Ecosystem Health

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On most understandings of what an ecosystem is, it is a kind of thing that can be literally, not just metaphorically, healthy or unhealthy. Health is best understood as a kind of well-being; a thing's health is a matter of retaining those structures and functions that are good for it. While it is true both that what's good for an ecosystem depends on how we define the system and that how we define the system depends on our interests, these facts do not force us to the conclusion that an ecosystem has no good of its own. Ecosystems and persons can have goods of their own in spite of the fact that the schemes we use to categorize them are matters that we decide upon.

INTRODUCTION

Talk of *ecosystem health* has experienced a dramatic rise in popularity over the last fifteen years or so to the point where the concept is now widely used in both popular and academic discussions of environmental problems. During that time, however, no consensus has developed about what the term *ecosystem health* is really supposed to mean. As a result, writers have continued to assign the term different meanings according to their purposes, producing an enormous number of widely varied and often incompatible definitions.[1] Moreover, of those who have considered the question directly, most have concluded that ecosystems aren't the kind of thing that can actually be healthy or unhealthy. Many of them claim that *health* is a concept that can only be applied to ecosystems metaphorically; others claim that it cannot be applied to ecosystems at all. Interestingly, none of the scientists or philosophers who have taken up the issue explicitly[2] have come to the conclusion that ecosystems can, literally, be

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[1] Compare, e.g., T. E. Kolb, M. R. Wagner, and W. W. Covington, "Concepts of Forest Health," *Journal of Forestry* 92, no. 7 (1994): 10–15; Paul A. Mistretta, "Managing for Forest Health," *Journal of Forestry* 100, no. 7 (2002): 24–27; David J. Rapport, "Ecosystem Health: Exploring the Territory," *Ecosystem Health* 1 (1995): 5–13; USDA Forest Service, *Healthy Forests for America's Future* (Washington, D.C.: USDA Forest Service, 1993); and USDA Forest Service, "General Information: Location and Setting for the Targhee National Forest," 13 May 1997 (cited 4 December 2002), available at http://www.fs.fed.us/r4/caribou/Targhee/general.htm.

[2] Although they do not consider the question directly, Laura Westra, James Karr, and Ellen Chu do use the term *ecosystem health* (which they take to be a necessary condition for ecosystem integrity) in its literal sense. See Laura Westra, *An Environmental Proposal for Ethics: The Principle of Integrity* (Lanham, Md.: Rowman and Littlefield, 1994), pp. 24–25; James R. Karr

healthy or unhealthy. In spite of this, however, one still finds the term widely used in its literal sense.[3]

In this paper, I argue that ecosystems can be literally healthy or unhealthy. My claim is that it makes just as much sense to call an ecosystem healthy as it does to call a person or a plant healthy. My arguments on behalf of this claim proceed in three main sections. First, I consider the reasons that have been given against literal claims of ecosystem health and suggest that they aren't very good reasons at all. Next, I present an account of health that makes room for ecosystems to count as bearers of health. Finally, I consider an objection to this account that stems from worries about ecosystems being "social constructions."

ECOSYSTEM HEALTH

The rationale that is usually given for rejecting literal attributions of health to ecosystems is the claim that the concept of health only literally applies to organisms. Thus, the story goes, because ecosystems are not organisms, not even "superorganisms," they are not the kind of thing that can be healthy or unhealthy. At best, health or unhealth can be metaphorically ascribed to ecosystems—on this view, our talk of a "healthy ecosystem" would be like our talk of a "healthy economy."[4] If this view were right, then the only question we would be left with is whether *health* is an apt metaphor for describing ecosystemic states. However, I do not think that matters of health ascription can be handled

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and Ellen W. Chu, *Restoring Life in Running Waters: Better Biological Monitoring* (Washington, D.C.: Island Press, 1999), pp. 16–19. See also Robert Costanza, "Toward an Operational Definition of Ecosystem Health," in *Ecosystem Health: New Goals for Environmental Management,* ed. Robert Costanza, Bryan G. Norton, and Benjamin D. Haskell (Washington D.C.: Island Press, 1992), pp. 239–56. I thank Peter Miller for bringing these passages to my attention.

[3] See, e.g., "Antibiotics Are Harming Streams," *Chemical Week,* 14 August 2002, p. 7; Gale A. Norton, Editorial, "A Better Plan for the Forests," *Washington Post,* 17 September 2002, p. A21; and Carol Kaesuk Yoon, "New Studies Reassess Importance of Biodiversity," *New York Times,* 2 September 1997, p. C4.

[4] Those who claim that ecosystems can only be healthy metaphorically include J. Baird Callicott, "The Value of Ecosystem Health," *Environmental Values* 4 (1995): 345–61; Peter Calow, "Can Ecosystems Be Healthy? Critical Consideration of Concepts," *Journal of Aquatic Ecosystem Health* 1 (1992): 1–5; Nancy Ross et al., "The Ecosystem Health Metaphor in Science and Policy," *The Canadian Geographer* 41 (1997): 114–27; Glenn W. Suter, II, "A Critique of Ecosystem Health Concepts and Indexes," *Environmental Toxicology and Chemistry* 13 (1993): 1533–39; and D. Wicklum and Ronald W. Davies, "Ecosystem Health and Integrity?" *Canadian Journal of Botany* 73 (1995): 997–1000. At one point, Suter suggests an even narrower scope for the literal meaning of *health,* claiming that "all uses of the term *health* refer to the root concept of human health" (p. 1534, emphasis omitted). Calow seems to assume this narrower alternative)as well (p. 1). Wicklum and Davies imply that all uses of *health* are best seen as analogies to mammalian health (p. 997). Others criticize even the metaphorical attribution of health to ecosystems. See, e.g., Dale Jamieson, "Ecosystem Health: Some Preventive Medicine," *Environmental Values* 4 (1995): 333–44.

as easily as proponents of this argument suppose. The claim that ecosystems are not organisms is widely accepted, and I do not intend to challenge it here. But, on the definition of *organism* used by those who make the above argument, it is not true that only organisms can be literally healthy.

While some general-purpose dictionaries define *organism* as simply "a living thing," ecologists and biologists, particularly those who wonder whether ecosystems are organisms, tend to have much more elaborate definitions. The Oxford *Dictionary of Biology* claims that to be an organism, something must be capable of reproduction, growth, and maintenance. Other criteria for organismhood put forward by those in the ecosystem health debate include centralized control, a high level of organization, a homeostatic nature, strong internal feedback, goal-directed activity, consistent structure among tokens of the same type, regular development, tight integration, clearly defined boundaries, and distinct identity.[5] Regardless of whether these are sensible necessary conditions for being an organism, most of them do not seem to be required for ascriptions of health. Consider, for example, reproductive capacity: surely mules and hybrid tomatoes can be healthy or unhealthy, even though they cannot reproduce. Slime molds and people with split brains can also be so, even though control of their behavior is not centralized. Organisms (or, should we say, proto-organisms?) with high degrees of phenotypic plasticity may not exhibit consistent structure or regular development; yet we feel comfortable calling them unhealthy when they, e.g., catch some disease.[6] While we may worry that organisms (proto-organisms?) with permeable or otherwise unclear boundaries have identities that aren't exactly distinct (conjoined twins are one example that comes to mind), we nonetheless can tell when they are ailing.[7]

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[5] Elizabeth Martin and Robert S. Hine, eds., *A Dictionary of Biology,* 4th ed. (New York: Oxford University Press, 2000); Callicott, "The Value of Ecosystem Health"; Peter Calow, "Ecosystem Health: A Critical Analysis of Concepts," in *Evaluating and Monitoring the Health of Large-Scale Ecosystems,* ed. David J. Rapport, Connie L. Gaudet, and Peter Calow (New York: Springer-Verlag, 1995), pp. 33–41; John R. Kelly and Mark A. Harwell, "Indicators of Ecosystem Response and Recovery," in *Ecotoxicology: Problems and Approaches,* ed. Simon A. Levin et al. (New York: Springer-Verlag, 1989), pp. 9–35; David J. Rapport, "Ecosystem Health: More Than a Metaphor?" *Environmental Values* 4 (1995): 287–309; David J. Rapport, "Defining Ecosystem Health" in *Ecosystem Health,* ed. David Rapport et al. (Malden, Mass.: Blackwell Science, 1998), pp. 18–33; Ross et al., "The Ecosystem Health Metaphor in Science and Policy"; Suter, "A Critique of Ecosystem Health Concepts and Indexes." Many of these requirements are quite vague, but none of the authors who insist on their importance makes an effort to explain them any further.

[6] An organism is phenotypically plastic if it is such that the same genotype can produce varying phenotypes under different environmental conditions. That is to say, the more phenotypically plastic an organism is, the more the environment will matter in determining its phenotypes.

[7] Also sometimes mentioned as a criterion of organismhood is being the subject of genetic selection and evolution. However, it is not clear that anything that we count as an organism meets this requirement. On the face of it anyway, it is genes or traits, not individual organisms that are selected for/against by natural selection. Likewise, it isn't individual organisms that evolve, but rather species or gene lines.

In general, I think, the discussion about the nature of organisms, and whether ecosystems count as organisms, has been a red herring in the debate about ecosystem health. It may be that our preferred definition of *organism* will also end up being our preferred set of requirements for being a bearer of health, but we shouldn't start off by assuming that this set must be the case.[8] Rather than worry about the features of organisms, we should directly consider what characteristics a thing must have before we can call it healthy or unhealthy.

AN ACCOUNT OF HEALTH

When we say that something is healthy, we mean that it is thriving or flourishing. When it is in a state of perfect health, all of its essential parts are in good working order, and its vital processes are running smoothly or capable of running smoothly when called upon. Furthermore, when something is healthy, it is, in this regard, better off than it would be if it were unhealthy.[9] This description gives us three requirements for being a bearer of health: having (1) structure, (2) parts with functions, and (3) the ability to be better/worse off. Let us consider in further detail what each of these involves.

Structure

Giving an account of what it is to have a structure is the easier of our two tasks, for there is widespread agreement on this matter. To have a structure is just to be organized in a certain way, to have a certain kind of configuration. Of course, every physical thing has *some* structure—i.e., it is physically configured in some way or another. For this reason, we don't just want to say that healthy things are those that maintain some structure or other because then physical objects couldn't fail to be healthy (at least with respect to structure). Rather, healthy things are those that maintain the structure that they are supposed to have—the structure that is appropriate for them in their particular circumstances (age, environment, etc.). Biologists uncomfortable with the presence of normative[10] language in scientific discourse sometimes prefer to talk of "characteristic" or "typical" structures rather than "appropriate" structures.[11]

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[8] To be a bearer of health is just to be the kind of thing that can be healthy or unhealthy, i.e., to be the sort of thing for which evaluations of health are appropriate.

[9] Naturally, the converse is also true. When something is unhealthy, it is in this regard worse off than it would be if it were healthy. For the remainder of the paper, I focus on what it takes to be the kind of thing that can be healthy, but my assumption is that these arguments also apply to unhealthiness.

[10] To be normative is to contain or imply an evaluation or an "ought."

[11] I think this approach involves a conceptual mistake. Even if pollutant-induced growth deformities in frogs were to become so pervasive that they occur in the vast majority of individuals, we wouldn't think of such deformities as constituting a frog's health. See Ruth Macklin, "Mental Health and Mental Illness: Some Problems of Definition and Concept Formation," in *Concepts of Health and Disease: Interdisciplinary Perspectives,* ed. Arthur L. Caplan, Tristam Engelhardt,

However, I think all parties can agree that when we say that things stay healthy in part by maintaining their structure, we don't mean that they're healthy in virtue of maintaining *any* structure. We mean that they're healthy in virtue of maintaining a certain kind of structure. For now, let's refer to this "certain kind of structure" as a *health-related structure*.

Function

Function is a much more difficult concept to define. In fact, there has been much philosophical debate concerning the proper account of function, and disagreements on the matter continue to the present day. Currently, the two most popular accounts are due to Larry Wright and Robert Cummins, respectively. For simplicity's sake, I only discuss Wright's account here, though I think similar arguments could be made using Cummins' account. Wright offers us what he calls an "etiological account" of functions: for *F* to be a function of *X* is for it to be the case that *X* is there because it does *F,* and that *F* is a consequence of *X*'s being there.[12] Wright wants to be able to distinguish *the* function (or functions) of something from *a* function of the thing, i.e., between "what its functions are" and "the various ways in which it functions." For example, while *a* function of the heart is serving as an example in the literature on functions, it is not *the* function of the heart because serving as a philosophical example isn't causally responsible for the presence of hearts. Pumping blood, on the other hand, is *the* function of the heart. The heart is there because it pumps blood, and the pumping of blood is what results from the heart's presence.

Unfortunately, Wright's view of functions has some features that make trouble for our strategy of defining *health* in terms of proper functioning. The problem is that it counts too many things as functions. For example, on Wright's account, "making people rich" would count as the function of the lactation of dairy cows. Their lactation does make people rich (by enabling the production of profitable milk), and this process occurs in the cows because it makes people rich. (If their lactation had failed to produce profitable milk, dairy farms would have gone out of business, and there would be no dairy cows.[13]) But it doesn't seem right to think that making people rich is *the* function of their lactation just

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Jr., and James J. McCartney (Reading, Mass.: Addison-Wesley, 1981), pp. 391–418; and James G. Lennox, "Health as an Objective Value," *Journal of Medicine and Philosophy* 20 (1995): 499–511. While it might be the case that we often try to determine which structures are healthy ones by looking at which structures are normal or typical in a population, the conclusion that should be drawn isn't that to be a healthy structure is just to be a typical structure. What it shows, rather, is that we treat what's typical as evidence of what's healthy, but in doing so are conceptually committed to taking into account other evidence that what's typical is not, in fact, what's unhealthy.

[12] Larry Wright, "Functions," *Philosophical Review* 82 (1973): 139–68; p. 161.

[13] Of course, this example only works in places where dairy cattle and beef cattle are separate breeds, since presumably only there would the unprofitability of milk render dairy cattle obsolete.

because, if their lactation hadn't made people rich, people would have let their breed die out, or perhaps never even bred them in the first place. Rather, we'd probably be inclined to say that the function of their lactation is feeding their young, even if, as is the case on many dairy farms today, they never actually get to do so. Similarly, we probably wouldn't want to accept that *the* function of the reproductive system in beef cattle is making tasty hamburgers, or that *the* function of living is dying, though similar stories might be told there.[14]

Now you might think we should just bite the bullet here and say that, even though we don't ordinarily think of these as functions, the fact that we don't do so just shows that we're unimaginative in our function attributions. However, even if we were to grant this point and allow them to count as functions, our use of these function attributions to license health attributions is still left highly problematic. That is to say, even if we're willing to call them functions, we still wouldn't be willing to accept the further conclusion that their maintenance constitutes health. It would be bizarre to say that if the dairy cow lactates as usual, but its milk fails to make people rich, the cow is thereby *unhealthy*.[15] Or that if tastes change, and hamburgers are no longer considered a tasty treat, the beef cattle are thereby unhealthy. Even if we're willing to adopt a very permissive view of what counts as a function, such conclusions would lead us to make claims about health that are fairly absurd.

The conclusion to draw, then, is that even if we count these behaviors as functions, they cannot be functions the maintenance of which is required for health. Thus, we need to find some further condition that will pick out only those functions that are relevant to health. Let us call this subset of functions *health-related functions*.

So far, then, what we have is that something is healthy insofar as it maintains its health-related structure and its health-related functions. It might fairly be said that this analysis has not yet strayed too far from the obvious. The real work, of course, is to show how to pick out which structures and functions should count as health-related ones. To accomplish this task, we need to take a closer look at the normative nature of health.

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[14] The story for beef cattle: making tasty hamburgers is an effect of their reproduction (no reproduction, no tasty hamburgers), and their reproduction occurs because it results in their making tasty hamburgers. (Beef cattle have been bred for taste—they wouldn't exist, and thus be in a position to reproduce, if parts of them didn't taste good.) The story for dying: dying is an effect of living (no living, no dying), and living occurs because it results in dying. (It's only because things that came before us died that there's enough room, food, etc. for us living things here now.) See Jonathan Bennett, *Linguistic Behavior* (Cambridge: Cambridge University Press, 1976), p. 45. For problem cases similar to these, see Christopher Boorse, "Wright on Functions," *The Philosophical Review* 85 (1976): 70–86; and Peter Godfrey-Smith, "Functions: Consensus without Unity," *Pacific Philosophical Quarterly* 74 (1993): 196–208.

[15] Even if market prices were good, many would argue that it isn't healthy for dairy cows to lactate at economically optimal levels. See, e.g., Peter Singer, *Animal Liberation,* new rev. ed. (New York: Avon, 1990), pp. 136–39.

NORMATIVITY

Health is an inherently normative concept, as it is by its very definition a good state. But what kind of goodness is it? That is to say, in what sense, and for whom, does health have normative import? The first thing to notice is that we can't mean all-things-considered goodness since there are cases where we might reasonably think that the good of health is outweighed by other goods. We might, for example, think it not unreasonable for someone to make small sacrifices in health in order to effect political change or complete a great work of art. For this reason, it is better to think of health as a state that is inherently good in the sense of "*prima facie* good," or "good, all other things being equal."[16] That is to say, health is by definition valuable, although this value can be outweighed by other values.

But we can still ask what it means to say that health is a *prima facie good*. The term *good,* after all, can be used in a number of ways. Sometimes we use it to mean "morally good," other times to mean "a good of its kind," and still other times to mean "advantageous" or "good for what has/does it." Consider the following statements:

(1) I know we don't have a lot of money, but still, it's good to be as generous as one can toward those in need.
(2) Al Capone was a pretty good gangster—he wasn't a coward like Sammy"the Bull" Gravano or a show-off like John Gotti.
(3) I don't know what I did to deserve all this, but, hey, it's good to be lucky!

Statement (1) is a claim about moral goodness; *good,* in this context, could be replaced with "virtuous" or "morally right" without any change in meaning. In statement (2), *good* means "good of its kind." Here "a good gangster" means something like "an excellent example of a gangster" or "a paragon of gangsterhood." In (3), *good* means "good for." Here *good* is synonymous with "advantageous" or "beneficial."

In which of these ways might health be inherently good? It is fairly clear that health isn't in itself a moral good. A healthy person is not thereby a morally better person. So health isn't inherently good in the sense found in (1). It also seems right to say that health isn't *only* a matter of being a good of a kind, though determinations of health certainly require goods-of-a-kind judgments. That is to say, in making claims about which kinds of structures and functions

[16] There is some disagreement in the philosophical literature about how best to understand the term *prima facie*. For our purposes, we can just think of it as meaning "all other things being equal." Technically minded philosophers may grumble about this understanding, but our present purposes are not served by more precision on this matter.

are appropriate for which kinds of things, and about the extent to which particular things have these structures and functional capabilities, we are making claims about what it is to be a good of this kind, and to what extent particular things meet the standards of the kind. However, health can't be just a matter of being a good of a kind. A good bonsai tree, veal calf, or patient might be a good of its kind; yet it would not thereby count as healthy.

It is at this point that the third type of *good,* being *good for*, enters the picture. While it is true that health requires having a structure which meets a certain standard, this standard is itself set by yet another standard—one that's rooted in a different kind of goodness, namely, *goodness for*. This third sense is the primary sense in which health is inherently good. In saying that to be healthy is by definition to be good in a certain way, we are saying that it is to be good for that which has it. Now, again, this is *prima facie* good, not all-things-considered good. It may turn out that your health is, through some strange twist of fate, responsible for ruining your life's work, in which case your health could turn out to be, on the whole, bad for you. But it will still be the case that, all other things being equal, it is better for you that you be healthy than that you be unhealthy.

So how does this account of *good* help us, if at all, in thinking about health-related structures and functions? Well, we might think that the normative nature of health can tell us which structures and functions count as health-related ones. That is to say, the constraint we were looking for above to distinguish health-related structures and functions from other structures and functions is a *normative* constraint.

Let's go back to our cases of problematic function ascription. If part of what it is to be healthy is to be better off, then on the present analysis we should limit the kinds of functions we take to be partly constitutive of something's health to those that are good for it. To see how this analysis would work for actual cases, we'll first need an analysis of *good for* (i.e., "well-being," "welfare," "interests") to use. I suggest we use Stephen Darwall's analysis of *good for:* Something is good for you if it would make sense for someone who cared for you to want it for you for your sake.[17] Darwall's account has a number of advantages, but most important for our purposes is that it can make sense of the well-being of things that don't have a subjective point of view on the world.

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[17] Stephen Darwall, *Welfare and Rational Care* (Princeton: Princeton University Press, 2002), p. 9. Darwall distinguishes between caring for something and merely caring about it: "[C]are [or] concern for someone (or something) for his (its) sake can differ from other kinds of care or concern. There is a broad sense in which we can be said to care about anything just in case we value it. But something's being important or making a difference to one in this broad sense need not involve care or concern for any person or thing, whether we think it objectively important or just important to us. Someone might care intensely and wholeheartedly about whether his shirts are ironed without this involving any concern for anything for its sake, including the shirts. The kind of care that is involved in a rational care theory of welfare is concern for someone for the person's sake" (p. 13).

This feature is useful in the case of ecosystems, but it also allows us to talk about the well-being of such things as newborn infants, plants, and simpler animals.

Using Darwall's account of well-being, we can note the following: even if we count making people rich as a function of dairy cow lactation, someone who cares for dairy cows won't necessarily want this function to be performed for the cows' sakes. Even though making people rich might be what's responsible for the cows being here in the first place, someone who cares for a dairy cow might sensibly prefer that people didn't take such a keen economic interest in her milk. The same is true for making tasty hamburgers and dying—just because these things might be causally responsible for the existence of something we care for, it doesn't mean we should want them to continue.

The general reasons why not all functions are health-related functions can now be seen more clearly. Health is by definition *prima facie* good for things that have it. But not all functions are good for those things in which they're found. It's easy to see why. On Wright's view, function ascriptions are backward looking. Whether or not something counts as having a particular function is determined by looking at its history and/or the history of its ancestors. But decisions about what to want for those you care for are frequently forward looking. So the question of whether or not fulfilling this function happened to contribute to the existence of things like it in the past only matters to the extent that it bears on the question of whether fulfilling the function is likely to benefit the thing we care for now.

To summarize, we've seen that being healthy is a matter of retaining one's structure and functional capacities, and thus that being a bearer of health involves having a structure and parts with functions. But we've also seen that structure alone isn't sufficient for being healthy (or being a bearer of health), since not all structures/functions are constitutive of health. What marks those that make up a thing's health is that their retention contributes to the thing's well-being. That is to say, health-related structures and functions are those that it would make sense for a carer to want their bearer to retain, for their bearer's own sake. This last condition, we saw, came from the normative nature of health, viz., that it is part of the very concept of health that it is *prima facie* good for that which has it. Now it should be noted that if we were talking about human health, or the health of anything else with a capacity for other kinds of well-being besides health, this account wouldn't be enough. Among other things, we would also need to say something about how to distinguish health from these other forms of well-being, e.g., moral virtue or a robust capacity for delight. But since we're going to apply this account to ecosystems, which don't have other kinds of well-being with which health could be confused, we can dispense with this further analysis here.

Now that we have a fairly clear picture of what requirements a thing must meet in order to be a bearer of health, we're in a good position to consider the

question of whether ecosystems meet these requirements. Before doing so, however, we must get a clearer idea of what ecosystems *are*.

WHAT IS AN ECOSYSTEM?

The standard definition of *ecosystem* given by most ecology textbooks today is something along the lines of "a system of the biotic and abiotic features of an area in interaction with one another." This definition is a fairly vague one—too vague, in fact, to be a useful guide for determining which things in the world should be counted as ecosystems. The problem is that it includes far too many things as ecosystems: on this definition, my computer and I count as an ecosystem, as do you and your shoes, my office and its occupants, etc. But when ecologists talk of ecosystems, they don't have in mind *every* possible combination of interacting biotic and abiotic things. Part of the reason for the vagueness in the standard definition is that ecologists don't agree on how exactly to characterize ecosystems. In practice, they use different criteria for delineating ecosystems, depending on their research interests and theoretical predilections. By moving to a very high level of generality, textbook authors can generate a definition that includes as many of these different models as possible. But because of its generality, appeals to this definition won't be enough to tell us which things in the world should be counted as ecosystems. For this reason, we have to consider some of the different models of ecosystems used by ecologists, in order to see if any of them can be considered entities that have health-related structures and parts with health-related functions.

To get a sense of the different methods ecologists have for delineating ecosystems, consider a very simple example. An ecologist, Louella, is looking at a particular geographical area, and trying to decide whether there is one ecosystem present there or two.[18] What factors should she consider in making this decision? One thing she might consider is the pattern of species distribution. Does one part of the region have a very different set of characteristic species than the other part, or are the same species found throughout the region?[19] Or she might look at population distribution and behavior. Do populations interbreed throughout the region, or are there two subregions with populations that tend to remain isolated from each other? She might also look at patterns of trophic dependency within the region. Are there two different subregions containing

[18] "One or two" is obviously an unlikely decision scenario, but I use it here for the sake of simplicity. Notice also that this way of framing the problem ignores the question of how to delimit ecosystems in time, which is also an important part of determining the boundaries of ecosystems.

[19] Classifications of terrestrial ecosystems using both ecotope and vegetation classification models, for example, tend to focus primarily on species distribution, and that of flora in particular. See, e.g., Han J. Runhaar and Helias A. Udo de Haes, "The Use of Site Factors as Classification Characteristics for Ecotopes," in *Ecosystem Classification for Environmental Management,* ed. Frans Klijn (Boston: Kluwer, 1994), pp. 139–72.

things that tend to eat only things from within their own subregion, or is there one food web that encompasses the whole region?[20] Do nutrient flow patterns and energy flow patterns tend to be subregion-specific or regionwide?[21] Finally, she may also consider gross topological features. Are parts of the region separated from each other by rivers, lakes, oceans, or deserts? Is part of the region terrestrial while the other part is aquatic? Is part of the region high altitude while the other part is low altitude? Or are the geographical features of the region fairly uniform?[22]

Very often, the answers to two or more of these questions point to the same delineation of ecosystems: populations separated by oceans often do not interbreed; different topological features tend to produce different patterns of speciation; and so on. But such situations aren't always the case: two deserts separated by a mountain range might have the same characteristic species; exogamous species[23] may have populations that interbreed even though they don't live near each other or share the same food web; etc. As a result, which of these features our ecologist takes to be most *important* when dividing up ecosystems may well determine what scheme she ultimately ends up with. These judgments of importance can be made on the basis of many factors: how relevant each type of feature is to Louella's present research, which features she has been trained to notice first, what the norms of her field or subfield are, which features are easiest or cheapest to measure, etc.[24]

ARE ECOSYSTEMS BEARERS OF HEALTH?

Structure and Function

Would any of the above-mentioned ways of delineating ecosystems yield an entity that has a structure or parts with functions? The first thing to notice is

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[20] See, e.g., R.L. Lindemann, "The Trophic-Dynamic Aspect of Ecology," *Ecology* 23 (1942): 399–418.

[21] For an example of ecosystem classification based on nutrient flow, see Roman J. M. Lenz, "Ecosystem Classification by Budgets of Material: The Example of Forest Ecosystems Classified as Proton Budget Types," in Klijn, *Ecosystem Classification for Environmental Management,* pp. 117–37; for a model based on energy flow, see H. T. Odum, M. T. Brown, and S. Ulgiati, "Ecosystems as Energetic Systems," in *Handbook of Ecosystem Theories and Management,* ed. Sven E. Jørgensen and Felix Müller (Boca Raton: Lewis Publishers, 2000), pp. 281–302.

[22] Gross geological and topological features often play an important role in "spatially nested" or "hierarchical" models of ecosystems, particularly in defining larger units—i.e., those closer to the top of the hierarchical scale. See, e.g., Frans Klijn, "Spatially Nested Ecosystems: Guidelines for Classification from a Hierarchical Perspective," in Klijn, *Ecosystem Classification for Environmental Management*, pp. 85–116; and Robert G. Bailey, *Ecosystem Geography* (New York: Springer Verlag, 1996).

[23] Exogamous species are those that breed outside their own population group.

[24] See also Bryan G. Norton, "A New Paradigm for Environmental Management," in Costanza, Norton, and Haskell, *Ecosystem Health,* pp. 23–41.

that each way of delineating ecosystems actually describes a certain kind of structure: a cycle of energy flow, a pattern of speciation, a system of trophic dependencies, etc. So the requirement that bearers of health have *some* kind of structure is easily met in the case of ecosystems, although which structure that is will depend on how the ecosystem has been defined.

Most of these ways of defining ecosystems will also yield ecosystems that have parts with functions. To see why, consider the following example: imagine a forest ecosystem that frequently experiences fires. After the fires, the forest regenerates quickly. The heat from the fire causes seeds to be released; the light that reaches the forest floor in the newly burned-out area causes them to sprout and begin to grow; and so on, until the burned-out area has been reforested. Let's call this, collectively, the regeneration process. Here, we probably would think that the function of this regeneration process is to reforest the burned-out areas. But would we be right? Let's look at Wright's two requirements for having a function.

The second requirement, that the performance of the function is a consequence of the part being there, is easily met—there is no doubt that the reforestation is a result of the presence and operation of the regeneration process. The first requirement has been a matter of some controversy, but I think it too can be met. This first condition states that the regeneration process must *exist* because it reforests burned-out areas. Some writers have argued that this cannot be true, because it implies that natural selection operates on ecosystems, and, they point out, ecosystems are not proper units of selection.[25] But nothing in Wright's definition requires that the causal mechanism be natural selection occurring at the ecosystem level. All it says is that there must be *some* causal mechanism by which reforestation is responsible for the presence of the regeneration process. It could be the case that selection at the gene level (in different organisms) selected for the behaviors constitutive of the regeneration process. Because reforestation was advantageous to the genes that caused these behaviors, they survived and reproduced, which eventually led to the current forest with all of its reforesting capabilities. On Wright's view, as long as the parts are causally responsible for whatever we are calling their functions, and as long as the cause of the existence and/or presence of the parts includes the fact that they perform these functions, then these parts count as having these functions. Thus, any characterization of ecosystems that picks out features that do certain things, and by doing so tend to perpetuate those very same features, is a description of an ecosystem with functioning parts.

Most of the characterizations of ecosystems just described will likely yield such parts with functions. Within a system of energy flow, photosynthesizers will probably have a function; within a system of nutrient flow, nitrogen-fixers

[25] E.g., Calow, "Can Ecosystems Be Healthy? Critical Consideration of Concepts," pp. 1–2; Calow, "Ecosystem Health: A Critical Analysis of Concepts," pp. 34–35; Wicklum and Davies, "Ecosystem Health and Integrity?" p. 998.

will probably have a function; within systems of trophic dependencies, predators and prey will probably have functions; and so on.[26]

Thus, I think we can conclude that ecosystems do have a structure and, at least under most definitions, parts with functions. Next we have to ask whether any of these are health-related structures or health-related functions. In other words, are any of them structures/functions that it would make sense for someone who cared for the ecosystem to want the ecosystem to retain *for its sake*?

Well-Being

On many of the common, everyday understandings of ecosystems and their functions, the answer is obviously yes. If I really do care for the forest in which I live, it will certainly make sense for me to want the regeneration process to continue to function for the forest's sake. Otherwise, the next forest fire that came along would destroy it for good. So it does seem right to say that it would make sense for someone who cared for the forest to want the regeneration process to continue to function for the sake of the forest. However, a critic might object that wanting the process to continue only makes sense on the condition that it makes sense to care for the forest in the first place, and we haven't shown that caring for the forest does make sense.

So, does it make sense to care for ecosystems, and if so, why? In order to answer this question, we need to say something about how to determine what it does and doesn't make sense to care for. We can think of the constraints on what it makes sense to care for as falling into two main categories: general rationality conditions and rules imposed by the nature of care. The general rationality conditions are the usual suspects: complete information concerning relevant facts, freedom from errors in reasoning, emotional sensitivity to the situation, etc. One way to think of the principle unifying these conditions is that care is rational when endorsement of it is reflectively stable. That is to say, your care is rational when it is the case that, no matter how much more you were to learn about the situation and reflect upon the details, though abstracting away from the potential side-effects of such reflection (fatigue, boredom, etc.), you would still think it appropriate to care.[27]

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[26] Of course, we could probably come up with definitions of ecosystems that don't have functioning parts—e.g., exclusively topological definitions such as "whatever happens to be above 14,000 feet on this mountain." In the absence of parts with functions, such ecosystems could not be bearers of health.

[27] Elizabeth Anderson, *Value in Ethics and Economics* (Cambridge: Harvard University Press, 1993). The term *appropriate* here means something like "warranted, given the evidence," not "the thing to do, all things considered." Of course, this definition isn't the only way one could understand what unifies the general rationality conditions. A realist subscribing to a correspondence theory of truth might claim that the conditions are unified by their tendency to produce correct desires/beliefs, where correctness amounts to being an accurate reflection of independent facts of the matter. It's unclear, however, that there are any independent facts of the matter about

The rules imposed by the nature of care are slightly more difficult to discern. Like most attitudes, care is at least *prima facie* incompatible with certain other attitudes and desires. Care is, for example, *prima facie* opposed to the attitudes of hatred or indifference. To both care for someone and either hate or be indifferent to that person, if it is even possible, is to have conflicting emotions. Care is also similar to, yet distinct from, other attitudes in its psychological neighborhood. For example, it differs from obsession (where one cares very much *about* its object, but not necessarily *for* the object), protectiveness (which might lead to the same behaviors as care, but is compatible with only valuing its object for the sake of something else), empathetic identification with (in which the desire for the object's good might just be an expression of extended self-interest), and so on. By looking closely at the considerations we use to distinguish care from other attitudes, we can get a sharper picture of what care is like.

In order to know whether our view of well-being allows for the well-being of ecosystems, we need to know whether either the general rules of rationality or the rules governing care would deem irrational *every* case of care for ecosystems, for such a claim would need to be established by opponents of ecosystemic well-being to make their case. So we need to ask: is it possible for people to care for an ecosystem, and for this care to be an attitude that they would still think appropriate, no matter how much they learned about the ecosystem, themselves, or their reasoning processes, etc.? Or would all those who claim to care for ecosystems deem their care inappropriate if only they could see the situation more clearly?

I think it is clearly *not* true that every case of caring for an ecosystem could be ruled out on these grounds. What reasons could someone have for thinking that every instance of care for an ecosystem must necessarily fail the rationality test? The claim that all such instances will fail for different and unpredictable reasons is fairly implausible—presumably there must be something about ecosystems that makes it the case that all of them will fail the test. But what fact about ecosystems could there be? Is there some piece of information about ecosystems that would undermine the attitude of care? Someone might claim that we will not approve of caring for ecosystems as such once we learn that an ecosystem is just a collection of biota and abiota that exist together only because of chance and selective pressure, or that ecosystems come and go with great frequency over geological time, or that the boundaries of ecosystems are often drawn by scientists on the basis of their research interests, or that most ecosystems today have been greatly affected by humans. But while this new information might undermine the attitudes of some carers, it needn't undermine *all* instances of care.

Think about the analogues to this information in the case of our care for people. Many of us care for our friends, and think it perfectly reasonable to do

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which things in the world it makes sense to care for; nor is it clear how we could discover these facts even if they do exist.

so, in full knowledge that their existence is due to natural selection, that their lives are necessarily limited, that large debates about how to define personal identity are still unresolved, and that much of what we care for in these people is the result of a history of social influence. There's nothing about these facts that necessarily undermines one's care for people; nor should it. Likewise, then we have no good reason for thinking that it should do so in the case of ecosystems. We reach the same conclusion in the case of improvements in reasoning and emotional sensitivity. While it certainly *could* be the case, care for an ecosystem needn't be based on an error in reasoning or an emotional blind spot. Although some caring attitudes taken by some people might turn out to be incompatible with other attitudes they think it appropriate to take toward ecosystems, it won't always be the case. Plenty of environmentalists, for example, quite clearly care for the ecosystems on the behalf of which they work—they try to protect these systems from harm, are concerned about threats to them, and are saddened or angry if these harms come about anyway. In sum, then, there is just no good reason for thinking that *all* instances of care for ecosystems must be irrational. If this conclusion is right, then in cases where the attitude of care isn't irrational, and where we can come up with desires (for things for the ecosystem for its sake) that would make sense given this attitude, the ecosystem will count as having a well-being, and thus will meet the normative requirements for being a bearer of health.[28]

THE SOCIAL CONSTRUCTION OF ECOSYSTEMS

That said, there might be a more serious worry we could raise about the claim that ecosystems have a well-being. The worry is as follows: as we saw above, what constitutes the ecosystem, where its boundaries are, and so on, are matters of decision and not simply discovery. Furthermore, the delineation of ecosystems is underdetermined by nature itself; so it isn't just *in fact* a matter of decision, it's necessarily and inescapably so. But then one might wonder how it can make sense to desire things for the ecosystem's sake if the ecosystem doesn't have an independent sake (because it doesn't have an independent existence) of its own.

Here's a slightly more specific way to put the worry: if the definition of any particular ecosystem depends on human interests, and if what counts as good for the ecosystem depends on how the ecosystem is defined, then what's good for the ecosystem depends, although indirectly, on human interests. But how can ecosystems really have a good of their own if what's good for them is a function of human interests?[29] To have a good of your own, someone raising

[28] Considerations of space do not permit a discussion here of how this analysis applies to artifacts. This is, however, a very important issue—one which every account of health must face.

[29] I should note here that the phrase "human interests" is ambiguous between what's good for us, and what we take an interest in. The objection assumes that the former is what's operative in delineating ecosystems. I grant this point for the sake of argument, though I'm not sure that it's right. But what I hope to show here is that even if it is right, this kind of worry is still unfounded.

this objection might claim, what's good for you cannot just be a function of what's good for something else. If we really want to think of an ecosystem as a thing out there in the world with a good all its own, then that good has to be in some important way independent of us.

As a first step toward replying to this worry, we should get clear about how exactly "what the ecosystem is" might depend on human interests. Some writers have characterized this relationship by claiming that ecosystems are "social constructions."[30] It's not obvious that social-construction talk clears up more confusions than it creates, but if we do want to use social-construction talk here, we should be very clear about what it does and does not mean. The things that make up ecosystems—nutrients moving from one place to another, organisms reproducing with one another, energy flowing from one point to another—exist whether or not we choose to believe in them. They're out there in the world mind-independently, or at least as mind-independently as we think things get.[31] The classificatory schemes by which we delineate ecosystems, on the other hand, seem to be very straightforwardly determined by us and our interests, and this should be no surprise.

In the case of ecosystems, what the world presents us with is a bunch of interacting stuff. But it is generally a matter of decision, not discovery, that we should

(1) group some of the stuff together and call it a whole—an ecosystem;
(2) distinguish this whole from other wholes using certain principles of individuation; and
(3) distinguish this type of whole from other types of wholes using certain principles of identification.

While these decisions are made on the basis of facts about the stuff we're trying

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[30] Alan Holland, "The Use and Abuse of Ecological Concepts in Environmental Ethics," in *Ecologists and Ecological Judgments,* ed. N. S. Cooper and R. C. J. Carling (New York: Chapman and Hall, 1996), pp. 27–41, for example, refers to them as "scientific constructions," which he contrasts with being "real" (p. 34). Allan K. Fitzsimmons, *Defending Illusions: Federal Protection of Ecosystems* (Lanham, Md.: Rowman and Littlefield, 1999) refers to them as "mental constructs" and "heuristic devices" (p. 28).

[31] It should be noted that not even those who have argued most forcefully for the view of nature as a social construction deny this point. See, e.g., Jane Bennett and William Chaloupka, "Introduction: TV Dinners and the Organic Brunch," in *In the Nature of Things: Language, Politics and the Environment,* ed. Jane Bennett and William Chaloupka (Minneapolis: University of Minnesota Press, 1993), pp. vii–xvi; and William Cronon, "Introduction: In Search of Nature," and "Toward a Conclusion," in *Uncommon Ground: Rethinking the Human Place in Nature,* ed. William Cronon (New York: W.W. Norton and Co., 1996), pp. 23–56, 457–58. But critics have not always been quick to notice this feature of the social constructionists' claims. David W. Kidner, "Fabricating Nature: A Critique of the Social Construction of Nature," *Environmental Ethics* 22 (2000): 339–57, for example, takes the social constructionists' position to be that "there is no world 'out there' independent of human cognition and language" (p. 342).

to categorize, they are also made on the basis of facts about us—for example, facts about what's in our interests.[32]

The next thing to notice is that what counts as an ecosystemic function at all is (fairly directly) determined by the way in which we choose to define the system. For this reason, what it makes sense for carers to want for the sake of the ecosystem will also be at least partly determined by this decision. Thus, for example, if one defines an ecosystem as essentially involving certain characteristic species, then anything that threatens the presence of these species thereby threatens the existence of the ecosystem. However, different species can sometimes be functionally redundant. That is to say, they can perform the same ecosystemic functions, and thus are, from the point of view of certain ecosystemic processes, interchangeable. So if we define the ecosystem not in terms of characteristic species but in terms of, say, energy flow, then the extinction of one species wouldn't threaten the ecosystem as long as something else steps in to perform that same function within the system of energy flow. It's possible, then, that under one definition of the ecosystem, the extinction of a particular species will threaten the very existence of the ecosystem, while under a different definition, the ecosystem wouldn't even be *changed* by the extinction, much less threatened by it. But if so, then what is good or bad for the ecosystem, i.e., what it would make sense for someone who cared for it to want for it for its sake, really does depend on which way we choose to define the ecosystem.

Before replying to this objection, it is worth pointing out that we get an analogous problem in the case of persons. (Here I don't mean human bodies, but something more like selves.) As the literature on personal identity makes clear, how to define a person is still a matter of considerable controversy.[33] Not only are there conflicting views about what we should count as a person (e.g., should fetuses, the comatose, and/or the insane count?), but also about what we should count as the *same* person (e.g., is a person the same one after a brain injury, amnesia, a religious conversion, or treatment for a mental illness?). The criteria for personhood, like the criteria for ecosystems, are underdetermined by natural facts. In light of this underdetermination, what ultimately determines which things we count as persons are our interests, both personal and communal: thinking of my future selves as the same person as my current self enables practical reasoning—choosing, planning, etc. Thinking of the current you as the same person as the former you enables social conventions for attributing responsibility—praise, blame, etc.[34]

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[32] Worries about individuation, though not discussed in terms of social construction, are raised by Andrew A. Brennan, "Ecological Theory and Value in Nature," in *Environmental Ethics,* ed. Robert Elliot (Oxford: Oxford University Press, 1995), pp. 188–214.

[33] See, e.g., Derek Parfit, *Reasons and Persons* (New York: Oxford University Press, 1984), pt. 3.

[34] Christine M. Korsgaard, "Personal Identity and the Unity of Agency," *Philosophy and Public Affairs* 18 (1989): 101–32.

As was the case with ecosystems, then, what counts as a person is a function of human interests. As was the case with ecosystems, the well-being of persons depends on our definition of them. For example, cashing in my IRA to finance a night on the town is good for me only if the "I" whose well-being we're talking about will be the same person who gets to go out on the town, but not the same person who will find him or herself penniless at age seventy. So the way that we specify what counts as a person, and what counts as the same person, will in part determine what counts as contributing to or detracting from personal well-being. If this analogy is right, then we should expect an analogous worry to arise here: if what counts as "you" depends in part on society's general interest in attributions of responsibility, and if your well-being depends on what counts as "you," then your well-being will be a function of the interests of society, which seems to violate our understanding of what it is to have a good of your own.

But there's an important distinction that both the ecosystem worry and the analogous worry in the case of persons fail to take into account. Let me offer the following definition of what it is to have a good of one's own: object *O* has a good *G* of its own if and only if it doesn't have *G* just insofar as *G* helps *O* contribute to the good of something else. So when I say, "regular oil changes are good for the car," this is a case of something having a good that is *not* its own. We could say that the car has a good, oil changes, but it has this good just insofar as oil changes help the car contribute to the good of something else—the car's owners, designers, people in general, etc. But the cases of ecosystems and persons are not like the case of the car. Ecosystems don't have a good just insofar as what's good for them helps them contribute to the good of humans generally. Species preservation can still be good for an ecosystem even if preserving the species doesn't in *any* way help the ecosystem contribute to the good of people. Likewise, getting more rest can still be good for me even if it doesn't at all help me contribute to the good of humans generally. My good and the ecosystem's good don't necessarily help me or the ecosystem contribute to the good of something else; at most, how "I" am defined and how "the ecosystem" is defined contribute to human interests in general. But having your *definition* contribute to the good of something else is different from having your *good* help you to contribute to the good of something else. While the former is the situation for ecosystems and persons, the latter is what it would take for your good to be merely derivative, i.e., not a good of your own.

While it's true, then, that what's good for an ecosystem depends on how we define the system, and that how we define the system depends on our interests, these facts do not force us to the conclusion that the ecosystem has no good of its own. Ecosystems (and persons) can have goods of their own, in spite of the fact that the schemes we use to categorize them are matters that we decide upon.

CONCLUSION

In sum, then, we can see ecosystem health as a matter of maintaining the structure and functions that are good for the ecosystem. In order to determine which structure and functions are good for the ecosystem, we should ask what it would make sense for someone who cared for the ecosystem to want for it for its sake. At least on most understandings of what an ecosystem is, there *are* things it would make sense for a carer to want for an ecosystem for its sake. Insofar as this is the case, ecosystems *are* the kind of thing that can be healthy or unhealthy in a fully literal sense.

One final note. Even if it is sound, this argument doesn't show that moral agents have duties to, or even regarding, ecosystems. That is to say, even if ecosystems can be healthy or unhealthy, it remains to be seen how and why the health of ecosystems should matter in its own right to moral agents. To reach conclusions about this issue, we'd need to show why it should matter to any of us what it makes sense for a hypothetical carer to want for the sake of an ecosystem, especially if we don't in fact care for the ecosystem. Showing that ecosystems are the kind of thing it *makes sense* to care for isn't the same as showing that we all *should* care for them, since on the above analysis, all making sense comes to is not being mistaken. But, of courses, not being mistaken in doing certain things isn't the same as being obliged to do them. So more work would have to be done to get the conclusions drawn here to yield anything approaching the kind of moral obligations toward ecosystems that some environmental ethicists would like to see.