

## **DIFFERENT MEANS, SHARED ENDS: ENVIRONMENTAL RESTORATION AND RESTORATION ECOLOGY**

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### **Abstract**

Restoration of the environment is not simply a practical matter. The topic carries with it immense metaphysical and aesthetic interest. In the same way that the science of ecology and the cultural phenomenon of environmental politics are inseparable, restoration of the environment is inextricably tied to and informed by several areas of discourse: ecology, cultural ecology, human ecology, environmental history and environmental ethics. The multi-disciplinary scope of the literature review undertaken for this work allowed for the reconceptualization of key terms and ideas of critical importance to restoration.

### **Introduction**

This work demonstrates that our ideas of restoration can plausibly rest as much on our social traditions as they do on scientific theory. Like ecology, restoration ecology has developed in a social, economic and political context that has had an influence over the type of issues selected for analysis (Bocking, 1997). Cairns (1988) has stated that the discipline of restoration ecology was made academically possible by the first Earth Day celebration. Most of the work undertaken during the 1970s can be characterised as grassroots reform-oriented restoration of local environments (Sweeney, 2000). The initial plurality of meaning characteristic of the early populist interpretation of the meaning of restoration mirrors that of ecology (Westoby, 1997) both informing (Myserud & Myserud, 1997) and contrasting with the scientific discourse (Davis, 2000).

Several environmental crises characterised the late seventies and early eighties, *viz.* acid rain, massive forest die-back, acidified lakes, eutrophication, the greenhouse effect and the discovery of the ozone hole. In response to social concerns, the concept of ecosystem stress (Seyle, 1973) was given high prominence in the early years of the decade. Several important contributions defining stress (Ivanovici & Wiebe, 1981) and summarising the trends expected in stressed ecosystems appeared (Odum, 1981, 1985). Implicit in the notion of stress is the larger societal judgement of the quality of change to an ecosystem (usually bad). The relationship of restoration ecology to ecosystem stress is, broadly speaking, that of alleviation.

Bradshaw's (1982) thesis that restoration is the "acid test" of ecology spoke directly, not only to the compelling societal notion that ecosystems would have to be restored (Berger, 1990), but to the hope that they could be restored (Dobson et al., 1997). Also in 1982, the Palme Commission introduced the concept of environmental security. It challenged the traditional definition of security based on political and military might arguing that economic and social progress depended on environmental security which could only be achieved through environmental conservation and restoration (Palme Commission, 1982). In 1987, the Brundtland Commission (WCED, 1987) criticised the illogic of conventional economic development and introduced the idea of sustainable development. Overnight, the 'environment,' long considered merely a backdrop to human experience, became a necessity and not a luxury.

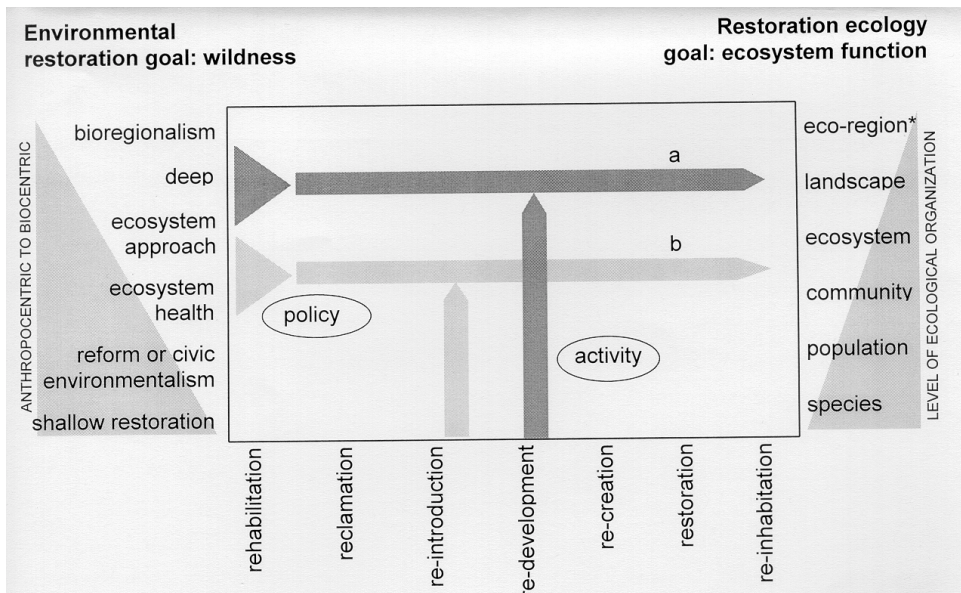
The design of appropriate management practices, known variously as ecodevelopment or ecological rationality (Dryzek, 1987), was called for by local citizen action groups and global policy makers alike. The impetus for rational development including restoration came from the recognition that while humans destroy the productive, protective, and waste assimilative capacities of ecosystems, they are also capable of creating and sustaining ecologically sustainable pathways of economic development, a process known variously as ecosystem redevelopment (Brinck et al., 1988) or reform sustainable redevelopment (Regier et al., 1989). Odum (1981) had already described such development, one that minimises ecosystem disturbance, as an "anthropogenic subclimax," in other words, a human created and maintained stable ecological state different from the climax which would obtain in the absence of human intervention.

Because human impacts are ubiquitous and complex, it had become crucial to understand the causes and consequences of human induced ecosystem damage; problems needed to be identified, rationalised and pursued (Freedman, 1995). Thus, throughout the 1990s developments in theory and practice continued to draw on both social and scientific developments across a variety of spatial scales, from the idea of environmental (Costanza, 1999) or ecosystem health (Cairns & Neiderlehner, 1995) at the landscape level to the wealth of knowledge generated at the level of the molecule (Lovejoy, 1998) and applicable to bio-remediation techniques (Dobson et al., 1997; Lovely & Woodward, 1992).

## Discussion

Existing work falls into one of two main categories: environmental restoration and restoration ecology, which are linked through management and policy options (See Figure 1). Environmental restoration is a social movement whose theory and practice requires the critical appraisal of socially organised knowledge-claims (Sweeney, 1999) such as the moral primacy of pristine wilderness (Cronon, 1995; Denevan, 1992; Bowden, 1992), crucial ideological tenets of conventional economic discourse such as sustainable development (Descola & Pálsson, 1996), misleading social metaphor such as ecological ‘investment,’ ‘services,’ and ‘debt’ (Hornborg, 1996; Grange, 1977), and daring conceptual bets such as universally applicable images of environment and society (Guha, 1997; Redclift, 1995), reinhabitation (Bernard & Young, 1997; Mills, 1995) and the utopian bioregional movement (Brennan, 1998).

The spectrum is broad, ranging from neighbourhood clean-up and enhancement campaigns of short duration to full-fledged social criticism over the long haul (See Table 1). Any ideology that calls for sweeping social changes arguably faces an inherent tension between moderation and radicalism. In environmental restoration, as in sustainable development, this has meant “bargaining with the forces of the status quo and biding one’s time while popular mentalities slowly evolve” (Bess 2000). In other words, the process has been constrained by having to wait for a change in value systems.



**Fig. 1:** Linking social and ecological paradigms through a continuum of restoration activities. Examples a and b show a qualitative congruency between ecological and social paradigms of differing scales.

Restoration ecology is a field of scientific inquiry. It is little more than a decade old. It is not established as a mature science with a clear sense of direction, although it has a growing body of researchers constituting a self-defined community, i.e., contributors to the journal *Restoration Ecology*. Presently, no standard methods are available in the field of restoration ecology and, as a consequence, little of restoration ecology is routine (MacMahon & Jordan, 1994; Cairns, 1988). Because the discipline itself has no “methodology” it is very difficult to say that it has a paradigm, or “general set of rules and procedures under which people study and investigate the subject matter of a discipline” (Kuhn, 1962). Rather, restoration ecology depends on four inter-related social and biological conditions: how nature is valued by society, the extent of social commitment to restoration, the ecological circumstances under which restoration is attempted, and the professional evaluation necessary to accomplish it (Jackson et al., 1995). The degree to which these four social and biological conditions can be inter-related is shown in the wide variety of restoration terms shown in Table 1. The theoretical approach of the discipline embraces physical, social, cultural and ethical constituents. The discipline of restoration ecology is interwoven with political ideas, normative claims and moral propositions. It is an “engaged science” (Lawton, 1997) which makes it necessary to assess the crosscut of different streams of contemporary thought as they respond to and inform the ambient social, political and economic drivers affecting both nature and the intellectual enthusiasm of a nascent discipline.

**Table 1** Restoration terms and definitions

<b>Restoration*</b>	To bring back into a former or original state. Ecological restoration means restoring to a former or original state at a particular ecological level of organization. Restoration is often regarded as a distinctive form of conservation management, differing from “preservation,” “conservation,” “stewardship,” or even “management” itself. There is no sharp distinction between these various forms of manipulation. All of them involve a series of attempts to compensate in a specific way for alterations typically caused by human activities.
<b>Rehabilitation*</b>	This is a broad term that may be used to refer to any attempt to restore elements of structure or function to an ecological system, without necessarily attempting complete restoration to any specified prior condition; for example, replanting of sites to prevent erosion.
<b>Reclamation*</b>	This term typically refers to rehabilitative work carried out on the most severely degraded sites, for example, land disturbed by open-cast mining or large scale construction. Though reclamation often falls short of restoration in the fullest sense (a copy of the native ecosystem is not achieved), it is clearly a necessary step in the process of restoration under such conditions. In a sense, it is the first step to restoring a more natural ecosystem. Unfortunately, the disciplines of reclamation and restoration have developed more or less independently, and only recently has significant communication between them occurred.

<b>Pre-planned Mitigation as Restoration†</b>	Assumes that a system is going to be altered, that alternatives have been evaluated, i.e., conservation measures which would obviate the need for the proposed construction (biocultural restoration). Pre-planned mitigation calls for a post-operative appraisal in the planning stage; good examples include the construction of dams and the closure of sanitary landfills. A key question is “what might be done in locating and building the original construction to make the conversion easier when it is no longer functioning as it was originally intended?”
<b>Molecular Restoration</b>	Bioremediation techniques focus on the short-term use of species-specific activities to clean up heavy metals such as cadmium and mercury from effluent, uranium and other long-lived nuclear isotopes from land. Species may be engineered for specific clean-up duties.
<b>Re-creation*</b>	Re-creation attempts to reconstruct an ecosystem, wholesale, on a site so severely disturbed that there is virtually nothing left to restore. The new system may be modelled on a system located outside the range of the historical system, or may be established under conditions different from those under which it occurred naturally. Such efforts are not restoration in the strictest sense, but they can lead to important insights into the systems involved and the conditions that support them that can be invaluable in restoration efforts.
<b>Re-Introduction</b>	Can be based on the belief that the re-introduction of rare and distinctive species adds to the natural aspect of the community, especially true of plants. The re-introduction of plant species should be undertaken using species appropriate for successional stages. Once stabilized, animal re-introduction activities can be initiated taking care to identify pollinators and to understand their interrelationships. Re-introduction as a unique form of restoration often focuses on flagship species, top food chain predators, i.e., the wolf or panther, or animals that need large home territories, i.e., the elephant. Re-introduction as restoration should link different levels of ecological organization, i.e., deer populations may be brought under control by re-introducing wolves, thus reducing the impact of winter browsing on forests; beaver re-introduction improves patch dynamics in floodplain forests.
<b>Re-development as Restoration</b>	Also known as reform sustainable development. Falls economically under the broader category of “economic restructuring.” Extractive resource activities which have grown brittle are integrated into the surrounding landscape matrix, i.e., harvesting wood from a mono-culture plantation v. harvesting that same product from a multi-aged uneven stand. Should diffuse environment versus economy tensions in which debate focuses on one resource activity.
<b>Ecological Recovery*</b>	Recovery involves letting the system alone, generally in the expectation that it will regain desirable attributes through natural succession. This zero-order approach to restoration may or may not work. It is best regarded as a key component of restoration – the contribution of the system itself. In such cases the restorationist seeks to complement and reinforce natural processes.
<b>Bio-cultural Restoration</b>	The emphasis is on framing restoration activities within a local multi-stakeholder model. It includes “altrusim”, “community collaboration,”

and “consensual decision making.” The cornerstone of biocultural restoration is that healthy ecosystems rest on the sustainable community use of resources which in turn protects and conserves biodiversity.

**Shallow Restoration**

Performed almost exclusively by volunteers, “shallow” or “reform ecological restoration” is based on small scale interventions, i.e., cleaning up a neighbourhood stream; up-rooting invasives; or, perhaps, re-introducing rare and distinctive species that add to the natural (traditional) aspect of the plant community (Leopold 1998).

**Deep Restoration**

Deep restoration, draws upon “deep ecology” as a justifying tool to challenge the dominant social and economic paradigm, is a radical social with a strong emphasis on, wilderness spirituality, and the restoration or recovery of an “ethic of inseparability,” perceived as an at-homeness in the natural world. Ecological recovery here might be known as “working on wild land without taming it.”

**Re-inhabitation**

Emphasis is on the (eco)region. Re-inhabitation is based on the development of an environmental ethic which tells us as much about using nature as about not using it. Based on the metaphor of environmental health and is implemented using the ecosystem approach. Also known as “managing [name of region] as home,” i.e., managing the Great Lakes Basin as home.

**Revitalization**

Logically speaking, nothing can come back into being after it has been destroyed. There exists, however, the theoretical possibility that previously extant, now extinct, species may be replaced through the recovery of significant genetic material. Examples include, the mao (*Moa moa*) (Bell, 1998) and the Tasmania wolf (*Thylacine* sp.). There is some evidence for optimism in recovering genetic similarity, i.e., the auroch, or wild cattle, native to southern England has been extinct since the 1600s, but has been genetically ‘recreated’ and now roams wild in similar habitat, in the Oostvaardersplassen of Holland (Parkin, 1996). These species have in fact been “brought back to life” and the term revitalization seems appropriate. In cases of obligate mutualism, where one species is extinct and the other is not able to reproduce as a result, the restoration of the process may also fall under this rubric, i.e., the Dodo and Calvaria palms (Temple, 1977), and the Dodo itself (Maddox 1993).

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\* denotes terms adapted from MacMahon and Jordon, 1994

† denotes terms adapted from Cairns, 1988

One measure of intellectual enthusiasm is the degree of recent cross-over from other more established disciplines and the resulting contribution being made to restoration ecology, i.e., linking restoration with ecological theory and processes at the individual, population, community and landscape levels. Previously qualitative discourses, i.e., the ecosystem approach (Regier, 1992; Ehrenfeld & Toth, 1997), ecosystem redevelopment (Brinck et al., 1988; Bell et al., 1997), and ecosystem health (Costanza, 1992, 1999; Rapport et al., 1998) are now entering a new phase characterised by a more self-consciously theoretical approach (Michener, 1997). These include indicators to assess the state of ecosystem health (Shear, 1996), a variety of methodo-

logical frameworks for quantifying sustainability (Michener, 1997; Costanza & Daly, 1992), the economic value of ecological functions (Tietenberg, 1992), and critical consideration of cultural carrying capacity (Hartig & Vallentyne, 1989; Calow, 1992). Those projects which seek to restore ecosystem integrity through remedial action planning (Lee et al., 1982) provide a unique opportunity to manipulate species, soil, water and even landscape at the ecosystem level (Ehrenfeld & Toth, 1997).

Recent advances in the field have emphasised the need for a refinement in methodology, i.e. a universality of its basic research and applications, scientific rigour, quantitative methodologies, and predictive modelling. In terrestrial ecosystems protocols for establishing and maintaining vegetation have been developed (NRC, 1994). Several studies have shown that the establishment of appropriate plant species does not necessarily result in the restoration of ecosystem function (Simenstad & Thom, 1996; Zedler, 1996). This has intensified discussion on the criteria for assessment of successful restoration. In aquatic ecosystems similarities in stream management (Petersen, 1987; Gore, 1985) have emerged along with a diversity of methods for their restoration (Eiseltová & Biggs, 1995). Similarly, the completion in 1995 of the Decision Support System for Evaluating River Basin Strategies (DESERT) (Ivanov et al., 1995) links the conservation and restoration of water in the landscape to water in rivers across a variety of spatial and temporal scales.

The question of engaged science continues to be the subject of much discussion among conservation biologists (Toulmin, 1996), and by restoration ecologists (Brinck et al., 1988; Regier, 1992; Cairns & Heckman, 1996; Lawton, 1997). Prescriptions for engagement, a “science for survival” (Barry & Oelschlaeger, 1996), can also be found at the level of international governance, i.e., *Caring for the Earth* (IUCN, 1991) and the *Global Biodiversity Strategy* (IUCN, 1992). The idea has also begun to appear in standard ecology textbooks, i.e., *Ecology: Individuals, Populations and Communities* (Begon et al., 1996). The recognition of the significance of cultural values within the evolving multi-dimensional social discourse on the environment, or “conversation about conservation” (Soulé, 1995) is a well established characteristic of the scientific literature on restoration.

Calls for “biocultural restoration” (Cairns & Pratt, 1995) or the making of a new civil society (Regier, 1992) founded on ecological literacy (Orr, 1992) persist because knowing the “facts” of environmental abuse has not stopped our abusing the environment. Maintaining the *status quo* or the normal sequence of ecosystem degradation and exploitive development (Rapport et al., 1985) can no longer be presumed to depend on ignorance of the extent to which human life depends on other life forms. Thus, one of the principle themes encountered in supporting literature is the further elucidation of the ways in which the dominant social and economic paradigm supports ecological distress (Hornborg, 1996; Soulé & Lease, 1995; Harvey, 1990).

## Summary

To be successful restoration projects demand a comprehensive approach, *viz.* remedial action planning (LaViolette, 1993; Meine, 1992). There is a need for “multi-sectoral restoration” (Sweeney, 2001) because effective measures of restoration are incomplete without social and economic components. Such an approach has the advantage of moving beyond both inadequate ecosystem understanding within the public sphere, *i.e.*, air and water as public goods, and the adversarialism encountered in resolving common property resource issues. By restructuring the “ownership” of restoration projects support is more likely to develop to ensure initiation, long-term maintenance and monitoring.

Environmental restoration and restoration ecology while employing different means do have shared ends. Restoration, continues to be a “bridge” between the natural and the social sciences and will doubtless continue to benefit from other more established disciplines on both sides of the “two cultures divide” (Snow, 1959; Worster, 1996). Instead of firmly dividing nature and culture, restoration goals, forwarded by the inclusion in the project of all stakeholders, are capable of drawing insight from a variety of sources and proposing common ground for the common concern of environmental security.

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