

Re: "A Noosphere", book review of "Pushing our Limits: Insights from Biosphere 2" by Dr. William Schlesinger

Dear Editor,

I appreciate that Biosphere 2 was acknowledged as an important experiment in integrating technosphere and biosphere towards the goal of a noosphere (Vernadsky's "sphere of intelligence" where humans learn to better manage our impacts). The harmonization of these elements has been a focus of Institute of Ecotechnics work for several decades before and after Biosphere 2.

H.T. Odum was a great ecological pioneer from whom I learned systems ecology, ecological engineering and the importance of doing science at many scales.

I attempted in the book to address attitudes towards science which favor small-scale (reductionist) approaches over larger scale (systems or holistic) science and the unfortunate animosity at times between the two approaches. Science needs to be done at all scales including innovative, multi-disciplinary research endeavors.

The goal of the farm system in Biosphere 2 was not just to feed the crew, but to develop non-toxic, non-polluting high production systems where nutrients and water are recycled.

The review asserts because there were no replicates to Biosphere 2, there could only be descriptions of what occurred and "strong inferences of cause and effect were impossible". That viewpoint is contradicted by the reviewer's acknowledgment that "descriptive work underlies nearly everything we know about global change ecology".

Scientific methods were used in Biosphere 2 to discover causal mechanisms and their impact on system functioning. Two examples: discovering the underlying processes and sequestration pools of the "missing oxygen" using isotope analysis (1). Later studies of the Biosphere 2 coral reef under experimentally manipulated CO<sub>2</sub> atmospheric concentrations were important predictors of the impact of global climate change on coral health and reproduction in the world's oceans (2,3).

These and other studies demonstrated that Biosphere 2 could be a potent research facility using the tools of many levels of science. Biosphere 2 was a unique laboratory that included complexity at *multiple levels* to experimentally study the whole integrated system, rather than studying each component in isolation.

We need science at all scales to help us deal with the urgent question of how to better understand the functioning of our biosphere. To be of relevance in our current ecological crisis, these should include people and our technologies, including farming, to find ways we can meet our needs without damaging - and better yet restoring - the health of the biosphere.

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Santa Fe, NM

1. Severinghaus JP, Broecker WS, Dempster WF, MacCallum T, & Wahlen M. Oxygen loss in Biosphere 2. EOS, Transactions American Geophysical Union 1994;75(3):33-37
2. Langdon C, Takahashi T, Sweeney C, Chipman D, Goddard J, Marubini F, Aceves H, Barnett H & Atkinson MJ. Effect of calcium carbonate saturation state on the calcification rate of an experimental coral reef. Global Biogeochemical Cycles 2000;14(2):639–654
3. Langdon C, Broecker WS, Hammond DE, Glenn E, Fitzsimmons K, Nelson, SG, Peng, TH, Hajdas J & Bonani G. Effect of elevated CO<sub>2</sub> on the community metabolism of an experimental coral reef. Global Biogeochemical Cycles 2003; doi:10.1029/2002GB001941.