ULYSSES REVISITED -

A CLOSER LOOK AT THE

SAFE MINIMUM STANDARD RULE

John Rolfe

Emerald Campus
University of Central Queensland

1.0 Introduction

Randall (1991) has argued that decisions about environmental matters should follow a two stage process. Decisions should be made on the basis of costs and benefits, but remain constrained by the Safe Minimum Standard rule (SMS). The use of the SMS as a caveat to Cost Benefit Analysis (CBA) in decisions about resource allocation can be defended as an example of binding behaviour in the same way that Ulysses, sure that attraction to the siren's songs would lure the Argo to the rocks, had himself bound to the mast so that he could not capitulate to his short term desires.

The simplicity of the Ulysses example paints an attractive appeal for the SMS rule to be adopted. Referral to the rule will stop us from choosing extinctions for short term gains. As well, adoption of the SMS rule circumvents many of the problems besetting the use of CBA in environmental resource issues. An additional benefit is that its rules based approach captures some of the middle ground in the debate between economists and environmentalists. Randall (1991) argues that the dual approach has broad appeal across many of the philosophical traditions in Western thought.

However, the very simplicity of the Ulysses metaphor does not promote a clear understanding of the relationship between the SMS rule and CBA. Environmentalists may gain some pleasure from picturing what they regard to be the fickle and myopic results of CBA being controlled by the fixed rule approach of SMS. However they are unlikely to realise that the implementation of the SMS rule is reliant on many of the same human preferences which are embodied in CBA. Thus the differences between the two approaches may not be all that large, especially if we are to be consistent in setting the values underlying each rule. As well, the outcomes of each rule are likely to change in tandem as the underlying preferences of society vary.

The purpose of this paper is to show that the SMS rule is in fact less binding on CBA than a first interpretation of the Ulysses story would imply. While this outcome may be disappointing for some, it helps to focus attention on the practical application of the SMS rule. Problems of consistency and non-vacuity make it difficult for the SMS rule to be set independently of the CBA framework, and mean that most applications of the SMS rule can be justified by the use of costs and benefits. The Ulysses metaphor remains, in economics and in literature, a myth.

2.0 The Economic Framework

Economics can be best described as a study of choices. To be able to compare choices, economists find a common method to value alternatives. The method of valuation is always reliant on the philosophical framework underpinning its necessary assumptions. One of the strengths of economics is that these assumptions are usually made clear to policy makers. While economics does have several approaches to valuation, the most

commonly used means of evaluating choices, Cost Benefit Analysis, reflects many of the assumptions used in mainstream economics.

2.1 Cost Benefit Analysis

Cost Benefit Analysis is one of the most important tools economists use to assess choices about resource use. In welfare economic terms it can be viewed as a Potential Pareto Test. That is, the investment decision rule is that the benefits of an action should be larger than the costs, and that it should be possible in concept for those benefiting by the action to compensate those disadvantaged and still retain a surplus.

CBA can be described (following Randall 1988) as anthropocentric, consequentialist and utilitarian in nature. The preferences of humans are considered. These preferences are considered to be consciously determined and all embracing. Options are valued according to the compensation required to return humans to their original level of satisfaction. Thus Willingness to Pay (WTP) and Willingness to Accept (WTA) measures indicate compensation levels that leave individuals indifferent between options. The measurement of costs and benefits on the basis of WTA and WTP grounds CBA on the use of human preferences and the constraints of individual income and wealth endowments.

The use of CBA involves the calculation of benefits and costs that flow from a particular option, the discounting of values to a common base to allow for time preference, and the summing to test for a residual net benefit. When environmental resources are assessed, many values that are expressed as benefits and costs are not easily observable in markets. A range of these values have been described in the literature[1]. Use values relate not only to the direct commercial use of resources, but to the aesthetic, recreational and other immediate individual uses that humans make of the environment. Option values equate to an insurance premium (positive or negative) for conserving the environment in case it provides a future, but as yet unknown, use value. Quasi-option values reflect the irreversible nature of many uses of environmental resources in the face of uncertain knowledge. Existence values indicate the satisfaction humans derive just from knowing that a certain species exists, independent of any use or option values. Randall (1991) suggests that calculating these values separately raises the possibility of double counting and recommends that Total Use value be used as a

---

[1] Chapter 9 in Pearce and Turner (1990) offers a summary of the concepts with subsequent references.

basis for measurement[2].

CBA is an economic tool that has been generally used to clarify resource use decisions, both for individuals and for society. It is not surprising to find CBA used to provide information about environmental resource issues, but its applicability has received some criticism[3]. First there are the criticisms relating to the assumptions on which CBA is based. CBA accepts the existing distribution of wealth and income. It is non-judgmental about peoples' preferences. It considers only the preferences of humans. It does not consider the equity implications of who receives benefits and bears costs. Next there are the intergenerational problems relating to time preference, and the effective trivialisation of costs and benefits occurring in the distant future given a small positive interest rate. As well, many costs and benefits are not traded in organised markets and some measurement or estimation process must be used to quantify them. CBA has a rapacious appetite for information but has difficulties with conditions of ignorance, uncertainty and irreversibility.

3.0 Safe Minimum Standard

An alternative approach to environmental issues is the Safe Minimum Standard (SMS), developed by Ciriacy-Wantrup (1968) and Bishop (1978). This suggests that once conditions and numbers fall towards the threshold level necessary for a species' survival, it should be preserved unless the costs of doing so are unnecessarily high. Thus for each species or ecological community there should be a SMS of conservation. The SMS rule assumes a priori that there are large benefits associated with preservation, and that ignorance, uncertainty and irreversibility are conditions to be treated with caution. Only when the costs of preservation prove to be unbearably high is the SMS rule relaxed.

No solid theoretical foundation exists for the SMS rule (Hohl and Tisdell 1992), unlike CBA which is based on the potential Pareto improvement criteria. Bishop (1978) used game theory as a basis for the SMS rule. By minimising the possibility of

---

[2] This can be supported by considering bequest value. One approach (Bennett 1992) treats the different benefits as relating to the individual only, with bequest values picking up the preferences for other people. The other (Randall 1991) incorporates bequest value in each of the other benefits. Thus the understanding and measurement of use, option, quasi-option and existence values will vary according to the treatment of bequest value. Total value though should be a consistent measure and thus be preferred.

[3] Some examples of environmentalist critiques are Holmes Rolston III "Valuing Wildlands" Environmental Ethics 7, (1985) pp. 24-48, and Mark Sagoff (1988) "Some Problems with Environmental Economics" Environmental Ethics 10, pp. 55-74. Randall (1988) provides an economic critique of CBA.

maximum losses, it could be shown that conservation was the preferred option in most cases where a disastrous outcome was possible. However Bishop and Ready (1990) show that the use of game theory will not always favour the selection of the SMS rule.

4.0 The Joint Approach

Randall (1991) suggests that the use of the SMS as a caveat to CBA helps to avoid problems of human myopia. He poses the problem of how protection can be offered to the environment without awarding it trump status. He appeals to several broad strands of philosophy to argue that resource decisions should generally be made on the basis of benefits and costs, but subject to a SMS caveat. Here, Randall's arguments are summarised.

In the instrumentalist utilitarian tradition, species and natural systems have value because of their various uses, their store of genetic value and their contribution towards waste assimilation and environmental stability. One of the major criticisms of CBA is that the preferences of humans which underlie CBA may not be fully rational. Environmental assets may be squandered for short term gain at the expense of major long term losses. Ehrlich and Ehrlich (1981) use a rivet popper analogy to illustrate this. Here their rivet popper continues to remove rivets from aeroplane wings on the justification that no planes have been lost yet. While we might not know the point at which rivet removal causes disaster, we are certain that the practice will lead to catastrophe. Extension of the analogy to the environmental debate shows how the continued loss of species and systems contributes to the likelihood that the next loss is disastrous.

The use of benefits and costs to evaluate decisions fits neatly into the instrumentalist utilitarian framework. However to avoid consequences of CBA that we are sure that we (or future generations) will regret, Randall suggests that the SMS rule be used as a constraint over the CBA process. The SMS rule would not be absolute, but a comprehensive process would be needed to relax it. This process is also a defence against the piecemeal approach of CBA where projects are assessed on an individual basis and approved if assessed benefits outweigh assessed costs. By insisting on the "Time Out" perspective that the SMS rule implies, Randall is guarding against the possibility that quasi-option values have not been accurately valued under CBA.

A contractarian basis for the SMS rule derives from the notion that all parties to a contract have rights, or enforceable claims. Arrangements that respect the rights of all affected parties are legitimate. The starting point for an arrangement should ideally be agreed to by all parties. Using a vehicle such as Norton's (1989) thought experiment along the lines of

Rawlsian contract[4] which took representatives from unknown generations and species, it is straightforward to show that all parties would press for the continued existence of species to maximise their chances of existence. Thus the SMS rule would be likely to be a component of a just constitution.

Randall also argues that the use of benefits and costs (subject to the SMS rule) remains plausible with contractarian thought. Because preference satisfaction counts, and many decisions in society are too complex to be satisfied through individualistic methods, the maximising approach of CBA can be supported as a second best result where at least benefits outweigh costs.

In a moral deontic approach, preserving the environment could be classed as a moral duty for humans. However it is unlikely that this duty should trump other moral duties such as those relating to the life prospects of humans. It could be argued though that humans have a duty to make substantial, but not unlimited, sacrifices for the environment. On this basis, the SMS rule is justified without granting the environment trump status. Once we move away from a SMS threshold, decisions about resource allocation from a moral perspective should give some weight to the satisfaction of human preferences. Because the satisfaction of human preferences is morally worthy, the use of CBA has some validity from a moral deontic framework.

Randall has mounted a strong case for the SMS rule to be adopted as a caveat to CBA. By developing a broad approach to the SMS rule he has given it a multi-faceted appeal and relevance across disciplines. In doing so Randall has portrayed the SMS rule in a very different light to CBA. He has cast the SMS rule as a theoretical anchor point to control and correct potential problems with CBA. The practical application of the SMS rule is left until the question of defining "unbearable costs" has been resolved.
However the implication of Randall's approach has been that the practical definition of "unbearable costs" would be the same under different philosophical frameworks.

The use of the Ulysses metaphor reinforces Randall's approach. Binding behaviour (the SMS rule) protects us from short term desires that are irrational but overwhelming. As Randall (1991) points out, the SMS rule will protect us from actions that "... we (or future generations of people we care about) will regret ...". The role of the SMS rule has been cast as a safety net because the ability of CBA to handle potential extinctions is suspect.

5.0 Criticisms of the Joint Approach

There are several groups of problems in the depiction of the SMS rule as a steadfast control over CBA. The first deal with

---

[4] See also Tacconi and Bennett 1993 for an example of this approach.

problems of implementation because the application of the SMS rule will vary according to what shortcomings in CBA that it is supposed to cover. The second group of problems relates to the similarities between the two rules. The consistent setting of benefits under both rules minimises the differences between them. The third group relates to the differences between the rules, and shows how different interpretations of "unbearable costs" make it difficult to use the SMS rule across various disciplines. These groups of problems are outlined in the following sections.

5.1 The Introduction of the Decision Rule

In the Ulysses example of binding behaviour, the costs and benefits of the binding option were well anticipated. Elster (1977) has shown how binding behaviour can be consistent with both rational behaviour and utilitarianism (Randall 1991). Binding behaviour is a technique that people use to guard against irrationality and weakness of will. An alternate focus of binding behaviour under the SMS rule is to guard against unpredictable outcomes. Here binding behaviour minimises the risk that some terrible, but as yet unknown consequences follow from allowing environmental extinctions to occur. The SMS rule in this case would ban the Ehrlichs' rivet popper from operating.

These two justifications for the SMS rule lead to very different implementation rules. The first example is the classic Ulysses case where we are sure that environmental extinctions are "bad", but that the short sighted and irrational nature of human behaviour blinds us to longer term considerations. The introduction of a fixed rule against extinctions will guard against myopic behaviour. The rule needs to be very inflexible because humans, following classic rent seeking behaviour patterns, will present arguments and evidence to justify exceptions[5].

This justification presents two small difficulties as well as the comparison to the more flexible approach. The first difficulty with the fixed rule approach is that it presupposes that extinctions are "bad" and preservation is "good". This Ulysses approach to preservation, complete with prior knowledge and no subsequent new information, characterises only those economic examples that assume perfect knowledge. The problem is that we would expect a complementary CBA approach to pick up the same weighting towards preservation. The fact that it does not is explored in the next section of the paper.

---

[5] The aim of the environmental ethics debate is to find justification for some fixed rule. Ehrenfeld (1988) for example, "would like to see (conservation) find a sound footing outside the slick terrain of the economists and their philosophical allies".

The second problem is that it is by no means clear that we have to leave an economic framework to solve problems of irrationality and weakness of will. Binding behaviour can clearly be justified in terms of costs and benefits and people commonly precommit themselves to maximise their long term benefits[6]. The Ulysses metaphor is really a CBA of binding behaviour. If we have, or can assume perfect knowledge about environmental outcomes, then binding behaviour can easily be justified in terms of costs and benefits.

The alternative justification for the SMS rule is that it guards against uncertainty and lack of information. Here, in the absence of perfect knowledge, the emphasis is on improving information and maintaining options. In this case it makes little sense to impose binding patterns of behaviour. If a set rule was in place, new and additional information would be worthless because it would have no influence. Decisions should logically be updated as relevant information comes forward. If the SMS rule imposed a binding pattern of behaviour, it would be impossible for subsequent information to have any relevance.

This implies that the operation of binding behaviour depends on the justification for the SMS rule. If the introduction of the rule is justified on some prior assessment of outcomes, then some binding pattern of behaviour may be necessary to ensure that desired outcomes are achieved. This "Ulysses" case though can be justified by costs and benefits, and the SMS rule is simply an application of CBA. However, if the introduction of the SMS rule is justified for precautionary motives, then the extent of binding behaviour may simply be the adoption of the SMS rule to avoid the complications of CBA. Thus, the operation of the SMS rule has the potential to vary widely according to the purpose for which it is adopted.

5.2 Benefit Setting Under the SMS Rule

From a utilitarian economic framework, the adoption of the SMS rule brings a presupposition that the benefits of conservation and preservation are very high relative to the costs. For the introduction of the SMS rule to be considered, the implication is that CBA has not valued environmental benefits highly enough. There are several reasons why this may occur.

One reason may be that humans are myopic when they value environmental goods. Yet if by implication people are myopic about the benefits of preservation why should society or the government on their behalf set benefit values for SMS artificially high but not adjust benefit values in a CBA? If those preferences for preservation are not picked up with CBA,

---

[6] Most rule based behaviour at both individual and society level can be justified in terms of costs and benefits because it minimises transaction costs.

how much political support is going to exist for a government to be able to introduce the SMS rule?

A second reason could be that an extended cost benefit framework excludes some benefits captured by the SMS rule. There seem to be two main possibilities. The first is that CBA does not accurately capture all the preferences about future events. In the words of Randall (1991), the SMS means "actions we are reasonably sure we (or future generations of people we care about) will regret are forbidden." Under an extended CBA, there are two areas where these regrets may not be captured. Benefit values may not capture the full extent of people's altruism to future generations. Alternatively, option and quasi-option values may not capture the possibility of future conservation values[7]. The second possibility is that people do hold accurate perceptions about environmental benefits, but wealth and income constraints prevent them from registering effective preferences under CBA. For this to occur though society must be stratified to the extent that rich people demand hedonistic pleasures while poor people demand environmental protection.

Another possibility is that CBA is not well equipped to handle conditions of risk, uncertainty and imperfect knowledge. The choices that it indicates between short term gains and long term losses do not accurately reflect people's preferences. Thus adoption of the SMS rule satisfies people's precautionary motives to a larger extent than does the use of CBA. This argument is substantially different to the previous ones because it accepts that CBA may measure all the relevant preferences but that the subsequent treatment of those preferences is not satisfactory. Because benefits flow from correct decisions, and losses from incorrect ones, a different form of decision rule to check or handle precautionary problems can be justified by CBA.

It may be possible to argue that the SMS rule is a more multi-faceted measure than CBA of the range of preferences, rights and moral duties that people hold. In appealing to the various traditions in Western thought for support, Randall creates the impression that SMS rule captures a more complete range of processes. It is not easy though to show how the WTA and WTP measures of CBA are unsatisfactory standards of measure. Rejection of CBA here in favour of the SMS rule must raise questions about the appropriateness of a range of economic measures.

---

[7] There is only a subtle difference between the two approaches. If a narrow definition of a rational economic person is used, then it is clearer to separate which benefits are personal ones, and which are to be awarded to others (bequest values). Under a wider definition of rationalism, the purpose of the benefits is not important, and bequest values form a part of other values (use, option, quasi-option and existence).

If we accept the position that the SMS is preferable to CBA because it recognises some additional benefits, two logical conclusions emerge. The first is that the smaller the difference in benefit measurement, the less that the SMS rule is preferred over CBA. The second is that if both rules measure the benefits of conservation accurately there is potential for them to achieve the same results[*].

At some point there must be a limit to the values that mainstream economics can accept. Given the roots of mainstream economics in anthropocentrism, consequentialism and individual preferences, that point seems to be reached where people care, in one form or another, for future consequences or beings. If people do not care for the future, then there is a limit for what economics, (and for political processes), can prescribe. Because we do not know the actual demands of future generations, any estimate of the rights of future generations is limited to current perceptions. Thus current bequest values are the best indication as to the rights that will be awarded to future generations.

Following Randall, let us accept that people do care enough about the future for the SMS rule to be introduced. People do this because of concerns about the environment, future prosperity, happiness and wholeness. Why, and this is the recurring theme of this paper, does the SMS rule pick up these preferences but not CBA. At the very least there must be a major correlation between the two approaches. When a society is concerned about the future it may adopt the SMS approach but we would expect those values to be also reflected in a CBA measurement of existence, use, option and quasi-option values. If a society placed no weight on the future, not only would the SMS approach be rejected, but low values would be expected for non commercial use, option and quasi-option values. As a society strengthened its preferences for the environment we would expect both support for the SMS rule and relevant benefits under the CBA approach to increase in tandem.

The introduction of the SMS rule will impose another level of costs to the decision making process about environmental factors. Its introduction will necessitate strong political and social support and would be evidence of strong preferences held by people about conservation. Thus in a society willing to use a SMS rule we would also expect to find CBA values reflecting environmental sympathies. Rather than being independent, the operation of the two rules is going to be a tandem exercise driven by the preferences of the human population.

---

[*] There would still be significant differences in the implementation of the rules because the burden of proof is effectively reversed between the rules.

5.3 Cost Setting Under the SMS Rule

It seems that there are some common elements to both the CBA and SMS approaches. These become even clearer when costs are considered. The SMS rule exists only while the costs remain bearable. Yet the definition of where the limit to tolerable costs falls is likely to rest on the preferences of people. Again, some potential for myopia exists, but the situation will generally be similar to that of CBA. The level of tolerable costs is that which is below the level of benefits. Costs will vary according to the preferences of people, which in turn will be influenced by considerations of income, perceptions, information and other factors. Thus the underlying preferences of people will determine the implementation level for both CBA and SMS. As the preferences of people vary, so will the actual decisions taken under both approaches.

However, the definition of intolerable costs is likely to vary according to the philosophical framework chosen. Under a consequentialist framework the emphasis of the decision rule is on avoiding large disasters. Thus the definition of unbearable costs is related in some way to the scope of the disaster. Under the more precise instrumentalist framework, the definition is related more closely to the preferences people have for alternative goods. In a deontological setting, human subsistence may count as a moral good of equal significance. Thus the intolerable cost is one that threatens subsistence[9].

Thus from a practical perspective, human preferences are likely to be the main factor in assessing the level of unbearable costs. There will be a high degree of complementarity between the SMS rule and CBA. When society chooses a high level of unbearable costs we would expect those preferences to be picked up by CBA. But the point at which unbearable costs is reached is going to vary according to the philosophical framework adopted. This casts doubt on the ability of the SMS rule to deliver a consistent result.

6.0 The Use of the SMS Rule

The affinity between the SMS rule and CBA casts doubt on the ability of the SMS rule to operate in an independent manner. Its ability to do so can be tested in the following way. Thompson (1990) suggests that an ethic for the use of the environment needs to be consistent, non-vacuous and decidable[10]. Consistency means it must not be arbitrary, non-vacuous means that all individuals or systems must not be

---

[9] I am indebted to Alan Randall for suggesting some of these points.

[10] While the SMS rule is not an ethic in itself, Randall's use of the rule is an appeal for the rule to be used as a surrogate for several ethics. The use of Thompson's criteria gives a guide as to its usefulness.

given equivalent values, and decidable means that it is able to dictate what has value in order to be able to solve ethical dilemmas (Nelson, 1993).

As shown above, the application of the SMS rule may not be consistent depending on the purpose for which it is used and the framework chosen for defining unbearable costs. It has the benefit of being decidable, providing a clear cut rule. It has a problem with being non-vacuous, in that the SMS rule does not fit very neatly with the concept that different species and processes have different conservation priorities and values. One problem is that the SMS rule could be generally applied to biota and relationships that are unique in some sense but remain fundamentally less important than other matters.

Some doubt therefore is attached to the ability of the SMS rule to act as an independent caveat to CBA. This occurs because the underlying preferences of society are going to influence the introduction and operation of the SMS rule, and because there are problems with consistency and non-vacuity requirements.

However, it is possible to defend the use of the SMS rule as an extension of CBA rather than as an independent caveat. There are three major arguments. The first is that CBA is not always performed in an extended format and a narrower, more technical version of costs and benefits are often measured[11]. The use of the SMS rule would be a safeguard against the possibility that an incomplete version of CBA was adopted. The second argument is that the costs of performing and checking an extended CBA are very high, and it may be much simpler and cheaper to impose the SMS rule as a substitute. The third is that the SMS rule reverses the burden of proof and guards against a piecemeal approach that whittles away preservation.

The major advantage about developing the SMS rule from a utilitarian consequentialist background is that some scope for precision and ranking of priorities exists. The SMS rule would be able to be flexible in its implementation, and the definition of "unbearable" costs would a consistent comparison to benefits. The dependence on human preferences means though that the operation and application of the SMS rule would vary as preferences changed, and that the Ulysses image of an unyielding control over CBA would be, as in literature, a myth.

---

[11] Sen (1987) contrasts the narrow "engineering" approach with the wider "ethics based" approach principally in terms of the definition of rationality. There are really two issues for CBA. The first is that a narrow approach may only consider only preferences revealed in market transactions. The second is that a narrow approach may restrict the goals of the rational economic person to a limited set.

7.0 Conclusion

Where is Ulysses now? We have seen how underlying preferences influence both the SMS and CBA approaches, and how the decision levels change in tandem for each as the underlying preferences of society change. More importantly, the operation of the SMS rule depends on the situation. In some cases it establishes a set pattern of behaviour. In others it is imposed for precautionary motives. As well, the definition of unbearable costs for relaxing the rule will vary according to the philosophical framework that is adopted. This means that Randall's general depiction of the SMS rule as a uniform control over CBA is flawed. Instead, the operation and relaxation of the SMS rule will vary according to the circumstances and the philosophical framework adopted.

These complexities are not a death knell. Use of the SMS rule still offers advantages. It is clear and simple, it reverses the burden of proof away from the environment, and it is risk adverse. However while it may win general approval, the operation of the rule and the setting of "unbearable costs" may be more contentious. Problems of consistency and non-vacuity cast doubt on the ability of the SMS rule to stand as an independent measure.

The SMS rule can be more easily supported as an extension or surrogate for CBA. It is in this role that the Ulysses example functions. Binding behaviour is justified where the long term benefits outweigh the costs of pandering to short term desires. Traffic rules, compulsory schooling and a host of other rules can be justified by reference to benefits and costs. It is perhaps ironic that instead of the Ulysses metaphor showing how CBA can be "controlled", it more aptly illustrates the use of a fixed rule as an economic instrument.

BIBLIOGRAPHY

Bennett, J 1992 Biological Diversity Conservation and Economics, Report prepared for the Department of the Arts, Sport, the Environment and Territories, Canberra.

Bishop, R C 1978 "Endangered Species and Uncertainty: The Economics of a Safe Minimum Standard", American Journal of Agricultural Economics, Vol 60, pp. 10-18.

Bishop, R C and Ready, R C 1990 "Endangered Species and the Safe Minimum Standard", American Journal of Agricultural Economics, No 57, 1978, pp. 10-18.

Ciriacy-Wantrup, S 1968. Resource Conservation: Economics and Policies, UCLA.

Ehrenfeld, D 1988 "Why Put a Value on Biodiversity", in Wilson, E O (ed) Biodiversity, National Academy Press, Washington, pp. 200-205.

Ehrlich, P and Ehrlich, A 1981 Extinction: The Causes and Consequences of the Disappearance of Species, Random House, New York.

Elster, J 1977 "Ulysses and the Sirens: A Theory of Imperfect Rationality", Social Sciences Information, Vol 16, No 5, pp 469-526.

Hohn, A and Tisdell, C 1992 "How Useful Are Environmental Safety Standards in Economics - The Example of Safe Minimum Standards for Protection of Species", Discussion Paper No. 97, Department of Economics, University of Queensland.

Nelson, M P 1993 "A Defense of Environmental Ethics: A Reply to Janna Thompson", Environmental Ethics, Vol 15, No 3, pp 245-57.

Norton, B G 1989 "Intergenerational Equity and Environmental Decisions: A Model Using Rawls' Veil of Ignorance", Ecological Economics, Vol 1, pp 137-159.

Norton, B G 1991 Towards Unity Among Environmentalists, Oxford University Press, New York.

Pearce, D W and Turner, R K 1990 Economics of Natural Resources and the Environment, Harvester Wheatsheaf, New York.

Randall, A 1988 "What Mainstream Economists Have to Say About the Value of Biodiversity", in Wilson, E. (ed), Biodiversity, NAP, Washington DC.

Randall, A 1991 "The Value of Biodiversity", Ambio, Vol 20, pp. 64-68.

Randall, A and Thomas M 1991 The Role and Limits of Economics in Decision Making Regarding Non-Indigenous Species, Report to Congress of the United States, The Ohio State University, Columbus.

Sen, A 1987 On Ethics and Economics, Blackwell, Oxford.

Tacconi, L and Bennett, J W 1993 "Implications of Intergenerational Equity for Biodiversity Conservation", Vanuatu Forest Conservation Research Report No 2, University College, University of New South Wales, Canberra.

Thompson, J 1990 "A Refutation of Environmental Ethics", Environmental Ethics, Vol 12, No 2, pp 147-60.