Reference SON: *Strategic initiative*

Lead PI: *Kyle McKay (ERDC)*

Project Development Team (PDT): *Bruce Pruitt, Craig Fischenich (ERDC), Jock Conyngham (ERDC), Tom Prebyl (U of GA)*

District Collaborators: *Brian Zettle (SAM), Mick Porter (SPA), Joshua Willis (SWG DA Intern)*

Other Partners: *Seth Wenger, Amy Rosemond, Caitlin Conn, Natalia Shim (U of Georgia), Mary Freeman, Brian Crawford (USGS), Rachel Katz (USFWS)*

Funded: *2013, 2015, 2016, 2017*

Keywords: *Hydrologic variability in aquatic systems, Temporal ecology, Environmental flows, Hydropeaking effects*

Wiki

Upcoming Activities

Reports/Interim Results

Images

Ecosystem Restoration in Variable Environments[1]

Research Need

Adequately accounting for environmental variability is a critical concern in quantifying long-term success of ecosystem restoration projects. Ecosystems and ecological processes experience numerous sources or expressions of periodic, stochastic, and catastrophic environmental variation (e.g., seasonal temperature dynamics, rainfall fluctuations, and large floods, respectively[2]. These dynamic environmental conditions lead to variable and uncertain ecological benefit provided by these systems. For instance, an arid stream may be a significant source of aquatic habitat during wet years, and a nearly dry riverbed during drought. Moreover, many restoration projects have operational elements that respond to, and are often designed to change, ambient conditions (e.g., diversion structures, flood control features, etc.). Additionally, climate and land use change may alter future levels of environmental variability and potentially increase uncertainty as ecological responses change and adjust.

In order to better design, efficiently operate, and adaptively manage project features to optimize environmental benefits, project planners and operational specialists require tools for responding to variability and disturbance (e.g., drought).

Project Objectives & Plan

This project seeks to provide a suite of techniques for quantifying and incorporating environmental variability into project planning. Three primary and several secondary deliverables are proposed for this project:

- Review the state-of-the-science and synthesize techniques for quantifying environmental variability.
- Review the role of variability in setting and crossing ecological thresholds, maintaining ecosystem resilience, and designing restoration projects accordingly.
- Develop a case study to demonstrate accounting for variability of environmental benefits of restoration projects.
- Present findings to users in webinars, conference presentations, and on-site demonstrations with collaborating field personnel.

Payoff

Understanding and quantifying variability is particularly important in non-stationary environments, which are the new norm in aquatic ecosystems[1]. Developing techniques for evaluating variability will help practitioners to plan and design for fluctuating environments, increase the resilience of restoration projects, and avoid negative thresholds in restoration outcomes.

Products

Journal Articles

McKay, S. Kyle (in review) Meaningless Mean Discharge for Environmental Flow Management, Journal of the American Water Resources Association.

Bhattacharjee N.V., Tollner E.W., Willis J.R., and McKay S.K. (Submitted) Applying environmental flow analysis and time series analysis for assessing economic development along selected river reaches. Journal of the American Water Resources Association.

Shrestha S., Dwivedi P., McKay S.K., and Radcliffe D. (Submitted) Hydrological impacts of changing land use and climate in the context of rising exports of wood pellets: A case study from the Oconee River Basin in Georgia. Science of the Total Environment.

Technical Reports (TRs)

McKay et al (In peer review 2017) Proctor Creek Ecological Model (PCEM): Phase 1 Site Screening. ERDC/EL TR-XX-XX, U.S. Army Engineer Research and Development Center, Vicksburg, Mississippi.

McKay et al (In peer review 2017) Proctor Creek Ecological Model (PCEM): Phase 2 Benefits Analysis. ERDC/EL TR-XX-XX, U.S. Army Engineer Research and Development Center, Vicksburg, Mississippi.

Touzinsky K. and McKay S.K. (in preparation) Conceptualizing variability in ecosystem restoration. ERDC TR-EMRRP. U.S. Army Engineer Research and Development Center, Vicksburg, Mississippi.

Pruitt B.A. and McKay S.K. (in preparation) Variability in hydraulic geometry relationships: Piedmont case study. ERDC TR-EMRRP. U.S. Army Engineer Research and Development Center, Vicksburg, Mississippi.

Technical Notes (TNs)

Bhattacharjee N.S., Willis J., Tollner E., and McKay S.K. (In review) Habitat provision under alternative environmental flow regimes. ERDC TN-EMRRP-SR. U.S. Army Engineer Research and Development Center, Vicksburg, Mississippi.

Conference Presentations/Webinars/Workshops

McKay Ecological Society of America 2015 presentation - Quantifying hydrologic variability

McKay/Conn 30 May 2017 ERDC Webinar – Using Ecosystem Functions to Inform Water Management Decisions (https://cw-environment.erdc.dren.mil/exchange.cfm?Option=Webinar&Type=Past&CoP=Env&Id=366&ICS=No)

McKay 25 Jul 2017 ERDC Webinar – Ecosystem Restoration Webinar Series – SMART Planning and Ecological Model Development – A Case Study in Proctor Creek, Atlanta, GA

McKay/Conn 19 Sept 2017 ERDC Webinar - Making Sense of Noisy Environmental Systems: Characterizing and Quantifying Variability (https://cw-environment.erdc.dren.mil/exchange.cfm?Option=Webinar&Type=Past&CoP=Env&Id=386&ICS=No)

The Messy Business of Urban Stream Restoration – A case study in the southeastern United States. IGB Leibniz-Institute of Freshwater Ecology and Inland Fisheries, October 2017, Berlin, Germany.

Capturing the Socio-Economic Payoff from Managing Rivers for Environmental Objectives. PIANC Smart Rivers, September 2017, Pittsburgh, Pennsylvania.

Trading-Off Socio-Economic and Ecological Outcomes Associated with Municipal Water Supply. Society for Freshwater Science, May 2017, Raleigh, North Carolina.

The Messy Business of Urban Stream Restoration in Proctor Creek, Atlanta. Symposium on Urban Stream Ecology, May 2017, Browns Summit, North Carolina.

[1]Project Alias – Work Unit Documentation Title: *Ecosystem restoration in variable environments*

[2] Milly P.C.D., Betancourt J., Falkenmark M., Hirsch R.M., Kundzewicz Z.W., Lettenmaier D.P., and Stouffer R.J. 2008. Stationarity is dead: Whither water management? Science, 319, 573-574.