# Committee on Resources

## Witness Testimony

Testimony on Oversight Hearing on Resident Exotic Plants and Pests
Threatening the Health of Our National Forests
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Before the
House of Representatives
Subcommittee on Forests and Forest Health
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My name is Faith T. Campbell. Today I am representing the National Association of Exotic Pest Plant Councils (NAEPPC) when I speak about invading plant species. The views I express on forest insects and diseases, or on other animal pests, are my own, as these subjects falls outside the concern of the NAEPPC.

### Summary

*Biological pollution -- invasions by alien or exotic species -- threaten all American ecosystems and hundreds of species. Forty-two % of American species listed under the Endangered Species Act are harmed by invasive alien species. For 18% of listed species, alien invasions are the major threat. Introduction of exotic diseases, insects, mammalian herbivores, and competing vegetation has had the best-documented effects of any factor on genetic diversity of forest ecosystems, reducing both species diversity and intraspecific diversity. Exotic invasions are exacerbated by and in turn exacerbate the effects of other anthropogenic threats to forest health. This statement will focus on the impacts of exotic insects, fungi, pathogens, and invasive plant species.*

*Exotic forest pests and introduced plants have greatly altered the species composition of forests in the East and have had severe impacts on certain tree species and forest systems in the West. Some tree species important as sources of timber, other products, wildlife food, or through other ecological services have been virtually eliminated throughout their ranges or greatly reduced in numbers in large portions of their ranges. The herbaceous or shrub layers of large but unrecorded areas of forest are being transformed into virtual monocultures by exotic vines, herbs, and shrubs. In some cases, these plant invasions have been shown to reduce forage or cover for wildlife. Damaging invasions by exotic pests or "weeds" cause billions of dollars in damage and millions of dollars in control costs -- so far, without halting the invasions.*

*The impact of such invasions will grow in future years. Expanding international trade provides increased opportunities for foreign species to reach our forests. Trade in raw logs and plants imported for ornamental horticulture carries the greatest threat, but forest pests can hitchhike on a wide array of commodities and transport modes. Our national statutes to exclude plant pests and invasive plants are either incomplete as law or inadequately enforced. Worse, current negotiations to develop international standards for phytosanitary regulations threaten to undermine protections needed to minimize imports of additional harmful exotic species.*

Biological pollution -- invasions by alien or exotic species -- threaten all American ecosystems and hundreds of species. According to The Nature Conservancy, 42% of 958 American species listed under the Endangered Species Act are harmed by invasive alien species. For 18% of listed species, alien invasions are the major threat.

"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. (Ledig 1992).

However, I would like to emphasize the synergism arising from the convergence of these damaging factors. For example, areas in Shenandoah National Park in which trees died as a result of a past severe gypsy moth infestation have now grown up in tree-of-heaven or stinktree (*Ailanthus altissima* ). In the Great Smoky Mountains National Park, rooting by feral hogs appears to be increasing infection of beech trees by beech bark disease (*Nectria galligena* and/or *N. coccinea var. faginata* ).

While I am not an expert on the impact of invasions by animals, I believe the greatest damage has been disruption of aquatic communities as a result of introduced fish and such invertebrates as zebra mussel. Impacts on forest terrestrial ecosystems are often closely related to fragmentation. The most widespread of these problems are unnaturally high levels of nest parasitism by cowbirds; an overabundance of such native species as deer and raccoons; and predation by feral cats. Predation, "plowing" and herbivory by feral hogs is damaging forests in some areas.

## DAMAGE FROM INTRODUCED TREE PESTS

More than 60 % of the 165 million forested acres in USDA Forest Service Region 9 have been seriously damaged by introduced insects, fungi, or pathogens (Burkman, *et al* .). The loss of nuts and berries formerly produced by vanishing or severely reduced tree species has had a poorly documented but surely substantial impact on wildlife species of the forest. "The wholesale killing of American chestnut by blight on thin soils on upper slopes in places in Pennsylvania has in some instances resulted in soil deterioration .., and centuries may be required to restore the original value of the watershed." (Boyce 1961) The dogwood's leaves contain a large amount of calcium and are important in building rich soils (Hepting 1971). Much of the remaining "old-growth" forests in the East consists of steep creek valleys populated heavily by eastern hemlock (*Tsuga canadensis* ) (Davis 1993) -- a species being killed in much of its range by the hemlock woolly adelgid.

Exotic pests have also caused serious damage to some forests in the West. Eighty to ninety percent of the whitebark pine (*Pinus albicaulis* ) trees in Glacier National Park and the Bob Marshall Wilderness are infected by white pine blister rust (Schmidt 1992). Whitebark pine seeds are a major food source for the grizzly bear, black bear, red squirrel, and Clark's nutcracker (Kendall and Arno 1989; Schmidt 1992). In Oregon and California, Port-Orford-cedar's (*Chamaecyparis lawsoniana* ) leaf litter is less acidic and higher in calcium than that of associated conifers, thus probably contributing to desirable soil properties, particularly on serpentine sites (Zobel et al. 1985).

Total expenditures by the U.S. Department of Agriculture to combat exotic pests of trees in Fiscal Year 1993 approached $19 million. Over three-quarters of all USDA tree pest control funds were focused on gypsy moth. The vast preponderance of the total was spent by the Forest Service to combat pests already

present in the country (Lorimer, personal communication, Smith, personal communication, Miller, personal communication).

Other economic damage due to tree mortality or morbidity caused by alien pests in North America includes loss of about $2 billion in timber revenues (Pimentel 1986). Port-Orford-cedar has been severely reduced as a timber supply; in 1989, Port-Orford-cedar brought an average price of over $2,600 per thousand board feet -- nearly five times the price for Douglas-fir (Warren 1990). Expensive pest control, tree improvement breeding, silvicultural controls, and other programs have been needed to maintain harvest levels of red pine Pinus resinosa, white pines (*Pinus* , subgenus *Strobus* ), and the oaks (*Quercus* spp.). Losses to recreational industries are also significant. Gypsy moth-infested areas experience up to a 20 percent reduction in recreational use (Goebl 1987).

Cities with many American elms (*Ulmus americana* ) spend up to an estimated $100 million per year on the removal of trees killed by Dutch elm disease, caused by an introduced fungus *Ophiostoma* (= *Ceratocystis) ulmi* (Mazzone and Peacock 1985). Use of Port-Orford-cedar in ornamental plantings has been impacted by infestation by the fungus *Phytophthora lateralis* (Roth *et al* . 1972). The genetic base for continuing horticultural developments for dogwoods (*Cornus* spp.), hemlocks, and Fraser fir (*Abies fraseri* ) -- increasingly popular as a Christmas tree -- is severely eroded.

## DAMAGE FROM INVASIONS BY PLANT SPECIES

The United States has also suffered high levels of ecological and economic damage as a result of invasions by alien plant species. Alien plant invasions damage half of our National parks and 60% of the preserves managed by The Nature Conservancy. An estimated 5 - 6 million acres of National forests and grasslands are infested. Incomplete data show alien plants already displace native plant communities and destroy habitat for wildlife species on more than 169,000 square miles of our native grasslands and wetlands. This is 4.6% of the total area of the United States -- an area larger than the state of California.

According to the Federal Interdepartmental Committee on Management of Noxious and Exotic Weeds (FICMNEW), Federal agencies spend about $42 million each year to combat exotic plant species. Some states and local governments spend additional millions: $30 million on aquatic and wetland weeds in Florida, $6 million in Washington State, probably more than $2 million in Colorado. The public expenditure is not sufficient to control the plants' spread. Noxious weeds continue to spread across our Western public lands at a rate estimated at 4,600 acres per day -- a new area size of Delaware every year. The Forest Service has sufficient funds to treat less than 100,000 acres per year. Weeds, primarily exotic plant species, cause $20 million in losses or increased cultural expenses to U.S. agriculture each year.

In the Interior West, such exotic plant species reduce forage for such species as elk (Kummmerow). High elevation meadows are invaded by spotted and Russian knapweed, leafy spurge, Canada thistle, and especially yellow toadflax (Beck). In the Pacific Coast region, Scotch broom *(Cytisus scoparius* ), French broom (*Genista monspessulana* ), Portuguese broom (*Cytisus striatus* ), and Spanish broom (*Spartium junceum* ) hinder forest regeneration over millions of acres. Scotch and French broom together have invaded more than one million acres in California. In Oregon, infestations are found in each of the more than four hundred townships located below 3,000 feet in elevation west of the Cascades. Scotch broom is reported to be found on disturbed land, including clearcuts, throughout western Washington. The total cost associated with broom infestation has not been documented, but losses from just Scotch broom infestations are known to exceed $1 million in Oregon alone.

Plant invasions are much farther advanced in the East, although data are poor. Of the approximately 200 plant species invasive in the eastern forests, data are currently available only for one, kudzu (*Pueraria montana* ). The "vine that ate the South" occupies some 10,000 square miles of our forests -- an area about the size of Maryland. Eastern, primarily forested, states have relatively high proportions of the flora that are exotic. For example, in New England and Illinois, the proportion is nearly 30% (OTA 1993). As pointed out in the Taylor report, much of the region is close to ports where plants have been imported for centuries. An additional factor is the virtually complete alteration of the natural vegetation in the course of European settlement. While many forests have regrown since the early 1900s, they are not the same forests. They are fragmented. Furthermore, continuous disturbance by both natural events -- e.g. ice storms or hurricanes -- and anthropogenic events -- e.g., acid precipitation, defoliation by other damaging alien species -- may assist the establishment of invasive alien plants.

In the eastern deciduous forests we find numerous species of exotic vines, shrubs, and trees, and some herbaceous plants. The most widespread of the invasive vines are Japanese honeysuckle (*Lonicera japonica* ), oriental bittersweet *Celastrus orbiculatus* , and porcelain berry vine (*Ampelopsis brevipedunculata* ). Spreading primarily south from its site of introduction in Pennsylvania is mile-a-minute or tearthumb *Tracaulon (Polygonum) perfoliatum* . Near urban or suburban areas, forests are invaded by such common garden standbyes as English ivy( *Hedera helix* ), wintercreeper (*Euonymous fortunei* ), and periwinkle (*Vinca major* and *V. minor* ). These vines can inhibit reproduction of trees as well as to smother the native wildflowers.

Numerous exotic shrub species are also established in portions of the deciduous forests. Eurasian species of shrub honeysuckle (*Lonicera* spp.), privet (*Ligustrum* spp.), barberry (*Berberis* spp.), burning bush (*Euonymus alatus* ), and autumn olive (*Elaeagnus umbellata* ) can completely dominate forest shrub layers. Wildlife, especially common birds, spread the seeds of some species from urban areas far into even "undisturbed" forests.

Among the troublesome tree species are stinktree -- virtually everywhere; in the north, Norway maple (*Acer platanoides* ); in the MidAtlantic and South, empress or princess tree (*Paulownia tomentosa* ); in the Gulf states, popcorn or Chinese tallow tree (*Sapium sebiferum* ); and, in the Mississippi valley, golden chain or golden shower tree (*Koelreuteria paniculata* ).

Herbaceous layers are being transformed by ground-level herbs and grasses as well as the vines. Particularly troublesome are garlic mustard (*Alliaria petiolata* ) and Japanese stilt grass (*Microstegium vimineum* ). Lesser celandine (*Ranunculus ficaria* ) has totally replaced native flora in bottomland hardwood swamps in the Potomac River valley and in Delaware. According to Ann Rhoads of the Morris Arboretum, the wildflowers that appear briefly each spring and then go into dormancy play an important role in capturing the first flush of nutrients released in the spring thaw and making it available to other species that leaf out later. Do these exotics interfere with this process?

The National Association of Exotic Pest Plant Councils supports increasing funds and staff for the USDA Forest Service and other agencies to enable them better to carry out weed suppression and control efforts. The four member councils have endorsed Pulling Together: National Strategy for Invasive Plant Management. As an individual, I continue support for increased resources to the USDA Forest Service, Agricultural Research Service, USGS/Biological Resources Division, and other agencies to address harmful exotic insects, fungi, and diseases threatening native tree species.

## THE THREAT OF NEW HARMFUL EXOTIC INVADERS

However, if site-specific management is to have any chance of success against the exotic pests or weeds, the managers need a respite from of new invaders coming into America. Unfortunately, current policies are not providing adequate protection. Since 1991, at least five new exotic pests have been discovered in the country, including the larger pine shoot beetle ( *Tomicus (=Blastophagus) piniperdia* ) in 1992 near Cleveland, Ohio (Kucera 1992); the spruce beetle (*Ips typographus* )in the port area of Erie, Pennsylvania in spring 1993 (Hofacker 1993); and the Asian long-horn beetle (*Anoplophora glabripennis)* in Brooklyn, New York in 1996 (USDA Forest Service NA-PR-01-97). Most troubling of all, the Asian gypsy moth has twice reached various American port cities on either the superstructures of ships or military equipment (Gibbon 1992; USDA Forest Service and APHIS 1993). Aggressive spraying of *Bacillus thuringiensis* ("Bt"), near the affected ports has apparently controlled the infestations. Additional steps were taken in hopes of preventing infestations of ships reaching U.S. or Canadian shores from Siberia in the future. However, fewer precautions have been taken with regard to shipments from Europe -- the origin of the second introduction.

Unfortunately, macroeconomic trends ensure that more pests and weeds will be introduced in the future. The responsibility for preventing introduction of new harmful exotic species is delegated to the USDA Animal and Plant Health Inspection Service (APHIS. Several statutes convey the authority for APHIS to inspect shipments and, if necessary, quarantine or deny entry of known or suspected pests. This authority with regard to invasive plants is contained in the Federal Noxious Weed Act of 1974. One of the most important steps that members of the Committee on Resources could take to improve forest health would be to support measures to improve APHIS' ability to prevent introductions of new pests and weeds or to eradicate the invader when it is first detected (cf. Boyce 1961; Ashton & Mitchell 1989; Macdonald et al. 1989).

**New Tree Pests**

The reduction of harvesting on National forests has created an interest in importing large quantities of logs from Siberia, New Zealand, Chile and other countries with climates and forest types similar to those in North America. Considerable attention -- justified in my view -- has focused on the possibility that these imports will introduce exotic pests into North America. Such pests could have extremely high economic and ecological costs if they became established in the widespread coniferous forest ecosystems of the American west. In 1961, Boyce predicted that "[a] virulent introduced parasite is infinitely more destructive to pure than to mixed stands, . . . no more potentially dangerous situation for disaster can be imagined than the extensive pure Douglas-fir forests of the Pacific Northwest or the far-flung pure stands of ponderosa pine and lodgepole pine in other parts of the West."

Risk assessment teams appointed by the U.S. Department of Agriculture to examine possible impacts associated with imports of raw wood products from Siberia, New Zealand, and Chile reached similar conclusions thirty years later.

The Siberian assessment team concluded that "the close similarity between (Siberia and similar latitudes of North America) promises to produce many taxa from Siberia that will find suitable hosts in various parts of the forests of Western North America. . . . Some species are likely to become serious pests." The assessment team determined that 175 species of arthropods, nematodes, and fungi were associated with just one tree species Siberian larch (*Larix siberica* ). An economic analysis, based on a review of 36 "representative" species, estimated the net present value of potential losses at between $24.9 million (best case scenario) and $58 billion (worst case scenario). These figures represented only the potential impacts to commercial timber species in the western U.S.; they did not consider ecosystem damage, impacts to nonconsumptive industries

associated with forested land, or harm to agriculture.

A pest assigned a high risk in the New Zealand assessment -- the woodwasp and associated fungus *Sirex/Amylostereu m* complex (USDA Forest Service 1992) -- is actually native to Eurasia, including Siberia. Yet it is mentioned only briefly in the Siberian assessment, and no risk is assigned (USDA Forest Service 1991b). I suggest that the potential monetary losses from Siberian pests should be adjusted upward in recognition of the *Sirex/Amylostereum* complex.

In analyzing the ecological threat, the authors of the Siberian assessment stated,

. . . It is impossible to state the probability of extensive infestation . . . . However, since the risk of spread of these pests is high, large-scale infestations and tree mortality are likely to occur. . . . Loss of a significant proportion of living trees within stands would trigger complex changes in food supply and habitat. . . . Detrital food chains -- fueled by dead organic matter -- would be favored, while food chains that depend on living trees would collapse unless the system recovered very quickly. . . . (USDA Forest Service 1991).

The Risk Assessment authors predicted that mycorrhizal fungi, several species of voles, flying squirrels, and spotted owls could not make the transition to a detrital food chain. Deer and elk would be further limited by the increased scarcity of closed-canopy forests, which provide winter forage and shelter. Western yew, accipiter hawks, and salmonid fish would also decline (USDA Forest Service 1991b).

The risk assessment team for Monterey pine (*Pinus radiata* ) logs imported from New Zealand gave detailed attention to only two diseases and five insect species. The economic losses associated with introduction of these are estimated to fall between $52 and $364 million, exclusive of the costs of suppression, job loss, watershed damage, recreation, or ecological damage (USDA Forest Service 1992).

A third risk assessment addressed potential introductions of exotic pests on wood importations from Chile of Monterey pine and two indigenous hardwoods. The team examined the risk of introduction for a total of 16 arthropods and six diseases. Only "limited consideration" was given to other harmful pests e.g., nematodes, that "conceivably" could be associated with logs from Chile (USDA Forest Service 1993). No overall estimate of costs associated with these possible introductions was made.

The authors of the Chilean assessment emphasized the lack of knowledge on foreign tree species' biology and interactions with pests in their native environment. Add to this the fact that pests may be insignificant in their native range but find a particularly vulnerable species when introduced into a new environment. Given the inevitable gaps in our information, assessments must be considered to offer low estimates of the impacts of potential pests introduced into North American forests.

In my view, the statutes under which APHIS regulates imports of plant pests provide adequate authority, although I understand APHIS' preference to consolidate them. Whether or not APHIS' consolidation measure is enacted, APHIS must expand and strengthen its implementing regulations if it is to protect our forests from additional exotic pests. The majority of exotic forest pests in North America have been introduced on imported nursery stock (See Appendix B) or logs. Preventing additional introductions hitchhiking on imported nursery stock will require more intensive inspections and, probably, new technologies. The General Accounting Office recently criticized APHIS for not inspecting cargo adequately.

Regulations specifically governing timber imports were adopted only in 1995 (7 CFR Parts 300 and 319). These regulations do not appear to me to be adequate. First, they place too great a reliance on the country of

origin of the shipment. Harmful pests can arrive from anywhere. "Dutch" elm disease is caused by a fungus native to Asia, but it reached our shores on logs imported from Europe. Asian and hybrid gypsy moths reached North Carolina on military equipment being returned from Germany. APHIS should also expand its more aggressive prevention program in which it studies pests in foreign countries that have a potential to attack North American trees to areas other than Siberia. APHIS should apply much more stringent controls to dunnage and other wooden packing materials, which are implicated in the recent introductions of the pine shoot beetle and spruce beetle. A second foundation for these concerns is information contained in the risk assessment conducted regarding proposed imports of logs from Chile. First, bark-inhabiting insects are often found on de-barked logs. Second, pests are frequently transported in dunnage or crates (USDA Forest Service 1993). These reports confirm doubts about the effectiveness of de-barking as a phytosanitary measure and the importance of adequate phytosanitary controls on dunnage. Finally, APHIS must adapt its exclusion programs to the imminent phase-out of methyl bromide.

**Additional Invasive Plants**

Introductions of additional invasive exotic plants are even more poorly controlled, but less well documented. A plant species' invasiveness is often recognized only decades after it first became established in the wild. This fact explains scientists' concern over data indicating that 4,000 foreign plant species are outside cultivation. Some proportion of these probably will turn out to be invasive. Furthermore, thousands of other plants have been introduced for our gardens or other purposes -- more than 8,000 species in Hawaii. Perhaps 10% will probably escape when conditions are right.

Finally, new plant species are imported every year. If one extrapolates from current data and concludes that about 10% of all vascular plants are "weedy," there could be as many as 26,000 species capable of becoming invasive once they are introduced into new environments (Rapoport 1991).

Already, 64% of the most invasive plant species across the nation are still offered for sale. Among species invasive in our forests, the proportion is even higher, ranging upward from 67% for the vines (and including even kudzu!) to 90% for the trees. Included among the herbaceous species still offered for sale are some of the most notorious invaders damaging meadows and grasslands in the Mountain states: nodding or musk thistle, Canada thistle, and Scotch thistle; diffuse, short-fringed, and even spotted knapweeds; dyer's woad; and Dalmatian and common toadflax.

APHIS and the NAEPPC agree that the Federal Noxious Weed Act of 1974 contains several gaps that undermine its effectiveness in protecting our forests and other ecosystems from invasive alien plant species. Chief among these gaps are

- unclear priorities which mean APHIS has "listed" only one species that invades primarily natural environments (*Melaleuca quinquenervia,* in the Florida everglades);
- lack of authority to list widespread species;
- lack of authority outlaw interstate shipments of noxious weeds;
- lack of emergency authority to restrict imports of harmful plant species while expediting their inclusion on the list.

The NAEPPC urges members of the Committee on Resources to sponsor a companion bill to S. 83, which would close the loopholes identified above.

The most efficient method to eliminate exotic pest infestation is to prevent the organism from entering the

country. Exclusion of additional weedy species is "National Goal 1" in Pulling Together. However, no law now requires that new plant introductions be evaluated as to whether they will probably be invasive. Nor has a sponsor been found for a bill that would require pre-import screening. Such a requirement, while contentious, is vital to protecting our forests and other ecosystems from waves of new invaders.

This already inadequate level of protection is in grave danger of being lowered even further as a result of the emphasis on reducing "non-tariff barriers to trade" associated with adoption of the World Trade Agreement. The United States is playing an active role in on-going international negotiations aimed at developing standards that will become a "ceiling" that limits what phytosanitary measures our nation and other countries may adopt under the WTA to prevent introduction of new harmful exotic species or reintroduction of those already present. Unfortunately, the U.S. negotiators -- led by the U.S. Trade Representative and APHIS -- have not sought input from governmental or non-governmental land-managing, natural resource, and environmental protection agencies -- or the scientists who have led the study of biological invasions. As a result, the U.S. negotiators have accepted draft standards that will not allow our government to exclude potential invaders in a timely manner.

The current draft text does not reflect the growing scientific awareness of and concern about the impacts of invasive alien species. This increased recognition is seen in last year's Congressional reauthorization of programs to control aquatic invasive species; release of Pulling Together; as well as our government's participation in the July 1996 Norway/UN Conference on Alien Species and follow-up statements at the Conference of the Parties to the Convention on Biodiversity. However, NAEPPC can find no indication that this heightened awareness and broader perspective have been incorporated into development of the U.S.' negotiating position at the WTA negotiations.

Knowledge of these species' harmful impacts is certain to increase in the near future. By ignoring current scientific concerns and failing to allow for future developments, the draft text imposes such restrictions on governmental exclusion actions that it is likely to increase the danger of damaging invasions by harmful exotic species -- both those currently unsuspected and those already known.

We urge less reliance on economic measurements in determining harmful impacts, especially those to natural ecosystems and species. We recommend further providing a mechanism for a gradual shift away from a "dirty list" to a "clean list" approach. In other words, over time, countries would stop allowing any species to be imported until injury had been demonstrated; instead, they would consider a species to be "guilty until proven innocent" and evaluate its invasive potential before allowing it to be imported. While the "guilty until proven innocent" approach represents a complete reversal from current practice in most countries, it is the wave of the future. Already, New Zealand and Australia are moving in this direction. For the WTO standards to be fully "science based", the negotiators should adopt this principal. We recognize that such a step would require an intensive study of the types of screening tests to be used in determining the "safety" of the proposed import (or newly detected hitchhiker -- *i.e.*, inadvertent or accidental introduction). We believe such additional scientific work is warranted to ensure that the standards adopted will function well in the decades to come. While we prefer an entirely new foundation for decision-making under the WTA phytosanitary agreement, realism requires that we address the current draft. We consider neither alternative proposed criterion to govern designation of a "quarantine pest" to be acceptable.

The first alternative requires that the pest be "officially controlled". Given fiscal realities, the federal government will be able to carry out a control program for only a tiny fraction of the thousands of damaging invasive alien species already present in the country or that will enter it in coming decades. State actions may fulfill the "officially controlled" requirement, but the fifty states vary considerably in their interest,

willingness, and fiscal ability to carry out such programs. A prohibition against implementing a prevention and exclusion -- *e.g.*, "quarantine" -- program means that additional individuals of exotic species not being "officially controlled" will almost certainly enter the country. Such additional reintroductions should be prevented because they add to the numbers of the pest or weed, its geographic range, and the likelihood of genetic variability which may enable the pest to spread to new regions or with greater virulence.

The second alternative criterion requires that a risk assessment be carried out prior to designation of a species as a "quarantine pest". Again, the federal government lacks the resources to conduct a risk assessment on the probably thousands of invasive nonindigenous species already causing damage in the country, much less the millions of potential invaders. Furthermore, scientists and economists lack sufficient information to evaluate in advance most species' ability to invade or the damage that would result from an invasion. This knowledge gap is particularly true for those species which have not yet been introduced into the country -- *i.e.*, precisely those which are the purported principal targets of the quarantine system being developed. Indeed, the draft text does not recognize the very high levels of ignorance and uncertainty that will always apply in the field of managing invasive alien species.

Furthermore, the draft language prohibits designating as a "quarantine pest" a species that is already widely disseminated. This provision does not accord with scientific thinking. There are strong reasons to prevent new or continuous reintroduction of widespread pests. Such additional reintroductions add to the numbers of the pest in the country, the geographic areas into which it has been introduced, and the likelihood of genetic variability within the introduced pest. Increased genetic variability may well enable the pest to spread to new regions or with greater virulence. For example, the NAEPPC list of species invasive in the United States is far longer than any official list. At present, few of these species are currently listed pursuant to either federal or state noxious weed laws. This legal gap hampers efforts to curtail their spread. Unfortunately, the definitions of "quarantine pests" in the draft would prevent implementation of exclusion efforts aimed at such widely disseminated species. This provision does not accord with scientific thinking. We earlier outlined the scientific basis for preventing new or continuous reintroduction of weeds that are already present. While widespread species already, by definition, occupy much of the suitable habitat, prevention of still further spread nevertheless remains valuable. The negotiators should revise the text to allow quarantine measures against widespread species.

I support calls in the negotiation to increase scientific research aimed at identifying pest and weed species that may damage our forests. "Early warning" research into known and unknown pest species abroad has been recommended by Boyce (1961); Australia implements such a program for invasive alien plant species (Humphries). However, this research should be in addition to a fully functional quarantine program; implementation of import controls should not be conditioned upon completion of such studies.

**Notes**

1. e.g., chestnut blight (Cryphonectria (= Endothia) parasitica), Dutch elm disease (Ophiostoma (= Ceratocystis) ulmi), European gypsy moth (Lymantria dispar), dogwood anthracnose (Discula destructiva), white pine blister rust (Cronartium ribicola), balsam woolly adelgid (Adelges piceae), butternut canker (Sirococcus clavigignenti-juglandacearum), and hemlock woolly adelgid (Adelges tsugae).

2. Federal Plant Pest Act (1957) [7 U.S.C. 150aa - 150jj]; Organic Act (1944) [7 U.S.C. 147a - 147e]; Plant Quarantine Act (1912) [7 U.S.C. 151 - 164a, 167]; Agricultural Quarantine Enforcement Act (1989); Forest & Rangeland Renewable Resources Research Act (1978) [16 U.S.C. 1642]; Cooperative Forestry Assistance Act (1978) [16 U.S.C. 2101, 2102, 2104]; and Executive Order 11987 (1977).

3. 7 U.S.C. 2801-2814.

**Sources**

Ashton P.J. and D.S. Mitchell. 1989. Aquatic Plants: Patterns and Modes of Invasion, Attributes of Invading Species and Assessment of Control Programs. In Drake, J.A., H.A. Mooney, F. diCastri, R.H. Groves, F. J. Kruger, M. Rejmanek, M. Williamson. 1989. Biological Invasions: A Global Perspective. SCOPE 37 (Scientific Committee on Problems of the Environment). John Wiley & Sons. New York and Toronto.

Beck, K.G. Professor of Weed Science. Colorado State University. Personal communication to F.T. Campbell.

Boyce, J.S. 1961. Forest Pathology, Third Edition, McGraw-Hill Book Company, Inc. New York.

Burkman, W. Q. Chavez, R. Cooke, S. Cox, S. DeLost, T. Luther, M. Mielke, M. Miller-Weeks, F. Peterson, M. Roberts, P. Seve, and D. Twardus. 1993. Northeastern Area Forest Health Report. NA-TP-03-93. United States Department of Agriculture, Forest Service. Northeastern Area State and Private Forestry, Radnor, Pa.

Davis, M.B. 1993. Old Growth in the East. Wild Earth. Richmond, VT.

Gibbon, A. 1992. "Asian Gypsy Moth Jumps Ship to United States." Science. Vol. 235. January 31, 1992.

Goebl, M. 1987. Gypsy moth infestation on the Allegheny National Forest has direct impacts on recreationists. In Coping with the gypsy moth in the new frontier, S. Fosbroke and R.R. Hicks, Jr., eds., W. Va. Univ. Books, Morgantown, WV, pp. 59-64.

Hepting, G. 1971. Disease of forest and shade trees of the United States. United States Department of Agriculture, Forest Service Agricultural Handbook No. 386. 658 pages.

Hofacker, T.H. 1993. United States Department of Agriculture, Forest Service Staff Entomologist. Memorandum of meeting on May 28, 1993 (undated).

Humphries, S. At Aspen Global Change Institute workshop on Biological Invasion as a Global Change. August 1994.

Kendall, K.C. and S.F. Arno. 1989. Whitebark pine - an important but endangered wildlife species. In Proceedings - Symposium on Whitebark Pine Ecosystem: Ecology and Management of a High-Mountain Resource. Bozeman, Mt. March 29-31, 1989. Schmidt, W.C. and K.J. McDonald, Compilers. pp. 264-273.

Kucera, D.R. 1992. New introduction, Common pine shoot beetle. Pest Alert, United States Department of Agriculture, Forest Service, Northeastern Area, NA-PR-??-92.

Kummerow, M. Weeds in Wilderness: A Threat to Biodiversity. Western Wildlands, Vol. 18, No. 2.

Ledig, F.T. 1992. Human Impacts on Genetic Diversity in forest Ecosystems. Oikos 63: 87-108. Copenhagen 1992.

Lorimer, N. Staff Entomologist, Forest Pest Management, United States Department of Agriculture, Forest Service, Washington, D.C. Personal communication to F.T. Campbell.

MacCleery, D.W. 1992. American forests. A history of resiliency and recovery. United States Department of Agriculture, Forest Service FS-540, 59 pages.

Macdonald, I.A.W., L.L. Loope, M.B. Usher, O. Hamann, 1989. Wildlife Conservation and the Invasion of Nature Reserves by Introduced Species: a Global Perspective. In Drake, J.A., H.A. Mooney, F. diCastri, R.H. Groves, F. J. Kruger, M. Rejmanek, M. Williamson. 1989. Biological Invasions: A Global Perspective. SCOPE 37 (Scientific Committee on Problems of the Environment). John Wiley & Sons. New York and Toronto.

Mazzone, H.M. and J.W. Peacock. 1985. Prospects for control of Dutch elm disease - biological considerations. J. Arboriculture 11: 285-292.

McGovern, T. Operations Officer, Domestic and Emergency Operations. United States Department of Agriculture, Animal and Plant Health Inspection Service. Hyattsville, MD. Personal communication to F.T. Campbell.

Miller, Richard. United States Department of Agriculture, Forest Service, Timber Program, Washington, D.C. Personal communication to F.T. Campbell.

Pimentel, D. 1986. "Biological Invasions of Plants and Animals in Agriculture and Forestry". In Mooney, H.A. and J.A. Drake (eds.). Ecology of Biological Invasions of North America and Hawaii. Springer-Verlag. New York.

Rapoport, E.H. 1991. Tropical versus temperate weeds: A glance into the present and future. In Ramakrishnan, P.S. 1991. Ecology of Biological Invasion in the Tropics. National Institute of Ecology, New Delhi.

Roth, L.F., H.H. Bynum, and E.E. Nelson. 1972. Phytophthora root rot of Port-Orford-cedar. United States Department of Agriculture, Forest Service Forest Pest Leaflet No. 131.

Schmidt, W.C. 1992. Effects of White Pine Blister Rust on Western Wilderness. In Society of American Foresters 1992 Annual Meeting, Proceedings. SAF Publication 92-01.

Smith, Dr. Richard, United States Department of Agriculture, Forest Service, Forest Insect and Disease Research, Washington, D.C. Personal communications to F.T. Campbell.

United States Congress. Office of Technology Assessment. 1993. Harmful Non-Indigenous Species in the United States.

United States Department of Agriculture, Forest Service. 1991b. Pest Risk Assessment of the Importation of Larch from Siberia and the Soviet Far East, Miscellaneous Publication No. 1495, September, 1991.

United States Department of Agriculture, Forest Service. 1992. Pest Risk Assessment of the Importation of Pinus radiata and Douglas-fir Logs from New Zealand, Miscellaneous Publication No. 1508, October 1992.

United States Department of Agriculture, Forest Service. 1993. Pest Risk Assessment of the Importation of

Pinus radiata, Nothofagus dombeyi, and Laurelia philippiana Logs from Chile. Miscellaneous Publication No. 1517. September 1993.

United States Department of Agriculture Forest Service and Animal and Plant Health Inspection Service. 1993. National Gypsy Moth EIS Team. Caterpillar Courier. October 1993.

Warren, D.D. 1990. Production, prices, employment and trade in Northwest forest industries, fourth quarter 1989. United States Department of Agriculture Forest Service Research Bulletin. PNW-RB-174.

Zobel, D.B., L.F. Roth, and G.M. Hawk, 1985. Ecology, Pathology, and Management of Port-Orford-Cedar (Chamaecyparis lawsoniana). United States Department of Agriculture Forest Service. Pacific Northwest, General Technical Report, PNW-184.

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