An Altered River

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In the past, when I thought of rivers, I thought of water. I thought of drinking water, cooling off on a hot summer day, or needing protection from it during a flood. But when it comes to rivers like the Missouri, I've learned that it is also important to think about sediment. This understanding has led me to believe that our Missouri River is no longer what it once was.

The Missouri River is an alluvial river, meaning its bed and banks are made up of sediment that can be shaped by the flow of water. Alluvial rivers are frequently compared to conveyor belts, moving water and sediment downstream. The amount and timing of river flows, amount and type of sediment from a river's watershed, the material making up the riverbed and banks, and vegetation around the river will determine the shape the river takes. The study of how these factors come together and result in a particular river form is called fluvial geomorphology.

You might ask, "but rivers are always changing, what's the point in guessing the form it will take?" You're right in that rivers are always changing. However, if there's little disturbance to the river (like changes to its typical flows or the amount of sediment supplied to it, or both as we will see later) over time, an alluvial river will find a "dynamic equilibrium".[1]

This means the river may change its location in its floodplain, but things like river channel width and depth, average bed sediment size, riverbed slope, and riparian (area influenced by water around the waterbody) vegetation types will stay generally stable through time. Understanding what a river's stable form "should have been" can give us an idea of just how disturbed a river is and what it would need to look and function like to be considered in equilibrium again.

The Missouri River in North Dakota took its current route about 13,000 years ago. I'd recommend John Bluemle's book, North Dakota's Geologic Legacy, for more details on how the Missouri River formed in North Dakota. The river had likely found a dynamic equilibrium between that time and the near present. Features of the earlier river included: two high flow periods where water and sediment routinely escaped the river banks and spilled onto the floodplain, one in the spring from the melting plains snowpack and one in the early summer from the melting Rocky Mountain snowpack; large amounts of sediment supplied to the river by its bed and banks (the "Big Muddy"); islands within the river channel; a meandering river that frequently formed and exposed unvegetated sediment; and many trees within its floodplain. Meriwether Lewis' journals also note the extensive amount of wildlife seen along the river during the time of the Lewis and Clark Expedition.

Today's Missouri River is changed. Six major dams constructed along the river's mainstem, including the Garrison Dam in North Dakota, provide many benefits like flood control, power generation and recreation. But those benefits come at a cost.

Dams alter river flows, typically by capturing floodwaters in their reservoirs and then metering out the water over time. Dams and their reservoirs also act like sediment traps, capturing nearly 100% of the sediment that would have passed by the dam site historically.[2] Given these significant changes in the flow and sediment of rivers, and now, your familiarity with the principles of fluvial geomorphology, you can see how a dam can easily disturb a river.

The United States Geological Survey completed a study in 2013 to understand how dams have changed the Missouri River in North Dakota.[3] It found that the river was in a mainly erosional state from the

Garrison Dam to about 60 miles downstream of it; in a sort of equilibrium for the next 30 miles including the Bismarck-Mandan area; and that sediment was building up in the river channel downstream from Bismarck-Mandan because of the Lake Oahe reservoir. The study noted that this last point was significant because ice jam flooding, like that in Bismarck-Mandan in March 2009, may become more probable with time.

The 2013 study and another in 2016 indicated the river channel has not migrated significantly since the mid-1970s due to a combination of factors, including the river channel cutting down in its bed because of Garrison Dam and bank stabilization structures built in the Garrison reach in the 1960s, 70s, and 80s.[4]

Additional studies have found the lack of river migration and prevention of out-of-bank flows by the Garrison Dam (the flooding of 2011 was an exception) has significantly impacted cottonwood trees' ability to regenerate along the river.[5, 6] Young cottonwoods are not replacing the old ones and this should be seriously concerning to us. Johnson et al. points out the importance of cottonwood forests by saying, "Riparian forests in drylands are especially valued for their high biodiversity; these forests may cover only 1% of the landscape area but support – for example – more bird species than all other vegetation types combined."

A North Dakota Game and Fish Department (NDGFD) report points out that cottonwoods are particularly important because they're a "foundation species".[8] Foundation species structure plant and animal communities within an ecosystem.[9] The NDGFD report notes, "changes in the abundance and distribution of cottonwood trees can have far reaching impacts on riparian ecosystem processes and biodiversity."[10 s]

It's clear that the Missouri River has changed. Some parts of the river are eroding while others are experiencing sediment deposition. The river's floodplain forest is changing too. Cottonwood forests keep our landscapes vibrant and teeming with wildlife. Given that so many of our state's economic and recreational opportunities are dependent on natural resources, we would be wise to take care of those which have outsized impacts on the whole, like the Missouri River.

Luckily, the people of North Dakota have an opportunity to come together and think of solutions to our problems. An example could be a "Cottonwood Task Force". Members of the public, local groups, state, and federal agencies with knowledge of the river would come together to understand our cottonwood issue, set goals for the future, and work to meet those goals.

North Dakota Department of Water Resources Director Andrea Travnicek said, "We should do all we can to help the Missouri River reach its highest potential. We should seek creative solutions that balance human considerations with the ecological health of the river. North Dakota's long-term health depends on the Missouri River's health."

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