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A functional flows approach to selecting ecologically relevant flow metrics for environmental flow applications

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ABSTRACT

The science and practice of environmental flows have advanced significantly over the last several decades. Most environmental flow approaches require quantifying the relationships between hydrologic change and biologic response, but this can be challenging to determine and implement due to high data requirements, limited transferability, and the abundance of hydrologic metrics available for evaluation. We suggest that a functional flows approach, focusing on elements of the natural flow regime known to sustain important ecosystem processes, offers a pathway for linking understanding of ecosystem processes with discrete, quantifiable measures of the flow regime for a broad range of native taxa and assemblages. Functional flow components can be identified as distinct aspects of the annual hydrograph that support key biophysical processes, such as wet season flood flows or spring recession flows, and then quantified by flow metrics, such as 5% exceedance flow or daily percent decrease in flow, respectively. By selecting a discrete set of flow metrics that measure key functional flow components, the spatial and temporal complexity of flow regimes can be managed in a holistic manner supportive of multiple ecological processes and native aquatic species requirements. We provide an overview of the functional flows approach to selecting a defined set of flow metrics and illustrate its application in two seasonally variable stream systems. We further discuss how a functional flows approach can be utilized as a conceptual model both within and outside of existing environmental flow frameworks to guide consideration of ecological processes when designing prescribed flow regimes.