

Cottonwood Mortality and Hydrologic Manipulation: A study of gradients and thresholds in regulated and natural flow regimes in northwest Colorado

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Abstract. Fremont cottonwood (*Populus deltoides* ssp. *wislizenii*) is a dominant species and the primary native riparian tree in the Upper Colorado River Basin. Creation and maintenance of cottonwood floodplain forests is dependent the dynamic relationship between tree physiology and river hydrology. We explore this relationship by relating basal area increment (BAI; a measure of growth) to hydrologic flow metrics. The three study sites represent a range of flow regulation: Brown's Park is on the highly regulated Green River below Flaming Gorge Dam, Deer Lodge Park is on the unregulated Yampa River, and Island Park lies below the confluence of these two rivers and is moderately regulated. Cottonwood BAI and river flow metrics are analyzed over nearly a century. The operation of the Flaming Gorge Dam since 1963 allows us to examine pre-post regulation rates of cottonwood growth *within* a site. With comparisons across study sites we identify differences *among* sites. Branch dieback is hypothesized as a mechanism for cottonwoods to survive periods of water stress. We examine the dates of branch dieback from trees at Brown's Park and correlate them to flow metrics to assist in identifying thresholds of water stress imposed by flow regulation that cause reduced growth. The hypothesis that BAI in mature trees is positively correlated with a more natural flow regime is supported by this work. A second hypothesis that mature trees that survived river regulation show reductions in BAI to a lower, sustainable level (perhaps through branch dieback) is also supported.