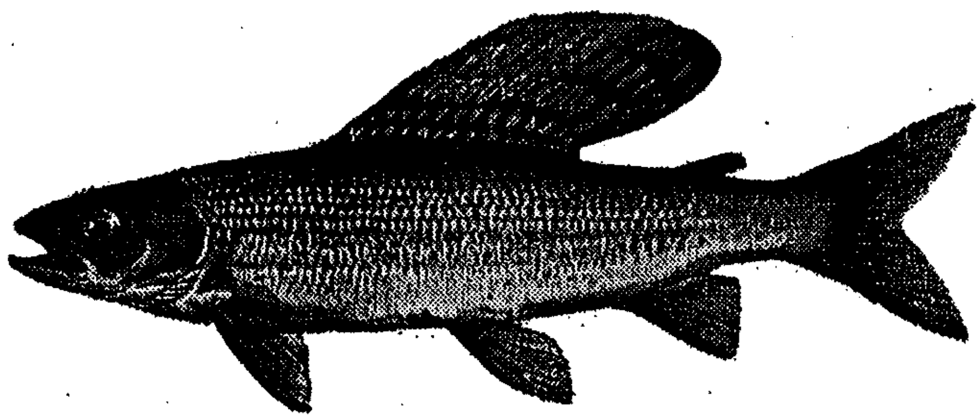
UPPER MISSOURI HEADWATERS FLUVIAL ARCTIC GRAYLING REINTRODUCTION PLAN



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and

the Fluvial Arctic Grayling Workgroup

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INTRODUCTION

Arctic grayling (_Thymallus arcticus_) were once widespread in the Missouri River drainage upstream of Great Falls. Grayling were endemic to the Missouri River and its tributaries: the Smith, Sun, Teton, Madison, Gallatin, Jefferson, Beaverhead, and Big Hole rivers. During the 20th century, the range of fluvial, or river-dwelling, grayling became restricted to the Big Hole River, about 4% of its native range (Kaya 1992a). The impacts of climatic change, introductions of non-native fishes, habitat alteration, and over-harvest by anglers are considered primary reasons for the decline of fluvial grayling (Vincent 1962, Kaya 1992a).

The Big Hole River grayling population declined in abundance through the mid-1980's to low levels. Concern for the population resulted in formation of the interagency Fluvial Arctic Grayling Workgroup (FGW) to coordinate restoration of fluvial grayling in the Big Hole River and throughout native range in Montana. A plan was developed to recover Arctic grayling with a goal of "at least five stable, viable populations distributed among at least three of the major river drainages...within the historic range of Montana grayling... (FGW 1995)."

The upper Ruby River above Ruby Reservoir, and South and North forks of the Sun River above Gibson Reservoir, were identified by Kaya (1992b) as a candidate sites for reintroducing grayling. These streams were of particular interest because they provide a relatively long unimpeded river reaches, a basic requirement of fluvial grayling habitat. Over 40 miles of the Ruby River upstream of the reservoir, 13 miles in the South fork and 21 miles of the North fork of the Sun River may encompass suitable habitat for fluvial grayling with respect to pool habitats, adequate flow, temperature, and geomorphology. Reintroduction efforts on the Ruby River have been on-going since 1997 and were initiated on the South and North Fork of the Sun River in June and July 1999. In July 1998, the FGW supported three additional reintroduction sites: 1) the Missouri River Headwaters near Three Forks, 2) the upper Madison River, and 3) the lower Beaverhead River. Reintroduction efforts on the Beaverhead River were initiated in July 1999 when 16,000 yearling were planted between Twin Bridges and Dillon. Madison River efforts will be forestalled until on-going research on whirling disease, rainbow trout, and Tubifex life histories can be completed.

Missouri River Headwaters

The reintroduction reach encompasses 73 river miles including; the Missouri River from Toston Dam to its headwaters at Three Forks (22 miles), the Gallatin River from its mouth to the confluence with the East Gallatin River (12 miles), the Madison River from its mouth to the Greycliff Fishing Access site (21 Miles), and the Jefferson River from its mouth to the confluence with Willow Creek (18 miles)(Figure 1). For simplicity, the entire restoration reach described above will be referred to as the Missouri River Headwaters in this document. This area is of particular interest because it provides relatively long unimpeded river reaches, and may encompass suitable habitat for fluvial grayling with respect to pool habitats, adequate spawning substrate, geomorphology, and low numbers of potentially competing trout. This document is the Reintroduction Plan required for fluvial Arctic grayling reintroductions in the Montana Fluvial Arctic Grayling Restoration Plan (FGW 1995), and by the Memorandum of Agreement between Montana Fish, Wildlife, and Parks and the U.S. Fish and Wildlife Service in February 1996.

Restoration Goals, Objectives, and Scope

The restoration goal is to reintroduce fluvial Arctic grayling into the Missouri River Headwaters beginning in 2000, and to establish a stable, naturally reproducing population by 2007. Objectives of the reintroduction are to:

1) Establish a self-sustaining fluvial grayling population in the Missouri Headwaters,
2) Monitor survival, movements and densities of introduced grayling to determine factors affecting success of reintroduction,
3) Through monitoring, document natural reproduction by 2005, and,
4) Attain stable to increasing population densities in sampling

sections where natural reproduction equals or exceeds annual mortality for three consecutive years.

It is recognized that the success of any reintroduction will hinge upon a complex set of environmental variables beyond the control of resource managers. Thus, it is important to define the scope of time that will be dedicated to the effort. If limiting factors are identified, but cannot be remediated, that will realistically preclude founding of a self-sustaining population, the project will cease. Therefore, if natural reproduction is not documented by October, 2007 and data do not demonstrate a likelihood of correcting limiting factors, the project will be discontinued and resources will be diverted to alternative reintroduction sites.

IDENTIFICATION OF ISSUES AND SUITABILITY FOR GRAYLING

A number of issues must be addressed to successfully plan and implement the reintroduction program. Issues were identified by representatives of the FGW, Montana Fish, Wildlife, & Parks (MFWP), and interested publics through written comments and at open meetings held in Ennis, Three Forks, and Twin Bridges, in April 1999, and at additional meetings in Ennis and Twin Bridges in June 1999. These issues are summarized in an Environmental Assessment and Decision Notice issued by Montana Fish Wildlife and Parks, July 1999.

Endangered Species Act

The U. S. Fish and Wildlife Service (USFWS) formerly classified fluvial Arctic grayling in Montana as "Category 1" under the Endangered Species Act; that is, enough substantial information exists to support a proposal to list it as threatened or endangered (USFWS 1991). This category was renamed "Candidate" in February 1996 (USFWS 1996), and fluvial Arctic grayling currently remain classified as a Candidate species. A petition to list fluvial Arctic grayling as endangered was submitted in October, 1991 (USFWS 1993). A recent finding on the petition recommended that listing fluvial Arctic grayling was "warranted, but precluded" by higher priority listing actions (USFWS 1994).

The potential for listing fluvial Arctic grayling as endangered is a primary concern of the some residents of the proposed sites. Reintroduction of a candidate species to the proposed sites is perceived to potentially affect fisheries and land management on public and private lands. However, a recent agreement between USFWS and MFWP may alleviate many of the concerns as to the affects of a potential listing.

A Memorandum of Agreement was developed to maintain efforts to protect and restore fluvial grayling in the Big Hole River while expanding the program to reestablish additional populations. This agreement, signed in February 1996, includes a provision that, "By December 31, 2000, a minimum of four ...reintroductions will be in progress...within the historic range (MFWP Files)." This reintroduction effort will help to fulfill this requirement, along with other on-going reintroductions. The goal of the Agreement is to restore fluvial grayling to a level such that listing under the Endangered Species Act is not warranted. Progress toward establishment of a viable population of fluvial grayling in the proposed sites would be an important step toward fulfilling the terms of the agreement, achieving grayling restoration, and precluding the need to list. In the event that terms of the agreement are not met, a status review will be initiated in 2002 to re-determine the necessity of listing.

Private Property

The majority of the reintroduction reach flows through private land. These lands are primarily undeveloped agricultural lands used for pasture and irrigated hay production. Diversions for irrigated hay and pasture lands are substantial for all systems, and total 555,400 acres upstream from USGS gaging station at Toston (USGS 1998). Concerns were voiced that reintroducing grayling may impact private lands management. The primary concerns, relating to the Endangered Species Act, are addressed above. No additional legal protection would be provided to grayling, other than angling regulations. Statutes protecting grayling and their habitat in the designated upper Missouri River Headwaters reach would include laws already in effect, regardless of presence or absence of grayling. For instance, the Montana Stream Protection Act (124) and Montana Natural Streambed and Land Preservation Act (310) require permits to alter streambeds and banks. Water rights granted under the Montana Water Use Act would be unaffected by the introduction of grayling. Entrainment of grayling into legally permitted irrigation canals could only be prevented via voluntary corrective measures. If corrective measures are necessary, financing would be sought to avoid imposing financial burdens on landowners. Thus, private land management rights would remain unchanged with respect to a grayling reintroduction.

Public Lands Management

Public lands in the Missouri River Headwaters restoration reach are limited to widely dispersed sections of State and Bureau of Land Management (BLM) properties. State Fishing Access sites (FAS) include Greycliff and Cobblestone Cove on the Madison River, Gallatin Forks at the confluence of the East and West Gallatin Rivers, Missouri River Headwaters State Park at the confluence of the three tributaries and Fairweather State FAS on the mainstem Missouri (Figure 1). The potential effects of introducing grayling into these drainages would be minimal and regulations for the existing fishing access would pertain to current laws (Stream Access and private property laws). No regulatory changes for fishing access sites on State or BLM lands would be required. Fishing regulations will remain catch and release for grayling.

Other possible land management activities that may be impacted would include road maintenance. As stated in the section above on private lands, existing statutes protecting streambeds and banks would remain unchanged in the presence of Arctic grayling.

Fisheries Management

The reintroduction reach supports wild, resident game fish populations of rainbow trout, brown trout, and mountain whitefish. Resident non-game species include mottled sculpin, longnose dace, longnose and white suckers, and carp. Other species that have been documented but are rare include cutthroat trout, flathead chub, golden shiner, stonecat, yellow perch, black crappie, largemouth bass, and brook trout. The headwaters area supports few angler days relative to stream miles. In 1997, angler pressure for the lower Gallatin (Mouth-East Gallatin) ranked 20th in the region with an estimated at 7,494 (SE=1031) angler days and the Missouri River between Toston and Three Forks ranked 56th in the region at 956 (SE = 481). Estimates for the specific reaches of the Madison and Jefferson Rivers encompassed in the restoration reach are not available, but are most likely fairly low due to low densities of sportfish and more popular upstream reaches (MFWP 1998).

Game fish populations have recently been monitored by electrofishing surveys in the lower Madison, lower Gallatin, lower Jefferson, and Missouri River Headwaters reaches. Survey reaches include the Greycliff Section on the Madison, the Logan Section on the Gallatin, the Trident Section on the Missouri, and the Willow Creek Section on the Jefferson (Figure 1). Densities of rainbow and brown trout in these areas are relatively low (200-600 fish per mile) compared to productive upstream reaches(Table 1). Rainbow trout recruitment may be limited by quality of spawning and rearing tributaries, while brown trout (primarily a mainstem spawner) recruitment may be more associated with flow regimes (Ron Spoon, MFWP Fisheries Biologist, Personal Communication). Other factors that may be limiting trout densities include high temperature regimes, riparian degradation, sedimentation and whirling disease.

Kaya (1992b) expressed concern that the presence of non-native fishes in Missouri Headwaters may hinder success of reintroduction efforts. Arctic grayling are an aggressive fish that have been observed to successfully defend territories against similar-sized rainbow and brown trout in low densities (MFWP Files). In lower reaches of the Big Hole River, grayling at low densities (15-30 age 1+ per mile) co-exist with rainbow and brown trout at high densities (1,500-2,000 age 1+ per mile). Densities of grayling are highest (50-100 age 1+ fish per mile) in the upper reaches where brown and rainbow trout densities are low (<50 age 2+ per mile). Grayling in Deep Creek, a tributary of the Big Hole River, and in the Sportsmans to EastBank Section of the Big Hole River co-exist successfully at approximately 50 age 1+ grayling per mile with rainbow trout densities exceeding

200 age 2+ per mile. Established resident species may influence survival of stocked grayling through predation and competition for food and space. Thus far, grayling planted in the Ruby River have had no negative effects on rainbow\cutthroat trout population densities or condition factors (Opitz 2000). The affects of resident populations and stocked grayling on each other will be monitored.

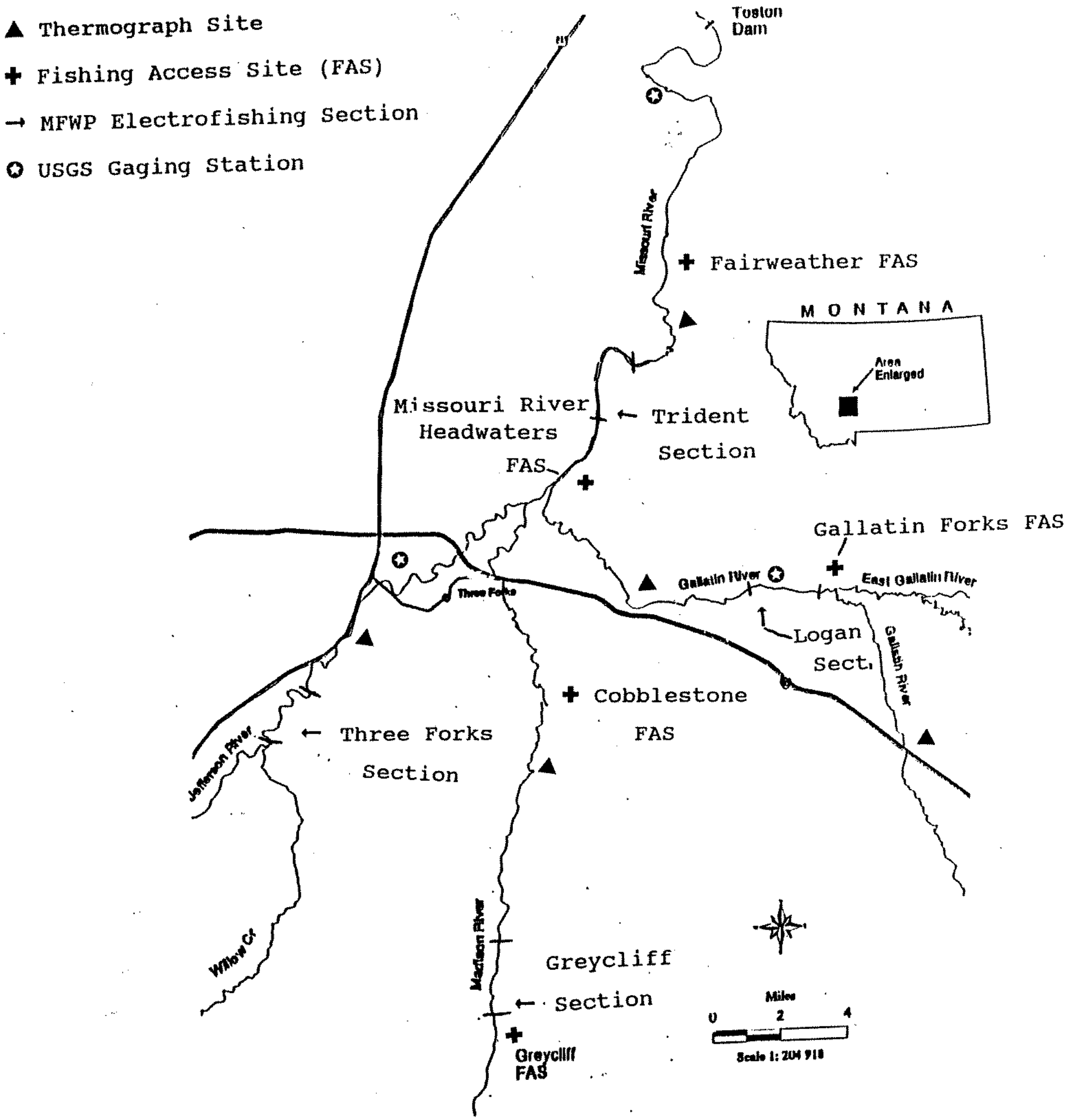

Figure 1. Map of Missouri River Headwaters Restoration Reach including Fishing Access Sites (FAS) and Montana Fish, Wildlife and Parks electrofishing sections, USGS gages and thermograph sites.

Table 1. Estimated densities of age 2 and older rainbow (RB), and brown trout (LL) from Montana Fish Wildlife and Parks electrofishing sampling sections in the lower Madison, lower Gallatin, and the mainstem Missouri downstream from Three Forks, Montana. Estimates for brown trout on the Three Forks section are age 3 and older. Estimates could not be made for rainbow trout in the Three Forks Section.

Sampling Section	Length Miles	River	Year	Abundance RB(#/mi)	Abundance LL(#/mi)
GreyCliff	3.2	Madison	1989	530	1665
			1990	194	1098
			1992	1214	1088
			1994	393	709
			1995	388	508
Logan	4.0	Gallatin	1999	350	355
			2000	321	377
Trident	5.0	Missouri	1981	219	256
Three Forks	7.0	Jefferson	1986	na	346
			1988	na	362
			1998	na	160
			1999	na	200

Angling regulations in the restoration reach will not be changed following the reintroduction of grayling unless biologically justified. Currently, grayling are managed under catch-and-release-only regulations in Montana streams. Daily bag limits for trout in the restoration reach are 5 daily and in possession except for the Jefferson River which is catch-and-release-only for rainbow trout, and 5 brown trout with only one over 18 inches. All of the encompassed reach is open year round to angling. If research and monitoring identifies predation, or competition, from non-native species as a factor limiting grayling survival, MFWP biologists will review data, and identify options to formulate management recommendations.

Grayling may migrate into upstream tributary reaches or downstream in the Missouri River. While grayling will be protected under catch-and-release regulations, no further regulatory measures for grayling will be exerted in these reaches. Access to these other reaches may provide grayling with additional necessary habitats to sustain a viable population.

Whirling Disease

Presence of the myxosporean parasite *Myxobolus cerebralis* and symptoms consistent with whirling disease has been documented in the Madison, Gallatin, Jefferson and the mainstem Missouri River (Vincent 2000). In 1999, numerous sentinel cages were used to determine the presence or absence, the degree of whirling disease infection, and to determine likely sites where whirling disease may have population impacts. Sites within, or in nearby upstream reaches include two sites in the East Gallatin, one in the mainstem Gallatin at Logan, one at the mouth of Madison River, five sites on the Jefferson and one site at the mainstem Missouri near Toston (Vincent 2000). All sites on the East Gallatin, Mainstem Gallatin and Jefferson tested whirling disease positive with low to moderate intensity levels. Whirling disease has not been detected at the mouth of the Madison River, and results were inconclusive at Toston. However, many of the sites were tested in fall months and it is premature to conclude that whirling disease infection rates are benign. In fact, deformities indicative of whirling disease have been detected in each headwater reach. Distribution of the intermediate host, *Tubifex tubifex* worms, are unknown in the restoration reach. However, habitats of cold, nutrient-rich water, necessary for Tubifex proliferation are present. Hence, the potential for proliferation of the parasite exists in the restoration reach and upstream mainstem and tributary systems.

While rainbow trout densities have severely declined in the upper Madison, research on the effect of whirling disease in the restoration reach are on-going. Brown trout can be a carrier of the myxosporean parasite, and are not immune to whirling disease (Opitz 1999). However, whirling disease has generally had minimal effects on brown trout populations (Dick Vincent, MFWP, Personal Communication). Populations of brown trout have remained at low levels in the restoration reach, and are more likely limited by flow and habitat conditions. Whirling disease susceptibility tests at University of California at Davis and two field experiments in Montana strongly support the contention that grayling are highly resistant to whirling disease infection. There is no evidence to suggest that whirling disease will negatively affect grayling in a whirling disease positive environment, and in fact, may benefit grayling by decreasing interspecific competition with infected trout populations.

Habitat and Biological Suitability

Gradient in the restoration reach of less than 1% is typical of historic fluvial grayling habitats, and current Big Hole River reaches preferred by fluvial Arctic grayling. Flow in the Jefferson River is partially regulated by Clark Canyon Reservoir and Ruby Reservoir. Flow in the Madison is partially regulated by Hebgen Lake and Ennis Lake. The Gallatin River has no regulating reservoir and the mainstem Missouri has no regulating dam in the restoration reach. Toston Dam, at the downstream boundary of the restoration reach, is a barrier to fish movement and creates a small run-of-the-river irrigation storage reservoir. All of the systems are modified by irrigation withdrawal during summer months. Mean monthly discharge data for each USGS gage (USGS 1890-1998) are summarized in Table 2. The restoration reach undergoes dewatering during summer months that may be severe during drought periods. Minimum flows have not been established for the three tributaries, however, recommended wetted perimeter (Montana Fish Wildlife & Parks 1989) are summarized in Table 3. Maintaining wetted perimeter recommendations may not be feasible during all years, however, instream flows far below recommended wetted perimeters in summer months reflect the magnitude of water diversion for agricultural use.

Impacts of dewatering on grayling during prolonged drought periods, as documented in the upper Big Hole River, may also affect grayling in the Missouri River Headwaters. In the Big

Hole River, between 1988 and 1995, mean monthly flows ranged from 58.7 to 85.8% of long-term (50-year) average. Arctic grayling densities in the Big Hole River declined dramatically from 111 age 1+ grayling per mile in 1983 to 22 age 1 + grayling per mile in 1989. Instream flows improved in mid 1990's and grayling densities increased to 96 per mile by 1997 (Magee and Byorth 1998).

Low flows typically occur in August and are below winter base flows in the Missouri, Jefferson and Gallatin Rivers(Table 3). The Madison River is regulated by Ennis Dam 40 miles upstream from the mouth and does not experience the magnitude of dewatering as the Gallatin, and Jefferson Rivers. For example, in the severe drought years of 1988 and 1994, minimum flows in August were well below historic average and more severe in the Jefferson River (6.5% and 27% of the mean average in 1988 and 1994, respectively) and the Gallatin Rivers (53% and 66%, respectively) compared to the Madison (70% and 85%, respectively) (Table 3). The gage is 40 miles upstream from the Three Forks confluence and does not reflect irrigation withdrawal that occurs downstream of the gage.

Peak flows in the Missouri Headwaters restoration reach typically occur in April, May, and June, (Table 2) and are somewhat regulated and vary by water year depending on agricultural demand. Lower and regulated flow levels during spring months may affect grayling spawning success. Arctic grayling in the Big Hole River typically spawn in late April or early May between lowland and highland runoff utilizing newly eroded and cleansed spawning gravels from ice scouring and the fluvial process. While spawning substrate is available in the restoration reach and specifically in the active braided tributary channels, grayling may have to adapt behaviorally to facilitate natural reproduction.

While the Madison River may not have the magnitude of dewatering, it may not have the positive attributes of natural flow regimes and high water events. Specifically, decreased sediment transport, limited recruitment of riparian and cottonwood communities, and limited access to the flood plain. Within the restoration reach, poor riparian development in upstream tributaries and the mainstem systems have increased bank instability and sedimentation. Lack of cottonwood and willow recruitment from limited flood plain access or severely depleted flow regimes may decrease riparian community recruitment. Poor grazing practices and channel stabilization projects to protect floodplain developments have aggravated the instability problem. Sediment loads (tons per-day) and suspended sediment data is limited. Single daily measurements at Toston Dam for 1900-1995 are summarized in Table 4. High sediment loads may negatively affect spawning success by infiltrating spawning substrates with fine sediments. High sediment loads may also limit aquatic invertebrates by imbedding substrate and decreasing oxygen flow, and decreasing food sources for many other aquatic species including introduced Arctic grayling.

Table 2. Monthly mean discharge (cubic feet per second (cfs)) at the USGS Jefferson River gage near Three Forks, Madison River gage below Ennis Lake, Gallatin River gage at Logan, and Missouri River gage near Toston.

Month	Gage (cfs)			
	Three Forks①	Ennis②	Logan③	Toston④
January	1239	1378	690	3368
February	1349	1385	706	3722
March	1620	1440	796	4154
April	2511	1563	1058	5700
May	4107	2019	2160	9030
June	5398	3024	3016	12700
July	2322	1881	1039	5370
August	1029	1546	497	2821
September	1278	1642	654	3499
October	1660	1963	775	4473
November	1678	2029	822	4763
December	1362	1520	749	3779

① Three Forks 2.5 miles Northwest of the town of Three Forks: 1938-1998.
② Ennis Lake Near McAllister 1.5 miles downstream of Ennis Lake: 1939-1998.
③ Gallatin River at Logan: 1894-1998.
④ Missouri River near Toston: 2.2 miles south east of Toston: 1890-1998.

Table 3. Recommended MFWP wetted perimeter flows (CFS), historic winter base flows, historic mean August minimum flows, mean August flows in 1988 and 1994, and percent of historic August mean flows in two extreme drought years (1988 and 1994) for tributaries and mainstem Missouri River.

Reach	WetP CFS	Winter Base Flow	Mean August Flow	Mean August 1988 (Percent)	Mean August 1994 (Percent)
Jefferson at Three Forks	1,100	1,180	901	59 (6.5%)	242 (27%)
Gallatin from Mouth to E.Gal	1,000	684	488	257 (53%)	322 (66%)
Madison Ennis Dam-Mouth	1,300	1,390	1,531	1,068 (70%)	1,192 (86%)
Missouri Canyon Ferry-Three Forks	2,400	3,360	2,762	896 (32%)	1,272 (46%)

Table 4. Mean monthly sediment loads (tons per day), sediment concentration (mg/l), specific conductance (US/CM) and ranges and discharge from USGS Missouri River at Toston gaging station for single day measurements in March, June, August, and November from 1990-1995.

Month	Sediment Load Tons/day	Sediment Conc. (mg/l)	Specific Conductance	Discharge
March	108(65-322)	10 (4-25)	383 (362-407)	3,540 (2,920-4,770)
June	6386 (112-25,900)	116(10-378)	269 (213-314)	11,702 (4160-25,400)
August	102 (27-320)	13 (11-20)	341 (331-350)	2513 (1080-3700)
November	103 (68-145)	9 (6-15)	386 (343-423)	4420 (3590-5690)

Water quality parameters vary between the Missouri River Headwaters and the Big Hole River. At Toston Dam, USGS data from water years 1990-1995 reported specific conductances ranging from 213-423, averaging 345 μmhos/cm and mean pH was 8.4 (USGS 1990-1995). Surveys in the upper Big Hole River in August 1993 indicated mean specific conductances of 85.3 μmhos/cm and mean pH of 7.6 (MFWP Files). Water chemistry and consequently the biological productivity in the Missouri River Headwaters may affect survival of stocked grayling. The limestone geology of the Missouri River Headwaters releases biologically rich elements into the river. Further, dams act as nutrient sinks and sources, concentrating and transferring nutrients downstream to the highly productive tailwaters. However, the tailwater effects are diluted further downstream and trout abundance is greater immediately below Clark Canyon, Ruby, and Ennis dams. Chemical composition of the Missouri River Headwaters may also be affected by runoff of agricultural fertilizers. Chemical composition of the Missouri River Headwaters, subsequent biological productivity, and the effects of sediment loads, bank instability, and poor riparian development are unknown and may affect macro-invertebrate productivity. Invertebrate composition and densities have not been measured in the Missouri River Headwaters. Effects of sediments on invertebrate populations may be included in the monitoring protocol of the Missouri River Headwaters Arctic grayling restoration efforts.

Annual water temperatures recorded in the Missouri River Headwaters are limited to the USGS Toston gage with some periodic data from other locations, Table 5. Water temperatures over 21°C are typically considered stressful to salmonids (Behnke 1991). Maximum temperatures surpassed 21°C from 0-14 days in June, 0-26 days in July, 0-31 days in August, from 1990-1998(USGS 1990-1998)(Table 5). Maximum temperatures in 1990-1998 averaged 19.6°C in June, 23.2°C in July, and 24.1°C in August (USGS 1990-1998). Thermal tolerance of grayling is exceeded above 25°C (Lohr et al. 1996). A maximum temperature of 26.5°C occurred in August 1992 and surpassed the thermal tolerance level for fluvial Arctic grayling. Temperatures greater than 25°C occurred on numerous days in July and August 1990 and 1992, and can be expected to exceed thermal tolerance levels in drought or prolonged high temperature regimes. As part of the Madison-Missouri dam mitigation process, flow release will be increased from Ennis dam based on specific temperature triggers to reduce thermal stress and potential fish mortality. During high temperature regimes the lower Madison fishery, including introduced Arctic grayling, will benefit from pulsed flow releases preventing prolonged thermal stress.

Temperatures in some reaches of the upper Big Hole River exceeded thermal tolerance for Arctic grayling in five of seven years between 1988-1994, when stream flows were at historic lows, and again in 1996 and 1998 with higher flows. Arctic grayling in the Big Hole River have been able to survive, and have increased in abundance under higher flows regimes with temperatures exceeding lethal levels between 1995-1998. While temperatures in the Missouri River Headwaters will surpass 21° C during most years in July and August and may reach lethal levels, adequate flows may provide Arctic grayling the ability to seek refugia in micro-habitats with cooler temperature regimes (deep pools, springs). In prolonged drought periods with decreased flows and warm water temperatures, thermal stress may negatively effect grayling and other resident species. Water temperatures will be monitored at different locations within the proposed reach to assess thermal regimes (Figure 1.)

Table 5. Mean maximum daily temperatures for June, July and August, and number of days in which temperatures exceeded 21°c from 1990-1998 at USGS Toston gage station.

	June		July		August	
Year	Max	Days> 21°	Max	Days> 21°	Max	Days> 21°
1990	21.0	2	25.0	24	26.0	19
1991	17.5	0	24.5	22	24.5	31
1992	23.0	14	25.0	12	26.5	21
1993	19.5	0	19.0	0	20.5	0
1995	19.5	0	21.5	7	23.0	11
1996	19.0	0	23.5	26	24.5	25
1997	18.5	0	23.0	12	NA	NA
1998	19.0	0	24.5	22	24.0	24

REINTRODUCTION AND MONITORING PROTOCOL

Grayling will be stocked into the restoration reach beginning June 2000 and continue each year at least through the year 2002. Yearling (age 1+) and young-of-the-year (<age 1)(YOY) grayling may be supplied by USFWS Fish Technology Center in Bozeman or MFWP State Fish Hatcheries with fish descended from wild fluvial Big Hole River stock. Recommended minimum stocking rates are densities of 350 grayling per mile or 25,500 yearlings based on predicted mortality of 75%-90% first year mortality. Assuming 75% annual mortality approximately 90 survivors per mile would remain after one year, which is roughly the Big Hole River's highest density in recent years. Stocking rates will depend on availability of fish, and may be increased if fish are

available. Stocking rates of YOY grayling should be equal to or greater than those of yearling plants. Grayling will be transported in aerated tanks to release sites, tempered to river temperatures and released. A subsample of each lot will be held in live cars to assess short term survival for 1 to 3 days. Release site locations will be at the upper, middle, and lower portions of the reintroduction reach. Yearling grayling should be released immediately after runoff in late June or early July. YOY should be stocked in late August (as temperatures decrease) to maximize growth in the hatchery but allow sufficient acclimation before winter. Grayling will be clipped every other year to identify year classes. Planting schedules, stocking rates, and locations will be determined based on survival, movement, and information gathered in the monitoring program.

Monitoring

Thorough monitoring of restoration efforts is necessary to maximize the probability of success and to document factors that may hinder or help future reintroductions. Monitoring will continue through 2007 unless data dictate that successful establishment of a self-sustaining population is unlikely.

Electrofishing will be employed as a primary monitoring tool to document survival, dispersal, population density, and fish community composition. Electrofishing sections in the reintroduction reach will include: Greycliff section on the Madison, Logan section on the Gallatin, Trident section on the

Missouri, and the Three Forks section on the Jefferson. Additional sections upstream in the Jefferson including the Waterloo and Hells Canyon Section may document upstream movement. Each section will be electrofished in spring to investigate over-winter survival, maturity, dispersal, and to identify spawning areas. Fall electrofishing surveys will document post-plant survival, dispersal, growth, and condition factor.

Further monitoring investigating limiting factors affecting the establishment of a self sustaining population may include; invertebrate surveys and food habits of grayling and sympatric species using gastric lavage techniques, and predation of grayling by brown or rainbow trout. Summer distribution surveys may include hook and line and voluntary creel surveys to assess dispersal and survival. Habitat and sediment surveys will assess relationships of habitat usage, availability, and sediment regimes with survival. Radiotelemetry, coded wire, and visual implant (VI) tags may be used to individually mark fish to assess movement and dispersal. Thermographs will be deployed at various locations to assess temperature regimes and flows will be monitored at the USGS gaging stations. The extent of additional research and monitoring projects will depend on funding sources and workload and may include a graduate study through Montana State University.

CONCLUSIONS

Analysis of social and biological issues indicates that a reintroduction of grayling into the Missouri River is feasible and should be pursued. The assistance of local communities in identifying issues and their support for the reintroduction will be a key in the success of the program. The few concerns voiced during public meetings and comment periods were primarily concerned with the impacts of the Endangered Species Act on private land management if the grayling were listed. Concerns regarding this issue should be allayed by the cooperative agreement between USFWS and MFWP, which will allow the reintroduction program to continue without the likelihood of classification of fluvial Arctic grayling as endangered. Much about the biological suitability of the Missouri River Headwaters for grayling is unknown. While cursory analysis of habitat, temperature, flow, and species composition data indicate both positive and negative attributes, the potential for establishing a self-sustaining population will best be answered by a well-planned reintroduction followed by thorough monitoring. Arctic grayling in the Big Hole River have survived many environmental changes over the past 100 years, including stream dewatering, elevated water temperatures, barriers blocking seasonal migrations, and non-native trout introductions. Progeny from the surviving Big Hole River stock may offer a better chance to re-establish populations in modified historic habitats like the Missouri River Headwaters.

The key to conserving Montana's unique stock of fluvial Arctic grayling is maintaining the Big Hole River population at maximum stable levels while re-establishing additional populations throughout its native range. Our goal of establishing a self-sustaining population in the Missouri River Headwaters will be an important step in preserving Montana's fluvial Arctic grayling.

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