Movement and utilization of fluvial habitat by age-O Arctic grayling, and characteristics of spawning adults, in the outlet of Deer Lake, Gallatin County, Montana
by Mark Arthur Deleray

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science in Fish and Wildlife Management $
Montana State University

Abstract:
The Arctic grayling (Thymallus arcticus) population of Deer Lake (Gallatin County) differs from most Montana lacustrine populations in being outlet spawners and in having an extended period of stream residence of young fish. Estimated numbers of spawning adults were 803 ± 104 in 1989 and 1109 ± 124 in 1990, with a male:female ratio of about 1.0:1.0 in both years. After swimming up from the gravels, age-0 young remained in the stream for at least their first 2 to 3 months and some young for over a year. Age-0 grayling used slow water velocities, silt and sand substrate, and shallow depths while in the stream. The mean water column velocity (0.6 depth) and total depth at preferred fry locations increased with fry growth. These observations suggest habitat characteristics that may be important to young grayling in a fluvial environment. The extended stream residence of the young also suggests that Deer Lake grayling may be able to permanently inhabit streams.

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Mark Arthur Deleray

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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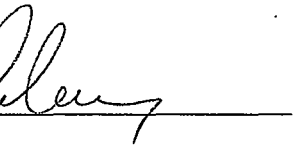
Signature 

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TABLE OF CONTENTS

TABLE OF CONTENTS-Continued

LIST OF TABLES

LIST OF TABLES-Continued

LIST OF FIGURES

LIST OF FIGURES-Continued

ABSTRACT

The Arctic grayling (Thymallus arcticus) population of Deer Lake (Gallatin County) differs from most Montana lacustrine populations in being outlet spawners and in having an extended period of stream residence of young fish. Estimated numbers of spawning adults were 803 ± 104 in 1989 and 1109 ± 124 in 1990, with a male:female ratio of about 1.0:1.0 in both years. After swimming up from the gravels, age-0 young remained in the stream for at least their first 2 to 3 months and some young for over a year. Age-0 grayling used slow water velocities, silt and sand substrate, and shallow depths while in the stream. The mean water column velocity (0.6 depth) and total depth at preferred fry locations increased with fry growth. These observations suggest habitat characteristics that may be important to young grayling in a fluvial environment. The extended stream residence of the young also suggests that Deer Lake grayling may be able to permanently inhabit streams.

INTRODUCTION

Within this century both Montana and Michigan have had indigenous stocks of Arctic grayling (Thymallus arcticus). The Michigan grayling is extinct due to a combination of factors including overfishing, grazing and logging practices, and introductions of non-native fishes (Vincent 1962). The original range of the Montana grayling was the upper Missouri River drainage above the Great Falls. Montana still has populations of the native grayling. However, only one fluvial population remains (Big Hole River) and it too appears to be declining in numbers (Kaya 1990). The fluvial populations of Montana grayling have diminished, possibly due to the effects of introduced exotic salmonids (Salmo trutta, Salvelinus fontinalis, Oncorhynchus mykiss), poor land use practices, overfishing, and dewatering of streams. All other populations are lacustrine and introduced, except those of Red Rock and Elk lakes, which are indigenous (Vincent 1962).

There is interest in recovering the Big Hole River grayling population and in reintroducing grayling into other Montana streams. Grayling used in restoration efforts must be capable of living in a fluvial system. It has been shown that young Montana grayling from different

stocks behave differently in running water (Kaya 1989, 1991). The Big Hole River stock is the most obvious choice for restoration of fluvial populations. However, because of their low numbers, it is difficult to capture ripe Big Hole grayling for spawning purposes. Also, it is questionable whether all grayling used in restoration efforts should originate from a single source. A single origin, from a population reduced to low densities, may limit the genetic diversity of reestablished fluvial populations.

Unlike most grayling populations in Montana, the Deer Lake (Gallatin County) grayling are outlet spawners (allacustrine), rather than inlet spawners. Previous observations suggested that young of the Deer Lake population may remain in the outlet stream for at least several months before moving up into the lake (C. M. Kaya, Montana State University, pers. comm. 1989). In contrast, young of inlet-spawning populations typically move downstream into a lake soon after swimming up from the gravels.

The objectives of this study were to determine: (1) if young Deer Lake grayling have an extended period of residence in the outlet stream; and, if so, (2) the habitat selected by young grayling during stream residence. The results of this study will help determine the likelihood for successful transplants of Deer Lake grayling into a

stream or into a lake with only an outlet stream. Results will also be valuable because of the scarcity of information on habitat use and selection by very young grayling in fluvial habitats. In conjunction with primary objectives, I also determined characteristics of the spawning population entering the Deer Lake outlet stream.

STUDY SITE

Deer Lake is located in the Madison Range of southwestern Montana, within the Gallatin National Forest and the Lee Metcalf Wilderness Area. The Deer Lake trailhead starts on Highway 191, 76 km north of West Yellowstone and 61 km south of Bozeman, Montana (Figure 1). The lake is in a large cirque at 2780 m above sea level (USGS 1950), and 10 km from the trailhead. At this elevation, whitebark pine (Pinus ablicaulis), limber pine (P. flexilis), and subalpine fir (Abies lasiocarpa) dominate and grouse whortleberry (Vaccinium scoparium) is the most prevalent shrub. Deer Lake is oval shaped, roughly 400 m long and 160 m wide, and covered by ice 6 to 7 months of the year. The southern end of the lake is relatively shallow, while the northern end is quite deep. No depth measurements have been taken.

Deer Creek originates at the southeast end of Deer Lake and flows southeast to the Gallatin River. After flowing roughly 300 m from the lake, Deer Creek plunges over a waterfall. This waterfall acts as a barrier blocking any upstream fish movement (Figure 1). The 300 m stream section from the lake outlet to the waterfall formed the study site, and is hereafter referred to as the outlet

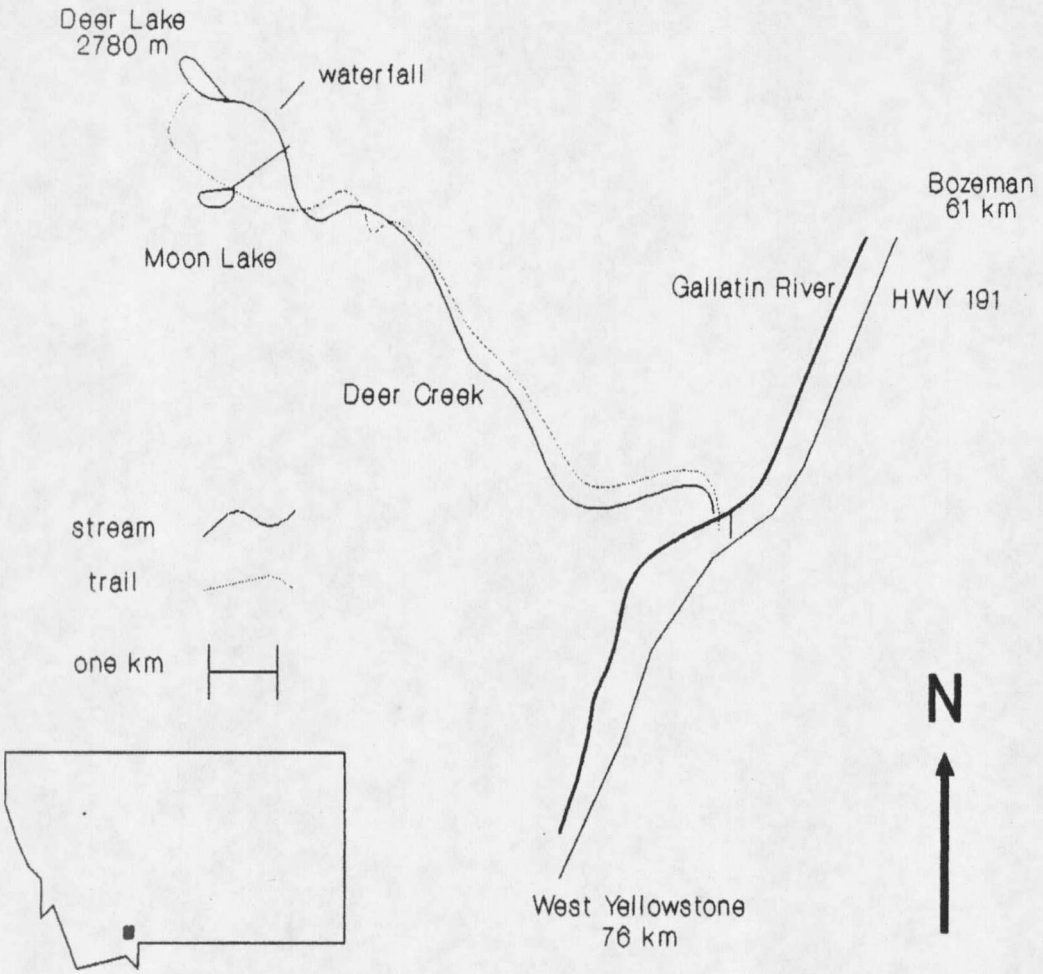

Figure 1. Location of Deer Lake, Montana.

stream. The width of the outlet stream ranges from less than 1 m to over 14 m. Within 100 m of the lake outlet, there are at least three springs discharging directly into the outlet stream.

The outlet stream is characterized by two general habitat types. One type consists of runs and riffles with faster water velocities. These areas have the narrowest channel widths and a wide range of substrate sizes, from very fine to boulder. The second type consists of wide, shallow areas of slow flows, and fine substrates. These will be referred to as flats.

The only fish species in Deer Lake is the Arctic grayling. Although the origin of the population is not known, it probably was started through stocking. Deer Lake grayling are genetically similar to other lacustrine populations originating from plants of Madison/Red Rock grayling (R. Leary, University of Montana, pers. comm. 1990).

Dense concentrations of spawning grayling appear in the outlet stream sometime between late May and early July (Kaya 1990). Although the adults would be very vulnerable in the clear, shallow water, no eagles, osprey, bears or bear tracks were seen in the area. Later in summer, when young were abundant, a belted kingfisher was seen in the study site. Deer Lake is fished throughout the summer. The daily creel limit is five grayling. Fishermen appear

quite successful, although not all keep fish.

A small inlet stream at the north end of Deer Lake provides potentially 4 m of spawning area between the rock cirque and the lake. However, grayling do not appear to use the inlet stream for spawning (Kaya 1989), perhaps because of its small size and cold temperatures. During the 1989 spawning run, no grayling were seen in the inlet and the water temperature (4.1 C) was lower than that of the outlet (about 11.0 C).

METHODS

During May and early June of 1989 and 1990, I made repeated trips to Deer Lake to determine when the lake surface thawed and when adult fish entered the stream. In both years, observations began when ice cover melted from the lake and outlet stream, and continued until ice started to form along the margins in October (1990) or early November (1989). Due to the remoteness of Deer Lake, the lightest and smallest equipment available was used. All equipment was carried in backpacks.

Temperature Measurements

As ice cleared from the stream, I placed a Peabody Ryan thermograph (model D) in the stream roughly 30 m from the lake outlet. This location was known to be used by spawning and young grayling (Kaya, pers. comm. 1989). In 1989, the thermograph was installed on June 8 and in 1990 on June 12. In 1989, a second thermograph was placed near the mid-point of the study site in a riffle known to be a major spawning site (Kaya, pers. comm. 1989).