



Derivation of the Extrinsic Values of Biological Diversity from Its Intrinsic Value and of Both from the First Principles of Evolution

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Abstract: *Conservation ethics have been based on 2 philosophical value systems: extrinsic value (defined broadly to include all values that derive from something external to the thing valued) and intrinsic value. Valuing biological diversity on the basis of an extrinsic value system is problematic because measurement is often difficult; extrinsic value changes as spatial or temporal scales change; extrinsic value differs on the basis of external factors; some species have trivial or negative extrinsic values; and extrinsic value varies across human cultures and societies and with such factors as socioeconomic conditions, individual experiences, and educational backgrounds. Valuing biological diversity on the basis of an intrinsic value system also poses challenges because intrinsic value can be seen as a disguised form of human extrinsic value; intrinsic value is initially ambiguous as to which objects or characteristics of biological diversity are to be valued; all aspects of biological diversity (e.g., species and ecosystems) are transitory; species and ecosystems are not static concrete entities; and intrinsic value of one species is often in conflict with the intrinsic value of other species. Extrinsic and intrinsic value systems share a common origin, such that extrinsic values are always derived from intrinsic value and life mutually expresses both intrinsic and extrinsic values—these are derived from and are products of biological evolution. Probing the values that underlie conservation helps the community clearly articulate its aims.*

Keywords: conservation ethics, evolutionary fitness, utilitarian value

Derivación de los Valores Extrínsecos de la Biodiversidad a Partir de sus Valores Intrínsecos y de Ambos a Partir de los Primeros Principios de la Evolución

Resumen: *Las éticas de conservación se han basado en dos sistemas filosóficos de valores: valor extrínseco (definido para incluir todos los valores que derivan de algo externo a la cosa valorada) y valor intrínseco. Valorar la biodiversidad con base en el sistema de valor extrínseco es problemático porque tomar medidas frecuentemente es difícil; el valor extrínseco cambia a la par de las escalas espaciales y temporales; el valor extrínseco difiere con base en los factores externos; algunas especies tienen valores extrínsecos triviales o negativos; y el valor extrínseco varía a lo largo de las culturas y sociedades humanas, y con cuáles factores, como las condiciones socioeconómicas, las experiencias individuales y el trasfondo educativo, se relaciona. Valorar la biodiversidad con base en el valor intrínseco también presenta obstáculos porque éste puede verse como un valor extrínseco humano disfrazado; el valor intrínseco es, inicialmente, ambiguo a cuáles objetos o características de la biodiversidad están siendo valoradas; todos los aspectos de la biodiversidad (p. ej.: especies y ecosistemas) son transitorios; las especies y los ecosistemas no son entidades concretas estáticas; y el valor intrínseco de una especie está continuamente en conflicto con el valor intrínseco de otra especie. Los sistemas de valor extrínseco e intrínseco siempre están derivados del valor intrínseco y la vida expresa en silencio tanto los valores intrínsecos como los extrínsecos—que se derivan y son productos de la evolución biológica. Sondar los valores que subyacen a la conservación ayuda a que la comunidad articule sus metas claramente.*

Palabras Clave: aptitud evolutiva, éticas de conservación, valor utilitario

Introduction

Two philosophical value systems support the conservation of biological diversity. One is based on the idea of extrinsic value and the other on the idea of intrinsic value. Here, I define *extrinsic value* broadly to encompass all values that are referential to a value external to the entity to be valued (others use *extrinsic value* in a restricted sense as a label for nonutilitarian referential value and *instrumental value* as the broader label for referential value [J. B. Callicott, personal communication]). Intrinsic value is value inherent to the entity valued (Agar 2001).

The debate on the philosophical meaning and political strength of these value systems is ongoing (e.g., Noss 2007; Justus et al. 2009a, 2009b; Sagoff 2009). For instance, Justus et al. (2009b) argue that extrinsic values are the only values needed or useful in cost-benefit analyses and political debates, whereas Jepson and Canney (2003) argue that the recognition of intrinsic value through spirituality is expressed in every society and, for example, inspired the creation of national parks (e.g., Yosemite National Park, California).

The 2 value systems are not mutually exclusive (Oksanen 1997; Norton 2000); conservationists use the ideas together and separately to argue for conservation. Oksanen (1997) and Norton (2000) argue that the line between them evaporates if one considers that human spiritual values and the value associated with moral pleasure can be measured. Justus et al. (2009b) argue that the consequence of quantifying spiritual and moral value is that extrinsic values are primary and intrinsic values only make sense in relation to extrinsic value—essentially that humans are the measurers of all value. My goal in this essay is to reframe the discussion of these value systems as a basis for conservation and to argue that they both derive from and are the products of biological evolution.

Extrinsic value establishes the value of biological diversity with reference to something external to it, in which, then, must reside the primary intrinsic value. I argue, with Sajama (2005), that extrinsic value can exist among any sets of species (e.g., a pollinator has extrinsic value to the plant it pollinates), but the extrinsic value of biological diversity is, of course, most often proposed in terms of value to humans. Even proponents of extrinsic value recognize intrinsic value as primary in a deeper sense. For example, Justus et al. (2009b) argue the centrality of extrinsic value on the basis of the recognition of an intrinsic value, the value of human well-being, whether such extrinsic value is derived from material usefulness to humans or from usefulness for nonmaterial aesthetic stimulation and spiritual inspiration. Of course, humans are able to articulate value, but Sajama (2005) argues that extrinsic value is present and mutely expressed in all species interactions. For example, the extrinsic value of a pollinator is mutely expressed by the plant it pollinates. This mutely expressed value can be measured in real

terms by the energetic cost to the plant of the petals and nectar that attract the pollinator. Cost-benefit results drive evolution in all species interactions, although complex trade-offs and the nature of the underlying genetic variation prevent perfection in evolutionary outcomes.

By contrast, intrinsic value is the value inherent to the valuable thing and thus requires no external reference point, human or otherwise (notwithstanding that humans define and articulate this value) (Agar 2001). Applied to species, intrinsic value is the basis of the claim that species have the right to continued existence (Callicott 2006a). The U.S. Endangered Species Act requires no statement of extrinsic value in the process of listing and protection; species that are on the verge of extinction are covered, whether of utilitarian value or not (Callicott 2006a). This remains true, despite ongoing debate about how to measure the economic costs and benefits of protection of such species.

Intrinsic and extrinsic value systems, as rationales for the conservation of biological diversity, are each problematic in their own ways. I consider extrinsic value to be secondary to intrinsic value because for an entity to have value in an extrinsic sense, there must be an external entity by which its value is judged. Thus, there is an assumed, if at times undefined, external primary value on which this secondary referential value is based (Aristotle in *Nicoachean Ethics*, Book 1, from Callicott [1995], Oksanen [1997], and S. Sajama [personal communication]). The extrinsic value of biological diversity to humans can only exist if one posits that humans have intrinsic value or that some human condition, such as human life, well-being, freedom from suffering, happiness, or spiritual satisfaction, has an intrinsic value.

Herein, I use the broad definition of biological diversity (Noss 1990): it has 4 levels (genes, species, ecosystems, landscapes) imposed as concentric circles on 3 axes (composition, structure, and function).

Problems Posed by Extrinsic Valuing of Biological Diversity

The extrinsic value of biological diversity to humans can be defined under 4 categories: goods, ecosystem services, information, and spiritual happiness or satisfaction (Callicott 2006b). Regardless of category, there are 5 types of problems inherent in the extrinsic value system as a rationale for conservation of biological diversity: measurement, scale, context, negative species values, and human subjectivity.

Measurement

How does one establish a common currency for biological diversity so that values can be enumerated and compared (Nijkamp et al. 2008)? Environmental economists

attempt to measure the benefit of biological diversity in common currency under the assumption that money will show the preference for a particular policy or action and the ability of society to afford the associated cost (Brauer 2003; Turner et al. 2003). Although it is possible to deduce monetary values when some aspect of biological diversity is openly traded on markets, it becomes more difficult and contentious if the value of biological diversity is established indirectly or depends on planned or potential future use (Nunes & van den Bergh 2001). In a 1908 memorandum to the National Governors' Conference on Conservation, John Muir wrote, "Nothing dollarable is safe" (taken from Righter [2005]). Even when one can assign a dollar value to biological diversity, there may be other uses or configurations of biological diversity that are more valuable if reduced to the same units. Extrinsic value, unlike intrinsic value, has gradations and results in a comparative analysis of choices. It is worrisome, as well, that the dollar value, even when well established, changes with scale and context.

Scale

The extrinsic value of biological diversity is scale dependent (White & Jentsch [2005]; see White [2006] for a discussion of scale dependence in judging the right or wrong of an action). For example, people living in rural areas may have a different frequency distribution of opinions from those living in cities. Thus, the majority of people living in Florida support the reintroduction of Florida panthers to areas where the species was extirpated, yet most rural people strongly oppose such action (R. Noss, personal communication). An obvious example of scale dependence in the definition of extrinsic value with regard to time is that short-term values may be entirely different from long-term values (e.g., clearcut logging maximizes value of the harvest in the short term but can lead to soil erosion and loss of productivity in the longer term). Arguments for natural resource use that are based on economic valuation at small scales of time and space—the tyranny of the immediate against a backdrop of slow evolution of biological diversity and ecosystems—are powerful in the political arena. In a democratic context, these scale problems raise the perennial issues of national versus local interests and the needs of the present versus future generations.

In biological studies, I and others have found it useful to divide the scale into 2 components: grain (the size of a contiguous sample) and extent (the dimension over which a set of observations are distributed) (e.g., Palmer & White 1994; Nekola & White 1999; White & Jentsch 2005). One can apply grain and extent to scale problems in the assessment of human opinions. For spatial scale, one can assess opinions (or establish voting districts) at any grain size (neighborhood, township, county, state, country) and distribute the sample across any spatial ex-

tent (neighborhoods within a township or across townships, counties, states, or countries). As with biological systems, there is scale dependence. One can posit that the frequency distribution of opinions depends on the grain and extent of the sample. Grain and extent can be defined for time as well: grain is the duration of the continuous and discrete data (e.g., a set of opinions or votes at one point in time) and extent is the total time over which data are collected (e.g., repeat surveys carried out at monthly or yearly intervals).

Confronted with this scale dependence, one could argue that the extrinsic value of biological diversity must find some universal basis and thus always be determined at very large spatial and temporal scales. Although this is tenable, it is not always persuasive in the political arena. Nonetheless, one could argue that conservation goals should aim for universality and favor large scales in places that retain continuity over long periods. Others might argue the opposite; that is, generations living now and generations most affected should decide how natural resources are used or whether they should be protected. Efforts to think globally, act locally are an attempt to reconcile these views. In democratic societies, the solutions to these dilemmas are the ballot box and the laws and constitutions that uphold the democratic process. Differences in opinion are inevitable, but this does not mean all opinions are equally weak or equally persuasive. In a free society, these conflicts are subject to reasoned argument, debate, and persuasion. The argument that humans depend on ecosystem services and that these services depend on biological diversity, for instance, is subject to all the vicissitudes of the extrinsic value system, but this argument may be compelling and successful nonetheless.

Context

External circumstances can alter extrinsic value. For instance, tourism dollars generated near wilderness landscapes may fluctuate with the cost of gasoline—the higher the price of gasoline, the lower the value derived from visits to motels and restaurants near the wilderness area. The spread of a new disease through native insect vectors can change how these insects and their habitats are valued. These context issues include these vagaries of the market, although one could also devise measures of extrinsic values that are not based on short-term market value alone but on a greater spatial and temporal scale of valuation (Reid 2006).

Negative Species Value

Some species, and the habitats that support them, have positive value, others negative value to humans, at least at some scales of space and time. These negative values, regardless of reality, have been motivating forces for such

actions as predator control and the draining of swamps to reduce insects and disease exposure. However, if extrinsic value is judged from the perspective of species other than humans, one can posit that all species have positive value to at least some other species, in which case one would also have to admit that all species also have negative values for at least some other species. My reference to the extrinsic value that species have to other species rests on the intrinsic value of those other species to themselves and this, in turn, invests intrinsic value in all living things.

One could argue that all species have a place (e.g., the swamp supports the mosquitos whose larvae feed the trout), so that even species with negative value (mosquitos spread disease) play a positive role (fishing). This returns one to the dilemma of scale and to measurement problems because negative values may still outweigh positive values (costs of disease may exceed the value of trout).

Human Subjectivity

Extrinsic values that are defined relative to human well-being often depend on subjective opinions or preferences. Different cultures and different individuals within the same culture have different traditions of value for nature or species and these values evolve over time. Even within one cultural setting, different populations have different experiences and attitudes about biological diversity. These different experiences and attitudes may work in different directions relative to conservation goals. Urban people, because of a lack of exposure and experience, may view a natural setting negatively, whereas rural people may view such a setting positively. But urban people may see recreational, aesthetic, and spiritual value in wilderness, whereas rural people may perceive wilderness areas as wasted resources. Simaika and Samways (2010) argue that biophilia and biophobia are learned and not innate. Arguments that children need a greater connection to nature in order to lay a foundation for environmental understanding and value also suggest the importance and subjectivity of experience (Louv 2008). This bias is expressed in the greater value humans often place on sentient versus nonsentient animals, on warm-blooded versus cold-blooded animals, and on animals with relatively large heads and eyes (traits of the human infant) (Gould 1979). Whether it is fear of insects or snakes or the phenomenon of plant blindness (Wandersee & Shusser 1999), humans often exhibit these biases whether these are learned or innate. We see it in the prohibition on hunting but the allowance of fishing (although for noncommercial purposes) in national parks in the United States.

Leopold (1949) saw human ethical development as a root problem in conservation. He argued that humans have to proceed up an ethical chain from purely selfish

values (only the self has value, all else is of value only in relation to that self) to values of the larger community (“the land” in Leopold’s parlance). The transference of ethical values from self to other species or the land is called extensionalism (Engel 2009). Although Leopold (1949) averred that all species “should continue as a matter of biotic right, regardless of the presence or absence of economic value to us . . . —at least in spots,” his land ethic also recognizes intrinsic value at the ecosystem level (White & Tuttle 2013). Although he never used the term *ecosystem*, Leopold (1949) characterized “the biotic [Eltonian] pyramid” as a “fountain of energy flowing through a circuit of soils, plants, and animals.” And this pyramidal energy circuit was “something we can see, feel, understand, love, or otherwise have faith in” (Leopold 1949).

This discussion frames extrinsic value relative to humans, but it could be framed relative to any species. That framing is subject to the same 5 issues just discussed (i.e., issues of measurement, scale, context, negative value, and experience apply for any species used as a reference for extrinsic value). The inevitability of these issues illustrates the limitations of defining the value of biological diversity from the perspective of a single species, human or not.

The 5 types of problems suggest extrinsic values are, at many times and at many scales, inconstant. Even when such values can be presumed stable relative to the short time frame of a political decision, one also has to establish whether the extrinsic value of a conservation action outweighs the cost of the conservation action plus the cost of lost opportunity—values that might be realized from some alternative action. These challenges imply a constant struggle to establish and prove extrinsic value. Despite these challenges, Justus et al. (2009b) argue that the extrinsic values of biological diversity, including those that are based on human spiritual or moral values, are the only real values. Although I disagree with this assertion (see also Sagoff [2009]; Justus et al. [2009a]), extrinsic value to humans is a strong argument when it comes to political decisions.

Problems Posed by Intrinsic Valuing of Biological Diversity

In its purest form, intrinsic value is absolute and does not change due to outside circumstances. In this form, it is the basis of a categorical imperative (as Kant suggested) and is not measurable, graduated, or comparable—unlike the inherent measurement gradation of extrinsic value on a scale of 0 to 1, intrinsic value is always 1. Because it is a posited conclusion (a priori, as Kant suggests) and is not subject to empirical analyses, the intrinsic value of biological diversity is said ultimately to derive from spiritual, religious, or moral principles. To the contrary, I argue

that intrinsic value is innate, if mutely expressed, in living things and derivable from evolutionary first principles.

The problems associated with the intrinsic value of biological diversity are that intrinsic value is a disguised form of human extrinsic value; that it is ambiguous because it is unclear which objects or characteristics of biological diversity humans find intrinsically valuable; that all aspects of biological diversity (e.g., species and ecosystems) are transitory; that it is difficult to define species and ecosystems as concrete entities; and that the intrinsic value of one species is often in conflict with the intrinsic value of other species.

Intrinsic Value versus Extrinsic Value

All value systems are anthropogenic because the idea of value and the methods of valuation are human created. Furthermore, whether or not intrinsic values exist outside the human articulation of such value, humans assign their own material or nonmaterial value to biological diversity when they articulate that value. In other words, the articulation of intrinsic value creates, simultaneously, an extrinsic value. The popularity of the idea of intrinsic value may therefore rest on the value of the pleasure humans take in moral satisfaction (Norton 2000). Altruism in humans, a social animal, may have a genetic basis that supports this moral pleasure. This reasoning converts the declaration of intrinsic value into a nonuse extrinsic value that is based on the intrinsic human value placed on moral pleasure. This value has been quantified as existence value (the value humans place on knowing that another species continues to exist, with no requirement for a use value) and behest value (the value humans place on the continued existence of the species).

Alternatively, one can separate intrinsic value from its recognition by humans. Existence and behest value can be measured on the basis of the amount of money individuals are willing to pay to vouchsafe the continued existence of another species, a measure of extrinsic value. This may, however, reveal the valuer's preferences and so produce a value that is graduated rather than absolute (that is, a particular person may care more about some species than others). Justus et al. (2009*b*) take the point of view that intrinsic values are, through the medium of human emotional and spiritual pleasure, extrinsic values and must be measured as such. In response to Sagoff (2009), they also propose that human-centered values are the only ones that can be used in cost-benefit analyses and thus the only practical way of finding environmental solutions (Justus et al. 2009*a*). I argue that although the recognition, measurement, and articulation of intrinsic values are human enterprises that create extrinsic values, intrinsic value nonetheless exists.

A fundamental counterargument to the position that spiritual and moral values are purely extrinsic human values can be made. Spiritual and moral values are not

arbitrarily imagined and imposed by humans; they are derived more generally from the existence of life itself, which creates in human beings a search for meaning. Spiritual and moral values are a human response to the perceived mysteries of life and existence, an existence that predates human consciousness.

Ambiguity in the Aspects of Biological Diversity to Which Intrinsic Values Are Assigned

Noss's (1990) scheme for describing biological diversity presents one with the issue of whether the intrinsic value of biological diversity lies in its entities (genes, individuals, species, ecosystems, landscapes) or its processes (evolution, adaptation, population dynamics, integrity, health, resilience). The extreme of this debate is to invest value only in the individual entities (hence, individual rights, sometimes granted exclusively to sentient organisms) or in the ecosystem (hence, the holism of Leopold's 1949] concept of the land). Nature is both the object and the process—one does not exist without the other and both evolve through time. As described more specifically below, the objects themselves are only the snapshots of continuous lines of descent and relations. I argue that the biological root of intrinsic value lies in this larger view of life as continuous, with its manifestations at any one time being the vessels for its current existence.

Transitory Nature of All Species and Ecosystems

Species evolve in response to changing physical and biotic environments, and ecosystems change in composition and structure over time. If one bases a conservation ethic on the intrinsic value of biological diversity, how does one deal with the fact that no state of nature is eternal and one cannot freeze species or nature as if they were static museum objects (Oksanen 1997; Hampicke 1999; Colyvan et al. 2009)?

I present 2 answers to this question. First, one can assert that intrinsic value of species and ecosystems includes the intrinsic value of their ability to adapt and change. Second, rates of adaptation and change are relatively slow compared to political decisions about conservation. Thus, as long as the innate capacity for change is retained, acting on the basis of the intrinsic value of current species and ecosystems as manifest now protects the raw materials of future adaptational change. Adaptation is change, but a special kind of change that occurs because of continuity with the past. Existing species and ecosystems are the vessels for that change. As a result, past historic states always play a role in conservation (although their relevance declines through time). One must accept that historical states are not the only acceptable states. However, historic and current states are nonetheless important because they provide the quality of continuity as precursors to future change.

If adaptation and change are a function of the diversity of the system (e.g., recall Fisher's fundamental theorem that the rate of evolution is a function of the amount of genetic variation), then one encounters another problem with intrinsic value: species and ecosystems differ in their capacity for change because they contain different ranges of genetic and phenotypic responses to past evolutionary and historic events. What is often meant by conservation of the ability to change is conservation of (including restoration to) a historical state of genetic and species diversity, rather than an imposition of an optimum amount of variation that has no precedent. Of course, one's tolerance of historical levels of diversity versus management to increase diversity may be a function of the degree of threat to biological diversity—the higher the immediate threat the more likely one is to create preserves where local composition and diversity does not have a historic precedent or to inflate local genetic diversity above historic precedence by increasing gene flow through human action.

Entification of Species and Ecosystems

Are species and ecosystems entities that can support intrinsic value? Not only are species and ecosystems transitory, they are each made up of elements and processes that contribute to a whole that is conceptual, not easily bounded, and often subject to contrary classifications. Entification also embeds a scale issue in that the classification of the objects is different at different spatial and temporal scales. In the short time frame and narrow geographic focus of political decisions, scientific authorities may agree on the definition of a species or ecosystem, yet at larger scales such definitions become problematic. Although it is pragmatic to define entities (and this must often be established as part of legislation), I return to the issue of life's wholeness or continuity as intrinsically valuable below. Callicott (1994) provides a thorough rationale for the moral standing of "wholes" versus individuals (see also Agar 2001).

Conflicting Values of Species

If all species have intrinsic value, what about the antagonisms among species (Sajama 2005; Sarkar 2008)? Sajama (2005) asked, if both wolves and lambs have intrinsic value, but the wolf eats the lamb, what is intrinsic value? The lamb has extrinsic value to the wolf as the means by which wolves survive and reproduce. Furthermore, the lamb eats grasses—the grass is purely of utilitarian value to the lamb. In this sense, every species values other species on a graded extrinsic scale that ranges from negative to neutral to positive. Sajama argues further that wolves, lambs, and grasses all implicitly express an intrinsic value: the success of their own species. Thus, we can make a more general argument that the nature of

the living process, in all organisms, expresses an intrinsic value—life mutely and universally expresses its own inherent value. Selection promotes traits that increase survival and reproduction, and the very nature of life is to express this simple fact as an implicit intrinsic value.

Discussion

That all living cells embed the principle (through survival and reproduction) that life promotes life could hardly have an alternative on a planet of drifting continents, changing climates, windstorms, fires, floods, species antagonisms, and struggle for existence. Life has been selected to exert a positive pressure against these forces, and selection works against any mutations that lower this positive pressure—every species can increase exponentially, albeit different species have the potential to increase exponentially at different absolute rates. Life is by nature always a multiplicative process, at least under the right conditions, that produces the "vigorous self-renewal" described by Leopold (1949). The 2 components of fitness, survival and reproduction, are themselves the means by which life mutely states its own intrinsic value. It is then not surprising that our common descent with other living things produces such human spiritual proclamations as the importance of a reverence for life, whether this is tied to reverence for a creator or the process of evolution.

If one thinks of life as continuous descent from common ancestors, then the life process has passed on this intrinsic value to units (individuals, species), which are themselves fleeting. This continuity of life suggests that value intrinsic to living things is a universal inherited value. This value is present in all manifestations of life (species, ecosystems), but it is not those manifestations themselves that define the value—the manifestations are the value's temporary vessels. Given this argument, the intrinsic and extrinsic values expressed by humans are generally a description of how all species relate to others. All species mutely express their own intrinsic value, and all species mutely express the extrinsic value system they live by in which other species can have negative, positive, or neutral value.

The inherited intrinsic value of the living process is manifest in the transitory elements of biological diversity at any one time and depends on the diversity of those elements as the basis of such processes as adaptive change and the resilience of ecosystems. The value intrinsic to life underlies an overall property—nature's creativity (Rolston 1994). Adaptive change and ecosystem resilience as manifestations of life's intrinsic value also underlie the critical extrinsic value for the human species.

I conclude that all living things and biological diversity express implicitly both intrinsic and extrinsic values. Humans define and articulate these values (Sajama 2005),

but the values have existed and have been mutely expressed since life began and are part of the joint inheritance of all living things. Intrinsic value is the primary value system for life—it is based on survival and reproduction, the very traits that evolution optimizes. To act on the basis of the intrinsic value of life is to conserve the genetic, species, and ecosystem diversity of the planet and to provide for the continuity that allows adaptive change to continue.

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