Multi-use management in the Atchafalaya River Basin: Research at the confluence of public policy and ecosystem science

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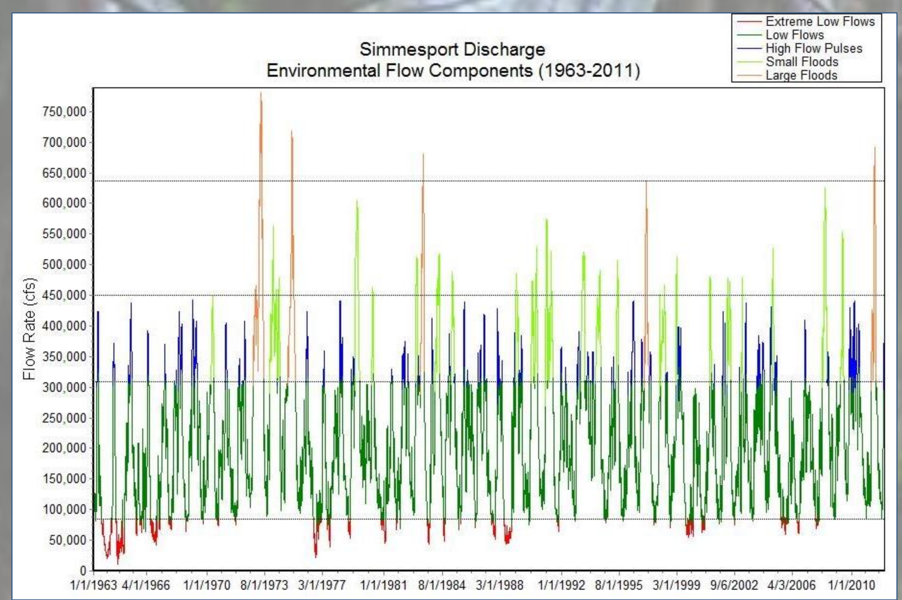
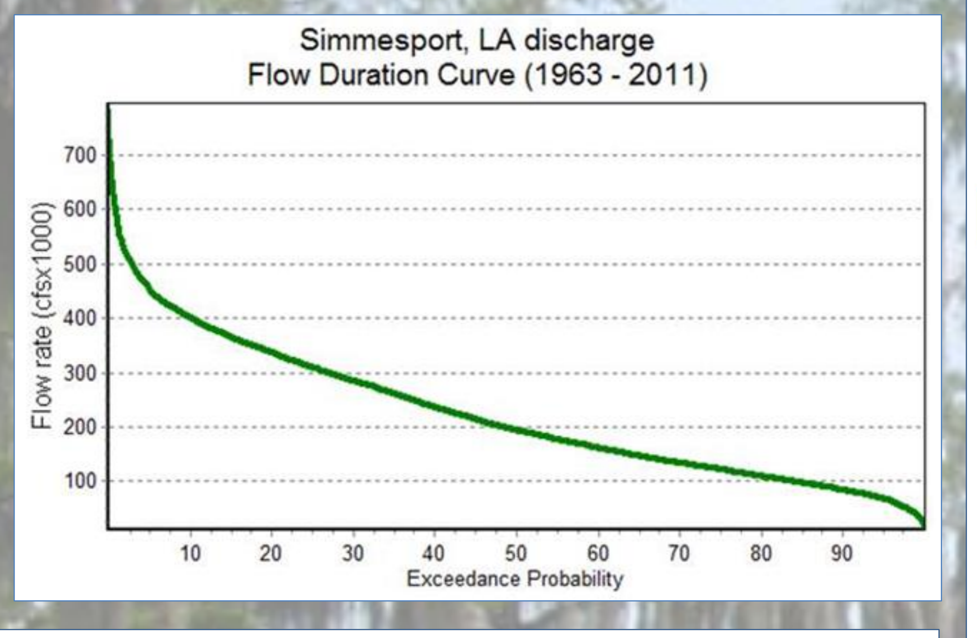
Introduction

Watershed management is as much a science as it is an art. Scientific research reveals trade-offs, complementarities, and uncertainties in biophysical systems, but it is the successful merging of that information with multiple perspectives of local resource use, varying scales of political jurisdiction, and consideration of the broader impacts of decisions, both spatially and temporally, that makes for good resource management decisions. These principles have guided our work in the Atchafalaya River Basin (ARB). The ARB in Louisiana is the largest distributary of the Mississippi River and the principal floodway of the Mississippi River & Tributaries Project. It provides many ecosystem services valued in the billions of dollars annually but is in a state of ecological decline due to large-scale and local water management problems. Attempts to address these ecological issues are hampered by stakeholder conflicts and a management framework that has not allowed for meaningful local involvement in decisions. Our focus is twofold: 1) identify institutional arrangements that contribute to the social components of problems and 2) use existing data on land cover, inundation levels, and ecological properties to develop models relating ecosystem services to flow regime. Knowledge of these institutional and biophysical relationships will allow managers to better understand the impacts of decisions and allow for improved efforts to maintain the long-term viability of an important ecosystem.





Hydrograph and Flow Duration Curve created using Indicators of Hydrologic Alteration (IHA) Software

The Social Component of Problems

The Louisiana Department of Natural Resources – Atchafalaya Basin Program's decision process was overhauled in 2008 to reflect a policy shift from a focus on recreation to multi-use water resources management. The new process espouses adaptive management principles through an Annual Plan process, establishes a firm commitment to scientific fact-finding, and increases local stakeholder involvement through public hearings where stakeholders can propose water management projects. Project proposals are developed by a Technical Advisory Group (TAG) and approved by a Research and Promotion Board (RPB).

Research and Promotion Board

- Dept. Natural Resources
- Dept. Environmental Quality
- Dept. Health and Hospitals
- Dept. Culture, Rec., Tourism
- Office of Governor
- Dept. Transportation and Development
- Dept. Ag. and Forestry
- State Land Office
- Dept. Wildlife and Fisheries
- Atchafalaya Levee Board
- St. Martin Parish*
- St. Mary Parish (non-voting)*
- Iberville Parish (non-voting)*
- Assumption Parish (non-voting)*

Technical Advisory Group

- U.S. Fish and Wildlife Service
- U.S. Geological Survey
- U.S. Army Corps of Engineers
- Department of Wildlife and Fisheries
- Department of Natural Resources
- Department of Environmental Quality
- Department of Agriculture and Forestry
- Louisiana State University School of Renewable Natural Resources

* Parishes have one voting member and three non-voting members. Changes annually.

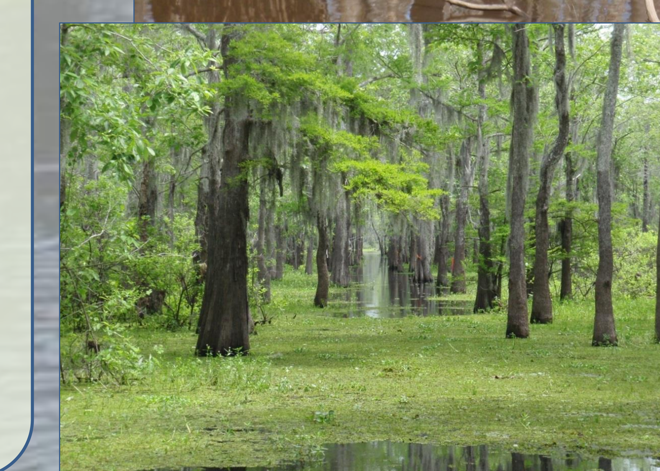
However, support for this approach is waning as intra-stakeholder conflicts continue and mistrust of decisions increases despite general agreement among stakeholders on the ARB's ecological problems and a desire to solve them. Stakeholders cite a lack of involvement in the decision process and a backdoor inclusion of their ideas, an assertion supported by the clear lack of stakeholder representation in the TAG or RPB. The public hearings are more a forum for posturing and divisive behavior than a meaningful, collaborative environment. Our work highlighted this dynamic as NGOs have stepped in to try and bridge the communication gaps between stakeholders and decisionmakers. In one instance, consensus was being sought from the same group that proposed the project in the first place!

A new approach to stakeholder involvement in the decision process is needed to address the social components of problems in the ARB; one that allows for continuous collaboration between local stakeholders and decisionmakers when developing water management projects. Such an approach is necessary to reduce conflict, promote trust, and ensure the long-term integrity of an important ecosystem.

Map showing the locations of the West Atchafalaya Floodway, the Morganza Floodway, the Main Atchafalaya Floodway, and the other structural components which allow for operation of the system.

Study Area

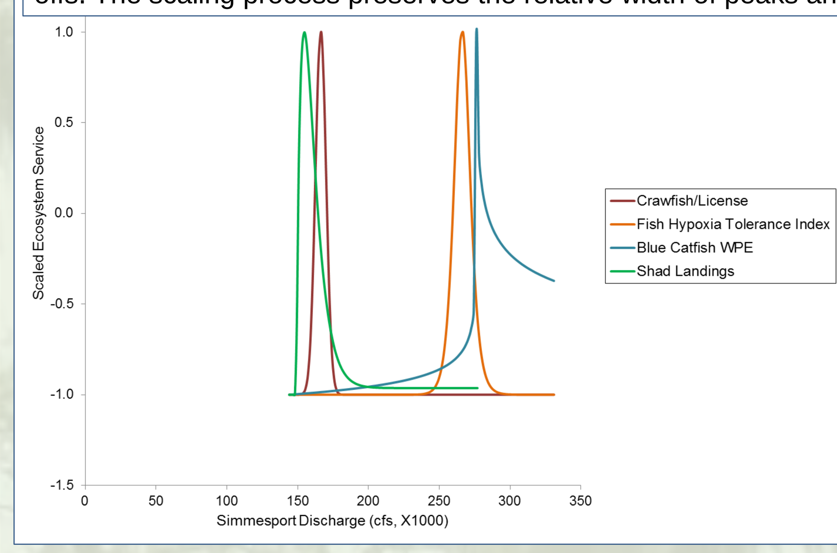
The Atchafalaya River Basin (ARB) in southern Louisiana is a vast and complex system. It is tasked with protecting major cities from flooding while providing a throughway for shipping to the Gulf of Mexico, producing oil and gas for the region, and serving as habitat for important flora and fauna. The Basin is experiencing a decline in some ecosystem services due to past management decisions and natural processes.

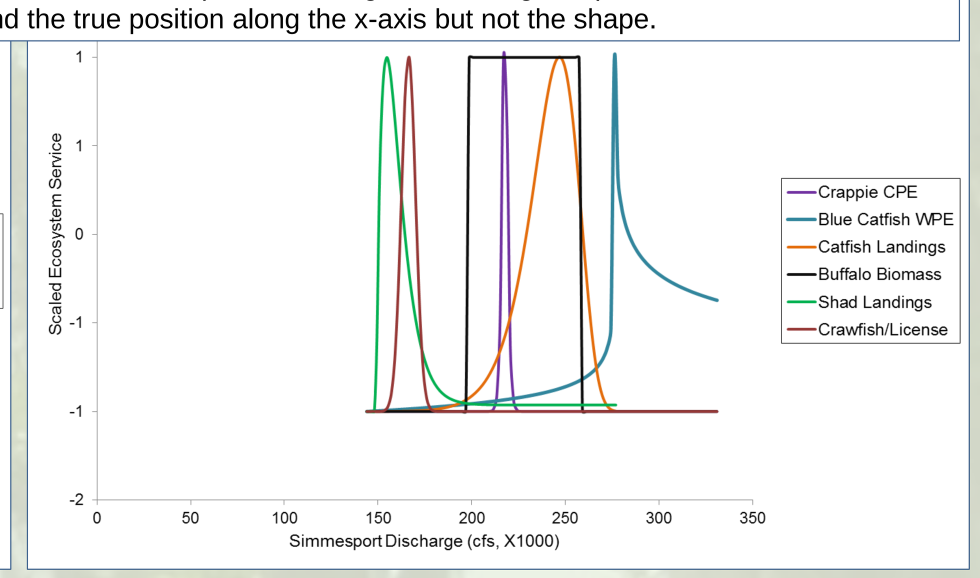


Modeling Biophysical Complexities: Trade-offs and Complementarities among Ecosystem Services

We obtained data from published and unpublished literature and from public databases for aquatic organism and commercial fisheries services (18 datasets; Alford & Walker 2011; LDWF databases and reports) and navigation (lockage events at Old River and Bayou Sorrel locks). We also developed a new model of total potential denitrification for the southern portion of the ARB. The denitrification model is based on published denitrification rates for three habitat types (Scaroni et al. 2011), the distribution of those habitats in the ARB (National Wetlands Inventory), the area of each habitat inundated at different river stages (Natural Resources Inventory and Assessment System), average water temperatures, and annual hydrographs (USGS). We aggregated all data to annual statistics to match the majority of data available. Linear (R Statistical Environment) and nonlinear (TableCurve2D) regression was used to determine the relationship between mean annual discharge (Simmesport, LA gage) and ecosystem services.

Figures 1 and 2. Relationship between fisheries metrics (scaled between -1 and 1) and discharge, illustrating complementarities and trade-offs. The scaling process preserves the relative width of peaks and the true position along the x-axis but not the shape.





We found significant (or marginally significant) linear and nonlinear relationships between ecosystem services and discharge for 11 of the 20 ecosystem services datasets. Crawfish and shad fisheries, for instance, are maximized by lower annual discharges compared to blue catfish, and higher discharges may promote hypoxic conditions in the ARB (Figs. 1 and 2). The relationships reveal the complexities of managing for multiple services in the ARB. Some services appear to be complementary, signaling natural allies among stakeholders, as for oyster, shad, and crayfish fisheries and navigation (Fig. 3). Other services exhibit trade-offs in which flows that maximize some services may diminish others. While there are many complexities not considered in our models (e.g., lag effects, other flow variables), our work can serve as a frame for viewing inherent management difficulties in the ARB and can be used as initial flow-ecology hypotheses for further work in adaptive management and environmental flows.

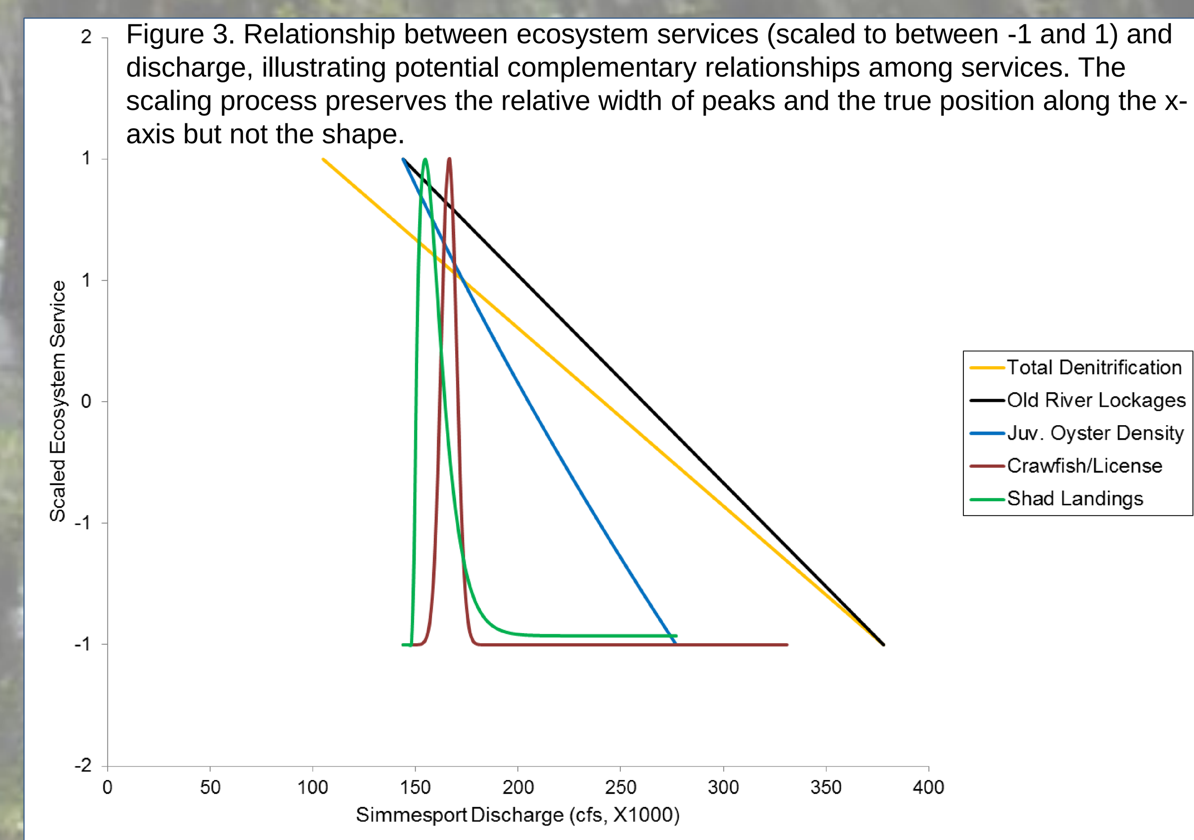


Figure 3. Relationship between ecosystem services (scaled to between -1 and 1) and discharge, illustrating potential complementary relationships among services. The scaling process preserves the relative width of peaks and the true position along the x-axis but not the shape.

References

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Acknowledgments

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