POPULATION SURVEYS AND ANALYSIS OF FALL AND WINTER MOVEMENTS OF ARCTIC GRAYLING IN THE BIG HOLE RIVER:

1991 Annual Report

By

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and

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ABSTRACT

The fluvial Arctic grayling, once common in headwaters of the Missouri River, is currently restricted to the Big Hole River drainage. In recent years, grayling abundance has declined in the Big Hole drainage, and concern for the future of the fluvial grayling has increased. An interagency committee was formed to oversee and coordinate restoration efforts and this study is a result of that effort. The 1991 field season began in September with objectives determine population estimates in the McDowell-Wisdom Section and survey other areas to mark grayling, and to observe movements of winter habitats and characterize those areas using radiotelemetry. The estimated population of grayling in the McDowell-Wisdom section was 34/mi, approximately equal to the estimate in 1990. The population appears to have stabilized at low levels after several years of decline. A large proportion of grayling captured in the censuses were Age I, indicating potential for an increase in numbers in the future. Fall movements indicate that grayling use pool habitats throughout the Big Hole River drainage, from Wisdom downstream at least to the Wise River area. Winter movements were generally minimal and oriented around points-of-capture.

INTRODUCTION

In the early 19th century, the Montana grayling (Thymallus arcticus montanus [Milner]) intermittently ranged throughout the upper Missouri River drainage upstream from the present location of Great Falls, Montana. Whereas the majority of aboriginal grayling populations existed in fluvial environments, only one "strictly" fluvial indigenous populations remains, in the Big Hole River drainage of southwestern Montana. This population represents the last remaining, completely fluvial Arctic grayling in the lower 48 United States (Kaya 1990).

Concern for the diminished range of the fluvial Arctic grayling resulted its classification: as a "species of special concern" by the Endangered Species Committee of the American Fisheries Society (AFS), Montana Department of Fish, Wildlife, and Parks (MDFWP), and the Montana Natural Heritage Program (MNHP), as a "sensitive species" by the U.S. Forest Service (USFS), and as a "Category 2 species" under the Endangered Species Act by the U.S. Fish and Wildlife Service (USFWS) (Williams et al. 1989, Kaya 1990).

Vincent (1962) ascribed the decline of Arctic grayling in Montana and Michigan to: habitat alteration, climatic change, introduction of non-native fishes, and exploitation by humans. Research to date on the Big Hole River grayling is as follows. Liknes (1981) and Liknes and Gould (1987) investigated the distribution, abundance, and habitat of the grayling in the upper Big Hole River drainage. They found grayling to be most abundant in the Big Hole River upstream of its confluence with the North Fork, and documented the presence of grayling in 11 tributaries. Spawning sites were found to be concentrated in the same area, and in three tributaries by Shepard and Oswald (1989). Aspects of interactions with other salmonids, and habitat usage by young-of-the-year (YOY) grayling were investigated by Skaar (1989), McMichael (1990), and Streu (1990). Population abundance has been monitored in the upper Big hole River since 1983 by Oswald (Files, MDFWP, Dillon), and estimates indicate a downward trend in grayling numbers from a high of 111 per mile in 1983 to a low of 22 per mile in 1989.

Each of the above investigators expressed concern for the future of Big Hole grayling, and stressed the need for a concerted research effort into factors affecting the population and causing the apparent decline. An interagency committee was formed in 1987 to coordinate research and restoration efforts which included representatives of the Montana Chapter of the AFS, Montana Cooperative Fisheries Research Unit, MDFWP, MNHP, Montana State University, University of Montana, U.S. Bureau of Land Management (BLM), USFWS, and USFS (Kaya 1990). The committee produced a restoration plan for the Big Hole grayling which led to the development of a Memorandum of Understanding between AFS, BLM, the Montana Council of Trout Unlimited, MDFWP, USFS, and USFWS, agreeing to fund a 5-year research project to provide the

information necessary to preserve and enhance the Big Hole grayling.

The project began in September of 1991, with the following objectives:

1. To derive population estimates for grayling in the McDowell-Wisdom electrofishing section of the Big Hole River, and survey known fall grayling habitats, and

2. To monitor winter movements of Big Hole grayling using radio-telemetry to locate and characterize winter habitat.

Data included in this report were collected between September 1, and December 1, 1991.

STUDY AREA AND METHODS

Population Surveys

Grayling were sampled by electrofishing in three study sections: McDowell, Wisdom, and North Fork, and in several locations of known grayling habitat (Figure 1). A mobile positive electrofishing system was used consisting of a 1500 watt gasoline powered AC generator with a Leech rectifying unit mounted on a fiberglass drift boat and was fished downstream. Grayling were netted, anesthetized in an ethyl 4-aminobenzoate solution, measured to 0.1 inches in total length, weighed to 0.01 lb, given a fin clip, marked with a color coded and individually numbered VI tag (Visible Implant, Northwest Marine Technology, Inc.), allowed to recover from anesthesia, and released.

Marking runs were conducted between September 3 and October 24, and recapture runs were completed between September 24 and October 21, 1991. Surveys were conducted from September 27 to October 27, 1991. Population estimates were derived for the combined McDowell and Wisdom Sections using the Chapman Modification of the Peterson Method (Chapman 1951).

Radiotelemetry

A sample of 16 grayling captured during electrofishing was implanted with radiotransmitters. Grayling were chosen on the basis of transmitter weight <2% of body weight (Hop et al. 1986), and location of capture. Transmitters were implanted in grayling captured from near Wisdom, Mt. as far as 2 miles downstream from Wise River, Mt. (Figure 1).

Implantation procedures were modified from Hart and Summerfelt (1975). Grayling were anesthetized in ethyl 4-aminobenzoate, and placed on a device designed to hold the fish

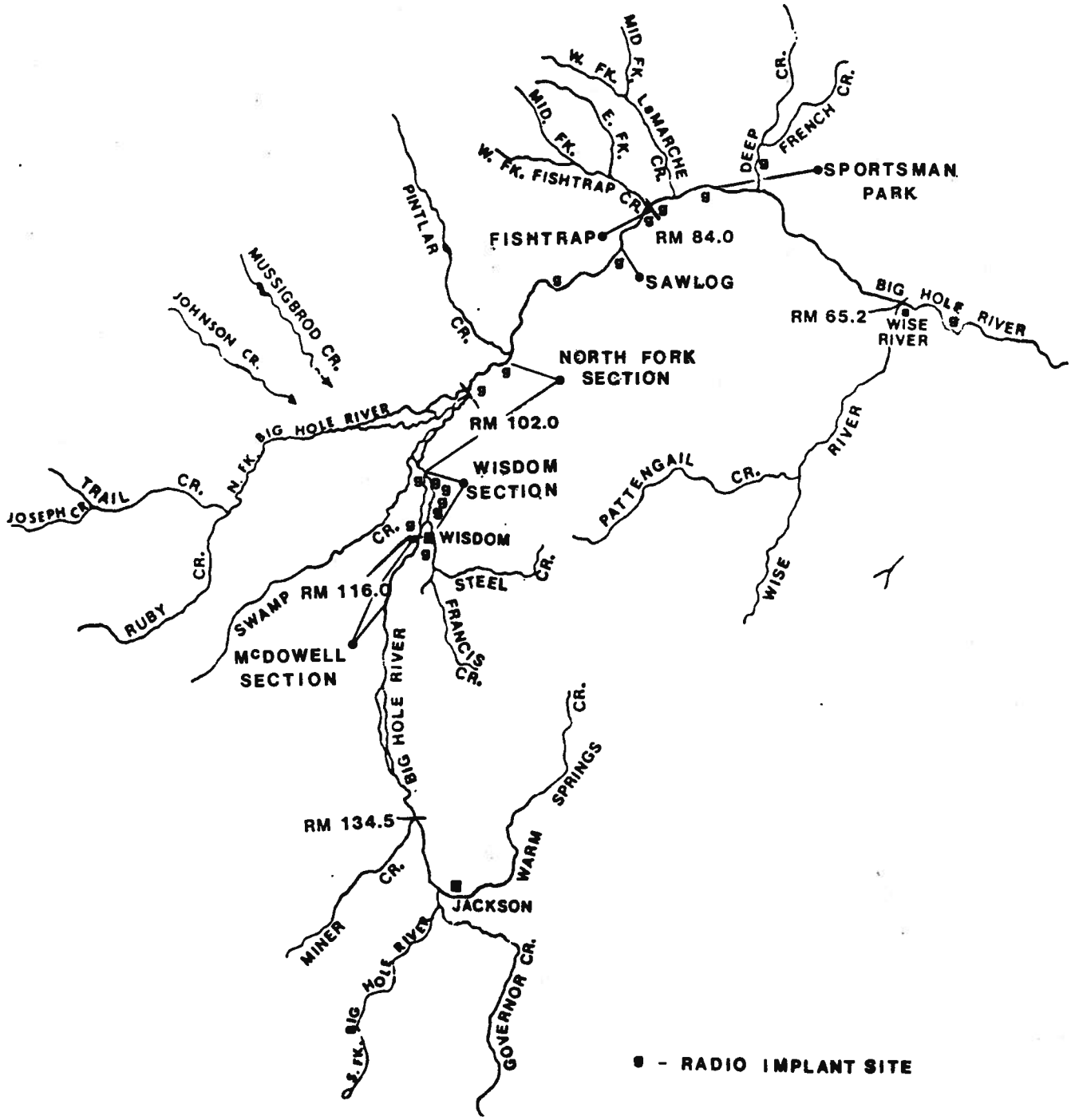

Figure 1. Map of the Big Hole River study area and locations of grayling captured for radiotelemetry.

in place while its head and gills were immersed in an anesthetic bath. An incision was made 0.5 to 1 inch from the linea alba and immediately anterior to the pelvic girdle. A transmitter was inserted through the incision into the body cavity and placed to rest on the pelvic girdle. The trailing antennae was either sutured into the incision or threaded behind the pelvic girdle using a 1.5 inch gap cutting needle. Transmitter specifications included: Advanced Telemetry Systems (ATS)(Isanti, MN) Model 357 transmitters, weighed 4 g, 1.0 x 0.5 inches with an 8 inch trailing antennae, 95 day battery life, and transmitting in the 49 mHz range. The incision was sutured with #1 Silk non-absorbable surgical sutures. After the surgery was completed, grayling were placed in a live car, allowed to recover, and released at or near the point of capture, as recommended by Stasko and Pincock (1977) and Hop et al. (1986).

Grayling with transmitters were relocated on foot, from a vehicle, or fixed wing aircraft using an ATS Model R2100 receiver and loop antennae. Locations were either general (within approximately 100 yards) or specific (within a few square feet). During specific relocations, an effort was made to determine whether the fish was actively moving or stationary. If a fish was recorded as stationary for 3 relocations, the fish was disturbed in order to determine whether it was alive or not. Locations were recorded on data sheets, plotted on 7.5 minute topographical maps, and stored in a computer database (DBXL, Wordtech Systems).

RESULTS AND DISCUSSION

Population Estimates and Surveys

McDowell-Wisdom Section

A total of 145 grayling was captured during fall surveys 0of the McDowell-Wisdom study section. Forty-eight Age 0 (3.6-6.9 inches), 66 Age I (7.0-9.9 inches), and 31 Age II+ (10.0-14.9 inches) grayling comprised the catch. The population of grayling was estimated to be 34.3/mi (26.7/mi Age I, 7.6/mi Age II+), which is approximately equal to the estimate of 1990. Although the estimates are not directly comparable because of changes in electrofishing sections, the population appears to have stabilized from the apparent decline from highs of 111/mi and 74/mi in the Wisdom section in falls of 1983 and 1984, respectively, to a low of 22/mi in McDowell-Wisdom section Fall, 1989.

This population estimate may not be valid, due to low recapture efficiency (r=5), and movements that may have taken place between mark and recapture runs. Also, only the East (Steel Creek) Channel was sampled due to hydrological changes which diminished flows in the West Channel and prevented sampling

there. In the past, sampling in both channels have been included in estimates. Problems in obtaining consistent grayling population estimates in the study section reinforce the need expressed by Oswald (1990) for a large scale estimate encompassing the entire reach of the Big Hole River from Wisdom to Divide.

Length-frequency analysis demonstrates a relatively abundant year class of Age I grayling, which should have a positive influence on the 1992 spawning run (Figure 2). Only 48 YOY grayling were captured during fall censuses. Although higher flows and fall movements may have affected catchability of Age 0 grayling, the catch was low with respect to catches of approximately 260 in 1989, and 125 in 1990. As reported by Oswald (1990), the concentration of YOY grayling in 1991 was greater in the Wisdom reach than in the McDowell reach, which was contrary to observations prior to 1990, and may indicate problems with spawning habitat developing in the McDowell reach.

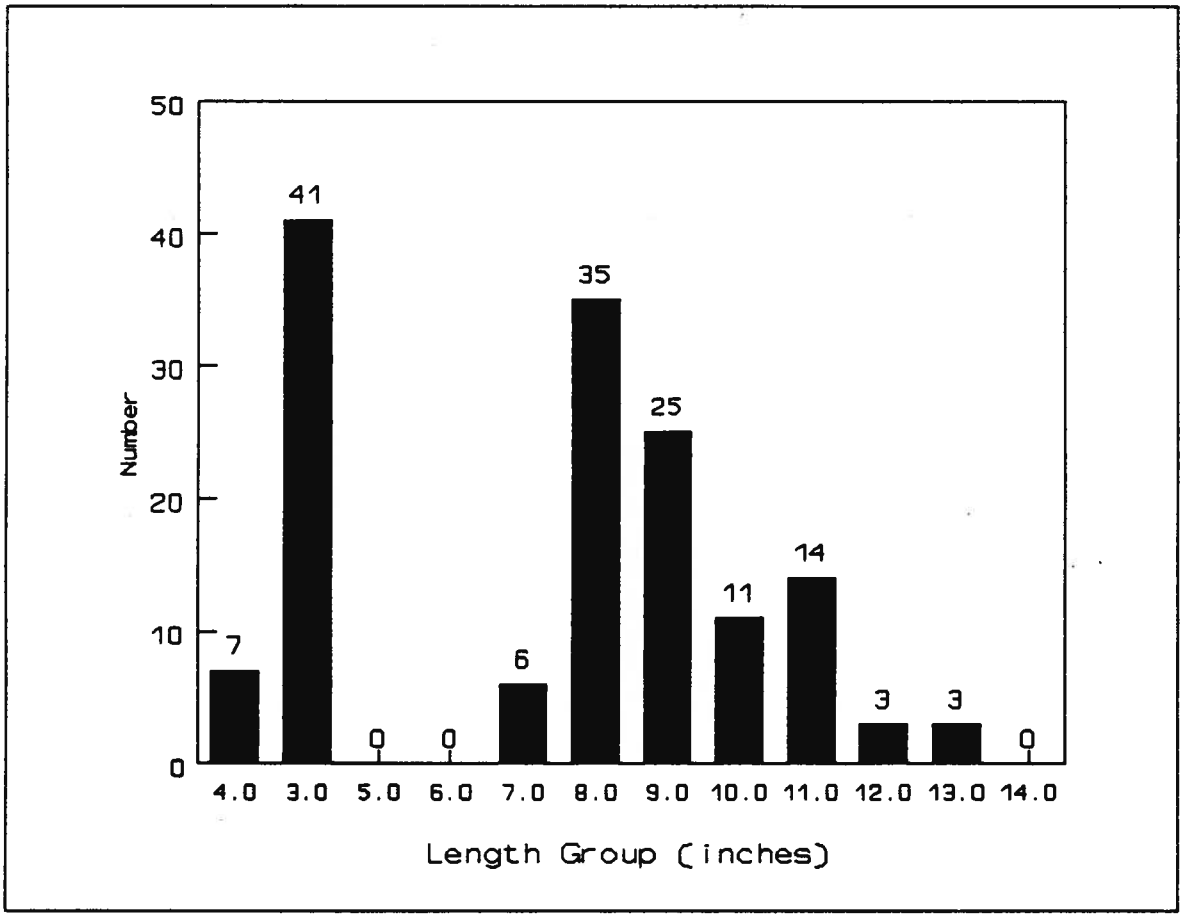

Figure 2. Length-frequency distribution of grayling captured in the McDowell-Wisdom electrofishing section, Fall 1991.

North Fork Section

The 12.5 mile North Fork section was surveyed September 25 and 26, 1991. Ten grayling were captured: 6 Age 0, 2 Age I, and 2 Age II+. Similar surveys on September 7 and 10, 1990 captured 28 Age 0, 6 Age I, and 6 Age II+ grayling, and on October 23 and 24, 1990, 3 grayling were captured. Only 1 grayling was captured in a Fall, 1989 survey (Oswald 1990). This area appears to be used primarily for spawning and rearing, and as a transitional zone during fall migrations; consequently, catch rates are probably indicative of seasonal movements and not population trends.

Three Pools

A series of pools located at the mouths of Fishtrap and Sawlog Creeks, and at Sportsman's Park were surveyed on September 27, and October 22, 1991. A total of 63 grayling was captured. Catch, age composition, and location are summarized for 1987 - 1991 in Table 1.

Length-frequency analysis of catches at Three Pools between 1987 and 1991 reflects varying age composition of the grayling population between years (Figure 3). The low proportion of yearling (8.0-9.9 inches) to mature (>10.0 inches) grayling in 1988 and 1989 reflects poor recruitment in the 1987 and 1988 spawning years, respectively, both years of severe drought. An increasing trend in the proportion of yearling to mature grayling in 1990 and 1991 may indicate a potential for an overall increase in grayling abundance. The length-frequency distribution derived from grayling captured in the McDowell-Wisdom section in 1991 supports this potential (Figure 2). The absence of Age 0 grayling from the Three Pools surveys indicate, perhaps, that they do not winter in the same habitats as do older fish.

Table 1. Age composition of catch at Three Pools survey area, Big Hole River, Montana, 1987-1991.

Year	# Runs	Sawlog			Fishtrap			Sportsmans			N
		0	I	II+	0	I	II+	0	I	II+	
1991	2	0	2	11	0	19	9	0	8	14	63
1990	1	0	0	20	0	0	3	0	4	6	33
1989	2	3	1	11	0	2	18	0	4	27	66
1988	1	0	3	12	0	0	16	0	1	7	39
1987	1	0	5	5	0	1	31	0	11	20	73

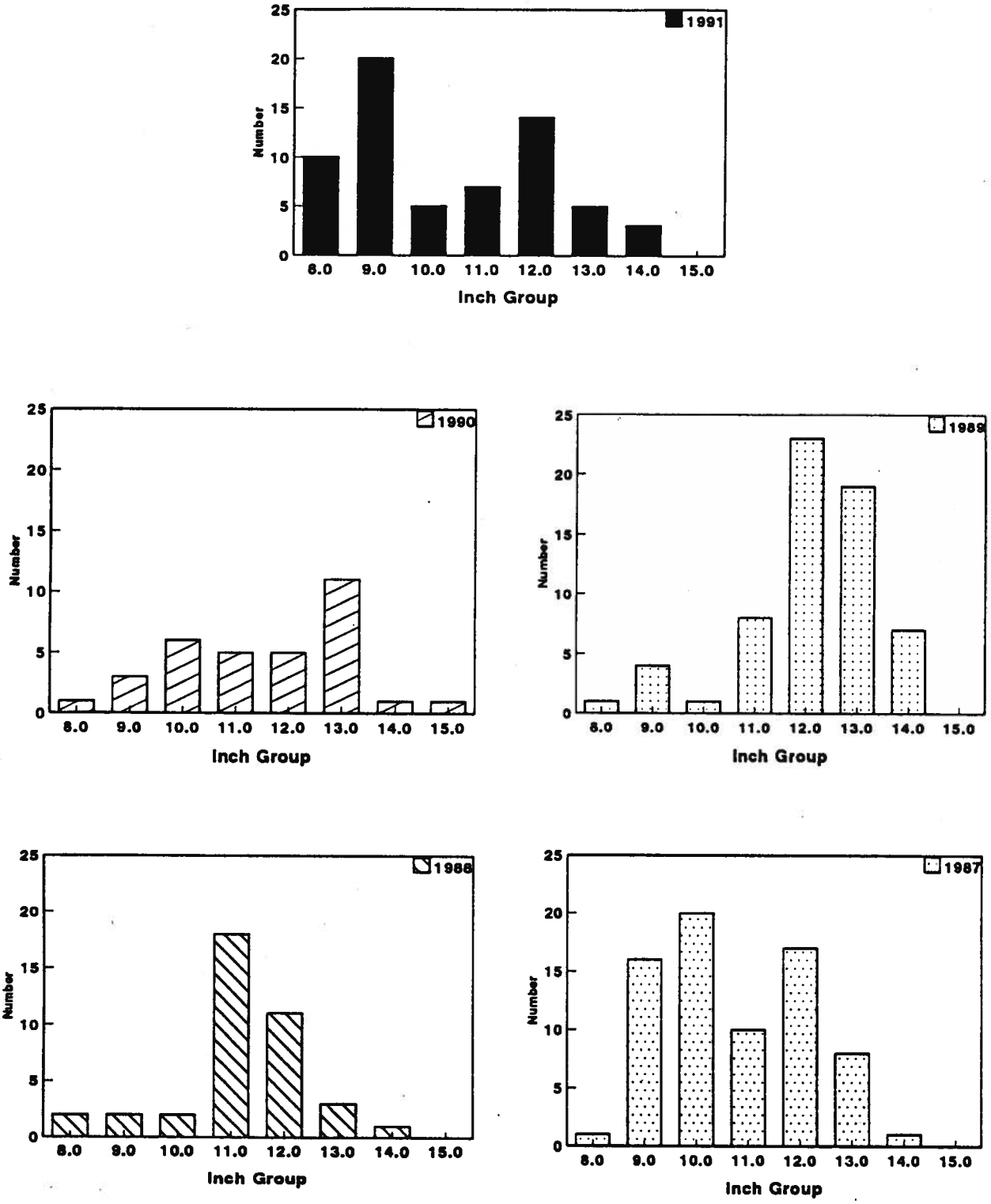

Figure 3. Length-frequency distribution of grayling captured in Three Pools survey area, 1987-1991.

Radiotelemetry

Radiotransmitters were implanted in 16 grayling between September 23 and October 22, 1991. Ten male and 6 female grayling received transmitters, ranging in length from 10.9 to 14.4 inches and weighed 0.50 to 0.87 lbs. Locations of implantation are shown in Figure 1. To date, 12 radioed grayling are considered active, 2 inactive (possible mortalities), 1 is missing, and 1 grayling is presumed dead as the transmitter has been retrieved. Of the remaining transmitters, battery life is sufficient for 8 tags to continue transmitting through December, while 7 will transmit into January, 1992.

Movements through November 1991 are summarized in Table 2. Total net movements (downstream - upstream) of -11.3 mi indicated a tendency toward upstream movements, with a mean of -0.71 mi. (Net movement would be expected to be 0 if movements were strictly random). Gross movement (downstream + upstream) for all grayling combined was 28.65 mi, with a mean of 1.79 mi.

The majority of grayling (11) exhibited net movements 1.0 mi or less from their point-of-capture, 6 of which did not move from their point-of-capture. Several grayling were observed to move short distances from their point-of-capture, returning to the same pool after a short time. One grayling was marked in Deep Creek, a tributary of the Big Hole River, and has remained there to date. Five grayling exhibited net movements >1.0 mi. Movements of 9.6 mi and 4.2 mi were recorded, both upstream, from Sportman's Park and Fishtrap, respectively. Both of these areas contain what is considered good winter habitat and reasons for these movements are unclear. Three fish made movements >1.0 mi downstream, all marked in the Wisdom or North Fork Section.

Periods of major movements occurred during the first 2 weeks of October, 1991, and again between November 7 and 27 (Figure 4). Major movements appeared to coincide with increasing flows and changes in weather patterns, although no documentation is yet available. Brook trout and mountain whitefish spawned during this period, and may have affected fall movements of grayling by providing an attractive energy-rich source of food. A tagged grayling was observed in Steel Creek among spawning brook trout, apparently feeding on drifting eggs.

Preliminary data suggest that grayling winter throughout the upper Big Hole River, including at least one tributary. In general, grayling were relocated in pool areas often associated with springs. Although a few major movements were observed, the majority of grayling remained at or near their point-of-capture. Fall migrations may have taken place prior to, or during the time in which transmitters were implanted. Nonetheless, important winter habitat is obviously dispersed from the Wisdom area downstream at least as far as the Wise River area. The possibility that winter movements are not yet complete is feasible, and continued observations will be made into January.

Table 2. Summary of radiotelemetry frequency, net and gross movements, status, and date tag was implanted in grayling, captured in the Big Hole River, Montana, 1991.

FREQUENCY	DISTANCE MOVED (mi)		STATUS	DATE IMPLANTED
	NET[a]	GROSS[b]		
49.380	0	0	Active	9/23/91
49.360	-0.4	4.6	Active	9/24/91
49.340	+1.4	1.4	Active	9/23/91
49.320	0	0	Inactive	9/24/91
49.300	+1.6	2.2	Mortality	9/25/91
49.280	+2.35	3.45	Active	9/26/91
49.260	-0.5	0.5	Active	10/15/91
49.240	-4.2	4.2[c]	Active	9/27/91
49.220	-9.6	9.6	Inactive	9/27/91
49.200	0	0	Active	10/16/91
49.180	-0.4	0.4	Active	10/16/91
49.160	0	0	Active	9/27/91
49.140	-0.2	0.2	Missing	10/16/91
49.120	0	1.6	Active	10/22/91
49.100	-1.0	1.0	Active	10/22/91
49.000	0	0	Active	10/7/91
Total	-11.3	28.65		

[a] Net = downstream movements - upstream movements
[b] Gross = downstream movements + upstream movements
[c] Does not include any movements while missing

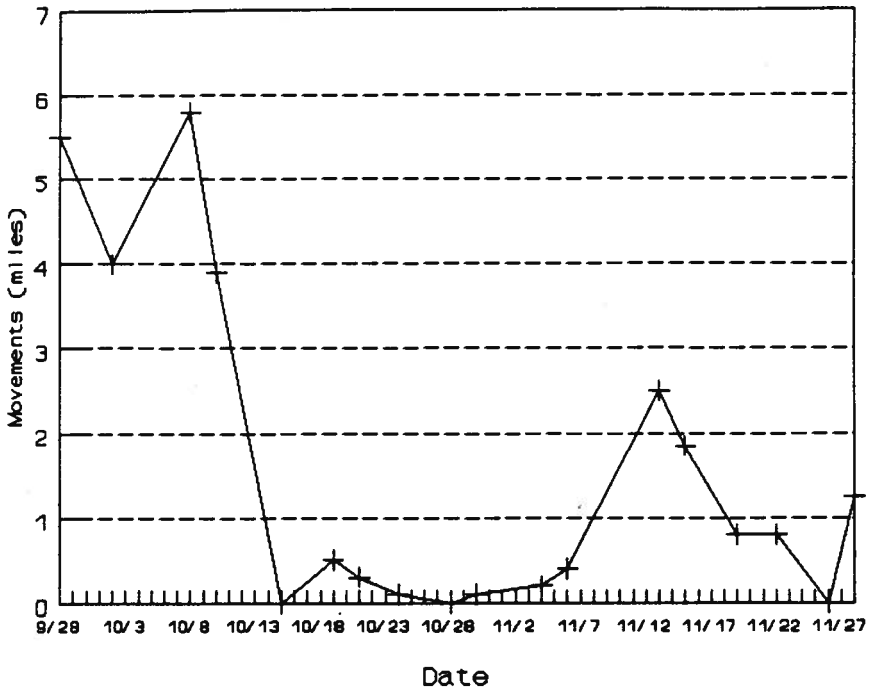

Figure 4. Summary of movements of radio-implanted grayling in the Big Hole River, September through November, 1991.

MANAGEMENT IMPLICATIONS

Population Surveys

The estimated population of grayling in the McDowell-Wisdom Section was 34/mi, similar to that of 1990. Although the estimates may not be directly comparable, it indicates that the population may have stabilized from the decline observed between 1983 and 1989. A strong representation of the Age I year class in the McDowell-Wisdom Section and the Three Pools indicate a potential for an increase in grayling numbers. However, low numbers of Age 0 grayling in the McDowell-Wisdom Section may indicate a poor spawning year, and will be monitored in the future. In addition, the low number of Age 0 grayling captured in the McDowell Reach in 1990 and 1991 may indicate a decline in quality or availability of spawning and rearing habitat and will be investigated.

Problems experienced in acquiring an accurate population estimate stress the need to conduct a large scale population survey from the McDowell Reach to the Divide area. Under proper flow conditions this survey will be conducted in the Fall of 1992.

Radiotelemetry

The majority of radio-implanted grayling exhibited minimal movements from their point-of-capture, although a few grayling exhibited upstream movements, primarily from the lower end of the study area. Preliminary data suggest that grayling winter habitat is distributed throughout the Big Hole River from Wisdom at least as far downstream as the Wise River area, as well as at least one tributary. Pools are undoubtedly selected as winter habitat, and the influence of springs appears to be important. Winter habitat will be characterized in the spring.

Grayling movements will be monitored through the remaining life of the tags. Telemetry has proven useful for analyzing fall movements of grayling to winter habitat and should be continued through another fall season. Tags should be implanted from mid-August through October to provide a more complete picture of Fall and Winter movements.

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