A River Ran Through It

Socio-environmental synthesis as a means of preparing ecological restoration goals – Glen Canyon Dam and the Colorado River

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Background:

The Glen Canyon Dam was completed in 1963 on the Colorado River, 16 miles upstream from Lee's Ferry, Arizona, and led to the creation of Lake Powell. At 250 mi^2, Lake Powell is the second largest artificial reservoir in the United States (after Lake Mead, located several hundred miles downstream). Initially, the Glen Canyon Dam was built to moderate flow of the Colorado River, reducing both floods and droughts in the region, and to ensure water availability to the Upper Basin of the Colorado River. Lake Powell is the focal point of the popular Glen Canyon National Recreation Area, and allows for hydroelectric generation at the dam.

However, the Glen Canyon Dam is a contentious issue, pitting environmental, social, and financial concerns against one another. Proposals to decommission the dam and drain the reservoir have gained support from mainstream environmental organizations (e.g., the Sierra Club Board of Directors endorsed the idea in 1996), while stakeholder support to maintain the dam and lake abounds as well. Since the mid-1990s, dam managers have occasionally released above-average volumes of water in order to temporarily alter the stream hydrology and attempt to restore geological and ecological characteristics of the river below the dam.

Your class will take the role of a multi-stakeholder advisory board concerned with ecological restoration in the Upper Basin of the Colorado River. Your task is to consider the economic, social, and environmental aspects of the Glen Canyon Dam, Lake Powell, and the Colorado River, and identify a set of goals that would drive ecological restoration in the region. You should consider all possible options (from a "do-nothing" approach to the complete removal of the dam), and identify a framework that could be used to evaluate competing socio-environmental demands of the river. Finally, you should begin to synthesize existing economic, social, and environmental data, and generate restoration goals for the region.

Part 1: Introduction

In your team, examine the hydrograph presented in Figure 1, and respond to the following questions:

1) What patterns do you see over the period 1921-2014?
2) How would you characterize the stream flow prior to the dam's completion in the mid 1960s? What would you estimate the average flow to have been? What were the peak and minimum flows, and how often did they occur? How variable was the stream flow?
3) How would you characterize the stream flow following the dam's completion in the mid 1960s? What would you estimate the average flow to have been? What were the peak and minimum flows, and how often did they occur? How variable was the stream flow?
4) Do you notice any atypical periods? What are they, and what may have caused them?

Part 2: Restoration goals (individual)

Individually, consider the changes to stream flow that have occurred since the construction of Glen Canyon Dam. Multiple ways of altering the current stream flow could be proposed, in order to simulate historical stream flow. Think about the following questions:

1) What aspect of pre-dam stream flow would you like to restore in order to simulate historical stream flow?
2) How would you measure this aspect of the pre-dam disturbance pattern?
3) What would you consider successful?

Part 3: Restoration goals (team)

As a small group, discuss your individual proposals and come up with a shared vision for ecological restoration on the Colorado River. Identify specific restoration goals and 2-4 practices that you think would allow these goals to be successful.

Now examine the information provided in Table 1. Consider the economic, social, and environmental aspects of Glen Canyon Dam, and consider the following questions:

1) How would your restoration practices affect the economic aspects of Glen Canyon Dam or Lake Powell?
2) How would your restoration practices affect the social aspects of Glen Canyon Dam or Lake Powell?
3) How would your restoration practices affect the environmental aspects of Glen Canyon Dam or Lake Powell?
4) How would different stakeholders in the area react to your plan? Who might support it? Who would be against it?
5) Did your initial restoration goals and practices rely more on one aspect than on the others (economic, social, and/or environmental)? Which one? How would you adapt or revise your goals and practices to consider the other aspects?

Part 4: Reflection

As this case study demonstrated, ecological restoration projects frequently involve a variety of complicated social and environmental concerns, data, and views. The Glen Canyon Dam is obviously an enormous issue, affecting millions of stakeholders and vast areas of the West, and as such, is likely more complex than many restoration projects. However, the majority of restoration projects will include social and environmental elements, and could be approached from a similar standpoint.

Spend a few moments thinking about other restoration projects that you're familiar with, and think about competing social, economic, or environmental concerns that influence the restoration goals or management decisions. Come up with at least three take-away points that will inform your approach to future restoration projects, and be prepared to discuss them with the rest of the class.

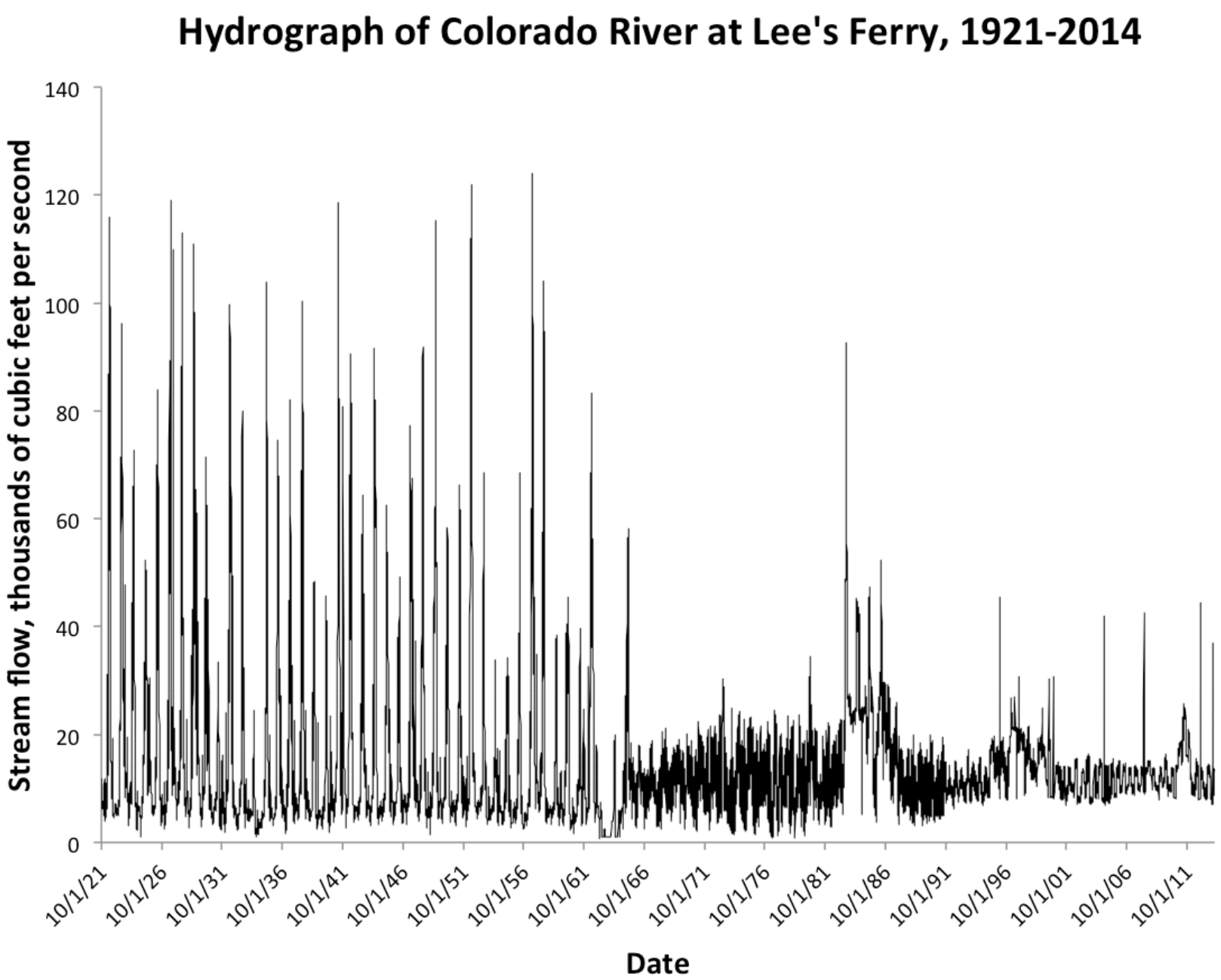

Figure 1: Hydrograph of the Colorado River stream flow at Lee's Ferry, Arizona, Oct. 1, 1921 through Jan. 15, 2014. Stream flow is presented as the daily maximum, in 1000 ft^3/second. Data from USGS, National Water Information System, http://waterdata.usgs.gov/nwis/sw.

Table 1. Some economic, social, and environmental impacts of the Glen Canyon Dam and Lake Powell. Data adapted from Cohn 2011.

Economic

- Annual maintenance costs of the dam range from $11 million to $29 million
- Whitewater rafting through the Grand Canyon annually contributes $21 million to the regional economy
- Tourism in the Glen Canyon National Recreation Area annually contributes $400 million to the regional economy
- Anglers taking advantage of the non-native trout fishery below Glen Canyon Dam contribute $1.8 million annually to the regional economy
- Provides approximately 5000 GWh of electricity each year, ~3% of the power supply in the Four Corners region

Social

- 2.5 million visitors annually to GCNRA
- Annually, 15,000 to 20,000 people experience whitewater rafting in the Grand Canyon below Glen Canyon Dam
- Lake Powell provides water and power to 38,000 Native Americans in the Upper Basin
- Lake Powell provides a potential water reserve that could be used for municipal water and irrigation, particularly in the Upper Basin
- Annually, 20,000 anglers engage in sport fishing on the non-native trout fishery below the dam

Environmental

- Dramatic changes to stream flow. Prior to construction of Glen Canyon Dam, stream flow regularly peaked at over 100,000 cfs (at Lee's Ferry). Currently, releases from the dam are limited to 5,000 to 8,000 cfs
- Occasional additional releases of up to 40,000 cfs are allowed, with the goal of simulating natural floods, restoring sandbars, and maintaining channels downstream
- Historically, river temperatures varied dramatically, with annual fluctuations of 50°F (from ~30°F to ~80°F)
- Now, river temperatures average 48°F, with only 4°F fluctuation annually.
- Tamarisk and other non-native plant species are able to colonize the banks below the Glen Canyon Dam.
- Sandbars and channel hydrology are substantially altered
- 8 native fish species were present prior to construction of the dam, 5 of which are currently endangered or have been extirpated from the region
- 100 million tons sediment deposited annually in Lake Powell, which is 85% of the sediment carried in the Colorado River.