The spawning and rearing habitats of rainbow trout and brown trout in two rivers in Montana
by Steven Kent Sando

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 habitats of rainbow trout and brown trout redds and fry in the Beaverhead and Yellowstone rivers were studied from April-November, 1979 and March-May, 1980. The middle 90% of 67 rainbow trout redds on the Beaverhead River were found at depths of 23.0-43.0 cm, in current velocities of 0.40-0.83 m/sec and composed of substrates of at least 50% pebble and less than 1.6% silt. On the Yellowstone River, the middle 90% of nine rainbow trout redds were found at depths of 24.0-34.0 cm, in current velocities of 0.42-0.65 m/sec and composed of substrates of at least 50% pebble and less than 0.6% silt. The middle 90% of 77 brown trout redds on the Beaverhead River were found at depths of 18.0-46.0 cm, in current velocities of 0.35-0.95 m/sec and composed of substrates of at least 33% pebble and less than 3.0% silt. On the Yellowstone River, the middle 90% of 25 brown trout redds were found in depths of 17.0-34.0 cm, in current velocities of 0.28-0.63 m/sec and composed of substrates containing at least 60% pebble and less than 0.1% silt. A total of 102 fry of both species averaging 3.3 cm in length were found in the Beaverhead River at a mean depth of 14.9 cm, in an average current velocity of 0.05 m/sec over a substrate composition averaging about 80% fines and 20% gravel. A total of 31 rainbow trout and 114 brown trout fry averaging 6.8 and 7.7 cm in length respectively were found on the Beaverhead Rivet in waters with a mean depth of 22.5 cm, an average current velocity of 0.12 m/sec over a substrate composition of about 70% fines and 30% gravel. Fry were always found within 1m of cover and shifted from use of largely semi-aquatic vegetation to largely submerged organic debris as they increased in length.

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Date 3 March 1981

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ABSTRACT

The habitats of rainbow trout and brown trout redds and fry in the Beaverhead and Yellowstone rivers were studied from April-November, 1979 and March-May, 1980. The middle 90% of 67 rainbow trout redds on the Beaverhead River were found at depths of 23.0-43.0 cm, in current velocities of 0.40-0.83 m/sec and composed of substrates of at least 50% pebble and less than 1.6% silt. On the Yellowstone River, the middle 90% of nine rainbow trout redds were found at depths of 24.0-34.0 cm, in current velocities of 0.42-0.65 m/sec and composed of substrates of at least 50% pebble and less than 0.6% silt. The middle 90% of 77 brown trout redds on the Beaverhead River were found at depths of 18.0-46.0 cm, in current velocities of 0.35-0.95 m/sec and composed of substrates of at least 33% pebble and less than 3.0% silt. On the Yellowstone River, the middle 90% of 25 brown trout redds were found in depths of 17.0-34.0 cm, in current velocities of 0.28-0.63 m/sec and composed of substrates containing at least 60% pebble and less than 0.1% silt. A total of 102 fry of both species averaging 3.3 cm in length were found in the Beaverhead River at a mean depth of 14.9 cm, in an average current velocity of 0.05 m/sec over a substrate composition averaging about 80% fines and 20% gravel. A total of 31 rainbow trout and 114 brown trout fry averaging 6.8 and 7.7 cm in length respectively were found on the Beaverhead River in waters with a mean depth of 22.5 cm, an average current velocity of 0.12 m/sec over a substrate composition of about 70% fines and 30% gravel. Fry were always found within 1 m of cover and shifted from use of largely semi-aquatic vegetation to largely submerged organic debris as they increased in length.

INTRODUCTION

The withdrawal of water from streams in the western United States by agricultural, municipal and industrial interests has increased substantially in recent years and is continuing. Withdrawals reduce instream flows and decrease the water depth, cover, current velocity and the availability of suitable substrates (Giger 1973, Bayha 1974, Wesche 1976, White 1976) which result in a lowered carrying capacity for fish (Nelson 1978).

Conservation agencies are becoming increasingly concerned about providing sufficient instream flows to maintan quality habitat for fishery resources. The Montana Department of Fish, Wildlife and Parks is attempting to protect some fisheries habitat by legally establishing minimum instream flows. The department has obtained water rights on 12 streams and has also established flow reservations on the Yellowstone River drainage. It is preparing to file for flow reservations on streams in two more major drainages within 3 to 5 years.

The instream flow reservations obtained by the department on Montana streams are subject to challenge every 5 years. Retention of the reservations is dependent upon showing a biological need for them. As a result, studies are needed to establish the relationship between flows and fish populations. The purpose of this investigation was to measure selected characteristics of the spawning and rearing habitats of rainbow trout *(Salmo gairdneri)* and brown trout *(Salmo trutta)*

in the Beaverhead and Yellowstone rivers so that these necessary habitats in streams can be protected by minimum instream flows. Field research for the investigation was conducted between April, 1978 and June, 1980.

DESCRIPTION OF STUDY AREAS

Beaverhead River

The Beaverhead River is located in Beaverhead County in southwestern Montana. The waters forming it arise in the Centennial and Tendoy mountains and flow into Clark Canyon Reservoir. The Beaverhead River is formed below Clark Canyon Reservoir and flows for about 100 km to join the Ruby and Big Hole rivers near Twin Bridges, Montana.

Flows in the Beaverhead River are controlled by releases from Clark Canyon Reservoir which is managed primarily for flood control and irrigation. The flows released into the river are relatively low from October through March when water is stored in the reservoir and are relatively high from April through September when water is released for irrigation (Nelson 1978).

The study section was located directly below the Clark Canyon Dam and extended from the U.S.G.S. gaging station at Grant, 0.4 km below the dam, to just below Pipeorgan Bridge about 12 km downstream (Figure 1). The elevation of the river at the gage station is about 1659 m above mean sea level. Gradients and other physical characteristics of the Beaverhead River measured near Grant and about 4 km downstream in the Hildreth Section are given in Table 1.

The chemical characteristics of the Beaverhead River at two sites within the study area are presented in Table 2. The measured parameters varied little between sampling stations. Flows recorded at

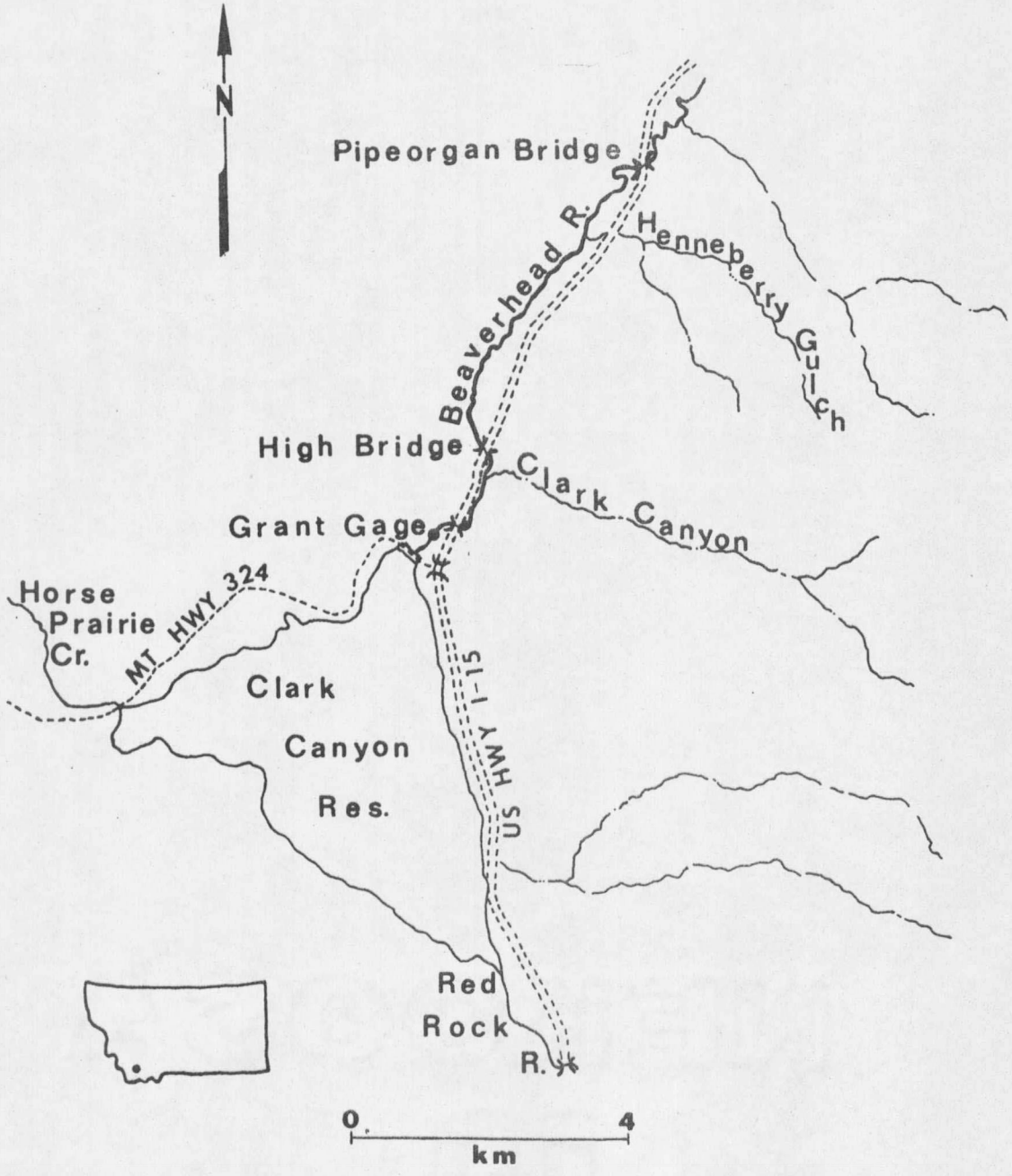

Figure 1. Map showing the location of the study area on the Beaverhead River.

Table 1. Selected characteristics of the channel of the Beaverhead River at two sections within the study area. Data from Nelson (1978).

Section	Sinuosity	Gradient (%)[1/]	Riprap (%)[2/]	Willow bank cover (%)[3/]
Grant	1.19	0.21	14.6	
Hildreth	1.32	0.33	1.2	67

1/ $\% = \frac{\text{Rise}}{\text{Run}} \times 100$

2/ $\% = \frac{\text{Total length of riprap on both banks}}{2 \times \text{section length}} \times 100$

3/ $\% = \frac{\text{Total length of willow cover on both banks}}{2 \times \text{section length}} \times 100$

Table 2. Selected chemical characteristics of the Beaverhead River at sites within the study area, measured in the summer of 1972. Data from Smith (1973).

Parameter	Distance (km) below Clark Canyon Dam	
	0.4	9.7
Turbidity (JTU)	4	4
Conductivity (μmhos @ 25° C)	565	572
pH	8.1	8.2
Dissolved oxygen (ppm)	9.6	9.7
Total alkalinity (ppm $CaCO_3$)	198	199
Total hardness (ppm $CaCO_3$)	220	230
Ammonia (ppm NH_3-N)	0.14	0.08
Nitrate (ppm NO_3^--N)	0.057	0.110
Nitrite (ppm NO_2^--N)	0.015	0.018
Orthophosphate (ppm PO_4^{-3}	0.11	0.10

the Grant gaging station for the study period are presented in Figure 2. These flows were slightly below the average discharge for the record period of 1962-1979 (U.S.G.S. 1979).

Water temperatures for 1972 taken near the Grant gaging station are presented in Figure 3. The reservoir, which was constructed in 1964, has caused reduced fluctuations in water temperatures in the upper reaches of the river and altered the natural temperature regime by inducing a general trend of lower water temperatures in the early spring and higher temperatures in the fall (Smith 1973).

Rainbow trout, brown trout, mountain whitefish (*Prosopium williamsoni*), burbot (*Lota lota*), white sucker (*Catostomus commersoni*), mottled sculpin (*Cottus bairdi*) and longnose dace (*Rhinichthys cataractae*) have been reported in the study area (Nelson 1978).

Yellowstone River

The Yellowstone River flows from its headwaters in Yellowstone National Park in northwestern Wyoming in a northeasterly direction through southeastern Montana for 1091 km to its confluence with the Missouri River near Cartwright, North Dakota. Approximately 70% of the annual flow of the river comes from mountain snowpack which causes high flows in the spring and low flows through fall and winter (Peterman 1979). The upper Yellowstone River from Gardiner to Big