


SYMPOSIA PAPER

The Coevolution of Descriptive and Evaluative Beliefs in Aldo Leopold's Thinking

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Abstract

The founder of conservation biology, Michael Soulé, set out a vision for conservation biology that was explicitly value-laden, analogous to cancer-biology. In so doing, he drew on the writings of Aldo Leopold, known among philosophers primarily for his land ethic. Employing and extending the work of Anderson (2004) and Clough (2020), I argue that the Leopoldian views that Soulé was drawing on were the product of the coevolution of descriptive and evaluative beliefs over the course of Leopold's life, grounded in his experiences, resulting in tested and reliable—albeit defeasible—values underlying conservation biology.

1. Introduction

Michael Soulé, co-founder of the Society for Conservation Biology and its first President, is widely considered to be the founder of conservation biology (Sanjayan, Crooks, and Mills 2020). Soulé argued that conservation biology is a crisis-oriented discipline like cancer-biology, implying, he said, that ethical norms are an inherent part of it. He stated that the ethical norms include value judgments such as the postulate that the “diversity of organisms is good” which “cannot be tested or proven” (Soulé 1985, 730).

In coming to these views, Soulé cited several scholars who influenced him, including Aldo Leopold, who has likewise been extremely influential in conservation biology and related fields. Indeed, many of the ideas that Soulé described have precedents in Leopold's thinking. For example, Leopold explicitly compared health in humans to health in the land, suggesting that the science of doctoring the land had not really begun yet (Leopold 1949). Leopold also stated that the ecologist typically “lives alone in a world of wounds” as a “doctor who sees the marks of death in a community that believes itself well” (Leopold 1947/2013)—essentially describing a crisis discipline. And Leopold hypothesized that diverse flora and fauna, along with soil fertility, were essential for land health, where “health” was a state of vigorous

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self-renewal in each component of the land and in all collectively—the collective functioning of interdependent parts for the maintenance of the whole (Leopold 1944/1991).¹

Given his foundational status and his explicit commitments to value-driven science, Leopold is a promising figure to examine in trying to understand the role of values in conservation biology. In this paper, I argue that Leopold's evaluative beliefs and descriptive beliefs—which were not entirely separable—coevolved over the course of his life. This supports and elaborates on the values-as-evidence account of science (Goldenberg 2015), particularly as articulated by Anderson (2004) and Clough (2020). More provocatively, I suggest that this coevolution of evaluative and descriptive beliefs in Leopold's thinking implies that many of the values underlying conservation science are well-tested and thus reliable, with the caveat that testing is a continuous and ongoing process.

I begin with a brief background on Leopold and a chronological summary of Leopold's changing beliefs about wolves and deer. I then turn to the implications of Leopold's changing beliefs for the values-as-evidence view and the implications of Leopold's changing beliefs for conservation biology. I then summarize and conclude.

2. Background

Aldo Leopold (1887–1948) was a 20th-century hunter, forester, wildlife manager, ecologist, conservationist, and professor. Among philosophers, he is best known for his posthumously published book *A Sand County Almanac* (ASCA)—in particular, the chapter entitled “The Land Ethic.” Yet during his lifetime he produced more than 500 published and unpublished works, many written for a scientific audience rather than a general audience; ASCA was written for a general (layperson) audience. Understanding Leopold requires going beyond ASCA.

Leopold's approach to science was value-laden in a number of respects, so that by the end of his life he had identified various entities and properties to be of value: land communities, members of land communities, land health, and the factors necessary to sustain land health (species interactions/interdependence, biodiversity, soil health). Moreover, he thought that science and ethics could not be separated (Meine 1987, 177):

Some scientists may dismiss this matter [of a conservation ethic] forthwith, on the ground that ecology has no relation to right and wrong. To such I reply that science, if not philosophy, should by now have made us cautious about dismissals . . . no ecologist can deny that our land relation involves penalties and rewards which the individual does not see, and needs modes of guidance which do not yet exist. Call these what you will, science cannot escape its part in forming them. (Leopold 1933, 635)

He also advocated incorporating values into policy decisions. For example, he suggested an approach that would “reorganize and gear up the farming, forestry, game cropping, erosion control, scenery, or *whatever values may be involved* so that

¹ Here it's worth noting that Soulé cited Leopold on the empirically based generalization that species are interdependent and the need to be cautious about preserving biodiversity in the face of our ignorance about it (Soulé 1985, 729).

they collectively comprise a harmonious balanced system of land-use” (Leopold 1935/1999, 47; emphasis added).

In one of his most famous essays, “Thinking Like a Mountain,” also in ASCA, Leopold encapsulated in several short paragraphs something that in fact took him a lifetime to realize (Flader 1994, Meine 2010):

In those days we had never heard of passing up a chance to kill a wolf. In a second we were pumping lead into the pack, but with more excitement than accuracy: how to aim a steep downhill shot is always confusing. When our rifles were empty, the old wolf was down, and a pup was dragging a leg into impassable slide-rocks.

We reached the old wolf in time to watch a fierce green fire dying in her eyes. I realized then,² and have known ever since, that there was something new to me in those eyes—something known only to her and to the mountain. I was young then, and full of trigger-itch; I thought that because fewer wolves meant more deer, that no wolves would mean hunters’ paradise. But after seeing the green fire die, I sensed that neither the wolf nor the mountain agreed with such a view. (Leopold 1949, 129–30)

How does someone go from wanting to kill every wolf to mourning the death of one wolf? I use Leopold’s trajectory of this change in his thinking to illustrate how his evaluative beliefs coevolved with his descriptive beliefs over time. But first, a couple of caveats. This will be a high-level overview, lacking much of the detail. Moreover, note that I primarily follow only one strand of Leopold’s thinking—other related ones would be, e.g., his changing views of *land health*, the nature of a *biotic/land community*, and *land management*.

3. Trajectory of Leopold’s views on wolves

The following chronology was developed using material from Flader (1994) and Meine (2010) in conjunction with primary sources from Leopold.

1887–1904 (youth): From his father Carl Leopold, Aldo Leopold learns to appreciate and enjoy the natural world; his father also impresses upon him a hunter’s ethics.

1909: Leopold begins work as a forester in the Apache National Forest.

1918: Broadening his research interests from forestry to “game management,” Leopold writes of the value of *biodiversity* in trees and in “game” and starts to become concerned about *land sickness*, but predators/wolves play no role in his views of either (Flader 1994).

1920: He advocates extirpating wolves in New Mexico in order to provide more deer for hunting: “It is going to take patience and money to catch the last wolf or lion in New Mexico. But the last one must be caught before the job can be called fully successful” (Leopold 1920). Leopold thinks that the absence of predators means more deer to hunt. In this same year, Leopold first uses the word “ecology” in print, a fairly new term that he had learned about from his professional reading (Meine 2010), but he is seemingly not (yet) seeing the extirpation of wolves in an *ecological* context.

² This is poetic license.

1925: Leopold states, “To facilitate ecological studies, the introduction of exotics should be carefully avoided ... *For the same reason, it is important to avoid the extermination of predators*, but there is no danger of this as yet” (quoted in Meine 2010, 242; emphasis added). So, he has eased off from wanting to eliminate wolves, but not (yet) from predator control.

1927: Leopold receives a report of overabundance of deer and damage to forage in the Gila Wilderness in New Mexico. There were also reports of dramatic increases in the number of deer and effects on the supply of forage in the Kaibab National Forest in Arizona. He seems to have assumed these were special cases and not “cause for alarm” (Flader 1994, 120). As a trained, professional forester, Leopold would have been attentive to data about damaged forests.

1929: He receives more data from the Gila, now showing that the buck:doe ratio was 1:4; he speculates that many of the does were barren and that killing off too many of the large predators might be one factor in that, given that small predators like coyotes primarily kill the young deer. In response, he recommends focusing on killing coyotes and letting the lions alone for a while.

1929–1930: He receives more bad information about deer from the Gila, including reports of unhealthy deer. There is disagreement over what to do, with some arguing for reducing the size of the deer herd, but Leopold refrains from taking sides. Some argue that it was the cattle, not the deer, that were the problem.

1935: This seems to have been a turning point, i.e., the point where it becomes fully clear to Leopold that the absence of big predators like wolves is a major problem. During a trip to Germany, Leopold sees severely damaged forests and deer with nutritional deficiencies, yet the forests had been conscientiously managed. That the forests were managed eliminates other possible explanations for the deterioration, such as the explanations that he invoked in earlier cases of problems with deer herds. The size of the deer herd was the only remaining plausible explanation. Around the same time, foresters in northwestern Wisconsin found large deer population sizes with overbrowsing and starvation of deer; they thus recommended herd reduction. Concerning Germany, he writes:

When too dense a deer population is built up, and there are no natural predators to trim it down, the palatable plants are grazed out, whereupon the deer must be artificially fed by the game-keeper, whereupon next year's pressure on the palatable species is still further increased, etc. ad infinitum. The end result is the extirpation of the palatable plants (Leopold 1935/2013, 373).

By 1936, when he visits Chihuahua, Mexico, Leopold sees wolves as essential for land health in that region. As the years pass, he learns about more and more problems in predator-less land communities.

1944: Leopold writes a book review that criticizes the book's lack of mention of

... the modern curse of excess deer and elk, which certainly stems, at least in part, from the excessive decimation of wolves and cougars under the aegis of the present authors and of the Fish and Wildlife Service. *None of us foresaw this penalty.* I personally believed, at least in 1914 when predator control began, that there could not be too much horned game, and that the extirpation of predators

was a reasonable price to pay for better big game hunting. *Some of us have learned since the tragic error of such a view, and acknowledged our mistake.* (1944, 929; emphasis added)

By 1948 (the end of his life), wolves are incorporated into Leopold's land ethic. He sees them as having rights in virtue of being members of the land community as well as essential for the health of the whole. He writes:

We have no land ethic yet, but we have at least drawn nearer the point of admitting that birds should *continue as a matter of biotic right*, regardless of the presence or absence of economic advantage to us.

A parallel situation exists in respect of predatory mammals, raptorial birds, and fish-eating birds. Time was when biologists somewhat overworked the evidence that these creatures preserve the health of game by killing weaklings, or that they control rodents for the farmer, or that they prey only on "worthless" species. Here again, the evidence had to be economic in order to be valid. *It is only in recent years that we hear the more honest argument that predators are members of the community, and that no special interest has the right to exterminate them for the sake of a benefit, real or fancied, to itself.* Unfortunately this enlightened view is still in the talk stage. In the field the extermination of predators goes merrily on: witness the impending erasure of the timber wolf by fiat of Congress, the Conservation Bureaus, and many state legislatures. (Leopold 1949, 211–12; emphasis added).

In sum: Leopold goes from thinking that wolves should be extirpated; to thinking that predator control was OK as long as predators weren't extirpated, but mainly because predators were needed for ecological study; to explaining away data that were showing a connection between large deer populations and damaged forests, at best acknowledging predators as one factor among many; to finally being confronted with data so incontrovertible that he believes a lack of predators to be the cause of deer population explosions that lead to damaged forests and starving deer; to thinking that wolves were essential for land health; to admitting in print that he had been tragically mistaken in thinking that there couldn't be too much "game" and in calling for the extirpation of predators; and finally, by the end of his life, seeing wolves and other predators as members of the community who should continue as a matter of biotic right. This is a tectonic shift in values, but it is a shift that occurs gradually throughout the course of his lifetime, with data playing a central role in that shift.

It all began with valuing nature experiences and hunting. These are the values that first led him to think that attempting to extirpate wolves was a good idea, a belief he did not hold about non-predators. The belief about extirpating wolves is a descriptive belief about what actions would yield more deer and a better hunting experience, but it is a descriptive belief tinged with evaluative beliefs about the value of hunting and what makes for good hunting. His values perhaps caused him to hold on to that descriptive belief longer than he ought to have, even when the evidence was telling him otherwise. But finally the data became incontrovertible. And when that happened, he changed his descriptive beliefs about killing wolves, and, in short order, also changed his evaluative beliefs about wolves in a way that was more in line with

his values concerning other animals and that also preserved his hunter's values. Thus, both the data *and* his values played a role in his new descriptive beliefs. Moreover, his beliefs about how to preserve (descriptive), and the importance of preserving (evaluative), species interdependencies and land health were expanded.

4. Implications of Leopold's trajectory

This trajectory shows how Leopold's evaluative beliefs and descriptive beliefs changed over time. As a deer hunter, Leopold valued certain things (being out in nature, large deer populations) and not other things (wolves), but gradually and ultimately came to believe valuing deer hunting was undermined by disvaluing wolves. In light of his experiences, he came to see wolves, deer, and all the members of the land community as valuable, and essential parts of a valuable whole, a belief that is both descriptive and evaluative. As historian Susan Flader argues: "Leopold's thinking was shaped by the land itself, and by his changing perception of it . . . When one looks for critical junctures in his thinking, one finds them as often as not associated with *some new field experience*." (Flader 1994, 35; emphasis added)³

Elizabeth Anderson (2004) claims that there can be a *bidirectional influence* between "fact judgements" and "value judgements."⁴ That is, she maintains, facts can count as evidence for value judgments, and value judgments can help us *see* certain facts. To which I add: this bidirectional influence can be ongoing—there can be *coevolution of judgments*—over the course of years. Leopold's valuing of the outdoors led him into forestry, but forestry didn't fully capture all he found valuable in the outdoors, eventually leading him to game management. But game management turned out to be a difficult issue to address—in fact, not just for deer/wolves, but more generally (see Meine 2010). Eliminating all the predators did not have the expected results. The data could be explained away for many years, but eventually Leopold was forced to accept that more deer did not lead to better hunting—it led to denuded forests and starving deer. During the same time, Leopold begins to emphasize the value of a healthy land community, and eventually fits wolves into that picture. And that eventually becomes the value of wolves in and of themselves, regardless of their benefits to others.

In short, Leopold's trajectory exhibits a bidirectional influence between descriptive beliefs and evaluative beliefs over *decades*—a coevolution. Leopold stated that the land ethic is a "product of social evolution" (1949, 225). Perhaps that reflects the evolution of his own ideas, with descriptive beliefs modifying evaluative beliefs (and vice versa), analogous to the way that bees modify flowers (and vice versa) over the course of many years. Of course, social (i.e., cultural) evolution is famously much faster than biological evolution and the mechanisms are not identical; I use "coevolution" in a metaphorical sense here.

³ Flader (1994) provides an extended discussion of Leopold's changing views over time. She argues that integrity/coevolved diversity, stability, and beauty were "fundamental to Leopold's thinking from the beginning" but that they "acquired new meanings and implications throughout his life in response to his changing perception of the environment, so they meant something quite different in the end from what they had in the beginning" (Flader 1994, 34). My focus in this paper is narrower, on Leopold's changing views on wolves and deer.

⁴ These are Anderson's terms. I prefer Clough's terminology: descriptive beliefs and evaluative beliefs, respectively. These avoid controversy over the nature of facts as well as judgments.

Seeing a case where evaluative beliefs and descriptive beliefs coevolve over time allows us to see that refinements of beliefs need not be large or sudden. This makes the refinements more psychologically plausible even if human agents aren't reliably open-minded (cf. Yap 2016). That is, there is no presumption here that new data will cause a person to experience a large change in their descriptive or evaluative beliefs, or any change in beliefs at all. The presumption is rather the much more modest one that they *can* cause such changes, gradually and over time.

Anderson (2004) further suggests that some values may be systematically more epistemically fruitful than others. Again, Leopold's trajectory illustrates this well. Leopold's early values turned out to be epistemically *unfruitful*. His valuing the experience of deer hunting a large population of deer turned out to undermine not only deer hunting but also the health of the deer and the health of the land communities that they were members of. His early values led him to advocate poor management policies; he spent his later years fighting to correct those policies as his evaluative beliefs and descriptive beliefs changed.

However, unlike Anderson, I resist the idea that “[t]he *primary* evidence for being mistaken about a standard of appraisal [for a value judgment] is itself tied to emotional experience” (Anderson 2006, 5; emphasis added). I think that emotional experiences *can* serve as evidence for value judgments, so I am not fully objecting to Anderson's view here, but Leopold's life shows that other experiences, like field experiences, can do the same. This is not to say that Leopold's emotional experiences were irrelevant to his values, just that they did not seem to be the driving forces behind his changes in values. Rather, the available evidence suggests that the driving forces were typically his field experiences and data exposure more generally.⁵

Sharyn Clough's account of the relation between evidence and values—that no intermediary, emotional or otherwise, is needed between evidence and values—better fits the lessons of Leopold's trajectory. Clough asserts that:

... values, including political values, are themselves beliefs with empirical content, derived, more or less well, from the evidence of experience that generated the beliefs; that where relevant and well-supported by evidence, the inclusion of values in scientific theorizing can increase the objectivity of research; and that where *irrelevant* and *poorly supported*, the inclusion of values can decrease the objectivity of research. (Clough 2020, 7; references omitted, emphasis in original)

Leopold's early valuing of large deer populations and disvaluing of wolves indeed exhibited values with empirical content. His values presumed that the best way to preserve the deer-hunting experience was by killing predators, which was entangled with a disvaluing of predators; early on, Leopold referred to wolves as “vermin,” saying that “advisability of controlling vermin is *plain common sense*, which nobody

⁵ The passages from “Thinking Like a Mountain” quoted above might seem to suggest that it was an emotional experience that prompted the change in Leopold; however, the only reference that has been found to the experience was in a letter to his mother that briefly mentions the wolf killing in passing (see Meine 2010). A brief remark made in passing does not suggest that at the time—as opposed to after many years of reflection—he found killing the wolf to be a significant emotional experience.

will seriously question” (Leopold 1919/2013, 201; emphasis added). But those values—that “common sense”—turned out to have poor empirical support. Later evidence overturned them for more empirically supported values: that the deer-hunting experience cannot be maintained without large predators like wolves, and, eventually, for the view that wolves should be allowed to continue as a matter of biotic right and that they are essential for land health in many cases.⁶

Clough further maintains “that scientists, as with all of us, can increase the objectivity of research by adopting a *pragmatically-inclined* appreciation of the *fallible, inductive* process by which we gather evidence in support of any of our beliefs, whether they are described as evaluative or descriptive” (2020, 7; emphasis added). Again, this fits Leopold’s story. The process was certainly a *fallible* one; early evidence concerning the failures of “predator control” didn’t change Leopold’s mind, and then when it did start to change his mind, it was only incrementally. But eventually, *inductively*, Leopold came to see things differently. *Pragmatically*, Leopold’s early values *simply didn’t work*. His later values, which shifted toward the value of biodiversity and soil health for the value of land health more generally, worked better—even as these are still fallible, as all evaluative and descriptive beliefs are.

Given that the process by which we gather evidence in support of our beliefs is a fallible one, it should not be surprising that there are those who still do not accept Leopold’s view that wolves are and should be treated as members of the community (a belief that has both evaluative and descriptive aspects). Indeed, as a recent article notes, “a common belief about large predators is that they compete with hunters by decreasing ungulate populations through additive mortality” (Trump et al. 2022, 2), a belief that the authors seek to debunk through their study of elk in Alberta over a 26-year period. This belief is sometimes conjoined with a belief that predator “control” ought to be instituted, even though most studies show it not to be efficacious or cost-effective (Miller et al. 2013, 390). Evaluative beliefs can become entrenched and be hard to change—but so can descriptive beliefs. The point here is that they often go together. Perhaps the best that can be done is to try to show people that given certain beliefs they have (e.g., about the value of hunting ungulates), other beliefs that they have (e.g., about the disvalue of wolves) are simply not consistent—that their complete set of values *doesn’t work*, necessitating change. There is no guarantee that that process will succeed, but Leopold’s life trajectory shows that it is possible that it will.

Leopold’s evaluative beliefs, his values, were tested—well-tested—as were his descriptive beliefs. That is, they evolved over time as they were tested against the evidence of his experiences, in ways that go beyond what I have space to discuss here. *To the extent that these tested beliefs still underlie much of conservation biology*—and I think they do to a significant extent—they put conservation biology on a firm empirical footing. New empirical findings may change those values to some extent, and modified values may change descriptive beliefs in turn, but a proper understanding of the relation between evaluative beliefs and descriptive beliefs shows that the

⁶ It might seem like Leopold did not have to shift toward thinking that wolves and other species should be allowed to continue as a matter of biotic right—that perhaps he only needed to say that they are important insofar as they contribute to land health—but as noted in the quotation above, even when “overworked” such arguments often failed to protect species.

value-ladenness of today's conservation biology can be an asset rather than a liability. Some of these values are well supported by evidence and relevant to projects of importance. They thus help strengthen the empirical adequacy of conservation biology.

5. Summary and conclusions

Leopold's evaluative and descriptive beliefs about wolves and deer (and biodiversity and land health) not only influenced each other, they did so repeatedly over the course of his career, each modifying the other in light of his experiences in the world, in what I am calling a coevolutionary process. My analysis of Leopold supports Anderson's (2004) account of the bidirectional influence of "fact judgements" and "value judgements." It also supports Clough's (2020) account of the direct effect of experiences in the world on both evaluative and descriptive beliefs in a fallible, inductive process. And it extends both accounts by showing that these influences can occur repeatedly over an extended period, so that the two types of beliefs coevolve, being tested and refined over time. Although it is a single case, it shows that such coevolutions of belief are possible and worth looking for elsewhere.

To the extent that the values articulated by Leopold and Soulé in turn still underlie conservation biology, they provide a firm grounding for future findings in the field. Soulé was right that such value judgments can't be "proven," but they can be shown to be fruitful, sustainable guides to policy and action, even as they continue to be modified over time.

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