Introduction

. . . In the United States, the ravages of imported insects injurious to cultivated crops, not being checked by the counteracting influences which nature had provided to limit their devastations in the Old World, are much more destructive here than in Europe.

The year was 1864, the book was *Man and Nature* (1864), and the author was George Perkins Marsh, one of the intellectual giants of the 19th century or any century. At the time, Marsh was the United States' ambassador to Italy, but he had been an observer of man's use and misuse of natural resources over much of his 63 years. His book, *Man and Nature*, was the definitive book of his century for arousing environmental sensitivity among the general public in the United States and Europe and specifically mentioned the threat of exotic pests when unfettered in a new environment. At the time of publication, exotic pests were not a visible threat to any forest tree species for notation in Marsh's book, but within one-half century the stalwart of eastern forests, American chestnut, would come under attack by an exotic fungus.

American chestnuts in southwestern North Carolina. Photograph courtesy of The American Chestnut Foundation (http://chestnut.acf.org/).

One hundred years before the publication of *Man and Nature*, American forests were free from exotic pests and thriving. Naturalist John Bartram journeyed into the Pennsylvania wilderness to investigate the flora and fauna. In his diary (Bartram, 1751), Bartram wrote about the different kinds of trees he observed during the journey. The most frequently encountered trees were white and black oaks, followed by eastern white pine, American chestnut, a tree that he called spruce but probably was eastern hemlock, hickory, sugar maple, American linden, pitch pine, elm, American beech, and white walnut or butternut (Hicks, 1997). What has happened to these tree species since that walk almost 250 years ago, is a national tragedy. Exotic pathogens and insects, sometimes referred to as alien, introduced, or non-indigenous pests, have devastated many of these species (*cf.* Campbell and Schlarbaum, 1994) [see the Gallery of Pests in this report]. The magnitude of impact exotic pests have wrought upon North American forests can be illustrated by listing the prominent tree species mentioned in John Bartram's journal against the exotic pests that have affected them (Table 1). Nearly every species has been attacked by an exotic insect, pathogen, or a combination of both. Some species have been virtually eliminated as an integral component of the eastern forest, *e.g.*, American chestnut, while other species are presently being extirpated, *e.g.*, butternut.

Bartram most often mentioned "white" and "black" oaks, which probably referred to species in two subgenera, *Leucobalanus* (white oaks) and *Erythrobalanus* (black or red oaks), within the oak genus. Oak species currently are the preferred food of the European gypsy moth, an insect that was intentionally imported into this country. Gypsy moth can annually damage millions of acres of northeastern and Lake State forests and is progressively spreading into central and southern hardwood forests. Eastern white pine populations have been heavily damaged by white pine blister rust, which was imported on diseased nursery stock. The American chestnut, once comprising 25 percent of the eastern hardwood forest (Kuhlman, 1978), has been essentially removed from bottomland eastern forests by ink disease from a soil-born algal fungus, *Phythophthora cinnamomi*, and upland eastern forests by the chestnut blight fungus. Where American chestnut once grew to over 150 feet in height, only short-lived sprouts now exist, coming from the root systems of long-dead stems. Eastern hemlocks, important to plants and animals in mountain riparian zones, are currently being eliminated by the hemlock woolly adelgid. Sugar maple and American linden are subject to severe defoliation by exotic thrips species. The American elm, that once shaded our streets and houses, was removed from urban and forest settings by Dutch elm disease, a disease brought to this country on elm logs imported from Europe. Beech bark disease complex, a combination of an imported scale insect and native and exotic fungi, has killed approximately 94 percent of the beeches in northeastern forests, reducing this once proud species to thickets of sprouts. A once valuable hardwood species, butternut, is being eliminated from eastern forests, as butternut canker disease moves from southern forests into the Lake States, New England, and Canada.

Table 1. Frequency of species observed by naturalist John Bartram in a 1751 trip through Pennsylvania (from Hicks, 1997).

Species	No. Times Mentioned	Exotic Pest
White and black oak[1]	25	European gypsy moth
White pine	12	White pine blister rust
Chestnut	10	ink disease Chestnut blight Chestnut gall wasp
Spruce (=Hemlock)	10	Hemlock woolly adelgid
Hickory	8	-
Sugar maple	8	Pear thrips Asian longhorned beetle
American Linden (=American basswood)	7	Basswood thrips
Pitch pine	7	Pine shoot beetle
Elm	6	Dutch elm disease
American beech	6	Beech bark disease complex
White walnut (=Butternut)	6	Butternut canker

Exotic pests have been damaging American forests for over 150 years. Many exotic pests have arrived in this country on shipments of diseased nursery stock or on logs that were not properly sanitized. There are other avenues of importation, however, as shown by the recent arrival of Asian gypsy moths on ships transporting grain to the Pacific Northwest and military equipment to the South (Campbell and Schlarbaum, 1994). Some pests are species specific, *e.g.*, butternut canker kills only butternut trees, while other pests attack a broad range of species, *e.g.*, gypsy moth feeds on over 300 different plant species. Currently, there are estimated to be over 20 harmful exotic pathogens and 360 harmful exotic insects known to attack trees and shrubs in the United States (Mattson *et al*., 1994; Liebhold *et al*., 1995).

In general, eastern forests have been more heavily impacted by exotic pests than western forests. The East was colonized earlier by Europeans, and a number of intercontinental trade routes were established long before western trade routes were developed. Additionally, eastern forests generally are more diverse than western forests, with the exception of California, thereby providing more opportunities for establishment of pests to feed on closely related host species. Western forests have not been spared; white pine blister rust has severely damaged western white, sugar, whitebark, and limber pines. A root disease has decimated populations of Port-Orford-cedar. More recently, sudden oak death, a stem and branch disease, has killed more than 100,000 trees belonging to a number of oak species found in California and southern Oregon (http://camfer.cnr.berkeley.edu/oaks/). Exotic pests will likely increase in the future due to rising imports from formerly closed countries such as Russia and China, and importations of wood products (USDA Forest Service, 1991, 1992b, 1993). Northern, southern, and Pacific Coast forests are all near numerous ports-of-entry and correspondingly have a high potential for the introduction of new pests when compared to the Inland West and Alaska.

There is a stark contrast between the forests, swamps, and prairies viewed by John Bartram and other early naturalists/explorers, such as William Bartram, Lewis and Clark, and Edwin James, and their present appearance. The assault of agriculture, the industrial age and associated pollution, and urban sprawl on the American landscape have too often left the natural ecosystems that once graced the landscapes in a struggle for survival or identity. Yet the human race ***does*** share the planet with the fauna and flora, and the continued existence of all is intertwined. Studies have shown the resilience of plant and animal populations to rebound after being pushed to the brink of

[1]Latin names of trees and pests mentioned in this report appear in Appendix 1.

extinction. However, resilience ultimately depends upon the existence of surviving populations with enough genetic diversity to initiate successfully the rebuilding process. Therein lies the threat of exotic pests to North American ecosystems: the extirpation of host species that lack resistance to insects and pathogens that have evolved in isolation from these pests.

The overall impact to the ecosystem, however, is not limited to the host species; associated plants and animals also are affected. Each of the widespread pest infestations has permanently altered forest landscapes in terms of plant and animal species composition. In the eastern forests, the loss of American chestnut to the exotic chestnut blight fungus probably drastically reduced populations of black bears and turkeys (Pelton, personal communication). Reductions in whitebark pine populations due to white pine blister rust (another exotic fungus) have impacted grizzly bear and Clark's nutcracker populations in western forests (Kendall and Arno, 1989). According to Ledig (1992), "Introduction of exotic diseases, insects, mammalian herbivores, and competing vegetation has had the best-documented effects on genetic diversity [of forest ecosystems], reducing both species diversity and intraspecific diversity." The impact of forest exotic pests on North American forests has been greater than other more widely publicized, human-caused factors, including forest fragmentation, changed demographic structure, altered habitat, and pollution, which have been commonly ascribed to cause decline in health and integrity.

The Public and Biological Pollution

Exotic pest outbreaks have periodically concerned the American public. The devastation of American chestnut in eastern forests, white pine blister rust affecting five-needle pine species, the loss of American elms, and more recently, maples along city streets due to Dutch elm disease and the Asian longhorned beetle, have raised public awareness. However, in these instances the awareness was species specific and usually only for the duration of local devastation. This ambivalence toward exotic pests, coupled with no or limited inspections and quarantine of imported wood, logs, and wood-based packaging until the mid 1900s, has allowed occasional entry of exotic species. Heavy gypsy moth infestations occasionally aroused a public outcry in the areas affected, but overall neither the public nor elected representatives have been aware of the widespread impacts of a multitude of exotic pests on forest ecosystems. A glimmer of awareness came in 1977 when President Carter signed Executive Order 11987. This order instructed federal agencies to use their existing authorities to "restrict" the introduction of exotic species to natural ecosystems and encouraged the states to do likewise. The Carter Administration did not follow through aggressively, however, and interest waned completely with the change of Executive Branch administrations.

Public awareness of the exotic pest problems, in a general rather than species-specific sense, began to increase following the 1993 publication of *Harmful Non-Indigenous Species in the United States* by the Office of Technology Assessment (OTA report), which summarized the extent of exotic pest damage and costs to native ecosystems (OTA, 1993). In 1994, we wrote *Fading Forests: The Threat of Exotic Pests to North American Forests*, to inform the American public about the impact of exotic pests on forest ecosystems and the threat of introduction of additional pests—primarily through the importation of unprocessed logs. Unfortunately, few earlier publications linked resident exotic forest pests, recent introductions, or the growing risk of future harmful introductions with the rapid growth of international trade and associated trade agreements that have outstripped phytosanitary safeguards and resources.

Subsequently, there has been an increasing attention to ecological and economic damage caused by invasive exotic species (=exotic species whose introduction does, or is likely to, cause appreciable ecological or economic damage). Books have been published by The National Geographic Society (Devine, 1998), Worldwatch Institute (Bright, 1998), and Island Press (Cox, 1999; Mooney and Hobbs, 2000; Van Driesche and Van Driesche, 2001); reports have appeared in technical journals and books (Wilcove *et al*., 1998; Westbrooks, 1998; Schlarbaum *et al*., 1999; Pimentel *et al*., 2000; Campbell, 2001); influential articles have been published by the general media in magazines and newspapers such as *Harpers, Newsweek, Time, The Washington Post, the Chicago Tribune,* and *The*

New York Times. Most of the publications on invasive species since the OTA report, however, have given relatively little attention to the impact of exotic pests on forests. For example, native tree species essentially eliminated from the forest, such as American chestnut, or reduced in number throughout their ranges or in portions of their ranges are not included in statistics upon which are based statements that invasive species threaten 49 percent of America's "imperiled" species (Wilcove *et al*,.1998).

In response to the increased concern over biological pollution, President Clinton issued Executive Order 13112 on February 3, 1999, establishing a National Invasive Species Council (NISC) to formulate a national strategy (Appendix 2); a strategy we called for in the terminal essay of our 1994 paper. Over the next two years, the NISC, the Invasive Species Advisory Committee, and supporting technical committees met and developed the National Invasive Species Management Plan (National Invasive Species Council 2001, http://www.invasivespecies.gov/council/nmp.shtml). The National Plan set target dates for federal agencies to begin a coordinated effort to address the many facets of biological pollution, including exotic forest pests.

Environmental Concern About Exotic Forest Pests

The latter decades of the 20th century saw unprecedented growth in private citizen groups concerned with the environment, in particular forest ecosystems. Many of the issues pursued by these groups reflect public interest and concern. Yet these groups' concern has not extended to exotic forest pest problems, which is puzzling. We believe that various contributing factors are responsible for the public's ambivalence:

1) The filling of the host species niche with other arborescent species. The host species disappears, but the gap is rapidly filled by other tree species. Many people do not discern individual tree species, but rather just see a forested landscape.

2) The tendency, with a species-specific exotic pest problem, to view loss from a single species perspective, rather than the initiation of a cascade of ecological effects that will affect flora and fauna dependent upon or associated with the host species.

3) The lack of appreciation of the cumulative impacts of established and newly introduced exotic pests on the forest ecosystem.

4) The minimal involvement of forest tree pest experts in policy formulation at the political level as compared to pest experts representing agricultural and horticultural commodity groups. There are a limited number of tree species, *e.g.*, Douglas-fir, southern yellow pine, and western white pine, that are regionally important to timber or pulp companies and private landowners. When problems with these species occur, then there is a broad base of support for solutions, both political and biological. A good example is the $13 million allocated in 2001 for restoration of southern yellow pines to lands that have been devastated by the native southern pine beetle. Butternut, eastern hemlock, and American beech command no such lobbying efforts, as they are comparatively minor commodities.

5) A lack of awareness of the impact of new international trade agreements on government's ability to protect our forests from new introductions.

6) General ignorance of the types and quantities of imports that serve as pathways of introductions: wood products, wood packaging, and horticultural plants.

This apparent lack of public interest needs to be rectified if forest pests are to receive a meaningful "share" of the increasing allocations of resources to combat invading exotic species. Solutions to the difficult scientific and policy problems that expose our forests to ever-greater damage from established and newly introduced pests will become more expensive and less feasible the longer the problem is ignored. Additionally, there is good evidence to

believe that the exotic forest pest problem will be much worse in the future.

Recent and Potential Problems

Our forests remain vulnerable, as is demonstrated by recent introductions of new exotic pests and the spread of native pests to previously isolated areas, *e.g*., eastern forest pests appearing in western forests, and an increase in host range of established exotic pests. Additionally, the "shrinking world," in terms of international trade, will only exacerbate this problem. We describe here briefly examples of these new threats to North American forest integrity; for more detail, see the Gallery of Pests.

Recent Introductions

Common (or larger) pine shoot beetle. The common (or larger) pine shoot beetle was first discovered in July 1992, near Cleveland, Ohio (Kucera, 1992). It entered the country on solid wood packing material (SWPM). Despite the United States Department of Agriculture, Animal and Plant Health Inspection Service's (USDA APHIS) 1995 regulations governing SWPM, this beetle continues to be detected on shipments (USDA APHIS and Forest Service, 2000). Established populations of this pest are spreading despite APHIS' restrictions on the movement of potentially infested material; the species is now found in 11 states and 2 Canadian provinces (USDA APHIS and Forest Service, 2000). The pine shoot beetle has the potential to cause billions of dollars in damage when it reaches southern pine plantations and western forests; it could severely damage lodgepole pine, the most common tree in the northern Rocky Mountains (Thomas Hofacker, USDA Forest Service, personal communication, 1999).

Common shoot beetle adult in damaged shoot. Photograph courtesy of Steve Passoa, USDA APHIS PPQ (http://www.bugwood.org)

Asian longhorned beetle. The Asian longhorned beetle has repeatedly entered North America (USDA APHIS and Forest Service, 2000), resulting in establishment of nine separate infestations in the Chicago and New York areas by the end of 2000. The species has been observed to feed on a variety of hardwood species, but prefers maples.

Asian longhorned beetle adult. Photograph courtesy of Kenneth R. Law, USDA APHIS PPQ (http://www.bugwood.org)

In an attempt to eradicate the Asian longhorned beetle, federal, state, and local officials had destroyed nearly 5,800 trees in New York and Chicago at a cost of approximately $25.1 million by March 2000 (USDA APHIS and Forest Service, 2000). USDA APHIS has estimated that the establishment of Asian wood-boring insects belonging to this and related genera could, if left unchecked, cause $41 billion in losses to forest products, commercial fruit, maple syrup, nursery, and tourist industries in the Northeast (USDA APHIS, 1998d). Nationwide, Asian longhorned beetle damage to urban trees could reach $669 billion (Nowak *et al*., 2001).

If the Asian longhorned beetle becomes established in North American forests, it has the potential to alter North American ecosystems across the continent. The impact would probably change dominant species composition and age structure in hardwood forests, particularly forests composed largely of maple and poplars, *ca*. 48 million acres primarily from New England to the Great Lakes (USDA APHIS and Forest Service, 2000). USDA scientists predict that the impact of Asian longhorned beetle will exceed that of any insect, including the European gypsy moth (Kucera, 1996).

Asian longhorned beetle larvae and damage in tree. Photograph courtesy of Larry R. Barber, USDA Forest Service (http://www.bugwood.org)

Increased Host Range for Established Exotic Pests

White pine blister rust. In the Western states, white pine blister rust has been found in one stand of limber pine in the central Rocky Mountains. Limber pine is a five-needle pine species that is not commonly harvested for timber or pulp, but it is a common component of western forest ecosystems. Devastation of this species would have significant impacts on the structure and function of these ecosystems as well as to recreational use of the forests.

White pine blister rust canker on young eastern white pine. Photograph courtesy of Minnesota Department of Natural Resources Archive (http://www.bugwood.org)

Spread of Native Pests to Previously Isolated Forest Ecosystems

Pine pitch canker. The pathogenic fungus pine pitch canker is native to the southeastern United States, Mexico, and Haiti. Introduced into California, it is killing the narrowly endemic Monterey (=*Radiata*) and Torrey pines. The fungus might also cause serious damage to "[a]ll economically important native pine species" in California (USDA Forest Service, 1998a).

Possible Introductions of Exotic Forest Pests

Sudden oak death syndrome. Since 1995, a newly described pathogen (Werres *et al*., 2001) , *Phytophthora ramorum*, has been detected in the coastal hardwood forests of California and more recently, in southern Oregon. The disease has killed more than 100,000 oak trees in 10 coastal Californian counties. Major eastern oaks, particularly northern red and pin oaks, are also vulnerable (David Rizzo cited in Mary M. Woodsen, "If Oak Malady Moves East, Many Trees Could Die," *New York Times,* September 4, 2001). The sudden oak death pathogen attacks a wide variety of plants in addition to oaks (Werres *et al*., 2001; Rizzo et al., 2002), including rhododendrons, madrone, evergreen huckleberry, and California buckeye. To date, no solution to sudden oak death has been found.

Symptoms of sudden oak death disease on tanoak. Photograph courtesy of Joseph O'Brien, USDA Forest Service (http://www.bugwood.org)

Sudden oak death disease on coast live oak. Photograph courtesy of Joseph O'Brien, USDA Forest Service (http://www.bugwood.org)

Vulnerable oak species are distributed along 1,500 miles of the California and Oregon coasts; some are the dominant hardwood in large areas, growing in nearly pure stands in some forests. In the East, red and pin oaks dominate forests covering a combined range from northeastern Texas to Nova Scotia. These species provide habitat and acorns to a wide variety of wildlife. If the disease continues to spread, it will alter forest composition with significant implications for wildlife habitat and food chains. Additionally, the dead trees could pose a serious fire hazard in some areas.

While no one yet knows where the sudden oak death pathogen originated, evidence suggests introduction on rhododendrons imported from Europe. The pathogen was previously only known from Europe on rhododendron and *Viburnum* species until discovery on oaks and other species in California (Rizzo *et al*., 2002). Additional studies are needed to determine the true origin and vectors for this extremely dangerous disease.

Damage from European spruce bark beetle larvae. Photograph courtesy of William M. Ciesla, Forest Health Management International (http://www.bugwood.org)

Pests With an Increased Probability of Introduction and Establishment

European spruce bark beetle adult. Photograph courtesy of Steve Passoa, USDA APHIS PPQ (http://www.bugwood.org)

European spruce beetle. The European spruce beetle is found across Europe and Asia (USDA APHIS and Forest Service, 2000), where it causes considerable damage. This beetle is one of the most commonly detected pests travelling on SWPM, even after adoption of the 1995

regulations intended to prevent introductions of bark-associated insects (USDA APHIS and Forest Service, 2000). Several times, the beetle has been found in dunnage or warehouses after escaping detection by inspectors (Hofacker, 1993, LaGasa *et al*. 1997, USDA APHIS and Forest Service, 2000); the pest has apparently been eradicated before it became established. The European spruce beetle carries various fungi, some of which can be extremely pathogenic. If introduced beetles were accompanied by a virulent fungus, and native beetles also spread the fungus, "It could . . . be as disastrous to North American spruce as the Dutch elm disease was to elms" (USDA Forest Service, 1991).

Woodwasp-*Amylostereum* complex. The woodwasp *Sirex noctilio* and associated fungus *Amylostereum areolatum* are native to Eurasia and North Africa (USDA APHIS and Forest Service, 2000) and have been introduced in New Zealand, Australia, and South America (USDA Forest Service, 1992b). This insect-disease complex would threaten any pine in the "lower 48" states, especially Monterey pine and loblolly pine, as plantations of these species growing in foreign countries have been damaged (USDA APHIS and Forest Service, 2000). There is a high likelihood that wood wasp larvae will be in SWPM or other wood articles shipped from both its native and introduced ranges; the insect is commonly intercepted by APHIS inspectors. The wasp can spread rapidly by natural means (USDA Forest Service 1992b). However, an efficient biocontrol agent has been identified (USDA APHIS and Forest Service 2000).

European wood wasp adult female. Photograph courtesy of William M. Ciesla, Forest Health Management International (http://bugwood.org)

Mortality in pine plantations in Europe due to the European wood wasp. Photograph courtesy of William M. Ciesla, Forest Health Management International (http://www.bugwood.org)

Asian gypsy moth. The Asian strain of the gypsy moth, which belongs to the same species as the European gypsy moth, feeds upon more than 500 species of plants (USDA APHIS and Forest Service, 2000), including many conifers and hardwood species. Unlike the European strain, the female Asian moths have the ability to fly up to 40 miles (USDA Forest Service, 1991), and thereby would greatly accelerate dispersal and colonization. The Asian gypsy moth has been introduced to Europe and has reached North America several times as egg masses on ships. Each time, emergency control programs have apparently succeeded in eradicating the moth. New introductions of Asian gypsy moth appear inevitable; infestations would probably be extremely difficult to control.

Gypsy moth females laying egg masses. Photograph courtesy of William M. Ciesla, Forest Health Management International (http://www.bugwood.org)

The Costs of the Exotic Forest Pest Problem in North American Forest Ecosystems

The devastating impacts of exotic fungal pathogens and insects that attack trees and woody shrubs in the United States have been described by numerous sources (USDA APHIS, 1997; Niemela and Mattson, 1996), including in our first report (Campbell and Schlarbaum, 1994). Pimentel *et al*. (2000) estimate losses and costs associated with established forest pests introduced to North America at $4 billion annually. As previously mentioned, the impacts of exotic pests extend beyond their host species to flora, fauna, and sometimes the environment associated with the host. The true environmental and economic costs of forest damage by exotic pests is difficult to assess (*cf*. Oliver *et al*., 1997). Estimation of lost commodity values is easier than for non-commodity values. For example, lost timber revenues from exotic pest damage can be estimated. In contrast, how can a monetary figure be assigned to the loss of the aesthetic value of a mountain stream when the surrounding hemlocks die from hemlock woolly adelgid feeding?

Studies and risk assessments have shown the high level of damage that insects and fungal pathogens from forests or plantations in Europe, Mexico, Asia, or several countries in the Southern Hemisphere could potentially cause if introduced into the U.S. (USDA Forest Service, 1991, 1998a; Campbell and Schlarbaum, 1994; Niemala and Mattson, 1996; USDA APHIS, 1998c; USDA APHIS 1998d; USDA APHIS and Forest Service, 2000; USDA Forest Service, 2001). While technical tools for preventing introductions have improved, increased volume of trade and more rapid transport together provide increased opportunities for exotic organisms to reach our shores. Alarmingly, policy decisions focused on expanding international trade have already led to relaxation of phytosanitary safeguards and threaten further weakening despite the heightened risk.

What is at risk from a human perspective? Forests are valued in different ways; probably each individual treasures forested land from a unique perspective. Public debates over forest use illustrate just how differently people value forests and, unfortunately, how people can ascribe only a narrow set of values to a natural resource. We believe that the general public tends to view many exotic forest pest problems as "single issue" problems, *e.g.*, the Fraser firs are dying, and do not realize the niche each species fills in the ecosystem. For example, the loss of the American chestnut is widely bemoaned; however, little is said about the corresponding loss of mast for wildlife and habitat that the chestnut provided. Oliver *et al*. (1997) divided health-related forest values into two general categories: 1) values expressed as condition and function of the forest; and 2) values provided by the forest. The condition and function of the forest are important to many people. A forest that is relatively free from exotic pests protects the associated watershed and site, and sequesters carbon is very desirable. In addition, the forest is valued for commodities, recreational opportunities, and historical, cultural, and/or spiritual values. We believe that if the general public would think more broadly about the role each host species plays in the forest ecosystem, concern levels for forest health and integrity will rise.

Since we wrote *Fading Forests*, a scant eight years ago, we have increasingly recognized the relationship between world trade policy and a rising likelihood of introduction of exotic pests. We believe that economic globalization (international trade) is the principal cause of exotic species introduction into North American ecosystems—that unless significantly different, more effective, phytosanitary policies are implemented, increases in trade will be paralleled by increases in exotic pest problems. While the challenges posed by established and future exotic forest pest problems are varied — ranging from policy and the mechanics of prevention, eradication, and control to restoration of lost species and damaged ecosystems—it was the changes in international trade policy that prompted us to update our earlier paper. We seek, in this second edition, to inform the general public of the potential ramifications of these policy changes on prevention of exotic pests from entering this country. Correspondingly, much of this report will focus on international trade agreements and the provisions within these legally binding agreements that weaken our country's ability to defend against pest introductions. The report will also examine the weaknesses in federal laws, regulations, and policies that govern exclusion, quarantine, eradication, and control of exotic pests. Finally, given the increased public exposure of exotic pest problems and the establishment of the National Invasive Species Council, we expanded our discussion to suggest a comprehensive strategy to protect our natural heritage from destruction.