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Environmental Values and Adaptive Management

BRYAN G. NORTON

School of Public Policy
Georgia Institute of Technology
Atlanta, GA USA 30332-0345
Email: bryan.norton@pubpolicy.gatech.edu

ANNE C. STEINEMANN

City Planning Program
Georgia Institute of Technology
Atlanta, GA USA 30332-0155
Email: anne.steinemann@arch.gatech.edu

ABSTRACT

The trend in environmental management toward more adaptive, community-based, and holistic approaches will require new approaches to environmental valuation. In this paper, we offer a new valuation approach, one that embodies the core principles of adaptive management, which is experimental, multi-scalar, and place-based. In addition, we use hierarchy theory to incorporate spatial and temporal variability of natural systems into a multi-scalar management model. Our approach results in the consideration of multiple values within community-based ecosystem management, rather than an attempt to maximise a single variable such as economic efficiency. We then offer two heuristics – one procedural and one evaluative – to guide a community toward shared goals, and to develop indicators to measure progress toward these goals. We illustrate our approach by application to environmental and developmental decisions in the Southern Appalachians.

KEY WORDS

Adaptive management, environmental evaluation, management, multi-criteria analyses, sense of place values

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INTRODUCTION

While it is a truism that environmental policy is ultimately driven by 'social values', there is currently considerable confusion regarding how to understand and assess social values, and corresponding confusion regarding the role of values in the broader process of environmental policy formation, implementation, and management. In this paper, we set out to describe an alternative direction for environmental value studies, a process that emphasises pluralism, participation, and iteration rather than just simple elicitation of preferences and preference-aggregation. Our goal will be to provide an approach that will help to better understand environmental values, especially in public processes for environmental management.

Our approach to environmental values is based on theory, but our theory is not one of the usual ones, such as utilitarianism, or a theory that nature or its elements have 'rights' or something like that. Ours is a theory about *process* rather than a theory about *ultimate values*. We take the view that, since we live in a diverse society – and neither hope nor expect that this will change – the problem is not to decide which theory of ultimate value is correct, but rather to design a process by which diverse societies – with many voices expressing many worldviews and ultimate values – can act in a way that will tend toward a working consensus in environmental policy decisions (Norton, 1991). In the context of our theory, it is useful to have a variety of ways of expressing values and a variety of ways of measuring values. We do not, initially, seek a universal currency, such as dollars or units of happiness by which all values can be expressed; instead, we seek a set of indicators that expresses the values of the community as directly, clearly, and precisely as possible. In order to accomplish this goal, it will be necessary to go beyond one-time elicitations of the preferences of individual consumers, and to engage community members in a process of further clarification and integration of these values as a part of the search for democratically accepted management goals.

The goal of this paper is to add one important piece to a very complex puzzle – the gradual emergence of a new, more holistic understanding of environmental management, what is sometimes called 'ecosystem management', or 'adaptive management'. We offer a general approach that encourages the development of a more comprehensive and systematic approach to identifying and measuring social values, an approach that is pluralistic in the modes of expression and measurement of environmental values. We seek, that is, a way to use the social sciences – including economics, but not limited to economics – in a broader public discourse about goals and objectives of management. At present, there seem to be only two ways to talk about environmental values – the relatively undisciplined discourse of ordinary language – or the algorithmic (but incomplete) models of technical policy analysts such as risk assessors or

microeconomists. We seek a more formal method for ascertaining public values than that of common, everyday discourse; we do not try to treat decisions about how to manage resources holistically as decidable within technical models such as cost-benefit analysis. We believe that it will be helpful to introduce some common conventions and procedures that will guide the evaluation of environmental changes – thereby improving upon public discourse – without shifting completely out of public discourse and into technical, computational approaches to counting value. Even the advocates of such technical, computational approaches admit that such approaches are unable to capture large-scale, ecological values (Freeman, 1993: 485), the very values adaptive managers and other holists should embrace as key to their management process. The middle ground we seek is that of a pluralistic theory that can be supplemented with a process heuristic intended to focus diverse communities on the right questions, and an evaluative heuristic that guides communities to discuss various indicators. These heuristics can, we believe, guide a forum of people with diverse values to focus on what to measure and on what to protect – by appealing to their values – but to do so in a way that may allow people of differing values to choose mutually acceptable indicators and goals regarding those indicators. The heuristics, if successful, provide a link between pluralist theory and various procedural practices that may encourage the development of consensus and cooperative behaviours in community-based management processes.

Some background may help to place our goal in the larger context of management studies. More or less independently, advocates of ecological, holistic approaches to environmental management from several countries have developed local institutions and public processes to address local and regional environmental problems, problems that emerge at the level of larger ecological systems that function as habitats for human settlements and activities. Some theory, based in ecology and in the Leopoldian simile of learning to 'think like a mountain' (Leopold, 1949), has been developed. Adaptive monitoring and management, developed in Western Canada and incorporated into many management efforts in the United States, represents one 'package' of theory and suggested practices and guidelines (see, for example, Lee, 1993; Gunderson, Holling, and Light, 1995). Other practitioners employ similar or overlapping methods, without adopting the label, 'adaptive manager', so our emphasis on adaptive management can be thought of as more or less representative of a range of holistic, community-based environmental management projects. The premise of our paper is that these new approaches to management will require a new, more systematic approach to the evaluation of ecosystem-level environmental change.

We are aware that some of these projects have been studied by social scientists, and that evaluations of such projects have been mixed (for reviews, see Cortner and Moote, 1994; McClain and Lee, 1996; also see Innes and Booher,

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1999a; 1999b; Walters, 1997; Sabatier, 1998). Our purpose, however, is not to assess the success and failure of such projects, empirically, but rather to take tentative steps toward a new approach to environmental values, an approach that is appropriate to public discourse in the context of an adaptive, ecosystem management process. Our approach combines elements of the two existing approaches. Evaluation is undertaken in ordinary, public discourse, and using a suite of technical devices – multiple measurable indicators – that employ measures that are not necessarily inter-definable or technically comparable. Given this understanding, environmental values and evaluations will be summarised and balanced in ordinary discourse, but the balancing will include a careful look at specific, measurable indicators as useful technical guidance in the more political decision as to what to do. This careful look, however, will *not* be represented as an algorithmic aggregation of the multiple indicators and measures. This ordinary-discourse summation and political discussion concerns how to weigh and prioritise multiple measures as guided by heuristics which, while incapable of resolving substantive value questions by themselves, can guide an orderly public process of deliberation, summation, experiment, and revision. This pluralistic approach to ways of measuring environmental values simply recognises that, in diverse modern democracies, multiple values are expressed in multiple vernaculars. So, public deliberation, while carried on in public, ordinary discourse, is gradually studded with technical devices that prove themselves useful in measuring and evaluating environmental change. Balancing of technical measures is itself not a technical measure; integration of these plural values is carried out in public discourse, but public discourse provided some guidance through heuristics.

The pluralism proposed here is motivated by methodological considerations (Norton and Toman, 1997), and need not be understood as a doctrine about ultimate values. It is part of a broader experimental strategy that seeks first to express diverse values in multiple and perhaps incommensurable ways, and then seeks ways to organise and present those diverse goals as a starting point for a more holistic analysis. Here, the various 'reductionist' ideas of moral and economic theory can contribute to the process – they serve as guides toward systematisation and integration of values, and help us to formulate both consensus positions and disagreements more clearly. The search for successful environmental policies, on our broader approach, however, becomes a search for specific policies and practices that support multiple values, rather than an attempt to maximise a single variable such as economic efficiency or ecosystem preservation. This pluralistic, integrative approach focuses attention on the process whereby communities with diverse values articulate, discuss, revise, and reconcile competing values. In this way, it may be possible to create an environmental policy that protects many or most of the values that are articulated

by community members, and to do so democratically (Kemmis, 1990; Morrison, 1995; Gundersen, 1995; Kempton et al., 1995; Burgess, et al., 1988a; 1988b; Burgess, et al., 1998; Harrison, et al., 1996; Norton and Hannon, 1998). Since this process approach encourages the expression of multiple values, and does not insist that these diverse values be expressed in a single measure, we advocate the use of more than one criterion applied within an iterative, adaptive system of management (see Glasser, 1995, for a review of multi-criteria systems).

Looking forward, in Part I, we consider the current trend toward what is called 'adaptive management', exploring the following three core principles that articulate the basic approach of adaptive managers.

1. *Experimentalism*. Adaptive managers emphasise experimentalism within a dynamic system, recognising that an ongoing search for knowledge is necessary to set and achieve environmental goals.

2. *Multi-scalar Analysis*. Adaptive managers model and monitor natural systems on multiple scales of space and time.

3. *Place Sensitivity*. Adaptive managers adopt local places, understood as humanly occupied geographic places, as the perspective from which multi-scalar management orients.

Having stated and explained these core principles in Part I, which is intended to set the broader context for the introduction of the new approach to valuation in adaptive management, we ask: what value theory, and what general approach to valuation studies, fits appropriately into adaptive management processes, such as watershed management or ecosystem management projects? In Part II, we relax some of the assumptions of single-criterion analysis and compare our approach to existing alternatives for characterising and analysing environmental values, and propose that the object of efforts at evaluation in an adaptive management context should be *various possible development paths*. Development paths can be judged according to multiple criteria; it is helpful to think of one category of long-term concerns as whether policies are likely to hold open valued options for the future. In Part III, we show how focusing on a choice of indicators for successful management within an adaptive management context can create a locally appropriate set of measurable indicators that 'stand in for' important and widely shared social values. We offer two heuristics that encourage communities involved in adaptive management processes to propose and discuss multiple criteria and to 'try out' many indicators that might separately track important social values. Finally, in Part IV, we illustrate our approach by applying our system of valuation to a real discussion of environmental and development goals in the Southern Appalachians.

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I. ADAPTIVE MANAGEMENT: AN EMERGING PARADIGM?

We propose a more comprehensive, process-oriented approach to valuation and we suggest that this can be embedded within the tradition, and growing practice, of adaptive management. In this part, we introduce adaptive management by associating this trend with three core principles, which will set the stage for asking what types of valuation and public participation processes can be expected to be successful in the management context.

Our hypothesis is that, if the new, adaptive management processes being proposed today are to be successful, they will require new ways of involving the public in environmental decision making. Decades of experience with public involvement in traditional processes, such as environmental impact assessment, has revealed systematic limitations (Shepherd and Bowler, 1997). First, public involvement is often a discrete event or events, a snapshot of pre-project conditions, rather than a dynamic, adaptive process that considers changes over time, especially changes after project implementation (Shepherd, 1998). Our approach recognises that individuals' preferences and perceptions can and do change, particularly in response to new information and changing environmental conditions, and that ongoing community involvement is an important part of the overall dynamic of adaptive management. Second, traditional methods tend to emphasise two-directional, but mainly episodic, information exchanges between decision-makers and the public, rather than social learning and communication among individuals. Social learning refers to changes in the social conditions that occur when individuals learn from one another and their environment, including how individuals see their private interests linked with the shared interests of other citizens (Webler, et al., 1995; Gunderson, et al., 1995; Gundersen, 1995; Daniels and Walker, 1996). Our approach builds upon the concept of social learning to include values and goals associated with place-based features of a community. Third, usual methods often treat the public interest as a one-time accommodation or aggregation of individual interests (Reich, 1998), rather than preserving the plurality of values in an ongoing process of decision-making. Our approach encourages individuals to express such multiple values, without requiring that they be measured according to a single criterion. This approach could, in principle, permit communities to better examine trade-offs and choose among alternative development paths in order to preserve valued place-based features. Adopting a place-based approach does not imply that only local values count – to take a place-based approach is to look at environmental problems, as they emerge on multiple scales, from specific, local perspectives. Local perspective is thus not inconsistent with development of regional, national, or global policies; it is simply a recognition that most people and most communities look at larger-scale problems *from* their local viewpoints. As attention is turned to larger-scale environmental problems which affect larger and larger communities, these locally oriented individuals and communities

must – if they are to act effectively in this larger arena – form larger communities and develop policies that are also adaptive at regional and larger scales.

As noted in the Introduction, adaptive management is used here as representative of a variety of holistic, community-based environmental management processes. Speaking specifically, however, for concreteness, the adaptive management tradition has roots in the ideas of Aldo Leopold (1949; also see Norton, 1990; 1996; Lee, 1993) and even earlier in the philosophical tradition of American pragmatism (Lee, 1993; Norton, 1988; Norton, 1996); it was christened and given prominence by C. S. Holling and associated scientists in the late 1970s (Holling, 1978; Walters, 1986; Lee, 1993; Gunderson, et al., 1995; Norton, 1996). One also hears many references to 'ecosystem management' (Agee and Johnson, 1988; Samson and Knopf, 1996; Grumbine, 1994). We see these trends as complementary, with ecosystem management being a term that relates to choosing physical boundaries of the management unit, while adaptive management refers to the methods and processes often favoured once an ecologically delineated management unit is identified.

In this paper, we emphasise adaptive management and the methods available to adaptive managers, while recognising that other, emerging traditions share its basic ideas. We discuss adaptive management as representative of holistic, community-based environmental management more generally, and argue that these three axioms can be thought of as representative of a generic notion of holistic, ecological management. We believe that this widely shared core of ideas and axioms sets significant constraints on the type of valuation approach that will be appropriate in the day-to-day practice of such management.

Adaptive management is, above all, *experimental* management, and this represents its first core principle. Adaptive management assumes a dynamic system as the context of management – surprise is to be expected – but management methods should be designed, along with other primary goals, to reduce uncertainty through conscious study of management practice. Calling this style of management 'adaptive' links the tradition to the evolutionary ideas of Charles Darwin and his successors, since communities as well as organisms, 'experiment' with various survival strategies.

This first core idea of adaptive management, then, entails that management actions, whenever possible, should test hypotheses about natural systems, and that controls should be designed so as to learn from pilot projects and other isolable experiments. Adaptive management is self-consciously experimental scientific management in a dynamic system. As will be emphasised below, this same experimental spirit can be applied in the search for environmental values and goals.

The second core principle of adaptive management is that the dynamic systems of nature must be modelled as *multi-scalar*. They are complex, dynamic systems which unfold at multiple scales of time and space. This insight was articulated by Leopold (1949; Norton, 1990), who in the 1940s encouraged

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managers and citizens not just to think as individuals, but also, metaphorically, to 'think like a mountain' – to think, that is, on the temporal and spatial scale of a mountain and the ecological and geological processes going on there. This multi-scalar insight has been applied more technically in adaptive management today, by the incorporation of the principles of hierarchy theory into multi-scalar management models (Holling, 1992, 1996; Gunderson, et al., 1995; Norton, 1991, 1995a; Norton and Ulanowicz, 1992), as will be discussed after the third core principle.

The third core principle of adaptive management, 'place-sensitivity', has both a physical and a social aspect. Physically, place-based management is very aware of the particularities of local conditions and the function of local subsystems in larger systems. It emphasises the particularity of complex, local processes and emphasises information derived locally. This place-based anchoring therefore encourages perspectival and case-based science (Sagoff, 1988, 1998; Shrader-Frechette and McCoy, 1994); while theory is not eschewed, it is generalised from specific, local cases, rather than spun out from top-down reasoning and 'applied' to local situations. Socially, adaptive management recognises the importance of local communities and the ways they use their physical resource base and, accordingly, adaptive managers emphasise public involvement and social learning in the management process. While not assuming that local people always know best, adaptive managers are respectful of public inputs from local groups and residents, taking their hopes, concerns, and values as a starting point in the search for management goals. Local habitation of a place, one might say, forms an integral part of the dialectic between nature and culture that has evolved in a place, and should be taken into account in forming management goals and plans.

One might ask, Why these three principles? The first principle is usually considered to be the defining attribute of adaptive management – it is what distinguishes it as a movement or tradition. Adaptive management is management designed to use the experimental method – in juxtaposition with public involvement and stakeholder advocacy – to reduce uncertainty in environmental decision making (Lee, 1993). How, then, do the other two principles gain special, or core, status? The answer, we believe, is found in the central role of hierarchy theory in adaptive management.

Hierarchy theory, which emerged roughly synchronously with adaptive management, has been incorporated into the thinking of adaptive managers. It is so central to their conceptualisations of the management problem because it provides adaptive managers with a means to organise the spatial and temporal relationships that are so important in multi-scalar management. It thereby functions as a general guide to operationalising the second core principle of adaptive management, and embodies this principle in the structure of more complex, scale-sensitive models of management. Hierarchy theory can be summarised in only two 'axioms' (Allen and Starr, 1982; O'Neill, et al., 1986;

Allen and Hoekstra, 1992): (A1) all observation and measurement must be oriented from some point within the system (more on this axiom, below); and (A2) smaller subsystems change at a more rapid rate than the slower-changing, larger systems which provide their environment.

Hierarchy theory, then, especially in its second axiom – to take their significance in reverse of their natural order – operationalises the multi-scalar nature of adaptive management by modelling natural systems on spatio-temporal scales that differ by at least an order of magnitude. This multi-scalar approach also operationalises the idea that cultural evolution proceeds at a much more rapid pace than did purely genetic evolution, because of the ability of cultures to store and pass on information to their successors, rather than having that information passed on by processes of natural selection. But culture becomes evermore essential, so human communities must survive if the individuals that compose them are to succeed in perpetuating their genes and their practices. Hierarchically organised models are rich enough, conceptually, to model both processes, and to relate these processes, which unfold at different temporal scales, to each other. Applying this framework to adaptive management models, in particular, we can say that struggles for individual and community survival unfold at different spatio-temporal scales. Hierarchy theory can also provide opportunities for operationalising choices, based on the expected scale of impacts of a policy, as to which criteria should be emphasised in various situations (Norton, 1995a; Norton and Ulanowicz, 1992; Norton and Toman, 1997).

Since the first axiom of hierarchy theory treats all observation and policy discussion as orienting from some location in a complex dynamic system, it encourages – in the study of social values, as well as in descriptive modelling – the involvement of local communities in the articulation of management goals and in the design of management experiments. The two axioms of hierarchy theory therefore correspond (in reverse order) to, and in a broad sense operationalise, the second and third core principles of adaptive management. The first axiom is important scientifically because it operationalises a post-Newtonian, participatory notion of observation in distinction to the traditional scientific view of the world as observed by an outside observer.

This first axiom of hierarchy theory is also important in the tradition of adaptive management, however, for the role of local communities in management activities. Adaptive managers, committed to experimentation and to the ongoing formulation and reformulation of both management models and management goals, believe that involvement of affected stakeholders is essential if they are to develop the necessary relationship of mutual trust with local communities, and to aid in the development of larger-scale, regional and national communities devoted to better management at larger scales. This trust is essential if communities are to 'buy into' ongoing adaptive management processes, and to remain sufficiently involved to allow social learning to occur

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at community and regional levels (Lee, 1993; Gunderson, et al., 1995). The first axiom, which orients adaptive management practice, as well as science, from a specific place within a larger, multi-scaled system, thus operationalises both a scientific and a political focus *from a specific locale, which represents a point within a complex, dynamic, and multi-scalar system*. This axiom of hierarchy theory supports the adaptive managers' commitment to a place-based approach to communities and their resource use.

The incorporation of these two axioms of hierarchy theory into adaptive management creates a conceptual model in which environmental problems are understood from particular local places within a complex, multi-scaled system in which small, fast-changing components – both physical and social – behave against the backdrop of larger-scaled and slower-cycling super-systems that serve as their environments. Environmental problems might, of course, arise at larger as well as smaller scales; but adaptive management conceptualises problems *from* a given local place, and *within* a multi-scaled system.

A useful way of thinking about these formal assumptions is to see 'choices' of individuals in the more complex system of hierarchy theory, which roughly represents the individual as being in a 'place' within a complex, dynamic system in which change occurs on multiple scales according to significantly different dynamics. This location and complexity is expressed in Figure 1, in which individuals at one point in time face a mixture of opportunities and constraints that reflect resources available at that time. Alternatively, these can also be thought of as representing various strategies for survival open to them at the time in question. Certain patterns of individual choices in an earlier generation can, when taken in the aggregate, change the environment in ways that decrease the opportunities available to persons who live in the future, making the range of choices they face poorer than the ones found by the prior generation. If this occurs as a result of conscious choices and policies of the earlier generation, then the earlier generation can be blamed for reducing the opportunities of future people, who will also be struggling to survive given the resources available to them. This conceptual model, then, incorporates both aspects of hierarchy theory in its structure and, as a corollary, provides a schematic definition of failures of sustainability. A community is not living sustainability if the development path they are following will lead to a situation in which future individuals are lacking crucial opportunities that will, once lost, irreversibly diminish their life choices. Correspondingly, a positive, but still schematic, definition of sustainability would require the maintenance, over future generations of options and opportunities essential to the ecological integrity and social identity of a given community.

In this Part, we have characterised adaptive management – characteristic of holistic, community-based management – as a tradition that is unified by at least three core principles and a schematic definition of 'sustainability'. In this sense, the core principles might be thought of as constituting a 'paradigm' or a broad
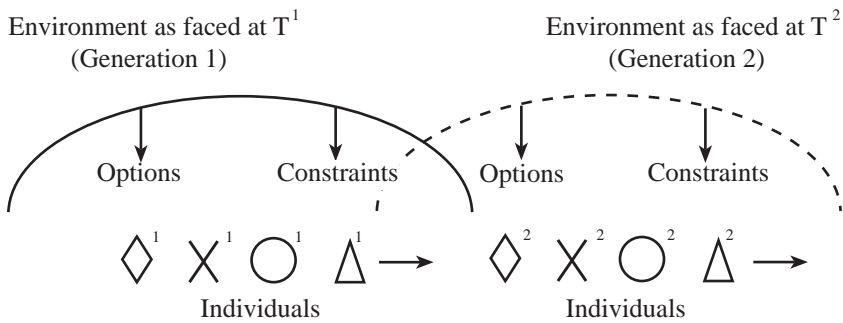
ENVIRONMENTAL VALUES AND ADAPTIVE MANAGEMENT

A. AT A GIVEN TIME:

The Environment

Options   Constraints

◇ ✕ ○ △
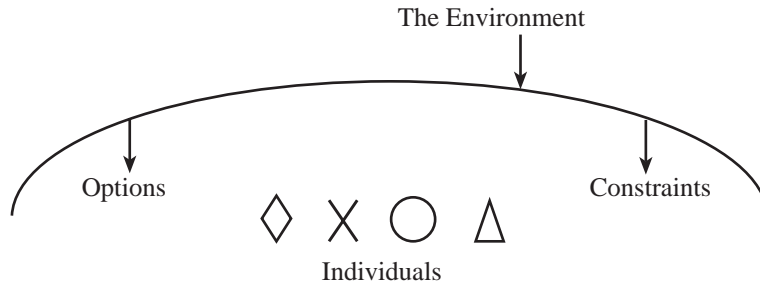
Individuals

Individuals face their environment as a complex mix of *options* and *constraints* as they *adapt* to their environment at any given time.

B. THE CROSS-SCALE DYNAMIC ACROSS TIME:

Environment as faced at T^1 Environment as faced at T^2
(Generation 1)   (Generation 2)

Options   Constraints   Options   Constraints

$◇^1$ $✕^1$ $○^1$ $△^1$ → $◇^2$ $✕^2$ $○^2$ $△^2$ →

Individuals   Individuals

Environment and resource use problems now appear as *cross-scale spill-over effects*, as collective impacts of individuals in Generation 1 alter the larger environmental system, creating a changed environment for individuals in Generation 2 (causing them to face a new mix of options and constraints).

FIGURE 1. The basic 'panarchical' model – hierarchically organised (Holling)

'conceptual model' for thinking about environmental problems and solutions. We are suggesting at least that these three ideas hang together as more than three random beliefs of adaptive managers. The first defines their distinctive approach to management, and the other two simply embody and elaborate the physical and

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social consequences of their formal, modelling decision to use the assumptions of hierarchy theory to organise space-time relationships. Having defined sustainability by embedding the concept within an adaptive management model, we can now proceed to draw out some of the consequences that would seem to follow for environmental valuation.

II. AN EVALUATIVE APPROACH FOR ADAPTIVE MANAGEMENT

Since the main focus of this paper is environmental values and valuation, we can now ask: What approach to the study of values is appropriate for adaptive management, given that it must be guided by, or at least consistent with, these three core principles of adaptive management? Implicit in this question is the suggestion that different frameworks of evaluation might be compared and chosen according to their appropriateness for particular tasks. We thus understand the question of choosing an appropriate approach to environmental valuation as sorting through available and possible paradigms for the articulation, interpretation, and measurement of values. As has been made clear by philosophers of science (Kuhn, 1996; Toulmin, 1972), broad scientific approaches such as welfare economics embody constellations of important assumptions, norms, principles, and definitions, sometimes referred to as 'paradigms'. A paradigm is characterised by the assumptions it makes in constituting its subject matter as a topic for research: these assumptions can make a paradigm exquisitely suited for a specific task – and these assumptions can also make a paradigm unsuitable for other tasks with different demands.

Valuational approaches can be divided into two broad categories: *single-criterion* and *multi-criteria* systems. In the first category, several general approaches have been prominently suggested in the literature; welfare economics and intrinsic value theory provide divergent examples of single-criterion systems of evaluation. There are even more types of multi-criteria systems, but most of these are not characterised by a significant body of consensually accepted principles or theory, and they are more distinguished by their intent to achieve value inclusiveness than by adherence to strict theoretical assumptions. Most multi-criteria systems are partial, indeterminate, and generally unable to provide comprehensive and non-arbitrary guidance in decision making (Glasser, 1995), so examination of them requires considerable speculation. Despite this, we propose a multi-criteria system and accompany it with a means to make it more comprehensive and less arbitrary through an iterative public process.

Theoretically, the system we propose is best thought of, initially, as resulting from the relaxation of various methodological assumptions of single-valued, economic-style environmental valuation according to which preferences, repre-

sented as individual willingness of consumers to pay for changes in their environment, are aggregated to arrive at the economic value of an outcome. In relaxing these conditions, it is not necessary to repudiate economic valuation, provided we are pluralistic. Rather, we recognise that maintenance and growth of a healthy economy may be one important and necessary condition for sustainable living and that economic valuation is therefore important, but there may well be social goals that cannot at this time be well represented in terms of willingness of consumers to pay for isolable 'environmental commodities' (Vatn and Bromley, 1994).

One important difference between our approach and that of economists is that we are interested in the ways that the values of respondents change over time. Since economists emphasise the stability of preferences, they often assume that respondents' preferences are stable for the period of a given study.[1] Since we expect to be involved in studying, and contributing to, an ongoing process, it seems more appropriate to assume participants' values will change over time. Once the evaluative task is conceived in this way, contingent valuation methods and other economic measures become useful tools among others, and in some cases contingent valuation methodologies could be used to register changes in preferences in longitudinal studies of preferences expressed at different times. How participants' preferences and values change across time therefore becomes an interesting subject of empirical study, and a number of methods are available to begin such studies. This alteration from a static to a dynamic viewpoint on preferences apparently requires more than a simple one-time elicitation of preferences, and thereby encourages the development of new evaluative tools, especially ones that can be applied iteratively and over time. These changes, in turn, suggest a somewhat different role for social scientists in the process of evaluation and of goal-setting. By introducing process-related techniques that are hypothesised to encourage consensus, the social scientist has admittedly become a part of the process, having assumed an expanded role that is likely to be controversial. Again, we simply respond that our approach is experimental and iterative; our commitment to social learning requires experiments to expand our ways of evaluating environmental policies; we can learn by doing. The experimental attitude can be maintained, methods tried out, and hypotheses tested, provided there is healthy scepticism regarding all assumptions, and a commitment to improve our decision process in the next application.

Increasing evidence from cognitive psychology and related fields contradicts economists' assumption of stable preferences, if it is taken as an empirical generalisation that preferences are in fact stable. This evidence is of two types. One type of evidence, referring to what are called 'preference reversals' (Tversky, et al., 1990; Slovic, et al., 1990; Grether and Plott, 1979), shows that respondents, when they respond variously to equivalent inquiries, apparently do

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not express preexisting preferences, but rather 'construct' preferences on demand (Slovik, 1995; Gregory, et al., 1993). A second type of evidence shows that the context in which a question regarding preferences is posed seriously affects answers elicited (Kahneman, et al., 1982; Sagoff, 1988; Blamey, et al., 1993). Again, it is not necessary to challenge economists' decision to elicit preferences as one-time snapshots. It may be that decisions having mostly economic impacts – decisions made in competition with other opportunities for consumption – usually are made against a backdrop of accepted, current market conditions and can be viewed as relatively constant over the relevant time periods. Because of the multi-scalar nature of adaptive management, and the multi-generational implications of the sustainability concept, it makes sense to view preferences as changeable across time, and to treat their change as an object of social science study when we look at long-range directions of environmental policy (Norton, et.al., 1998). A multi-criteria system of evaluation can in this way supplement economic valuation with longer-term indicators associated with community values. Given the multi-scalar nature of adaptive monitoring and management models, these longer-horizon values are particularly appropriate.

While economists and decision scientists assume discounting will eventually provide a solution to balancing social values across time, its use remains suspect and controversial outside those disciplines. In the Environmental Protection Agency's much-cited *Reducing Risk* report (USEPA, 1990) the Ecology and Welfare subcommittee rejected the use of discounting to compare present with future risks. We believe that understanding how to evaluate long-term impacts of environmental policy will require a more dynamic approach to environmental valuation, one in which the articulation of community goals is considered an ongoing and creative process. We also believe that, in improving our understanding of long-term evaluation, we must recognise the potential for major shifts in the preferences and values people express (Norton, 1994; Norton, et al., 1998).

Our approach, which emphasises iterative public participation across time, can respond to the lability and the contextuality of preferences in two related ways. First, our approach addresses the problem of arbitrariness among criteria *theoretically*, by offering a theory of environmental values that explains how, and on what basis, communities may pursue multiple goals, even goals that are associated with quite different scales and dynamics (Norton and Ulanowicz, 1992; Norton, 1995b). Figure 1 illustrates these goals as represented in a single multi-scalar system. Second, our approach addresses the problem of weighting criteria in actual decision processes *empirically*. By working with stakeholder groups and other participants in a particular community over a period of time, we can help the participants to articulate multiple, independent criteria, making it possible for the community members themselves to debate and balance competing goals.

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Our idea is neither to assume that there are many, incommensurable values, nor that there is a single measure of value. We simply note that discussion begins with the expression of multiple values. Our process is then designed to articulate and make these initially independent values more precise by encouraging articulation of independent criteria, and by experimenting with multiple criteria and associated measurable indicators. Since we begin with no commitment to a given number or type of indicators, we enter the process of articulating the social values of a community with an experimental spirit. Throughout the process, we can be watchful for ways to integrate, systematise, and simplify diverse values and goals. We seek to accomplish these systematisations through experimentation and interaction within a process of public discussion, rather than by definitional fiat.

Another difference between our approach and economic valuation methodologies is that we focus on a different, and more holistic, 'object' of valuation. Economists attempt, to the extent possible, to construe changes in the environment as discrete 'commodities' – commodities that could (at least hypothetically) be available for 'purchase' in a market situation. This creates an atomistic approach to valuation, with the environment understood as many discrete elements. Values of actual changes in the environment – which will usually involve changes in the availability or price of several or many such 'commodities' – are then aggregated from distinct elements. Our approach, by contrast, is to evaluate 'development paths' more holistically. A development path can be thought of as a direction the community could proceed into the future, a direction that will be significantly affected by the policies and decisions the community makes.

By considering the object of evaluation to be development paths, we can see a given community's problem as that of choosing, among the acceptable paths to economic development, that path that also holds open the most important options for future generations. On this view, individuals in the present must, as in Leopold's (1949) simile, 'think like a mountain'; this requires thinking about the long-term as well as the short-term impacts of decisions, and thoughtful attempts to integrate these. We are proposing that we operationalise Leopold's idea as an explicit element of the adaptive management process by evaluating development paths according to multiple criteria, recognising with Leopold that different management criteria are applicable to dynamics that unfold on distinct temporal scales. For example, the rate of erosion of mountainsides is not normally a major factor in our economic decisions; but when we think of our bequest to future generations, erosion rates might represent important evidence about how we are doing. The object of evaluation would thus be alternative development paths, which can be thought of as coherent scenarios – ways that development of a community could go from a given point. These might include

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actual projections based on no-intervention assumptions, but could also include coherent alternative development scenarios, paths that would unfold over several scales of time, given various policy interventions.

Further, our approach differs from that of economic valuation in that, since we place less emphasis on aggregation of values across geographic space, we emphasise and encourage place-based and local values, and we expect that the scientific data sought, and the management experiments undertaken, will often be tailored to local ecological conditions and local social concerns. We recognise that some communities will place a very high value on certain local features of their environment, features that lend distinctiveness to local places. Thus we are not surprised if, in the process of discussing values, goals, and indicators, a community adopts somewhat idiosyncratic indicators associated with their special sense of their local place. We believe this emphasis on local features and on local distinctiveness, while not necessarily inconsistent with the economists' goal of creating a single criterion employing a single currency, fits especially well with the basic tenets of an adaptive management system as described above. It allows each community to choose indicators without restricting available measures to those that can be translated into the universal vocabulary of 'willingness-to-pay', and encourages cross-community variation in process and outcome.

So, in a variety of ways, our approach diverges from the assumptions and day-to-day practices of economic valuation; but our approach also differs from extant multi-criteria approaches. The approach described in the literature on multi-attribute utility theory (MAUT), including value trees and value-focused thinking (Keeney, 1996; Gregory and Keeney, 1994; Gregory, et al., 1992; Gregory, et al., 1993), appears initially similar to ours in that these methods undertake valuation with an eye on social context. Generally, these methods use stakeholder objectives to frame decision problems: they identify and structure attributes, elicit stakeholder values, assign weights to attributes based on those values, and then mathematically combine values and facts to obtain a summary measure. Like our approach, these methods seek to incorporate the multidimensional aspects of value into decision-making. Neither approach has a simple algorithm for weighting various values, and it is possible for management efforts to be stalled if powerful interest groups steadfastly advocate opposed values. The goal of both approaches is to continue the dialogue, creating and nurturing community and a sense of trust, even as differing policy mixes are advocated. Our work differs from that of MAUT advocates in several important respects, however.

One primary difference is that these other methods place numbers on values, and then structure values into an algorithmic system, such as a value tree. Values, on this approach, are inferred from public behaviour or elicited in discourse with participants, given a numeric value within a particular theory of value and then analysed within a technically defined system of analysis. This approach assumes

that individual and social values can be quantified, organised, and then combined mathematically. Our approach, by contrast, is engaged in ordinary discourse, with technical calculations, indicators, and measures serving as aids to a more open and deliberative public discourse. Our approach seeks to incorporate diverse and perhaps qualitative expressions of values into decision-making, without requiring that all values be quantified and modelled, or that all stakeholders agree on the hierarchy of attributes and the values of those attributes. Whereas advocates of MAUT elicit preferences and then use a multi-criteria system to analyse and aggregate those preferences within a technical model, we view preferences as changing as a result of public deliberation and new information, and we embed multi-criteria analysis within the public process, refining and changing the criteria in response to changing public knowledge and values.

Another difference is that many of these other methods ultimately reduce diverse and multiple values to a single summary number. In this sense, multi-criteria decision-making becomes single-criterion decision-making. While this approach is analytically convenient, it loses crucial aspects of context by collapsing multiple scales into a single dimension. Questions remain regarding whose values count, how much they count, and how to combine those values. In contrast, our approach preserves the plurality of values, and encourages expression of multiple values as part of the public process, without requiring that diverse and perhaps incommensurate values be combined into a single measure.

Additionally, MAUT assumes the explicit separation of facts and values (Gregory, et al., 1993). We, on the other hand, assume that facts and values are often linked, and that it may not always be possible to separate the two, or the effects of one on the other. What people believe can affect what they prefer, and vice-versa. So, our approach explicitly considers and supports the effects of social learning in the articulation and reconsideration of values. For instance, through a public participation process, stakeholders' understanding of the causes and consequences of environmental degradation may change, thereby influencing their preferences for one policy alternative over another. By evaluating development paths more holistically, we avoid the arbitrary separation of a respondent's *perceptions* of a good and their *preferences* for it. We propose, one might say, endogenising the development, analysis, and weighting of competing values into a broader adaptive management process.

In summary, our approach focuses on adaptation rather than algorithm, on plurality rather than combination, and on participation rather than quantification. Even supporters of MAUT note that: 'Very few arenas can accommodate this type of rational display of facts, values, and conflicts' (von Winterfeldt and Edwards, 1986: 379). By concentrating on development paths throughout an ongoing process, we shift the emphasis away from discretising and quantifying particular values placed on singular 'commodities', and toward a public process that evaluates development paths holistically and continues also to discuss whether chosen criteria are adequate to capture the community's values.

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III. SOME HEURISTICS FOR PARTICIPANTS IN ADAPTIVE MANAGEMENT PROCESSES

Development of multiple criteria within an ongoing public process may suggest to some a chaotic approach to policy formation; but we believe it is possible to design a process that can bring some semblance of order to a public process of setting environmental goals and deciding on the priorities among them. One crucial aspect of this process is to choose management goals and criteria of success that reflect broad social values, social values that are reflected in the fondest hopes and the greatest fears of the public. Here, one might expect considerable diversity in people's statements of goals at the beginning of the process. But as participation continues, the group may embrace integrative indicators as ways of stating goals that would protect many values simultaneously.

While we believe that the process must involve a serious discussion of the values held by various community members and stakeholders, we do not recommend that the search for consensus start with discussions of the 'ultimate value' of nature or with the articulation of very general values. An advantage of a circular, iterative process is that we can choose to 'begin' our interventions at any point in the ongoing process. We suggest that public discussions of management goals begin with an examination of the environmental indicators that will be used to measure 'success' in management. Values will be relevant and will enter the discussion, because social values held by individuals will be invoked as reasons to choose, or give weight to, a particular criterion or indicator. But starting with the problem of choosing an initial set of rough-and-ready indicators – which will then be submitted to further discussion, refinement, and revision – allows us to make the problem a concrete issue about what we should measure and monitor; and it also leaves open the possibility that some specific indicator will be supported by people with quite different values. In this way, it may be possible to integrate many social values on a quite practical level by agreeing on a suite of indicators that support several social values simultaneously.

The history of environmental policy has made clear that, in many cases, advocates of quite diverse values – bird hunters and bird watchers, for example – can unite behind shared goals – such as maintaining or creating habitat for migratory birds – without resolving their underlying differences in the way they value birds. Much can sometimes be gained, then, by postponing direct confrontations over ultimate values, or at least pushing these into the background, allowing stakeholders with diverse values to seek concrete goals that will further their quite different values (Norton, 1991). This outcome can be encouraged by actively seeking 'integrative' indicators, ones that track a variety of values and that are acceptable to participants with diverse moral viewpoints.

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A good example of an integrative indicator for regional planning is a 'percentage-of-impervious-surfaces-measure'. This indicator, which can be fairly accurately measured by satellite imagery, also has arguable scientific connections to important social values including clean water supply, the amount of wildlife habitat, and other management objectives that may be favoured by a patchwork constituency. This constituency, though embracing diverse values, may thus support a goal of minimising impervious surfaces. This goal, accompanied with a means to measure success in reducing impervious surfaces over time through satellite imagery, may be a useful guide to decision makers because it can serve as a stand-in for some pretty important – and widely held – social values. Shared management foci such as this can also create a public context in which management experiments are undertaken, measurements are carefully recorded, and management options are explored through pilot projects designed to reduce uncertainty about the outcomes of various, proposed management options. The important thing is that, in the meantime, the community goes forward to discuss *both* the question of how they are doing in achieving stated goals, *and also* the question of how well our chosen indicators and measures seem to be tracking socially important variables. Again, the central concept is the Deweyan idea of social learning, which can occur when communities commit themselves to an ongoing process of participation in setting management goals and priorities. Adaptive management, when it incorporates ongoing public involvement through stakeholder groups and interactions between managers, scientists, and the public, can provide a context, and help to create a trusting, experimentally-minded community that encourages social learning and the gradual adoption of shared criteria by which to measure how the society is doing in protecting social values.

Given our emphasis on local participation in defining management goals, it is impossible of course to provide anything like a complete list of sustainability indicators in a theoretical paper such as this. Choosing and weighting these indicators will require, we believe, many local processes that will no doubt lead to many and diverse outcomes. The most we can do in this paper, then, is to sketch some characteristics of a process, including some tools for evaluating environmental change, that might help communities to develop a set of indicators that will define, for them, the goal of sustainable living in their place. Our contribution to the process is to offer some heuristics that might guide participants in locally based adaptive management processes to ask, and to answer, the right questions on the way to this result. Expecting diversity of viewpoints, we seek a process that can develop trust and cooperation and allow social learning, even within a diverse community. How can we improve the likelihood that communities engaged in these processes will tend toward consensus in the choice of goals and of policies to pursue those goals?

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Since we focus on the task of choosing measurable indicators as a goal of public participation, a task that will require unusual attention of participants to scientific and political aspects of the management process, it would be unrealistic to hope that the task of choosing indicators could be accomplished by the 'general' public, through direct democracy. Adaptive managers have instead advocated an inclusive process in which, by whatever means, a public advisory committee is formed. This committee should be inclusive in membership, encouraging participation of representatives from all stakeholder groups, including involved scientists, representatives of government agencies, and so forth. What is required of this committee is regular participation and an honest effort to understand and solve problems. It is also helpful if the representative stakeholders on the advisory committee can maintain regular communication with their constituencies. This committee must develop trust among its members, try to find common ground with representatives of opposed groups, and – just as importantly – serve an educative function with their constituencies. In this way, it is hoped that an 'epistemological community' – a group of people with enough trust and shared vision of what the questions and problems are – can begin cooperating in choosing policies, and in using scientific testing to evaluate policies to respond to the problems faced (Lee, 1993; Gunderson, et al., 1995). It is also hoped that the members of this advisory committee will communicate well enough with their constituencies to arrive at policies that will have broad public support. Again, the local and situational nature of the process we describe prohibits detailed description of such a committee, or its exact workings. Nevertheless, we assume – in order to have a context for our heuristics – such a committee has been formed as a part of a public process of adaptive management of an ecosystem, that there is enough commitment on the part of members of the committee so that complex questions can be posed and answered through experiments, and that participants remain involved long enough for social learning to occur. Given such an adaptive system in place in a local community, we are then able to offer two heuristics that may help the community to progress toward shared goals and shared measures of environmental success and failure that they associate with those goals.

A Process Heuristic

The first heuristic is a way of thinking about the process. The Process Heuristic suggests dividing the ongoing process into two tiers, or 'phases', which we can call the 'action phase' and the 'reflective' phase (Page, 1977; Norton, 1995a; Norton and Toman, 1997; Norton, et al., 1998). In the *action phase*, there exist several goals and associated 'action rules'. These rules will include general evaluative criteria, such as the Cost-Benefit test, the Safe Minimum Standard of Conservation, and the Precautionary Principle, and it will also include more specific goals, and associated indicators, such as 'minimise impervious surfaces

in the watershed', or some other indicators that express more distinctive, place-based aspects of the community's environment. These multiple criteria and indicators, in order to be deployed in real decision situations and according to an evaluative plan, however, must be formulated and weighted in a *reflective phase*. In the reflective phase, a second-order public discourse is thus initiated to design an evaluative procedure employing some combination of the various criteria, or decision rules, in the action tier, according to the appropriateness to a given problem situation. In practice – in active community-based processes – the two phases will of course normally overlap and proceed simultaneously. This two-phase, iterative mechanism is thus simply a heuristic designed to help discussants shift focus from *evaluating* development paths, to the reflective task of *choosing an appropriate evaluative model in a given, particular situation, and back again*.
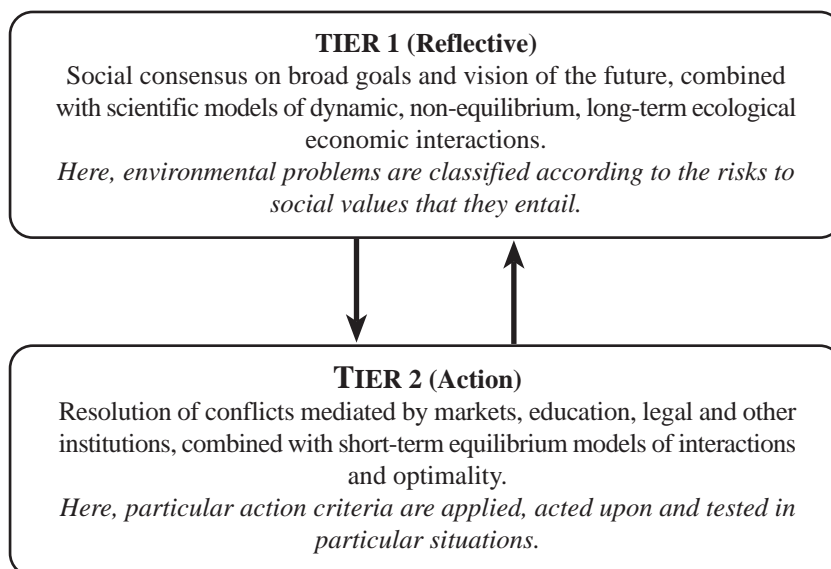

TIER 1 (Reflective)

Social consensus on broad goals and vision of the future, combined with scientific models of dynamic, non-equilibrium, long-term ecological economic interactions.

Here, environmental problems are classified according to the risks to social values that they entail.

TIER 2 (Action)

Resolution of conflicts mediated by markets, education, legal and other institutions, combined with short-term equilibrium models of interactions and optimality.

Here, particular action criteria are applied, acted upon and tested in particular situations.

FIGURE 2. The two-tiered decision structure

An Evaluative Heuristic

We turn now, more specifically, to the choice of evaluative criteria for use in this process. As noted above, we evaluate development paths, which are ways that a community could develop in the future, given its current status. There are of course many possible development paths proceeding from any point, but it may be possible to identify a few alternative directions and associate these with policy

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choices facing a community. If so, it may also be possible to specify a small battery of measurable criteria, or 'indicators', that could be used to evaluate proposed development paths (Alberti, 1996; Maclaren, 1996; UNCHS, 1994). For this task, we need a system of valuation that encourages articulation of multiple values and goals, coupled with a process of ongoing discussion, debate, information-gathering, and revision of goals as described above. Citizens and stakeholders must be engaged in an ongoing, iterative process that builds both trust and an expanding data base, creating an atmosphere conducive to social learning. One important role of stakeholder and citizen participants in management is to help adaptive managers focus attention on problems that are considered important by responsible community members. Since, especially in the beginning stages of a participatory process, we can expect divergent values and concerns to be stated, a multi-criteria approach to valuation allows participants to express their own values in their own terms. Social scientists, as part of the process, can help participants to articulate their varied concerns more clearly and precisely. Ideally, there will emerge a small cluster of measurable environmental indicators, with each of these being advanced by some or all participants as useful measures that are associated with worthy social values. Since stakeholders, arrayed in ongoing participatory groups, can continue conversations about goals and values, adaptive managers can hope that clarification and sharpening of specific values, along with some systematisation, consolidation, and simplification of multiple evaluative criteria, will occur. In the process, the choice of goals, values, indicators, and evaluation criteria, all become a part of the ongoing, experimental approach to management.

We have described a process, consisting (at least implicitly) of two phases, in which an ongoing advisory committee moves back and forth between a reflective phase of goal-setting and discussing associated proposals of particular indicators, or slates of indicators, based on outcomes of the actions taken, and a more action-oriented phase of proposing and choosing policies. This action-oriented phase involves the application of criteria already judged appropriate in a reflection on goals and possible measures associated with them. In it the group proceeds to choose policies by which to pursue those goals, and then attempts implementation and evaluation of those policies. Every cycle through the phases provides further information to feed back into the reflective phase, and this information can either confirm or provoke reconsideration of goals, values, and indicators. This discussion proceeds by focusing primarily on choosing widely acceptable indicators, all the while encouraging people to express their values and suggestions as a part of the ongoing reflection on goals. Our approach offers no ready solutions or decisive algorithms, and certainly no one-size-fits-all criteria or indicators. What we can offer, as the elements of our more systematic, procedural approach to environmental evaluation and decisions, are (a) a general theory based in adaptive management and in democratic practice that supports

a public process in a setting designed to encourage experimentation and to induce social learning; and (b) some simple heuristics to help particular communities in particular situations to ask the right questions and to gradually move toward agreement regarding goals of environmental management and regarding how to measure success in seeking those goals.

Throughout both phases it is assumed that the process is open and that participants interact with the broader public, both in order to inform and educate the broader public about the process and also to get feedback from the public about proposed management goals and progress in achieving them. Because our theory is community-based and democratic, it is not possible, dealing on the theoretical level of this paper, to be both substantive and specific in defining goals and indicators within the system we describe. This, again, is not surprising in that our theory locates the definition of sustainability and community goals in a local, public process that is expected to have varied outcomes in different communities.

The evaluative heuristic recommends that, in local management situations and with advisory/stakeholder committees fully involved, an iterative process be begun with an exercise in choosing an open-ended slate of indicators that express all participants' values. At first the list of indicators will be inclusive, and there should be discussion of how the various indicators can be associated with policy goals, and how experimental initiatives might be undertaken to establish relationships between various indicators and broad management goals. One requirement of a good indicator will be that it must be measurable, and that measurement must be reasonably efficient and effective; this practical require-ment will be, in the course of discussion, balanced against the expected correlation of various indicators and measures with broad social goals of the community. Once a slate of measurable indicators is proposed, the task of gathering base-line data and formulating goals for changing current states of the environment can be undertaken, and a round of policy discussions about options can lead into the action phase where the proposed multiple criteria are used to rank various proposed management options. Here, adaptive managers will advocate experimental management initiatives, localisable experiments and pilot projects – with controls – that allow the community both to learn about outcomes of policies in a limited locale, and also to learn about and assess the performance of the current slate of indicators. Throughout this process, it is expected that stakeholders and laypersons will interact regularly with scientists and technicians, learning both about the technical strengths and weaknesses of particular indicators, as well as ascertaining how well the indicators track social values of interest. As the process passes, implicitly or explicitly, through the action and reflective phases time and again, it is hoped that social learning will occur.

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One of the key goals of our multi-criteria approach is to allow participants in the process to articulate and gradually agree upon some goals – especially long-term goals – that are expressed in non-economic terms, such as explicit moral commitments to hold open certain options and opportunities that give character and distinctiveness to a place. These are values that participants are not comfortable 'trading off' against short-term economic gains; these values, one might say, are privileged within that community because they represent what we will call its 'constitutive' values (Ariansen, 1997). Constitutive values are values which, to participants and community members, represent a voluntary self-identification with the peculiarities and charms of a particular place. If constitutive values of a place are threatened, a community member would fear for the special identity of his or her home place. Such fears might be expressed as 'If *that* were to happen – if my community were to change in *that* way – I wouldn't even care to live here anymore'. This outcome occurs when a place loses its 'integrity', and the constitutive link between a community, its environment, and its values is (at least figuratively), severed (Ehrenfeld, 1993). While it may be argued that loss of communities and the values they cherish should, on the Darwinian idea of selection, be considered a natural outcome of the competitive process, our purpose is to ensure that communities can, if they choose to be proactive, articulate policies that maintain a commitment to local natural and cultural history.

In this part we have tried to describe a process of public participation that is rich enough to fulfil the demands of an ongoing project to manage a watershed or an ecosystem according to the principles of adaptive management. We introduced our approach by showing ways in which it differs in important respects from both single-valued criteria and from most of the multi-criteria approaches currently under discussion. We have also shown how our process, if adapted to apply in many different communities, could provide a context for fruitful discussion of environmental goals. Our process endogenises choices of goals and indicators, and anticipates social learning in the realm of values and community planning. The multi-scalar nature of adaptive management makes multi-scalar monitoring and evaluation possible, and it is a challenge, but hopefully a realistic one – for communities to devise multiple modes of evaluation for impacts that occur at different scales and on differing cycles. We have assumed a multi-criteria system of evaluation embedded in an adaptive management project, with hierarchy theory structuring space-time relations. We believe this pluralistic system, if embedded in an adaptive, participatory process and supplemented with our two heuristics, can be expected to help diverse communities move toward consensus in articulating goals and also in choosing ways to measure attainment of those goals.

IV. AN APPLICATION:
EVALUATING DEVELOPMENT PATHS IN THE SOUTHERN APPALACHIANS

In order to give some concreteness to discussions of projects of this sort, we quote the sincere expression, by a local environmental activist from Southern Tennessee, of what was to us a convincing 'environmental value', and which may be representative of sense of place values. The activist was expressing his frustration at a series of governmental and private decisions, decisions that seemed to make it more and more inevitable that large multinational corporations would be allowed, even encouraged, to construct mega-mills along the Tennessee River, huge mills for grinding hardwood forests into chips. The extraordinary scale of these mills would ensure that virtually all of the remaining hardwood forests in the Southern Appalachians will be 'chipped out'. The activist said, 'If they let the chipmills in, they'll scour the Southeast, and replant fast-growing pines in straight rows. I grew up in a hardwood forest. We like our hardwoods. I'll fight to stop them, but it seems pretty hopeless, with the government talking "jobs", and the big Japanese money behind the mills'. The chipmills, and the fast-growing plantation pine forests that will inevitably follow the cutting of hardwoods, will predictably ensure jobs and income for the area for the foreseeable future, so it seems doubtful that the value the activist was expressing was an economic value in any simple sense. What exactly is the value he was expressing?

The value surely has an aesthetic component – the activist was expressing an aesthetic preference for mixed hardwood landscapes over pine plantation landscapes – but this is just as surely not the whole of the value as experienced (Norton and Hannon, 1998). Conceptually, it makes sense to think of the additional value, beyond the aesthetic preference, as a value placed on retaining key options or opportunities in the location where the activist lives. Suppose the activist is a hunter; he might have continued his argument: 'I love hunting; it makes me come alive each Fall; I usually go hunting in the river valley, over in the National Forest. My Grandpa and my Pa used to go there, and they showed me where the deer pass through a little draw early in the morning on their way to the river. Now, my father doesn't usually feel good enough to go along, but my son and I have hunted there every season since he turned 12 years old'.[2] These embellishments to the story – which could of course just as easily have included hiking, photography, or bird watching experiences – are important because they begin to show how aesthetic preferences, experience, and choices all play a role in the individual evaluation process.

Obviously, it is impossible, scientifically, to capture all of this detail in basic measures, so our goal is to offer principles that might guide a process in which this rich fabric of individual experience is fed into – and shaped by – a

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participatory, ecosystem process. Speaking generally about these very specific experiences, we can say that, for the activist, there is a range of experiences or options which are especially important, experiences that are somehow essential to his sense of self and to his sense of family and community. If these options are destroyed as a result of the destruction of the hardwood ecosystem he has grown up with, this outcome would leave him poorer by eliminating options that give meaning to his life, that connect him to his past, and that give him hope for the future. Following Ariansen (1997), we have called the values associated with these options 'constitutive values', because, if they are lost, the integrity of a place – its identity as a place – is diminished, as is the sense of self of community members.

Building on this example, we note (a) that the value the activist defends is independent of economic growth issues – there is little doubt the entry of chipmills will stimulate economic activity in the area – so the values involved are unlikely to be captured in exclusively economic measures; (b) the threatened loss of value can only be given context and meaning in a longer time-frame of decades and even generations – it is therefore not easily expressible in 'present dollars'; (c) the loss is clearly place-based – the activist is not making a claim that hardwoods are always and everywhere better than pine forests, but rather that hardwoods are naturally and culturally 'appropriate' to his home place; (d) the value in question has more to with holding open certain valued options, options which provide meaning and continuity to a community and its culture – the threatened loss that motivated the activist would represent a restriction in the future options open to him and his children; and (e) the value in question seems to refer, not so much to 'objects' or 'elements' of nature, but to variations in the type of economic development that emerges in the region.

Assuming that our activist is likely to favour at least some economic growth and increasing standard of living for the region, and given that we have just analysed the values that motivate his activism as non-economic, we may now have a simple example of how one might use a two-criteria system of value as part of a process to help our activist to integrate two conflicting values. The situation faced by our activist can be characterised as follows. Development interests have proposed to pursue a particular path toward economic development, a path that would positively affect economic activity, and likely increase income levels in the area over coming decades. According to economic criteria, then, the chipmill path scores high, perhaps higher than any other development opportunities, if projected over a few years. But our activist also knows that there will be predictable ecological and landscape effects if that development path is pursued. We have interpreted our activist as criticising the chipmill path as eventually reducing and eliminating certain options which, to him, are highly valued in a non-economic sense having to do with his personal, family, and community identity. If certain options were gradually obliterated as his community pursues the chipmill path, these longer-term and more personal values will

be obliterated as well, reducing the continuity he feels with his children and with the communities that evolve in his place in the future. Logically speaking, then, the loss of these valued options, which support important values constitutive of the activist's sense of self and community, can be understood as losses that are not directly compensable in economic terms. The activist and his family, he believes, will be worse off than they would have been if a different path toward development were followed. This can be described as a non-compensable loss because it is attributed even though the chipmill path to development is likely to make them richer. And, as long as both goals can be expressed in terms of more-or-less, then dialogue can continue. If our activist could live with a 25 or 40 percent reduction in hardwood cover, a variety of more diversified growth paths would open up for discussion.

Our activist's objection to the chipmill path can now be given expression as follows: 'While the chipmill path to development scores very high on projections regarding its impact on economic growth in the region, it has unacceptable consequences. I am seeking a development path that scores reasonably well on economic growth measures and is also able to hold open important options that give meaning to my life and to my social interactions; it is important to me, and to my community, that these options be held open for the future – they represent our identity as a family and as a community. I will work to implement such a policy because I simply cannot accept the personal and social costs of destroying options that are so key to our long-term attachment to this place'. This set of concerns, if expressed by an activist, is not perspicuously discussed according to a single-criterion system. It seems more like a problem of finding a development path that comes closer to fulfilling two criteria, based on independent variables. Since it is impossible to maximise more than one variable in a system, one must find a prudent and efficient trade-off between development goals.

Some readers may be concerned that, by saying such losses are non-compensable, we imply that intergenerational values will be applied as lexicographically prior, and thus 'trump' all economic values. We do not intend to suggest strict lexicography, but rather treat both economic growth and protecting options for the future as important goals. Neither criterion need be given absolute, or lexical, priority; but it might make sense to set *de minimis* standards for each criterion, and restrict serious consideration only to paths of development that can be expected to achieve minimal levels for each. If our activist were a member of an advisory committee in an adaptive management process, we can imagine him proposing that his community should choose 'percentage-of-area-in-mixed-hardwoods' as a useful indicator, and he could explain that the hardwoods are, to him, a useful stand-in for many of his values. Assuming there is also a participant representing local business interests, we can expect her to make a case for setting a goal of consistent and robust economic growth. Discussion and negotiation now becomes a matter of trade-offs, between goals and degrees of achieving them, within a democratic process. While the values

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advocated by the varied stakeholders are not commensurable, both are at least roughly quantifiable and representable as matters of degree. The value of our evaluative heuristic is now clear: if we maintain multiple criteria throughout the participatory process, it will be easy for the participants to discuss the usefulness and importance of the two indicators, and which one should be emphasised in which situation.

Further, once the goals and indicators are stated, and gradually improved over time, their more-or-less nature will encourage the development of many more alternative paths, or scenarios for development. Relatively little attention has been given to the creation and evaluation of alternatives based on clearly articulated stakeholder values (Gregory and Keeney, 1994; Gregory, et al., 1992). Moreover, environmental decision-making methods have focused more on the selection of the 'best' alternative from a selected set of alternatives, rather than the process by which alternatives can be refined, created, and evaluated (Steinemann, 2001; Keeney, 1996). Our approach could, in principle, result in better mixes of economic development and environmental protection, and even the generation of new and creative responses to perceived environmental problems.

We realise that the case we develop here is somewhat idiosyncratic, and perhaps simpler than would be many full-fledged public and community processes. The case we choose for illustration is admittedly favourable for our case because we focused only on one stakeholder, an activist who has already chosen his high-priority issue, and an issue that just happens to be associated with a measurable feature of the landscape. In a real case, there would be a very 'noisy' process of getting from many, diverse goals and values to a small number of indicators that are candidates to guide management choices. The point of the example is not to draw any generalisations about the nature of environmental values in all situations, but rather to work through one example to show how a systematic, but not monistic or technical, approach to environmental valuation may encourage communication and community-based cooperative management.

At this point, we have helped the activist, his colleagues and those who favour economic development to express the multiple, and not immediately commensurable, values that affect an important decision. In our approach, participants are able to express their various concerns in a simple conceptual model and, at the same time, our approach offers simple heuristics. The challenge for the activist and the community he lives in is to find a development path that scores high enough on the economic growth criterion, and avoids the unacceptable consequence of creating an ecological and historical or social discontinuity in a single generation. In order to accomplish this, the community must articulate and examine multiple possibilities in search of shared, long-term values they can adopt as long-term commitments of their community. This task, undertaken by

an advisory committee, will involve weighing risks of various actions and policies, but it will also involve choosing which options – and associated values – are to be privileged as constitutive of the community's commitment to, and cultural connection with, their past and future (Norton, 1999).

Since we do not consider our activists' values to be fixed, and we assume other members of his community would express different values, all of this will be part of a complex and changing process. If we can encourage our activist into a public participation process, however, then he and his neighbours – some appearing as plain citizens and others as representative of various interests in the community – can begin to articulate which outcomes and risks are unacceptable, and to play off economic criteria against other criteria in search of acceptable compromises. In this sense, we have created a context in which a very simple multi-criteria system with only two incommensurable criteria – pushed forward by the energies of conflicting interest groups and (hopefully) a shared desire to adopt a policy – that can serve as an opportunity for building toward consensus. The problem remaining, of course, is the big one – to identify, to articulate, and then to associate these options and values with measurable features of the environment. This act of choosing appropriate indicators must be undertaken by any community that accepts the challenge of pursuing adaptive and democratic environmental policy formation. If our theory and our speculation about place-based, pluralistic, and dynamic valuation is correct, however, we have perhaps pushed the argument to its limit in this pre-empirical examination of theory and issues. The identification, articulation, and measurement of these important values must be undertaken, we have argued, within a broad-based, participatory, iterative process; a process that must be begun, and pursued continually, within a larger adaptive management process in each particular place that resolves to live sustainably, according to a definition its people have actively chosen.

CONCLUSION

Our approach to valuation studies has been consciously shaped by the core principles of adaptive management, which we have taken as representative of an emerging trend in search of a more comprehensive paradigm for environmental management. Our approach to valuation is, accordingly – and in correspondence to the three core principles of adaptive managers – experimental, multi-scalar, and place-based. In this paper we have presented an approach to environmental valuation that is both pluralistic and, to some degree, systematic; it is an approach that involves a political process assisted by heuristics. Our approach differs from technical, decision processes such as quantitative risk assessment or multi-attribute utility theory, by being openly political and value-laden; it differs from usual political discourse by encouraging rational discussion of values in the

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context of a search for shared indicators and management objectives, rather than relying on emotion and differentials in political power. The goal is to embody people's commitments to important values in their choice of appropriate indicators and policy goals.

We believe that a shift to this approach to valuation studies can improve the role of public involvement in environmental decision-making. Public involvement is often a discrete event or events before project implementation, rather than an ongoing, adaptive process. In this regard, public involvement methods share the problem of traditional economic valuation methods: they elicit preferences as they exist at a specific time, and provide often only a snapshot of pre-project conditions. Our approach recognises that environmental conditions and individuals' perceptions can and do change, and that ongoing community involvement is central to the evaluation process. We offer two heuristics: a process heuristic that encourages alternation between action and reflection, and an evaluative heuristic that encourages the development of multiple criteria to assist in choosing among various development paths. Applying these heuristics, our approach could, in principle, permit communities to design, and choose among, alternative development paths in order to preserve valued place-based features and to chart a course toward sustainability.

NOTES

[1] The question of preference-stability is sometimes conflated with the question of 'consumer sovereignty' (See for example, Stigler and Becker, 1977) – the view that individuals are the best judge of their own wellbeing – but these are clearly separable issues. Although we have elsewhere expressed concern regarding consumer sovereignty as an assumption in environmental valuation (Norton, 1994), our emphasis here is on the narrower question of changeability of preferences as an important aspect of public involvement in environmental goal-setting.

[2] The activist is a real person, and most of the information above was based on a real conversation in which most of these points were either made or implied.

REFERENCES

Agee, J.K., and Johnson, D.R. 1988. *Ecosystem Management for Parks and Wilderness,* Seattle, WA: University of Washington Press.

Alberti, M. 1996. 'Measuring Urban Sustainability', *Environmental Impact Assessment Review,* **16**(4–6):381–424.

Allen, T.F.H. and T.W. Hoekstra 1992. *Toward a Unified Ecology: Complexity in Ecological Systems.* New York: Columbia University Press.

Allen, T.F.H. and Starr, T.B. 1982. *Hierarchy: Perspectives for Ecological Complexity.* Chicago: The University of Chicago Press.

Ariansen, Per. 1997. 'The Non-utility Value of Nature. An Investigation into Biodiversity and the Value of Natural Wholes'. In *Skogforsk, Communications of the Norwegian Forest Research Institute,* (Meddelelser fra Skogforsk) 47. Agricultural University of Norway, Aas, Norway.

Blamey, R.K., Common, M.S., and Norton, T.W. 1993. 'Sustainability and Environmental Valuation', *Environmental Values,* **2**: 299–334.

Burgess, J., Harrison, C.M., and Limb, M. 1988a. 'Exploring Environmental Values Through the Medium of Small Groups. Part One: Theory and Practice', *Environment and Planning A*, **20**: 309–326.

Burgess, J., Harrison, C.M., and Limb, M. 1988b. 'Exploring Environmental Values Through the Medium of Small Groups. Part Two: Illustrations of a Group at Work', *Environment and Planning A*, **20**: 457–476.

Burgess, J, Harrison, C.M., and Filus, P. 1998. 'Environmental Communication and the Cultural Politics of Environmental Citizenship', *Environment and Planning A,* **30**(8): 1445–1460.

Cortner, H.J. and Moote, M.A. 1994. 'Trends and Issues in Land and Water Resources Management: Setting the Agena for Change', *Environmental Management,* **18**: 167–173.

Daniels, S., and Walker, G. 1996. 'Collaborative Learning: Improving Public Deliberation in Ecosystem-Based Management', *Environmental Impact Assessment Review,* **16**: 71–102.

Ehrenfeld, D. 1993. *Beginning Again: People and Nature in the New Millennium.* New York: Oxford University Press.

Freeman, R. 1993. *The Measurement of Environmental and Resource Values.* Washington, D.C.: Resources for the Future.

Glasser, H. 1995. *Towards a Descriptive, Participatory Theory of Environmental Policy Analysis.* Ph.D. Dissertation, Department of Civil and Environmental Engineering, University of California, Davis.

Gregory, R., and Keeney, R. L. 1994. 'Creating Policy Alternatives Using Stakeholder Values', *Management Science*, **40**(8): 1035–1048.

Gregory, R., Keeney, R. L., and von Winterfeldt, D. 1992. 'Adapting the Environmental Impact Statement Process to Inform Decisionmakers', *Journal of Policy Analysis and Management,* **11**(1): 58–75.

Gregory, R., Lichtenstein, S., and Slovic, P. 1993. 'Valuing Environmental Resources: A Constructive Approach', *Journal of Risk Uncertainty*, **7**: 177–197.

Grether, D.M. and Plott, C.R. 1979. 'Economic Theory of Choice and the Preference Reversal Phenomenon', *American Economic Review,* **69**: 623–638.

Grumbine, R. E. 1994. 'What Is Ecosystem Management?' *Conservation Biology,* **1**: 27–38.

Gundersen, A.G. 1995. *The Environmental Promise of Democratic Deliberation.* Madison, WI: University of Wisconsin Press.

Gunderson, L., Holling, C.S., and Light, S. 1995. 'Barriers Broken and Bridges Built: A Synthesis'. In *Barriers and Bridges.* New York: Columbia University Press.

Harrison, C.M., Burgess, J, and Filius, P. 1996. 'Rationalising Environmental Responsibilities: Comparison of Lay Publics in the UK and the Netherlands', *Global Environmental Change,* **6**(3): 215–234.

Holling, C.S. 1978. 'Adaptive Environmental Assessment and Management', *Wiley IIASA International Series on Applied Systems Analysis.* New York: John Wiley & Sons.

Holling, C.S. 1992. 'Cross-Scale Morphology, Geometry and Dynamics of Ecosystems', *Ecological Monographs,* **62**(4): 447–502.

Holling, C.S. 1996. 'Engineering Resilience versus Ecological Resilience', In P.C. Schulze (ed.) *Engineering within Ecological Constraints.* Washington, D.C.: The National Academy Press.

Innes, J.E. and Booher, D.F. 1999a. 'Consensus Building as Role Playing and Bricolage: Toward a theory of collaborative planning', *Journal of the American Planning Association*, **65**(1): 9–26.

Innes, J.E. and Booher, D.F. 1999b. 'Consensus Building and Complex Adaptive Systems: A framework for evaluating collaborative planning', *Journal of the American Planning Association*, **65**(4): 412–423.

Kahneman, D., Slovic, P., and Tversky, A. (eds) 1982. *Judgement under Uncertainty: Heuristics and Biases.* New York: Cambridge University Press.

Kemmis, Daniel. 1990. *Community and Politics of Place*. Norman, OK: University of Oklahoma.

Kempton, W., Boster, J.S., and Hartley, J.A. 1995. *Environmental Values in American Culture.* Cambridge, MA: The MIT Press.

Keeney, R. L. 1996. 'Value-focused Thinking: Identifying Decision Opportunities and Creating Alternatives', *European Journal of Operational Research,* (**92**): 537–549.

Kuhn, T. 1996. *Structure of Scientific Revolutions,* 3rd Edn. Chicago, IL: University of Chicago Press.

Lee, K. 1993. *Compass and Gyroscope.* Covelo, CA: Island Press.

Leopold, A. 1949. *A Sand County Almanac.* London: Oxford University Press.

McClain, R.J. and Lee, R.G. 1996) 'Adaptive Management: Promises and Pitfalls', *Environmental Management*, **20**: 437–448.

Maclaren, V. 1996. 'Urban Sustainability Reporting', *Journal of the American Planning Association* **62**(1): 184–202.

Morrison, Roy. 1995. *Ecological Democracy.* Boston, MA: Boston South End Press.

Norton, B.G. 1988. 'The Constancy of Leopold's Land Ethic', *Conservation Biology*, **2**(1): 93–102.

Norton, B.G. 1990. 'Context and Hierarchy in Aldo Leopold's Theory of Environmental Management', *Ecological Economics,* **2**: 119–127.

Norton, B.G. 1991. *Toward Unity Among Environmentalists.* New York: Oxford University Press.

Norton, B.G. 1994. 'Economists' Preferences and the Preferences of Economists', *Environmental Values,* **3**: 311–332.

Norton, B.G. 1995a. 'Evaluating Ecosystem States: Two Competing Paradigms', *Ecological Economics,* **14**: 113–127.

Norton, B.G. 1995b. 'Ecological Integrity and Social Values: At What Scale?' *Ecosystem Health,* **1**: 228–241.

ENVIRONMENTAL VALUES AND ADAPTIVE MANAGEMENT

Norton, B.G. 1996. 'Integration or Reduction'. In A. Light and E. Katz (eds), *Environmental Pragmatism.* London: Routledge.

Norton, B.G. 1999. 'Ecology and Opportunity: Intergenerational Equity and Sustainable Options'. In Dobson, A. (ed.), *Fairness and Futurity.* Oxford : Oxford University Press.

Norton, B.G., Costanza, R., and Bishop, R. 1998. 'The Evolution of Preferences: Why 'Sovereign' Preferences May Not Lead To Sustainable Policies And What To Do About It', *Ecological Economics,* **24**(2,3): 193–212.

Norton, B.G., and Hannon, B. 1998. 'Democracy and Sense of Place Value', *Philosophy and Geography,* **3**: 119–245.

Norton, B.G., and Toman, M. 1997. 'Sustainability: Ecological and Economic Perspectives', *Land Economics,* **73**(4): 553–568.

Norton, B.G., and Ulanowicz, R.E. 1992. 'Scale and Biodiversity Policy: A Hierarchical Approach', *Ambio,* **21**: 244–249.

O'Neill, R.V., DeAngelis, D.L., Waide, J.B., and Allen, T.F.H. 1986. *A Hierarchical Concept of Ecosystems.* Princeton, NJ: Princeton University Press.

Page, T. 1977. *Conservation and Economic Efficiency.* Baltimore, MD: Johns Hopkins University Press.

Reich, R.B. 1988. 'Policy Making in a Democracy'. In R.B. Reich, (ed.)*, The Power of Public Ideas.* Cambridge, MA: Harvard University Press.

Sabatier, P.A. 1998. 'The Advocacy Coalition Framework: Revisions and Relevance for Europe', *Journal of European Public Policy* **5**(1): 98–130.

Sagoff, M. 1988. *The Economy of the Earth.* Cambridge: Cambridge University Press.

Sagoff, M. 1998. 'Aggregation and Deliberation in Valuing Environmental Public Goods: A Look Beyond Contingent Pricing', *Ecological Economics,* **24**(2,3): 213–230.

Samson, F.B., and Knopf, F.L. (eds) 1996. *Ecosystem Management.* New York: Springer-Verlag, Inc.

Shepherd, A. 1998. 'Post Project Monitoring and Impact Assessment', In H. Fittipaldi and A. Porter (eds), *Environmental Methods Review: Retooling Impact Assessment for the New Century.* Washington DC: Army Environmental Policy Institute.

Shepherd, A., and Bowler, C. 1997. 'Beyond the Requirements: Improving Public Participation in EIA', *Journal of Environmental Planning and Management,* **40**(6): 725–738.

Shrader-Frechette, K.S. and McCoy, E.D. 1994. *Method in Ecology: Strategies in Conservation.* New York: Cambridge University Press.

Slovik, P. 1995. 'The Construction of Preference', *American Psychologist,* **50**: 364–371.

Slovic, P., Griffin, D. and Tversky, A., 1990. 'Compatibility Effects in Judgement and Choice'. In Robin M. Hogarth (ed.) *Insights in Decision Making: A Tribute to Hillel J. Einhorn*, 5–27. Chicago, IL: University of Chicago Press.

Steinemann, A. 2001. 'Improving Alternatives for Environmental Impact Assessment', *Environmental Impact Assessment Review* **21**: 3–12.

Stigler, G. J. and Becker, G. S. 1977. 'De gustibus non est disputandum', *American Economic Review,* **67**(March): 76–90.

Toulmin, S. 1972. *Human Knowledge*, Vol. 1. Princeton, NJ.: Princeton University Press.

Tversky, A., Slovic, P. and Kahneman, D. 1990. 'The Causes of Preference Reversal', *American Economic Review,* **80**: 204–217.

BRYAN G. NORTON AND ANNE STEINEMANN

United Nations Conference on Human Settlements (UNCHS), 1994. *Report of the Expert Group Meeting on Urban Indicators for Country Reporting.* Geneva: UNCHS (Habitat II).

United States Environmental Protection Agency (USEPA) Science Advisory Board, 1990. *Reducing Risk: Setting Priorities and Strategies for Environmental Protection.*

Vatn, A., and Bromley, D.W. 1994. 'Choices without Prices without Apologies', *Journal of Environmental Economics and Management,* **26**: 129–148.

von Winterfeldt D., and Edwards W. 1986. *Decision Analysis and Behavioral Research.* Cambridge: Cambridge University Press.

Walters, C.J. 1997. 'Challenges in Adaptive Management of Riparian and Coastal Ecosystems. *Conservation Ecology* **1**(2). http://www.consecol.org/vol1/iss2/art1

Walters, C.J. 1986. *Adaptive Management of Natural Resources.* New York: MacMillan.

Webler, T., Kastenholz, H., and Renn, O. 1995. 'Public Participation in Impact Assessment: A Social Learning Perspective', *Environmental Impact Assessment Review,* **15**: 443–463.