



# What are 60 warblers worth? Killing in the name of conservation

John A. Vucetich and Michael P. Nelson

J. A. Vucetich (javuceti@mtu.edu), School of Forest Resources & Environmental Science, Michigan Technological Univ., Houghton, MI 49931, USA. – M. P. Nelson, Lyman Briggs School of Science and Dept of Fisheries and Wildlife, Michigan State University, East Lansing, MI 48824, USA.

Ecological research sometimes entails animal suffering and even animal killing. The ethical appropriateness of animal suffering and killing in conservation research may entail considerations that differ from many other kinds of research. This is true, inasmuch as conservation research is specifically motivated by an ethical premise: an appreciation for non-human life. In striking contrast with other academic fields (e.g. medicine), however, the ethical dimension of conservation research is only rarely discussed. When it is discussed, it tends to be characterized by logical errors. These errors are important because they are general (i.e. both common and with far-reaching implications), and they are easily made by intelligent people; especially those with no formal training in ethics or logic. Failure to recognize these errors could stymie efforts to increase the ethical quality of ecological research conducted in the name of conservation.

We take advantage of a recently published dialogue concerning the ethical appropriateness of a specific field experiment that entailed killing black-throated blue warblers, *Dendroica caerulescens*. Both sides of this debate exemplify the kinds of errors to which we refer. In this paper we briefly review the arguments presented on each side of this debate, highlight their mistakes, and indicate necessary corrections. We argue that: (1) compliance with animal research regulations, while important, inadequately accommodates the ethical aspects of animal research, and (2) individual ecologists ought to understand themselves what does and does not represent sound and valid arguments for ethical decisions. Finally, we discuss how any ecological researcher might begin to apply our analysis to his or her own research.

“Lacking adequate exposure to the principles of environmental ethics, most practitioners of conservation (especially those emerging from university resource management programs) quickly become missiles without guidance systems.”

E. “Phil” Pister, Executive Secretary, Desert Fishes Council, retired fisheries biologist

Consider a field experiment that measured behavioral and ecological differences between territorial pairs of black-throated blue warblers, *Dendroica caerulescens*, with and without neighboring conspecifics (Sillett et al. 2004). The experiment entailed killing, with a shotgun, a number of individual black-throated blue warblers. The number of warblers killed was not reported. However, reasonable inferences drawn from the

researchers’ methodological description indicate that, to obtain four replicates of an experimental treatment, the researchers killed between 60 and 120 black-throated blue warblers. Sillett et al. (2005) attempted to defend the ethical appropriateness of their actions, in part, on the grounds that their experiment represented conservation research.

The conservation of non-human life and ecological processes that depend on such life is good and right. This is an ethical claim and it is the principle that founds and motivates the scientific discipline of conservation biology (Groom et al. 2005). Although not unique, conservation biology is conspicuous and distinctive among scientific disciplines for its open relation to (environmental) ethics. Despite its ethical underpinnings, journals representing conservation science engage in stunningly little discourse on the ethical dimensions of its own endeavor. Between

1995 and 2005, several top conservation/ecology journals (i.e. *Animal Conservation*, *Biological Conservation*, *Conservation Biology*, *Ecology*, *Ecological Monographs*, *Ecological Applications*, *Journal of Animal Ecology*, *Journal of Applied Ecology* and *Oikos*) published just 14 papers containing the word “ethics” or “ethical” in their title or keywords (ISI literature search). For context, a single journal, the flagship journal of American medical research, *The Journal of the American Medical Association* (JAMA), published 173 such papers during the same time period. On a per journal basis, JAMA alone publishes papers about ethics at a rate that is two orders of magnitude greater than these ecology/conservation journals. This contrast may indicate that the ethical outlook of the conservation science community is fundamentally anthropocentric (i.e. non-human things are valuable insofar as they serve human interest, and otherwise possess no moral relevancy) and therefore the ethical dimensions of ecological research need not require much attention. In contrast to JAMA, conservation scientists seem to signal (regardless of attitude or sentiment) that the moral dimensions of their work are not worth much discussion because they are insignificant, intractable, or obviously settled.

However, the case of Sillett et al. (2004) suggests otherwise; given that it provoked a dialogue about the ethical nature of lethal experiments in conservation research (Bangert 2005, Sillett et al. 2005). Unfortunately, the Sillett et al./Bangert dialogue is symptomatic of a discipline inexperienced with mature discussion of ethical matters. The dialogue contains numerous and significant errors of logic and represents inadequate consideration of the ethical dimensions associated with killing sentient creatures in the course of ecological research and in the name of conservation. In this paper we: 1) briefly review the arguments by Sillett et al. (2004, 2005) and Bangert (2005), 2) highlight their mistakes and make corrections, and 3) discuss how any ecological researcher might begin to apply our analysis to his or her own research.

Our analysis presumes that conservation researchers would take for granted that: 1) killing a sentient creature is a serious matter, 2) the consideration of its justification requires great care, and that 3) ethical justifications are not purely subjective rationalizations.

## The arguments

In this section, we aim to highlight the main arguments presented by Sillett et al. (2004), Bangert (2005), and Sillett et al. (2005), with the least possible comment or interpretation.

### The original research: Sillett et al. (2004)

Sillett et al. (2004) do not offer an explicit rationale for the purpose of justifying the warbler killing. Certainly, the warbler killing is justified insofar as it was a logistical necessity, given the experimental design to which Sillett et al. (2004) were committed. Significantly, they were silent with respect to justifying that the benefits of the research outweigh the costs of the warbler killing.

We also take note of Sillett et al.’s (2004) explicit statement that their methods followed state and federal laws and university policies concerning animal handling. Most scientific journals require explicit disclosure of such facts in cover letters accompanying manuscript submission. For this reason, such compliance can be reasonably presumed without explicit disclosure in each published article. Accordingly, most (certainly not all) published articles entailing the handling of vertebrate individuals do not explicitly disclose such compliance; or disclose such compliance only in acknowledgement section. Publishing an explicit disclosure may indicate that Sillett et al. (2004) anticipated objections to their warbler killing and believed that adherence to law and policy would provide adequate defense of their ethical behavior.

### The complaint against killing: Bangert (2005)

Bangert (2005) argues that the killing is ethically unjustified for two main reasons:

(B1) Although Sillett et al. (2004) followed laws and regulations, this is not enough to ensure ethical practice. Self-regulation is important for maintenance of adequate ethical standards. Bangert clearly intended “self-regulation” to mean individual self-reflection leading to individual self-regulation; not merely adherence to institutional regulation. According to Bangert, Sillett et al. (2004) did not appropriately self-regulate, and here they are in error.

(B2) Some ecological and conservation research is unjustified because it entails “destroy[ing] the very things (animals and their habitats) that we are desperately trying to preserve (Bangert 2005).” He acknowledges that important experiments might justify killing, but neither generally nor automatically.

Bangert’s explicit indictment of Sillett et al. (2004) rests upon an implicit assumption about the relationship between (B1) and (B2). Namely, that Sillett et al. failed

to explicitly account for (B2), and in doing so they commit an unethical act according to (B1).

### **The defense against the complaint: Sillett et al. (2005)**

The defense presented by Sillett et al. (2005) entails an appeal to rule-following and arguments concerning the benefits of their research as compared to the cost of killing.

(S1) With respect to rule-following they write: "Lethal methods are sometimes required as part of sound, scientifically rigorous ecological research. We support such research if it conforms to established ethical standards . . . , meets legal requirements . . . , is peer-reviewed, and addresses relevant scientific questions."

(S2) Sillett et al. do not provide any further arguments to justify or defend the ethical status of their work. However, they do present a few passages that seem to imply or reflect an argument. These passages are: "[o]ne of the most urgent avian conservation issues is the decline of migratory bird populations," and "large-scale deforestation of breeding habitat [is] truly invasive and destructive for songbird populations." These passages seem to imply, or at least permit one to think, that any particular instance of new, high-quality, basic ecological research is automatically justified because it has a reasonable chance of being significantly valuable to conservation, which itself has a moral imperative.

### **The mistakes**

The Sillett-Bangert dialogue entails at least three significant, yet common, mistakes. Here we identify and critique these mistakes.

The first mistake, illustrated by (S1), is a mistaken assumption: ethical responsibility may be deferred to others. This is manifest in two ways. One manifestation of this mistake is in thinking that rule-following adequately ensures ethical behavior. Sophisticated ethical training is not required to appreciate the problem with this assumption. Not all cases of rule-following are ethical (e.g. the defense or deflection of war crimes charges by referring to following orders from one's superiors); and not all cases of rule-breaking represent unethical behavior (e.g. the civil disobedience of Rosa Parks, Martin Luther King, Jr. and Gandhi). Moreover, even if perfectly applied and adhered to, the rules and standards of various animal care committees merely

reflect one certain type of animal welfare ethic. However, given the contested nature of animal welfare ethics (Frey 1983), mere adherence to any specific type of animal welfare ethic does not guarantee the moral correctness of the action; it only guarantees that a given ethic and hence policy was adhered to. Hence, adhering to "established ethical standards" in no way guarantees that one's work is in fact ethical.

While adherence to codes of conduct may coincide with moral maturity, major philosophers throughout the history of western philosophy have effectively argued that moral maturity requires transcending rule-following (e.g. Aristotle's *Nicomachean Ethics*, Plato's *Meno* and *Republic*, Hume's *Inquiry Concerning Human Understanding*, Ross 1930, McIntyre 1981, Burnyeat 1980). According to these philosophers, moral maturity also requires the ability to understand and assess ethical decision-making processes. While this does not guarantee, it would seem to foster, the development of research whose ethical quality exceeds that demanded by existing regulatory standards. Moreover, failure to understand ethical decision-making processes risks committing fallacies that logicians know formally as the fallacy of begging the question and fallacy of affirming the consequent (Copi and Cohen 2005).

As an aside, the ethical standards for research involving animal use vary significantly among countries (Gales et al. 2003), with some being more restrictive than others. While important ethical insight would certainly arise from assessing which regulatory standard and what degree of restrictiveness represents the greatest moral maturity, space precludes presenting such an analysis here. One difficulty with such an analysis would be that more restrictive standards do not necessarily equate with the highest possible ethical quality. This is because simple restrictions (e.g. to say that an animal cannot be treated in some particular way) only account for one kind of ethical cost entailed by research. However, the overall ethical quality entails all the ethical costs and benefits of the research (e.g. the ethical benefits of the research, such as better conditions for other animals – human or otherwise). More importantly, such an analysis would be independent of the point we make here (i.e. mere adherence to a particular, existing regulatory standard cannot by itself lead to moral maturity).

A second means of deferring ethical responsibility is reliance on peer-review. Peer-review does not ensure the ethical appropriateness of research; in the same way that it does not ensure scientific quality. Researchers that regularly produce research of the highest scientific quality do not, we suspect, primarily gauge the quality of their own work by asking themselves whether or not it will merely pass peer-review. Such researchers engage

in torturous self-reflection, introspective contemplation, and self-rejection of many ideas that initially seemed worthwhile. The motivation, we believe, is an earnest desire to ever-increase the scientific quality of his or her work. It seems cogent to think that producing research with a high ethical quality requires similar effort, creativity, and outlook. That outlook is not a desire for an approved research project, but for the greatest ethical quality possible. Just as few of us are at risk of producing research of overly-high scientific quality, few of us are at risk of being overly ethical.

In sum, a mature defense of Sillett et al. (2004) would rely little on propositions such as (S1). Moral institutions (e.g. codes of conduct, laws and rules) are important, but they should never satisfy. For emphasis, the problem with deferring ethical responsibility to others is entirely distinct and not inconsistent with believing that some moral institutions represent a significant improvement on past practices. Finally, representative societies – from nation-states to professional societies – become more authoritarian and less democratic to the extent that their constituents defer responsibility, including ethical responsibility.

The second mistake (manifest in (S1)) is an uncritical assessment of the relationship between ecological research and conservation. Indeed, ecological knowledge is essential for conservation. However, this fact alone does not imply that any particular instance of new, high-quality, basic ecological research is automatically justified because it has a reasonable chance of being significantly valuable for conservation. The burden is to critically judge what kinds of ecological research are likely to be valuable for conservation, or justified despite their ethical costs. Relatively little has been written about the value of ecological research for conservation. This is disturbing because what has been written clearly indicates that conservation scientists understand neither the relationship between ecological research and conservation nor how they ought to be related (Song and M'Gonigle 2001, Byers 2002, Srivastava 2002, Linklater 2003, Clearly 2006).

Apparently, the relationship between research and conservation is uncertain and the conservation value of any particular bit of research cannot be taken for granted. Consequently, researchers have a burden to articulate how their research might reasonably benefit conservation and how this benefit would outweigh the ethical costs of the research. Sillett et al. (2004, 2005), for example, provide no such articulation. Institutionalizing the process of explicitly tending to these issues in grant proposals and publications would help better understand the relationship between research and conservation.

Avoiding this fallacious line of reasoning requires knowing and being able to admit that some ecological research will benefit conservation and some will not.

Some ecological knowledge is so nuanced that in all likelihood it will not contribute to conservation practice. Our sense is that researchers widely accept that effective conservation is not generally limited merely by a lack of ecological knowledge (Ehrlich 1995: 223 for a related perspective). That is, whereas we already know that overkill, habitat destruction, and exotic species are the ultimate ecological causes of species endangerment (Diamond 1989), the ultimate solution is fundamentally sociological in nature. For these reasons, one may not be justified in generally taking for granted that some particular piece of ecological research is of significant value to conservation.

Our distinction between practical conservation knowledge and nuanced knowledge may be analogous (perhaps deeply analogous) to the distinction between Caughley's (1994) small-population paradigm (which focuses on why, when, and how small populations go extinct) and declining-population paradigm (which focuses on understanding why, when, and how populations become small, e.g. habitat destruction). Caughley (1994) inspired significant dialogue and disagreement (Hedrick et al. 1996). The ethical dimension of Caughley (1994) loomed large, but remained largely implicit. The implicit ethical dimension is that each paradigm has an ethical value that is determined in part by its utilitarian value for conservation. Treatments of Caughley (1994) might be more robust if their ethical dimension were handled explicitly and appropriately.

The third mistake is a mistaken assumption: individual sentient creatures have no value beyond their value to the population. Contrary to this assumption, there is a substantial rationale for assigning at least some measure of intrinsic value to individual sentient non-humans. This rationale is developed across a wide range of scholarly perspectives in environmental ethics, including Animal liberation (Singer 1990), Animal rights (Regan 1983), Biocentrism (Taylor 1986), Extended individualism (Johnson 1991), Universal consideration (Birch 1993), Deep ecology (Naess 1989) and Ecocentrism (Callicott 1989, 1999, Rolston 1994). This list includes neither all western ethical traditions nor any non-western ethical traditions that would find this third assumption to be mistaken. The robustness of this principle, defended by various ethical theories, is buttressed by the empirical observation that many people, and we guess many conservation scientists, value individual sentient non-humans (Kellert 1993, Anonymous 1998, Manning 2003).

This third error is manifest in (S2). To confirm, note that if individuals have value beyond their value to the population, the justification for lethal methods is substantially more complex than Sillett et al. (2004) indicate. The justification of lethal methods also entails comparing the costs to individual warblers with the likely benefits to populations of warbler (or related

species). Nowhere do Sillett et al. (2004, 2005) discuss the extent to which the likely benefits to the population would outweigh certain costs to individuals.

Apparently, preeminent ecologist Robert H. MacArthur was encouraged by his colleagues to conduct field experiments, which would have required killing warblers, to evaluate some ideas for which he is now well known (MacArthur 1958). He refrained from such research because he did not think the scientific insight would have outweighed the cost to the warblers (W. C. Kerfoot, pers. comm.).

Additional aspects of this third mistake are illustrated by Sillett et al. (2004), when they write: "We agree with Remsen (1995) that such attitudes (i.e. objection to killing for research purposes) also indicate 'a lack of awareness of the extent and causes of natural mortality'." This statement refers to the following argument: concluding that no ethical costs are incurred by killing individual sentient organisms requires one to believe that: 1) individuals have no value beyond their value to the population's viability, 2) many individuals will die anyway, and 3) mortality is compensatory (Boyce et al. 1999). Assertions (2) and (3) mean that if some event does not cause an individual to die today (e.g. being killed by an ecological researcher), some other event (e.g. predation or starvation) is liable to cause its death in the near future (i.e. ~three to six months). This argument is sound so long as all three assertions hold. However, if one presumes that individuals have some intrinsic value or some value beyond their value to the population's viability (i.e. if one presumes that assertion (1) is false), this argument reduces to: there is no ethical cost in killing a sentient, non-human individual because many other individual(s) will die anyway and the individual that I kill has a significant chance of dying soon, regardless of my action. If applied to the killing of humans, this argument would clearly be absurd. The absurdity of the argument holds when applied to individual non-human sentient creatures given that being sentient (rather than being human *per se*) is a commonly assumed, ethically relevant quality (Regan 1983, Singer 1990, Rawles 2004). The fundamental, yet apparently overlooked, point is that judging the ethical rightness or wrongness of killing in the name of conservation is very difficult precisely because both populations and individuals are valuable (Leopold 1949). If only one were valuable, the ethical solution would be substantially simpler.

Moreover, ecological research indicates that assertion (3) does not always hold either. Mortality is often only partially compensatory, and the compensation entails increased reproduction, not a decrease in other causes of mortality (Boyce et al. 1999).

## Environmental fascism

A more general form of the third mistake would be: the value of conservation (especially if this equates with 'the conservation of populations and species') trumps all other values (including the value of individuals).<sup>7</sup> Rawles (2004), for example, provides a detailed analysis demonstrating that killing sentient organisms in the name of protecting biodiversity is not, in many important cases, obviously justified. Neglecting the cost to individuals, or thinking that concern for individuals is misplaced, runs the serious risk of transforming conservation research (and management) into what others in environmental philosophy have referred to as environmental fascism (reviewed by Nelson 1996).

Fascism is a political theory wherein (Rocco 1925): "society is the end, individuals the means, and . . . life consists in using individuals as instruments for its social ends." The demagoguery of Mussolini and Hitler was their sanctification of human communities at excessive costs to human individuals. Fascism is thought to be objectionable because it posits that the good of the community is the only good, and people are only valuable to the extent that they benefit the community. Some philosophers (Regan 1983, Aiken 1984, Attfield 1991, Biehl and Staudenmaier 1995, Ferry 1995) have accused some environmentalists and some environmental philosophers (especially those inspired by A. Leopold's Land ethic) of environmental fascism, which occurs when one speaks and acts as though the good of environmental collectives is the only good, and individuals comprising one environmental collective or another are only valuable to the extent that they benefit some environmental collective. Environmental philosophers (Callicott 1989, 1999, Nelson 1996) who have been accused of environmental fascism don't embrace it; instead, they explain how their positions do not represent environmental fascism. That is, they point out how their positions account for the value of both individuals and collectives, such as populations.

However, ecologists: (1) unknowingly risk environmental fascism when they fail to assess the value of collectives (e.g. populations, species, ecosystem) relative to the value of individuals, and (2) unknowingly embrace environmental fascism when they presume that the value of the collective is the only value (Sillett et al. 2005). Because all environmental philosophers think environmental fascism is best avoided, conservation scientist may need to avoid certain rhetoric and practices, and work to account for appropriate balances between non-human individuals and ecological collectives. Such work will likely require dialogue between

conservation scientists and philosophers that has heretofore been inadequate.

## A minimal ethical principle

Avoiding the mistakes outlined above requires recognition that no single value always or automatically trumps all other values. Conservation has value. Individuals have value. When values compete – the usual state of affairs – determining the ethical status of a potential action requires qualitative cost–benefit analysis. We appreciate that cost–benefit analyses (at least certain types) have a reputation for causing ecological damage and suffering. However, cost–benefit analysis per se is not the trouble. The trouble with cost–benefit analysis has been its conversion into a purely objective calculus that tends to either ignore or mis-weigh important costs and benefits (Sagoff 2004).

Cost–benefit analysis in its most basic form is merely an appeal to rational consistency. Qualitative cost–benefit analysis entails comparing and judging disparate values (e.g. the value of a warbler – or 60 warblers – against the value of bits of ecological knowledge, or potential ecological knowledge). Although such judgments are difficult and partially subjective, they are possible, not entirely arbitrary, and ultimately inevitable. Moreover, because this type of cost–benefit analysis is not simply formulaic, each individual researcher is obligated to work out the ethics of individual research projects.

Below we provide some thoughts to aid one's judgment concerning the ethical costs and benefits of ecological research.

### Judging benefits

Some benefits to consider are:

- The researcher benefits from research through prestige and promotion. The salient consideration here is that when the cost–benefit analyst (i.e. the researcher) is the beneficiary and incurs no cost, there is a tendency to overestimate the benefit and underestimate the cost. Under these circumstances, accurate assessments of cost require empathy, and accurate assessments of benefit require humility. Neither trait is acquired without effort.
- A possible benefit of ecological research is knowledge that satisfies pure curiosity or generates wonderment about, and hence respect for, a certain species or ecological system. For much of the history of science, research for the satisfaction of curiosity has been valued greatly. We do not deny this value of scientific inquiry. However, it is

difficult to imagine that mere curiosity would ever justify the intentional killing of a sentient creature. Killing sentient creatures is arguably inconsistent with the goal of generating wonderment and respect.

- The benefit of ecological research may also be partly judged by its overall scientific quality. For reasons including prestige, job security, and commitment to valuable science, most scientists strive for the highest scientific quality they can possibly achieve. Moreover, for a given ethical cost, the ethical quality of research increases with its scientific quality. The point is the nature of scientific quality is not merely pragmatic, it is also ethical.

A comprehensive discussion of factors that determine the scientific quality of research are beyond the scope of this paper and are the subject of active research in the philosophy and sociology of science (Merton 1979). However, it seems worthwhile to consider that (at one extreme) research relying on age-old methods to address perennial questions may not produce profoundly new or unexpected information (Kuhn 1962), and (at the other extreme) research relying on under-tested methods or poorly rooted in ecological theory is also at risk of not producing new, relevant knowledge.

- A possible benefit of ecological research is knowledge that it better conservation. Judging the benefit of much research for conservation would be difficult. Consider Simberloff and Wilson (1969), which incurred the ethical cost of fumigating a set of island ecosystems. The scientific value of Simberloff and Wilson (1969) is a matter of public record and suggested by the number of times it has been cited. However, judging the conservation value of Simberloff and Wilson (1969) would seem to require, at least, a sense for answers to questions like: The insights of Simberloff and Wilson (1969) have resulted in preventing the extinction of how many species and minimizing human impact on how many square kilometers of landscape? Again, by asking the question, we do not imply a negative answer. Our claim is that judging the conservation value of research would be difficult but critically important.

Uncertainty about the conservation value of research does not preclude one from making rational, ethical decisions about the research. However, such decisions do require acknowledging and accommodating the uncertainty. This circumstance is deeply analogous to making management decisions in the face of ecological uncertainty. Decision-making in the face of such

uncertainty is notoriously difficult (Turner and Hartzell 2004, Regan et al. 2005).

## Judging costs

Some costs to consider are:

- When ecological research entails killing organisms, the primary considerations include the number killed and their sentience. Sentience may be usefully equated with the capacity to suffer (Singer 1990, Chandroo et al. 2004). Although no precise definition of “sentience” has universal acceptance among ethicists, there is little controversy that sentience and suffering are morally relevant qualities. To non-professional ethicists, the various perspectives on the meaning of sentience would seem highly nuanced and rarefied (For an introduction to the topic see Rosenthal 2002). Inasmuch as sentience and suffering are ethically relevant qualities, a rationally consistent morality requires that we grant sentient animals moral consideration. Although sentience seems important, our intention is not to make it to sole morally relevant factor.
- Frequently, ecological research causes direct or indirect suffering to animals. Such costs may be significant (e.g. the suffering caused by tooth-pulling for aging mammals, electro-shocking fish, mist-netting birds, and perhaps all forms of animal handling). Ecologists, perhaps more than others, are well equipped to recognize animal sentience and suffering. The cost of animal suffering, however, can be more difficult to judge than the costs of killing because, in addition to numbers and sentience, these decisions also entail judging the degree of suffering.

By a remarkable synthesis of philosophical concepts and physiological observations of teleost fish, Chandroo et al. (2004) demonstrate how deeply-entrenched anthropocentric tendencies and limited knowledge about the status of the non-human world can cause us to overlook animal suffering when, by all reasonable accounts, it exists. Neither uncertainty nor intuition about the suffering of a non-human should be taken as safe grounds for presuming that suffering is absent. Making a rational decision under such circumstances is genuinely challenging, but possible.

- All ecological research has a financial cost. This cost has an ethical dimension because research funding could be diverted to accomplish other positive ends; conservation or otherwise.

The above points may appear pedantic and obvious. However, in the few instances where ethical costs are handled explicitly (e.g. Bangert/Sillet et al. dialogue), they seem to be mishandled. This mishandling and the complicated nature of applied ethics suggest that these points are neither pedantic nor can a proper analysis of these points be taken for granted. To think otherwise runs the risks of committing the fallacy of affirming the consequent.

## How much moral worth ought an individual have?

Just as it seems unethical to attribute no moral worth to non-human, sentient individuals, it seems equally inappropriate to attribute as much moral worth as we would to a human. A general suggestion has been that the degree of moral worth owed to an individual ought to be commensurate with the sentience of the individual (VanDeVeer 1979, Pluhar 1995, Varner 1998, Agar 2001). Although assigning moral worth on the basis of sentience seems eminently rational, it presents several challenges. Most basically, is it even sensible to speak about amounts (relative or absolute) of moral worth? Ethicists have paid considerable attention to this problem (Zimmerman 2001), leaving us with two thoughts: 1) the idea that moral worth is in some way calculable seems inescapably necessary, and 2) reasonable methods for “calculating” moral worth continue to be elusive. Moreover, although sentience is an objective trait of an individual, perceived moral worth depends greatly on the observer’s willingness and ability to empathize (Preston and de Wall 2002). Humans are notorious for employing marvelously intricate rationalizations to deny patently obvious moral worth, e.g. when we aim to justify warfare (Maiese 2003). We should, therefore, be vigilantly on guard for such excuses.

To approach this problem positively, begin by considering Gensler’s principle of ethical consistency (PEC) (Gensler 1996): “treat others only as you would consent to be treated in the same situation.” To apply a PEC to another is to assign it moral worth. It seems reasonable to apply PEC consistently and not arbitrarily; that is, to apply PEC unless there is good reason not to. Social psychology indicates that application of PEC depends on one’s ability to empathize (i.e. to imagine myself in another’s situation), and in many cases application of PEC depends only on the ability to empathize (Batson 1991). Moreover, empathy is limited by familiarity and perceived similarity (Preston and de Wall 2002). Therefore, one can arguably empathize with, and thereby apply a PEC to, anything with which one is familiar and can observe similarity.

These ideas suggest that you ought to treat non-human individuals with as much moral worth as you are able, where your ability is limited by familiarity and perceived similarity, which can be stretched, through personal effort, to indeterminate lengths. This perspective is neither final nor exclusive. However, it does illustrate that one can approach the challenge of moral worth in a coherent manner; and in a fashion that simply exercises or tends to commitments that one already has (here, the commitment to consistency). The application of PEC to environmental ethics has roots in prior work (Gould 1990) and has been appreciated by environmental ethicists (i.e. Gould (1990) has been reprinted in Pojman's *Environmental ethics* (2005)). Finally, the dependence of empathy and PEC on similarity and familiarity has important implications for the training of student ecologists and for how researchers portray their research on non-humans to the public.

## Conservation in practice

### High stakes

Conservation actions (in contrast to research) also sometimes entail animal killing or suffering (especially, the control of exotic animal species). The ethical stakes for conservation actions can be greater than for conservation research, because both the costs and benefits of conservation actions are often greater. The stakes are higher because, compared to conservation research, conservation actions can immediately entail ethical costs to many more sentient individuals and benefits exist on a much grander scale (e.g. the restoration of a landscape or preservation of a species).

### Examples

To illustrate the genuine difficulty entailed by determining the ethical nature of a conservation action, we outline the ethical dimension of three conservation action scenarios:

1) brood parasitism, by brown-headed cowbirds, may be a proximate cause of endangerment for a few species (e.g. least Bell's vireo, Kirtland's warbler, southwestern willow flycatcher, black-capped vireo). This premise has been used to justify killing many thousands of individual cowbirds. This justification has also been challenged on grounds that (Rothstein 2004): 1) other, anthropogenic factors, not nest parasitism, are the ultimate causes of endangerment for these species, 2) killing cowbirds may not always increase the viability of endangered species, and 3) the potential benefits of cowbird killing may not outweigh the financial

costs. (For context, the USFWS spends approximately \$90 000 per year to kill cowbirds for Kirtland's warbler conservation, Muehter 2005.) These issues are sufficiently complex and important that they motivated formation of the North American Cowbird Advisory Council, an NGO comprised primarily of scientists, whose mission is: "ensuring that all phases of cowbird management are based on good science and are executed in a [financially] cost-effective manner [<http://cowbird.lscf.ucsb.edu/>]." The evaluation of cowbird killing is typically reduced to a cost-benefit analysis that accounts for the financial costs, benefits associated with preventing extinction of a few bird species with narrow geographic ranges, and scientific uncertainty about the effectiveness of killing cowbirds. By accounting for these factors only, cowbird killing may or may not be justified.

Among professional ecologists, concern about the ethics of killing cowbirds in the name of conservation seems to have been limited to a small group (Rothstein 2004, Ortega et al. 2005). For example, Rothstein (2004) writes:

A serious concern about cowbird control revolves around ethics. When there is reason to believe that cowbird control will have beneficial effects on a threatened or endangered species, only extreme animal-rights advocates are likely to oppose it. When managers initiate cowbird control in a knee-jerk fashion, without determining whether it is really needed, then ethics come into question.

This treatment accommodates much ethical concern by questioning the morality of cowbird-killing when its need or effect is dubious. However, an adequate treatment would also recognize that believing 'individual, sentient creatures have at least value beyond their effect on some population's viability' is not limited to "extreme animal-rights advocates" (Kellert 1995, Anonymous 1998, Manning 2003). Accommodating this well-reasoned belief requires a substantially more sophisticated treatment of ethics than is represented by the above quotation. The argument, as presented, even risks making the third mistake described in *The mistakes and inheriting the problems associated with environmental fascism* (Nelson 1996).

An appropriate treatment of the ethics of cowbird-killing would entail directly engaging a comparison of the ethical costs associated with killing individual cowbirds with other costs and benefits of cowbird-killing. All such discussion would require acknowledging that value of the life of a single cowbird is very unlikely to be zero. Consider the specific case of cowbird-killing for Kirtland's warbler conservation: between 1971 and 2002, more than 124 000 cowbirds were killed in the name of Kirtland's warbler



conservation (Rothstein 2004). Given this information, the relevant ethical question is: is the Kirtland's warbler species (i.e. the collective) worth more than 124 000 cowbird lives, given that the effect of cowbird killing is uncertain and that physical welfare to humans is not at stake (this diminishes, but not to zero, the value of the species, as a collective). In the context of cowbird-killing for conserving other species, one must also answer questions like: is cowbird-killing ethically justified if efforts to reverse land management practices that facilitate brood parasitism and ultimately cause endangerment remain woefully inadequate? (Some believe that brood parasitism is facilitated by forest fragmentation, Robinson et al. 1995, Donovan et al. 1997). Is it ethical to permit land developers or government agencies to fund cowbird-killing as a means of mitigating planned habitat destruction (Rothstein 2004)? Are the financial benefits associated with land management worth the lives of thousands of cowbirds, annually? The development of answers to these questions requires more sophisticated thought by a broader group of conservationists than has been applied to date.

2) Some conservationists have proposed reintroducing wolves in the Adirondack region of New York, USA. To assess the technical feasibility of this proposal, Paquet et al. (1999) conducted a population viability analysis. They concluded, without controversy, that a reintroduced wolf population could have a significant chance of survival and a significant chance of failure in the Adirondack region. On the basis of this technical result, some thought that a wolf reintroduction would be justified. However, Paquet et al. (1999) concluded that a reintroduction was unjustified, because a population, if it were to persist, would be living in what would be analogous to a wolf "ghetto", where individuals would suffer high rates of road kill and poaching. Expressing a belief that it is morally wrong to knowingly and intentionally subject sentient individuals to such a fate, Paquet et al. (1999) further concluded that: 1) the technical results of their viability analysis justify a serious effort to reduce human hatred of wolves and car lethality in the region, and 2) wolf reintroduction would only be appropriate afterward. Paquet's ethical consideration reflects the value of both populations and individuals. However, some conservation scientists believe that the Paquet conclusion places too much value on individual wolves.

3) Ungulate harvesting and culling is commonly justified on the grounds that it 'replaces' the 'control' that predators (which were native, but extirpated by humans) would have had on ungulate populations. Such control is taken to be necessary because the ungulates consume and affect vegetative communities, sometimes profoundly altering vegetative communities

across entire landscapes. Examples of this justification may be found in Sæther et al. (1996, 2001), Lemke (2003), and Wright (1999). The ethically-minded conservationist ought to consider whether: it is ethical to kill an ungulate because it consumes vegetation; it is ethical to kill an ungulate because native predators are absent, while no one is working to reintroduce or recover the missing native predators; it is the case that anthropogenic and non-anthropogenic population controls are adequately equivalent forces? Here, we are not questioning whether harvesting ungulates is ultimately or ever ethical. Rather, more serious consideration seems required to appropriately judge when it is ethical to kill ungulates in the name of conservation.

These examples are deeply complex because they entail interactions among possibly five distinct groups of morally relevant things: individual conservationists, other human individuals, human society (as a collective), individual creatures that comprise the non-human world, and ecological collectives (e.g. populations and communities) that comprise the non-human world. The numerousness and nature of these interactions is arguably what sets environmental ethics apart from general ethics. Clearly, original solutions are needed: solutions that are as likely to come from academic ethicists as from academic ecologists, or more likely from their collaboration.

## The nature of applied ethics

A few concluding perspectives explain how applied ethics can and cannot serve conservation science. First, because ethical decision-making is inherently and unavoidably imprecise and non-formulaic, we should guard against transmogrifying it into a formulaic exercise. Most applied and theoretical ethical frameworks warn against this (Kohlberg 1981, Kjonstad and Willmott 1995).

Nevertheless, some argue that ethical decisions can be made formulaically, objectively, and precisely by using frameworks such as decision theory. This view is tempting because decision theory is precise and formulaic, but the view is false because decision theory does not solve ethical problems without presuming much that is imprecise and non-formulaic. That is, decision theory is not entirely objective (Sen 1987, Kaplan 1996, Putnam 2002).

More specifically, decision-theoretic frameworks objectively account for costs and benefits of potential decisions and outcomes, as well as probabilities of outcomes given certain decisions. Consequently, these frameworks seem like a panacea for making complex ethical decisions and are increasingly advocated for use by natural resource managers (Wade 2000, Dorazio and Johnson 2003, Enck et al. 2006). However, the non-objective dimensions of decision-theoretic frameworks

are that, in practice, (1) the assignment of costs and benefits are fundamentally normative, and (2) the probabilities are not precisely or accurately estimable by empirical means in many cases. In such cases these probabilities are assigned values which are heavily influenced by subjective and value-laden factors (Dennis 1996). These cost, benefit, and probability assignments determine decision theoretic solutions. Ultimately, the remarkable formulaic machinery of decision theory disguises its subjective elements. Consequently, ethical decision-making cannot be reduced to a formulaic process such as decision theory. Although formulaic approaches can play a role in ethical decision-making (e.g. Canadian Council on Animal Care has used such approaches), ethical decision-making cannot be reduced to a mere formulaic process.

In these ways, applied ethics is similar to conservation science. Attempts at universally acceptable formulaic solutions for complex problems, such as how to conserve species or communities, are tempting and would be convenient. However, reducing complex conservation problems to mere logarithms is arguably inappropriate and misses the point of conservation problem-solving.

Second, the perceived imprecise and rhetorical nature of scholarly ethics does not render its application impractical or impotent. The foundation of practical ethics is self-reflection upon ethical theory. Self-reflection is practically important because it powerfully influences our actions. To avoid radical moral relativism (Gowans 2004), however, self-reflection needs to be structured and guided by (or at least reactive to) the contemplation of formal ethical discourse and theory. When executed properly, self-reflection for improving the ethical quality of my research project would seem to be as difficult as self-reflection for improving the scientific quality of my research.

Third, although we may not always know with certainty whether a specific research project or conservation action is ethical, we do know with certainty that it is unethical not to think seriously about it. The strength of ethics is not a tendency to develop single correct solutions; rather its strength tends to be the identification of solutions that are wrong. This is not unlike Popper's scientific logic. The reasonable goal of applied ethics is not ethical perfection or even black-and-white declarations that this or that action is or is not ethical. The purpose of applied ethics is to become progressively more ethical. Ethical progress within the field of conservation science is not favored by the lack of attention it receives in formal discourse by its practitioners.

Fourth, realizing ethical progress requires belief that such progress is both necessary and realistically attainable. Believing in the possibility of ethical progress is justified by recent ethical progress. For example, many nations (e.g. USA) have recently rectified some inequitable treatments among human sexes and races.

Examples of recent moral progress within environmental contexts include the Hunting Act of 2004 (England and Wales) which banned fox hunting with dogs and the US Endangered Species Act (1973), which seems to assign intrinsic value and direct moral worth to many non-human species. Necessity and possibility create a tension that motivates ethical progress.

Signs of more virtuous research may include: 1) not judging your own research to be virtuous merely on the basis of others' willingness to fund, permit, or praise it; 2) a commitment to the invention and use of less intrusive methods (e.g. collection of DNA from feces, Kohn and Wayne 1997, rather than blood or other tissues); 3) a tendency to engage in fewer, higher quality research projects, rather than engaging in greater quantities of lower quality research; 4) increased formal and informal dialogue concerning the ethical nature of research; 5) increased attention to morally relevant empirical facts (especially animal suffering and sentience); and 6) increased frequency of publications (co-authored by professional ethicists) and calls-for-proposals (for agencies and organizations that traditionally fund science) that deal explicitly with the ethical dimensions of conservation research and action. To compliment this list Gales et al. (2003), provide a list of proposals representing institutional changes that would promote dialogue with researchers and aimed at improving the ethical quality of research. Seeing these signs may or may not indicate an increase in the ethical quality of conservation research and practice. However, failure to see these signs would mean that increased ethical quality is unlikely.

Conservation and the ethical issues it entails will challenge us until the time when humanity itself faces extinction. Consequently, taking the time and effort to build ethical approaches in conservation and ecology that are solid, if not simple, would be worthwhile. Our hope is that this paper will inspire discourse that adds to and corrects this discussion.

*Acknowledgements* – We thank the US National Science Foundation (DEB-9903671 and DEB-0424562), the Idaho Humanities Council, and the Univ. of Idaho Research Council for grant support. The content of article does not necessarily reflect the views of the National Science Foundation, the Idaho Humanities Council, or the Univ. of Idaho Research Council. We also thank L. Vucetich, R. O. Peterson and T. A. Waite for useful comments, and P. Troxell for introducing the authors to each other.

## References

- Agar, N. 2001. Life's intrinsic value. – Columbia Univ. Press.
- Aiken, W. 1984. Ethical issues in agriculture. – In: Regan, T. (ed.), *Earthbound*. Random House, pp. 247–288.

- Anonymous 1998. The Biodiversity Project. Engaging the public on biodiversity: a road map for education and communication strategies. [www document]. URL [www.biodiversityproject.org/roadmap.pdf](http://www.biodiversityproject.org/roadmap.pdf)
- Attfield, R. 1991. The ethics of environmental control, (2nd ed.). – Univ. of Georgia Press.
- Bangert, R. 2005. The ethics of lethal methods. – *Front. Ecol. Environ.* 3: 241.
- Batson, C. D. 1991. The altruism question: toward a social-psychological answer. – Erlbaum.
- Biehl, J. and Staudenmaier, P. (eds) 1995. *Ecofascism: lessons from the German experience*. – AK Press.
- Birch, T. H. 1993. Moral considerability and universal consideration. – *Environ. Ethics* 15: 313–332.
- Boyce, M. S. et al. 1999. Seasonal compensation of predation and harvesting. – *Oikos* 87: 419–426.
- Burnyeat, M. F. 1980. Aristotle on learning to be good. – In: Rorty, A. O. (ed.), *Essays on Aristotle's ethics*. Univ. of California, pp. 69–92.
- Byers, J. E. et al. 2002. Directing research to reduce the impacts of nonindigenous species. – *Conserv. Biol.* 16: 630–640.
- Callicott, J. B. 1989. In defense of the land ethic: essays in environmental philosophy. – Suny Press, Albany, NY.
- Callicott, J. B. 1999. Beyond the land ethic: more essays in environmental philosophy. – Suny Press, Albany, NY.
- Caughley, G. 1994. Directions in conservation biology. – *J. Anim. Ecol.* 63: 215–244.
- Chandroo, K. P. et al. 2004. Can fish suffer?: perspectives on sentience, pain, fear and stress. – *Appl. Anim. Behav. Sci.* 86: 225–250.
- Clearly, D. 2006. The questionable effectiveness of science spending by international conservation organizations in the tropics. – *Conserv. Biol.* 20: 733–738.
- Copi, I. M. and Cohen, C. 2005. *Introduction to logic*, (12th ed.). – Prentice-Hall.
- Dennis, B. 1996. Discussion: should ecologists become Bayesians? – *Ecol. Appl.* 6: 1095–1103.
- Diamond, J. 1989. Overview of recent extinctions. – In: Pearl, M. and Western, D. (eds), *Conservation for the twenty-first century*. Oxford Univ. Press, pp. 37–41.
- Donovan, T. M. et al. 1997. Variation in local-scale edge effects: mechanisms and landscape context. – *Ecology* 78: 2064–2075.
- Dorazio, R. M. and Johnson, F. A. 2003. Bayesian inference and decision theory—a framework for decision making in natural resource management. – *Ecol. Appl.* 13: 556–563.
- Ehrlich, P. R. 1995. The scale of human enterprise and biodiversity loss. – In: Lawton, J. H. and May, R. M. (eds), *Extinction rates*. Oxford Univ. Press, pp. 214–224.
- Enck, J. W. et al. 2006. Integrating ecological and human dimensions in adaptive management of wildlife-related impacts. – *Wildlife Soc. Bull.* 34: 698–705.
- Ferry, L. 1995. *The new ecological order*. – Univ. of Chicago Press.
- Frey, R. G. 1983. Rights, killing, and suffering: moral vegetarianism and applied ethics. – Blackwell.
- Gales, N. et al. 2003. Ethics and marine mammal research. – In: Gales, N. et al. (eds), *Marine mammals: fisheries, tourism and management issues*. CSIRO Publishing, pp. 321–330.
- Gensler, H. J. 1996. *Formal ethics*. – Routledge.
- Gould, S. J. 1990. The golden rule – a proper scale for our environmental crisis. – *Nat. Hist.*, Sept. issue
- Gowans, C. 2004. Moral relativism. – In: Zalta, E. N. (ed.), *The Stanford encyclopedia of philosophy* (winter 2004 edition), URL= <<http://plato.stanford.edu/entries/moral-relativism>>
- Groom, M. J. et al. 2005. *Principles of conservation biology*, (3rd ed.). – Sinauer.
- Hedrick, P. W. et al. 1996. Directions in conservation biology: comments on caughtley. – *Conserv. Biol.* 10: 1312–1320.
- Johnson, L. E. 1991. *A morally deep world: an essay on moral significance and environmental ethics*. – Cambridge Univ. Press.
- Kaplan, M. 1996. *Decision theory as philosophy*. – Cambridge Univ. Press.
- Kellert, S. R. 1993. The biological basis for human values of nature. – In: Kellert, S. R. and Wilson, E. O. (eds), *The biophilia hypothesis*. Island Press, pp. 42–69.
- Kellert, S. R. 1995. – In: Soule, M. E. and Lease, G. (eds), *Reinventing nature: responses to postmodern deconstruction*. Island Press, pp. 103–121.
- Kjonstad, B. and Willmott, H. 1995. Business ethics: restrictive or empowering? – *J. Bus. Ethics.* 14: 445–464.
- Kohlberg, L. 1981. *Essays on moral development: the philosophy of moral development*. (Vol. I). – Harper and Row.
- Kohn, M. H. and Wayne, R. K. 1997. Facts from feces revisited. – *Trends Ecol. Evol.* 12: 223–227.
- Kuhn, T. S. 1962. *The structure of scientific revolutions*. – Univ. of Chicago Press.
- Lemke, T. O. 2003. Gardiner late elk hunt annual report 2003. Montana, Fish Wildlife and Parks, Livingston, MT, USA.
- Leopold, A. 1949. *A Sand county almanac*. – Oxford Univ. Press.
- Linklater, W. L. 2003. Science and management in a conservation crisis: a case study with rhinoceros. – *Conserv. Biol.* 17: 968–975.
- MacArthur, R. H. 1958. Population ecology of some warblers of northeast coniferous forests. – *Ecology* 30: 599–619.
- Maiese, M. 2003. Dehumanization. – Univ. of Colorado. [www document]. URL [www.beyondintractability.org/m/dehumanization.jsp](http://www.beyondintractability.org/m/dehumanization.jsp)
- Manning, R. E. 2003. Social climate change: a sociology of environmental philosophy. – In: Minteer, B. A. and Manning, R. E. (eds), *Reconstructing conservation: finding common ground*. Island Press, pp. 207–222.
- MacIntyre, A. 1981. *After virtue: a study in moral theory*. – Univ. of Notre Dame Press.
- Merton, R. K. 1979. *The sociology of science: theoretical and empirical investigations*. – Univ. of Chicago.
- Muehter, V. 2005. *Cowbirds and conservation*, Audubon Society [www document]. URL [www.audubon.org/bird/research/](http://www.audubon.org/bird/research/)
- Naess, A. 1989. *Ecology, community and lifestyle*. – Cambridge Univ. Press.

- Nelson, M. P. 1996. Holists and fascists and paper tigers ... oh my. – *Ethics Environ.* 1: 103–117.
- Ortega, C. P. et al. (eds) 2005. Management of cowbirds and their hosts: balancing science, ethics, and mandates. – *Ornithol. Monogr.* no. 57.
- Paquet, P. C. et al. 1999. Wolf reintroduction feasibility in the Adirondack park. Prepared for the Adirondack Citizens Advisory Committee on the feasibility of wolf reintroduction. [www document]. URL [www.consbio.org/cbi/applied\\_research/wolf/wolf.htm](http://www.consbio.org/cbi/applied_research/wolf/wolf.htm)
- Pluhar, E. B. 1995. Beyond prejudice: the moral significance of human and nonhuman animals. – Duke Univ. Press.
- Pojman, L. P. (ed.) 2005. Environmental ethics: reading in theory and application (4th ed.). – Thomson-Wadsworth.
- Preston, S. D. and de Waal, F. 2002. Empathy: its ultimate and proximate bases. – *Behav. Brain Sci.* 25: 1–72.
- Putnam, H. 2002. The collapse of the fact/value dichotomy and other essays. – Harvard Univ. Press.
- Rawles, K. E. 2004. Biological diversity and conservation policy. – In: Oksanen, M. and Pietarinen, J. (eds), *Philosophy and biodiversity*. Cambridge Univ. Press, pp. 199–216.
- Regan, H. M. et al. 2005. Robust decision making under severe uncertainty for conservation management. – *Ecol. Appl.* 15: 1471–1477.
- Regan, T. 1983. The case for animal rights. – Univ. of California Press.
- Remsen, J. V. 1995. The importance of continued collecting of bird specimens to ornithology and bird conservation. – *Bird Conserv. Int.* 5: 145–180.
- Robinson, S. K. et al. 1995. Regional forest fragmentation and the nesting success of migratory birds. – *Science* 267: 1987–1990.
- Rocco, A. 1925. An address delivered at Perugia in 1925. Translated and reprinted as *The Political Doctrine of Fascism in Readings on Fascism and National Socialism* [www document]. URL [www.gutenberg.org/etext/14058](http://www.gutenberg.org/etext/14058)
- Rolston, H. 1994. Conserving natural value. – Columbia Univ. Press.
- Rosenthal, D. M. 2002. How many kinds of consciousness? – *Consciousness Cognition* 11: 653–665.
- Ross, W. D. 1930. The right and the good. – Oxford.
- Rothstein, S. I. 2004. Brown-headed cowbird: villain or scapegoat. – *Birding*, August issue pp. 375–384.
- Sæther, B.-E. et al. 1996. Density-dependence and optimal harvesting of fluctuating populations. – *Oikos* 76: 40–46.
- Sæther, B.-E. et al. 2001. Optimal harvest of age-structured populations of moose *Alces alces* in a fluctuating environment. – *Wildlife Biol.* 7: 171–179.
- Sagoff, M. 2004. Price, principle, and the environment. – Cambridge Univ. Press.
- Sen, A. 1987. On ethics and economics. – Blackwell.
- Sillett, T. S. et al. 2004. Experimentally reducing neighbor density affects reproduction and behavior of a migratory songbird. – *Ecology* 85: 2467–2477.
- Sillett, T. S. et al. 2005. Authors' reply [to Bangert (2005)]. – *Front. Ecol. Environ.* 3: 241–242.
- Simberloff, D. S. and Wilson, E. O. 1969. Experimental zoogeography of islands: the colonization of empty islands. – *Ecology* 50: 278–296.
- Singer, P. 1990. Animal liberation, (2nd ed.). – The New York Review of Books.
- Song, S. J. and M'Gonigle, R. M. 2001. Science, power, and system dynamics: the political economy of conservation biology. – *Conserv. Biol.* 15: 980–989.
- Srivastava, D. S. 2002. The role of conservation in expanding biodiversity research. – *Oikos* 98: 351–360.
- Taylor, P. W. 1986. Respect for nature: a theory of environmental ethics. – Princeton Univ. Press.
- Turner, D. and Hartzell, L. 2004. The lack of clarity in the precautionary principle. – *Environ. Values* 13: 449–460.
- VanDeVeer, D. 1979. Interspecific justice. – *Inquiry* 22: 55–70.
- Varner, G. E. 1998. In nature's interests? Interests, animals rights, and environmental ethics. – Oxford Univ. Press.
- Wade, P. R. 2000. Bayesian methods in conservation biology. – *Conserv. Biol.* 14: 1308–1316.
- Wright, R. G. 1999. Wildlife management in the national parks: questions in search of answers. – *Ecol. Appl.* 9: 30–36.
- Zimmerman, M. J. 2001. The nature of intrinsic value. – Lanham: Rowman and Littlefield.