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Rivers, Scholars, and Society

A Situation Analysis

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Scholars, the societies we live in, and the institutions responsible for river management need to accept, understand, value, and succeed at living within the limits of our natural resources. This need applies across cultures and political systems. Rivers, because of the services they provide to humans and other forms of life, are effective ecosystems for demonstrating the conflicts that arise when humans do not learn how to curb their desires or share the benefits of nature. Scholars, people with advanced knowledge of a subject (usually taught in school), play an important role in showing society the consequences of its decisions and actions. We must learn and effect change at a rate that is faster than the rate at which humans are currently using and degrading earth's limited resources. Rivers, then, are high-visibility test cases for evaluating whether scholars in particular are functioning effectively in society.

One premise of the Rivers of the Anthropocene project is that a transdisciplinary approach by scholars will be more effective than single-, multi-, or interdisciplinary approaches to helping societies manage rivers (Kelly, this vol.). The expectation is that historians, scientists, artists, economists, and anthropologists, to name some of the scholar tribes, can develop more relevant and instructional sets of evidence and merge them into more influential messages when we work in collaboration. Palsson et al. (2013) described the need to take the first, collaborative learning step as a way to "reorganize our house" in preparation for helping society halt or reverse the impending environmental crisis. The implication is that the role that scholars play in society, that of village elders or wise men and women, can no longer be played adequately if we perform only as individuals or cliques.

It is a noble premise, and one that is difficult to criticize. But it requires additional thinking about the desired endpoint and the practical issues of getting there. Is the intent only to learn and inform together activities that are mostly under our control and measurable using traditional academic metrics? Or is success to be measured by real increases in river ecosystem quality, slower rates of river degradation, or wiser and fairer allocations of freshwater? If the latter, we need to identify the publics, institutions, and stakeholders we want to influence and develop common strategies to exert that influence. Success in this case will not just be under the control of scholars, but the result of scholars interacting effectively in diverse societies, cultures, and communities.

This chapter considers scholar-society relationships based on observations of past circumstances and likely future interactions. The relationships are complex, and thus they present challenges to the concept of traveling a more transdisciplinary path and arriving at the intended destination. The observations are framed here as a situation analysis—addressing where we are in time and establishing a base from which optional paths forward can be considered. "We" here usually refers to the broad community of scholars—natural scientists, social scientists, and humanists (Palsson et al. 2013), as well as economists, all of whom have specialized knowledge and make their living by learning and teaching, regardless of discipline, institution, or audience.

Our intent is to start at the end of the proposed journey and work backward. We begin by clarifying what we think is the collective desired endpoint: a future in which rivers are managed sustainably, in ways that adequately address the interests and requirements of diverse stakeholders and nonhuman species. From there we discuss how scholars need to function effectively in the societies that will have to accept responsibility for sustainable management. Last, we address scale, a special challenge of river socioecosystems and their future management.

A POTENTIAL DESIRED FUTURE: SUSTAINABLE MANAGEMENT OF RIVERS AS SOCIOECOSYSTEMS

For anyone, let alone two river scientists, to postulate a long-term societal goal may seem a bit pretentious. But it is necessary to clarify why scholars are considering the need to develop a transdisciplinary approach to—what exactly? So let's accept, for the purposes of discussion, that a useful and relevant societal goal is to be able to manage rivers sustainably. The most common and general definition of sustainability, the one that implies our intent to leave future generations with as many, or more, choices as we now have, works as a reasonable starting point here.

But for sustainability to function as an operational goal in real river policy development and management, this definition requires elaboration, including details of *how* society should achieve it. There is, for example, the now-widespread belief that sustainability can only be attained if humans are accepted as active

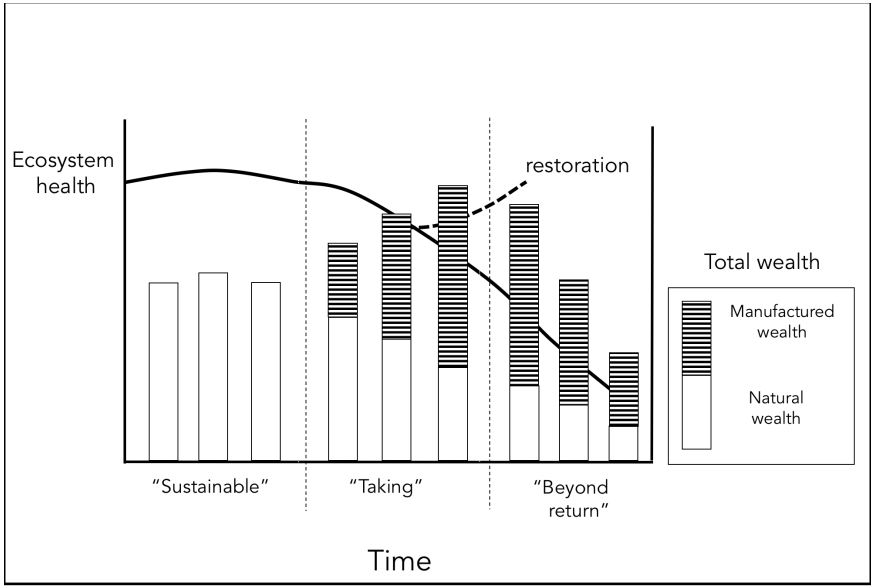

FIGURE 5.1. Theoretical ecosystem health and area wealth relationships during three stages of river use. Here "total wealth" includes both natural (equivalent to the natural capital of Daily [2003] and Karieva et al. [2011]) and manufactured wealth. During the initial stage, before humans became major environmental drivers, human use of a river results in minimal changes to the river's other ecological functions, such as its ability to support animal and plant species or biogeochemical processes. As the human footprint grows during the second "taking" stage, decreases in natural wealth are more than offset by increased manufactured wealth. The resulting increase in total wealth and benefits to humans are considered acceptable or even preferred over initial conditions, in spite of observable losses to other ecosystem functions. In the third stage, natural wealth and manufactured wealth both decline. The level of ecosystem health falls below a desirable level, and humans begin to see the river as a place to avoid. As the system moves from Stage 2 to Stage 3, more ecosystem functions are lost and a system state change occurs, from which restoration becomes virtually impossible in the foreseeable future.

components of ecosystems rather than as external driving factors. The inclusion of humans in ecosystems was one of the most substantial recent changes in natural resources management philosophy, a shift referred to as ecosystem management (Grumbine 1994). Adaptive management (Holling 1978), which recognizes that goal setting for complex systems is uncertain and that the iterative blending of learning and action is vital, is becoming more common where it is practical and realistic (Lee 1999). So progress has already been made. Many scholars are also exploring not only how ecosystems, cultures, and economies are linked, but the notion that "strong" sustainability requires the acceptance that economies are directly and strongly *dependent on* natural resources (Walker 2012). Figure 5.1 captures one interpretation of how river ecosystem health (Lubinski 2010), natural

wealth, and manufactured wealth interact with each other over a long period (the Anthropocene?) of increasing human use. If, collectively, scholars can quantify such relationships, the resultant knowledge could be applied to rivers before they degrade past the point of potential restoration.

Together, the above beliefs, among others, have given rise to the idea of treating rivers as socioecosystems (Machlis, Force, and Burch 1997; Folke 2006), which has great promise as an organizing concept. By evaluating rivers as socioecosystems, we are forced to accept trade-offs and identify minimally acceptable standards for all of the system components of interest. Multiple use dictates that no single user can have it all (Cairns 1972). But putting the concept of rivers as socioeconomic systems into practice will introduce many new policy and management hurdles. Presented as questions, some of these are:

- What institutions are ready, willing, and able to operate in this way? Do the existing institutions have adequate authorities to implement socioecosystem policies?
- What decision-making processes are appropriate for evaluating trade-offs, and who will be given the responsibility of making such trade-offs in an unbiased, fair, and transparent way?
- What models are suitable for adequately describing river socioecosystem complexity and uncertainties?
- How can boundaries be drawn around a river socioecosystem in a way that internalizes all of the relevant parts and relationships?
- How should governance processes be modified to promote the holistic concept of river socioecosystems but also to give voice to their diverse stakeholder groups that need to take part in the functioning of these systems?
- How will the linear, long (often interjurisdictional), and integrative nature of rivers make their treatment as socioecosystems even more difficult?

These will not be easy questions to answer. And scholars will not be the only people responsible for answering them. Scholars will act in the role of consultants. Not all scholars will engage, but those who do will need to start tailoring their plans to address these and related questions.

SCHOLAR-SOCIETAL RELATIONSHIPS IN THE DESIRED FUTURE

The questions listed above are probably not too hard for policy makers and managers to anticipate. The larger question for scholars, however, is what do we have to do, collectively, to keep the goal of sustainable river socioecosystems realistic, attractive, and feasible in the eyes of the public and decision makers. The changes that will be required in the way river institutions and publics think and act will take time and energy. Scholars can play a key role in activating the transition.

The existing institutions are invested in the status quo, and most are not currently capable of changing their own responsibilities and authorities. In the United States, there are no singular institutions that have the responsibility or authority to manage rivers as socioecosystems yet. Therefore, the work will need to be accomplished through partnerships. Partnerships have become much more common over the past three decades, but, except in urgent situations, they have required more time to make decisions and take actions than single organizations. They tend to be politically popular for limited periods, especially when created to resolve a specific problem. But once the problem is resolved (politically if not actually), funding lapses.

The transition is likely to be led by policy makers, via effective communication strategies with river publics. We need to know the latter's beliefs, goals, and value systems. Do they listen more with their heads or their hearts? What cultural norms are in play? Excellent ideas are being explored by our colleagues on the subject of how fit existing institutions currently are to achieve goals related to sustainability (Costanza et al. 2001; Farrell and Thiel 2013).

Once scholars know the institutions well, we will need to develop well thought out strategies for effecting change. Clearly, change can be effected by more than just information. If we accept the model that human actions are driven primarily by their needs and beliefs, we can start asking who among us is best equipped and thus has a better chance to succeed along different causal pathways (fig. 5.2). For example, scientists and economists can provide the necessary evidence to convince managers that the effort is doable and relevant, while artists and historians may focus more directly on public beliefs. All of this work will require improvements in the way that scholars communicate with nonscholars. Facilitation skills will be vital. Members of policy-making groups should be invited to join us as early as possible.

Change is not something that only others need to implement. We scholars will need to take a good look at ourselves and ask what our strengths and weaknesses are relative to performing as a team of village elders. Working together in a transdisciplinary way to learn more deeply about river socioecosystems will require more than occasional communications and the publication of single-author papers in professional journals. Sacrifices of individual time and desires are always necessary for the success of a group, and these are perhaps the primary reasons that transdisciplinary approaches have not been common among scholars in the past. We will have to learn to play by a new set of rules intended to ensure team success, sometimes at the apparent expense of individual success and sometimes when success itself is not only dependent on how well we do.

We will have to become much more aware of what drives each other. The Rivers of the Anthropocene Conference and Workshop suggested that our individual reasons for beginning this discussion were as diverse as our disciplines. Fundamental differences in our perceptions and beliefs were hinted at, especially when we

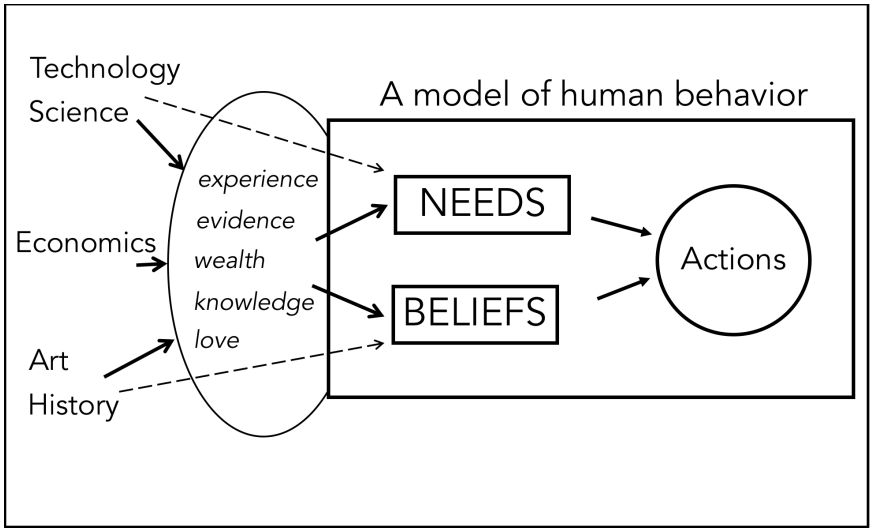

FIGURE 5.2. A model of what influences human actions. Scholars from different disciplines influence society (human actions) in different ways. Some disciplines, directly (dotted lines) or through their products (in italics), are more effective at changing human belief systems. Others are better at serving (and subsequently changing) important human needs. Collaboration among disciplines will require thoughtful partitioning of responsibilities to make adequate progress along both paths. Modified from Moore 1999.

discovered words and phrases whose definitions we as individuals were taking for granted. Figure 5.3, for example, initiated a debate about whether the terms "ecosystem integrity," "pristine," "natural," and "restoration" were still relevant to the management of rivers as socioecosystems. Our ability to persuade river policy makers and managers will be dependent on how we communicate as well as what we communicate. Agreement on where and when such terms should be used will be critical. An accepted glossary for moving forward will be an important task. But more important will be extended discussions explicitly intended to determine the extent to which we all truly want the same thing. Close inspection and spending more time together are likely to reveal commonalities and those concepts on which we have divergent opinions.

SCALE AS A SPECIAL CHALLENGE OF RIVER SOCIOECOSYSTEMS

Rivers are extraordinarily functional and provide a wide range of services to humans. It is in part their functionality that has led to the extremes to which they have been altered to serve even more human needs. The effort proposed in the

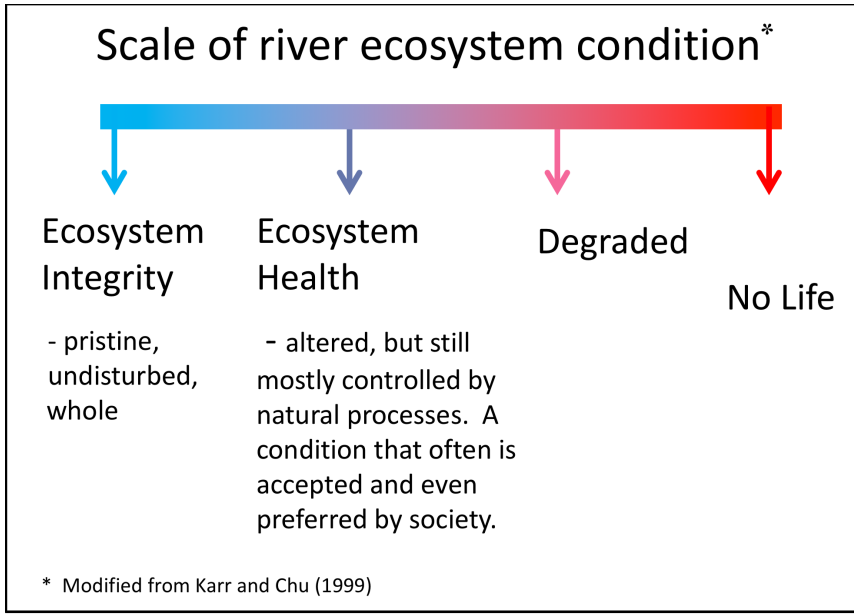

FIGURE 5.3. Noteworthy conceptual markers along a spectrum ecosystem condition. A simple attempt to clarify levels of ecosystem condition illustrates how disciplinary attitudes shape perceptions of terms and their values. This figure, for example, revealed deep differences in comfort levels among conference participants for the use of terms like "ecosystem integrity," "pristine," and "natural." The inability of scholars from different disciplines to agree on the definitions and values of such terms is a major challenge to functioning in a transdisciplinary approach. More important, this inability makes it extremely difficult for scholars to gain the respect and trust of societies that need to use such terms in emerging programs.

Rivers of the Anthropocene project suggests that we think of rivers as systems whose behaviors can be better understood if compared to each other. Many such efforts have been completed in the past (Oglesby, Carlson, and McCann 1972; Coates 2013). The exercise should expose, across many rivers in diverse cultures and political systems, common features of human-river relationships and foster greater understanding of the essence of those relationships.

But the concept of river socioecosystems has never been investigated at the level of comprehensiveness suggested at the conference. Ironically, a distinct feature of rivers makes them especially difficult for exploring the joint concepts of transdisciplinarity and socioecosystem management.

The functions and services that rivers provide cover a diversity of spatial scales. There are hierarchical networks of river basins and drainage networks—parts of the global hydrologic cycle that cross all manner of landscapes, ecosystems, and political and demographic boundaries. Basin landscapes are well-known, major

drivers of river flows, water quality, and human use, but groups of humans that band together as river caretakers or managers seem to lose, except in special cases, connections with rivers and their basins at very large spatial scales. Hannon (1994) attributed this to the tendency of humans to discount the value of things that exist or happen at greater distances in space and time.

Many authors have described breakpoints in the hierarchy of river networks using relatively common terms such as "basin," "river," "reach" (usually between tributaries along a main-stem), "segment," and "habitat." Human interests in rivers can follow the borders of any of these levels of scale. On the Upper Mississippi River, as an example, human (community) perceptions of the river as a neighborhood seem to exist mostly at the reach level. A several-hundred-mile reach of this river, which mostly drains forest or dairy landscapes, is characterized by a narrow floodplain, and because of its fishing and hunting values was designated a national wildlife and fish refuge in the 1920s. Below this reach, however, the river's tributaries begin to drain flatter landscapes, which are dominated largely by agriculture and which now carry higher loads of nutrients and sediments to the main-stem. The main-stem floodplains, in turn, have been leveed, in part because upstream changes in the ability of the landscape has made downstream flooding more severe and less predictable. In this reach, the main-stem river begins losing its aesthetic appeal. Although it retains its value as a fish and wildlife resource, that value is held by a smaller percentage of the reach's public, the majority of whom see the river as something that needs to be kept on the other side of the levee.

Most large rivers are characterized, like the Upper Mississippi, by a small number of distinctive reaches defined by hydrologic or physiographic features. But histories of human usage, highlighted by dams, diversions, floodplain land use, and levee systems, have also provided artificial boundaries that exert powerful influence over the perceptions of nearby human communities. River system differences may well outweigh their commonalities from the perspective of determining important community boundaries or managing harmoniously across scales.

CLOSING POINTS

Scholars, in addition to their teaching duties, have often played the role of village elders in society, but usually that role has been carried out on an individual basis. When scholars have worked together, much of that work has been within professional societies, organized along disciplinary lines as opposed to societal problems. Working collaboratively to help society learn and act to achieve a very complex goal that has yet to be commonly valued and accepted will be challenging in predictable and unanticipated ways.

It may not be necessary to create a single common scholar's vision in support of sustainable river management. Such a vision would by necessity be so prescriptive as to erode the diversity and creativity of thought that scholars value so highly.

But success will require sacrifices of individual control and rewards. Academic institutions will need to adapt by recognizing the value of such collaborations and making the necessary resources available.

River systems are iconic in terms of representing human–natural resource relationships that will be vital in achieving future sustainability. We must learn and effect change at a rate that is faster than the rate at which humans have and are currently using and degrading earth's limited resources. Society does need to realize that the traditional approach, taking care of the economy and human conveniences first and fixing the environmental problems later, is not going to be viable in the future. If scholars can learn how to be effective participants in the management of these highly used socioecosystems, that learning can be applied to virtually any other system at less risk of overexploitation.