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Is Aldo Leopold's "Land Community" an Individual?

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13.1 Introduction

In his 1949 essay "The Land Ethic," Aldo Leopold—a twentieth-century forester, hunter, game/wildlife manager, and professor who has been very influential in environmental ethics and conservation biology—famously stated:

> 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 1949: 224–225; emphasis added)

This passage, and Leopold's land ethic more generally, implies that the biotic community is a locus of direct moral obligation, or even, some argue, an entity with intrinsic value (Callicott 1987, 2013). But what did Leopold mean by "biotic community?" Interestingly, Leopold considered the biotic community to include not only biotic components but also abiotic components: "soils, waters, plants, and animals, or collectively: the land" (Leopold 1949: 204).[1] So, "biotic community" is a somewhat misleading term; *land community*, another term that Leopold employs in "The Land Ethic," seems more appropriate (and thus I will use it for the remainder of this chapter).[2]

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[1] Indeed, in an earlier work, Leopold clarifies that he uses the term "biota" to include "not only plants and animals, but soils and waters as well" (1939: 727).

[2] Leopold's reference to "the" biotic community or "the" land community might lead one to think that there was only one such community, consisting of the entire earth. However, I do not think that was Leopold's meaning; I think it was just a poetic manner of speaking, one which I echo in this essay. Evidence for my claim can be found in "The Land Ethic" itself, where Leopold refers to marshes, bogs, dunes, and deserts as examples of "entire" biotic communities that are seen as lacking economic value (1949: 212).

Some authors have raised concerns about making the land community the ethical locus of the land ethic, regardless of what we call it. Kristin Shrader-Frechette sums up these worries well:

> Nor is it obvious how to define the system at issue. The ecological problem of defining the system at issue is analogous to the economic problem of defining a theory of social choice and choosing some "whole" that aggregates or represents numerous individual choices. Defining an ecological "whole" to which Callicott and Leopold can refer is especially problematic, both because the biologists (e.g., Clements, Elton, Forbes) cited by Callicott to explicate his [Leopold's] views are no longer accepted by most contemporary scientists as having correct views about ecological communities, and because the contemporary variant of Clements's position, the GAIA hypothesis, has been rejected by most ecologists as an unproved metaphor or mere speculation. At best it is an hypothesis. They admit the scientific facts of interconnectedness and coevolution on a small scale, but they point out that particular ecosystems and communities do not *persist* through time. Hence, there is no clear referent for the alleged "dynamic stability" of an ecosystem or community. (Shrader-Frechette 1996: 60)

From this passage, I glean the following concerns:

1. It is not clear how to define a land community, which Shrader-Frechette seems to think of in terms of an ecological community or an ecosystem.
2. The concept of "land community," at least as explicated by J. Baird Callicott in his earlier work,[3] is outdated and rejected by contemporary science, and the closest contemporary view has also been rejected by most contemporary scientists.
3. Particular land communities are not things that persist through long periods of time.
4. Thus, there is no clear referent for the land ethic and the stability that it seeks to promote.

Indeed, even Callicott, who has been called the "leading philosophical exponent of Aldo Leopold's land ethic" (Norton 2002: 127), thinks that particular land communities cannot be clearly identified, adding to Shrader-Frechette's list of concerns the following:

5. The boundaries of communities and ecosystems are not fixed by nature, but rather determined by the scientific questions that ecologists pose (see, e.g., Callicott 2013; Eliot 2013).

[3] See Callicott (2013) for a revised and updated account.

Some of these concerns can be understood as concerns that the land community is not an *individual.* Yet Leopold did seem to think that the land community was an individual, even if he didn't use the word "individual" specifically; for example, in some essays (e.g., Leopold 1923/1991, 1934/1991, 1944/1991) he explored the idea that the community is an organism. In "The Land Ethic" (1949), he seemed to de-emphasize (although not eliminate) his characterization of communities as organisms, but even there he still maintained that the members of communities are interdependent; referred to soils, waters, plants, and animals *collectively*; and spoke of the organization (or, in degraded situations, the *dis*organization) of land. Relatedly, in an unpublished essay written in 1944, Leopold "sketch[ed] the concept of land-as-a-whole" (Leopold 1944/1991: 310), described land-health (or land-illness) as an attribute of the community as a whole, and suggested that "the components of land have a collective as well as separate welfare" (Leopold 1944/1991: 316). These all seem to be ways of getting at what we would today term "individuality." Can these views of Leopold's be defended, or is the land ethic undercut because the concept of "land community" cannot be characterized, as Shrader-Frechette suggests?

In what follows, I will examine the concept of a "land community" focusing on the following two questions in particular:

1. Is the concept of "land community"—which, as we shall see, blends ideas that would more typically belong to either community ecology or ecosystem ecology—hopelessly misguided or outdated? Does any past or contemporary work support such an entity?
2. If the concept of a "land community" can be defended, is it coherent enough to be a locus of direct moral obligation or an entity with intrinsic value?[4] In other words, is it an *individual*?[5]

My ultimate goal is to see if there is a *defensible* concept of "land community" as an individual that is close to Leopold's stated views; I will argue that there is. This will not establish that the land community *is* a locus of direct moral obligation or an entity with intrinsic value—it will only establish that it is a *candidate* for being a morally considerable entity (i.e., I seek to establish only a necessary condition, not

[4] Here I set aside the question of whether there is such a thing as intrinsic value (see, e.g., O'Neill [1992], McShane [2007], and Zimmerman [2015] for general discussion). The question I am asking is rather, assuming that intrinsic value exists, does a land community have the necessary characteristics for intrinsic value? Or, if there is no such thing as intrinsic value, does a land community have the necessary characteristics for moral consideration?

[5] See Odenbaugh (2007, 2010) and Eliot (2011, 2013) for discussion of ecological communities and ecosystems as individuals. The view I defend here has some similarities to both accounts; see also Levins and Lewontin (1980, 1985). Lean (2015) argues against individuality for communities but defends a related concept, which he calls an "indexical community." However, these accounts do not address the question of whether communities and ecosystems can or should be combined and whether the combination would be an individual.

a sufficient one). But rather than solely looking to Clements, Elton, and others to understand Leopold—influences are important, but influence is never complete—let us begin with Leopold himself.

13.2 Land Communities as Blended Community–Ecosystems

Land, Leopold tells us, "is not merely soil; it is a fountain of energy flowing through a circuit of soils, plants, and animals. Food chains are the living channels which conduct energy upward; death and decay return it to the soil" (1949: 216). So, Leopold's concept of a land community not only included abiotic components, but was also at least partially characterized in terms of *matter and energy flow*. This was represented by a biotic pyramid (visually depicted in a diagram in his 1939 essay, "A Biotic View of Land") that he described as follows:

> Plants absorb energy from the sun. This energy flows through a circuit called the biota, which may be represented by a pyramid consisting of layers. The bottom layer is the soil. A plant layer rests on the soil, an insect layer on the plants, a bird and rodent layer on the insects, and so on up through various animal groups to the apex layer, which consists of the larger carnivores. (Leopold 1949: 215)

However, Leopold also emphasized that a land community is composed of *interdependent parts*. Drawing on the work of community ecologist Charles Elton (see Newton [2006] for discussion), Leopold described a complex tangle of lines of dependency for food and other "services" such as shade (see Figure 13.1). Food chains are sometimes thought of as just an energy conduit, but for Leopold they also represented trophic (feeding) relationships and other types of relationships between members of different species. Leopold thus stressed the interactions between organisms and the way in which changes in some species affect other species, and he did so throughout "The Land Ethic" and elsewhere. For example, he analyzed the consequences of deer overbrowsing in the absence of predators (Leopold 1943).

Leopold's land community concept thus emphasizes matter and energy flow through organisms and abiotic components and also emphasizes the interdependence among organisms and abiotic components. This is notable because some authors (e.g., Callicott and Mumford 1997; Odenbaugh 2007) have differentiated between two types of entities and two types of approaches in ecology: ecological communities and a community ecology approach on the one hand, ecosystems and an ecosystem ecology approach on the other. It is the latter approach, the ecosystem approach, that includes abiotic components and invokes matter and energy flow, de-emphasizing (or even disregarding) organisms and populations. This

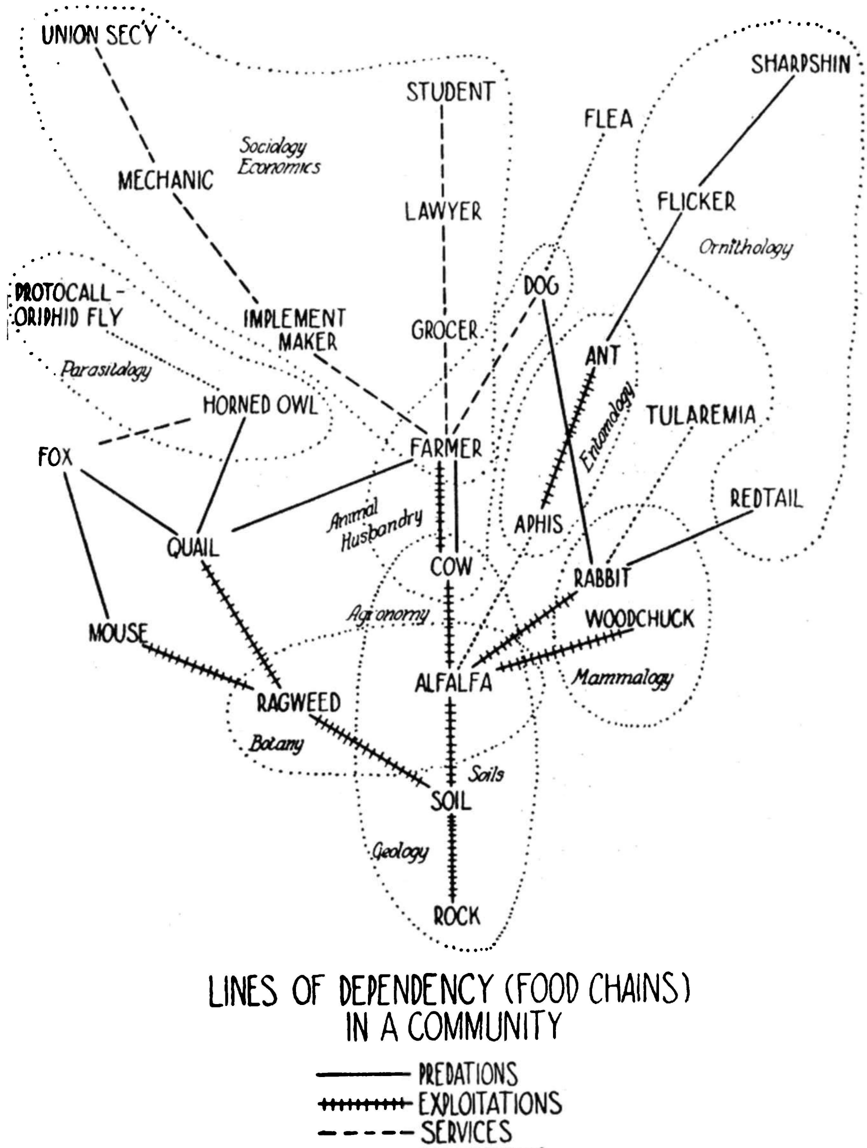

FIGURE 13.1 *How Leopold visualized the tangled "lines of dependency" in a land community.*

Reprinted from Leopold, Aldo.1942. The role of wildlife in a liberal education. *Transactions of the Seventh North American Wildlife Conference* April 8–10, 1942: 485–489. Copyright 1942 by the Wildlife Management Institute. Reprinted with permission.

approach contrasts with the former approach, the community ecology approach, which emphasizes interactions between organisms.[6]

Therefore, Leopold's "land community" concept combines aspects of the concept of "ecological community" as it is typically conceived with aspects of the concept of "ecosystem" as it is typically conceived.[7] But is this combination tenable? Does it complicate the case for the land community as an individual? In order to answer these questions, we need to have a better understanding of how Leopold's land community concept is situated in the history of these terms. Was he bucking a cogent scientific consensus (was he just a lone wolf?), or is his stance understandable given the historical flow of ideas? I seek to address these questions because there seems little point in spending time discussing whether an idiosyncratic scientific concept satisfies a philosophical conception of individuality, especially if the concept turned out to be misguided or outdated (concern (2) of the list in Section 13.1) with respect to our contemporary understandings. However, as we shall see, it is not idiosyncratic, misguided, or even outdated to blend the concept of ecological community with the concept of ecosystem. Moreover, the examination of others who have had similar ideas to Leopold's will help both to flesh out the land community concept and to highlight potential challenges.

13.3 Early Community and Ecosystem Concepts

What follows is a potted timeline of central figures in the development of ecological community and ecosystem concepts, with an eye toward situating the concept of a Leopoldean land community.

Frederic Clements (1916) characterized multispecies groupings as *communities*.[8] He is particularly (and somewhat notoriously) known for thinking of communities as organisms, but Eliot (2011) has given good reason to think that Clements's commitment to communities as organisms has been overstated. Regardless, as mentioned earlier, there are traces of thinking of communities as organisms in Leopold (Callicott 1987).

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[6] In what follows, I will use the term "land community" when I mean to refer to Leopold's conception or my elaboration of it; when I use just "community" or "ecological community" I am referring instead to its meaning in community ecology.

[7] To be clear (and as will be discussed further later), not *all* ecologists conceive of "ecosystem" and "community" in these strictly divergent ways; some include population interactions in their study of ecosystems and some include abiotic components in their study of communities. Indeed, I hope to debunk the notion that these are always disparate approaches.

[8] Lynn Nyhart (2009) traces the idea of a biological community even earlier, to Karl August Möbius in the late nineteenth century, who characterized these living communities (*Lebensgemeinschaft*) in terms of the dependence of their members on one another and on their physical conditions of existence.

Charles Elton (1927) believed that plants and animals are not mere assemblages of species living together, but rather that they form closely knit communities[9] with interdependent members comparable to our own human communities; he also believed that these other plant/animal communities include humans. He saw relations between animals as largely food relations, giving rise to food chains, the food-cycle, and the "pyramid of numbers" (Elton 1927). Leopold met Elton in 1931 (Meine 2010) and was very influenced by him (Newton 2006), not only in terms of Elton's concept of community but also by his ideas concerning food chains and the pyramid of numbers (what Leopold called the "land pyramid"). The parallels between the two sets of ideas are obvious and striking.

Arthur Tansley (1935) is generally credited with the ecosystem concept. He argued that plants and animals are too different to be considered part of the same community and so rejected the community concept altogether. He did believe that biomes (*sensu* Clements), "the whole webs of life adjusted to particular complexes of environmental factors," are real "wholes," often integrated wholes—but he did not believe that they are organisms. Rather, he maintained that biomes, together with all of the physical factors involved, are *systems* (ecosystems); this, he suggested, is the more fundamental conception. According to Betty Jean Craige (2002), Leopold's concept of "land" as a system with biotic and abiotic components predated Tansley in Leopold's 1933 essay, "The Conservation Ethic" (1933/1991); according to Callicott (2013), Leopold anticipated many of Tansley's ideas of an ecosystem in his 1939 essay, "Biotic View of Land." In other words, it appears that Leopold included abiotic components and energy flow independently of (and perhaps prior to) Tansley. Thus, Leopold may be less in a Tansleyan tradition and more in an Eltonian one. Callicott (2013) speculates that Leopold may have influenced Lindeman (perhaps through Evelyn Hutchinson) although Lindeman doesn't cite Leopold.

Raymond Lindeman (1942) was a key developer of the ecosystem concept—but for him, trophic or "energy-availing" relationships occur *within the community.* He thought that the discrimination between living organisms as parts of the "biotic community" and dead organisms and inorganic nutritives as parts of the "environment" seemed "arbitrary and unnatural."

Eugene Odum (1971), like Lindeman, included a community of interacting organisms leading to a flow of energy in his ecosystem concept:[10]

> the community cannot exist without the cycling of materials and the flow of energy in the ecosystem. An ecosystem is any unit that includes all of the organisms (i.e., the "community") in a given area interacting with the

[9] Odenbaugh (2007, 2010) attributes to Elton an ecosystem concept rather than a community concept, but I don't see evidence for this (see also Hagen 1992).

[10] Odenbaugh (2007) says that Odum characterized ecosystems purely in terms of their energetics. But there still seems to be a strong community component to Odum's concept.

> physical environment so that a flow of energy leads to clearly defined trophic structure, biotic diversity, and material cycles (i.e., exchange of materials between living and nonliving parts) within the system. (1971: 8)

Perhaps not by accident; he was influenced by Leopold (Craige 2002) and cited Leopold explicitly.

So, Odum's and Lindeman's *ecosystem* ideas, by incorporating *community* elements, are actually very much in line with the idea of a Leopoldean land community and could thus potentially be used to flesh out Leopold's concept. Moreover, the division between community ecology and ecosystem ecology is not as clean as, for example, Callicott and Mumford (1997) would have us think.[11] The history of the two is entangled (Hagen 1992), and using a concept drawing from both areas of ecology is not a rogue eccentricity of Leopold's.

But a lot has changed since 1971, flagged by Donald Worster's (1990) critique of Odum's (and Clements's) notion that nature moves toward order and harmony:

> Ecology is not the same as it was. A rather drastic change has been going on in this science of late—a radical shifting away from the thinking of Eugene Odum's generation, away from its assumptions of order and predictability, a shifting toward what we might call a new *ecology of chaos*. (Worster 1990: 162)[12]

And even if Worster's critique is off the mark, we might still reasonably wonder whether there are *contemporary* candidates for a land community that combine community and ecosystem elements, with or without assumptions of stability.

13.4 Contemporary Community–Ecosystem Concepts

The short answer is "yes": O'Neill (2001), Chapin et al. (2011), Schultze, Beck, and Müller-Hohenstein (2005), and Hastings and Gross (2012) all combine ecological community and ecosystem elements (again, interactions between organisms and matter/energy flow, respectively) in describing the entities that they study, as I describe in what follows.[13]

O'Neill (2001) argues that we must recognize the simple empirical fact that ecosystems are collections of interacting populations, with component populations shaped by natural selection (O'Neill 2001: 3278). He suggests that the resulting biotic potential determines ecosystem dynamics just as much as chemical and

[11] A caveat: the *practice* of community ecology and ecosystem ecology may be more divergent than ecologists' stated concepts of community and ecosystem are. My focus for now is on the concepts.

[12] I don't fully accept Worster's characterization of past or contemporary ecology, but I will grant it for the purposes of this chapter.

[13] Biodiversity and ecosystem functioning (BEF) research also seems to embrace a blended community–ecosystem approach; see discussion and references in Dussault and Bouchard (2017).

physical constraints. He points out that while various problems can be solved by viewing an ecosystem purely in terms of functional groups that recover to the same rate processes, feedbacks, and complex organization (e.g., accounting for situations where species are moving in and out of an area over time), such an approach creates its own problems (for example, a matter/energy flow focus overlooks ecotones, i.e., zones where one vegetation type suddenly changes into another, and also minimizes the role of natural selection). In other words, we *need* to study both community and ecosystem elements. He further maintains that the critical property of an ecosystem is not stability but rather the ability to change state in response to a continuous spectrum of change and variability (sustainability).

Chapin et al. (2011) maintain the view that ecosystem ecology addresses the *interactions* between organisms and their environment as an integrated system—that it addresses the interactions that link biotic systems, of which people are an integral part, with the physical systems on which they depend. On their view, an ecosystem consists of all the organisms and the abiotic pools with which they interact; ecosystem processes are the transfers of energy and materials from one pool to another. They state that they are taking a "nonequilibrium perspective," recognizing that most ecosystems exhibit unbalanced inputs and losses, their dynamics are influenced by varying external and internal factors, they exhibit no single stable equilibrium, disturbance is a natural component of their dynamics, and human activities exert a pervasive influence. So, although the definition of ecosystem that Chapin et al. provide is a bit unfocused, they do allow for interaction together with a nonequilibrium perspective and also usefully distinguish the *processes* of an ecosystem from what an ecosystem *is*.

Schulze et al. (2005) characterize ecosystems as *networks of interrelations* between organisms and their environment in a defined space. They assert that the limits of an ecosystem must extend so far that the essential parts of material turnover per ground area (e.g., carbon assimilation, nitrogen mineralization, formation of ground water, etc.) are taken into account quantitatively. This suggests that there can be mistaken ways of characterizing the boundaries of an ecosystem because to leave out areas of significant material turnover would cause a misdescription of the characteristics and limits of the partial system. More on this point later.

Hastings and Gross (2012) characterize an *ecosystem* as a system composed of both the organisms (animal, plant, microbe) and the abiotic environment and all interactions among and between these components. On the other hand, they characterize an ecosystem *model* as a model designed to capture the pools and fluxes of mass (and sometimes energy) in an ecosystem. This nicely separates what an ecosystem *is* from the particular aspects of an ecosystem (flow of materials and energy) that an ecologist might study.

In summary, here are some important and useful insights that can be drawn from these contemporary ecologists who combine community and ecosystem approaches. First, both the "matter/energy flow" alone approach creates problems as does the "population interaction" alone approach (O'Neill 2001). Second, sustainability, rather than stability, may be the relevant property (O'Neill 2001), so that the worries that Worster raises become moot; Chapin et al. (2011) also explicitly advocate for a nonequilibrium approach. Third, what an ecosystem *is* may be different from its *processes* (Chapin et al. 2011) and its *models* (Hastings and Gross 2012). Fourth, some purported boundaries may exclude relevant processes and thus be inappropriate (Schulze et al. 2005). Fifth, these ecologists collectively challenge the picture of community ecology and ecosystem ecology as distinct approaches.

13.5 Potential Problems with a Combined Community–Ecosystem Concept

But there are some potential problems with a combined community–ecosystem approach, flagged even by those who endorse such an approach. Post et al. (2007) maintain that boundaries are set by discontinuities or steep gradients in the flux and flow of material and energy and/or by discontinuities or steep gradients in interactions between populations of different species. However, they point out that whereas some systems are *well-bounded* (which is not to say "closed"), others are *open* (Post et al. 2007). In well-bounded systems (e.g., lakes, islands) these two criteria coincide—and coincide with physical boundaries as well—making delineating ecosystem boundaries relatively straightforward. In such systems, "interactions among organisms are typically stronger and cycling of material and energy is typically tighter within than across the physical boundaries of these ecosystems" (Post et al. 2007: 115). On the other hand, in open systems (e.g., most terrestrial habitats, estuaries, and streams), the two approaches do not coincide, as when resources come from areas where species are not interacting (e.g., upstream). The problem, then, is how to understand the boundaries of open systems. As indicated in Chapter 1 of this volume, one important aspect of epistemic individuation is demarcating an individual from other things and environments. In biology, abiotic elements are often considered "the environment," but with the land community, the abiotic components are part of the entity, so the question is even more challenging than usual.

Post et al. (2007) describe various challenging scenarios for understanding the boundaries of open systems. Suppose, for example, large "inputs" are coming from the "outside" at short temporal scales, as is the case when, for example, highly mobile organisms such as geese and migrating fish move large amounts of nutrients around the landscape, with lakes, wetlands, and streams receiving these nutrients.[14] Then we should recognize that the system is larger than we had initially thought.

[14] O'Neill et al. (1986) imagine a similar situation, but where the community is more extensive than the matter/energy flows.

Alternatively, suppose that "internal" cycling of matter/energy is stronger than "external" inputs, as is the case when, for example, a watershed is visited by few mobile organisms or when it has a very high productivity. Then we should consider "internal" cycling to dictate the boundary.

Post et al. conclude: "In open ecosystems where there is little or no congruence among physical and functional boundaries . . . each different question may dictate very different definitions of ecosystem boundaries" (2007: 122). Although this is an interesting position worth considering, it doesn't seem to me that Post and colleagues have made the case for it. That is, they don't seem to have described situations where different questions would indicate different boundaries; on the contrary, as I describe in the preceding paragraph, they seem to have offered solutions to such cases where one might *think* that such a problem arose. Perhaps they mean simply to suggest, as they suggest at various points in the paper, that different temporal scales might affect whether we consider a system to be open or well-bounded, with all systems being open given a long enough time scale. While this is an important consideration, and while relevant time scale needs to be factored into questions concerning boundaries, it does not seem to follow that different questions dictate different system boundaries. To put the point another way, it seems that they have offered a scheme for understanding how, *given* a time scale, system boundaries ought to be characterized.

But even taking Post et al.'s stated conclusion at face value, a question remains: are open systems where different questions dictate different ecosystem definitions and different ecosystem boundaries coherent enough to be entities that we owe direct obligations to or to be entities that have intrinsic value? (This is concern (5) of the list in Section 13.1.) This question has an ontological component and an ethical component, which I will discuss in turn.

In order address the ontological component—namely, the status of interest-relative entities—it will be instructive to consider similar views. Callicott likewise holds that ecosystems "are in effect defined, both spatially and temporally, by the ecological question posed" (2013: 3), yet he maintains that they are "real, existing entities" (2013: 94)—at least in part. That is, he maintains that "when we come to isolate them, to bound them, for purposes of ecological study, we partly create them" similar to the way, he says, that "electrons emerge fully into existence when quantum physicists measure them" (2013: 41). Setting aside questions about his interpretation of physics and the strangeness of this analogy, it is difficult to understand what Callicott means. Does he mean that, in the absence of investigators, there really are no ecosystems or communities, at least not in a full sense? Perhaps not, but then it seems as though one cannot continue to defend ecosystems and communities as individuals or as "real, existing entities."

Eliot (2013) offers a more sophisticated version of the argument that our interests partially determine whether something is a community. According to Eliot, boundaries are determined by the set of causal relations relevant to some interest; furthermore, a community is "a real object, in so far as its component populations are connected by a particular kind of causal connection" (2013: 8).[15] Odenbaugh (2010) similarly claims that different causal relations may pick out different ecosystems, although he does not tie this claim to our human interests. However, we don't seem to have such loose causal relation requirements for other putative individuals, such as organisms.[16] For example, in the human body, "circulates blood" does not fully coincide in physical space with "circulates oxygen," yet we think of those causal relations as picking out the same individual (the same organism), not two different individuals. This is presumably because the system that circulates blood and the system that circulates oxygen are tightly interconnected with other systems from which they are not fully separable. So we should at least consider whether the same is true for putative communities/ecosystems.

Turning to the ethical component of the question, if (contra to what I argued earlier) Callicott's understanding of the ontology is correct—if ecosystems are real yet interest-relative—then it seems like the moral considerability of an ecosystem is dependent on an ecologist studying it. If the ecosystem loses moral considerability (indeed, ceases to fully *be* an ecosystem) when it is not being studied, then that is a weak notion of moral considerability indeed. So, Callicott's understanding of "ecosystem" is insufficient for his (and our) ethical purposes, making a continued search for a possible workable alternative desirable.

On the other hand, Eliot's and Odenbaugh's alternative approaches toward characterizing communities/ecosystems, which are ultimately grounded in causal relations, also run into problems concerning moral considerability. Here, the problem arises because of the multiplicity of possible boundaries. To be clear, the worry here is *not* that boundaries may be a bit fuzzy, since surely many real, existing entities have fuzzy boundaries; for example, to be an organism is to constantly lose and gain cells, yet human organisms are surely "real, existing entities." (We thus ought not be surprised when land communities turn out to have fuzzy boundaries as well, as they do.) Rather, the problem is one (as highlighted by Russow 1981 for the case of species) of how many entities there are. Considering a given geographical area, do we have one land community, two land communities, or more? Perhaps a lack of a definitive answer to that question is not problematic on its own, but what if different ways of drawing boundaries for a given geographical area cross-cut each other, so that, in some cases, we have one land community as a subset of another, whereas with others, one land community overlaps with another? It makes it unclear as to what we have moral obligations to, especially if we have to make choices between different purported land communities. Can we eliminate or add moral obligations simply by asking different sorts of

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[15] See also McShane (2004) on this point.

[16] This is not to deny that characterizing organisms is without challenges (see, e.g., Dupré [2010] and [Clarke 2011] for some of the complications), just to suggest that organisms are often taken to be prototypical individuals, thus making it reasonable to argue using them as analogy.

scientific questions? Are all possible ways of drawing boundaries equally legitimate? It would seem that there are an infinite number of possible ways of drawing boundaries for a given geographic area;[17] do our moral obligations shift with each possible drawing? That seems untenable and unworkable.

Moreover, would it be wise to try to treat purported land communities well while failing to consider some of the population interactions or energy flows relevant to their sustainability? It seems as though one would run into practical problems if one did so. To use the analogy of the human body again, it would be akin to trying to benefit one's arm muscles without consideration of one's heart and lungs; eventually, the arms will fail when the body fails from ill health. So again, we ought to consider more closely the question of whether there are ways that boundaries of open systems can be delineated that are more systematic and defensible.[18]

13.6 Response to Problems

Indeed, there seem to be (at least) three ways of handling open systems, systems where the spatial area of the densely interacting populations is larger than that of the dense matter/energy flow—or vice versa:

One possibility is that *the land community exists within the* larger *of the two areas.* In other words, we always "go big"; if the spatial area of the densely interacting populations is larger than that of the dense matter/energy flow, the land community consists of the area covered by the densely interacting populations, whereas if the area of the dense matter/energy flow is larger than that of the densely interacting populations, the land community consists of the area covered by the dense matter/energy flow. However, a possible problem with this approach is that we would lose the concept of the ecosystem as a focal level, going beyond locales that lend themselves to concrete study in the field—perhaps to biomes (Currie 2011). This doesn't strike me as a devastating objection—we could just acknowledge that what we study is always a subset of the entity itself—but the objection is worth taking seriously, especially if there are better alternatives.

A second possibility is that *the land community exists within the* smaller *of the two areas.* In other words, we always "go small"; if the spatial area of the densely interacting populations is smaller than that of the dense matter/energy flow, the land community consists of the area covered by the densely interacting populations, whereas if the area of the dense matter/energy flow is smaller than

[17] Perhaps Post et al., Callicott, Eliot, and/or Odenbaugh have some way of limiting the questions asked and the boundaries drawn, but I am not sure what those would be, given what they have said.

[18] To my knowledge, Leopold did not address the question of how to determine the boundaries of land communities. Thus, my hope here is to develop an account that is Leopoldean in spirit, with land communities as individuals, emphasizing interdependencies between organisms.

that of the densely interacting populations, the land community consists of the area covered by the dense matter/energy flow. The problem with this proposal is that it might exclude *causally relevant factors* for the future states of populations and abiotic components and thus give a misleading picture that would be subject to error, making this proposal completely untenable, in my view. Note that this problem is similar to one faced by drawing multiple boundaries, discussed at the end of the last section.

A third possibility is that *the land community includes interactions or matter/energy flows from the larger area if and only if those interactions or matter/energy flows are stronger or larger than those of the smaller area.* This, in essence, seems to be how Post et al. handled cases such as those where mobile organisms brought large amounts of nutrients into lakes, wetlands, and streams. This is the solution that I am inclined to accept; it promises to preserve land communities as objects of study while taking into account most of the important causal processes that affect the land community's future ("most of" because, since no biological system is closed, there is always the potential for a rare but strong causal influence from the outside).

Here it might be objected that we do not even have sufficient congruence to constitute ecological communities and ecosystems, much less congruence between ecological communities and ecosystems. Kim Sterelny, for example, raises concerns about the lack of congruence within purported ecological communities, using Black Mountain (a bush reserve near Australian National University) as an example:

> "Black Mountain" names a quite heterogeneous region of about 10 square kilometers with gentle variation from patch to patch. As a consequence of these gradual changes in character, the different populations might not be correlated. A local brushtail possum population may overlap with a local ringtail possum population, a local boobook owl population, a greater glider population, and a number of eucalyptus populations. For on Black Mountain, there are no sharp changes that matter to all of these species, keeping local populations congruent with one another. (Sterelny 2006: 225)

However, this lack of congruence does not invalidate the third solution to the problem of boundaries. It is not necessary that all the populations of a community be located in the same place; what matters is that there is there is continuity of causal interaction across the populations, even if, for example, the local ringtail population is not interacting with the local boobook owl population. As long as the interactions among the listed populations are stronger than other, "external" interactions, they are all part of the community. This is analogous to the case of a continuous population (Millstein 2010), where the endpoints of a population spread over space do not interact with each other even though there is interaction among the organisms across the entire space, forming one population.

Moreover, a quick comparison to organisms shows that the parts of an individual need not be congruent; just as a heart muscle and a leg muscle are not congruent, the populations (the "parts") of a community need not be congruent.[19] The objection is puzzling.

Sterelny raises a further sort of worry about drawing boundaries for an interactionist account of ecological communities specifically:[20]

> the interaction patterns of different components of putative communities may well not coincide. Even if communities are networks of interacting populations, they are typically demographically open. Migrants move in and out of most habitat patches. As we saw in Section 2, such movements are likely to have stabilizing effects. We have two populations rather than one if organisms of the same type are related by metapopulation dynamics rather than competition. The echidnas in Black Mountain are part of a different population, and hence a different community from the echidnas on the O'Connor Ridge (about a kilometer to the north) if they are a source population for the O'Connor Ridge echidnas. They then buffer that group against population collapses rather than competing with them for scarce resources. Prima facie, though, there is not much reason to expect the dynamics of echidna populations to match those of larger and more mobile organisms, or those of smaller and less mobile ones. (Sterelny 2006: 217)

Again, however, I do not see that this is an insurmountable objection.[21] If we have correctly identified the echidnas as forming a metapopulation, then the interactions between those two populations are rare (see Millstein [2010] for a discussion of the metapopulation concept). So, even though these rare interactions may sometimes turn out to be significant (as in the case that Sterelny describes, where one population recolonizes a location where another population has gone extinct or nearly extinct), there is no difficulty in saying that the echidnas in Black Mountain are part of one community and the echidnas on the O'Connor Ridge are part of another. They still represent a situation where there are continuous interactions among Black Mountain populations and among O'Connor Ridge populations with discontinuities between—discontinuities do not imply that there are *no* interactions, only that they are fewer and weaker. And if it were to turn out, contra to supposition, that there were significant migrations and interactions between the echidnas on Black Mountain and the echidnas on the O'Connor Ridge, then we have misidentified the echidnas as a metapopulation; they would instead be a patchy population (see Millstein 2010), and we would then have a case for considering all of the populations (consisting of different species) of O'Connor Ridge and Black Mountain to be one community (since, again, it is not required, as

[19] Thanks to Gregory Mikkleson for this point.

[20] Sterelny is responding to Levins and Lewontin (1985).

[21] In fairness, Sterelny does admit that "It is hard to tell just how serious this problem is" (2006: 225).

discussed in my response to the first of Sterelny's objections, that every population interact with every other population or that they be in the same place).

I have focused on the objection that the populations within ecological communities lack sufficient congruence for us to identify their boundaries, but the same sort of responses can be made to those who might claim that the matter/energy flows of ecosystems lack congruence. Individuality does not require location in the same space; the University of California, Davis, is an individual even though part of it is in Davis, part is in Sacramento, and part is in Bodega Bay. So there can be, say, flow of nutrient *X* in one area and flow of nutrient *Y* in another, but those flows would be part of the same ecosystem so long as there is continuity of flow between them.

Recall, however, that the goal of this chapter is not to defend an ecological community concept or an ecosystem concept per se, but rather to defend a combined ecological community–ecosystem concept (i.e., a land community). And I have already described how to address lack of congruence between an ecological community and an ecosystem: the land community includes interactions or matter/energy flows from the larger area if and only if those interactions or matter/energy flows are stronger or larger than those of the smaller area.

13.7 Toward a Leopoldean Land Community Concept

Insights from Sections 13.2–13.6 lead me to propose:

> A *Leopoldean land community* consists of populations[22] of different species interacting with each other and with their abiotic environment; these *survival-relevant interactions* often produce a *flow of energy and materials* between biotic components and between biotic components and abiotic components (and vice versa).[23]

Let me elaborate on this proposal a bit more.

Survival-relevant interactions between the populations include competition for scarce resources, predator/prey, parasite/host, pollinator/pollinated, and provision of shade or shelter. Note that this list is reminiscent of Leopold's own typology of dependencies, as shown in Figure 13.1: predations, exploitations, services, and

[22] Too often (e.g., O'Neill 2001; Odenbaugh 2007; Post et al. 2007) communities are spoken of as being composed of species and species interactions, but this is loose language (i.e., I don't think any of these authors actually believe that the entire species need be present or interacting). A species may be composed of multiple populations, not all of which are part of the same community. This is true even if the populations form a metapopulation, that is, if they are weakly connected (Millstein 2010). Damuth's (1985) term "avatar," referring to the population of a species found in a particular community, would be appropriate here.

[23] These survival-relevant interactions give rise to the interdependencies that Leopold spoke of. I will provide a more complete account of Leopold's concept of "interdependency" in a future work.

parasitisms. *Relevant flows of materials and energy* include primary production (photosynthesis, chemosynthesis), secondary production, evapotranspiration, decomposition, and nutrient cycling. These are not meant to be controversial, or even original, parts of my proposal; they are simply the typical interactions and matter/energy flows identified by ecologists. Survival-relevant interactions between the populations can produce flows of materials and energy, but flows of material and energy can also produce or affect survival-relevant interactions between populations. *Food webs* are of particular importance to a combined community–ecosystem approach because they can represent species interactions within a community *and* energy flow through those species (Post et al. 2007); they are thus of particular importance to a land community.

Land community boundaries[24] for *well-bounded systems* are where discontinuities or steep gradients in the flow of material and energy coincide with discontinuities or steep gradients in species interactions. Land community boundaries for *open systems* are at a minimum delineated by the smaller of the two types of discontinuities or steep gradients, including the more extensive interactions or matter/energy flows *if and only if* those interactions or matter/energy flows are stronger or larger than those of the smaller area. This approach has the advantage of including all significant causally relevant factors for the future states of populations and abiotic components (interdependencies). It may mean that there are fewer land communities than one might have thought; however, I am not sure that this is a problem. Ecologists may reasonably choose to study subsets (including particular types of interactions or particular matter or energy flows) of these for various pragmatic reasons, but such choices do not affect the ontology of land communities.

Although here I have drawn on Post et al. (2007) in using discontinuities or steep gradients to identify boundaries, this approach is similar to Simon's (2002) account of "nearly complete decomposability," which I have used elsewhere in characterizing the concept of population (Millstein 2009, 2010). It is different from Simon's approach in focusing on the strength of interactions and flows—where "strength" can be understood as the size of the effect that changes in one population produce in another population or the size of the effect on abiotic components—rather than their rate. This difference should not be seen as a crucial one; *differences in the rate of interactions are likewise relevant for boundaries of land communities.*

This approach has the added benefit of addressing Eliot's (2011) concern that interactions alone do not offer a basis for differentiating particular communities (in context, he is criticizing Odenbaugh's interactionist account of communities) from the global community of all organisms if all or most organisms are connected by interactions. On the view defended here, weak, small, or infrequent interactions

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[24] Note that land community boundaries are fuzzy rather than sharp.

would not suffice to add an "(n + 1)th" population to a land community. Moreover, even if a strongly negative interacting population (say, a population of superpredators like the snakehead fish in the Potomac River System; see Odenkirk and Owens 2007) were added to a land community or a strongly positive interacting keystone population (say, wolves in Yellowstone; see Ripple and Beschta 2007) were eliminated from a land community, as long as other interacting populations persist, the land community persists. It might not persist in a healthy state (which is where conservationist concerns would enter in), but it persists; thus, the account I have proposed here is not subject to the "(n + 1)th" or "(n – 1)th" problems that Eliot (2011) describes.

The composition of species in a land community may change over time; moreover, the populations that it contains may evolve over time. The land community is the same entity if, and only if, there is continuity of interaction and matter/energy flow within the entity through time.[25] Thus, since their members may change, land communities may or may not be stable in the sense of "stasis" or "equilibrium." Sustainability (similar to what *Leopold* meant by stability or land health; see Newton 2006) may be a more pertinent trait or feature (O'Neill 2001). For example, Leopold (1944) traced four epochs within Southwestern Wisconsin,[26] but his concern was land health in the face of different practices, not change of species (although he was concerned that the latter often negatively affected the former, while acknowledging many cases in which it did not do so).

Land communities also have beginnings and endings in time. Although I lack the space to fully develop the ideas here, I would use a similar approach to the one I developed elsewhere for thinking about populations through time (Millstein 2015) for thinking about land communities through time. However, I suspect that one difference will be that whereas populations come into existence and go out of existence fairly frequently, that land communities do so only relatively rarely. There would have to be a complete loss of continuity (a complete absence of interaction and matter/energy flow) for a land community to go "extinct." On the other hand, given the current state of the environment and current societal practices, new land communities might most commonly be formed by human-caused splitting of an existing land community.

A land community so described would be an *individual* in the Ghiselin-Hull sense (see, e.g., Ghiselin 1974, 1997; Hull 1976, 1978)[27]; it would:

- Be a *particular* thing, not a class; it would be a *spatiotemporally restricted* entity (i.e., located in a particular place and time, even if not continuous in space).

[25] See Odenbaugh (2007) on this point with respect to the ecological community concept.

[26] Fur trade epoch, 1680–1832; Fire epoch, 1750–1850; Wheat epoch, 1832–1878; Dairy epoch, 1872–(his) present.

[27] See also Hamilton, Smith, and Haber (2009) and Millstein (2009).

- Not merely be an assemblage; it would be an *integrated*, cohesive entity because of the *causal interactions* among the parts, giving the parts (to some extent) a shared fate. (This is the most important criterion, in my view; recall Leopold's claim that the components of the land community have a collective as well as separate welfare.)
- Have *beginnings* and *endings* in time.
- Be *continuous* through time, allowing for change over time.

This characterization challenges the so-called Gleasonian picture of communities as mere coincidental assemblages of whatever organisms happen to be located in a particular place at a particular time. Some philosophers (e.g., Regan 1983) cast doubt on the idea that mere "collections" can have moral rights, so this is a salient point. While it is an empirical question as to whether there are causal interactions among populations of different species that affect their survival (and so, an empirical question as to whether there are land communities in the sense I have described) or whether they are mere assemblages, there is certainly plenty of evidence (more than I could reasonably capture here) that such causal interactions exist. Indeed, Eliot (2011) argues persuasively that Gleason (e.g., Gleason 1917) has been interpreted too radically, noting that "Every ecologist, including Gleason, recognizes interactions among organisms, including that some require others, to survive" (Eliot 2011: 102). Once one considers, for example, that trophic interactions (which affect both the eaten and the eater) are sufficient, it becomes virtually impossible to deny the existence of survival-relevant interactions. And recent work suggests that these and other interactions are important enough that order and timing of species immigration during community assembly can affect species composition and abundances (Fukami 2015). On other hand, if Gleason turns out to have been right that the compositions of species in an area change frequently, nothing I have argued for is challenged here since it is the causal interactions and matter/energy flows that are essential to the land community's continuity and individuality and not any particular composition of species (addressing concern (3) of the list in Section 13.1).

On this view, *individuality comes in degrees*, especially with respect to integration, thus eliminating the need for a separate term for "wholes" (see Odenbaugh 2007). Here I set aside the question of whether the land community is an organism or whether it is a unit of selection,[28] both of which bring additional complications. I also set aside questions that Sterelny (2006) raises over whether communities are

[28] That is, I am not considering whether the land community satisfies a criterion of *evolutionary* individuality, as do, e.g., Clarke (2011) and Ereshefsky and Pedroso (2013). Nothing I have said in this chapter presupposes that land communities are units of selection; for example, interdependence between organisms could evolve via co-evolution of populations. Note that there are still other concepts of individuality in the literature; however, my claims in this chapter should be understood only to apply to the concept of individuality characterized here.

"internally regulated" or the extent to which they have emergent properties; even Sterelny acknowledges:

> Of course local populations do not live completely independently of one another. Life at Black Mountain is diffusely interdependent; the organisms that live there are not autonomous islands of life. Plants often depend on animals for pollination and seed dispersal, on symbiotic partners for crucial nutrients, and on detrivores for nutrient cycling. Consumer guilds—herbivores and carnivores—are obviously dependent on other organisms. (Sterelny 2006: 216)

This interdependence, stressed by Leopold in "The Land Ethic" and elsewhere, is the essential piece needed to make the case for the individuality of land communities. Organismality, internal regulation, being a unit of selection, and/or emergent properties might make for a more "robust" individuality, but they are not necessary for it. That is, they are not necessary for differentiating an individual from an abstract type or a mere set or a mere assemblage. Moreover, the concept of individuality relied on here is sufficient to pick out an entity that can be distinguished from other entities of its type and which persists in time, allowing for it to be a candidate for direct moral obligation and intrinsic value.

13.8 Conclusion

There are, admittedly, further issues to be worked out. For example, does it matter whether the interactions that compose the land community are between populations, or are interactions between the populations' organisms sufficient? If it does matter, are interactions such as predator/prey interactions genuinely population-level rather than organism-level? Also, is there a *general* way to specify these interactions? Eliot (2011) suggests that Odenbaugh's (2007) specification that the interactions be "ecological" or "biotic" is vague. In Section 13.6, I specified that the interactions should be population-level survival interactions. Is that sufficient to address Eliot's concern about vagueness? Another sort of worry is whether I have left open the possibility of land communities at different scales; one might think, for example, that there could be local land communities, regional land communities, and the like. If my account cannot accommodate this possibility, is that a problem? Perhaps not; ecologists speak of meta-communities (Leibold et al. 2004); there might be meta–land communities or meta–meta–land-communities.

Nonetheless, I hope to have shown that there is some reason to think that a Leopoldean concept of a land community is consistent with some contemporary ecology, to have given a more precise characterization of it, and to have demonstrated that if any such entity exists in the world, it would be an individual. If this is correct, then a Leopoldean land community is at least a candidate for direct moral obligation and intrinsic value; the next step would be to show not only that it has the necessary characteristics for direct moral obligation and intrinsic value, but also that it has sufficient ones. I leave that next step for a future work.

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