Ecosystem flow requirements for the Bill Williams River, Arizona, USA: a Sustainable Rivers Project

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ABSTRACT

The Nature Conservancy has developed an approach for defining "environmental flows" and is applying this to several rivers in the U.S. as a part of a collaboration with the U.S. Army Corps of Engineers known as the "Sustainable Rivers Project". The Sustainable Rivers Project is designed to evaluate, and if necessary, recommend changes to dam operations to restore and protect the health of rivers and surrounding natural areas while continuing to meet human needs for services such as flood control and power generation. The Bill Williams River downstream of Alamo Dam in western Arizona is one of the Sustainable Rivers Project's focus rivers. In this paper we provide details on 15 years of work done by the multiple government agency partnership known as the Bill Williams River Corridor Steering Committee. We review the physical, biological and linked models designed to evaluate system response to dam releases, and provide examples of the application of these modeling tools. Ecological flow requirements were estimated by teams of experts for representative taxa of interest from several biotic groups such as riparian vegetation, aquatic invertebrates, avifauna, and mammals. Tools that have been utilized to model the system have primarily been generated by the U.S. Army Corps of Engineers Hydrologic Engineering Center (HEC). Models include a one-dimensional hydraulic model with GIS integration capabilities based on LIght Detection And Ranging (LIDAR) generated topographic information (HEC-RAS); an operations simulation model (HEC-ResSim); and an integrated physical-biological model in which spatially specific biotic responses are predicted based upon quantitative estimates of ecosystem flow requirements (Ecosystem Functions Model or HEC-EFM). We present results of these linked models for predictions of woody riparian seedling establishment, development of aquatic habitat, delineation of bird habitat, and estimating the effects of beaver activity.