

HORTI SELBYANI

BOTANICAL GARDENS AS HERALDS OF GLOBAL CHANGE

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Biodiversity used to be an obscure technical term. Now it is a household word coupled to a familiar message. I will wager that most people in the United States have heard about how we must catalogue species and conserve organisms and ecosystems. The acceptance of biodiversity into everyday language signals that many Americans realize that not all is right in our relationship with our planet. Environmentalists should view this development as an opportunity. We are, after all, facing an environmental crisis of unprecedented magnitude, and it is the electorate that ultimately decides whether U.S. public policy responds intelligently or not.

Now that we have the public's attention, what are those of us close to the action doing to win the hearts and minds of the individual voter? Is our argument as compelling and vigorous as it should be, given our knowledge and influence? Of more direct import, are we meeting our obligations as informed citizens, biologists, and people who help shape the missions and activities of botanical gardens? Are we crafting our case intelligently and advancing it vigorously enough to make a significant difference?

Advocates of support for inventorying and preserving biodiversity often cite links to human health to justify their requests for funds. Cures for major human illnesses, they say, await discovery among the unexplored elements of the global flora. Truth be told, fairly extensive surveys of tropical plants over the past decade have proven disappointing. Indeed, I am convinced that advances in molecular biology hold far greater promise for improved medicines than do undiscovered natural products in plants. Nor is the argument about aesthetics sufficiently compelling. *Homo sapiens* is remarkably adaptable, consistent with our gregarious nature. Witness the fact that junk food has become the preferred fare for millions of Americans. Similarly, landscapes such as New York City's Central Park and, worse yet, the near monoculture of the golf course, have become satisfying proxies for nature for countless residents of the United States. Finally, allusions to the centrality of biodiversity in crucial emergent qualities of natural ecosys-

tems (such as stability, resilience, and productivity) remain too controversial to cite as a reason to stop knocking pieces out of our global bio-support system.

If we hope to win the battle to preserve biodiversity, we need to wage our war against something much larger and more threatening—something uncomfortably palpable to the informed citizen. I look at the argument this way. Whether we like it or not, all of us are subjects in a massive, uncontrolled experiment that equals the phenomenon known these days in technical circles as “Global Change.” So what is global change, who is responsible for it, and how does it at once subsume and exceed the biodiversity issue? Moreover, why should realization that we are guinea pigs yet again cause serious concern? Humans manipulate each other daily; none of us is immune, nor in many instances do we seem to care. So why should complacency fostered by many years of material comfort and widespread ecological illiteracy be overridden now? And can it be overridden? The answer is simple enough; global change is the decisive challenge, with the highest stakes for us as well as the other millions of species that occupy this planet. This message must prevail.

The immediate driver of global change is our population's continuing, unsustainable growth, but the number of people, per se, is not causing the greatest problem. It is the desire of the less fortunate 90 percent of the existing 6 billion members of *Homo sapiens* to emulate the profligate life styles of the top 10 percent. Some of the consequences of full-borne human consumption that already extirpate species are fairly subtle, but others are starkly obvious. The most easily ignored mechanisms operate through climate change, nutritive supplementation, and introductions of alien species. Massive dissipations of natural capital in the forms of fossil fuel, topsoil, clean water, and species and ecosystems are not exactly on the public radar screen either. All of these phenomena and events and more constitute global change.

My point is this. Destruction of natural habitats by means of bulldozers and fire is not the

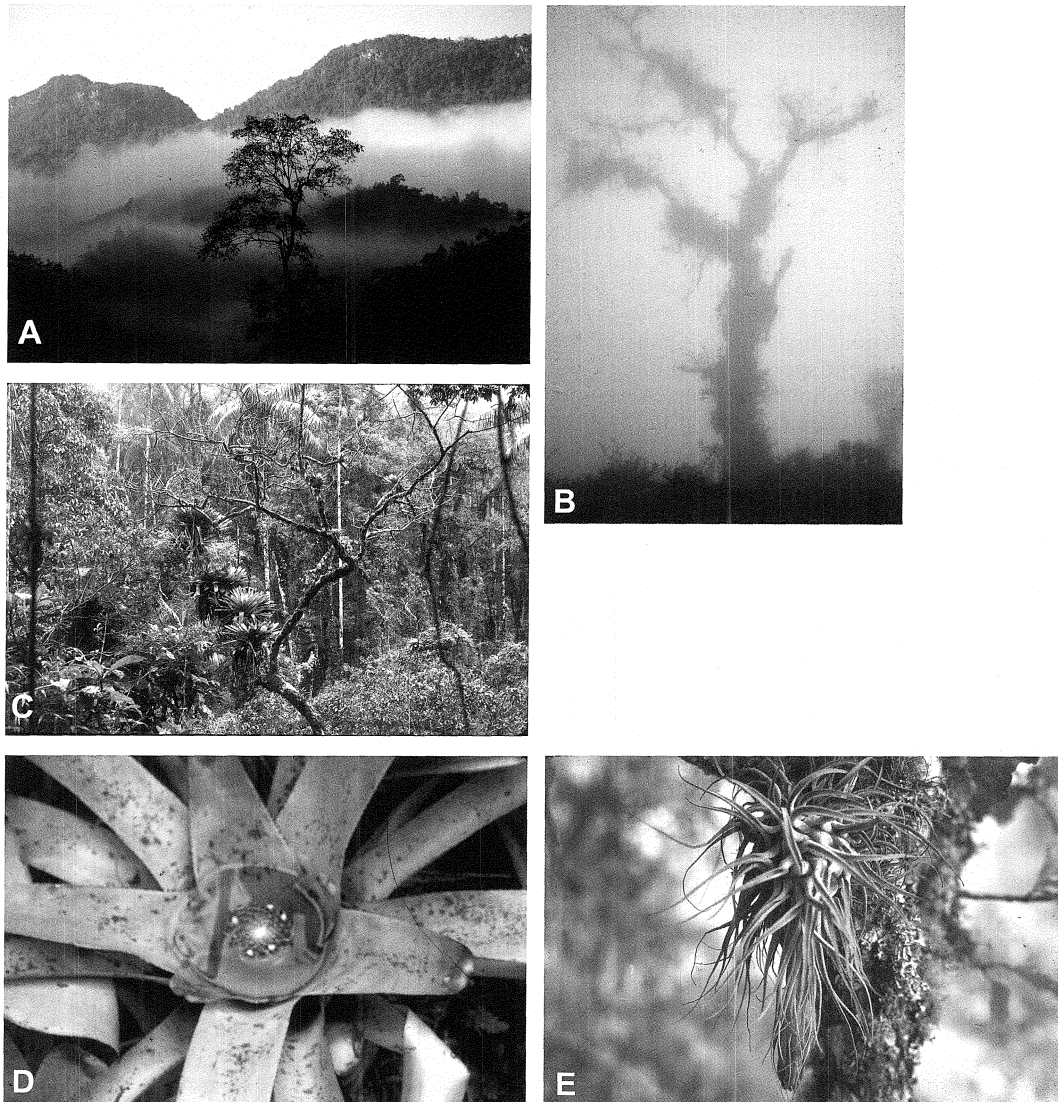


FIGURE 1. Epiphytes and their forest canopy environments illustrate the vulnerabilities of these plants to climate change. **A.** An early morning cloudbank regularly forms at the same elevation in montane forest. **B.** A tree that bears diverse epiphytes is enveloped by life-sustaining fog in a Costa Rican cloud forest; global warming may modify and shift locations of the narrow life zones with the necessary conditions for these drought-vulnerable epiphytes. **C.** The Atlantic Rain Forest in Brazil hosts bromeliads that depend on foliar “tanks” to maintain water balance and adequate nutrition. **D.** A *Neoregelia* specimen in the humid Atlantic Rain Forest is equipped with a tank shoot. **E.** *Tillandsia macdougallii*, native to cool semiarid pine-oak forests in Oaxaca State, Mexico, is unable to intercept enough moisture to rely on the tank strategy. Along with other epiphytic bromeliads in this region, *T. macdougallii* depends instead on water- and nutrient-absorbing foliar trichomes that, if wet too much of the time, suffocate the plant. Many tank-forming and all trichome-dependent bromeliads, as well as other epiphytes, practice CAM-type photosynthesis; but to maintain positive carbon and water relations, plants must operate within relatively narrow temperature ranges.

only agent eliminating species and ecosystems. Acid rain, enhanced deposition of reactive nitrogen, and wholesale introduction of alien species to vulnerable biosystems act as well. Short of

catastrophic habitat conversion, global change adversely affects flora in several ways, some more easily appreciated than others. The potential for a shift in the distribution of rainfall to

disrupt a biosystem is understandable enough, but what about the more subtle second- and third-order effects of altered climate and other components of global change? What about elevated CO₂ and its compounding influence as a fertilizer? What about the recent doubling of nutritive nitrogen in rainfall resulting from the combustion of fossil fuels?

Different plants respond differently to conditions such as chronic, low-level stress and over fertilization. Competitive and mutualistic interactions may shift along with susceptibility to disease and predation. Such changes enhance the success of some plant species and diminish the fortunes of others. Additionally, impacts on flora ripple through food chains affecting the welfare of animals as well. Plants—when provided more or less water, nitrogen, and CO₂ than the historic levels to which they adapted in the Darwinian sense—respond in disparate and unpredictable ways. Some genotypes, for example, respond by altering growth rates, water use efficiency, protein content of foliage, and aspects of body structure such as the ecophysiological influential shoot/root ratio.

You cannot expect to preserve biodiversity without doing substantial groundwork. Protecting biodiversity is just one of many related goals and probably not, in itself, a particularly achievable one, if success depends on convincing the public. Global change is a dangerous experiment, and one being conducted without public authorization, rational design, or responsible oversight. Biodiversity is only one of its potential victims. A lot more hangs in the balance than the fates of biological species of little apparent value to most people. Awareness of the threat to humans is what counts in this conservation.

So what can we as informed citizens, natural scientists, and persons responsible for running botanical gardens do about global change? All of us can demonstrate responsible behavior in our daily lives by reducing consumption and promoting sustainable uses of land, energy, and materials. Those of us with first-hand experience also can use our insights to strengthen the case for responsible public policy toward the environment. My work on the ecophysiology of vascular epiphytes during the past three decades has allowed me to appreciate the sensitivity to climate change of this major group of tropical plants. Epiphytes are, in a real sense, canaries in the mine—in this case, the tropical forest. The

rest of the scientific community needs to be made aware of this sensitivity through technical communications. Finally, those persons responsible for setting policy and running the Marie Selby Botanical Gardens are well positioned to more powerfully shape the discussion about global change.

Maintaining a beautiful landscape will always be a primary function for all botanical gardens. In addition, Selby Gardens has chosen wisely to support needed research on tropical vegetation, especially epiphytes. Selby Gardens should now step up the third and most crucial part of its mission by speaking louder and smarter about the need to deal responsibly with global change. The Gardens can do this by continuing to sponsor speakers on the environmental crisis and to develop related, more regular educational programs on this subject. The Gardens can become an even more positive force for the rational use of natural resources by constructing facilities and instituting practices friendlier to the environment than current convention. The Gardens, for example, should cite climatic neutrality as a goal in its master plan. Thoughtfully constructed facilities and wise operations will serve Sarasota well and also educate influential visitors from across the globe. Such a compelling opportunity to demonstrate intelligent use of our planet during the early stages of a global crisis will not come a second time.

ABOUT THE AUTHOR. David Benzing is the Robert S. Danforth Professor of Biology at Oberlin College in Oberlin, Ohio. A Selby Gardens adjunct Senior Scientist, he is a founding member of the *Selbyana* Editorial Board. His research includes the impact of orchids and bromeliads in tropical forests and the use of epiphytic bromeliads for monitoring air quality. He teaches plant systematics, ecology, evolution, and environmental science, and his students often assist in his research, many pursuing graduate biology degrees. Dr. Benzing has a B.A. in zoology from Miami University and a M.S. in biology and Ph.D. in botany from the University of Michigan. He is a leading author of books on epiphyte biology, and his monograph on bromeliads was published in 2000 by Cambridge University Press. This essay is based on a slide lecture delivered by the author at the Expeditions Seminar held in January 2001 to mark the Silver Anniversary of the Marie Selby Botanical Gardens.