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# The Ichthyofauna of Small Streams on the Charles M. Russell National Wildlife Refuge, Montana

## Abstract

*The ichthyofauna of the small streams on the Charles M. Russell National Wildlife Refuge is poorly known because no systematic survey had been conducted previously. We sampled fish and visually evaluated habitat at 18 third and fourth order streams, stratified to ensure good geographic coverage. A total of 13 streams had fish present, two streams had water but no fish, and three streams had no water present. Most streams with water were intermittent; only two streams had flowing water. A total of 19 fish species was captured of which 14 species were native to Montana. From one to 12 fish species, and from one to 899 individual fish were captured per site. Overall, 87 percent of individual fish captured were native species. Introduced species made up over 50 percent of fish captured at only one site and 7 of 13 streams had no introduced species. The most common species were fathead minnow (*Pimephales promelas*), plains minnow (*Hybognathus placitus*), lake chub (*Couesius plumbeus*), white sucker (*Catostomus commersoni*), common carp (*Cyprinus carpio*), flathead chub (*Platygobio gracilis*), and longnose dace (*Rhinichthys cataractae*). Rough positive correlations between a qualitative habitat index and numbers of fish species and individual fish were observed. Because most of the species we captured are rare in the adjacent Missouri River or Fort Peck Reservoir, we suspect that most fish complete their life cycles within the streams we sampled, despite the low quantities of water present. We further speculate that connectivity among streams that enter Ft. Peck Reservoir has been reduced because the reservoir acts as a partial barrier to the movements of most of the fish species we captured.*

**Key words:** Montana fishes, prairie stream fishes, native fishes, introduced fishes, prairie streams, intermittent streams, Charles M. Russell National Wildlife Refuge, reptiles, amphibians.

## Introduction

A systematic survey of the fishery resources of the Charles M. Russell National Wildlife Refuge (CMRNWR) has never been conducted with the exception of the Missouri River and Fort Peck Reservoir. This information is needed to assist in the Federal Reserved Water Rights Negotiation Process because sufficient flows to maintain fish populations are included in Federal Reserved Water Rights. Additionally, assessments of fish assemblages inhabiting the Refuge's small streams are needed to document the Refuge's aquatic biodiversity. The objective of this study was to document the ichthyofaunal assemblages and qualitative habitat conditions of a subset of streams on the Refuge.

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## Study Area And Methods

The CMRNWR is a 445,000 hectare National Wildlife Refuge located in northeastern Montana (Fig. 1). The Refuge straddles the Missouri River and the entire 101,000 hectare Fort Peck Reservoir, created by the construction of Fort Peck Dam in 1933. Elevations on the Refuge range from 685 to 988 m; about 80 percent of the landscape is comprised of the "Missouri Breaks"—steep ridges, badlands and coulees (Graetz and Graetz 1999). Vegetation types range from open forests of Rocky Mountain juniper (*Juniperus scoluporum*) and ponderosa pine (*Pinus ponderosa*) with occasional Douglas fir (*Pseudotsuga menzesii*), to riparian gallery forests of plains cottonwood (*Populus deltoides*) along the Missouri River, and sagebrush (*Artemesia tridentata*) and grassland prairies. The dominant geological features south of the river and reservoir are the Hell Creek formation and Fox Hills sandstone, whereas the north side of the Refuge was glaciated in the Pleistocene and is dominated by Bearpaw shale (Graetz and Graetz 1999). Just one large perennial stream, the Musselshell River, enters the Missouri River or Fort Peck Reservoir. The streams we sampled were third and

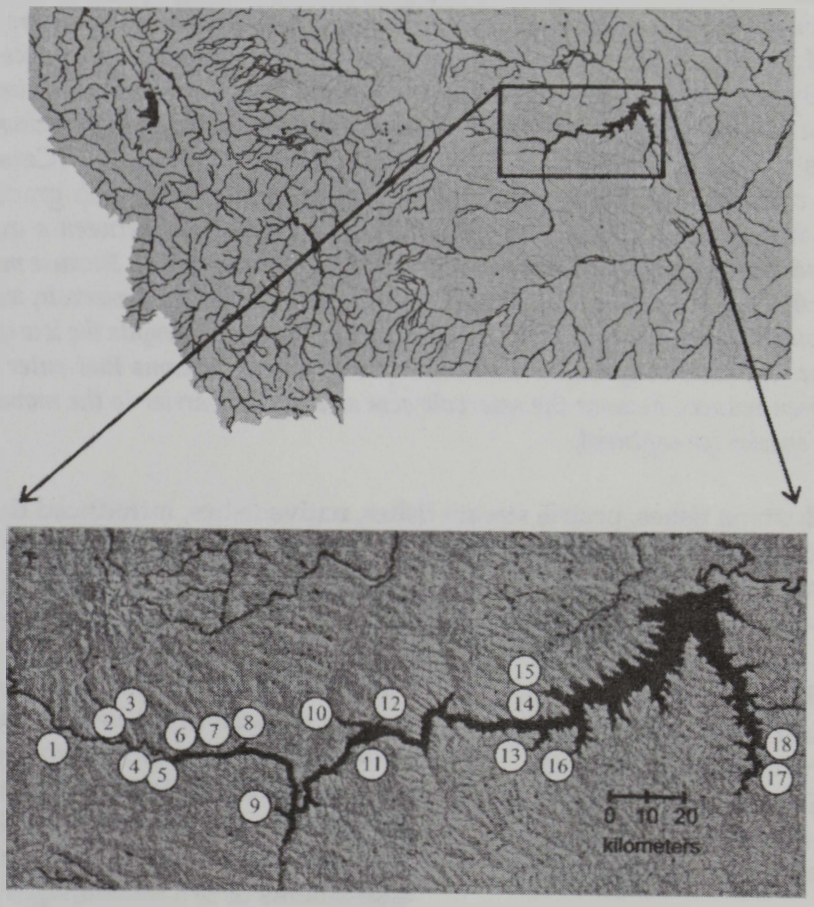


*Figure 1. Map of study area. Open circles indicate locations of sites sampled during survey of Charles M. Russell National Wildlife Refuge during July 1999. Site 1 = Armells Creek, Site 2 = Siparyann Creek, Site 3 = Rock Creek, Site 4 = Sand Creek, Site 5 = Carroll Coulee, Site 6 = Sevenmile Creek, Site 7 = CK Creek, Site 8 = Beauchamp Creek, Site 9 = Crooked Creek, Site 10 = Fourchette Creek, Site 11 = Devils Creek, Site 12 = Kill Woman Creek, Site 13 = Snow Creek, Site 14 = Carpenter Creek, Site 15 = Sutherland Creek, Site 16 = Hell Creek, Site 17 = Nelson Creek, Site 18 = McGuire Creek.*

fourth order (intermittent tributaries counted when determining stream order) streams. The majority of the streams we sampled have headwaters on the prairie, whereas three streams have headwaters in the Little Rocky or Judith mountains.

Of 29 streams identified by CMRNWR personnel as possibly supporting fish populations, 18 were selected for sampling (Fig. 1). The sites were stratified to ensure good geographic coverage. We sampled the streams in July 1999.

At each site, we walked about 1.6 km along the stream to determine if water was present and to select a representative reach for sampling. We sampled a reach that was 40 times the average wetted width of the stream, a length normally adequate to capture 90 percent of the fish species present in a stream (Lazorchak *et al.* 1998). At sites with mean wetted width of < 4 m, we sampled a minimum reach length of 150 m. All streams were sampled within 3.2 km of the Missouri River or Fort Peck Reservoir, except Rock Creek, which was sampled 6.2 km above the Missouri River and Beauchamp Creek, which was sampled 8.0 km above Fort Peck Reservoir.

Fish were captured by seining with a 3.6, 4.6, or 9.1 m long by 0.9 m tall seine with 6.4 mm mesh. Block nets were placed at the upstream and downstream end of the sampled reach in streams with continuous water. All fish captured were identified to species in the field, except the genus *Hybognathus*. Fishes of this genus are difficult to identify to species in the field, so we preserved 20-36 individuals in 10 percent buffered formalin and determined species identity in the laboratory. The proportion of each *Hybognathus* sp. in the subsample was then multiplied by the total *Hybognathus* spp. in the sample to extrapolate an estimate for the total number of each *Hybognathus* sp. at the site. The single *Phoxinus* sp. we captured was also preserved and identified in the laboratory. While sampling for fish and traveling between sites, we recorded observations of the presence of amphibians and reptiles.

A rapid visual habitat assessment was performed on each of the streams following the U.S. Environmental Protection Agency's (USEPA) wadeable streams protocol (Lazorchak *et al.* 1998). This habitat assessment included 12 parameters; each parameter was evaluated visually and rated in terms of habitat quality on a scale of 0 to 20, yielding a total possible score of 240. Total scores were categorized as poor (0-60), marginal (61-120), sub-optimal (121-180), or optimal (181-240). The relationships between total habitat scores and the number of fish species captured and the number of individual fish captured were examined using linear regression.

# RESULTS

## Fish Surveys

A total of 4,376 fish comprising 19 species was captured. Fourteen of the species captured were native to Montana; the remaining five were introduced species (Brown 1971, Holton and Johnson 1996). The 19 fish species belonged to six families (Table 1): Cyprinidae (12 species), Catostomidae (three species), Ictaluridae (one species), Cyprinodontidae (one species), Gasterosteidae (one species), and Centrarchidae (one species).

Eighteen streams were sampled; 13 had fish present and five had no fish present (Table 2). Most streams with fish were not flowing during sampling; fish were captured in residual pools separated by dry reaches. Only two streams (Nelson and Rock creeks) had flowing water during sampling. Of the streams without fish, two streams had some water present in isolated pools, and three streams had no water present in the reach that we examined. The

**Table 1.** *Fish species captured during a survey of the Charles M. Russell National Wildlife Refuge, Montana, 13-27 July , 1999.*

| Family/species | | Native or introduced |
|---|---|---|
| Cyprinidae | | |
| lake chub | *Couesius plumbeus* | native |
| common carp | *Cyprinus carpio* | introduced |
| western silvery minnow | *Hybognathus argyritis* | native |
| brassy minnow | *Hybognathus hankinsoni* | native |
| plains minnow | *Hybognathus placitus* | native |
| spottail shiner | *Notropis hudsonius* | introduced |
| sand shiner | *Notropis stramineus* | native |
| Northern redbelly x finescale dace | *Phoxinus eos x P. neogaeus* | native |
| fathead minnow | *Pimephales promelas* | native |
| flathead chub | *Platygobio gracilis* | native |
| longnose dace | *Rhinichthys cataractae* | native |
| creek chub | *Semotilus atromaculatus* | native |
| Catostomidae | | |
| river carpsucker | *Carpoides carpio* | native |
| longnose sucker | *Catostomus catostomus* | native |
| white sucker | *Catostomus commersoni* | native |
| Ictaluridae | | |
| black bullhead | *Ameiurus melas* | introduced |
| Cyprinodontidae | | |
| plains killifish | *Fundulus zebrinus* | introduced |
| Gasterosteidae | | |
| brook stickleback | *Culaea inconstans* | native |
| Centrarchidae | | |
| green sunfish | *Lepomis cyanellus* | introduced |

number of species captured at each site ranged from one to 12, and the number of individuals captured ranged from one to 899. Nelson Creek had 12 species; Crooked Creek had 10 species; Beauchamp and Armells creek had eight species; Fourchette Creek had seven species; Hell Creek had six species; CK and Rock creeks had five species; Sutherland Creek had four species; McGuire Creek had three species; Kill Woman Creek had two species; and Siparyann and Snow creeks had one species. Sand Creek and Carroll Coulee had some water present as isolated pools but no fish, and Carpenter, Devils, and Sevenmile creeks had no water present.

Fathead minnow (*Pimephales promelas*) were the most common fish captured; they were present at 10 of 13 sites with fish present (Table 2). Other common species (captured at five or more sites) were plains minnow (*Hybognathus placitus*), lake chub (*Couesius plumbeus*), white sucker (*Catostomus commersoni*), common carp (*Cyprinus carpio*), flathead chub (*Platygobio gracilis*), and longnose dace (*Rhinichthys cataractae*; Table 2). Rare species (captured at ≤4 sites) included sand shiner (*Notropis stramineus*), longnose sucker (*Catostomus catostomus*), river carpsucker (*Carpoides carpio*), western silvery minnow (*Hybognathus argyritis*), black bullhead (*Ameiurus melas*), brassy minnow (*H. hankinsoni*), spottail shiner (*N. hudsonius*), creek chub (*Semotilus atromaculatus*), brook stickleback (*Culaea inconstans*), green

sunfish (*Lepomis cyanellus*), northern redbelly X finescale dace hybrid (*Phoxinus eos* X *P. neogaeus*), and plains killifish (*Fundulus zebrinus*; Table 2).

We observed three species of adult frogs and toads (northern leopard frog, *Rana pipiens*; Woodhouse's toad, *Bufo woodhousei*; and Great Plains toad, *Bufo cognatus*), unidentified tadpoles and toadlets, one salamander species (tiger salamander, *Ambystoma tigrinum*), one lizard species (short-horned lizard, *Phyrnosoma douglasi*), and three snake species (plains garter snake, *Thamnophis radix*; racer, *Coluber constrictor*; western rattlesnake, *Crotalus viridis*).

## Habitat Surveys

Habitat assessments were performed on 14 creeks. Composite habitat scores ranged from 79 (33%) to 191 (80%) of 240 possible points (Table 3). One stream had a score in the optimal range, nine streams scored in the suboptimal range, and four streams scored in the marginal range. No streams scored in the poor habitat range.

## Relationships Between Habitat and Fish

Linear regression revealed positive relationships between total habitat score and number of fish species and number of individual fish captured. The relationship for total habitat score and number of fish species captured approached statistical significance ($P = 0.09$, $r^2 = 0.22$), whereas the relationship for total habitat score and number of individuals captured was weaker ($P = 0.27$, $r^2 = 0.10$).

# Discussion

Despite low quantities of water, the majority of streams we sampled supported fish, and most streams had multiple year classes of fish. Invertebrates, amphibians, and reptiles also were common in and around these streams. Although at least 14 species of nonnative fish have been introduced into Fort Peck Reservoir (Alvord 1979, Needham and Gilge 1982), the ichthyofauna of the small streams of the CMRNWR was dominated by native species. Fourteen of 19 species, and 87 percent of individual fish captured in this survey were native species. Seven of 13 streams had no introduced species, and no stream had more than two introduced species. Only one site (Armells Creek) had over 50 percent of individuals as introduced species. We expect the extreme environmental conditions typical of intermittent prairie streams, such as low water quantities, high water temperatures, and high flow variability (Paloumpis 1958, Matthews 1988, Zale *et al.* 1989) also are normal in the small streams of the CMRNWR. These conditions probably prevent establishment of all but the most tolerant introduced species, such as common carp, black bullhead, plains killifish, and green sunfish.

Factors that may influence fish species richness and abundance in small streams of the CMRNWR include frequency and magnitude of stream flow, stream size, i.e., stream order, habitat quality, and connectivity to other streams or Fort Peck Reservoir. Despite dry periods when aquatic habitat is limited to residual pools (Paloumpis 1958, Zale *et al.* 1989, Bramblett and Fausch 1991), and disturbances such as floods (Fausch and Bramblett 1991), fishes often persist in the residual isolated pools of intermittent streams. However, intermittent prairie stream pools normally have lower species richness (Paloumpis 1958, Metcalf 1959, Kuehne 1962, Harrel *et al.* 1967, Horwitz 1978) and higher variability in species presence/absence and abundance (Fausch and Bramblett 1991) than larger, more stable, and perennial downstream reaches. Only two streams, Nelson and Rock creeks were flowing at the time of our survey. Nelson Creek had the highest species richness (12 species) and Rock Creek had six species. However, because five non-flowing streams had

**Table 2.** *Numbers of fish captured in each stream on the Charles M. Russell National Wildlife Refuge, Montana, 13-27 July, 1999.*

| | Species[1] | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Site, Date | BB | BM[2] | BS | CC | CR | FM | FC | GS | JS | LC | LD | LS | PH | PK | PM[2] | RC | SS | SH | SM[2] | WS | Totals |
| Armells, 7/27/99 | 0 | 0 | 0 | 158 | 0 | 6 | 40 | 0 | 22 | 0 | 0 | 2 | 0 | 0 | 20 | 3 | 0 | 0 | 31 | 0 | 282 |
| Beauchamp, 7/22/99 | 0 | 17 | 5 | 0 | 0 | 92 | 0 | 0 | 0 | 105 | 56 | 0 | 0 | 0 | 235 | 0 | 78 | 0 | 0 | 54 | 642 |
| Carpenter, 7/14/99 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Carroll, 7/25/99 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CK, 7/22/99 | 0 | 0 | 0 | 0 | 0 | 15 | 0 | 0 | 0 | 45 | 0 | 2 | 0 | 0 | 101 | 0 | 0 | 0 | 0 | 2 | 165 |
| Crooked, 7/24/99 | 0 | 0 | 0 | 1 | 0 | 138 | 3 | 3 | 0 | 60 | 9 | 0 | 0 | 0 | 265 | 24 | 153 | 0 | 0 | 68 | 724 |
| Devil's, 7/26/99 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Fourchette, 7/23/99 | 24 | 0 | 0 | 300 | 0 | 213 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 57 | 0 | 0 | 0 | 114 | 8 | 717 |
| Hell, 7/15/99 | 0 | 0 | 0 | 0 | 0 | 49 | 144 | 0 | 0 | 191 | 9 | 0 | 0 | 0 | 155 | 0 | 13 | 0 | 0 | 0 | 561 |
| Kill Woman, 7/13/99 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 40 | 0 | 0 | 0 | 0 | 0 | 43 |
| McGuire, 7/16/99 | 0 | 0 | 0 | 2 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 16 | 0 | 0 | 0 | 0 | 0 | 20 |
| Nelson, 7/16/99 | 7 | 0 | 0 | 0 | 11 | 149 | 2 | 0 | 0 | 13 | 2 | 2 | 0 | 1 | 572 | 1 | 118 | 0 | 0 | 21 | 899 |
| Rock, 7/21/99 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 3 | 85 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8 | 99 |
| Sand, 7/25/99 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sevenmile, 7/21/99 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Siparyann, 7/20/99 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Snow, 7/15/99 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 24 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 24 |
| Sutherland, 7/14/99 | 0 | 0 | 0 | 2 | 0 | 106 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 80 | 4 | 0 | 192 |
| Total captured | 31 | 18 | 5 | 463 | 11 | 773 | 190 | 3 | 23 | 442 | 161 | 6 | 1 | 1 | 1461 | 28 | 362 | 80 | 149 | 161 | 4376 |
| No. of sites where present | 2 | 2 | 1 | 5 | 1 | 10 | 5 | 1 | 2 | 7 | 5 | 3 | 1 | 1 | 9 | 3 | 4 | 1 | 3 | 6 | |
| Mean total length | 83 | 72 | 41 | 64 | 114 | 71 | 71 | 103 | NM[4] | 71 | 61 | 116 | 56 | 55 | 71 | 105 | 52 | 61 | 102 | 115 | |
| SD[3] total length | 44 | 4 | 3 | 104 | 28 | 7 | 18 | 37 | | 20 | 10 | 21 | | | 9 | 16 | 4 | 11 | 18 | 52 | |
| Range of total length | 20-198 | 69-75 | 39-45 | 25-500 | 60-175 | 32-77 | 37-132 | 75-145 | | 35-180 | 34-90 | 82-144 | | | 30-111 | 72-132 | 39-68 | 52-95 | 79-136 | 35-250 | |

[1] BB = black bullhead (*Ameiurus melas*); BM = brassy minnow (*Hybognathus hankinsoni*); BS = brook stickleback (*Culaea inconstans*); CC = common carp (*Cyprinus carpio*); CR = creek chub (*Semotilus atromaculatus*); FM = fathead minnow (*Pimephales promelas*); FC = flathead chub (*Platygobio gracilis*); GS = green sunfish (*Lepomis cyanellus*); JS = juvenile sucker (*Catostomus spp.*); LC = lake chub (*Couesius plumbeus*); LD = longnose dace (*Rhinichthys cataractae*); LS = longnose sucker (*Catostomus catostomus*); PH = northern redbelly x finescale dace hybrid *(Phoxinus eos x P. neogaeus)*; PK = plains killifish (*Fundulus zebrinus*); PM = plains minnow (*Hybognathus placitus*); RC = river carpsucker (*Carpoides carpio*); SS = sand shiner (*Notropis stramineus*); SH = spottail shiner (*Notropis hudsonius*); SM = western silvery minnow (*Hybognathus argyritis*); WS = white sucker (*Catostomus commersoni*).

[2] The number of brassy minnow, plains minnow, and western silvery minnow in each sample was estimated by identifying species of a subsample of up to 36 fish in the laboratory and extrapolating the ratio of each species at the site to the total *Hybognathus* spp. sample for that site.

[3] SD = standard deviation

[4] NM = not measured

**Table 3.** *Rapid habitat assessment scores for streams sampled on the Charles M. Russell National Wildlife Refuge, Montana, 13-27 July, 1999. Total scores were categorized as poor (0-60), marginal (61-120), suboptimal (121-180), or optimal (181-240).*

| | Habitat parameter[1] | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Site, Date | | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | Total |
| Armells, 7/27/99 | 10 | 11 | 10 | 9 | 20 | 8 | 10 | 5 | 13 | 16 | 16 | 5 | 133 |
| Beauchamp, 7/22/99 | 16 | 11 | 12 | 12 | 20 | 13 | 12 | 8 | 12 | 16 | 16 | 5 | 153 |
| Carroll, 7/25/99 | | | 11 | | 20 | 10 | 8 | | 8 | 8 | 8 | 2 | 79 |
| CK, 7/22/99 | 5 | 6 | 12 | 5 | 20 | 7 | 7 | 3 | 6 | 5 | 8 | 2 | 86 |
| Crooked, 7/24/99 | 11 | 11 | 16 | 11 | 20 | 13 | 10 | 5 | 11 | 12 | 19 | 4 | 143 |
| Fourchette, 7/23/99 | 8 | 7 | 7 | 11 | 20 | 7 | 6 | 4 | 9 | 10 | 16 | 2 | 107 |
| Hell, 7/15/99 | 13 | 13 | 11 | 6 | 20 | 7 | 8 | 5 | 12 | 18 | 20 | 5 | 138 |
| Kill Woman, 7/13/99 | 15 | 13 | 12 | 16 | 20 | 10 | 14 | 5 | 6 | 11 | 16 | 20 | 158 |
| McGuire, 7/16/99 | 13 | 9 | 8 | 2 | 20 | 3 | 8 | 2 | 16 | 18 | 18 | 5 | 122 |
| Nelson, 7/16/99 | 17 | 17 | 15 | 17 | 20 | 12 | 8 | 13 | 16 | 18 | 18 | 8 | 179 |
| Rock, 7/21/99 | 16 | 16 | 16 | 16 | 20 | 15 | 8 | 16 | 18 | 20 | 20 | 10 | 191 |
| Sand, 7/25/99 | 9 | 10 | 13 | 8 | 20 | 13 | 15 | 2 | 13 | 15 | 16 | 5 | 139 |
| Snow, 7/15/99 | | 6 | 8 | | 20 | 6 | 7 | | 13 | 16 | 16 | 3 | 98 |
| Sutherland, 7/14/99 | 13 | 3 | 16 | 13 | 20 | 14 | 6 | 4 | 12 | 20 | 20 | 6 | 147 |

[1] Habitat parameters: 1 = Instream cover; 2 = Epifaunal substrate; 3 = Pool substrate characterization; 4 = Pool variability; 5 = Channel alteration; 6 = Sediment deposition; 7 = Channel sinuosity; 8 = Channel flow status; 9 = Condition of banks; 10 = Bank vegetative protection; 11 = Grazing or other disruptive pressure; 12 = Riparian vegetation width. See Lazorchack *et al.* (1998) for detailed description of habitat parameters and scoring methodology.

equal or higher species richness than Rock Creek, flow status alone did not account for species richness.

Fish species richness in a drainage basin generally increases with increasing stream order (Kuehne 1962, Schlosser 1982, Fausch *et al.* 1984, Rahel and Hubert 1991). Increased fish species diversity in higher order streams has been attributed to increased habitat diversity (Gorman and Karr 1978) or moderation of environmental conditions and increased volume of habitat (Rahel and Hubert 1991). However, local geomorphic conditions may reduce species richness in downstream reaches in some prairie streams (Barfoot and White 2000). All of the streams we sampled were third or fourth order, but they varied in the amount of water

present. For example, Devil's and Nelson creeks were both third order streams, but Devil's Creek was completely dry in the reach we surveyed whereas Nelson Creek had flowing water and supported 12 species of fish. Because we did not take quantitative depth and wetted width measurements, we could not examine statistical relationships between amount of water present and species richness and abundance. However, our observations suggest a generally positive relationship between the amount of water present and species richness.

The rough correlation between Rapid Habitat Assessment scores and species richness suggests that habitat quality was one factor influencing the number of species that the streams supported. Other studies have demonstrated that fish species richness increases with increased habitat diversity and quality in warmwater streams (Gorman and Karr 1978, Schlosser 1982). The relationship we observed for habitat scores and number of individuals was weaker than the relationship between habitat quality scores and species richness. This is not unexpected, because abundance of individuals generally is more variable than presence or absence of species in streams (Karr and Chu 1999).

Species richness also may be seasonally elevated in adventitious streams, i.e., small feeder tributaries of a much larger stream or reservoir, because of increased connectivity to larger bodies of water that harbor a larger species pool (Gorman 1986). Because all of the sites we sampled (except Beauchamp and Rock creeks) were located roughly the same distance upstream of either Fort Peck Reservoir or the Missouri River, all had similar connectivity to larger bodies of water. Because of their proximity, the fish we captured may complete parts of their life cycles in Fort Peck Reservoir or the Missouri River.

However, most of the species we captured apparently are more common in small streams than in the adjacent Missouri River or Fort Peck Reservoir because only common carp, river carpsucker, white sucker, and flathead chub were abundant (>100 individuals captured) in 142 seine hauls at 19 locations in Fort Peck Reservoir in 1981 (Needham and Gilge 1982), and only three (common carp, river carpsucker, and white sucker) of the 19 species of fish captured in this study are reported as being abundant in Fort Peck Reservoir (Alvord 1979). Also, in the reach of the Missouri River adjacent to the tributaries we sampled, of these 19 species, only western silvery minnow and flathead chub were abundant during a three-year survey of fish using multiple gear types (Lee Bergstedt, Montana Cooperative Fishery Research Unit, personal communication). Thus, we suspect that most fish species we captured are capable of completing their life cycles within the small streams we sampled. Moreover, the presence of multiple year classes in most streams sampled suggests that these streams provide year-round habitat for fish. Possible exceptions to year-round small stream residency on the CMRNWR are spottail shiner, which was introduced to Fort Peck Reservoir in 1985 and prefers large, clear rivers (Holton and Johnson 1996), western silvery minnow, which are thought to prefer larger rivers and creeks (Brown 1971, Cross and Collins 1995), and longnose sucker, which generally prefers cooler water (Brown 1971, Scott and Crossman 1973, Baxter and Stone 1995).

Prior to damming of the Missouri River to form Fort Peck Reservoir, fish populations of the adventitious streams flowing into the reservoir may have had a metapopulation (Hanski and Gilpin 1991) structure. Because of limited quantities of water, fish assemblages in these streams are vulnerable to local

extinction from drought, water withdrawals or lowered water tables. Though many of the species we captured are not abundant in the Missouri River, the river probably serves as an occasional corridor between the small streams. Currently, the open lentic waters of Fort Peck Reservoir, with its large populations of introduced piscivorous game fish, including northern pike (*Esox lucius*), walleye (*Stizostedion vitreum*), and smallmouth bass (*Micropterus dolomieui*), may be more of a barrier to movements than a corridor between the streams. Although no obvious relationship between species richness and connection with the Missouri River versus connection with Fort Peck Reservoir is currently evident, future recolonization may be more difficult than before construction of Fort Peck Dam.

We captured three fish taxa that are either of special concern or on watch lists. The northern redbelly dace X finescale dace hybrid is a Class C Montana Fish of Special Concern (Hunter 1997). Class C species have "Limited numbers and/or limited habitats in Montana; widespread and numerous in North America as a whole. Elimination from Montana would be only a minor loss to the gene pool of the species". This taxon is likely very rare on the CMRNWR; we captured only a single individual. The plains minnow and the western silvery minnow are currently listed on the Montana Natural Heritage Program Watch List. The Watch List lists species for one or more of the following reasons: "there are indications that the species may be less common than currently thought; the species is currently declining in Montana or across much of their range; or there is so little information available that they cannot be adequately ranked" (Montana Natural Heritage Program 1999). However, plains minnow populations appear reasonably secure on the CMRNWR because they were the most abundant species captured, and they occurred at 9 of 13 sites with fish present in this survey. The western silvery minnow was fairly rare, as we captured this species at only three sites, although it is probably more common in the Missouri River than in the small streams we sampled (Grisak 1996).

The small streams of the CMRNWR supported fairly diverse assemblages of native fish, amphibians, and reptiles that constitute an important component of the Refuge's biodiversity. Fish abundance and diversity may be related to habitat quality and water quantity. Because of limited water quantities in these streams, biological assemblages are probably vulnerable to extirpation from drought, water withdrawals, or lowered water tables. Moreover, reduced connectivity of streams caused by Fort Peck Reservoir may increase the difficulty of recolonization following local extinctions. Our initial survey represented only a "snapshot" of conditions; a temporally and spatially expanded survey would increase our understanding of the status and variability of fish assemblages in the small streams of the CMRNWR.

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