Does anybody give a dam? Long-term impact of large impoundments on the Des Moines River, Iowa, USA

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Multi-dam complexes are common in the United States but are poorly studied in comparison to river reaches impacted by a single dam. In central Iowa, the Des Moines River is controlled by two large impoundments, constructed during the mid-20th Century for flood control. Saylorville Dam and Red Rock Dam bound the city of Des Moines, Iowa, with one dam upstream and one downstream. In addition to a lack of literature about multi-dam complexes, few studies have examined the long-term impact of dams in the Upper Midwest. This led me to my summer research question: *How have Saylorville Dam and Red Rock Dam altered the hydrology and geomorphology of the Des Moines River since their completion?*

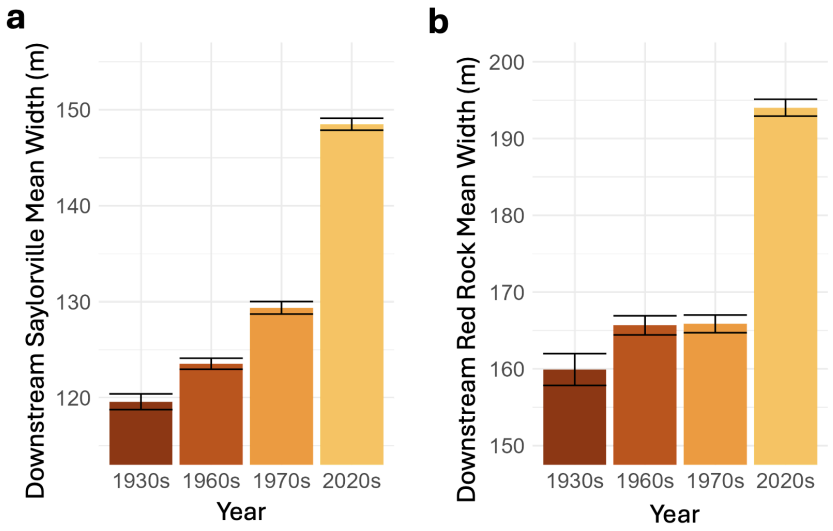

Figure 1. Mean channel width of the Des Moines River during four time periods, a) downstream of Saylorville (completed in 1977) and b) downstream of Red Rock (completed in 1969).

To assess the geomorphic evolution of the river, I analyzed aerial imagery spanning from the 1930s to the 2020s, including images before, between, and after the construction of the dams. The river channels were digitized in a geographic information system and analyzed using R package cmgo (Golly & Turowski, 2017), which calculated channel width and migration. Hydrologic analysis was done using stream gage data downstream of Saylorville, downstream of Red Rock, and on a relatively undammed tributary as a control.

The Des Moines River channel has widened since the 1930s. During the time in between the completion of both dams, widening slowed downstream of Red Rock and accelerated upstream, which is typical after completion of a flood control dam. However, the river quickly returned to even faster widening after both dams were completed, changing from a rate of 0.15% per year during the pre-dam period to 0.31-0.35% per year during the post-dam period. (Figure 1). Additionally, stream gauge data shows that annual peak discharge has remained stable or increased over time, despite the introduction of the flood control dams. Humans have directly rerouted, straightened, and constrained the planform of the river throughout the study region to prevent flooding in urban areas. Channel migration and meander cutoffs have also occurred without direct human influence in several places along the river (Figure 2).

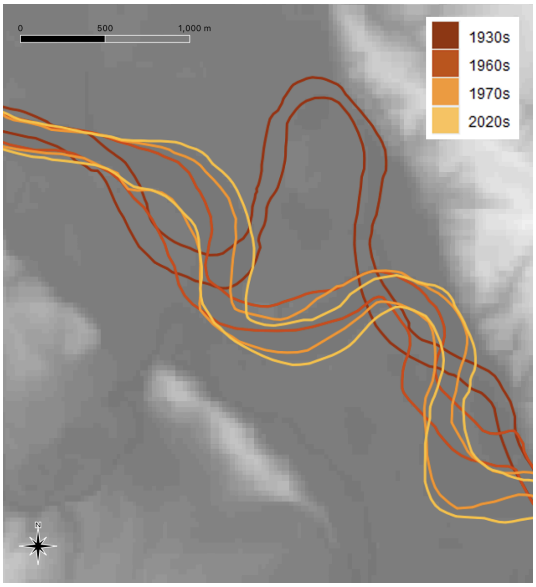

Figure 2. Aerial view of Des Moines River showing channel shape from 1930s to present, with darker shades being older and lighter shades being younger. The base layer is a digital elevation model; the darkey grey shows the floodplain. This image shows a meander cutoff ~8 km downstream of Red Rock.

These results add new insights to our understanding of hydrologic and geomorphic change in a region under intense pressure from urbanization, agriculture, and climate change and provide further context to our understanding of multi-dam systems and how humans interact with them.

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