Arctic Grayling Monitoring Report 2010

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Arctic Grayling In Montana

I. Introduction

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

In October 1991, the United States Fish and Wildlife Service (USFWS) received a petition to list fluvial Arctic 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 Arctic 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 the 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 Arctic 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 a single DPS was appropriate for Montana Arctic grayling, known as the Missouri River DPS of Arctic grayling. The existing and projected biological, environmental, and management conditions surrounding Arctic grayling were considered before determining the Missouri River DPS of Arctic grayling warranted listing as "threatened" or "endangered" under the ESA. The Missouri River DPS of Arctic grayling again received a LPN of three, and listing was precluded by higher priority listing actions.

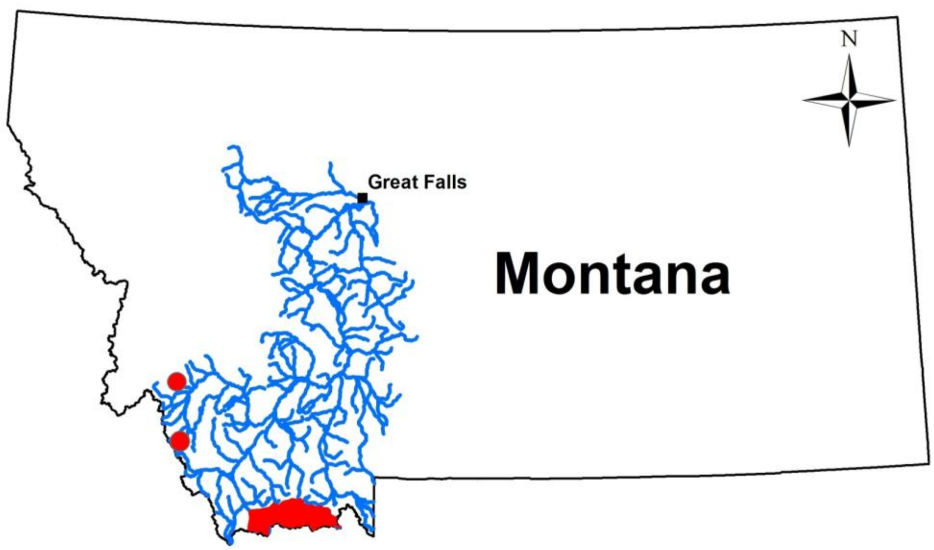

Figure 1. Historic Arctic grayling distribution in Montana. Fluvial populations (blue) occupied the Missouri River drainage upstream of Great Falls, MT. Adfluvial populations (Red) occupied habitat in the Big Hole and Centennial watersheds.

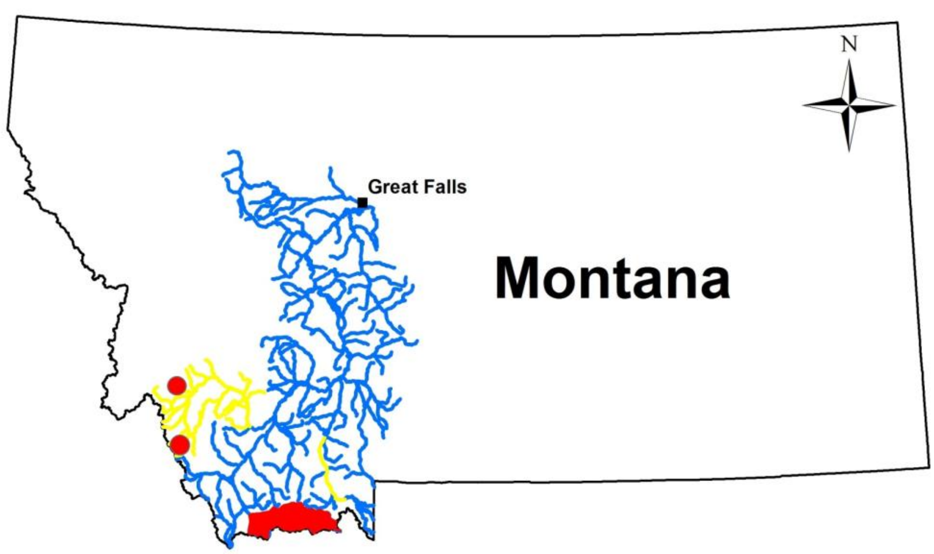

Figure 2. Present distribution of the five known Montana Arctic grayling populations. Fluvial populations delineated in yellow and adfluvial populations in red.

III. Big Hole River Arctic Grayling Population

A. Introduction

The Big Hole River is home to the last known native fluvial Arctic grayling population in the contiguous United States. Decline in abundance and distribution of this population 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). Arctic grayling conservation efforts have been summarized annually in the AGRP Annual Monitoring Report since 1991 (Byorth 1991, 1993, 1994, 1995a, 1997; Byorth and Magee 1996 and 1998; Magee 1999, 2002, and 2003; Magee and Opitz 2000; Magee and Lamothe 2003 and 2004; Magee et al. 2005; Magee et al. 2006; Magee et al. 2007; Magee and McCullough 2008, 2009 and Magee et al. 2010). The Big Hole CCAA actions have been reported annually since 2006 (Lamothe and Petersen 2006; Lamothe et al. 2007; Lamothe 2008 and 2009, Magee et al 2010).

Fluvial Arctic grayling conservation objectives initiated through the AGRP and the Big Hole CCAA within the Big Hole River watershed from January 1 through December 31, 2010 were to:

1) Develop and implement site-specific conservation plans on private properties enrolled in the Big Hole CCAA.

2) Promote and initiate habitat improvement 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 Arctic grayling.

4) Monitor water temperature, instream flow, and habitat parameters related to habitat improvement projects within critical stream reaches for Arctic grayling in the Big Hole River watershed, and as required by the Big Hole CCAA.

5) Monitor abundance and distribution of Arctic grayling and native and sportfish species in the upper Big Hole River watershed.

6) Recolonize Arctic grayling into restored habitats in Rock Creek using remote site incubators (RSIs).

B. Arctic Grayling Recovery Program

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 Arctic 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 Arctic 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.

C. Candidate Conservation Agreement with Assurances for Fluvial Arctic Grayling in the Upper Big Hole River

The Big Hole CCAA was developed as a tool to implement conservation actions for Arctic grayling on private lands. Under this agreement the USFWS issued FWP an ESA section 10(a)(1)(A) Enhancement of Survival Permit. The agreement was executed on August 1, 2006, which gave FWP the authority to enroll non-federal landowners within the Big Hole CCAA project area (project area). The project area includes the Big Hole River watershed from Dickie Bridge upstream to the headwaters (Figure 3). Enrolled non-federal landowners 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). The Big Hole CCAA partnering agencies include: FWP, DNRC, NRCS, and USFWS (hereafter, collectively referred to as the Agencies). The Agencies assist with the development, implementation and monitoring of conservation actions.

Thirty-three landowners have enrolled approximately 158,000 acres of private and state-leased property into the Big Hole CCAA. Site-specific conservation plans are developed for each landowner by an interdisciplinary technical team made up of individuals representing the Agencies. Guidelines outlined in the Big Hole CCAA document (FWP and USFWS 2006) are addressed by implementing conservation measures that:

1) Improve stream flows

2) Improve and protect the function of riparian habitats

3) Identify and reduce or eliminate entrainment threats to Arctic grayling

4) Remove barriers to Arctic grayling migration

Conservation measures are unique to each site-specific conservation plan but often include: irrigation flow management, grazing management, entrainment monitoring, and updates or installation of supportive infrastructure (e.g., stock water tanks, riparian fence, fish ladders, etc.).

The Big Hole CCAA has helped alleviate private property concerns associated with the potential ESA listing of Arctic grayling, and generated support from private landowners to improve habitat conditions for Arctic grayling throughout the project area (Lamothe et. al 2007). The goal of the Big Hole CCAA is to increase the abundance and distribution of Arctic grayling in the Project Area (FWP and USFWS 2006). The Agencies will monitor fish and habitat responses to the Big Hole CCAA throughout the life of the agreement (i.e., 20 years). FWP will annually survey 10 stream reaches to determine Arctic grayling population demographics and abundance. Fish monitoring reaches include one mainstem and one tributary reach within each Big Hole CCAA management segment (A – E; Figure 3). Entrainment surveys are conducted in irrigation ditches on enrolled properties to assess the impacts of entrainment on the Arctic grayling population. Riparian habitat is monitored using the NRCS Riparian Assessment Method. Additional stream channel habitat is monitored by assessing channel morphology (e.g., cross sections and pebble counts), instream water temperature and stream discharge.

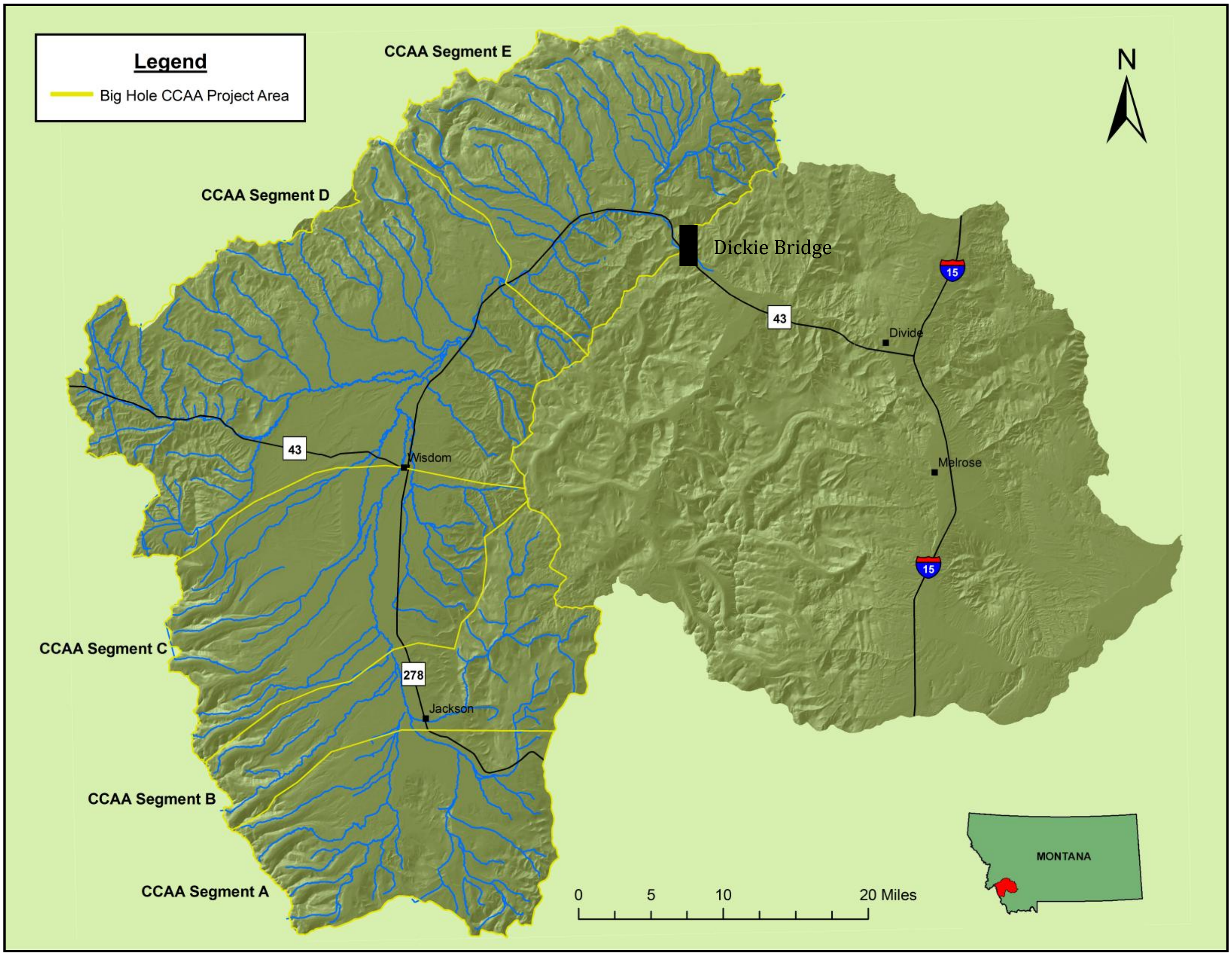

Figure 3. The Big Hole CCAA project area and management segment boundaries (A - E) within the Big Hole River watershed.

D. Big Hole River Watershed Habitat Monitoring

Stream Water Temperature

Methods

In 2010, FWP collected stream temperature data at 16 (seven mainstem and nine tributary) locations in the project area (Figure 4). Stream temperature monitoring sites were selected at one mainstem and one tributary location within each Big Hole CCAA management segment, to evaluate habitat enhancement projects and critical grayling habitats. Big Hole River sites included Saginaw Bridge, Miner Lakes Road, at the confluence with Miner Creek, the Wisdom Bridge, Pintlar pool, Mudd Creek Bridge, and Dickie Bridge. Big Hole River tributary sites included Governor Creek, Miner Creek, Rock Creek, Swamp Creek, the North Fork of the Big Hole River Steel Creek, Fishtrap Creek, LaMarche Creek and Deep Creek.

Stream temperature data were recorded at 60-minute intervals and summarized as daily minimum, maximum and mean, and hours and days exceeding 70 and 77º Fahrenheit (Tables 1 and 2). 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).

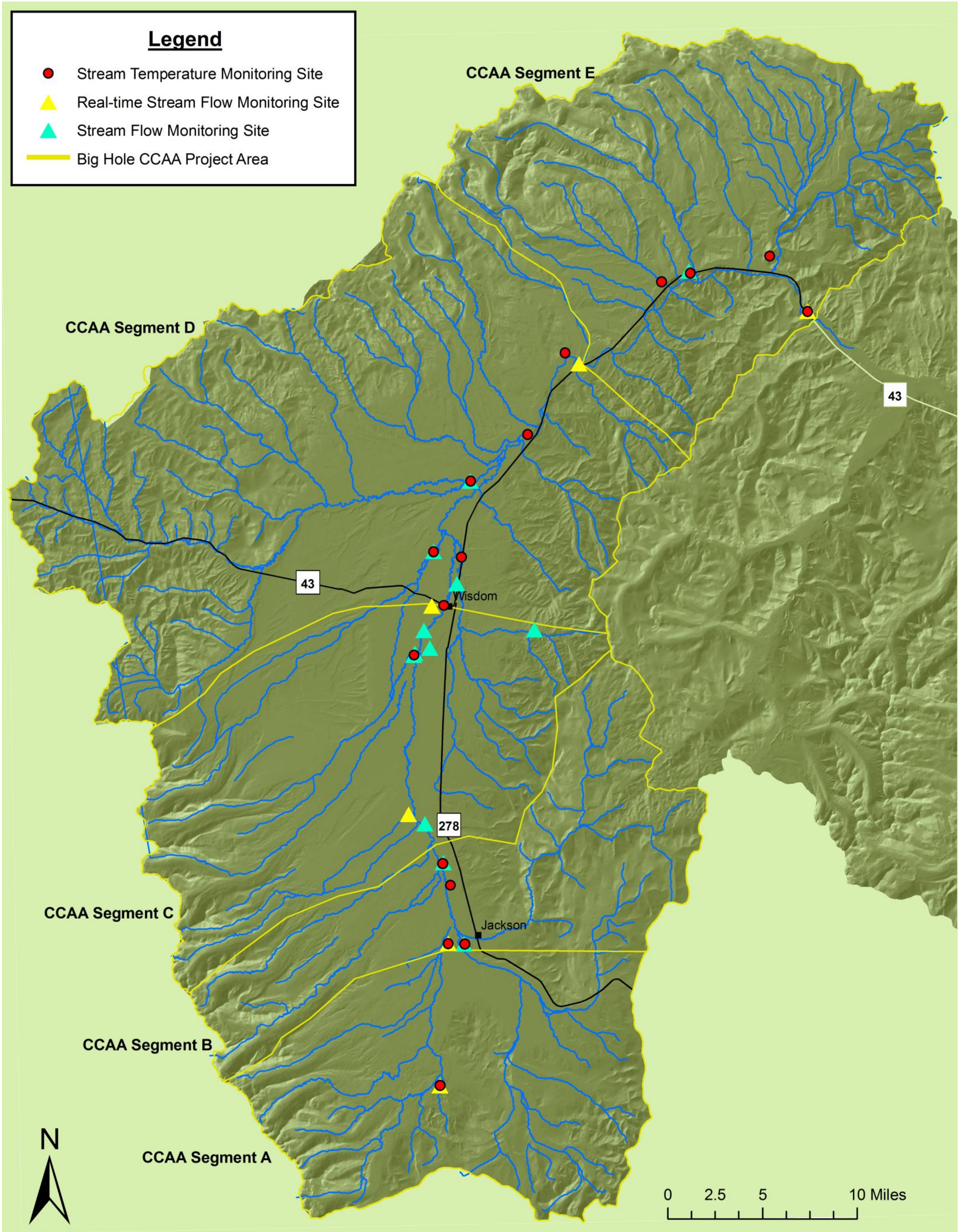

Figure 4. Location of stream temperature monitoring sites (red circle), USGS real-time stream flow monitoring sites (yellow triangle), and DNRC stage-recording stream discharge monitoring sites (aqua triangle) in the Big Hole CCAA project area.

Results

The Mudd Creek Bridge site exceeded 70º Fahrenheit for the most days (N = 29; Table 1) of all mainstem Big Hole River sites. Similarly, Steel Creek and Swamp Creek sites exceeded 70º Fahrenheit the most days (N = 33; Table 2) of all tributary Big Hole sites. No stream temperature monitoring site exceeded 77º Fahrenheit in 2010 (Table 1 and 2).

Table 1. Summary of data from temperature monitoring sites on the Big Hole River in 2010 and the number of days exceeding 70˚ and 77˚ Fahrenheit at each site.

Big Hole River Sites	Days >70˚F	Days >77˚F
Saginaw Bridge	0	0
Miner Lakes Road	0	0
Confluence with Miner Creek	0	0
Wisdom Bridge	26	0
Pintler Pool	23	0
Mudd Creek Bridge	29	0
Dickie Bridge	21	0

Table 2. Summary of data from stream temperature monitoring sites in Big Hole River tributaries in 2010 and the number of days exceeding 70˚ and 77˚ Fahrenheit at each site.

Big Hole Tributary Sites	Days >70˚F	Days >77˚F
Governor Creek	24	0
Miner Creek	8	0
Rock Creek	3	0
Steel Creek	33	0
Swamp Creek	33	0
North Fork Big Hole River	28	0
Fishtrap Creek	0	0
LaMarche Creek	0	0
Deep Creek	0	0

Stream Flow Monitoring

Methods

Stream flow in the Big Hole River watershed is primarily influenced by cumulative snowpack and precipitation events. The NRCS monitors the Big Hole River watershed cumulative snowpack and precipitation for the water year (October – September) at seven Snotel sites and collects snowpack data at an additional 12 Snow Course sites. Results are reported online at: http://www.nrcs.usda.gov.

The DNRC maintained a network of 13 continuous water stage recording instruments (eight Big Hole River tributary sites and five irrigation diversion sites) and four real-time flow gage instruments (Big Hole River at Saginaw Bridge, Miner Lakes Road, the confluence with Miner Creek, and Dickie Bridge) to monitor stream flow dynamics within the project area (Figure 4). The United States Geological Survey (USGS) managed real-time flow gaging sites at Wisdom and Mudd Creek Bridge. Real time gaging site data can be viewed online at www.usgs.gov. This gaging network is critical to the Agencies and private landowners for instream flow conservation efforts.

Results

Peak snowpack for the period-of-record (POR; NRCS 1971 – 2000) in the Big Hole River basin typically occurs in mid-April. On April 15, 2010, the Big Hole River basin snowpack was only 63% of the average for the POR for that date. Peak snowpack in the Big Hole River basin in 2010 occurred on June 1, and was 122% of the average for the POR for that date. June precipitation in 2010 was 161% of the average for the POR. The combined rain-on-snow runoff in early June in the Big Hole River basin produced a long duration bank-full flow event (Figure 5). Peak flow at the USGS Wisdom stream flow monitoring site occurred on June 17 at 3,870 cfs; 204% of the average for the POR (USGS 1988 – 2010). Cumulative precipitation for the water year (October – September) was 107% of the average for the POR (NRCS 1971 – 2000).

A minimum flow of 37 cfs occurred on August 28, 2010 at the USGS Wisdom stream flow monitoring site. Irrigation water reductions by landowners enrolled in the Big Hole CCAA improved stream flows throughout the summer and fall. Ten landowners voluntarily returned 80 cubic feet per second (cfs) of water back to the Big Hole River or tributaries between May and September 2010.

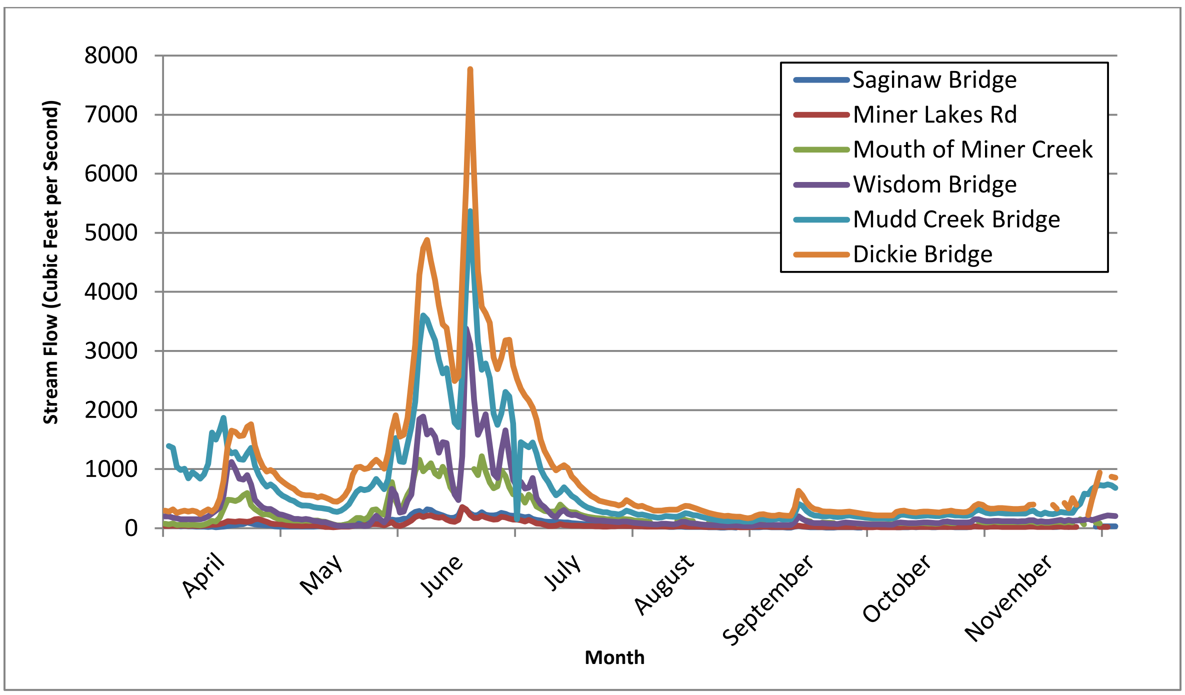

Figure 5. Big Hole River stream flow data collected at real-time gaging stations at the upper Big Hole CCAA project area boundary (Saginaw Bridge), and the lower boundary of each Big Hole CCAA management reach (Miner Lakes Road, mouth of Miner Creek, Wisdom Bridge, Mudd Creek Bridge and Dickie Bridge).

E. Rock Creek Recolonization

Introduction

Rock Creek historically flowed into the Big Hole River upstream of the town of Wisdom and was a productive stream for grayling. FWP electrofishing surveys in Rock Creek captured over 60 grayling per mile in the 1980s (Figure 9). A change to an irrigation system in the late 1980s caused Rock Creek to flow into an irrigation ditch and essentially eliminated connectivity between Rock Creek and the Big Hole River. Soon after, grayling abundance declined (Figure 9). In 2005, design alternatives were generated to restore connectivity between Rock Creek and the Big Hole River. Project stakeholders decided to reactivate a historic Rock Creek channel. In addition, 2.5 miles of existing channel was restored to reference condition by increasing pool quality and frequency, stabilizing and sloping 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). A combination of electrofishing, trapping, and tagging were used from 2007 – 2009 to document grayling colonization of Rock Creek, post-restoration. Extensive monitoring efforts captured only one grayling in Rock Creek during that period. 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 June 2010, FWP initiated Arctic grayling recolonization efforts into Rock Creek by incubating gametes from the Big Hole fluvial brood stock using remote site incubators (RSI).

Methods

A fluvial Arctic grayling genetic brood reserve was developed using gametes collected from the Big Hole River population, to support reintroduction or recolonization efforts. Gametes collected from the brood reserve are taken to a hatchery and developed to eye-up stage, then transported to RSIs. Remote site incubators have been used to develop Arctic grayling fry under a controlled environment with a high rate of success (Kaeding and Boltz 2004). On May 17, 2010, Arctic grayling gametes were collected from the Axolotl Lake brood reserve and taken to the Yellowstone River Trout Hatchery and developed to eyed eggs. On May 28, 2010, eyed eggs were placed in RSIs on Rock Creek.

Approximately 80,000 eggs were placed in incubators at three RSI sites (Figure 6). Site #1 is the furthest upstream located at Helen Springs, a spring creek tributary to Rock Creek. Sites #2 and #3 were located downstream of pin and plank diversion structures (Figure 6 and 7). Pin and Plank diversions can be managed to reduce impacts from high stream flows that occur during RSI operation (Figure 8). Diversions also create backwater areas favorable for weak swimming fry. Placing RSIs downstream of diversions may also reduce the potential for entrainment in irrigation ditches.

Remote site incubators were monitored daily to ensure operation and to 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.

Remote site incubator locations were chosen to minimize entrainment. However, the potential for entrainment of grayling fry was still considerable due to the high number of irrigation PODs located on Rock Creek from the mouth to Helen Springs (n = 11). To quantify entrainment, on August 10 and 11, 2010, electrofishing surveys were completed on three miles of irrigation ditch from six PODs on Rock Creek (Figure 6)

To quantify the number of grayling that were produced from RSIs and survived for at least 3 months, electrofishing surveys were completed on September 9, 21, and October 5, 2010. Surveys were completed on one reach near RSI Site #1 and two reaches in the lower three miles of Rock Creek near RSI Sites #2 and #3 (Figure 6).

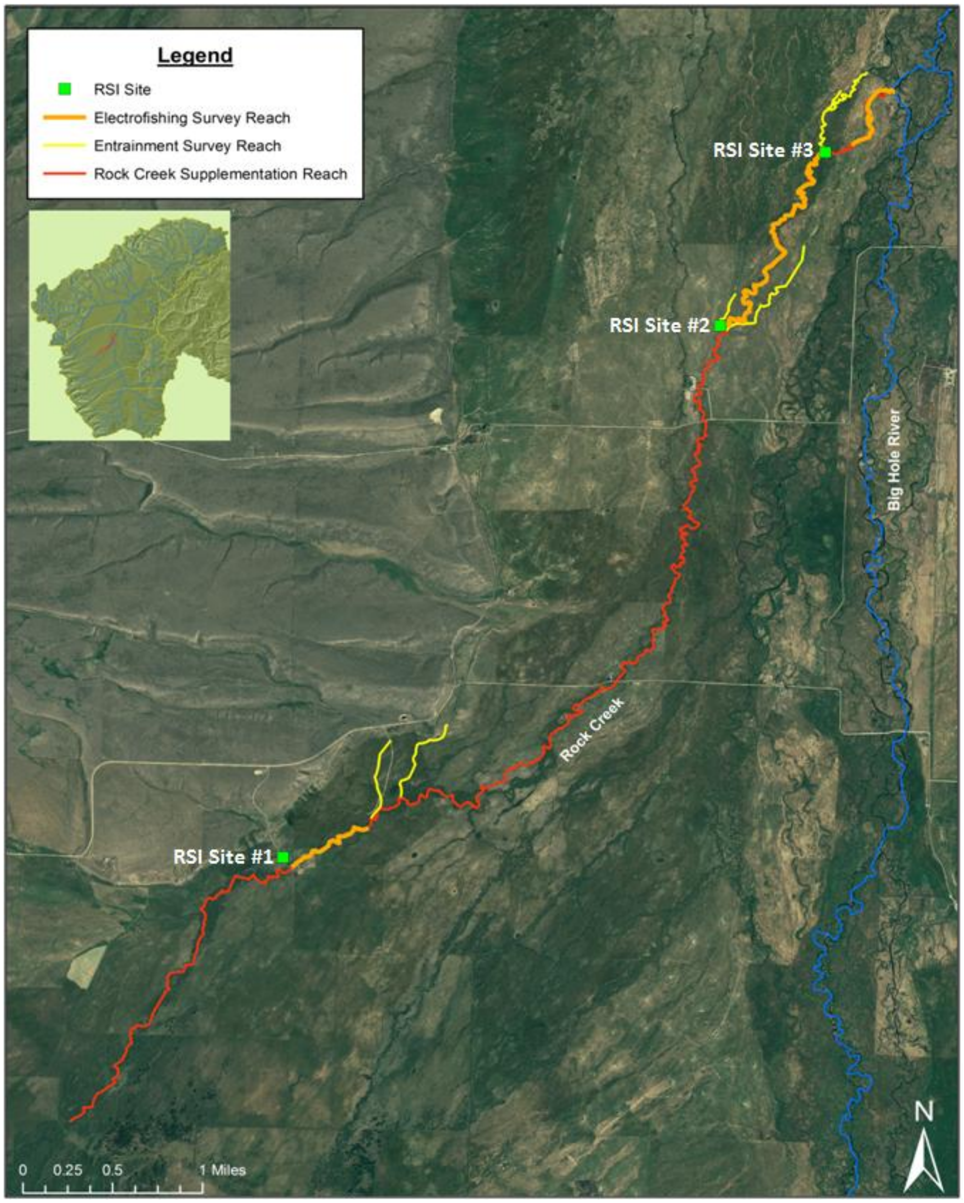

Figure 6. Rock Creek remote site incubator (RSI) locations, fall electrofishing survey reaches and entrainment survey reaches.

Figure 7. Remote site incubators were positioned downstream of existing pin and plank diversion structure to alleviate high flow conditions and provide backwater areas for fry.

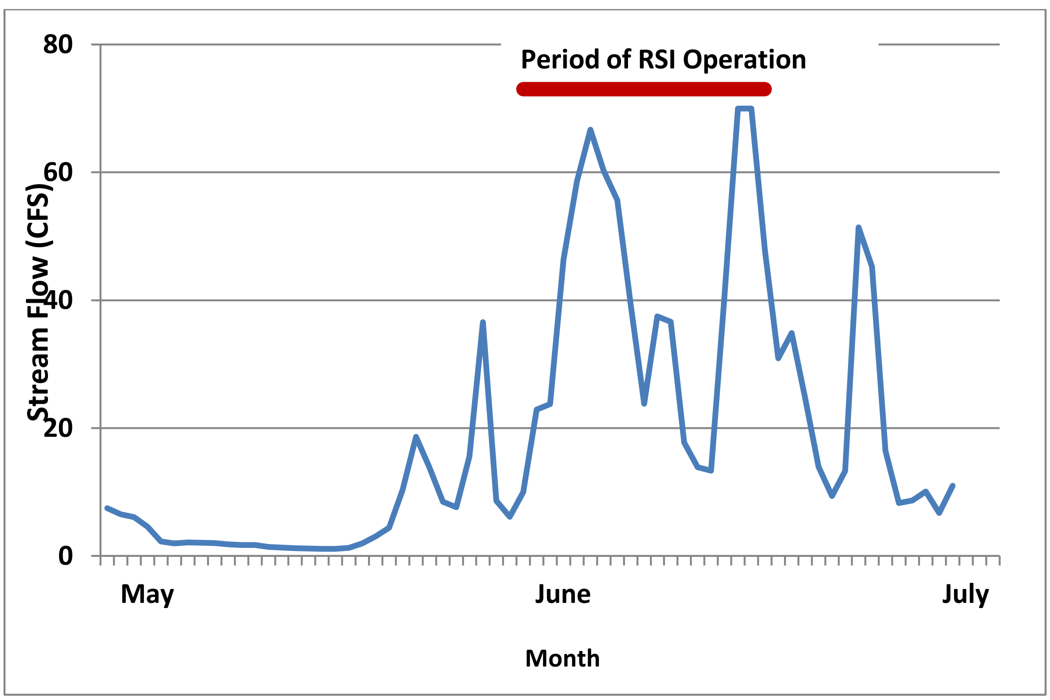

Figure 8. Rock Creek stream flow in cubic feet per second (cfs) and the period of operation for remote site incubators.

Results

Remote site incubators produced grayling fry at all sites; however, emergence time varied between sites. The first observed fry emerged from RSI sites #1 and #3 (Figure 6) on June 5 and fry emerged at all RSI sites by June 7. All fry emerged and left the RSIs by June 16.

Twenty-one grayling were captured in one irrigation ditch originating from Rock Creek. No grayling were captured in the other five irrigation ditches surveyed (Figure 6). Captured grayling were transported and released in the Big Hole River.

Electrofishing surveys in the lower three miles of Rock Creek captured 401 YOY Arctic grayling (Figure 6 & 9). Despite visual observations of Arctic grayling fry (100+) in June at RSI site #1, no grayling were captured during the Rock Creek survey near the mouth of Helen Springs (Figure 6).

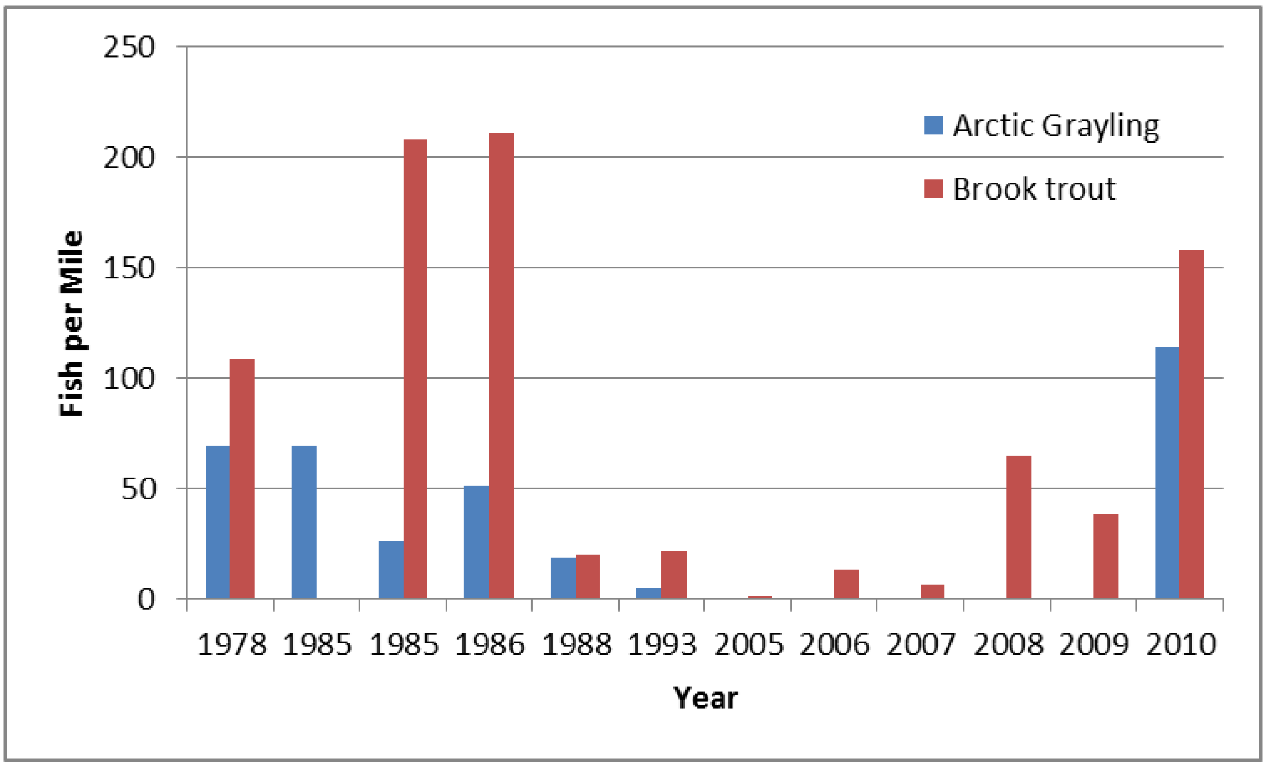

Figure 9. Arctic grayling and brook trout number per mile based on catch per unit effort in Rock Creek from Montana Fish, Wildlife and Parks electrofishing surveys.

F. Big Hole River Arctic Grayling Population Monitoring

Methods

In 2011, Montana Fish, Wildlife & Parks 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, monitoring fisheries response to habitat improvement projects as required by Big Hole CCAA site-specific conservation plans.

Drift boat or crawdad mounted mobile-anode equipment and backpack electrofishing units were used to conduct 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). Arctic grayling greater than six inches in total length were tagged with a visible implant (VI™) tag in the transparent adipose tissue immediately posterior to the left eye. A fin clip was taken for genetic analysis, and a scale sample was taken for age determination.

In 2010, FWP conducted electrofishing surveys on 12 mainstem (42.7 miles) and 16 tributary reaches (19.6 miles) in the Big Hole watershed (Figure 10). 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). Other mainstem reaches include the Jerry Creek and Melrose reaches and the “Pools” (Sportsman, Fishtrap, and Sawlog). Additional tributary reaches included Plimpton Creek, Swamp Creek, Fishtrap Creek, LaMarche Creek, Little Lake Creek, Minnie Creek, French Creek, Bear Creek, Conner Gulch and Bryant Creek.

Data collected during 2010 electrofishing surveys were summarized with Fisheries Analysis 1.2.7 (Montana Fish, Wildlife & Parks 2007). Catch-per-unit effort (fish/mile) was calculated from a single-pass electrofishing effort for each sampling reach. Catch-per-unit-effort data were used to track trends in population abundance and spatial distribution. Arctic grayling data were summarized using a length-frequency histogram to describe the population age structure (Figure 11), and as catch-per-unit-effort for YOY (< 6.0 inches) and age 1+ (> 6.0 inches) Arctic grayling by sampling reach (Figure 12 and 13). 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 drainage to quantify entrainment of Arctic grayling. Arctic grayling captured during entrainment surveys were anesthsized using MS-222, weighed (± 0.01 lb), measured for total length (± 0.1 in), VI tagged and transported to the Big Hole River or nearest tributary. The location of Arctic grayling capture and release sites were recorded. In 2010, FWP surveyed 12.2 miles of irrigation ditch associated with 19 PODs (Figure 10).

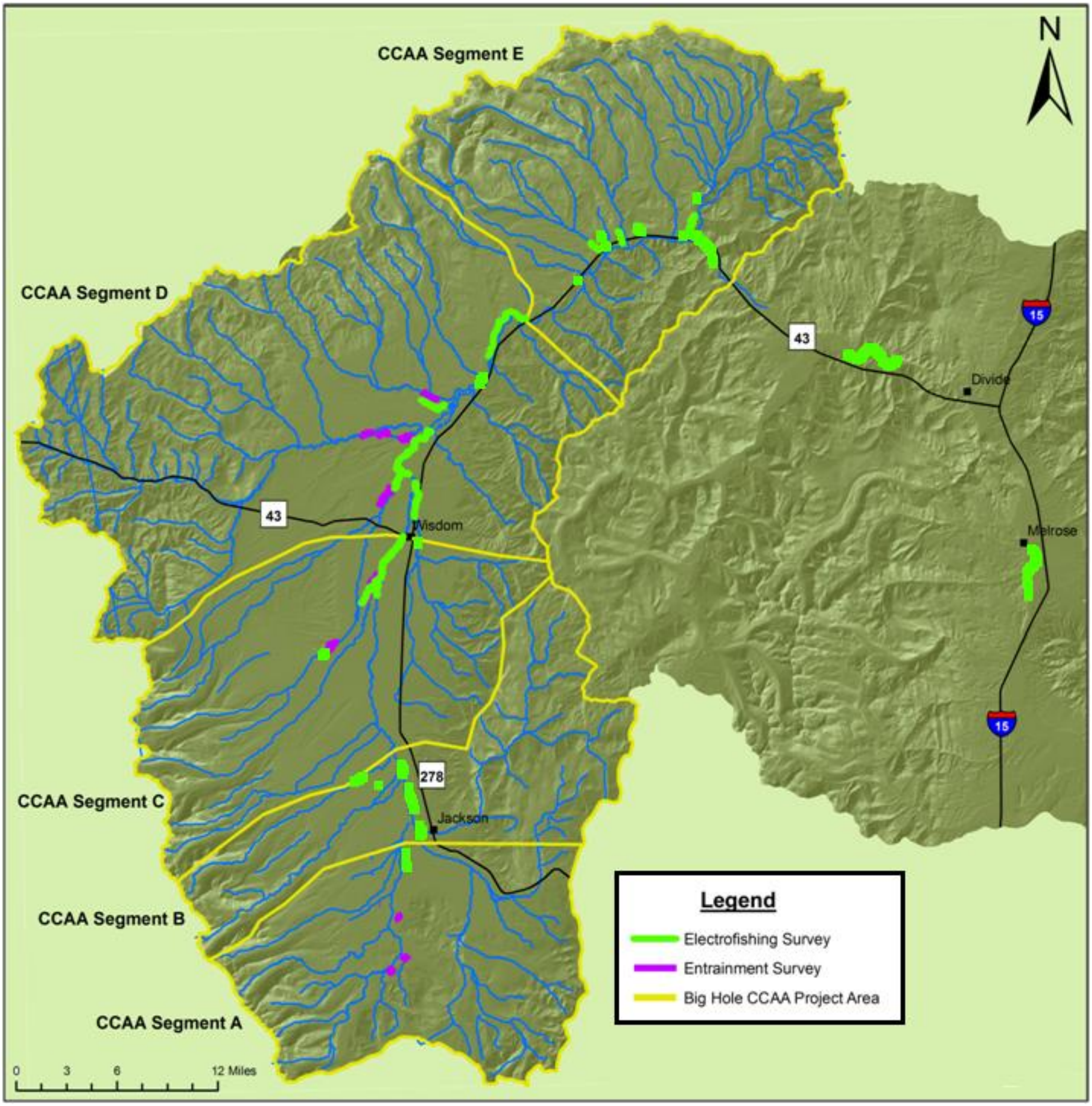

Figure 10. Electrofishing and entrainment survey reaches completed in the Big Hole watershed in 2010 by Montana Fish, Wildlife and Parks.

Results

Arctic grayling were captured in an 80 mile reach extending from Melrose to Wisdom. Electrofishing and entrainment surveys captured 618 Arctic grayling in the Big Hole River watershed in 2010. The majority of grayling captured were YOY (< 6 inches; N=559), including 422 YOY in Rock Creek and one irrigation diversion from Rock Creek. The remaining 59 grayling captured were Age 1 and older (> 6 inches; Figure 10). Despite greater electrofishing effort in the mainstem Big Hole River than in tributaries, more Arctic grayling were captured in tributaries (Figures 12 and 13). Entrainment surveys accounted for the capture of thirty-eight grayling individuals.

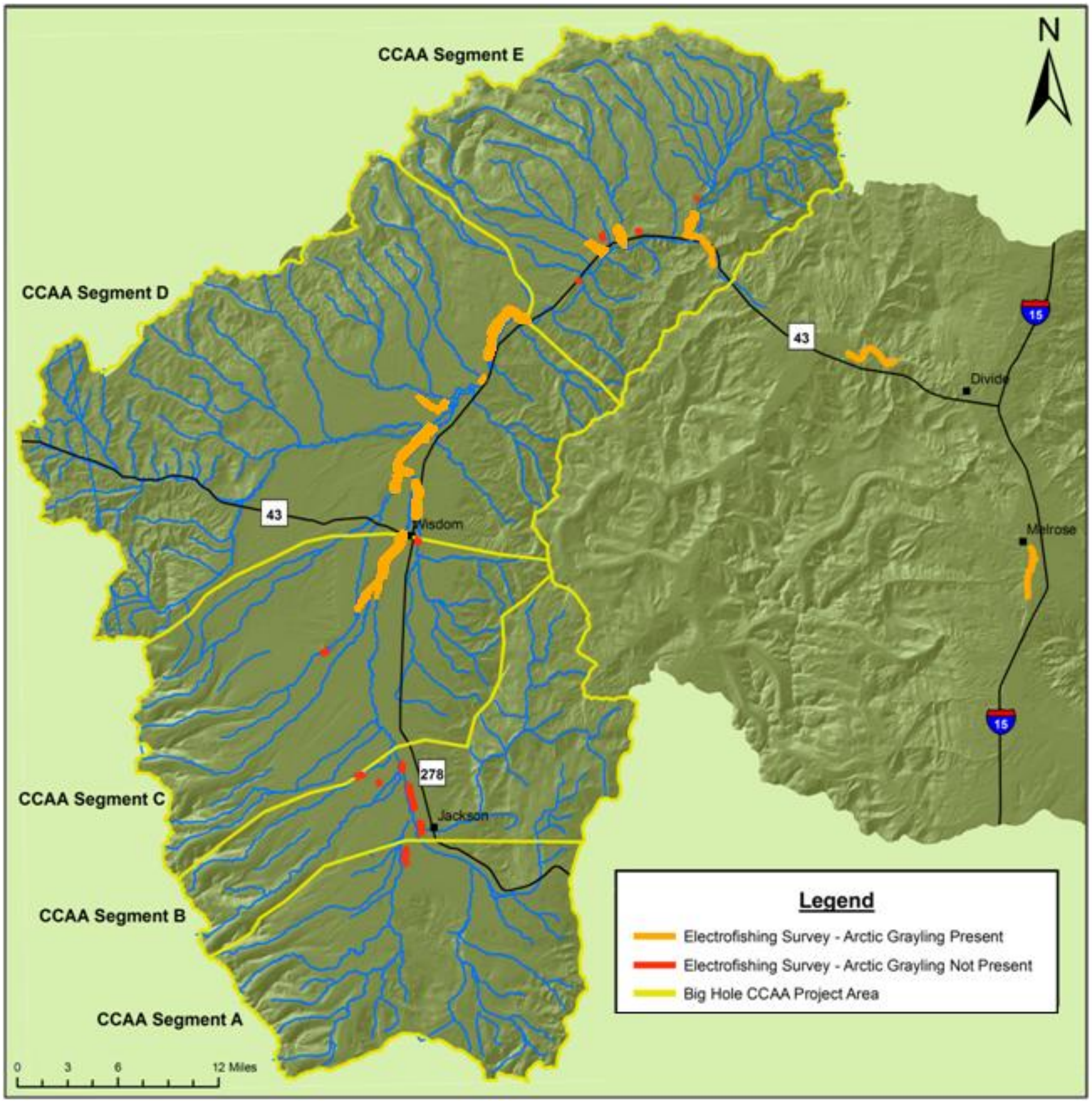

Figure 11. Electrofishing survey reaches completed in 2010 in the Big Hole River watershed by Montana Fish, Wildlife and Parks. The presence of Arctic grayling (orange) or absence of Arctic grayling (red) is shown for each sampling reach.

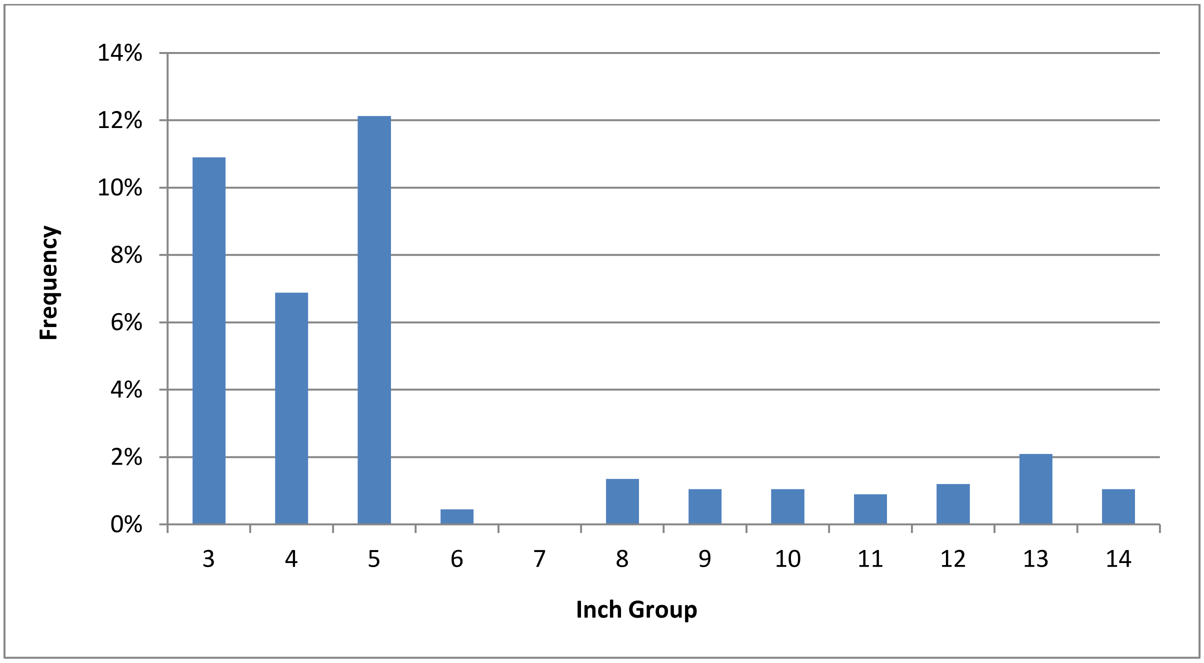

Figure 11. Length-frequency histogram for Arctic grayling captured during the 2010 electrofishing and entrainment surveys in the Big Hole River watershed (N = 196). Grayling individuals captured in association with Rock Creek recolonization efforts are omitted to portray the size structure of the natural population.

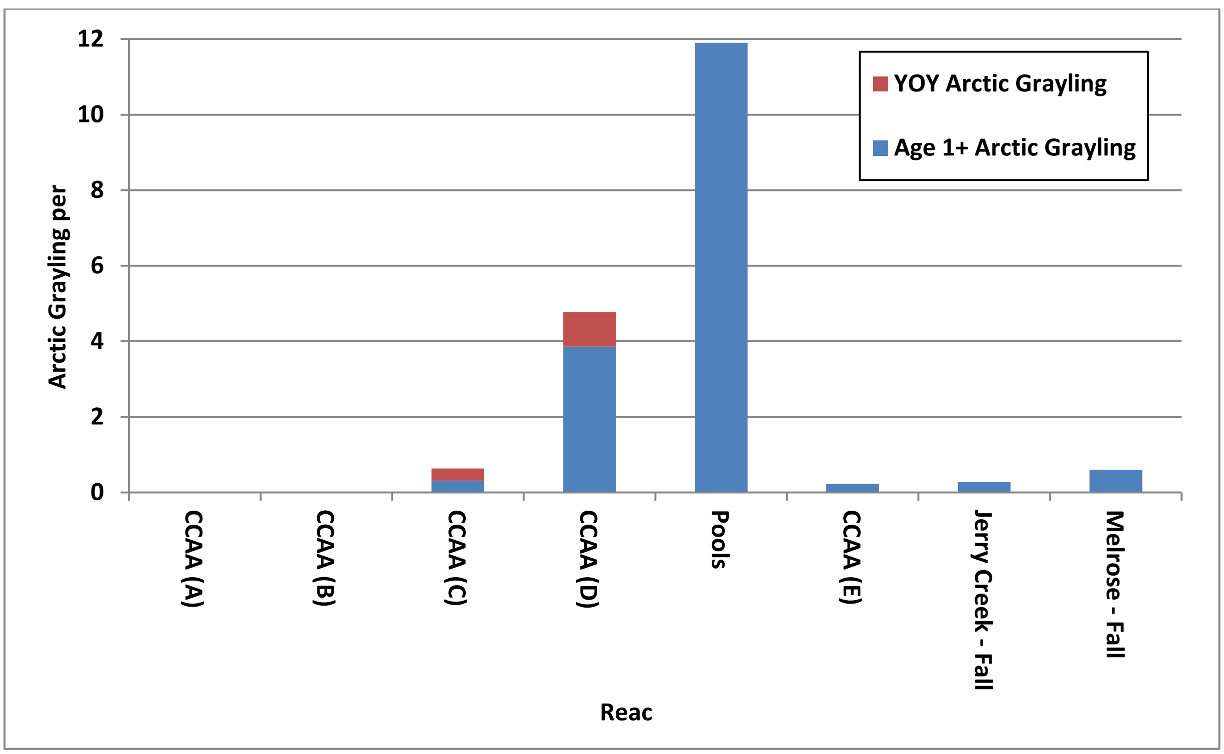

Figure 12. Young-of-the-year (YOY) and Age-1+ Arctic grayling captured per mile in the sampling reaches in the Big Hole River during FWP 2010 electrofishing surveys.

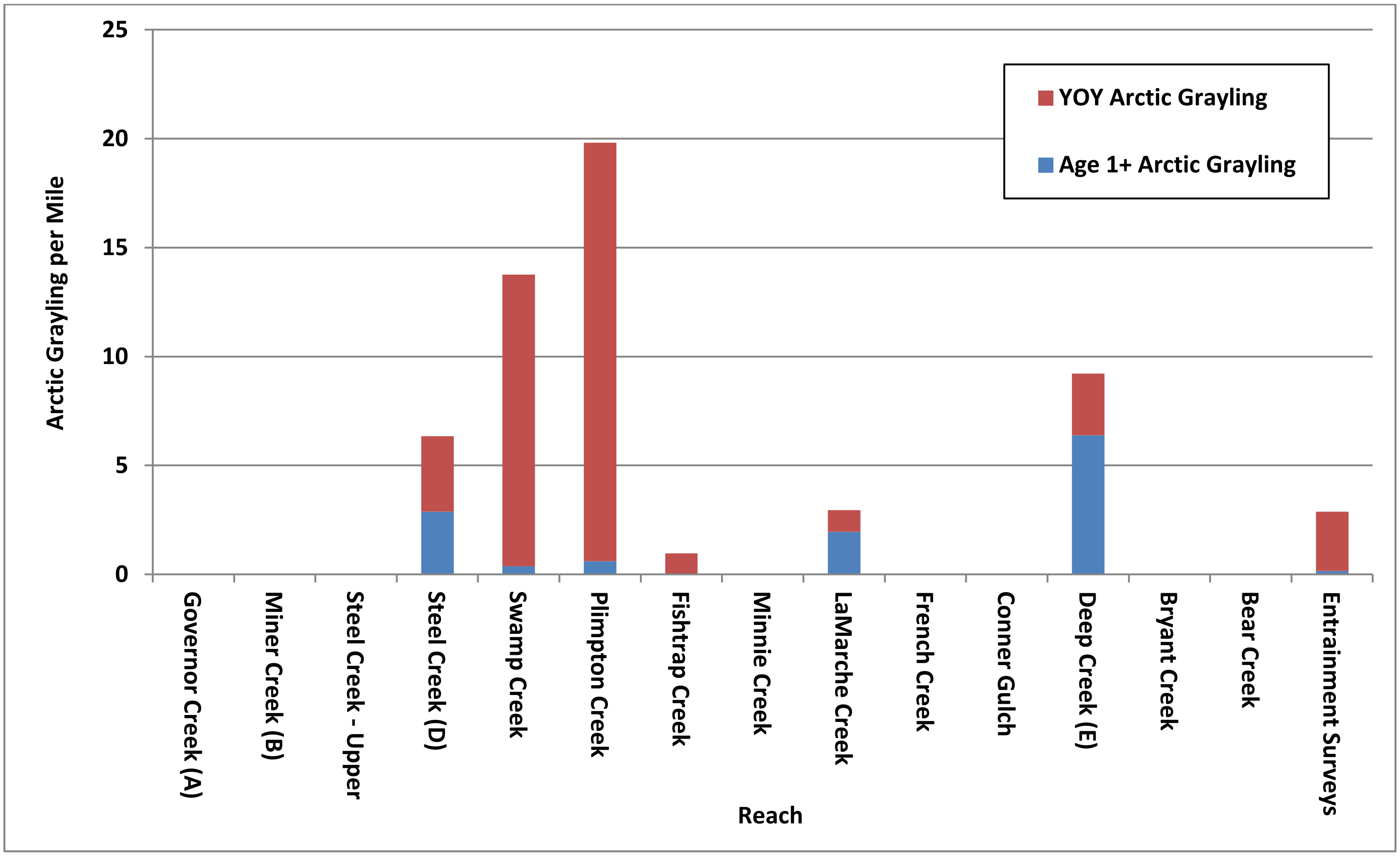

Figure 13. Young-of-the-year (YOY) and Age-1+ Arctic grayling captured per mile in the sampling reaches in the Big Hole River tributaries and entrainment surveys during 2010.

IV. Upper Ruby River Arctic Grayling Population

A. Introduction

Arctic Grayling Recovery Program goals include establishing fluvial Arctic grayling populations within the native, historic range (Fluvial Arctic Grayling Recovery Plan 1995). The upper Ruby River, upstream of Ruby Reservoir, was identified as suitable for fluvial Arctic grayling restoration due to its size, low gradient and relative low density of non-native salmonid species (Kaya 1992; Figure 13). Reintroduction efforts in the upper Ruby River began in 1997. Age 0, 1 and 2 hatchery reared Arctic 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. Ruby River grayling reintroduction efforts were supported by 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, no grayling supplementation has occurred since 2008.

In 2010, grayling population monitoring efforts evaluated abundance, distribution, age-class structure, and the occurrence of natural reproduction.

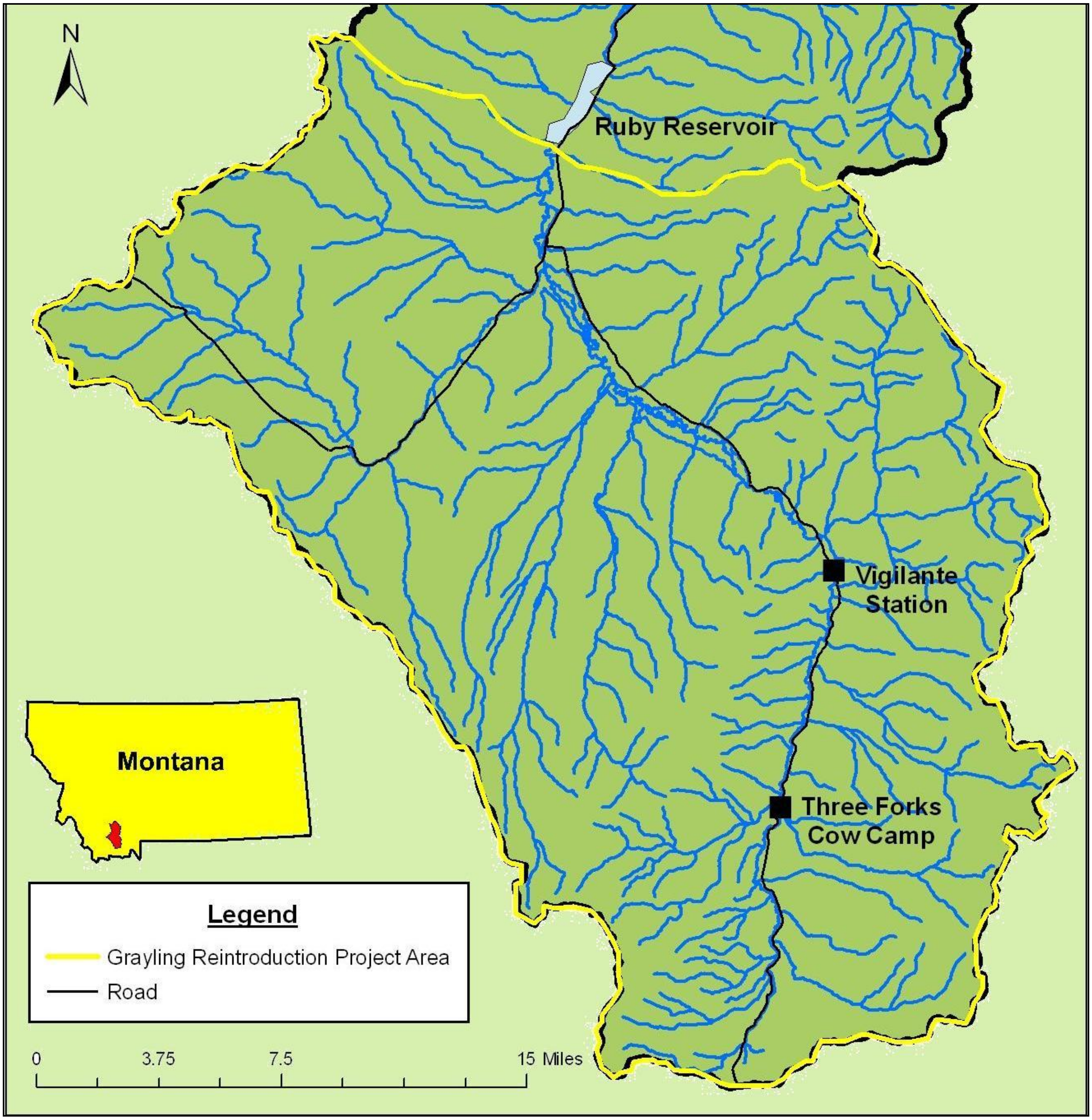

Figure 13. The Arctic grayling reintroduction area within the upper Ruby River watershed.

B. Ruby River Watershed Habitat Monitoring

Stream Temperature Monitoring

Methods

Stream water temperature data was collected in the upper Ruby River at three mainstem and six tributary sites (Figure 14). Sites were selected to characterize mainstem and tributary temperatures within the reintroduction area, and to monitor stream temperatures in relation to habitat enhancement projects. Temperature loggers recorded data at 60-minute intervals and data were summarized as daily minimum, maximum and mean temperature, and hours and days exceeding 70 and 77º Fahrenheit. Seventy degrees Fahrenheit served as a thermal stress threshold for salmonid species (Behkne 1991), and 77 º Fahrenheit represents the upper incipient lethal temperature for Arctic grayling (Lohr et al. 1996).

Results

Seventy degrees Fahrenheit was exceeded at one mainstem (Canyon) and two tributary sites (Warm Springs Creek and Middle Fork of the Ruby; Table 3). Cumulative days exceeding the thermal stress threshold (70º Fahrenheit) were most numerous in at the Canyon mainstem site (N = 15) and the Warm Springs Creek tributary site (N = 94; Table 3). Stream temperatures did not exceed exceeded 77º F at any monitoring site.

Stream Flow Monitoring

Methods

Stream flow conditions in the Ruby River watershed are primarily influenced by cumulative snowpack and precipitation events. The NRCS monitors the Ruby River basin snowpack and cumulative precipitation at five Snotel sites and collects snowpack data at an additional six Snow Course sites. Results are reported online at www.nrcs.usda.gov.

The USGS monitors stream flow in the upper Ruby River watershed at a real-time gaging station directly upstream of the Ruby River Reservoir (Figure 15). Measurements are recorded at 15-minute intervals and reported online at www.usgs.gov.

Results

The April 1, 2010 Ruby River basin snowpack was only 82% of the average for the POR. However, a cold wet spring increased the snowpack to 155% of the average for that date for the POR (1971 – 2000) by June 1, 2010. Cumulative precipitation for the Ruby River watershed was 113% of the average for the POR. Peak discharge recorded at the USGS real-time flow monitoring station for 2010 occurred on June 5 at 1,050 cfs (Figure 16).

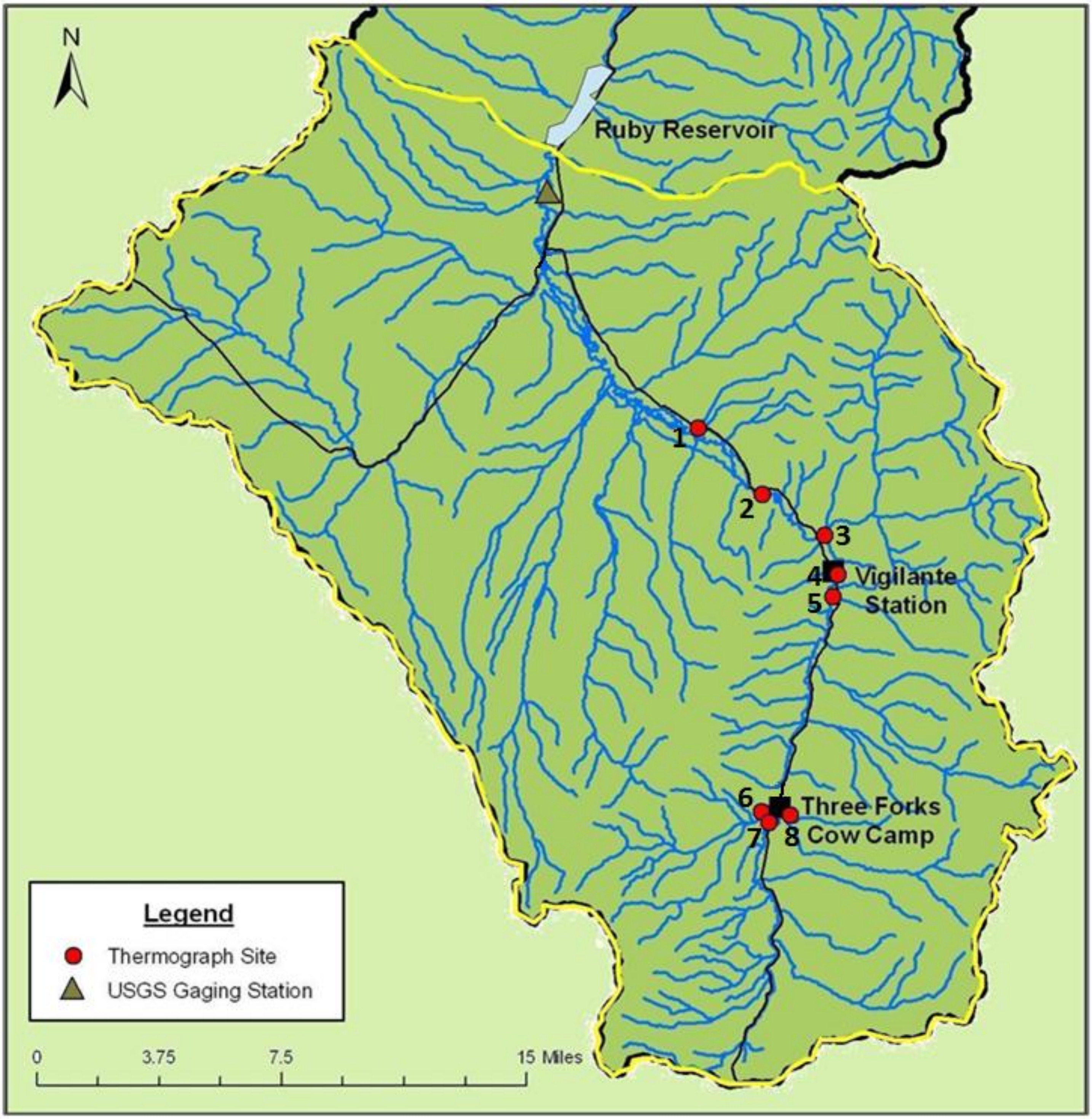

Figure 15. The location of stream temperature monitoring sites and the USGS stream flow gaging station in the upper Ruby River watershed (reintroduction area). Refer to Table 4 to reference thermograph site numbers.

Table 3. Upper Ruby River stream temperature monitoring sites and the associated number of days exceeding 70˚ and 77˚ Fahrenheit in 2010. Map site # refers to the temperature monitoring site in Figure 15.

Map Site #	Upper Ruby Watershed Sites	Days > 70˚F	Days > 77˚F
1	Canyon	15	0
2	Willow Creek	0	0
3	Warm Springs Creek	94	0
4	Vigilante Station	0	0
5	Lazyman Creek	0	0
6	West Fork Ruby River	0	0
7	Middle Fork Ruby River	14	0
8	East Fork Ruby River	0	0

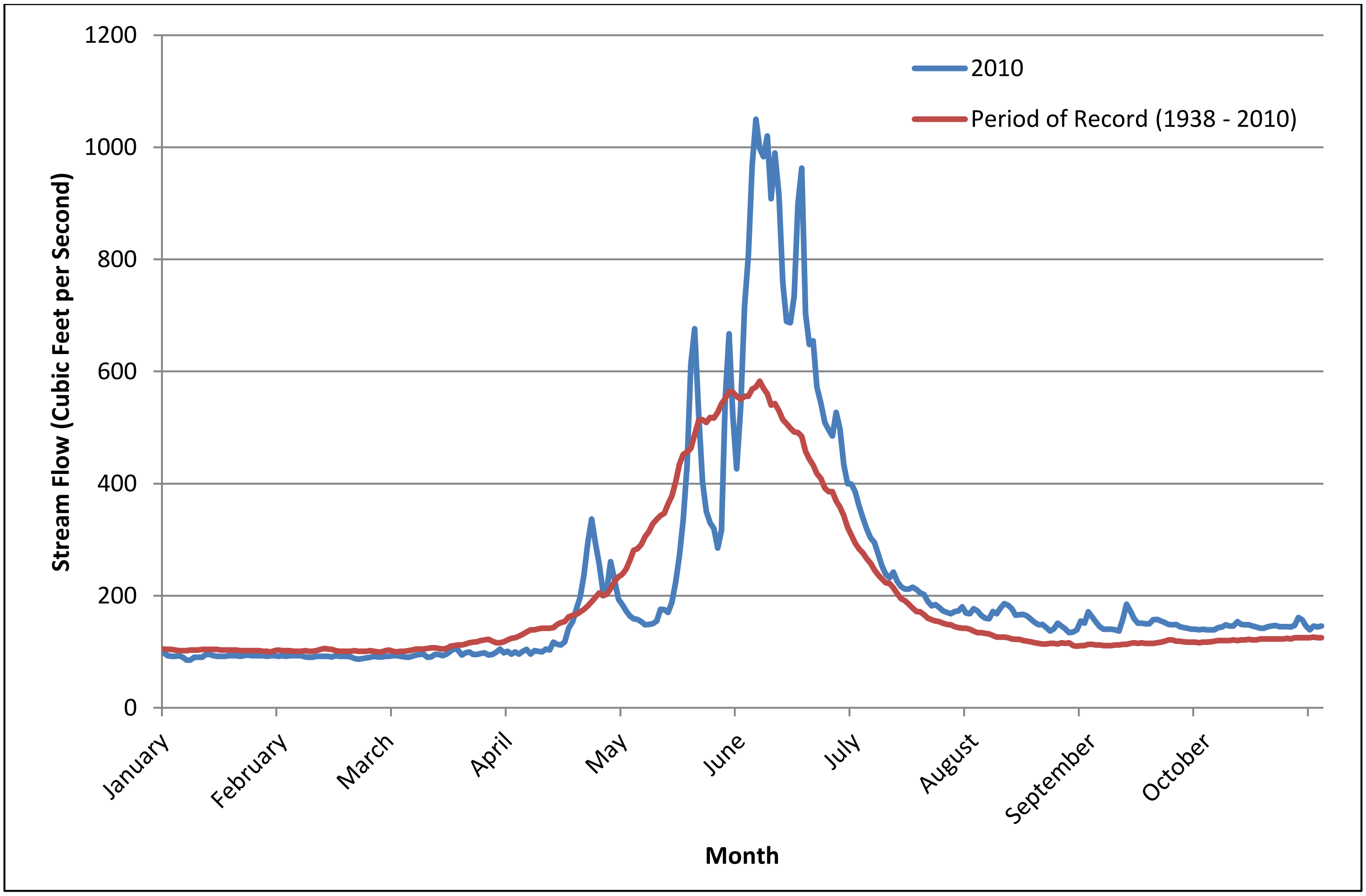

Figure 16. Stream flow recorded by the USGS for the Ruby River above the Ruby River Reservoir in 2010.

Ruby River Arctic Grayling Population Monitoring

Methods

In October 2010, FWP completed single pass electrofishing surveys on five reaches in the upper Ruby River watershed (Figure 17). Reaches included the Vigilante and Burnt Creek reaches on the Ruby River and Poison Creek, Shovel Creek and Corral Creek on the Middle Fork of the Ruby River . Arctic grayling, rainbow/cutthroat trout hybrids, brown trout, and brook trout were captured to monitor distribution and relative abundance. Captured fish were anesthetized using MS-222™ and measured for total length (± 0.1 in) and weight (± 0.01 lb) and pelvic fin clips were removed as a temporary mark. Grayling greater than six inches in length were tagged with a visible implant (VI™) tag in the transparent tissue immediately posterior to the left eye. A fin clip was taken for genetic analysis, and a scale sample was taken for age determination.

Data were summarized with Fisheries Analysis 1.2.7 (Montana Fish, Wildlife & Parks 2007) 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. Arctic grayling data were summarized using a length-frequency histogram to characterize population age structure (Figure 18), and catch-per-unit-effort (fish/mile) of YOY (< 6.0 inches) and Age 1+ (> 6.0 inches) per reach (Figure 19).

Results

Arctic grayling were captured in all five survey reaches, encompassing approximately 20 river-miles between Vigilante Station and the Middle Fork of the Ruby River. A total of 94grayling were captured, of which 37 were YOY. Presence of YOY verified that natural reproduction had occurred for the second year since supplementation efforts ended (Figure 18). Young-of-the-year Arctic grayling were captured in three of the five reaches sampled including the Vigilante (mainstem), Corral Creek (tributary) and Shovel Creek (tributary) reaches (Figure 19). Arctic grayling relative abundance was summarized by reach as catch-per-unit-effort (fish/mile) with the highest abundance in the three reaches in the Middle Fork of the Ruby River (Figure 19).

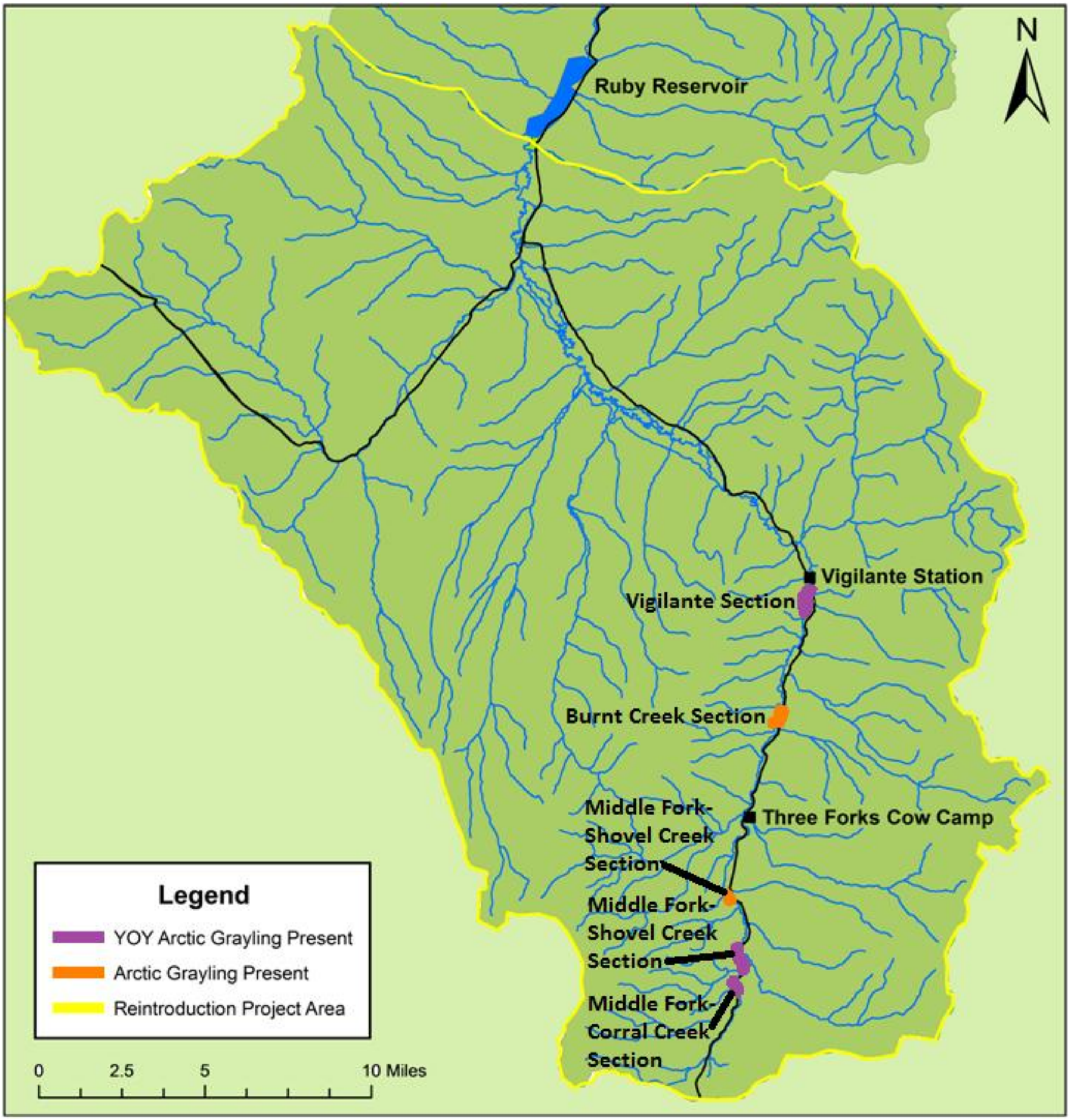

Figure 17. Montana Fish, Wildlife and Park's 2010 electrofishing reaches in the upper Ruby River watershed .

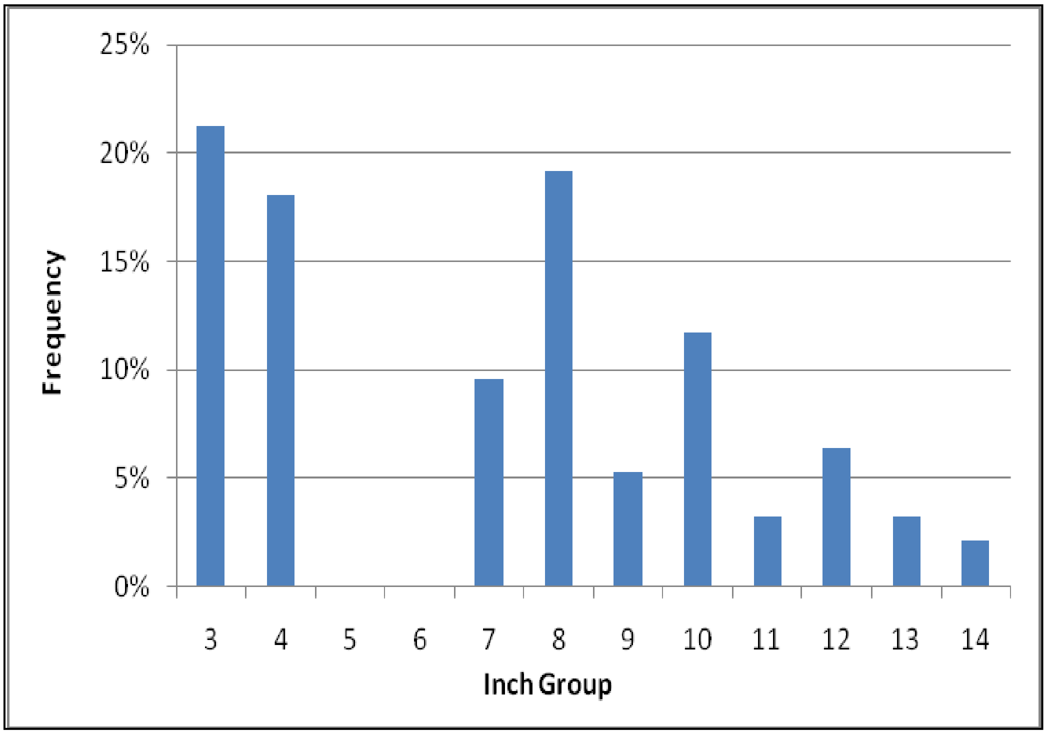

Figure 18. Length-frequency histogram for Arctic grayling captured during 2010 Montana Fish, Wildlife and Parks electrofishing surveys in the upper Ruby River watershed (N = 94).

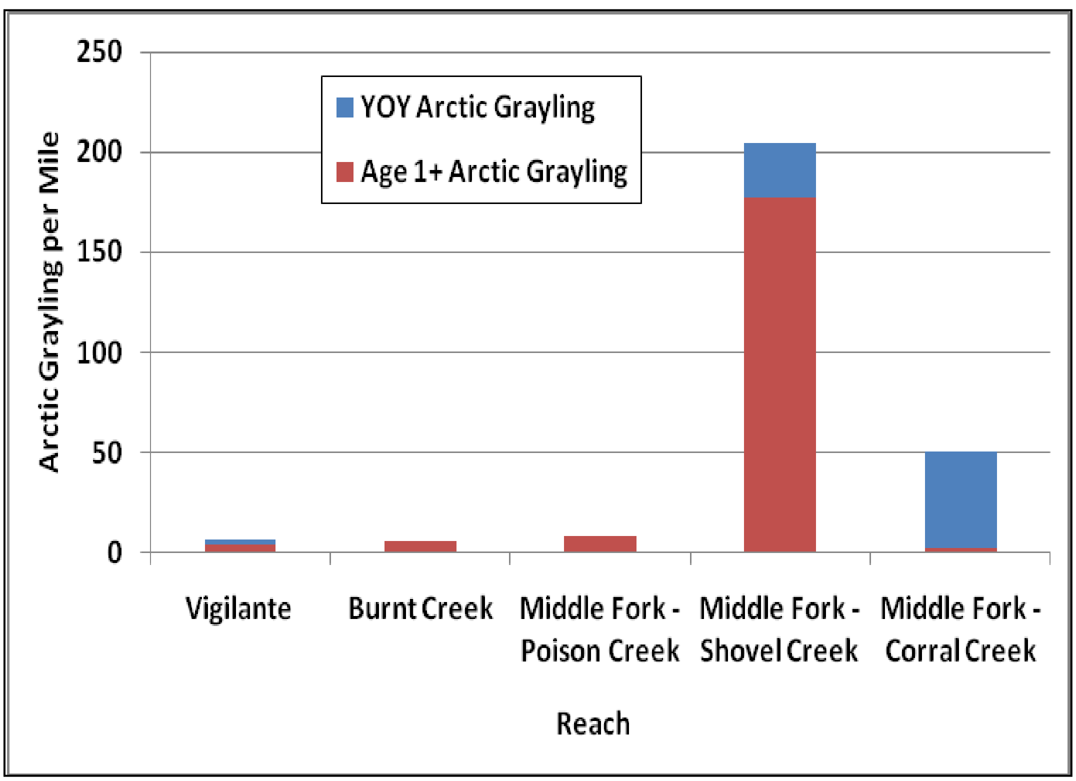

Figure 19. The young-of-the-year (<6 inches) and age-1+ Arctic grayling (> 6 inches) captured per mile by reach in the upper Ruby watershed during fall 2010 Montana Fish, Wildlife and Parks electrofishing surveys.

V. Fluvial Arctic Grayling Brood Program

A. Introduction

A fluvial Arctic grayling brood population has been 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 fluvial grayling 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 gamete source for introduction, reintroduction or recolonization efforts. 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 drainage.

B. Big Hole Gamete Collections

Methods

The grayling brood management plan (Leary 1991) outlines the need to maintain the genetic diversity of the brood populations by infusing gametes from wild Big Hole grayling every ten years. In 2010, FWP began those efforts with the goal of collecting gametes from ten pairs (20 individuals) over three years. On April, 26, FWP captured Arctic grayling in the North Fork section of the Big Hole River as part of the brood management effort.

Results

Big Hole grayling egg collection efforts on the North Fork section of the Big Hole River resulted in the capture of 46 Arctic grayling; 29 males, 10 females, and 7 immature. Eggs were collected from five females and artificially spawned with 19 males. The remaining females were gravid, but no eggs could be collected. Fertilized eggs were transported to the Yellowstone River Trout Hatchery (YRT). Progeny will be raised in the hatchery and planted back into the brood reserve populations at Axolotl Chain of lakes and Green Hollow II Reservoir in 2011. Results will be presented in the 2011 report.

C. Axolotl Lake Arctic Grayling Brood Reserve

Introduction

The Axolotl brood reserve was started in 1989 and has been critical to the Arctic grayling conservation efforts in Montana. Each spring FWP collects gametes from the brood reserves for introduction, 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) 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 conservation efforts, annual fish health screening are 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 history of the Axolotl grayling brood population. In 2010, fish health screening was conducted, gametes were collected for recolonization efforts in Rock Creek, and an additional age class was stocked.

Methods

On May 4 and 5, 2010 gill netting and 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 17 – 19, 2010 fyke trapping and hook-and-line methods were used to capture grayling for gamete collections. All captured grayling were 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.

Results

A total of 63 grayling were captured for fish health screening. All Arctic grayling tested negative for pathogens. A total of 844 Arctic grayling were captured for gamete collection. Average length of captured grayling was 10.2 inches and average fecundity of spawned females was 1,040 eggs. A total of 109,200 eggs were collected from 105 females and fertilized by 105 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. On May 28, 80,000 eyed eggs 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 2011.

On May 19, 2010 age-1Arctic grayling (N = 750) spawned from the Axolotl Lake brood population in 2009 were used to supplement the Axolotl Lake population to ensure the presence of multiple age-classes for future 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 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 conservation efforts in Montana.

In 2010, the Green Hollow II grayling brood was not used to support reintroduction or recolonization efforts. As a result, fish health screening did not occur. On May 18 and September 7, 2010. 750 and 1,250, respectively, age-1 grayling spawned from the Axolotl Lake brood population were stocked in Green Hollow II reservoir to maintain age structure and genetic diversity.

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IX. Appendices

Appendix 1. Total fish captured by species and reach during 2010 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)	1.59	0	200	8	0	17
Big Hole CCAA (B)	2.51	0	149	15	51	3
Big Hole CCAA (C)	6.32	4	149	2	3	10
Big Hole CCAA (D)	4.40	21	18	18	6	0
"The Pools"	0.84	10	2	20	21	0
Big Hole CCAA (E)	4.34	1	5	48	55	0
Jerry Creek Management Section	3.70	1	na	na	na	na
Melrose Management Section	3.32	2	na	na	na	na
Total	27.02	39	523	111	136	30

Appendix 2. Total fish captured by species and reach during 2010 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)	1.14	0	78	1	6	1
Miner Creek (B)	0.60	0	32	0	1	0
Rock Creek (C)	0.66	0	361	0	0	4
Rock Creek (C)	2.13	317	167	0	1	17
Rock Creek (C)	0.74	84	31	0	0	2
Steel Creek - Upper Reach	0.42	0	168	0	0	0
Steel Creek (D)	3.47	22	435	0	2	45
Swamp Creek	2.69	37	337	0	2	20
Plimpton Creek	3.28	65	101	4	1	14
Fishtrap Creek	1.04	1	24	11	4	4
Minnie Creek	0.52	0	0	0	0	0
LaMarche Creek	1.02	3	28	16	0	2
Deep Creek (E)	1.41	13	78	146	54	7
French Creek	0.13	0	5	15	3	0
Bryant Creek	0.17	0	14	14	0	1
Total	19.42	542	1,859	207	74	117

Appendix 3. Total fish captured by species and reach during 2010 FWP population monitoring surveys in the upper Ruby River watershed.

Ruby Watershed Reach	Reach Length (miles)	Arctic Grayling	Rainbow/Cutthroat Trout	Brown Trout
Middle Fork - Corral Creek	0.56	28	8	0
Middle Fork - Shovel Creek	0.22	45	13	0
Middle Fork - Poison Creek	0.61	5	96	0
Burnt Creek	1.12	6	71	0
Vigilante	1.60	10	130	8
Total	4.11	94	318	8