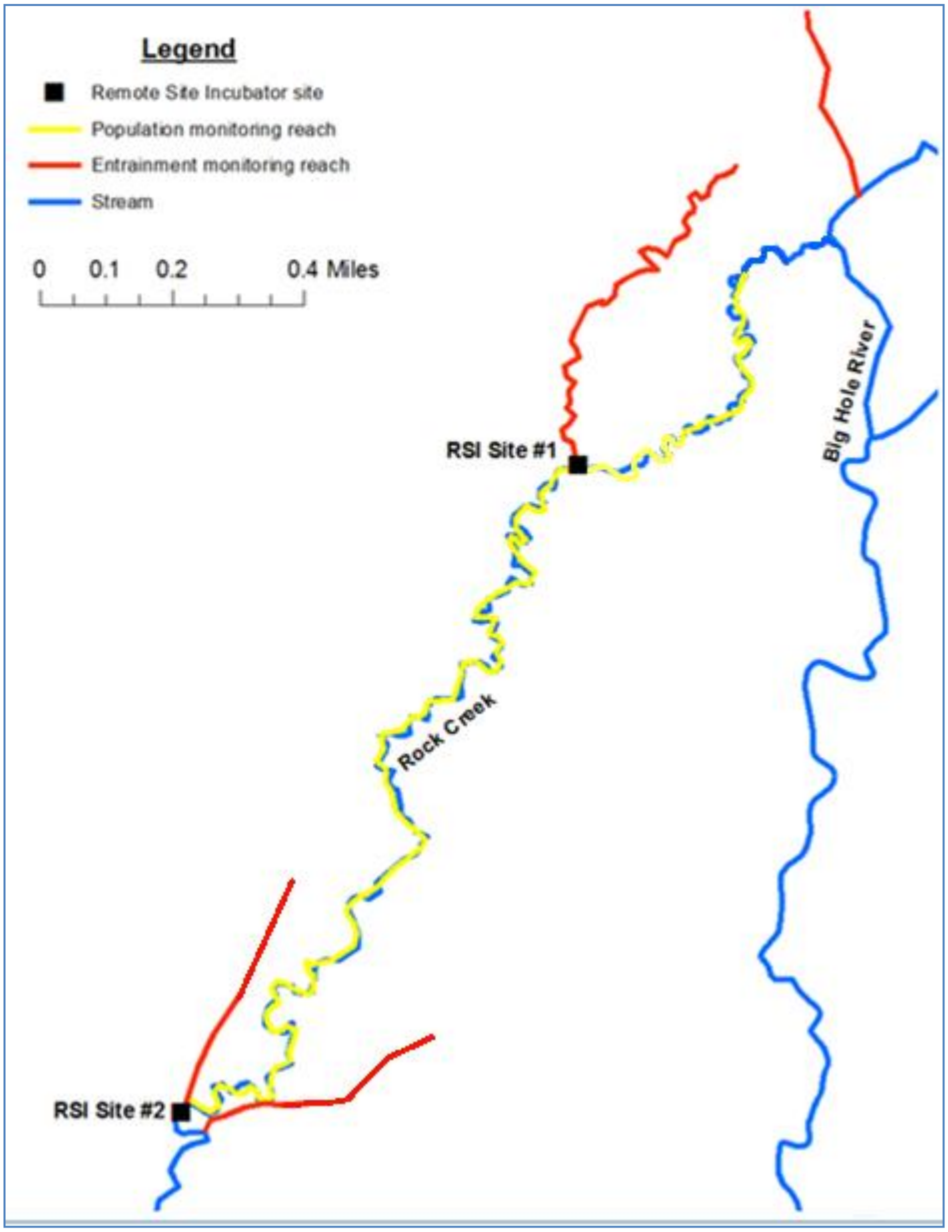

Figure 8. 2012 Remote site incubator (RSI) locations, fall electrofishing survey reaches and entrainment survey reaches on Rock Creek.

Figure 9. 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.

Results

Grayling gametes were collected on May 15 at the Axolotl Lake grayling brood pond. Eggs collected from female grayling (N = 100) were fertilized by milt collected from male grayling (N = 100). Fertilized eggs were transported to the Yellowstone River Trout Hatchery and incubated until eye-up stage. On May 25, 110,000 eggs (85% eye-up) were transported to 20 RSIs at two locations on Rock Creek (Figure 8). Emerged grayling fry were initially observed on June 4 and all grayling fry had emerged by June 11.

On July 5, 12, and 26, electrofishing surveys were completed on 2.4 miles of irrigation ditch from five PODs on Rock Creek and the Big Hole River to quantify entrainment of grayling into irrigation ditches (Figure 8). No Arctic grayling were captured.

On October 17 and 18, a population monitoring survey was completed in Rock Creek to quantify the number of grayling produced from RSIs and survived for at least 3 months. Surveys were completed on the lower 2.9 miles of Rock Creek downstream of each RSI site (Figure 8). A total of 94 grayling were captured (33 grayling/mile), the majority of which were YOY (N = 58). Thirty-two age-1 and older grayling were captured. Rock Creek recolonization efforts have resulted in an increased abundance of grayling in Rock Creek (Figure 10).

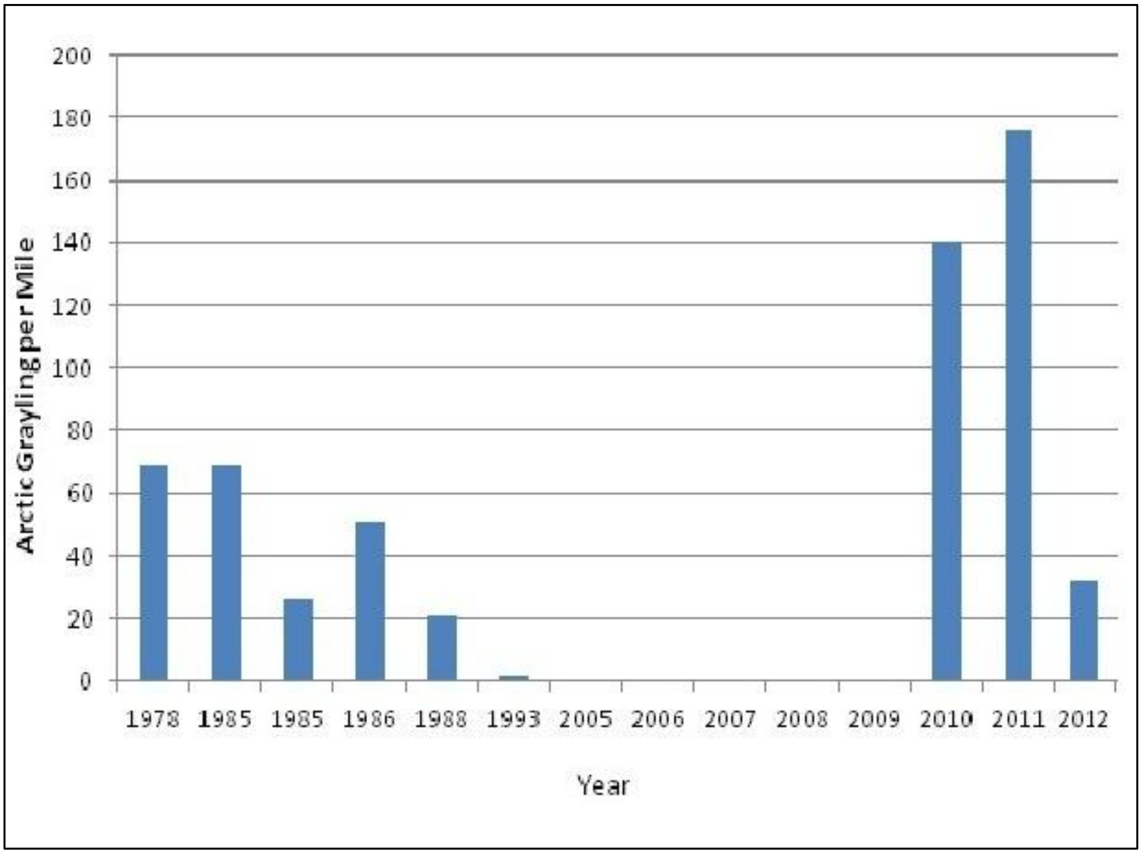

Figure 10. Arctic grayling catch per unit effort (fish/mile) electrofishing surveys in Rock Creek from 1978 - 2012.

F. Big Hole River Arctic Grayling Population Monitoring

Methods

In 2012, 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 using Tricaine Methanesulfonate-222 (MS-222), and measured for total length (± 0.1 in) and weight (± 0.01 lb). Grayling greater than six inches in total length were tagged with a visible implant (VI) tag in the transparent tissue immediately posterior to the left eye. A genetic sample (fin clip) was taken from 56 YOY Arctic grayling for genetic analysis to estimate the number of reproducing individuals in 2012.

In 2012, FWP conducted population monitoring surveys on five Big Hole River reaches (19.3 miles) and 13 tributary reaches (15.6 miles) in the Big Hole watershed (Figure 11). 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, the North Fork of the Big Hole River, Plimpton Creek, Howell Creek, Pintlar Creek, Squaw Creek, and LaMarche Creek.

Data collected during 2012 electrofishing surveys were summarized with Montana Fish, Wildlife & Parks Fisheries Information System (https://apps.fwp.mt.gov/fish/; Accessed November 2012). Catch-per-unit effort (fish/mile) estimates were summarized for single-pass electrofishing effort for each sampling reach. Catch-per-unit-effort data were used to track trends in relative abundance and spatial distribution. Grayling data were summarized using a length-frequency histogram to describe the population age structure (Figure 13), and as catch-per-unit-effort for YOY (< 6.0 inches) and age 1+ (> 6.0 inches) Arctic grayling by sampling reach (Figure 14 and 15). Population monitoring associated with Rock Creek was not included in these summaries because artificial grayling production tied to recolonization efforts skews the results of summaries intended to portray the natural population.

Electrofishing surveys were also conducted in irrigation ditches in the Big Hole River watershed to quantify grayling entrainment. In 2012, FWP surveyed 20.6 miles of irrigation ditch associated with 38 PODs (Figure 11).

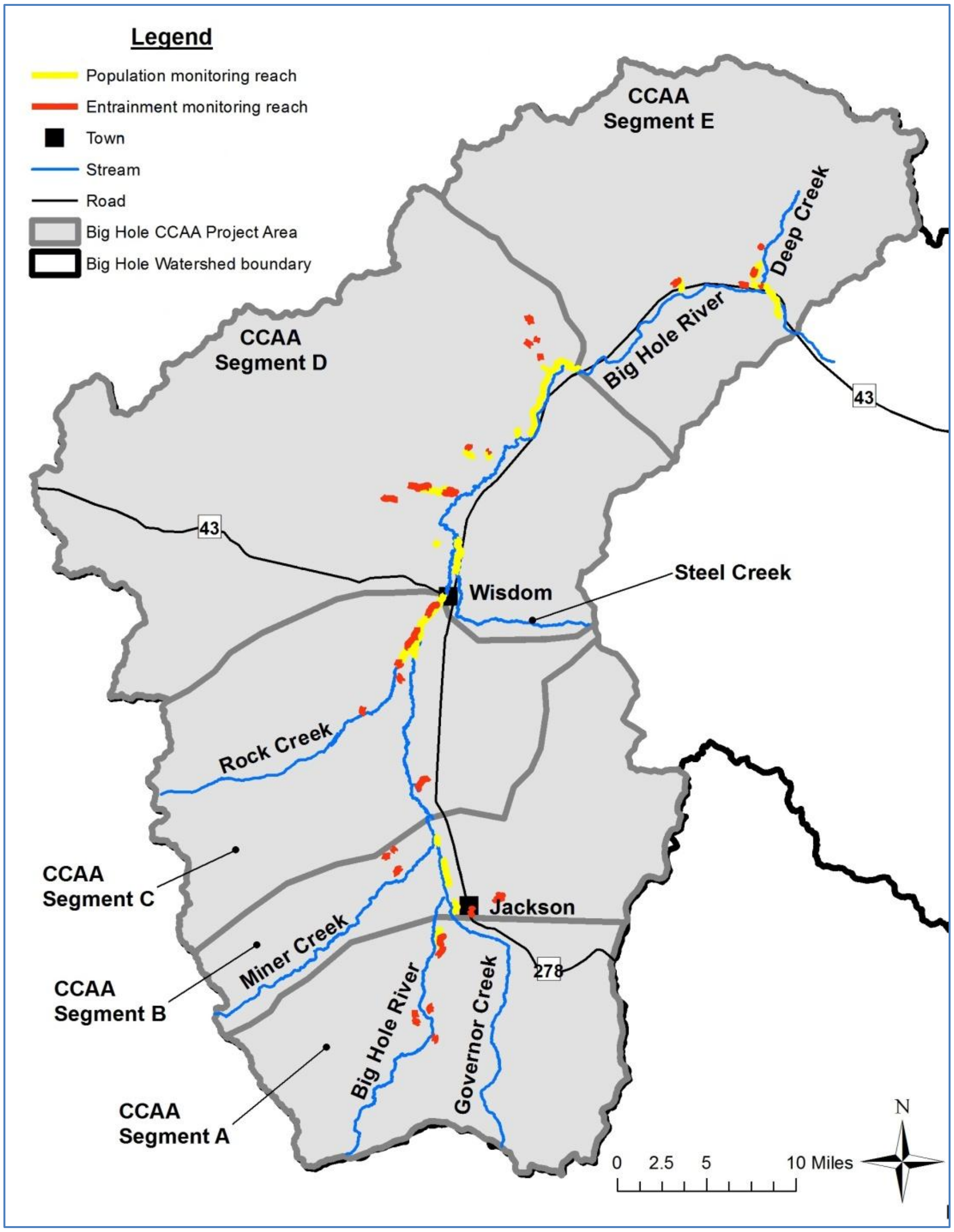

Figure 11. 2012 population monitoring and entrainment survey reaches completed in the Big Hole watershed.

Results

Population monitoring surveys resulted in the capture of 250 Arctic grayling. Ninety-four individuals were captured in Rock Creek and are assumed to be a result of recolonization efforts. Of the remaining 156, 96 were age-1 and older (>6 inches in length) and 60 were YOY (<6 inches in length; Figure 13). Despite greater effort in Big Hole River reaches (19.3 miles) than in tributary reaches (15.6 miles), a considerably higher number of grayling were captured in tributary reaches (N = 126 (Rock Creek data excluded); figure 15) than Big Hole River reaches (N = 30; Figure 14).

Entrainment monitoring surveys resulted in the capture of no Arctic grayling.

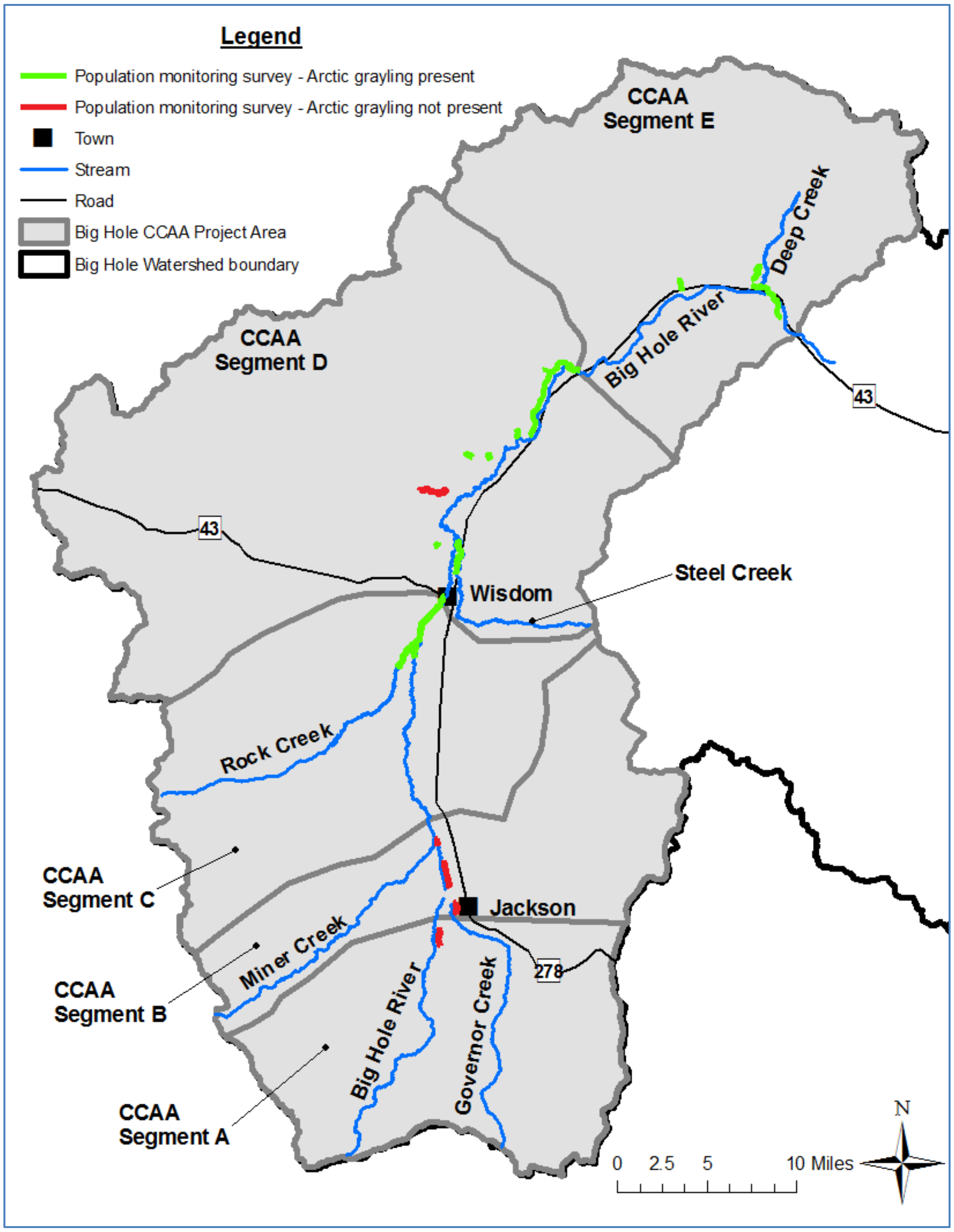

Figure 12. 2012 population monitoring survey reaches in the Big Hole River watershed. The presence of Arctic grayling (green) or absence of Arctic grayling (red) is shown for each sampling reach.

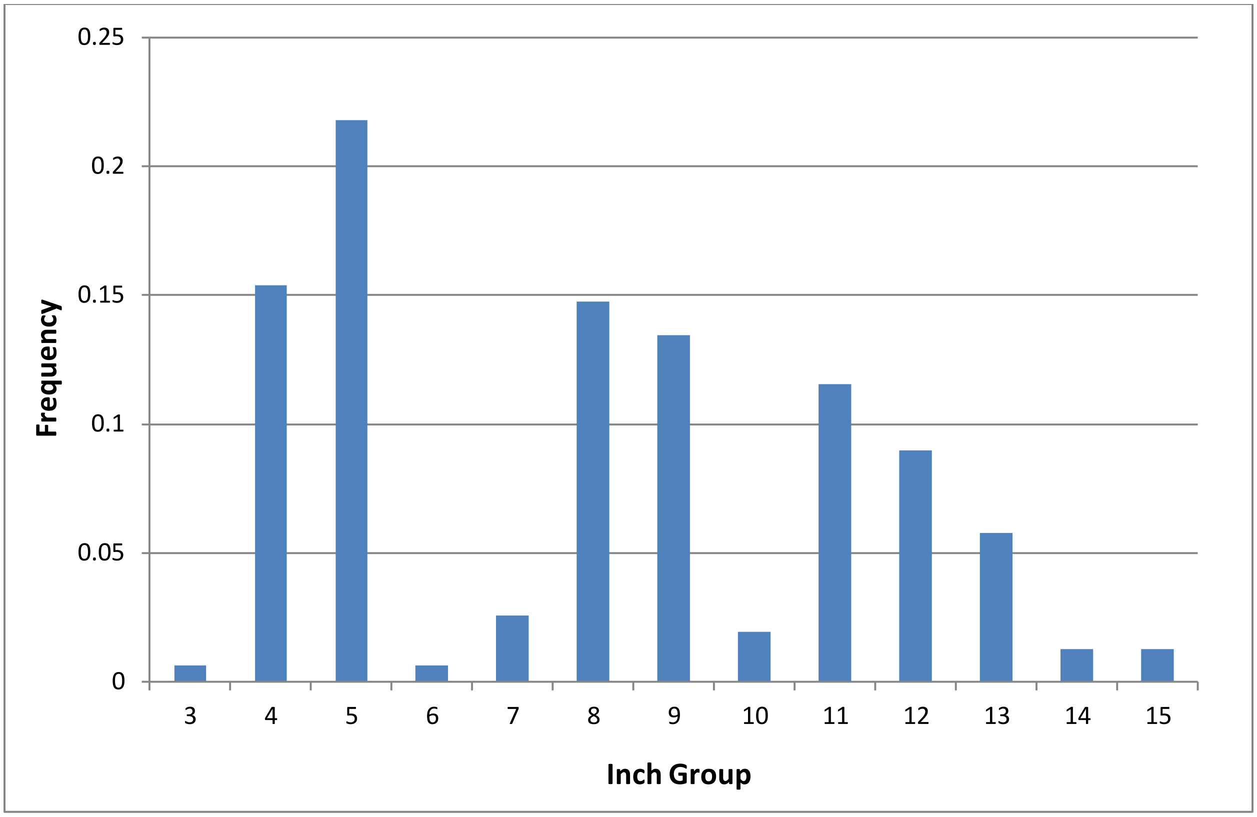

Figure 13. Length-frequency histogram for Arctic grayling captured during 2012 population monitoring surveys in the upper Big Hole watershed (N = 156). Grayling captured in association with Rock Creek recolonization efforts are omitted to depict the size structure of the natural population.

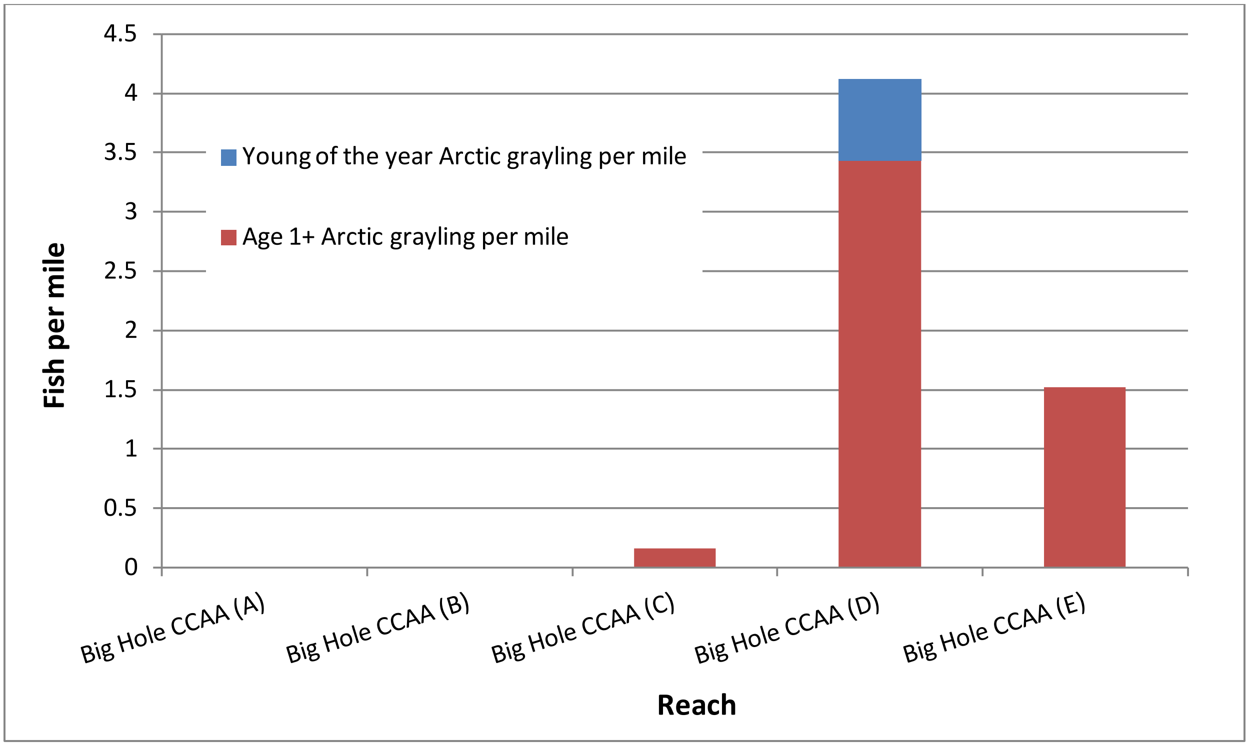

Figure 14. Young-of-the-year and age-1+ Arctic grayling captured per mile in the sampling reaches in the Big Hole River during 2012 population monitoring surveys.

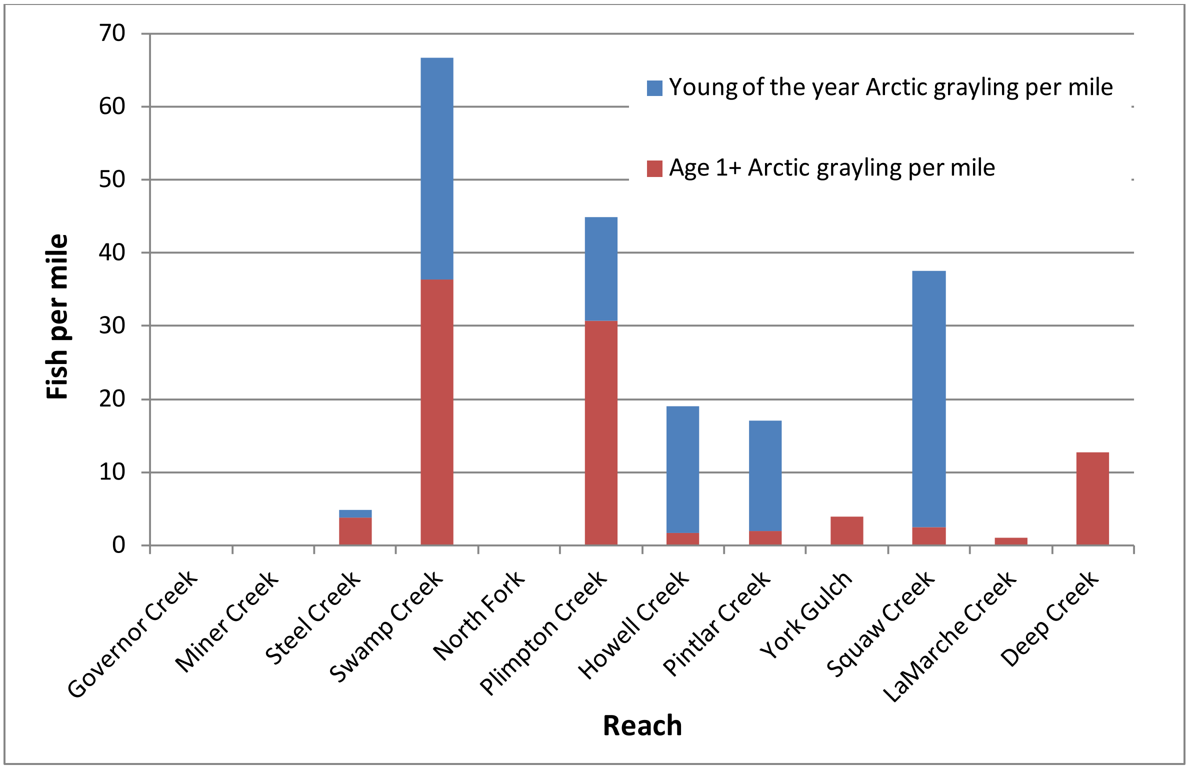

Figure 15. Young-of-the-year and age-1+ Arctic grayling captured per mile in the sampling reaches in Big Hole River tributaries during 2012 population monitoring surveys.

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 16). 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 fluvial 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, in 2009, reintroduction efforts ceased.

In 2012, population monitoring efforts evaluated abundance, distribution, age-class structure, and the occurrence of natural reproduction of the established population.

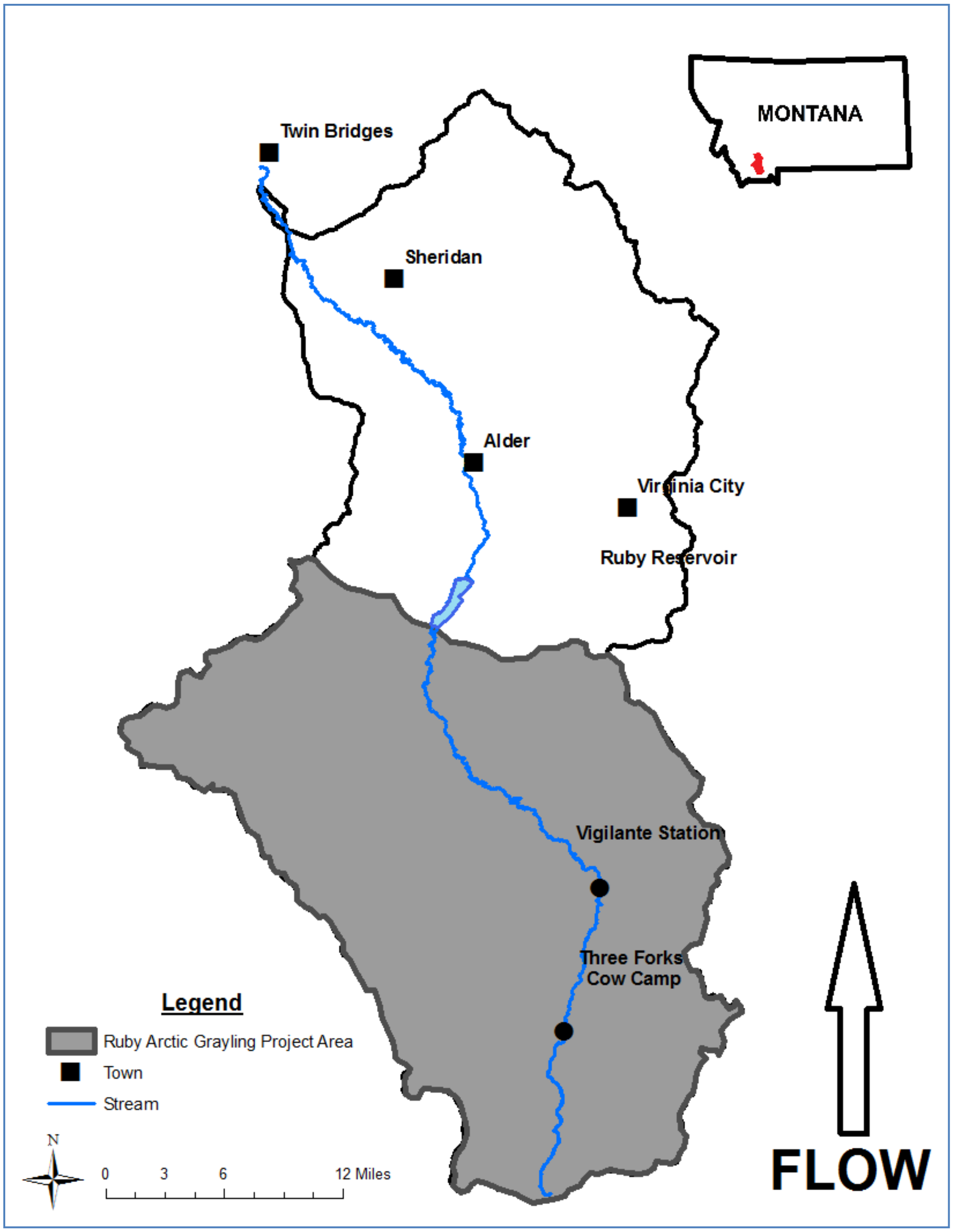

Figure 16. The Arctic grayling reintroduction area within the upper Ruby River watershed.

B. Ruby River Watershed Habitat Monitoring

Stream Temperature Monitoring

Methods

Water temperature data was collected at four locations in the upper Ruby River watershed: Sweetwater Bridge, Canyon, Vigilante Station, and Lazyman Creek (Figure 17). Sites were selected to characterize stream water temperatures in the reintroduction area. Temperature loggers recorded data at 30-minute intervals and data were summarized as daily minimum, maximum and mean temperature, and hours and days exceeding 70º and 77º Fahrenheit. Seventy degrees Fahrenheit served as a thermal stress threshold for salmonid species (Behkne

1991), and 77º Fahrenheit represents the upper incipient lethal temperature for Arctic grayling (Lohr et al. 1996).

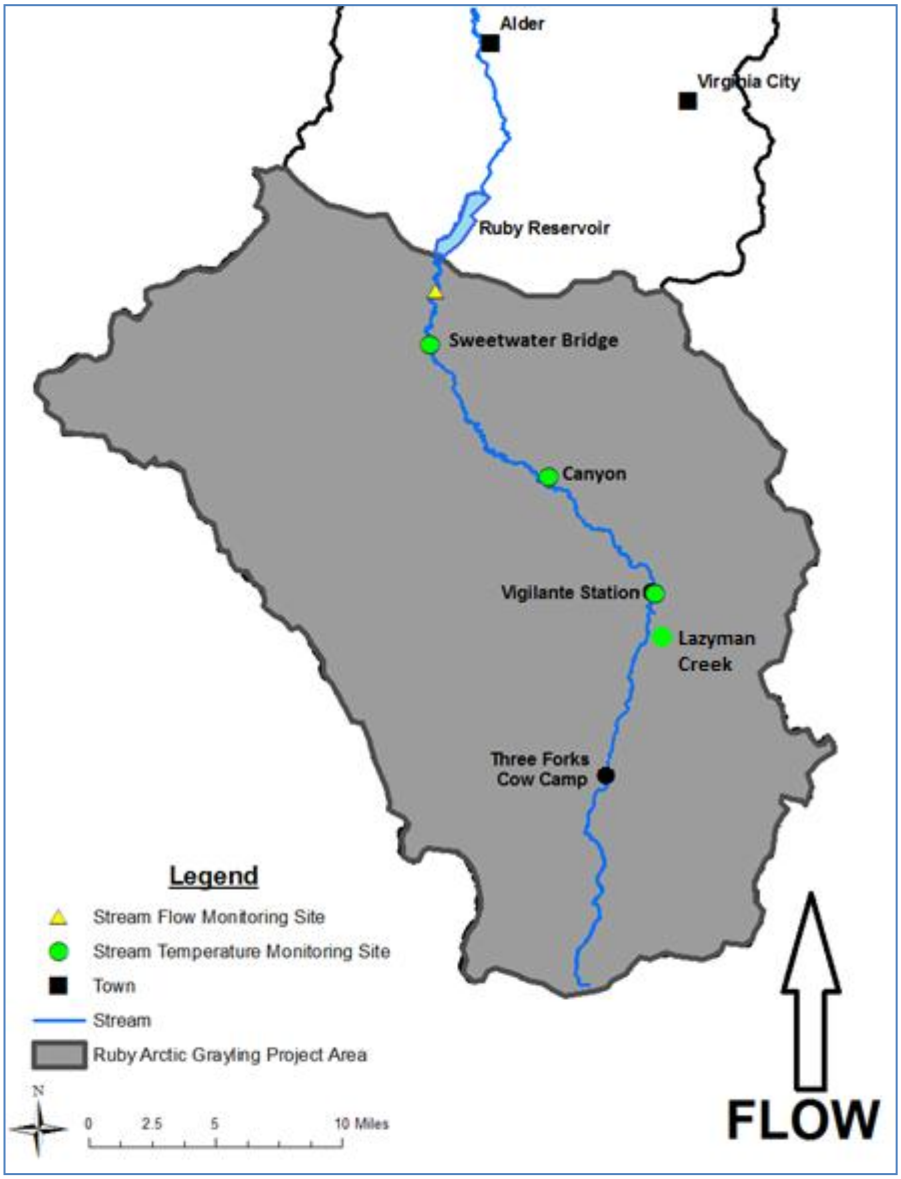

Figure 17. Location of stream temperature monitoring sites (green circle) and stream flow monitoring site (yellow triangle) in the upper Ruby grayling project area.

Results

Seventy-seven degrees Fahrenheit was not exceeded at any stream temperature monitoring site (Table 2) in 2012. Highest mean and maximum temperature data was recorded at the Canyon monitoring site (59.3°F and 75.8°F, respectively). The Canyon monitoring site was located directly downstream of the Ruby River's confluence with Warm Spring's Creek; a tributary with an average annual temperature ranging from 65-69°F.

Table 2. 2012 upper Ruby watershed stream temperature monitoring sites summarized as the seasonal mean and maximum temperature and cumulative hours exceeding 77º Fahrenheit.

Monitoring Site (Big Hole CCAA Management Segment)	Mean Seasonal Temperature (degrees Fahrenheit)	Maximum Seasonal Temperature (degrees Fahrenheit)	Cumulative Hours Exceeding 77º Fahrenheit
Sweetwater Bridge	55.7	70.3	0
Canyon	59.3	75.8	0
Vigilante Station	52.4	73.4	0
Lazyman Creek	45.7	60.2	0

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 17). Stream flow data are recorded at 15-minute intervals and reported online at www.usgs.gov.

Results

The USGS continuous stream flow monitoring site upstream of Ruby Reservoir documented a peak mean daily flow of 659 cfs on April 27 (Figure 18).

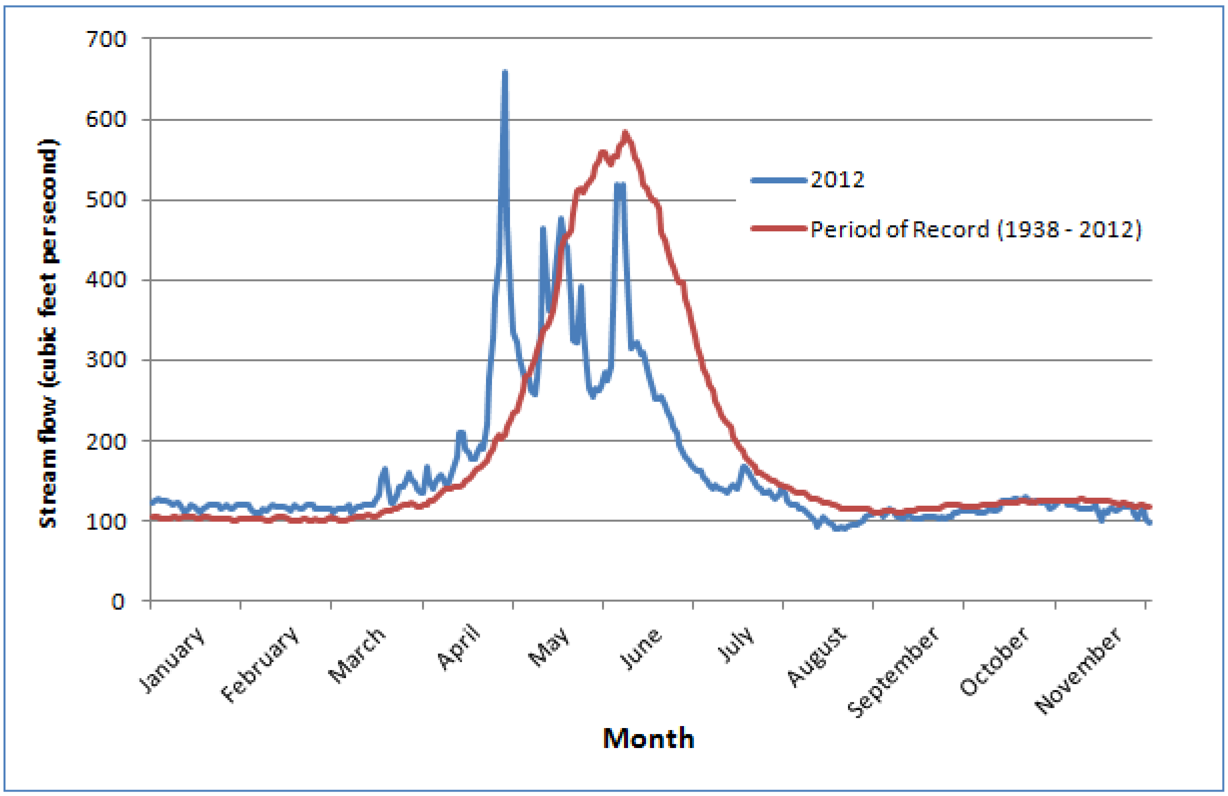

Figure 18. 2012 Ruby River stream flow data recorded above the Ruby River Reservoir.

Ruby River Arctic Grayling Population Monitoring

Methods

In 2012, 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 (± 0.1 in) and weight

(± 0.01 lb). Grayling greater than six inches in total length were tagged with a visible implant (VI) tag in the transparent tissue immediately posterior to the left eye, and a scale sample was taken for age determination. A fin clip was taken from all captured grayling for genetic analysis.

In 2012, FWP completed single pass electrofishing surveys on seven reaches in the upper Ruby River watershed; three in the mainstem Ruby River, three in the Middle Fork of the Ruby River (Middle Fork), and one in a tributary to the Middle Fork (Figure 19). Reaches included the Greenhorn, Lower Vigilante and Burnt Creek reaches on the Ruby River, Shovel Creek, Corral Creek, and Twin Springs on the Middle Fork, and Corral Creek.

Data collected during 2012 electrofishing surveys were summarized with Montana Fish, Wildlife & Parks Fisheries Information System (https://apps.fwp.mt.gov/fish/; Accessed November 2012) , and catch-per-unit-effort (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 20), and catch-per-unit-effort (fish/mile) of YOY (< 6.0 inches) and age 1+ (> 6.0 inches) per reach (Table 3).

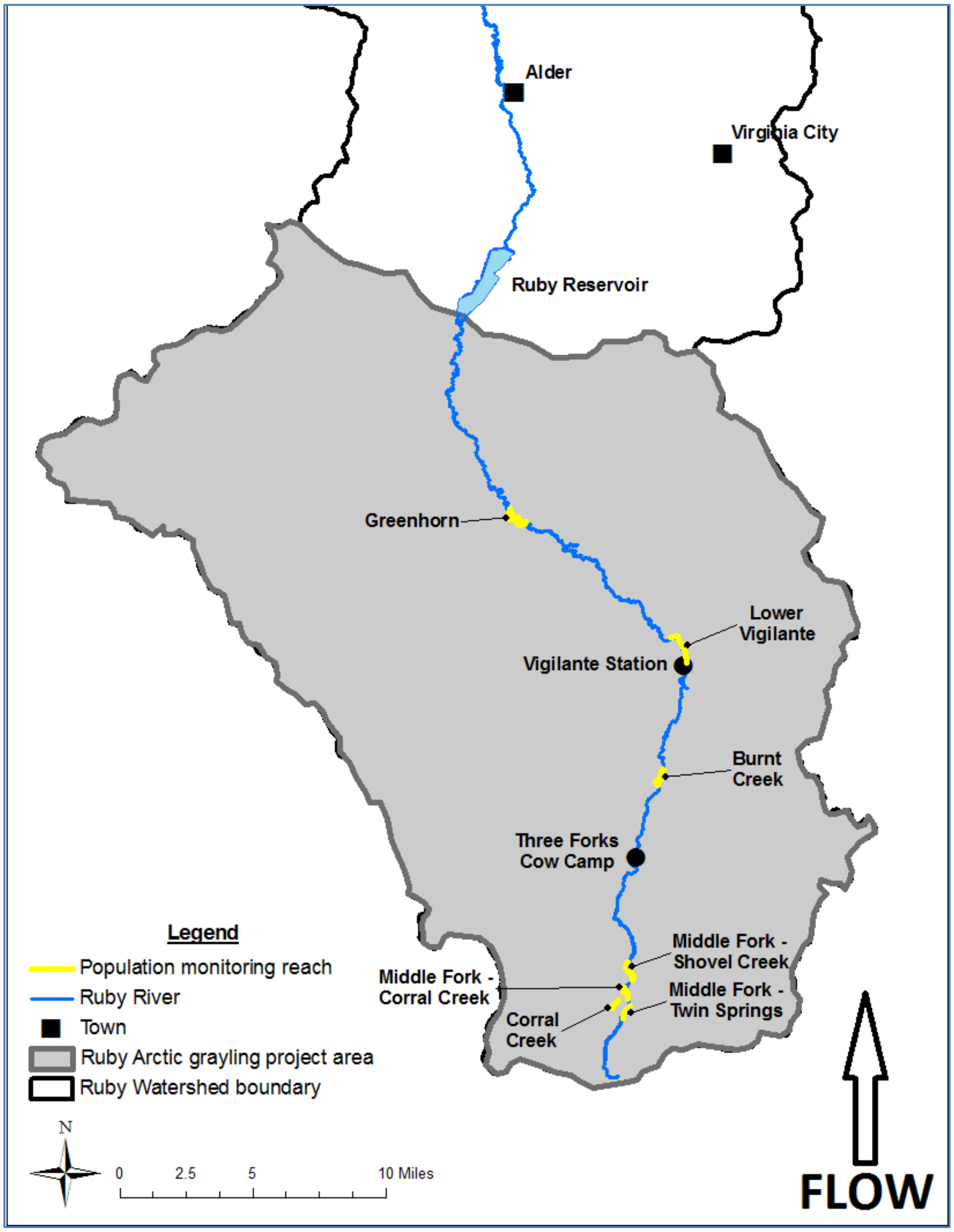

Figure 19. 2012 population monitoring reaches in the upper Ruby River watershed.

Results

Arctic grayling were captured in all population monitoring reaches, except Greenhorn and Corral Creek. Distribution encompassed approximately 21 river-miles between the Lower Vigilante and Middle Fork – Twin Springs sections. A total of 106grayling were captured, of which 13 were YOY. Presence of YOY verified that natural reproduction had occurred for the fourth consecutive year since supplementation efforts ended in 2008 (Figure 20). Young-of-the-year grayling were captured in Middle Fork – Shovel Creek, Middle Fork – Corral Creek, and Middle Fork – Twin Springs reaches (Table 3). Grayling relative abundance was summarized by reach as catch-per-unit-effort (fish/mile) with the highest abundance in the Middle Fork – Shovel Creek reach (Table 3).

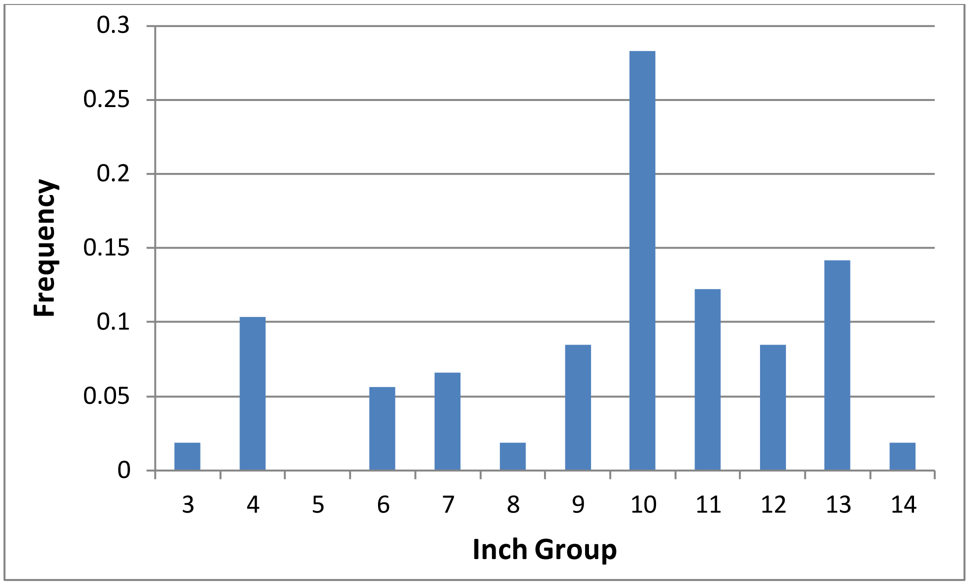

Figure 20. Length-frequency histogram for Arctic grayling captured during 2012 population monitoring surveys in the upper Ruby River watershed (N = 106).

Table 3. 2012 upper Ruby watershed population monitoring survey results.

Reach	Distance	YOY	YOY/Mile	AGE 1+	AGE 1+/Mile	Total	Total AG/Mile
Middle Fork – Twin Springs	0.55	2	3.64	9	16.36	11	20.00
Middle Fork – Corral Creek	0.49	2	4.08	0	0.00	2	4.08
Corral Creek	0.21	0	0.00	0	0.00	0	0.00
Middle Fork – Shovel Creek	0.78	9	11.54	32	41.03	41	52.56
Ruby River – Burnt Creek	1.14	0	0.00	20	17.54	20	17.54
Ruby River – Lower Vigilante	1.76	0	0.00	32	18.18	32	18.18
Ruby River – Greenhorn	3.02	0	0.00	0	0.00	0	0.00
Total	7.95	13	1.64	93	11.70	106	13.33

V. Fluvial Arctic Grayling Brood Program

A. Introduction

A fluvial 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 FWP Yellowstone River Trout Hatchery (YRT Hatchery), 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 in fluvial grayling historic range. 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 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 18 and 23, FWP surveyed the North Fork section of the Big Hole River to determine grayling spawning activity, and capture grayling for gamete collection.

Seven individuals produced from 2011 Big Hole grayling gamete collection efforts supplemented genetic diversity of the fluvial grayling brood in 2012.

Results

Big Hole grayling gamete collection efforts on the North Fork section of the Big Hole River resulted in the capture of 53 Arctic grayling; 26 males, 24 females, and 3 immature. Eggs were collected from nine females, fertilized, 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 2013.

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 throughout the existance of the Axolotl grayling brood population. In 2012, fish health screening was conducted, gametes were collected for recolonization efforts in Rock Creek, and an additional age class was stocked.

Methods

On April 30, hook and line methods were used to capture grayling for fish health screening. Captured grayling were measured for total length (± 0.1 in) and weight (± 0.01 lb) before tissue samples were taken for lab analysis.

On May 15, fyke trap and hook-and-line methods were used to capture grayling for gamete collection. All captured grayling were marked with a temporary fin clip to produce a mark/recapture estimate, measured for total length (± 0.1 in) and weight (± 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.

On May 21, fyke traps and hook-and-line methods were used to recapture grayling to produce a mark/recapture estimate. Captured fish were measured for total length (± 0.1 in) and weight (± 0.01 lb).

Results

A total of 60 grayling were captured for fish health screening. All grayling tested negative for pathogens.

A total of 745 Arctic grayling were captured for gamete collection and mark/recapture estimate efforts. Average length of captured grayling was 10.6 inches and average fecundity of spawned females was 1,456 eggs. A total of 145,600 eggs were collected from 100 females and fertilized by 100 males. Eggs were stripped from all other females and discarded to minimize egg retention. Fertilized eggs were transported to YRT Hatchery and incubated to eye-up stage. On May 25, 110,000 eyed eggs (85% eye-up) were transported to Rock Creek and placed in RSIs. The remaining grayling were overwintered at YRT Hatchery, and will supplement the grayling brood populations in 2013. Mark/recapture techniques estimate the Axolotl Arctic grayling population at 2,685 (standard deviation – 375).

On May 15, age-1grayling (N = 500) were stocked into the Axolotl Lake brood population to ensure the presence of multiple age-classes for future gamete collections. Seven of the stocked individuals were produced from 2011 Big Hole grayling gamete collections; the remainder were produced from 2011 Axolotl Lake grayling spawning efforts.

D. Green Hollow II Arctic Grayling Brood Reserve

Green Hollow II reservoir is located on Turner Enterprises property near Bozeman, Montana, and supports a fluvial 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 recolinzation efforts in Montana.

The Green Hollow II grayling brood population was not used to support reintroduction or recolonization efforts in 2012. As a result, fish health screening did not occur. No grayling were stocked into the brood population.

A mark/recapture estimate was produced for Green Hollow II reservoir in 2012. Fyke traps and hook-and-line methods were used to mark fish on May 3, and recapture fish on May 16. In total, 296 grayling were captured, and the population was estimated at 780 (standard deviation – 194). Additionally, 15 brook trout were captured and removed from the reservoir.

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IX. Appendix A

Appendix 1. Total fish captured by species per reach during 2012 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	132	2	13	16
Big Hole CCAA (B)	2.51	0	121	6	249	12
Big Hole CCAA (C)	6.32	1	160	3	31	5
Big Hole CCAA (D)	5.83	24	24	21	18	1
Big Hole CCAA (E)	3.28	5	2	80	93	0
Total	19.27	30	439	112	404	34

Appendix 2. Total fish captured by species per reach during 2012 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	173	0	60	1
Miner Creek (B)	0.60	0	36	0	11	6
Rock Creek (C)	2.86	94	140	0	0	7
Steel Creek (D)	2.91	14	338	0	7	12
Swamp Creek	0.33	22	na	na	na	na
North Fork	2.90	0	32	0	12	1
Plimpton Creek	0.78	35	230	5	15	5
Howell Creek	0.58	11	na	na	na	na
Pintlar Creek	0.53	9	na	na	na	na
York Gulch	0.26	1	na	na	na	na
Squaw Creek	0.40	15	na	na	na	na
LaMarche Creek	1.02	1	77	4	2	3
Deep Creek (E)	1.41	18	43	154	44	3
Total	25.72	126	929	163	151	31