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*Dedicated by former President John F. Kennedy at Grey Towers National Historic Landmark
to further Gifford Pinchot's forest conservation legacy.*

Invasive Species: Conserving Biological Diversity in Reunited Gondwanaland

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Protecting biological diversity in forested ecosystems is one of the greatest scientific and operational challenges in sustainable forest management. Yet forest managers may have been holding the key all along. Intensive forest management and forest plantations—done in the right ways, in the right places, and with adequate attention to offsite ecological, economic and social effects—could become one of our most useful tools for conserving biodiversity *and* sustainably meeting global wood needs.

The need to conserve biological diversity—and especially to protect habitat for threatened and endangered species—represents a fundamental challenge to sustainable forest management. Scientific uncertainty as to just where the limits of sustainability lie, and the degree of sensitive species' resilience to recover should these limits be exceeded, have resulted in a conservative approach to biodiversity conservation. In many instances, this precautionary approach regards even a modest level of human manipulation in the ecosystem as ex-

ceeding the limits of what can be sustained.

Zoologists and botanists who have studied speciation—the process by which plants and animals adapt to



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different environments and evolve new species—tell us that invasive species are in the process of greatly simplifying the world's ecosystems. At the end of the Paleozoic Era, some 250 million years ago, today's continents were joined in a single large landmass, referred to by scientists as

Gondwanaland. With few physical or climatic barriers, a relatively few plant and animal species ranged freely over this super continent, filling the available ecological niches. With the drifting apart of the continents, and the opening of vast new oceanic barriers to travel by terrestrial species, a multitude of new species evolved and diversified. Similar ecological niches in Asia, Africa, the Americas and most notably Australia were eventually filled by very different types of flora and fauna.

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Leadership in Forest Conservation Thought, Policy and Action



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The continents are physically no closer to one another today, of course, but in biotic terms they have been brought together by the extensiveness of human trade, "giving the animals and plants of the now separated continents access to their age-old corridors of dispersal" (Ward 2001). "The functional reuniting of Gondwanaland may take us back to a lower global biodiversity reminiscent of that bygone age." Considering just mammals, for example, biologists estimate that, had the continents remained together as they were at the end of the Paleozoic, we would have approxi-

mately 2,000 mammalian species, about half of what exists in the world today. It has also been estimated that the current transportation of mammals among the continents is leading to extinctions that will eventually have about the same result, approximately 2,000 mammalian species globally (Vitousek et al. 1996).

History may someday show that the critical turning point for global biodiversity came not during the Industrial Revolution, or even during the rapid expansion of human population and technology in the 20th

century, but with the 15th and 16th-century voyages of Columbus, de Gama, Vespucci and Cooke. Some scientists have postulated that global biodiversity peaked some time in the centuries immediately prior to the age of European exploration, and has steadily declined ever since (Wilson 2002).

The extent and rapidity with which we now travel and trade among continents introduces new organisms to continents and ecological niches

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ABOUT THE PINCHOT INSTITUTE

Recognized as a leader in forest conservation thought, policy and action, the Pinchot Institute for Conservation was dedicated in 1963 by President John F. Kennedy at Grey Towers National Historic Landmark (Milford, PA)—home of conservation leader Gifford Pinchot. The Institute is an independent nonprofit organization that works collaboratively with all Americans nationwide—from federal and state policymakers to citizens in rural communities—to strengthen forest conservation by advancing sustainable forest management, developing conservation leaders, and providing science-based solutions to emerging natural resource issues. Further information about the Pinchot Institute's programs and activities can be found at www.pinchot.org.

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separated eons ago. Some of these are aggressive, generalist species that outcompete native species, occupying the ecological niche and displacing them—e.g., cheatgrass, kudzu, or Scotch broom. Others are pathogens and pests for which native species are unprepared—e.g., chestnut blight, or gypsy moth. Local populations are decimated and are unable to re-establish themselves, clearing the way for more aggressive species—often alien invasives.

Forest ecologists are now finding that this is one of the most surprising and troubling after-effects of large scale wildfires. It is well established, of course, that periodic fires have long played an important and natural role in many forest types. Today, however, with the presence of hundreds of alien plant and animals species—many of them more aggressive and resilient than native species—the ecological outcome of wildfires is much different. Large-scale wildfires wipe the slate clean, and clear the way for invasives. The result is a species composition changed, perhaps forever, from that which was native. This has particularly serious implications for the habitat of threatened or endangered species, such as the thousands of acres of spotted owl habitat destroyed in Oregon's Biscuit Fire in 2001. In previous millennia, much the same late-successional habitat could be expected to develop over a century or two. Today, such an outcome is far less certain.

This may throw into question our entire approach to conserving biodiversity, and especially our current efforts at saving threatened or endangered species. Are our best efforts little more than momentary pauses in the march of species over the brink of extinction, pushed on by global forces now far beyond our control? Maybe, or maybe not, depending upon the species in question and its circumstances relative to alien invasives. Certainly human population

and its impact on the natural environment will continue to increase, and international commerce will become ever faster and more extensive. This will bring with it added responsibilities for sustaining natural systems, which ultimately what is necessary to sustain ourselves. According to some of the nation's leading conservation biologists:

Our activities are causing rapid, novel, and substantial changes to Earth's ecosystems. Maintaining populations, species, and ecosystems in the face of those changes, and maintaining the flow of goods and services they provide humanity, will require active management for the foreseeable future. There is no clearer illustration of the extent of human dominance of Earth than the fact that maintaining the diversity of "wild" species and the functioning of "wild" ecosystems will require increasing human involvement. (Vitousek et al. 1997)

The key to conserving biological diversity in the world's forest ecosystems may have two sides: the protection of large, undisturbed bioregions in which the pathways for penetration by alien invasive species is actively minimized; and intensively-managed plantations to meet global wood fiber needs from the smallest possible area, while relieving development pressures on those remaining large, native forests.

Concentrating a large share of wood fiber production in intensively managed plantations has potential negative ecological, economic and social effects, both on-site and off-site. These effects are relatively well understood, as are the technological and policy means for mitigating them. Similarly, there are potential negative effects associated with creating large-scale bioregions. But the ecological consequences of not taking both these steps are beginning to dawn on us. The effects are significant in scope

and intercontinental in scale, and we have neither the technologies nor policy mechanisms to effectively mitigate them.

The ongoing consolidation of the forest products industry worldwide, and the increasing shift of commodity wood fiber production to intensively managed plantations, are being driven by economic factors that are likely to become even more compelling in the decades ahead. Rather than reflexively opposing this trend in the forest industry, and the long-term global economic tides on which the forestry industry itself is but a small boat, perhaps it is time for conservationists to recognize that our best, most vital, and most urgent opportunity to conserve biodiversity may be to work with rather than against this trend, guide its future pathway using new science and improved policy, and turn what initially may have seemed to be a liability into one of our strongest assets for conservation.

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