Community structure and habitat associations of fishes of the lower Tongue and Powder rivers
by Ryan Joseph Trenka

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

Abstract:
The Yellowstone River is one of the nation's few remaining free-flowing rivers and contains some of the healthiest populations of several fish species of special concern (pallid sturgeon, blue sucker, Hybognathus spp., sturgeon chub, sicklefin chub and flathead chub). Much of the lower basin contains numerous irrigation diversions, but the effect of these diversions on the native fish community is poorly understood. As part of a larger effort to assess these effects, this study examined biotic and abiotic factors in the lower Tongue and Powder rivers, two major tributaries to the Yellowstone River in eastern Montana. Little is known about general distribution, abundance and life history of native fishes particularly sturgeon chub, flathead chub and Hybognathus spp. nor native game species such as sauger and shovelnose sturgeon which have substantially declined in these sections of the rivers. Fish populations and habitats of the Tongue and Powder rivers were inventoried to investigate longitudinal changes in fish communities and habitat. Additionally, relations between diel and seasonal use of major macrohabitats were examined. Twenty-five species representing 10 families were collected. The most abundant and species-rich family was Cyprinidae. Relatively unaltered habitat conditions in the Powder River supported a relatively unaltered fish community. Relative abundance of all non-game species has remained relatively stable compared to historical data. Populations of game fishes including sauger and shovelnose sturgeon have declined considerably. The Tongue River has been adversely affected by diversion dams and water withdrawals. Spring runoff, which triggers spawning activity, has been diminished by dam operation. Minnows used shallower, slower edge habitats in both rivers, areas extremely altered by modification of natural flow regime. In the Tongue River, the channel has become narrower and more uniform in depth, substrates have become larger and firm, aquatic vegetation has increased and turbidity levels have decreased when compared to the Powder River. This has resulted in decreased populations of benthic invertivores and increased numbers and species more adapted to sight feeding and fishes adapted to spawning over larger open substrate and plant material. Game fish population levels have declined here as well, pointing to possible basin wide problems.

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APPROVAL

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Ryan Joseph Trenka

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

The Yellowstone River is one of the nation's few remaining free-flowing rivers and contains some of the healthiest populations of several fish species of special concern (pallid sturgeon, blue sucker, *Hybognathus* spp., sturgeon chub, sicklefin chub and flathead chub). Much of the lower basin contains numerous irrigation diversions, but the effect of these diversions on the native fish community is poorly understood. As part of a larger effort to assess these effects, this study examined biotic and abiotic factors in the lower Tongue and Powder rivers, two major tributaries to the Yellowstone River in eastern Montana. Little is known about general distribution, abundance and life history of native fishes particularly sturgeon chub, flathead chub and *Hybognathus spp.* nor native game species such as sauger and shovelnose sturgeon which have substantially declined in these sections of the rivers. Fish populations and habitats of the Tongue and Powder rivers were inventoried to investigate longitudinal changes in fish communities and habitat. Additionally, relations between diel and seasonal use of major macrohabitats were examined. Twenty-five species representing 10 families were collected. The most abundant and species-rich family was Cyprinidae. Relatively unaltered habitat conditions in the Powder River supported a relatively unaltered fish community. Relative abundance of all non-game species has remained relatively stable compared to historical data. Populations of game fishes including sauger and shovelnose sturgeon have declined considerably. The Tongue River has been adversely affected by diversion dams and water withdrawals. Spring runoff, which triggers spawning activity, has been diminished by dam operation. Minnows used shallower, slower edge habitats in both rivers, areas extremely altered by modification of natural flow regime. In the Tongue River, the channel has become narrower and more uniform in depth, substrates have become larger and firm, aquatic vegetation has increased and turbidity levels have decreased when compared to the Powder River. This has resulted in decreased populations of benthic invertivores and increased numbers and species more adapted to sight feeding and fishes adapted to spawning over larger open substrate and plant material. Game fish population levels have declined here as well, pointing to possible basin wide problems.

INTRODUCTION

The Yellowstone River Basin contains many diversion dams and water intake structures. Many of these have been in place for decades and were constructed to provide water for irrigation. These diversions are known to prevent or impede the upstream movement of fish, and many fish are lost due to canal entrainment (Hesse 1987).

Declines of certain native fish populations in the Missouri River drainage have resulted in one being listed and others proposed for listing as threatened or endangered under both State and Federal laws. Currently only one species, the pallid sturgeon *(Scaphirhynchus albus),* is federally listed as endangered. An additional seven species (blue sucker, *Cycleptus elongatus*; western silvery minnow, *Hybognathus argyritus*; plains minnow, *Hybognathus placitus*; sturgeon chub, *Macrhybopsis gelida*; sicklefin chub, *Macrhybopsis meeki*; flathead chub, *Platygobio gracilis*; and paddlefish, *Polyodon spathula)* have been proposed or being considered for listing by the U.S. Fish and Wildlife Service (USFWS 1994).

While populations of many of these at-risk species appear healthy in the upper, less altered reaches of streams in the Missouri River Basin (White and Bramblett 1983), little is known about their abundance, distribution and habitat requirements, particularly when correlated with the effects of diversion structures.

Recognizing that irrigation intake structures may be contributing to the decline of native fish populations, the Bureau of Reclamation (BOR), Montana Fish Wildlife and Parks (MTFWP), and other State and Federal agencies initiated a study to examine major diversion dams and large water intakes on the Yellowstone River system in Montana with the overall goals of minimizing migration restrictions for listed and candidate endangered species and certain game species, and for reducing entrainment and impingement of fish at water intakes. To meet these goals, knowledge of the distribution and habitat needs of native fishes is prerequisite. Since this information is generally lacking (Gould 1985), I examined the fish communities and their habitat associations in the lower Tongue and Powder rivers, tributaries to the lower Yellowstone River, with an overall goal of gaining critical information to assist BOR studies aimed at understanding and protecting Yellowstone River fishes in relation to irrigation diversion and intake systems as well as land and water development. I examined certain ecological attributes such as habitat associations, patterns of movement, and distribution to try to better understand the relationships between streams, their habitats, and their fish communities. The specific objectives of this study were: (1) to describe fish species composition and the relative abundance of those species in the lower Tongue and Powder rivers, (2) to describe diel and seasonal use of major macrohabitat types by the fish community, and (3) to describe the physical characteristics of the habitats used by the fish community.

STUDY AREA

The Tongue and Powder rivers are major tributaries to the lower Yellowstone River (Figures 1 and 2), which lies in the unglaciated Missouri River plateau. This area is primarily classified as one of the following geological land types; Northern Smooth High Plains, Northern Rolling High Plains, Pierre Shale Plains and Badlands, or Rolling Soft Shale Plains. Most of the lower Yellowstone basin is underlain by the Fort Union Coal Formation, a remnant of the Hell Creek Formation. The Fort Union Formation was formed 50-60 million years ago in a vast shallow lake. Extensive coal fields formed in this area of once large swamps and thick forests (Elser et al. 1977).

The dominant land use of the lower Yellowstone basin is agriculture, primarily irrigated cropland. In the lower basin the predominate riparian plant community is an extensive cottonwood-willow complex that hosts a diverse wildlife community, including numerous species of special concern in Montana. The lower Yellowstone River also supports a diverse and productive fishery, which is dependent upon adequate flows and good water quality (Elser et al. 1977). Historically, 46 species representing 12 families have been collected in the lower reaches of the Yellowstone (Phil Stewart, Montana Fish Wildlife and Parks, Miles City, Montana, personal communication, 1996). Several riverine species, including shovelnose sturgeon, channel catfish and sauger are known to utilize both the Tongue and Powder rivers, migrating long distances in the spring associated with spawning (Elser et al. 1977).

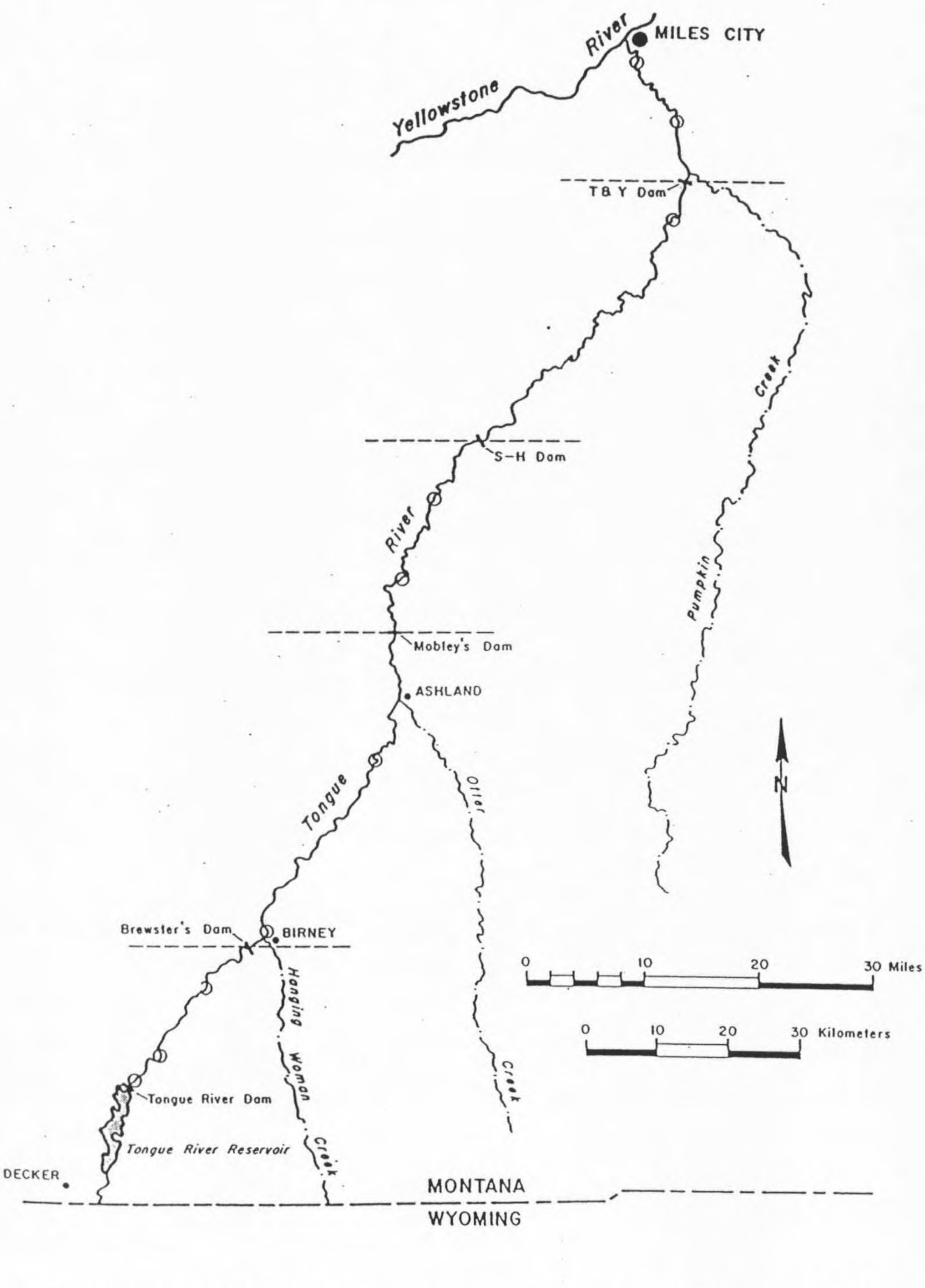

Figure 1. Map of the Tongue River, Montana. Specific study area is portion of Tongue River from T & Y dam to confluence with Yellowstone River, Montana.

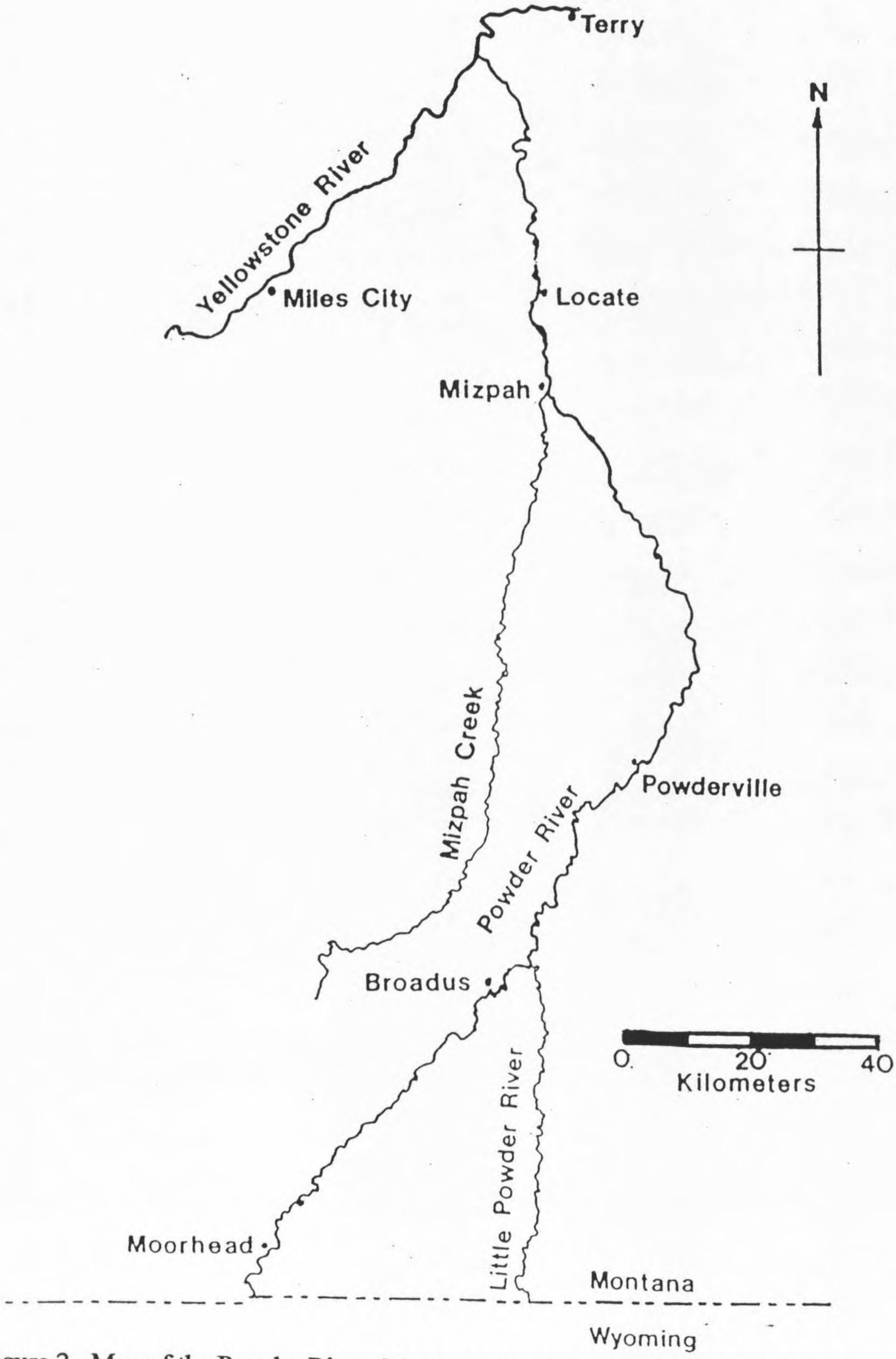

Figure 2. Map of the Powder River, Montana. Specific study area is portion of Powder River from Mizpah Creek to confluence with the Yellowstone River, Montana.

Tongue River

The Tongue River gets its name from an Indian word for a tree-covered limestone slab outlined by rock that resembles a bison tongue. The headwaters of the Tongue arise from the eastern side of the Bighorn Mountains in Wyoming and flow northeasterly through Wyoming and Montana to its confluence with the Yellowstone River at Miles City, Montana. Drainage area of the Tongue River basin is 13,932 km^2, with approximately 70% occurring in Montana. The total length of the Tongue River from the Montana-Wyoming border to its mouth is 337 km. Average annual discharge is 11.9 m^3/s (Elser et al. 1977). Flow from the Tongue is generally less than six percent of the Yellowstone at their confluence, and peak discharge is bi-modal with its greatest flow usually occurring in March and another peak typically in June.

The Tongue River basin is comprised of narrow stream valleys, plateaus and gently rolling uplands. Relief is compromised in the lower reaches with less rugged conditions occurring nearer the confluence. Agriculture is the major land use in the basin with cattle ranching and irrigated or dry land farming dominating. Water quality of the Tongue is generally considered to be better than most other prairie streams of the Great Plains (Elser et al. 1977).

Flow of the Tongue River in Montana is regulated by a series of five dams, four of which are lowhead structures used to divert irrigation water. The first and largest is the Tongue River Dam located just inside the Montana border near Decker, Montana. The dam was built in 1940 as a storage facility and aids in flood control. It stores about

85 hm^3 (8,512 ha-m) of water with a full pool area of 1,416 surface ha. (Elser et al. 1977).

My study area was in the lower 32.2 km of the Tongue River, from the T&Y diversion dam, located just upstream from the confluence of Pumpkin Creek, to the confluence of the Tongue and Yellowstone rivers (Figure 1). T&Y dam is the most downstream diversion on the river and the largest of the four lowhead diversions. The dam is 3 m high and 95 m long, spanning the entire river channel. It has a water right of 6.73 m^3/s; therefore, during irrigation season instream flows above the dam are significantly higher than below the dam (Liston et al. 1994). Historically, this 32.2 km reach has been dominated by slow-water fish assemblages with migrant fish from the Yellowstone River using this reach when flows allow passage.

Powder River

The Powder River today is similar to what early pioneers encountered more than 100 years ago. Early settlers described it as a mile wide and an inch deep, too thin to plow and too thick to drink. The Powder River basin drains an area of approximately 34,318 km^2 in northeast Wyoming and southeast Montana. Over half of the drainage is in Wyoming and is bordered to the southwest by the Bighorn Mountains. The Powder River flows north to its confluence with the Yellowstone River near Terry, Montana. It is bounded on both sides by low divides and breaks that separate it from the Tongue River to the west and the Little Missouri, Belle Fourche, Cheyenne and the North Platte rivers to the east and south (Rehwinkle 1978). Although its origin is on the eastern slopes of the Bighorn Mountains, it is generally classified as a Great Plains River (Rehwinkle 1978).

The Powder River, including the South Fork, is approximately 780 km long and is characterized by erratic flows and silt-laden bed load, resulting in a constantly shifting channel. It rarely develops pools and generally lacks aquatic and riparian vegetation. Annual discharge averages 17.6 m^3/sec and is naturally saline with an average total dissolved solids of 1100 mg/L (Rehwinkle 1978). The yearly discharge pattern of the Powder is typical of a prairie stream, with spring runoff resulting in a bi-modal discharge pattern. A smaller discharge peak historically occurs around March, followed by a larger peak in June, receding to minimal flows in late summer.

The climate of the area varies altitudinally, with precipitation occurring primarily as snow at higher elevations. The plains section is arid with only 0.367 m of average annual precipitation. Air temperatures are similarly extreme, with summer highs exceeding 38 °C and winter lows commonly reaching -34 °C (Rehwinkle 1978).

Although water quality and quantity have naturally limited fish population diversity and abundance, the Powder River is an important spawning tributary for several species (Rehwinkel 1978). The river has been used extensively by migrant spawning populations of fish species including shovelnose sturgeon (*Scaphirhynchus platorynchus)*, channel catfish (*Ictalurus punctatus)*, and sauger *(Stizostedion canadense)*. Additionally, it was formally documented as a spawning area for the pallid sturgeon *(Scaphirhynchus albus)*, now an endangered species and currently absent from the area (Rehwinkle 1978).

My study area was the lower 72.1 km of the Powder River, from the mouth of Mizpah Creek to the confluence of the Powder and the Yellowstone river near Terry, Montana (Figure 2). This reach is characterized by an incised channel of approximately 6 to 30 m width (Rehwinkle 1978). Throughout this reach, the channel is either sinuous or irregularly meandering with prevailing midchannel bars and silt or sand as the dominant bed materials in low gradient areas and bedrock outcrops of limestone and sandstones dominant in higher gradient areas (Rehwinkle 1978).

METHODS

Macrohabitat Classification and Sample Site Selection

In the spring of 1997 the Tongue and Powder rivers were classified into five predominant fluvial macrohabitat types: main channel crossover, outside bend, inside bend, bar and secondary channel. This classification was a modification of the system developed by Sappington et al. (1996).

Main Channel Crossover

The main channel conveys the majority of the river discharge, and is defined as the thalweg of the river. Fish and habitat data were collected in the channel crossover area, which is the inflection point of the thalweg (ie., location where the thalweg crosses over from one concave side of the river to the next concave side).

Outside Bend

The outside bend was defined as the concave side of a river meander. In the Tongue River, outside bends were usually associated with rip-rap of some form. In the Powder River, outside bends were associated with eroding banks. Each outside bend was sampled between channel crossovers, while the lateral boundary was from the shore to the thalweg.

Inside Bend

An inside bend was the convex side of the river channel. Longitudinal and lateral boundaries were the same as outside bends. This macrohabitat was characterized by point bars (ie., terrestrial/aquatic interface area of deposited sediment lying within the spatial boundaries of the inside bend).

Bar

A bar was areas above water but surrounded by stream flows, and were vegetated or non-vegetated. Bars are formed by deposition and because they are an active part of the flow geometry, they change in size, height, or location with flow conditions (Heede 1980). Most bars in the study area were mid-channel bars, a typical bed form for wide and shallow streams.

Secondary Channel

Secondary channel macrohabitats were flowing channels which carried less flow than the main channel. Their upstream and downstream ends were connected to the main channel permitting fish passage and water flow.

Macrohabitat types were identified and enumerated for both rivers using aerial photographs with ground truthing conducted and all channel changes noted. A systematic random sample was used to ensure that the sample was representative of all study reaches. Scheaffer et al. (1990) defined it as a sample obtained by randomly selecting one element from the first *k* elements in the frame and every *kth* element thereafter. Thus after a random start, macrohabitats were systematically sampled at a randomly selected interval throughout the study reaches. Certain sampling sites were eliminated if access was limited or sampling conditions were inefficient. In this case, I randomly chose to move upstream or downstream to the next nearest habitat unit.

Fish and Habitat Sampling

Macrohabitats were sampled using three techniques. Pulsed direct-current electrofishing was used to sample fish in outside bend macrohabitats in 1997 and the spring of 1998. Electrofishing was discontinued after the pre-runoff period in 1998 because consistently high turbidity reduced visibility, making netting inefficient.

Electrofishing was conducted using a single boom suspended system mounted on a 4.3 m aluminum flat bottom boat with a 15 hp outboard motor. Electric current was generated using a Honda 5000 watt generator and converted into pulsed direct current via a Coffelt VVP-15 electrofishing unit. The distance covered while electrofishing was estimated using a Rangematic 1200 rangefinder and recorded.

Seining was used in inside bends, secondary channels, and bar macrohabitats. Seining was an effective method for collecting small fish in shallow macrohabitats (inside bends, bars and secondary channels) where the net wall extended from the surface to the bottom. Seining is most effective for nearshore residents or species that concentrate near shore seasonally or on a diel basis (Kelso and Rutherford 1996). Water depth in these habitats was too shallow to operate the boat, and electrofishing was not a viable technique. A net haul was the standard unit of effort (number of fish/seine haul) (Sappington et al.1996). I compared bag seine and beach seine efficiency early in the 1997 field season and determined that the standard beach seine was more applicable in the sand and silt conditions encountered frequently. The beach seine used for sampling was 10.7 m long and 1.8 m high with 5 mm mesh and had a 29.5 kg lead line and a top float line. To deploy the seine, one end was anchored on shore by a technician while the other end was pulled upstream to full extension along the shoreline. Once the net was extended, the net was then pulled in a 180-degree arc around the anchored pivot.

Main channel crossover macrohabitats were sampled by drifting multifiliment experimental mesh gill nets. Nets used on the Tongue River were 15.2 m in length and 1.8 m high while nets used on the Powder River were 30.4 m long and 1.8 m high. They contained four panels of equal length with mesh sizes of 1.9 cm, 3.8 cm, 5.1 cm, and 7.6 cm, respectively. Nets were drifted 100-200 m, estimated using a Rangematic 1200 rangefinder. If the net became snagged and required substantial effort to retrieve, and/or the net folded around a snag, the drift was eliminated from the sample. All sampling techniques were standardized using the protocol of Sappington et al. (1996), modified to accommodate the smaller scale of the Tongue and Powder rivers.

To describe fish species composition and longitudinal distribution, a systematic random sample was employed to ensure representative sampling of the entire study reach of both rivers. Sampling took place in the base flow period (Aug 1-Sept 10) when fish movement was likely to be minimal. In both rivers, at least three of each macrohabitat type were sampled in the study area to examine the longitudinal distribution and composition of the resident fish community.

To describe seasonal and diel use of major macrohabitat types by the fish community, three ecologically important time periods were chosen for sampling:

1) Pre-runoff: This typically occurs in April and May when water temperatures are

warming, water flows are increasing, and the majority of fish in these systems are spawning or are in pre-spawn stage. Sampling occurred between 4/15-5/15.

2) Post-runoff: This typically occurs in July when water temperatures are high and flow is decreasing. During this period fish are moving toward or are concentrated at feeding areas, some exhibit post-spawning migration patterns (Buckley and Kynard 1985). Sampling occurred between 7/1-7/31.

3) Base flow: This typically occurs in August or September when flows are relatively stable or slowly decreasing. Fish are typically in or moving to their wintering habitats. Sampling occurred between 8/1-9/10.

To examine the seasonal use of macrohabitats by the fish community, I systematically sampled at least three of each macrohabitat type in the Tongue and the Powder rivers, during each of the three sampling periods described above. To examine the diel use of macrohabitats by the fish community, I sampled these habitats on a 24 h cycle, excluding main channel crossover due to the safety concerns of drifting nets at night. During the 1997 diel sampling period, at least one of the other four habitats was sampled during late summer periods. In the 1998 field season, I was able to sample at least one inside bend, bar, and secondary channel during pre-runoff and again in late summer periods. The macrohabitat site randomly selected for diel sampling was sampled four times throughout a 24-h period: noon, sunset, midnight, and sunrise. Sampling started approximately one half hour before each designated time and ended approximately one half hour after that time. Location of diel sampling was not completely random because certain areas were extremely difficult to sample at night. It was also necessary to select sampling sites in close proximity to each other to maximize sampling efforts and minimize the safety concerns of night work.

To describe the physical characteristics of the macrohabitats used by the fish community, 10 physical parameters were measured at each sampling site in conjunction with fish collection to identify macrohabitat associations. Depth and velocity was measured using a standard top-set wading rod and a Marsh-McBirney meter. Depth was measured to the nearest 0.1 m and velocity to the nearest 0.1 m/s at 0.6 water depth to represent mean column velocity. During seining, depth and velocity were taken at 25% and 75% of full extension along a transect perpendicular to the center of the arc anchored onshore. After each electrofishing run and gill net drift, depth and velocity were measured mid-channel at 25% and 75% of the length of the run. Air and water temperature (°C) were measured at each sampling site using a hand-held thermometer. Turbidity was measured using a Secchi disk. At each site the disk was lowered into the water, and the depth at which it disappeared was recorded to the nearest centimeter. Conductivity was measured at each site using a hand-held Hanna DIST WP3 conductivity meter. Location was recorded at each site using a Magellan NAV 5000 GPS unit and comparing that with U.S. Geological Survey topographical maps with 1:24000 scale. Flow and river stage were reported using USGS provisional flow data at station 06308500-- Tongue River at Miles City, Montana, and station 06326500--Powder River near Locate, Montana. Weather information was also noted by visual observation, and recorded.

Dominant substrate was determined by visual observation or feeling substrate diameter at each depth and velocity measurement location and assigned a corresponding number (Table 1).

Table 1. Criteria used to classify substrate sizes in Tongue and Powder rivers (modified from Platts et al. 1983)

Substrate Type	Size (mm)	Code
Silt	<1	5
Sand	1 to 4	4
Gravel	4.8 to 76	3
Cobble	76.1 to 304	2
Boulder	>305	1
Bedrock		0

All fish sampled that were >40 mm in total length were identified, enumerated, weighed to the nearest 1 g, and measured to the nearest 1 mm. In samples that contained more than 50 individuals of one species, 50 were randomly selected for weighing and measuring, the remaining portions of that catch were counted and recorded. Specimens not identifiable in the field were preserved and identified later at Montana State University-Bozeman.

Data analysis

Statistical analyses were conducted using the Statistical Analysis System (SAS 1998). A Tukey Studentized Range multiple comparison test was used to test for differences among habitats. Analysis of variance and Tukey's multiple comparison test were used to examine differences in flathead chub proportion within diel sampling periods (dawn, noon, dusk, and midnight). Bars, inside bends, and secondary channels were analyzed while outside bends were deleted from analysis due to small sample size. A Ryan-Einot-Gabriel-Welsch Multiple Range Test (REGWQ) was used to examine differences in proportion of seasonal catch of flathead chub among macrohabitats. Proportions *(p)* were transformed by taking the arcsin $\sqrt{p}$ to approximate normality (Zar 1996).

RESULTS

A total of 3,484 individuals representing 21 species in 8 families were collected in the Tongue River (Table 2). Five species were non-native to Montana (Brown 1971). The most abundant and species-rich family was Cyprinidae. Flathead chub was the most common species collected in the Tongue River, making up 55.2% of total catch, followed by *Hybognathus spp,* emerald shiner, longnose dace, and goldeye.

A total of 2,315 individuals representing 19 species in 9 families were collected in the Powder River (Table 3). Three species were non-native to Montana (Brown 1971). The most abundant and species-rich family was Cyprinidae. Flathead chub was the most common species collected in the Powder River, making up 77.41% of total catch, followed by *Hybognathus spp,* longnose dace, goldeye, and channel catfish.

Tongue and Powder River Fish Assemblages

Flathead chub In my survey the flathead chub was the most abundant species in the Tongue and Powder rivers. A total of 1924 were collected in the Tongue River representing 55.2% of catch, and 1,792 were collected in the Powder River, representing 77.4% of total catch.

The flathead chub was widely but unevenly distributed in the Tongue River, occurring throughout the entire study area, but 37% of total catch occurred between river

Table 2. Fish species composition, occurrence, and abundance from the Tongue River, Montana, May-September 1997 and 1998.

Common name	Scientific name	Number	Relative abundance (%)
Flathead chub	*Platygobio gracilis*	1924	55.20%
Hybognathus sp.		560	16.07%
Emerald shiner	*Notropis atherinoides*	234	6.71%
Longnose dace	*Rhinichthys cataractae*	167	4.79%
Goldeye	*Hiodon alosoides*	107	3.07%
Channel catfish	*Ictaluris punctatus*	110	3.16%
Shorthead redhorse	*Moxostoma macrolepidotum*	127	3.64%
River carpsucker	*Carpoides carpio*	80	2.30%
Longnose sucker	*Catostomus catostomus*	66	1.89%
Carp[a]	*Cyprinus carpio*	42	1.21%
Stonecat	*Noturus flavus*	24	0.69%
Fathead minnow	*Pimephales promelas*	23	0.66%
Shovelnose sturgeon	*Scaphirhynchus platorynchus*	2	0.06%
Walleye[a]	*Stizostedion vitreum*	5	0.14%
Smallmouth bass[a]	*Micropterus dolomieui*	5	0.14%
Sauger	*Stizostedium canadense*	3	0.09%
Burbot	*Lota lota*	1	0.03%
Blue sucker	*Cycleptus elongatus*	1	0.03%
Black bullhead[a]	*Ameiurus melas*	1	0.03%
Smallmouth buffalo	*Ictiobus bubalus*	1	0.03%
Black crappie[a]	*Pomoxis nigromaculatus*	1	0.03%

[a] Non-native species

Table 3. Fish species composition, occurrence, and abundance from the Powder River, Montana, May-September 1997 and 1998.

Common name	Scientific name	Number	Relative abundance (%)
Flathead chub	*Platygobio gracilis*	1792	77.41%
Hybognathus sp.		176	5.05%
Longnose dace	*Rhinichthys cataractae*	48	1.38%
Goldeye	*Hiodon alosoides*	100	2.87%
Channel catfish	*Ictaluris punctatus*	79	2.27%
Shorthead redhorse	*Moxostoma macrolepidotum*	6	0.17%
River carpsucker	*Carpoides carpio*	17	0.49%
Longnose sucker	*Catostomus catostomus*	2	0.06%
Sturgeon chub	*Macrhybopsis gelida*	60	1.72%
Carp[a]	*Cyprinus carpio*	9	0.26%
Stonecat	*Noturus flavus*	5	0.14%
Shovelnose sturgeon	*Scaphirhynchus platorynchus*	10	0.29%
Sauger	*Stizostedium canadense*	1	0.03%
Bigmouth buffalo	*Ictiobus cyprinellus*	3	0.09%
Burbot	*Lota lota*	2	0.06%
Blue sucker	*Cycleptus elongatus*	1	0.03%
Plains killifish[a]	*Fundulus zebrinus*	2	0.06%
Black bullhead[a]	*Ameiurus melas*	1	0.03%
Freshwater drum	*Aplodinotus grunniens*	1	0.03%

[a] Non-native species

km 4.5-6 (Figure 3). Flathead chub abundance showed a significant weak negative correlation with increased distance from the mouth (river km) $R^2 = -0.204$, $P = 0.038$, n= 104). Abundance patterns, distribution, and exact location of collection indicated that the flathead chub has somewhat specific habitat requirements. Flathead chub abundance was greatest in shallow macrohabitats, with 81.8% of catch occurring in bar and inside bend habitats (Figure 4). Most flathead chubs (83.9%) were captured where water depth was between 0.2-0.59 m, and 59.4 % were captured where water velocities were between 0.2-0.59 m/s (Figure 5).

Flathead chubs were widely and evenly distributed in the Powder River. The largest numbers were collected at river km 1.1, where 7.5% of total catch occurred (Figure 6). As in the Tongue River, abundance patterns, distribution, and exact location of collection indicated that the flathead chub has somewhat specific habitat requirements. Ninetyeight percent of flathead chubs were collected from inside bends, bar, and secondary channel habitats (Figure 7). Abundance was greatest at shallow, moderately swift habitats, with 81.5% of catch occurring at depths between 0-0.39 m, and 96% occurring in areas with velocities between 0.2-0.79 m/s (Figure 5).

Hybognathus spp. This group of similar species (western silvery minnow, plains minnow, brassy minnow), that are difficult to identify from each other without dissection, are all native to Montana. As a group, *Hybognathus spp.* were second in abundance of species collected in the Tongue River. A total of 560 was collected representing 16.1% of catch in the Tongue River. *Hybognathus spp.* were found throughout the study area of the Tongue River but were unevenly distributed.

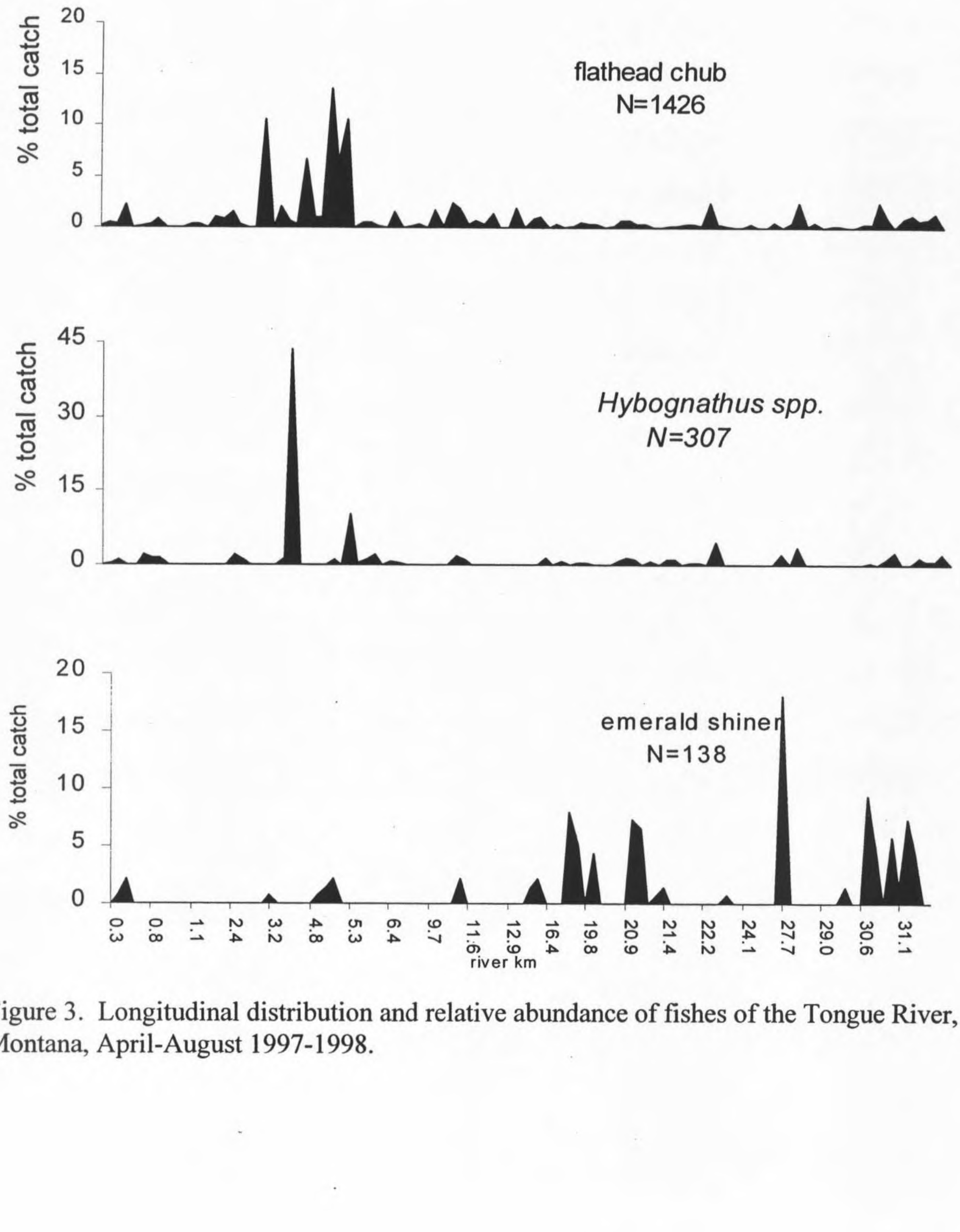

Figure 3. Longitudinal distribution and relative abundance of fishes of the Tongue River, Montana, April-August 1997-1998.