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Preface

Biosphere 2—The Special Issue

As editor-in-chief of *Ecological Engineering*, I am pleased to introduce this 22-paper special issue (Marino et al., 1999) of our journal on Biosphere 2, the fascinating 1.25-ha (and up to 190000 m³) glass-enclosed mesocosm in the Arizona desert. This special issue, nicely edited by Bruno Marino of Harvard University and H.T. Odum of University of Florida, explores a new frontier of our new field of ecological engineering (Mitsch, 1993, 1998).

As early as 1993, we initiated discussions on the possibilities of a special issue of the journal on Biosphere 2, truly a mesocosm in the sense of Vernadsky (1929), Adey and Loveland (1991), Beyers and Odum (1993) and Kangas and Adey (1996). Biosphere 2 designers set out to construct ecosystems or biomes, not monocultures, in a heavily subsidized environment, save for the sun, 50% of which did penetrate the glass, and the soil that was trucked in. Pumps were needed for the hydrologic cycle, blowers for atmospheric movement, and even a 165000 m³ 'lung' to relieve the pressure that builds up in the glass enclosed system. More than 10 MW of electrical power generating capacity stood nearby. Ecosystems did flourish in the biomes, never turning out exactly as they had been planned, but always providing insight on their true analogs in nature. CO₂ concentrations soared and O₂ concentrations dipped during those first years, showing us the importance of plants, microbes, soil carbon, and even building concrete on the system's biogeochemistry.

This special issue of *Ecological Engineering* represents the most comprehensive assemblage yet of findings from Biosphere 2, findings that were subjected to a strong peer-review process. Topics range from calibrated models that describe the system metabolism, hydrologic balance, and heat and humidity, to rainforest, mangrove, ocean, and agronomic system development in this CO₂-rich environment. The current manager of Biosphere 2, Columbia University, has used the project to illustrate some of the consequences of a CO₂-rich environment in our own Biosphere.

The real point that resonates with me about Biosphere 2 is the shear magnitude of what it costs in money, material, and energy to create enclosed healthy ecosystems, not a trivial point if we are some day interested in habitation in space. Perhaps Costanza et al. (1997) undervalued nature—they estimated US\$33 trillion per year as the

public service functions for the ecosystems of planet Earth ($\$64000 \text{ km}^{-2} \text{ year}^{-1}$). Biosphere 2 operational costs and annualized construction costs, on the order of \$10 million per year, allow us to estimate the real cost of recreating planet Earth ecosystems on the order of $\sim \$10^9 \text{ km}^{-2} \text{ year}^{-1}$ if we had to do it from scratch. The ecological message of Biosphere 2 is clear—we should appreciate and try to understand the workings of the ecosystems in the Biosphere that we have. Biosphere 2 helps us do that in many ways.

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