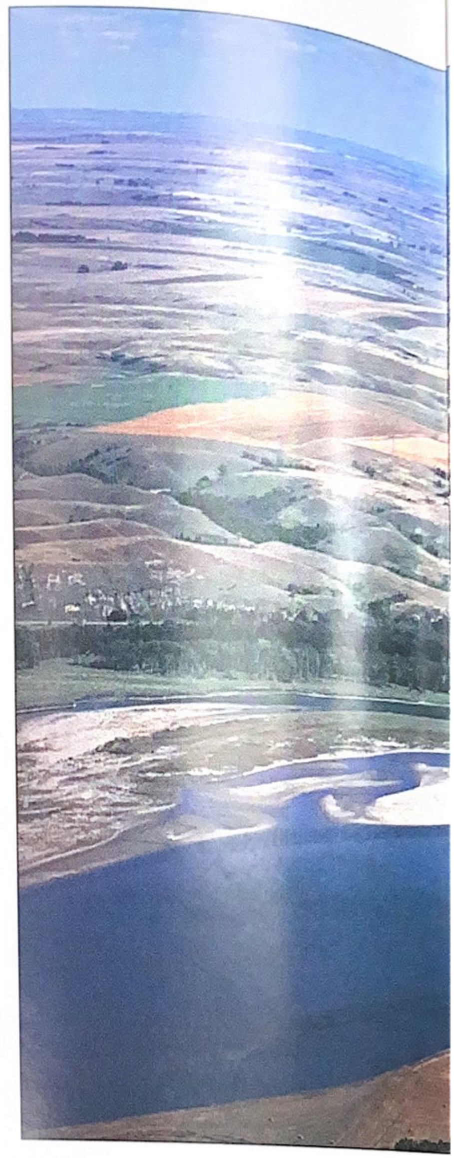
Missouri River Fishes:

Big Changes in the Big Muddy

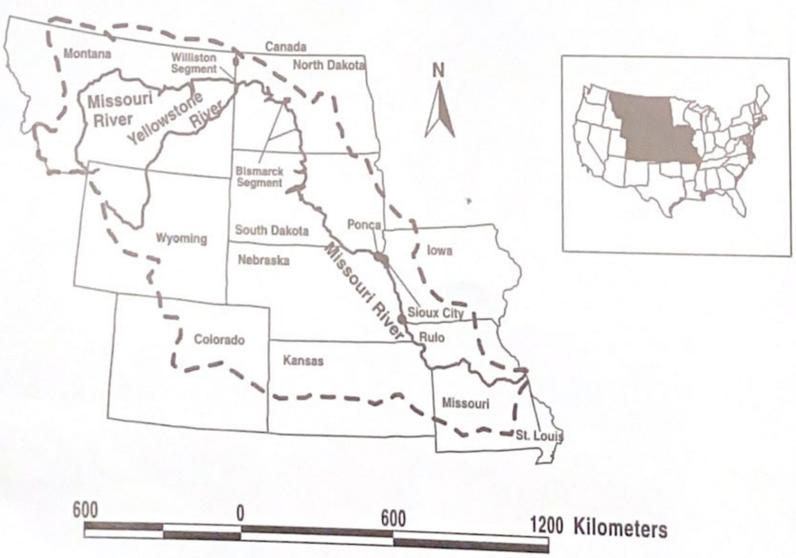
By Dennis Scarnecchia, Scott Everett, Tim Welker and Fred Ryckman

"From an aesthetic point of view, the Missouri River has an unenviable reputation. People who never see it except in crossing railroad bridges, from which they look down into a mass of muddy, eddying water, are liable to compare it unfavorably with other important streams. But to him who is fortunate enough to travel upon it, and to study it in all its phases, it is not only an attractive stream, but one of great scenic beauty."

– Hiram Chittenden, History of Early Steamboat Navigation on the Missouri River, 1903.

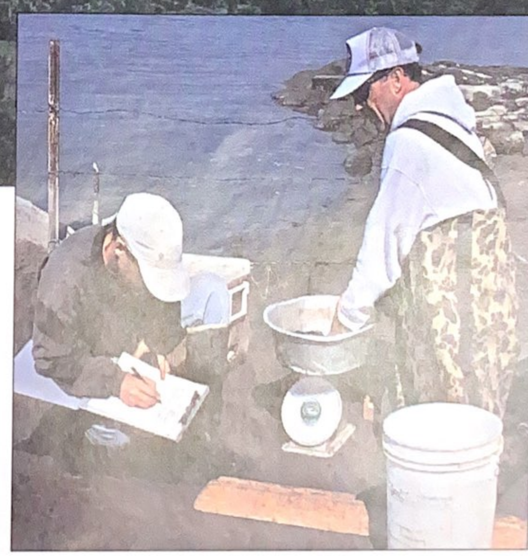


The Missouri River Basin



Few, if any, American rivers have been as important to our nation's historical development as the Missouri River. From its origin at Three Forks, Montana to its confluence with the Mississippi River at St. Louis, it is the longest river (2,340 miles) in the United States. To early fur traders and entrepreneurs, the Missouri was a dark, murky, snag-infested, unpredictable, and unforgiving conduit whose mysteries challenged the most able explorers and steamboat navigators of the day.

Since as early as 1830, industrial and agricultural society has tried to control it, shape it, contain it, dredge it, and stabilize its banks. Channel alterations have been a federal activity since the 1880s, first by the Missouri River Commission and later by the U.S. Army Corps of Engineers. The construction of six main-stem dams for flood control, hydropower,



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irrigation, water quality, and recreation has impounded one third of the length of the river, and extensive bank stabilization and channelization (channel straightening and deepening) has impacted much of the rest of the river.

Despite these changes, few major rivers are so little understood. This is especially so for the fishes and other aquatic life that live in and along the river. How the river functions for the array of fish and other organisms inhabiting it is just now being studied in detail.

The Missouri River in North Dakota today consists of two remnant flowing segments: from the Montana-Dakota border to the headwaters of Lake Sakakawea (called here the Williston segment), and from Garrison Dam to the headwaters of Lake Oahe (called here the Bismarck segment). The Williston segment still has, for the most part, a natural runoff pattern with May and June rises, a variety of fast and slow water habitats, a natural temperature regime, turbid waters, and shifting banks.

The 10 miles of free-flowing lower Yellowstone River within North Dakota also retains habitat closely resembling that of the pre-dam Missouri River. In contrast, rip-rap has stabilized banks along the Bismarck segment, permitting less hydraulic diversity than in the Williston segment. In addition, sediment trapped by Garrison Dam and unnatural releases of water from the bottom of Lake Sakakawea have not only altered runoff patterns, but given rise to a colder, clearer, and deeper river.

Above: The Missouri River runs clear and cold downstream from Garrison Dam.

Inset: Tim Welker, left and Fred Ryckman record data from sampled fish taken from the Bismarck segment.

In the past decade, several agencies, including the North Dakota Game and Fish Department, have increased their commitment to maintaining Missouri River habitat quality for future generations. In addition to efforts on game fishes, they have sought to better understand how all native Missouri River fishes have adapted to its shifting, turbid waters. Results of two recently completed studies highlight uniqueness of native Missouri River fishes and the influence of habitat changes on native fish in the Williston and Bismarck segments.

For example, consider the sicklefin chub and sturgeon chub, two native minnows formerly widespread throughout the Missouri River, but now much rarer in most locations basin-wide. As adaptations to the Big Muddy, both species have small eyes, reduced optic lobes in their brains, and many sensory bumps called papillae on their undersides, in their mouths, and on their heads and fins. They both have lean, sleek bodies with specially-shaped fins to withstand fast current. Not more than a decade ago, little was known about the status or habitat use of these species. However, improved effectiveness of sampling both species, using a benthic trawl, has enabled biologists in North Dakota to more accurately determine their distribution and abundance in the state, as well as define their habitat needs.

Recent studies have shown that even though both species have disappeared throughout much of the Missouri River basin, they remain widespread, though not abundant, throughout the Williston segment and lower Yellowstone rivers in North Dakota. Not surprisingly, these two river segments retain most of the natural runoff patterns, turbidity, and temperature conditions to which the fish had adapted.

We found both species most often in main channel and sandbar habitats where waters were turbid and fast-moving. However, the precise habitats occupied by each species were slightly different. Sicklefin chubs were most often found as waters became deeper, whereas sturgeon chubs were most often found as waters became shallower.

Two other native minnows, the flathead chub and western silvery minnow, were also collected in the Williston segment. These two species, in relation to the sicklefin and sturgeon chubs, used slower-moving waters. Thus, each of the four species each used distinct portions of the diverse habitat available in the Williston segment.

Natural erosion along the Bismarck segment.

Riprap bank stabilization along the Bismarck segment. Extensive riprapped shoreline, while protecting crops planted near the river, impedes the natural functioning of the river to the detriment of most native fish species. Riprap also causes the bank to erode elsewhere, leading to the need for more riprap.

The fish community in the Bismarck segment, below the dam, was completely different from the Williston segment. Despite extensive sampling, none of the four small minnow species found in the Williston segment was found in the Bismarck segment. The colder, clearer, and faster water of the Bismarck segment no longer favored these species. Replacing them were a few emerald shiners, spottail shiners, and fathead minnows. We still do not know exactly why the four minnow species have disappeared from the Bismarck segment. Perhaps the unnatural water releases prevent successful spawning, or perhaps the clearer waters below the dam make these small minnows easy prey to sight-feeding predators such as sauger.

Other remarkable species differences were found between the two segments. In the Williston segment, deep-bodied suckers such as bigmouth and smallmouth buffalo and river carpsuckers made up 94 percent of the sucker catch. High concentrations of microscopic zooplankton, a primary food source, may have contributed to their prevalence in this segment. In contrast, longnose suckers and white suckers dominated the Bismarck segment, making up 98 percent of the sucker catch there. These species fed more on aquatic insects and algae rather than zooplankton, which was scarcer in the Bismarck segment than in the Williston segment.

Another species, the shovelnose sturgeon, grew more rapidly in the Williston segment than the Bismarck segment and ultimately grew up to six inches longer in the Williston segment. The exact reasons for the slower growth in the Bismarck segment are not known. Slower growth might result from less food or higher energy demands for fish in the fast-moving, scoured-out main channel. Slower growth can lead to delayed maturation, delayed spawning, and a less productive fish stock.

The shifting, turbid channel of the Williston segment supports not only native minnows, but several other fish that thrive in turbid water, such as paddlefish, shovelnose sturgeon, and the endangered pallid sturgeon. These fishes have small eyes, and detect food not by sight but by other means such as taste and electrical senses. Such species are now much scarcer or absent in the clearer Bismarck segment, favored by fish species that feed by sight.

A natural river provides a variety of habitats, both slow and fast, clear and turbid, for a variety of species. In the more natural Williston segment, we found an array of sleek, streamlined species such as the sicklefin chub, sturgeon chub, and blue sucker in the fast-moving main channel, along with blockier, less streamlined species such as the buffalofishes in the side channels and backwaters. In contrast, the Bismarck segment, which had less diversity of depths and velocities, had less diversity of fish inhabiting it.

The ongoing challenge for the North Dakota Game and Fish Department is to maintain native fishes and their habitats while society continues to use the waters of the Missouri River for important industrial and agricultural uses. Studies to date have indicated that maintaining a natural flow pattern, natural temperature regime, naturally high levels of sediment, and a freely shifting channel (rather than rip-rapping) are important to the survival of many Missouri River native fishes in North Dakota. Such studies are beginning to clear up some of the mystery surrounding the Big Changes in the Big Muddy.

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Below: The turbid water habitats of the Williston segment are important to maintaining a diversity of native fish species. Inset: Native fishes such as the sicklefin chub, sturgeon chub, and other species are adapted to these waters.

Inset: Dennis Scarnecchia

Fred Ryckman