Environmental Ethics and Decision Theory: Fellow Travellers or Bitter Enemies?

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Abstract: On the face of it, ethics and decision theory give quite different advice about what the best course of action is in a given situation. In this paper we examine this alleged conflict in the realm of environmental decision-making. We focus on a couple of places where ethics and decision theory might be thought to be offering conflicting advice: environmental triage and carbon trading. We argue that the conflict can be seen as disagreement about other things (like appropriate temporal scales for value assignments, idealisations of the decision situation, whether the conservation budget really is fixed and the like). The good news is that there is no conflict between decision theory and environmental ethics. The bad news is that a great deal of environmental decision modelling may be rather simple minded, in that it does not fully incorporate some of these broader issues about temporal scales and the dynamics of many of the decision situations.

1. Introduction

On the face of it, ethics and decision theory give quite different advice about what is the best course of action in a given situation: one says to do what's right while the other says to maximise expected utility.[1] We could say that the perceived conflict is about doing what is "right, and for the right reasons" versus pursuing a strategy that is merely pragmatic/expedient/economically efficient.[2] In this paper, we examine this alleged conflict in the realm of environmental decision-making. There is a great deal of disagreement in the community when it comes to environmental issues and at least some of this disagreement appears to be a result of disagreement about the role of ethics in decision making. Looking carefully at a couple of controversial cases will help shed light on the nature of the roles of ethics and decision theory in environmental decision making, and help us to better understand the relationship between the two.

The two examples of environmental decision-making we will focus on are environmental triage and carbon trading. Environmental triage is so-named because it mirrors the kind of triage strategy that is familiar in medical contexts, where waiting times and even treatment is determined by seriousness of the illness and expectations of recovery. There is no sense, for example, in wasting valuable medical resources on

[1] See Jeffrey (1990) and Resnik (1987) for introductions to decision theory. See Pojman and Pojman (2008) for many of the classic readings in environmental ethics.

[2] The latter are also often thought to be rational. The conflict might thus be seen as an apparent conflict between norms: between what is ethically right and what is rational. Alternatively, it could be seen as the recasting of a familiar debate in ethics about whether right action is about the actions themselves (broadly deontological views) or about the outcomes of actions (broadly consequentialist views).

a patient who is likely to die, irrespective of the treatment. In triage, in the conservation setting, the idea is that in the face of potential species extinction, say, when resources are limited, we should allocate resources so as to minimise the number of extinctions. That is, we may need to "give up" on some species because either those species do not have a high enough chance of recovery, or the price for their recovery is too high. More precisely, we want to minimise the expected number of extinctions, and this may involve allowing some species to go extinct in order to save others.[3]

The other example we will discuss is carbon trading and/or offsetting. This is a way of controlling emissions of carbon dioxide. Companies/economic agents are allowed a certain quantity of carbon dioxide emissions; those companies that emit more than their quota are penalised—they must buy carbon credits from others who have a surplus, or else offset their extra carbon dioxide emissions via carbon sequestration projects. Companies that emit less than their quota are rewarded, because they may sell their credits to other companies. The idea is that, once we establish what the overall carbon dioxide emissions target should be, the most efficient way to achieve the target is to let the market determine who reduces their emissions and by how much. It is assumed that individual economic players will choose to engage in emissions–reductions programs to the extent that it is economically advantageous for them to do so.[4]

From these brief descriptions of these schemes, it may seem that environmental triage and carbon trading are entirely different environmental strategies and will raise entirely different issues. Certainly, the specifics of these policy instruments will be rather different, and different problems will arise in their implementation. But what they have in common is that they both enjoy some support, and yet also some fundamental opposition within the conservation community. More importantly, the reasons that both evoke strong negative reactions amongst some conservationists seem to be much the same. Or at least, we will argue that this is the case. Both triage and carbon trading amount to strategies for efficient, cost-effective environmental conservation. On the face of it, they seem to have a firm decision-theoretical basis, and yet might be thought to ride roughshod over some environmental ethical issues.

In Section 2 we outline the case in favour of both triage and carbon trading. In Section 3 we present and dismiss some commonly-heard, but nevertheless poor, arguments

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[3] Ecological triage was first proposed in relation to species preservation in Walker (1992). This approach is further developed and defended in, for example, Possingham (2001), Field *et al*. (2004), Wilson *et al*. (2006), and Marris (2007), Colyvan (2007) and Colyvan *et al*. (forthcoming b). Also see Richards *et al*. (1999) for an application of similar operations-research methods in a real conservation management application.

[4] We focus on carbon trading, but there are similar disincentive schemes for other sorts of environmental pollutants (see, for instance, Kneese and Schultze 1975). Note also that there is an assortment of policy options for regulating carbon dioxide emissions. Carbon trading (with or without the option of gaining extra credit via carbon sequestration) is very prominent amongst these (see Capoor and Ambrosi 2007). Discussions of carbon trading proposals can be found in, for instance, Ackerman and Stewart (1988), Grubb (1990), Hahn and Hester (1989) and Pearce *et al*. (1989, pp. 165–166). A different approach is for governments to impose a tax on carbon dioxide emissions that would allow agents to emit as much of the pollutant as they can afford to pay for. See Epstein and Gupta (1990) and Weimer (1990) for details on such "green tax" proposals. Alternatively, governments might simply stipulate the pollution rights and duties of economic actors, with no trading or buy-out options for excessive polluting.

against these strategies. The subsequent sections of the paper are an attempt to construct a cogent argument against triage and carbon trading. We conclude that there *are* good arguments to be advanced against triage and carbon trading. At least, there are good arguments against particular versions or implementations of these strategies in some situations. Whether triage and carbon trading are justifiable will depend on the details of the case at hand. This should not be seen as a conflict between decision theory and ethics but, rather, as an internal dispute about the appropriate decision-theoretic representation of the decision situations confronting environmental managers and policy makers.

2. The case for triage and carbon trading

Both triage and carbon trading invoke a kind of instrumental rationality that seems beyond reproach. Take triage first. Here we have fixed resources and predetermined conservation goals—typically conserving as many endangered species as possible. All that triage amounts to is the optimal allocation of the resources in the pursuit of the goal in question. Why would we choose to spend our resources in any other way? Now consider carbon trading. Here there is a choice between achieving a particular and predetermined environmental target—restricting carbon emissions to below a certain target—by one or another means. The central insight of the carbon-trading strategy is to allow market forces to determine the most efficient means of achieving the target in question. This means that we do not incur greater costs than required. Why would we not go for this option? In each case there is a constraint—whether this is a fixed set of resources and/or a fixed target outcome—and we are advised to make the best decision that satisfies the constraint.

Of course, for the case of triage, it may be difficult to determine what is the best way to spend the limited resources in question. To begin with, there are various, often competing, conservation goals (Margules and Pressey 2000, Possingham 2001); managers must decide whether the appropriate focus is the persistence of selected species, or else the representation of some other biological entity like terrestrial habitat types or reef types in a marine ecosystem, or else some combination of biodiversity indicators. Secondly, we are dealing here with complex ecological phenomena, and any probabilities that enter into the decision problem will be largely based on subjective expert judgment. One would expect that it would be very difficult for an ecologist to determine how likely it is that, say, some critically endangered species will recover, given some chosen management strategy (perhaps captive breeding, perhaps larger reserve systems, perhaps something else). The point is just that we must estimate, as well as we can, the probabilities that are relevant to our decision problems. To just choose an action, (like trying to save all endangered species, starting from the most critically endangered), without trying to estimate the relevant probabilities of survival, amounts to an implicit assumption about the probabilities that may be way off the mark. It is, in effect, accepting whatever probabilities required to make this the best course of action. So we cannot escape probability judgments in our conservation planning. Better to consciously determine what the relevant probabilities are than to ignore them and inadvertently accept implausible probability assignments. Environmental triage, then, just amounts to the principle of maximising expected utility. To give an example (and one that will recur in this paper): if utility is taken to be directly proportional to the number of persisting

species, triage dictates that we choose the management option that has the greatest expected number of persisting species, where this calculation rests on our best-informed probabilities regarding the survival of the species of interest under the various options.

As mentioned, carbon trading is a little different because the constraint here is the conservation goal; given a pre-specified emissions target, we want to meet that target in the most efficient way possible. In a sense, carbon trading is, from the start, a more substantial suggestion than triage. It does not just counsel us to choose the strategy that is most efficient for reducing emissions by a given amount, it also embraces the stronger claim that given any target for emissions, the most efficient way to achieve that target is to harness the efficiency of the market. We will take this point for granted in this paper—that it is, indeed, most efficient to use market instruments to reach an emissions target.[5] Of course, it will be difficult to settle on a target for carbon-dioxide emissions. This involves thinking about how important the climate issue is, relative to other human concerns—a very significant and difficult question, to say the least—and to determine what levels of carbon emissions correspond to various climate change scenarios. But to try to avoid these prickly issues and carry on with the status quo, or some other measure for reducing greenhouse emissions, is just to implicitly accept some arbitrary target. If we want to take action, as a society, on air pollution and climate change, then we need to articulate goals. And the argument for carbon trading is that once these goals have been articulated, we want to achieve them in the most cost effective and efficient way possible.

It is important to note that the cases outlined in this section for triage and carbon trading are in terms of the basic premises behind these schemes, rather than the specifics of their implementation. Of course, in practice, there will be many different ways of implementing either of these policies, and some of these will be better than others, depending on things like the quality of data collection and monitoring, and, for carbon trading, the legal framework for handling compliance.[6] So far we have been abstracting away from these issues, and have been focussing on the basic rationales for triage and carbon trading. Although we have depicted this basic rationale as beyond dispute, many do oppose triage and carbon trading at the most basic level, regardless of the particulars. One of our aims here is to try to shed light on why this is so. We begin in the next section by presenting what we regard as weak arguments against triage and carbon trading. There is some room for cogent criticism of triage and carbon trading, but such criticism turns on at least some of the details about how the schemes are implemented. Some may be unwilling to engage in debate about triage/carbon trading if the most basic constraints involved—conservation resources available/emissions targets—are not satisfactory. We discuss when such a position would be defensible in Section 4.

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[5] In any case, while there may be some reason to question this economic assumption (recall the alternatives to carbon trading mentioned in a previous footnote), this does not seem to be the source of the opposition to carbon trading that we have in mind, and which we will get to in the next section.

[6] See Bekessy *et al*. (forthcoming) for discussion of some of the pitfalls of various implementation strategies for bio-trading.

3. Some arguments against triage and carbon trading

Some conservationists/environmentally-concerned citizens express a strong negative reaction towards triage and carbon trading. And this is before any of the particulars of the schemes have been tabled. The basic idea seems to be that it is wrong to think strategically when it comes to matters of such importance as the environment: when we are dealing with matters of extinction and persistence of species/ecosystems, some seem to think there can be no negotiating. Presumably, these opponents would not endorse giving up on good decisions when the stakes are high, and instead act in an aimless, ad hoc way. The claim must be that there are principled reasons why decision-theoretic reasoning breaks down in these serious, life-and-death-type cases. Perhaps biodiversity and environmental well-being are thought to be the kinds of goods that cannot be valued in the usual way; they are set apart from other human interests, and cannot be traded with or substituted by any other sorts of goods. In particular, they cannot be traded for material wealth. Or so the argument might go.

Proponents of this sort of argument might appeal to particular environmental ethical positions to support their views. To give an obvious example, they might identify as "deep ecologists" who claim that nature/biodiversity has value in and of itself, independent of any value that we humans might attribute to it (see Naess 1973; for a critical survey of deep ecology, see Sylvan 1985). This kind of value would, indeed, be difficult to account for in human-centred decisions. By its very nature it is a value that is not for humans to apportion and trade with other values. There are also more "shallow" environmental ethical positions that nonetheless recognise the natural environment as having a value that goes well beyond humanity's short-sighted material needs. Goodin (1992), for instance, describes a "green theory of value" that ultimately celebrates the otherness of natural processes for allowing humans to feel part of something larger than themselves. On this account, the natural environment stands apart from anything human-made by virtue of its very naturalness, and is thus, to some extent, irreplaceable.

Whatever the theoretical underpinnings, there are a couple of ways one might formalise the value of biodiversity/the natural environment so that this kind of good is set apart from other human interests. The first—an appeal to infinite value—cripples decision-making right from the start. We illustrate how this would go for the triage case (which in fact only involves environmental goods). The second—an appeal to incommensurate value—can lead to stalemates. Incommensurability is more relevant to the carbon-trading debate so we use this as our example. We argue that there are problems with invoking either of these two kinds of value. Indeed, to the extent that the infinite-value or incommensurability formalism represents any particular position in environmental ethics, such a position is shown to be problematic.

At least some opposition to triage seems to go as follows: all threatened species are extremely important and we should not give up on any; if there is some possibility that we can recover a species from near extinction, then we should try to do so, starting with the most needy/threatened case. This may well be the right strategy were there no limitations on resources. Perhaps some opponents of triage simply do not appreciate that, even in an ideal world in which everyone places considerable value on biodiversity, there will still be limits to the resources that can be committed to

conservation. The bottom line is that there are always resource constraints and once this is appreciated, triage is the only rational way to proceed.

But now consider how infinite utilities might bear on this. Suppose that each species is so important (whether to humans, or in and of itself) that there is infinite value in it being extant. If every species has infinite value, then there would be no good reason to simply abandon the "hopeless" cases, because an action that had even the slightest chance of leading to the survival of the most threatened/needy would have infinite expected value. In which case, we could not rationally prioritise some courses of action over others—at least not by the means we have been discussing so far. Indeed, it might be argued that we must appeal to other ethical considerations in order to decide a course of action, and that these further considerations favour treating the most needy species first.

Assigning every species infinite value might amount to a principled reason for objecting to the kind of expected utility calculations that underpin triage, but this move introduces a host of problems, and is simply untenable. To begin with, we have no way of distinguishing between conservation outcomes. One recovered species has the same value as one hundred recovered species. And worse still, any action that has some chance, however small, of saving one species is as good as any other: hunting black rhinos is no better or worse than captive breading or allocating reserves for the rhinos. With the introduction of infinite values, conservation decision-making is no longer able to discriminate between various conservation strategies and goals. Moreover, it is not clear what the moral rules are that might come to the rescue and tell us how to proceed. After all, why save the most endangered first? Why not the least endangered? The situation gets even worse. Not only does the introduction of infinite values cripple conservation decision-making, it also cripples decision making elsewhere: so long as there is some non-zero probability that a positive conservation outcome will eventuate, the action in question will have infinite expected utility.[7]

Perhaps the attitude that some have towards carbon permits and carbon offsetting is also best explained by appeal to the infinite value of an unchanged environment, or the infinite disutility of carbon dioxide emissions, such that no amount of cash or offsetting (even in the form of carbon sequestration projects) can make up for the initial damage. If so, this stance will have the same problems as just described.[8] In a similar vein, but without the problems posed by the appeal to infinite value, it might be argued that no specific monetary value (or range of monetary values), and even no specific amount of carbon sequestration, balances a given amount of carbon dioxide emissions, whatever the existing concentration of carbon dioxide in the atmosphere and level of social welfare. The idea would be that the two sorts of goods are completely incommensurable. Like the infinite-value case, incommensurability might be seen as explaining why it is impossible to make the sorts of decisions required for carbon offsetting.

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[7] See Hájek (2003) and Sorensen (1994) for more on the problems associated with infinite values, and Colyvan *et al.* (to appear) and Goodin (1996) for more on problems with assigning infinite values to environmental outcomes. Justus *et al.* (2009) discusses problems associated with entertaining intrinsic values in conservation management decisions.

[8] In any case, it is likely that the exchange rate between carbon dioxide emissions and derived social goods will vary, depending on existing levels of both carbon dioxide pollution and social welfare.

Invoking incommensurability, however, does not amount to a good argument against carbon offsetting. For a start, invoking incommensurability is dangerous. It effectively makes certain kinds of decisions inconclusive. If apples and oranges are genuinely incommensurable then there is simply no common currency to trade between the two. An orange is neither more valuable, less valuable, nor the same value as an apple. One cannot compare the two and so decisions involving apples and oranges in the outcomes of different actions will be inconclusive. Although it is sometimes suggested that environmental value is incommensurable with other values (perhaps because the former is understood as an intrinsic value, or else because environmental goods cannot be replaced/substituted), this position needs qualification if it is to be taken seriously. If environmental values were completely incommensurable with other values, it is not clear how we could motivate even the most modest conservation efforts. Nature would be neither more valuable, less valuable nor the same value as a parking lot. Anyone who shares the view that at least some portions of nature are more valuable than some parking lots, denies that the two are entirely incommensurable. Indeed, such incommensurability is utterly implausible and runs counter to the whole business of conservation. If the natural environment is to be preserved it must be recognised that it is valuable and that we are willing to allocate resources (e.g. money) to its preservation. This cannot be done if natural resources are thought to have incommensurable value, for such values cannot be compared with any others.[9]

Back to incommensurability and carbon trading. First we need to be careful not to confuse incommensurability with epistemic difficulties associated with determining the right substitution between emissions and public money/carbon sequestration. Despite our ignorance of what the right substitution between emissions and sequestration is, for instance, we can still settle on something, depending on how vigilant or risk-averse we want to be about carbon dioxide pollution.[10] In any case, it is plausible that the problems are not entirely epistemic; there is likely to be some degree of incommensurability between existing environmental well-being and restoration projects (e.g. sequestration) or other social goods. The point is just that these values are not *entirely* incommensurable, because that would make any decision that involved conflicts between them inconclusive. At any given time/state of the world, there may be a number of exchange rates between carbon dioxide emissions and carbon sequestration/social goods that cannot, in principle, be decided between. So long as any such incommensurability is only limited, however, we will still be able to make conclusive decisions in a large number of cases. Indeed, some have proposed

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[9] We should perhaps distinguish two kinds of incommensurability here. The first is where the value of one item is measured on a scale orthogonal to the scale for the value of the other. In this case, not only will there be no way of comparing the value of the two items, there will be no way of comparing the value of any item *of the first kind* with any item *of the second kind*. This kind of incommensurability is like trying to compare temperature with length. This is what we are calling *complete incommensurability*. The other, *partial incommensurability*, is where the value of the two items are on the same scale but each may lack a precise value. If the values of items are represented by (perhaps overlapping) intervals on the same scale, the values will not be totally ordered. That is, some items will be neither of equal value, of greater value, nor of lesser value than some items. With partial incommensurability, some comparisons can be made but there will always be some decisions that will be inconclusive.

[10] There are various methods available for representing different kinds of uncertainty in environmental and other decision problems, and not all of these methods are probabilistic (Regan *et al*. 2002; Burgman 2005).

comprehensive theories of rational choice for conditions of partial incommensurability or indeterminacy (see, in particular, Levi 1986). Moreover, when it comes to legislation that requires precise exchange rates/permit prices, we can simply settle on something, as in the case of epistemic uncertainty, depending on how risk-averse we want to be about carbon dioxide pollution.[11]

While some may concede that partial incommensurability/uncertainty with respect to the relative standing of environmental and social values should not obstruct rational decision-making, they may nonetheless resist the idea of paying to pollute. Goodin (1994) offers a defence of this view that involves comparing carbon trading with the much-criticised practice of "selling indulgences" within the medieval church. But as Goodin himself points out, it all depends on how carbon trading/offsetting schemes are perceived. The problematic interpretation is to regard a carbon permit as a payment to society that completely absolves any harm done to the environment and/or society, such that one may act with a clean conscious. This is a dangerous way of looking at things because, in practice, it is likely that the payment for carbon dioxide pollution will not, at least in the early stages of such a scheme, be as demanding as it should, and will only go some way towards compensating for environmental damage. But even if the payments were very stringent, there would still be cause for moral regret if one pursued a particular course of action when, all other things being equal, there were other more environmentally benign options available. It might be argued that the market takes care of this problem—provided all externalities are accounted for, markets achieve the most efficient or optimal outcomes. But even if this is true in the "ideal" situation, where fully rational agents pursuing self-interest alone act under conditions of perfect competition, it is a long stretch to claim that it is generally true in practice.[12]

As Goodin acknowledges, there is a less morally loaded way to perceive carbon trading/offsetting schemes and it is this interpretation we have been emphasising. The idea is that carbon trading/offsetting is just a good economic instrument for achieving a pre-determined carbon emissions target. The choice of target is not something that is determined posthoc by the market, but is rather a political decision that ideally represents the values and goals of the community at large. Individual agents who abide by the regulatory system can regard themselves as acting fairly and in the interests of the community, whether or not they are morally "clean" when it comes to the environment is a much more complex issue.

It should be apparent from our discussion thus far that there is ample scope for community values to enter into any triage or carbon trading proposal. Those who are anxious to incorporate environmental and other non-monetary social goods into the decision making need not resort to assigning infinite value to these goods, or to overstating the case for incommensurability. We need not throw out our best decision-

[11] See Steele (2006) for a discussion of the Precautionary Principle and the issue of uncertainty in environmental decision-making.

[12] See Hausman and McPherson (1996, pp. 43–44) for a discussion of this perception of the market. Goodin (1994) resists the idea that optimal emissions levels can be determined by the market once a suitable per unit price is set, on the grounds that there will always be too much (in principle) uncertainty about what is the right price for pollution.

making tools just because they are, in some instances, badly used.[13] In the case of triage, there is a significant value judgment in deciding how much of the community's shared resources should be directly devoted to protecting biodiversity. More fine-tuned value judgments then enter into the choice of measures for biodiversity and thus the kind of utility that we seek to maximise.[14] Such judgements turn on questions in environmental ethics. (In practice, however, biodiversity estimates will be somewhat crude given the constraints of data collection.) Value judgments, whether explicit or implicit, figure no less in carbon trading proposals. As mentioned, carbon trading requires the articulation of community goals for emissions reductions. Beyond this significant value issue, there are a host of other choices to be made regarding fairness and equality. For instance, the community needs to decide how carbon-emission permits should be distributed in the first instance, and also whether there should be periodic redistribution of permits (such that the right to pollute can only ever be leased temporarily).[15] Indeed, rather than being anathema to value considerations, decision modelling, in the form of social welfare functions, has proven invaluable in addressing these kinds of distributive justice issues (see, for example, Sen 1979, 1997 and 1999, and Hausman and McPherson 1996).

Finally, it might be argued that the whole decision-theoretic approach is politically dangerous in environmental contexts, in that it involves value judgements and (estimates of) probabilities. Each of these, the argument continues, is difficult to determine and open to revision. So, it would seem that an opponent of some environmental endeavour, can derail proceedings, rather easily, by casting doubt on the utility and probability assignments in question. A climate-change sceptic, for instance, might stall action on the reduction of greenhouse-gas emissions by emphasising the extent of the uncertainty in all parts of the relevant science, with the aim of casting doubt on the probability assignments used in the decision to reduce green-house gasses. According to this line of thought, the decision theory approach might well be right, in some sense, but it is easily subverted and is thus not an appropriate tool for conservation management.

The first thing to say in response is that scepticism cuts both ways: sometimes environmentally-unpalatable decisions can be undermined by questioning the science involved. For instance, an environmentalist might cast doubt on the thoroughness or impartiality of an environmental impact statement that cleared the way for industrial use of a piece of natural environment. Decision theory does not stack things against the environment; it can equally well be used to stack things in *favour* of the environment. The second point in response is that, just because decision theory is open to manipulation in these ways, does not mean it should be abandoned. After all, if we are talking about unsupported scepticism, then the science will help settle matters (as, indeed, it largely has in the climate change debate). And just because there is doubt about the values and (perhaps subjective) probabilities, does not mean

[13] Of course there are many technical difficulties encountered in assessing the values and probabilities in question, especially when it is appreciated that it is the expected value of society as a whole that we seek to maximise.

[14] See Maclaurin and Sterelny (2008) and Sarkar (2002) on the merits of different theoretical definitions of "biodiversity". Regan *et al*. (2007) documents the various components of biodiversity or environmental well-being deemed important by a group of ecologists and other stakeholders.

[15] The issues become even more complex when we consider how much the wealthy, carbon-hungry countries as a whole, rather than individual companies, should compensate developing countries. Grubb (1990) discusses some of the justice issues that arise in the distribution of emissions permits.

that anything goes. If there is uncertainty, it should be acknowledged and treated accordingly. Even in cases where there is genuine, unresolvable uncertainty (such as model uncertainty—uncertainty about the details of the models used to derive the predictions and probabilities), sensitivity analysis will help to show how robust or volatile the decisions in question are.[16] A method that is explicit about uncertainty and provides the means to deal with it strikes us as less open to political manipulation than alternatives where uncertainty is ignored or otherwise not treated in an appropriate fashion.

4. A decision-theoretic case against triage and carbon trading

In this section we outline a more substantial argument against triage and carbon trading/offsetting. It is not an argument against these schemes outright. Our discussion so far should have made it clear that in our view a blanket dismissal of these schemes is untenable—when stripped to their core, triage and carbon trading/offsetting are simply instances of a very uncontroversial kind of practical rationality. But one still might have concerns about a particular triage or a particular carbon-trading proposal. There are several related reasons for unhappiness about such schemes and they all revolve around the optimality of the long-term payoffs of such schemes.

Take triage first. Recall, that here the strategy is to treat the available resources as fixed, and then optimise the expected recoveries of species (to continue with our example conservation goal). Note that, in effect, such a decision is treated as a one-off decision. But, presumably, there will be another allocation of resources next year (or whenever). According to the standard triage strategy, the optimisation is performed every time there is a new allocation of resources. Each decision is treated in isolation, and yet they are a part of a series of decisions, the timing of which may well be highly predictable depending on administrative processes. Local optimisation at each stage of a sequential decision process does not always result in the overall optimal outcome. One way to see this is to note that conservation budgets are typically not fixed from year to year. Surely, in ensuring optimal long-term conservation outcomes, one of the agenda items should be the securing of adequate resources for the conservation efforts required. Blindly accepting an inadequate budget, treating it as fixed, and then optimising outcomes based on this, may be the best you can do in any given year, but may well jeopardise future conservation efforts. It might, for instance, be in the best interests of conservation to refuse an inadequate budget and hold out for more. It all depends on how other parties are predicted to respond to pressure from conservationists. The problem thus becomes game theoretic rather than decision theoretic.[17] To put the point in a slightly different way, the triage strategy is based on an optimisation model that presupposes that the budget is fixed and that the decision is one off. In the face of iterated conservation decisions and variable budgets, the triage strategy at the very least needs refining. It seems that the standard triage

[16] Sensitivity analysis is a method for testing whether plausible changes to the scientific model will lead to different decisions. See Regan *et al.* (2002) and Burgman (2005) for more on the treatment of the various kinds of uncertainty and meta-uncertainty in ecology and conservation settings.

[17] Game theory is the branch of rational choice theory that deals with bargaining situations. See Osborne (2004) and Resnik (1987) for an introduction to game theory. Skyrms (2004) explores how iterated games can shed light on the development of social contracts.

strategy concedes too much to funding agencies in accepting whatever is allocated and making do with that.[18] In short it is not always optimal in the long term to make the best of a bad lot; sometimes it is better to reject the bad lot or refuse to cooperate until things are improved.[19]

There is also the issue of the reallocation of resources. Triage assumes that reallocation is possible and cost free. Suppose, for example, that triage recommends withholding resources initially intended for the preservation of a particular species and instead recommends redirecting those resources elsewhere. But often the original resources are provided by a particular funding agency, in a particular country, and for a particular purpose. It may not be possible to reallocate those resources to another purpose in another country. And even when such reallocations are possible, they may result in significant costs. This and other such idealisation of the triage model might well give us reason to reject that model in favour of a more sophisticated one, where resources are not fixed, and there are non-trivial reallocation costs. But relaxing such assumptions does not amount to a rejection of the decision-theoretic approach, for, as Hugh Possingham (2007) points out, all these issues are amenable to decision theoretic (or in some cases game-theoretic) treatment. Indeed, it is hard to see any other way to approach issues involving tradeoffs.

Now reconsider carbon trading. Here, one might have concerns about the emissions target in a particular carbon-trading scheme. After all, there is no mechanism for the market to lower the target; the market merely optimises meeting the target. There is room for disagreement about the target that has been set, and it seems perfectly reasonable to push for the lowering of targets over subsequent years. Depending on the social and political environment at the time, it may well be strategic for the conservationist to show strong opposition to the basic proposal, and not participate in any further discussions of the schemes until the issue of adequate targets are dealt with in a satisfactory manner. Again, this can be seen as a case of attempting to achieve a better global result (that is, a better conservation outcome in the long-term).[20]

Some have also argued that in the long run trading schemes for carbon and other environmental pollutants may have a negative effect on basic attitudes towards the environment. The claim is that monetary rewards for good action, can, under particular conditions, undermine people's motivation to perform the action for its own sake (see Kelman 1981 and Frey 1986 & 1993).[21] In the case of carbon trading, the idea is that certain kinds of incentives for emissions reductions may spoil the potential for firms to develop a more mature sense of corporate responsibility that would lead

[18] Of course a great deal of effort does go into negotiations over resource allocation, but this is quite separate from the optimisation performed in triage. The point being made here is that these two aspects of conservation management should not be disconnected.

[19] The analogy with workers strikes seems apt here. What is optimal in the long term for workers is sometimes to refuse to work for unfair wages, despite needing the money in the short term. There are fairly standard game-theoretic, bargaining treatments of such cases.

[20] There are other details of particular triage and carbon-trading schemes that might also give rise to opposition. The methods of policing compliance in carbon trading for example might at first blush seem like a mere detail, but an opponent might reject the whole scheme until such details have been provided and shown to be appropriate.

[21] Goodin (1994) also makes this point to support his argument concerning "selling environmental indulgences".

them to reduce their emissions voluntarily. The main fear is that a weak sense of responsibility as regards carbon dioxide emissions would "spill over" into other domains where there is not the possibility of instituting payments for environmental damage. In other words, the concern is that the perceived worth of conservation efforts in all areas, not just with regard to air pollution, would lesson with time. So even though some varieties of carbon-trading scheme may produce better conservation results in the short term, they may not, on balance, be optimal in the long term if general attitudes towards the environment become more lax and this leads to a significant amount of other environmental degradation that would not have otherwise occurred.

5. Concluding Remarks

What the objections in the previous section have in common is that they focus attention on the apparent short-sighted focus of triage and carbon trading—at least as these strategies are standardly presented. What is required is more long-range or sustainable thinking with regard to conservation strategies in the broader political setting. Moreover, such long-range thinking may also recommend considerable efforts to change people's attitudes towards the environment. This, in turn, might involve: spending resources on high profile species that are not always best suited (ecologically) for saving, or encouraging companies to undershoot carbon-emission targets, not so they can profit by selling the offsets, but in order to develop more robust and global environmental sensibilities. The value of education and a genuine concern for the environment are what seem to be missing from (or are at worst undermined by) the triage and carbon-trading strategies. We are thus led back to the apparent conflict between decision theory and ethics.

This apparent conflict, though, is *merely* apparent. All of these issues—the role of education, the potential benefits of attempting to save a high-profile species, or the value of genuine green companies, or the potential gains from holding out for more conservation resources or more stringent pollution targets—can, and should, be incorporated into the decision-theoretic approach. These issues just amount to additional options or future choices and accompanying social interactions that must be incorporated when we are considering possible conservation strategies and their long-range consequences. It is likely that many disputes that look to be about conflicting core values will turn out to depend upon scientific issues—how to appropriately model the consequences of the various management options, and what are the best predictions about future social behaviour under the different scenarios.[22]

It might seem that we are nonetheless sidelining ethical considerations by forcing them into the decision-theory framework, but this is simply a mistaken way of looking at things. We discussed earlier how ethics may play a role in determining the appropriate utility functions to use in particular management decisions, or to help settle what the goals of conservation efforts should be—maximising biodiversity, preserving our favourite species, or something else. What environmental ethics cannot do, however, is determine the right course of action on its own.[23] For the latter

[22] See Baron (2006) for a similar deflationary account of bioethics.
[23] For a start, ethical theories typically do not give advice about what to do in the face of uncertainty (Colyvan *et al*. forthcoming a).

involves trade offs, uncertainty and optimisations, and these all require decision theory.[24]

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