



Humans should not forget that they are part of a biospheric system upon which they are dependent. Even in a democracy, humans cannot decide which natural laws to obey or ignore.

Do Unto the Biosphere What You Expect Others to Do: A Universal Ethos and the Carrying Capacity of a Finite Planet

A democracy is based on the concept that the impetus for any law originates with the citizens. In the United States, poll after poll has shown that the citizens favor protecting the environment, although the polling results vary with how the questions are stated. Also, individuals vary widely in the how much they are willing to change their personal behavior and how much of their own funds they are willing to pay to protect the environment. On complex issues such as the environment, laws tend to favor the minimal amount essential to offer protection, but not necessarily to ensure robust health. A societal ethos or set of guiding beliefs is usually more effective than laws because compliance results from peer pressure, not from surrogates of society who are enforcing the law.

In the case of the global environment, individuals can make a difference if there are enough of them; however, the relationship is between the two complex systems of human society and the planet's ecologic life support system. The ecologic life support system provides signals that indicate its condition or health to those skilled in interpreting the signals and measuring the conditions. Skilled individuals include a wide variety of disciplines, such as atmospheric scientists, ecologists, chemists, engineers, scientists, economists, and modelers. In short, the average citizen may espouse a reverence for natural systems and acknowledge a dependence on the planet's ecologic life support system, but may not have the training or time to gather the evidence necessary for making informed judgments. Evidence on the condition of the ecologic life support system is generally gathered by teams of individuals with a variety of professional skills. As is always the case for complex, multidimensional systems that are continually changing, all projections will be probabilistic with varying degrees of confidence in them, depending on the robustness of the evidence. Furthermore, trust must be placed in the relatively few individuals who are charged with maintaining environmental quality since corrective action may often be necessary in a short time span.

Human society has only one planet, so prudence requires that human society take precautions to prevent damage to Earth, even if uncertainty exists about how much damage will occur, or even if damage will occur, and if the damage is likely to be catastrophic. Nature follows universal laws that were in existence long before the laws of human society were developed. Most societies that have ignored these natural laws have paid severely for this transgression. Human laws may be a guide in respecting natural laws, but human laws that are not compatible with natural laws will not free human society from the consequences of breaking natural laws.

Many cultures have their own versions of the Golden Rule (1). It is a splendid aspiration, but the Golden Rule must be modified when developing a set of guiding beliefs for sustainable use of the planet. This rule applied to the biosphere would be "Do unto the biosphere what you expect the biosphere to do unto you." In other words, human society must treat the biosphere well if it wants the biosphere



John Cairns, Jr.

to treat it well by continuing to provide the ecosystem services that are essential for the survival of the human species. As presently interpreted (i.e., applying only to relationships among humans), the Golden Rule would place those who ravage the environment on an equal footing with those

who sacrifice to protect biospheric integrity. Destructive exploiters leave the next generation impoverished. On a finite planet, resource allocation under some version of the Golden Rule will not result in sustainable use of the planet as now envisioned. If the Golden Rule were reinterpreted to include the biospheric life support system and the species that comprise it, it might serve in a sustainability context because human society would treat nature with reverence for the services it provides. In a system with limitless resources, the Golden Rule would work, but the planet is resource-limited and the system that provides natural resources and ecosystem services deserves tender, loving care. On a finite planet with finite resources and an exponentially growing demand for material goods, consumption must not exceed delivery or the planet will lose natural capital. To preserve natural capital, the Golden Rule must apply to all species. Such a paradigm shift could occur because human behavior does change. However, preserving what remains of biospheric integrity requires that this change occur early in the 21st century. It is a possibility with a very low probability.

The difficulty of achieving a paradigm shift has been noted previously (2–4). The paradigm shift (3) refers to human society's behavior toward natural systems (i.e., natural capital) so that sustainable use of the planet might be achieved. If this paradigm shift fails to develop "from below," conditions may well appear that will force a less democratic solution to preserving the planet's ecologic life support system. For example, scarce resources were rationed during World War II, and in 2001 California had rolling blackouts, a form of rationing electricity that is far from democratic. When *Time* magazine (5) puts global warming on the cover and devotes much attention to possible future scenarios, the problem is clearly not trivial. As Gorbachev (6) noted, nature will not wait if society moves too slowly in making the paradigm shift. If the rise in ocean levels and concomitant flooding of coastal areas occurs (5), democratic "directed from below" remedial measures will suffer as they do in almost every major crisis. The *Time* article makes it quite clear that the United States, a major producer of greenhouse gases, is unlikely to develop a consensus on a means of reducing greenhouse gases soon, despite increasingly robust scientific evidence that this reduction is necessary. This predicament foreshadows unmistakable consequences before a consensus is reached. However, when the realization of ecologic disequilibrium occurs, the time lag of 100 years to readjust the atmospheric

greenhouse gases (5) will probably result in calls for types of political action (mutually agreed upon coercion) that are now unacceptable.

I endorse an attitude shift (2) directed from below (i.e., grassroots) and have devoted much attention to it. However, prudence requires an alternate plan (from government) for coping with ecological disequilibrium in case the body politic is too slow and nature does not wait for it to act. There are persuasive reasons for being sanguine about what human society could do to develop a sustainability ethos (7) but equally persuasive reasons for being pessimistic about what will be done (8).

Numerous books document the rapidly increasing disparity in per capita material possessions (9,10). Implementing any version of the Golden Rule would ruin hopes of achieving sustainable use of the planet unless *a*) the most affluent 25% of the human population drastically reduces its personal expectations of material benefits and/or *b*) the Golden Rule is viewed as an aspiration or purely mental model to be achieved at some distant time. If the Golden Rule is implemented as being a fair and equitable sharing of material resources without sacrificing the material goods of the affluent, it is a prescription for ecological disaster. As a caveat, a certain amount of material goods (to assure being fed, “watered,” and kept warm) is essential to a quality life. However, any consumed resources must be taken from some other creature, human or nonhuman.

A few illustrative examples of the consequences of the redistribution of resources follow (11,12).

- If each person in the planet's most populous nation (China) were to eat one additional chicken raised on grain each year, production would require as much grain as Canada (number 2 grain exporter) exports annually.
- If China's per capita consumption of seafood matched Japan's, 100 million tons more than today's total catch would be needed; many fisheries are already overharvested.
- If China's per capita consumption of wood products equaled Japan's, the demand would exceed Japan's nine times over.

Living by the Golden Rule on a finite planet occupied by interdependent life forms that are competing for limited resources requires resource partitioning. It is widely expected that the population of the United States will double in the next 50 years. The natural world has feedback loops to limit attempts to overexploit resources (e.g., disease, famine, war). To avoid these, human society must also develop anticipatory feedback loops.

Intelligence could be used to develop a more harmonious relationship with natural systems and to avoid exploiting Earth's resources without restraint. On a finite planet, exponential growth, or any growth beyond certain limits, must eventually exhaust natural capital. A society practicing a perpetual growth paradigm will probably collapse (13,14). As McNeill (15) noted, it is possible that China has shifted, over thousands of years, from one unsustainable set of practices to another. In mathematical terms, Bartlett (16) has shown that each increase of 1 billion barrels of oil in the size of the estimated ultimate (oil) recovery beyond the value of $2.0 \times 1,012$ barrels can be expected to result in a delay of approximately 5.5 days in the date of maximum production. As was evident during the gas shortages of the 1970s, scarcity can quickly change patterns of behavior. Technology can postpone the ecologically damaging effects of scarcity, but with billions already impoverished, the effects cannot be indefinitely postponed. Even within human society, the perpetual growth paradigm seems incompatible with the Golden Rule.

Human society cannot exist without the biospheric life support system. As Berry (17) noted, human society is forsaking the natural world for growth. Berry remarked with regret that the process of exponential growth has eroded all those experiences that make life satisfying: the sense of community, and intimacy with the natural world, wonder, and beauty.

Of course, Simon (18) and many other economists argue that human creativity, technology, and ingenuity can, in a free market system, find substitutes for any resources that have been depleted. However, technology cannot replace many of the services from natural systems, which was persuasively demonstrated in 1993 when the \$200 million “Biosphere II” project in Arizona could not maintain a breathable atmosphere for its eight human inhabitants. Even if the present exploitation of natural capital did not jeopardize human welfare and the Golden Rule were applied to the needy billions of the human species, what about the over 30 million other species with which humans share the planet? Is the Golden Rule applicable only to one species? Will the destruction of other species to satisfy human society's insatiable demand for material goods damage humans spiritually?

Former United States Secretary of the Interior Stewart Udall (19) many years ago described a condition of material wealth that was an astonishingly accurate description of conditions at the end of the 20th century:

The conservation challenge of today is essentially one of quality. Technology holds the key to survival for years to come, if we are to believe the scientists. But what kind of survival? Glassed-in, air-conditioned boxes with elbow-to-elbow barbecue pits and wall-to-wall frustrations hardly add up to quality, even though the pits are replete with beef steaks and the arm-chair table sports a box of chocolate creams.

This scenario describes only some individuals in a country that has less than 5% of the world's population and appropriates nearly 25% of the world's energy and material goods. The planet's biospheric integrity simply cannot survive an implementation of the Golden Rule that would bring the entire world to the level of affluence of the United States.

Natural systems cannot treat humans as one human treats another under the Golden Rule. In addition, natural systems can affect human society in both beneficial (e.g., ecologic services) and harmful ways (e.g., antibiotic and pesticide resistance). The big problem is lag time. For example, the residence time of carbon in the atmosphere is approximately 100 years (5). Humans are accustomed to a much more rapid response. Ecologic response time may have a multigenerational span—a major adjustment for humans in a “dot.com” era. Although ecosystems respond to stress in a variety of ways, human society lacks robust diagnostic methods and is often reluctant to accept the evidence where reliable methods are available. The important point here is that individuals are not capable of gathering the complex, multidimensional evidence needed to determine the health and conditions of natural systems. Moreover, most individuals are not sufficiently literate about these complex, multivariate systems to interpret the data, especially when an emergency situation develops. Thus, while I favor decisions “directed from below” (2), specialists will be needed to judge complex issues just as they do in courts of law. There is, however, an important difference: humans do not make natural law as they do societal law. Natural law (e.g., gravity, mortality) may not appeal to everyone at the “grassroots” level, but it cannot be repealed nor can the consequences of ignoring it be avoided. Humans should not forget that they are part of a biospheric system upon which they are dependent. Even in a democracy, humans cannot decide which natural laws to obey or ignore. However, ecotoxicologists can interpret some of nature's laws and describe how to avoid violating them. Nature will enforce them with a variety of consequences if they are violated. Perhaps this enforcement is the ultimate “grassroots” action—over 30 million species “telling” one species (*Homo sapiens*) it had better behave.

Shaping humanity's future depends to a large extent on its capacity for reason and wisdom. Disagreement over society's relationship with the interdependent web of life is the result of differing degrees of optimism about the human capacity for rational conduct. Moreover, what appears to be a rational act for an individual (amassing as many material possessions as one's finances permit) will, if carried out by a sizable

numbers of individuals, damage the interdependent web of life. Even if short-term behavior appears rational, there is reason to doubt human society's capacity to cope effectively with multidimensional, complex, comprehensive developments at large temporal and spatial scales.

Both individuals and cultures differ markedly on the degree to which the future can be foreseen and/or shaped. *Homo sapiens* copes best with specific, immediate, and unmistakably harmful effects. From this perspective, sustainable use of the planet, the Golden Rule, and other quests for equity and fairness are a denial of reality, which places practitioners at a competitive disadvantage. In short, as a species, humans are doing the best they can. They may be able to envision a better, utopian world, but the world, as it now exists, is the best that the species can achieve. It is a pity that perceived self-interest impoverishes other species and members of the human species, but when resources are finite, less competitive individuals simply cannot make the grade. Even proclaimed optimists could not be faulted for being skeptical about individual and societal self control.

Civility is rarely apparent these days in societies that are dominated by road rage, parental brawls at juvenile sporting events, "in-your-face" radio and television shows, and political elections. Other communal species manage well without what humans call civilization. In the 20th century, civilization was increasingly identified with technology because it can reshape the environment to fulfill perceived "needs." However, what humans want ultimately determines the quality and ethos of the civilizing efforts. When these "wants" result in technologies that damage the ecologic life support system and reduce civility among individuals (e.g., cell phones in churches), the nature of the goals and values are revealed. As I have noted elsewhere (20), the integrity of natural systems is best determined by a realistic examination of the practices of human society, which affects it. The "shape" of the environment is now primarily determined by the "shape" of human society. Pogo said it best: "We have met the enemy and he is us!" (21).

Globalization and the multidimensional nature of human society require specialization. In the absence of integrative efforts, connectedness is lost or dimly perceived. To integrate, one must trust the evidence gathered by the specialists. This trust has suffered grievously in recent years. Evidence-based, probabilistic determinations have been replaced by slogans and dogma: "economic progress," "you can't stop progress," "smart development," "sustainable growth," "infinite substitutability of resources," and the like. But the ultimate problem in applying the Golden Rule to both the human and other species is the separation of means and ends. These relationships require a synthesis of ideas that transcends the contradictory tendencies in human society, such as simultaneous quests for material goods and spirituality, that block the development of a robust ethos or set of guiding beliefs. If this synthesis does not happen from "below," there will inevitably be calls for action from "above" as the crisis worsens.

A large number of environmentally literate individuals committed to sustainable use of the planet could accomplish wonders. However, the time required to become sufficiently well informed to make appropriate judgments on complex environmental issues is substantial, arguably impossible, for most people. As an example, Bartlett (22) discussed a surprising mathematical result: one can always find a declining rate of consumption of a finite resource such that the resource will last forever. However, to realize this, one would need a tightly controlled society; a free market would not achieve this goal. Bartlett's example is superb because *a*) it provides a management program for nonrenewable resources; *b*) the information has been available for 15 years in a professional journal; and *c*) such evidence appears to have little impact on policy decisions, possibly because the universal equations are not easily explained on the nightly news.

Bartlett (23) noted three average annual growth rates for the United States recorded during the 1990s: *a*) electric generating capacity, 0.76% per year; *b*) population, 1.2% per year; and *c*) electric

energy consumed, 2.1% per year. As a consequence, population growth accounted for approximately 60% of the demand for electricity in the United States during the 1990s. The average electric power usage in the United States is about 1,500 watts per person. It costs about \$1/watt to purchase a new coal-fired electric generating plant. Thus, every time one new person is added to the population served by an electric utility, the rate is approximately \$1,500 to purchase the generating capacity for that new person (24). The calculations are simple and require facing facts about immigration and consequent costs that people would rather evade.

Despite all of the drawbacks, most American citizens have an abiding faith in the "bottom-up" system, which requires both reason and literacy to be successful. However, as Ehrlich (25) noted, *Homo sapiens* is a small-group species now living mostly in large groups, generally without daily intimate relationships with natural systems. Furthermore, there is the "discount by distance" phenomenon (26) in which there is less concern about problems perceived as temporally or spatially distant. Finally, McNeill (15) remarked that the 20th century witnessed environmental transformations of a scale never before seen, the consequences of which remain among the most troublesome riddles of our common future. Surely we should reevaluate our institutions and societal behavior to know where we have been and where human society is headed. This evaluation is the least we can do if we are to achieve sustainable use of the planet!

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John Cairns, Jr.

Department of Biology

Virginia Polytechnic Institute and State University

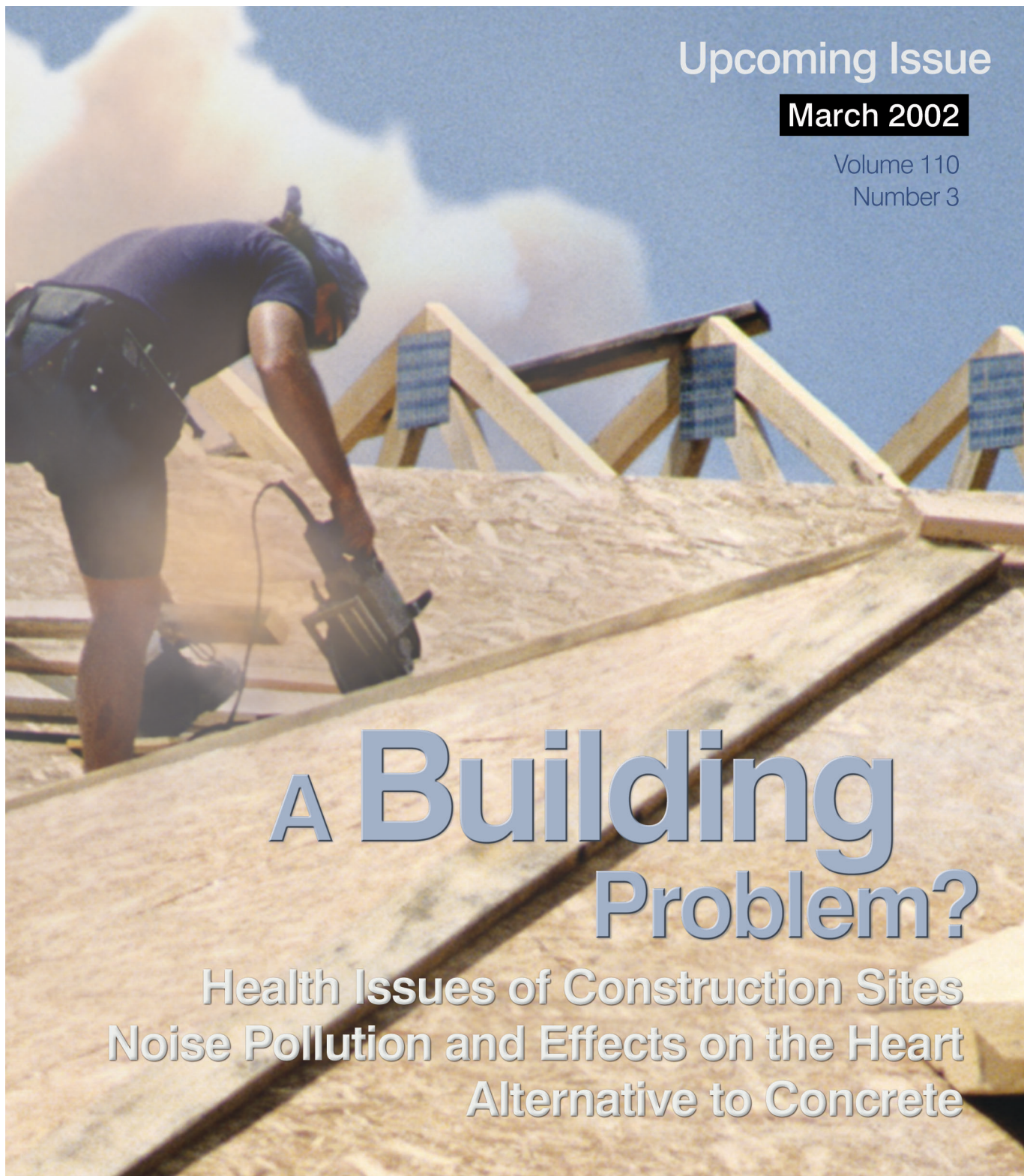
Blacksburg, Virginia

E-mail: jcairns@vt.edu

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