

## THE BIOSPHERIC LIFE SUPPORT SYSTEM: A UNIFYING CONCEPT FOR ECOTOXICOLOGISTS AND ECOLOGISTS

John Cairns, Jr.  
Virginia Polytechnic Institute and State University, Blacksburg, Virginia,  
USA  
jcairns@vt.edu

The biospheric life support system, consisting of natural capital and the ecosystem services it provides, has maintained conditions favorable to the genus *Homo* for 2 million years and for *Homo sapiens* for 200,000 y. Maintaining the health and integrity of the biospheric life support system is central to the well being of humankind. Many threats jeopardize its integrity, including toxic substances, climate change, habitat destruction, and ecological overshoot. Natural capital and the ecosystem services it provides are the basis for all other forms of capital, so preserving their health is an act of enlightened self-interest.

All toxicologists know that increasing exposure to most chemical substances will elicit a response (usually deleterious). Humankind cannot afford a further deleterious response in the biospheric life support system (e.g., caused by increased greenhouse gas emissions). Monitoring is essential for ensuring maintenance of the health and integrity of natural capital and ecosystem services (Cairns 2002). However, gathering evidence (monitoring) is only half the solution—the other half is communicating the results and central issues to the general public and decision makers. With luck, enlightenment, or both, humankind will focus on the consequences of damage to the biospheric life support system, the depreciation of natural capital, and the diminished output of ecosystem services, all of which are central to the well being, and probably the survival, of *H. sapiens*.

Ecologists spend much time discussing the loss of biodiversity; however, because approximately one half of the world's human population lives in cities and nearby suburbs, most people in densely populated areas have little or no contact with truly natural systems. Political leaders and the citizens they represent are poorly informed about the scientific aspects of biodiversity, although some religions have been effective by urging protection of God's creatures as a moral and ethical imperative. However, if people also understood that biodiversity is essential to the maintenance and integrity of the biospheric life support system, their motivation to protect it might increase.

In the last 2 decades, much attention in the profession has been given to ecosystem services which, until recently, have been "free." Ecosystem services include such activities as maintenance of the atmospheric gas balance and water quality; pollination by insects, bats, and so on; and creation of topsoil. Of particular interest is the ecosystem service of the sequestering of carbon by trees, wetlands, soils, and tundra.

Carbon "sinks" can become carbon sources (e.g., burning forests and drying wetlands).

Biodiversity has changed markedly after the 5 great extinctions, but not necessarily to a mixture of species as likely to maintain conditions as favorable to humans as the present biospheric life support system. In short, humankind and the present biospheric life support system are closely linked. If Earth's temperature increases more than 2 °C, many species now alive will become extinct. Many of these extinctions will cause much human suffering because those species provide valuable ecosystem services.

The present preoccupation with economic growth, even after a global financial meltdown, distracts from the main goal of finding the best ways to use scarce resources both to meet human needs and to preserve the integrity of the biospheric life support system. Another important issue blocking protection of the biospheric life support system is the continual emphasis by distracters on uncertainty in science, as if uncertainty were not a major part of all politics, investing, and lifestyles.

Furthermore, the economic valuation of ecosystem services, which can now be used in cost-benefit analyses, could provide additional support for policies that protect the biospheric life support system. Obviously, disequilibrium in the biospheric life support system will increase the scarcity of many resources. Exponential human population growth will further reduce resources per capita, which increases the probability that future generations will be poorer than those living today. In a globalized world, the economic effects of resource depletion will travel rapidly. In addition, uninformed optimism misrepresents the degree to which technology can replace lost resources and services—some ecological effects will be irreversible. Ecotoxicologists should play a major role in protecting the biospheric life support system. If they do not, then other, less qualified people will fill their niche. Time is short and much work needs to be done. Being well grounded in the scientific and economic literature congruent with this undertaking will not be easy, but it is essential.

## REFERENCE

- Cairns Jr J. 2002. Monitoring the restoration of natural capital: Water and land as ecosystems. In: Younos T, editor. *Advances in water monitoring research*. Highlands Ranch (CO): Water Resources Publication. p. 1–31. (Out of print, but available online at <http://www.johncairns.net/Books/CairnsEsepBook.pdf>, Chapter 29.)