

# Riparian vegetated area in pre-dam, post-dam, and environmental flow periods in Canyonlands National Park from 1940 to 2022

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## Abstract

The upper Colorado River is a highly regulated system that provides habitat for federally listed species, disproportionate number of flora and fauna and is the water supply for the western United States. River regulation has led to wide scale channel narrowing. Over the last three decades dams have been operated with a more natural hydrograph for environmental reasons. We sought to use remote imagery from 1940-2022 to examine rates of channel narrowing in the pre-dam, post-dam, and environmental flows eras along three river reaches in Canyonlands National Park. We found an increase in the vegetated area along the Colorado River (above the confluence with the Green River) and the Green River since 1940. We documented a 6.12% and 4.00% narrowing in the post-dam period and a 19.51% and 6.49% narrowing in the environmental flows period on the Colorado and Green Rivers, respectively. The Cataract Canyon reach (Colorado River below the confluence) has been stable since 1966. All three river reaches showed the slowest period of narrowing in the last 16 years of environmental flows that coincided with a large peakflow in 2011. All three reaches showed a decrease in vegetated area after the 2011 flood, followed by an increase in vegetated area to similar levels to before the 2011 flood. Environmental flows that mimic the natural hydrograph may have slowed channel narrowing, but it is clear that periodic large peaks are also necessary. Managers must be careful that any environmental flows that take from the spring peak are carefully considered.

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Figure 1. Green River, Colorado River, and Cataract Canyon (Colorado River below confluence of Green and Colorado Rivers) study reaches in Canyonlands National Park, Utah.

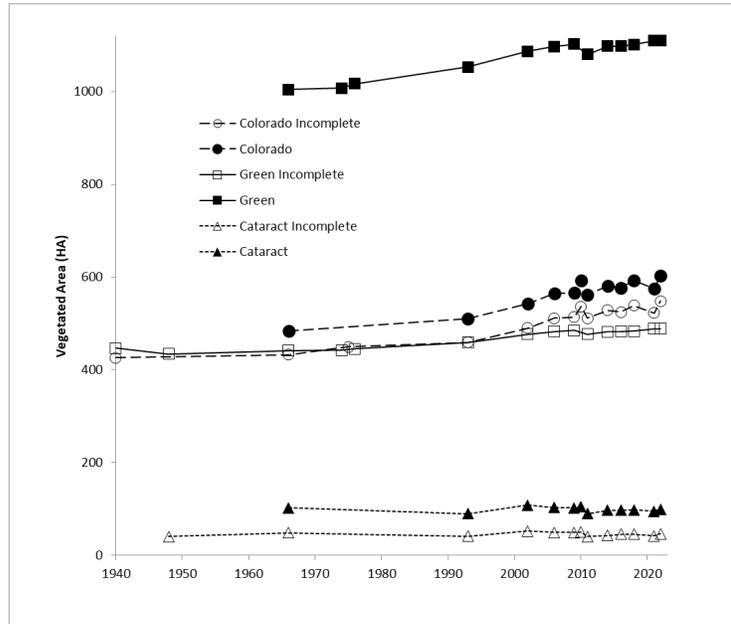


Figure 2. Incomplete imagery for vegetated hectares along the Colorado River, Green River, and Cataract Canyon in Canyonlands National Park 1940-2022 (unfilled markers) and complete imagery (filled markers) 1966-2022. Note that the shape of the incomplete and complete lines for each reach

demonstrating that the imagery back to 1940 is a good representation of the entire river reach.

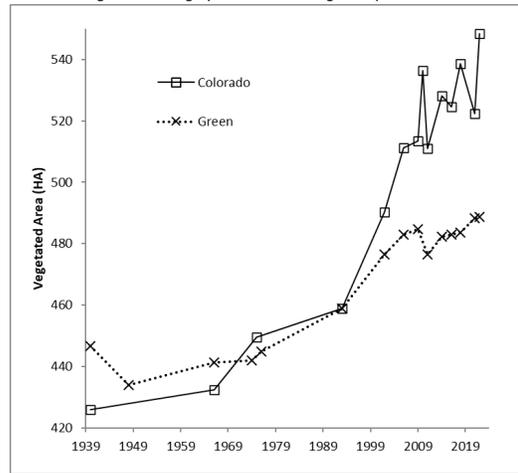


Figure 3. Vegetated hectares along the Green River (dashed line) and Colorado River (solid line) above the confluence with the Green River in Canyonlands National Park, 1940-2022. This shows a larger increase in vegetated area on the Colorado than on the Green. It also shows how both rivers have reacted similarly since the 2011 high flows.

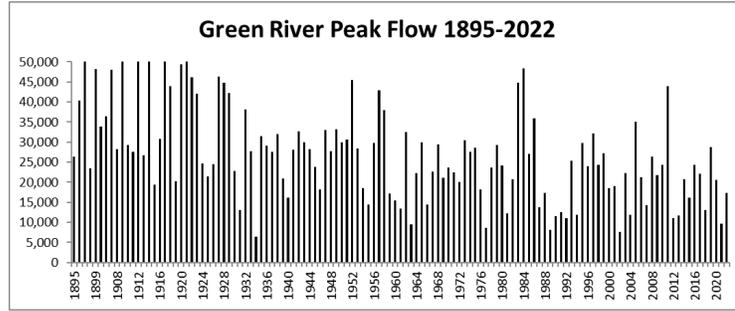


Figure 4. Peak flows of the Green River at Green River, Utah (station 09315000) from 1895 to 2022.

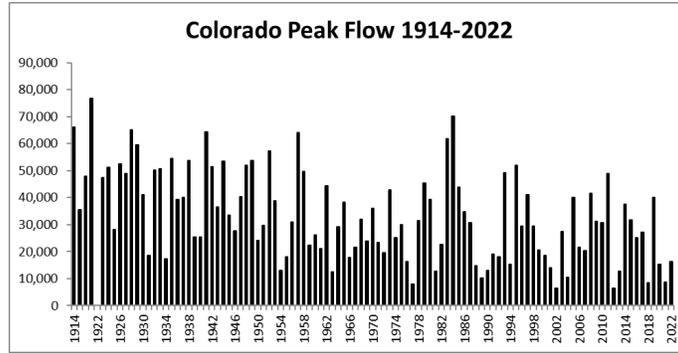


Figure 5. Peak flows of the Colorado River at Cisco, Utah (station 09180500) from 1914 to 2022.

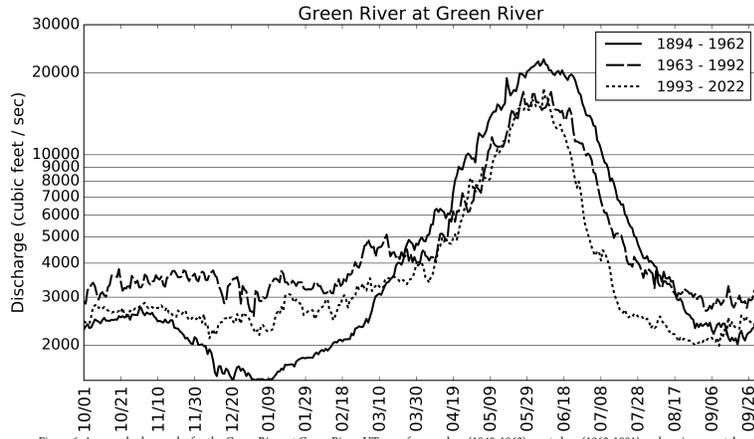


Figure 6. Average hydrographs for the Green River at Green River, UT gauge for pre-dam (1940-1962), post-dam (1963-1991) and environmental flows (1992-2022). Note that the peaks remain as high with environmental flows as pre-environmental flows, but the base flows in summer (July-Sep) are lower.

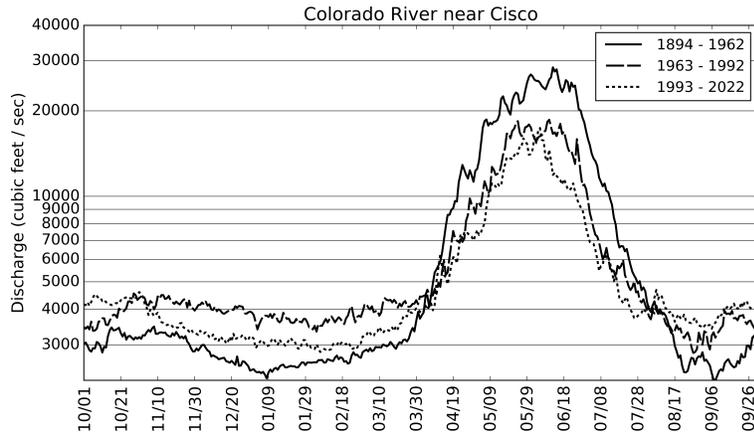


Figure 7. Average hydrographs for the Colorado River near Cisco, UT gauge for pre-dam (1940-1966), post-dam (1966-1991) and environmental flows (1992-2022). The peaks and the summer base flows are very similar between the post-dam and environmental flow periods.