

Incorporating Interdisciplinary Assessment to Enhance Collaborative Resource Governance: The Case of the Upper Colorado River Endangered Fish Recovery Program

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ABSTRACT The Colorado River travels through seven states and two countries, nine national parks and provides water for 40 million people across the arid west. It is also the most endangered river in America. This article outlines a case study of the Upper Colorado River Endangered Fish Recovery Program (UCREFRP), a collaborative effort designed to restore the Colorado pikeminnow population on a section of the Colorado River known as the imperiled 15-mile reach. After years of failed litigation, stakeholder efforts to develop water management solutions led to the establishment of the collaborative. This case study elucidates how collaborative governance efforts take shape, and how they can be more comprehensively assessed by drawing on interdisciplinary approaches from natural and social sciences. This case is an enduring example of the way trade-offs and power imbalances must be managed in collaborative governance, and introduces the importance of environmental and ecological justice, that is, how the collaborative process and benefits of collaborative solutions can be distributed more equitably across social and nonhuman stakeholders.

KEY MESSAGE

This case study encourages critical thinking about (a) the social and ecological outcomes of collaborative governance approaches, and (b) interdisciplinary approaches to assessing those outcomes. Students identify and analyze the problem, interventions, and relationships of the Upper Colorado River Endangered Fish Recovery Program (UCREFRP) from different disciplinary perspectives. They engage in activities designed to teach the process of natural resource collaborative assessment and why this assessment process is important for successful partnerships. A critical component of this is learning a participatory approach to identifying indicators and analyzing complex trade-offs between these indicators. Students analyze qualitative data, consider the value of different knowledge sources, and ways of knowing about conservation. Learners will reconceptualize or adapt their assessment of collaborative governance outcomes by utilizing an interdisciplinary approach to more holistically evaluate measures of success for the UCREFRP. This

consists of incorporating cost-saving and sharing [1] and consensus-based decision-making [2], but also broadening the focus to account for the progress of ecological stakeholders and their power relative to human stakeholders in collaborative assessments [3]. In doing so, we ask students to contemplate questions of environmental and ecological justice, that is, to what extent is the water management decision-making process fair and equitable (procedural justice), and, to what extent are the benefits and burdens of water management decisions distributed equitably (distributive justice)? [4] By delving into this complexity, students will work through implications of equity issues that develop when we incorporate both social and ecological outcomes into assessing collaborative successes. This added theoretical lens highlights the important issues of equity that can develop when a collaborative aimed at enhancing the wellbeing of a nonhuman species is deemed a success based on human stakeholder satisfaction while at the same time neglecting the wellbeing of the nonhuman species [3]. Furthermore, it

helps students better understand the relationship between stakeholders, power, and decision-making in collaborative governance efforts.

INTRODUCTION

The Upper Colorado River Endangered Fish Recovery Program (UCREFRP) is a multi-agency arrangement that formed a collaborative governance process with the goal of delisting four fish from Endangered Species Act (ESA) protection by 2023 [5]. This case study focuses on the Colorado pikeminnow. The UCREFRP has considerable influence on how stakeholders including farmers, ranchers, municipalities, environmental groups, and industrial uses develop water in the basin [6, 7]. The UCREFRP is presented as an exemplary case of how collaborative water governance efforts may deter expensive legislation and court battles through cooperation [8, 9]. The success of the program is identified as one of the primary management issues on the Colorado main stem and allows for the future use of Colorado River water in compliance with interstate compacts, treaties, and applicable federal and state laws [8]. However, this conceptualization of programmatic “success” is largely based on establishing consensus through collaborative process and avoiding lawsuits [1, 2]. Loomis and Ballweber see the program’s capacity for cost savings as a success over litigation, but suggest that whether the cost shifting that also occurs within this program is equitable “depends on one’s perspective” [1, page 361]. All the while, the fish population has failed to recover suggesting that this collaborative is less successful when the fish are considered the central stakeholder of the program. Frequently, the ecological progress of fish species is subordinated to positive social outcomes, such as increased development, economic benefits, and consensus-based decision-making. This poses important questions about the extent to which nonhuman species and their needs are weighed relative to human stakeholder needs (and desires) when it comes to assessing collaborative governance efforts, which is fundamentally a question of ecological justice [4].

The UCREFRP is a case study of shared decision-making structures and processes, or collaborative governance, an approach that has become common in the U.S. mountain west and watersheds around the globe. Collaboratives work across political and ecological scales to propose relevant policy solutions to socio-ecological issues. Below we present the problem of balancing water needs across human stakeholders while protecting endangered fish species. This case challenges future resource leaders to work through the inevitability of

trade-offs and the role of power in distributing the benefits of collaborative solutions to social and nonhuman stakeholders. It also challenges them to bring in new theoretical lenses of justice to further enrich assessments of collaboratives and trade-offs. The case emphasizes social and hydrological processes as necessarily interconnected where water’s physical processes shape and are shaped by UCREFRP decision-making.

CASE EXAMINATION

The Colorado River is the hardest working river in the West. It traverses seven states and two countries, provides water to approximately 40 million people, and irrigates nearly 4.5 million acres of farmland [9]. Its 10 hydroelectric dams can produce more than 4,200 megawatts of electricity—enough to power between three and four million average U.S. homes [9]. But this progress was not achieved without altering the habitat and threatening the existence of four native fish species. Compounded with prolonged drought and increased seasonal water variability, four fish native to the Colorado River—the Colorado pikeminnow, the humpback chub, the bonytail chub, and the razorback sucker—are now considered endangered by the federal government [10, 11]. The building of dams and reservoirs, alteration of water flow patterns, introduction of non-native species, diversion of water for irrigation and urban purposes, and destruction of plant life along river banks has affected the habitat and reproductive success of the rare fish [10]. In this case, we focus on the river’s Colorado subbasin where Colorado pikeminnow populations are dwindling.

The pikeminnow was included in the U.S. List of Endangered Native Fish and Wildlife on June 4, 1973, receiving protection under the original ESA of 1973 and fueling years of litigation [9, 10]. Under the auspices of stopping all diversions on the Colorado River, Western Colorado water users sued the federal government for obstructing development on the subbasin [9]. If water users wanted to continue diverting water for agricultural production and municipal use, the federal government required water users to come up with a plan to address the needs of the endangered fish [10].

The multi-jurisdictional nature of river and water management conflicts increases the complexity of the UCREFRP’s efforts to develop a collaborative governance solution. At the highest level, federal regulatory water rights are available to the federal government for water appropriation via federal

environmental mandates like the Clean Water Act and the ESA. These mandates allow the federal government to preempt the usually dominant state water policy to “protect the quantity and quality of stream flows” by enjoining water diversions when these statutes are invoked [12, page 305]. Thus, the ESA provides U.S. Fish and Wildlife Service (USFWS) a powerful tool with the potential to disrupt water use and development anywhere in the United States, at any point, for any reason. It is this power, its potential repercussions halting water diversions, and expensive, unsuccessful legal battles that ultimately drove the formation of the UCREFRP [1, 13]. Following three years of public negotiations, USFWS formally published the agreement outlining institutional arrangements for consensus decision-making in 1987 [10].

A diverse set of stakeholders including farmers, ranchers, water managers, state water administrators, and representatives from USFWS, the Bureau of Reclamation, and the Bureau of Land Management formed a collaborative decision-making process to address the endangered fish listings across the entire Upper Colorado River Basin. In the Colorado subbasin, this collaborative effort focuses on a 15-mile stretch of river identified as critical habitat for the Colorado pikeminnow (see Figure 1, Colorado subbasin is highlighted with the red line).

The 15-Mile Reach

The 15-Mile reach is located downstream of several large water diversions and upstream of the confluence with the Gunnison River. It offers critical spawning habitat for

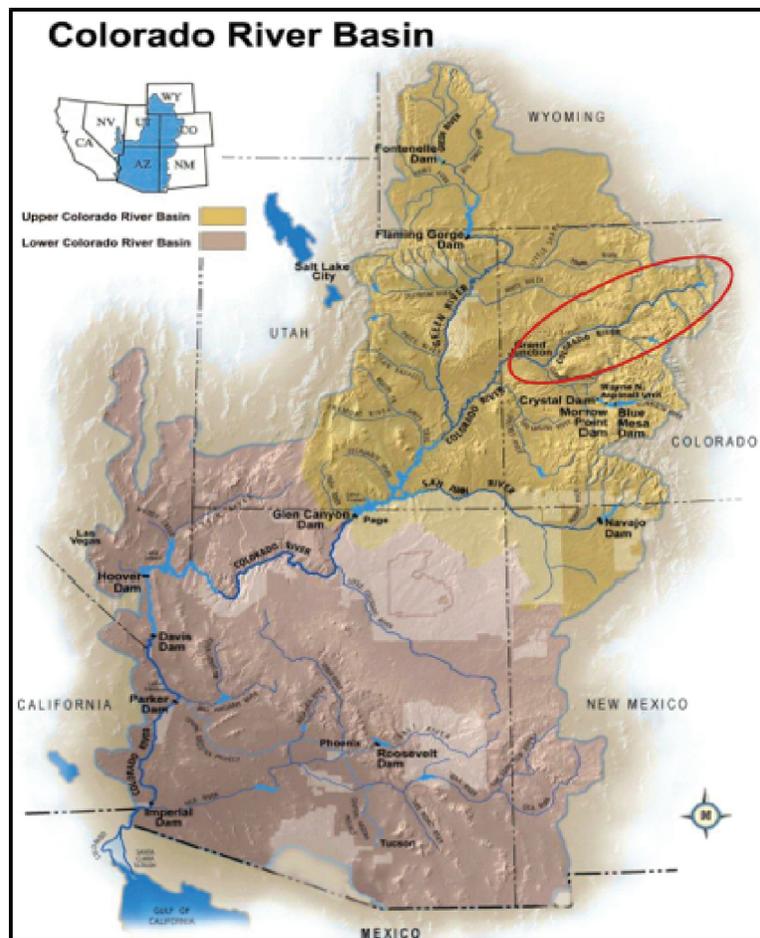


FIGURE 1. The Colorado River Basin with Colorado subbasin inside the red oval. Adapted from Reclamation and Arizona: 1960s Photo Gallery (Image 6, “The Colorado River Basin States”), U.S. Department of the Interior Bureau of Reclamation. Available: <https://www.usbr.gov/lc/phoenix/AZ100/1960/photogallery.html#top-of-page>

both the Colorado pikeminnow and the razorback sucker. It also provides a balance of temperature and available food sources that are optimal for adult Colorado pikeminnows. Low water flows due to upstream diversions in the late summer/early fall reduce habitat for the Colorado pikeminnow and razorback sucker. Reduced flows impair the creation and maintenance of habitat on the 15-mile reach and for this reason recovery actions are focused on this section of river [14].

Using Qualitative Methods to Analyze Socio-hydrological Complexities

The collaborative was born from the complexities of value conflicts, economic and political power imbalances, and trade-offs that the formal legal system could not untangle. Participant efforts and diverse reflections on the process highlight this complexity. A farmer reflects on the problem, decision-making process and the justification for the UCREFRP collaborative processes:

Are we giving up water? It's almost more visceral than water rights, what are you giving up, what are you getting in return, are we getting enough? Is there any amount big enough to compensate us for what we're giving? . . . the [irrigation company] board was somewhat reluctant to do it. . . given our role with the [Bureau of] Reclamation we're not in complete control of our destiny. The [Forest] Service and reclamation, previous manager, I think put it correctly in this way: if this is inevitable how do we get something good out of what is demanded from us. I think the discussions parallel some of the discussions we're having currently. If we don't do this and can't help all get on board with this compliance, we have to get in compliance no matter if the fish recovery program is implemented or not.

After almost three decades of collaborative work on the subbasin, participants have mixed opinions about the process. One irrigation company president shares:

There were trade-offs. In general, it created a system that does work for everybody and there were benefits too in terms of modernization of systems that the government paid . . . It enabled the farmers to modernize their irrigation systems without a huge cost to them, but at the same time use less water.

A local rancher resents endangered species protection all together as follows:

That's a lot of federally mandated stuff. You know endangered fish recovery, these humpback suckers that all

the people in Grand Junction caught the damn things back in the 1940s, threw them out on the bank because they aren't worth a shit for nothing. And put catfish in the river because catfish are good to catch, good for people to eat. Yeah, endangered fish is not very high on my list. That is probably one of the biggest waste of federal money. We're already digging ourselves into a black hole that there is no light at the end of the tunnel. . . . I don't think we had to give up any water, all the federal projects are somewhat tied together. . . . And still, if I catch one of them I'll throw the damn thing out on the bank over my shoulder and not tell anybody. . . . They're out to protect species but nothing is protecting us.

Another rancher reflects opposite sentiments:

Any kind of retrofit or changes that needed to be made, the bureau has been great at that. . . . If we need to make this more efficient operation we need a mini excavator. They pay for one, they buy one. Recovery has been truly great to work with. They realize that we're irrigators first and fish do come second but we tried not to act that way. I get along really well with all the recovery people.

These quotes reveal mixed sentiments, though Western Colorado water users have deemed the story of the UCREFRP a collaborative success [15]. As such, it is important to recognize that even "successful" collaboratives often have stakeholders who hold diverse beliefs about its efficacy. For this reason, it is important for observers to ask the following two questions: if the organization's definition of "success" the right measure? If so, "successful for whom?" This is particularly important in this collaborative as human actors are generally satisfied with the distribution of water within the context of the collaborative—but nonhuman stakeholders, such as the Colorado pikeminnow, continue to struggle for population gains [2, 7]. Brower has made this point explicitly, and recommends changes to consensus-based collaborative governance in the Upper Colorado River to reestablish species recovery as a central component that is often overshadowed by human special interest groups and their bureaucratic goals [2]. This is a risk that accompanies evaluating a collaborative exclusively based on social outcomes. Conversely, focusing on ecological outcomes alone overshadows the influence that diverse sets of human stakeholders have on the collaborative process. This can create the illusion of participatory, consensus-based decision-making while failing to determine to what extent diverse human stakeholders have the space to participate in collaborative decision-making processes in a meaningful way, what room they

have for dissension, how much power they hold relative to others (procedural justice), and what potential positive and negative impacts may result from focusing exclusively on river health and native fish populations (distributive justice). Alone, these approaches run the risk of creating or enhancing ecological or environmental injustices, respectively.

CONCLUSION

Neither approach alone can lead to a full understanding of effective collaborative governance, and it is imperative that students understand the necessity of interdisciplinary approaches and the subjectivities that influence decision-making process to become thoughtful and effective future resource managers.

This UCREFRP case is an enduring example of the way trade-offs and power imbalances must be managed in collaborative governance, and introduces the importance of environmental and ecological justice so benefits of collaborative solutions can be distributed more equitably across social and nonhuman stakeholders. This is pertinent not only for the UCREFRP but is critical for governance efforts more broadly along the Colorado River, globally in the face of climate change and increasing threats to biodiversity and fragile ecosystems.

THE CASE IN THE CLASSROOM

This case is divided into four modules that can be adapted individually or can build on one another throughout a semester (please see supplemental information: Case Study Module Overview). Each of the four modules is further divided into Module Sessions, which include a session overview, preparation materials, a brief lesson plan, a description of activities, suggested class materials, a summary of applicable concepts and tools, additional resources, suggested learning outcome assessments, and detailed lecture and activity notes to provide instructors with important background information and resources (please see supplemental information: Sample Teaching Notes). The modules expose students to different disciplinary approaches for analyzing how the collaborative process and benefits of collaborative solutions can be distributed more equitably across social and nonhuman stakeholders. The UCREFRP case encourages critical thinking about the way trade-offs and power imbalances must be managed in collaborative governance.

Module 1 introduces the UCREFRP as an example of long-term collaborative environmental governance. It uses

systems-thinking and concept modeling activities to familiarize students with the intended impacts of the UCREFRP on conservation targets, cultivating thinking about scale and complexity in a social-hydrological system. The socio-environmental framework provides a useful tool for understanding the “big picture” of the case study, but also sets the stage for subsequent modules, which ask students to think critically about the assumptions implicit in this assessment approach.

In module 2, students learn about the “why and how” of assessing collaborative initiatives. Students shift from thinking about the collaborative as a conceptual model towards a deeper understanding of how perspectives and power influence process. They apply a participatory approach to identify assessment indicators while thinking carefully about trade-offs.

Module 3 begins by exploring how epistemology, ontology, and research paradigms shape the research process, highlighting interesting tensions often overlooked in the application of socio-environmental frameworks. Students are then introduced to qualitative methods of analysis and engage in a coding activity to synthesize primary interview data.

Module 4 further explores the value of cross-disciplinary theories and methods for the assessment of collaborative initiatives. Students describe the value of different types of knowledge sources and ways of knowing. For the final activity, students incorporate critical theory and ideas of environmental and ecological justice into their assessment strategies to more equitably represent the needs of all organisms in the system.

You can access the complete case study at <http://www.sesync.org/for-you/educator/case-study-collection>.

Introductory Video Links to Share with Students

- American Rivers. 2013. *Colorado River: America's Most Endangered River*. Available: <https://vimeo.com/67579458>
- Ruth Powell Hutchins Water Center. 2015. *Water in the Desert: The Grand Valley and Its Rivers*. Available: <https://vimeo.com/106882559>

Historical Background

- Quartarone, F. 1995. *Historical Accounts of Upper Colorado River Basin Endangered Fish*. Available: <http://www.coloradoriverrecovery.org/general-information/general-publications/Historicalaccounts.pdf>

CASE STUDY QUESTIONS

1. How can we apply systems thinking to represent our case as a complex socio-hydrological system in order to identify and analyze its problems, interventions (the UCREFRP), and feedbacks?
2. What are the benefits and challenges of applying an interdisciplinary lens to a case study?
3. In what ways is collaborative environmental governance a potentially valuable approach for addressing problems that span jurisdictional boundaries?
4. What are socio-hydrological indicators of collaborative successes and challenges?
5. How can social scientists work analytically with the socio-ecological systems framework?
6. How can natural science students develop an understanding of the importance of social science research and begin to incorporate it into their future work?
7. How can we synthesize conflicting perspectives of ethics and justice from social science and conservationist perspectives?
8. What can we learn from the examination of our case under diverse research paradigms and to tackle the socio-hydrological complexity of collaborative governance arrangements?
9. How can we incorporate environmental and ecological justice into policy recommendations for improving UCREFRP assessment (i.e. identifying gaps, additions for enhancing equity across stakeholders, different indicators)?

AUTHOR CONTRIBUTIONS

Karie Boone: Lead on conceptualization, data curation, formal analysis, investigation, project administration, supervision, and original draft.

Ch'aska Huayhuaca: Support on conceptualization, methodology, project administration, original draft, review and editing.

Stacia S. Ryder: Support on conceptualization, methodology, original draft, review and editing.

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COMPETING INTERESTS

The authors have declared that no competing interests exist.

SUPPORTING INFORMATION

1. Complete Overview of Case Study Curriculum: This matrix describes the four modules of the complete case study curriculum. It defines the learning objectives, specific objectives, assignments, and activities associated with each module. (PDF)
2. Selection from Teaching Notes: The notes provide all the information that someone would need to be able to teach this case study. These notes are for the instructor and include a detailed module overview, preparation materials, lesson plan, activity plan, class materials and homework suggestions. (PDF)
3. Module 2 Lecture Slides: Complementing the teaching notes and muddle readings, these slides present an introduction to collaboration and its evaluation.

REFERENCES

1. Loomis, J. and Ballweber, J. 2012. "A Policy Analysis of the Collaborative Upper Colorado River Basin Endangered Fish Recovery Program: Cost Savings or Cost Shifting?" *Natural Resources Journal* 52(2): 337–362.
2. Brower, A., Reedy, C. and Yelin-kefer, J. 2001. "Consensus versus Conservation in the Upper Colorado River Basin Recovery Implementation Program." *Society for Conservation Biology* 15(4): 1001–1007.
3. Baxter, B. 2004. *A Theory of Ecological Justice*, London: Routledge.

4. Schlosberg, D. 2009. *Defining Environmental Justice: Theories, Movements, and Nature*, New York, NY: Oxford University Press.
5. Extension of the Cooperative Agreement for the Recovery Implementation Program for Endangered Fish Species in the Upper Colorado River Basin. Available: <http://coloradoriverrecovery.org/documents-publications/foundational-documents/2009extension.pdf>
6. Colorado Water Conservation Board (CWCB). 2015. *Overview of Each Basin: Colorado Water Plan Second Draft*, Denver, CO.
7. UCREFRP. 2017. *2016-2017 Highlights: Upper Colorado River Endangered Fish Recovery Program*, Denver, CO. Available: <http://www.coloradoriverrecovery.org/general-information/general-publications/briefingbook/2017-BriefingBook.pdf>
8. U.S. Department of the Interior. Bureau of Reclamation. 2016. SECURE Water Act Section 9503(c)-Reclamation Climate Change and Water 2016. Chapter 3: Colorado River Basin. 31 July 2016. Available: <https://www.usbr.gov/climate/secure/docs/2016secure/2016SECUREREport-chapter3.pdf>
9. Lochhead, J.S. 1996. "Upper Colorado River Fish: A Recovery Program That Is Working—Myth or Reality?" In *Biodiversity Protection: Implementation and Reform of the Endangered Species Act* (Summer Conference, June 9–12), Boulder, CO: University of Colorado Law School. Available: <http://scholar.law.colorado.edu/cgi/viewcontent.cgi?article=1011&context=biodiversity-protection-implementation-and-reform-endangered-species-act>
10. U.S. Fish and Wildlife Service. 2002. "Colorado Pikeminnow (*Ptychocheilus Lucius*) Recovery Goals: Amendment and Supplement to the Colorado Squawfish Recovery Plan." Denver, CO. Available: https://www.fws.gov/southwest/sjrip/pdf/DOC_Recovery_Goals_Colorado_pikeminnow_2002.pdf
11. Taylor, P.L. 2014. "Emerging Environmental Flow Governance on the Upper Colorado River: A Collaborative Alternative?" *Colorado Water*, Newsletter of the Water Center of Colorado State University. Available: http://wsnet.colostate.edu/cwis31/ColoradoWater/Images/Newsletters/2014/CW_31_5.pdf
12. Doremus, H. and Tarlock, A.D. 2003. "Fish, Farms, and the Clash of Cultures in the Klamath Basin." *Ecology Law Quarterly* 30(2): 279–350. Available: http://scholarship.kentlaw.iit.edu/cgi/viewcontent.cgi?article=1674&context=fac_schol
13. U.S. Fish & Wildlife Ser. Region 6, U.S. Dep't of Interior, Recovery Implementation Program for Endangered Fish Species in The Upper Colorado River Basin. 1987. Available: <http://Coloradoriverrecovery.Org/Documents-Publications/Foundational-Documents/1987bluebook.pdf>
14. Rees, D., Miller, W. and Ptacek, J. 2008. *Ecological and Physical Processes during Spring Peak Flow and Summer Baseflows in the 15-Mile Reach of the Colorado River*, Vol. 1, Fort Collins, CO.
15. The Colorado River District. 2016. "Endangered Fish Recovery Program." *Colorado River District Website*. Available: <http://www.coloradoriverdistrict.org/supply-planning/endangered-fish-recovery-program/>