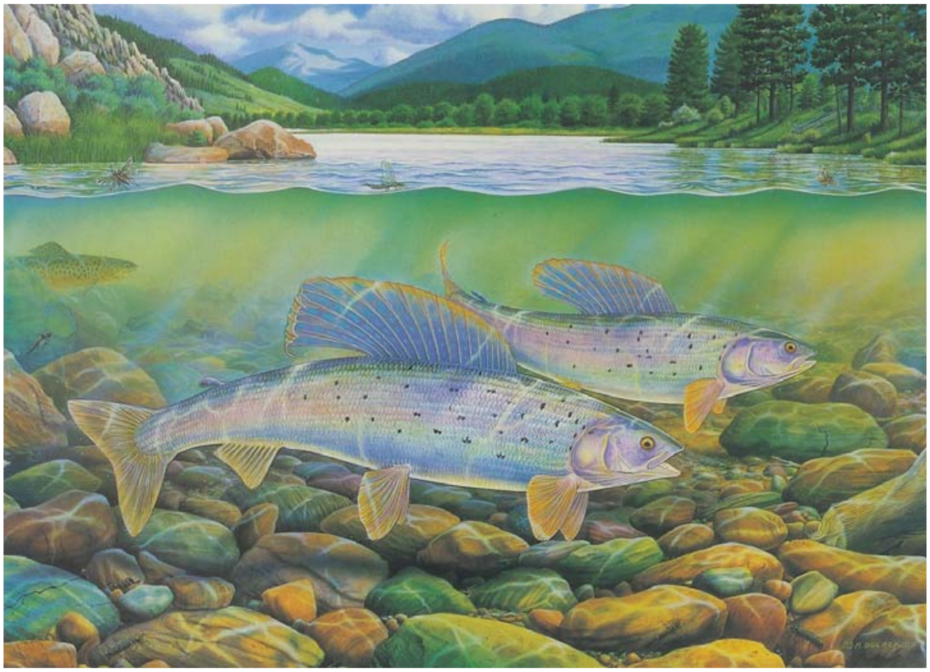
ARCTIC GRAYLING RECOVERY PROGRAM

MONTANA ARCTIC GRAYLING MONITORING REPORT 2006



Emily Rens
James Magee

Montana Fish, Wildlife & Parks
Dillon, Montana

Submitted To:

Montana Arctic Grayling Workgroup
Beaverhead - Deerlodge National Forest
Bureau of Land Management
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Montana Arctic Grayling

Introduction

Montana Arctic grayling *Thymallus arcticus* are at the southern extent of Arctic grayling distribution, and are discrete from other Arctic grayling populations within their circumpolar range. They are genetically and geographically distinct from populations residing further north, in Canada and Alaska (Kaya 1990). Montana grayling populations can be divided into two genetic groups, the Big Hole-Madison group, exhibiting fluvial (stream dwelling) life history characteristics, and the Red Rock Lake group, exhibiting adfluvial (lake dwelling) characteristics. Declines in both *native* fluvial and adfluvial grayling populations in Montana over the past 30 years have spurred numerous management, conservation, and research actions. Grayling conservation efforts that occurred in 2006 are summarized in this report.

Fluvial Arctic grayling

Fluvial Arctic Grayling Status

The fluvial form of Arctic grayling historically occupied the Missouri River and it's major tributaries, upstream of Great Falls, MT. Currently, fluvial Arctic grayling distribution is limited to the Big Hole River, representing 4% of their native, historic range. Fluvial Arctic grayling 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 and the Montana Natural Heritage Program (MNHP) (Holton 1980, MNHP 2004). The U.S. Forest Service (USFS) and the Bureau of Land Management (BLM) classify fluvial Arctic grayling as a sensitive species. In October 1991, the U.S. Fish and Wildlife Service (USFWS) received a petition to list fluvial grayling in Montana throughout its historic range under the Endangered Species Act (ESA). The USFWS 1994 finding classified fluvial grayling in Montana as a Category 1 species, which indicates that there is enough information on file to support a proposal to list the grayling as threatened or endangered (USFWS Fed. Reg. 1994). In March 2004, the USFWS elevated grayling listing priority for a Distinct Population Segment (DPS) from a level 9 to a level 3 (USFWS Fed. Reg. 2004). This is the highest priority level given to a DPS. The priority level was elevated because: 1) the current distribution of fluvial grayling represents less than 5% of the historic range, and 2) recent population surveys indicate a decline in the Big Hole River population. In May of 2004, the USFWS was petitioned to emergency list the fluvial grayling due to ongoing drought conditions and decreased population abundance. The USFWS announced their revised 12-month finding on the petition April 24, 2007. The decision states that listing the upper Missouri River DPS of fluvial Arctic grayling is not warranted, and they withdraw the fluvial Arctic grayling from the candidate list.

Big Hole River Population

Introduction

The fluvial Arctic grayling of the Big Hole River represent the last strictly fluvial native grayling population in the contiguous United States. After the population declined during the mid-1980's, the Arctic Grayling Recovery Program (AGRP) was formed, which now includes representatives from FWP, the BLM, USFS, USFWS, MNHP, Montana State University (MSU), University of Montana (UM), Montana Chapter of the American Fisheries Society (MCAFS), Montana Trout Unlimited (TU), Pennsylvania Power and Light (PPL), and the National Park Service (NPS). The program's goals are to address ecological factors limiting the Big Hole grayling population, monitor and enhance essential habitats, monitor abundance and population demographics, restore additional grayling populations within their native range, develop relationships that promote conservation actions and inform the general public of grayling conservation efforts and status. Monitoring and research results have been reported annually since 1991 (Byorth 1991, 1993, 1994, 1995a, 1997, Byorth and Magee 1996, and 1998, Magee 1999 and 2002, Magee and Opitz 2000, Magee and Lamothe 2004, and Magee, Rens and Lamothe 2005).

Big Hole River

Objectives of the project in the Big Hole River, from January 1 through December 31, 2006 were to:

- Promote and initiate habitat improvement projects that include: riparian enhancement, improve fish passage, minimize entrainment, and improve stream flow dynamics in the Big Hole River basin on private land through the Candidate Conservation Agreements with Assurances Program (CCAA).
- Develop and promote landowner relationships and continually educate public and interest groups of grayling conservation needs and status.
- Monitor water temperatures and discharge in the Big Hole River and its tributaries.
- Monitor abundance and distribution of grayling and sympatric native and sportfish species in the Upper Big Hole basin.
- Serve as a technical advisor for the Big Hole Watershed Committee.

Methods

Conservation Efforts and Projects

Conservation efforts and projects initiated in 2006 focused on the conservation measures outlined in the CCAA. The Big Hole River Fluvial Arctic Grayling CCAA is an agreement between the USFWS and a non-federal landowner that voluntarily agrees to manage their lands or waters to remove threats to grayling. Landowners receive assurances against additional regulatory requirements if grayling become listed under the ESA. The CCAA Umbrella Agreement held by FWP outlines specific flow, fish passage, entrainment, and riparian restoration goals for derived reaches on the Big Hole River.

The goal of the CCAA program is to secure and enhance the population of fluvial Arctic grayling within the upper reaches of the Big Hole River drainage (Figure 1). Under the CCAA, FWP will hold an ESA Section 10(a)(1)(A) Enhancement of Survival Permit issued by the USFWS. Once this CCAA is executed, FWP will issue Certificates of Inclusion to non-federal property owners within the project area who agree to comply with all stipulations of the CCAA and agree to develop and implement an approved site-specific plan. Site-specific plans will be developed with each landowner by an interdisciplinary technical team made up of individuals representing FWP, USFWS, Natural Resources Conservation Service (NRCS), and the Department of Natural Resources and Conservation (DNRC). Conservation measures addressed in each plan will: 1) Improve streamflow, 2) Improve and protect the function of streams and riparian habitats, 3) Identify and reduce or eliminate entrainment threats to grayling, and 4) Remove barriers to grayling migration.

Installing a fish ladder to improve fish passage on the Big Hole River

The Enhancement of Survival Permit delineates the upper Big Hole into five management reaches (Figure 1). Conservation measures described above will be implemented in each management reach. Flow, temperature, habitat, channel morphology and population monitoring will be completed annually in each reach. Results of 2006 CCAA efforts are reported separately and available online at www.graylingrecovery.com (Lamothe and Petersen 2006).

Due to below average snow pack and precipitation in winter/spring 2005 and projected below average runoff, FWP biologists, DNRC hydrologists, Big Hole Watershed Committee (BHWC) members, landowners and the local water commissioner organized a conservation plan to enhance instream flows. These efforts were continued in 2006. TU provided funding to hire a local water commissioner to assist in implementing and tracking voluntary conservation

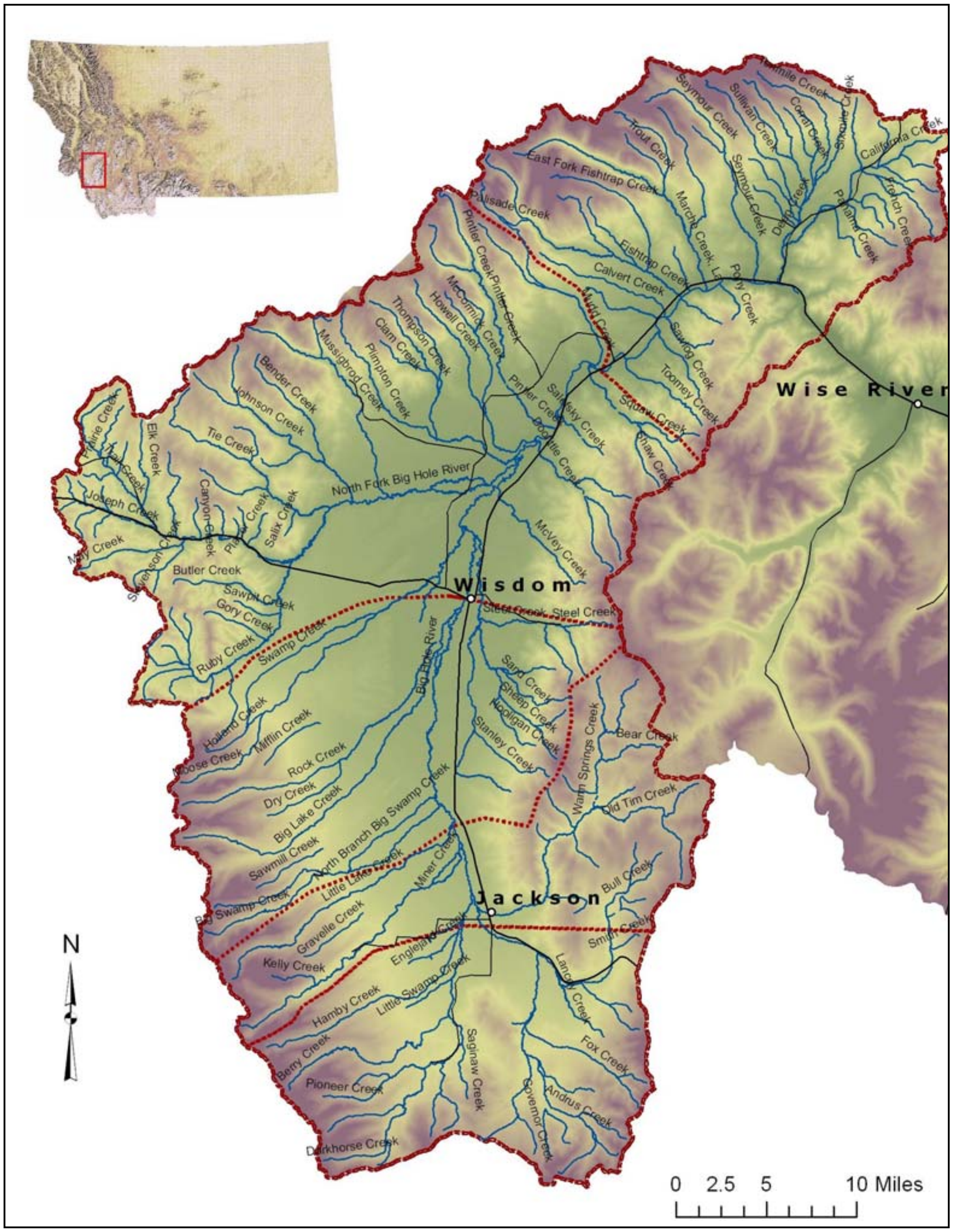


Figure 1. Map of the Upper Big Hole River, tributaries, towns, and CCAA boundaries (dotted red).

measures. Landowners were asked if they would voluntarily reduce diversions to facilitate suitable stream flows during spring spawning. Additional projects were initiated that improved irrigation efficiency, stabilized banks, reduced sedimentation, protected riparian corridors; improved fish passage and enhanced instream habitats to benefit Arctic grayling and sympatric species.

Water Temperatures and Stream Discharge

The U.S. Geological Survey (USGS) measured discharge of the mainstem Big Hole River from April - October at the Wisdom and the Mudd Creek Station, and year round at the Melrose Station [USGS 2006, http://waterdata.usgs.gov/nwis (Figure 2)]. Sixteen Aqua Rods™ (Sequoia Version 4.0 2003) were monitored to spatially assess flow dynamics in the Upper Big Hole River and tributaries. Aqua Rod locations include the mainstem Big Hole River at Saginaw Bridge, Miner Creek Road Bridge, Big Swamp Creek Road Bridge, Little Lake Creek Road Bridge, Twin Lakes Road Bridge, below the mouth of Steel Creek, and Dickie Bridge. In tributaries, Aqua Rods were monitored at the mouth of the North Fork, Steel Creek and LaMarche Creek (Figure 2). Water temperature was monitored at the USGS Wisdom and Melrose stations, at six Aqua Rod sites and 25 thermograph stations located in the mainstem Big Hole or tributaries (Figure 2). FWP used Onset Hobotemp™ and Stowaway™ thermographs to record temperatures at 60-minute intervals. Data were downloaded into Microsoft Excel and analyzed to determine daily maximum, minimum, and average temperatures.

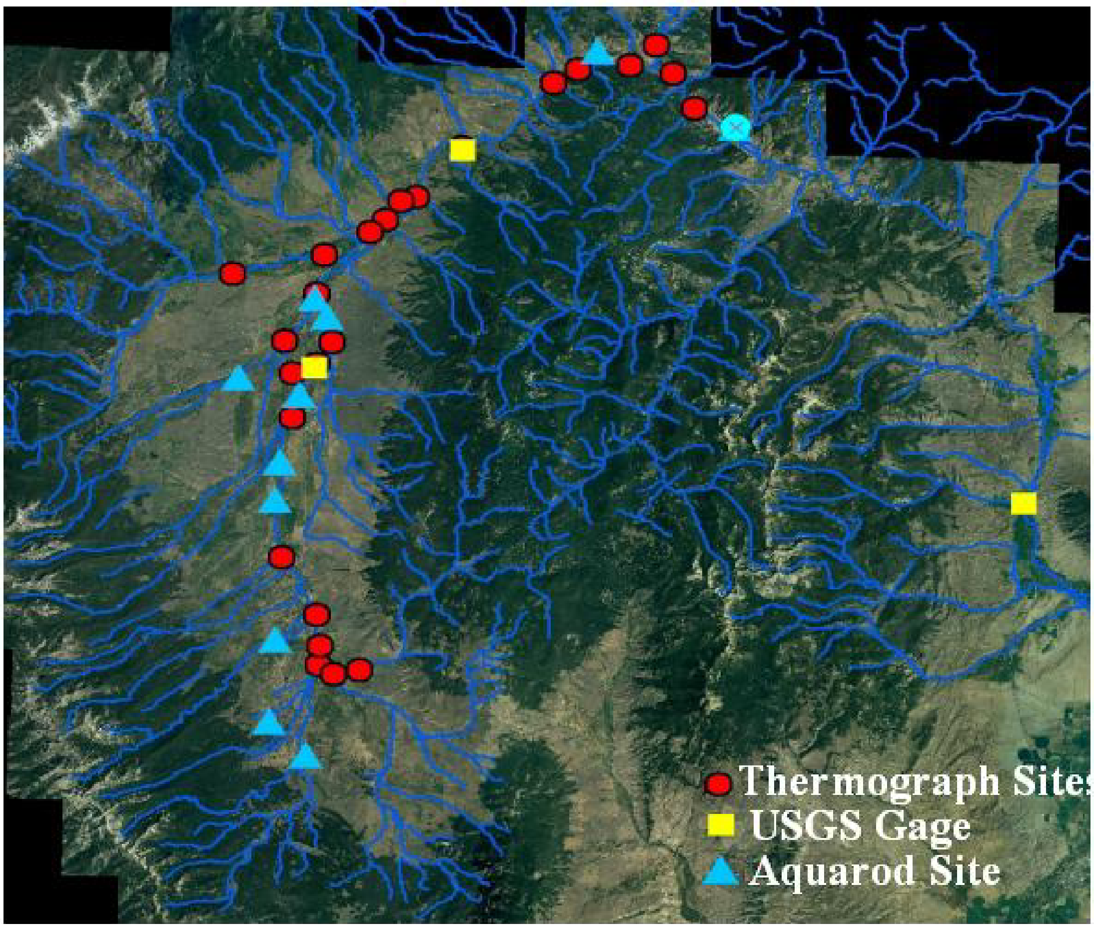


Figure 2. Map of the Big Hole River delineating locations of Aqua Rods, thermographs, and USGS gages in CCAA management segments.

Population Monitoring

FWP monitors the Big Hole River grayling population to assess population abundance, recruitment, age class strength, and distribution. Rainbow trout *Oncorhynchus mykiss,* brown trout *Salmo trutta,* brook trout *Salvelinus fontinalis,* and burbot *Lota lota* greater than 6 inches are also sampled to document densities and relative abundance. All sizes of grayling are sampled.

Electrofishing sampling uses a mobile-anode DC system powered by 4,000-watt generator coupled with a Coffelt Mark XXII-M rectifying unit mounted on a drift boat or Coleman Crawdad™. Target species are captured and held in a live well. Fish are anesthetized, measured [total length (± 0.1 in.) and weighed (± 0.01 lb.)], fins are notched as a temporary mark, and scales are collected for age determination. Grayling greater than 6-inches long are tagged with a visible-implant (VI) tag in transparent adipose tissue immediately posterior to the eye. Genetic samples are taken via pelvic fin clips, and preserved in non-denatured alcohol.

FWP Electrofishing boat on the Big Hole River

Fall population surveys in the Upper Big Hole River and tributaries provide an index of grayling abundance and recruitment. FWP conducted electrofishing surveys between September 18 and November 9, 2006. One-pass surveys were completed on a mainstem and a tributary reach in each of the 5 CCAA management reaches. These reaches will be referred to CCAA (A), CCAA (B), CCAA (C), CCAA (D) and CCAA (E) on the mainstem River and include Governor, Miner, Rock, Steel and Deep Creek sections on the tributaries (Figure 3). Additional surveys were conducted on mainstem reaches, including, Wisdom, and the "Pools" (Sawlog, Fishtrap and Sportsman's pools) and on tributaries including the North Fork, Big Lake Creek, Swamp Creek, Mudd Creek, Fishtrap Creek, LaMarche Creek, York Gulch, Berry Creek, Pintler Creek, and Seymour Creek (Figure 3). If more than 10 grayling were captured in a sampling section, a mark and recapture population estimate was done. Catch per unit effort (number of fish per mile) estimates were completed on all other sampling reaches. Mark recapture estimates were conducted on Fishtrap Creek, LaMarche Creek, Deep Creek and the "Pools" (Figure 3). Surveys were not completed on the Jerry Creek and Melrose Sections during fall 2006 due to low-flow conditions.

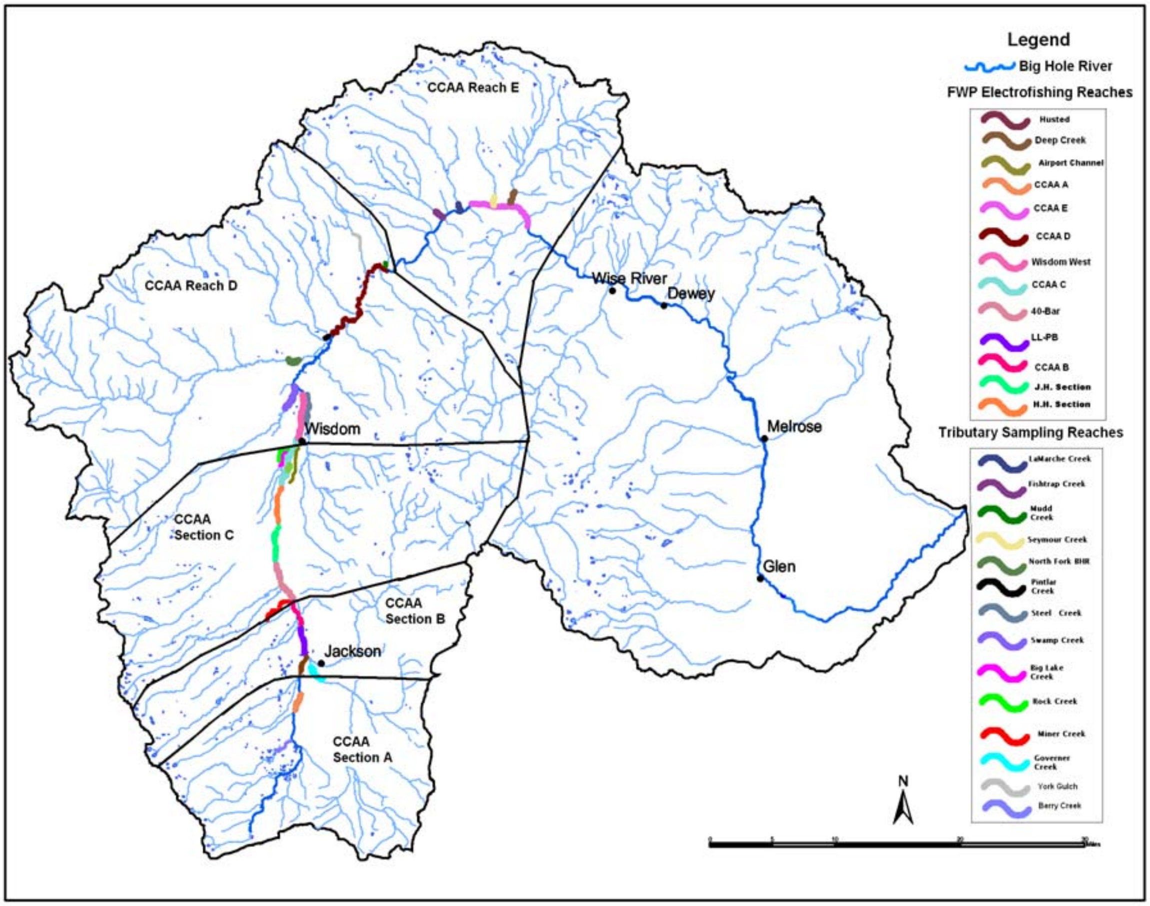


Figure 3. Map of the Big Hole River showing FWP electrofishing reaches in fall 2006 and the CCAA management segments.

Electrofishing data are entered and summarized with Fisheries Analysis 1.2.7 (Montana Fish, Wildlife & Parks 2004). Catch-per-unit-effort (CPUE) for all age classes is reported as the number of fish captured per mile. These data are used to show trends of grayling population abundance and spatial distribution. Length–frequency analyses are used to summarize population age structure.

Results

Conservation Efforts and Projects

As part of the CCAA enrollment, landowners agreed to participate in conservation measures that would improve instream flows beginning in mid-April. Landowners individually reduced or delayed diversions to enhance instream flows. Snow pack conditions were considerably better in 2006 than 2005 [103% vs. 52% of Period Of Record (POR) (USGS 2006, http://waterdate.usgs.gov/nwis)]. Improved snow pack in conjunction with flow conservation measures enhanced flows substantially during the grayling spawning period (BHWC, 1997)(Figure 4). Big Hole River peak runoff generally occurs from June 1 – June 15, and flows typically decline thereafter through August. In 2006, peak flows occurred in early April and early June, and were improved from 2005 (Figure 4). These high flow and bankfull events moved sediment through the system and scoured streambeds, potentially improving habitat conditions for spawning grayling.

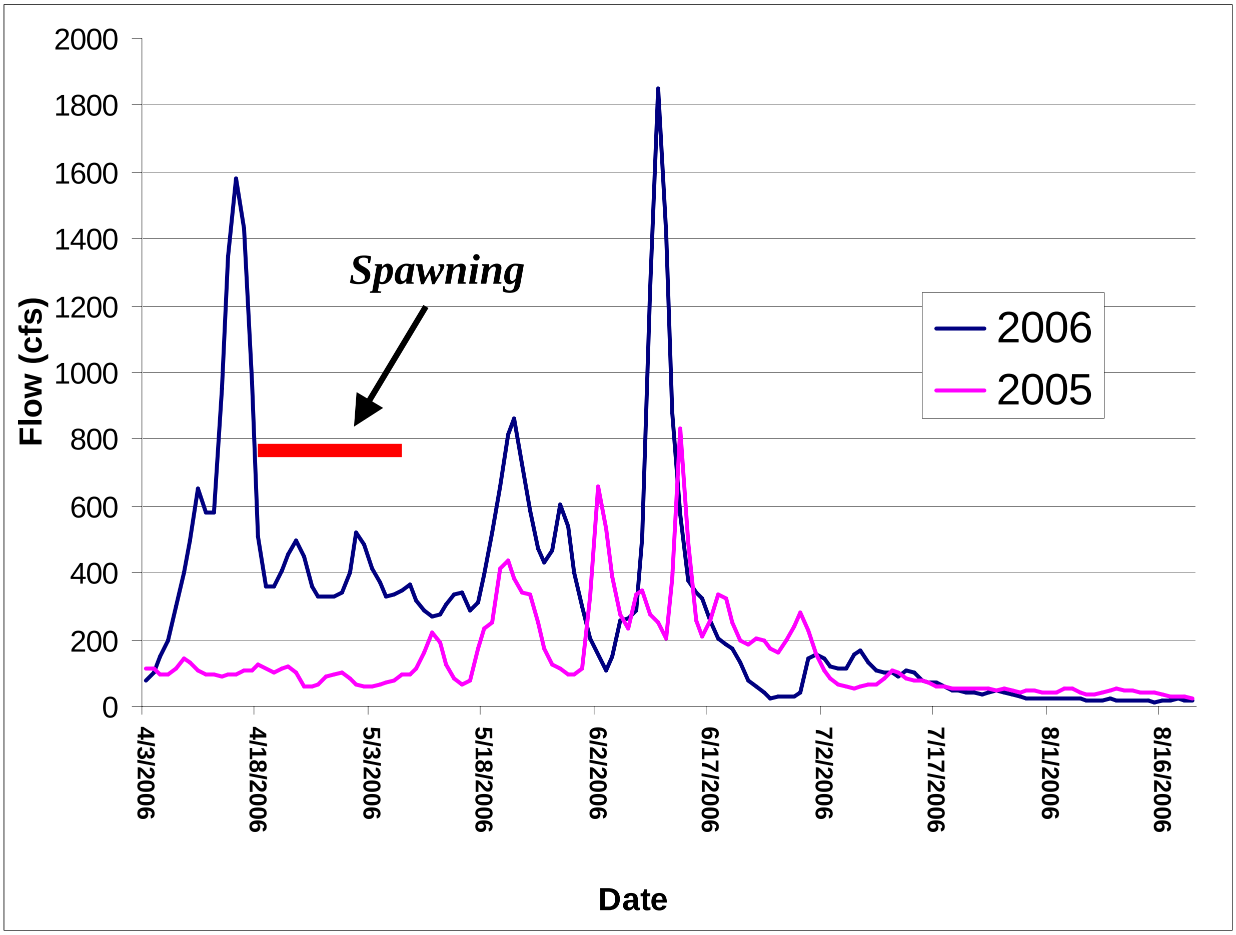


Figure 4. Hydrograph at the USGS gage at Wisdom, MT showing instream flows in 2005 and 2006.

The Big Hole Drought Management Plan (DMP) promotes instream flow conservation measures and implements angling closures to further reduce stress to aquatic species during extreme low-flow periods. The DMP for the upper reach of the Big Hole (from Rock Creek Road to the Mouth of the North Fork) stipulates 20 cubic feet per second (cfs) as an average daily flow (ADF) required to maintain a wetted channel and to allow fish species access to other reaches and tributaries that may have improved conditions. When instream flows at Wisdom decline below 20 cfs ADF, FWP implements an angling closure to reduce additional potential stress (BHWC 1997). In 2006, an angling closure was implemented on the upper reach from August 10 – October 14. This was an earlier closure than in 2005 (August 25); however, it was an improvement over 2004 when the upper reach was closed for the entire angling season (May 21-November 30), due to below average instream flows.

In 2006, instream flows improved compared to 2005 (despite continued drought conditions) due to voluntary agreements with landowners, water conservation projects, and improved snow pack conditions. Landowners reduced flow diversions, replaced non-functioning headgates, improved diversion structures and developed alternative stock water sources to mitigate below average precipitation.

In 2006, numerous conservation projects were initiated and completed on the Big Hole River and its tributaries. These projects improved fish passage, irrigation efficiency, riparian vegetation, bank stability, and water quality (Figure 5). Projects were funded cooperatively by FWP, BHWC, USFWS Partners, NRCS, BLM and individual landowners.

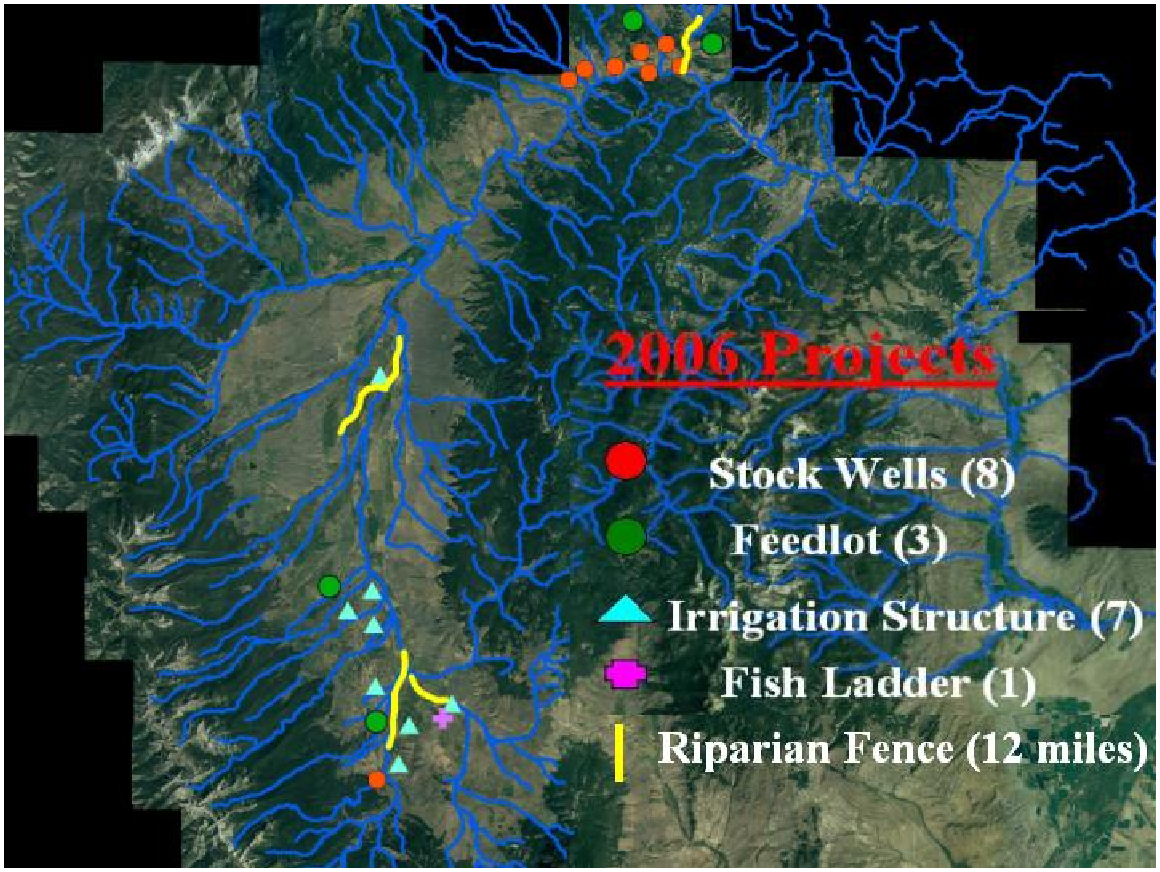


Figure 5. Habitat projects initiated and/or completed in 2006, and previously installed fish ladders on the Big Hole River and its tributaries. Numbers in parenthesis indicate the number of structures installed or completed.

Water Temperatures and Stream Discharge

Instream water temperatures are a result of air temperature, day-length, riparian health/shading, channel morphology and streamflow. Maximum stream temperatures in the upper Big Hole River typically peak in July and decrease in August as nighttime temperatures are cooler and day-length decreases. Maximum temperatures in 2006 occurred on July 21 and July 22 for most thermograph sites (Figures 6 and 7). Instream temperatures increased from the headwaters (Miner Creek site) downstream to the lower end of CCAA (C), and then decreased at the Sportsman's and Dickie Bridge sites. Mainstem sites (Pintlar and Sportsman's) with high width to depth ratios and little woody riparian vegetation for shading exceeded upper incipient lethal temperatures (77°F) for Arctic grayling (Lohr et. al. 1996); (Figures 6 and 8). The Steel Creek and mouth of the North Fork sites had similar thermal regimes as nearby mainstem reaches, while the other tributaries (Swamp, Fishtrap, LaMarche and Deep Creek) had fewer recorded hours with stream temperatures over 70º and 77º (Figure 6).

The snow pack in the Big Hole basin was 103% of the POR and 170% of the 2005 snow pack on April 1, 2006. Lowest mean daily flow at the USGS Wisdom gage was 15 cfs on August 15, and the highest mean daily flow was 1,850 cfs on June 10, 2006. Despite higher snow pack, poor precipitation from late June to October resulted in stream flows below the long-term average. Precipitation from May-September was approximately 2.98 inches below the long-term mean at Wisdom. Stream flows were 83%, and 82% of the POR for the Wisdom, and Melrose USGS gages respectively (Figure 9). At Mudd Creek gage station, flows were over 100% of the long-term average in April and May (192% and 172% respectively), however, flows dropped below the long term average from June through October, reflecting poor summer precipitation (Figure 9). Stream flows improved in 2006 from 2005 because of improved snow pack conditions and flow conservation efforts by landowners.

Population Monitoring

Grayling captured in fall electrofishing surveys (n = 225) were dominated by juveniles with 78% Young-of-the-Year (YOY) (<6inches), 12% age-1 (7-9 inches), 5% age-2 (10-12 inches), and 5% age-3+ (>12 inches); (Figure 10). Over half of the YOY sampled in 2006 were captured in Steel Creek. Age-2 grayling were dispersed throughout the Big Hole and tributaries from Deep Creek upstream to Wisdom (CCAA section C); (Figure 11). Age-3 and older grayling remain at low abundance exemplified by lower CPUE in the "Pools" (Sportsman's, Fishtrap and Sawlog Pools), which historically captured higher numbers of adult grayling (Figure 11).

Grayling with Visible Implant (VI) tag

In recent years, tributaries have been utilized by all age classes of grayling, and have had the highest abundance of grayling in fall surveys compared to mainstem Big Hole reaches. Tributaries provide favorable habitat conditions for grayling and other species; Fishtrap, LaMarche and Deep Creek had among the highest catch rates of grayling as well as brook trout, rainbow trout, and burbot (Appendix A, Table 1). The Schindler reach in the mainstem Big Hole had the highest CPUE of brook trout for mainstem reaches (Appendix A, Table 2). Rainbow trout and brown trout are more abundant in downstream reaches and tributaries [Deep Creek, CCAA (E) (Appendix A, Tables 1 and 2)].

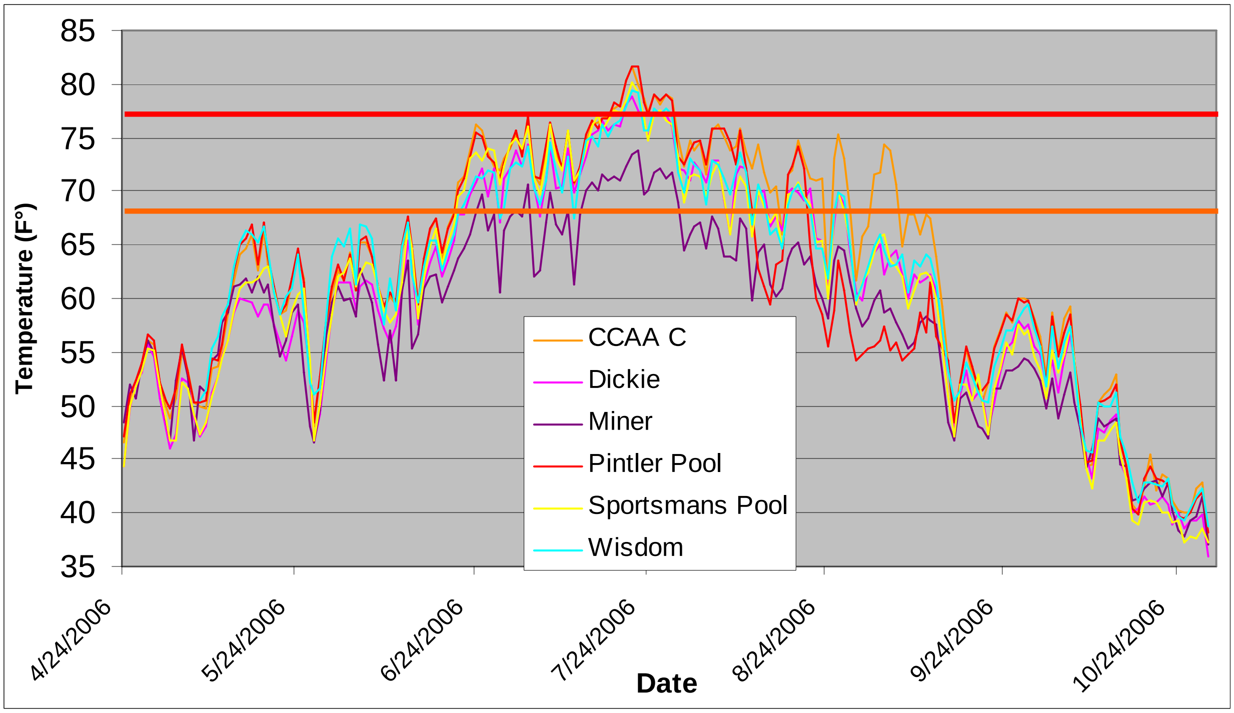


Figure 6. Big Hole River maximum daily temperatures from FWP Hobo temp-loggers on the Big Hole River, 2006.

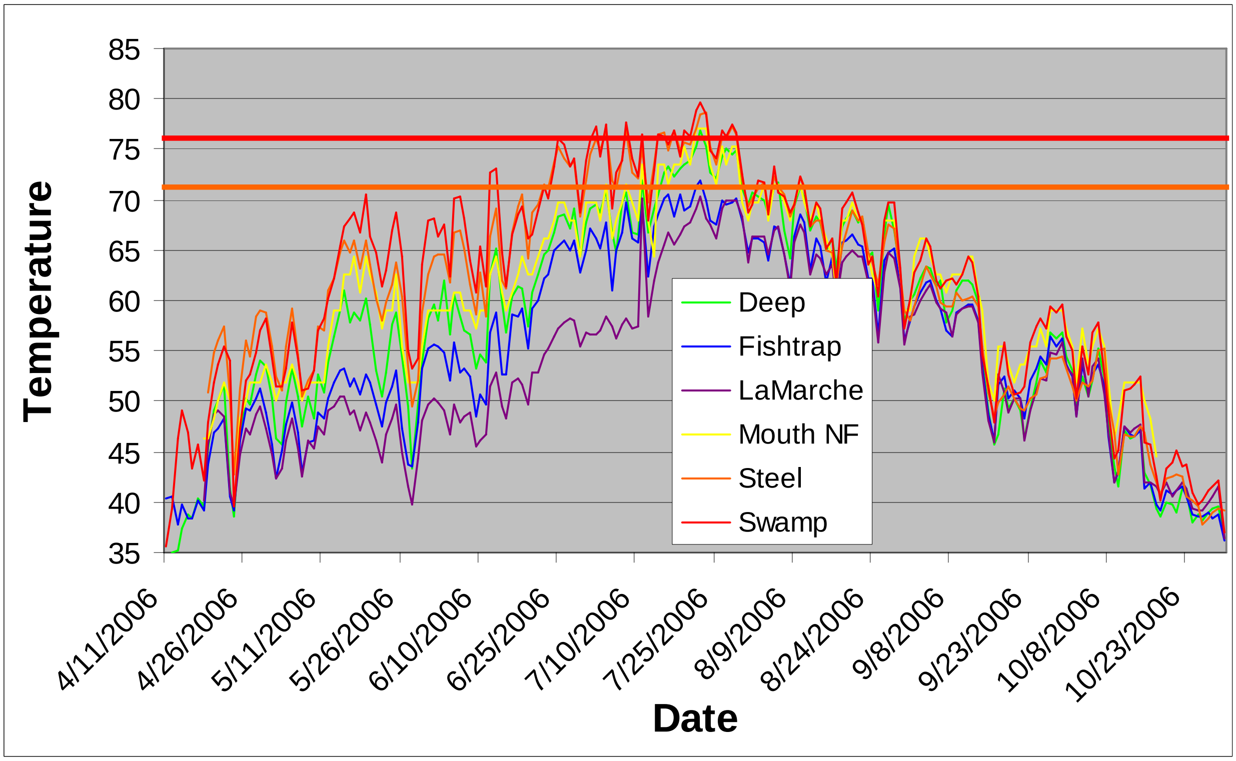


Figure 7. Big Hole River tributary maximum daily temperatures from FWP Hobo temp-loggers on the Big Hole River, 2006.

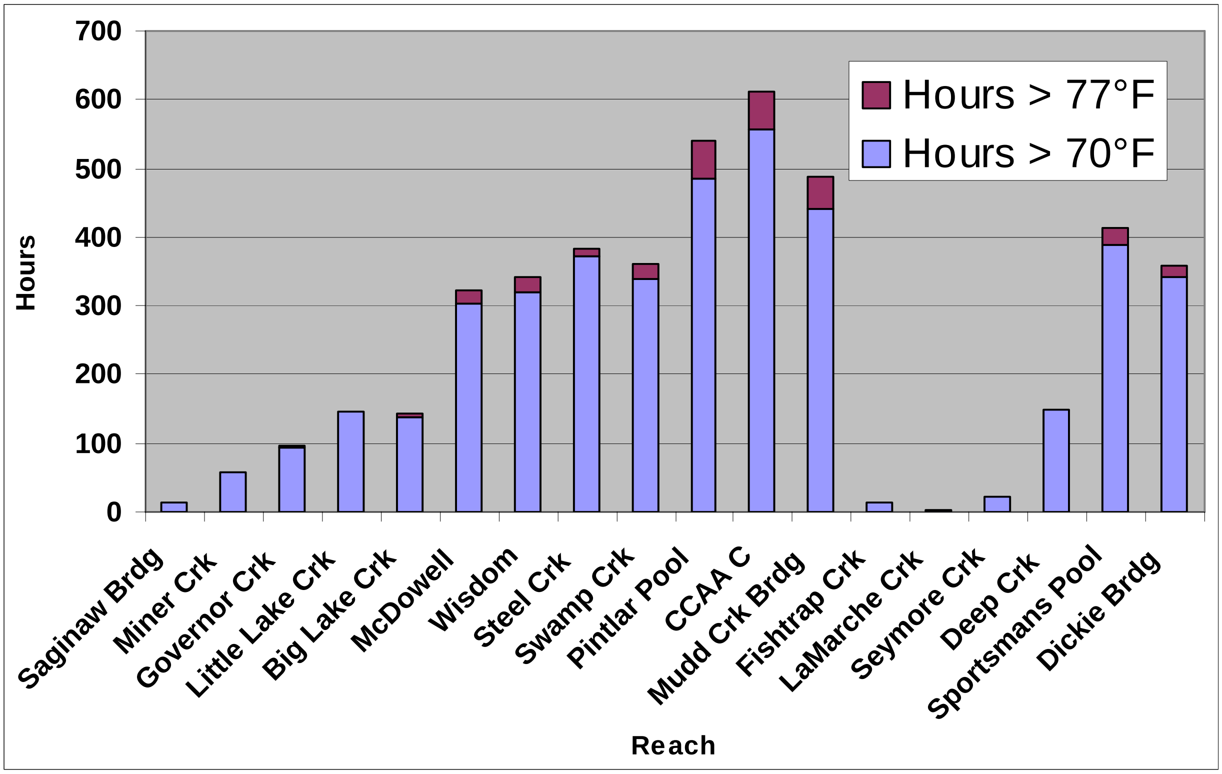


Figure 8. The total number of hours recorded at each thermograph station that exceeded 70°F and 77°F from April to October 2006.

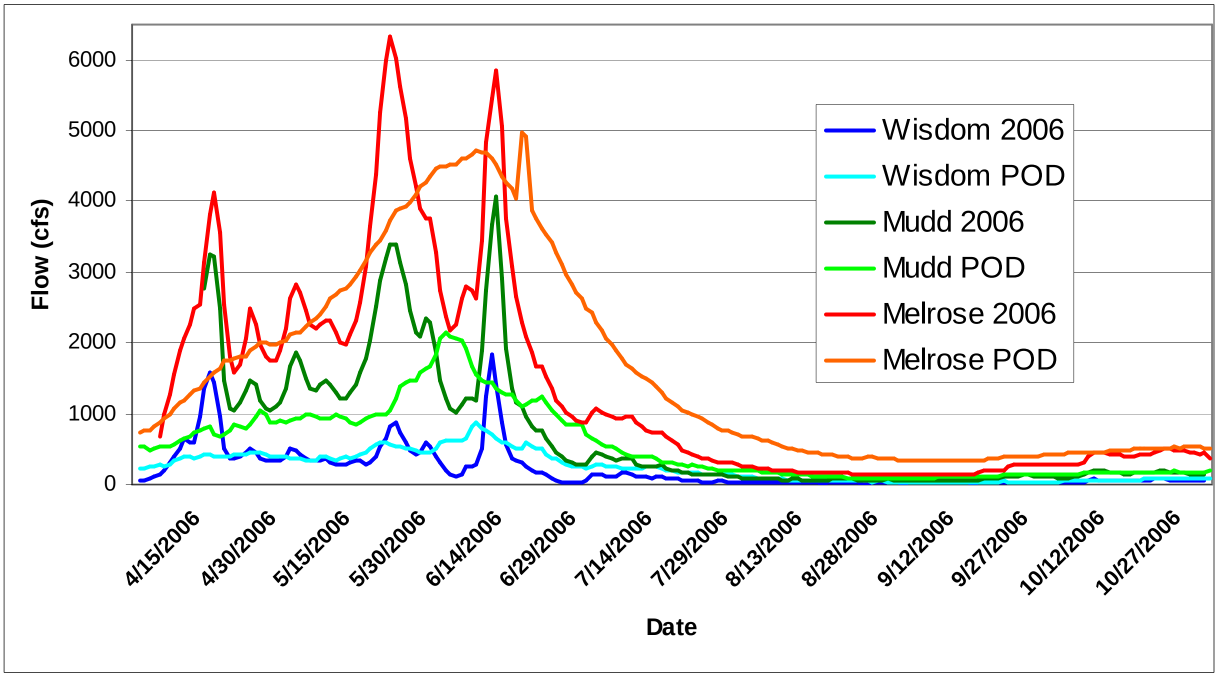


Figure 9. Mean Daily Flow in 2006 and for the Period of Record for Mudd Creek, Melrose, and Wisdom USGS gages (data are provisional).

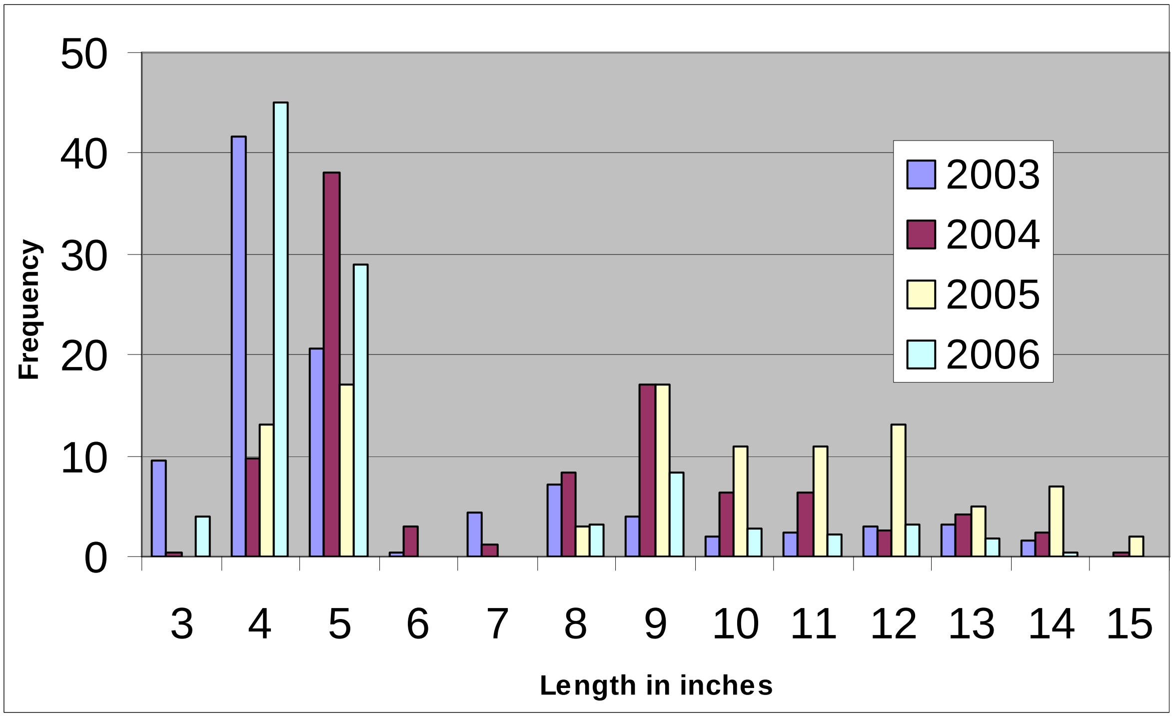


Figure 10. Arctic grayling length-frequency histogram from fall 2003-2006 from fish sampled during FWPs electrofishing surveys on the Big Hole River, Montana.

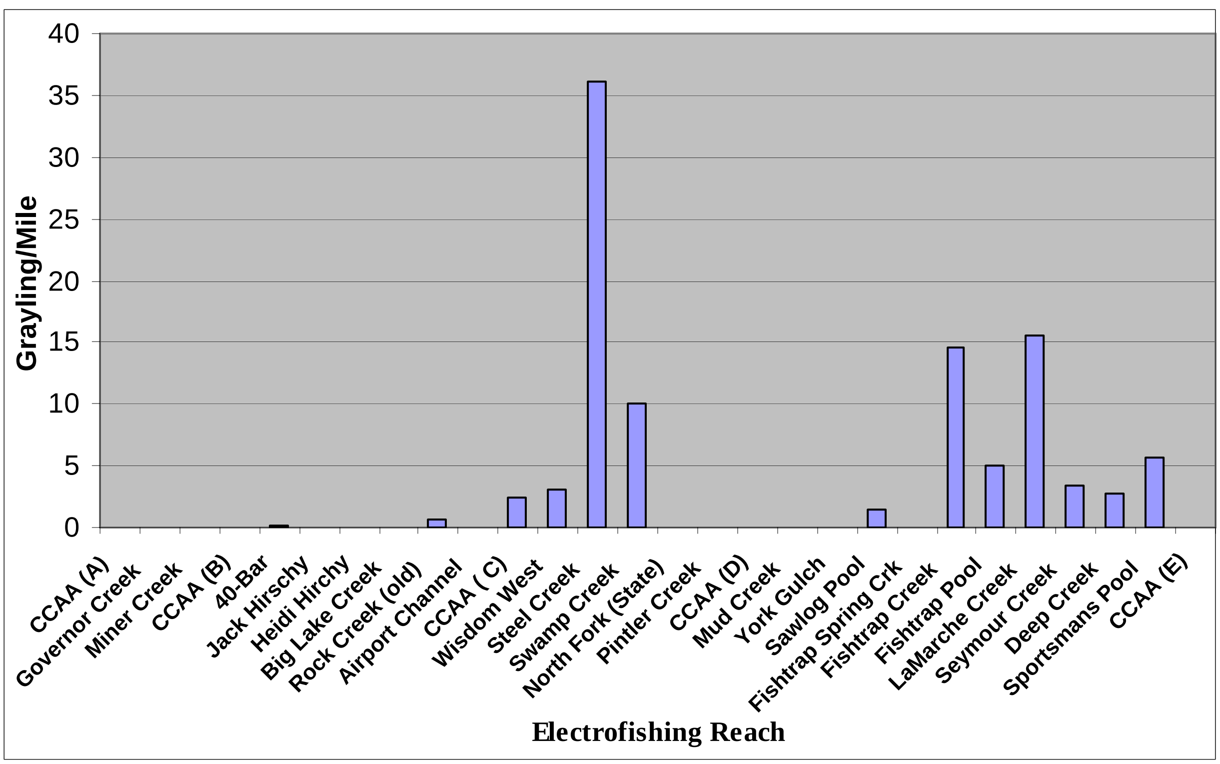


Figure 11. Catch per unit effort (grayling per mile) for FWP fall 2006 electrofishing sections on the Big Hole River, Montana.

Discussion

Spatial distribution of grayling and sympatric species is a function of habitat availability, access, migration patterns and instream thermal and flow conditions. Optimal habitat conditions increase carrying capacity; however, unimpeded spatial and temporal access to these habitats is essential for grayling propagation and survival. Population surveys in 2006 showed a clustered distribution of grayling in the mainstem and tributaries from Sportsman's Pool upstream to the Forty Bar section (approximately 50 miles); (Figure 12). Habitat conditions between grayling capture sites need to be improved to allow grayling to access quality habitat. The extensive range of grayling necessitates basin-wide conservation efforts that include habitats required for all life history stages. Conservation measures must address factors limiting grayling habitat, including stream flow dynamics, riparian and channel health, fish passage and entrainment. Tributaries with intact riparian areas, healthy channel morphology and unimpeded access (such as Fishtrap, LaMarche, and Deep Creek) have had the highest abundance of both grayling and sympatric species over the past 3 years. Almost 80% of all grayling captured in fall 2006 were located in tributaries. In general, these tributaries offer cooler temperatures, quality pools, and overhanging cover, and therefore habitat more favorable to grayling than many of the mainstem sections of the river. However, management segments with reaches on the mainstem Big Hole River (CCAA Reaches A and B) with healthy channel morphology and riparian corridors also contain high abundance of trout species. In contrast, fall surveys indicate that these upstream mainstem reaches have few grayling, again, emphasizing the need to manage habitat on a basin wide scale and ensure connectivity with suitable habitats downstream and throughout the Big Hole River and it's tributaries.

Tributaries provide quality grayling habitat

New headgates improve irrigation efficiency and instream flows

With lower than average precipitation levels in 2006, the Big Hole River suffered from drought conditions for the seventh consecutive year. Percent snowpack was higher in 2006 than in 2005 and lowland and mountain run-off hydrograph peaks were closer to the POR, and improved grayling spawning conditions.

Voluntary conservation measures implemented by landowners and irrigation management by the Big Hole water commissioner were invaluable towards improving stream flows. Conservation projects, which improve irrigation efficiency, have been initiated and will continue in 2007 (2006 CCAA Annual Report). Over the past 15 years, much of the conservation focus has been on upper river instream flows (particularly at the Wisdom

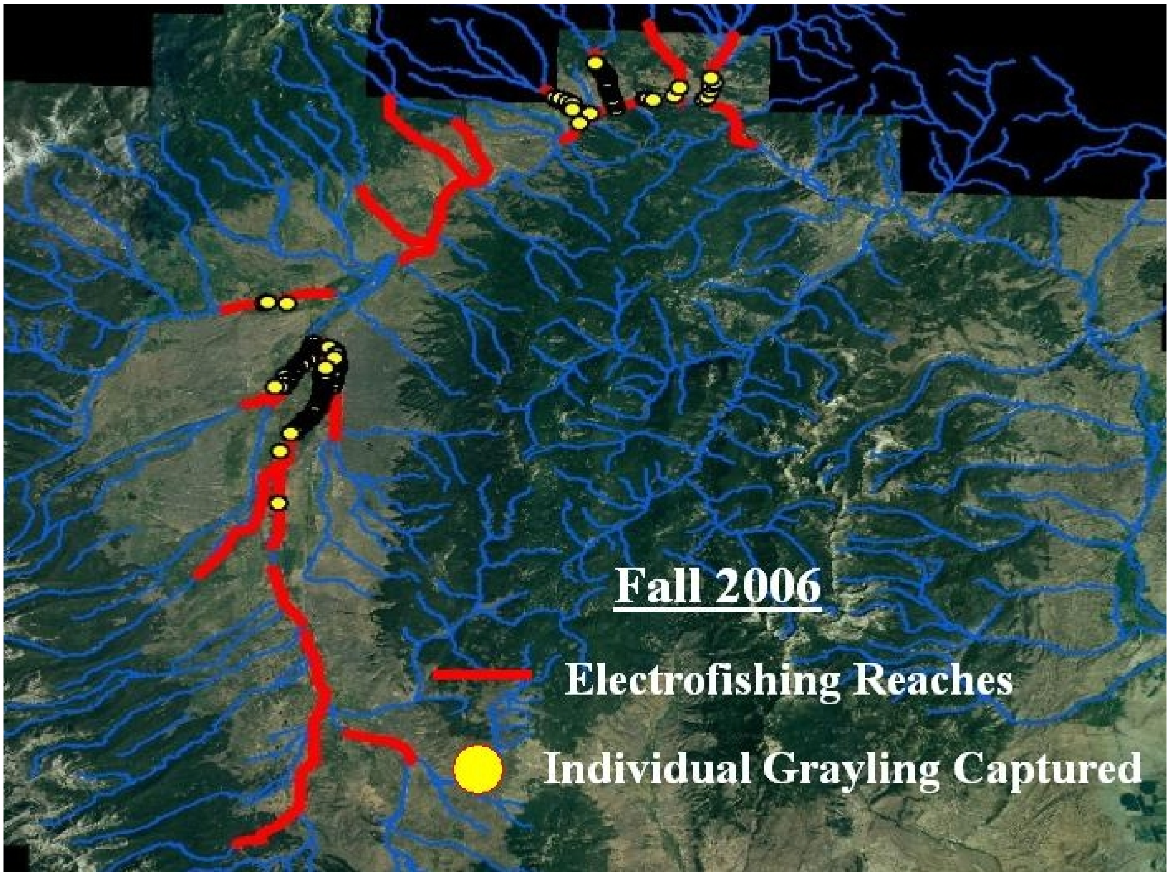


Figure 12. Locations of Big Hole River electrofishing reaches and individual grayling captured during FWP fall sampling in 2006.

Bridge), however, it is imperative that conservation efforts address limiting factors other than instream flows (identified in the CCAA) and on a broader scale.

The majority of the current range of Arctic grayling in the Big Hole River is on private lands. The CCAA represents a unique opportunity to implement conservation efforts on private lands that will benefit Arctic grayling and the entire Big Hole River ecosystem while working with the landowners on an individual and community basis. As of April 15, 2007 27 non-federal landowners have enrolled approximately 125,000 acres of private and 4,900 acres of state lands into the CCAA program. Arctic grayling conservation projects will take place on these enrolled acres. Efforts in 2007 will focus on developing site-specific conservation plans with the landowners enrolled in the CCAA Program, and implementation of habitat improvement projects that benefit Arctic grayling and the natural stream ecology.

Montana Fish, Wildlife & Parks and partners in the Arctic Grayling Recovery Program will continue to implement the CCAA in 2007. Efforts to work with landowners, watershed and interest groups, and cooperative agencies will continue to conserve, protect, and enhance fluvial Arctic grayling in Montana.

Red Rock Lakes

Introduction

The Arctic grayling residing in Red Rock Lakes MT, are the only known native adfluvial (lake dwelling) population remaining in Montana. Historically, these grayling spawned in numerous tributaries to Upper and Lower Red Rock lakes. Currently, Red Rock Creek and Odell Creek appear to be the only spawning tributaries being utilized (Boltz 2006); (Figure 13). Declines in population size can be attributed to habitat alteration, drought conditions, reduced stream flows, siltation, and predation or competition from non-native fish species.

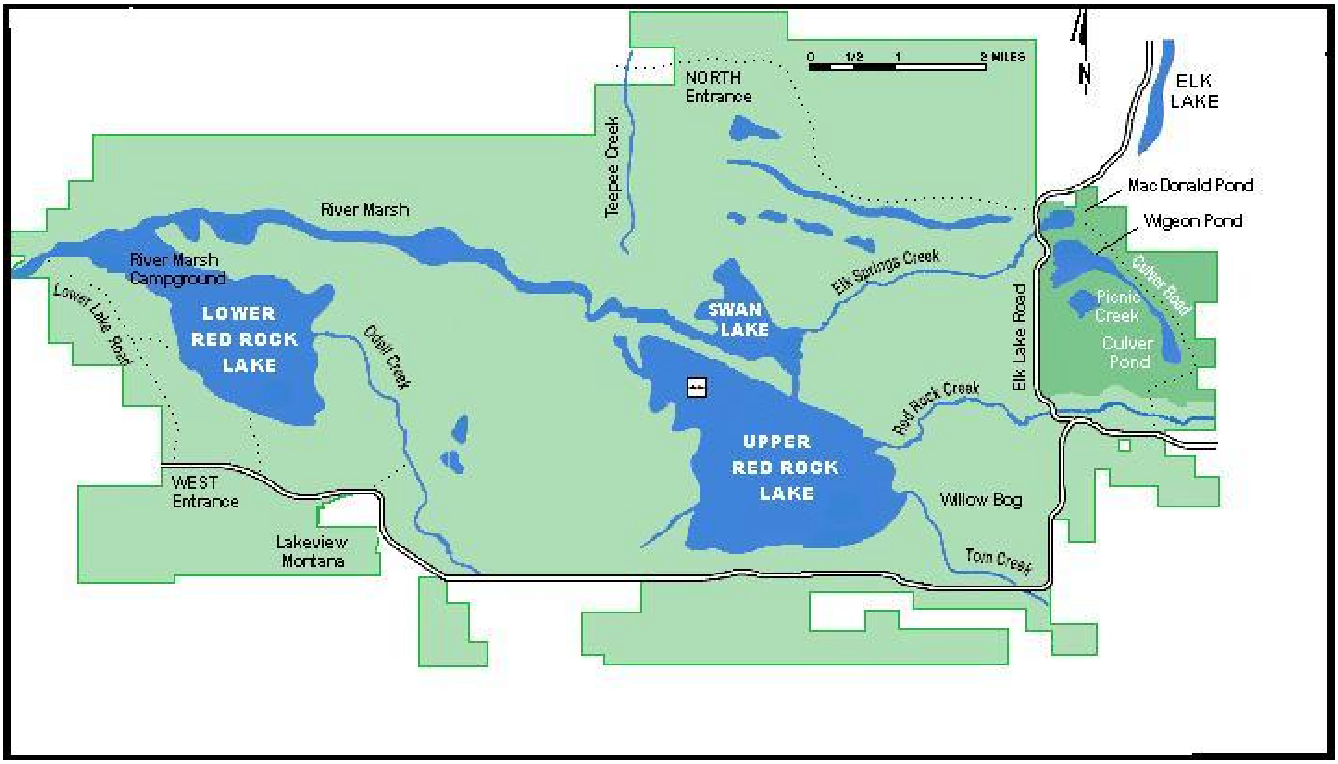


Figure 13. Map of Red Rock Lakes National Wildlife Refuge.

Research

The USFWS initiated a study in 2005 to describe grayling seasonal migrations (specifically use of Odell Creek for spawning), winter habitat use, and fish community dynamics of the Lower Red Rock Lake (Figure 13). This study will take place over several years, and results will be used to guide management of the water levels in the Lower Red Rock Lake. Reduction in the quality of the aquatic vegetative community in Lower Red Rock Lake and River Marsh has resulted in an adaptive management plan that will increase submerged vegetation for trumpeter swans and other wetland-dependant wildlife. The effect of manipulating water levels in Lower Red Rock Lake and River Marsh on the grayling population will also be determined through this study.

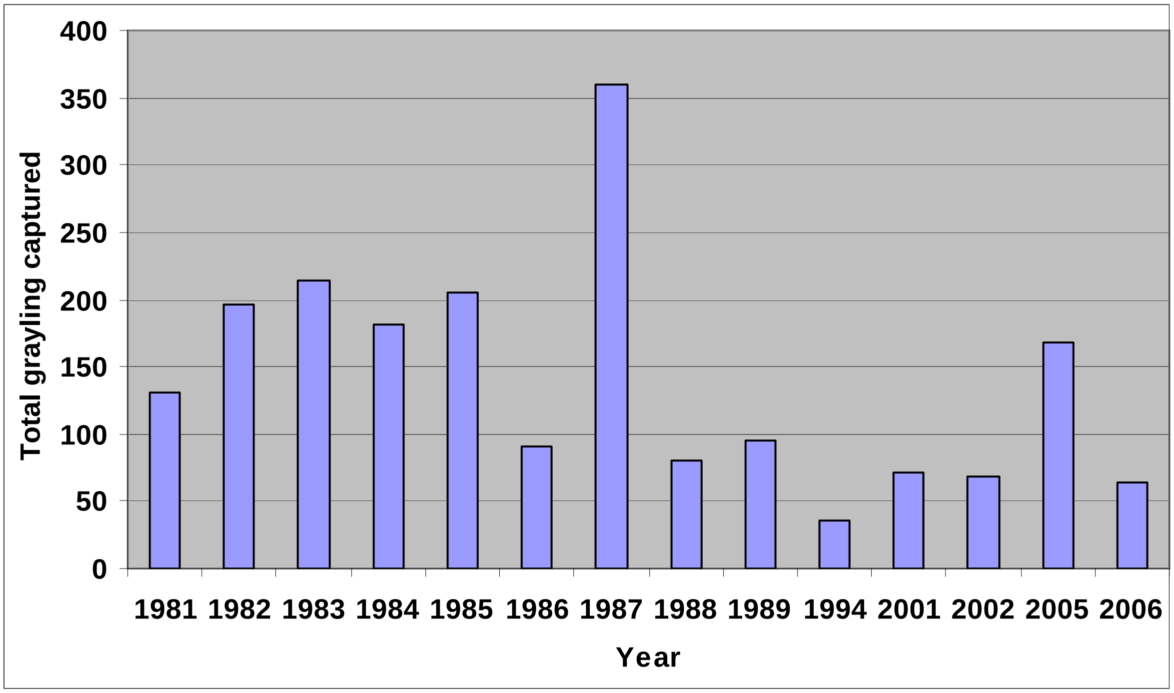


Figure 14. Total number of grayling captured during electrofishing surveys of Red Rock Creek from 1981 – 2006.

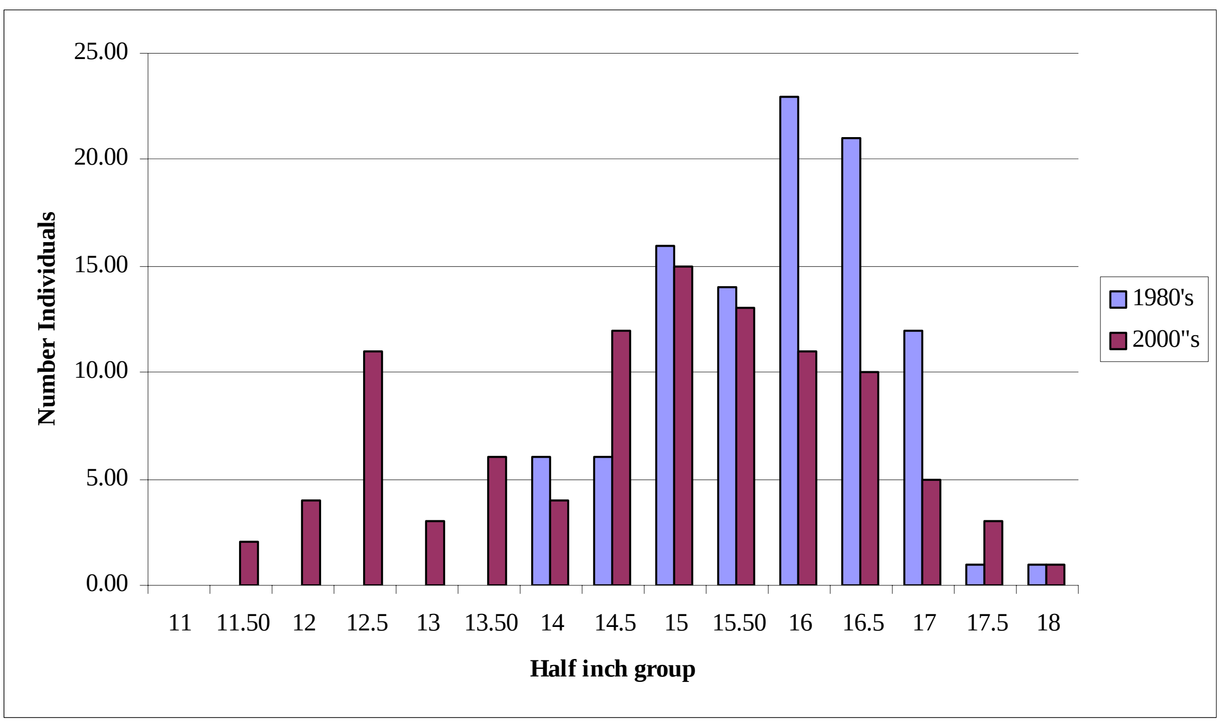


Figure 15. Length frequency histogram of grayling lengths from the 1980's and 2000's from Red Rock Creek, MT.

Adfluvial Arctic Grayling Spawning Run

FWP has been monitoring the Red Rock Creek spawning run regularly since 1980. Standard monitoring efforts for the Upper Red Rock Lake adfluvial Arctic grayling population continued in 2006 with two boat electrofishing efforts one week apart in the Corral Study section of Red Rock Creek. No gamete collection to support the Rogers Lake brood pond was attempted in response to the poor spawning run size (Oswald et al. 2006); (Figure 14). Despite an increase in sampling effort, grayling catches in the Corral Creek study section have declined. A random sample of grayling lengths from the 1980's and 2000's indicates the overall length of grayling may also be decreasing (Figure 15). However, the timing of sampling may influence the size of grayling captured, for example, smaller precocious grayling may migrate to spawning habitat sooner than mature adults.

Sunny Slope Canal

Introduction

The Sunny Slope Canal is the major water source for the Greenfield Irrigation District, located in Teton County, Montana. The canal originates at the Pishkun Reservoir Dam, which was stocked with 330,000 grayling from 1937- 1943 (Figure 16). Poor stocking records do not indicate the exact source of these grayling; however, they were likely derived from the Madison/Ennis grayling (Barndt 1996). Grayling were able to migrate into the Sunny Slope Canal through the reservoir outlet and were first documented in the canal in the early 1940s (Barndt 1996).

Arctic grayling have disappeared from Pishkun Reservoir; however, they have established a self-sustaining population in Sunny Slope Canal. To protect this population from potential predators moving into the Sunny Slope Canal, the reservoir outlet was fitted with a 2-cm mesh fish screen that inhibits fish movement from the reservoir to the canal. The grayling population exists in a 3.5-mile section of the Sunny Slope Canal that has contrasting flow conditions (Figure 16). During irrigation from May through September, flows range from 200 – 1,680 cfs. From September through May, the canal is dewatered, and the only remaining water is in intermittent pools extending from the dam 3.5 miles downstream and in pools located at the base of concrete flumes found further downstream (Figure 16). The Grayling Restoration Plan will evaluate management options to protect the unique population of Sunny Slope Canal grayling.

Monitoring Efforts

The Sunny Slope Canal grayling population exists in a 5-mile section of canal immediately downstream of the reservoir outlet. Telemetry studies indicate that many grayling move downstream during summer flows and

Male grayling captured in Upper Turnbull drop pool

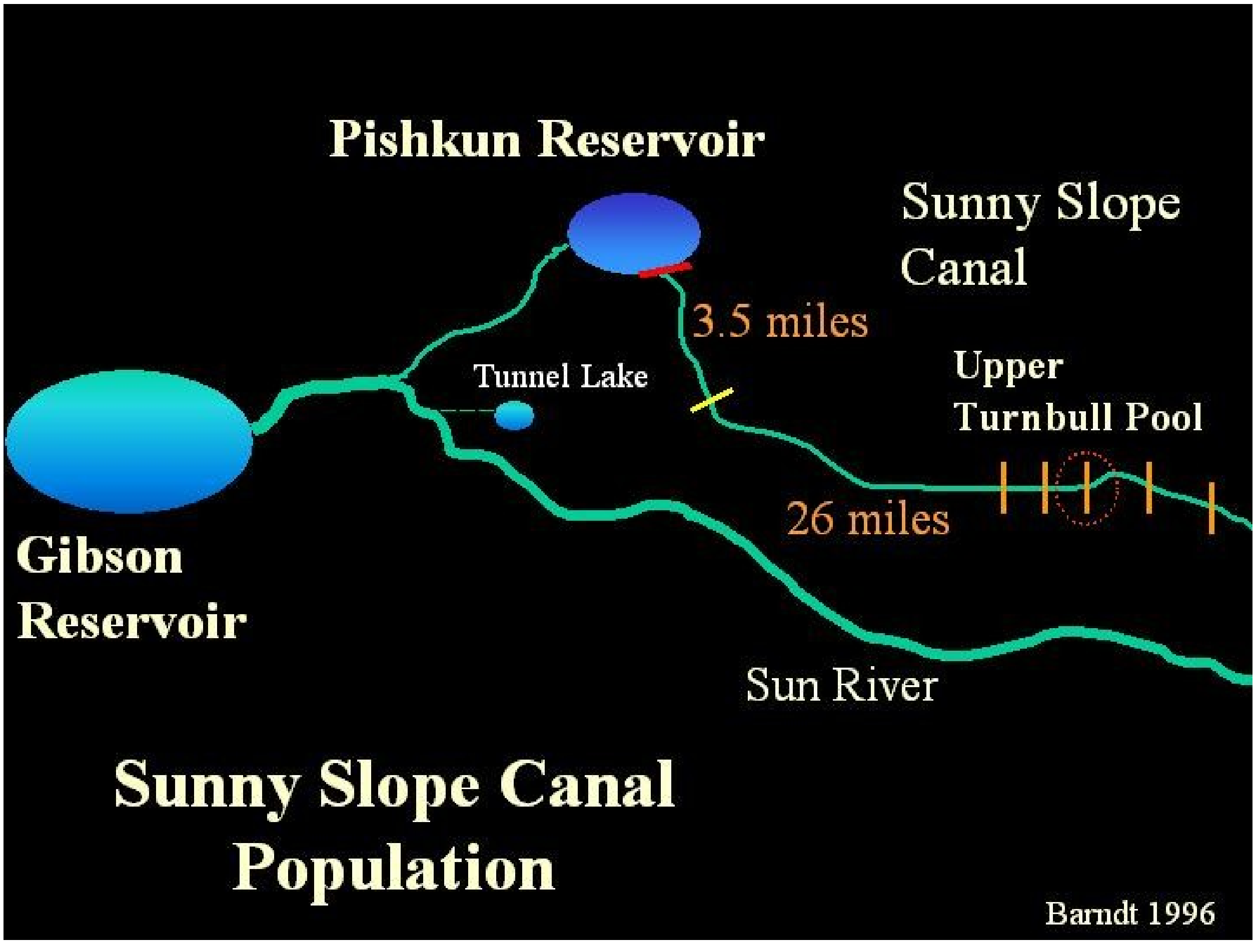


Figure 16. Map of Sunny Slope Canal, and fall 2006 seining location.

are present in the pools below drop structures, when flows cease (Barndt 1996). These drop structures are impassable to upstream movement by fish, therefore, grayling trapped in these pools are lost to the population. Starting in 1985, FWP has relocated grayling captured in drop pools to Tunnel Lake, located 4 miles from Pishkun Reservoir. Tunnel Lake has also been stocked with grayling from Red Meadow Lake to provide native fishery. Sunny Slope Canal drop pools are periodically seined to rescue stranded grayling.

On November 9, 2006 the Upper Turnbull drop pool located approximately 30 miles downstream from the dam, was seined for grayling (Figure 16). One 10 x 100 foot seine was used to sample the entire pool. A total of 279 grayling ranging from 5.5 – 16.6 inches were captured. Lengths and weights were recorded, and scales and genetic samples were taken from each fish. These grayling were then relocated to Tunnel Lake.

Madison River / Ennis Lake

Introduction

The grayling population residing in the Madison River and Ennis Lake is believed to be a remnant of the Madison River fluvial Arctic grayling population. Ennis Lake was formed by Madison Dam, built in 1907 for power generation. This dam is a barrier to migrating fish. With the construction of the dam, grayling adopted adfluvial life history characteristics and now inhabit the lake but move into the Madison River to spawn. Spawning occurs in the 1.5 miles of the Madison River upstream of Ennis Lake. The grayling generally reside in the lake during the rest of the year. FWP began monitoring this population starting in the early 1990s, and abundance has declined (Figure 17).

Monitoring Efforts

Electrofishing surveys have taken place on the Madison River upstream from Ennis Lake since 1990. In 2006, spring electrofishing sampling was conducted between April 17 and May 9, 2006. The Fletcher Channel of the Madison River was sampled three times, with two shocking boats sampling different channels each day (Figure 17). A total of 7 grayling were captured. All of these grayling were males, ranging in length from 14.5 – 15.5 inches. Lengths, weights, scales and pelvic fin clips for genetic analysis were taken from each fish. From 1994 to 2005, Ennis Lake beaches were seined for YOY grayling in June and July. YOY numbers have continually declined (Figure 18).

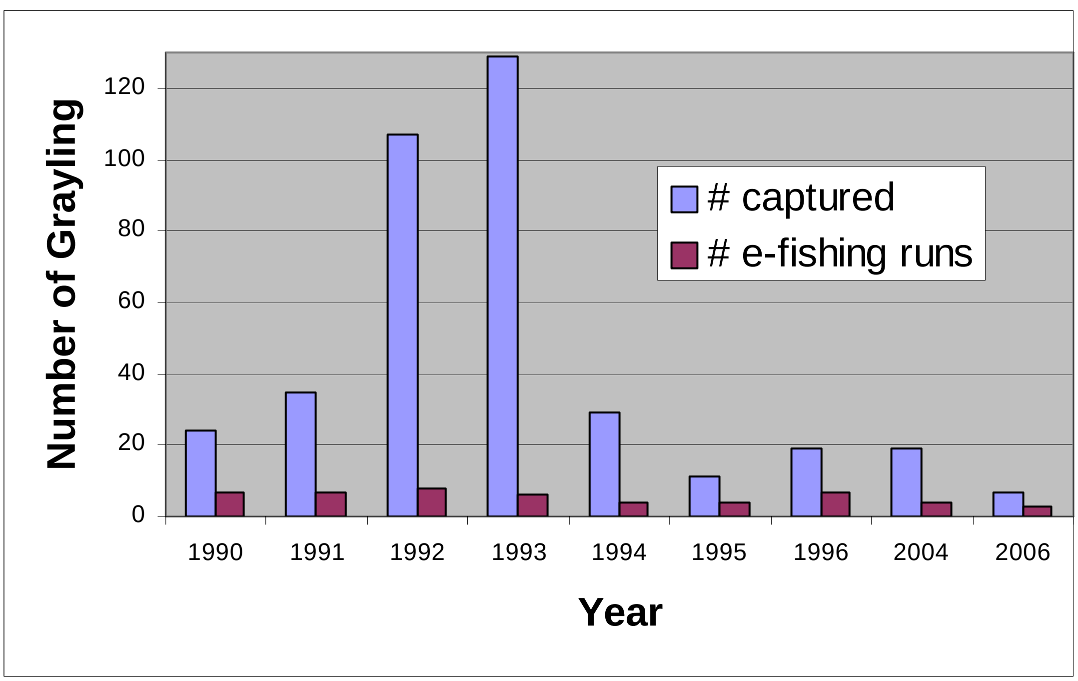


Figure 17. Grayling captured by electrofishing during spring spawning surveys on the Madison River upstream from Ennis Lake.

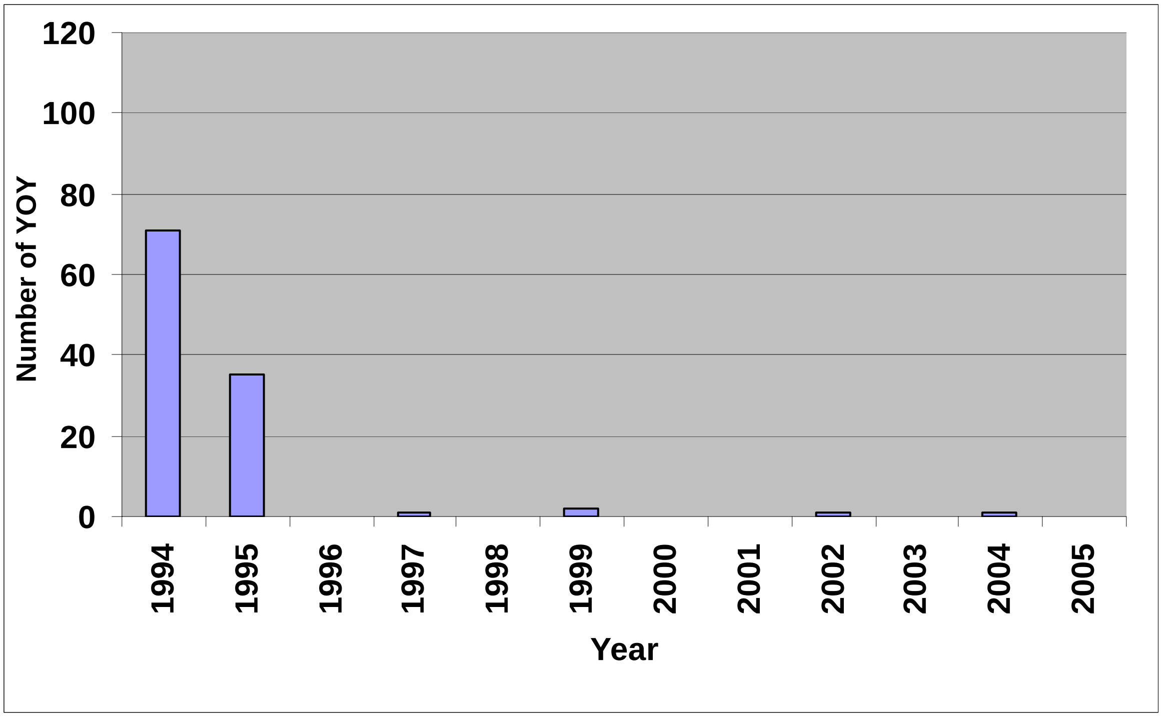


Figure 18. Number of YOY captured by beach seining in Ennis Lake from 1994 – 2005.

Reintroduction Efforts

Introduction

The long-term restoration goal for the Montana fluvial Arctic grayling recovery plan is to establish five populations (including the Big Hole) within the species' historic drainages by 2020 (Montana Fluvial Arctic Grayling Restoration Plan, 1995). The fluvial grayling brood program was developed to ensure that the genetic integrity of fluvial grayling was preserved, and to provide a source of grayling for restoration efforts. Three fluvial brood stock populations have been developed, and are located at FWP Yellowstone River Trout Hatchery, Axolotl chain of lakes and Green Hollow II Reservoir. Reintroduction efforts were initiated in 1997 in the Upper Ruby River, and were expanded to the North and South forks of the Sun River in 1999, the lower Beaverhead River in 1999, and the Missouri River Headwaters in 2000. Due to drought conditions and

Green Hollow II Grayling Brood Reservoir limited resources, the Montana Arctic Grayling Workgroup in 2002 recommended focusing reintroduction efforts on the Upper Ruby River, but continuing other efforts as funding, workload and resources allowed. In 2006, FWP stocked age-1 grayling or raised grayling fry using remote site incubators (RSIs), in the North Fork of the Sun River, Missouri River Headwaters, and the Upper Ruby River. FWP also continued to assess the limiting factors and survival of previous grayling stocking efforts. Specific objectives of the restoration efforts reported in this summary were to:

- Monitor grayling brood stock populations at Axolotl Lake and Green Hollow II Reservoir, collect gametes, and supplement additional year classes as needed.
- Monitor abundance and distribution of planted grayling and potential competitors/predators at each of the restoration sites.
- Monitor to determine if natural reproduction of grayling has occurred at each of the restoration sites.
- Monitor physical factors such as stream flows and temperatures that may affect success of establishing grayling populations at each of the restoration sites.
- Continue to stock hatchery-reared grayling or use RSIs in the Upper Ruby, North Fork of the Sun, and Missouri River Headwaters.

Brood Program

The Arctic grayling brood reserves at Axolotl chain of lakes and Green Hollow II Reservoir provide gametes that are developed to eyed eggs, fingerlings or yearlings for reintroduction efforts in streams or rivers in historically native drainages of fluvial Arctic grayling. These brood populations are sampled annually to estimate abundance, determine size structure, conduct fish health testing, and to collect gametes. Fyke nets, gill nets and hook-and-line techniques are employed to capture grayling. As per the FWP fish health protocol, all grayling (including fertilized eggs) are tested for pathogens prior to transporting to state hatcheries or planting into restoration streams.

Methods

Green Hollow II Reservoir Brood

The Arctic grayling brood reserve at Green Hollow II Reservoir was established in 1998 on Turner Enterprises' Flying D Ranch. This brood reserve has since been supplemented periodically with progeny of the fluvial grayling brood stock derived from Big Hole River grayling.

Pathogen testing ensures disease-free status of grayling broods

For pathogen testing, kidney samples were taken from 60 grayling, 9 brook trout, and 1 rainbow-cutthroat trout hybrid on April 18, 2006, and ovarian fluids were taken from 60 grayling after being spawned on May 16, 2006. Big Springs Trout Hatchery personnel assisted with gamete collection on May 16, 2006.

To reduce the risk of Bacterial Kidney Disease, as per request of the FWP Fish Health Committee all captured fish except grayling (Eastern Brook trout, rainbow trout and rainbow/cutthroat trout hybrids) were removed from the lake during population surveys and gamete collection efforts.

Axolotl Lake Brood

The grayling brood reserve was established in Axolotl Lake in 1989 and has been supplemented periodically with progeny of the fluvial grayling brood stock derived from Big Hole River grayling. For pathogen analysis, kidney samples were taken from 60 grayling on April 25, 2006, and ovarian fluids were taken from 60 spawned grayling on May 22, 2006.

Collecting eggs from a female grayling

Most captured grayling were weighed, measured, and marked for population estimation. As grayling became ripe, they were sorted by sex and retained in separate live cars. Big Springs Trout Hatchery personnel assisted with egg collection on May 22, 2006.

Eggs were stripped from female grayling, pooled, and fertilized with milt from multiple males. After fertilization, eggs were rinsed, packed in ice and transported to Big Springs State Fish Hatchery. Stripped grayling were then released in to the lake.

Results

Due to unseasonably high temperatures in April and May 2006, gamete viability was very poor from spawning efforts at both Axolotl and Green Hollow. Rapid increases in brood pond temperatures resulted in poor eye-up of fertilized eggs (24% from Green Hollow, 0% from Axolotl).

Eyed-eggs from the grayling brood stock

Green Hollow II Reservoir Brood

All grayling and trout samples submitted for disease analysis tested negative for pathogens. We collected 388 grayling for gamete collection and population abundance estimates. Mature grayling captured were age 6 and 7, with a mean length of 12.0 inches. Mark recapture analysis estimated N = 713 (±133). On May 17, we spawned 105 females and collected approximately 221,900 eggs. Fecundity averaged 2,113 eggs per female. On May 25, approximately 38,000-eyed eggs were transported from Big Springs State Hatchery to the upper Ruby River for RSI efforts. A total of 19 brook trout and 7 rainbow-cutthroat trout hybrids were removed from the lake during spawning activities. To supplement the brood population, Yellowstone River Trout Hatchery stocked Green Hollow II Lake with 750 age-1 grayling produced from 2005 gamete collection.

Axolotl Lake Brood

All samples submitted for disease analysis tested negative for pathogens. On May 21 and 22, 610 Arctic grayling were captured for gamete collection and population estimation. Average length for all grayling captured was 12.1 inches. Mark-recapture analysis estimated N= 794 (±41) grayling in the Axolotl Brood Lake population. On May 22, we spawned 80 females and collected approximately 116,128 eggs. Due to the increasing presence of larger, older fish, the average fecundity increased dramatically over the past four years from 419 eggs per female in 2002 to 1,451 eggs per female in 2006. Fertilized eggs were taken to Big Springs State Fish Hatchery for development to eye-up; unfortunately by June 2, 2006, all eggs were dead. To supplement the brood population, Yellowstone River Trout Hatchery stocked Axolotl Lake with 750 age-1 grayling produced from the 2005 gamete collection.

Discussion

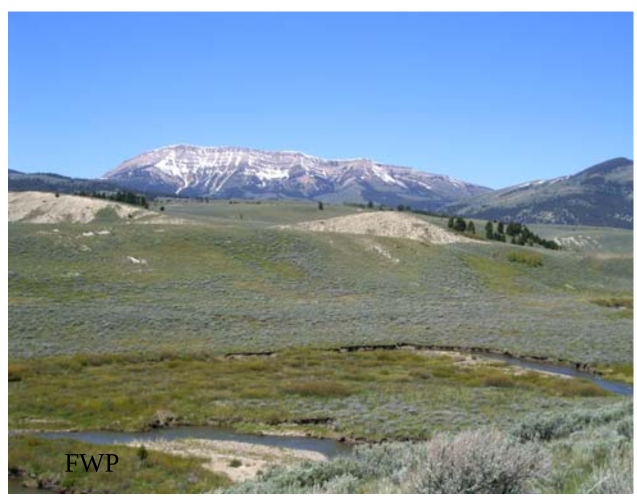
In 2006, brood populations supplemented continued reintroduction efforts in the Upper Ruby, North Fork of the Sun, and Missouri Rivers can be attributed in part to the success of the brood program. As the grayling in both Green Hollow and Axolotl brood lakes have matured, the average fecundity has increased substantially, thereby increasing the number of eyed-eggs available for hatchery stocking and RSI efforts. Additionally, maintaining the disease-free status of our brood populations has allowed us the continued opportunity to utilize grayling from the brood populations. Despite limited egg viability in spring 2006, grayling reintroduction efforts continued in the Upper Ruby River.

Upper Ruby River Reintroduction Efforts

Methods

Arctic Grayling RSI and Stocking Efforts

Arctic grayling reintroduction efforts began in the Upper Ruby River in 1997. Age-1 and 2 hatchery reared fluvial Arctic grayling were planted annually from 1997-2005. RSIs became the sole means of introducing grayling in to the system in 2005. RSIs have been used to produce grayling fry that have been incubated under the selective mechanisms of the stream system since 2003. This technique has proven successful at producing fry, and will potentially produce mature grayling that return to natal RSI streams to spawn.



Upper Ruby River

Population Monitoring

In order to assess distribution, abundance and population demographics of stocked, RSI, and potentially naturally reproduced grayling; we completed electrofishing surveys in 4 reaches of the Upper Ruby River in April 2006 and 9 reaches in September and October 2006. Surveys were distributed from Ruby Reservoir upstream to Divide Creek (Figure 19). Spring surveys included Upper Letter, Canyon, Vigilante Bridge – Vigilante Station, and Shovel Creek sections (Figure 20). Spring surveys were limited upstream of Shovel Creek due to ice conditions. Fall surveys were completed on Upper Letter, Greenhorn, Canyon, Vigilante, Three Forks, Lazyman Creek, Willow Creek, Pete Creek section, Middle Fork Culvert, and Middle Fork sections (Figure 20). The Willow Creek and Lazyman Creek sections were completed in part for pre and post habitat improvement project monitoring. Electrofishing data were entered and summarized with Fisheries Analysis 1.2.7 (Montana Fish, Wildlife & Parks 2004). Density estimates are reported as number of fish per mile with the standard deviation in parentheses. Catch-per-unit-effort (CPUE) for all age classes is reported as number of fish captured per mile. CPUE was used to show trends of grayling population abundance and spatial distribution. Length–frequency histograms are used to summarize population age structure. Mark-recapture estimates were completed for the Vigilante and Three-Forks sections in fall 2006.

Water Temperature and Stream Discharge

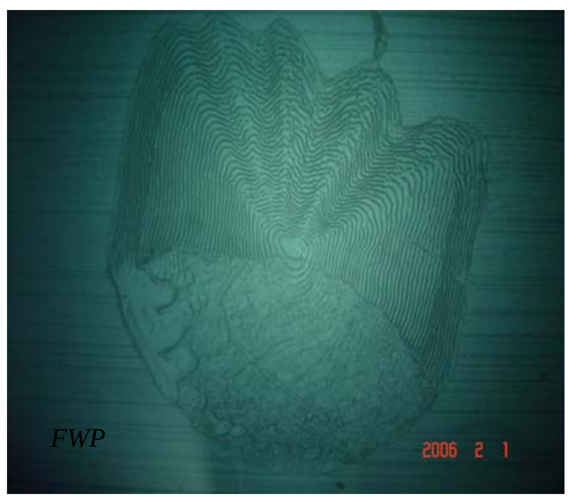
Stream flows are monitored annually at the USGS gage station just upstream from Ruby Reservoir (Figure 21). Water temperature was monitored at Sweetwater, Canyon, Warm Spring Creek, Vigilante, Three Forks, Middle Fork, East Fork, West Fork, Lazyman Creek, and Willow Creek (Figure 21). FWP used Onset Hobotemp and Stowaway thermographs to record temperatures at 60-minute intervals. Data were downloaded into Microsoft Excel and analyzed to determine daily maximum, minimum, and average temperatures.

Results

Arctic Grayling RSI and Stocking Efforts

In the spring of 2006, eyed eggs from Green Hollow II brood population were developed in 31 RSIs at 10 locations from May 25 – June 16 (Figure 20). Each RSI received approximately 1,200 eggs. Grayling YOY produced from RSI and/or natural recruitment were captured during

Grayling scale showing growth patterns of a wild fish (first year growth annulus is closer to the center of the scale)



Grayling scale showing growth patterns of a hatchery fish (first year growth annulus farther from the center)

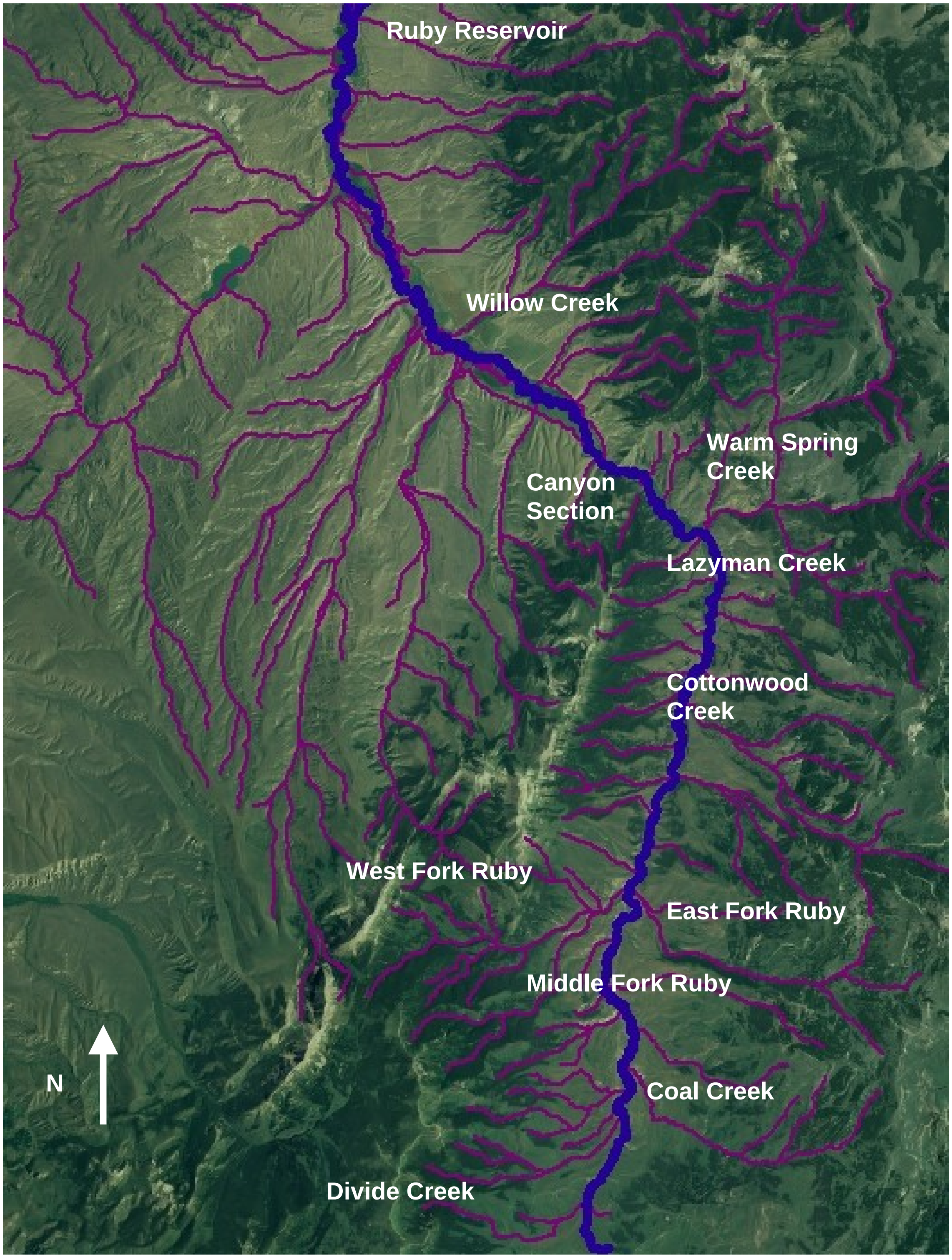


Figure 19. Map of the Upper Ruby River and it's major tributaries.

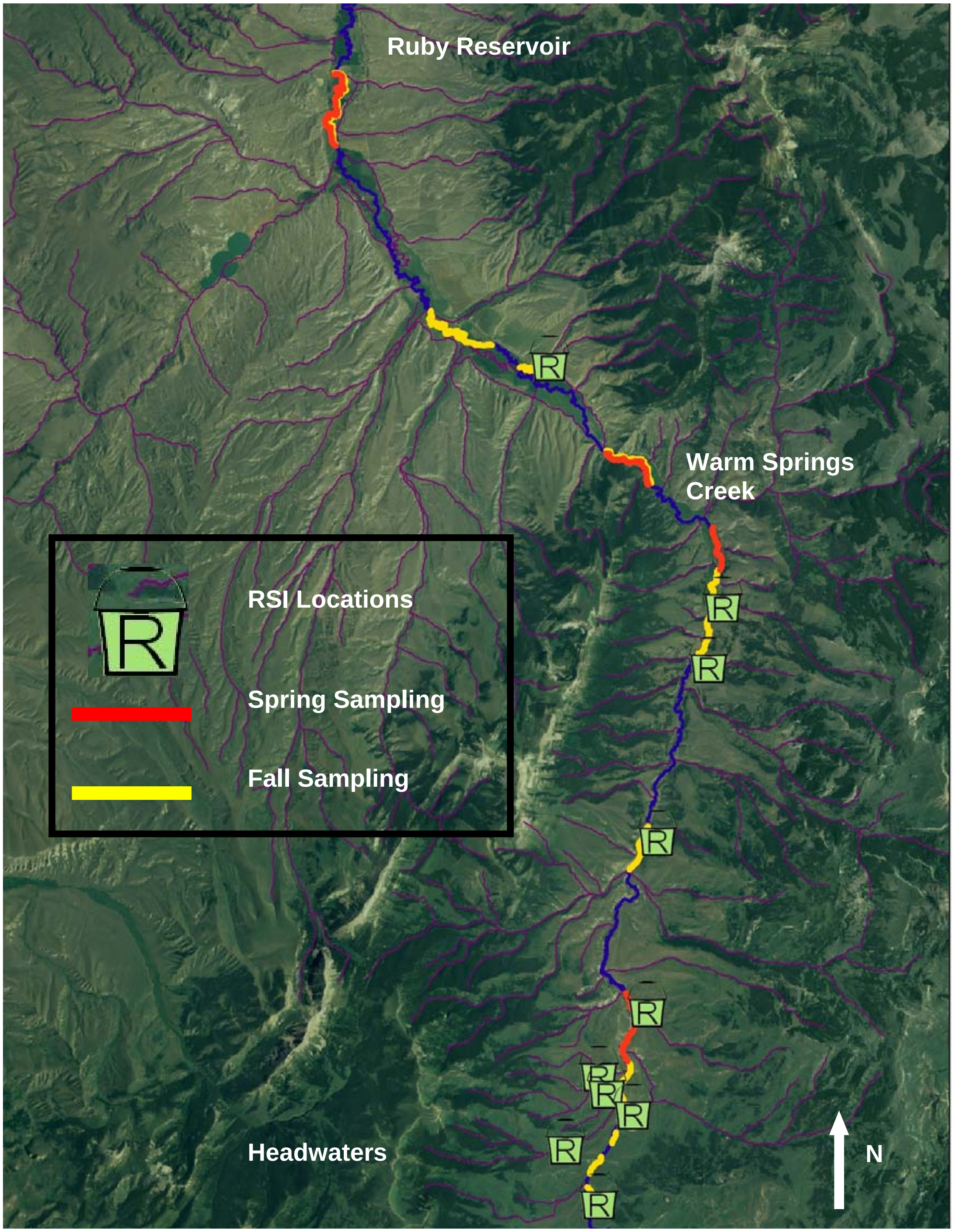


Figure 20. FWP spring and fall electrofishing survey reaches and RSI locations in the Upper Ruby River Drainage, MT 2006.

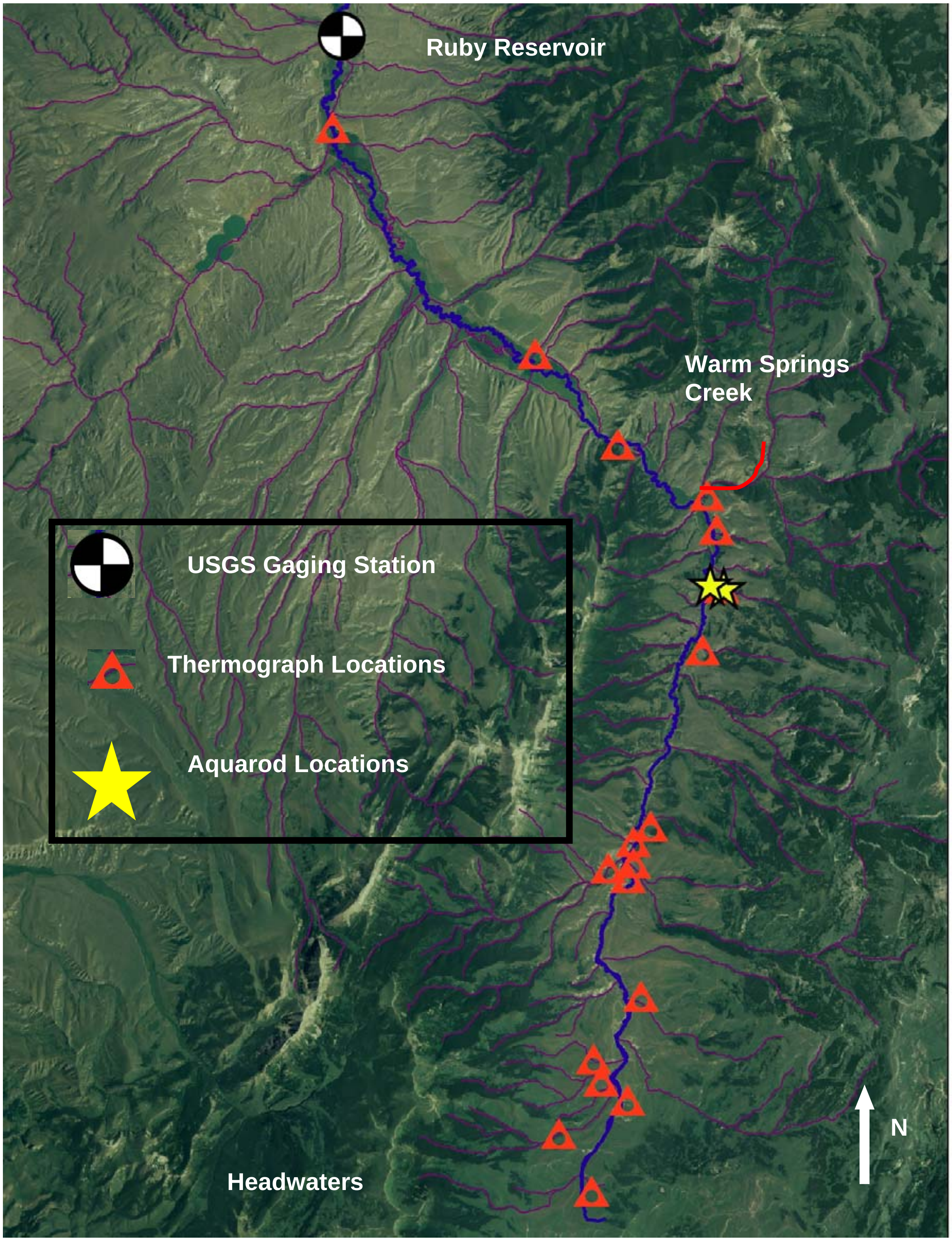


Figure 21. FWP thermograph sites, USGS gage, and Aquarods on Lazyman Creek, in the Upper Ruby River, MT 2006.

Remote Site Incubators (RSIs) in a tributary to the upper Ruby River

fall 2006 surveys and ranged from 4.4 -5.5 inches (Figure 22). Stocked grayling from 2003 (age 4), 2004 (age 3) and 2005 (age 2) ranged from 7.6 – 12.2 inches in length (Figure 22). We also caught numerous age 1 and 2 grayling that were not stocked but were either produced from RSI or from natural reproduction. We are not able to distinguish RSI grayling from naturally reproduced grayling. However, scale analysis was used to differentiate wild (produced from RSI or from natural recruitment) and hatchery raised grayling. Hatchery raised grayling exhibited constant growth patterns due to an unchanging and stable environment. In contrast, wild grayling scales showed growth patterns more typical of fish exposed to natural thermal regimes and less dependable food sources throughout the year.

Population Monitoring

Spring electrofishing surveys were completed in 4 reaches and fall surveys were completed in 9 reaches to assess previous plant survival, RSI fry production, distribution, abundance, and population demographics. Spring surveys found highest densities of grayling in the Shovel Creek reach (Figure 23). Spring surveys most likely underestimated yearling and age-1 grayling distributed in upper portions of the drainage where some surveys could not be completed due to ice conditions. Fall surveys found the highest densities of grayling in the upper survey reaches (Figure 24). These grayling were a combination of planted grayling, grayling produced from RSIs, and possibly some from natural recruitment. The highest CPUE for grayling in fall 2006 surveys was in the Culvert section of the Middle Fork, which had the highest CPUE in fall 2005 as well (Figure 24).

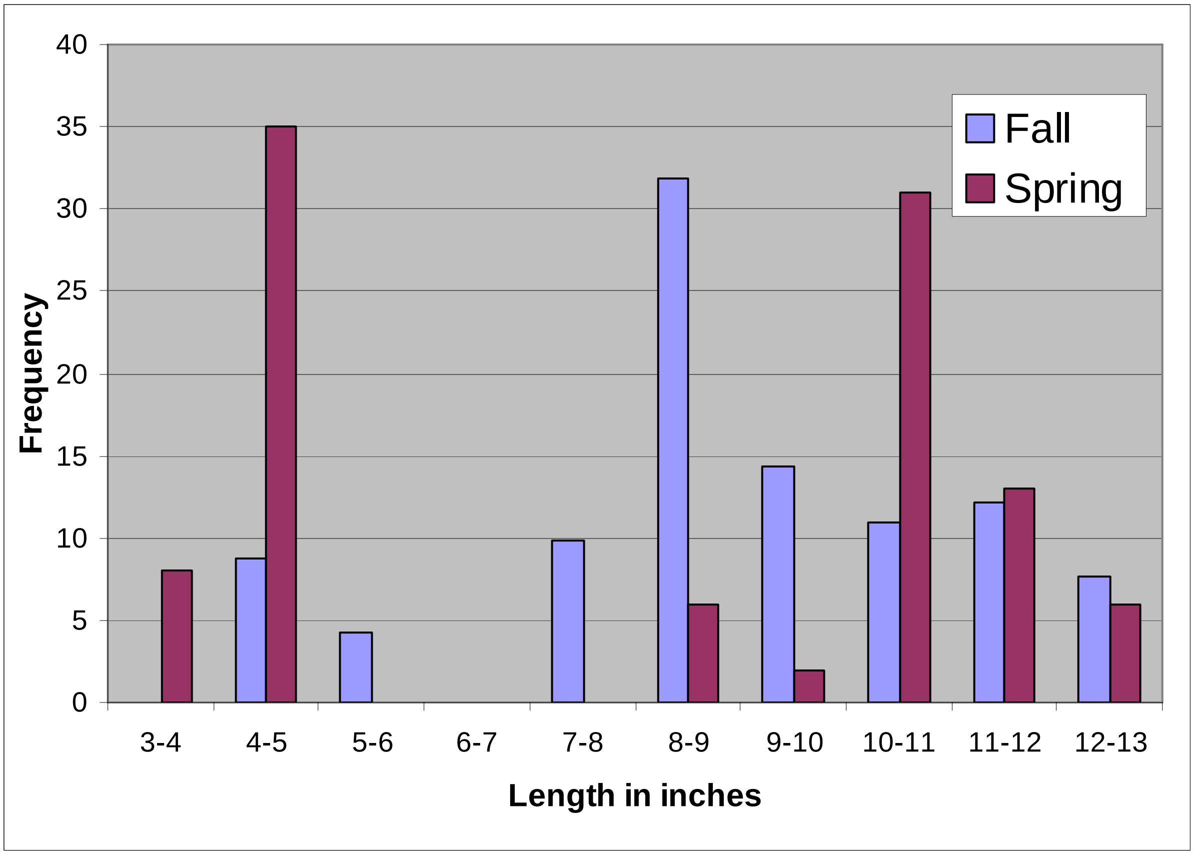


Figure 22. Length freuency histogram for Arctic grayling captured by FWP electrofishing surveys in spring and fall 2006 in the Upper Rby River, Monana.

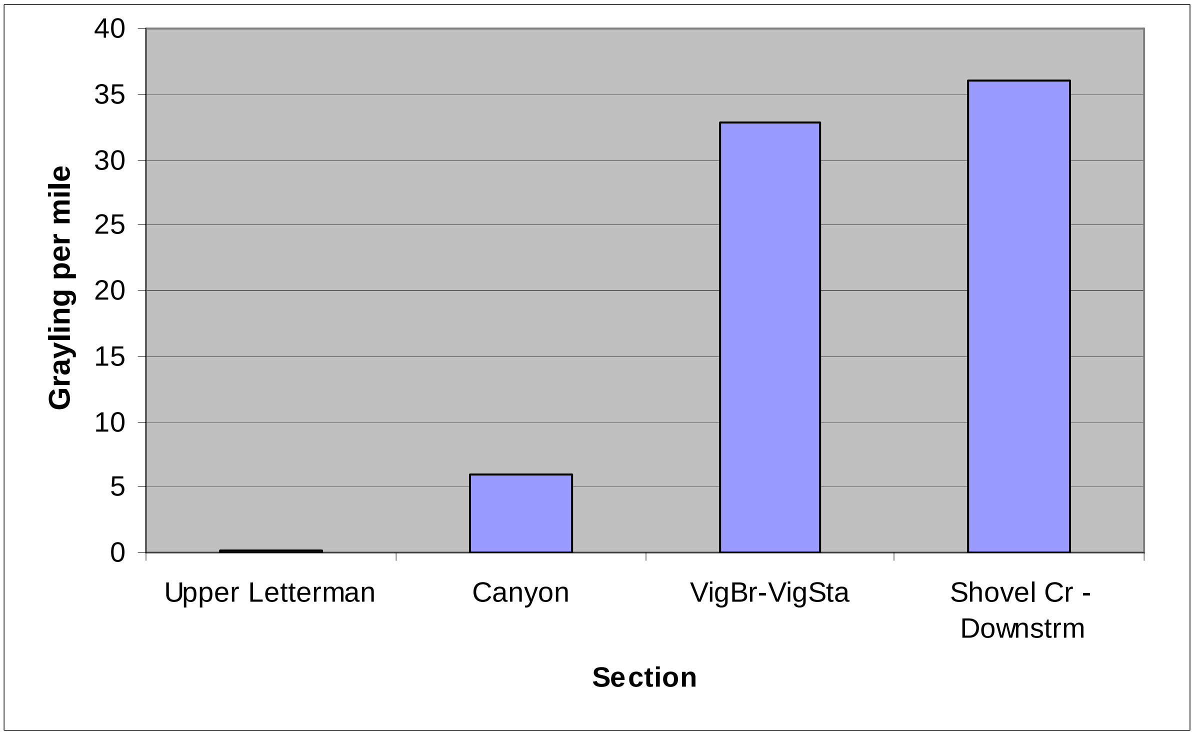


Figure 23. Catch per unit effort (fish per mile) graph of all grayling captured during spring FWP electrofishing samples in the upper Ruby River, MT 2006.

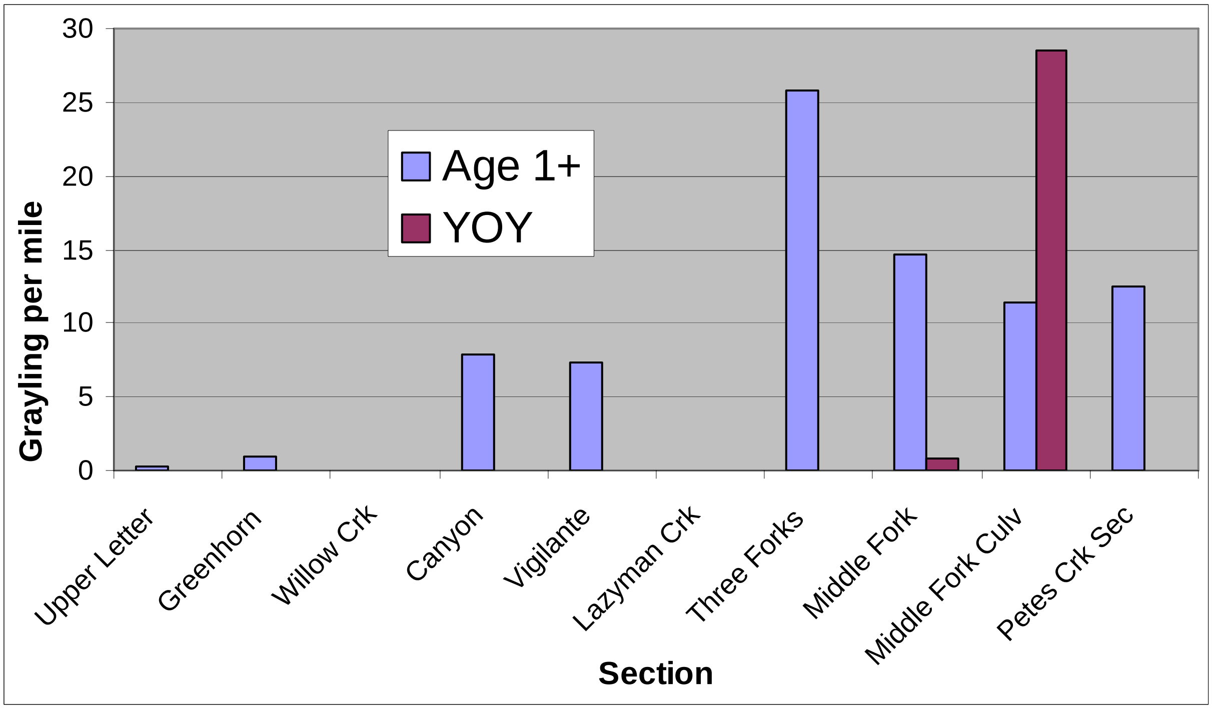


Figure 24. Catch per unit effort (fish per mile) for age-1+ and YOY Arctic grayling by reach in fall 2006 from FWP electrofishing surveys in the Upper Ruby River, MT.

The majority of the grayling captured in this section were YOY (71%), and the remaining were age-1 or older (28%). Fall 2006 mark recapture grayling estimates (reported as the number of grayling per mile with standard deviation in parentheses) were 10 (std = 2.4 grayling per mile) in the Canyon Section, 7 (std = 1 grayling per mile) in the Vigilante Section, and 31 (std = 5.1 grayling per mile) in the Three-Forks Section grayling per mile. These estimates are much lower than those from 2005 reflecting reduced numbers of stocked grayling.

Few grayling were found in the lower reaches (downstream of the Canyon Section); (Figure 24). This may be due to the distance from RSI or planting locations, habitat limitations, and possibly the presence of brown trout. No brown trout were found upstream of the Canyon Section (Figure 25). Cutthroat hybrid abundance is highest in the Canyon and Three Forks sections, and decreases up and downstream from these reaches (Figure 25).

All of the YOY (age-0) grayling captured in 2006 were in 2 reaches of the Middle Fork (Figure 24). Age-1 grayling were captured from the headwaters to the reservoir, with highest densities in the upper watershed, and very low densities (less than 1 grayling per mile) in the downstream sections closer to the reservoir (Figure 24). Fewer YOY (less than 7 inches) were captured in fall 2006 (11) than in 2005 (151) with similar sampling efforts. These grayling may be from successful RSI fry production and/or from natural recruitment. Scale analysis indicates that at least 12% of the grayling captured in 2006 were produced from RSIs or natural recruitment, as apposed to grayling from hatchery stocking.

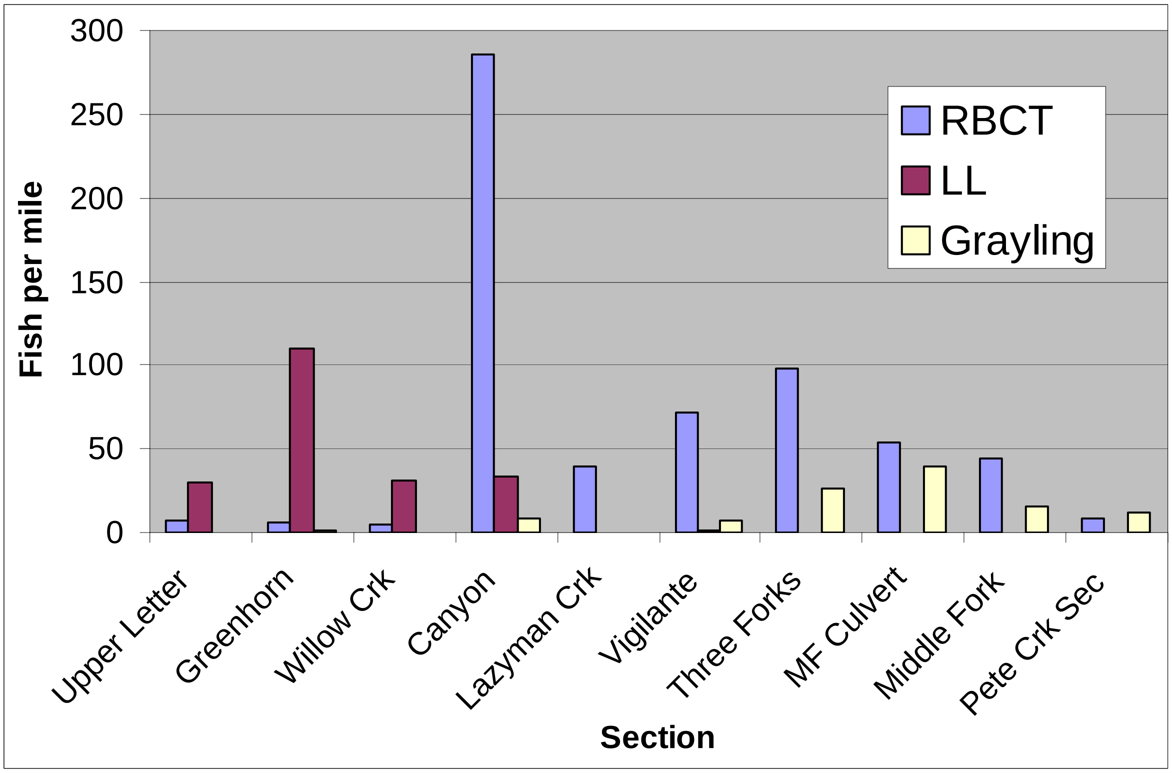


Figure 25. Catch per unit effort (fish per mile) for Arctic grayling (GR), brown trout (LL), and rainbow/cutthroat trout hybrids (RBCT) by reach for FWP electrofishing surveys in fall 2006 in the Upper Ruby River, MT.

Grayling produced from RSIs in 2003, 2004, and 2005 have successfully over wintered. These grayling were captured in spring of 2006 surveys with total lengths ranging from 3.6 - 4.7 inches, and in the fall ranging from 7.6 – 8.9 inches.

Water Temperatures and Stream Discharge

Temperature data for the mainstem Ruby and its tributaries are only available for 4 of the 8 annually monitored sites. Three of the thermograph loggers were lost, and one malfunctioned. Maximum, minimum, and average daily temperatures were calculated for Canyon, East Fork, West Fork, and Lazyman Creek sites. Daily maximum temperatures were coolest in Lazyman Creek, a spring fed tributary to the Ruby River located upstream from the Vigilante Guard Station. The Canyon site had the highest maximum instream temperatures due to the input of Warm Springs Creek (Figure 25). Warm Springs Creek flows into the Ruby River just downstream of Vigilante Station. The average year around temperature for this tributary is 68°F. Daily maximum stream temperatures in the upper Ruby River typically peak in mid-July and August, and decrease starting in mid-August due to cooler air temperatures and decreasing day length. Maximum temperatures in 2006 occurred on July 22 for most thermograph sites (Figure 26). Temperatures remained below the stress threshold (70°F); (Lohr et al. 1996) for grayling and salmonid species for all monitoring sites except for the Canyon and East Fork sites (Figure 26). Monthly flows at the Alder USGS gage were 124% and 136% of the long term average for the POR in April and May respectively, and 83 – 97% of the POR in June, July and August 2006

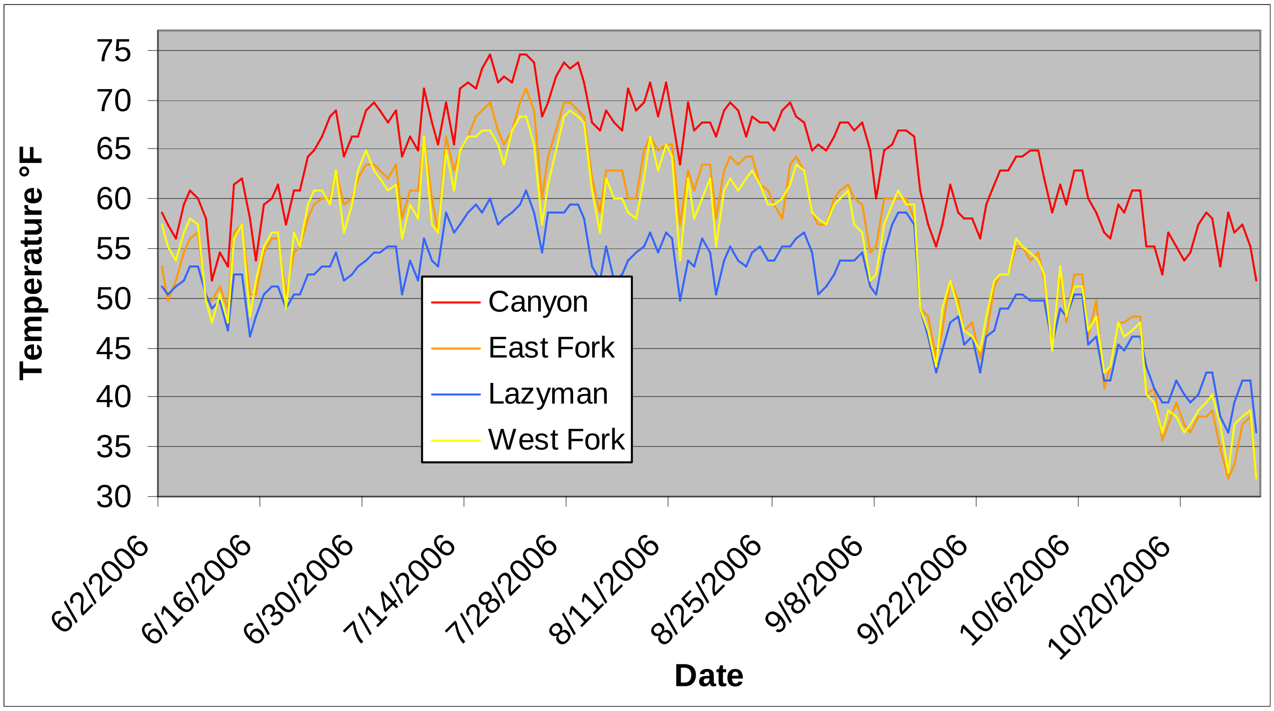


Figure 26. Maximum daily temperatures from 4 thermograph stations on the Upper Ruby River, 2006.

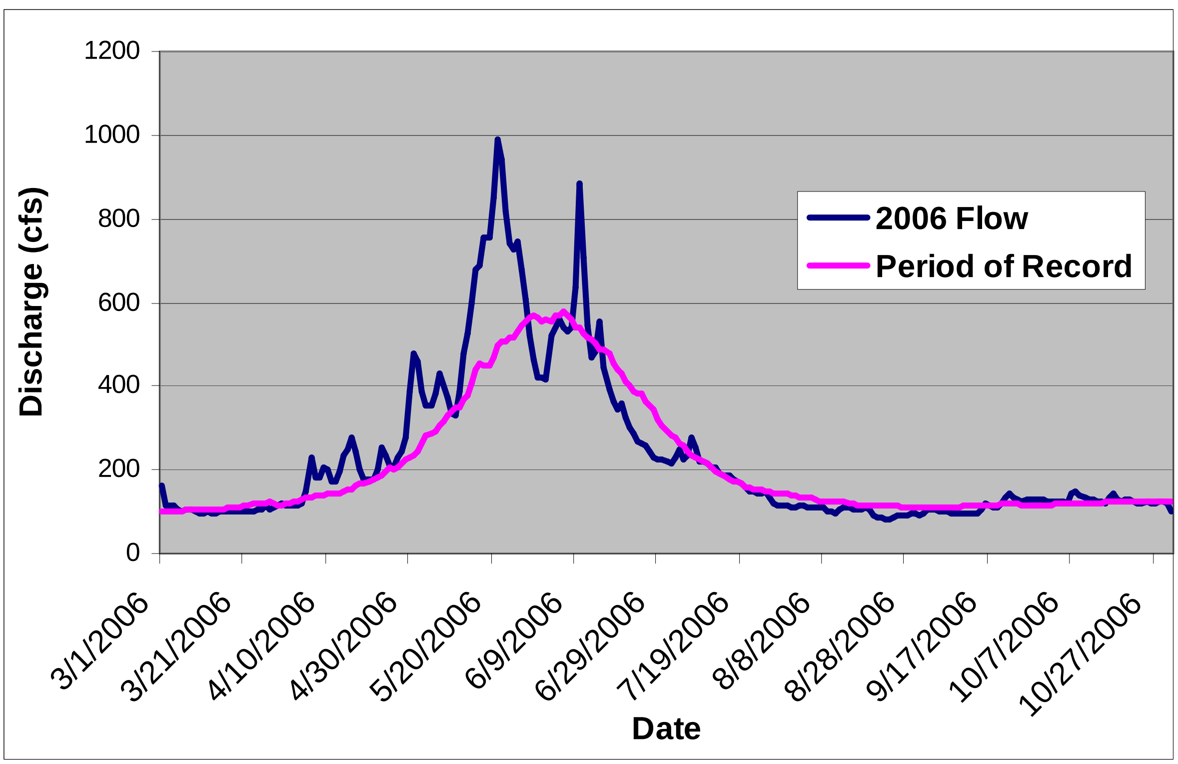


Figure 27. Mean daily flow (cfs) in 2006 and the long-term average for the POR at the USGS Alder gage above Ruby Reservoir (data are provisional).

(Figure 27). The lowest mean daily flow was 82 cfs on August 23, and the highest mean daily flow was 988 cfs on May 21, 2006. Adequate flow and thermal regimes may have positively influenced survival rates of RSI or wild grayling.

Habitat Improvement Projects

Several habitat improvement projects on the Ruby River and tributaries were completed or initiated in 2006. The purpose of these projects is to address the potential limiting factors to the grayling population, including, low pool frequency, and limited spawning and rearing habitats. In 2006, the Willow Creek channel restoration project was completed. This project involved relocating Willow Creek back into its historical channel, which increased channel length three-fold and created quality fish habitat. The restored section of the creek was sampled in the fall with a backpack electrofishing unit to determine species composition, abundance, and project success. No grayling were captured; however, native species such as mottled sculpins and mountain whitefish, and non-native species including brown trout, rainbow hybrids, and brook trout, were captured during surveys. Various sizes (ranging from 2.0 -11.5 inches) of each fish species were captured indicating spawning and juvenile rearing habitat conditions are favorable.

Willow Creek Restoration Project

In the fall of 2006, a project was initiated and partially completed to develop spawning habitat for grayling in 3 small tributaries in the upper Ruby River drainage. These tributaries have adequate stream flow, minimal sediment input and have been used to successfully incubate grayling eggs using RSIs. The expectation is that mature grayling will be able to spawn and potentially imprint juveniles to these sites. About 10-20 square feet of spawning size gravel was installed at each site. Gravel was stabilized using low-head log structures at the downstream end of the target reach.

In 2007, a project will be implemented on Lazyman Creek to create a functional spawning channel, and juvenile backwater rearing areas. This project will also improve riparian vegetation, stabilize banks and maintain base flows. RSIs will be used to produce grayling in Lazyman Creek in 2007.

A project is also underway on the main stem of the Ruby River, downstream from the confluence with Lazyman Creek (Figure 19). This project includes stabilizing and revegetating eroding and trampled banks, to reduce sediment inputs to the river. In addition, 8 pools of varying volume, instream complexity and overhead cover will be excavated to create adult pool habitat. Pools will be sampled during spring and fall population monitoring to determine grayling use. Cross sections will be measured annually to assess changes in pool volume and channel shape. Project monitoring results and outcomes will be used to guide future river restoration efforts on the Ruby River.

Discussion

Reintroduction results in the Upper Ruby River are encouraging. Natural recruitment was documented in 2000 and 2002, and over the past four years RSI techniques have improved, thereby increasing the annual numbers of grayling fry entering the Upper Ruby River. In 2005 and 2006 we captured substantially more YOY and yearlings produced from RSI's or natural recruitment. These grayling were developed and have survived under natural selective mechanisms. Young-of-the-year and age-1 grayling are distributed from Divide Creek to Vigilante Station (approximately 23 miles) indicating that rearing habitat is available at some level in this reach. However, the majority of the YOY grayling were captured upstream of Coal Creek, where other native and non-native fish species are less abundant and the potential for inter-specific competition or predation is limited. Abundance of grayling in upper reaches may also be attributed to a healthy riparian corridor, and numerous beaver ponds, which provide quality winter habitat for both YOY and older grayling. Focusing RSI and stocking efforts further upstream than in previous years may be effective in keeping grayling in upstream sections where brown trout and rainbow/cutthroat hybrids are less abundant, and where over-wintering habitat from beaver dams is beneficial. In 2007, we will expand RSI efforts to encompass other areas in the upper Ruby River drainage. Ideally, dispersing RSIs in areas with potential spawning habitat will imprint developing fry to return to these reaches to spawn.

Sun River Reintroduction Efforts

Methods

The North and South Forks of the Sun River Reintroduction efforts began in 1999. A total of 34,500 age-1 grayling were stocked from 1999-2001. In 2004 and 2005, RSIs were used to hatch grayling fry in the North Fork of the Sun River (Figure 26). Due to poor egg condition in spring 2006, RSIs were not used in the Sun River system. A combination of electrofishing, snorkeling, angling, and trapping methods have been used to assess overall population demographics, distribution, survival, and to determine if natural recruitment has occurred. In spring 2006, electrofishing surveys were conducted on Big George Creek and Lange Creek (Figure 28). A snorkel survey was completed from the South Fork Falls downstream to Gibson Reservoir.

Horses and mules are used to pack grayling eggs to RSIs in the North Fork of the Sun River

Results

Snorkel surveys were completed at the mouth of the South Fork of the Sun River (Figure 28). Ten adult (>10"), and 6 age-1 (<8") grayling were observed in the pools below the waterfall on the South Fork. Backpack shocking efforts on Big George Creek captured 2 adult spawning grayling. Lange Creek electrofishing surveys were hampered by high instream flows and no grayling were captured.

Discussion

Because of poor egg-take at Green Hollow and Axolotl Brood ponds in the spring of 2006, no reintroduction efforts were completed on the North Fork of the Sun River in 2006. In 2007, 20-25 RSIs will be used pending successful egg take in the spring. The presence of age-1 and adult grayling in the mouth of the South Fork of the Sun River indicate either natural reproduction is occurring or RSI produced grayling are moving downstream. Future sampling will be necessary to identify additional natural recruitment and investigate life history patterns (fluvial, adfluvial/lacustrine). RSI efforts and monitoring surveys will continue in 2007.

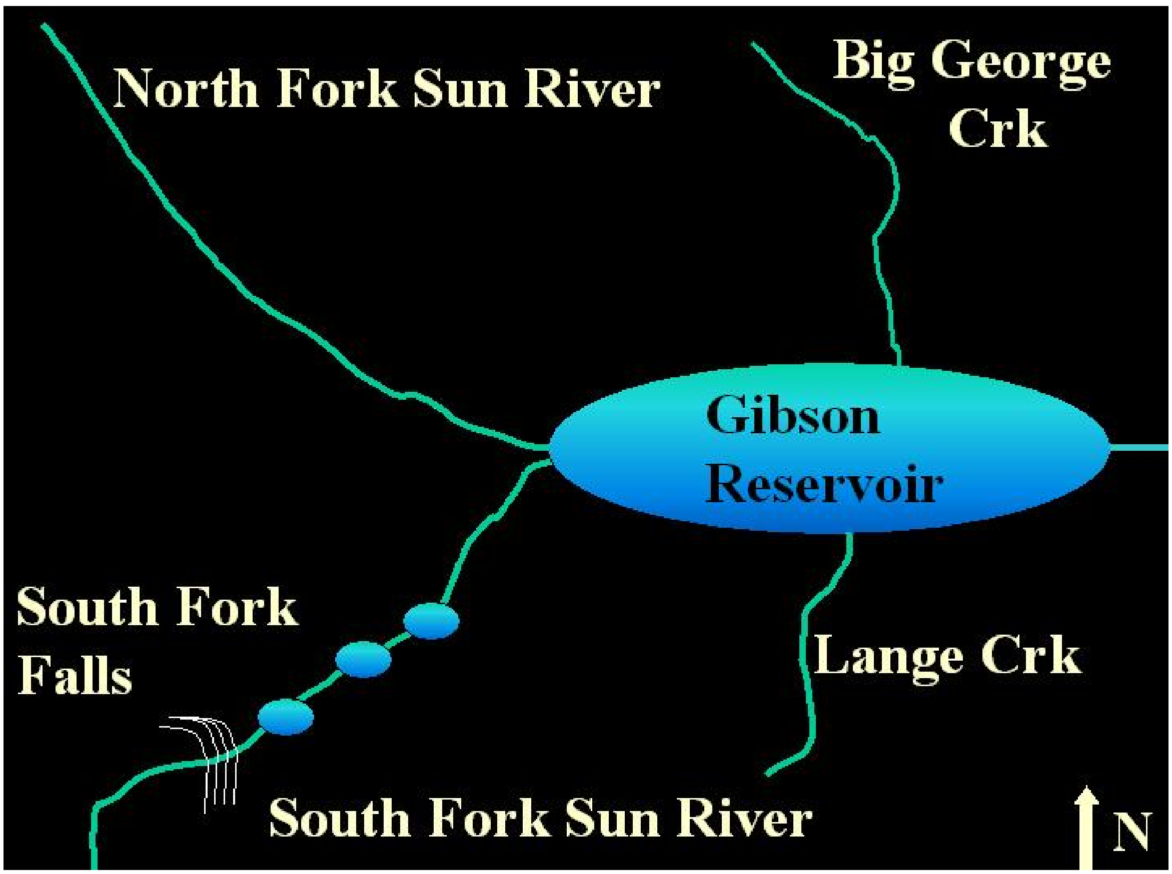


Figure 28. Map with North and South Forks of the Sun River, Gibson Reservoir and tributaries showing FWP electrofishing and snorkel survey locations.

Missouri River Headwaters Reintroduction Efforts

Methods

The Missouri River Headwaters Reintroduction efforts began in 2000 and age-1 and YOY grayling were stocked annually from 2000-2006. In 2006, age-1 grayling (progeny of the

Axolotl brood stock) were planted in the lower Madison and Gallatin Rivers. On the Madison River, a total of 15,660 grayling were planted near the Greycliff and Milwaukee Bridge Fishing Access Sites on April 10 and 11, 2006. On the Gallatin River, a total of 26,386 grayling were planted on April 20 and 21 near the town of Logan. Fall electrofishing surveys are conducted annually to document survival, dispersal, population density, and fish community composition. On November 7, 2006, jet boat electrofishing surveys were completed on the Logan section on the Gallatin, and the Trident section on the Missouri River (Figure 29). The Madison River was not sampled in the fall, 2006.

Results

In 2006, 42,046 yearling grayling averaging 7.5 inches in length were planted in the lower Madison and Gallatin Rivers. No grayling were captured during fall electrofishing surveys in the Trident section on the Missouri River or the lower Gallatin River. Due to poor survival of grayling stocked from 2000-2006, this reintroduction site will not be stocked in 2007, and future efforts will be determined by the ongoing revision of the Montana Grayling Restoration Plan.

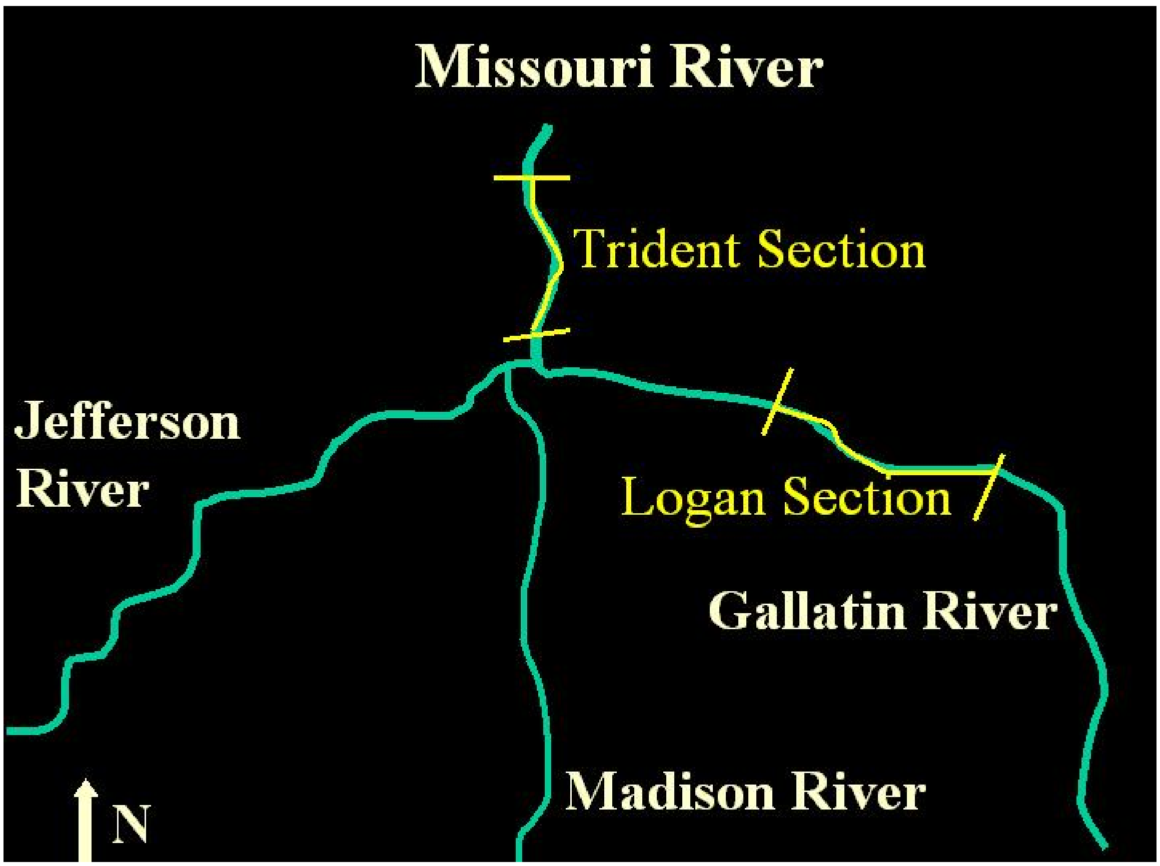


Figure 29. Map of the Upper Missouri, Madison, Gallatin and Jefferson Rivers and FWP electrofishing sections in fall 2006.

Discussion

Efforts to restore fluvial Arctic grayling populations in the Missouri River Headwaters have been challenging and have occurred over a period of extreme drought. Few stocked grayling have been captured from 2000 – 2005 and no grayling were captured during fall population surveys in 2006. This could be a result of limited sampling efforts in a large river system, the timing of surveys, habitat limitations exacerbated by stressful drought conditions, poor survival, and most likely a combination of all of the above. Due to poor survival and habitat limitations, stocking and population monitoring to assess survival, distribution, and population demographics will not continue in 2007.

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Appendix A

Table 1. Catch per unit effort (# of fish/mile) of all species sampled in the Big Hole River tributaries in FWP electrofishing reaches in fall 2006.

Tributaries	EBT	RBT	LL	GR	LING
Governor Creek	130.7	0.0	0.7	0.0	13.6
Miner Creek	251.1	4.4	13.3	0.0	0.0
Big Lake Creek	6.7	0.0	0.0	0.0	0.0
Rock Creek	12.6	0.0	0.0	0.6	0.0
Steel Creek	54.9	0.0	0.3	36.1	26.4
Swamp Creek	62.6	0.4	1.9	10.0	28.5
North Fork	77.8	0.0	5.9	0.0	3.6
North Fork SL	25.0	0.4	1.6	0.0	1.4
Mudd Creek	400.0	17.6	35.3	0.0	11.8
Fishtrap Creek	519.2	67.5	5.0	26.7	4.2
LaMarche Creek	201.7	85.3	5.2	15.5	10.3
Seymore Creek	271.2	120.3	1.7	3.4	0.0
Deep Creek	26.7	69.0	31.9	2.9	3.8

Table 2. Catch per unit effort (# of fish/mile) of all species sampled in the mainstem Big Hole River in FWP electrofishing reaches in fall 2006.

Mainstem	EBT	RBT	LL	GR	LING
CCAA A	900.0	25.3	0.6	0.0	9.4
CCAA B	197.9	11.5	11.1	0.0	20.0
HH Section	70.1	3.1	8.1	0.0	8.1
JH Section	42.7	7.0	1.2	0.0	9.6
40-Bar	43.6	1.1	2.9	0.3	32.6
CCAA C	10.0	0.4	0.1	2.5	6.1
Airport Channel	2.2	0.0	0.0	0.0	2.8
Wisdom	10.6	0.3	0.4	3.1	6.6
CCAA D	3.5	0.9	0.6	0.0	0.9
CCAA E	0.8	40.2	14.4	0.0	2.7
Fishtrap Pool	22.5	42.5	30.0	2.5	2.5
Sawlog Pool	2.3	4.6	5.7	1.1	0.0
Sportsmans Pool	8.3	144.4	22.2	5.6	0.0