Restoration ecology: the challenge of social values and expectations

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The Society for Ecological Restoration's Science & Policy Working Group define ecological restoration as the process of assisting the recovery of damaged, degraded, or destroyed ecosystems (SER 2002). While ecological restoration involves restoring ecosystems at specific project sites, restoration ecology is the science on which the practice is based, and should ideally provide clear concepts, models, methodologies, and tools to support it.

Restoration ecology is still an emerging science, with its roots in practical restoration projects around the world. Research generally focuses on improving the conceptual, technical, and socioeconomic bases for conducting effective ecological restoration. In recent years, there has been a move away from site- and situation-specific studies of particular restoration projects to a broader consideration of the conceptual basis for restoration ecology and the publication of synthetic treatments of the subject (Hobbs and Norton 1996; Whisenant 1999; Hobbs and Harris 2001; Perrow and Davy 2002; Temperton *et al.* in press).

To restore an ecosystem, we need to understand how it worked before it was modified or degraded, and then use this understanding to reassemble it and reinstate essential processes. There is an increasing recognition that ecosystem dynamics can be complex, non-linear, and often unpredictable. The importance of broad-scale processes and interactions between adjoining ecosystems adds further complexity, since impacts in one place may be the result of events or management decisions elsewhere. This makes it difficult to correctly diagnose the problems leading to ecosystem degradation or preventing recovery, and to initiate effective corrective or restorative management.

The type of intervention required in restoration depends heavily on the type and extent of damage to the ecosystem. In some cases, relatively small changes in the management or manipulation of the species composition are required, as in the removal of harmful invasive species or the replacement of missing species. In other cases, a substantial alteration of the physical and/or chemical environment may be needed to restore ecosystem or landscape processes such as hydrology and nutrient dynamics. In still others, the scale of the restoration treatments required can be massive – for example, the restoration of the Florida Everglades involves extensive restoration activities over much of southern Florida (SFWMD 1996). The more degraded an ecosystem is, and the more fundamentally the basic ecosystem processes have been altered, the more difficult and expensive restoration will be.

Similarly, the difficulty and expense of restoration depends on the goals we set. It is relatively easy to achieve successful restoration when the goal is to restore some degree of function and/or some of the species. However, it is very difficult to achieve complete restoration of the ecosystem back to its original state (Lockwood and Pimm 1999). It is often hard to determine what the ecosystem structure and composition was in any particular place, since there are seldom accurate historical records. This is sometimes done using reference ecosystems, or relatively undisturbed areas nearby that are similar to the original state of the area to be restored. However, the objective of restoration is often to return the system to some previous state, often one that existed prior to human influence, such as pre-Columbian North America. We will probably never know enough about what past ecosystems were like to reset the clock and return to some notional "pre-human" state. In many situations, this is probably impossible because of ongoing broad changes in the global environment (Vitousek *et al.* 1997).

Deciding on restoration goals involves a set of values, including the ethical and philosophical bases for our actions, concepts of "good" restoration, its aims, humanity's place in nature, and the influence of indigenous peoples on the environment. Setting realistic restoration goals is essential to the planning process. Yet, these goals are often determined by preconceptions or misconceptions that place more value on particular ecosystem states or on how the ecosystem was, or might have been, at some particular time. These preconceptions may limit or bias the discussion of restoration possibilities, and therefore prevent the development of more effective and efficient strategies.

Thus, while restoration ecology is making important strides in developing a sound conceptual basis and improved understanding and techniques, it faces an important challenge in tackling the societal expectation of ambitious restoration goals. A mix of scientific uncertainty, value-laden decisions, and unrealistic expectations can lead to costly and demoralizing failures. A clear exposition of what is possible in particular cases, and at what cost, is required. In most cases, there will be a range of options that vary in expected outcome and relative cost, and there needs to be a clear

process for deciding between them.

Restoration is becoming an increasingly important tool in our attempt to manage, conserve, and repair the world's ecosystems, but it is always going to be more costly and less effective than preventing damage in the first place. Setting realistic goals for restoration goes beyond scientific understanding of how ecosystems work and how we can reassemble them.

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We agree that one of the primary challenges faced by restoration ecologists is to recognize the role their own values play in setting restoration goals (Davis and Slobodkin 2004). We certainly do not advocate a purging of values from restoration ecology – quite the contrary. Restoration ecologists should embrace and explicitly affirm their values regarding the environment.

We are concerned, however, that restoration ecologists often seem to disguise their values as science, although this is probably done unconsciously. For example, arguing to restore an ecosystem's "health" or its "ecological integrity" sounds like an argument with a scientific foundation. (How could one ever be opposed to ecosystem health?) However, ecosystems are not evolutionary entities with evolved homeostatic properties. An ecosystem can be altered, but it makes no sense to refer to ecosystems as healthy or sick. Even statements that refer to "damaged" ecosystems, or that call for the "repair" of ecosystems, are ultimately value-laden statements. When someone refers to a healthy ecosystem, what he or she actually means is that this is a desirable ecosystem, from that individual's perspective. When we say we want to restore an ecosystem's health or integrity, we are really saying that we prefer an ecosystem of a particular type. As scientists, it is important that we be honest in our communication with each other and the public. Let's state our values up front.

In hindsight, it may be unfortunate that restoration ecology emerged with that name. The word "restoration" invokes a particular type of ecosystem management, one aimed at returning ecosystems to some prior condition. We share Hobbs' concern that an excessively ideological approach to restoration ecology may limit management options and discourage more flexible approaches to managing the environment. In particular, restoration ecology should look primarily to the future when defining its goals. What type of ecosystem will best meet our desires and needs in the future? What types of ecosystems will be consistent with projected changes in climate and population size?

As with all important human endeavors, it will always be useful and wise for habitat managers to look to the past for perspective and insights. Nevertheless, except for those limited cases when the goal is a true historical restoration, we believe habitat management efforts will be most effective if they are not unduly restricted by a paradigm dominated by the past. The image of restoration ecologists as ecological caretakers or caregivers, working to restore the health of our environment, is attractive but inaccurate.

The fact that restoration ecologists are actually acting as landscape engineers or ecological architects, conceiving a vision for an ecosystem and then working to implement it, in no way diminishes the value and importance of this work. Whatever name it is given, whether it be restoration ecology, ecological architecture, or simply habitat management, this field needs to play an even more prominent role in society, if our environment is to meet the needs (biological, physical, aesthetic, and spiritual) of future generations. As Hobbs points out, restoration ecology is a very young discipline. The Society for Ecological Restoration (SER) was established only 17 years ago, and the first issue of its journal, *Restoration Ecology*, was published in 1992. The field has exhibited astounding growth in this short time. Given that it attempts to accommodate and affirm both science and values, it is hardly surprising that restoration ecology is experiencing growing pains as it matures.

What is important now is how it responds to these growing pains. Efforts to rigidly preserve a more limited mission for the discipline, in which practitioners work to restore "ecosystem health" through the restoration of past envi-

ronments, will probably lead to ossification within the field, a decline in its scientific credibility, and a loss of public support. We encourage all involved in this important new discipline to be flexible and open to new perspectives and visions.

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Restoration ecologists, like all practicing applied ecologists, confront two broad challenges. First, effective restoration requires a goal or policy, preferably an unambiguous one that is articulated, accepted, and codified (Lackey 2003). This therefore becomes a mandate for implementing the necessary restoration strategy. Second, restoration tools and techniques are often technically challenging and may require the application of poorly understood ecological principles. Altering ecosystems to create some desired past or new state often results in unexpected, sometimes disastrous ecological consequences.

Both challenges are important and formidable, but here I will focus on the first, because without resolving it we cannot accomplish the "how-to" challenge of the second. Many of restoration ecology's so-called failures are due less to technical inadequacies than to a lack of straightforward and broadly accepted restoration goals.

In a perfect world, society sets clear public policy goals, usually through elected or appointed officials, or career bureaucrats who implement legislative directives. Setting restoration goals requires choosing between competing values and priorities. Theoretically, at least, the public's values and priorities are considered pertinent, not those of bureaucrats or scientists. Restoration ecologists provide scientific information coupled with professional judgment on the consequences or feasibility of alternative restoration goals, but ultimately the choice of goals should be a societal one.

As anyone with experience in public policy will agree, the deliberative democratic process tends to be messy. One key cause is that public opinion is often badly fractured with respect to ecological policy issues. In such a political environment, it is impossible to come to a broad consensus on what an appropriate goal should be. For example, there are at least a dozen articulated visions of what salmon restoration should entail in the western United States. Achieving each goal would require different actions and policies which, politically speaking, creates different sets of winners and losers. For salmon recovery and other divisive ecological restoration issues, no governmental institution has the power to force the adoption of a clear, succinct restoration goal. More typically, the goal is so vague that few find it objectionable.

In the absence of agreement over restoration goals (or even that restoration is needed), technocrats have an understandable impulse to insert what they think is, or should be, the appropriate goal. The temptation to insert personal values is also great, because technocrats require a specific ecological target to implement a restoration program. For example, should restoration be aimed at recreating the ecological state that existed at the beginning of the Holocene, just prior to 1492, or at the end of last week? The answer is a value judgment, a policy choice – the product of political deliberations, not a scientific decision. Certainly, restoration ecologists and other scientists should assess the feasibility and ecological consequences of achieving each possible restoration target, but the choice lies with society in general.

Similarly, notions of degraded or damaged ecosystems, metaphors of ecosystem health or biotic integrity, or the relative importance ascribed to natural conditions versus altered ones need to be calibrated by societal values and preferences, not by those offered by scientists and technocrats (Lackey 2001). For example, one person's "damaged" ecosystem is another person's "improved" ecosystem. A "healthy" ecosystem can be either a malaria-infested swamp or the same land converted to an intensively managed cornfield. Neither condition can be considered "healthy" except through the lens of an individual's values and preferences.

We applied ecologists must be on guard constantly for the incursion of normative science into our technical language and thought. Normative science has built-in, often subtle policy preferences. Referring to an ecosystem as being "sick" or "healthy" implies a value judgment, suggesting that one ecosystem state is preferable to another. Such a determination may be appropriate as a personal or collective policy judgment, but should not be offered under the guise of science.

Given that society often does not articulate a clear policy goal for applied ecologists, what should a conscientious restoration ecologist do? First, know clearly the boundary between scientific or technical issues and value judgments. To the extent possible, try to exhort decision makers to focus on the often fractious value choices, rather than the technical and scientific debate, which frequently ends up serving as a surrogate polemic for an inability to settle value debates. Also, be brutally honest with decision makers about the technical feasibility of each possible policy option and the uncertainties associated with the resulting ecological consequences. Often, the most useful input that restoration ecologists can provide is to identify the probability of success for various possible restoration targets and the associated ecological risks.

Restoration ecology is a promising but still emerging science. We must avoid the trap of mixing personal policy preferences and judgments with scientific information and expression. Restoration ecology has too much to offer society to risk losing its credibility, by having its potential

scientific contributions dismissed because they are infected with policy advocacy masquerading as neutral science.

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I appreciate Hobbs setting the tone of this discussion with his comments on social values and expectations. It has been my experience, working with a variety of land managers, federal, state, and local officials, and a number of non-government organizations, that in addition to societal values, we also struggle with the definitions involved in ecological restoration.

In dealing with societal expectations for ecosystem restoration, and therefore restoration ecology, I have observed that, for the most part, these are more about making systems productive for our use than about returning ecosystems to some theoretical, pre-human disturbance state. Most of us have values based in the practicality of needing natural resources for survival. From this perspective, ecosystem degradation has more to do with systems no longer providing resources than with any spiritual or humanistic value system supporting the concept that ecosystems have a value outside of a human context.

There is therefore little support for ecosystem restoration and maintenance in a state that allows a system to function free of human intervention. This is true even when restoration is taking place in parks and wildlife preserves; even there, we cannot ignore the desires of the people that are designing the ecological studies and developing the restoration projects, nor of those that happen to live near the political boundary in question. Someone who has a job in the city, a new car, and a full belly sees the natural environment in a radically different way from someone who lives in the country, has no job, and is cold and hungry. In the same way, the individual who enjoys sitting and contemplating in a natural setting views ecological restoration very differently from the one who wants to drive snowmobiles, go skiing, and drink wine by the fireplace at night.

The second important issue involves terms and definitions. As scientists, we spend a lot of effort trying to be correct and precise. We love to create words and definitions and then debate those definitions, and whether particular situations fit one or another. This is especially true in the field of ecological restoration, because people are approaching the subject from so many perspectives: the ecologist, the landscaper, the land manager, the Native American, the farmer, the forester, and many more.

If you hold that restoration specifically means to restore to a pre-existing condition, it is easy to apply that definition to, say, a 1955 Chevrolet convertible, because we can get the engineer's plans and a very specific list of parts. From that point of view, it is equally fitting to say that ecological restoration is not restoration at all, because we do not have a complete list of parts in the best of circumstances, and we never have the engineer's plans. If you add the prerequisite that we also need to understand how it worked before it was degraded, then you can even more easily argue that today's version of ecological restoration is not restoration in that strict sense.

Since the common question is, "Restore to what?", what are we to do? We must understand that words are only signposts to reality and simply proceed. Otherwise, as Higgs (2003) suggests, we are going to have to come up with a whole new set of words for what we are doing when we manage ecosystems with the intention of bringing back something that was lost. Sometimes that means a species or a suite of species, sometimes natural processes, sometimes making a degraded landscape green and biologically productive again. Ecological restoration is a term that symbolizes all these types of landscape management activities. It is an overarching concept that we are trying to formulate here, not a precise classification of activity, because we never deal with all the complexity of any ecosystem. No matter how refined we may be able to get, restoration ecology will never give us the detail we need to do ecological restoration specifically.

Hobbs suggests that the development of a broad conceptual basis for restoration ecology is only a recent phenomenon, as is the recognition that "ecosystem dynamics can be complex, non-linear, and often unpredictable". Indeed, while some were working on restoration projects as early as the 1930s (Leopold 1934), it wasn't until the 1980s that Bradshaw (1980), Bradshaw and Chadwick (1983), Jordan *et al*. (1987), and Cairns (1988) wrote about a conceptual basis for restoration ecology. On the other hand, Gleason wrote that ecosystems were dynamic and individualistic in time and space back in the 1920s (Gleason 1926, 1927). While it took most ecologists decades to catch up to his ideas, it really is an old idea presented before its time.

I believe that restoration ecology alone cannot provide the basis for ecological restoration. We need an integrated program of inventory and monitoring, research, and adaptive management to carry out the complicated and difficult task of ecosystem restoration, especially if we are dealing with more than a few acres (Halvorson and Davis 1996).

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One of the most vexing issues facing restorationists is how to set appropriate goals for projects. It is tempting to look to ecological science for help. If ecologists could tell us the characteristics of a healthy ecosystem in an area, then restorationists would seem to have an objective guide, just as medical science seems to provide a guide for physicians (Covington 2003). Human health is a value-laden concept, but it is largely rooted in empirical knowledge about how the body works.

Unfortunately, the analogy between medicine and restoration is strained. In general, ecosystems are much more dynamic than organisms, their boundaries are more permeable, and appraisals of their health depend on the choice of temporal and spatial scales (Hull and Robertson 2000). In a single area, a variety of ecosystem states could be characterized legitimately as healthy, and debates about health are likely to mask disagreements about value (Throop 2000). It is possible that when ecology matures, it will include general concepts such as health and integrity, that map onto objective features of the world and carry a strong positive value, but this seems unlikely. Consequently, Hobbs is right to insist that a wide range of values and background assumptions, about such things as our place in nature, play critical roles in the selection of restoration goals.

How should we select which values ought to determine a project's goals? Our culture is singularly uncomfortable about basing controversial decisions on careful reasoning about values. We are heirs to the legacy of positivism, which holds value judgments to be mere expressions of emotion or personal preference. This leads us to adopt decision-making procedures that take values as givens, rather than as subject to rational correction. Thus, we often create policy based on maximizing preference satisfaction (utilitarianism) or satisfying the majority's preferences (democratic decision making). Selecting restoration goals using stakeholder negotiations (Gobster and Barro 2000) or developing restoration's democratic potential (Light 2000) can turn into means for satisfying preferences. Democratic procedures have the virtue of improving the success of restoration projects by involving stakeholders in the planning. They may also serve to educate stakeholders and thereby to improve values, but they carry considerable dangers as well. Ecosystem values, such as biodiversity, integrity, and wildness, are often inadequately reflected in stakeholders' immediate preferences, which tend to focus on short-term desires. Democratic procedures often have an anthropocentric bias that would not survive rational critique.

Recently, we have been recovering methods of reasoning about values. We sometimes derive specific values from more basic principles, but more frequently, we assess values by seeing how well they fit with our best science and our other considered value judgments (Griffin 1996). For example, Aldo Leopold's value of ecological stability can be assessed by testing its fit with current theories about ecosystem dynamics. Often, such reasoning will not produce a unique best set of values, but it will show some value judgements to be less justified, than others, and it will lead to decisions that effectively balance competing justified values and avoid biases.

Hobbs provides reasons for broadening the range of restoration goals beyond the traditional emphasis on an "original" or pre-disturbance state of an ecosystem. Our ignorance about the history of an ecosystem, our inability to return a system to an earlier trajectory, and changes in surrounding systems, make many traditional restorations unsuccessful. Furthermore, such attempts are often costly, and sometimes rooted in misconceptions about ecosystems.

The points raised above highlight the dangers of valuing pre-disturbance goals, but dangers lurk in other directions too. If we separate restoration from history, considerations of cost, aesthetics and convenience are likely to become more pronounced. We will be tempted to use restoration to serve human ends, rather than ecosystem values. Moreover, we will increase the probability that restoration will have negative, unintended consequences. Given the current state of our knowledge, we should question our ability to design ecosystems that function as well as pre-disturbance systems. Perhaps most important, the idea of designing ecosystems to meet current needs – whether our own or those of other inhabitants of an ecosystem – seems linked to the hubris that is often responsible for the ecosystem degradation we are trying to correct. If arrogance is part of the problem, then the humility involved in returning nature to a pre-disturbance state, where possible, may be part of the solution.

We must be realistic in our expectations of restoration, but we should also be conservative in our approach. By one definition, a conservative is someone who values the past. We should not be slaves to the past, but we should value "historical fidelity" (Higgs 2003). If we try to return

a system to a previous trajectory, we are less likely to make new errors. We are also less likely to turn restored ecosystems into commodities – replaceable technological creations that are bought and sold in the marketplace (Higgs 2003). We are more likely to deepen our connection with nature (Jordan 2003) and to speed the return of wildness (Hettinger and Throop 1999). At least in areas where natural processes can govern ecosystem dynamics, we should start with a strong presumption in favor of restoring pre-disturbance systems. We may override this presumption where conditions make such goals too challenging or the costs too high, but we should be acutely aware of the dangers we court in moving too far in other directions.

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