Ecology and Valuation:

Big Changes Needed

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Abstract

Ecological Economics has developed as a "transdisciplinary science," but it has not taken significant steps toward a truly integrated process of evaluating anthropogenic ecological change. The emerging dominance within ecological economics of the movement to monetize "ecological services," when combined with the already well-entrenched dominance of contingent pricing as a means to evaluate impacts on amenities, has created a "monistic" approach to valuation studies. It is argued that this monistic approach to evaluating anthropogenic impacts is inconsistent with a sophisticated conception of ecology as a complex science that rests on shifting metaphors. An alternative, pluralistic and iterative approach to valuation of anthropogenic ecological change is proposed.

What do you get if you cross an economist and an ecologist? While genetic technology has (thankfully) not yet allowed for this experiment to be attempted at the level of the individual, over the last 20 years the field of ecological economics has emerged and grown as a result of just this type of cross-fertilization at the disciplinary level. As nurtured through ISEE conferences, other national ISEE meetings, in colleges and agencies, and in the writings in the journal, Ecological Economics, the field is the result of a sustained experiment in integrated ecological and economic understanding of environmental problems and the challenge of sustainable living. Is the post-disciplinary, trans-disciplinary chimera that stands before us a fulfillment of the vision that gave it birth? Or are we feeding a beast that does not serve the purpose for which it was

designed? Perhaps it is time to evaluate the direction and standing of the field of ecological economics.

A report card, however informal, may be timely because, as we understand the current situation, the trans-disciplinary field of ecological economics faces an important choice, a crossroads that will determine its future shape as a discipline and will determine--for us at least—whether the experiment has been a success. If one judges the field of ecological economics on the basis of our learning about the interactions of ecological and economic forces and the importance of their interpenetration, we believe great progress has been made. If, however, one were to ask whether the practitioners of ecological economics have evolved a new framework for evaluating ecological and economic impacts of anthropogenic change, we think the only honest answer is, "No; and progress, much less success, in developing that framework has been elusive." The shortcoming lies not in association with the old, conventional framework, but rather with inaction in developing compelling alternative.

Ecologists still think like ecologists and economists still think like economists. While practitioners in both fields have learned from the cross-fertilization, so far ecological economics has only succeeded in harnessing two complementary disciplines and created a forum for discussing policy in a context informed by both. This is no mean accomplishment, but it merely places the field at a cross-roads. Will the "field" of ecological economics go forward with two sets of methodologies, applying descriptive and hypothesis-testing methods when uncertainty is faced, and applying economic value measurement methods using direct and indirect methods to establish willingness to pay (WTP) for goods and services as methods for *evaluating* those changes?

If the field does remain dualistic in this sense, it will be a result of confusion surrounding positivism's commitment to value neutrality in science. Ecologists, many of whom cling to value neutrality as if their science depends upon it, are anxious to shift responsibility regarding valuation to others; and once ecologists and economists began working closely together, the ecologists have simply ceded the ground to economic analysis, without challenging the mainstream economists' fiction that economics, itself, can be "positive" and value neutral (Arrow et al., 2004). One would look in vain among the writings of logical positivists of the Vienna Circle for a more impassioned

commitment to positivism than is expressed by Milton Friedman and other advocates of free markets (Friedman, 1962). In the area of environmental valuation studies (the subfield that estimates values associated with anthropogenic environmental change), the myth of positivism appears as the fiction that economists' valuation studies merely measure human behavior in the search for human welfare.

While space does not permit a full-out refutation of this myth, here,[1] we simply note that positivism and its commitments to value neutrality have lost all plausibility given our developing understanding of the complex role of assumptions and metaphors play in the development of all "models", whether models of human behavior or models of galaxies. In the present case, it is simply not plausible for environmental economists, operating on the implicit metaphor of earth as a welfare-producing machine, to use that hidden metaphor to narrow the ways one can legitimately value, or express one's values toward, nature, and then claim that their measures are "value free." The metaphor of welfare machine illuminates one type of values drawn from nature while, for example, a metaphor of nature as "home" to ecological communities, or John Muir's insisting the forests were "man's cathedrals, and each of these metaphors highlights different values.

Our point, then, is that assumptions built into the model, confusedly called "positive" by mainstream economists, and adopted more and more by ecological economists, cannot be "positive". When ecologists buy into the economic model for "valuing change," they simply embrace one of the many metaphors necessary to comprehend the complexities of environmental changes and their impacts on humans.

What is interesting about the tendency of economists and ecologists to continue to think disciplinarily within ecological economics, is that they are both following the dictates of the positivist ideal of value neutrality. Ecologists, worried that they will not be viewed as sufficiently "objective" and "scientific," refuse to consider the important role of values in the development and use of ecological models.[2] Economists, worried that they will violate their oath as value-neutral, "positive" social scientists, claim their measurement of welfare based on the measurement of preferences is "positive" science.

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[1] For an all-out argument against the positivist myth of a fact-value dichotomy, see Norton, (2005, especially Ch. 3 and Part 9.3).

[2] This point has been made before (Norton, 1998). made before.

Positivism, however, has lost all credibility in the philosophy of science, and positivism in both economics and ecology has led to a dead end in attempts to characterize the impacts of environmental change. To limit such measurement to *descriptions* of welfare change cannot reflect the diversity and complexity of human interactions with, and evaluation of, the constantly changing, dynamic environment as conceived by ecologists.

The alternative is to seek a new approach to evaluating change, an approach that takes into account insights from both economics and ecology. For us the key question regarding the successful integration of ecological and economic science depends upon whether the new field creates a new and more satisfactory approach to evaluating changes that occur as a result of human activities. In this area, we think ecological economics has a long way to go. More urgently, as we read randomly in the field, we do not even see progress toward this goal.

Having already invoked the cliché of a field at a cross-roads, we might as well say that a "wrong turn" is being taken. If we correctly read the turn signals indicated by the mix of articles and books published in the discipline recently, the field is moving away from, not toward, a truly integrated conception of how we might meaningfully evaluate ecological and environmental change. In this paper, we argue that, in order to truly reform environmental policy according to ecological and economic principles, it will be necessary to develop a new, pluralistic, multi-scalar, and multi-criteria method of evaluating anthropogenic changes to natural and social systems.

Let us be clear: we do not oppose making, publicizing, and discussing estimates of economic values; nor do we think this way of framing some research questions is incompatible with pluralism. What worries us is that the current enthusiasm for ecosystem service methods (used in tandem with contingent valuation methods) has locked the rhetoric of environmental evaluation in a very monistic, utilitarian, and economic vernacular that leaves little or no room for other social scientific methods, or for appeal to philosophical reasons or theological ideals. It also discourages a more profound re-examination of how one might create a rational process of policy evaluation that truly takes into account both economic and ecological impacts of our decisions. At the very least, enthusiastic pursuit of monistic analysis serves to distract the ecological economics from genuine development.

One of us, as a philosopher, was attracted into the fringes of the discipline of ecological economics by the possibility of finding a community of scholars who were seeking a new way to conceptualize and count the impacts of economic and policy decisions on ecological systems and processes. But we hear less and less discussion of these deep issues as ecological economists have embraced quantitative analysis of non-market values and ecosystem services as the means to identify, monetize, and count environmental values in virtually every circumstance and context. Even if one grants—and we believe the jury is still out on this question—that placing dollar values on ecosystem services can be rhetorically effective, we still worry that the discipline of ecological economics is being swept by a tide of dollar-valuations toward a monistic methodology of estimating and aggregating benefits in dollar terms only. If so, pluralism—what we think is the most promising avenue toward a new, integrated approach to evaluation—will never be given a chance. If that happens, ecological economics will remain two mutually interactive disciplines yoked together in a dualistic discourse: Ecologists will describe change; those economists engaged in valuation studies will measure change in their monistic, monetary vocabulary, and their discourse will never provide novel insights about how to truly integrate the diverse factors that must go into a comprehensive evaluation of the impacts of policy change. Our criticisms of the field, then, do not derive from its association with mainstream economics. Rather than guilt by association, we see guilt by inaction in developing a pluralistic framework. Thus, this article is best understood as a call for action in a field at a crossroads.

Part I: The Choice: Monism or Pluralism

To explain the choice we think the field faces, we introduce a useful distinction—originally applied to ethical approaches to environmental policy analysis by the legal scholar, Christopher Stone—between "monistic" and "pluralistic" approaches to the evaluation of environmental outcomes. Monistic approaches to evaluation attempt to represent all environmental value in one framework of analysis—such as utilitarianism, cost-benefit analysis, or rights theory. Pluralistic theories, on the other hand, do not attempt to enforce a universal vocabulary upon the discourse of environmental value. The monistic approaches are thought by many to have an advantage in that, given their requirement that all values must be expressed in one vernacular, they can at least claim to

be comparing comparables, and they can provide some hope of a definitive and decisive outcome in the form of a final accounting in a single system of analysis. Pluralistic theories, on the other hand, seem messy and confusing to interpret, leaving all kinds of open questions when our evaluative criteria point in different directions. We argue, however, that environmental problems are messy, often involving conflicts between competing goods, and that embracing—and somehow learning to manage—a pluralistic and diverse evaluation process seems more likely to be useful than seeking algorithmic predictions of costs and benefits or by assigning rights to more and more elements of nature. Messy environmental problems may best be addressed by pluralistic and diverse evaluation processes, not by a single, uniform evaluation process. Unlike monism, which starts by converting values to a single vernacular, pluralism accepts the fact of pluralism—the fact that people express their values toward nature in many vernaculars, and then seeks a methodology that will make sense of the cacophony (Minteer and Manning, 1999). Monism converts those expressions into a single vernacular, like a translator at the United Nations. Monism finds and uses a common tongue (fraught with the many problems associated with translation, especially in nuanced contexts), while pluralism retains the original expressions and seeks another frame for analysis. Is there another frame, another evaluative unit, than what monism employs?

Using this distinction, we can state our current concern: we fear ecological economics is drifting—maybe even stampeding—in the direction of monism, both in conceptualization and in accounting, in evaluating environmental change. The onrush of journal articles, federal and nonfederal grant programs, and policy analyses that use or support ecological services valuation may crowd-out other approaches. Unless we are mistaken, the trend in ecological economics is toward a single quantification of environmental values in terms of dollars of impact on human welfare. Use values are more and more counted in terms of dollars-worth of ecosystem services, while non-use values are explored mainly through various elicitation techniques, all designed to assign a dollar value to some element, aspect, or attribute of natural systems. Both types of values, however diverse, must be interpreted, on this monistic view as individual values, individual values that are aggregated in units like dollars. While there remain differences and disagreements about the direct comparability of economists' estimates of market

values at the margins with estimates of dollar values derived from "ecosystem services," as will be explored in more detail below in Part II, the overall trend seems to be toward entering policy frays with a single sword: the aggregated dollar value of goods, services—welfare—derived by humans from nature. This distracts us from stampeding in new directions.

Norton (2005, Part 4.1) argues in detail that most environmental problems have the classic characteristics of "Wicked Problems," as defined by Rittel and Webber (1973). Discussants, that is, cannot agree on problem formulation because their conflicting interests cause them to characterize the problem differently. Trying to force all values at issue into a single, monistic framework leads to a politics of ideology and exclusion, as interest groups that define the problem differently struggle to gain control of public discourse and enforce the methodology that yields "one right answer". Issues of value formulation that should be discussed openly are hidden in bureaucratic decisions concerning "appropriate" discount rates, for example. Recognizing multiple values and multiple vernaculars, encouraging open discussion of values—pluralism—can lead to negotiation and reformulation of problems as people develop new, sometimes more similar, "mental models" of problem situations.

One cannot blame ecologists for wanting to join forces with economists and offer more comprehensive accounting—in dollar values—of "ecosystem services" in addition to the measurable market values for products and outcomes of ecological functioning. What ecologists miss, however, is that the pursuit of a monistic evaluation of policy measured in dollars faces them with a terrible dilemma. Can ecologists be confident that, if they pass the task of valuing ecological change to economists, or if they themselves engage in the economic valuation of ecosystem services, important "ecological values" will be adequately valued? By "ecological values," we mean the whole range of (economic) values that humans derive from ecological systems, including services, provision of material resources, aesthetic values attributed to pristine and/or healthy systems, recreation, spiritual, and bequest values (Mitchell and Carson, p. 61). For the sake of definiteness, we mention examples such as the values of biodiversity and ecological complexity. What is crucial here is to recognize how difficult it would be to construct a comprehensive accounting of these values within the disciplinary definition of

value as understood in mainstream economics. It will be difficult precisely because of mismatch between the production of those goods—which involves complex, inter-related ecological processes in which contributions of parts of the system are often impossible to separate into discrete units—and the methods of economists, which demand the identification of discrete units of good in order to associate dollar values with precisely specifiable changes in those units, so that consumers or respondents can choose their preferred trade-off. Specifying changes in units of goods does not map clearly or neatly onto changes in identifiable, discrete components of the ecological processes.

In the following Part, we develop the Ecologists' Dilemma in more detail, by articulating the intellectual and informational costs of forcing ecological information affecting social values into a monistic, monetary vernacular. At the heart of this dilemma is the emergence and growing dominance of the ecosystem services methodology, which measures (in dollars) the economic contribution of certain aspects of nature (conceived as units of goods and services) to human welfare. The very success of this approach, however, worries us because this quantified approach is becoming so dominant in ecological economics that the field seems at this point to be adopting monism by default, without even canvassing for alternative approaches. In fact, there has been some questioning of the growing emphasis on ecosystem services. This is a helpful sign, but we see little positive movement toward more comprehensive analytical or valuational tools. If we seek an integrated and comprehensive system for evaluating environmental and ecological change, we must embrace and develop a pluralistic, but integrated, system of evaluation and policy. Such an integrated system of evaluation would of course involve economic indicators and considerations—but it would be pluralistic in the sense that it counts values other than units of human welfare measured in terms of aggregated WTP. The pluralistic approach subsumes the monistic valuation exercise.

Part II: Economic Monism and Ecology: A Problem of Units of Analysis

Can economic monism provide an adequate account of values gained and lost, such as the value of biodiversity and ecological complexity, as a result of anthropogenic change to ecological systems? The answer to this question hinges on whether the complex and long-term impacts recognized by ecological experts can be reasonably expected to be captured by an analysis of impacts of ecological change on human welfare

measures understood as aggregations of individuals' WTP for the benefits. Addressing this question, however, results immediately in controversy.

Will the monistic system of dollar-measured accounting be constructed according to the strict rules of economic analysis, as developed within the field of economics, or will there be some alternative to this dominant paradigm so that ecological values that have only tenuous and unquantifiable implications for measurable human welfare can be included in an "economic" analysis? The ambiguity, in this situation, of the term "economic" reflects the ecologists' dilemma. If "economic" benefits and costs are understood according to the *disciplinary definition* developed in mainstream environmental economics, then references to benefits and costs are to the effect of policy changes on the welfare of individual's, as marked by their own assessment of their well-being (Bockstael et al., 2000). We should note that these mainstream authors do not *assert* monism about environmental values; indeed, they mention both that there may be alternative *conceptions* of value and that, even within the economic conception, if only quantifiable measures of WTP are counted, there will no doubt be social values that will not be counted within that precise definition. Many mainstream economists accept that, in the political process, some value aspects of a situation will simply come down to judgments not based on economic data, and leading economists, such as Sen (2002), have explicitly rejected monism. We do not mean, then, to imply all economists are monists. Our point, rather, is that the stampede of ecological economists toward monism in practice must ignore the very reasonable position of many mainstream economists that there are environmental and social values that will escape economists' measurement. The argument, then, comes down to which ecological services will be measured and how they will be measured in order to achieve—as ecological economists seem to try to be doing—a monistic system of valuation on which all values are potentially expressed as WTP.

Most mainstream environmental economists have no problem, in principle, with attributing WTP value to ecosystems, including both "use" values, such as tertiary treatment of sewage, and "existence" values—the value placed on the very existence of a pristine ecosystem, for example. The problem, rather, is whether there exist today, or could exist in the foreseeable future, methods that can provide, not only "in-principle-

possible," but also "in-reality-available" estimates of the value of ecosystems. Can estimates of individuals' WTP, measured by an acceptable method of estimating economic choice behavior—as measured in either actual or hypothetical markets-- be expected to capture all or most of the values that ecologists associate with ecological functioning, processes, and complexities?

With this context set, we can state the ecologists' dilemma concisely and rigorously: Should ecologists, who wish to assert that natural systems and their features have value, accept the economists' "disciplinary definition" of value and the methodological strictures that come with it? Or, should they relax that definition, allowing the more liberal counting of values of "ecosystem services"? We proceed by examining, in turn, the prospects for capturing ecological values in a useful economic analysis if ecologists give an affirmative or a negative answer to this dilemmatic question.

The disciplinary definition has been elaborated with a variety of taxonomies of environmental values, taxonomies that usually apply to both "market" and "non-market" goods (Freeman, 2003; Mitchell and Carson, 1989). Economists have offered a variety of classifications of benefits (goods) and damages (bads) derived from natural systems (Freeman, 1993, pp. 12-13), and ecological values. In order to explore whether important ecological goods such as maintaining biological diversity and ecosystem functions are likely to be included in an exclusively economic accounting, we follow loosely the taxonomy offered by Mitchell and Carson in their respected book on the contingent valuation method (Mitchell and Carson, 1989, p.61). Mitchell and Carson have two large categories, "use" and "existence" benefits that can be measured, and illustrate these categories with the example of improvement of freshwater quality. Under "use" values, they include, for example, as a benefit of improvements of water quality, "enhanced general ecosystem support, (food chain)," as one category of value. Can economists provide reasonable estimates of people's WTP for goods such as this?

Economists differ in their degrees of optimism on this question. Until recently, indeed, most economists who considered this question argued that, unless an ecological change can be associated with a measurable change in a good or service, it could not be registered as either a benefit or a cost in economic terms (Baxter, 1974; Freeman, 1993;

Freeman, 1995). Samuelson's (1954) reservations about the practical limits of our ability to measure values related to pure public goods hold sway in many quarters. For example, Freeman, in a "qualification" in the conclusion of his comprehensive account of the measurement of environmental values in 1993, referred to such values as "biodiversity, the reduction of ecological risks, and the protection of basic ecosystem functions," and stated: "When policies to protect biodiversity or ecosystems are proposed, economists may be able to say something sensible about the costs of the policies; but except where nonuse values are involved and where people use ecosystems (for example, for commercial harvesting of fish or for recreation), economists will not be able to contribute comparable welfare measures on the benefit side of the equation." (Freeman, 1993, p. 485.)

Today, there seems to be more interest, and confidence, in placing dollar values on ecological benefits such as "enhanced general ecosystem support" by devising ingenious ways to estimate welfare measures for such goods. In the second edition of the 1993 book cited above, Freeman (2003, pp. 458-459) weakens his qualification, arguing that—at least in principle—it is possible to estimate values of "ecological services," within an accounting of individual's willingness-to-pay; but, as will be noted below, he sets what would appear to be impossibly high requirements for actually measuring such values.

This is where the distinction, mentioned above, between "in-principle" and "in-reality" methods that can actually measure ecological goods comes to bear. While some economists may expect a breakthrough, a new method to measure the currently unmeasurable aspects of dynamic changes affecting "ecological values" seems as likely as a global market in individually transferable carbon emission permits. In practice, many crucial economic values associated with ecological change may <u>never</u> be measurable. Economists, as noted above, list both market and non-market benefits and costs of ecological change. The value of market goods can be determined by examining actual transactions. In some cases, non-market goods can be measured as indirectly "revealed preferences," as in the hedonic method of calculating travel cost (where values for a good can be inferred from costs incurred to access the good, or estimates of values can be inferred from differentials in home sale prices, for example), where associated

market transactions allow the imputation of willingness to pay for the good. In other cases, especially where no "use" is associated with the valuing of a good, no market behavior can guide estimates, so economists have developed the "contingent valuation" method and associated methods that construct situations in which respondents "state" their preference in a hypothetical market, a questionnaire, or a bidding game. Values such as "existence" values—the value derived from just knowing that something exists or that an aspect of the natural world is protected—can only be estimated using stated preference methods. Despite some concern about the comparability of revealed and stated preference estimations, most economists are developing ways to aggregate the values attributed by these methods, and hence they treat these approaches as complementary, allowing their aggregation in a cost-benefit analysis that can, in principle, accommodate both market and non-market goods (Freeman, 2003, pp. 456-457).

Freeman, while apparently more optimistic about the development of rigorous methods to measure ecological benefits in 2003 than he was in 1993, sets out a frightful challenge if one were to attempt to use standard tools for measuring stated value, the "good" for which respondents must express a WTP. "To estimate the economic value of a basic ecosystem function, we need to know the link between that function and the ecosystem service flows that it supports. This will not always be easy to uncover," he says. This understatement is followed shortly with an acknowledgment that "In fact some aspects of ecosystem behavior might be fundamentally unpredictable." Freeman also notes that this link might be made by conceiving the ecosystem as a "production process," but then one faces the complication that "in terms of production theory, ecosystems are multiproduct production systems in which jointness in production is likely to be a dominant feature" (Freeman, 2003, p. 459; Norton, 1988).

The difficulties involved notwithstanding, economic analysis requires that, if ecological values are to be included within the disciplinary definition of value accepted in economics, there is a well-defined change that a consumer or respondent can react to, whether the behavior is registered in real or hypothetical markets. The marginal approach of economic value involves not absolute, but comparative, trade-off value and this requires a precise characterization of the "good" involved, which may in the case of

ecological changes prove impossible in practice. To illustrate this point, consider the "good," listed by Mitchell and Carson, of "enhanced general ecosystem support (food chain)." Could the value for this good be inferred from actual behavior, either directly or indirectly? Apparently not directly, since enhancements of food chains are not traded in markets. Could the value of this good be attributed to consumers indirectly, for example, if an enhanced food chain would perhaps lower seafood prices, resulting in welfare gains? In order to estimate the decrease in seafood price, one would have to know how, and to what degree, the food chain improvement, over what period of time, affected future prices. In order to fulfill Freeman's requirements, one would have to be able to specify the "production process" if one were to assess the indirect effect of food chain enhancement on seafood prices. Further, if the food chain is considered as a contribution to a production process, it clearly involves jointness in production, requiring even more detailed information of causal nexuses in complex ecological system. Information necessary to accomplish a precise characterization of such a good is unknown, and much of it is virtually unknowable.[3]

Perhaps one might construct hypothetical markets in food web enhancement, and seek stated-preference data to support estimation of WTP for changes in ecological values. There are two approaches to characterizing changes: (1) to identify a "commodity" that respondents may be willing to pay for; and (2) to develop "scenarios" which embody varied concentrations of certain valued characteristics, and asking respondents what they would pay for these varied concentrations.

1. The "commodity" approach, which estimates the value of a commodity by developing a hypothetical market, assigns value to a commodity carefully described to respondents. They are asked to respond as if they were considering a purchase of a private good in a free market, simulating a market transaction by means of a questionnaire, interview, or bidding game. The commodity approach seems to work well

[3] Even if it were knowable, and we have an “easy case” of an environmental good with associated use values, the use of revealed preference data is not without its own intrinsic limits. Revealed preference approaches hinge on actual behavior in actual markets and thus struggle to provide value estimates of *a priori* changes or of “out of sample” environmental changes. Thus, if the predicted changes in the food chain fall outside our range of experience, past behavior may be a poor guide to the values at stake in the new scenario.

if the commodity described has reasonable analogues in private markets, and the behavior of offering a price for similar entities is familiar to the respondents, such as paying for upgraded utility services. On the other hand, this approach works much less well for environmental "goods" that people have difficulty envisioning as commodities. Then respondents tend to be confused and offer unreliable or protest answers.[4] Complex functions of ecosystems that are essential to system support, but yield no easily measurable units of good, are examples of environmental goods without reasonable market analogues. As Vatn and Bromley (1994) argue, support functions of ecosystems are "invisible" unless one knows a great deal about the structure and function of an ecological system, often more than trained ecologists in fact know about such systems. So, attempts to evaluate "ecological values" by creating "commodities" would certainly undervalue the "invisible" functions that are necessary to support, in turn, the production of goods and services that are considered valued commodities. This problem results from a more general disconnect between the language of commodities and the language of ecology: the units of analysis in ecology—systems—are not amenable to description as discrete commodities (Vatn and Bromley, 1994). The commodity approach, then, cannot capture those values, from biodiversity to ecosystem functions, that are most often cited as ecological values.

2. An alternative approach, endorsed by Mitchell and Carson (1989), for example, is for economic researchers to outline multiple complex and holistic "scenarios," which differ in a specifiable way. Respondents are then asked to report their willingness-to-pay for the difference among scenarios. Moving away from exclusive valuation of commodities in hypothetical markets via analogy to actual, free markets, Mitchell and Carson suggest using a "referendum" model, asking respondents, for example, how much they would be willing to be taxed to bring about an environmental improvement. This decision model/analogy avoids the atomistic demands of the commodity approach, and may at first glance seem much more attractive to those

[4] Lay respondents struggle to appreciate what “a 10 ppb change in average ambient concentrations of a particular airborne pollutant” actually means. If explaining a complex yet clearly identifiable “unit” of change is met with difficulty, imagine the difficulty in communicating an even more nuanced change in ecological functionings when the unit is a system and change involves sophisticated ecological knowledge.

concerned to include systemic and other ecological values in any accounting of environmental values.

Shifting to the scenario approach still requires that the key differences associated with policy interventions be made clear to respondents, and the respondents must be able to make trade-offs over those differences if the monistic project of representing all environmental values in commensurable, WTP terms is to be completed. Completing this task, in turn, requires identifying and measuring several types of values, by use of a variety of methods.

So, if ecologists in the ecological economics field choose the first horn of the dilemma, they should not expect those methods to provide anything like comprehensive estimates of ecological values for the foreseeable future, because even if one accepts the in-principle possibility of developing such methods, economists are very far from the methodological breakthroughs that would be necessary to actually estimate those values (not to mention the costliness of available practices!). Even if the validity of positive economics and monism were uncontested, the practical limits of economic valuation in a cost-benefit framework are substantial. These practical limits may seriously constrain the usefulness of conventional economic valuation to inform evaluation of pure environmental public goods or of scenarios with which we lack much experience.

Some ecologists, becoming impatient with these disciplinary strictures, and the remarkable and intransigent methodological problems they pose, have expressed frustration that strict adherence to the disciplinary definition of economic value makes it difficult to measure and assign dollar values to highly valued aspects of ecosystems, and have recommended the relaxation of the strict rules of economic valuation. Ecologists and others, grasping the second horn of the ecologists' dilemma, have thus proposed calculating the total contribution of natural systems to economic well-being through the delivery of "ecosystem services" (Costanza et al., 1997; Dailey, 1997). Advocates of this approach measure, by whatever means available, the economic impacts of various ecological processes and outcomes on human well-being. They have thus relaxed the disciplinary definitions and rules that allow careful comparison of resource elements on a *marginal* basis. The value of a resource element, within the disciplinary system, is the difference in value between that element and the value of the next best substitute.

Advocates of ecosystem service accounting, on the other hand, often offer either "absolute" values—the value that would be lost if the service in question were to be completely lost—or they estimate the value of an element as what it would cost to provide the service, once performed by natural systems for free, through technological fixes.

Mainstream environmental economists have reacted strongly to this proposed alteration of disciplinary definitions and rules. Bockstael et al. (2000, p. 2) have referred to the large numbers estimated by advocates of the relaxed definition as the aggregated contribution of natural systems to human well-being as "absurd," because the total value of these services exceeds the aggregated annual total of global Gross National Product, implying people are willing to pay more than they make to protect ecosystem services. Mainstream economists argue that the advocates of the relaxed definition have rejected the "current concepts of *economic* value," and they are asking questions that are not relevant to the concept of economic value as it is used disciplinarily and in the development of cost-benefit analyses (Bockstael et al. 2000, p. 2). This disagreement, then, is at the heart of what we call the ecologists' dilemma.

Note that the ecologists' dilemma arises once a commitment is made to monism. One can avoid the dilemma simply by embracing an explicitly pluralistic conception of environmental values, as suggested by Bockstael et al. (2000). We have made much of the difference between the two approaches (mainstream economists' and ecologists' like Costanza) to measuring ecological services, but our central point is that, regardless of their differences on how to define and measure impacts of ecological processes on human welfare, these approaches are equally committed to expressing environmental values as increments in individual welfare.

To see, on a deeper level why monism in valuation represents a danger to the future of ecological economics, one must grasp the model-dependent and metaphor-guided aspect of models, including models of preference and choice. Return briefly to Freeman's discussion of the possibility of articulating the value of ecological goods jointly produced by ecosystems. Freeman (2003, p. 459), attributing the solution to Barbier, suggests that one can "think of the relevant components of the ecosystem as being involved in a production process," and then try to identify "changes in service

flows in response to changes in ecosystem conditions." This is a telling point. Freeman recognizes that, in order to measure an ecological service produced by an ecosystem, one can "think of it as" a production system, which is only one of many alternative ways one can "think of" an ecosystem. Freeman refers to this decision as a question of "model uncertainty," but this is a misnomer: it is a *choice* of a model considered appropriate for a given task. There is no underlying "true" model of an ecosystem that may or may never be observable. The choice of an appropriate metaphor is not a matter of uncertainty that may be remedied by more data—it is instead a choice of a guiding metaphor which, in turn, highlights some values and hides others. Barbier's approach generates dollar values *on the assumption that ecosystems are production processes for human goods.* This assumption, itself, is not based on empirical data, but rather on what Barbier thinks is important, what he wants to know about the system, and on what he values.

The point here is that, if we recognize that the decision to model ecological values in the economic framework is a *choice* among multiple possible metaphors and models, then the decision as to what is important to measure rests on a value judgment. The decision to treat nature as a production system for the purpose of measuring economic values, was a decision *not to employ alternative metaphors that would highlight alternative pathways and alternative values.* This choice exercises an underlying *value* which in turn determines how the model will be constructed. Ecologists' contribution to the valuation of ecological goods, will probably not be, at least not solely, one of identifying causal pathways once an economist has already chosen an economics-based, production-related model for characterizing value. The ecologists contribution will be, rather, to illuminate the multiplicity of ways we can understand ecosystems, and in relating multiple values and kinds of values to ecological change by identifying and helping communities to choose alternative guiding metaphors for ecological processes. In Part III, we further explore the crucial role of metaphors in understanding and evaluating ecological change.

Part III: Post-Positivist Ecology

In a series of papers with several co-authors, Steward Pickett has explored the possibilities of using lessons of ecology to better understand the lived environment, including lessons they have drawn from their study of the Baltimore Long-Term

Ecological Research site (LTER) (Pickett and Cadenasso, 2006; Pickett et al., 2004). Advocating the use of the ecosystem concept as a useful tool for communication among scientists and among scientists and the interested public, including stakeholders and government agencies (Pickett and Cadenasso, 2002, 5; Pickett et al., 2004), these authors identify several "frameworks" that have been useful in Baltimore, and they think these may be useful in other contexts as well; These are: (i) "spatial patch dynamics…", (ii) the watershed as an integrative tool," and (iii) "the human ecosystem framework" (Pickett and Cadenasso, 2006, 114) these authors frame the question as one of choosing a model appropriate to one's purpose, arguing that "The richness of topics, complexity of model domains, and range of behaviors that models can exhibit suggest that ecosystem models can be used for diverse purposes" (Pickett and Cadenasso, 2002, 5; Pickett and Cadenasso, 2006; Kolasa and Pickett, 200x) This pragmatic, constructivist, and instrumentalist approach to models is linked by Pickett and co-authors with an explicit endorsement of the importance of metaphors associated with ecosystems, seeing them as having a creative and generative role in science; and as valuable in communicating ecological ideas to the public and policy makers in public discourse.

What is really fresh in this work is that it is based on a recognition that human purposes—goals, values, priorities—are integral to ecological model-building.[5] Pickett and Cadenasso (2002, 6) say, "This area of communication includes education, the media, policy making, and management. In such public uses, the precision and narrow focus of technical terms is eschewed in favor of richness of connotation and in support of societally important, if sometimes controversial, values. " Substantively, Pickett and Cadenasso also advocate the identification of ecological systems with spatially defined areas, and also advocate encouragement of recognition of systems as "places" with social meaning and endowed with "responsibility and empowerment" (Pickett and Cadenasso, 2002, 6). This work is so important because, drawing heavily on recent thought in the philosophy of science, Pickett and colleagues are creating an integrated dialogue about

[5] We do not mean to suggest this group of authors is alone in making this dramatic move, nor in their application of ecological insights to policy discussions. See, especially, Clark, (2002) and Peter Taylor (2005)

environmental policy and scientific research that is post-positivist and self-reflexive about the choices that are made in building models and framing environmental problems.

We believe ecological economists should respond to this opportunity to re-think the relationship between the models we use to describe natural processes and the models we use to evaluate changes in their processes. Pickett and the others just cited in the last footnote are advocating no less than an inversion of our usual thinking about science, values, and policy. The old positivist model advocated first gathering descriptive information and data, and then predicting impacts of actions, followed by a microeconomic estimate of the dollars-worth of impacts on the welfare of consumers. Norton (2005) calls this "the Serial View of Science and Policy" and criticizes it in more detail.

Pickett and colleagues argue that, at its deepest level the ecosystem concept rests on metaphors, and these metaphors connect our values and emotions with our choices of models. In order to be applied to real-world situations, the ecosystem concept demands experimentation with new analogies and interpretations, and this level of "experiment is deep enough to connect to our values, fears, and aspirations. They do not propose that we first describe changing systems and then evaluate the changes according to a single computation of the effects on human welfare. Instead, they embrace an open-ended search for many partial, but complementary, models that tell stories from multiple points of view, recognizing that this search will be guided by our diverse values and purposes. Taylor (2005, 226-227) refers to such an approach to research as "reflexive" ("applying one's method to one's own work") and as involving "practical reflexivity" … "that takes into account the range of practical conditions that enable researchers to build and gain support for their *representations.*"[6]

[6] We have, with our own set of colleagues, developed what we call a "two-phased process" of policy formation and evaluation. The phases, while intermixed in time, are characterized by the different frame given the questions addressed and the purposes driving choices. In the ***Reflective Phase*** goals are discussed and strategies are formed. In adaptive management, the reflective phase is very important because it is in this phase that one evaluates outcomes of prior actions—and prepares new experiments to reduce uncertainty (Norton, 2005). In the ***Action Phase*** actions are undertaken based on agreed-upon goals according to agreed-upon strategies. Again, in a system of management that is functioning adaptively, actions will be taken both to address perceived problems, but

Rather than leave the work of Pickett and colleagues at this rather abstract level, we cite the development of Aldo Leopold's views on science, management, and evaluation. Leopold, the great American Forester-Philosopher, constructed a plausible, but complex conceptual model for understanding evaluation ecologically. Leopold's changing views on wolf management represents a process of self-reflexive modeling and it illustrates how a rich understanding of reflexive model-building can change both perception and sense of responsibility simultaneously and inseparably. By using Leopold's transformation as a historical case that can be evaluated with hindsight, we can begin to see how metaphors, model building, management and science can all be brought together in something we would today call, "adaptive management". What we think has not been adequately recognized—and so Norton (2005) emphasized it--is the inseparability of Leopold's choices in modeling and monitoring from his consideration of values and responsibilities. Far from shying away from values in managing and in building scientific models, Leopold often used fundamental metaphors for understanding ecological phenomena—and human responsibilities regarding those phenomena.

As one spectacular example, we refer to Leopold's famous simile, "thinking like a mountain," which was the title of a brief essay that criticized his earlier wolf eradication programs; that essay was published in Leopold's1949 classic, A Sand County Almanac and Essays Here and There. Leopold built upon a conceptual base created in the earlier essay, "Marshland Elegy," where he sketched out three separate "scales" of time, a micro-scale of human perception of time (which Leopold illustrated by writing impatiently of waiting for the cranes to arrive at the crane marsh), ecological time (the scale on which the cranes had established a viable habitat within a marsh system evolving out of the ice ages), and geological, deep time (during which the mountains, lakes and marshes were gouged and re-shaped by geological processes). Leopold left his reader with the idea that human beings cannot understand their affairs realistically, unless they see them as embedded within a larger geological and evolutionary story. These processes, he said, which were expressed in the longstanding migration of the cranes, make the cranes "the

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also to reduce uncertainty and learn from doing (Norton et al., 1998; Norton and Steinemann, 2001; Norton, 2005).

symbol of our untamable past, of that sweep of millennia which underlies and conditions the daily affairs of birds and men" (Leopold, 1949, p. 97).

Leopold continues this theme of multiple time scales in the subsequent essay, "Thinking Like a Mountain," opening his thoughts with the observation that "only the mountain has lived long enough to listen objectively to the howl of the wolf" (Leopold, 1949, p. 129). While the essay focuses initially on the death of an old she-wolf, Leopold makes it clear that her death was a metaphor for the extinction of the wolves from the Southwest Territories: the simile illustrates Leopold's recognition that systems formed over decades and centuries, if violently altered, will suffer long-term, ecological impacts—loss of vegetative cover, erosion, loss of topsoil-- as well as desired, immediate impacts such as an expanded deer herd. When Leopold lamented not "thinking like a mountain," he was criticizing himself for not having considered the impacts of his actions on multiple scales of time and as affecting systems of larger spatial scale. Similarly, ecologists' contribution to valuation studies is not limited to providing causal detail within a particular, constrained, economic model, but also exploring alternative metaphors one might use to understand and evaluate ecological change.

Learning to think like a mountain is learning to think pluralistically: it is not to stop thinking economically, but it is to start thinking in terms of long-term ecological impacts *in addition to economic analysis*. It is to adopt a more complex model of nature, and to learn to evaluate impacts on multiple scales. When Leopold figured out that his predator eradication program—a great success in the short run--had led to over-population of deer and a destruction of the vegetative cover, he was forced to shift his "mental model" from an economic calculation of economic impacts of improved deer hunting to a more complex, ecologically informed model of the situation. What is interesting and important is that he *simultaneously* and inseparably accepted responsibility to submit future policy proposals to another layer of analysis—an analysis of the violence and the likelihood of significant impacts on ecological systems that are usually slower-changing.[7]

[7] In this paper, we concentrate on redirecting evaluative discourse, and have not said nearly enough about the importance of developing institutions that are capable of addressing future challenges. See Bromley (2006) as providing a complement to our

This old example, we think, illustrates the richness of Pickett's use of the ecosystem concept to which he attributes a very flexible, technical definition applicable at many scales and in many contexts, but relies heavily upon metaphor and modeling to bring the technical definition to bear upon particular cases. The fleshing out of an ecosystem model on the ground is part of understanding what is going on, and it involves highly metaphorical thinking. In Leopold's case, the new metaphor allowed him to balance short-term economic thinking against long-term ecological thinking. The metaphor of "mountain-thinking," (and "watershed thinking", and "wetland-thinking.") is, first of all, a re-orientation of thought—a shift in both scale and in "problem formulation", but it is also an act of accepting responsibility for all the future effects of our choices that are foreseeable in the present. Leopold's guiding metaphor tells us to see the effects of our action in a larger ecological scale.

Leopold's model choice, driven by his over-arching ecological metaphor of the "mountain," is both an act of scientific insight and an embrace of responsibility. The metaphorical dimension that expresses itself in the choice of a guiding metaphor is then activated, applied by the specification of a "domain and a variety of features". This middle dimension is described as embodying "the specifications needed to address the many and real or hypothetical situations that the [technical] definition might apply to" (Pickett and Cadenasso, 2002, p.1).

Leopold's metaphorical leap into a multi-scalar, pluralistic system shaped the models he used both to understand and to evaluate future proposals for game management. The metaphorical shift opened up new possibilities in the construction of models, and new opportunities to evaluate policy proposals on multiple temporal scales and according to multiple criteria. Leopold's pluralistic approach, which we understand as a first try at specifying a multi-scalar, adaptive approach to management (without the label, "adaptive management" itself), seems to us to be the most promising approach to the evaluation of ecological change available.

Part IV: Ecologically Sensitive Evaluation: A Sketch

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argument by proposing that environmental economists, once they give up their pricing emphasis, adopt the role of institutional analysts in the tradition of Veblen, Common, and the "old institutionalists." Also see Norton (2005) for an extended discussion of this and related issues.

As was noted in passing, above, most environmental/ecological "problems" emerge as "messes," as what Rittel and Webber (1973) called "wicked problems": they do not emerge as well-defined problems that are formulated similarly by different participants in the discussion. There will, on the contrary, be varied complaints and varied explanations of what the problem is, often associated with varied value positions and perspectives of the participants. Positivist science, in these early stages of problem formulation, is irrelevant. One cannot test hypotheses—indeed one cannot even know what hypotheses to test—if participants in the discourse differ radically about the nature of the problem at hand. The positivists bypass the "messes" that are key to beginning an ongoing, iterative, public dialogue. It is in this messy dialogue about goals and aspirations, however, that metaphors and similes allow the reconstruction of a problem by virtue of reconstructing the models used to characterize that problem. What is useful at this stage is a discussion of values, goals, and aspirations, interspersed with attempts to achieve short-term and intermediate goals that can be agreed-upon.

We suggest a shift in the unit of analysis to *development paths* (Vatn and Bromley, 1994; Norton, 2005). Development paths are ways our community/place can develop over time and into the future. Development paths can be thought of, alternatively, as *scenarios*, but here scenarios are used creatively and reflectively, to explore and evaluate possible scenarios according to multiple criteria and not, as in economic models, as a methodological tool to measure welfare change. Proposed policies can be understood as interventions to modify or stabilize systemic effects on community or place, and simulations can be used to explore how policy options might lead to varied scenarios. Goals can be set, not as abstract principles that demand maximization of a single index value (e.g., economic welfare) but as descriptions of favored development paths. Proposed policies, and the development paths they are modeled to shape and encourage, can then be evaluated on multiple criteria, including economic criteria (such as job creation and comparative efficiency of different institutional means to achieve improvements on key criteria), but also including longer-term impacts on ecological systems. So, we are am proposing an alternative approach to evaluation of environmental change which shifts the unit of evaluative analysis from WTP for atomized, discrete commodities, or clearly describable changes in scenarios, to

development paths that can be evaluated according to impacts on multiple scales of time and space. In this way we can choose development paths to protect a range of human values, recognizing the multiple ways humans value nature.

Where do these criteria come from? They should be worked out in the process of building models that are responsive to social problems. This process--what we call "adaptive management"--ideally includes public involvement as well as agency and managerial participation in an ongoing process that attempts to learn by doing. Individuals and groups will argue that certain features and processes are of value; further discussion will explore whether these features and processes can be associated with a measurable indicator. Rejecting the positivist model of describing environmental change and then assessing welfare impacts on consumers for each and every commodity or service before and after an intervention would actually be very liberating for ecological economists (Bromley, 2006). It would also bring the system they use to evaluate change more in line with the lessons of ecology. Discussion of environmental policy will be reformed as debate turns from how values will be expressed as measurable dollar quantities to proposals of varied economic and ecological indicators, proposals of management goals with respect to those indicators, and discussion of priorities among goals and indicators.

We are suggesting that *ecological economics* abandon the artificial mindscape of positivism. That mindscape encouraged the serial treatment of science, the completion of an account of the key variables constituting a problem before values and human purposes can be consulted and brought to bear upon problem formulation. It has also imposed upon us, relying on the unrealistic and artificial distinction between descriptive and prescriptive discourse, the dualistic discourse that <u>still</u> separates ecologists and economists. The dualistic, serial view of science and policy is a hopeless model because we cannot know what science is relevant, or what data to collect, until we know what is important. As long as problem formulation remains unresolved—as it typically does in unproductive management processes--it is impossible to know what data is relevant. Discussion deteriorates into turf wars among disciplines, all urging their particular data and analysis as definitive. In place of the serial view, we suggest making the process of evaluation—and the process of problem re-formulation— endogenous to adaptive

management, and that we adopt an experimental approach to understanding and evaluating changes in social values entailed by human impacts on natural systems. This experimental approach—experimenting with different metaphors and "models" to characterize a problem—exemplifies Pickett's third "aspect" of model-building. This third aspect must embody a reflexive, self-critical and other-critical process of choosing appropriate models for communicating about, and working to solve, environmental problems.

Making evaluation a sub-process of ongoing adaptive management processes should make us—philosophers, economists, and ecologists alike—aware of the choices we make when we "model" deterioration or recovery of ecological systems. The choices we make in scaling models, in locating boundaries—both spatio-temporal and conceptual, and in describing the mechanisms and processes driving a problem--must be carried out at the metaphorical level as described by Pickett and colleagues. At this deep level, the metaphors we choose and the models we build re-conceptualize "messes" as emergent problems capable of encouraging learning through doing. This learning can only take place, however, if goals and values are open for public debate in an ongoing discourse that encourages rich metaphors and diverse values.

In place of the methodological debates about how to force all values into a single measure, this approach offers a public discourse focused on choosing appropriate "indicators" of sustainability. Choices of indicators reflect the choosers' values in the indirect sense that choosing to monitor some ecological process is evidence that that process is of interest to the choosers, or at least that it is associated with some other factor of interest to them. So, discussion of environmental values can be absorbed into a community-level process of choosing some small set of indicators which, if followed and stabilized, would protect most of the community's values. Given shared and varied values drawn from nature, the community decides what indicators to monitor. Values people have remain important in the process, but their values feed into an ongoing process of discussion, debate, and management experiments. Crucial to these experiments is reflexive model-building directed at characterizing and communicating the nature of perceived threats to social values. Embedding the search for models and guiding metaphors in public discourse encourages problem-based model-building—a

process that in turn encourages "social learning" at the deepest, metaphorical, level. (See Figure 1.)

This new approach does not decide, before doing research, what kind of values will be found. Rather, we advocate elicitations following the important methodological breakthroughs of Kempton et al. (1995), who begin the characterization of people's environmental values with open-ended interviews. In this way they can maintain the richness and diversity—and look for the similarities—among varied respondents' answers.

Also, the context of evaluation is shifted. Evaluation will no longer be monistic: proposed policies will be evaluated according to multiple criteria applicable at multiple spatial scales—impacts on a list of indicators that is currently hypothesized to reflect, at least roughly, the values of participants who helped to choose them. As various problem models are introduced into the public discourse, as various metaphors are tried out, there is the possibility of reconciling problem formulation through the adoption of common models characterizing the problem. In successful cases, these exercises in community model-building can lead to the kind of social learning that can "re-model" complex and wicked problems and improve communication by disentangling messes into addressable problems. In this process, public policies and actions will be hypothesized to affect various valued and monitored processes. Proposed actions can then be compared according to their likely effects on the list of monitored processes. And these comparisons, if taken together, can function as a multi-criteria evaluation of possible actions.

Key to all these connections and learning about them is the creative choice of appropriate metaphors, and the development of effective and transparent models for seeing the likely effects of possible choices that will determine development paths—and what gets protected—as we move into the future. As these models operationalize chosen metaphorical representations, attention then shifts back to evaluating the effects of proposed actions and policies on those monitored processes (indicators). Adaptive management and social learning, on this approach, are given the chance to address problems iteratively, embodying plural values in multiple criteria, and by focusing attention on important choices that will constitute the future.

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Figure 1: Metaphor and Iteration: We need metaphors and "models" to understand any complex process; Metaphors and "stories" of a place, such as Leopold's Thinking Like a Mountain, re-orient science, creating models more appropriate to our values; in turn, this leads to more useful science (adaptive management) and, most importantly, to acceptance of responsibility for long-term impacts. This progression, in turn, encourages yet more meaningful science and adaptive management.