An evaluation of the reintroduction of fluvial Arctic grayling into the upper Ruby River
by Bradley William Liermann

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science in Biological Sciences
Montana State University

Abstract:
This study was conducted to assess the survival, movement and growth of fluvial Arctic grayling reintroduced into the upper Ruby River as part of a program to reestablish populations within their native range in Montana. Numbers and ages of fish planted were 29,808 age 0 in 1997, 9,804 age 1 in 1998, and 7,349 age 1 in 1999, distributed among three areas over a 20.2 km reach. Of the 9,804 age 1 fish planted in 1998, 3,750 were given wire tags while all age 1 fish reintroduced in 1999 were given wire tags. Wire tagging locations were varied by planting section to assess post-stocking movement. Electrofishing mark-recapture surveys were conducted at four primary sites and one pass catch-per-unit-effort (CPUE) surveys at six secondary sites in September and October each year and at three primary sites the following April. Recaptured grayling were tested for the presence of wire tags, counted, measured, and weighed, and normative brown and rainbow trout were counted. Movements of recaptured fish were assessed by comparing capture and release sites through wire tag recaptures, by operating a weir trap located about 13 km below the lowest planting site, and by a survey of angler catches. Habitat parameters were measured at seven of the same primary and secondary survey sites in 1998 and 1999, including length, wetted width, and average depth of pools, runs, and riffles. From these data, pool-and-run volume, pool-and-run to riffle ratio, width to depth ratio, and sinuosity were estimated for each reach. Age 0 fish planted in 1997 had no apparent survival by the following spring. Age 1 fish planted in 1998 and 1999 showed good survival for the initial three months, averaging 206 and 370 fish per Ion in October, in two principle monitoring sections. However, comparisons of CPUE estimates indicated reductions of about 80% between October and the following April.

Downstream movement appeared low; wire tag data indicate that by three months after release, average downstream movements were 0.7 km in 1998 and 4.6 Ion in 1999, and only eight were captured at the weir trap each year. After the initial three months of both years, fish increased significantly ($p<0.001$) in both mean length and weight but Fulton's condition factor decreased significantly ($p<0.001$) during this period and also over the following winter. Regression analyses found only pool-and-run to riffle ratio to be a significant habitat predictor of grayling abundance. Other habitat parameters and also densities of brown and rainbow trout densities were not significantly correlated with densities of age I or 2 grayling. However, small sample size ($n=14$) due to a limited number of sample sections and only two years of data collection and similarity of brown trout abundance among sections substantially limited this analysis. Reintroduction of Arctic grayling into the upper Ruby River thus appeared initially successful, although future monitoring is necessary to determine the extent to which low winter survival will affect their long-term persistence in this stream and also to further monitor the natural reproduction.

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APPROVAL

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Bradley William Liermann

This thesis has been read by each member of the thesis committee and has been found to be satisfactory regarding content, English usage, format, citations, bibliographic style, and consistency, and is ready for submission to the College of Graduate Studies.

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ABSTRACT

This study was conducted to assess the survival, movement and growth of fluvial Arctic grayling reintroduced into the upper Ruby River as part of a program to reestablish populations within their native range in Montana. Numbers and ages of fish planted were 29,808 age 0 in 1997, 9,804 age 1 in 1998, and 7,349 age 1 in 1999, distributed among three areas over a 20.2 km reach. Of the 9,804 age 1 fish planted in 1998, 3,750 were given wire tags while all age 1 fish reintroduced in 1999 were given wire tags. Wire tagging locations were varied by planting section to assess post-stocking movement. Electrofishing mark-recapture surveys were conducted at four primary sites and one pass catch-per-unit-effort (CPUE) surveys at six secondary sites in September and October each year and at three primary sites the following April. Recaptured grayling were tested for the presence of wire tags, counted, measured, and weighed, and nonnative brown and rainbow trout were counted. Movements of recaptured fish were assessed by comparing capture and release sites through wire tag recaptures, by operating a weir trap located about 13 km below the lowest planting site, and by a survey of angler catches. Habitat parameters were measured at seven of the same primary and secondary survey sites in 1998 and 1999, including length, wetted width, and average depth of pools, runs, and riffles. From these data, pool-and-run volume, pool-and-run to riffle ratio, width to depth ratio, and sinuosity were estimated for each reach. Age 0 fish planted in 1997 had no apparent survival by the following spring. Age 1 fish planted in 1998 and 1999 showed good survival for the initial three months, averaging 206 and 370 fish per km in October, in two principle monitoring sections. However, comparisons of CPUE estimates indicated reductions of about 80% between October and the following April. Downstream movement appeared low; wire tag data indicate that by three months after release, average downstream movements were 0.7 km in 1998 and 4.6 km in 1999, and only eight were captured at the weir trap each year. After the initial three months of both years, fish increased significantly ($p<0.001$) in both mean length and weight but Fulton's condition factor decreased significantly ($p<0.001$) during this period and also over the following winter. Regression analyses found only pool-and-run to riffle ratio to be a significant habitat predictor of grayling abundance. Other habitat parameters and also densities of brown and rainbow trout densities were not significantly correlated with densities of age 1 or 2 grayling. However, small sample size ($n=14$) due to a limited number of sample sections and only two years of data collection and similarity of brown trout abundance among sections substantially limited this analysis. Reintroduction of Arctic grayling into the upper Ruby River thus appeared initially successful, although future monitoring is necessary to determine the extent to which low winter survival will affect their long-term persistence in this stream and also to further monitor the natural reproduction.

INTRODUCTION

Arctic grayling (*Thymallus arcticus*) are widely distributed throughout northern latitudes, with populations found in northern Asia and North America. Although Arctic grayling populations are common in northern North America, only two glacially isolated populations were native to areas south of Alaska and Canada. One population was previously found in Michigan and the other still exists in the upper Missouri River drainage of Montana (Vincent 1962). Arctic grayling populations display two specific life history types throughout this historical distribution, fluvial and adfluvial. Populations which exhibit fluvial life histories both live and spawn in river or stream environments while adfluvial populations live in lakes or reservoirs and spawn in rivers or streams (Varley and Gresswell 1988).

In Montana, fluvial Arctic grayling were once widely distributed throughout the upper Missouri River drainage above the Great Falls (Figure 1, Kaya 1992a). Currently, many populations of Arctic grayling still exist in Montana, however most are introduced adfluvial populations (the only native adfluvial population being found in Red Rocks Lake). The only truly fluvial population still present in Montana is found in the upper Big Hole River in southwestern Montana. It is estimated that this population inhabits approximately 4% of the historical range of fluvial Arctic grayling in Montana (Kaya 1992a). This decline in fluvial Arctic grayling throughout its range in Montana has been attributed to establishment of nonnative species, habitat alteration, overharvest, and climatic change (Vincent 1962). Due to their limited range and threat of extinction, fluvial Arctic grayling in Montana are now considered a species of special concern by the

Montana Department of Fish, Wildlife and Parks (MFWP) and a candidate species under the Endangered Species Act by the U.S. Fish and Wildlife Service (Holton and Johnson 1996; USFWS 1996). The current restoration goal for fluvial Arctic grayling in Montana is to establish "at least five stable, viable populations distributed among at least three major river drainages" of the upper Missouri River (Montana Fluvial Arctic Grayling Workgroup 1995).

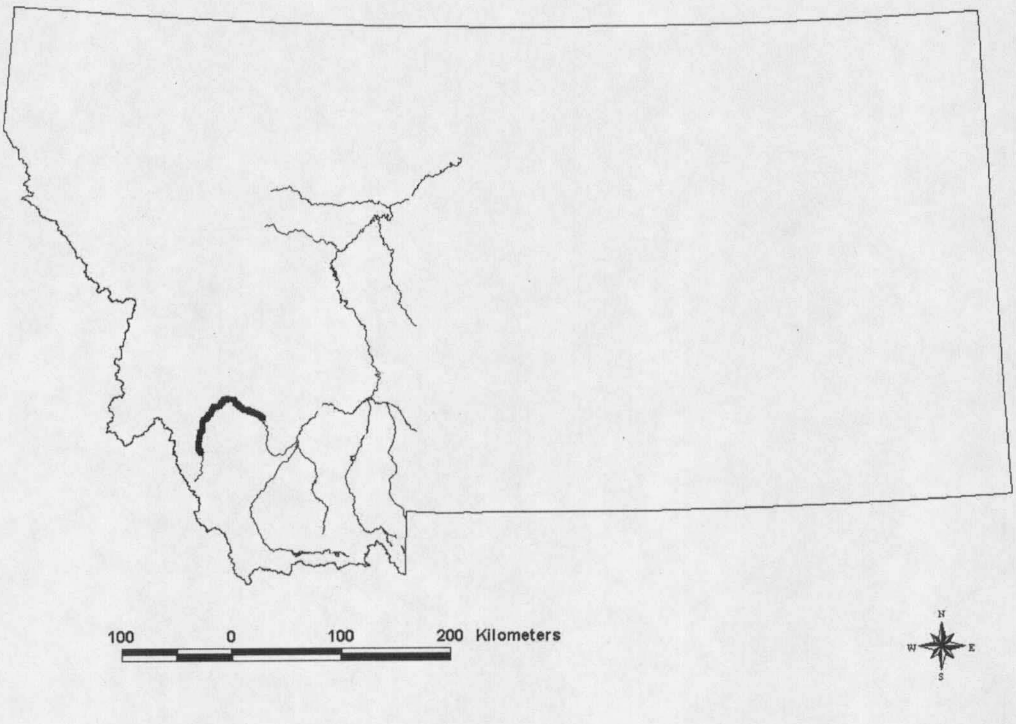

Figure 1. Historical and current distribution of fluvial Arctic grayling in Montana. The approximate historical distribution is represented by all the streams shown, while the current distribution (upper Big Hole River) is highlighted in bold. Kaya (1992a) estimates that fluvial Arctic grayling occupy approximately 4 % of their historic range in Montana

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All past attempts to reestablish Arctic grayling populations within stream environments in Montana have failed (Kaya 1992b). One possible reason for the failure of these past attempts is the use of adfluvial parental stocks, such as from Red Rocks Lake, instead of more appropriately adapted fluvial parental stocks. Kaya (1990) lists many unpublished reintroduction attempts from the 1930's and 40's which used adfluvial stocks to reintroduce Arctic grayling into stream environments in Montana, all of which failed. This list includes reintroductions into the Madison, Gallatin, and Smith Rivers, all streams which historically were inhabited by Arctic grayling. Jones et al. (1977) attempted to establish Arctic grayling in Canyon Creek, Yellowstone National Park using a combination of fish from fluvial stocks and adfluvial stocks. Although a population was not established, Jones et al. (1977) observed that individuals from lacustrine stocks appeared to be absent from plant locations only weeks after the reintroduction while fluvial grayling were still present several months after. The observation that fluvial Arctic grayling seemed better adapted to holding position in stream environments than Arctic grayling from adfluvial stocks was later confirmed in both laboratory and field experiments (Kaya 1991; Kaya and Jeanes 1995).

More recently, Arctic grayling reintroductions using progeny of a fluvial population have been attempted. In 1992 and 1993, 5,400 and 10,120 yearling Arctic grayling were planted into the West Gallatin River. These Arctic grayling were progeny of the Big Hole River fluvial population (Lere 1995). Post-reintroduction monitoring, which relied primarily on angler surveys, found that reintroduced fluvial Arctic grayling dispersed large distances downstream after release with the average fish having moved 77