POLICY PERSPECTIVE

The natural environment is valuable but not infinitely valuable

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Abstract

This article discusses the appeal to infinite value in environmental decision making. We argue that invoking infinite values as a means of faithfully representing the worth of certain parts of the natural environment is a mistake. Infinite values have a number of theoretical and practical problems associated with them. For example, we show that invoking infinite values makes it hard to motivate conservation management decisions with greater probability of success. It is also difficult to motivate decisions that lead to better environmental outcomes, such as an increase in the area of habitat preserved. The upshot is that environmental decision making would be crippled if infinite values were introduced.

Introduction

It has been argued that giving conservation absolute priority over competing interests would best protect the environment. Attributing infinite value to the environment or claiming it is "priceless" are two ways of ensuring this priority (e.g., Hargrove 1989; Bulte & van Kooten 2000; Ackerman & Heinzerling 2002; McCauley 2006; Halsing & Moore 2008). But such proposals would paralyze conservation efforts. We describe the serious problems with these proposals and their practical implications. We also diagnose and resolve some conceptual confusion permeating the literature on this topic.

Before we set about criticizing the view that some parts of the natural environment have infinite value, we should mention the motivation behind the idea. Invoking infinite values is very natural in a deontological approach to decision making. Such approaches take there to be absolute, nonnegotiable duties and obligations, such as the obligation not to wantonly harm other humans. Problems arise, however, when we try to reconcile such obligations with the maximizing of expected utility in the standard formal decision theoretic framework. Indeed, problems also arise in informal decision making, or anywhere where trade-offs need to be made (Colyvan *et al.* 2010). One way to preserve the nonnegotiable character of obligations in the face of trade-offs is to assign infinite utility to human life, the environment, or whatever is the object of the obligation in question. We take it that this is the underlying motivation for assigning infinite value to parts of the natural environment: it arises from a sense of duty to conserve nature that is not negotiable and not overridden by economic concerns. While we have some sympathy with such motivation, as we shall see, assigning infinite values to the natural environment is not the way to realize the ambitions in question.

Intrinsic, infinite, and incommensurable values

Protecting the natural environment involves, among other things, recognizing what is valuable about it and the type of value at issue. Three distinct types of values are often conflated: *intrinsic*, *infinite,* and *incommensurable value* (Maguire & Justus 2008; Justus *et al.* 2009). *Intrinsic value*, if it exists, is simply value that is independent of valuers; the value something has irrespective of its utility in pursuing further goals. Some think that the natural environment has such value (e.g., McCauley 2006; Sagoff 2008) others think that the notion of intrinsic value is deeply problematic (Justus *et al.* 2009). In contrast, something's *instrumental* value is its value to particular valuers, typically for specific purposes. Money is a clear example: it is useful in pursuing other valuable things, but has little or no value in itself. Something with *infinite value* is more valuable than anything of finite value, but on standard accounts (Hájek 2003), all infinite values are regarded as equal. Comparing two outcomes, where at least one has infinite value, is therefore straightforward: if one outcome is finitely valued, the infinitely valued outcome is more valuable; if both values are infinite, then they are equally valuable (according to the standard accounts of the relevant mathematics). Finally, the values of two things are *incommensurable* if they are incomparable: one is not more valuable than the other, nor are they equally valuable. For example, quantities in different units are incommensurable when there is no conversion between them (e.g., is 1 kg larger than a 1 meter?). Note that infinite values are comparable, as we have just shown, so they are not incommensurable. Whether there are genuinely incommensurable values is controversial, but some claim that trade-offs between financial reward and human life are impossible because of an underlying incommensurability of value. But the perception of incommensurability in such cases may be a result of cognitive and emotional burdens associated with the trade-offs in question (Luce *et al.* 2000). Although they are commonly confused, incommensurable and infinite values are distinct.

Claiming that aspects of the natural environment (biodiversity, ecosystems, etc.) are infinitely valuable is not the same as claiming they are incommensurable or intrinsically valuable. When properly distinguished, we see that these three kinds of values are not only different, each is motivated by independent considerations. The motivation for attributing infinite value to the natural environment is reasonable: it attempts to correct a perceived undervaluation of the environment in many economic cost–benefit analyses. The proposed cure, however, is much worse than the ill.

Values are indispensable in both formal and informal decision making. Formal decision making relies on structured mathematical decision rules to arrive at a decision whereas informal, or behavioral, decision making does not necessarily rely on repeatable decision rules or quantification. The former is based on maximizing expected values in all decisions. Expected values are values weighted by probabilities, and decisions therefore depend on both probabilities and values. This formal approach is widely used in economics, risk analysis, and elsewhere, and has had numerous applications in conservation biology (e.g., Maguire 1986; Tufto *et al.* 1999; Marín *et al.* 2003; Hauser *et al.* 2006). Our focus is the formal theory of decision making, called *expected value theory* (or equivalently, *expected utility theory*), but much of the analysis also applies to informal methods, where values also play important roles.

The case against infinite values

Attributing infinite value to anything, let alone the environment, would incapacitate decision making. We consider three such problems: (1) lack of discrimination, (2) swamping of probabilities, and (3) epistemological implausibility. First, infinite value is insufficiently discriminative of salient outcomes. For example, if some habitat is assigned infinite value (e.g., mangrove forests), attributing meaningful values to larger or smaller regions of that habitat is problematic because, according to standard accounts of infinite value, all infinitely valued items are equal. Once something is assigned infinite value, no better outcome is possible, but in real-world applications this is clearly mistaken. A region of a specific habitat may be highly valuable but, all else being equal, saving more of the habitat is surely more valuable, as numerous studies of relationships between reserve area, biodiversity representation, fragmentation effects, and population viability have confirmed (see Saunders *et al.* 1991; Whittaker & Fernández-Palacios 2007, Ch. 10; Justus *et al.* 2008). Assigning infinite value precludes such finer discriminations. Nonstandard accounts of decision theory allow some of these discriminations to be made (e.g., Colyvan 2008; Easwaran 2008), but require further development before such problems can be avoided entirely.

Second, infinite value swamps probabilities (Hájek 2003). If an outcome (e.g., protection of threatened habitat) is assigned infinite value, the expected value of actions that have the slightest chance of producing that outcome is infinite (recall that expected value is the sum of the probabilities of outcomes weighted by their value). This occurs because the result of weighting an infinite value by a nonzero probability is infinite as well. For example, if persistence of an endangered species is considered infinitely valuable, actions with *any* nonzero chance of ensuring its survival will have infinite expected value. In particular, actions with high and actions with low probabilities of species survival would have identical expected value. This would imply indifference about actively protecting endangered species and passively doing nothing, and this is patently the wrong result. Nevertheless, this result is a direct consequence of assigning infinite value to highly desired outcomes. Since greater chance of success is one obvious reason for preferring some conservation efforts over others, infinite values should not be assigned to the goals of such efforts.

The third problem concerns how knowledge of infinite values is attainable. Infinite value must be intrinsic or instrumental (i.e., not intrinsic). If it were intrinsic, it would be unclear how such values could be known. The *intrinsic* value of something is independent of its utility to valuers, such as humans. As such, it is nonrelational—it does not depend on other things—and thus would seem to be unknowable by us. Indeed, as an ethical basis for conservation, accounts of intrinsic value of any kind are seriously flawed (Justus *et al.* 2009). If, on the other hand, the supposedly infinite value is considered *instrumental*—for instance, if a species or ecosystem were infinitely valuable to humans (e.g., as claimed in Bulte & van Kooten 2000; Halsing & Moore 2008)—all evidence is to the contrary. People do not act as though they attribute infinite value to anything. If they did, they would sacrifice any finite amount of money, goods, or well-being for even a miniscule chance at achieving what they putatively infinitely value and moreover, would not care about the probabilities in question—they would be just as happy with a small chance as with a large chance at an outcome that is allegedly infinite in value. As trade-offs between safety and convenience, efficiency, and profit in numerous contexts demonstrate, even human life is not taken to have infinite value. People do care about the probabilities and this only makes sense if the values in question are finite. In the environmental case, people (rightly) hold that actions increasing the chances of endangered species survival are worthwhile, and they do not hold that different-sized patches of identically suitable critical habitat are equally valuable, all else being equal. Moreover, people are generally unwilling to forgo large finite payoffs (such as lifetime earnings) in exchange for survival of endangered species.

Three conclusions follow: (1) the claim that aspects of the environment have infinite value is empirically implausible; (2) assigning infinite value to the environment would produce highly counterintuitive advice about conservation decisions; and, (3) this advice would cripple conservation management because it precludes making reasonable value prioritizations in decision making. We would be unable to differentially value, and thereby motivate, conservation actions that have greater chances of success.

Lexical ordering

Another proposal, which some might think avoids problems with infinite value, invokes a lexical ordering of outcomes. The idea, that some entities are "priceless" compared to others, is that some classes of entities trump others, although other value measures may help rank entities within a particular class. This approach is called "lexical" because it resembles an alphabetical ordering of words. Words beginning with "A" precede words beginning with "B," but words beginning with "A" can then be ordered according to another rule (e.g., their second letter). Applied to conservation issues, the view is that there is a strict ordering of values in which environmental concerns are primary and others, economic considerations, for example, are secondary (Hargrove 1989; Ackerman & Heinzerling 2002; McCauley 2006). Higher-prioritized values trump lower ones, so the latter can only function as tiebreakers when higher-ordered considerations are inconclusive. Unlike explicit appeals to infinite value, this view can represent ecosystems being better (or worse) on environmental values such as providing services, esthetic beauty, "wilderness" etc. It can also represent the superiority of saving an ecosystem *and* creating jobs over saving the ecosystem alone. But these advantages over more naïve approaches to infinite value mask similar shortcomings; lexical orderings implicitly invoke infinite value—albeit in a nuanced way. (There are other motivations for lexical ordering, such as economy of cognitive effort, where the lexical orderings are a kind of decision making heuristic aimed at avoiding difficult trade-offs and come with an associated loss of accuracy (Kahneman *et al.* 1982; Payne *et al.* 1993; Gigerenza & Selton 2001). Our focus here is primarily on the motivation from obligations. But the problems outlined below are also problems for the heuristic-based lexical approach. We would suggest that in environmental decision making, at least, the savings in effort offered by a lexical approach does not warrant the resulting loss of accuracy.)

Lexical orderings make the value of higher-ordered entities relatively infinite compared with lower-ordered ones. That is, higher-ordered entities are infinitely valuable when measured in units of lower-ordered entities, but only finitely valuable when measured in units of even higher-ordered entities. Thus, the lexical approach merely expresses, in a different way, the idea that the environment is infinitely valuable. It gives the environment priority by effectively assigning it infinite monetary value, for instance. Unlike the account of infinite value explained above, however, the lexical account can recognize different orders of environmental value by assigning them to different lexical levels. For example, saving one endangered species might be better than any financial reward (because saving it is lexically higher than financial reward), saving two species is lexically better than saving one, saving two species while incurring financial costs is better than saving one at zero cost, and saving one at zero cost is better than saving one while incurring financial costs.

But the lexical approach only escapes some of the problems discussed above. In particular, it still effectively assigns infinite monetary value to small environmental improvements and this opens the door on the most serious of the problems just discussed. In particular, the lexical approach fails when actions and outcomes are uncertain, that is, when probabilities of actions producing particular outcomes must be considered and expected values must be the focus. On the lexical approach, minute but nonzero chances of outcomes of higher lexical order are better than achieving lower-ordered outcomes with high probability, even certainty, because higher-ordered outcomes are effectively infinitely valuable when compared with lower-ordered outcomes. For instance, a lexical ordering might hold that actions with a minute chance of preserving two endangered species are always better than actions that guarantee saving one species. Such results are counterintuitive and counterproductive. They demonstrate a fundamental flaw in the lexical approach. Sensible nontrivial trade-offs between outcomes at different lexical levels must be possible, but this is precluded by both the explicitly infinitary and lexical approaches to environmental value. Indeed, for practical as well as theoretical purposes, it seems reasonable to insist on a maxim such as "trade-offs between all outcomes must be possible." (Such a maxim is formally written into standard decision theory as the Archimedean or Continuity Condition (Jeffrey 1983; Resnik 1987).)

Implications for policy: conservation based on finite values

Taking nature to have infinite value, explicitly or lexically, is clearly problematic. It makes the discriminations required for effective and efficient conservation impossible. Advocates of infinite value are right about one thing: we should not sell nature short. The value attributed to nature must not be based on indefensibly narrow economic or market measures. With sensible and realistic valuations, environmental decision making can be approached via familiar cost–benefit analyses (Bennett & Blamey 2001; Possingham 2001; Wilson *et al.* 2006; Colyvan and Steele, in press).

The problem with traditional cost–benefit approaches to environmental decisions is not that such approaches "sell out on nature" (McCauley 2006), but rather that they do not faithfully represent the value of nature. Nature is often undervalued. While formal cost–benefit analyses have gained traction in environmental decision making, adoption of comprehensive approaches to environmental valuation that include more than economic, market, or narrowly defined biodiversity measures has not kept pace. Attempting to correct for this, however, by inflating nature's value to infinity is a mistake that would cripple conservation efforts. The key to valuing nature lies in greater interaction across disciplines that have traditionally been viewed as irrelevant to the practice of conservation biology. Disciplines such as history, political science, economics, philosophy, geography, psychology, and anthropology all have something to contribute. While interdisciplinary endeavors present many challenges, such synthesis is necessary for comprehensive evaluations of nature that go beyond narrow economic measures. And only after such comprehensive evaluations are in place, can we implement sound conservation policy.

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