Conservation Biology

Essay

Ecological Sustainability as the Fourth Landmark in the Development of Conservation Ethics

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Abstract: *Aldo Leopold, in "The Land Ethic," made 2 important contributions to conservation ethics: he emphasized the community and ecosystem levels of organization and he explicitly included people as members of the biotic community. Leopold's writings remain eloquent, inspirational, and influential, but the ideas he describes are inherently complex, and ecological science has continued to evolve since "The Land Ethic" was published in 1949. We used 4 sets of quotations from Leopold's essays to develop our commentary on the meaning of and challenges in interpreting his work and to explore the ongoing development of conservation ethics: the "A-B cleavage" (Leopold's description of the contrast between utilitarian value versus a broader definition of value in nature), "land health" and the rightness of human action, the right of all species to continued existence in natural populations "at least in spots," and humans as "plain member[s] and citizen[s]" of the "land-community." We define the broader function of land and land health in "The Land Ethic" as including completeness, dynamic stability, and self-renewal in a way that incorporates the needs of humans and all other species. We argue that the consequences of implementing Leopold's land ethic include multiple conservation goals nested within an overall systems approach and that conservation science must clarify the implications of Leopold's ethic by quantitatively investigating and defining large-scale, system-level ecological sustainability. At this scale, land use will encompass areas ranging from large expanses of wilderness to areas dominated by humans.*

Keywords: conservation ethics, ecological sustainability, land ethic, land health, Leopold

La Sustentabilidad Ecológica como el Cuarto Hito en el Desarrollo de la Ética de la Conservación

Resumen: *En la "Ética de la Tierra", Aldo Leopold hizo dos contribuciones importantes a la ética de la conservación: enfatizó los niveles de organización comunidad y ecosistema e incluyó explícitamente a la gente como miembros de la comunidad biótica. Los escritos de Leopold siguen siendo elocuentes, inspiradores e influyentes, pero las ideas que describe son inherentemente complejas, y la ciencia ecológica ha continuado su evolución desde que "La Ética de la Tierra" fue publicada en 1949. Utilizamos cuatro conjuntos de citas de ensayos de Leopold para desarrollar nuestro comentario sobre el significado de y los retos de la interpretación de su obra y para explorar el desarrollo de la ética de la conservación: la "División A-B" (la descripción del contraste entre el valor utilitario versus una definición más amplia de valor en la naturaleza), "salud de la tierra" y la rectitud de la acción humana, el derecho de todas las especies a una existencia continua en poblaciones naturales "por lo menos en manchas" y humanos como "simple(s) miembro(s) y ciudadano(s)"de la "comunidad de la tierra." Definimos la función más amplia de la tierra y de la salud de la tierra en "La Ética de la Tierra" mediante la inclusión de la integridad, estabilidad dinámica y auto renovación de manera que incorpora las necesidades de los humanos y todas las demás especies. Argumentamos que las consecuencias de la implementación de la ética de la tierra de Leopold incluyen múltiples metas de conservación anidadas en un enfoque integral de sistemas y que la ciencia de la conservación debe clarificar las implicaciones de la ética de Leopold investigando y definiendo la sustentabilidad ecológica nivel sistema y a gran escala. En esta escala, el uso de suelo comprenderá extensas áreas silvestres y áreas dominadas por humanos.*

Palabras Clave: Ética de la conservación, ética de la tierra, Leopold, salud de la tierra, sustentabilidad ecológica

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Introduction

Conservation ethics in North America has been described as having 3 historical roots (Callicott 1990; Meffe & Carroll 1994): the preservation ethic (called the romantic-transcendental conservation ethic by Callicott [1990]), the resource conservation ethic, and the evolutionary-ecological land ethic. The preservation ethic and resource conservation ethic developed during, and were responses to, the rampant exploitation of natural resources in the United States that intensified in the late 1800s. The preservation ethic, as represented by the work of John Muir, argues for the conservation of wilderness as free of human influence as possible. This ethic can be seen today in the management philosophy of the U.S. National Park Service, as presented in the Organic Act of 1916. The resource conservation ethic, as represented by the work of Gifford Pinchot, argues for the wise use and management of natural resources in a way that will not impair their ability to generate social benefits in the future. The resource conservation ethic underpins the management philosophy of the U.S. Forest Service as described in the Forest Reserve Act of 1891. The third historical root of North American environmental ethics, the evolutionary-ecological land ethic (Callicott 1990), is based on the ideas of Aldo Leopold, particularly as they were developed in "The Land Ethic," an essay published in *A Sand County Almanac* in 1949. Here, we focus on the issues raised by Leopold in "The Land Ethic," but we also show that his philosophy implicitly allows many different kinds of land use and suggests that different conservation ethics will inevitably be applied to different tracts of land, including the contrasting conservation ethics promoted by Muir and Pinchot.

Leopold's writings are eloquent and inspirational and remain widely quoted and influential. However, the science of ecology has evolved in the 60-plus years since *A Sand County Almanac* was published, and this evolution should inform the way conservationists interpret Leopold's land ethic in the 21st century (Callicott 1996, 2002). The ideas Leopold was striving to articulate are inherently complex and anticipate a system-level view that remains a challenge today. As a result, his writings pose questions that still need to be addressed. In articulating and discussing these questions, we examined the meaning and implications of Leopold's world view. Our essay is, in part, an extension of ideas about "multipatch" environmental ethics developed in White (2006) and White and Jentsch (2005) and discussion of the intrinsic value of biological diversity in White (2013).

Leopold's Contributions to the Definition of *Conservation Ethics*

We focused on 2 of Leopold's contributions to the development of ethical values in conservation: what he called the "land-community" and his argument that people should be included in that community. Leopold (1949:203–204) wrote:

> All ethics so far evolved rest upon a single premise: that the individual is a member of a community of interdependent parts . . . The land ethic simply enlarges the boundaries of the community to include soils, waters, plants, and animals, or collectively: the land.

And, "The only sure conclusion is that the biota as a whole is useful, and biota includes not only plants and animals, but soils and waters as well" (as quoted in the compilation of Leopold's writings published in Flader and Callicott [1991:267]).

On human place in the community, he wrote (as quoted in Flader and Callicott [1991:303]):

> Who is the land? We are, but no less than the meanest flower that blows. Land ecology discards at the outset the fallacious notion that the wild community is one thing, the human community another.

And, "In short, a land ethic changes the role of *Homo sapiens* from conqueror of the land-community to plain member and citizen of it" (as quoted in Flader and Callicott [1991:204]).

Leopold's community focus and his inclusion of people in the community provide the framework for our thesis that the conservation of biological diversity and human well-being are part of one large-scale and system-level challenge: to define a sustainable relationship between people and the environment.

Questions Raised by Leopold's Land Ethic

We used 4 sets of quotations from Leopold to further clarify the challenges of interpretation the land ethic presents as they relate to the "A-B cleavage" (Leopold's description of the contrast between utilitarian value vs. a broader definition of value in nature), "land health" and the rightness of human action, the right of all species to continued existence in natural populations "at least in spots," and humans as "plain member[s] and citizen[s]" of the "land-community."

A-B Cleavage in the Way Humans Value the Land

Leopold (1949:221) described what he called the A-B cleavage in the way that humans place value on land. "One group (A) regards the land as soil, and its function as commodity-production; another group (B) regards the land as a biota, and its function as something broader." Thus, group A represents direct exploitation, either without regard to sustainability or, at best, with determination of maximum sustained social benefit, as described by

the scientific utilitarianism of Gifford Pinchot. But what does group B represent? Leopold's "something broader" assumes a particular kind of function at the system level. How does one specify this function? Because he places humans in that system, yet also seeks something broader than utilitarian value, the something broader implicitly embeds Pinchot's utilitarian purposes in a larger context that must include other purposes as well, including conservation of resources without regard to human needs.

Land Health and the Rightness of Human Action

"[A] thing is right when it tends to preserve the integrity, stability, and beauty of the biotic community. It is wrong when it tends otherwise" (Leopold 1994:224–225). Although this is an eloquent and much-quoted statement, it leaves us with the challenge of defining *integrity*, *stability*, and *beauty*. We argue that these are interrelated concepts in the land ethic. Integrity and stability are relatively easy to define. Integrity in the land ethic represents completeness—that the elements of the land are fully present, including populations, communities, and an intact soil and other abiotic factors. Leopold understood population and community dynamics, so his concept of stability includes these dynamics at smaller scales and dynamic stability at larger scales. The idea that landscapes could be in equilibrium despite disturbances, such as fire, wind, and flood, and the resulting successional change is one of the major ideas of disturbance ecology (Turner et al. 1993; White et al. 1999). For instance, the concept of qualitative or persistence equilibrium describes the persistence of species, populations, and communities despite fluctuations in local or landscape abundance and the dynamic processes of birth, death, immigration, and emigration.

Population dynamics and the interplay of disturbance and succession within ecosystems occur on time scales of years to several centuries. What about longer-term abiotic changes caused by climate change and continental drift and biotic responses to these changes, such as range shifts, adaptation to new conditions, and evolution—dynamics that occur on time scales of thousands of years? One could avoid this problem by arguing that changes at these long-time scales can be safely ignored at the short-time scales of conservation decisions, but even those short-term decisions have implications for longer-term community and ecosystem responses. More fundamentally, one could argue that Leopold's understanding of dynamics included adaptive and transformative change (the land, as a functioning system, self-renews even if species and ecosystems are changing) and thus represented an argument for stability of the living system rather than stability of the expression of this living system in particular genes, species, or ecosystems. If we interpret Leopold in this way, the idea of stability has been enlarged beyond the narrow context of its common-language meaning, but this is consistent with Leopold's ideas about the function of the land as a living, evolving system. In the land ethic there is always implied a right or normative standard to the fit of living things, environment, and people, so adaptive change simply maintains that standard when the environment changes.

Having defined *integrity* as completeness and enlarged the definition of *stability* to include short- and long-term dynamics, one arrives at the most challenging of Leopold's list for the rightness of human action: beauty. Because Leopold was a wildlife biologist who wrote, for example, about the importance of predators (e.g., in the essay "Thinking Like a Mountain"), surely his definition of beauty includes nature "red in tooth and claw" (Tennyson 2004 [first published in 1850]). Surely, Leopold's beauty therefore involves a particular and special function of the whole, a function that must satisfy the needs of all species including people, support current function, and allow for future change. In the literature on systems ecology, this kind of healthy functioning has been articulated as the ecosystem qualities of persistence (ability to stay the same), resistance (ability to withstand perturbation), and resilience (ability to return to a former state) (Holling 1973). To these 3 terms, we add adaptation (ability to change in a way that produces a new state with unimpaired function in a changed environment). In other words, Leopold's beauty describes the functioning of a healthy system that exhibits dynamic stability (persistence, resistance, resilience, and adaptive response) and possesses integrity (functionally related population and community elements).

Leopold (as quoted in Flader and Callicott [1991:310]) also wrote about the ideal functions of the land through his use of *health* and *vigorous self-renewal*:

> The land consists of soil, water, plants, and animals, but health is more than a sufficiency of these components. It is a state of vigorous self-renewal in each of them, and in all collectively.

This quotation further implies the dynamic processes and functional relations that underlie the beauty Leopold saw in a healthy ecosystem and the dynamic stability and larger-scale heterogeneity required for self-renewal of each component and the system as a whole.

The 3 components of Leopold's sense of sustained and healthy functioning, seen through a modern lens, are, thus, integrity (having all the right components), stability (persisting, resisting, rebounding, and adapting), and beauty (having all the right functions). Leopold certainly viewed the 3 as intertwined. Subsequent ecological research reveals, however, that the relation between the parts, dynamics, and functions of the ecosystem is made imprecise because of the role of niche overlap and redundancy of the component species. The key is to adopt a systems-analysis approach to parts and functions

(Meadows 2008). Such an analysis will also help in the understanding of the tolerance of the system for variation in parts and functions.

The Right of all Species to Continued Existence At Least in Spots

Of other species, Leopold (1949:211) wrote that they "should continue as a matter of biotic right, regardless of the presence or absence of economic advantage to us." He also wrote that species had "the right to continued existence and, at least in spots, their continued existence in a natural state." The phrase *at least in spots* suggests he realized that not all species are compatible with each other or with humans and that habitat heterogeneity and the dynamics of ecosystem patches mean that one would never expect all species to co-occur—with one another or with us—everywhere. Even within one ecosystem, prey populations need some spatial or temporal refuge from predators. When we add one very demanding species into the equation (humans), which Leopold explicitly does, it is obvious that species cannot be everywhere within the environmental conditions determined by their physiological abilities because some are incompatible with human populations and uses (and vice versa).

Humans as Part of the Land

Leopold's placement of humans in the land-community lead to another critical observation, already hinted at by the phrase *at least in spots*: the importance of heterogeneity. For instance, Leopold was concerned with the loss of large predators in ecosystems. Those predators require large blocks of land with low human influence. But he also considered humans part of the land. This means a range of states is needed, from wilderness with little human presence to areas occupied by and supporting dense human populations. Therefore, the functioning Leopold describes must, at the largest spatial scales, include areas that are low in human influence and those that are dominated by human influence. Leopold (as quoted in Flader and Callicott [1991:260]) wrote more directly about the necessary heterogeneity, albeit in a description of smaller-scale heterogeneity across a landscape in relation to wildlife populations: "Doesn't conservation imply a certain interdispersion of land uses, a certain pepper-and-salt pattern in the warp and woof of the land-use fabric?" That is true of the co-occurrence of people and biological diversity at every scale, but it is also true in terms of the importance of heterogeneity to species that use multiple habitats or that require places of refuge from competitors, diseases, and predators. Implicit in the "warp and woof" is that the ideal for both humans and nature is an uneven distribution of each across the landscape—it would be better for natural systems to have dense human populations in a few areas and to leave other areas relatively free of human activities than to have the same number of people spread evenly across space.

Although it is a positive and necessary step to integrate conservation with human land use, the devil is in the details. Leopold's land ethic leads one to ask specific questions such as how many people, how much human use of land and resources, and how is this use arranged on the landscape? Leopold implicitly suggests a mix of human-dominated and human-free areas, but in what mix, what ratio, what arrangement? The answers to these questions are not abstract or philosophical; rather, they depend on the real spatial dimensions and constraints of ecological processes. The effort to integrate humans in sustainable ecological systems also implicitly requires a statement of human population size that is compatible with biological diversity at large scales. That is, it requires stating the human population size that is compatible with large expanses of wilderness for conservation of species that require large areas, with large blocks of forest for forest-interior species, and with the large tracts of land required to maintain ecosystem services, such as clean water, and to support human recreational and spiritual needs. The carrying capacity of humans on the planet should not be set by human material needs alone, but by the needs of all other species and human nonmaterial needs. Hence, if conserving biological diversity is a goal, the human population must have a cap smaller than the planet could otherwise support on the basis of human material needs alone.

Incorporating human presence in conservation strategies is important for another reason. There are few places left to preserve where human effects are low. Human effects, if only because of anthropogenic climate change, are everywhere. Important ecological functions, such as seasonal migration, range shifts, top–down effects of large predators on lower trophic levels, and disturbance dynamics (wind, fire, flood), require connectivity and such large areas that human-dominated areas are inevitably part of both the problem and the solution. Hence, the definition of *naturalness* and how to position management by humans in relatively human-free landscapes has become an important issue (e.g., Cole & Yung 2010; Hobbs et al. 2010; White et al. 2010).

Large-Scale, System-Level Sustainability as the Fourth Landmark for Conservation Ethics

The most important challenge of adopting Leopold's land ethic is to define the integration of biological diversity conservation and human populations in real terms and in a way that produces the right function of the whole at large scales. Previously we discussed Leopold's elements of this function (integrity, stability, beauty, and health

or vigorous self-renewal) and we used *in spots* and *the pepper-and-salt pattern* to represent the heterogeneity and patchiness that are a necessary backdrop for the function Leopold sought. In an earlier era, a label for the function of the whole would have included *balance*, but this word has fallen out of favor because the nature-in-flux paradigm has prevailed over the nature-in-balance paradigm (Pickett et al. 1992; Lodge & Hamlin 2006). To his credit, as early as 1939, Leopold questioned the idea that nature is in balance. He wrote (as quoted in Flader and Callicott [1991:267]):

> "Balance of nature has its merits and also defects. Its merits are that it conceives of a collective total, that it imputes some utility to all species, and that it implies oscillations when balance is disturbed. Its defects are that there is only one point at which balance occurs, and that balance is normally static."

In the last decade, *sustainability* has become the dominant normative term for system-level performance that conforms to Leopold's idea of self-renewal. Newton and Freyfogle (2005) criticized use of the word *sustainability* and proposed use of *land health* for the function that Leopold sought to define. They argued that *sustainability* leaves open the question of what it is that is sustained. For instance, Callicott and Mumford (1997) believe *sustainable development* is a problematic phrase. Also, because the human-dominated world system is already unsustainable, some argue that the human-environment relation needs to be improved before it can be sustained.

Despite these objections, following Callicott and Mumford (1997), we use *ecological sustainability* as the label for Leopold's large-scale, system-level function, and we assert that this is the fourth major historical reference point for a conservation ethic. Although Newton and Freyfogle (2005) rejected *sustainability* as too open-ended, specifying *ecological sustainability* narrows the meaning while retaining useful flexibility. Ecological sustainability can be analyzed for any part or process of an ecosystem at any scale. Although one can analyze ecological sustainability at small scales, the most important analyses will be at large scales. Furthermore, what needs to be sustained is a dynamic process—literally, the cradle-to-cradle cycle of vigorous self-renewal of parts and processes. This self-renewal also contributes to the seemingly contradictory qualities that are essential at the system level (i.e., the qualities of staying the same and changing, whether at small or short-term scales or at large and long-term scales that involve adaptive and transformative change). The species that compose biotic communities and the functions these species carry out in ecosystems at any one time are transitory when viewed at longer temporal scales, but they are also the vessels that allow for longer-term change to maintain continuity of function.

A further corollary of this thinking is that ethical right and wrong are scale dependent—that the rightness or wrongness cannot be defined solely at small scales of space (patch scale) and time (disturbance intervals) (White & Jentsch 2005). The definitions of *right* and *wrong* have to be sought at the multipatch scale (how the collection of individual patches and actions add up, rather than the small-scale specifics of human choices) and at longer time scales (White 2006). Conservation aims may be contradictory at the patch scale. Leopold wrote, "It can be safely said that when it comes to actual work on the ground, the objects of conservation are never axiomatic or obvious but always complex and usually conflicting" (as quoted in Flader and Callicott [1991:83]). With humans included in the land, the issue is not whether farms replace natural areas in order to support human populations, but rather how many farms replace how many natural areas, how might farming be done to support local biological diversity and ecosystem services, how many farms must be turned into conservation lands through restoration, and how does one conserve human-free areas to support the species dependent on relatively large areas? In this sense, Leopold's work suggests that different conservation values, such as the poles of the parks-versus-people debate (Minteer & Miller 2011), while competitive and mutually exclusive at small scales, coexist as part of one consistent conservation ethic at large scales; that is, the human social heterogeneity of purpose must be a mirror of the environmental and ecosystem heterogeneity that is also required. It is obvious that some of each is needed, but there are real constraints involved in the sense that species have requirements in terms of the size, quality, and arrangement of habitats.

Given the scale of ownership and political decisions, another challenge Leopold articulated was the realization that nothing could be done about conservation "without creating a new kind of people" (Leopold, letter to Douglas Wade, 23 October 1944. Leopold Papers, 9/25/10-8 Box 1, Folder 3, 465. University of Wisconsin Digital Collections). That the problem was one of human ethics motivated the land ethic (Leopold as quoted in Flader and Callicott [1991:254]):

> "Our tools are better than we are, and grow better faster than we do. They suffice to crack the atom, to command the tides. But they do not suffice for the oldest task in human history: to live on a piece of land without spoiling it."

Leopold pointed the way toward a change of human thinking that would allow us to conceive of our species as part of a larger system.

A world that is sustainable for both biological diversity and people requires answers to the questions, What is the sustainable level of human effects on the land (these effects are determined by the size of the human

population times the per capita effects of human life styles)? And how should human use be arranged on the landscape? To apply a sustainable conservation ethic and to be a new kind of people requires that humans define the answers to these questions not philosophically but quantitatively. This will involve determining spatial scales and constraints in nature (determined by biological and ecological processes that control such attributes as viable population sizes, seasonal migration, patch dynamics, and other key functions) and science-informed design of heterogeneous landscapes made up of places that range from wilderness (areas with very low human population density) to urban areas (areas with city parks and other green spaces). At a large scale, this prescription fits the ethic of ecological sustainability, but at small scales we accept what Robinson (2011) called ethical pluralism, in that particular tracts will have "right" uses that represent different values. For example, both ecologically sustainable wilderness (e.g., for wolves and mountain lions) and areas for sustainably meeting the needs of humans (e.g., for food) are needed. In some cases, the 2 values are fulfilled on the same tract, as when a large wilderness area also protects the water supply for human populations. The preservation ethic and resource conservation ethic are often competitive at the scale of a single tract of land, but they can coexist at the larger scale of the sustainable conservation ethic. That scale derives from Leopold's land ethic, but it is made real by quantification of the spatial placement and amount of human- to nature-dominated lands.

To find quantitative solutions that will produce ecological sustainability for both biological diversity and people, systems thinking (Meadows 2008) is needed and must be applied from both the bottom up and top down. The bottom–up approach means activities of individuals and communities at a variety of small and regional scales must be informed by how these activities scale up to a larger system. The top–down approach means starting with the limits of planet Earth, constraints of size and arrangement of habitat needed to support biological diversity, and determination of the true, sustainable carrying capacity for humans that allows a rich biological world to persist. Humans are capable of this, but science and education are critical. Individuals must learn to think at a systems level—to see the large-scale forest *and* the trees—and to accept controls that are based on analysis at large scales.

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