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Abstract:

The reasons to restore ecosystems are numerous, disparate, generally understated, and commonly underappreciated. We offer a typology in which these reasons—or motivations—are ordered among five rationales: technocratic, biotic, heuristic, idealistic, and pragmatic. The technocratic rationale encompasses restoration that is conducted by government agencies or other large organizations to satisfy specific institutional missions and mandates. The biotic rationale for restoration is to recover lost aspects of local biodiversity. The heuristic rationale attempts to elicit or demonstrate ecological principles and biotic expressions. The idealistic rationale consists of personal and cultural expressions of concern or atonement for environmental degradation, reengagement with nature, and/or spiritual fulfillment. The pragmatic rationale seeks to recover or repair ecosystems for their capacity to provide a broad array of natural services and products upon which human economies depend, and to counteract extremes in climate caused by ecosystem loss. We propose that technocratic restoration, as currently conceived and practiced, is too narrow in scope and should be broadened to include the pragmatic rationale whose overarching importance is just beginning to be recognized. We suggest that technocratic restoration is too authoritarian, that idealistic restoration is overly restricted by lack of administrative strengths, and that a melding of the two approaches would benefit both. Three recent examples are given of restoration that blends the technocratic, idealistic, and pragmatic rationales and demonstrates the potential for a more unified approach. The biotic and heuristic rationales can be satisfied within the contexts of the other rationales.

INTRODUCTION

Ecological restoration is an elective initiative that fosters the sustainable recovery of ecosystems that have been degraded, damaged, or destroyed. Restoration returns an ecosystem to its historic trajectory and recovers its former biotic expressions to the extent that contemporary conditions allow (Clewell 2000a; SER 2002). The restoration movement has captured the imagination of conservationists globally and the serious attention of professional resource managers, ecologists, and the environmentally informed public. Substantial public funding has underwritten numerous restoration efforts, many scholarly works have been written, professional associations have formed, and numerous conferences conducted. Non-government agencies (NGOs) are deeply involved in restoration, and citizen-volunteers have devoted countless hours to projects. Ecological restoration for gain has even been hailed as a major growth industry of the future (Cunningham 2002). In spite of such interest, insufficient synthesis and justification has been provided to answer the fundamental question, *Why?* (Aronson & Van Andel 2005). Why is it important, or worthwhile, to restore ecosystems?

Various philosophical writings—some of which will be explored below—describe benefits that accrue from restoration without specifically identifying them as fundamental motivations to restore ecosystems. The title of a recent article by John Cairns (2002) suggests a comprehensive assessment of the rationale to restore. However, the text is really a compelling exhortation for expanding the scale of restoration work worldwide. Hobbs and Norton (1996) explored several reasons to restore without attempting a full synthesis. Descriptions of restoration projects frequently ignore the *Why* question and imply that the need for restoration is inherently obvious and its intentions are noble. The underlying reasons to restore remain understated and unappreciated.

In this paper, we attempt a synthesis of the answers to the question of why we restore ecosystems. We recognize five general rationales or motivations for restoring ecosystems: Technocratic, Biotic, Heuristic, Idealistic, and Pragmatic. These are not mutually exclusive categories, but they comprise a typology that facilitates their systematic description. Two contrasting paradigms weave their way through these rationales and add tension to their descriptions. In one, humans stand apart from nature and exploit it. Ecological restoration is considered a technical task to be imposed on nature by institutional authority to satisfy societal values. The opposing paradigm posits that humans comprise an inseparable subset of nature and that nature and culture sustain each other. The act of ecological restoration is mutually beneficial and is as restorative to restorationists as it is to ecosystems.

Technocratic Rationale

Technocratic restoration is undertaken by government agencies and other large institutions to recover the social values that were once provided by ecosystems prior to suffering environmental impacts. For the most part, the social values pertain to water quantity and quality issues, associated erosion control, wildlife habitat and endangered species protection. Much technocratic restoration is conducted on public lands, either in-house by agency personnel or out-sourced under contract to design firms, environmental engineering firms, or small companies that specialize in ecological restoration, or sometimes to universities or NGOs. The lion's share of technocratic restoration has been conducted on both public and private lands to satisfy permit conditions that mandate compensatory mitigation. Mitigation is a strategy required by government agencies to compensate for unavoidable adverse environmental impacts and losses. Mitigation has been practiced in the USA for three decades where it serves as the major source of employment for restoration practitioners. Recently, mitigation has been conducted in Europe under the auspices of the European Union (Mercer 2005).

Ecological restoration is not in itself mitigation. Instead, it is one way of compensating for environmental damage caused by public works projects and private developments. Satisfactory ecological restoration has been accomplished in the context of compensatory mitigation (Munro (1991); Clewell (1999); Clewell et al. (2000). However, many compensatory mitigation efforts which have been touted by agency personnel and other proponents as "ecological restoration" could qualify only as subsets of full-fledged and longer-term restoration projects as recognized by SER (2002).

Technocratic restoration is essential for managing large and complex endeavors, such as the Kissimmee River restoration in Florida (Cummins and Dahm 1995). Such projects require governmental coordination of the many contractors who are engaged and agency oversight for the disbursement of public funds and for assurances that a maze of relevant laws and regulations are satisfied. For less ambitious projects, technocratic restoration provides a similar framework for project management, fiscal accounting, legal council, administrative consistency, and powers of enforcement.

Public agencies that conduct, sponsor, or issue permits for ecological restoration generally dictate the goals, objectives, performance standards, and strategies of restoration projects. An agency is thereby assured that its restoration projects conform to its mission and policies and ultimately to the enabling legislation that governs it. Uniformity in project design across projects is maintained by an agency for internal convenience and to strengthen its capacity to defend itself against legal challenges initiated by regulated interests and environmental organizations, particularly in respect to mitigation. Consequently, technocratic restoration is almost universally accomplished in an authoritative, “top-down” manner. This situation causes an undesirable bifurcation between agency personnel who design ecological restoration projects or approve restoration plans in their offices and restoration practitioners who conduct the restoration on-site. To agency personnel and the public that they serve, the rationale for ecological restoration is embodied in the mission of their agency, such as improvement of parkland, wildlife habitat, endangered species habitat, and water quality. To the restoration practitioner, the rationale for technocratic restoration is the satisfaction of governmental stipulations in contracts, permits, and consent orders. In other words, the role of the restoration practitioner is technical rather than creative. It is not conducive to forming a strong bond between culture and nature. In addition, the public is sometimes effectively excluded from technocratic restoration planning and is seldom offered the opportunity to become engaged in restoration work on account of liability issues and the exigencies of quality control, timeliness and budget. Consequently, local stakeholders tend to under-appreciate restoration projects and their public benefits.

Public agencies commonly treat ecological restoration as if it were civil engineering with finite endpoints. This practice simplifies determinations of compliance by contractors and permit holders with agency requirements. However, ecosystems are dynamic entities lacking finite endpoints and whose trajectories are governed in part by complex, stochastic events. For this reason, ecological restoration does not lend itself to an engineering paradigm. Restoration remains feasible only if it satisfies institutional mandates.

Biotic rationale

Ecological restoration is, or should be, scientifically informed by ecological principles and knowledge. Organizing principles of ecological science have contributed significantly to the biotic rationale, particularly the concepts of biodiversity. The perpetuation of biodiversity is an oft-cited reason for conducting ecological restoration. The predilection for conserving local biodiversity is a cherished value, not only among biologists and environmentalists, but also across much of the public sector in many cultures and countries. Among the best-known examples of restoration dedicated to fostering biodiversity are those intended to benefit rare and endangered species (Falk et al. 1996; Bowles & Whelan 1994). Other projects are designed to perpetuate threatened biotic communities, such as those occurring in coral reefs (Lirman and Miller 2003). Much attention has been directed at the genetic level of organization to conserve local ecotypes and thus assure species fitness (Montalvo et al. 1997). Other attention has been given to restoring biodiversity at the landscape level, particularly in Europe. For example, major effort has gone into restoring sustainable rural landscapes consisting of social-ecological ecosystems such as species-rich chalk meadows (Willems 2001).

Heuristic rationale

The heuristic rationale to restore ecosystems is to elucidate ecological principles from ecosystems undergoing restoration and to serve as a pedagogic aid in ecological science. Bradshaw (1987) proposed that ecological restoration could serve as an "acid test" for ecology. He noted that restoration projects would allow experimental resolution of conflicting theories of ecosystem development. Harper (1987) foresaw that restoration experiments would give insights into ecological processes. He suggested that the reassembly of ecosystems during restoration could resolve questions such as whether or not increases in genetic composition or species diversity could lead to ecosystem stability and resilience, or the roles of mutualists and animals in shaping plant communities. A recent book, edited by Temperton et al. (2004), serves as a principal outcome to date of this approach.

The growing literature in restoration ecology is largely devoid of papers that attempt to elaborate the principles of community ecology from studies at ecological restoration projects (Palmer et al. 1997). One likely reason is the difficulty of establishing replicate plots at heterogeneous project sites. Another is the difficulty in isolating the effects of single variables. Restoration generally requires continuing aftercare, and post-installation manipulations can destroy experimental designs. Although such studies may eventually be forthcoming, restoration ecologists to date have largely been content to tease data from restoration sites that resolve more narrowly defined questions or that evaluate restoration strategies and methods. The expansion of ecological science is rarely sufficient motivation to initiate a restoration project. Instead, restoration ecologists have availed themselves of the research opportunities that projects established for other reasons. In summary, the heuristic rationale for ecological restoration has generated more promise than product.

Restoration that has been conducted to demonstrate ecological science has been similarly limited in extent. John Curtis restored examples of Wisconsin's major ecosystems at the University of Wisconsin Arboretum for teaching purposes (Jordan 2003). Faculty at DuPage College, Illinois, restored a prairie on campus as an outdoor laboratory in environmental science. Other schoolyard restorations have been installed with pedagogic acclaim. Full-fledged restoration sites—particularly those operated as environmental stewardship projects by The Nature Conservancy and similar NGOs—have provided significant firsthand opportunities for environmental education at all educational levels. In spite of such efforts, the heuristic rationale for conducting restoration appears to be more derivative and opportunistic than it is a principal motivation for initiating restoration projects.

Idealistic rationale

People are attached to wild areas in the same way that farmers love their land. An angler may become attached to a favorite lake, or a peasant may revere a patch of woods that provides fuel wood for the hearth. Others in the local community may share an attachment, and these wild places may become foci for cultural activities. The local community may fight to preserve and protect such places from external threats and may provide management to assure their integrity. Lacking this psychological attachment, natural areas are taken for granted, and the benefits that may accrue from them go unacknowledged. Little impetus exists to protect and preserve such under-appreciated lands.

Some of the earliest attempts at ecological restoration were initiated and conducted by local volunteers who took their attachment to wild lands to another level. Many such practitioners and others perceive ecological restoration as an effective palliative to reconcile people with our often-destructive relationship with nature. We recognize four cultural, personal, and spiritual elements that comprise the idealistic rationale. Ecosystems are not treated as commodities in need of repair but as inseparable aspects of culture. In short, restoration conducted for idealistic reasons affirms the synthesis of nature and culture.

Idealistic elements of the rationale for restoration were woven as fragments throughout Aldo Leopold's writings (Meine and Knight 1999) and were thoroughly developed by William Jordan who continues to write eloquently on these themes (Jordan 2003). Idealistic restoration projects are largely conducted by local stakeholders in a casual manner that is unfettered by time limitations, strict budgets, and institutional constraints. Although projects may be conducted on public lands and with public funding, project control is largely retained by the practitioners who actually do the work. Many of them are volunteers rather than paid professionals. They may be supported by institutions such as private land trusts, botanical gardens, or local governmental bodies. The leisurely pace of restoration and dependence on volunteer labor reduce restoration costs. However, project work is generally limited in spatial scale. It is also largely limited to projects that do not require expensive equipment or detailed design work. This kind of restoration project is often approached in a hit-or-miss manner, without adequate attention to baseline data, monitoring or documentation. Despite its obvious drawbacks, this casual approach has garnered considerable success and public notice for some projects (Stevens 1995). The four elements in idealistic ecological restoration are:

1. *Atonement for environmental damage.* Many private individuals who engage as volunteers in restoration are motivated in part by their abhorrence of past or on-going environmental damage. The act of restoration can be identified as a ritual of atonement for living in a culture that is responsible for causing morally unacceptable environmental degradation (Jordan 1994; Higgs 1997). In addition, restoration shelters the practitioner from the environmental despair that is pervasive among preservationists, because restoration repairs environmental damage and imbues the practitioner with optimism and a sense of expiation. Jordan (1990, 1992b) explained that restoration reverses the alienation of culture from nature, which in turn is, "...the real root of ecological catastrophe." Ecological restoration has been especially attractive to those whose cultural roots stem from the Protestant Reformation. Jordan (1992b) suggested that the need for a ritualized expression of atonement was particularly needed by this large segment of Christian culture that has minimized ritual and the comfort it lends to people in despair. Restoration projects in Europe, and in the southern hemisphere (South Africa, Australia, New Zealand) are correspondingly concentrated in Protestant regions, with some exceptions, such as Spain. Additional factors of course influence the geography of restoration. For example the engineering or "nature development" aspects of Dutch culture may override the influence of their predominant religion.

2. *Reentery into nature.* A strong impetus exists among many people of urbanized and highly technical cultures to seek respite in nature, whether in a context of meditation, contemplation or recreation. This tendency was described by Eisenberg (1998) in terms of a universal cultural polarity between the *Tower* and the *Mountain*. The Tower represents the epitome of urban culture and artifice in many cultures and over many millennia (cf. the Tower of Babylon in ancient Mesopotamia). The Mountain, by contrast, represents the ideal of nature both in Western and Eastern traditions. The Biblical Garden of Eden from which humans were expelled and yearn to return was thought to be located on a Mountain.

   The concept of wilderness in North America embraces this metaphor of the Mountain and combines it with a longing to return from the Tower to a mythical

Eden-space, as represented for many by pre-European settlement landscapes. The underlying goal is to rediscover an acceptable midpoint in which becalmed nature remains present, and potent, but does not overwhelm a certain sense of security and well-being (Jordan 1992a ; Turner 1994). Arcadia is the name given to such a place. To formalize this idea, the act of restoring ecosystems becomes a contemporary ritual or performance by which we approach the Arcadian ideal. Jordan (1991) explained that restorationists try to reduce the Arcadian ideal to practice—to re-inhabit nature and bring it inside our 'living space' or *oecumene*. In Europe the goal of restoration is only very rarely conceived as some archaic or pre-settlement condition—Neolithic or Paleolithic. Much more often, the reference is rather a rural, partly agricultural landscape with managed and unmanaged patches in the matrix, as was characteristic in the Middle Ages and right up to the second half of the 20th century in many regions. This Arcadian ideal is much more realistic in socio-ecological terms, but it encounters obstacles related to social trends (rural exodus, urban sprawl) and economic policies of host countries and the European Union.

Restoration offers a mutually beneficial relationship betweens humans and nature where post-modern people savor a hands-on interaction with Nature that involves something other than sports or tourism. William Jordan considered this—in the North American context—to be the most important attribute of ecological restoration—more so than any tangible ecosystem benefits—and he called restoration a way of celebrating our relationship with nature. He noted that hiking, canoeing, hunting, and similar activities do not represent a full reentry into nature; instead, they exploit nature. He asserted that ecological restoration represented full and unselfconscious participation with nature. Alternatively, it can be seen as a ritualistic performance or form of theater in which we act out our relationship with nature to reinforce a new idea or vision we wish to embrace and transmit to others (Jordan 1986, 1987, 1989).

3. *Renewal of the nexus between nature and culture.* Most indigenous tribal people and other traditional cultures have been disrupted by the vicissitudes of modern

civilization. With their cultural identity shattered, many tribal people have been set adrift in an unfamiliar urban milieu. The traditional lands on which they depended for all their needs were exploited for extractive resources or otherwise ruined. To borrow again from Eisenberg (1998), indigenous people have been expelled from Arcadia and forced to take residence in the Tower. Some ecological restoration projects attempt to restore cultural ecosystems and traditional cultures simultaneously by engaging tribal members in projects designed for this dual purpose. Rogers-Martinez (1992) insisted that the restoration of a cultural landscape requires the concurrent restoration of culture and that the two are inseparable. This theme has been treated in depth by Janzen (1988, 1992, 1998, 2002), as well as Bonnicksen (1988), House (1996), Higgs (1997) and others. Ecological restoration has been initiated in rural India to recover and expand sacred groves that are revered by tribal peoples of Hindu tradition as the homes of deities (Ramakrishnan 1994; Desai 2003). In this context, ecological restoration becomes an extension of religious practice for tribal people who participate in restoration and as an exercise in upholding religious tradition for other practitioners who facilitate these projects.

4. *Spiritual renewal.* The act of restoring ecosystems is a kind of meditation or yoga for some people, perhaps unintentionally so at first, during which the practitioner suddenly realizes that he or she is an active and vital participant in ecosystem processes. This intuitive realization is an epiphany that effects or contributes to spiritual renewal. Clewell (2001) described it as an encounter with immanent divinity. The experience is personal and subjective, and thus differs from reentry into nature, or renewal of the nexus between nature and culture, as described above, which is more of a social ritual whereby we reach into our collective subconscious to a mythic level of awareness. In contrast, spiritual renewal that arises from restoration practice is individualistic and is not equated with traditional religious practice.

Pragmatic Rationale

We began this essay with the statement that ecological restoration is an elective process that gratifies human values. Now we identify two elements comprising the pragmatic rationale—restoration of natural capital and the restitution of anthropogenic climate change—that someday may be recognized as mandatory reasons to restore ecosystems. Without restoration conducted specifically for these reasons, human wellbeing will suffer, and the planet will become less habitable. The current rate of environmental destruction leads towards this eventuality. Surprisingly, in the literature on ecological restoration, the pragmatic approach is the least well developed of all, despite being the most compelling for a broad, international constituency.

1. *Restore Natural Capital*. Natural capital, as we use that term, consists of sustainable ecosystems and ecological landscapes from which humans derive services and products that improve their economic wellbeing without costs of production (Daly and Farley 2004). A few examples of these services are the detention of potential flood waters, erosion control, protection of recharge areas, and transformations of excess nutrients. Natural products include timber, seafood, rangeland, and fuel wood (Costanza 1991; De Groot 1992; Daily 1997; Alcamo et al. 2003).

    Previously, discussions on this topic were directed almost exclusively to the conservation of remaining ‘wild’ nature, to avoid seeing it transformed to short-term uses of dubious durable benefit (Balmford et al. 2002). However, our remaining stock of natural capital is already too low to support many national economies or to provide on a sustainable basis the benefits and wellbeing sought by average citizens everywhere on this increasingly crowded planet (Repetto 1993; Cairns 1993; Wyant et al. 1995; Clewell 2000b; Milton et al. 2003).

    The rationale for restoring natural capital rests upon three propositions: *First*, nature sustains us (Leopold 1949). People of all cultures depend on the natural products and services derived from natural ecosystems to provide much (or all) of their sustenance and wellbeing. *Second*, economic wellbeing is contingent upon the availability and sustainability of natural capital at or above existing levels (Costanza & Daly 1992; Daly and Farley 2004). A reduction in the quantity or quality of natural ecosystems lowers living conditions. Conversely, an increase in the quantity or quality of natural ecosystems would improve living conditions. *Third*, ecological restoration is the only option for appreciably improving the quality and augmenting the inventory of natural ecosystems.

The third proposition assumes that ecosystems—undisturbed and restored—provide a range of natural services and products of economic consequence that are available without costs of production. Most of these same services and products can be provided by intentionally managed lands, such as agroforests, improved pastures, and forest plantations. Such lands, though, and the engineered and "designer" ecosystems that were created therein, are simplified in terms of ecological complexity. They provide a narrower array of natural services and products, and they may be expensive to manage and maintain, in the mid- and long-term. In general, they are much more vulnerable to external shocks and outright collapse.

Intensively managed lands provide more of the particular service or product for which they are administered; however, that benefit may be reduced or entirely defrayed by secondary impacts caused by management. For example, managed lands are commonly cleared of their native cover, irrigated or ditched and drained, and given applications of agrichemicals. Consequences of management may include depressed water tables, increased amplitude of stream discharge, and heightened levels of nutrients, contaminants, and suspended solids in receiving waters. In addition, intensively managed lands are relatively prone to colonization by generalist species—many of them non-native or invasive—at the expense of desirable species that require more complex, specialized habitat.

Efforts to restore natural capital may require massive programs initiated by governments and international institutions. Implementation of such national programs can bring about positive socio-economic consequences—job creation and training; social fabric weaving, etc.—and possibly reduce social estrangement and political unrest. In this context, the designation of ecological restoration as a growth industry by Cunningham (2002) assumes credence.

2. *Ameliorate climate*. In their powerful but little-known paper, Schneider & Kay (1994) argued that the biosphere is particularly efficient in the dissipation of energy from solar radiation as heat from the Earth's surface through transpiration and metabolic activities. Stated in terms of the second law of thermodynamics, organisms generate more entropy than physical systems (Ulanowicz & Hannon 1987). This assertion was supported by measurements of considerably lower surface temperatures in old-growth forests relative to clearcuts, regeneration, roads, and a quarry in Oregon, using an aircraft-mounted thermal infrared multispectral scanner (TIMS) (Holbo & Luvall 1989; Luvall & Holbo 1991). Surface temperature variability was further documented with TIMS data recorded along flight lines over several life zones of tropical rainforests in Costa Rica (Luvall 1990). Similar results were predicted from climatological modelling that assumed the conversion of Amazonian tropical rain forest to degraded pasture (Shukla et al. 1990). Pastures were predicted to be from 1 to 3 degrees C warmer than forest, precipitation and evapotranspiration lower, dry seasons prolonged, and the potential for fire greater. In addition, pasture grasses would have shallower and sparser root systems than forest trees, and the moisture storage capacity of the soil would be reduced. These studies suggested that (1) vegetation cover regulates climate, and (2) mature, complex ecosystems regulate climate more effectively than younger, or less complex, ecosystems.

Simplification and outright removal of ecosystems is occurring rapidly at an increasing rate globally. Correspondingly, the capacity of the biosphere is reduced for the regulation of temperature, precipitation, and other climatic parameters. Schneider & Kay (1994) posited that as ecosystems mature, they develop increasingly complex structures with greater diversity and more hierarchical levels with which to abet energy degradation. As succession progresses, ecosystems capture more energy, exhibit more energy flow, and develop more and longer cycles of energy and materials with less leakage—all in accordance with the second law of thermodynamics and with Eugene Odum's seminal hypotheses on the "strategy of ecosystem development" (Odum 1969).

In short, Schneider & Kay (1994) assert that the biosphere functions to dissipate energy and thereby maintains temperatures at levels that can sustain life in all of its manifested forms. Conversely, reductions in its complexity may reduce the capability of the biosphere to regulate temperature within acceptable limits. Deteriorating climatic conditions, massive species extinctions, and ecosystem collapse are potential consequences.

Dissipative capacity is contingent upon species richness. The more that energy is partitioned among species, the more pathways are available for energy degradation. The climatic regime of the entire planet is therefore dependent on species richness, and on the capacity of large numbers of co-existing species to maintain the effectiveness of energy dissipation. Consequently, we depend on complex manifestations of biodiversity to maintain the habitability of the planet at an acceptable level. This understanding gives us a solid pragmatic basis for conserving biodiversity. Heretofore, the argument for preserving biodiversity consisted of a value-laden ideal that was adorned with promises of a few ancillary economic benefits such as pharmaceuticals and ecotourism. The thermodynamic consequences of biodiversity justify its conservation on the basis of physics that is amenable to empirical analysis and modelling.

As humans simplify ecosystems and thereby degrade the biosphere, the planetary capacity to dissipate heat from solar radiation is imperilled. Not only do we need to restore ecosystems for their value and importance as natural capital, we must also do so concomitantly to protect Earth's climate. The fostering of ecological complexity should be a universal goal of ecological restoration. We should rededicate our restoration efforts towards augmenting species richness, developing complex community structure, and providing specialized habitats for specialized species.

An implication of this thermodynamic paradigm is that global warming may be attributable in part to anthropogenic degradation of ecosystems. Regardless of the causes of global warming—whether induced by emissions of greenhouse gasses or by reductions in thermodynamic regulatory capacity—the same remedy applies: ecological restoration, which increases carbon sequestration and ecosystem complexity. The thermodynamic paradigm also forcefully suggests that "greening up" landscapes with a simple vegetation cover for purposes of carbon sequestration is insufficient. Instead, full-scale ecological restoration may be needed to assure an accelerated return of ecological complexity and its dissipative capacity.

We caution, however, that the relationship between climate and thermodynamic dissipation of solar radiation as mediated by the biosphere remains sketchy and will require more formulation and documentation before it can be advanced as a major concern for public policy. Only after climatic amelioration through restoration is substantiated by compelling evidence can we anticipate public policy interest in ecological restoration as a remedy. In the meantime, we suggest that climatic amelioration by restored ecosystems would be a relevant topic of investigation for restoration ecologists.

We propose that ecological restoration will emerge as the prevailing strategy for addressing both of the vital pragmatic issues presented here, in close association with conservation and ecosystem management policies and practices. Concomitantly, the demand for ecological restoration will rise to levels that heretofore could not have been imagined but which are inevitable if total stocks of natural capital are to be maintained at or above current levels.

Conclusion: The Unified Approach

The five rationales for ecological restoration are individually inadequate. Technocratic restoration suffers from the mediocrity of bureaucratic authoritarianism and a lack of public understanding and support. The biotic and heuristic rationales are insufficient justifications by themselves to warrant mounting full-fledged restorations of consequential size. The idealistic rationale by itself is limited to small, uncomplicated projects without much need of technical, managerial, logistical, and legal support and that require ~~a~~ no fixed completion date. The pragmatic rationale, when widely implemented, will require the full capacity of technocratic restoration and will necessarily become an expansion of it. We contend that well conceived and executed ecological restoration requires the melding of the technocratic and idealistic rationales. To do so, institutions that conduct technocratic restoration must relinquish some authority and actively work in partnership with stakeholders. Conversely, stakeholders—particularly local citizenry—must be motivated to assume responsibility in a partnership and inject restoration projects with idealism and cultural meaning. The attraction for such a marriage between the technocratic and idealistic rationales consists of the societal benefits accruing from the pragmatic rationale. Citizen-stakeholders will not support restoration with enthusiasm unless they clearly understand and value its economic benefits. Without wide public support and participation, governments may be unable to generate political support to undertake pragmatic restoration projects. Once underway, such projects will likely fulfill the biotic rationale, simply because restoration protocol requires it (SER 2002). The heuristic rationale can be satisfied concomitantly with any other rationale.

We mention three restoration projects that have successfully merged the technocratic and idealistic rationales. The first is the approximately 1,200-km^2 Guanacaste Conservation Area in Costa Rica, where entire villages have benefited economically and culturally from tropical dry forest restoration (Allen 2001; Janzen 2002). Stakeholders conducted the restoration under the direction of visionaries, including ecologist Daniel Janzen, who forged an effective although unlikely coalition of Costa Rican agencies, politicians, local landowners and international philanthropic organizations.

The second example is the ten-year-old Working for Water program in South Africa, in which twenty thousand people are employed to eradicate invasive alien woody plants, particularly deep-rooted trees that transpire soil moisture and deprive native plants and agricultural lands of water. Jobs, livelihoods and a renewed social unity are being created while natural – native- landscapes are being restored through the elimination of ’water-stealing’ invasive species (Van Wilgen et al. 1996, 2004; Holmes et al. 2000; Holmes 2001; Milton et al. 2003). The program has contributed significantly to nation-building during the post-apartheid era.

The third example concerns the restoration of the formerly heavily-polluted Alexander River in Palestine and Israel. The river is being cleaned up, and ecosystems in its basin are in process of restoration (Brandeis 2005). Beginning in 1995, 135 separate projects were conducted by several thousand volunteers from both nations under the direction of a voluntary administrative authority that had no offices and owned no property. The project enjoyed widespread political support from 21 villages and towns along the river's course. School children were engaged in tree planting, fish stocking and recreating and protecting safe sites for soft-backed turtle nests. Palestinians and Israelis worked side by side in this united effort and gave hope to all involved that the two warring nations could resolve their strident political differences. The Alexander River project suggests that implementation of international peace initiatives could be added as another rationale for ecological restoration.

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