The Economic Basis for a Partnership Between Human Society and Natural Ecosystems

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> We like to believe that if we secure adequate data bearing on a scientific problem, then anybody with normal intelligence who takes the trouble to become acquainted with these data will necessarily arrive at the same conclusion regarding the problem in question. We like to speak of conclusions demonstrated, settled, proved and established. It appears, however, that no evidence is powerful enough to force acceptance of a conclusion that is emotionally distasteful. (Th. Dobzhansky, 1945)

Introduction

Although some people act ethically for the common good of natural systems and human society, others only do so if consequences are clearly understood. The consequences of destroying natural systems are not generally understood by many because the educational system has not acquainted students with substantive understanding of how the world works. However, the shortage of landfill space, the increased cost of coping with floods (e.g., the Mississippi floods of 1993) and maintaining water quality, and the threats to human health caused by air pollution and contamination of food stuffs are relatively easily understood by the average citizen in economic terms. A partnership between human society and natural systems is most likely to develop if the initial concerns of human society are about the economic costs that will be incurred if ecosystem services (such as maintaining the atmospheric gas balance and maintaining water quality) are replaced by technological systems requiring a substantial capital investment and high energy costs. Giving up the life-style to which a substantial portion of human society has become accustomed is definitely emotionally distasteful. However, if human society realizes that its life-style may be lost anyway if the present course is continued, then significant cultural changes might conceivably occur. Education is always given as the answer to many of society's problems, but education that does not include a direct, explicit statement of the consequences of ill-considered actions will almost certainly fail. In my more pessimistic moments, I always reach the conclusion that a number of shocks equivalent to Hurricane Andrew or the San Francisco earthquake may be necessary to produce significant alterations in life-style. Single events widely spaced geographically or temporally will almost certainly not be shocking enough — people still build or repair houses near geologic faults, on floodplains, and in the regular path of hurricanes; construction does not seem to be markedly altered as a consequence of a single event, however disastrous.

The concept of an economic partnership between human society and natural ecosystems on a sustainable basis is not yet widely accepted, but neither is it unknown. For example, a journal entitled *Ecological Economics* is published by Elsevier Science Publishers, B.V., Amsterdam, The Netherlands. Folke et al. (1991) document the ways in which ecosystems support the economy with necessary environmental goods and services in the Baltic Sea region. The economies of human societies require large, well-functioning ecosystem areas for the production and maintenance of environmental goods and services (e.g., Odum, 1989; Folke and Kautsky, 1989; Hammer, 1991). Since the consequences of contracting AIDS and the demonstrable consequences of drug addiction have become apparent to at least some members of human society, the question is: can abuse of ecosystems be compellingly demonstrated when our success has been less than comforting in two epidemics (AIDS and drugs) where the direct consequences to the individual are ignored by large segments of society? The problem is, of course, that many members of human society feel "the odds apply to thee but not to me." This discussion is a preliminary examination of the problem and by no means a blueprint of a solution.

The human race has the power to destroy many of the remaining species on the planet and most of the few remaining, relatively undisturbed natural habitats. In the long-term, however, Mother Nature will always win — no matter how many species and habitats are destroyed, over geological time, the system will recover. Mass extinctions and the consequent destruction of habitat are evident in geologic records, providing at least reasonable proof that mass extinctions are not the end of life on earth. Furthermore, biological diversity becomes re-established, although not in the pre-extinction form. The survival of human society in anything similar to its present form is certainly far from assured. In fact, in June 1992, the officers of the Royal Academy of Sciences in the United Kingdom and the Academy of Sciences in the United States (1992) issued a joint statement indicating that the present rate of environmental destruction and concomitant rapid human population growth could, if continued into the next century, cause extremely serious problems. The Union of Concerned Scientists (1992-1993) issued a world scientists' warning to humanity that states roughly the same idea — human society's relationship with the environment, as well as some other relationships, cannot long stay in its present form. The latter was signed by over 100 living Nobel laureates and over 1600 members of the U.S. National Academy and their

colleagues elsewhere in the world. These were not messages from the "gloom and doom" environmental extremists organizations but from mainstream science, which finds the present course of events regarding the relationship between the human species and natural systems unsustainable very far into the future.

Alternative Human Society/Natural System Relationships

There are three broad general human society/natural system alternative relationships.

(1) Short-term economic gain is the prime determinant in the relationship and economic "necessity" will commonly override ecological considerations.

(2) Long-term sustainable use of natural systems by human society is the prime determinant in decision-making and anything that impairs the quality or use of natural ecosystems by future generations is vigorously opposed.

(3) Natural systems are conceded to have the same rights as human society, and a balance between the interactions that facilitates this is given the highest priority in decision-making.

The Case for Short-Term Economic Decision Criteria

The case of the spotted owl versus the logging industry in the U.S. Pacific Northwest is a case in point for a highly industrialized nation. If the past rate of destruction of old growth forests in that area continues at its present rate, the logging industry would undergo a substantial change in the not-too-distant future, even if logging of all old growth forests were permitted. Additionally, technological advances have markedly reduced the number of logging jobs so that these would be reduced even if logging at past rates were to continue. In short, the spotted owl and the old growth forests were, in the minds of many people, worth sacrificing to maintain for a decade or two the present logging industry and life-style. There can be little doubt that anyone capable of simple arithmetic would realize that the era will end. The question is, will it end with complete destruction of the old growth forests (possibly with a few token remnants remaining) or will it end with most of the remaining old growth forests intact? The government's position, which still may be modified, appears to be a compromise—permitting some additional destruction but reducing the rate of destruction. This changes the relationship between human society and natural systems only by degree. Ultimately, technology such as computer screens may replace newsprint or paper recycling may reduce substantively the need for use of old growth forests, but society chose not to implement these alternatives, including finding alternative jobs for lumberers, because economic disruption was more distasteful than ecological disruption.

In a developing country, ecological destruction may be viewed as the only way of obtaining fuel or new agricultural areas for a rapidly expanding population. In these circumstances, ecological destruction may be perceived as the only way to ensure human survival, albeit at levels that citizens of developed countries would consider totally unsatisfactory. The motto here might well be: if short-term survival is highly uncertain, why bother with the long term? As Tin Wen Lian, Malaysia's ambassador to the U.N. Conference on Environment and Development, stated, "We are certainly not holding our forests in custody for those who have destroyed their own forests and now try to claim ours as part of the heritage of mankind" (*Environmental Professional*, 18(2), back cover, May 1993). The message is clear — developing countries have no intention of listening to exhortations to preserve their forests until developed countries set a better example of stewardship with their own.

It seems quite clear that neither developed nor developing countries are likely to alter their view of the human society/natural systems relationship unless some dramatic event forces this to occur. The leadership of developing countries (such as Bhutan) or developed countries (such as Sweden) in preserving natural resources does not seem to have made much of an impact globally. Like good examples everywhere, they are admired but not emulated.

The Sustainable Use Relationship

A sustainable use relationship would be a true partnership in which human society would make substantive adjustments in resource use, life-style, etc. in order to promote an enduring sustainable relationship. Human society would go well beyond maintaining ecosystems purely for personal benefit because of an ethos, which the Greeks interpreted as a set of guiding beliefs. Pericles put it more succinctly, "All honor to him who does more than the law requires." This would mean going beyond economic or societal benefit except for aesthetics. At the present time, such a relationship seems extremely unlikely to even the most optimistic people, and even irrational to some citizens. However, if environmental literacy increases dramatically, such a relationship is at least conceivable.

Illustrative Economic Services Provided by Natural Systems

Some psychologists feel that human well-being is enhanced by interactions with natural systems. Ecosystem services are listed that definitely enhance the survival of human society in its present form and some are listed that the average person would probably not categorize as essential to the survival of human society in its present form.

(1) Species and ecosystems act as sentinels and provide a warning when harmful concentrations of toxic materials appear in the environment. The "Mimiyata disease" (methyl mercury poisoning) was first detected in Japanese cats that ate fish heads discarded by a fish processing plant. Later, the same symptoms exhibited by the cats appeared in humans who ate the fish. Warnings of toxic effects of DDT and other pesticides have also appeared in natural systems.

(2) Maintaining a favorable (to humans) gaseous planetary envelope. Our air has been shown to be flagrantly out of equilibrium in a chemical sense (Lovelock, 1988). Margulis and Lovelock (1974) provided a persuasive argument for a biological modulation of the earth's atmosphere. On the other hand, Doolittle (1991) believed that keeping the planet's atmosphere at a constant state favorable for life in its present form would require foresight and planning, which could not possibly have evolved by natural selection. As usual, conflicting theories exist within the scientific community that work primarily by disproving hypotheses rather than "proving them." Thus, there will always be uncertainty, and, on this question, it might be prudent not to take risks with the present gas balance that is favorable to us by markedly impairing the living system thought to maintain it. Even when the risks are minimal, if catastrophic events could result, it might be well to avoid such improbable risks as much as possible.

(3) Natural systems as sources of new medicines. According to Farnsworth et al. (1984), approximately 119 pure chemical substances extracted from higher plants are used in medicines throughout the world. This would be notably higher if medicinal herbs used in the People's Republic of China and a number of other countries were included. Over a decade ago, the British Crown Colony of Hong Kong, with a 1981 population of just over 5• million, had 346 independent herbalists and 1,477 herbal shops (Kong, 1982). Although some investigators feel that computer modeling of chemical formulations will predict sources of new drugs, it seems foolish to waste the rich source of herbal medicines until the efficacy of the computer models has been better tested. Preserving natural systems will protect medicinal plants at a very low cost to human society.

(4) Providing flood control. Maintenance and enhancement of economically valuable aquatic ecosystem functions such as flood water storage and conveyance, pollution control, ground water recharge, and fisheries and wildlife reduction have been treated too lightly in aquatic resource management. The structures, such as dams, levees, storage basins, canals, and the like, built for flood control are expensive to construct and maintain, do serious ecological damage, and are often ineffective (e.g., Mississippi floods of 1993). Alternatively, paying attention to floodplains and wetlands by preventing building construction and the like on them will enhance a self-maintaining system that improves water quality and stores flood water, releasing it gradually into surface or sub-surface systems essentially free.

(5) Improving water quality. Although there was an investment of more than $260 billion from 1970 to 1984 for the construction and operation of both public and private wastewater treatment facilities, water quality (in terms of chemical characteristics) appears to have improved only marginally (USEPA, 1984; Smith et al., 1987). Leopold et al. (1964) estimate that there are more than 3.25 million miles of U.S. stream channels. The USEPA estimated in 1990 that 758,000 of these miles were adversely affected by effluents from municipal and industrial treatment plants. Wooten and Jones (1955) estimated that in 1955 there were an additional 155,000 miles of constructed agricultural drains. In addition, there are an estimated 12,000 miles of inland waterways. None of this enhances water quality maintenance. Lakes, streams, and wetlands are more than conduits in the overall hydrologic cycle — they are systems for the biological and chemical transformation of materials that almost invariably renders them less harmful to humans, although there are some notable exceptions (such as mercury to methyl mercury). The degradation of various societal wastes is an ecological service that natural systems can perform when they are in good health. The $260 billion put into waste treatment might have been more effectively spent if used to ensure that natural aquatic systems remained in robust health and condition and, therefore, could provide all the services of water quality maintenance, flood control, and the like, which they do so well.

(6) Recreational amenities. Costa Rica has about 25% of its land mass in national parks and preserves. Also, one of the world's largest ecological restoration projects is located there (Janzen, 1988). It should come as no surprise that tourism is Costa Rica's second largest industry. Even in developed countries, such as the United States, tourism is economically important to a huge number of states. Even if ecosystems have been damaged, they may again become tourist attractions and an economic asset locally. The Kissimmee River demonstration restoration project (National Research Council, 1992) has also reversed a trend toward a declining fishery, declining wildlife, birds, and vegetation. The damage in the Kissimmee River and adjacent wetlands occurred when a parallel canal was dredged, which diverted water from the original sinuous river and shortened the travel time as well. Fortunately, the decline in fisheries and wildlife occurred over such a short time span that people remembered "the way it was." They wanted it back "the way it was!" The portion partially restored thus far gives dramatic evidence that an aroused citizenry who appreciates natural systems is willing to pay to have them restored and that they are, if done promptly and well, a major source of satisfaction to them.

Is a Human Society/Natural System Partnership Possible?

The world scientists' warning to humanity (Union of Concerned Scientists, 1992-93) should give even the most unconcerned citizen pause. There is also Odum's (1992) Concept 7 that states there are two kinds of natural selection, or two aspects of the struggle for existence: organism versus organism, which leads to competition, and organism versus environment, which leads to mutualism. Odum notes that, to survive, an organism does not compete with its environment, as it might with another organism, but it must adapt to or modify its environment and its community in a cooperative manner. This concept is not a new one but was first suggested by Kropotkin (1902) and re-examined more recently by Gould (1982). There are also indications from the policy and industrial sector of a need for re-examining this relationship; for example, the conference "From Rio to the Capitals: State Strategies for Sustainable Development" sponsored by the Louisville Development Foundation, Inc., Louisville, Kentucky, and held May 25-28, 1993. Supplement Issue 3, May 1993, printed by *The Courier-Journal*, Louisville, Kentucky, had such titles as "From Conflict to Co-Existence: New Politics in the Environment" and "Building a Sustainable Oregon" by Governor Barbara Roberts. Finally, the April, 1993 (Vol. 22, No. 3) issue of *Chem. Ecology*, a publication of the Chemical Manufacturers Association, had a lead article titled "Designed with the Environment in Mind," commonly called "Green Design." This article focused on what designers and engineers should take into account when designing a new product so it will be "environmentally friendly" from extraction of the raw materials to its re-incorporation into natural systems.

The Transition Period

Concept 20 in Odum's (1992) series deals with going from dominionship to stewardship in human society's relation to the environment. In short, Odum advocates going from a parasite-host model for man and the biosphere (exploiting it) to taking care of it. Odum speculates that despite, or perhaps because of, technological achievements, humans remain parasitic on the biosphere for life support. However, survival of a parasite depends on reducing virulence and establishing a reward feedback that benefits the host (e.g., Alexander, 1981; Anderson and May, 1981).

As Odum (1992) notes in Concept 19, transition costs are always associated with major changes in nature and in human affairs. Changes from present to sustainable use agriculture and from a high per capita energy society to a low per capita energy society may well improve the quality of life from lessening air pollution to reducing the incidence of traffic gridlock. This need not mean loss of jobs (e.g, Renner, 1991).

Increasing the Survival Potential of *Homo sapiens*

Odum's Concept 6 is that natural selection may occur at more than one level. One of the tenets of this hypothesis is that a species benefitting the community of species with which it is associated has a survival value greater than a species that does not (e.g., Wilson, 1976).

Conclusion

Until human society develops a much higher level of environmental literacy and a sense of *ethos* (loosely translated as a set of guiding beliefs), together with a conviction that there should be equity and fairness in the relationship between human society and natural systems, the relationship will probably be primarily determined on economic grounds with a strong preoccupation with the perceived needs of human society. Some of the services ecosystems provide (albeit unintentionally) to human society, including such things as maintenance of the atmospheric gas balance and water quality, would be inordinately expensive and perhaps impossible to carry out with technological means. We can do so in spaceships for limited periods of time at enormous cost but cannot do so for the entire planet, even if the energy and technology were available to do so because of the enormous additional costs in a period when most societies are in recession or worse. The enormous rise in human population size and the concomitant rapid rate of destruction of both species and habitats indicate that a new relationship must develop quite rapidly or the ecological portion of the life support system may be unequal to the task necessitated by the enormous human population increase. Nature has recovered a number of times from catastrophic losses of species, although this occurs over geological time far, far longer than the human life span. It is not likely that human society as we now know it would have comparable resiliency, although, even if it does, such catastrophic change should be avoided to reduce suffering. Whether human society will change from domination of natural systems to a partnership with them will probably be one of the most important questions affecting the future of our species and our society.

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