

# PLANETARY SUSTAINABILITY

## The Age of Transition to Sustainability: The End of the Exponential Growth Period

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**Abstract.** Arguably, no curve in the world increases indefinitely—certainly no growth curve of human society. The quest for sustainable use of the planet involves estimating levels of activity, particularly resource use, that can continue indefinitely. Since the biosphere is dynamic, this continuation is not a stagnant, steady-state situation but rather a mutualistic interactive relationship between human society and the planet's ecological life support system. Human technology, creativity, and ingenuity may modify natural laws, but cannot be used to repeal them. Attempts to maintain the recent exponential growth of the human population, affluence, and artifacts cannot continue forever, or probably even for another century. At best, quality of life will be diminished, and, at worst, a substantial loss of human life will occur if both ethical and ecological issues are not freely and openly discussed. Sustainability may be visionary and unattainable, but it does offer an opportunity to improve the quality of life for future generations of humans and the other life forms, an opportunity that is far greater than possible with present unsustainable practices.

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*Death is knocking at the door.  
Let him knock, we have other things in mind.*  
—Stevenson (2001)

*Whoever thinks a faultless piece to see,  
Thinks what ne'er was, nor is, nor e'er shall be,  
In every work regard the writer's end,  
Since none can compass more than they intend;  
And if the means be just, the conduct true,  
Applause, in spite of trivial faults, is due.*  
—Alexander Pope, *Essay on Criticism*

The sine qua non of sustainable use of the planet is that one species, *Homo sapiens*, can persist for as long as the planet lasts. Some mammals have persisted for significant periods of time, but to postulate survival for an indefinite period of time would certainly be an unprecedented event. Theoretically, human creativity, technology, and ingenuity offer promise of achieving sustainability, but these attributes can also be used to promote unsustainable practices for the short-term benefit of a few individuals.

The use of the word *sustainable* as an adjective to modify the word *development* (e.g., World Commission on Environment and Development, 1987; Harris et al., 2001), which is usually associated with the word *growth*, is a cause for concern. Sustainable use without abuse seems a better descriptor, but would be less reassuring to those to whom growth and development are sacred. The phrase *smart growth* is even more appealing to advocates of perpetual growth, but there is no persuasive evidence that smart growth is indefinitely sustainable. Neither is there robust evidence that developing a more harmonious, mutualistic relationship between human society and the planet's ecological life support system will be sustainable. The biosphere is a dynamic system, especially over geological time, and to believe it will remain suitable for one species (humans) indefinitely may be the ultimate hubris. Still, achieving sustainability is a challenging undertaking that requires a reexamination of human society's relationship

with the biosphere and human society's responsibility to both its descendants and those of other life forms.

One major factor to consider during the transitional period is the degree to which sustainable practices are implemented globally. Those countries and areas not doing so are likely to experience emigration on a massive scale. This movement of population might temporarily alleviate carrying capacity problems in the country exporting people, but might easily destabilize a country aspiring to achieve sustainability. Sea level rise or exceptional hurricanes could easily result in numerous refugees, as could war, famine, or economic depression.

### The East Sea: A Glimpse of the Future?

Raspail's (1975) prophetic novel, *The Camp of the Saints*, tells of a flotilla of 100 rusty ships headed north from the Ganges carrying hundreds of thousands of impoverished people so desperate that they are willing to risk everything in hope of reaching the southern coast of France and a better life. Five more fleets from Africa and Asia join them, and the sheer numbers threaten to overwhelm France's resources and culture. The book describes the indecision and unwillingness of politicians to take action. They are torn between their humanitarian instincts and their desire to maintain their country's political stability and integrity. Raspail describes (in a review by Uhlich, 1994-1995) the vision that led to his book:

They were there! A million poor wretches, armed only with their weakness and their numbers, overwhelmed by misery, encumbered with starving brown and black children, ready to disembark on our soil, the vanguard of the multitudes pressing hard against every part of the tired and overfed West.

Raspail literally saw *them*, saw the major problem they presented—a problem absolutely insolvable by any present moral standard. To let them in would destroy France. To reject them would destroy them. So-called Christian charity would prove itself powerless. The times would be cruel.

More recently, Dickinson (personal communication, 2001) has called attention to the story of the *East Sea*, the rusty freighter that ran aground in mid-February 2001 near the French Riviera. Turkish smugglers had packed at least 910 Kurdish men, women, and children into the hull of the 90-foot ship, with a one-way destination in mind. The captain and crew fled by light boat after setting the ship facing land with the propellers turning so that it could not drift away.

Dickinson (personal communication, 2001) reports that one day after the *East Sea* grounding, 200 Africans in four boats landed illegally in Spain. If one boatload, planeload, or other conveyance of refugees were to be accepted, a torrent of vessels would head in the same direction. The countries of choice are unlikely to sink such vessels, certainly not in international waters or airspace, and the distance to the shoreline is not far, especially if a substantial number of ships or planes had to be tracked. As is the case for immigration into the United States, Britain, Germany, France, and a number of other countries, citizens are far from being of one mind in how to resolve this problem, and elected politicians are ever mindful of the effect of minority opinions on their chances for reelection. These worst case scenarios become increasingly probable daily as the world's population increases, the disparity in wealth becomes ever greater, resources become ever scarcer, and terrorists' weaponry becomes even more frightening.

This apocalyptic possible future scenario is presented here because the changes necessary for the transition to sustainable use of the planet requires behavior changes of both individuals and human society that would be unthink-

**Table 1. Factors Affecting Population (Bartlett, 1994)—Nature Chooses from the Right-hand Column, People Choose from the Left-hand Column**

Factors Increasing Population <sup>1</sup>	Factors Decreasing Population
Procreation	Abstinence <sup>2</sup>
Motherhood	Contraception/Abortion
Large families	Small families
Immigration	Halting immigration
Medicine/Public health/Sanitation	Disease
Peace	War
Law and order	Murder/Violence
Scientific agriculture	Famine
Accident prevention (55 mph speed limit)	Accidents
Clean air	Pollution (cigarette smoking)
Ignorance of the problem	Knowledge of the problem

Notes: 1. Many of the activities in the left-hand column are subsidized with taxpayer money (my comment, not Bartlett's). For details, see Myers with Kent (1998).  
 2. Added by Cairns, with Bartlett's approval.

**Table 2 Illustrative Choices that Will Hamper or Facilitate Sustainable Use of the Planet**

Hamper	Facilitate
1. Born to shop	1. Simple living
2. Exponential growth of resource use	2. Frugal use of resources
3. Flagrant individualism	3. Community spirit
4. Misery as the primary means of human population control (e.g., Boulding, 1971)	4. An enlightened social contract as the primary means of population control
5. Live for the moment	5. Compassion for future generations
6. Technology and ingenuity to free humans from natural laws	6. Acknowledgment of human dependence on ecological life support systems
7. Species extinction, if it actually occurs, does not bother me	7. Humans have an ethical and moral responsibility to cease anthropogenic extinction of other species
8. Economic development can and should raise all humans to the U.S. per capita level of affluence	8. The planet cannot support Earth's present population at the U.S. per capita level of affluence
9. Nobody can tell me what to do on my property	9. Property owners should be financially responsible for ecological damage resulting from their management practices
10. With low oil and coal prices, why spend money on alternative energy sources?	10. Solar and other alternative energy sources should be developed at an accelerated rate
11. No sharing of resources until human needs are fully satisfied	11. We should share resources equitably with other species—now
12. It is my right to drive wherever I please and own as many cars as I can afford	12. Environmentally, mass transit is essential for sustainable use of the planet

able for many people if the alternative were not so grim. A simple, ecological definition of sustainable use of the planet is “living on the services ecosystems provide without damaging the integrity of the systems that provide them.” Even under the best circumstances, the transition may be difficult, arguably impossible, because many people will not believe apocalyptic events are occurring until they personally experience them. The only hope is that reason guided by intelligence and evidence will prevail and, thus, thwart the catastrophes that exponential growth on a finite planet will otherwise bring.

### The End of Mass Migration

Humans have always moved over the land masses or even, as did the Polynesians, over vast uncharted expanses of the Pacific Ocean in the hopes of finding uninhabited areas with abundant resources. Some cultures, including the Polynesians, transported domesticated or semi-domesticated plants and animals with them to ensure that certain familiar types of food and fiber would be available in their new locations. Since other creatures preceded humans on the planet and since the evidence indicates that humans did not initially have a global distribution, human migrations have displaced other species and simultaneously competed with them for both space and resources. As human population size and levels of material affluence increased exponentially, subsequent migrations resulted in the displacement of members of the human species, and, since Earth is a planet of finite size, diminished average per capita resources. In the United States particularly, the view still

exists that the planet provides a vast cornucopia of infinite resources that needs only the technology to acquire them. The persistence of this belief is explained, but not justified, by the fact that the United States, which has less than 5% of the world's population, consumes nearly 25% of Earth's resources. In short, the size of the ecological footprint (e.g., Wackernagel and Rees, 1996) in the United States (and Canada) is substantially larger than most of the rest of the world and significantly larger than most other developed countries.

### The End of Exponential Growth on a Finite Planet

Bartlett (1994) has produced a superb video on exponential growth, which should be required viewing in a world where exponential growth is almost worshiped and its deficiencies ignored or denied. Even a “modest” growth rate in population of 1.7% results in a doubling time of just over forty years. Table 1 (Cairns, 1999) lists factors that would increase population and those that would decrease population. Most people would unhesitatingly choose activities that would primarily increase population and would choose sparingly, if at all, from activities that decrease population. However, if activities that decrease population are not chosen, nature will do so indiscriminately. Table 2 (Cairns, 1999) lists choices that will either hamper or facilitate sustainable use of the planet. The items listed that hamper sustainable use describe the behavior patterns in vogue today, and the items listed that facilitate sustainable use are choices that most affluent people would soundly reject. Durant and Durant note that “inequality is not only natural and inborn, it grows with the complexity of

civilization” (1968). In addition, they note: “We conclude that the concentration of wealth is natural and inevitable, and is periodically alleviated by violent or peaceable partial redistribution” (1968). The burning question of the twenty-first century is how this redistribution will occur, since the disparities now existing are arguably the greatest in human history. Add to this disparity the greatest array of mass technologies for destruction in human history, and the question becomes how to avoid catastrophic changes in both the environment and human society. Unquestionably, changes will not be attractive to most people who presently are enjoying the “good life.” A few illustrative examples of changes follow.

### *Ceasing the Worship of Economic Growth*

As Douthwaite (1999) notes, economic growth has enriched the few, impoverished the many, and endangered the planet. Hardin (1993) has provided a superb analysis of why human society should live within limits. Ehrlich (2000) decisively destroys the notion that there is a single, genetically determined “human nature” and provides robust scientific evidence to both explain the human predicament and what must be done to escape it. McNeill (2000) has documented the degree to which the twentieth century witnessed environmental transformations of a scale and subtlety never before seen and the consequences of these transformations, which remain the most challenging problems of the human condition in the twenty-first century. As Myers with Kent (1998) document, much environmental damage is caused by perverse governmental subsidies, which politicians are encouraged to maintain because of a sizable army of well paid, special interest lobbyists. As a caveat, it is worth reaffirming that not all growth is environmentally damaging. Growth in spirituality, sense of community, sense of place, in human society’s relationship with the environment, etc. require neither enormous resources nor substantial funding and are attributes that most humans claim to desire.

### *Reducing Ecological Footprint Size*

Flavin (2001) is persuasive in telling of the disparity between rich and poor nations and the ecological health of the so-called E-9 nations that account for 57% of the world’s population and 80% of the total economic output. An example of this disparity is that the per capita purchasing power in the United States was \$29,240 in 1998 and was \$2,060 in India (Flavin, 2001). Flavin also summarizes the myriad signs of human-induced global climate change and a number of other environmental challenges that are testing environmental limits. Both social and environmental reasons are compelling for reducing the size of any ecological footprint that is above the global norm, as well as reducing the global norm if this footprint damages the ecological life support system.

### *Averting Disasters Stemming from Destructive Practices*

Abramovitz (2001) documents disasters caused by ecologically destructive practices and emphasizes fostering resilience in nature and communities. Some ecosystems are perturbation-dependent (e.g., floods, fires, hurricanes) and, arguably, all ecosystems may be, differing only in the size and periodicity of the perturbation and the temporal and spatial spans that they encompass. A recent trend in population modeling is to design models that are spatially explicit, thus capturing heterogeneity of natural world landscapes (e.g., Dunning et al., 1995). The relationship of this type of modeling to sustainability is quite clear in view of the number of people displaced by environmental disasters. Many of the displaced individuals appear in countries ill prepared to host them. Sustainable use of the planet requires that ecologically destructive practices be diminished to the extent feasible. In addition, increasing the resiliency of natural systems to these practices will increase natural capital, which is good for both human society and ecosystems.

### *Adjusting to Nature’s Pulsing Paradigm*

The dominant global paradigm could be characterized as the perpetual exponential growth paradigm. When considering daily activities, from church membership to mutual fund performance, growth is usually the first descriptor used—with the caveat that the more exuberant the growth the better. Of course, some notable exceptions exist! For example, growth in small geographic areas may be a concern to policymakers because of a loss in the sense of community or ease in driving from one area to another. At the national or global economy, growth at a lower rate than that of the recent past poses many concerns.

Although not usually explicitly stated, some sustainable use models focus on either a steady state condition (rare) or “smart growth” or “sustainable growth.” However, sustainability, especially in the natural capitalism form, envisions a harmonious relationship with the planet’s ecological life support system, its natural capital, and its ecosystem services. Odum, Odum, and Odum note, “while the steady state is often seen as the final result of development in nature, a more realistic concept may be that nature pulses regularly to make a pulsing steady state—a new paradigm gaining acceptance in ecology and many other fields” (1995). They further state, “we suggest that if pulsing is general, then what is sustainable in ecosystems is a repeating oscillation that is often poised on the edge of chaos” (1995). Odum and colleagues make a persuasive case for the prevalence of pulsing at all ecological scales. The widespread energy transfer through the coupling of oscillators seems to be the general rule and steady states are the exception, although they can be induced by eliminating the outside pulses (Beyers and Odum, 1993). If the hypoth-

esis is correct (and evidence suggests it is), then the end of the exponential growth period for human society will not involve achieving a steady state of sustainable use of the planet, but rather the more difficult adjustment of coupling human society's behavior and practices to the pulsing system described by Odum and colleagues.

Persuasive reasons suggest the need to adjust to a pulsing system:

- (1) Natural capital is the basis of all forms of human society's capital (Hawken, Lovins, and Lovins, 1999);
- (2) Human society is dependent on the delivery of ecosystem services (Costanza et al., 1997) and, if natural systems pulse, then inevitably some pulsing would occur in the delivery of ecosystem services;
- (3) Damaging the integrity of natural systems by ignoring their pulsing nature will almost certainly, in the long run, require far more of an adjustment of human society than adjusting to the pulses that should be, as the science develops further, more and more predictable.

Some common situations in human society mitigate against living harmoniously with nature's pulses:

- (1) In democratic societies, elections that are at four-year or other intervals almost certainly will not correspond with the pulsing periods of nature. The pressures on elected politicians for reelection or on dictators to remain in power will tempt them to ignore nature's pulses;
- (2) Human economies also pulse, and the temptation to diminish environmental protection during an energy crisis (as is perceived to exist in the United States in 2001) or some other similar crisis will almost certainly ensure that the economic cycles will be given more attention than the natural cycles;
- (3) Arguably, the most intractable situation is the need to admit that humans are not as much in control of events as they have convinced themselves they are. Denial of dependence is more likely than admission of dependence on natural systems.

On the other hand, if human society is going to make a major paradigm shift, why not do it all at once—move from the perpetual exponential growth paradigm to the nature's pulsing paradigm in one leap, using the illusory steady state as a fleeting benchmark en route from one major paradigm to another.

### *Implementing the Precautionary Principle*

The precautionary principle (PP) asserts that, when an activity raises threats of harm to human health or the environment, precautionary measures should be taken even if some cause-and-effect relationships are not fully established scientifically (e.g., Raffensperger and Tickner, 1999). Arguably, this activity would be the most difficult

human behavioral change to achieve in the transition from exponential growth to sustainability. For example, the evidence for global warming is sufficiently documented for this phenomenon to appear on the cover of the April 9, 2001 issue of *Time* and be covered in a special report (Bjerklie et al., 2001).

Global climate change of even modest dimensions will definitely have a major effect on the quest for sustainable use of the planet. Greenhouse gases of anthropogenic origin are a major factor in global warming, and the United States is responsible for roughly 25% of these. Yet the United States has not signed the Kyoto Accord to limit anthropogenic production of greenhouse gases, and, as of early 2001, none of the nations that signed the accord has ratified it. If there was ever a case for precautionary action, this one is certainly a top contender; yet, the fact that some scientists disagree with the conclusions of mainstream science (e.g., Singer, 1998) is used as an excuse for procrastination. Ignored in this delay is the fact that disagreements will always exist among scientists, because scientists are responsible for challenging and testing every hypothesis. An absolute consensus, therefore, is not only extremely unlikely, but is also extremely undesirable. If the precautionary principle is not given serious attention in a matter of this magnitude, it is unlikely to affect any policy decision, however horrendous the consequences of not taking precautionary action.

### **A Hard or Soft Landing to Sustainability?**

Odum (2001) is hopeful that a harmonious relationship will develop between natural and techno-ecosystems. However, a mutualistic coexistence is only one of the possible outcomes, since one with severe consequences to human society is also quite possible (Cairns, 1994, 1997). Overshooting carrying capacities (Cairns, 1998, 2001) is a highly probable outcome (i.e., a hard landing), and a mutualistic coexistence (i.e., a soft landing) becomes increasingly less probable the longer present practices continue.

### **Seeking a Contract with Nature**

Humans are always seeking contracts. Children behave in certain ways to get adult approval. Teenagers behave in other ways to acquire the esteem of their peers. Adults use certain types of behavior to bring about community approval and may receive censure for other behaviors. In the educational system, grades above a certain level will gain an appropriate degree. Certain types of behavior in areas of employment will get promotion and monetary rewards; other types will perhaps even end in unemployment. However, even within human society, these social contracts are being increasingly ignored. For example, the conductor at a symphony concert raises his baton and the silence is con-

tagious—and then a cell phone rings and totally disrupts what would otherwise have been an enchanting moment.

Nature makes no contracts, even with a species (humans) able to bend but not abolish nature's laws. With appropriate technology, humans inhabit parts of the planet previously inaccessible to them and utilize amounts of energy available to no other species. However, nature can still exact penalties worldwide—floods, antibiotic resistant diseases, agricultural pests that become highly resistant to pesticides, and, of course, the ultimate control, death.

Nature does not negotiate or bargain. If certain laws are followed, human society will probably be rewarded, but nature is dynamic and constantly changing, so this situation is by no means assured. Patently, the most important factor is the lack of understanding humans have of how complex, multivariate natural systems work over large temporal and spatial spans. For example, the residence time of carbon in the atmosphere is approximately 100 years (Bjerklie et al., 2001). Given the pulsing nature of ecosystems, the response times of ecosystems may be on temporal spans not yet grasped by humans and in a form not readily recognized by present states of knowledge. Odum's (2001) fear that human society will overshoot carrying capacities and refuse to become proactive is a regrettable, but highly probable, scenario. Despite formidable evidence to the contrary, I continue to have faith that reason will prevail, and an environmental ethos, coupled with ethics and fairness, will emerge. Without in any way denigrating human technology, I believe that reason and ethos are the most admirable products of the human mind and that social evolution to reach a harmonious mutualistic coexistence with natural systems is possible. If such a coexistence is not possible, even a charitable person might conclude that intelligence, as humans define it, is an evolutionary failure.

### **Cherishing Natural Systems**

It is difficult to find precisely the right word to describe a sustainable, mutualistic relationship between human society and natural systems. Anthropogenic effects are so ubiquitous that natural systems, even as they were a century ago, are extremely rare today. By natural system I mean healthy, self-maintaining ecosystems with their integrity intact. *Respect* is an inadequate descriptor because, as viewed today, it is regarded as optional, not obligatory, and, in the present usage of the word, may well be a facade for those who wish a positive environmental image but are unwilling to commit to a level of personal involvement that would give the word substance. *Esteem* is a marginally better word, possibly because its meaning has been less degraded than the word *respect*. *Reverence* is arguably a satisfactory word because it implies a reverence for life even if it remains beyond society's control and is something that human society neither dominates nor destroys. *Sacred* is perhaps a better word than *rev-*

*erence* because it combines the components of inviolate and mysterious. *Sacred* requires a degree of reverence that cannot be set aside for economic development, job security, or personal exploitation of private property that damages adjacent ecosystems or the bioregional ecological fabric. *Sacred* also has a strong element of mystery which, among other things, indicates that violating the system for short-term gains (or even long-term gains) may well result in consequences to all of human society that are horrible to contemplate, yet increasingly probable as the environmental damage continues.

The word *cherish* carries the explicit requirement of active, tender, and nurturing care and seems a good way, if not the perfect way, to describe a mutualistic relationship between human society and natural systems. Cherishing does not permit endangering the planet's ecological life support system for perceived economic benefits. A superb alternative is the word *treasure* as a verb, which means "to hold or keep as precious" and also "to collect and store up (something of value) for future use." Furthermore, as Myers with Kent (1998) have shown, many economic enterprises that are so damaging to the environment are actually subsidized by tax dollars (or other currencies); if these enterprises paid for the damage they did to the environment and had no subsidies, they would probably not survive economically. The fact that human society uses government funding to subsidize damage (Myers with Kent, 1998) to the planet's ecological life support system shows how far society has to change in establishing a mutualistic relationship between human society and natural systems. Furthermore, Hawken, Lovins, and Lovins (1999) have shown that enterprises can be environmentally sensitive and profitable as well, even without government subsidies.

The central issue is, of course, whether human society will come to cherish or treasure the planet's ecological life support system before suffering serious consequences or after unmistakable catastrophic consequences are clearly evident to all of society. Kane (2001) describes how the lives of humans have become extremely complicated and documents the hidden social costs of a highly materialistic society. The literature calls for repairing (e.g., Hayes, 2000) and protecting (e.g., Caldwell, 1972) the biosphere, even though humans are increasingly attempting to fill non-material needs materially (Kane, 2001). In the quest for short-term gratification—which only seems to increase loneliness and decrease civility—humans may be irreparably damaging the lives of present and future generations. It does not seem possible for human society to drive more than 50 to 75% of the species on the planet to extinction without causing its own extinction. Life on Earth has survived some dramatic extinctions and recovered from them, although not to any semblance of the predisturbance condition. Cherishing the biospheric life support system is an act of enlightened self-interest

for human society, not a “triaging” activity for environmental weirdos.

I agree with Dubos that “humanized environments could be very different from what they are, but this does not mean that they can safely be anything” (1980:48). Few humans now alive could survive, let alone flourish, in a true wilderness. Recent television shows have displayed the difficulties of doing so effectively—sometimes in nauseating detail. Even these experiments were for relatively short periods of exposure from which one could always opt out. Dubos (1980) also comments that much of what humans think of as “nature” is merely human-altered landscapes with a harmonious combination of woodland, meadows, and cultivated fields. In short, from a human perspective, nature has been both embellished and despoiled. The quest for sustainability (at least as I view it) is not for a return to true wilderness over much of the planet, but, rather, an attempt to cease despoiling ecosystems for short-term material and economic gain. This position is between “nature knows best” and “economists and developers know best.”

## Conclusions

There is no robust evidence that sustainable use of the planet by a single species is possible. However, human suffering and biotic impoverishment (loss of both species and habitat) will be markedly reduced by a systematic and orderly transition from a series of unsustainable practices to practices less damaging to the integrity of the planet’s ecological life support system. Earth’s biosphere is a dynamic system, and a sustainable relationship with it will require establishing a mutualistic relationship between it and human society. This change will require precautionary measures to protect the ecological life support system when the consequences of misjudgment are severe and the outcome uncertain based on available evidence.

Many people who denigrate cherishing or treasuring natural systems attempt to mask esteem for the environment as putting them (other creatures) before us (human society) and as a period of intellectual stagnation. Achieving sustainable use of the planet by having compassion for other species, compassion for future generations, and compassion for those less fortunate members of the human species now present is arguably the greatest challenge human society has ever or will ever face. The transition must be guided by reason, ethics, and a sense of fairness and equity rather than by a profit motive, which in itself is not bad, unless it suppresses these other attributes.

Individuals are not defined by their material possessions, although many advertising agencies would have society believe otherwise. Rather, individuals are valued for their actions, or for their actions and practices, that benefit others, including other species. In the past, many extraordinarily wealthy people realized this fact and established organizations, funds, and the like (such as Alfred Nobel

and Andrew Carnegie). The dream of sustainable use of the planet can be realized if society takes action to implement this vision. The human species may not be destined to last forever, but it can make its existence more glorious than it now is. Sustainability requires the best from each individual so that, collectively, a heritage will be left that future generations will cherish. Persuasive evidence indicates that the time to realize this dream is growing ever shorter, but it is not yet irrevocably beyond human society’s grasp. Hope rests in the idea that ethics in environmental politics will emerge as one of the guiding forces of this paradigm shift!

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## References

- Abramovitz, J. (2001). “Averting Natural Disasters.” In Worldwatch Institute (ed.), *State of the World*. New York: W.W. Norton.
- Bartlett, A.A. (1994). *Arithmetic, Population, and Energy*. A 65-minute videotape copyrighted by the Regents of the University of Colorado. Copies available from Kate Albers, Information Technology Services, University of Colorado, Boulder 80309-0379 (telephone: 303-492-1857).
- Beyers, R.J. and O.T. Odum (1993). *Ecological Microcosms*. New York: Springer-Verlag.
- Bjerklie, D., A. Dorfman, W. Dowell, R. Buchanan, M. Calabresi, J.F. Dickerson, D. Thompson, W. Kan, J. Kirwin, and J. Ressler (2001). “Feeling the Heat.” *Time* 157(14):22-36.
- Boulding, K.E. (1971). “Foreword to T. R. Matus *Population: The First Essay*.” In K.E. Boulding, *Collected Papers*, Vol. 11. Boulder, CO: Colorado Associated University Press.
- Cairns J., Jr. (1994). “Ecological Restoration: Re-examining Human Society’s Relationship with Natural Systems.” The Abel Wolman Distinguished Lecture. Washington, DC: National Academy of Sciences.
- Cairns J., Jr. (1997). “Global Coevolution of Natural Systems and Human Society.” *Revista de la Sociedad Mexicana Historia Natural* 47:217-28.
- Cairns J., Jr. (1998). “Consilience or Consequences: Alternative Scenarios for Societal Acceptance of Sustainability Initiatives.” *Renewable Resources Journal* 16(2):6-12.
- Cairns J., Jr. (1999). “An Epic Struggle: Sustainability and the Emergence of a New Social Contract.” *The Social Contract* IX(4):211-18.
- Cairns J., Jr. (2001). “Speculative Scenarios about Sustainable Use of the Planet.” *The Social Contract* XL(2):146-52.
- Caldwell, L.K. (1972). *In Defense of Earth: International Protection of the Biosphere*. Bloomington, IN: Indiana University Press.
- Costanza, R., R. d’Arge, R. de Groot, S. Farber, M. Grasso, B. Hannon, K. Limburg, S. Naeem, R. O’Neill, J. Paruelo, R. Raskin, P. Sutton, and M. van den Belt (1997). “The Value of the World’s Ecosystem Services and Natural Capital.” *Nature* 387:23-260.
- Douthwaite, R. (1999). *The Growth Illusion*. Gabriola Island, British Columbia: New Society Publishers.
- Dubos, R. (1980). *The Wooing of Earth*. New York: Charles Scribner’s Sons.
- Dunning, J.B., D.J. Stewart, B.J. Danielson, B.R. Noon, T.L. Root, R.J. Lamberson and E.E. Stevens (1995). “Spatially Explicit

- Population Models: Current Forms and Future Uses. *Ecological Applications* 5:3-11.
- Durant, W. and A. Durant (1968). *The Lessons of History*. New York: MJF Books.
- Ehrlich, P.R. (2000). *Human Natures*. Washington, DC: Island Press.
- Flavin, C. (2001). "Rich Planet, Poor Planet." In Worldwatch Institute (ed.), *State of the World*. New York: WW. Norton.
- Hardin, G. (1993). *Living Within Limits*. Oxford, UK: Oxford University Press.
- Harris, J.M., T.A. Wise, K.P. Gallagher, and N.R. Goodwin (2001). *A Survey of Sustainable Development*. New York: Island Press.
- Hawken, P., A. Lovins, and H. Lovins (1999). *Natural Capitalism: Creating the Next Industrial Revolution*. New York: Little, Brown and Company.
- Hayes, D. (2000). *The Official Earth Day Guide to Planet Repair*. Washington, DC: Island Press.
- Kane, H. (2001). *Triumph of the Mundane: The Unseen Trends that Shape Our Lives and Environment*. Washington, DC: Island Press.
- McNeill, J.R. (2000). *Something New Under the Sun: An Environmental History of the Twentieth-Century World*. London: W.W. Norton.
- Myers, N. with J. Kent (1998). *Perverse Subsidies: Tax \$s Undercutting Our Economies and Environments Alike*. Winnipeg, Manitoba: International Institute for Sustainable Development.
- Odum, E.P. (2001). "The 'Techno-Ecosystem.'" *Bulletin of the Ecological Society of America* 82(2):137-38.
- Odum, W.E., E.P. Odum, and H.T. Odum (1995). "Nature's Pulsing Paradigm." *Estuaries* 18(4):547-55.
- Raffensperger, C. and J. Tickner (1999). *Protecting Public Health and the Environment: Implementing the Precautionary Principle*. Washington, DC: Island Press.
- Raspail, J. (1975). *The Camp of the Saints*. English translation. Petoskey, MI: The Social Contract Press.
- Singer, S.F. (1998). *Hot Talks, Cold Science: Global Warming's Unfinished Debate*. Oakland, CA: Independent Institute.
- Stevenson, R.L. (2001) "Trilbies Are Fashionable Again." Quoted by A. Cook in BBC Letter to America, April 23.
- Uhlich, G. (1994-1995). "Out of Africa." *The Social Contract* V(2):102-3.
- Wackernagel, M. and W.E. Rees (1996). *Our Ecological Footprint*. Gabriola Island, British Columbia: New Society Publishers.
- World Commission on Environment and Development (1987). *Our Common Future*. Oxford: Oxford University Press.