Bioethical Inquiry (2013) 10:533–537
DOI 10.1007/s11673-013-9475-2

CASE STUDIES

Multiple Criteria and Trade-Offs in Environmental Ethics

Comment on "Ethics of Species Research and Preservation" by Rob Irvine

Sahotra Sarkar

Received: 1 July 2013 / Accepted: 15 September 2013 / Published online: 3 October 2013

Keywords Animal welfare · Biodiversity · Multi-criteria analysis · Objectives hierarchy · Trade-offs · Values

Introduction

Irvine (2013) raises an interesting problem: we have a sentient endangered species on the brink of extinction. It may be possible to ward off that extinction if we know more about the behavioral traits of the species. To do so will require that we remove some individuals from the natural population and perform experiments on them. Even with a maximal commitment to prevent suffering, this process will necessarily inflict some pain on the individuals removed and studied. Should we do it?

The main point made in these comments is that cases such as this are not "hypothetical" in the sense of only being thought experiments. Irvine has articulated a problem that routinely occurs while devising biodiversity conservation policy in the field. Moreover, conservation biologists have been explicitly aware of the problem for decades (Callicott 1980; Sarkar 2005). The problem is of a type—*viz*., a conflict between different natural values—that is far more common than has typically been acknowledged in environmental ethics (Sarkar 2012; see the section on "Trade-Offs Between Natural Values" below). The decision theory community has developed standard techniques for addressing such problems though they are often difficult to implement in practice (see "Multi-Criteria Analysis" below).

The example envisions a conflict of interest between individuals of a species and that species itself. However, the potentially harmed individuals need not come from the same species, and individuals may experience harm beyond that incurred in an experiment performed for the sake of gathering useful data. For instance, for biodiversity conservation in Costa Rica, it was common practice to cull dogs that destroyed nests of endangered sea turtles (Sarkar 2005). In South African national parks, elephants were culled to prevent them from destroying the habitat through uncontrolled population growth (Sarkar 2005). Similarly, in central Texas it is necessary to trap and remove brown-headed cowbirds (*Molothrus ater*) which parasitize nests of the endangered Black-capped Vireos (*Vireo atricapillus*) (U.S. Fish and Wildlife Service 1991). The point is that, in each of these cases, there is a conflict between the level of the individual and the level of biodiversity, with the latter including higher taxonomic levels. In all these cases, the harm inflicted on individuals may be reduced, typically at great economic cost, but not eliminated completely. In this piece, for reasons of space, I will leave aside the question why, given

The original article by Rob Irvine, published in the *Journal of Bioethical Inquiry*, 10(2): 261–262, can be located at doi:10.1007/s11673-013-9443-x.

S. Sarkar (✉)
Department of Philosophy and Section of Integrative Biology, University of Texas,
Austin, TX, USA
e-mail: sarkar@austin.utexas.edu

limited resources available for biodiversity conservation, cost considerations are also ethically salient (for a discussion, see Margules and Sarkar 2007).

Philosophically, perhaps the most important consequence of this conflict is that it is indicative of serious problems of using intrinsic value arguments for biodiversity conservation that were once highly popular among Northern environmentalists (McShane 2007). Typically (though not always) these arguments start with a premise that human individuals are intrinsically valuable because of some essential trait they possess (sentience, rationality, *etc.*). Next, there is a claim that some other entities (*e.g.*, animal individuals) also possess the relevant trait. The conclusion drawn is that these other entities must also have intrinsic value. It turns out that all plausible candidates for the relevant trait are individual properties; consequently, these arguments do not produce an ethic for biodiversity conservation that may necessarily require harm for some individuals in the interest of conserving entities at higher taxonomic levels.

If we abandon intrinsic value arguments in environmental ethics, we are mainly left with various kinds of anthropocentrism. The point that is often not realized is that a sufficiently sophisticated anthropocentrism does not reduce to a form of consequentialism founded upon the satisfaction of felt preferences (that is, upon demand values) (Norton 1987). But we are left with a spectrum of human values, some based on felt preferences, others perhaps on second-order preferences (Jeffrey 1974), sometimes called transformative value or transformative power (Norton 1987; Sarkar 2005, 2012). In the environmental context, what is relevant is the subset of these values that constitute natural values, *i.e.*, "those that promote the persistence and increase of nonhuman biota or enhance the non-anthropogenic aspects of the physical environment" (Sarkar 2012, 21). The salient point is that there is a multiplicity of such values and there may be conflicts between some of them (see "Trade-Offs Between Natural Values" below). Note that, from this perspective, these natural values are also human values in the sense that they are anthropocentric.

Trade-Offs Between Natural Values

There is a hierarchy of natural values. At the highest level, these include biodiversity, biotic welfare, environmental fidelity, environmental service, and wild nature. This list is probably not exhaustive but seems to be the most comprehensive one currently to exist (Sarkar 2012). That each of these categories should constitute a value requires normative justification; much of traditional environmental ethics has been devoted to that task (Sober 1986; Norton 1987; Callicott, Crowder and Mumford 1999; Sarkar 2005), which is beyond the scope of this piece. I will assume that all of these values are relevant; though, strictly, Irvine's case only requires that we value the conservation of species and the welfare of individuals.

At the next lower level of the hierarchy, biodiversity includes vulnerability, rarity, richness, suitability to habitat, proximity to native range, and the cultural role of entities, at all taxonomic levels from genotypes to phyla and higher. Biotic welfare is easy to define for individual organisms—it could include health, longevity, well-being (presence of pleasure or absence of pain). However, at higher levels of organization, welfare is not easy to define. For instance, is the concept of the well-being of a species beyond the well-being of its individuals anything more than a metaphor? Such problems can largely be avoided by assuming that the goal of biodiversity conservation incorporates any intuition that we may have about biotic welfare beyond the welfare of individuals. Turning to environmental fidelity, it is the value typically pursued in attempts at ecological restoration (Higgs 2003; Sarkar 2011). Environmental services include productivity, environmental security, and ecosystem services. Wild nature includes both wilderness (the absence of signs of human presence) and wildness (the lack of human power to control).

It should be obvious that some of these values may be mutually incompatible. For instance, the potential conflicts between biodiversity and wilderness are now well-known (Sarkar 1999), irrespective of whether wilderness itself can be normatively justified as a value (Guha 1989). There may be conflicts between biodiversity and productivity: a monoculture (say, of corn) may have much higher productivity than a diverse crop. Even within a higher-level category there is potential for conflict between lower-level values subsumed under it: For instance, for biodiversity, an area with high richness (*i.e.*, the number of taxa present in it) may have a low rarity score if none of the taxa present in it is rare or a low vulnerability score if none of these taxa is at significant threat of immediate extinction. Thus, these conflicts must be navigated and, unless we choose to ignore some of our values when they are in conflict with others, trade-offs must be introduced between values that are incompatible—the

challenge is to do so rationally (see "Multi-Criteria Analysis" below).

Thus, the type of conflict that Irvine has brought up for discussion should be viewed as another exemplar of numerous such potential conflicts between natural values. What is perhaps unfortunate is that these conflicts have not been widely recognized outside of conservation biology and those areas within environmental philosophy that focus on biodiversity.

The anthropocentric perspective proposed here allows this conflict to be navigated using a trade-off between multiple human values: for instance, how we should balance our concern for a species versus our concern for the well-being of individuals.

Multi-Criteria Analysis

Formal decision theory can be fruitfully used to analyze such problems. For simplicity, this discussion will assume a single decision-making agent. If multiple individuals are involved (as is typically the case in biodiversity-related decisions), this means that these individuals deliberate among themselves to settle on a decision-analytic structure (von Winterfeldt and Edwards 2007). The first part of this structure consists of the set of feasible alternatives, *A*, among which a decision must be made. Because more than one value must be incorporated into this decision (see "Trade-Offs Between Natural Values" above), this is a multi-criteria decision problem (Keeney and Raiffa 1993). The second part of the decision-theoretic structure is a hierarchical representation of these values, the so-called objectives hierarchy, *OH* (Keeney 1992). The previous section of this response to Irvine provided a general scheme for constructing such a hierarchy of natural values. But the *OH* must be tailored to an individual context so that *all* and *only* the relevant values are included—this is the stage when substantive ethical deliberation *must* begin. For instance, in Irvine's case, the only relevant highest-level categories in the *OH* (typically referred to as the "fundamental objectives") are biodiversity and biotic welfare. Biodiversity may have four subcategories: vulnerability, rarity, suitability to habitat, and proximity to native range. Welfare seems to require none (in this case). it is not being suggested that this is the "canonical" *OH* for this problem; rather, the *ethical* task at hand is to construct the best such *OH*, and more than one may be equally admissible.

Ethical deliberation is equally central to the next stage: the values must be compared to each other so that they can be "compounded" into a decision. A wide array of techniques are available for such aggregation, and technical and conceptual problems are associated with each of them (Figuera, Greco, and Ehrgott 2005; Moffett and Sarkar 2006); these are beyond the scope of this piece. Depending on the technique chosen, it may be sufficient to provide merely an ordinal ranking of the values at each level of the *OH* (biodiversity is more important than welfare, welfare is more important than environmental services, *etc.*). Or, it may be necessary to assign a cardinal ranking, that is, precise quantitative values (which are much more difficult to assign credibly). These rankings depend on contextual information. For instance, how biodiversity compares to welfare depends on whether it is the diversity of rare and endangered species (as in Irvine's case) or of common ones and whether the harm is likely to be minimal (as in Irvine's case) or includes long-lasting excruciating pain. Not all taxa are equally important (Vane-Wright, Humphries, and Williams 1991). Minor harm may be tolerable (*e.g.*, capture of and experimentation on individuals); culling individuals may not. Equally relevant are judgments about the effectiveness of the decision: How sure are we that the removal of the individuals and the planned experiments will yield outcomes that genuinely help conservation efforts?

The value of such an exercise is that it enhances transparency in two ways:

1. An explicit *OH* and its associated ranking lets us examine whether all and only relevant values have been considered, whether the presumed hierarchical relations between them are ethically sound, and whether the rankings should be what they are. Moreover, a failure to construct a credible *OH* may indicate that not enough information is available for a rational decision. For instance, from my perspective, Irvine's example is incomplete in three ways: (i) We do not know how intrusive the experiments will be on the individuals. (ii) We are not informed of what hypothesis is being tested or results expected. (iii) We do not know why, how, and to what extent the expected results will usefully guide conservation efforts.
2. An explicit *OH* and its associated ranking make the ethical analysis repeatable. This is desirable because it enables us to check if there was some mistake

(especially if a complex aggregation method was used). But it also has the advantage of allowing others to understand how a decision was made by their being able to repeat the process.

In Irvine's example the most important conclusion to be drawn was that we need additional information for a rational decision, as indicated earlier.

Final Remarks

This resort to multi-criteria analysis is not intended as a blanket endorsement of formal decision theory. Rather, as I have advocated elsewhere (Sarkar 2012) and will emphasize below, the deployment of decision-theoretic techniques should be *critical*. This has four aspects:

First, the use of formal techniques must not replace rational deliberation. Given the extent to which software decision support tools are used for biodiversity conservation decisions nowadays (Sarkar et al. 2006), it deserves continuing emphasis that the deliberative process must not be short-circuited. In many cases, deliberation may be sufficient to produce a decision and formal decision analysis would be irrelevant.

Second, the best use of formal decision analysis may well be as a heuristic rather than to produce a decision. A preliminary attempt to initiate decision analysis may sharpen our characterization of what the debatable issues are (which may then be settled entirely by deliberation) or what information is missing. For Irvine's example, this is how formal decision theory was used in the section above on "Multi-Criteria Analysis": It showed what information we need for a rational decision.

Third, for some complex decisions, formal analysis may be impossible; for instance, if the set of feasible alternatives is unstable or if two values are incommensurable (that is, they cannot be placed on a unique scale [Sarkar 2005]). Such a failure does not preclude rational decisions—these must be arrived by deliberation rather than by formal computation.

Fourth, while a detailed discussion of this issue is beyond the scope of this piece, assumptions about rationality made in decision analysis are themselves open to philosophical dispute (Resnik 1987). Moreover, there are well-known decision-theoretic paradoxes showing that, in some circumstances, these assumptions are mutually incompatible (Arrow and Raynaud 1986; Sarkar 2012).

In other words, decision analysis, as envisioned here, should be taken to support normative ethical analysis, not supplant it.

Acknowledgments Thanks are due to Rob Irvine for comments on an earlier draft.

References

Arrow, K.J., and H. Raynaud. 1986. *Social choice and multicriterion decision-making*. Cambridge: MIT Press.

Callicott, J.B. 1980. Animal liberation: A triangular affair. *Environmental Ethics* 2(4): 311–338.

Callicott, J.B., L.B. Crowder, and K. Mumford. 1999. Current normative concepts in conservation. *Conservation Biology* 13(1): 22–35.

Figuera, J., S. Greco, and M. Ehrgott, eds. 2005. *Multiple criteria decision analysis: State of the art surveys*. Berlin: Springer.

Guha, R. 1989. Radical American environmentalism and wilderness preservation: A third world critique. *Environmental Ethics* 11(1): 71–83.

Higgs, E. 2003. *Nature by design: People, natural process, and ecological restoration*. Cambridge: MIT Press.

Irvine, R. 2013. Ethics of species research and preservation. *Journal of Bioethical Inquiry* 10(2): 261–262.

Jeffrey, R.C. 1974. Preference among preferences. *Journal of Philosophy* 71(13): 377–391.

Keeney, R.L. 1992. *Value-focused thinking: A path to creative decisionmaking*. Cambridge: Harvard University Press.

Keeney, R.L., and H. Raiffa. 1993. *Decisions with multiple objectives: Preferences and value tradeoffs*, 2nd edition. Cambridge: Cambridge University Press.

Margules, C.R., and S. Sarkar. 2007. *Systematic conservation planning*. Cambridge: Cambridge University Press.

McShane, K. 2007. Why environmental ethicists shouldn't give up on intrinsic value. *Environmental Ethics* 29(1): 43–61.

Moffett, A., and S. Sarkar. 2006. Incorporating multiple criteria into the design of conservation area networks: A minireview with recommendations. *Diversity and Distributions* 12(2): 125–137.

Norton, B.G. 1987. *Why preserve natural variety?* Princeton: Princeton University Press.

Resnik, M.D. 1987. *Choices: An introduction to decision theory*. Minneapolis: University of Minnesota Press.

Sarkar, S. 1999. Wilderness preservation and biodiversity conservation—keeping divergent goals distinct. *BioScience* 49(5): 405–412.

Sarkar, S. 2005. *Biodiversity and environmental philosophy: An introduction*. Cambridge: Cambridge University Press.

Sarkar, S. 2011. Habitat reconstruction: Moving beyond historical fidelity. In *The handbook of the philosophy of science, volume 11: Philosophy of ecology*, ed. K.

deLaplante, B. Brown, and K.A. Peacock, 327–361. New York: Elsevier.

Sarkar, S. 2012. *Environmental philosophy: From theory to practice*. Oxford: Wiley-Blackwell Press.

Sarkar, S., R.L. Pressey, D.P. Faith, et al. 2006. Biodiversity conservation planning tools: Present status and challenges for the future. *Annual Review of Environment and Resources* 31: 123–159.

Sober, E.R. 1986. Philosophical problems for environmentalism. In *The preservation of species: The value of biological diversity*, ed. B.G. Norton, 173–194. Princeton: Princeton University Press.

U.S. Fish and Wildlife Service. 1991. *Black-capped vireo (Vireo atricapilla) recovery plan*. Albuquerque: United States Fish and Wildlife Service.

Vane-Wright, R.I., C.J. Humphries, and P.H. Williams. 1991. What to protect? Systematics and the agony of choice. *Biological Conservation* 55(3): 235–254.

von Winterfeldt, D., and Edwards, W., 2007. Defining a decision analytic structure. In: Edwards, W., Miles Jr., R. F., von Winterfeldt, D. (Eds.), Advances in Decision Theory: From Foundations to Applications. Cambridge University Press, Cambridge, UK, pp. 81–103.