

From Adaptive Management to Adjustive Management: A Pragmatic Account of Biodiversity Values

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Abstract: *The conservation of biodiversity poses an exceptionally difficult problem in that it needs to be effective in a context of double uncertainty: scientific (i.e., how to conserve biodiversity) and normative (i.e., which biodiversity to conserve and why). Although adaptive management offers a promising approach to overcome scientific uncertainty, normative uncertainty is seldom tackled by conservation science. We expanded on the approach proposed by adaptive-management theorists by devising an integrative and iterative approach to conservation that encompasses both types of uncertainty. Inspired by environmental pragmatism, we suggest that moral values at stake in biodiversity conservation are plastic and that a plurality of individual normative positions can coexist and evolve. Moral values should thus be explored through an experimental process as additional parameters to be incorporated in the traditional adaptive-management approach. As such, moral values should also be monitored by environmental ethicists working side by side with scientists and managers on conservation projects. Acknowledging the diversity of moral values and integrating them in a process of collective deliberation will help overcome the normative uncertainty. We used Dewey's distinction between adaptation and adjustment to offer a new paradigm built around what we call adjustive management, which reflects both the uncertainty and the likely evolution of the moral values humans attribute to biodiversity. We illustrate how this paradigm relates to practical conservation decisions by exploring the case of the Sacred Ibis (*Threskiornis aethiopicus*), an alien species in France that is the target of an eradication plan undertaken with little regard for moral issues. We propose that a more satisfying result of efforts to control Sacred Ibis could have been reached by rerouting the traditional feedback loop of adaptive management to include a normative inquiry. This adjustive management approach now needs to be tested in real-case conservation programs.*

Keywords: adaptive management, adjustive management, biodiversity conservation, environmental ethics, pragmatism, values monitoring

Del Manejo Adaptativo al Manejo Ajustativo: Un Recuento Pragmático de los Valores de la Biodiversidad

Resumen: *La conservación de la biodiversidad plantea un problema excepcionalmente difícil en el que necesita ser efectiva en contexto de doble incertidumbre; científica (i.e., como conservar la biodiversidad) y normativa (i.e., cual biodiversidad conservar y porqué). Aunque el manejo adaptativo ofrece un método promisorio para superar la incertidumbre científica, la incertidumbre normativa casi no es abordada por la ciencia de la conservación. Expandimos el método propuesto por los teóricos del manejo adaptativo mediante el diseño de un método integrador e iterativo que incluye ambos tipos de incertidumbre. Inspirados por el pragmatismo ambiental, sugerimos que los valores morales en juego en la conservación de la biodiversidad son plásticos y que una pluralidad de posturas normativas individuales puede coexistir y evolucionar. Por lo tanto, los valores morales deben ser explorados mediante un proceso experimental como parámetros adicionales e incorporados al método tradicional de manejo adaptativo. Como tales, los valores morales*

deben ser monitoreados por éticos ambientales trabajando al lado de científicos y manejadores en proyectos de conservación. El reconocimiento de la diversidad de valores morales y su integración en un proceso de deliberación colectiva ayudará a superar la incertidumbre normativa. Utilizamos la diferencia de Dewey entre adaptación y ajuste para ofrecer un nuevo paradigma construido alrededor de lo que llamamos manejo ajustativo, que refleja tanto la incertidumbre como la probable evolución de los valores morales que los humanos atribuyen a la biodiversidad. Ilustramos cómo este paradigma se relaciona con las decisiones de conservación prácticas mediante la exploración del caso del Ibis Sagrado (*Threskiornis aethiopicus*), una especie introducida en Francia que es objeto de un plan de erradicación emprendido con poca consideración de los aspectos morales. Proponemos que se podría haber obtenido un resultado más satisfactorio de los esfuerzos por controlar ibis sagrados al redireccionar el círculo tradicional de retroalimentación del manejo adaptativo para incluir una encuesta normativa. Este método de manejo ajustativo necesita ser probado en programas de conservación reales.

Palabras Clave: conservación de la biodiversidad, ética ambiental, manejo adaptativo, manejo ajustativo, monitoreo de valores, pragmatismo

Introduction

The objective of conservation biology is to “provide principles and tools for preserving biological diversity” (Soulé 1985:727). Although such an aim seems clear, it is far from certain that it will lead to unequivocal prescriptions. Indeed, the problem in biodiversity conservation is the necessity to act in a context of double uncertainty: a scientific uncertainty (i.e., how to preserve biodiversity) and a normative uncertainty (i.e., which biodiversity to preserve and why). Although adaptive management offers a promising approach to fulfill scientific uncertainty (Williams et al. 1996), normative uncertainty often remains difficult to overcome.

This normative uncertainty stems from the fact that biodiversity is a fuzzy concept that can be understood at different levels of organization and at different spatiotemporal scales. For instance, a local increase in biodiversity may sometimes correspond to a global impoverishment (Sax & Gaines 2003). Phylogenetic biodiversity may also be decoupled from taxon richness, which causes discrepancies in mapping of biodiversity hotspots (Forest et al. 2007).

Second, biodiversity would not have to be preserved if it was not considered valuable. Yet, different values can be invoked, and these values lead to different conservation priorities. The economic valuation of biodiversity, for instance, may promote the preservation of plant genetic diversity because of the pharmaceutical value it offers (Bonalume & Dickson 1999), whereas an aesthetic valuation of biodiversity can lead to a focus on flagship plant species (Caro et al. 2004). Hence, the way people value biodiversity is of critical importance, and conservation scientists should not ignore normative issues related to conservation.

We followed the path opened by adaptive-management theorists and developed an integrative and iterative approach to conservation that would encompass both scientific and normative uncertainty. We were inspired by philosophical pragmatism, which offers useful tools with

which to tackle the ethical issue raised by the plurality of biodiversity values and the possible conflicts with other values.

To emphasize the paradigm shift we propose, we borrowed from the Deweyan distinction between adaptation and adjustment and offer a new term: *adjustive management*. We illustrated this approach with the case of the Sacred Ibis (*Threskiornis aethiopicus*) in France, where it is an alien species. One of the most salient features of our approach is the design of normative indicators that allow proper evaluation and monitoring of ethical values of agents involved in the conservation program (scientists, managers, users, locals) in the same way biological and sociocultural indicators are monitored in the adaptive-management process.

Adaptive Management and Scientific Uncertainty

Scientific uncertainty limits knowledge in two ways, theoretically and practically. It poses a theoretical limit because one does not know with certainty which theoretical hypotheses are the most relevant in a specific situation and a practical limit because the task of conservation is to determine the practical measures needed to improve a situation. Conservation measures generally must take into account natural phenomena (e.g., predator-prey relationships) and sociocultural phenomena (e.g., hunting regulations). But neither biology nor human affairs belong to the realm of certainty. In a complex web of biological relationships, unexpected outcomes are common. Similarly, the results of a given policy remain difficult to predict, and a given policy may sometimes have unpredictable adverse effects, such as the increase of poaching pressure after a hunting ban (Courchamp et al. 2006). It is thus necessary for scientists to work with humility and to be able to rapidly detect and correct the effects of the conservation measures they promote.

To tackle this scientific uncertainty, conservation biologists and natural resources managers developed an

approach that allows for both an increase in knowledge and the evaluation of alternative policies, “adaptive resource assessment and management” (Holling 1978). This method soon became known as adaptive management and was most often used in North America and Australia for managing fishes, forests, and harvested waterfowl (Nichols et al. 1995).

At the heart of this approach is an experimental conception of policy design. “Adaptive management is an approach to natural resource policy that embodies a simple imperative: policies are experiments; learn from them” (Lee 1993). This approach is also often referred to as learning by doing. Adaptive management replaced the old-fashioned trial-and-error approach by a hypothesis-testing process. Practically, the adaptive-management framework follows several steps repeated in an iterative manner. (1) A working group, composed of an epistemic community (scientists, managers, policy makers) and stakeholders, attends a workshop to assess the problem. (2) The group formulates hypotheses and designs models intended to simulate key relationships among the components of the sociobiological system they seek to manage. (3) On the basis of these models, a range of policy options is proposed that provides different scenarios. (4) A preferred outcome is selected and the correspondent policy is implemented. (5) Indicators of the system are chosen and monitored. (6) The monitoring provides evaluation of the policy. (7) The evaluation is used as new information in the model in order to reassess the problem and to adapt the policy. This feedback loop is central to the approach.

Because of the disciplinary bias of those who developed adaptive management, much effort and development of the approach focused on the “*biological* learning through policy experimentation.” This bias is illustrated in Walters (1986). Walters proposed a detailed framework for improving and fine-tuning modeling tools required to present the expected outcomes of alternative policies that focused only on the ecological parameters of the system.

Nevertheless, following the first intuitions of Holling (1978), who recognized that goals of management are likely to change with time, a great deal of work has been done recently on the role of the sociocultural components of the system. Some of this work insists on the importance of coupling community-based decision making and adaptive management (i.e., adaptive co-management) (Armitage et al. 2007), whereas other works focus on identifying the determinants of transformations of human systems and their institutions (Gunderson et al. 1995; Gunderson & Holling 2002). These approaches, however, are aimed mostly at the wise use of resources (e.g., sustaining New Brunswick forestry) or ecosystem services (e.g., restoring functions of the Everglade marshlands; Gunderson et al. 1995) and rarely tackle the issue of unexploited biodiversity (but see Salaf-

sky et al. 2002). Even the claim that it is important to target the resilience of both sociological and ecological systems (Gunderson & Holling 2002; Walker & Salt 2006) does not question the background moral framework that ascribes a strictly instrumental value to the nonhuman world. For instance, social learning may change the preference of a community or institution from maximizing striped bass (*Morone saxatilis*) harvest in the short term to optimizing long-term harvest for future generations by implementing a harvesting ban (Costanza & Greer 1995) without their questioning the idea that bass are a mere resource. In this case the preferences evolve but the underlying moral values remain the same. These developments may be considered a step forward insofar as they take into account the scientific uncertainty about social systems, but they do not address the moral values that underlie human relationships with nature.

Pragmatism and Normative Uncertainty

In the context of biodiversity conservation, in contrast to resource management, the issue of moral values, and especially the way people value their unexploited environment, is critical. Indeed, the current biodiversity crisis urges people to act collectively despite a great diversity in the way they value biodiversity. Some people exclusively consider its instrumental value, for instance the economic benefit that can be expected from conservation. Others believe nonhuman animals or plants have a value in themselves and that they should not be reduced to a mere means to satisfy human ends. A more holistic perspective includes the noninstrumental value of species, ecosystems, or ecological processes themselves.

A considerable number of publications in environmental ethics are dedicated to developing theoretical arguments in support of each of these views (e.g., Taylor 1986; Singer 1993; Callicott 1999). An alternative approach is being more avidly defended by advocates of environmental pragmatism (Light & Katz 1996; McDonald 2004; Norton 2005; Minteer 2006). Inspired by philosophical pragmatism, a theory rooted in the work of a group of late nineteenth-century American thinkers (James 1909; Dewey 1927; Peirce 1936), environmental pragmatists reject moral monism and believe a plurality of individual moral positions can coexist and evolve, as long as a process of resolution for action at the collective level is sought.

In this view moral values are not fixed once and for all. Rather, they must be considered as a means by which the public seeks to solve problems. Hence, values are contextual, relative to a certain place, a certain time, and a certain group of people facing a problem and engaged in collective action. Moral values can thus be explored, scrutinized, and discovered in an experimental process involving all society.

For Dewey (1925), there is no strict separation between human experience and nature. Nature is the dynamic set of all phenomena and processes, and human affairs are part of this whole. According to this perspective, the traditional dichotomy between facts and values must be rejected in favor of a continuum between what is purely evaluative and what is not evaluative at all. Values, being natural phenomena among others, should be investigated on the same basis as anything else. Experimentalism, first developed in order to understand mere empirical facts, can thus be extended to inquiry about values. This belief in the continuity of facts and values is particularly relevant in the context of biodiversity conservation. As is often pointed out (e.g., Robertson & Hull 2001; Noss 2007; Chan 2008), the link between facts and values is much tighter in conservation biology than in other sciences. The extinction of a species, for instance, is rarely considered a simple fact. It is a biological phenomenon but it is also, above all, an evil that conservationists try to avoid.

It is surprising that the affiliation between adaptive management and philosophical pragmatism has remained unnoticed until Lee (1993). The famous learning-by-doing formula could have been excerpted from Dewey's work itself. In *The Public and Its Problem*, first published in 1927, one can read that "policies and proposals for social action [should] be treated as working hypotheses, not as programs to be rigidly adhered to and executed. They will be experimental in the sense that they will be subject to constant and well-equipped observation of the consequences they entail when acted upon, and subject to ready and flexible revision in the light of observed consequences" (Dewey 1927: pp. 207–208). This seems to be a fairly good description of the adaptive-management approach.

The philosophical anchorage of adaptive management in pragmatism has been extensively explored by Norton (2003, 2005). His thorough, philosophical analysis is nevertheless unsatisfying in the context of biodiversity conservation because of its anthropocentric slant. The core concept of Norton's analysis is sustainability, which, understood in its broader meaning, should be the ultimate goal of management. But there is no a priori reason to maintain that biodiversity should be conserved exclusively in order to ensure the continuing existence of human communities. Sustainability can be a necessary condition for conservation without being a sufficient one. Even if Norton pleads for pluralism, the emphasis he puts on sustainability and the energy he deploys to discredit every nonanthropocentric moral framework (Norton 1992, 2005) leave little room for a real pluralism, open to a wide variety of moral claims ranging from the more utilitarian to the more disinterested. As persuasively shown by Minter (2001), there is no need for pragmatists to abandon all reference to nonanthropocentric values as long as they are considered as context-

tual and noninstrumental values ascribed to nonhuman entities.

Most advocates of adaptive management have stopped halfway between the traditional command-and-control approach (Holling & Meffe 1996) and the pragmatic approach. They fully endorse the epistemological side of Deweyan propositions, but fail to explore the normative side of Dewey's works, which stands as a necessary counterpart to his theory of knowledge. This conclusion is supported by the fact that many evaluations of adaptive management point to the lack of fixed objectives, clearly stated at the beginning of the process, as a cause of its failure (Nichols et al. 1995; McLain & Lee 1996). As pragmatism suggests, not only can the preferences of agents for this or that state of the world change during the process, as resilience thinking and coadaptive management acknowledge, but so too can their moral values. For Dewey, this evolution of values results from a real normative uncertainty, not from disagreements between individuals or frivolous changes of valuation.

The current loss of biological diversity is a problem that calls for a collective characterization of what we want to protect and conserve and of what biodiversity we value. Should the focus be on local or global biodiversity? Should alien species be eradicated to protect ecosystem integrity and endemism? Should mammals be favored over plants? Should priority be given to useful species over useless ones? Should natural diversity be valued per se, or should it be valued on the basis of the goods and services it ensures? It is likely there is no one answer to any of these questions; rather, different contexts will give rise to different outcomes. Conservationists should tackle this kind of uncertainty and attempt to bring to light and discuss the moral values at stake. We believe adaptive management can greatly benefit from pragmatistic accounting of moral values in dealing with normative uncertainty as well as scientific uncertainty.

Accommodation, Adaptation, and Adjustment

A problematic situation can be characterized as a mismatch between external conditions and preferences of an individual or a group. The preferences themselves depend on agents' values, their knowledge of the situation, and the particular context they face. Dewey describes three different ways through which a problematic situation can be overcome: namely by accommodation, adaptation, or adjustment (Dewey 1934). Even if each of these could be used to address the biodiversity problem, we think the third is most appropriate.

Accommodation occurs when external conditions are thought to be fixed or beyond the influence of an individual or society. In this case, the gap between desires and reality is passively accepted. In context of the biodiversity crisis, the accommodation strategy would be

acceptance of the dramatic decline of biodiversity without any attempt to slow it down. Obviously, that is not an attitude conservationists would like to adopt.

Adaptation is a progressive and active change of external conditions to adapt them to the desires of the individual or group. Here, Dewey's meaning of *adaptation* must be distinguished from Darwinian adaptation, which implies a change of both external conditions and the individual or group. We believe that in many adaptive-management projects, the word *adaptive* does not refer primarily to the Darwinian and evolutionary concept of adaptation, but rather to the Deweyan concept of adaptation described above. In traditional adaptive management, the task is mainly to adapt the nonhuman environment, especially the availability of natural resources and services, to human preferences. Even when the evolution of these preferences is assessed, the underlying moral values are rarely questioned. In this sense, adaptive management resembles sustainable development, and it is thus unfortunate that Norton puts such an emphasis on sustainability (2005). In sustainable development, the use of resources is rationalized, but the underlying will, namely the desire to develop, remains unquestioned. Similarly, the core goal of adaptive management is wise use of natural resources, but the fact that nature *is* a resource generally remains unchallenged.

Adjustment, on the contrary, is the reflexive and evolving change in both human values and external conditions that resolves the tension. It is a holistic conception of the relationship between the agents and their natural environment. In this process, the whole person—or group—is changed, not some specific preference unsuited to specific environmental conditions. Dewey said what occurs during an adjustment process “is a change *of* will conceived as the organic plenitude of our being, rather than any change *in* will” (Dewey 1934:17). Adjustment is an active coevolution between the social group and its environment that has much more to do with Darwinian evolution than what Dewey called adaptation (Dewey 1910).

Moral values are highly plastic. They can be regarded as collective tools to face problematic situations and, as such, they are part of the solution to biodiversity erosion. The present biodiversity crisis results from an ill-advised path of development, created by human preferences that are highly damaging to the environment. Conservationists should aim not only for quick changes in the set of current preferences, but also for a progressive revision of values and a change in lifestyles that could be a significant help to biodiversity conservation. Such progress has more to do with a real adjustment of societies to the new context of crisis than to a mere modification of the external circumstances. The biodiversity crisis asks for more than just wise use of resources. It demands that we question more deeply our relationship with nature and the values we ascribe to it. Resource management and biodi-

versity preservation, although they both address the way we interact with the environment, have different scopes. Although the former only defines the best means to get what we want, the latter asks us to reassess how we value nature and, especially, its diversity. For this reason, the mere adaptation of the external world to fit human preferences ignores one of the most critical issues within biodiversity conservation, namely, the way we value nature.

Adjustive Management in Practice

There are ways to put the normative perspective into practice. We examined protected-area situations in which conservationists have to determine what biodiversity to conserve and how. We believe this approach can also be applied to more-complex situations when conservation seems to conflict with other aims.

Special efforts have been made recently to increase public participation in adaptive management. In such cases, the collective goals are not so hard to define (e.g., the optimal use of a resource in the long term or the maximal efficiency of a service), and the real challenge is to determine which means will best fulfill the objective. In the context of biodiversity conservation, the goals themselves can be so diverse that the participation of the public in their definition can be tricky.

Such complexity is exemplified by the situation of the Sacred Ibis along the French coast (Clergeau et al. 2005). This alien species escaped from captivity and now breeds in the wild (> 475 breeding pairs in 2004). Its recent range expansion has been the subject of much debate among wildlife managers and the public. The species was welcomed by some people, whereas others pled for its destruction. In 2006 managers of protected areas decided unilaterally to eradicate the species in the name of the precautionary principle, on the grounds that it could represent a threat to several local tern species (e.g., *Cblidonias niger*, *Sterna sandvicensis*, *Sterna hirundo*; Clergeau et al. 2005). Since the beginning of the eradication campaign, more than 3000 Sacred Ibis have been shot.

With their decision, the managers promoted one vision of “good” biodiversity, that is, “native” biodiversity. One might also have carried out such prescriptions to promote global rather than local biodiversity because the extension of the distribution range of the Ibis outside its natural area could be viewed as a factor of biodiversity homogenization, which must be avoided. Measures opposite to those that were actually taken could also have been promoted in the name of biodiversity conservation. One could argue that, in the absence of proof that Sacred Ibises have a deleterious effect on native species, and given that the presence of a new species increases

biodiversity locally, the correct policy would have been to monitor the impact of Sacred Ibis on local biodiversity before taking any action. Alternatively, one could argue that it is the evolutionary potential of biodiversity that should be valued and that this new species is a positive disturbance factor on ecosystems. Finally, one could argue that although Ibises pose a threat to biodiversity, it is nonetheless wrong to kill them because it is the right of sentient beings to live or because of the “sacred” character of the species. Thus, in this apparently simple situation, with only one species, there are at least half a dozen different positions that could be taken, each corresponding to different moral values and different conceptions of the type of biodiversity worth preserving.

Unfortunately, in the case of Sacred Ibis, no participatory process was undertaken. Moreover, the points of view of the different parties concerned were so divergent that it is hard to imagine that a consensus could have been possible. Nevertheless, we suspect that the absence of public participation played an important role in the polarization of the groups who were for and against the eradication. We think a better solution could have been reached through an adjustive process. We took the case of the Sacred Ibis and devised a plan to address the problem within an adjustive-management framework built on the seven phases of adaptive management.

In the first phase the working group engaged in the process is designed to include philosophers or ethicists to facilitate clarification of the moral issues at stake (Minteer & Collins 2005). Members of this group are not stakeholders seeking to maximize satisfaction of their own interest group (Brower et al. 2001). This kind of role freezes positions, preventing the evolution of participant preferences and values. Rather, the participants engage in a collective and collaborative process to reach a satisfying consensus (Keough & Blahna 2006). In the case of the Ibis, this kind of group would have allowed the debate to move beyond scientific uncertainty about the impact of this species on native biodiversity by revealing the clash between divergent moral values and would have prevented the systematic discrediting and caricaturing of groups who did not want the Ibises to be eradicated.

In the second phase hypothesis formulation and modeling is completed with nonquantitative elements tuned to the normative inquiry. Different narratives are developed to compare hypothetical situations, revealing special features of the problem’s normative issues. For instance, the participants could be asked whether their perception of the Ibis invasion would vary if the species had expanded its range to France following global warming or a purposeful introduction rather than by escaping from a zoo. Those narratives help reveal and discuss moral intuitions of the participants.

In the adjustive variant of the third stage of adaptive management, ethicists expose the different normative frameworks proposed by environmental ethics (e.g.,

strong anthropocentrism, weak anthropocentrism, zoocentrism, biocentrism, ecocentrism), just as in adaptive management scientists help participants understand the relevant facts and processes. During the policy design process, it is not necessary that participants agree on values. The Ibis advocate need not convince the conservationist that it is immoral to kill sentient animals, and the conservationist does not need to persuade the bird-watcher that alien species are less valuable than native ones. All participants need to do is try and, ideally, succeed in finding indicators reflecting collective interests for a particular state of affairs, even when disagreements on values remain (Norton 2005). Tools already exist to facilitate information sharing, discussion, and consensus building, for example role-playing games (Mathevet et al. 2007), citizen panels (Crosby et al. 1986), dynamic modeling (Costanza & Ruth 1998) and, more theoretically, the many works on deliberative democracy (Cohen 1989; Habermas 1996; Bohman 1998; Dryzek & Niemeyer 2006). This stage exercises collective creativity. For instance, in the Ibis case, different scenarios, ranging from shooting alien birds to leaving them alone, could have been set up and compared.

The fourth step, policy implementation, would not differ significantly between adjustive and adaptive processes.

In the fifth phase the evolution of participants’ values is monitored thoroughly in the same way as factual changes induced by policy implementation are monitored. The enlargement of the epistemic community to human scientists such as philosophers, sociologists, or anthropologists (Berkes 2004; Minteer & Collins 2005) allows development of qualitative indicators and analysis of participants’ answers to qualitative questions about their perception, understanding, evaluation, and general preferences about the situation of concern (Fischer & Young 2007). A fine-grained typology of different possible values ascribed to biodiversity is worked out, inspired by environmental ethics theories but carefully adapted to the particular situation. In the Ibis example one could have classified the different possible objects of moral concern: living beings, sentient beings, sacred beings, all species, native species, ecosystem integrity, evolutionary potential, and so forth.

In the evaluation phase (phase 6) feedback on the evolution of participants’ normative commitment is gathered to assess whether the tensions and discrepancies among participants have been overcome and to determine what agreement allowed for such a resolution (an agreement on the conception of biodiversity, on preferences, or on moral values). For instance, if conservationists and animal advocates are still strongly opposed about moral issues, they can collaborate to provide optimal solutions (Perry & Perry 2008). In the Ibis example a sterilization program or the destruction of eggs could have been selected as acceptable for all parties. This evaluation should be

designed to provide transferable evidence that will enhance the general efficiency of biodiversity conservation (Sutherland et al. 2004).

In the final phase normative indicators are identified that facilitate reassessment of the problem in a feedback loop and establishment of adjustments of the management plan. The hypothesis and models can be changed to suit the evolution of public perception and the public's evaluation of the situation at stake. In such an adjustive process, conservationists might accept that the conservation targets may themselves be reexamined and, in this sense, lose some of their primacy over the situation, but if their goals are defensible, the power lost will be advantageously compensated for by a greater legitimacy and stronger public support.

Conclusion

We believe our proposal improves on the adaptive-management approach because it includes the normative uncertainty that is pervasive in problems of biodiversity conservation. Not only can a plurality of values be ascribed to biodiversity, but these values may give contradictory prescriptions and promote protection of different kinds of biodiversity. We advocate recognition that moral environmental values are diverse and evolving, and that their inclusion in adaptive management improves the approach.

The changes to traditional adaptive management that we advocate are justified by the fact that this approach generally focuses on natural resources and ecosystem services, which raise different issues than those pertinent to biodiversity conservation. Indeed, even the concepts of *resources* and *services* are normatively loaded and overly influence the relationship of humans to nature and treat the environment as only a provider of services and resources. Actions to conserve biodiversity must address the moral questions of the values humans ascribe to nature, and these moral questions should be included in the management process itself.

We believe the adjustive approach can improve the efficiency of biodiversity protection by including the essential issue of environmental values into the management process. We propose that it be discussed and experimented with so that it can be determined to what extent and in what circumstances it is an efficient strategy for biodiversity conservation. We thus invite conservationists to test and improve on our proposal and to overcome the present lack of acknowledgment of ethical issues in their everyday practice.

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