

**Linking Ecology and Horticulture
To
Prevent Plant Invasions**



PROCEEDINGS OF THE WORKSHOP
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Organizing Committee

John M. Randall, University of California
Patricia D. Raven, Missouri Botanical Garden
Peter H. Raven, Missouri Botanical Garden
Sarah Reichard, University of Washington (Chair)
Peter S. White, North Carolina Botanical Garden

Editor: Kate Fay, K. C. Fay and Associates

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Foreword

Plants are essential to sustaining the stability and quality of human life on Planet Earth. Their loss threatens the future of our children and our grandchildren. Today Planet Earth has lost a third of its forests, a quarter of its topsoil, and plants and animals are disappearing faster than we can learn about them, or even know what is gone. Invasive non-native plants pose one of the most serious threats to the protection of biological diversity worldwide, and the introduction and spread of these adventive species continue, in many cases, unchecked.

In December 2001, the Missouri Botanical Garden and the Royal Botanic Gardens, Kew, were honored to convene experts from across the globe to explore and develop workable, voluntary approaches for reducing the introduction and spread of non-native invasive plants. I am pleased to say that this landmark three-day gathering, *The Workshop on Linking Ecology and Horticulture to Prevent Plant Invasions*, made important progress. It produced the *St. Louis Declaration*, which includes *Findings and Principles* that frame the invasive plant species problem and offer a basis for practical and effective ways to address the problem. More significantly, *The St. Louis Declaration* also offers *draft Voluntary Codes of Conduct*. These codes can serve as guides for responses to curb the spread of invasive plant species, while promoting courses of action that will minimize this spread. The following “Workshop Proceedings” present outcomes from the Workshop, which I believe will have tangible impacts on this serious environmental and economic problem.

We at the Missouri Botanical Garden remain devoted to all endeavors that help conserve biological diversity while there is still much left to protect. We applaud the collaborative progress made at this Workshop by dedicated scientists, policy-makers, gardeners, landscape professionals, botanical gardens and arboreta, and the nursery industry.

Peter H. Raven
Director, Missouri Botanical Garden

Executive Summary

In December 2001, experts from across the globe met in St. Louis, Missouri to explore and develop workable voluntary approaches for reducing the introduction and spread of non-native invasive plants, which are serious threats to protecting biodiversity and ecosystems in the United States and other countries. *The Workshop on Linking Ecology and Horticulture to Prevent Plant Invasions* (the Workshop) was convened by the Missouri Botanical Garden and the Royal Botanic Gardens, Kew. It brought together for the first time some of the most respected leaders in their fields (See **Appendix F** for a list of participants). Extensive preparation for the Workshop began in early 2001, with leaders among a variety of groups recognizing the need for a more collaborative response to the growing problem of plant invasions. These leaders took the initiative to gather and establish a comprehensive and manageable workshop agenda; one that could attract broad participation.

This landmark three-day gathering yielded the *Saint Louis Declaration*, which consists of two major components:

1. **Findings and Principles** that frame the invasive species problem and present the underlying basis for successful efforts to address it; and,
2. **Draft Voluntary Codes of Conduct** that help govern decisions made by commercial, professional and government groups whose actions affect the spread of invasive plant species including government agencies, nursery professionals, the gardening public, landscape architects and botanic gardens and arboreta.

These products represent an important first step in this collaborative, comprehensive and effective response to the global invasive plant species problem. Plans to further develop solutions will seek to include additional key parties unable to attend the first workshop; including more representation from state government, garden writers and global experts, as well as from regional organizations and the international seed trade industry.

Some workshop participants presented perspectives on key topics that drive concerns and potential solutions related to the invasive plant species issue worldwide. These presentations ranged from the environmental impacts associated with invasive plants to how horticultural practices contribute to the spread of invasive plants. Those organizing the Workshop selected the presentation topics so that each of the following general categories could be addressed and combined to help the workshop participants establish the *Findings and Principles* and *Draft Voluntary Codes of Conduct*, a primary Workshop goal. The presentations also helped identify

possible future workshop focus areas and needs. The presentation and general discussion topics included:

- Environmental impacts associated with the spread of invasive plants
- How horticulture contributes to the spread of invasive plants
- The nursery industry's view of the problem and the status of response efforts
- The Federal government response to concerns about invasive plants
- Risk assessment as a tool for addressing invasive plant problems
- Experiences developing and using voluntary codes of conduct

Brief summaries of most of these presentations are presented below. Their authors are also identified.

Several key actions since the Workshop have already provided tangible progress toward implementing ***The St. Louis Declaration***. They include:

- The American Nursery and Landscape Association (ANLA) endorsed the **St. Louis Declaration** and adopted the *draft Voluntary Codes of Conduct for Nursery Professionals*.
- The Garden Club of America has endorsed the **St. Louis Declaration** and is reviewing and refining the *draft Voluntary Codes of Conduct for the Gardening Public*.
- The University of Washington is using the *draft Voluntary Codes of Conduct for Botanical Gardens* and evaluating all plantings and planting procedures on its campus, treating them as a plant collection.
- The Missouri Botanical Garden, The Chicago Botanic Garden and the North Carolina Botanical Garden have endorsed the **St. Louis Declaration** and adopted the *draft Voluntary Codes of Conduct for Botanical Gardens and Arboreta*.
- The Florida Nurserymen and Growers Association (FNGA), the largest state nursery association in the United States, has adopted the *draft Voluntary Codes of Conduct for Nursery Professionals*.
- The Board of Directors of the American Society of Landscape Architects (ASLA) will consider endorsing the *draft Voluntary Codes of Conduct for Landscape Architects* during its annual meeting in October 2002. Additionally, ANLA will host an education session on invasive plants during the annual meeting, to be held in San Jose, CA.

Workshop Findings and Principles

Among the most important and challenging components of the *St. Louis Declaration* to develop during the workshop were the *Findings and Principles*. They help guide effective responses to the invasive plant species problem. Given the diverse representation at the Workshop, such an effort was both hard work and rewarding. By framing the invasive plant species issue and presenting the underlying basis for successfully addressing it, participants were able to acknowledge its key sources, regional nature, threat to natural systems and biological diversity, and its magnitude. Workshop participants were then able to use these *Findings* to establish *Principles* to guide future responses by stakeholders playing a role in solving the invasive plant species problem. Parties may include landscape architects, the nursery professionals, federal, state, regional and local government agencies, botanic gardens and arboreta, garden clubs, garden writers, regional planning groups, international trade groups and others. The *Principles*:

- Address how future plant introductions should be pursued
- Emphasize the importance of a national problem response framework that leaves room for regional solutions
- Encourage the use of available assessment tools, resources and voluntary codes of conduct
- Establish the importance of public education and professional training
- Stress the fundamental importance of broad-based collaboration

With the *Findings and Principles* established, workshop participants were able to develop a set of draft voluntary codes of conduct. **Appendix A** contains the *Findings and Principles of the St. Louis Declaration*.

Draft Voluntary Codes of Conduct

A second component of the *St. Louis Declaration* is *Draft Voluntary Codes of Conduct*. They offer professional codes of conduct designed to curb the use and distribution of invasive plant species through self-governance and self-regulation by the groups concerned. This approach has already been used successfully to ameliorate other problems but its application to invasive plant threats is novel and innovative. Importantly, the workshop participants and others who helped draft the voluntary codes of conduct are acutely aware that education must accompany all efforts to address the problem and that some future government regulation may perhaps also be needed if such efforts prove insufficient. *Draft Voluntary Codes of Conduct* have been developed for nursery professionals, government, the gardening public, landscape architects, botanic gardens and arboreta. They are as follows and reprints can be downloaded from www.mobot.org/iss.

These *draft Voluntary Codes of Conduct* are now being considered for endorsement, and in some cases refinement, by the major professional societies and organizations representing each of the groups covered. If endorsed, they will be ‘tested’ and revised as necessary to improve their utility and effectiveness. At this time, plans are under development to gather workshop participants once again in Chicago in late October or early November to, among other matters, further establish final voluntary codes of conduct. If this event takes place, representatives from additional key groups will be invited and encouraged to participate.

Draft Voluntary Codes of Conduct for Government

1. Require risk assessment for government-led or financed plant introductions to ensure that no new harmful plant species are introduced, intentionally or unintentionally.
2. Do not distribute existing holdings of invasive plant species to areas where they can potentially do harm; eliminate these holdings or maintain new or existing holdings using appropriate safeguards.
3. Coordinate and facilitate collaboration in databases, early warning systems, monitoring, and other means of preventing invasive plant species problems.
4. Lead and fund (subject to budgetary considerations) the development of environmentally sound methods to control harmful invasive plant species, seek control of such species on public lands and promote their control on adjacent private lands.
5. Develop and promote the use of non-invasive plant species within all government units and to the public.
6. Facilitate, lead, coordinate and evaluate public outreach and education on harmful invasive plant species.
7. Encourage Federal employees and management to participate in ongoing training programs on invasive plant species.
8. Foster international cooperation to minimize the risk of the import and export of potentially invasive plant species.
9. Develop partnerships and incentive programs to lessen the impact of invasive plant species and provide non-invasive restoration materials.
10. Provide a forum for regular evaluation of the effectiveness of these voluntary codes of conduct towards preventing the invasive plant species problem.
11. Enforce invasive plant species legislation at all levels.

Draft Voluntary Codes of Conduct for Nursery Professionals

1. Ensure that invasive potential is assessed prior to introducing and marketing plant species new to North America. Invasive potential should be assessed by the introducer or qualified experts using emerging risk assessment methods that consider plant characteristics and prior observations or experience with the plant elsewhere in the world. Additional insights may be gained through extensive monitoring on the nursery site prior to further distribution.
2. Work with regional experts and stakeholders to determine which species in your region are either currently invasive or will become invasive. Identify plants that could be suitable alternatives in your region.
3. Develop and promote alternative plant material through plant selection and breeding.
4. Where agreement has been reached among nursery associations, government, academia, and ecology and conservation organizations, phase-out existing stocks of those specific invasive species in regions where they are considered to be a threat.
5. Follow all laws on importation and quarantine of plant materials across political boundaries.
6. Encourage customers to use, and garden writers to promote, non-invasive plants.

Draft Voluntary Codes of Conduct For The Gardening Public

1. Ask for only non-invasive species when you acquire plants. Plant only environmentally safe species in your gardens. Work towards and promote new landscape design that is friendly to regional ecosystems.
2. Seek information on which species are invasive in your area. Sources could include botanical gardens, horticulturists, conservationists, and government agencies. Remove invasive species from your land and replace them with non-invasive species suited to your site and needs.
3. Do not trade plants with other gardeners if you know they are species with invasive characteristics.
4. Request that botanical gardens and nurseries promote, display and sell only non-invasive species.
5. Help educate your community and other gardeners in your area through personal contact, and in such settings as garden clubs and other civic groups.
6. Ask garden writers and other media to emphasize the problem of invasive species and provide information. Request that garden writers promote only non-invasive species.
7. Invite speakers knowledgeable on the invasive species issue to speak to garden clubs, master gardeners, schools and other community groups.
8. Seek the best information on control of invasive plant species and organize neighborhood work groups to remove invasive plant species under the guidance of knowledgeable professionals.
9. Volunteer at botanical gardens and natural areas to assist ongoing efforts to diminish the threat of invasive plants.
10. Participate in early warning systems by reporting invasive species you observe in your area. Determine which group or agency should be responsible for reports emanating from your area. If no 800 number exists for such reporting, request that one be established, citing the need for a clearinghouse with an 800 number and website links to information about invasive plant species.
11. Assist garden clubs to create policies regarding the use of invasive species not only in horticulture, but also in activities such as flower shows. Urge florists and others to eliminate the use of invasive plant material.

Draft Voluntary Codes of Conduct For Landscape Architects

1. Seek out education and information on invasive species issues:
 - a) Work with local plant ecologists, horticulturists, nurseries, botanic gardens, conservation organizations and others to determine what species in your region either are currently highly invasive or show aggressive potential. Investigate species under consideration that may present a threat.
 - b) Increase interaction with other professionals and non-professionals to identify alternative plant material and other solutions to problems caused by harmful invasive plants.
 - c) Take advantage of continuing education opportunities to learn more about invasive species issues.
2. Identify and specify non-invasive species that are aesthetically and horticulturally suitable alternatives to invasive species in your region.
3. Eliminate specification of species that are invasive in your region.
4. Be aware of potential environmental impacts beyond the designed and managed area of the landscape plan (e.g. plants may spread to adjacent natural area or cropland).
5. Encourage nurseries and other suppliers to provide landscape contractors and the public with non-invasive plants.
6. Collaborate with other local experts and agencies in the development and revision of local landscape ordinances. Promote inclusion of invasive species issues in these ordinances.

Draft Voluntary Codes of Conduct For Botanic Gardens and Arboreta

1. Conduct an institution-wide review examining all departments and activities that provide opportunities to stem the proliferation of invasive species and inform visitors. For example, review or write a collections policy that addresses this issue; examine such activities as seed sales, plant sales, book store offerings, wreath-making workshops, etc.
2. Avoid introducing invasive plants by establishing an invasive plant assessment procedure. Predictive risk assessments are desirable, and should also include responsible monitoring on the garden site or through partnerships with other institutions. Institutions should be aware of both direct and indirect effects of plant introduction, such as biological interference in gene flow, disruption of pollinator relationships, etc.
3. Consider removing invasive species from plant collections. If a decision is made to retain an invasive plant, ensure its control and provide strong interpretation to the public explaining the risk and its function in the garden.
4. Seek to control harmful invasive species in natural areas managed by the garden and assist others in controlling them on their property, when possible.
5. Promote non-invasive alternative plants or, when possible, help develop non-invasive alternatives through plant selection or breeding.
6. If your institution participates in seed or plant distribution, including through Index Seminum, do not distribute known invasive plants except for bona-fide research purposes, and consider the consequences of distribution outside your biogeographic region. Consider a statement of caution attached to species that appear to be potentially invasive but have not been fully evaluated.
7. Increase public awareness about invasive plants. Inform why they are a problem, including the origin, mechanisms of harm, and need for prevention and control. Work with the local nursery and seed industries to assist the public in environmentally safe gardening and sales. Horticulture education programs, such as those at universities, should also be included in education and outreach efforts. Encourage the public to evaluate what they do in their own practices and gardens.
8. Participate in developing, implementing, or supporting national, regional, or local early warning systems for immediate reporting and control. Participate also in the creation of regional lists of concern.
9. Botanical gardens should try to become informed about invasiveness of their species in other biogeographic regions, and this information should be compiled and shared in a manner accessible to all.
10. Become partners with other organizations in the management of harmful invasive species.
11. Follow all laws on importation, exportation, quarantine, and distribution of plant materials across political boundaries, including foreign countries. Be sensitive to conventions and treaties that deal with this issue, and encourage affiliated organizations (plant societies, garden clubs, etc.) to do the same.

Actions for the *American Society of Landscape Architects (ASLA) Invasive Plants Species Task Force*

1. Encourage and work with Landscape Architecture degree programs to uniformly identify and address invasive species in plant materials courses.
 - a. Work with Council of Educators in Landscape Architecture to conduct survey of Landscape Architecture programs to determine need for improvements (e.g., ecological concepts, invasiveness, and the use of alternatives). Bill Fountain, University of Kentucky, and the task force will create survey format and ASLA will facilitate communications with CELA president regarding implementation of survey and dissemination of results.
 - b. Work with CELA to include issue of invasiveness in that organization's publications and/or within its annual conferences
2. Include invasive species issues in continuing education opportunities for practicing Landscape Architects (e.g. annual meeting, workshops, continuing articles in LA Magazine, and further information sharing derived from interaction with nursery, arboretum, botanic garden, and conservation communities.
3. Include on ASLA website: links to sites discussing methods for risk assessment and other IS issues
4. Work to include knowledge of invasive species and alternatives in existing certification systems for professionals. (e.g. LARE, International Society of Arboriculture Arborist Certification Program).

Workshop Presentation Summaries

The Environmental Impacts of Invasive Plants

John Randall, The Nature Conservancy

E.O. Wilson once said: “on a global basis...the two great destroyers of biodiversity are, first habitat destruction and, second invasion by exotic species”. Dr. Wilson’s comment reminds us, along with many other reasons, of the need for better understanding the impacts of invasive plants in natural areas. These impacts can be grouped under two broad categories:

- 1) ecosystem level impacts; and,
- 2) community and population level impacts. In some cases, invasive plants have little impact on natural areas. In others, they have positive impacts.

Invasive plants can affect the ecosystem processes that determine much about the whole suite of animals and plants that can survive in a system in at least several key ways. First, they can alter the rate and intensity of wildfires. The best known example of this occurs when cheat grass (*Bromus tectorum*) invades areas dominated by native sagebrush (*Artemisia* spp.) and other shrubs, promoting frequent fires which kill the shrubs. Along the Gulf coast, the invasive cogon grass (*Imperata cylindrica*) invades fire-adapted longleaf pine wire-grass communities where it increases the intensity of fires to a level that the native tree seedlings cannot survive.

Certain invasive plants can also alter an ecosystem’s hydrology by changing the location of the water table. For example, in South Florida’s everglades, the invasive Australian tree *Melaleuca quinquenervia*, has moved into parts of the ‘river of grass’ and changed these to forested swamp, lowering the water table in the process.

Invasive plants can also alter rates of sedimentation and soil erosion within ecosystems, depending on the plant type. For example, spotted knapweed (*Centaurea maculosa*) moves into grasslands in the inland northwest and other parts of the country where it displaces the native bunchgrasses and herbs, but its root systems are far simpler and do not slow runoff from rainstorms in the same way. Thus runoff and consequent erosion from invaded hillsides is far greater, and sediment loads in salmon streams far higher.

Certain invasive plants can also alter soil chemistry and nutrient cycles. For example, some nitrogen fixing species like *Myrica faya* have invaded systems like Hawaiian forests and shrublands that had few or no native nitrogen fixers and sharply altered nitrogen chemistry and

cycling there. Even the familiar Japanese barberry (*Berberis thunbergii*) can alter soil calcium levels and pH.

Invasive plants can also affect plant communities and their population levels. One important effect of this type is alteration of vegetation structure, which kudzu (*Pueraria lobata*) is famous for. Kudzu grows up and over forest trees, covering them with a dense blanket of leaves, which is sometimes so thick that the trees supporting it no longer get enough light to survive. Invasive plants can cause changes in the composition of the species of plants, animals, fungi and other microbes in the areas they invade by displacing native plants that native animals and other organisms need for food and shelter. For example, invasive honeysuckles (*Lonicera* spp.) move into forest understories in the east and Midwest where they can completely dominate the shrub layer and displace native species. Invaders like this compete with and deprive other plants for key resources, such as water, light, nutrients and space. Invasive plants negatively impact native animals, ranging from birds and mammals to insects by pushing out native plant species the animals depend on for survival. Some invaders also promote other non-native plant invaders, reduce recruitment of native species (e.g. Norway Maple [*Acer platanoides*] vs. the native Sugar Maple [*Acer saccharum*]) or hybridize with native species (e.g., on the west coast the non-native Atlantic saltmarsh cordgrass (*Spartina alterniflora*) hybridizes and threatens to swamp out the native *Spartina foliosa* and in Florida the invasive *Lantana camara* may hybridize with the native *Lantana depressa*.

Invasive plants can have such a wide variety of impacts on so many native species, biological processes and physical processes, but in some cases no harmful impacts have been detected from invading plants, particularly those that never become abundant. Because of this and because the time and resources required to prevent or control an invasion can be high, it is vital for conservation workers to first determine what their conservation goals and objectives are in a given area or for a given project. They should be able to state which species, communities and/or ecosystem processes they are protecting and managing for. Once this has been done, they should determine whether any of the invading plants in or near the area are known or thought to be capable of negatively impacting the species and processes targeted for protection. Information on the impacts –or lack thereof– of invading plants is thus vital for conservation land managers who need to make important decisions about how to allocate the limited time and money they have.

Horticulture as a Pathway of Invasive Plant Introductions in North America

Sarah Reichard, The University of Washington

Modern North American horticulture began its development in 1698 in the private garden of John Bartram. The 1700s saw great advancement with the first American experimental crop gardens, the first large commercial nursery and the first botanical garden. Reflecting a philosophy held by many at the time, Thomas Jefferson said in 1790, “The greatest service which can be rendered any country is to add a useful plant to its culture.” Forty years later, President John Quincy Adams helped establish national policy that encouraged plant introduction. He declared, “The United States should facilitate the entry of plants of whatever nature whether useful as a food for man or the domestic animals, or for purposes connected with the manufactures or any of the useful arts”.

Today there are numerous pathways for invasive plant species to enter the plant population. Botanic gardens, gardeners, nurseries, amateur seed exchanges, garden writers, landscape architects and the government all participate in the North American plant species introduction. In some cases they do so quite knowingly and within the bounds of what rules are in place for introductions and in others the introduction is accidental. Botanic Gardens and nurseries contribute through plant exploration projects using consortia of botanic garden partners across the globe, Index Seminum (seed exchanges), and by releasing invasive plant species seeds to nurseries and the public. Nurseries contribute by collaborating with foreign nurseries to identify attractive new plant species to introduce in the marketplace, as well through local and mail order sales. Amateur Seed Exchanges occur through worldwide societies and organizations of enthusiasts interested in growing exotic, new plant species. These exchanges predominantly take place informally, either via the internet and mail. Often, too, they occur as a result of interest in herbal remedies. The Government imports and breeds certain invasive plant species for erosion control and pasture/rangeland use, as well as imports, some which have agricultural value. Garden Writers are the gardening “tastemakers” for their readers; and thus can significantly influence garden planting ideas. In some cases, this can mean garden writers suggest to gardeners that they use an invasive plant species, without realizing the harmful potential these plants may present to a particular garden. In addition and to respond to their readers, garden writers also continue seeking new plant species and cultivars about which to write. As part of the expertise they offer, Landscape Architects specify to their clients plants that may be invasive. They also can influence what nurseries grow, since their purchases are large enough to affect what nurseries choose to supply. As with others, landscape architects are often unaware that plants they encourage clients to grow are invasive and potentially harmful.

In short the aforementioned groups have a significant collective impact on the rate of invasive plant species introductions in North America. Over time and if left unchecked the problem and costs associated with this problem will continue to grow. A key response to the spread of invasive plant species is the development of *voluntary codes of conduct*. The Botanical Gardens have already collaborated on such codes and are presently reviewing them. Their key elements are:

- 1) do no harm to plant diversity and natural areas;
- 2) perform risk assessments prior to introducing new plant species;
- 3) remove invasive plants from existing collections;
- 4) educate the public about this problem;
- 5) develop non-invasive plant alternatives to invasive plant materials; and,
- 6) follow all laws and quarantines.

Updates on Nursery Industry Efforts to Address Invasive Plant Species Concerns

Craig Regulbrugge, The American Nursery & Landscape Association

Paul Lewis, Nursery and Garden Industry of Australia

Hugh Gramling, Tampa Bay Wholesale Growers Association

The American Nursery & Landscape Association

The American Nursery and Landscape Association's (ANLA) historic focus has been to foster a favorable business environment for the nursery industry to conduct commerce and trade. ANLA has also continued to work closely with government to keep the market functioning as freely as possible. ANLA, too, has continued to recognize the need to stay actively involved with efforts to address the problem of "plant pests", even before the first quarantine laws were enacted in the early 1900s.

A number of key publications and events have helped shape the discussion on invasive plants since the early 1990s. These events have placed ANLA at the heart of efforts to respond to the invasive plant problem with and on behalf of its members. Here is the timeline of events as they happened: Congress effectively initiated a call to action with the publication of the Congressional Office of Technology Assessment Report, *Harmful Non-indigenous Species in the United States*, in 1993. Development of this thorough and far-reaching report encouraged the ANLA to publish and *Invasive Plants Issue Analysis* at about the same time, suggesting ways in which Congressional leaders and others should respond to the problem. As part of these outreach efforts, the ANLA hosted numerous meetings to survey member attitudes and scope responses to this issues. Then, beginning in 1999, a series of events facilitated passage of the Plant Protection Act of 2000. They included:

- 1) the signing by President Clinton of the Executive Order on Invasive Plant Species, which created the National Invasive Species Council;
- 2) creation and work of an ANLA Task Force to consider invasive plant prevention and management policy recommendations; and,
- 3) delivery of the National Plant Board's Safeguarding Review Report to the US Department of Agriculture (USDA).

The Plant Protection Act of 2000 consolidates authorities that had been contained in several existing statutes and authorized the USDA to undertake a host of actions designed to reduce the spread of invasive plant species, including noxious weeds, while increasing the penalties for failure to comply with its provisions. In 2001, The National Invasive Species Council published its National Management Plan, "Meeting the Invasive Species Challenge". As a step toward implementation of the National Management Plan, ANLA and the American Seed Trade

Association collaborated with USDA to organize a May 2001 workshop on methods for screening invasive plants.

As a result of increased activity surrounding the invasive plant issue, industry's perspective on the issue has evolved and their involvement has grown. Specifically, there is a growing awareness among members of the nursery industry about invasive plants. An interest in "being at the table" as solutions are developed has increased, as has interest in improving the environment. However, industry is also well aware that new plants, including some plants viewed by some people as "invasive" plants, drive the nursery market. In view of this, ANLA prefers that solutions recognize the benefits of plant introductions and that the potential of one plant to be invasive may be different than another, depending on what the plant is and where it is being introduced. ANLA also acknowledges that some nursery practices need to change, while solutions must be realistic, prioritized and market-based.

ANLA raised a few concerns and perceptions held some in the industry that workshop participants might want to consider as they respond with solutions to the invasive plants problem. They include the following:

- 1) some parties to this issue have as a goal to control the biological commons; and,
- 2) any regulatory responses to the problem must avoid serious disruptions to commerce, respect the confidentiality of businesses, avoid placing some businesses at a competitive disadvantage, constructively address regional differences in the degree of the invasive species problem, and be consistent with international legal obligations.

ANLA views the *prevention* approach for addressing the invasive species problem as promising. This approach benefits from improving predictive abilities, its conduciveness to a national response to the problem, and being able to accommodate concepts like accreditation. ANLA also notes that the Australian experience with prevention is worthy of close investigation and that any industry-wide voluntary efforts to address the problem should be pursued now. However, as efforts are pursued, they must reflect:

- 1) the importance of geography and the regional nature of the invasive plant problem;
- 2) clearly defined goals;
- 3) costs and benefits; and,
- 4) the need to make use of all available tools, including education, voluntary codes of conduct, regulation, and plant alternatives.

In conclusion, ANLA encourages all involved in addressing the invasive plant species problem to nurture all efforts to develop a broad consensus on operating principles and voluntary codes of conduct so that all aspects of horticulture, commercial and institutional, can be well positioned for the future. This is a particularly important goal since the capacity to implement and evenly

enforce a system for screening invasive plants, called for in the National Invasive Species Management Plan, does not yet exist. In any event, industry must be instrumental in forging solutions collaboratively with all parties.

Nursery and Garden Industry of Australia (NGIA)

Curbing the spread of invasive plants in Australia has been a high priority for the Nursery and Garden Industry of Australia for some time. This effort was a collaborative one between the nursery industry and the Natural Heritage Trust (including government, various councils and botanic gardens), established by the Australian Government. It was designed to:

- 1) identify invasive plants commonly sold by nurseries;
- 2) establish a list of suitable alternatives to the invasive plants;
- 3) educate the public about invasive plants and gardens; and
- 4) encourage the public to plant non-invasive plant species.

As their work progressed, the collaborators were also able to demonstrate the environmental problems associated with those invasive plants most commonly found in nurseries. One of the key milestones of this successful partnership is that the nursery industry both recognized and responded to the problem presented by invasive plants; stating that they were not the sole cause of the problem, could not solve it alone and were willing to actively participate in a joint effort to address it.

The nursery industry in Australia is relatively large. There are 8,000 nurseries throughout the country, with about 1,600 listed as members of the NGIA. Industry sales are approximately \$1.13 billion annually and growing; and the public are demanding increasing numbers of plants considered to be invasive. Considering their share of the economy combined with increasing concerns about the impacts of invasive plants, the nursery industry could quickly see the benefits of collaborating on solutions.

Today, this project has achieved much of what it set out to do, although more work is ahead. They have established and agreed upon a list of plants that have particularly harmful qualities as invasive plants. They have developed a list of plants that they recommend as alternatives to harmful invasives. They are close to producing and distributing extensive public educational materials and they are beginning to see tangible results of their efforts.

The partnership developed to respond to this problem benefited from a collaborative atmosphere of knowledge, trust and synergism. Nurseries know gardeners and what they want. Gardeners know and trust their nurseries to give them gardening advice. Government develops plans to

address public problems and these plans are workable when they are developed with input from industry and consumers. Overall cooperation enables cost-sharing and cost-mitigation. In short, the process recognized that all members had to agree on project goals at the outset and in creating them the partners realized their individual goals were very similar even though the associated motivations were not necessarily similar at all.

There were, of course, some challenges. Among the key challenges was gaining agreement on the list of plants that were identified as needing the most attention due to their invasive characteristics. Additionally, some non-nursery parties to the dialogue wanted suggested invasive plant alternatives only to be native plants and some saw certain suggested alternatives as a potential threat to ecosystems in the future. Getting the sufficient nurseries to participate and/or support the effort was also a challenge, since they were not predisposed to the benefits of such a process. Another challenge was to effectively communicate to the public so they both understood the benefits of this project and responded to its suggestions. Among the future challenges will be funding its final steps. Thus far, approximately \$1 billion (Australian) has been spent.

Florida Nurserymen and Growers Association (FNGA)

The spirit of cooperation, mutual need and community service has resulted in a unique and productive four-year relationship between two Florida groups normally at odds with each other. Specifically, The Florida Nurserymen and Growers Association (FNGA) and The Tampa Bay Wholesale Growers (TBWG) have teamed to work with the Florida Exotic Pest Plant Council (FLEPPC) to encourage Florida residents to stop growing, selling and distributing 46 plants, which they have identified as sufficiently invasive to warrant action guarding against their further distribution. Additionally, FLEPPC members have incorporated a regional component to their invasive plant lists to demonstrate to users where a particular invasive plant is problematic.

This effort is a model of cooperation between the nursery industry and the invasive plant movement, which has been recognized nationwide. Historically, the three groups had been combative. However, since beginning this collaboration by providing input to the University of Florida as it developed its invasive plant assessment protocol (the first objective science-based tools for determining invasiveness), these groups have become partners in the battle against invasive plants.

In recent months, FLEPPC has developed articles for FNGA publications identifying problem practices that spread invasive species and offer alternative solutions. Broader audiences are also being reached with this message, through joint press releases.

Notwithstanding the important progress that has been made, there are several areas where additional cooperation is needed. They include:

- 1) developing a model invasive plant ordinance that is mutually acceptable to all groups for local adoption;
- 2) generating best management practices for industry and gardeners to prevent the spread of invasive plants;
- 3) developing non-reproductive cultivars of invasive species with significant gardening use; and,
- 4) identifying other areas where a cooperative effort will eliminate a problem with minimal adverse impact of Florida's largest agricultural industry.

An Update on the National Management Plan

Lori Williams, National Invasive Species Council

In response to growing concerns about the effects invasive plant species have on our lives, President Clinton, issued Executive Order 13112 on Invasive Species (Order) in February 1999. The order established the National Invasive Species Council (Council), co-chaired by the Secretaries of Agriculture, Commerce and the Interior, and includes the Secretaries of State, Treasury, Health and Human Services, Defense and Transportation and the Administrators of the Environmental Protection Agency and the U.S. Agency for International Development. The Executive Order directs the Council to:

- 1) provide national leadership on invasive species;
- 2) oversee effective coordination of this Federal effort;
- 3) promote action at the local, state, tribal and ecosystem levels;
- 4) identify recommendations for international cooperation;
- 5) facilitate a coordinated network to document and monitor invasive species;
- 6) develop a web-based information network; and,
- 7) provide guidance on invasive species for Federal agencies to use in implementing the National Environmental Policy Act (NEPA).

The order also calls on the Council to prepare a National Management Plan (NMP).¹ The Council developed NMP with extensive input from Federal and non-Federal working groups, formal public listening sessions and a public comment period. It was completed in February 2001.

The National Management Plan presents important and interrelated areas that the Council considers priorities in addressing the invasive species problem and identifies recommended actions for each one. They are:

- 1) coordination and leadership;
- 2) prevention;
- 3) early detection;
- 4) control;
- 5) international cooperation;
- 6) research;
- 7) information management; and
- 8) education and outreach.

Prevention is the first line of defense against invasive plants and is often the most cost-effective approach to combating the problem. Diverse tools and methods are needed to prevent invasive species from becoming established in ecosystems where they are not native. As such, NMP recommends that a risk assessment screening system for evaluating intentionally introduced

¹ For further details, see “*Management Plan for Meeting the Invasive Species Challenge*” National Invasive Species Council, January 18, 2001 available on the web at www.invasive.species.gov.

invasive species and reducing the risk of establishment be developed and tested. It also recommends that key pathways by which invasive species move be identified and ranked and that mechanisms to reduce movement through these pathways be developed.

The National Management Plan stresses the need for a variety of approaches to be designed and used in combination with each other to prevent plant invasions. They include appropriate risk-based regulations, voluntary codes of conduct, research on the biology of invasive species and ecosystem vulnerability, and public education to further help prevention efforts.

The National Management Plan also calls for the Council to develop and test a fair, feasible and risk-based comprehensive invasive species screening system. Initially the system would only evaluate first time introductions of non-native species in consultation with all stakeholders. Later, screening system modifications or comparable measures would be developed to address those intentional invasive species introductions currently occurring in the United States. Among the key goals of the screening process under discussion today is to identify the pathways by which invasive species move and develop mechanisms to reduce their movement before they enter a protected area. Special efforts will continue to work with affected stakeholders and industries most affected by the screening process. The National Management Plan also recognizes that several needs must be addressed for the screening process to achieve its goals. Specifically it must be:

- 1) socially and politically feasible;
- 2) practical and workable;
- 3) biologically sound;
- 4) transparent and well articulated;
- 5) balanced fairly between costs and benefits; and,
- 6) comprehensive.

The National Invasive Species Council website (www.invasivespecies.gov) contains a significant amount of information on federally-led efforts to address this problem. It includes The National Management Plan, as well as updates on key related activities underway including, development of NEPA guidance, Plan implementation status, information sharing network and education and outreach activities and international issues assessment and meetings.

Developing A Code of Conduct: The North Carolina Botanical Garden Experience

Peter White, University of North Carolina

The North Carolina Botanical Garden (NCBG) has been an active leader among botanical gardens in efforts to “turn down the volume” of invasive plant species impacts. Its exotic species policy, first formulated in 1996, establishes two overarching goals:

- 1) to possess plant collections that do not harm natural areas and the native plant diversity of North Carolina and the Southeast; and
- 2) to protect and restore the Garden’s highest-quality natural areas by eradicating invasive exotic species.

Gardens are not just importers and growers of potentially invasive plants; they also export these to other regions and countries, e.g., through a long tradition of the exchange of seed lists worldwide among botanical institutions. Concerned about the effects of such unexamined exchange, in 1998 NCBG became the first garden in North America to voluntarily restrict its own distribution of plants and seeds. Since data are often lacking on the risk of moving specific plants, we assumed that distance itself was a likely predictor of risk of movement: the farther a plant is moved from his home range, the more likely it is to be invasive or to introduce genes that would cause outbreeding depression. Hence, we restricted our own distribution to a 12-state region of the Southeastern United States.

Finally, in 1999 we adopted a list of mandates for our own garden and issued these as the *Chapel Hill Thesis* (in emulation of Martin Luther’s ninety-five theses, the original statement of the Chapel Hill Thesis was nailed to a *Paulownia*, an invasive tree—and later published in the newsletters of the Botanical Garden Conservation International and the American Association of Botanical Gardens and Arboreta)^{1*}, as a statement of principles aimed at limiting the potential role of gardens and horticulture in this global conservation problem. This was adopted as our own formal policy as well. I will end this overview by presenting the Chapel Hill Thesis.

The 1990s were a decade in which increasing attention was paid to the invasive plant issue within the botanical garden and horticultural world. Among the landmarks for botanical gardens that we were involved in were the 1997 publication of a special insert on the invasives issue in the *Public Garden*, the journal of the American Association of Botanical Gardens and Arboreta^{2*}. Another key landmark was the workshop lead by Sarah Reichard on conservation ethics in botanical gardens at the 2000 annual meeting. These and other discussions helped set the stage for this Workshop in St. Louis.

* References 1-7 are found in Appendix B of these Proceedings.

During our internal and external discussions of this issue, we identified three key findings that caused us to be optimistic about solving the exotic species issue in horticulture. Fundamentally, our policies were based on these three findings: first, that not all exotics are invasive—in fact the invasive species represent a small percentage of introduced plants; second, that risk assessment was possible; and third, that alternatives to the use of invasives could be found.

Our first observation was that not all exotics are invaders and only a subset of cultivated species pose a threat to native plants and ecosystems^{3*}. At one end of the spectrum, some exotic plants are dependent on cultivation. Others persist after cultivation but do not establish new populations. Some spread locally after cultivation by vegetative means but not by seed. Some spread by seed, but only in human created habitats, such as lawns, roadsides and cultivated fields. Of more concern are those exotics spread into native habitats and reduce populations of native plants. Finally some exotic invaders spread into native habitats and alter key ecosystem functions such as hydrology, fire regime, or nitrogen availability. Given this spectrum of effects, it is obvious that the problem is not all exotics, but rather those that cause impacts to native species and ecosystems. Lippincott and Hall (1996)^{4*} presented a dramatic analysis of the number of invaders in Florida: of 25,000 species cultivated in the state, only 125 were serious invaders, of which only 40 were bought and sold in the horticultural trade and only 13 represented plants which are important part of the trade.

Given that not all introduced plants are invasive, risk assessment for introductions becomes critical. Our second observation was that successful tools for risk assessment are improving and being used increasingly. For example, a recent risk assessment conducted by Reichard (refer to **Appendix B**) suggested that if a simple decision tree had been used before introduction, 85% of the invasive woody plants of North America would have been excluded, another 13% would have been held for further evaluation prior to release, and only 2% would have been released for introduction^{5*}. Other risks assessment schemes and attempts to find the biological basis for risk assessment were also successful^{6*}.

Our final observation was that it was possible to find alternative species for invasive plants. For example, Harty (1993) described an early success story in Illinois: discussions among several branches of state government (including conservation, natural resources, agriculture, and transportation) produced a list of safe plants for all state government horticultural activities^{7*}. We knew from our own work in North Carolina that non-invasive alternatives were plentiful.

Among the key first responses by the NCBG to invasive plant species concerns was to create and begin using voluntary codes of conduct for handling invasive plant species. In developing its codes of conduct, NCBG established that codes should be designed to address how best to handle existing garden displays and plant holdings, plant and propagule introductions, invasive plant control in natural areas and the region, public awareness, and plant pest and disease organisms.

In 1999, the landmark *Chapel Hill Thesis: A Challenge to Botanical Gardens and Horticultural Institutions* was published^{1*}. It establishes the policy of the North Carolina Botanical Garden and recommends the use of codes of conduct for botanic gardens and horticulture institutions. It suggests that institutions:

- 1) perform risk assessment for introductions (do not introduce likely invasives);
- 2) remove invasives from plant collections;
- 3) control invasives in garden natural areas;
- 4) develop non-invasive and native plant alternatives and certify non-invasiveness for the trade;
- 5) do not distribute seeds and/or plants that will be invasive elsewhere;
- 6) educate the public;
- 7) become Partners with conservation organizations; and
- 8) obey important rules and enact strong procedures to minimize the risk of introducing diseases and pest organisms.

Clearly as we implement policies like these, it is critical to refine risk assessment, to share information and to continually refine our lists of those plants that cause unwanted impacts. We at the North Carolina Botanical Garden believe that the St. Louis Workshop will stand as another critical step in environmentally responsible horticultural practice.

[Please refer to **Appendix B** for literature citations.]

Prediction and Risk Assessment of Invasive Plants

Sarah Reichard, University of Washington

Among the most promising tools for estimating the potential of invasive plants is risk assessment. It produces an estimate of the likelihood and consequences of a particular invasive species introduction. These introductions can occur both accidentally, when seeds spread through a variety of means, and intentionally, when plants are used for horticulture and medicinal purposes, among other purposes.

Risk assessment involves the analysis of traits associated with invasive species, such as their reproductive characteristics, length of the juvenile period and germination requirements; and an analysis of the possible outcomes of the introduction. Once these parameters are understood, models can be developed to assist in the assessment. Both discriminant analysis and classification and regression tree models were produced for woody invasive and non-invasive species grown in the United States. The models were cross-validated to verify the accuracy of the assessment. From these models, an easy to use Decision Tree was produced (See **Appendix C.**) This Decision Tree uses clearly defined variables that are relatively easy to answer.

Risk assessment is not yet effective in predicting the possible impacts of the species because impact is an interaction of the traits of the species and the nature of the ecosystem invaded. For instance, some species are very good competitors and may extract resources such as water or nutrients so that native species cannot use them. This will only be a factor when those competitive species enter a system in which water or nutrients are limited. As methods mature, it will become increasingly possible to assess the type of impact a particular species may hold.

Because determining the risk of establishment is relatively simple when using the Decision Tree such a tool should be a key element of voluntary codes of conduct for those handling plant introductions, as well as for educators and regulators. As methods improve with development, risk assessment will become increasingly important. In addition to the Decision Tree, a host of tools and methods developed in Australia can also be very useful. They may be found at:

[Http://www.agric.wa.gov.au/progserv/plants/weeds/weedsci2.htm](http://www.agric.wa.gov.au/progserv/plants/weeds/weedsci2.htm).

[Other sources of information for using risk assessment can be found in **Appendix D.**]

Effective Public Education and Outreach

Sandy Lloyd, Department of Agriculture, Western Australia

Australia's efforts to combat problems caused by invasive plants include an extensive public education, awareness and outreach campaign. Among its reasons for waging this campaign are the impacts invasive plants have on agriculture, human health, property values and tourism; as well as the increasing frequency of new weeds found in Australia. The key questions the public awareness campaign is designed to respond to are:

- 1) where do invasive plants come from;
- 2) what effects to invasive plants present to Australians;
- 3) who contributes to the invasive plant problem and are they aware of their contribution;
- 4) how informed is the population about this problem; and
- 5) what have Australia's leaders done to respond to the problem?

The Australian campaign contains several key initiatives with each aimed at slightly different target audiences, including gardeners, seed merchants, mail order catalog shoppers, farmers and others. *National Weedbuster Week* is a major initiative that targets the media and aims to raise awareness and increase public understanding about the problems that weeds cause. Using seminars, field days, weed walks, school displays and academic competitions, *National Weedbuster Week* also helps make the connection between gardening, farming or grazing habits, and potential land and environmental degradation. Since its inception in 1997, *National Weedbuster Week* has been instrumental in fostering community ownership of weed problems and has resulted in the acceptance and support of weed management projects across the country.

Other initiatives include the creation of *Woody Weed*, a mascot who educates Australians about weeds, as he visits shopping malls, fairs, schools and politicians. Another initiative, the *Environmental Weed Action Network*, created by the Wildflower Society involves letter writing campaigns, lobbying, web page communications, literature dissemination, workshops and seminars: all aimed at educating the public and public leaders about the country's weed problem.

Australia's extensive coordinated communications and outreach efforts have made it possible to identify the key communications strategies and vehicles that have contributed to their success.

They include:

- Evaluate your target audience.
- Develop a clear message and present it to your target audience using an angle that resonates with that audience. For example, for gardeners, invasive plants are ordered from the Internet and arrive in Australia via the mail. For home fishpond owners,

noxious aquatic weeds are cultivated in home fishponds and then spread to lakes and rivers.

- Develop and use media contacts within key media forms (print, television radio) and use them aggressively. In the print media (gardening, camping, travel and lifestyle magazines and newspapers), articles, special features, press releases are effective. In the television media, news interviews and garden shows are effective. Radio bulletins and interviews are also effective.
- Find interview talent and develop photo opportunities

The nationwide public education, communications and outreach effort undertaken in Australia to combat weeds provides numerous examples that can be applied elsewhere as similar efforts get underway. Australia's model is both replicable and relatively simple, provided leadership [to move weed campaigns] forward develops and remains through key success milestones.

Future Directions

Since the December 2001 Workshop, there have been a number of follow-up activities discussed and implemented. As mentioned earlier, a number of important national organizations have already endorsed several of the products of the workshop, importantly the Draft Voluntary Codes of Conduct and the *St. Louis Declaration* (See www.mobot.org/iss). In addition, the Chicago Botanic Garden has agreed to host a follow-up meeting in the fall of 2002. While the specific agenda and participant list for this meeting have not yet been fully developed, the meeting will reconvene many of those who participated in the December 2001 workshop to further refine the Voluntary Codes of Conduct, as well as discuss a variety of other opportunities for advancing national level efforts to address the problems presented by invasive plants. Please follow planning and agenda development efforts for this meeting on the website referred to above.

Appendix A. The St. Louis Declaration On Invasive Plant Species

Findings

People are major dispersers of plants. The magnitude of this dispersal is unprecedented and has allowed dispersal of species that manifest aggressive traits in new areas.

Plant introduction and improvement are the foundation of modern agriculture and horticulture, yielding diversity to our supply of plants used for food, forestry, landscapes and gardens, medicinal and other purposes.

A small proportion of introduced plant species become invasive and cause unwanted impacts to natural systems and biological diversity as well as economies, recreation, and health.

Plant species can be invasive in some regions, but not in others. The impacts of invasive plant species can occur at times and places far removed from the site of introduction.

Principles a.k.a. The St. Louis Six

1. Plant introduction should be pursued in a manner that both acknowledges and minimizes unintended harm.
2. Efforts to address invasive plant species prevention and management should be implemented consistent with national goals or standards, while considering regional differences to the fullest extent possible.
3. Prevention and early detection are the most cost effective techniques that can be used against invasive plants.
4. Research, public education and professional training are essential to more fully understanding the invasive plant issue and positively affecting consumer demand, proper plant use, development of non-invasive alternatives, and other solutions.
5. Individuals from many fields must come together to undertake a broad-based and collaborative effort to address the challenge, including leaders in horticulture, retail and wholesale nurseries, weed science, ecology, conservation groups, botanical gardens, garden clubs, garden writers, educational institutions, landscape architects, foundations and government.
6. A successful invasive plant species strategy will make use of all available tools including voluntary codes of conduct, best management practices, and appropriate regulation. Codes of conduct for specific communities of interest are an essential first step in that they encourage voluntary initiative, foster information exchange, and minimize the expense of regulation.

Appendix B. Literature, Developing A Code of Conduct: The North Carolina Botanical Garden Experience, Peter White

1 White, Peter S. 1999. The Chapel Hill Challenge for Halting Invasives. American Association of Botanical Gardens and Arboreta, Newsletter, November, 1999: p. 3; White, Peter S., 1999. The Chapel Hill Thesis. Botanical Gardens Conservation NEWS Vol. 3, No. 3, p. 13; White, Peter S. 1999. The North Carolina Botanical Garden issues the Chapel Hill Thesis. Southeast-EPPC News 6(4):1-6.

2 White, Peter S. 1997. A bill falls due: botanical gardens and the exotic species problem. The Public Garden April 1997:22-25.

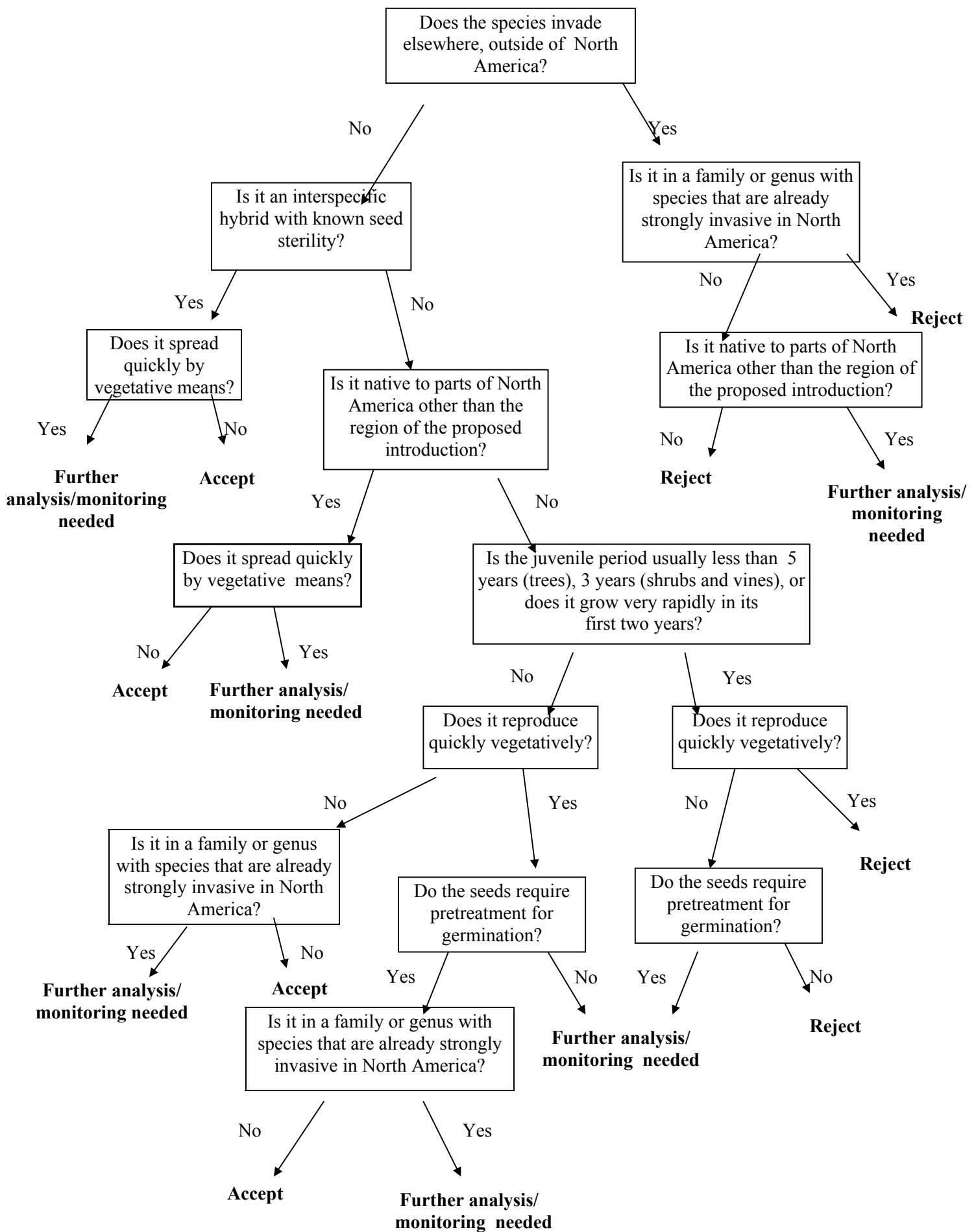
3 White, Peter S. 1998. Biodiversity and the exotic species threat. Pages 1-7 in: Exotic pests of eastern forests (Britton, K., ed.). Atlanta: Tennessee Exotic Plant Council and USDA Forest Service.

4 Doria Gordon, personal communication.

5 Reichard, S. and C. W. Hamilton. 1997. Predicting invasions of woody plants introduced into North America. Conservation Biology 11:193-203.

6 Pheloung, P. C. 1995. Determining weed potential of new plant introductions to Australia. A report on the development of a Weed Risk Assessment system commissioned and endorsed by the Australian Weeds Committee and NMPt Industries Committee. Agricultural Protection Board, Western Australia. 143 p.; White, P. S., and A. Schwarz (1998). Where do we go from here? The challenges of risk assessment for invasive plants. Weed Technology 12:744-751.

7 Harty, F. M. 1993. How Illinois kicked the exotic habit. Pages 195-209 in B. N. McKnight (ed.), Biological pollution: the control and impact of invasive exotic species. Indiana Academy of Science: Indianapolis.



Appendix D. Risk Assessment Methods and Tools Resource List

Invasive Species Government

The Invasive Species Government web site at <http://www.invasive.species.gov> is very useful.

Missouri Botanical Garden

The Garden web site at <http://mobot.mobot.org/W3T/Search/vast.html> is a good general reference with links to other web sites utilized in plant research. Use TROPICOS to search for plant names and their synonyms.

U.S. Department of Agriculture

The U.S. Department of Agriculture web site at http://plants.usda.gov/home_page.html often has biological information about species and is also good for checking for synonyms.

U.S. Agricultural Research Service

The U.S. Agricultural Research Service web site at <http://www.ars-grin.gov/npgs/tax/> has a variety of information about weedy plants.

Flora Europaea

The web page for the *Flora Europaea* project at <http://www.rbge.org.uk/forms/fe.html> will give you information about plant names and synonyms as well as their distributions in Europe.

Flora of China

The *Flora of China* web page at <http://flora.huh.harvard.edu/china/> facilitates searches for Asian plant species with good descriptions of many of these.

Big Weed List

<http://www.agric.wa.gov.au/progserv/plants/weeds/weeds/weedlist.htm> This list by Rod Randall is also known as the "Big Weed List" because it digests thousands of already produced lists of invasive species from around the world. This page offers a great summary for finding out if a species is invasive elsewhere, and where it invades.

Web-based search engines

One example is GOOGLE at <http://www.google.com>. Use the "Advanced Search" option and type the species name into the engine to turn up LOTS of web pages for most species. Web pages that end in ".edu" and ".gov" usually yield reliable information.

Appendix E. Workshop Proceedings Contributors

Betty Alloway

Federated Garden Clubs of Missouri

Jennifer Dowdell

American Society of Landscape Architects

Dr. Kayri Havens

Chicago Botanic Garden

Dr. Kathryn Kennedy

Center for Plant Conservation

Darrel Morrison

University of Georgia

Dr. John Randall

The Nature Conservancy

Dr. Patricia Raven

Missouri Botanical Garden

Craig Regelbrugge

The American Nursery & Landscape Association

Dr. Sarah Reichard

The University of Washington

Jocelyn Sladen

The Garden Club of America

Dr. Peter White

University of North Carolina

Lori Williams

The National Invasive Species Council

Appendix F. List of Participants

List of Participants

Ms. Betty Alloway
Federated Garden Clubs of Missouri
10000 Wornall Road, Apt. 1412
Kansas City, Missouri 64114 USA

Mr. Tony Avent
Plant Delights Nursery at
Juniper Level Botanic Garden
9241 Sauls Road
Raleigh, North Carolina 27603 USA

Ms. Jocelyn Ball
Kansas City Parks and Recreation Department
4600 E. 63rd Street
Kansas City, Missouri 64130 USA

Mr. Richard Barrett
Blue Hills Landscape Consulting
7128 Nall Avenue
Overland Park, Kansas 66208-2351 USA

Ms. Yvonne Baskin
Science Writer
Global Invasive Species Programme
PMB 145
200 South 23rd Avenue, Building D7
Bozeman, Montana 59718 USA

Ms. Rebecca Bech
USDA Invasive Species Coordinator and
Secretary's Liaison to the
National Invasive Species Council
USDA National Invasive Species Council
1951 Constitution Avenue, N. W., Ste. 320
Washington, D.C. 20240 USA

Mr. Pierre Bennerup
Sunny Border Nurseries, Inc.
3637 State Route 167
Jefferson, Ohio 44047 USA

Dr. Robert G. Breunig
Executive Director
Lady Bird Johnson Wildflower Center
4801 La Crosse Avenue
Austin, Texas 78739-1702 USA

Mr. Peter W. Bristol
Curator of Woody Plants
Chicago Botanic Garden
1000 Lake Cook Road
Glencoe, Illinois 60022 USA

Ms. Rebecca Connor
Federated Garden Clubs of Missouri
701 Cannonberry
St. Louis, Missouri 63119 USA

Ms. Sophie Connor
Federated Garden Clubs of Missouri
424 Hawthorne
St. Louis, Missouri 63119 USA

Ms. Carol Dawson
U.S. Bureau of Land Management
1849 C Street, NW, MS:314LS
Washington, D.C. 20240 USA

Ms. Jennifer Dowdell
American Society of Landscape Architects
636 Eye Street, NW
Washington, D.C. 20001-3736 USA

Ms. Kate Fay
Kate C. Fay and Associates
1121 Emerson Street
Denver, Colorado 80218 USA

Dr. James P. Folsom
Director
Huntington Botanical Gardens
1151 Oxford Road
San Marino, California 91108 USA

Mr. William M. Fountain IV
Extension Horticulture Specialist
University of Kentucky
N308g Agriculture Science Center North 0091
Lexington, Kentucky 40506 USA

Mr. John F. Gaskin
Missouri Botanical Garden
P. O. Box 299
St. Louis, Missouri 63166-0299 USA

Ms. Ann Gibbs
Regional President, Eastern Plant Board
National Plant Board
Division of Plant Industry
Maine Department of Agriculture
28 State House Station
Augusta, Maine 04333-0028 USA

Mrs. Cindy Gilberg
Vice President
Gilberg Perennial Farms, Inc.
2906 Ossenfort Road
Wildwood, Missouri 63038 USA

Mr. David Gilchrist
Nursery Technical Adviser
Horticultural Trades Association
England, U.K.

Mr. Hugh Gramling
Executive Director
Tampa Bay Wholesale Growers Association
1311 South Parsons Avenue
Seffner, Florida 33584 USA

Mr. Harlan Hamernik
Bluebird Nursery
P. O Box 460
519 Bryan Street
Clarkson, Nebraska 68629 USA

Dr. Kayri Havens
Manager, Endangered Plant Research
Chicago Botanic Garden
1000 Lake Cook Road
Glencoe, Illinois 60022 USA

Dr. Derald Harp
Assistant Professor
Department of Agriculture
Southeast Missouri State University
1 University Plaza, MS 6100
Cape Girardeau, Missouri 63701 USA

Mr. C. Dale Hendricks
President
North Creek Nurseries
388 North Creek Road
Landenberg, Pennsylvania 19350 USA

Ms. Becky Homan
St. Louis Post-Dispatch
900 North Tucker Boulevard
St. Louis, Missouri 63101 USA

Ms. Joan Hood
First Vice President
Federated Garden Clubs of Missouri
1504 Avenue A
Webster Groves, Missouri 63119 USA

Mr. George Hull
Research and Plant Development
Mountain States Wholesale Nursery
10020 W. Glendale Avenue
Glendale, Arizona 85307-2500 USA

Mr. Andy Jackson
Royal Botanic Gardens, Kew
Richmond, Surrey TW9 3AE
England, U.K.

Dr. Kathryn L. Kennedy
Director
Center for Plant Conservation
Missouri Botanical Garden
P. O. Box 299
St. Louis, Missouri 63166-0299 USA

Mrs. Carole Kroeger
Garden Club of America
c/o The Woodlands
9625 Ladue Road
St. Louis, Missouri 63124 USA

Mr. Rick Lewandowski
Director
Mt. Cuba Center for the Study of Piedmont Flora
Box 3570, Barley Mill Road
Greenville, Delaware 19807-0570 USA

Mr. Paul Lewis
Project Coordinator
Discovering Alternatives to Garden Escapes
Stopping the Spread of Invasive Plants
Nursery and Garden Industry of Australia
P. O. Box 907
Epping, N. S. W. 1710
Australia

Ms. Sandy Lloyd
Executive Officer
State Weed Plan
Department of Agriculture
Locked Bag 4
Bentley, D. C., W. A. 6983
Australia

Dr. Kimberlie McCue
Conservation Coordinator
Missouri Botanical Garden
P. O. Box 299
St. Louis, Missouri 63166-0299 USA

Mr. William A. McNamara
Director
Quarryhill Botanical Garden
P. O. Box 232
Glen Ellen, California 95442 USA

Mr. John C. McPheeters
President
Bowood Farms
c/o 700 South Price Road
St. Louis, Missouri 63124-1867 USA

Mr. R. Wayne Mezitt
President
Weston Nursery, Inc.
P. O. Box 186
Hopkinton, Massachusetts 01748 USA

Ms. Olga Martha Montiel
Assistant to the Director
Missouri Botanical Garden
P. O. Box 299
St. Louis, Missouri 63166-0299 USA

Dr. Harold A. Mooney
Department of Biological Sciences
Stanford University
Gilbert Building
Stanford, California 94305-5020 USA

Dr. Nancy R. Morin
Executive Director
Arboretum at Flagstaff
4001 South Woody Mountain Road
Flagstaff, Arizona 86001-8776 USA

Mr. Darrel G. Morrison
University of Georgia
609 Caldwell Hall
Athens, Georgia 30602 USA

Ms. Laurie E. Neville
Coordinator
Global Invasive Species Program
Department of Biological Sciences
Stanford University
385 Serra Mall/Herrin Labs 477
Stanford, California 94305-5020 USA

Dr. Margaret Pooler
Floral and Nursery Plants Research Unit
United States National Arboretum
3501 New York Avenue, N. E.
Washington, D.C. 20002 USA

Dr. John M. Randall
Director
The Nature Conservancy Invasive Species Program
Department of Vegetable Crops and Weed Science
University of California
124 Robbins Hall
Davis, California 95616 USA

Mr. Rod Randall
Weed Risk Assessment
Department of Agriculture
Locked Bag 4
Bentley, D. C., W. A. 6983
Australia

Dr. Patricia D. Raven
Research Associate
Missouri Botanical Garden
P. O. Box 299
St. Louis, Missouri 63166-0299 USA

Dr. Peter H. Raven
Director
Missouri Botanical Garden
P. O. Box 299
St. Louis, Missouri 63166-0299 USA

Ms. Susan M. Reed
Director, East Central District
Federated Garden Clubs of Missouri
12907 Topping Estates, South Drive
St. Louis, Missouri 63131 USA

Mr. Craig J. Regelbrugge
Senior Director of Government Relations
American Nursery and Landscape Association
1250 I Street, Suite 500
Washington, D.C. 20005 USA

Dr. Sarah Reichard
Research Assistant Professor
Conservation Biology
University of Washington
Center for Urban Horticulture
Box 354115
Seattle, Washington 98195-4115 USA

Mrs. Barbara Simonson
Federated Garden Clubs of Missouri
640 Tarrymore Lane
Kirkwood, Missouri 63122 USA

Mr. Richard Simonson
Litzsinger Road Ecology Center
640 Tarrymore Lane
Kirkwood, Missouri 63122 USA

Ms. Jocelyn Sladen
Vice Chairman
Endangered and Invasive Species
National Affairs and Legislation Committee
Garden Club of America
6712 Blantyre Rd
Warrenton, Virginia 20187 USA

Ms. Kassie Smiley
President
Federated Garden Clubs of Missouri
Route 3, Box 182
Unionville, Missouri 63565 USA

Ms. Jill Spaid
6750 Devonshire Avenue
St. Louis, Missouri 63109 USA

Ms. Carol Spurrier
U. S. Bureau of Land Management
Forest Fish and Wildlife Group
849 C Street N. W., LSB-204
Washington, D.C. 20240 USA

Mr. G. Martin Street, Jr.
Director of Conservation Programs
The Nature Conservancy of Mississippi
Mississippi Field Office
6400 Lakeover Road, Suite C
Jackson, Mississippi 39213 USA

Mr. John Swintosky
Landscape Architect
Jefferson County Parks and Recreation
P. O. Box 37280
Louisville, Kentucky 40233-7280 USA

Dr. Susan Timmins
Plant Ecologist
Science & Research
Department of Conservation
P. O. Box 10-420
Wellington
New Zealand

Dr. Lisa K. Wagner
Director of Education
South Carolina Botanical Garden
Clemson University
Clemson, South Carolina 29634-0174 USA

Dr. Peter S. White
Director
North Carolina Botanical Garden
The University of North Carolina at Chapel Hill
CB 3375, Totten Center
Chapel Hill, North Carolina 27599-3375 USA

Ms. Lori C. Williams
Executive Director
National Invasive Species Council
1951 Constitution Avenue, N.W.
Suite 320 – South Interior Building
Washington, D.C. 20240 USA

Dr. Phyllis N. Windle
Senior Scientist, Global Environment Program
Union of Concerned Scientists
1707 H Street, N. W., Suite 600
Washington, D.C. 20006 USA

Dr. George Yatskievych
Curator
Missouri Botanical Garden
P. O. Box 299
St. Louis, Missouri 63166-0299 USA