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## **WHAT IS NATURE WORTH?**

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## WHAT IS NATURE WORTH?

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### 1. A WORLD OF UNAVOIDABLE CHOICES

Over the past century, a combination of human population growth, technological advance and economic development has imposed severe pressures on our natural environment.

The litany of concerns is familiar: the destruction of pre-existing animal and plant species and the creation of new ones by bioengineering, the depletion of mineral resources and fish stocks, modification of the earth's climate, etc. At the same time, increasing wealth within many societies has freed energies to be focused away from the day-to-day exigencies of life and onto concerns about the longer-term implications of human advance. As the sense of alarm has intensified, age-old calls to love God's creation have been supplemented by secular exhortations to avoid disrupting the natural world to the disadvantage of future human generations. These appeals for stewardship and sustainable development are an important ingredient of private behavior and civil discourse. But a question inevitably arises how they relate in practical terms to the unavoidable choices at the interface of human activity with the rest of nature.

A couple of examples will illustrate the challenge. Nature is held to have value apart from any advantage it conveys to humans:

Christian understandings of God as Creator, Spirit and Redeemer imply that the whole creation and its creatures are valued and loved by God . . . [and therefore] All life forms have intrinsic value, and are to be treated with appropriate care and concern.<sup>1</sup>

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<sup>1</sup> J. Nash, *Loving Nature: Ecological Integrity and Christian Responsibility*, (Nashville, TN, Abingdon, 1991), 137.

Stated even more boldly: “Every intervention in nature that can never be rectified is a sacrilege”.<sup>2</sup> But what is the pathway from these understandings to the complex decisions we face in a modern economy? In practice, policies regarding any aspect of natural resources and environment usually involve many choices and dozens to hundreds of effects of different kinds and varying levels of significance—so many, in most cases, that the human mind cannot comprehend them all individually. For any process of coherent discussion and responsible decision some method of aggregation or summary is essential. Moreover, when there is uncertainty, and a possibility of learning over time and later adjustment, some means is needed to represent the sequential choices that we face.

Consider wetlands protection as an example. Most would agree that we should sustain wetlands for their biological diversity, water cleaning functions, and support of fish populations. If we can prevent the building of a shopping center on a 100-acre wetland, say at an economic cost (of putting it somewhere else) of \$100 per acre, should we do it? If we can restore a previously disrupted wetland at \$1000 per acre, should we do that? How about removing the Charles River Dam and re-converting the Back Bay of Boston to its original condition as a wetland? And if not, why not?

Similarly, we are exhorted to care for the human condition in the distant future:

What does our generation owe to generations yet unborn? . . . there is an order to the universe which must be respected, and . . . the human person, endowed with the capability of choosing freely, has a grave responsibility to preserve this order for the well-being of future generations.<sup>3</sup>

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<sup>2</sup> J. Moltmann, “The Destruction and Healing of the Earth: Ecology and Theology,” in M. Stackhouse and D. Browning (eds.), *God and Globalization (vol. 2): Theological Ethics and the Spheres of Life*, (Harrisburg, PA, Trinity, 2001), 279.

<sup>3</sup> Pope Paul II as quoted in a statement by the National Conference of Catholic Bishops/United States Catholic Conference, “Global Climate Change: A Plea for Dialogue, Prudence and the Common Good”, 15 June 2001.

This mandate may be further anchored in the language of rights: the rights of future generations and even of non-human life and inanimate objects. But how can this guidance be applied to actual decisions? For example, geologists estimate that we are draining the world's oil and natural gas. Future generations likely will thus face much higher prices for these valuable fuels, dampening their prospects for living as well as we do. In their interest should we penalize oil use now, say with a tax? At a current level of 10 cents per gallon? \$1.00 per gallon? \$10 per gallon?

This paper explores what the discipline of economics has to contribute in this domain of moral principle and practical choice, and I will make two arguments on this score. First, economics has a good deal to say, of great practical use. Economists have long dealt with issues of human impingement on nature, albeit using our own arcane language. After the speeches about stewardship and sustainability are finished, economic analysis is often where the rubber hits the road. One reason for the prominence of economic modes of thought is the near global dominance in our time of the mixed-market form of economic organization. The economies of most developed nations and growing number of others are now based on capitalist institutions sustained by a web of laws and institutions established by governments, whose social and environmental effects are moderated (more or less effectively) by public and interest group pressures and government regulatory and fiscal actions. It is a form of social organization characterized by near-universal consumer freedom of choice, private ownership (often through corporate forms) of the organizations that produce goods and services and of many natural resources, and coordination of economic activity through relatively free markets: the domain of modern economics.

Further, economic analysis is capable of encompassing a wide range of faith propositions and ethical concerns. It is true that many people drawn to the “dismal science” in fact have a progressive view of economic life and show confidence in the ability of the mixed-market system to deliver ever-improving conditions for humankind and, with proper government policies, protection for the environment and wise use of depletable resources.<sup>4</sup> But it is a common myth that economists think they are doing value-neutral science (if such exists anywhere) when applying their discipline to environment and other issues. It is understood by all but the shallowest practitioners that, particularly when applied to public choice, prevailing economic methods are anchored in a web of (often unstated) moral propositions and assumptions about political values and institutions.<sup>5</sup>

On the other hand, too often economics has too much to say about public choice and in particular about issues of long-term implications for the planet. Because of its underlying logic and empirical methods, economics is a very powerful mode of discourse, often able to overwhelm positions taken on the basis of “softer” traditions. It is all too easy for economic analysts to wander outside their domain of competence, to the risk not only of appropriate public decisions but also of the credibility of the insights the discipline can justifiably offer.

Economics is, of course, a vast discipline with fuzzy boundaries and much internal disagreement, not only on narrow questions ranging from the price of pork bellies to the inflation rate, but also on broad issues such as the relation of free markets to political

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<sup>4</sup> Some go further, making economics out to be a secular religion itself. I find the argument provocative, but not helpful in understanding the issues at stake here. See R. Nelson, *Reaching for Heaven on Earth: The Theological Meaning of Economics*, (Savage, MD, Roman and Littlefield, 1991).

liberty. Thus any short description of its handling of natural resources and environment is inevitably to some degree a burlesque. Nonetheless, I begin with a brief description of the way human activity is characterized in the standard economics model, and how these ideas form a basis for assessing our interaction with nature. Out of this brief exploration will come an economist's concept of natural capital and how it is valued, and what sustainability means in economic terms. Finally, the discussion will inevitably return to where it began, to confront arguments for the "inherent value" of nature and the "rights" of the future.

## **2. THINKING LIKE AN ECONOMIST**

Much of economic analysis is based on a set of simplifications of human behavior and organization. People are viewed as organized into decision units, and these units in turn are hypothesized to have preferences among various goods and services and states of nature.<sup>6</sup> These decision units are then presumed to interact with one another in various combinations, mainly though not exclusively through market transactions. The result of this interaction, in analysis models as in actual economic life, is some level of economic activity, output of goods and services, levels of exchange, distribution of goods among the participants, depletion of natural resources, and pollution. Economic analysis is concerned with how this system works, and the welfare economics sub-field with evaluation of its performance and ways that collective action might improve it.<sup>7</sup>

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<sup>5</sup> For example, see J. Rothenberg, *The Measurement of Social Welfare*, (Englewood Cliffs, NJ, Prentice-Hall, 1961).

<sup>6</sup> "States of nature" is economic jargon that covers a set of conditions wider than the concept of "nature" at issue here. It encompasses all conditions external to the individual decision unit's control and may include the local crime rate as well as the health of ocean fisheries.

<sup>7</sup> For a summary of the underlying economic theory, see R. Just, D. Hueth and A. Schmitz, *Applied Welfare Economics and Public Policy*, (London, Prentice-Hall, 1982).

The aspects of this model needed here can be summarized by looking at its components in a simple setting, giving only scant attention to the many complications that fill most pages of economic journals, and the workdays of practitioners.

### **2.1 Decision Units: Consumers and Producers**

Consumers comprise one type of decision unit. They may be variously described as individuals, households, families or other groups, but whatever the level of aggregation, they share a set of characteristics. They have preferences among private goods and services, leisure, and states of the world. Preferences in this sense are not limited to private goods traded in markets, like Big Macs, Toyotas, or a college education. They also encompass circumstances outside one's individual personal control, such as the murder rate in Boston, and conditions of nature, such as the preservation of the panda in the wild. Further, a preference does not require a justification, or even explanation, whether it originates in a desire for personal satisfaction, out of community spirit, or in response to moral dictate and/or religious faith.

As a general rule, consumers are assumed to know what they are doing. With allowance for the cost of information and the easing of decision cost by rules of thumb, it is assumed that people do not consistently make decisions that frustrate their underlying preferences. Thus the surest source of information about what people prefer is observation of what they actually do when confronted with choices, and these data are clearly expressed in market transactions. Later, we shall see some of the measurement problems that arise in extending the model to represent preferences for non-market goods and services, or states of the world for which there are no market data.

A second characteristic of the consumer, except in the few remaining socialist nations, is that they own most of the productive assets of a society, and they receive income from them. They own their own labor and receive wages; they own land and capital from which they receive rent, interest, and profits or dividends. And, in many societies they own in-ground natural resources like fossil fuels and minerals, from which they are paid royalties.

Producer units, on the other hand, also may be conceived at various levels of aggregation depending on the application, from individual firms to industry sectors, to the nation as a whole. Each has a set of technical opportunities determined by natural laws and the level of knowledge, and within these limits the producer applies labor, capital services, energy and intermediate goods and services (these last bought from other firms) to produce some output. Capital services come from the use (and frequently the depletion) of a stock of capital assets. These capital assets take various forms. Most familiar in economic analysis is physical capital resulting from human savings and manufacture—what I will call “made” capital. Also of use in some contexts are the concepts of human capital (produced by education and other social factors) and intellectual or knowledge capital (produced by R&D and various forms of organizational learning). Finally, and most important for the discussion to come, there are the services of natural capital—a concept that encompasses capital that was not produced by human effort.

Producer units have owners, as noted above, who want income from the assets they hold, and managers who try to give it to them. A simple example would be a corporate farm growing corn by employing labor (costing wages), tractors (a capital service

requiring an interest payment), seed and fertilizer bought from other producers, and land (costing rent). In the process the farmer might use, without paying, the waste disposal service of the local stream (natural capital), which is polluted by the excess nitrogen from the fertilizer application. The corn, in turn, may be sold to households for direct consumption, or to producers to make Fritos or bourbon.

## **2.2 Transactions, Prices, Value, and Welfare**

In the simplest case, economists imagine many of these units interacting with one another through the interplay of purchase and sale (demand and supply) in markets with a reasonable degree of competition, so no one unit can manipulate the resulting prices. These prices then contain various forms of information. They tell something about the costs of production, which is sum of the payments to all the needed inputs. Prices also reveal consumers' relative preferences, in their willingness to pay for different goods and services. Or, to use a term that more obviously extends to goods outside normal commercial purchases, price can be seen to reflect the "willingness to sacrifice" one preferred thing for another.

In this view, measures of value are to be found in these expressed preferences. If a consumer unit prefers Bundle A of goods and services to Bundle B, then Bundle A is of higher value to that unit. In terminology reflecting the origin of this way of thinking, the "utility" to the household or consumer is higher with Bundle A. Further, since information about these relative preferences is contained in the prices that result from production and exchange, the total dollar costs of the two bundles reflect their relative values.

Then, if an economy undergoes some change, say a change in the quantities and prices of private goods available or a public project affecting many members of the community, this same logic leads to a way to talk about whether it is a net improvement or not. For this purpose, economic analysts use the term “welfare”, which is a measure also defined over the household or consumer units. If consumers are put into a preferred position, as indicated by the aggregate value (measured as above) of private goods and services, public goods, and states of the world, then welfare is increased. And vice versa.

In anticipation of discussion to come, several points should be stressed about this way of thinking about preference, value and welfare. First, because notions of value are derived from human preference expressed largely in economic activity, and welfare is some aggregation over the preferences of the relevant group of consumers (citizens, people), I will add the word “economic” each time the words value or welfare are used in this sense. It would make it easier to categorize this mode of thought, and perhaps dismiss it. I do not do so, because one purpose of this essay is to explore the potential and the limits of this mode of analysis.

Also, I will speak of value and welfare in this sense as mediated through human agency or “human-mediated”. I choose this unfortunately awkward terminology to avoid the term “anthropocentric” which is frequently (and pejoratively) applied to economic analysis. Although some ethicists seem to hold an expansive sense of the term, others define it as involving concern only with self or “our own interests”.<sup>8</sup> In economics terminology, anthropocentric in this narrow sense would imply an exclusive concern with private goods consumed by the individual. I hope to make clear that preferences as

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<sup>8</sup> For example, see Richard Baer, “Environmental Realism,” a response printed in C. DeWitt, *Caring for Creation: Responsible Stewardship of God’s Handiwork*, (Grand Rapids, MI, Baker Books, 1998).

conceived in welfare analysis can be and frequently are more inclusive than this, and that values other than private goods for self can be mediated through human preferences within the economic system. Furthermore, such treatment is consistent with economic cost-benefit analysis, as discussed below.

As a description of human behavior this model of rational choice is subject to criticism, not least from sociology and psychology. It has staying power because of its demonstrated usefulness as a basis for analytical formulation and empirical studies. Of course, lying behind almost every sentence in the preceding paragraphs are large bodies of the research and controversy. How do the various types of economic units actually behave, and what is the nature of their interaction under different levels of buyer or seller power? How should we deal with interactions among units (like air pollution) that are not compensated through market transactions, and “public” goods (like the eradication of infectious disease) that, once provided, everybody gets for free? How should we account for distributional consequences? And what about the role of marketing—whether devoted to Gap jeans, the Boston Symphony or support for the World Wildlife Fund—and its use to manipulate preferences? The point to be made here is that these phenomena are frequently, and I would argue usefully, approached within the economics paradigm.

Finally, I would like to flag a key point along this trip through economic thinking where many observers step off the train. The conventional assumption behind most economic analysis is that preferences as revealed in market transactions and other behavior, however they came to be, are a valid basis for analysis—a concept sometimes classified as accepting “consumers sovereignty”. This assumption is anathema to many whose calling is to change extant preferences because they are believed to be

misinformed, socially irresponsible, ecologically devastating, or sinful. If the structure of economic thought is thus rejected outright on moral grounds then, for these critics at least, it has little to contribute to informing choices about “nature”. By the same action, however, those taking this prophetic position risk cutting themselves off from the day-to-day struggle with decisions about these issues.

### **3. THE ASSESSMENT OF PERFORMANCE**

As noted earlier, some means of aggregation is essential for clarity of assessment, because any policy choice or project decision will involve many consequences. A common approach weighs up positive and negative effects in welfare terms, as suggested above. Almost always a number of effects can, without much controversy, be aggregated by their market prices, such tons of steel and hours of labor. Often, however, studies also include non-market or community effects. To handle these non-market effects within an economic framework, one approach is to try to convert them into a common metric. It is not necessary to try converting everything into common units, but there is a limit to the number of separate descriptors lest analysis degenerate into an incoherent comparison of laundry lists.

#### **3.1 Non-Market Values**

Economic literature tends to separate non-market consequences into three categories: use value, option value, and existence value.<sup>9</sup> Value is imputed by means of a simulated market transaction, seeking an estimate of willingness to pay or willingness to sacrifice. The most straightforward is use value. For example, if a good or service is provided that

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<sup>9</sup> For details, see Smith, V., (1993). “Nonmarket Valuation of Environmental Resources: An Interpretive Appraisal,” *Land Economics* **69(1)**, 1-26. Reprinted in R. Stavins (ed.), *Economics of the Environment: Selected Readings* (4<sup>th</sup> ed.), (New York, NY, Norton, 2000).

consumers will actually use or experience, use value is an approximation of what they would pay if they were actually charged for it. Such valuation sometimes can sometimes be imputed from data on what is paid for similar experiences. For example, the value of a public hiking trail may be approximated by an estimate of the number of people who will use it and the amount they pay for similar outdoor recreation elsewhere.

Option value originates in preferences for (and willingness to pay for) the creation of, or maintenance of, the opportunity to consume or experience a good, though we may not actually plan to do so. For example, the Boston Ballet has option value for me. I very likely will never go to see it, but I might change my mind and I am willing to pay some amount to preserve the option. Finally, consumers may want some good or state of the world continue to exist, and be willing to pay something to sustain it, even though they know they will never experience it directly, or “consume” it in any normal sense. For example, I am never going to the Kabul museum to see the treasures of Afghan art, but their existence is part of my preference set, and I have some willingness to pay (through charitable contribution or higher taxes) to keep them in being.

Not surprisingly, although the concept of option and existence values is clear, empirical measurement is difficult and current methods controversial. The primary approach is contingent valuation, which estimates willingness to pay using survey techniques. Later I will highlight the limits of this method. The point to be stressed here is that, at least conceptually, estimates of human-mediated value assessed in this way can include public support for efforts to lower human pressures on “nature”.

### **3.2 Multi-Attribute Analysis**

As a practical matter it frequently is not possible, or desirable, to try to convert all aspects of a policy or project choice into a common metric, to be weighted-up into some single measure in dollars or other units. In these cases economic assessments turn to what is called multi-attribute analysis. Some effects may be aggregated in a conventional economic measure, but others are maintained and expressed in non-monetary units. An example might be a comparison of new neighborhood security programs whose estimated costs in increased police protection, and benefits in avoided property loss, might be summed in dollars, but whose hard-to-quantify community benefits (perhaps measured by the crime rate itself) would be carried along as a separate variable in the assessment. The limit to this approach, naturally, is in the human capability to understand and communicate many variables at once.

The most common version of this approach is cost-effectiveness analysis, usually encountered when costs can be credibly quantified using standard economic methods but benefits cannot. Frequently a constraint is being considered on some economic activity, and the analysis is focused on ways to meet the constraint at least cost. An example is analysis of various ways of achieving a targeted reduction in US greenhouse emissions. The climate benefits would not be converted to economic units, but the costs of control measures would. This technique often mutates into an implicit benefit-cost study, as the analysis is applied to different levels of constraint and judgments are made as to which is reasonable.

### **3.3 Time and Uncertainty**

Another issue that has to be dealt with in this way of thinking is how to weigh-up differences in goods and services, or states of nature, at different points in time. The

standard way of handling this task grew up in a period when the time horizon of concern in assessments of public choice was of the order of a person's lifetime, and usually much shorter. Information about preferences and the resulting relative prices (the tradeoff of goods today vs. goods tomorrow) is reflected in markets, in the form of the interest rate, and much analysis is based on these revealed preferences. Because of the special characteristics of many public decisions, and the recognition that preferences for public choice may be different than for private choices, there also has been a half-century debate about the proper way to estimate an appropriate social rate of discount, even for applications with time horizons that are short relative to the ones implicit in today's concern about sustainability or preservation of nature.

Two other aspects of such time-weighting procedure are also worth noting. First, the procedure presumes a decision-maker (or decision group) acting today on behalf themselves and others in the future, taking their (assumed) preferences in to account. And second, any discounting procedure must be applied to a single, common measure of the net benefits or costs, in the present and each future period. This last fact places restraints on the construction of analyses that may carry along several attributes. If some effects are left in their own natural units (e.g., number of natural species lost) then there is scant conceptual basis, at least within economic analysis, for distinguishing events at different point in time.

Another crucial concern arising in many decisions affecting natural capital is uncertainty, and it is one of the most difficult aspects of choice to communicate to policymakers and the public. For example, because of uncertainty one frequently encounters two viewpoint viewpoints in discussion of the policy to limit climate change:

“We should be taking strong action now!” vs. “We should wait for more information before imposing controls that would damage the economy.” An important and difficult task of economic analysis is to try to get beyond this dialogue of the deaf by presenting choices, with their uncertain consequences, so they can be easily understood. Coherent discussion of these types of issues is very difficult in the best of conditions; without some analytical apparatus it is hopeless.

#### **4. THE CONCEPT OF NATURAL CAPITAL**

Now at last we come to the issue of nature, only conceived as natural capital: *i.e.*, assets or states of the system that humans did not (wholly) create, and that provide services to human use or satisfaction over multiple periods of time.<sup>10</sup> The asset or its services may be traded in markets, or not. It may become depleted with the use of its services, perhaps without chance of recovery, or it may be renewable. The time element is key, and “renewable” usually means that depletion can be reversed on human time scales, which I (arbitrarily) take to be hundreds of years. A forest cut for wood can regenerate itself. Non-renewable natural capital includes fossil and mineral resources and some groundwater reservoirs that were established only on geologic time scales, and components of the earth’s current genetic endowment that would not likely evolve again and certainly not on human time scales. Fish stocks in the sea can recover from some level of pollution and/or over-fishing, but if pushed too far recovery becomes impossible. The proper valuation of these services, and of their underlying assets, is at the heart of the debate about stewardship and sustainability.

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<sup>10</sup> The “wholly” is a nod to Allenby who argues that much of what we think of as “natural” is in fact influenced by past human action. See B. Allenby, *Observations on the Philosophic Implications of Earth*

#### 4.1 The Value of Natural Capital

Expressions of concern with human depletion of natural capital have appeared at various times over the past few hundred years. The supply of firewood was a great problem in 17<sup>th</sup> and 18<sup>th</sup> century Europe, until wood was replaced by coal. In the early 20<sup>th</sup> Century, alarms were raised about the depletion of coal and other mineral resources, although substitution and technical change have pushed these concerns into the future. Over the decades, natural wildlife has been destroyed at an increasing pace. Rivers were tamed, harbors dug, and land converted to a variety of human uses.

The years following the World War II saw rising public concern about this process, captured by the metaphor of earth as a spaceship. The result was a growing body of national environmental laws and international environmental negotiations, and an increasing focus within economics on the proper valuation of natural capital. Most of the subsequent work was carried out within the welfare paradigm laid out above. One example is the reconsideration of the handling of natural capital within the national income and product accounts, by which governments monitor economic performance. From their beginning, national accounts have been concerned with whether the level of economic activity in any period was sustainable, and thus they have defined Net National Product as the maximum amount that can be consumed in one period while passing an intact capital stock on to the next. However, the concept applied is the one I have termed “made” capital, and thus the system does not properly account for the depreciation of natural capital. For example, economic growth in countries like Indonesia or Brazil is overstated to the degree that it came from the once-and-for-all destruction of tropical

forests. Following on the advice of the US National Research Council (NRC),<sup>11</sup> the US Department of Commerce is considering the development of satellite accounts to include the depletion of non-market natural resources.

The deficiencies of available valuation methods are reflected in the NRC study. The NRC panel could foresee some components of natural capital such as forest, land, mineral and other resource stocks, and states of the environment like the level of air pollution, that could be assessed under the use value concept above. On the other hand, it did not see credible methods of valuation of goods like species preservation and national treasures, such as the Florida Everglades. Contingent valuation, which is the primary method devised for putting these values into a common system, was viewed with suspicion, principally because it cannot be based on observed behavior.

At one fringe of the discipline emerged a new field of ecological economics. It tries to reverse the logic of conventional economic analysis.<sup>12</sup> Instead of seeing ecosystems (or natural capital more broadly) as something to be valued within the economic system, they try to place economic activity as only one system within a wider global ecological web. In their view (converted to the terminology I am using here) the natural capital stock itself is the primary focus, and limiting the scale of human impact on it is a primary objective of economic policy. As with other modes of economic thought, theirs is a human-mediated valuation of natural capital, only with a strong focus on future generations.

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<sup>11</sup> W. Nordhaus and E. Kokkelenberg (eds.), *Nature's Numbers: Expanding the National Economic Accounts to Include the Environment, Report of the Panel on Integrated Environmental and Economic Accounting*, Committee on National Statistics, US National Research Council (Washington D.C., National Academy Press, 1999).

<sup>12</sup> See R. Costanza, J. Cumberland, H. Daly, R. Goodland and R. Norgaard, *An Introduction to Ecological Economics*, (Boca Raton, FL, St. Lucie Press 1997).

Even if these valuation issues can be resolved, assessments pursued in this mode raise another troublesome issue of the weighting-up of effects at very different points in time—*i.e.*, the discounting issue. Because most standard discounting procedures impose a geometric decrease in weight over time, almost any positive rate yields a near-zero value if the time horizon is of the order of a century or more. This evidently unsatisfactory result has led to an intense debate about what alternative procedure makes more sense.<sup>13</sup> Proposals include non-constant (and declining) discount rates justified by uncertainty in future conditions, models of overlapping generations who trade with one another in common capital markets, and explicit references to an ethical position in favor of (unrepresented) future generations. There is as yet no consensus among economists as to which approach is best, except for the universal recognition that tradeoffs between the present and future are unavoidable, and a widespread acceptance that the correct social rate of time discount is not zero.

#### **4.2 Sustainability**

Closely related to questions of the value of natural capital and the influence of the discounting procedure is the concept of sustainability, and what that goal might mean in practice. Although arguments over the definition of this term seems endless, a useful approach follows from the welfare model. Sustainability can be seen as an issue of distributional equity: who gets what, now *vs.* the future. It implies an obligation to, “. . . conduct ourselves so that we leave the future the option or the capacity to be as well off

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<sup>13</sup> The debate is well summarized by P. Portney and J. Weyant (eds.), *Discounting and Intergenerational Equity*, (Washington, D.C., Resources for the Future, 1999).

as we are”.<sup>14</sup> The formulation is not unique. It is very close to the view stated by DeWitt, quoting Calvin, that we should hand the earth on to our descendents, “. . . as [we] received it, or better cultivated”,<sup>15</sup> or of Nash who adopts sustainability as his first ecological virtue and, quoting others, says, “A sustainable society is one that satisfies its needs without jeopardizing the prospects of future generations”.<sup>16</sup>

Sustainability, then, is about capacity—that is, the capital stock left to future generations including natural capital but also “made” capital, human capital, and knowledge capital. And since *everything* can’t be preserved it is also about substitution.

. . . when we use up something irreplaceable, whether it is minerals or a fish species, or an environmental amenity, then we should be thinking about providing a substitute of equal value, and the vagueness comes with the notion of value. The something that we provide in exchange could be knowledge, could be technology. It needn’t even be a physical object.<sup>17</sup>

If we were able to appropriately value all the aspects of natural capital that we are depleting or destroying we could assess whether the our version of the obligation to the future was being met. But, of course, as suggested by NRC panel’s hesitations, we can’t do this. The methods are weak, and even if they were up to the task for particular elements of change the world is too interconnected.

### 4.3 The Example of Climate Change

A number of these analysis issues can be illustrated in application to climate change, which probably is the ultimate challenge for human institutions, as for economic analysis. Several characteristics account for its nearly overwhelming complexity. First, the

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<sup>14</sup>R. Solow, “Sustainability: An Economist’s Perspective,” Eighteenth J. Steward Johnson Lecture to the Marine Policy Center, Woods Hole Oceanographic Institution, Woods Hole, MA, June 14, 1991. Reprinted in R. Stavins (ed.), *Economics of the Environment: Selected Readings*.

<sup>15</sup> C. DeWitt, *Caring for Creation: Responsible Stewardship of God’s Handiwork*, 31.

<sup>16</sup> J. Nash, *Loving Nature: Ecological Integrity and Christian Responsibility*, 64.

<sup>17</sup> R. Solow, “Sustainability: An Economist’s Perspective”.

problem is not what to do to prevent climate change; it is what to do to lower the *risk* of such developments. Some degree of natural climate variability and ongoing change is a natural feature of the planet, and some degree of human-caused change has already been programmed into the system by past emissions. Moreover, there are many steps between human activities and any ultimate climate-related damage, each fraught with uncertainty. We cannot know with precision how human emissions of greenhouse gases will evolve over the coming decades with no climate policy, or what would be the costs of control. The response of the climate machine—atmosphere, oceans and terrestrial biosphere—also is imperfectly understood.

The greatest uncertainty of all attends to the effects, positive as well as negative, that climate change would have on human society and natural ecosystems. Efforts are made to estimate the benefits of avoided change, but it is a Herculean task even to summarize the various possible physical and ecological effects. Valuation is even harder, and this situation is an example of a circumstance where economic analysis threatens to lose sight of its limits. The rough magnitude of economic market effects can be estimated using standard market-based techniques (*e.g.*, effects on agriculture, forestry, energy use, transportation, coastal damage), and some non-market effects can be captured using the “use value” concept introduced earlier. The problem comes with effects on ecosystems. Even were techniques of contingent valuation trusted (and most economists don’t) the scale and complexity of the change would overwhelm any such effort cast at the level of global climate.

Further, responding to climate change is not a one-time decision. Anthropogenic greenhouse gases are “stock” pollutant, so what matters is not the emissions in any

particular year, or even decade. What is important is the accumulation over 50 to 100 years and beyond. It doesn't matter greatly whether we start controls now or wait a few years, and during any waiting period some uncertainties may be reduced, so later we may know better what to do. Thus approaching some long-term goal, like the avoidance of "dangerous" atmospheric concentrations written into the Framework Convention on Climate Change, is a complicated matter of sequential choice. We make decisions only for today and cannot bind future generations. Thus responsible action is not independent of how we think our descendants will treat this issue, and how our behavior may influence theirs.

Finally, no one country can eliminate this risk. A multi-national effort is required, and thus unavoidable conflicts arise regarding the acceptable distribution of burdens. Analysis is needed to inform not only one nation or decision-maker, but a multi-nation negotiation.

In this circumstance, some way to sum up costs and environmental consequences is essential even to allow coherent thought and discussion of what is at stake long term, and the implications of various measures taken now. Moral exhortation may indicate the general direction in which we should march, but it does not illuminate the question of how far, or how fast, or which path to use. Many analysis methods are used to try to inform climate policy and the associated negotiations, but most have some interweaving of the economics paradigm outlined above.<sup>18</sup> Cost effectiveness analysis is common, carried out to explore alternative ways (and costs) of meeting short-term policy targets

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<sup>18</sup> See, for example, Chapter 10 of Intergovernmental Panel on Climate Change, Working Group III, *Third Assessment Report, Climate Change 2001: Mitigation*, (Cambridge, Cambridge University Press, 2001).

like the Kyoto Protocol, or long term goals like the stabilization of concentrations in the atmosphere.

Unfortunately, admitting the weakness of our estimation methods does not get us off the hook. We are making decisions every day that influence the future of the natural world, as did our parents and grandparents before us. There is no way we can avoid choices that influence the mix of capital assets we pass on to the future, and the composition of the “natural” component of that capital. Also, we must make those decisions in the face of uncertainty about the implications of our depletion and disruption of the various components of natural capital, and the endowment of new knowledge capital that may provide sufficient substitutes.

The magnitude of the challenge is suggested by Brad Allenby’s proposal that we must undertake Earth Systems Engineering and Management (ESEM).<sup>19</sup> To embrace that idea responsibly must imply the development of an understanding of what we are doing when working at “earth” scale. The nature of task can be seen in the less-ambitious field of industrial ecology, which attempts to guide the environmentally relevant choices of individual firms. A key analytical support for this work is life-cycle analysis, which attempts a cradle-to-grave tracking of materials and energy in assessments of the relative impact of different designs or materials choices, say for an automobile. Tracking dozens to hundreds of effects in physical terms is difficult enough, but the greatest challenge comes at the point where they must be somehow added together—*i.e.*, the problem of valuation. Allenby (p. 153) calls for a “new enlightenment”, and says,

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<sup>19</sup> B. Allenby, *Observations on the Philosophic Implications of Earth Systems Engineering and Management*.

Implementation of ESEM will not be just through policy, or science, or engineering: it will be through the great institutions of humanity: religions, cultures, economic structures, capitalist institutions, communities.

At this point I hear the policymaker calling, “Hey, while you’re working that out, help me understand the implications of this particular decision!” What happens “just through policy” is what matters to the future of natural capital, and any newly enlightened society will have to come right back to the issues outlined here in an effort to understand what, in specific actions, it ought to do. The challenge to analysis, economic or otherwise, is evident.

## **5. INTRINSIC VALUE AND FUTURE RIGHTS**

This exploration began with two types of guidance for the relation of humans to nature, both implying opposition to the notion that tradeoffs are unavoidable, and that analysis is needed to help decide how to make them. One was the argument that components of natural capital have “intrinsic” value and are inappropriately combined in such assessments dominated by human preference. The other was the concept that the future has “rights” that are not to be violated. It is worth returning to these points, taking the perspective of economic analysis, to see what help they offer to the task of assessing practical choices.

### **5.1 The Inherent Value of Natural Capital**

In contrast to value being mediated through human agency, an alternative view holds that some components of natural capital have value apart from any human needs, wants or concerns. Some, Nash quoted at the outset is an example, make the argument from a position of religious faith. Another so-called biocentrist view holds that all species (and, for some, all aspects of “nature”) have intrinsic value just because they exist, and further

that humans hold no special position in the order of being.<sup>20</sup> It is evident that my economist's construction of "natural capital", implying an asset providing services, is inconsistent with these views.

These ideas are then extended to include the language of "rights". Sometimes the rights apply only to living creatures, e.g.,

From a perspective that recognizes the intrinsic value of all God-created being, I affirm the rights of non-human creatures—but not without plenty of trepidation and confusion.<sup>21</sup>

The trepidation concerns the boundary of the set of creatures so classified, which is limited to those with "interests" who are capable of "striving to be and to do". It is a slippery definition, but one of little interest to others who extend "rights" to all of nature.

For example, a statement by the World Alliance of Reformed Churches states that,

"Nature—animate or inanimate—has a right to existence, that is, to preservation and development . . . to the protection of its ecosystems, species and populations . . . to the preservation and development of its genetic inheritance . . . to a life fit for their species . . . etc."<sup>22</sup>

Though I am not sure he would appreciate the association, the view underlying economics analysis is close to that expressed by Derr:

Against the attribution of intrinsic value to natural objects, I argue that . . . we humans supply the value, that nature is valuable because we find it so. There is no value without a valuer.<sup>23</sup>

Or, in the economics language used here, value is mediated through human preferences.

And, by extension, "rights" are conveyed by human agency.

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<sup>20</sup> E.g., P. Taylor, "The Ethics of Respect for Nature", *Environmental Ethics* 3, Fall 1981: 197-218. Reprinted in D. VanDeVeer and C. Pierce, *People, Penguins, and Plastic Trees: Basic Issues in Environmental Ethics*, (Belmont, CA, Wadsworth, 1986).

<sup>21</sup> J. Nash, *Loving Nature: Ecological Integrity and Christian Responsibility*, 173-174.

<sup>22</sup> Quoted by J. Moltmann, "*The Destruction and Healing of the Earth: Ecology and Theology*", 186.

<sup>23</sup> J. Derr, *Environmental Ethics and Christian Humanism* (Nashville, TN, Abingdon, 1996), 25-26.

As emphasized earlier, economic analysis does not probe the origin of whatever preferences are expressed. It may be argued (as Nash does) that God is the valuer, expressing love for the creation, and that humans, in faith, should respond accordingly. But such an expression of faith is nonetheless mediated through human preference and action. It is not a faith statement but an empirical fact that humankind (and, more relevant, our generation) will exercise dominion, either as steward or destroyer, to a degree few ever imagined before the modern era. Polar bears don't vote, and our preferences, whatever their origin, will have a huge effect the ultimate outcome. Viewed from an economics perspective, biocentrist rhetoric and calls for faithful stewardship are processes for shaping or influencing these preferences, and for changing perceptions of what is substitutable for what.

## **5.2 The Rights of Future Generations**

There is a line of thought in ecological economics that applies the language of “rights” to future generations.<sup>24</sup> In an analysis limited to the satisfaction of human preferences it is argued that, if exhaustible resources were distributed “by right” to future generations, their exploitation would follow a different (and better) pattern over time. Indeed, it is argued that sustainable development will not be possible without such a reassignment, removing the sole right to decide current depletion policy from the current generation. By the same logic they argue that future generations have “rights” to biological diversity.

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<sup>24</sup> Eg., R. Norgaard and R. Howarth, “Sustainability and Intergenerational Environmental Rights: Implications for Benefit-Cost Analysis,” in J. Reilly and M. Anderson (eds.), *Economic Issues in Global Climate Change: Agriculture, Forestry and Natural Resources*, (Boulder, CO, Westview, 1992).

If by the term “rights” they meant “Rights . . . are expectations regarding responsibilities”<sup>25</sup> then the concept would fall into a category similar to the claim of inherent value. But the project of ecological economics is greater: its proponents seek social and political reform to allocate such rights in a legal sense. But who decides what these rights are, and how they are to be enforced? Our descendents are not here to define their rights, or to claim them through argument, moral persuasion, voting, or whatever other means society provides for the definition and protection of rights. Some go further, and suggest that non-human nature has “rights” in this sense.<sup>26</sup> But these arguments fall to the same criticism. In an (also probably unwelcome) paraphrase of Derr, “No claim of rights without a claimant.”

Thus the notion of rights of future generations, or of non-human nature, may be a useful rhetorical device in the struggle to reduce the current rate of depletion and destruction, but it has little meaning in practical decisions and the analysis to inform them. The determination of any rights to be protected will be a decision of our generation, and the concept of rights of nature seems to add little to general notions of concern for (future) others. It also doesn’t help in the difficult determination of what is substitutable for what in the calculus of whether we are passing on an adequate capital stock to future generations —“made” and knowledge capital as well as natural capital. The problem remains of trading-off good against good, along with the responsibility to try to understand as clearly as possible what we are doing. We are thus driven back to calculation.

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<sup>25</sup> Arthur Dyck as quoted by J. Nash, *Loving Nature: Ecological Integrity and Christian Responsibility*, 170.

## 6. FINAL THOUGHTS

We are constantly resolving the issue of “what nature is worth” as we make decisions affecting resource policy, environmental protection, investment in future knowledge and “made” capital, and a host of other choices about political structure and economic life. The question I see is not whether to undertake such valuation but whether to be intentional about the choice process and try to develop some shared language and common metrics for the task. The alternative is to surrender choice to the loudest voice or the greatest power without the moderating influence of a widespread understanding of what is at stake. Economic welfare analysis is one attempt to construct a framework for this dialogue. It has an underlying structure that is unattractive to some; they believe it is extended to areas of life that should not be subject to such calculation, and/or they object to its focus on human preference. If we did not face difficult tradeoffs in our relation to nature—good vs. good and value vs. value—such attempts to add-up and compare costs and benefits would not be needed. But unfortunately we do, and it is for this reason that economic methods emerge as so influential in public deliberations. In the interest of stewardship and sustainability, therefore, I see the task as continuing to try to correct its limitations in dealing with very long-term consequences and the implications of major changes in the condition of the planet. The challenge is to adapt these methods more appropriately to choices of a magnitude and significance never foreseen by past generations of economic thinkers.

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<sup>26</sup> For a classic statement see C. Stone, *Should Trees Have Standing? Toward Legal Rights for Natural Objects*, (Los Altos, CA, Kaufmann, 1974). Reprinted in part in D. VanDeVeer and C. Pierce, *People, Penguins, and Plastic Trees: Basic Issues in Environmental Ethics*.