# Invasive Species: A Growing Concern

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## Abstract

A large — but unknown — number of alien species have become established in ecosystems across the United States, where some are causing serious damage. Forests of the Northeast have been particularly impacted by exotic species ranging from insects to starlings, and from herbaceous plants to pathogens. Government trade policies exacerbate the threat of new introductions. Funding shortfalls hamper an effective response to established pests. Scientists, forest managers, and other concerned people can help rectify these problems.

**Keywords:**
Alien species, exotic species, government policy, forest pests.

## Why is Concern Increasing?

Invasive species are the subject of increasing concern for several reasons:

* There is increasing awareness of the environmental and economic damage they cause;

* Thereare increasing numbers of introduced species, with the prospect of even greater numbers in the future, due to rising volumes of imports, new source countries, and human disturbance (from local fragmentation of all types of biomes to global climate change) which all facilitate invasions (Mooney and Hobbs 2001);

* Thousands of introduced species already present in the country continue to spread, resulting in higher levels of damage.

In a review of the status and trends of America's biological resources, the U.S. Geological Survey called bioinvasion "an ecological holocaust of major proportions" (U.S. Department of Interior 1998).

Thomas Ledig (1992) has written "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." Their impact has been

greater than that of other, more widely recognized, human-caused factors, including forest fragmentation, changed demographic structure, altered habitat, pollution, and favoring of certain "domesticated" species of trees.

Jerry Franklin has said (*Rocky Mountain News*, November 19, 2001, letter to the editor) "forest pest and pathogen introductions from other continents . . . represents (sic.) the greatest single threat, bar none, to the integrity of our natural and managed forests and all of the related biodiversity."

Scientists at Cornell University have determined that introduced species cost the nation $137 billion per year. While forest pests contribute a paltry $4 billion to that total (Pimentel et al. 2000), it is probable that the damage to natural ecosystems is incalculable (Mack et al. 2002).

The numbers of invasive species introduced into the United States, the extent of the area invaded, and the overall impact of these species are all undetermined. Some data have been compiled for certain categories, but all must be considered to be lower limits, since additional species or infestations of known species remain undetected. Scientists have recorded the presence of between 2,000 and 4,500 exotic insects and more than 200 alien plant pathogens in the United States. One-third of the exotic insects and 91% of the exotic pathogens are known to have harmful effects. Of these invaders, about 20 exotic insects and 10 of the plant pathogens have become serious pests in North American forests (Pasek et al. 2000).

The forests of the Northeast and Midwest (Forest Service Region 9) have probably suffered the most severe damage from these exotic insects and pathogens. More than 70% of the 165 million forested acres in the region are made up of forest types vulnerable to chestnut blight (*Cryphonectria parasitica*), Dutch elm disease (*Ophiostoma ulmi* and *O. novo-ulmi*), European gypsy moth (*Lymantria dispar*), dogwood anthracnose (*Discula destructiva*), and beech bark disease (*Cryptococcus fagisuga* and fungi in the *Nectria* genus). Add to these the subject of this week's meeting, hemlock woolly adelgid (*Adelges tsugae*).

Approximately 4,000 exotic plant species are growing outside cultivation in the United States (U.S. Department of Interior 1998; Kartesz 1999). This represents between 21 to 26% of the nation's flora (U.S. Department of Interior 1998). My inquiries have identified more than 500 exotic plant species as being serious invaders within the contiguous 48 states; many additional species are invasive in Hawaii or other tropical regions of the country.

Three states — California, Florida, and New York — are home to more than 1,000 exotic plant species. Connecticut, Delaware, Hawaii, New Jersey, and Pennsylvania are each inhabited by more than 750 exotic plant species (U.S. Department of Interior 1998). Exotic species constitute about one-third of the flora in New England, New York, and Pennyslvania (Rejmanek and Randall 1994).

I have estimated that the total area invaded by exotic plants is larger than the state of Texas (267,000 square miles). Most of the data on the extent of invasions pertains to grasslands and wetlands; few are available for plants that invade forests, although anyone walking in the woods of the mid-Atlantic or Northeastern states can confirm that exotic plants have penetrated a high

proportion of these woodlands. Unpublished forest inventory data from the Forest Service Southeastern Region (Region 8) demonstrated that by the early to mid-1990s, Japanese honeysuckle (*Lonicera japonica*) was present on 19% of interior forest plots, which represented more than 16 million acres of forested land in the five coastal southern states from Virginia to Georgia. Privet (*Ligustrum* spp.) was present on three percent of the plots, representing 2.4 million acres.

New threats from exotic species continually rise to attention. Among pests discovered in the 1990s that threaten forests of the mid-Atlantic and Northeastern states are the Asian longhorned beetle (*Anoplophora glabripennis*), pine-shoot beetle (*Tomicus piniperda*), and smaller Japanese cedar longhorned beetle (*Callidiellum rufipenne*). We also must be watchful for the brown spruce longhorned beetle (*Tetropium fuscum*), citrus longhorned beetle (*Anoplophora chinensis*), and Sudden Oak Death (*Phytophthora ramorum*).

Plant pests are not the only troublesome bioinvaders. Introduced starlings (*Sturnus vulgaris*) and house sparrows (*Passer domesticus*) have damaged populations of cavity-nesting birds, including bluebirds (*Sialia sialis*). Early indications are that the European paper wasp (*Polistes dominulus*) also may outcompete the bluebird for nest boxes (Eugene Morton personal communication,). West Nile virus (*Flavivirus genus*) could have major impacts on a wide range of bird populations. According to John Maerz of Cornell University, introduced earthworms are altering food webs and nutrient cycling in many forested areas. House cats and introduced sport fish are preying on native wildlife.

**Despite Rising Attention from Government, Progress Remains Uneven**

In recent years, the federal government has given increased attention to the invasive species challenge. In so doing, the government is responding primarily to economic losses suffered by western cattle ranchers and water users. The rising concern within the scientific community — including scientists employed by federal agencies — has contributed significantly, as well. As a result, President Clinton's Executive Order 13112 was issued in February 1999, and the first version of an invasive species management plan, called Meeting the Invasive Species Challenge, was released in 2001 (both can be accessed at http:\\www.invasivespecies.gov). Members of Congress have held hearings, introduced legislation, and requested reports from the General Accounting Office[1] and Congressional Research Service (Corn et al. 1999) — to look at various aspects of bioinvasion.

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[1]U.S. General Accounting Office. Report to Congressional Committees. Agricultural Inspection: Improvements Needed to Minimize Threat of Foreign Pests and Diseases. May 1997. GAO/RCED-97-102.
U.S. General Accounting Office. Report to Congressional Committees. Invasive Species. Federal and Selected State Funding to Address Harmful, Nonnative Species. August 2000. GAO/RCED-00-219.
U.S. General Accounting Office. Invasive Species: Obstacles Hinder Federal Rapid Response to Growing Threat. August 2001. GAO-01-724.

Nevertheless, progress has been slow and uneven. On the positive side, funding has increased for some programs, particularly the prevention/exclusion programs administered by the U.S. Deptartment of Agrigulture (USDA), Animal and Plant Health Inspection Service (APHIS). Between fiscal years 2000 and 2001, APHIS funding increased by almost $242 million, from slightly below $556 million in FY 2000 (GAO 2000) to $798 million (National Invasive Species Council, unpublished data). I am not convinced that these increases are being spent in the most effective way. APHIS continues to expand its staff of border inspectors, whereas I believe the agency should instead focus on regulations aimed at sterilizing entire introductory pathways — a concept called by some "integrated vector management" (Carlton and Ruiz, in press). Pathway sterilization should be supplemented by aggressive and rapid responses to those species that evade border controls.

APHIS continues to neglect plant pests that threaten forests and other natural systems as contrasted with agricultural crops. In 2000, APHIS devoted just 10% of its "rapid response" funds to pests threatening forests; nearly all was spent on Asian longhorned beetle eradication. Part of the problem is that the Congress has not funded APHIS' request for additional funds to work on "invasive species" (as distinct from agricultural pests) (GAO 2001). Only more vocal demands from scientists and organizations concerned about forest pests can change this imbalance.

Unfortunately, no other agency is authorized or funded to cover the gaps left by APHIS. One such gap is the absence of federal regulations restricting the movement of nursery stock, bark, or soil that might transport Sudden Oak Death from infestation sites in California, Oregon, or Europe (where the pathogen also is found). This pathogen has killed more than 100,000 oak trees in seven counties in California (http://conifer.cnr.berkley.edu/oaks/). A preliminary estimate of treatment costs, research, lost business/opportunities, etc. associated with Sudden Oak Death — first detected in the mid-1990s — is more than $20 million (Susan Frankel, personal communication). Preliminary research indicates Sudden Oak Death could cause serious environmental damage to oak forests in the east if it spreads (David Rizzo cited in: If Oak Malady Moves East, Many Trees Could Die, *New York Times*, September 4, 2001).

Unfortunately, the Forest Service has not fared equally well. The Forest Service received only $35.5 million for invasive species programs in FY 2001 ( National Invasive Species Council, unpublished data). Most troubling is that funding for the crucial research program , that ranges from basic investigations with broad application to highly targeted applied studies, has stagnated at $8.6 million for more than 5 years. "Full" funding for the research program would be $30 million -- almost four times as much. The effects of the funding shortfall are exacerbated by increasing costs and the "earmarking" of much of the funding to specific projects. Since 1985, the number of entomologists on staff has plummeted from 70 to 24, and the number of plant pathologists has dropped from 50 to 20 (Sheila Andrus, personal communication). Again, scientists, state governments, and organizations concerned about forest pests can increase funding for this program by making their wishes known to key members of Congress.

Some high-profile programs are funded, among them research on biocontrol agents for the hemlock woolly adelgid.

The Forest Service has tried to fill some of the gaps left by APHIS. For example, the Forest Service sought $3.5 million to study Sudden Oak Death biology and ways to control the pathogen. However, the Forest Service had to wait 7 months for funding, and then received only $1.1 million — less than one-third of the requested amount (GAO 2001). Furthermore, the Forest Service lacks APHIS' authority to impose regulations to curtail movement of potentially infested material.

Increased funding — and priority — for exotic forest pests should be part of a broad program expansion for invasive species. While overall federal expenditures rose 58% from FY 1999 to FY 2001,[2] they still constitute only 0.7% of the $137 billion in annual losses calculated by Pimentel et al. (2000). To effectively maintain protection and ultimately resolve biological invasions, funding must be considerably increased over current levels no matter what approach is used. It is essential that funds also be stable, to prevent interruptions of long-term projects, as identification, testing, and application of mitigation and control measures for introduced pests requires years of dedicated effort.

## Trade Policies Raise the Risk

If the United States is to be successful in slowing the flood of new invaders to a trickle, it is equally important to change trade policies. For the past decade or longer, trade policy has been driven by the desire to expand agricultural exports. This motivation is not economically rational because the plant pests and animal diseases in living organisms that are transported primarily by trade cost the United States an estimated $90 billion per year (Pimentel et al. 2000; D. Pimentel personal communication), while agricultural exports bring in only $50 billion annually (U.S. scales back its estimate for farm exports. *Seattle Post Intelligencer*, December 1, 1999).

Nevertheless, the U.S. Government's eagerness to expand markets for U.S. agricultural products has led it to negotiate trade agreements that severely constrain APHIS' ability to protect America's agriculture and ecosystems from invasions by alien pests. One of the most egregious examples is the definition of "quarantine pest" adopted by the International Plant Protection Convention (www.pps.go.jp/english/agr_01/contents.html).

> "A "quarantine pest" is a pest of potential economic (including environmental) importance to the area endangered thereby and not yet present there, or present but not widely distributed and being officially controlled (Article II.1, definitions);
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> An "official control program" is further defined by the IPPC's parent organization, the United Nations Food and Agriculture Organization, as involving "active enforcement of mandatory phytosanitary regulations . . . with the objective of eradication or containment . . ." This program must be established, authorized or performed by a nation's phytosanitary agency, i.e., APHIS."

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[2]From $631.5 million in FY 1999 (GAO 2000) to $996.6 million in FY 2001 (NISC compilation).

I doubt that hemlock woolly adelgid — which currently occupies more than one-third of the range of eastern hemlock (*Tsuga canadensis*) — qualifies as "not widely distributed". Furthermore, the ongoing state and federal effort, which focuses on developing biological controls for the pest, does not meet the definition of "official control program." As a result, hemlock woolly adelgid does not meet the definition of "quarantine pest" and, under trade agreements which APHIS helped to negotiate, it is not permissable for APHIS to prohibit its importation, e.g., as a contaminant on imported nursery stock.

In practice, APHIS continues to regard HWA as an "actionable" pest, and its staff would stop people from bringing it into the country. However, if the agency's actions were challenged by the exporting country, the agency would almost certainly lose any dispute taken to the World Trade Organization's dispute resolution bodies. APHIS is trying to overcome this problem by finding a way to qualify state agency efforts as meeting the definition, but I am skeptical that it can do so.

For at least two decades, experts have warned that APHIS is failing to carry out the principal task assigned to it: preventing introductions of damaging invasive species and responding rapidly when a new invader is detected. One reason for its failure is obvious -- APHIS can't keep up with expanding trade levels (La Fage and Williams 1979; GAO 1997; National Plant Board 1999; Pasek et al. 2000).

Another possible explanation is APHIS' conflicting mandates. The agency is expected simultaneously to prevent pest introductions and to facilitate trade (OTA 1993; GAO 1997; CRS 1999; National Plant Board 1999; Miller 2000). I believe that the evidence shows that APHIS' attempts to balance these conflicting goals have led to lowered protection standards at a time when rising volumes of imports raises the risks of introductions.

Introductions continue apace and the potential losses and costs associated with recent introductions completely overwhelm even Pimentel's impressive estimate of $137 billion (Pimentel et al. 2000). Among the numerous forest or agricultural pests detected since the mid-1990s are Asian longhorned beetle, citrus longhorned beetle, citrus canker, plum pox, and the Sudden Oak Death pathogen.

If one or more of these recently introduced pests becomes established, the $90 billion annual cost arising from plant pests and animal diseases would escalate rapidly. Costs of replacing city trees killed by the Asian longhorned beetle over 30 years, for example, has been estimated at $669 billion (Nowak et al. 2001). Discounted monetary losses for timber resources around Chicago and New York would add another $1 to $10 million to this toll in the first 30 years after introduction (Pasek et al. 2000). The citrus longhorned beetle could cause similar levels of damage since, despite its name, it feeds on an even wider variety of hardwood trees (www.wa.gov/agr/).

These estimates greatly understate the associated environmental costs, since most of these have not been given a market value.

I urge scientists to try to persuade American policymakers to put a high priority on responding effectively to the invasive species threat. Two vitally important steps are to restructure trade policies and "rapid response" programs so as to maximize our success in preventing new introductions, and to increase funding for research programs designed to provide a foundation for scientifically sound pest eradication and control programs.

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