(Patterns)

**Reservoir patterns within and among river basins in the United States**

INTRO

1. All about reservoirs — **Nicky, David**
   * Prevalence of reservoirs and why reservoirs are important
     + Socially, economically, environmentally, biologically
   * How are reservoirs allocated in basins and types or characteristics of reservoirs
     + BLM vs USACE
2. Need for a basin-scale view (expanding the scale paper) — **Victoria, Caleb**
   * TOPIC SENTENCE: Historically, reservoirs have been viewed as isolated systems but it is important to consider reservoirs as members of a larger network.
   * RCC- provides large scale view
   * Reservoir continuity concept
   * Cascading/ connectivity of reservoirs
     + TVA paper
   * Differences and similarities among basins
     + How and why are they different or similar
3. Why is it worthy to contrast basins — **Andy, Spencer**
   * TOPIC SENTENCE: With large scale climate changes, managing reservoirs at an individual reservoir scale may prove inefficient. Considering reservoirs within a larger network, i.e., basin, could improve understanding, predictability, and management efficiency.
   * Understanding and expectations and explanations
   * Helps frame future objectives
   * Management efficiency
   * Hasn’t been investigated??? — **Conner**
   * REMINDER: Send paper comparing subbasins within MS River Basin

For objectives 1 and 2, list testable hypotheses.

Consider including ecoregion as a factor to account for variability within river basins.

Introduction

Reservoirs are one of the oldest tools humans have used to change their environment. Some of the first reservoirs were constructed near Jerusalem and in Egypt for irrigation purposes and water supply as early as 2000 B.C.E (Martin and Hanson 1963). Since that time, the purpose of reservoirs has expanded to include navigation, flood control, and power generation. The interruption of natural flow to rivers can have drastic effects to the physical and biological characteristics (Dicon. Concept citation). As a result of their different designs, reservoirs can have different effects on their watersheds. Irrigation and water supply reservoirs, which tend to be very large and quite shallow, have a long retention period. Hydropower reservoirs tend to be built in areas that have a large change in elevation, and as a result can be very deep, which can change the downstream water temperature and chemistry. Because the navigation reservoirs were not meant to hold water for long periods, they tend to be much smaller, with a shorter retention time, and riverine in nature. Flood control reservoirs can be quite large, and often homogenize the natural water regime by holding back water during natural high water events and releasing water during low water periods, which can alter fish communities that have adapted to dynamic water levels. Within the United States, over 75,000 dams have been constructed since 1677 which provide a total storage capacity of 1300 km3 (Graff 1999, 2003). Reservoirs in the arid western half of the US were built largely for irrigation and power generation, while reservoirs in the eastern half were built largely for flood control and power generation, especially in the TN river basin. Many of the major waterways around the country also have impoundments built specifically to facilitate navigation.

Historically, reservoirs have been viewed as isolated systems, but it is important to consider reservoirs as members of a larger network (Miranda 2008). For rivers, a similar shift in thinking occurred with the introduction of the River Continuum Concept (RCC) which prompted scientists to expand their scope beyond observations in disjointed river segments and shifted their focus to a much larger scale from headwater to mouth (Vannote et al. 1980). Applying the RCC to reservoirs, however, is not a novel idea. Barbosa et al. (1999) coined the term Cascading Reservoir Continuum Concept (CRCC) after observing a serial pattern in eutrophication a series of seven reservoirs. In successive years, basin scale studies of the effects of reservoir cascades on water quality, invertebrates and fish have taken place (Sampaio et al. 2002; Abe et al. 2003; Callisto et al. 2005; Chick et al. 2006). **TVA PAPER.** Although these case studies support the application of a continuum concept for reservoirs within single basins, we propose an wider scale approach focusing on patterns not only within but also among basins.

With large scale climate changes, managing reservoirs at an individual reservoir scale may prove inefficient. Considering reservoirs within a larger network, i.e., basin, could improve understanding, predictability, and management efficiency. Reservoirs unlike natural lakes are included within a river network. This makes them especially important for predictability purposes and understanding how an issue in one reservoir may affect the rest in that given system of reservoirs. Coordination at the basin scale offers opportunities for developing comprehensive plans, synchronizing data collection, collaborating in geographically distributed management experiments, getting funding for basin-wide or local projects, and representing the interests of the basin to legislative bodies at the national level (Birds Eye View Paper - Miranda el al.?). Collaboration and management along a river’s cascade of reservoirs among managers to help better understand and share information will help keep the system as one whole structure. Basin scale thinking has improved overall understanding of physical, chemical, and biological characteristics of reservoirs in relation to their position within a basin, and by comparing reservoirs of similar cascade locations across different basins cascade patterns across basins can be identified and established. Established cascade patterns across basins could increase reservoir managers’ ability to predict how their reservoirs may change over time. Higher predictability of reservoir conditions would enable managers to frame objectives for their reservoirs in a timelier and more effective manner, and coordination of basin scale management approaches could be applied across basins, thus increasing the efficiency of basin scale reservoir management. Collaboration among reservoirs will inherently be difficult due to waterways not being confined to one state or one agency’s jurisdiction, but this is critical to the future of these types of systems.

Comparative studies are often been used in the early stages of investigations to help ascend from the initial level of exploratory research to a more advanced level of comprehensive theoretical models. We conduct a comparative study of river basins to improve our understanding of cascading gradient patterns in reservoir attributes. Specifically our objectives included (1) identify spatial patterns in reservoir physical, chemical, fish assemblage, and fisheries characteristics within river basins; (2) determine how basin attributes vary among basins; and (3) Identify large-scale management implications suggested with the observed spatial patterns.

Methods

1. Data
   1. Selection/determination of reservoir basins
   2. Reservoirs larger than 100 ha
   3. Data sources
   4. Relation of datasets to selected reservoirs
   5. Filtration of data
   6. Data missingness
2. Analysis
   1. identify spatial patterns in reservoir physical, chemical, fish assemblage, and fisheries characteristics within river basins
   2. determine how basin attributes vary among basins
   3. Linear models