

HUMAN ALTERATION OF EVOLUTIONARY PROCESSES

ABSTRACT

Soviet climatologist Budyko has remarked: “temperature and rainfall are the two major variables of life on Earth.” Human society is changing both of these phenomena markedly, along with many other key variables that affect evolutionary processes. A major risk is that the tempo (or rate of human-induced environmental change) may proceed more rapidly than the ability of scientists to understand, predict, or make any long-term changes that might reduce the severity of the consequences. Increasing evidence indicates that the general public and its leaders (i.e., policy makers and politicians) fail to grasp the full implications of a planet in which the types and rate of environmental change differ substantively from the climate records of the past 5 million years.

INTRODUCTION

Almost every human activity has some effect upon natural systems. When the human population was small and spread thinly over the planet, as it was for most of the 160,000 years the human species has inhabited the planet, adverse effects were localized and comparatively small. In short, the resilience of natural systems was not exceeded and, as a consequence, the impact on evolutionary processes was much less than it is today. Currently, however, effects are global and intense; illustrative examples follow.

- (1) Human population increased fourfold in the 20th century (Speth, 2004). The doubling time occurred within the life span of a single individual—a new phenomenon.
- (2) Affluence has increased even more because the global economic output has increased approximately twenty fold.
- (3) Humankind has become a major evolutionary selective force.
- (4) Perpetual economic growth is, arguably, the major paradigm for human society.
- (5) Species impoverishment (i.e., loss of biodiversity) and the consequent loss of valuable genetic information due to invasive species and habitat destruction and alteration, together with an increase in ubiquitous persistent toxic substances, has alarmed the scientific community for decades.
- (6) Over-harvesting, especially of marine fisheries, has made sustainable use of natural resources problematic.
- (7) Climate change has already become a major factor that is impairing ecosystems globally.

LOVE OF NATURE AND CATASTROPHES

Two major factors may diminish or stop damage to the 30+ million other life forms with which humankind shares the planet: (a) a love for and an ethical responsibility for the well being of other life forms and (b) fear of the consequences if humankind continues unsustainable practices (Cairns, 2004a,b).

Concern about natural systems and the environment became widespread during the latter part of the 20th century, which resulted in the first Earth Day in 1970 and the 1972 United Nations Conference on the Human Environment (The Stockholm Conference). The latter resulted in the United Nation’s Environmental Programme. However, the failure to implement any of these protective measures resulted in continued environmental degradation, although some notable successes were achieved. Even environmental catastrophes in the late 20th and early 21st centuries have resulted in a focus on symptoms rather than causes. Some ecological catastrophes (e.g., thinning and disappearance of the Arctic ice shelf) receive little or no attention from the “popular” news media. Other ecological events receive significantly more attention, such as the sea level rise at the Pacific Ocean island country of Tuvalu (Brown, 2001-2002) and the displacement of the Inuits (Native Americans in Alaska) covered by US Senator John McCain’s global warming hearings in the US Senate. Of course, the most dramatic catastrophe was the tsunami in late 2004, which caused massive loss of human life. Persuasive evidence indicates that the loss of protection from massive wave action increased tsunami damage substantially. This lack of protection would not have happened if the mangrove forests and coral reefs had not been damaged previously by human actions (e.g., Silverstein, 2005; Sharma, 2005). Ecological catastrophes are most likely to occur in areas or nations with significant ecological deficits (i.e., natural capital has been lost at a rate greater than the replacement rate) and will almost certainly have a major effect upon evolutionary processes, which, in turn, will have both long- and short-term effects upon human society. Finally, global warming and other human induced ecological changes that will affect evolutionary processes will result in severe consequences to human society.

One example is the suddenly warming climate, which is likely to be a serious threat to political stability (Schwartz and Randall, 2003). The “Pentagon Report” (Schwartz and Randall, 2003) describes an extreme scenario whose effects might be less than described or even worse because of interactions between subcomponents of the global systems. Effects on evolutionary processes are probable, regardless of the way the scenario unfolds.

EVIDENCE FOR HUMAN ALTERATION OF EVOLUTIONARY PROCESSES

An excellent summary of the alteration of evolutionary processes is available through the US National Academy of Sciences (Myers and Knoll, 2000), which provides abundantly referenced evidence that alterations have occurred and are likely to continue if present trends persist. Significant alteration of evolutionary processes will have major effects, mostly unfavorable, upon the dynamics of human society and humankind’s quest for sustainable use of the planet. Dixon and Adams (2003) speculate on what a post-human society might entail (these two authors consulted thirteen advisors with impressive credentials on evolutionary processes). Habitat fragmentation, now a global phenomenon, is another alteration that could cause a major disruption of evolutionary processes (e.g., Templeton et al., 2000).

Attesting to evolutionary alterations with massive documentation seems superfluous. Who can contemplate the massive recent alterations humans have made in the biosphere and conclude that these alterations have no effect upon evolutionary processes? Those persons would have to deny such evidence as the development of resistance to antibiotics in some disease organisms and the continual need to develop new pesticides to control pests. Why do policy makers not regard this paucity of readily available information as major evidence of the detrimental effects to human society of altering evolutionary processes?

DENIAL, ANTI-SCIENCE, AND SPECIAL INTEREST LOBBYING

One controversial explanation of the ineffectiveness of the environmental movement in the United States is that no prominent national leader has stated publicly and forcefully the detrimental consequences of present environmental trends. Leadership may fear alarming the general public or being labeled an extreme environmentalist (e.g., Shellenberger and Nordhaus, 2005). Although many laud the efforts of pioneers in the environmental field, some (Shellenberger and Nordhaus, 2005) believe that modern environmentalism is no longer capable of coping with the serious ecological crises of the world. For example, efforts to reduce global warming over at least two decades have not resulted in unsustainable practices being replaced by sustainable practices.

In contrast, Ehrlich and Ehrlich (2005) assert that, despite their belief that *The New York Times* Science Section has led the journalistic profession in reporting the consensus of the scientific community on the issues of climate change, the seriousness of the overall environmental situation has never been adequately covered by the media. Even though *The New York Times* has printed articles (Editorial, 20 January, 2005) on the human impact on the planet, no explicit statement about the seriousness of the impact has been forthcoming.

The well-known American religious leader Martin Luther King, Jr. stated: “A time comes when silence is betrayal.... Nor does the human spirit move without great difficulty against the apathy of conformist thought, within one’s own bosom and in the surrounding world” (Quote of the Week from *Sojourners* online newsletter, Wednesday, 19 January, 2005). How can the silence continue when the processes, including evolutionary, of Earth’s biological life support system are being seriously disrupted by human activities? Earth’s life support system has favored the human species for approximately 160,000 years, but the 30+ million species with which humans share the planet are not concerned with the fate of *Homo sapiens*. The other species are not committed to maintaining the life support system on the behalf of humans, even though conditions they produce now are beneficial to humans.

Speth (2004) believes that three factors are responsible for humankind’s failure to respond to global threats: (a) the collective power of the forces that produced this situation will not be adequately changed by half-measures, (b) the far-reaching complex responses required make redirecting the global agenda inherently difficult, and (c) global politics impede the development of a suitable global agenda. However, Speth believes the transition to sustainability can be made.

Gelbspan (2004), a recipient of the Pulitzer Prize, focuses on the consequences of global warming, which he feels is causing the planet to fall apart piece by piece in the face of persistent and pathological denial. Since Gelbspan is a journalist, his charge that the media has failed to make the connection between climate change and other events, such as altered rainfall patterns, is very persuasive. Gelbspan also feels another major failure of the media is ignoring the ferocious battles between the fossil fuel industry lobby and credentialed scientists who have made the study of global warming a major part of their professional careers. He uses as an example (pp. xii, xiii) the assault on the character and scientific integrity of Dr. Benjamin Santer, a world-class climate

modeler at the US Lawrence Livermore National Laboratory. Associated Press Special Correspondent Hanley (2005) remarks that the US delegation to a global conference on disasters wanted to purge a UN action plan of its references to climate change as a potential cause of future natural calamities. Clayton (2005) describes the fate of George Zeliger, a *whistle blower* (a person who makes a public disclosure of corruption or wrongdoing). Orr (2004) has written a very disturbing analysis of the effect of politics (especially when disguised as patriotism) on the environment.

The relevance of these incidences to human alteration of evolutionary processes is that the scientific process must be allowed to flourish and must not be suppressed when it appears to conflict with political or economic ideologies or matters of faith. The scientific process, including peer review, has been very successful in discrediting faulty hypotheses, but it does so by rigorous testing of them and their supporting data.

Wiener (2005) describes a situation in which 20 of the largest chemical companies in the US have developed a campaign to discredit two historians who studied the attempts of industries to conceal links between their products and cancer. This situation is unusual in that the companies have subpoenaed and deposed (in courts of law) the five academicians who recommended that the University of California Press publish the book *Deceit and Denial: The Deadly Politics of Industrial Pollution* by David Markowitz and David Rosner. Intimidating qualified reviewers strikes at the heart of the scientific process. In another somewhat similar situation, the British Government's chief scientific advisor, Chief Scientist Sir David King, has claimed there have been attempts to discredit him because of his attempts to call attention to the threat of global warming (Conner, 2005).

In the United States, arguably one of the scientific leaders in the world, the assault on science has three major components: (a) discredit scientists whose views differ from the dominant political or economic ideology and religious faith, (b) attempt to intimidate scientists and other academicians by litigation, which is both time consuming and expensive, (c) attempt to discredit scientific theories by implying they are merely educated guesses rather than carefully constructed frameworks for understanding a substantial body of evidence (e.g., Editorial, January 23, *The New York Times*, 2005). Theories supported by mainstream science are the most useful scientific theories. Attacks on the theory of evolution in the United States are increasing and persistent and are especially significant when they are against the texts used in the school system. If science is discredited in the educational system, understanding the effects of humans upon evolutionary processes will be markedly hampered. Fortunately, many scientifically advanced countries accept evolutionary theory, and both teaching and research can proceed in a systematic way in keeping with the processes of science.

Many Christians view evolution as God's means of creation, and the theory of evolution is taught in Catholic schools and many other Christian schools. Christian fundamentalists and creationists are a very politically active sub-set of all Christians, but their energy and fervor in promoting their beliefs have made teaching evolution a major issue in the United States. Sustainable use of the planet requires that humankind have a better understanding of evolutionary processes. Achieving this goal requires that the processes of science not be disrupted, especially in the education of future scientists.

CONCLUSIONS

The quest for sustainable use of the planet by *Homo sapiens* requires a mutualistic relationship between human society and natural systems. Disrupting evolutionary processes that facilitate this relationship will almost certainly have adverse, possibly fatal, effects upon human society. Another way to envision the quest for sustainability is avoiding a post-human world (Cairns, 2005). Lest this seem too fanciful, it is well to remember that *Homo sapiens* has only inhabited Earth for approximately 160,000 years out of an estimated 4.5 billion years that the planet has probably existed. In addition, the greatest anthropogenic damage has occurred in the last 200 years.

If ecological tipping points are reached or exceeded, disequilibrium will result. Regrettably, the only certain way to find an ecological tipping point is to reach it or exceed it, because no laboratory experiments are suitable for such large temporal and spatial spans. McCarthy (2005) discusses a report that estimates the climate change tipping point at 2° centigrade above the average world temperature prevailing in 1750 (before the Industrial Revolution). Since that time, human production of greenhouse gases, such as carbon dioxide, has markedly influenced the retention of the sun's heat in the atmosphere.

Speth (2003) believes that globalization is one of the profound phenomena in the present era that has affected the environmental, economic, and social aspects of the nations of the world. Because globalization involves so many political and economic systems, mid-course corrections of these powerful trends will be exceedingly difficult, but not impossible, to alter. To achieve this goal, a mutualistic co-evolution of human society and natural systems is necessary (Cairns, in press). If humankind fails in this undertaking, evolutionary processes will continue, although many other species will probably be driven to extinction. Failure would also

suggest that intelligence, as humans define it, did not provide the long-term survival value it was thought to have. I believe if intelligence is used to select sustainable practices, it will have proven to have long-term survival value.

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LITERATURE CITED

- Brown, L. R. 2001-2002. Rising sea level forcing evacuation of island country. *Earth Policy News*, Washington, DC. news@earth-policy.org
- Cairns, J., Jr. 2004a. Ecological tipping points: A major challenge for the experimental sciences. *Asian Journal of Experimental Sciences* 18(1,2):1-16.
- Cairns, J., Jr. 2004b. Coping with ecological catastrophes: Crossing major thresholds. *Ethics in Science and Environmental Politics* <http://www.int-res.com/atricles/esep/2004/E56.pdf>
- Cairns, J., Jr. 2005. Avoiding a posthuman world. *Science and Society* 3(1):13-24.
- Cairns, J., Jr. In press. Sustainable coevolution. *International Journal of Sustainable Development and World Ecology*.
- Clayton, M. 2005. Hard job of blowing the whistle gets harder. *The Christian Science Monitor* 20 Jan <http://www.csmonitor.com/2005/0120/p13s02-sten.html>
- Conner, S. 2005. Americans are trying to discredit me, claims chief scientist. *Independent News* 17 Jan http://www.news.independent.co.uk/low_res/story.jsp?story=601497&host=3&dir=58
- Dixon, D. and J. Adams. 2003. *The Future is Wild*. Firefly Books, Toronto, Canada.
- Editorial. 2005. At the limits of air and water. *The New York Times*. January 20.
- Editorial. The crafty attacks on evolution. *The New York Times*. January 23.
- Ehrlich, P. and A. Ehrlich. 2005. The *Times* and the environment. Letters to the editor on The Media and The Environment. *Pacific Conservation Biology* 10(1):2.
- Gelbspan, R. 2004. *Boiling Point*. Basic Books, New York, NY.
- Hanley, C. J. 2005. U. S. seeks to scuttle conference text linking climate change to disasters. *San Francisco Chronicle*, 19 January.
- McCarthy, M. 2005. Climate change: Report warns point of no return may be reached in 10 years, leading to droughts, agricultural failure, and water shortages. *The Independent*, 24 January.
- Myers, N. and A. H. Knoll (ed). 2000. *The Future of Evolution*. Proceedings of the National Academy of Sciences 98(10):5389-5479.
- Orr, D. W. 2004. *Patriotism, Politics, and the Environment in an Age of Terror*.
- Schwartz, P. and P. Randall. 2003. *An Abrupt Climate Change Scenario and its Implications for United States National Security*. Full PDF report (917 kb) available for download at <http://www.ems.org/climate/pentagon.climate.change.html>
- Sharma, D. 2005. Outside view: Tsunami, mangroves and economy. (UPI Outside View Commentator). *Washington Times* <http://www.washtimes.com/upi-breaking/20050109-105932-8248r.htm>
- Shellenberger, M. and T. Nordhaus. 2005. Death of environmentalism: Global warming politics in a post-environmental world. *Grist Magazine*, 13 January <http://www.grist.org/cgi-bin/printthis.p1>
- Silverstein, D. 2005. A tidal wave of lessons learned- an ENN Commentary. *Environmental News Network* http://www.enn.com/today_PF.html?id=6926
- Speth, J. G. 2003. *Worlds Apart: Globalization and the Environment*. Island Press, Washington, DC.
- Speth, J. G. 2004. *Red Sky at Morning: America and the Crisis of the Global Environment*. The Yale University Press, New Haven, CT.
- Templeton, A. R., R. J. Robertson, J. Brissen, and J. Strasburg. 2000. Disrupting evolutionary processes: The effect of habitat fragmentation in the Missouri Ozarks. *Proceedings National Academy of Sciences* 98(10):5426-5432.
- Wiener, J. 2005. Chemicals, cancer, and history. *The Nation* 7 February. <http://www.thenation.com/doc.mhtml?i=20050207+s=weiner>.