Historic Sedimentation and Projected Future Recovery of Lake Powell's Tributary Canyons

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ABSTRACT

Following closure of Glen Canyon Dam in 1963 and the subsequent filling of Lake Powell reservoir, more than 180 upstream miles of Glen, Narrow, and Cataract Canyons on the Colorado River were inundated. This inundation extent also includes the downstream reaches of numerous tributary canyons that once entered the Colorado River. Today, each of these tributary canyons contains a delta where fine sediment from the upstream watershed accumulates. These tributary canyons were once unique parts of Glen Canyon, appreciated by Powell and others in the late 1800s and valued for their recreational, cultural, and biological significance. As water levels in Lake Powell have receded since 2000, there is public interest in whether, and over what time period, tributary streams might evacuate the accumulated delta sediment and recover some of their past biophysical characteristics. The amount of fine sediment that has accumulated in these tributary mouths varies greatly throughout Lake Powell. Thus, the amount of fine sediment that must be removed in order for restoration to occur varies greatly from place to place. Our assessment is based on analysis of repeat bathymetric and topographic data to quantify the thickness and rate of sediment accumulation in 27 tributary canyons. Long-term fine sediment accumulation rates in these deltas have varied greatly, from negligible annual accumulation to nearly 1 m/year sustained over more than 5 decades. We also assessed the potential for deltas to be evacuated by estimating the unit stream power of regular floods in each tributary canyon. These data allow us to estimate the relative timescales of recovery, or sediment evacuation, from each of the 27 tributary canyons. We also used archived hydrometeorological data to estimate the frequency of sediment mobilization events (i.e., flash floods) in tributaries across the tributary watersheds, providing an alternative estimate of the rate at which accumulated sediment may be evacuated. Future reservoir levels, and the duration of inundation of tributaries, will be determined by both climate-driven shifts in water runoff and water management decisions by stakeholders. This research provides context for the recovery timescales associated with sedimentation during periods of inundation, and thus may inform targeted management of Lake Powell's water levels so as to mitigate impacts on tributary resources.