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Fish Associated with Dikes, Revetments, and Abandoned Channels in the Middle Missouri River[1]

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Fish associated with dikes, revetments, and abandoned channels along the Iowa-Nebraska portion of the Missouri River were collected by seining, electrofishing, and hoop netting in June, August, and October 1983. Samples collected by seining dike fields and abandoned channels were dominated by Cyprinidae and Centrarchidae. Electrofishing samples were dominated by flathead catfish (*Pylodictus olivaris*), goldeye (*Hiodon alosoides*), common carp (*Cyprinus carpio*), river carpsucker, (*Carpiodes carpio*), gizzard shad (*Dorosoma cepedianum*), and blue sucker (*Cycleptus elongatus*) in dike fields and revetted banks and by gizzard shad, river carpsucker, and bigmouth buffalo (*Ictiobus cyprinellus*) in the abandoned channels. Among fish collected in unbaited hoop nets, blue suckers and channel catfish (*Ictalurus punctatus*) were prevalent in dike fields; blue suckers, flathead catfish, and shortnose gar (*Lepisosteus platostomus*) along revetted banks; and white crappie (*Pomoxis annualaris*), black crappie (*P. nigromaculatus*), river carpsucker, black bullhead (*Ictalurus melas*), bigmouth buffalo, and gizzard shad in abandoned channels. Gear selectivity and differences in sampling efficiency in the diverse riverine habitats precluded statistical comparisons of most samples and stressed the need for development of improved sampling techniques and designs for large-river fishery research.

INDEX DESCRIPTORS: Missouri River, fish, hoop net, electrofishing, seine.

The Missouri River has undergone many man-made changes since the Lewis and Clark explorations of 1804-1806. Physical modification of the channel began in 1832 with the removal of snags to facilitate steamboat travel (Burke and Robinson 1979). In 1912, Congress authorized the U.S. Army Corps of Engineers to stabilize the river banks and provide a navigation channel 1.8 m (6 ft) deep and 61 m (200 ft) wide from Kansas City to the mouth. Six large multipurpose reservoirs were constructed on the upper Missouri River from 1940-1964. The river is unencumbered from Gavins Point Dam at Yankton, South Dakota, to its mouth 1390 km downstream. The Rivers and Harbors Act of 1945 resulted in the extension of the navigation channel upstream to Sioux City, Iowa, and increased the channel depth to 2.7 m (9 ft) and its width to 91.4 m (300 ft). The navigation channel was developed and is maintained by dikes and revetments that concentrate the river flow and force it to scour out a deep channel.

River channelization and the construction of dams has resulted in a shorter, narrower channel with reduced fluctuations in flow rate. Between 1923 and 1976, the Iowa-Nebraska portion of the Missouri River decreased 9% (29 km) in length, in water area by 66% (12,200 ha), and channel area by 80%. Channelization also resulted in nearly total elimination of islands and sand bar areas, which once covered 4700 and 8100 ha, respectively (Hallberg et al. 1979).

Channelization and the accompanying decrease in habitat variability decreased the abundance and diversity of fish (Funk and Robinson 1974). Fish are more abundant in the unchannelized than in the channelized reaches of the river (Schmulbach et al. 1975). Groen and Schmulbach (1978) reported larger catches, harvest rates, and numbers of fish per kilometer of stream, and larger average sizes of fish creeled in the unchannelized than the channelized river. Morris (1969) estimated that twice as many flathead catfish (scientific names of fishes are shown in Table 1) occur per kilometer in the unchannelized than in the channelized river.

Most studies of fish in the Missouri River have concentrated on population estimates and various aspects of the life history and biology of common fish species. Relatively few investigators have assessed the impacts of various channelization structures on the diversity and biotic integrity of riverine fish communities. The purpose of this study was to attempt to describe fish populations associated with dike, revetment, and abandoned channel habitats along the portion of the Missouri River bordered by Iowa and Nebraska.

METHODS

The study was conducted on the Missouri River between river miles 661 and 678. Fish communities were assessed in two dike fields reasonably close together between river miles 676.5 and 678; along two revetted banks opposite respective dike fields; and in two abandoned channels (bodies of water connected to the main stem of the river but having no current at normal river stages) near river miles 661 and 671. Sampling was conducted during June, August, and October 1983.

Fish were collected by seining, electrofishing, and hoop netting. All three habitats were sampled during each sampling month by each technique, except that the revetted bank habitat could not be seined because the water was too deep and the current too strong.

The dike field and abandoned channel habitats were sampled with common sense minnow seines 4.6 m long and 1.2 m deep, having 3.2 mm square mesh. The standard effort was a 15-m haul of the net; a total of 96 seine hauls was made. Seining in the dike fields was with the current; width of the hauls varied because the shoreline gradient was steep.

A pulsed DC shocker (336-504 V, 8.2 A) mounted on a boat was used for electrofishing. Four transects were sampled at each site. The boat was drifted downstream at the prevailing current speed in the dike fields and along the revetments. A constant speed was maintained in the abandoned channels where there was no current. The average time spent electrofishing each transect was approximately 3 minutes along revetted banks and dikes and 4 minutes in abandoned channels. A total of 72 electrofishing samples was taken during this study (at three habitats, two sites per habitat, and four transects per site during each of the three sampling periods).

Hoop nets (0.9 m diameter; 25-mm square mesh netting) were fished at eight locations per site. Nets were unbaited and set at each location for two consecutive 24-h periods and checked and emptied after each period. A total of 288 24-h sets was made.

Fish collected by each method were identified, and weighed and measured (total length). Fish collected by seining were preserved in 10% buffered formalin and later transferred to 45% isopropanol for storage.

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RESULTS

Cyprinidae and Centrarchidae dominated the 28 species of fish collected by seining the dike fields and abandoned channels (Table 1). We collected a total of 873 fish from the dike fields and 829 fish from the abandoned channels in the total of 48 seine hauls made in each habitat during the three sampling periods. Most of the non-cyprinid fishes caught were juveniles and included many young-of-the-year.

Cyprinids composed 87% of the fish collected with seines in the dike fields; sand shiners contributed 33% of the total catch, emerald shiners 26%, red shiners 13%, and fathead minnows 9%. The gizzard shad was the most abundant non-cyprinid, but constituted only 7% of the total catch. The catch of each species varied greatly with sampling period.

Centrachids constituted 60% and cyprinids 31% of the seine catch in abandoned channels (Table 1). Juvenile bluegills made up 42% of the catch, white crappies 15%, red shiners 13%, and emerald shiners 10%. All of the red shiners and most of the emerald shiners and sand shiners were caught in June, and all of the gizzard shad and most of the bluegills and white crappies in August. The catch in October was small and made up only 6.6% of the total fish collected from the abandoned channels by seining.

We collected 631 fish representing 22 species during the total of 72 electrofishing runs in the three habitats (Table 1). Of the 78 fish captured in the dike fields, the most abundant were goldeyes (24%), gizzard shad (18%), river carpsuckers (13%), flathed catfish (13%), and common carp (12%). No major seasonal trends in abundance were evident in the 12 species collected.

Electrofishing along revetted banks yielded 197 fish of 15 species

Table 1. Number of fish of different species collected with different gears in three habitats — dike field (DF), abandoned channel (AC), and revetted bank (RB) — of the Missouri River, River Mile 661-678, in 1983.

		Seine		Hoop Net			Electrofishing		
Common Name	Scientific Name	DF	AC	DF	AC	RB	DF	AC	RB
Gizzard shad	*Dorosoma cepedianum*	57	42	13	27	0	14	160	21
Shovelnose sturgeon	*Scaphirhynchus platorynchus*	0	0	7	1	14	0	0	0
Longnose gar	*Lepisosteus osseus*	0	0	1	0	3	0	0	0
Shortnose gar	*Lepisosteus platostomus*	0	0	3	7	21	0	4	2
Goldeye	*Hiodon alosoides*	0	0	13	0	6	19	1	27
Rainbow smelt	*Osmerus mordax*	8	0	0	0	0	0	0	0
Central stoneroller	*Campostoma anomalum*	2	0	0	0	0	0	0	0
Common carp	*Cyprinus carpio*	1	2	3	11	1	9	54	28
Speckled chub	*Hybopsis aestivalis*	2	0	0	0	0	0	0	0
Silver chub	*Hybopsis storeriana*	20	0	0	0	0	0	0	0
Shiner	*Notropis* spp.	10	13	0	0	0	0	0	0
Emerald shiner	*Notropis atherinoides*	223	81	0	0	0	0	0	0
River shiner	*Notropis blennius*	6	0	0	0	0	0	0	0
Red shiner	*Notropis lutrensis*	113	108	0	0	0	0	0	0
Spotfin shiner	*Notropis spilopterus*	0	1	0	0	0	0	0	0
Bigmouth shiner	*Notropis dorsalis*	12	0	0	0	0	0	0	0
Sand shiner	*Notropis stramineus*	285	39	0	0	0	0	0	0
Fathead minnow	*Pimephales promelas*	81	11	0	0	0	0	0	0
River carpsucker	*Carpiodes carpio*	37	4	0	0	0	0	6	1
Quillback	*Carpiodes cyprinus*	0	0	0	77	5	10	42	17
Smallmouth buffalo	*Ictiobus bubalus*	0	0	3	9	1	3	6	3
Bigmouth buffalo	*Ictiobus cyprinellus*	0	0	0	27	0	0	36	6
River redhorse	*Moxostoma carinatum*	0	1	0	0	0	0	0	0
Shorthead redhorse	*Moxostoma macrolepidotum*	0	0	3	1	6	2	0	12
Golden redhorse	*Moxostoma erythrurum*	4	1	0	0	0	0	0	0
Blue sucker	*Cycleptus elongatus*	0	0	67	0	155	4	0	22
Channel catfish	*Ictalurus punctatus*	1	0	43	7	14	0	0	2
Black bullhead	*Ictalurus melas*	0	0	0	48	0	0	10	0
Flathead catfish	*Pylodictus olivaris*	0	0	13	0	30	10	0	52
White bass	*Morone chrysops*	5	6	0	0	2	1	4	1
Green sunfish	*Lepomis cyanellus*	3	8	0	0	0	0	2	0
Orangespotted sunfish	*Lepomis humilis*	0	8	0	0	0	0	0	0
Bluegill	*Lepomis macrochirus*	0	347	1	23	0	0	14	0
Largemouth bass	*Micropterus salmoides*	0	7	0	1	0	0	5	0
Smallmouth bass	*Micropterus dolomieui*	0	0	0	1	0	0	0	0
White crappie	*Pomoxis annularis*	1	127	5	105	1	1	6	0
Black crappie	*Poxomis nigromaculatus*	0	4	0	43	1	0	0	0
Yellow perch	*Perca flavescens*	0	2	0	0	0	0	1	0
Sauger	*Stizostedion canadense*	1	0	0	0	0	0	1	2
Walleye	*Stizostedion vitreum*	0	2	1	0	1	1	1	0
Sauger × Walleye		0	0	0	0	0	1	0	0
Freshwater drum	*Aplodinotus grunniens*	1	15	1	3	5	3	3	1
TOTAL		873	829	177	391	266	78	356	197

(Table 1). Six species dominated the catch: flathead catfish (26% of the total), common carp (14%), goldeyes (14%), blue suckers (11%), gizzard shad (11%), and river carpsuckers (9%). Most of the flathead catfish were caught in August, and most of the gizzard shad and common carp in October.

Among the habitats sampled by electrofishing, the abandoned channel sites yielded the largest catch: 356 fish representing 17 species (Table 1). Gizzard shad were most abundant (46% of the catch; 88% of them captured in October). Common carp contributed 15% of the catch, river carpsuckers 12%, and bigmouth buffalo 10%.

A total of 834 fish divided among 22 species were caught in the 288 hoop-net sets (Table 1). In the dike fields, which yielded 177 fish of 14 species, blue suckers contributed 41% (of which 69% were caught in October) and channel catfish 26%.

In hoop-net samples along revetted banks blue suckers composed 58% of the 266 fish of 16 species collected (Table 1). They were well represented in the catch at each site and in each sampling period, but the largest catch occurred in October. Flathead catfish were most abundant in the collections in August and shortnose gars were most plentiful in October.

Among 391 fish of 16 species taken in hoop nets set in abandoned channels (Table 1), the six most abundant species were white crappies (27% of the total catch), river carpsuckers (20%), black bullheads (12%), black crappies (11%), bigmouth buffalo (7%), and gizzard shad (7%). All these species were most prevalent in June samples.

Only the data on catch per unit effort (CPE) from hoop nets (the number of fish captured per net per 24-h set) could be statistically analyzed. All habitats were sampled, and effort (numbers of 24-h sets) was equal at each site. In contrast to the passive sampling technique of hoop netting, seining and electrofishing are active sampling methods greatly affected by current speed, water depth, and the efficiency of sampling personnel. Large differences in efficiency of sampling in the various riverine habitats made sound comparison of CPE information obtained from these techniques impossible.

Few consistent differences in species composition were found between habitat types (ANOVA, $P>0.05$). However, as we expected, blue suckers, channel catfish, and flathed catfish were most abundant in fast waters of the revetted banks and dike fields and were seldom found in the lentic waters of the abandoned channels. River carpsuckers, black bullheads, bluegills, white crappies, and black crappies primarily inhabited abandoned channels.

Seasonal changes did not statistically affect the composition of the catch within a habitat; the high variability in CPE between sites weakened any statistical comparisons of CPE within a habitat between months. Consequently, catches in individual months are not shown in Table 1. The only statistically significant seasonal effect on catches in abandoned channels was a greater abundance of bluegills in hoop nets in June than in August or October. In the dike fields, the catch of channel catfish was significantly greater in June than in other sampling periods. No seasonal trends were evident in species collected along the revetted banks.

DISCUSSION

In comparison to other riverine systems, relatively little fishery research has been carried out on the Iowa-Nebraska portion of the Missouri River. Schmulbach et al. (1975) caught 44 species of fish along the Missouri River between Sioux City, Iowa, and Rulo, Nebraska. Kallemeyn and Novotny (1977) collected 39 species from sites between river miles 704 and 709 below Sioux City, Iowa and Hesse et al. (1982) found 59 species of fish in the river between river miles 532 and 645. We found 39 species. Sampling methodologies, however, differed greatly from study to study, as did sampling effort, making meaningful comparisons of results difficult or impossible.

The channelized portions of the Missouri River — especially those along the revetted banks — are difficult to sample and provide relatively poor fish habitats. Although current velocity along revetments was extremely swift (> 2 m/sec) and little fish cover was evident, we captured more fish (in both numbers of individuals and species) by electrofishing and hoop netting these areas than in the more physically diverse and protected dike pool habitats. The revetted bank samples were dominated by larger species, such as blue suckers and flathead catfish, which are well adapted for life in open, rapidly flowing water.

The dike fields had a similar assemblage of larger species predominantly composed of blue suckers, channel catfish, flathead catfish, and goldeyes. The quieter waters of the dike fields also provide habitat for a wide variety of minnows. Emerald shiners, sand shiners, and fathead minnows were most abundant in the seine samples. Kallemeyn and Novotny (1977) also found emerald shiners and sand shiners common in the channelized reaches, in addition to river shiners and red shiners. Rainbow smelt, not reported previously by Hesse et al. (1982), Schmulbach et al. (1975), or Kallemeyn and Novotny (1977), but captured in our June seine samples, probably came from the upstream impoundments where they had been stocked. Because of the large number of dikes along the river, the dike pools probably are important habitats for the production of fish more adapted to slower current — i.e., species that were once plentiful around sand bars and islands.

In previous investigations by Hesse et al. (1982), Kallemeyn and Novotny (1977), and Schmulbach et al. (1975) channel catfish were more prominent in the catch than they were in our study. In these other investigations, however, the hoop nets were baited with cheese, thus presumably attracting channel catfish. Our hoop nets were unbaited. The high relative abundance of blue suckers along the revetments and in the dike fields also was in contrast to findings in previous studies. Large numbers of this species were not previously reported, and Schmulbach et al. (1975) listed it as uncommon. Kallemeyn and Novotny (1977) reported that blue suckers preferred habitats with swift currents; 75% of the blue suckers they caught were from the revetted habitat.

Abandoned channels yielded the greatest species richness and greatest numbers of fish. These sites were productive areas for species typically found in lentic habitats, including gizzard shad, sunfishes, and some minnows. Although abandoned channels are the most productive sites that we studied, so few of these habitats remain that their current importance to the river fishery is debatable. Abandoned channels are vulnerable to drainage, siltation, and complete separation from the main stem of the river. As more abandoned channels lose interaction with the main channel, reductions in total river fish production may become even more evident.

Gear selectivity and differences in sampling and gear efficiency were major confounding factors in evaluating fish communities during this study. As a result, large sample variability, both within and between habitats, precluded statistical comparison of catches. Consequently, our limited sampling efforts yielded only a qualitative description of fish communities in different habitats of the Missouri River and not quantitative estimates of species' relative abundance that could be used for management purposes. Two critical research needs in large-river fishery research remain: (1) the development of improved techniques for sampling physically diverse riverine habitats, and (2) studies of sample sizes required to yield CPE data of satisfactory precision and accuracy.

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REFERENCES

BURKE, T. D., and J. W. ROBINSON. 1979. River structure modifications to provide habitat diversity. Presented at: The Mitigation Symposium: a national workshop on mitigating losses of fish and wildlife habitats. Fort Collins, CO.

FUNK, J. L., and J. W. ROBINSON. 1974. Changes in the channel of the lower Missouri River and effects on fish and wildlife. Mo. Dep. Conserv. Aquat. Ser. 11. 52 pp.

GROEN, C. L., and J. C. SCHMULBACH. 1978. The sport fishety of the unchannelized and channelized middle Missouri River. Trans. Am. Fish. Soc. 107:412-418.

HALLBERG, G. R., J. M. HARBOUGH, and P. M. WITINK. 1979. Changes in the channel areas of the Missouri River in Iowa from 1879 to 1976. Iowa Geol. Surv. Spec. Rep. Ser. No. 1.

HESSE, L. W., Q. P. BLISS, and G. J. ZUERLEIN. 1982. Some aspects of the ecology of adult fishes in the channelized Missouri River with special reference to the effects of two nuclear power generating stations, In: Hesse, L.W., G. L. Hergenrader, H. S. Lewis, S. D. Reetz, and A. E. Schlesinger (Eds.), The Middle Missouri River. The Missouri River study group, Norfolk, Nebraska.

KALLEMEYN, L. W., and J. F. NOVOTNY. 1977. Fish and food organisms in various habitats of the Missouri River in South Dakota, Nebraska, and Iowa. FWS/OBS-77/25, OBS National Stream Alteration Team, Columbia, Missouri.

MORRIS, L. A. 1969. Flathead catfish investigations in the Missouri River. Project No. F4R 14, Job No. 23. Nebraska Game and Parks Commission, Lincoln, Nebraska.

SCHMULBACH, J. C., G. GOULD, and C. L. GROEN. 1975. Relative abundance and distribution of fishes in the Missouri River Gavins Point Dam to Rulo, Nebraska. Proc. S. D. Acad. Sci. 54:194-222.