

OPINION ARTICLE

Ecological restoration success: a policy analysis understanding

Susan Baker^{1,2,3}, Katarina Eckerberg⁴

This article discusses how ecological restoration success can be understood and evaluated using a policy analysis lens. First, this article details a conceptual tool that helps to develop a more encompassing set of criteria to assess restoration activities that provide socioeconomic benefits. Second, by broadening the understanding of restoration success and how it can be evaluated, it allows a more critical view of evaluation itself and its uses as a policy tool. A table is presented that can help practitioners reveal preferences and clarify the aims and objectives of particular initiatives. The table also sensitizes practitioners to the complexity of the links between restoration rationales and evaluation criteria, which in turn may open up much needed discussion and dialogue between restoration participants about the underlying values an actor may wish to promote. It heightens awareness of the fact that evaluation methods need to recognize that restoration is driven by multiple rationales often in the same project, both process driven and output oriented, which in turn can change over time. Adding process and output criteria together may also raise issues of priority. Evaluation criteria thus need to be assigned in ways that reflect these multiplicities, while at the same time recognizing that some restoration values might be conflictual and that there may be winners and losers. Furthermore, judgement about “failure” of a project can change as new goals emerge in delivery and implementation. Ecological restoration evaluation should therefore be ongoing, contextual, and not a one-off event.

Key words: ecological restoration success, ecological restoration values, evaluation criteria, restoration process, socioeconomic benefits

Implications for Practice

- Ecological restoration policy and practice are value-laden, involving multiple interests and actors, each prioritizing different project objectives and types of action.
- Evaluation methods should recognize that restoration is driven by multiple rationales, often in the same project, which can change over time. Evaluation criteria thus need to reflect these multiplicities.
- A table is presented with examples of actions arising from, and supporting, these rationales and underlying values, which shape the appropriateness of specific evaluation criteria.
- The practitioner can draw across the table to understand better the linkages between values, actions, and evaluation criteria, thereby improving the targeting and usefulness of evaluation processes.
- Restoration evaluation should be ongoing, context relevant, and not seen as a one-off event.

Introduction

This article discusses how ecological restoration success can be understood using a policy analysis lens, a lens that draws heavily upon political science. We address the concerns of Wortley et al. (2013) about the knowledge gap in measures for evaluating socioeconomic attributes of restoration. Their literature review finds that few articles deal with social criteria and these

are mainly confined to describing the extent of community participation at project level. We argue, however, for the importance of applying a policy perspective. First, this article details a conceptual tool that helps to develop a more encompassing set of criteria to assess restoration efforts that provide socioeconomic benefits. This can support other efforts to widen the criteria base, such as within economics, where costs and benefits are being incorporated into the evaluation of restoration, especially at the project level (Holl & Howarth 2000; Kiker et al. 2005; Robbins & Daniels 2012). It can also contribute to developing approaches to conservation that recognize multiple values, so as to better support both practice and policy (Tallis & Lubchenco 2014). Second, by broadening the understanding of restoration success and thus how it can be evaluated, we present a more critical view of evaluation itself and its uses as a policy tool.

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¹Cardiff School of the Social Sciences, Cardiff University, Glamorgan Building, Cardiff CF10 3WA, U.K.

²Sustainable Places Research Institute, Cardiff University, 33 Park Place, Cardiff, Wales U.K.

³Address correspondence to S. Baker, email BakerSCM@cardiff.ac.uk

⁴Department of Political Science, Umeå University, Umeå, Sweden

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A Policy Analysis Lens

A useful way to begin is to start with a basic premise of policy analysis—that criteria of success are not to be treated as given, but rather seen as context and policy dependent. In this case, this means that they depend on what we want from restoration, in particular places, and at certain times. We use this starting point to track the interrelationship between restoration aims, their associated values, resultant project actions, and, in turn, appropriate evaluation criteria. We have organized this interrelationship around a table, which schematizes the links between different restoration types, their underlying values, associated actions, and appropriate evaluation criteria (Table 1).

Reading the Table

First, a word of caution! Table 1 is a heuristic device only and, as such, certain simplifications are necessary. Categorizing restoration types and associated actions proves particularly tricky when working with the concepts of ecosystem services and when seeking appropriate examples. This is because the original Millennium Ecosystem Assessment (MEA 2005) classification into provisioning, regulating, supporting, and cultural services suffers from a lack of rigor in application. Furthermore, the classification is subject to increasing revisions as it primarily becomes a way of describing ecosystem outputs as they directly contribute to human well-being (Haines-Young & Potschin 2013). We have nonetheless used the MEA categories, not least because they resonate with current policy language and have issue salience within contemporary public policy making.

Similarly, we recognize that most restoration projects are complex in terms of their objectives and that, furthermore, groups involved at project level may hold different understandings of what a specific restoration project is designed to achieve. Benefits and costs may also accrue over different time scales (Holl & Howarth 2000). We stress that entries in Table 1 can be grouped together, to form a more complete picture of these links and interrelationships. In reading Table 1, attention should be paid to the fact that project implementation may see restoration actions that overlap across values. This overlap can be illustrated by flood plain restoration, where projects can contribute both to managing water flows for the purposes of flood defense as well as the achievement of good water quality as required by the EU Water Framework Directive (Hering et al. 2010). Despite the strong utilitarian basis of such actions, such projects can also promote ecocentric values, in particular, enhancing the biodiversity of rivers through remeandering and revegetating riverbanks.

Table 1 can be read across, from left to right, as it is based on the premise that the rationales are associated with specific underlying values. These values capture the different beliefs about the relationship between humans and nature, including normative positions about how ecological restoration should function. Moving across Table 1, examples are given of actions arising from, and supporting, these rationales and underlying values, which in turn shape the appropriateness of specific evaluation criteria. For example, restoration driven primarily by the desire to maintain or enhance ecosystem services is seen as underpinned by utilitarian views of nature. Here, the

evaluation criteria are related to the practical functioning of the restoration outcome, in this case in service provision to meet human needs.

Second, Table 1 can be read downwards through the column, from the top of the left-hand side. Reading down, the different types of ecological restoration are presented, beginning with the classic understanding of restoration as driven by commitment to historic fidelity, down to more contemporary concerns to ensure the delivery of ecosystem services, to enhance those natural systems that benefit the widest number of peoples (Soulé 2013; Miller et al. 2014), and to promote novel ecosystems (Hobbs et al. 2009; Kareiva & Marvier 2012) as adaptation to climate change. The column continues by categorizing restoration according to socially orientated and morally driven purposes that, while not necessarily incompatible with other previous rationales, move attention away from ecological to more deeply ethical considerations.

While Table 1 uses several examples of restoration action, across a variety of different scales and ecosystem types, our examples should be seen as merely illustrative. Restoration can target local settings, such as the planting of green urban spaces, or operate across ecological regions, such as in programs for the reintroduction of apex predators, such as wolves, into an ecosystem. Commonly, projects can involve a mix of actions, including across scale.

Rationale for Restoration

The first column on the left-hand side categorizes the rationale for restoration, that is whether it is primarily aimed at the restoration of past ecosystems, meeting regulatory requirements, ensuring ongoing ecosystem service provisioning, addressing climate change challenges, or making moral restitution for past damages to nature. Early attempts to value ecological restoration concentrated on judging the success of ecological restoration outcomes in terms of technical performance criteria (Allison 2002). According to this view, ecological restoration was seen to aim at: (1) structural replication, rooted in the notion of, or attempts to obtain, ecological *fidelity*; (2) functional success, where biogeochemical processes operate according to expectations of the specific ecosystem; and (3) durability in the restored ecosystem, a characteristic that is dependent on subsequent management strategies (Higgs 2003, p 128–129; see also Higgs 1997). Although considerably modified by research on the interlinkages between ecological processes and human interactions (see Cook et al. 2004; Palmer et al. 2004; Ingram 2012; Kareiva & Marvier 2012; Kareiva et al. 2012), this view presents what we might call a “product-orientated” view of ecological restoration, primarily targeting the outcome of restoration efforts. This view is brought sharply to the fore when restoration is driven by the need to comply with environmental legislation and where planning interventions drive restoration practices, even when such compensatory actions do not result in “equivalence” (Baker & Eckerberg 2013). More recently, the promotion of resilience, in particular in the context of climate change, has come to be considered an important criterion of success (Dunwiddie et al. 2009). This raises the need

Table 1. Ecological restoration: linking values, policy preferences, project type, and evaluation criteria.

<i>Rationale</i>	<i>Underlying Value</i>	<i>Actions</i>	<i>Evaluation Criteria</i>
Return to past	Historical fidelity	Reintroduction of species assemblages and habitats, such as wolf, grasslands, and prairie	Structural replication, functional success, durability
	Nostalgic	Restoration of lost properties, such as natural disturbance from fires Removal of Invasive Alien Species (IAS) Rewilding	Effective management plan
Address environmental damage	Modernist	Remediation efforts at industrial or quarry site Brown field land management	Visual appearance of landscape, pollution containment, soil improvement, and safety
Comply with environmental standards or legislation	Regulatory	Mitigation, such as creation of new ecosystem to replace one destroyed elsewhere	No net loss
	Rational planning	Achievement of good water quality, e.g. EU WFD	Effectiveness of market instruments, e.g. mitigation banking Meeting environmental objectives, within specified time frame
Restore Ecosystem Services (ESS)	Utilitarian—nature as “capital”	Soil, seagrass or coral restoration [supporting]	Improvement in soil fertility, maintenance of agricultural production and crop diversity
	Anthropocentric “New Conservation”	Soft water management via restoration of flood plains [supporting and regulating]	Fewer floods and flood damage
		Reforestation [provisioning]	Availability of food, fiber and fuel; carbon sequestration
		Wild flower planting for insect pollinators [regulating] Enhancement of aesthetic landscape features [cultural]	Presence of green infrastructure
Promote novel ecosystems for climate change adaptation	Pragmatic	Acceptance of in situ IAS	System is maturing, or capable of maturing along stable trajectory
		Assisted migration/deliberate movement of species in anticipation of shifting climatic envelopes	Resistance and resilience of system Thermodynamic efficiency Provision of ESS
Restore ecosystem structure and function	Ecocentric	Habitat recreating, e.g. through rewilding rivers [remeandering, rebouldering, and dam removal]	Abundance and distribution of particular species [species richness]; Genetic variability within and between species
Provide for recreation	Social/economic	Create access infrastructure, e.g. pathways	Number of visitors
		Make varied leisure zones, such as fish ponds Planting of urban green spaces	Improved mental and physical well-being
Make amends to nature	Moral engagement/restitution	Local, small scale community projects, e.g. community forestry	Proximity to green spaces Integration into school curricula
		Preparation of educational activities to enhance environmental awareness	Number of volunteers engaging with projects at local level Sense of identity and connection to place Appreciation of human: nature interrelationship

to shift away from a “historic” toward a “futuristic” approach to restoration (Choi 2007). In the face of climate change, the purposeful designing of ecosystems, that is the creation of synthetic systems to achieve ecological, social, and/or economic goals, also achieves value (Martinez & Lopez-Barrera 2008; Palmer & Filoso 2009), as does the emergence of novel ecosystems within more naturally occurring processes (Hobbs et al. 2013). Similarly, ecosystems populated by what had hitherto been considered invasive, alien species, can now be valued as examples of resilience and as indicative of practices that adopt a pragmatic response to system stressors (Jackson & Hobbs 2009).

At the bottom of the column, a process-oriented view is revealed when restoration primarily aims at making amends to nature. This draws upon the research of Light and Jordan, where engagement in restoration is seen to provide a gift back to nature, making “restitution” for past environmental damage (Jordan 2000; Light 2000). Such actions add to the repertoire of ways in which society can reconnect with nature, creating community alongside other transcendent values such as meaning, beauty, and a sense of the sacred. This resonates, at least in part, with practitioners work within community restoration projects. It also shifts attention away from narrow “product” or output oriented notions of success to consideration of the processes involved in ecological restoration and how they facilitate or restrict participatory commitment (Higgs 1997). Here, it is the social or even individual input into the process of restoring, rather than the outcome in terms of ecological structure and function or the delivery of ecosystem services, which is more important as a criterion of success.

These considerations bring our discussion to a very different view wherein restoration is viewed by some not as a positive activity, but as a deeply anthropocentric and morally questionable endeavor. Elliot, for example, uses three characteristics—*origin, historical continuity and authenticity*—to distinguish the artefactual from the “natural,” arguing that ecological restoration shows a lack of authenticity, an interruption of historical continuity and a change of origin, all of which arise from the addition of human intentionality (Elliot 1982). In this view, compensatory restoration, for example, because it involves replacing one destroyed ecosystem by restoration measures elsewhere, denies the place connectivity of a particular site. The creation of de novo wetlands for compensatory planning purposes provides another example (Cowell 1993). This value, in particular the emphasis on historical authenticity, is heavily disputed in the literature (Clewell 2000). The value is excluded from Table 1 because, while recognizing that nonaction stems from a particular value, nonintervention is not linked to restoration actions.

Underlying Value

The focus on values owes much to the contribution that philosophy has made to the study of ecological restoration (see in particular Attfield 1994; Light 2000). What is interesting from the point of view of Table 1 is how these different conceptualizations of nature are used, in turn, as a lens with which to value restoration. There are many schematizations of restoration

values available within the literature, with different conceptualizations of the relationship between humans and nature used as the starting point for classification (Callicott et al. 1999; Swart et al. 2001; Keulartz et al. 2004; Keulartz 2007; Drenthen & Keulartz 2014). Callicott and colleagues, for example, use conservation philosophy as a base for their categorization of ecological restoration, drawing upon different views of the relationship between humans and nature to structure the different values associated with restoration, traditionally seen to fall into two broad, opposing categories: ecocentric and anthropocentric groupings. This allows them to present ecological restoration as operating along a continuum, ranging from “compositionism” to “functionalism” approaches. Compositionism places emphasis on returning a biotic community to its original composition of biodiversity and integrity, whereas functionalism places emphasis on the process of returning an ecosystem to a state of health (Callicott et al. 1999; see also Keulartz 2007).

A similar undertaking can be found by Keulartz (2007), where different kinds of management options are structured according to their relationship to different “metaphors” of nature. Such application has allowed (Swart et al. 2001) to understand why wilderness approaches remain so dominant in restoration practices in the United States, where the understanding of nature as wilderness, and thus apart from human society, has a strong cultural hold.

Table 1 draws upon such works, with the values column moving down through anthropocentric considerations and, as we come to the end of the column, deeply ecocentric and morally driven responses take our attention. However, Table 1 also utilizes a policy lens. At the start of the column, restoration is presented as a top-down activity, especially when driven by regulatory rationales. Implementation is often undertaken by commercial firms, allowing restoration to become the source of profitable business. At the end, restoration is more driven by participatory practices, providing a means whereby local communities can reconnect with nature. Restoration then holds both a redemptive value, providing opportunity to heal ourselves culturally and perhaps even spiritually by healing nature (Higgs 1997, p 342), and it allows communities to develop a “participatory-gardener” relationship with nature (Cowell 1993). This engagement shifts attention away from narrow “product” oriented notions of success to consideration of the processes involved in ecological restoration and how they facilitate or restrict civil society engagement. Such bottom-up approaches often complement top-down steering, but a policy lens points to the deeply significant differences between the two approaches. In contrast to traditional, top-down steering, participation is seen to form part of a wider trend in the governance of public policy. This trend is affording citizens greater opportunities to shape public policy across a wide variety of issue areas, including but not limited to policy processes operating at the local level (Baker 2014). This “decentered” form of engagement enhances social capital, that is, social networks and the norms of reciprocity and trustworthiness that enable people to work together to address common concerns. The promotion of this social capital is seen to underpin societal resilience in the fact of climate change (Adger 2000).

Actions and Evaluation Criteria

Many restoration activities embrace a variety of aims and objectives, not all of which are made explicit or are mutually reinforcing. Moreover, these can be combined in multiple ways during the practical implementation of restoration projects. In practice, the availability of funding, and the criteria for funding distribution, may change over time. Such changes in turn tend to promote different kinds of objectives. Moreover, actors involved in restoration, at both project and policy levels, may not share common rationales, and thus a particular project may be driven by several, not necessarily compatible, motivations. In this context, contradictory messages inevitably emerge, making it unlikely that unambiguous signals for policy will be found (Mace 2014). Nevertheless, it is possible to chart how certain actions relate directly to specific restoration values, linked in turn to different rationales, while recognizing that these represent simplifications of what goes on in practice.

Recognition of the multivariated context and practice, and their different rationales, helps to better understand why some projects can see that stakeholders share views on what should be done and how, while other projects are marred by ongoing conflicts and controversies. For example, removing a wooded area for the explicit purpose of enhancing the biodiversity of prairie grasslands may be viewed quite differently by local people that attach recreational value to that place as a wooded area (Gunter & Kroll-Smith 2007). Recognition of this multiplicity of values also offers a more robust basis for the next step in the policy process, evaluation. Views on what constitutes policy success are closely associated with whether, and to what extent, actions taken support one's preferences and underlying values.

There is considerable debate as to whether it is the processes or the outcomes, discussed above, that should form the basis for developing evaluation criteria and whether both can be combined in a single methodology (Davidson 2005). This debate is reflected in Table 1, where those that drive a more moral agenda for restoration practices would seek evaluation criteria that highlight the extent to which civil society participatory input was facilitated by restoration projects; whereas those that promote a classic understanding of restoration would view a successful project as one that results in functioning, ecological outcomes. The literature is increasingly aware that adherence to the concept of "historic fidelity" as an indicator of success may not be possible, and in the face of climate change, may not be wise to use as a measure of success when evaluating ecological restoration outcomes (Gunn 1991; Harris et al. 2006). We add to this call by arguing that there is need to develop a more diverse set of criteria for judging the success of restoration that are relevant to, and seen as legitimate by, divergent stakeholder groups. More importantly, methodological innovation is needed so as to find ways to combined approaches, allowing for more encompassing assessments of restoration efforts while still retaining the ability to provide useful findings. Such efforts might help overcome the seemingly unwillingness of both practitioners and the policy community to engage with the monitoring and evaluation of restoration projects (Bash & Ryan 2002; Kondolf et al. 2007). By giving space for different values, evaluation can also facilitate a process of learning by allowing the range of both

positive and negative experiences of real world experiments to be fed back to the next cycle of restoration design (Gross & Hoffmann-Riem 2005).

Devising broader, more inclusive and combined criteria for evaluation is also important because policy makers will typically build on past successes, which serve to promote certain practices above others. Although this may seem positive in that it can lead to transfer of best practice, there is a danger that it can result in institutionalized path dependency. Certain groups could welcome such rigidity because it guarantees that their interests and values are continuously prioritized. However, it risks making restoration inflexible and thus more difficult to use to address new challenges. Adhering to one set of criteria of success promotes one kind of value, an approach that is not useful, for example, when ecological restoration acts as a means of enhancing both ecological and societal resilience in view of climate change.

Adopting a policy science lens also makes us aware that in practice evaluation can be used for multiple purposes (Vedung 1997). Evaluation can serve instrumental purposes, aiming at improving cost effectiveness or be used as a mechanism to report output or impact to funding agents. It can also work in a more participatory way, by involving stakeholders and including their ideas and expectations in the assessment process itself. Furthermore, it may help political purposes in feeding back "success" judgments to policy makers in ways that merely legitimize prior policy decisions. It can even function as a tactical tool to gain time, or destroy a program. Evaluation is thus more than the application of mere instrumentality in managerial practice [effectiveness and efficiency]—it is also about obtaining policy and project legitimacy in complex political and administrative settings (Vedung 1997).

Furthermore, we need to be mindful that restoration is not a linear process, and outcomes do not map neatly onto prior, given objectives. From an ecological perspective, a specific endpoint is not assured, especially as restored sites become self-renewing (Clewell 2000; Kareiva & Marvier 2012). Dynamics are also evident from a policy perspective, as restoration objectives can change over time. For example, over time a preservationist approach to Swedish protected area management has partly been replaced by an interventionist approach, leading to great difficulty in establishing consensus on criteria for management and for determining success (Steinwall 2015). Reading Table 1 as an entirety can help overcome the difficulties that such dynamics bring. Such a reading allows us to see how, if restoration objectives change across temporal scale, criteria of success need to also change, or new combinations of criteria need to be generated.

Table 1 can help in gaining insight into project failures and the trade-offs that exist within projects with multiple objectives. Thus, for example, when restoration efforts target sites in watersheds with deforestation, mining, or development, actions that benefit one ecosystem service may interfere with another (Palmer & Filoso 2009). However, Table 1 remains neutral as to effectiveness and efficiency of particular approaches, being concerned instead with the need to be sensitive to the different rationales of restoration. Thus Table 1 serves an additional

analytic purpose. It can help us to overcome the unwarranted assumption, explicit or otherwise, that see restoration policy or projects as rational endeavors, that is as having clear, specified, and noncontradictory objectives, which can accordingly be evaluated against pre-determined benchmarks (see Allison 2002 for further discussion). We thus stress again that success has to be evaluated in context.

Conclusions

A policy science lens can help uncover the close links between goal-setting and choice of instruments and actions, and hence how evaluation is to be conducted and using which set of criteria. It shows that evaluation has to encompass both process driven and output oriented approaches, as both factors are present and both shape specific choices of actions that, in turn, require appropriate evaluation criteria (Baker et al. 2013). This lens does more than expand the evaluation criteria of restoration success to include socioeconomic markers. It heightens awareness of the fact that evaluation methods need to recognize that restoration is driven by multiple rationales, often in the same project, which can in turn change over time. Evaluation criteria thus need to be assigned in ways that reflect these multiplicities. It should be ongoing and not seen as a one-off event. In short, measures of restoration success need to be related to what a restoration project is designed to do, by whom, and when. Multiple benefits require the elaboration of multiple evaluation criteria and their flexible adaptation over time.

We have presented a table that can help practitioners reveal preferences and thus clarify the aims and objectives of particular initiatives. Table 1 also sensitizes practitioners to the complexity of the links between restoration and evaluation, which in turn may open up much needed discussion and dialogue between restoration participants about the underlying values an actor may wish to promote. The greater the opportunity to engage in such revealing processes at early stages in policy development, the less risk of project failure.

However, criteria cannot be simply be merged together into a “composite,” because there may be multiple and noncompatible objectives. Even if objectives are clear and discernible, and methodology improved to encompasses plurality, social scientists point to the dangers of simply assuming that evaluation can be undertaken under the presumption of process linearity and causality between actions and outcomes. Both processes and outcomes can be unpredictable and lead to unintended consequences that, in turn, require flexibility in evaluation approaches. Furthermore, adding process and output criteria together may also raise issues of priority: which value to prioritize over the other, when values are not mutually reinforcing? Such trade-offs may see winners and losers and thus some argue that the project was a failure.

We have explained how judgement about “failure” of a project is linked to what it is that the project is designed to do. First, failure is not an “objective” state, but related to what one expected the project to do and thus one actor’s failure can be another’s success. Second, project failure may also be the result

of gradual realization that aims and objectives were not clear, or coherent from the onset, so that, over time, inconsistencies can become more marked and divisions between stakeholders come to the fore. Failure in this case stems from lack of early and explicit agreement. We need also to be mindful that, while a project may fail, relative to original goals, it may be a success as new goals emerge in delivery and implementation.

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