PENNSYLVANIA DEPARTMENT of
CONSERVATION and NATURAL RESOURCES

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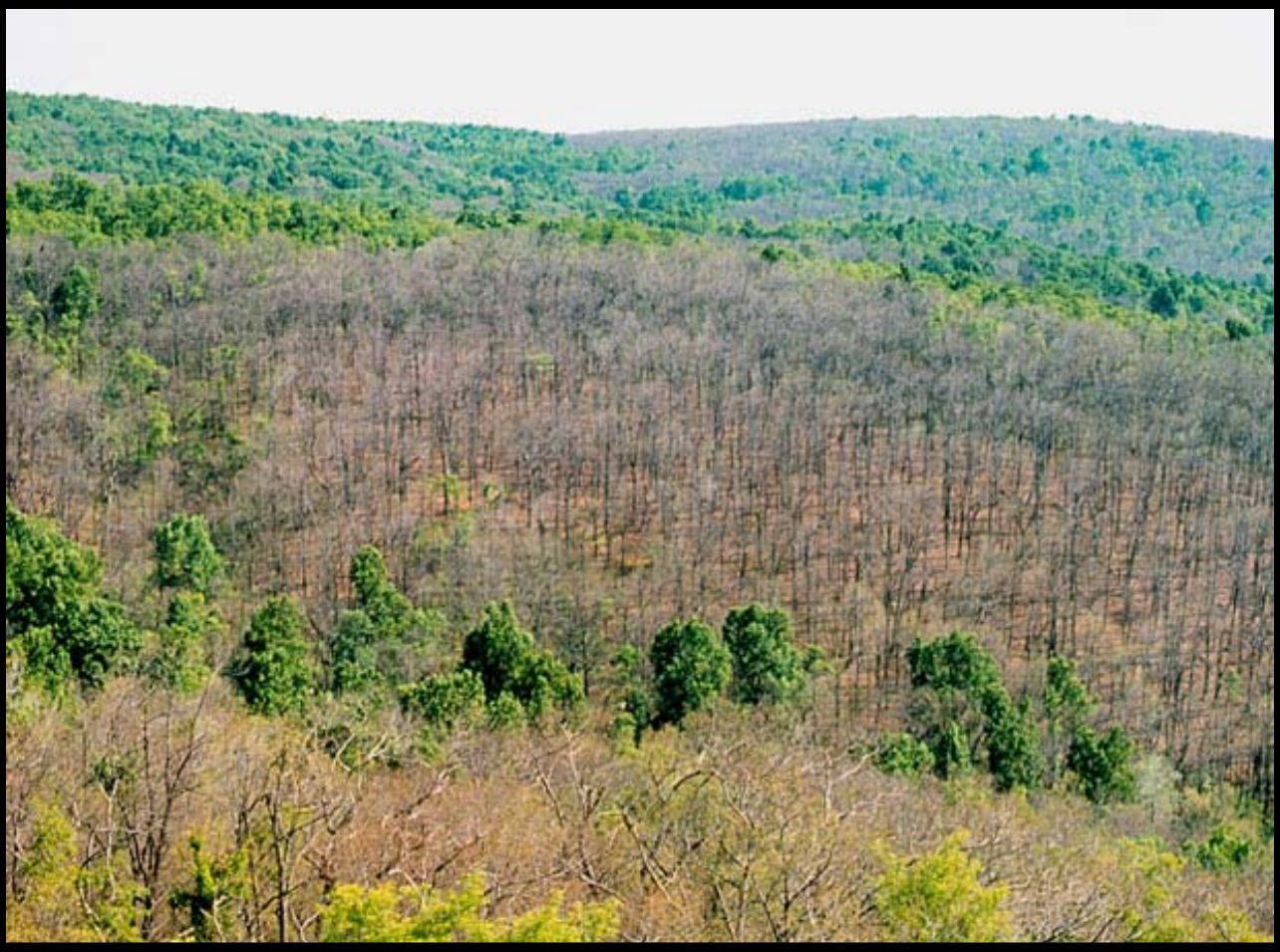
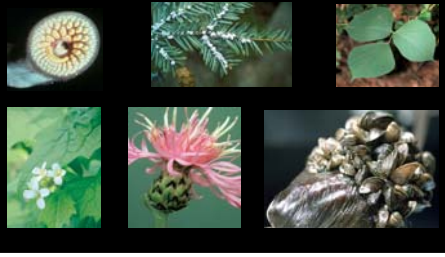


Invasive Species Management Plan



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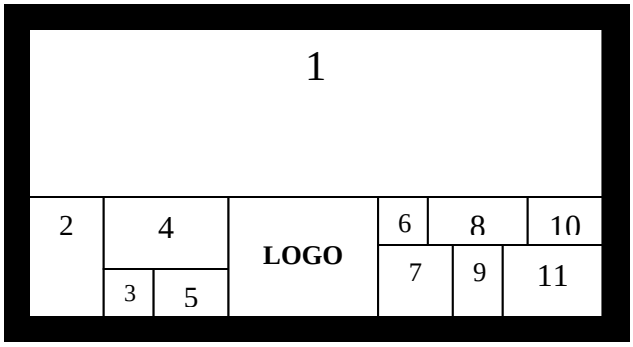

1. *Forest Defoliation by Gypsy Moth* – Mark Robinson, USDA Forest Service
2. *Purple Loosestrife* – Bernd Blossey, Cornell University
3. *Multiflora Rose Blossom* – James Miller, USDA Forest Service
4. *Gypsy Moth Larvae* – USDA Forest Service
5. *Emerald Ash Borer* – Sven-Erik Spichiger, PA Dept. of Agriculture
6. *Sea Lamprey* – U.S. Fish and Wildlife Service
7. *Garlic Mustard* – Jody Shimp, Illinois Dept. of Natural Resources
8. *Hemlock Infestation by Hemlock Woolly Adelgid* – CT Agricultural Experiment Station
9. *Spotted Knapweed* – Cindy Roche, Bugwood Network
10. *Kudzu* – James Miller, USDA Forest Service
11. *Zebra Mussels* – R. Westbrook, U.S. Geological Survey

Logo – Department of Environmental Protection, Graphics Department

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DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES

INVASIVE SPECIES MANAGEMENT PLAN

EXECUTIVE SUMMARY

Invasive species are one of the most significant threats to native ecosystems in the nation. As defined by Federal Executive Order 13112 (1999), a species is considered invasive if it is not native to the ecosystem under consideration, and its establishment causes or is likely to cause economic, environmental or human harm. Governor Rendell recognized the significance of this threat by establishing the *Pennsylvania Invasive Species Council* in 2004 to guide and coordinate invasive species prevention and control efforts at the state level. In response, Pennsylvania's Department of Conservation and Natural Resources (DCNR) proactively established an agency-wide Invasive Species Team to develop and implement the ***DCNR Invasive Species Management Plan***. The plan, based on results of two surveys administered to DCNR land managers and program staff (2004 and 2010), provides broad strategies and recommendations for invasive species prevention, survey and detection, and control. It also addresses appropriate habitat restoration, staff training and public outreach and education.

Major goals of the plan are to:

- Characterize invasive species issues and ongoing control efforts on DCNR lands and adjacent public and private lands
- Align DCNR with national and state-level invasive species initiatives and funding opportunities
- Raise awareness among DCNR staff and the general public about invasive species and their effects
- Provide background information for establishing policies, and addressing invasive species through DCNR management plans, technical assistance and grant programs
- Promote the use of state-of-the-art invasive species management and habitat restoration techniques on DCNR lands
- Incorporate climate change adaptation strategies into DCNR's invasive species prevention and control projects

Broad recommendations of the plan, as applied to Pa. lands and DCNR programs, are:

- Characterize existing and prevent new invasive species infestations
- Further develop opportunities and partnerships
- Incorporate invasive species efforts into existing programs
- Factor in energy extraction and climate change impacts into invasive species management
- Enhance public and staff awareness about invasive species issues
- Prevent and control invasive species, and restore native species
- Match human resources to specific tasks

- Identify funding needs and sources
- Measure progress

The plan will be administered:

- Through existing plans, guidelines and policies
- By incorporation into DCNR's planning process
- Through an annual work plan developed by the DCNR Invasive Species Team

This is the 2nd edition of the DCNR Invasive Species Plan. The Invasive Species Team intends the plan to be a working document that will be updated regularly.

CHAPTER 1 - INTRODUCTION

Purpose of the Plan

Invasion by invasive species has been identified as one of the greatest threats to species biodiversity. Introduction of these species is one of the most unrecoverable and permanent injuries to native biodiversity and the integrity of ecosystem processes. Once established, invasive species are extremely difficult to remove. When removal is possible, it comes at a high cost financially and ecologically. Even after successful recovery, the intricacies of the original ecosystem are often lost indefinitely.

The DCNR Invasive Species Team and additional staff have developed this plan to define issues related to invasive species in Pennsylvania, and to guide control efforts on DCNR lands and through DCNR programs. This strategic effort addresses, through a coherent agency-wide approach, the invasive species problems faced by our land managers, the landowners to whom we provide assistance and the general public.

Definition of Invasive

Federal Executive Order 13112 of 1999 defined an "invasive species" as a species that is 1) non-native (or alien) to the ecosystem under consideration and 2) whose introduction causes or is likely to cause economic or environmental harm or harm to human health. This definition covers all organisms, including vascular plants, animals (including invertebrates), fungi, bacteria and viruses. The Executive Order established the National Invasive Species Council, which developed a National Invasive Species Management Plan. That plan focuses on non-native species that cause significant negative impacts without providing an equivalent benefit to society.

Background – Why is DCNR Addressing Invasive Species?

1. Concern

Many nonnative disease, weed, insect and animal pests currently threaten the forests and recreational resources of Pennsylvania. Examples include emerald ash borer (EAB) (*see photo on right*) that can severely impact timber resources and recreational areas by killing ash trees. Another invasive insect, the Hemlock Woolly Adelgid (HWA), is destroying large swaths of the statewide population of eastern hemlock trees, thus negatively impacting recreational and aesthetic qualities of parklands, and degrading watersheds and terrestrial habitats. Invasive weed species such as Japanese stilt grass (*see photo on left*) adversely affect biodiversity and restrict forest regeneration. Aquatic invasive species like zebra mussels and Eurasian water-milfoil block waterways and restrict recreational use of lakes, streams and estuaries, and reduce the capacity of these waterways and lakes to support native aquatic life.

Invasive species already alter nutrient cycling, hydrology, fire regimes, light penetration levels, regeneration of native species populations and physical habitat structure throughout once healthy ecosystems. The long-term effects of these changes are unknown, but their rate of occurrence raises concern about the ability of native species to adapt, particularly in the face of reducing habitat

availability, increasing human encroachment and the effects of climate change. We have anecdotal evidence that a number of species of special concern are declining and may be lost in the state as a result of invasive species. Recent research has shown that some invasive species can interact to cause the populations of even common species to collapse.

Many invasive species, particularly forest pests, do not directly nor immediately destroy native habitats. Rather, these pests weaken native species and increase their susceptibility to secondary attack or invasion by a different species. For example, forest pests often initiate tree health decline that progresses for multiple years.

Beyond the threat to biological systems, invasive species directly impact a range of human activities and values. The most direct and obvious of these is the serious public health risk posed by some invasive species. West Nile Virus (WNV) is potentially fatal to humans, and giant hogweed plants (*see photo on right*) can cause serious skin burns and sensitivity to sunlight.

In addition to these dangers, invasive species constitute a threat to our economy and overall quality of life. The Brookings Institution 2003 report *Back to Prosperity* underlines the importance of Pennsylvania's "beckoning landscapes and superb natural assets" to the future vigor of Pennsylvania's economy. Among these assets are the many opportunities for outdoor recreation in natural landscapes. Invasive plants like Japanese knotweed (*see photo on left*) and mile-a-minute now create nearly impenetrable walls of vegetation along many miles of Pennsylvania's most scenic waterways. Such invasive plant infestation interferes with access to the rivers by recreational boaters, sporting anglers and others; as well as completely alters the aesthetics of the area, greatly degrading the general visitor experience.

In our many historic landscapes, the vegetation encountered at the time of an event or period of interest has often been replaced by more recent arrivals from around the world. Our shared heritage and the quality of visitor experiences are at risk following the encroachment of invasive species into an historic area.

The threat that climate change poses to the natural world also impacts invasive species. Environmental impacts due to climate change can enhance the spread of invasive species through range expansion and habitat alteration. Research has demonstrated that increased carbon dioxide in the atmosphere, altered precipitation patterns and higher average temperatures can enhance the success of invasive species.

Controlling invasive species is expensive. DCNR's Division of Forest Pest Management (FPM) is spending $220,000 of combined state and federal funds for Hemlock Woolly Adelgid suppression on DCNR lands over the next two years (2011-2012). FPM spends $500,000 in combined federal and state funds each year for forest pest surveys in Pennsylvania. The cost of the gypsy moth suppression program ranges from $500,000 to $10 million *per year*. Special projects are being funded over the next two years by the USDA Forest Service and FPM to evaluate emerald ash borer

management, conduct surveys for Asian Longhorned Beetle, Hemlock Woolly Adelgid, Emerald Ash Borer and other forest pests.

Many parks and forest districts have identified the need for additional resources to address the invasive species issues that threaten the quality of park habitats and visitor experiences. The impact of invasive species challenges the abilities of land managers to provide natural resource stewardship for public and private lands.

2. National Council and Management Plan

The National Invasive Species Council, established by Executive Order 13112, estimates that invasive species cost the U.S. at least $132 billion per year. The Council, established on the federal level to provide leadership and coordinate federal efforts to manage invasive species, developed a National Management Plan in 2001, with an update in 2008. The plan identifies activities needed for federal agency leadership and coordination, prevention, early detection and rapid response, control and management, restoration, international cooperation, research, information management, and education and public awareness. Federal activities affect funding and technical assistance related to state-level invasive species detection and control. Credible state invasive species management plans identify shared priorities with the federal effort, and help foster coordination in implementing both federal and state plans.

3. Pennsylvania Invasive Species Council

In January of 2004, Governor Rendell issued an Executive Order establishing the Governor's Invasive Species Council. The Order recognized the importance of controlling invasive species, and established the Council to: 1) advise and direct development and implementation of a state invasive species management plan; 2) provide guidance on prevention, control and rapid response initiatives; and 3) facilitate coordination among invasive species management efforts at all levels. The Council has representation from DCNR, as well as the Departments of Agriculture, Environmental Protection, Health, Transportation, Fish and Boat Commission, and Game Commission. The Council also has members of the public representing agriculture and natural resource organizations and educational institutions. Using the DCNR Invasive Species Management Plan as a guide, the Council created a statewide invasive species plan that is available to the public on its website at www.invasivespeciescouncil.com.

4. Existing federal and state laws and regulations dealing with invasive species

DCNR's invasive species activities exist within the context of other state and federal initiatives. A number of federal and Pennsylvania laws and regulations address both aquatic and terrestrial invasive species. These laws and regulations apply to DCNR lands and waters, and are listed in Appendix 1. A large number of bills addressing various aspects of invasive species have been introduced in Congress. They address control efforts for individual species, as well as broad planning and policy activities to protect public lands from the effects of invasive species (see www.invasivespeciesinfo.gov/laws/main.shtml).

5. Staff and stakeholder recommendations

Extensive in-house surveys (2004 and 2010), as well as a stakeholder meeting conducted by the Bureau of Forestry (BOF) in 2004, documented that invasive species are a problem on DCNR lands, and that there are high priority needs for inventories, controls, staff and public education and training, and resources to address needs. The recommendations that emerged from the initial planning process, as well as those that have developed in the years since then, have been incorporated into this invasive species plan.

Goals, Objectives and Accomplishments of the DCNR Plan

Goal 1: To clearly characterize the invasive species issues and ongoing control efforts on DCNR lands and adjacent public and private lands.

Objectives:

- Highlight identified issues and needs through a DCNR staff survey.
- Encourage science-based inventories, surveys, monitoring and control efforts.

Accomplishments:

- Summarized results of the invasive species surveys conducted early in 2004 and 2010.
- Surveyed for and monitored populations of various invasive insects, diseases and plants statewide.

Goal 2: To place DCNR in alignment with national and state-level invasive species initiatives and funding opportunities.

Objectives:

- Describe these initiatives.
- Recommend ways for DCNR to participate.

Accomplishments:

- Aligned with Federal Hemlock Wooly Adelgid initiatives.
- Aligned with national Emerald Ash Borer "Don't Move Firewood" campaign.
- Follow The Nature Conservancy's control protocols.
- Received federal funding from USDA and other agencies.

Goal 3: To raise awareness among DCNR staff and the general public about invasive species and their effects.

Objectives:

- Identify and outline educational needs and programs to address them.
- Identify educational tools, funding sources, technical assistance, information and partnerships.

Accomplishments:

- Developed and held trainings on invasives ID and control for DCNR staff.
- Gave presentations and workshops to external groups and the public.
- Created the Invasive Exotic Plant Management Tutorial website for both staff and the public to learn how to ID and control invasives.
- Wrote and distributed articles, fact sheets, other publications, and film about invasive species.
- Created interpretive signage for use in state parks that focuses on invasive plants.

Goal 4: To provide background information for establishing policies, and for addressing invasive species through DCNR management plans, technical assistance programs and grant programs.

Objectives:

- Identify applicable programs and planning processes.
- Recommend ways of incorporating invasive species management.
- Further current and endorse new research efforts to gather appropriate information concerning invasive species management.

Accomplishments:

- Incorporated invasive species information into individual state park management plans and the statewide forest resource management plan.
- Inserted language and resources into the DCNR grant programs that promote invasive species management plans, invasive control projects and native plant restorations.
- Developed and implemented invasive species prevention guidelines in rights-of-way guidance and in Marcellus shale permitting guidance.
- Helped secure passage of the 2009 Prescribed Burn bill to enable qualified non-profits to use controlled burns to address invasives and other issues.

Goal 5: To apply modern invasive species management and habitat restoration techniques on DCNR land.

Objectives:

- Build information-sharing networks for DCNR use.
- Identify appropriate management techniques.
- Identify and prioritize needs.
- Actively manage invasive species on DCNR lands accordingly.

Accomplishments:

- Created the InfoShare website so that park and forestry staff can exchange control method ideas.
- Actively manage invasives on DCNR lands through a variety of control methods.
- Work with academic researchers to test new control methods.

Goal 6: To incorporate climate change adaptation strategies into the agency's invasive species prevention and control programs.

Objectives:

- Identify ways that the impacts of climate change and energy extraction may affect invasive species in the state.
- Identify ways that adaptation strategies can be prioritized and then inserted into existing programs.

Accomplishments:

- Created a climate change adaptation strategy in 2010 that will help incorporate adaptation into the agency's initiatives.

How the DCNR Plan was Developed

1. DCNR Invasive Species Team

In 2003, DCNR's Office of Conservation Science (OCS) established the agency-wide DCNR Invasive Species Team to begin addressing the issue of invasive species on DCNR property. The team quickly determined a need for information about the status of invasive species on DCNR lands on which to base an executive invasive species management plan. The first action of the team was to develop and distribute a survey to all DCNR land managers and appropriate program administrators. The Invasive Species Team reconvened in 2009 to measure the agency's progress since the debut of the first version of the Plan. The team recognized the need for an updated staff survey, so in the spring of 2010, a second staff survey was distributed to agency staff. Survey results, summarized below and in more detail in Appendix 2, helped guide the development of the second edition of this Plan.

2. 2010 Agency-wide Survey Results

DCNR's State Parks, Forest Districts, Regions and Central Office bureaus responded with nearly 100 percent participation to the 18-question survey distributed by the Invasive Species Team. Survey questions were designed to obtain information regarding the (1) severity of the invasive species problem on DCNR and adjacent lands, (2) status of management efforts, (3) status of staff knowledge and needs, (4) existing funding devoted to invasive species control, (5) internal and external partnerships and (6) changes since the 2004 survey. Results from the survey have been compiled and are available on the *IntraDCNR* website.

The following are the most significant results from the survey:

a. Priority within DCNR: In 2010, 67 percent of staff ranked invasive species as a high priority for the agency (rank of 4 or 5); that is an increase of 43 percent since 2004. The number of staff considering invasives as a low priority dropped over that time period to just 2 percent of respondents. Biodiversity and ecosystem function are the two most important criteria for prioritizing invasive projects.

b. Prevention activities: All of the 2010 respondents said that they take preventative measures, up from 70 percent in 2004. Using native plants in landscaping and reaching out to the public are the most common prevention measures used.

c. Survey and detection: More than half the staff responded that they have active survey and detection programs.

d. Staff knowledge: The level of knowledge has increased since 2004. 31 percent of respondents said general invasive species knowledge is moderately high to high; an increase of 19 percent over 2004 levels. The number of people with low knowledge decreased from 64 percent to 26 percent. Knowledge of plant identification is highest, while the ability to ID invasive aquatics and diseases is lowest.

e. Partnerships: The number of staff partnering with outside organizations has doubled since 2004. Partners include federal and state agencies, non-profits, conservancies, universities and volunteer organizations.

f. Research: Management and control techniques are the biggest research needs that park and forest staff has. Some are working with universities and federal agencies on new methods, but more work is needed.

g. Funding and costs: Most respondents are still having trouble controlling their invasive species issues with current funding levels. More than 50 percent of them are not able to control even 20 percent of the species on their lands. The funding that they do have comes mostly from their operating budget, with additional funds from the Bureau of State Parks Resource Management and Planning Division (RMPD), USDA and some private grants.

h. High priority needs: As in 2004, staff in 2010 still have a need for additional funding and staff to deal with their invasive species issues. Training is also an important need, particularly control and prevention measures training.

CHAPTER 2 - PREVENTION

Purpose of Prevention

Preventing invasive species from becoming established can be more cost effective than restoring an injured ecosystem. Controlling established invasive species is costly and difficult, and complete eradication is extremely difficult. Prevention can avoid the potentially permanent species losses that may result from a pest invasion. For instance, nearly half of the species currently listed as threatened or endangered under the U.S. Federal Endangered Species Act are in jeopardy primarily due to invasive species. Initial changes in ecosystem processes and interactions may be undetectable, depending upon the specific species, prior to devastating impacts of invasions.

Preventing Introduction and Spread on DCNR Lands

Preventing the statewide introduction and spread of invasive species will be a difficult task as DCNR has minimal authority on private lands. Reducing the likelihood of invasion on DCNR property is, however, feasible and specific invasive species management techniques used by DCNR may serve as models for implementation on private lands. Land managers must become familiar with regional invasive species. Where heavy infestations on private lands are known to occur, DCNR land managers should monitor property borders and work with private landowners to control infestations and ensure that the invasives do not spread into public lands.

Natural pathways for the introduction and dispersal of pests include wind, water or animals. Areas disturbed by both natural and human causes (roadsides, trails, log landings, energy transmission rights-of-way and construction zones) are particularly susceptible to invasion and should be targeted for prevention efforts (interpretive signs, educational programming, equipment washing), as these are likely sources of seed or propagules for the translocation of invasive species. Motorized and non-motorized transportation devices (including ATVs and bicycles), hikers and horses disturb soils and transport seeds of invasive plants into recreational areas, providing optimum conditions for invasive plants to become established. Unclean watercrafts and angling equipment can transfer aquatic organisms between water bodies. Transport of firewood from one area to another may also encourage invasive species and is responsible for wide distribution of the invasive pest Emerald Ash Borer from Michigan to Pennsylvania. Escapees like wild boar from private hunting preserves can wreak havoc on the natural environment. Special attention is needed on newly acquired properties with varied land use histories. Sites that undergo land use change or disturbance, such as agricultural fields that are allowed to naturally revert to other vegetation communities, are especially susceptible to invasive species establishment.

To prevent the introduction and spread of invasives:

1. **Minimize disturbance when possible, and restore damage caused by unavoidable disturbances**
   Projects planned in relatively intact habitat areas are susceptible to invasive species introductions through disturbance. Project review must include consideration for the likelihood of facilitating invasions. Placing unnecessary trails and roadways in large, unfragmented tracts should be avoided in order to maintain ecosystem integrity. Construction rights-of-way should be minimized to further reduce susceptibility. Cover, mulch, seed or plant the disturbed area to prevent establishment of unwanted plants. Establishing native seed cover is preferred, when appropriate. Monitor the site and control unwanted plants that may appear.

2. **Reclaim/restore recently altered or newly acquired areas**
   Heavily disturbed areas, such as terrestrial habitats resulting from dam removal, are especially prone to invasion. Immediate reclamation of these areas by planting non-invasive plant species is essential. Establishing native species in restoration activities will help create a desired vegetation cover. Newly acquired land should be scouted for invasive species and, if necessary, quickly treated. Prompt action will discourage the disrupted area from serving as a pest source for neighboring tracts, especially if the invasive species is locally unusual or present in large numbers. Care should be taken, however, as equipment used in restoration activities may be vectors for invasive species introductions. Make sure any equipment was not used previously in heavily infested areas and is clean of mud, seeds and other propagules.

3. **Discourage the use of known or potentially invasive plant species**
   Plants that are native to a site should be selected for use in landscaping, whenever feasible. (An exception may be in landscaping an existing structure to represent historical accuracy. In that case, species intended for use should be carefully screened to ensure that known invasive species are not introduced). DCNR technical assistance to private land managers should strongly discourage the use of known or potentially invasive plants.

4. **Use reputable nurseries and seed sources**
   Ask vendors if they are aware of restricted species. Check for "hitch-hikers" in nursery stock, packing materials, and associated locations. Use only certified seed, where feasible.

5. **Use fertilizers wisely**
   The most commonly used supplemental nutrients in agriculture or landscaping include limiting factors in plant growth, principally nitrogen and phosphorous. High nitrogen levels offer a supreme growth factor for all plants, granting a particular advantage to invasive plants. Many invasive species have adapted to use plentiful nutrients for explosive growth; therefore excessive fertilizer application enhances the growth of invasives. Using soil tests to prescribe proper levels of fertilizer is important. The use of native plants will cut down or eliminate the need for fertilizers, as many native plants can grow well without them.

6. **Protect native plant communities**
   A key to controlling invasive plants is to protect native plant communities. Where native plant communities have been displaced, invasive plants thrive, especially on bare soil and disturbed ground. Where native communities are still present, non-invasive plants can move into the empty niche created by the removal of invasive species. Protecting native plant communities from disturbance, deer browse and other threats will strengthen their ability to resist invasion.

7. **Develop invasive species expertise**
   In order to prevent further invasions, land managers must be trained in invasive species identification, inventory and control methods. Training cannot be once and done; new species are discovered and control techniques change, so managers must remain knowledgeable.

8. **Inspect annually for invasive species**
   Effective scouting on state-owned and adjacent private lands will allow managers to identify invasive species before populations increase exponentially and reach levels difficult to control (*see the chapter on Survey and Detection*). Identifying and controlling organisms before populations reproduce will result in greater program success.

9. **Carefully consider location when disposing of mechanically removed invasive plant species**
   Reproductive parts of many invasive plants can withstand seasonal cycles, including drying and freezing, therefore composting invasive species residue is not recommended. Seeds and roots/rhizomes, especially, should be destroyed or carefully collected and discarded with trash to prevent reestablishment.

10. **Prioritize the management of existing on-site invasive species to prevent spread**
    Travel on roadways and trails is a major conduit for invasive species movement, thus control measures should target high traffic areas, as well as areas where new small populations have just been found. For individual projects, invasive species in areas that are frequently revisited should be treated prior to project initiation and monitored throughout project completion. In timber sales, for example, invasive species surrounding areas cleared for log landings or haul roads should be identified and controlled before timber harvesting commences.

11. **Examine common practices to determine how alterations may reduce the risk of invasive species introduction**
    To accomplish this task, the U.S. Fish and Wildlife Service employs a method known as Hazard Analysis Critical Control Point (HACCP) planning. This procedure for preventing introduction does not require each land manager to have detailed knowledge of invasive species present at a site. Employing the use of HACCP planning will allow DCNR to focus efforts and fiscal resources more effectively. See Appendix 7 for more information on HACCP.

12. **Review contracts for opportunities to strengthen prevention measures**
    Added language to existing contracts with internal and external groups (gas or timber leases, for example) may include equipment-cleaning requirements, avoiding the use of equipment that has been recently used in infested areas, liability for new invasive species introductions, disturbed habitat remediation guidelines and other appropriate preventive activities.

13. **Provide voluntary inspections**
    To prevent translocation of specific pests, visitors should be encouraged to voluntarily allow designated personnel to inspect their firewood, boats or bait for presence of invasive species. This is already standard procedure at some locations in Pennsylvania and in many other states.

14. **Know original sources of transferred and used materials**
    Require knowledge of the original source and previous sites of transferred topsoil, fill, shale, firewood or other materials brought into a site. Roadside shoulder material, removed during road shoulder maintenance, can be loaded with invasive plant seeds. If the source of this material supported invasive plants, the contaminated material should not be used in an uninfected area.

Other soil or fill material should be used only with a good plan for weed control following placement. A visit to the site of the material's origin may be necessary to evaluate whether its use is appropriate.

15. **Consider invasive species when making trail decisions and designations**
Consider the need for preventing invasive species introduction when establishing trails and roadways, as there is potential for horses, motorized transportation devices and even hikers to act as pathways of invasion. Avoid the construction of trails through known infestations.

Preventing Introduction of Species Not Yet in Pennsylvania

1. **Pathways**
The most common pathway for introducing insect pests and pathogens is the movement of infested firewood and timber from quarantined areas. In the case of Sudden Oak Death, another common route of introduction is via infected soils or plant materials, such as nursery stock. Certain insects, like the marmorated stinkbug, or invasive plant species, such as mile-a-minute (*see photo on right*) or Japanese stilt grass, are often transported along vehicular routes or on trails. Invasive aquatics like zebra mussels can enter an area on boats or fishing tackle, and rusty crayfish may be in a fisherman's bait bucket. Wild and domesticated animals and wind are also responsible for the introduction or spread of some invasive species. Recognizing the pathways for species introductions will help in identifying prevention tactics for those species.

2. **Changing Conditions**
Prevention activities usually focus on species that are already known to be a threat, yet with the potential impacts of climate change (variable precipitation, increased disturbances, higher average temperatures) there is the possibility that a species that is benign today may become invasive in the future, or that species from much further south can now extend their range into Pennsylvania. Longer warm seasons that favor outdoor recreation could extend the length of time that people inadvertently act as vectors for invasives. Continual monitoring for new species and reviewing research and literature from other states and countries will become more important as climate conditions change.

3. **Prevention methods**
The most common interstate prevention method is the enactment and enforcement of quarantines that restrict or prohibit the movement of infected materials. Monitoring programs along known pathways of introduction and movement may also serve as a preventive strategy.

Preventing Introduction and Spread on Private and Municipal Lands

DCNR has less control over the introduction and spread of invasive species on lands other than state forests and parks. On other lands throughout the Commonwealth, prevention measures will rely on less direct influences that DCNR can exert through funding programs and partnerships with other agencies and landholders across the state. DCNR's grants, external funding processes, outreach and

education provide opportunities to infuse invasive species prevention measures into conservation efforts throughout the Commonwealth.

DCNR provides millions of dollars in grant money every year to participating partners and agencies involved in natural resource conservation efforts, greenways programs, urban and community forestry projects and planning and educational programming. DCNR also has purview of many programs within other agencies and organizations that also provide funding streams for many types of projects and activities across the state. This subsection briefly describes ways DCNR could integrate invasive species prevention measures into funding mechanisms throughout the Commonwealth.

1. **DCNR grants**
   Prevention measures for invasive species are most easily integrated into grant processes over which DCNR has the greatest level of control. Thus, a close examination of existing DCNR grant programs is a high priority objective for the Invasive Species Action Plan. A comprehensive review of existing internal granting programs and processes for their appropriateness in providing for the prevention of invasive species is necessary to accomplish the following:

   - Ensure grant funds are not used to encourage invasive species
     Ascertain that DCNR grant monies are not inadvertently funding the planting of invasive species or otherwise facilitating their introduction or spread.
   - Incorporate grant-selection criteria
     Incorporate criteria to prioritize projects that contribute to invasive species prevention and the use of native plants in landscaping.
   - Require prevention plans and guidelines
     Require an invasive species prevention plan for projects that pose opportunities for the introduction or spread of invasive species.

   A second order objective of this review process is to establish a set of formal guidelines on how to incorporate invasive species prevention measures and concerns into new DCNR grant programs. Training on and dissemination of these guidelines would then be necessary for DCNR staff with roles as grant program decision makers and administrators.

2. **External funding processes**
   As a leading state conservation agency, DCNR should also play a leadership role in providing information and advisory services to other agencies and organizations within the Commonwealth. The DCNR review of external funding mechanisms should serve as a model system to ensure that invasive species prevention measures are applied more efficiently across the state.

   DCNR staff often participates on advisory committees for other agencies and organizations, and as reviewers of grant project proposals for external programs. As such, they should advocate following the activities described in the previous bulleted list.

The following actions provide a starting point towards the overall objective:

- Identify external granting sources
  External grant sources could either inadvertently contribute to spreading invasive species or be used to prioritize/fund prevention measures (e.g. federal or state road-building or other construction and infrastructure funding processes, federal and state agricultural assistance programs or cost-share practices, Departments of Education and Community/Economic Development grant programs).

- Outline decision-making structures
  Outline these for the highest priority funding programs and identify opportunities to influence them either in terms of directing monies for prevention measures or to include prevention measures as prerequisites on projects that pose threats of introducing or spreading invasive species.

- Prioritize Programs
  Priorities should be arranged in terms of strategic impact to the prevention of invasive species. Identify strategic priorities jointly in terms of potential positive contribution to furthering invasive species prevention measures and ability of DCNR to constructively influence desirable changes to funding criteria within a meaningful time frame.

3. Education, outreach and communication

Integrating invasive species information into ongoing education, outreach and communication efforts is essential to fostering public and staff awareness and action. DCNR's existing efforts in providing educational programs and materials offer appropriate channels for the distribution of information regarding invasive species prevention, although competition for resources by other priority issues may interfere at times. The following are identified as high priority educational opportunities for invasive species prevention within the current suite of DCNR educational efforts (*see also the chapter on education, training, and outreach*).

- Demonstration forests
  Currently, nearly every forest district maintains a demonstration forest as a tool for outreach and education to private landowners and other local groups. These outdoor classrooms often focus on the importance of using environmentally appropriate prescriptions while conducting a timber sale. Incorporating information on the importance of preventing invasive species during silvicultural operations would provide a critical arena for disseminating this information to a priority audience. To facilitate such programming during the use of these forests, educational materials and formal training should be provided to service foresters.

- Stewardship plans
  BOF assists private forest landowners in developing forest stewardship plans for their properties. Existing invasive species issues are recognized in current forest stewardship plans, which require more focus on prevention of future invasions. Literature on preventive management to be followed during a timber harvest (similar to materials developed for use at the demonstration forests) should be included in every stewardship plan, as well as a section on other general prevention measures especially appropriate for private forest landowners.

- State Parks educational programming

  Incorporating prevention education into State Parks programming is imperative, as State Park visitors represent a population of varying demographic characteristics. Programming could include pertinent information from invasive species identification to on-site impacts of invasive species. Fun, yet educational activities like weed pull competitions and invasive plant cook-outs can be done at parks statewide. A coherent strategy should be developed to assist state park education program coordinators in providing an effective curriculum on invasive species prevention.

- Other educational programs

  DCNR exerts considerable public influence in other outdoor educational opportunities, such as State Park environmental education centers, Eco Camp, the statewide Envirothon program and through cooperating partners and other agencies with mutual interests in natural resource-based conservation and education (Conservancies, Fish and Boat Commission, Game Commission, Conservation Districts, Cooperative Extension). Sharing curriculum materials and education strategies for invasive species prevention among such partners is critically important to ensure the widest possible social impact of DCNR outreach efforts. This is already being done throughout the agency, and should continue to be done whenever possible.

- Internal training

  After the completion of the 2005 version of the Invasive Species Management Plan, multiple internal training sessions on invasive species identification, prevention and control were held throughout the state (*see photo on right*). Pesticide re-certification and pesticide technician trainings are also being offered by the Bureau of State Parks to DCNR staff. Long term success of maintaining interest in and commitment to prevention measures will require increased coverage on prevention issues during internal management meetings and trainings.

- Wayside exhibits/cooperating portals

  Programs such as Pa. Wilds, Tree Vitalize, and others increase opportunities to reach the public. Several banners and interpretive panels about invasive species have been developed and are available for agency-wide use (*see photo on right*).

- Technical assistance

  Invasive species prevention can also be fostered through technical assistance programs provided by DCNR. The agency should continue to utilize existing sources of technical assistance (service foresters, FPM personnel, BOF Ecological Services Section) and the numerous websites that are available in order to prioritize prevention issues on private lands and throughout district and regional operations.

Prevention Recommendations

1. Require contractors to share the responsibility of preventing the introduction of invasives
Bureaus prepare necessary specifications that are a requirement for pre-approval of the contractor's sources of fill, soil, shale and related materials. Contractors should submit a description of the source, as required for other types of materials. The project inspector or a qualified departmental designee could then inspect the supply source and prohibit its use if contaminated by transferable agents of invasive species. Another option is to specify requirements for contractors to treat and control invasive species on placed fill material for a specified time period. Equipment cleaning and scheduling options (i.e. starting with the least invaded area and later moving to more invaded areas) should also be included, when feasible.

2. Include invasive species prevention methods for private landowners in plans and grants
DCNR can draw attention to and minimize the problem of invasive species by incorporating prevention methods into Stewardship and landowner assistance plans and grants distributed by the Bureau of Recreation and Conservation.

3. Continue to incorporate invasive species prevention sections into state park and state forest district resource management plans
While this has been done for many parks and districts throughout the state, efforts should continue until all plans incorporate this information. These sections should outline appropriate site-specific prevention methods. In addition, there should be a listing of locations requiring frequent monitoring because they are either areas of high spread potential (e.g. frequently traveled roadsides and trails) or "positive deviants," areas that are not yet impacted by invasive species and are biologically sensitive, diverse or unique.

4. Update the Invasive Exotic Plant Management Tutorial website so that it integrates the most up-to-date interstate, intrastate and intra-DCNR property prevention concerns
In addition to containing guidelines for preventing and controlling invasive species, this website also serves as a field guide, facilitating invasive species identification. Exhaustive lists of invasive species known within Pennsylvania and species that threaten to enter the state should be maintained here. As the invasive species issue is very dynamic, this website should allow for continual updates and links to additional information.

5. Develop a list of species that could become invasive or could enter the state if climate conditions change, and determine potential pathways for these species. This list will need to be continuously updated as climate conditions change and as research discovers new species of invasives.

6. Appoint someone within the agency to keep abreast of new developments in invasive species prevention
Prevention is a continually advancing issue that requires constant updating and prioritizing. The scientific community is constantly identifying new threats as researchers are learning more about the impacts caused by specific invasive species. DCNR needs to be aware of the most current information in order to make appropriate decisions to prevent invasive species.

Prevention Accomplishments (2005-2010)

1. The Bureau of Recreation and Conservation has incorporated criteria in their grant program that encourages the use of native plants, thus preventing some potential introductions of invasive plants into the landscape.

2. The Recreation Advisory Committee's invasive species subcommittee was awarded a grant through the Bureau of Recreation and Conservation to design, construct and install six boot brush signs in state parks throughout the state. These interpretive signs educate hikers about the negative impacts of invasive plants, and the attached boot brush allows hikers to brush any seeds off their boots to help prevent the spread of invasive plants (*see photo on right of one at Hills Creek SP*).

3. The Bureau of State Parks worked with Pa. SeaGrant to design and install a series of interpretive signs at boat docks that inform boaters about the need to clean off their boats to prevent the spread of aquatic invasive species.

4. The Bureau of Forestry compiled a list of species that are invasive in other states that may enter Pennsylvania through gas development.

5. The Bureau of Forestry has guidelines for monitoring non-native plantings. These guidelines were implemented as a result of the CAR (Corrective Action Request) received from the Forest Stewardship Council (FSC) about monitoring non-native plantings. BOF must follow these guidelines in order to maintain FSC certification.

6. The Bureau of Facility, Design and Construction typically specifies that contractors must provide a certification from a topsoil supplier that the material is, for example, "99.99% weed free" (or other specified requirement) when topsoil is brought in from off-site and there are invasive concerns.

CHAPTER 3 - SURVEY and DETECTION

Purpose and Goals for Doing Survey and Detection

The purpose of conducting a survey and detection program for invasive species is to:

1) inventory the distribution and abundance of invasive species already present to help establish management priorities; and
2) institute early detection of new invasive species to prevent establishment and eradicate the population.

The following goals have been identified for implementing a survey and detection program for invasive species:

Goal 1: Identify and prioritize species that present the greatest risk.

Goal 2: Identify and prioritize areas of greatest risk due to ecological or historical significance or proximity to a disturbed area or a habitat already containing invasive species. Protecting non-infested areas is of highest priority and is the basis for proactive management.

Goal 3: Identify surveys conducted by other agencies and share data collected by DCNR with other institutions. Sharing information will save time by providing baseline knowledge of nearby areas and increase collaborative capacity.

Goal 4: Maintain awareness of current invasive species research in order to develop and adapt monitoring and management options.

Goal 5: Collect data consistently and in a spatially explicit manner (i.e. using GIS mapping).

Current DCNR Survey and Detection Programs

DCNR staff is currently conducting the following survey and detection programs. Some of the species mentioned below are not yet found in Pennsylvania, and are part of a Federal/State Early Detection and Rapid Response (EDRR) Initiative.

1. Emerald Ash Borer (EAB) – Bureau of Forestry (BOF), Division of Forest Pest Management (FPM)

Several task force agencies are surveying ash trees in Pa. for EAB (*Agrilus planipennis;* Coleoptera: Buprestidae), including FPM, Pennsylvania Department of Agriculture, Animal and Plant Health Inspection Service (APHIS), and USDA Forest Service. Combined data concerning ash trees, state park campgrounds, ash forest product dealers, ash nurseries, and major transportation routes were used to prioritize sampling areas. DCNR inspected ash trees at several sites for signs of EAB infestation, including adult beetles, D-shaped emergence holes, S-shaped larval galleries, woodpecker damage and vertical bark splitting. FPM plans to increase public outreach through informative EAB brochure distribution and media to enlist the general public as volunteers who will help survey for this exotic beetle on private property.

2. Sudden Oak Death (SOD)

SOD is caused by a fungal pathogen, *Phytophthora ramorum*, which is able to injure multiple tree species in addition to oak species that are common to Pa. A risk map is used to determine priority survey areas in state forests and forested areas on the periphery of nurseries. Plant material is collected at survey sites and tested for presence of *Phytophthora ramorum* fungus.

3. Gypsy Moth (GM)

Surveys of GM (*Lymantria dispar*; Lepidoptera: Lymantriidae) egg masses are conducted by FPM and county coordinators each summer. Survey information is used to determine potential need for a biological control (agent: *Bacillus thuringiensis)* spray program the following year. Acres of GM defoliation are also tracked through ground and aerial surveys. FPM staff also survey for the presence of two biological control agents, the GM-killing fungus, *Entomophaga maimaiga*, and the nuclear polyhedrosis virus, by inspecting larval mortality in order to predict population crashes.

4. Hemlock Woolly Adelgid (HWA) **and Elongate Hemlock Scale** (EHS)

The General Hemlock Survey evaluates hemlock condition and infestation level by HWA (*Adelges tsugae;* Hemiptera: Adelgidae) and EHS (*Fiorinia externa;* Hemiptera: Diaspididae). The presence of other hemlock stressors is also noted in the survey and all survey data are compiled into a geodatabase. The General Hemlock Survey provides data on a township level and allows FPM to prioritize biological control and other management activities.

5. Asian Longhorned Beetle (ALB)

Urban and state park street trees that are susceptible to attack by ALB (*Anoplophora glabripennis;* Coleoptera: Cerambycidae) will be inspected for round insect emergence holes, discolored foliage, jagged maturation feeding along the leaf midvein, egg laying scars and toothpick-like frass. Many tree species are sensitive to ALB, especially the following groups: maple, horsechestnut, willow, birch and poplar. DCNR will enlist the public through media outreach in an effort to encourage citizens to look for this exotic beetle on private property.

6. Exotic bark beetles

Exotic bark beetles include a large group of pest beetles that are either a current or pending threat to Pennsylvania forestland. DCNR may use Lindgren funnel traps in the future to attempt to detect exotic bark beetles. Targeted species include *Hylurgops palliates, Hylurgus ligniperda, Orthotomicus erosus, Ips sexdentatus, Ips typographus, Pityogenes chalcographus, Tomicus minor, Tomicus piniperda, Trypodendron domesticum (see photo on right),* and exotic *Ambrosia* beetles in the genus *Xyleborus*. Most of these bark beetles are associated with pine and spruce trees.

7. Beech Bark Disease (BBD)

BBD is caused by a relationship between a scale insect and fungal pathogen, for which the disease is named. Surveys for the introduced beech bark scale (*Cryptoccus fagisuga*) and BBD (caused by *Nectria coccinea*, an introduced pathogen, and *Nectria galligena*, a native pathogen) are conducted by BOF personnel during routine pest surveys. Locations of scale-resistant beech tree populations are also recorded when observed.

8. Invasive plants

As indicated in the Invasive Species Team's staff survey responses, individual state parks and state forest districts conduct surveys for invasive plants. However, many of these surveys are not quantitative and there is currently no agency-wide survey strategy.

Plants that should be surveyed by state park and state forest personnel include, but not limited to:

- autumn and Russian olive (*Elaeagnus spp.*) (*see photo on right*)
- buckthorns (common, *Rhamnus cathartica*) (glossy, *Rhamnus frangula*)
- burning bush/winged Euonymus (*Euonymus alata*)
- butterfly bush (*Buddleja spp*.)
- callery/ Bradford pear (*Pyrus calleryana*)
- common reed (*Phragmites australis*)
- English ivy (*Hedera helix*)
- Eurasian watermilfoil (*Myriophyllum spicatum*)
- European/wild chervil (*Anthriscus sylvestris*)
- European white birch (*Betula pendulata*)
- giant hogweed (*Heracleum mantegazzianum*)
- greater and lesser celandine (*Ranunculus spp*.)
- Asian honeysuckle shrubs (*Lonicera spp*.) (*see photo on right*)
- Hosta (*Hosta spp*.)
- Hydrilla (*Hydrilla verticillata*)
- Japanese honeysuckle vine (*Lonicera japonica*)
- Japanese knotweed (*Fallopia japonica*)
- Japanese barberry (*Berberis thunbergii*)
- Japanese spiraea (*Spiraea japonica*)
- Japanese stiltgrass (*Microstigium vimineum*)
- jetbead (*Rhodotypos scandens*)
- jimsonweed (*Datura stramonium*)
- kudzu (*Pueraria montana*)
- mile-a-minute (*Polygonum perfoliatum*)
- Norway maple (*Acer platanoides*) (*see photo on right*)
- Oriental bittersweet (*Celastrus orbiculatus*)
- princess tree (*Paulownia tomentosa*)
- privets (Chinese, *Ligustrum sinense*) (European, *Ligustrum vulgare*)
- purple loosestrife (*Lythrum salicaria*)

- reed canary grass (*Phalaris arundinacea*)
- spotted knapweed (*Centaurea biebersteinii*)
- swallow-worts (black, *Cynanchum louiseae)* (pale or European, *Vincetoxicum rossicum)*
- tree-of-heaven (*Ailanthus altissima*)
- water chestnut (*Trapa natans*)
- wavyleaf basketgrass (*Oplismenus hirtellus* subspecies *undulatifolius*) (*see photo on right*)
- wisterias (Chinese, *Wisteria sinensis*) (Japanese, *Wisteria floribunda)*

Survey and Detection Recommendations

1. **Create dedicated positions in the bureaus for invasive species programs.**

2. **Include standardized survey protocols for invasive species in State Park and State Forest Management Plans.**

3. **Train DCNR employees in survey and detection methods.**

4. **Institute statewide monitoring programs for early detection and removal of invasive species.**

5. **Develop a centralized database system to store and analyze invasive species survey data**. The Park Information Management System (PIMS) could serve this purpose, as could the mapping at www.ipmapinvasives.org or the Early Detection and Distribution Mapping System (EDDS), housed at www.bugwood.org, that allows an infestation to be mapped and control methods recorded.

6. **Develop a quality assurance program for survey data.**

7. **Develop working relationships with researchers (federal agencies and universities) to create survey protocols that are repeatable and credible.**

8. **Enlist volunteers for survey and detection of invasive species.** For example, Penn State University would like to develop a volunteer training program similar to the Montgomery County Weed Warriors program.

9. **Evaluate and coordinate with other state programs for survey and detection.** For example, continue to work with PGC and USDA on feral swine surveys.

Survey and Detection Accomplishments (2005-2010)

1. Bureau of Forestry is surveying gas development areas for invasive species introductions.

2. Bureaus of Forestry and State Parks are working in conjunction with the Department of Agriculture to survey for wavyleaf basketgrass, which is not yet in Pennsylvania but is over the border in Maryland.

3. Bureau of State Parks has developed a formalized process for survey and detection of invasive species, using two GIS data dictionaries to standardize any data collected. One is used for survey-only efforts and one to track species infestations and control efforts.

4. According to the 2010 DCNR staff invasive species survey, at least 52 State Parks and 10 Forest Districts have programs for invasive plant surveys.

5. Bureau of Forestry and the USDA Forest Service's Forest Inventory and Analysis (FIA) program implemented an improved inventory system for Pennsylvania's forests. One of the improvements includes collecting data on invasive species. This inventory provides insight into the extent of the invasive species problem on both public and private forestlands across Pennsylvania.

CHAPTER 4 - CONTROLLING INVASIVES and RESTORING HABITAT

Purpose of Controlling Invasive Species

Failure by DCNR to effectively address the threat of invasive species will have permanent and widespread repercussions in the realms of biodiversity, recreation, economic growth, public health and safety, historic preservation, eco-tourism, silviculture and wildlife management. Current invasive species management decisions are likely one of most important factors by which future generations will judge our resource stewardship (in addition to our responses to fossil fuel and alternative energy development).

The invasion of certain species creates a significant increase in maintenance costs for the Department and other land managers. In order to maintain activities like recreational boating and timber production, as well as keep roads and other infrastructure clear, a variety of costly procedures are needed. Invasive aquatic plants must be chemically treated or mechanically removed to sustain open waterways for boating. Chemical treatment is also frequently required to control invasive species in silvicultural operations. The need for these expensive activities is expected to increase and spread geographically as various invasive species become more widely established in the state, and as climate conditions change.

Managing invasive species is not optional, although the timing and method of approach may vary by human discretion. Natural resources must be managed in order to maintain recreational and silvicultural options as well as to protect public health, functional ecosystems and the survival of species of special concern. DCNR should proactively maintain and improve the level of ecological integrity inherited from previous managers or invasive species may permanently alter native ecosystems, transform our historic landscapes and entirely eliminate multiple native species.

Planning to Control Invasive Species

Prioritizing areas and species before starting control efforts is important for selecting the most appropriate methods for the target species. Steps involved in developing a simple, brief plan include:

1. **Establish management goals and objectives for the site**
   This should include determining the "Stewardship Value" of a land management area. A "Stewardship Value" is based on an area's uniqueness and degree of disturbance. Areas that harbor rare or threatened flora or fauna, a rare or threatened plant community or an unusually pristine plant community would be high priorities.

2. **Determine which species or populations, if any, block or have potential to block attainment of the management goals and objectives**
   This determination should account for both the potential impact of the species in the site it is found and the extent the species has invaded that site. The more drastically an invasive species could change the current plant community or visitor use of the site, the more severe the impact. A low impact invasive species could co-exist on the site without changing the plant communities or use. Evaluating the extent to which a species occupies a site is necessary to prevent the establishment of high impact invasive species, eliminate small, rapidly expanding infestations and prevent further spread of established species. The highest priority goes to highly negative species that are perhaps not yet even on the property but are nearby, and "leading edge" or early detection locations of those species.

3. **Determine which methods are available to control the invasive**
   This accounts for the resistance of the infestation to control using the resources at your disposal, and the effort required to restore the site. Transitioning from an extensive infestation to a sustainable desirable plant community may not always be feasible with the resources at your disposal, or some species are just so prevalent in the state (gypsy moth, for example) that eradication is impossible. The highest priority for control is given when the invasive species can be selectively removed at the site, leaving a relatively intact native plant community. The next species and areas to be worked on would be those that can be removed and desirable vegetation will reclaim the site by keeping the invasive species suppressed. Areas requiring planting or seeding of desirable species after suppression of the invasive species should be addressed next. A site that probably cannot be restored with the resources available would be the lowest priority for control.

4. **Develop and implement a management plan designed to move conditions toward management goals and objectives**

5. **Monitor and assess the impacts of management actions in terms of their effectiveness in moving conditions toward these goals and objectives**

6. **Reevaluate, modify, and start the process again**

Control Methods on DCNR Lands

1. **Invasive plant control**
   Many different methods can be used to control invasive species on DCNR lands. Preventing the introduction of invasive species is less costly over time than trying to manage them. This approach requires a concerted effort to either prevent the initial introduction of the species or the ability to recognize and contend with populations as soon as they appear. Control methods depend on the species being controlled and the characteristics of the site being treated. Target species must be identified in individual parks and forest districts. Risks of each control method must be considered against the benefits of successful suppression. These controls might include biological control, synthetic pesticide application, mechanical control or prescribed fire. In many cases, necessary information regarding effective control is not currently available. Even control methods that work well under current climate conditions may have their efficacy tested by the impacts of climate change, so managers must be up-to-date on the latest research on control methods.

   Biological control uses an organism that is a natural enemy of the pest in its home range. This method may follow ‘classical’ or ‘augmentative’ methods. Classical biological control allows released agents to become permanently established, while augmentative control ascertains that released populations will die after very little or no regeneration. The control agent is often another exotic species. A biocontrol example is shown to the right – *Galerucella* beetles feed on the leaves on purple loosestrife.

Mowing and hand weeding are two methods of mechanical removal of invasive plants. Mowing can be effective when terrain permits and the loss of other vegetation on the site is not a concern. Mowing is effective to reduce biomass and allows for a more judicious pesticide application to eliminate resprouting. Volunteers can assist with hand removal, although this requires time, correct plant identification and removal, without unnecessary site disturbance.

Pesticides effectively control invasive species under many different environmental conditions, but application methods may be challenging and expensive. Herbicide use may raise concerns about effects on non-target species, water quality, residual chemicals in the environment and associated health hazards.

Prescribed fire has the potential for controlling some species, especially tree species with thin bark and those species that do not regenerate well. The ability to use prescribed fire effectively depends on weather and fuel conditions, and factors such as air quality limitations.

2. Insect and disease suppression programs

BOF's Division of FPM manages monitoring and control programs for many exotic insects and diseases throughout Pennsylvania. The Division has a long established suppression program for gypsy moth on forestlands owned by DCNR using biological insecticides as the principal control tactic. In 2010 and 2011, the division is again working with the Bureau of State Parks and within the BOF District Forests to control HWA populations on high-value eastern hemlock trees. Soil and tree injections of a systemic insecticide (*see photograph on right*) are used to suppress high populations of HWA. The BOF has released natural enemies of the adelgid since 1999 to establish populations of natural predators.

Proper timber harvesting may also be used to prevent the spread of forest pests from one forested region to another, particularly urban and residential greenways. Pest containment is critical and may be achieved by harvesting infested or potentially infested trees to create an isolated area for further pest treatment. If infested trees are removed, they must be discarded carefully to prevent the spread of the invasive pest.

3. Animal control methods (not including terrestrial insects)

DCNR partners with other regulatory agencies, land managers, private landowners and Non-Government Organizations to identify, report and prevent the proliferation of invasive animal species on DCNR property, both land and water. DCNR enlists the help of these groups to educate staff about identification and prevention measures. Control of invasive animals, both aquatic and terrestrial, should be done in conjunction with these organizations. Information about these groups is provided in Appendices 3 and 7.

Control Opportunities on DCNR Lands

1. **Funding for prevention and control efforts**
   Dedicated funding must be made available to state parks and forest districts in order for invasive species be controlled effectively. Current budget limitations do not allow for the staff, time and materials that should be allocated to a control program.

2. **Use of volunteers to control invasive plants on DCNR lands**
   Additional assistance could be obtained through the DCNR Conservation Volunteer program, the Pa. Parks and Forests Foundation (PPFF) Friends' Groups, Americorps or the Student Conservation Association (SCA). Volunteers are diverse in their abilities, knowledge, time availability and interests; they have been extremely valuable to both state parks and forests in efforts such as the maintenance of trails and picnic areas. These same individuals or organized groups could engage in simple mechanical control methods such as plant removal, or could assist with surveying areas to identify existing problems. They would require additional training, coordination and supervision by DCNR personnel.

3. **Silvicultural treatments**
   BOF plans and manages silvicultural treatments on all DCNR lands through the timber sale process. Changes in the statewide timber sale manual to address invasive species issues would provide the opportunity to manage invasive species when timber sales occur.

Control of Invasive Species on Private Lands

1. **Wildfire prevention, suppression and prescribed fire**
   The Division of Forest Fire Protection in BOF is responsible for the prevention and suppression of wildfires throughout the Commonwealth. These activities occur on both public and private lands and involve local municipalities, fire companies and private landowners.

   In addition to fire prevention and suppression activities, BOF is involved in researching the use of prescribed fire as an ecosystem management tool. Prescribed fire was mentioned previously as a potential tool for controlling invasive plants. Although BOF is not advocating the widespread use of fire to control invasive species, research efforts will continue. Prescribed burning could be a useful management tool for private landowners in the future, and it has been made more feasible by the passage in 2009 of the Prescribed Burning Practices Act, which limits the criminal and civil liability for people contracting and performing prescribed burns, as long as the burn plan has been reviewed and approved by DCNR.

2. **Forest pest management**
   Historically, non-native species such as the gypsy moth have caused widespread damage and mortality in Pennsylvania's forests. Counties submit areas of private land to FPM for inclusion in the statewide suppression program.

Currently, the HWA poses a major threat to Pennsylvania's hemlock trees. FPM monitors the spread of this pest through the Commonwealth and provides management advice to private landowners. Currently, DCNR confines direct suppression activities to State Parks and Forests. Since the first edition of the Plan, EAB can now be found in a handful of counties within Pennsylvania. These areas are under quarantine and FPM is doing surveys to detect the presence of EAB outside of the quarantine areas. Other pending threats to Pennsylvania forests include ALB, *Sirex noctilio* (a wood wasp) (*see photo on right*) and SOD. Multi-agency surveys are in place to detect these threats before they become established in the state. If these invasive species become established, FPM would be responsible for coordinating DCNR control efforts with state and federal agencies on both public and private lands.

3. Rural and community forestry

The Rural and Community Forestry (RCF) Section of BOF provides statewide direction and oversight for the Bureau's Service Foresters. Service foresters work locally with landowners, industry, schools, municipalities, and other organizations. Service Foresters have many opportunities to promote the importance of invasive species prevention and control among private forest landowners. RCF will provide the service foresters with the information and materials needed to carry out technical support on the invasive species issues in their district.

Restoration of DCNR Lands

The opportunity for invasive plant establishment should be reduced following any large disturbance, such as insect and disease outbreaks, fires, road stabilization, floods, wildlife openings and oil and gas extraction activities. The frequency of disturbances may increase under changing climatic conditions, so restoration work will be more important than ever. Yet those same climate changes can make restoration more difficult because some of our native species may no longer be able to live under the climate conditions. Creating a restoration plan that takes into consideration those potential changes before a disturbance occurs is ideal and provides the opportunity to reduce the potential for invasive species establishment. Restoration plans should include a determination of which native species may thrive in, or at a minimum tolerate, future climate conditions and avoid those species that may not be suited for the area if the climate should change.

Restoring areas affected by even minor soil disturbance (gas well installation, road building, raking, disking, road construction) may unintentionally provide ideal conditions for invasive seed germination enhanced by overuse of fertilizer, lime and cover crops containing uncertified seed. Uncertified seed mixtures may contain undesirable species that quickly establish and dominate the site. The selection of native plant species for all restoration activities is imperative.

Reclaiming sites not impacted by direct soil disturbance (fires, insect and disease outbreaks) also requires a restoration plan. Changes in light intensity touching the forest floor provide ample opportunities for invasive plant establishment. Minimizing soil disturbance during restoration, reducing fertilizer and lime use and selection of native plant species are important considerations. Restored sites must be monitored frequently, and invasive species populations must be managed immediately after initial detection, for most effective control.

Control and Restoration Recommendations

1. **Prioritize control based on location and species to necessitate information on current distribution of high priority species.**

2. **Develop invasive species control plans to guide control efforts at specific land tracts.**

3. **Develop and implement restoration plans for disturbed areas that advocate practices to reduce potential invasive species establishment.**

4. **Explore and develop funding for invasive species control both on public and private lands through grant and cost sharing programs.**

5. **Explore tools, opportunities and partnerships to expand opportunities for statewide management.**

6. **Encourage use of the Society for Ecological Restoration's restoration guidelines, as applicable** (*see Appendix 4*). These guidelines are intended for large comprehensive restoration projects. The general approach and specific portions of the guidelines are, however, useful for smaller-scale restorations.

7. **Encourage following the St. Louis Declaration Guidelines** (*see Appendix 5*). These guidelines are written for individual landowners, plant nurseries, professionals, government agencies, and other organizations. They may also be used as a teaching tool in environmental education programs and materials.

8. **Identify individuals throughout DCNR who will coordinate control efforts, facilitate communications and develop additional expertise.**

9. **Plans for invasive species control could be included in timber sale proposals.** Either additional funding will be needed to contract control practices or costs must be deducted from the price paid by the timber sale operator. However, this could reduce the revenue to the department from timber sale operations and increase the time needed by staff to administer such activities.

10. **Guidelines developed for preventing and controlling invasive species could be incorporated into fire suppression activities and the bureau's outreach efforts related to wildfire prevention and suppression.**

11. **Provide additional staff and resources to implement these recommendations.**

Control and Restoration Accomplishments (2005-2010)

1. The Bureaus of Forestry and State Parks are using a stem-boring weevil, *Rhinoncomimum latipes* Korotyaev, to control mile-a-minute vine on select state lands. These sites are monitored three times annually and results are sent to USDA APHIS to track the project's progress.

2. The Bureau of State Parks developed an Invasive Species Management Prioritization scheme that factors in stewardship value, invasive species extent, invasive species impact and restoration success into control efforts on state park lands.

3. Nolde Environmental Education Center hired an Americorps team in 2009 to help manage the invasive plants on the property. In previous years other state parks have used volunteer groups like Americorps and the Student Conservation Association (SCA) for invasives work.

4. Various other state park and forest districts are actively managing populations of invasive species and restoring the areas with native plantings.

5. The Office of Communication, Education and Partnerships, the Office of Conservation Science and Forestry staff partnered with the Susquehanna River Trails Association (SRTA) on a purple loosestrife monitoring and biocontrol project. In 2009, several islands on the Susquehanna River were surveyed for purple loosestrife populations. The following year, *Galerucella* biocontrol beetles were released on these islands. Follow-up monitoring will take place in subsequent years.

CHAPTER 5 – PRESSURES ON LAND MANAGEMENT AND RESTORATION

Introduction

Managing natural resources is not an easy task. The environment is constantly changing, resources such as funding and staff time are stretched over many priorities, and technologies come and go. Just when a manager thinks they have an invasive problem under control, along comes a new disturbance to reintroduce the species. Two such disturbances – energy extraction and climate change – will be growing concerns for land managers in the years to come. While the problems are large and statewide, there are some ways that individual land managers can cope with the potential these issues may have to introduce and spread invasive species.

Energy Extraction

Efforts are underway to find alternative sources of energy that are produced locally and have reduced impacts on the environment. These sources include wind, natural gas and biofuels, as opposed to the coal-generated energy that Pennsylvania has relied upon heavily in decades past. While these energy sources are being touted as more environmentally-sensitive than coal mining, they are not without some impacts to the natural world. One concern of all three is that they may facilitate the spread of invasive species through disturbance, habitat fragmentation and inter-state travel of equipment and vehicles. The influence that land managers have on where and how these facilities are sited may be limited, but there are options to minimize the chances that invasive issues will be magnified by these land uses.

Energy Extraction Recommendations

1. **Discourage the construction of well pads, turbine, pipelines, transmission corridors and roads in areas dominated by invasive species.**
2. **Encourage contractors to wash vehicles (especially tires and the interior of water trucks) before they initially arrive on-site and prior to them moving to a new area.**
3. **Replant well-pad areas with plants on the BOF suggested list of plants for revegetation.**
4. **Encourage the use of existing roads, rather than the construction of new ones.**
5. **Insert language into contracts that requires the periodic monitoring and control of invasives on-site and in the surrounding area.**

Climate Change

To land managers, the impacts of climate change may seem far off in the future or beyond their ability to control, but there is strong scientific evidence that climate change in underway. The climate has been changing since the earth was formed, but the pace at which it is now occurring is different. Increased carbon dioxide and other greenhouse gases in the atmosphere are altering climatic conditions. For instance, since 1850 atmospheric carbon dioxide has increased 35 percent; methane, which is 25 times better at trapping heat than carbon dioxide (CO2), has increased 150 percent; and

nitrous oxide, which is 300 times better at trapping heat, has increased more than 20 percent.[1]

How will those climatic changes affect public lands and natural resources? While many of the impacts to the U.S. will not be seen for a few decades, some changes can already be seen:

- Roughly 40 percent of terrestrial species that have been monitored for decades are relocating to stay within suitable climate conditions.[2]
- Periodic cicadas, an insect that spends 17 years underground before emerging as an adult, have been emerging four years earlier.
- The Audubon Christmas bird count shows that 50 percent of North American wintering bird species have moved north an average of 35 miles over the past 40 years – most notably the wild turkey has moves as much as 408 miles.
- Southern invasive species are moving into Pennsylvania. Kudzu is one example of this (*see photo on right*). It has spread north to at least 140 properties in the state.

The species composition of our forests and fields may change considerably in the coming decades due to warming temperatures and changing weather patterns. The manner in which we manage our lands may change, given new invasives moving in and natives moving out. While there is uncertainty about the degree to which climate change will affect the natural world, there are some steps that land managers can take now in order to limit the spread of invasives due to changes in climate.

Climate Change Recommendations

1. **Incorporate climate change adaptation strategies into individual park and forest management plans, as well as into specific invasive species management plans.**
2. **Create revised planting lists that take climate changes (precipitation, temperature, growing seasons) into account.**
3. **Perform genetic-based trials of native and non-native seedlings to see how they perform under varying climate conditions.**
4. **Monitor and inventory plant composition to record changes in species abundance and presence.**
5. **Use GIS mapping to track the results of inventory and monitoring activities.**
6. **Research species that are invasive in southern states and monitor for their movement northward.**
7. **Develop outreach products that educate staff and the public about the connections between invasive species and climate change.**
8. **Seek out additional funds to deal with invasive species issues, as they are likely to grow over the coming decades.**

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[1] Forster et al. "Changes in Atmospheric Constituents and in Radiative Forcing." *Climate Change 2007: The Physical Science Basis.* Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. 2007

[2] Parmesan and Yohe. "A globally coherent fingerprint of climate change impacts across natural systems." *Nature* ,Vol. 421, January 2003

CHAPTER 6 - EDUCATION, TRAINING and PUBLIC OUTREACH

Introduction

The greatest instrument in the prevention and control of invasive species is education. DCNR's Bureau of State Parks environmental education programs reach hundreds of thousands of people each year, while the Bureau of Forestry's Stewardship Program provides Pennsylvania's more than 500,000 private forest landowners with necessary knowledge to manage their forest for resource sustainability. These existing environmental education and stewardship outreach programs, combined with the work of DCNR's other offices and bureaus, offer a unique opportunity to reach a significant population across the Commonwealth. Education that promotes understanding of invasive species issues is a vital basis for partnerships between landowners, managers and the public. Shared knowledge includes recognition of problem species, habitat and land management practices that foster species establishment, and the ecological changes caused by populations. Land managers, both public and private, must be motivated toward recognizing, preventing and controlling invasive species, as well as conducting appropriate restoration of native habitat.

Identification of Educational Resources

1. Existing educational programs

DCNR currently maintains the largest conservation and environmental stewardship education program in the Commonwealth. The topics of invasive species identification and management have been introduced into appropriate education and training programs in the past, and should continue to be done.

2. Human resources and partnerships

Key individuals contribute to the Department's education and training programs. For instance, staff coordinates training programs, partners with external agencies on control work and facilitates cross-agency communication about invasive species issues. DCNR regional coordinators have been identified for the Bureau of Forestry; this should be done for other bureaus as well.

Development of Invasive Species Education and Training Programs

1. Target audiences
   Each education or training program will have its own unique audience(s). Staff will need to identify specific target audiences and their needs, based on the audiences' involvement with the prevention, detection, and management of invasive species. Potential target groups include: DCNR land managers and selected staff, DCNR support staff, partners/cooperators, private forestland owners, farmers, drilling and pipeline crews, the educational community and the general public.

2. Messages for each audience
   DCNR land managers and selected staff should continue to be trained to know the objectives of the invasive species plan, how to identify the invasive species that exist or could exist in their area, and effective management actions to deal with particular species. Education and training must continue to raise awareness of past actions that allowed invasive species to proliferate. Municipal officials and private landowners and managers need similar materials covering all aspects of identification, prevention and management strategies.

Training for all external groups should provide contact information for reporting detection and basic prevention information. Training for the educational community should include resources and be aligned with PA Department of Education Environment and Ecology Standards and Assessment Anchors. Programming for the general public begins by creating a general awareness of the overall invasive species issue, including impacts on the environment and economy.

3. Tools and methods appropriate for each audience
   Training tools must be sustainable, interesting and applicable to the audience being targeted. Existing tools should be used where available. Trainers and educators should identify additional tools that need to be refined or developed. Consider neighboring states, universities and federal agencies as potential partners.

4. Available teaching personnel matched with needs
   The role of existing and potential partner organizations must continue to be paired appropriately with specific types of training. Local sources of expertise are identified and included in educational and outreach materials. A schedule of upcoming courses or training should be disseminated to field staff through internal communications like emails and the intranet site.

5. Volunteer training
   Training programs specifically directed at volunteers should be included, as they can effectively assist in all phases of identifying and controlling invasive species.

6. Evaluating the program
   An evaluative component must be included in the overall program, in order to examine the success of training and education, thereby providing appropriate guidance for changing needs and directions in the future.

Implementation of Invasive Species Education and Training Programs

DCNR educators, trainers and invasive species coordinators will be responsible for the following on an on-going basis: to train DCNR employees to be knowledgeable about the DCNR Invasive Species Plan; to train DCNR land managers and selected staff to implement the Plan; to establish educational partnerships and outreach opportunities; and to provide continuous communication between DCNR employees and the general public.

DCNR employees will receive premier priority in training activities. DCNR will serve as a model for external groups and organizations. Following the training of DCNR employees, similar education and training programs will be developed for volunteers, partners, cooperators and the educational community.

For DCNR staff, training must be mandatory at a level appropriate to the employee position, and must be a repeated activity. Updates will be provided at recommended intervals on relevant topics. Formal policies may be required for the guarantee of a continuously successful program.

Outreach Recommendations

1. **Continue to revise existing DCNR educational programs to provide invasive species education and training to landowners, land managers and key land management cooperators across the Commonwealth.**

2. **Identify resources, including staff, funding and tools, required to successfully develop and implement the educational, training and outreach components of the DCNR Invasive Species Plan. This includes, but is not limited to, appointing regional invasive species coordinators within all DCNR bureaus.**

3. **Consider how to address the regional differences in invasive species issues.**

4. **Use existing and build new partnerships, especially with universities and colleges, to coordinate and mutually enhance educational materials and opportunities and to foster needed invasive species research.**

5. **Update the Invasive Exotic Plant Management Tutorial website so that it includes the most up-to-date, appropriate protocols for invasive species prevention, detection, survey and control.**

6. **Continue to incorporate messages about invasive species issues into ongoing routine interactions with the public.**

7. **Devise an initiative to evaluate the successes of education and training programs, providing recommendations for future activities.**

Outreach Accomplishments (2005-2010)

1. Bureau of State Parks RMPD holds registered pesticide technician trainings to ensure that staff is up-to-date on new developments in pesticide use and invasive species control methods.

2. The Office of Conservation Science (OCS) worked with BOF and BSP to develop and implement several invasive plant identification and control trainings for field staff throughout the state. The Bureau of Recreation and Conservation staff also participated in some of these trainings.

3. Two-day training programs are offered annually for DCNR staff by the Bureau of Forestry, Ecological Services Section.

4. The Wild Resource Conservation Program awarded a grant to the Mid-Atlantic Plant Pest Council for the creation of an online Invasive Exotic Plant Tutorial for Land Managers that provides detailed information about Pennsylvania's invasive plant species.

5. OCS partnered with other bureaus, offices and outside organizations to develop a series of conferences and bus tours based on sustainable landscapes. Sessions at the events focused on a variety of topics including invasive plant identification and control.

6. Invasive species coordinators have been appointed in each state forest district. Quarterly coordinator meetings keep staff members up to date about the DCNR Invasive Species Plan and train DCNR land managers and selected staff to implement the Plan.

5. Various bureaus within the agency have helped develop fact sheets, brochures, interpretive displays, educational programming and other outreach materials to inform the public about invasive species.

CHAPTER 7 - OVERALL RECOMMENDATIONS

The following are recommendations for actions DCNR should take to effectively and consistently address invasive species on DCNR lands and through DCNR programs.

1. CHARACTERIZE EXISTING PROBLEMS and PREVENT NEW ONES FROM EXPANDING

- Establish an agency-wide survey, detection and reporting program for all types of invasive species on state and adjacent lands and waters.
- Develop a reporting system and a database for the resulting data.

2. DEVELOP OPPORTUNITIES and PARTNERSHIPS

- Identify opportunities to strengthen existing partnerships, from federal to local levels, and develop new cooperative efforts to address invasive species problems through shared missions and resources.

3. INCORPORATE INVASIVE SPECIES EFFORTS INTO EXISTING PROGRAMS

- Provide incentives through existing grant and technical assistance programs to encourage grantee, contractor and private landowner participation.
- Add requirements to existing programs to prohibit use of species known to be invasive, and to prevent activities that encourage their establishment.

4. FACTOR IN ENERGY EXTRACTION AND CLIMATE CHANGE IMPACTS INTO INVASIVE SPECIES MANAGEMENT.

- Work with industry to minimize disturbances, steer land uses away from heavily infested areas and restore lands after development.
- Work with researchers to determine impacts of energy extraction and climate change on natural resources and invasive species.

5. ENHANCE PUBLIC and STAFF AWARENESS ABOUT INVASIVE SPECIES ISSUES

- Continue to develop, revise and distribute protocols and guidelines for invasive species identification, reporting, survey, prevention and control (the Invasive Plant Tutorial may be used for this).
- Continue to develop and make available various educational materials.
- Continue to incorporate invasive species information and issues into ongoing environmental education programs and interactions with the public.
- Develop methods for endorsing and compiling research projects on State Park and State Forest lands and transferring the information to the appropriate DCNR land managers.

6. CONDUCT PREVENTION, CONTROL, and RESTORATION ACTIVITIES DIRECTLY AFFECTING PARKS and FORESTLANDS

- Implement appropriate prevention, control and restoration measures and insert language about these measures into all contracts, leases and land management/maintenance activities.

7. MATCH HUMAN RESOURCES to SPECIFIC TASKS

- Identify and instruct existing employees who can help to implement these recommendations.
- Incorporate invasive species monitoring, detection and control into existing volunteer programs. Where feasible, develop new volunteer programs.
- Identify the need for contractors' services to accomplish specific activities.
- Pair appropriate tasks with members of internal and external partnerships. Allocate specific duties to related administrative teams.

8. IDENTIFY SPECIFIC FUNDING NEEDS and SOURCES

- Develop cost estimates for specific high priority projects.
- Continually revise the list of potential sources for grant funding and cost sharing.
- Identify specific projects for which to obtain grant funding, then develop and submit grant proposals.
- Identify potential implementation and research projects that could be accomplished through existing DCNR grant programs.

9. DEVELOP the MEANS for MEASURING PROGRESS in IMPLEMENTING THIS PLAN, and for UPDATING it PERIODICALLY

- Identify specific action steps for each of the recommendations, and prioritize them.
- Identify both internal and external teams that should have primary responsibility for implementing specific recommendations and action steps.
- Develop an implementation schedule, including regular communication between all involved parties.
- Administer an evaluative system to periodically measure the successes and failures of each new or existing program, including recommendations to future activities.

CHAPTER 8 - ADMINISTRATION and REVIEW of PLAN

The DCNR Invasive Species Team will meet at least annually, but ideally quarterly, to review progress in implementing the plan and to establish a direction for the next year by developing and prioritizing recommendations and activities. A brief implementation work plan, including a budget, will be developed annually outlining objectives and tasks to be accomplished within the upcoming year.

As a dynamic document, this plan will be updated at regular intervals to be established by the Invasive Species Team. Updates will depend on constant feedback from the field and bureaus, including information regarding partnerships with external groups.

Administration Recommendations

1. **Implementation through existing plans, guidelines and policies.**
   Elements of the plan will be integrated into existing management plans, guidelines, and policies.

2. **Incorporate into DCNR's planning process**
   Elements of this Invasive Species Management Plan should be incorporated into DCNR's planning process, especially for improving stewardship and management of state parks and forests, promoting statewide land conservation, and maintaining sustainable and attractive communities. Implementation can occur through the Regional Approach and Private Forest Lands Stewardship priorities, State Park Resource Management Plans, Forest Certification, State Forest Resource Management Plan, and through Environmental Education activities.

3. **Prepare an annual implementation work plan**
   The work plan will identify the following: specific annual goals and associated tasks; staff to lead each task; anticipated funding needs; and expected challenges. The work plan must define the relationships between tasks, partners and ongoing initiatives. Each plan will build on activities and knowledge learned from the previous year's work and should be able to show measurable progress.

4. **Institutionalize a departmental process for updating the plan.**
   The agency needs to determine how often this working document will be updated. At a minimum, it should be revised every five years, but because the pace at which knowledge and research on invasives occurs, a shorter time span may be in order.

APPENDICES

Appendix 1: National and State Invasive Species Laws, Regulations and Initiatives

NATIONAL/ STATE	TITLE	ADMINISTERING AGENCY	DESCRIPTION	WEBSITE
National	Plant Protection Act	US Department of Agriculture – Animal and Plant Health Inspection Service (USDA APHIS)	Regulates movement of plants, plant products, biological control organisms, noxious weeds, articles, and means of conveyance	www.aphis.usda.gov/brs/pdf/plantprotact2000.pdf
National	Noxious Weed List	USDA APHIS	List of aquatic, wetland, parasitic and terrestrial plants	www.aphis.usda.gov/plant_health/plant_pest_info/weeds/downloads/weedlist2006.pdf
National	Federal Domestic Quarantines	USDA APHIS	Lists plant pest quarantines	http://ecfr.gpoaccess.gov/cgi/t/text/text-idx?c=ecfr&rgn=div5&view=text&node=7:5.1.1.1.2&idno=7
National	Injurious Wildlife	U.S. Fish and Wildlife Service	Regulates importation of specified injurious wildlife species	www.fws.gov/contaminants/ANS/pdf_files/50CF_16_10-05.pdf
National	Regulated Plant Pest List	USDA APHIS	Lists plant pests that are regulated	www.aphis.usda.gov/import_export/plants/plant_imports/downloads/RegulatedPestList.pdf
National	Non-indigenous Aquatic Nuisance Prevention and Control Act (NANPCA)	U.S. Coast Guard	Aims to prevent future introductions of harmful aquatic non-indigenous species and controlling existing unintentional introductions	www.anstaskforce.gov/Documents/nanpca90.pdf
National	Federal Ballast Water Regulations	U.S. Coast Guard	Proposing new standards for controlling foreign organisms in ballast water	www.uscg.mil/hq/cg5/cg522/cg5224/bwm.asp
National	Noxious Weed Control and Eradication Act	USDA APHIS	Provides assistance through States to eligible weed management entities to control or eradicate harmful, nonnative weeds on public and private land	www.aphis.usda.gov/plant_health/plant_pest_info/weeds/downloads/7USC7781-S144.pdf

National	Hemlock Wooly Adelgid Management Initiative	USDA Forest Service	Proposing a 5-year initiative to develop and implement hemlock woolly adelgid management strategies. Calls for research and technology development combined with accelerated implementation of management techniques	http://na.fs.fed.us/fhp/hwa/pubs/other_info/hwa_mgt_plan.pdf
National	Don't Move Firewood Campaign	The Nature Conservancy	Encourages private citizens to buy firewood locally and report possible wood pest infestations	www.dontmovefirewood.org
National	Great Lakes Restoration Initiative	US. Environmental Protection Agency (EPA)	Funding to restore and protect the health of the Great Lakes, including Asian carp prevention, ballast water treatment, and aquatic plant control.	www.epa.gov/glnpo/glri
State	Noxious Weed Law, Title 3 P.S. Chapter 5A	PA Department of Agriculture (PDA)	Identifies PA noxious weeds, and prohibits their sale, growth and transport within PA	www.agriculture.state.pa.us
State	Fishing Law amendment of September 2002	PA Fish and Boat Commission (FBC)	Makes it unlawful to sell, offer for sale, purchase, possess, introduce, import, or transport live snakehead fish in PA	www.fish.state.pa.us/water/fish/snakehead/000index.htm
State	Clean Your Gear	FBC	Requires fishing and boating equipment to be cleaned off before leaving an infested area.	www.fish.state.pa.us/fishpub/summary/nuisance.html
State	Fish and Boat Code, Chapter 71	FBC	Propagation, stocking, transport, and importation of fish	www.fish.state.pa.us/rulemakings/182nprp.htm
State	Plant Pest Act, Title 3 P.S. Chapter 5C	PDA	Empowers PDA to take measures to detect, contain and eradicate plant pests	www.agriculture.state.pa.us
State	Emerald Ash Borer Quarantine	PDA	Restricts the movement of restricts the movement of ash nursery stock, green lumber of all hardwood species and any other ash material from the quarantined area	www.dcnr.state.pa.us/forestry/fpm_invasives_EAB.aspx

State	Aquatic Invasive Species Rapid Response Initiative	Great Lakes Regional Collaboration	Improve AIS response capability to insure that agencies can efficiently coordinate and pool resources as soon as a new invader is detected	www.glrc.us/initiatives/invasives/AISUpdate06-2008.html

Appendix 2: Summary of DCNR Staff Invasive Species Survey Results

Approach

DCNR's Invasive Species Team, with representatives from across the agency, developed an 18-question survey to determine the extent of invasive species issues, the level of knowledge about invasive species among the staff, and to determine the need for research and further assistance. Nearly one hundred percent of State Parks and Forest District staff responded, along with many regional and central office staff. OCS compiled the results of the 91 unique responses into a report, which is available on the IntraDCNR website.

Results were grouped under the following areas to facilitate data review and comparison: priority/control/prevention, staff knowledge, staff needs, partnerships, funding and costs, invasive species present and research. A brief summary of the survey results are included below.

Priority, Control and Prevention

Staff seems to recognize that invasive species are an important management consideration. In 2004, 24 percent of the respondents ranked invasives species as a high priority (level 4 or 5), while in 2010, 67 percent ranked them as a high priority; that is a gain of 43 percent. The number of respondents that think invasive species are a low priority (level 1) has also shifted considerably, falling from 24 percent in 2004 to just two percent in 2010: a decrease of 22 percent.

Biodiversity was the most important factor for prioritizing invasive species projects in both 2004 and 2010, followed closely by ecosystem function. Responses for forest regeneration and wildlife habitat were also relatively important and remained constant between 2004 and 2010. More people prioritized tourism and recreation higher in 2010 than they did in 2004; more than half the respondents gave it a low priority (level 1 or 2) in 2004, while only 29 percent gave it the same ranking in 2010: a decrease of 23 percent. "Central Office Request" generally ranked low on the scale in 2004—five individual respondents even added a "0" at the bottom of the scale—while it improved in 2004; most gave it a medium ranking (level 3).

The role of prevention in invasive species management has become more important over the years. In terms of the number of respondents taking preventative measures, 70 percent said they did in 2004, while 100 percent said they did in 2010: a 30 percent gain. Using native plants in landscaping work was the most common preventative measure in both 2004 and 2010, followed by public outreach and education. Minimizing disturbances and using weed free seed mixes were not common practices in 2004 (only three percent responded to each), but they were used much more frequently in 2010 (16 percent for each).

One question that was not asked in the original survey, "Do you conduct site monitoring after a project's completion to determine the presence of invasive species," shows that 55 percent of respondents do site monitoring, 20 percent do not, and the rest either are unsure or it does not apply to them. Performing site monitoring is an important component of prevention for new infestations of invasive species and helps to facilitate control projects should an infestation be discovered.

Survey and Detection
Having a grasp of the number and extent of invasive species in a given area is important when prioritizing control and prevention efforts. An active survey and detection program can help land managers discover new and potentially threatening species before they become an overwhelming issue. Between 2004 and 2010 there has been an increase in the number of staff conducting field surveys: up from 54 percent in 2004 to 62 percent in 2010 (an increase of eight percent). The largest increases took place in park region 1 and central office (gains of 29 percent and 34 percent respectively), while park region 3 had a noticeable decrease (down from 81 percent in 2004 to 38 percent in 2010: a drop of 43 percent).

Staff Knowledge
In general, staff knowledge of invasive species has improved since 2004. Back then 64 percent of the respondents ranked staff knowledge about all invasive species as low to moderately low (1 and 2), while in 2010, 26 percent ranked knowledge of all invasives as low to moderately low: a decrease of 38 percent. In 2004, only 12 percent ranked knowledge as moderately high to high (4 and 5), yet in 2010, 31 percent ranked it as moderately high to high: an increase of 19 percent.

For the levels of moderately high to high, invasive plants knowledge has increased from 28 percent in 2004 to 52 percent in 2010; for insects it decreased from 26 to 23 percent; for non-insect animals it increased from 26 percent to 31 percent; for aquatic species it increased from six percent to 14 percent; and for plant diseases there was an increase from six percent to eight percent. The only decrease in knowledge was in the category of invasive insects, but that was only a three percent decline. While the improvements show that staff is more knowledgeable about invasive species than they were six years ago, there is still room for improvement and future rounds of staff training may be in order.

Staff Needs
Not surprisingly, funding and additional staff are the greatest needs of park and district managers, with 63 percent marking that additional funds are critical (level 5) and 47 percent marking that having more staff is critical. This has remained relatively constant since 2004, with 64 percent noting that more funding was critical and 36 percent marking that additional staff was critical.

The other items that they could select as organizational needs – various forms of training, GIS mapping, technical assistance and policies – were all relatively on an even response level (necessary but not critical).

Of the different forms of training they could select, control methods are the most critical need for staff, followed by prevention and then identification. If staff is able to choose the format in which they receive training, they would most prefer informal “tailgate trainings” (71 percent), followed by “other” DCNR trainings and technical workshops (tied at 62 percent). Online webinars, forest health updates and ecological services section trainings all had roughly the same response rate (around 35 percent). Conferences were the least appealing format for staff, with only16 percent choosing this option.

Partnerships
In 2004, only 14 percent of respondents listed partnerships with other agencies, non-profit organizations or universities for addressing invasive species issues. Partners listed by more than one park or forest district included U.S. Fish and Wildlife Service, USDA Forest Service, Natural Resources Conservation Service, Pennsylvania Department of Agriculture, Pennsylvania Game Commission, Pennsylvania Fish and Boat Commission, and Penn State Cooperative Extension.

All of those same partners are still involved in DCNR projects in 2010, but the list has been expanded to include Friends' groups, universities, Western PA Conservancy, The Nature Conservancy and land trusts. There was an increase in partnerships in 2010; 26 percent of respondents have some form of agreement with outside organizations regarding invasive species (an increase of 12 percent).

Research
Research projects can help our staff identify the best prevention and control methods to use in the field. Unfortunately, in 2004 few parks and forest districts were conducting or cooperating with other organizations on research projects. More respondents listed research partnerships in 2010, although the majority is still not involved. Where research is being done, projects focus on control techniques, education, inventories and monitoring.

To get additional parks and districts involved in research from 2010 onward, we need to look at their research needs. According to the 2010 survey, management and control techniques are the biggest research need for staff, with 80 percent of respondents selecting it (this was the top choice in the 2004 survey, as well). Surveying came in second with 53 percent of respondents, followed by prevention with 45 percent, and lastly impacts with 34 percent.

Funding and Costs
Controlling invasive species can be an expensive endeavor, and competing management interests within a state park or forest district can limit the funds available to manage the problem. In 2004, only 11 percent of respondents said that at least half of their invasive species problems were being controlled with current funding levels. In 2010, that number more than doubled to over 20 percent. While that gain is positive, the number of respondents noting that less than 20 percent of their invasives problem is being controlled with current funds was more than 50 percent for both years. It appears that some parks and districts have been able to leverage more funds over the past six years but most are still struggling to combat the invasives on their land.

Both in 2004 and 2010, respondents overwhelmingly listed DCNR's unit/operating budget as their main source of funding for invasive species work. Many others listed funds from State Parks Resource Management and Planning Division, while a few Units listed USDA, county conservation districts, U.S. Fish and Wildlife Service, Friends' groups, the ATV fund, the regeneration fund and private donations.

Not all respondents provided a breakdown of their total costs and where they are spent, but for those that did, costs ranged from $250 all the way into the millions for forest pest management contract work. Averages have not been provided as the costs vary so widely from park to park and district to district.

Invasive Species Present

In order to properly manage for, and prevent, invasive species populations on state lands, staff needs to have a grasp of which species are already present. Unfortunately we do not have a sense of what staff believed in 2004, but in 2010, 86 percent of respondents noted that they and their staff know, with reasonable accuracy, the extent of the invasive species problem on their land. About an equal number marked “no” and “unsure.”

The composition of invasive species in a given area is constantly changing as new species move in and others are removed. Between 2005 and 2010, half of the respondents have noticed new species on their lands.

Appendix 3: Contact Information for DCNR Staff and Other State Agencies Responsible for Invasive Species Programs

Plant Protection and Noxious Weeds

Walt Blosser, Chief
Pennsylvania Department of Agriculture
Bureau of Plant Industry
Division of Plant Protection
2301 North Cameron Street
Harrisburg, PA 17110-9408
Office: (717)772-5205
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Melissa A. Bravo, Botanist/Weed Scientist
Pennsylvania Department of Agriculture
Bureau of Plant Industry
Division of Plant Protection
2301 North Cameron Street
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Fax: (717)783-3275
E-mail: mbravo@state.pa.us

Program responsibilities include administration of the Federal and State Noxious Weed Laws and Plant Protection Act; taxonomic identification of plants and weeds; weed surveys (especially for exotic species of limited distribution); noxious weed management and eradication efforts; and maintenance of the State Herbarium. Through the botany program, PDA participates and supports outreach and education efforts for non regulatory weed problems such as invasive plant species of concern and poisonous plant information. Other responsibilities include identification of insects and mites, nematodes, fungi, bacteria, and viruses; and pest survey and management/eradication efforts.

Invasive Plants

Ellen Shultzabarger, Chief
Ecological Services Section
DCNR Bureau of Forestry
400 Market Street, 6th Floor
PO Box 8552
Harrisburg, PA 17105-8552
Office: (717)787-3444
Fax: (717)772-0271
E-mail: eshultzaba@state.pa.us

The Ecological Services Section of DCNR's Bureau of Forestry administers the Department's native wild plant management program. The Wild Plant Program determines statuses (endangered,

threatened, etc.) for plant species within the Commonwealth in cooperation with the PA Biological Survey's Vascular Plant Technical Committee, provides technical representation to the Wild Resource Conservation Board, administers the Wild Plant Sanctuary Program, and is a member of the PA Natural Heritage Program (PNHP). The section is also responsible for providing guidance, procedures and environmental review of activities on State Forest Lands to promote flora, fauna and ecological resources. Ecological Services provides field surveys on State Forest Lands, and also conducts trainings for field staff.

Rachel Wagoner, Park Manager
Resource Management and Planning Division
DCNR Bureau of State Parks
400 Market Street, 8th floor
Harrisburg, PA 17105
Office: (717) 787-6674
Email: rwagoner@state.pa.us

The Resource Management Section uses planning, research, and communication to: protect and preserve the natural, scenic, and outdoor recreation resources of Pennsylvania's State Parks; assess and monitor current resource conditions and define desired resource conditions; provide a logical and consistent framework that allows each park to analyze a broad spectrum of options for long-term management; create an administrative record which demonstrates how resource planning decisions are made in a logical fashion; and provide guidance for development and implementation of park-specific planning.

Jessica Sprajcar, Conservation Program Manager
DCNR Office of Conservation Science
400 Market Street, 9th floor
Harrisburg, PA 17105
Office: (717) 214-7511
Fax: (717) 787-9067
Email: jsprajcar@state.pa.us

The Office of Conservation Science helps the agency incorporate science into its programs and projects. This includes providing technical assistance and training opportunities for staff and the public on invasive plant management and identification. OCS helps coordinate invasive species efforts between the various Bureaus and Offices within DCNR and external partners.

Forest Insects and Diseases

Dr. Donald A. Eggen, Forest Health Manager
DCNR Bureau of Forestry
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Fax: (717)9483957
E-mail: deggen@state.pa.us

The Division of FPM is responsible for protecting forestland from insects, diseases, and other factors affecting forest health. The division promotes programs designed to improve or maintain the health and biodiversity of forest ecosystems. The division's mission is accomplished by evaluating factors affecting the health of trees and forests; utilizing integrated pest management techniques to mitigate the effects of factors on the forest ecosystem; and promoting forest health to the public and forest user community.

Mammals and Birds

Calvin W. DuBrock, Director
Game Commission
Bureau of Wildlife Management
2001 Elmerton Ave.
Harrisburg, PA 17110-9797
Office: (717)787-5529
Fax: (717)787-3292

The Bureau of Wildlife Management oversees the planning and operation of the agency's wildlife research and management programs, including all game, nongame and endangered and threatened wildlife species.

Aquatics and Fish

Robert Morgan, Fisheries Biologist
Pennsylvania Fish and Boat Commission
Bureau of Fisheries
450 Robinson Lane
Bellefonte, PA 16823-9685
Office: (814)359-5129
Fax: (814)359-5153
Email: robemorgan@state.pa.us

The Fish & Boat Commission has nine area fisheries management offices. Fishery managers conduct surveys (biologist reports) of Pennsylvania waters, document the status of fisheries and develop comprehensive plans for managing fishery resources that are consistent with the protection, conservation and enhancement of the quality and diversity of the resource.

Andy Kyle, Environmental Group Manager
Department of Environmental Protection
Field Operations
Regional Coordination and Program Evaluation
DEP - Vector Management
P.O. Box 1467
Harrisburg, PA 17105-1467
Office: 717-346-8241
Fax: 717-346-8591
Email: akyle@state.pa.us

Vector management includes mosquito control for West Nile Virus protection, black fly suppression, rodent control and others. These programs are housed with DEP's Vector Management section.

Reptiles and Amphibians

Chris Urban, Chief
Pennsylvania Fish and Boat Commission
Environmental Services Division
Natural Diversity Section
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Bellefonte, PA 16823-9685
Office: (814)359-5113
Fax: (814)359-5153
curban@state.pa.us

The Division of Environmental Services (DES) was first created in 1971. The Division staff work with expert scientists and engineers from a variety of disciplines to insure that the aquatic resources (both game and nongame) remain protected. Staff reviews thousands of permit applications every year and also reviews environmental laws and regulations that could have an impact on species or their habitats. They also advise other internal PFBC program areas about environmental issues.

Appendix 4: Society for Ecological Restoration International (SER): Guidelines for Developing and Managing Ecological Restoration Projects, 2nd Edition

By Andre Clewell [1], John Rieger [2] and John Munro [3]
Last Revised: December 2005

For the complete text of each of the following sections visit the following web link:
www.ser.org/content/guidelines_ecological_restoration.asp

CONCEPTUAL PLANNING

Conceptual planning identifies the restoration project site, specifies restoration goals, and provides relevant background information. Conceptual planning is conducted when restoration appears to be a feasible option but before a decision has been made to exercise that option. The written conceptual plan captures the essence and character of the potential restoration.

1. Identify the project site location and its boundaries.
2. Identify ownership.
3. Identify the need for ecological restoration.
4. Identify the kind of ecosystem to be restored.
5. Identify restoration goals.
6. Identify physical site conditions in need of repair.
7. Identify stressors in need of regulation or re-initiation.
8. Identify and list the kinds of biotic interventions that are needed.
9. Identify landscape restrictions.
10. Identify project-funding sources.
11. Identify labor sources and equipment needs.
12. Identify biotic resource needs and sources.
13. Identify the need for securing permits required by government agencies.
14. Identify permit specifications, deed restrictions, and other legal constraints.
15. Identify project duration.
16. Identify strategies for long-term protection and management.

PRELIMINARY TASKS

Preliminary tasks are those upon which project planning depends. These tasks form the foundation for well-conceived restoration designs. Preliminary tasks are fulfilled after conceptual planning results in the decision to proceed with the restoration project.

17. Appoint a restoration practitioner who is in charge of all technical aspects of restoration.
18. Appoint the restoration team.
19. Prepare a budget to accommodate the completion of preliminary tasks.
20. Document existing project site conditions and describe the biota.
21. Document the project site history that led to the need for restoration.
22. Conduct pre-project monitoring as needed.
23. Establish the reference ecosystem or “reference.”
24. Gather pertinent autecological information for key species.
25. Conduct investigations as needed to assess the effectiveness of restoration methods and strategies.
26. Decide whether ecosystem goals are realistic or whether they need modification.
27. Prepare a list of objectives designed to achieve restoration goals.
28. Secure permits required by regulatory and zoning authorities.
29. Establish liaison with interested public agencies.

30. Establish liaison with the public and publicize the project.
31. Arrange for public participation in project planning and implementation to fulfill cultural goals.
32. Install roads and other infrastructure needed to facilitate project implementation.
33. Engage and train personnel who will supervise and conduct project implementation tasks.

IMPLEMENTATION PLANNING

Implementation plans describe the tasks that will be performed to realize project objectives. These tasks collectively comprise the project design. The care and thoroughness with which implementation planning is conducted will be reflected by how aptly implementation tasks are executed.

34. Describe the interventions that will be implemented to attain each objective.
35. Acknowledge the role of passive restoration.
36. Prepare performance standards and monitoring protocols to measure the attainment of each objective.
37. Schedule the tasks needed to fulfill each objective.
38. Obtain equipment, supplies, and biotic resources.
39. Prepare a budget for implementation tasks, maintenance events, and contingencies.

IMPLEMENTATION TASKS

Project implementation fulfills implementation plans. If planning was thorough and supervision is adequate, implementation can proceed smoothly and within budget.

40. Mark boundaries and work areas.
41. Install permanent monitoring fixtures.
42. Implement restoration tasks.

POST-IMPLEMENTATION TASKS

The attainment of objectives may depend as much on follow-up activities as it does to the care given to the execution of implementation tasks. The importance of post-implementation work cannot be overemphasized.

43. Protect the project site against vandals and herbivory.
44. Perform post-implementation maintenance.
45. Reconnoiter the project site regularly to identify needs for mid-course corrections.
46. Perform monitoring as required to document the attainment of performance standards.
47. Implement adaptive management procedures as needed.

EVALUATION AND PUBLICITY

Assessments are conducted to ensure the satisfaction of project objectives and goals. The project is publicized for public and technical consumption.

48. Assess monitoring data to determine whether performance standards are met and project objectives are attained.
49. Conduct an ecological evaluation of the newly completed project.
50. Determine whether cultural project goals were met.
51. Publicize and prepare written accounts of the completed restoration project.

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[2]Program/Project Management Division, California Department of Transportation, P.O. Box 85406, San Diego, CA 92186-5406, USA. mfpjrieger@cox.net
[3]Munro Ecological Services, Inc., 900 Old Sumneytown Pike, Harleysville, PA 19438 USA. munroeco@verizon.net

Appendix 5: The St. Louis Declaration on Invasive Plant Species

From: http://www.centerforplantconservation.org/invasives/codesN.html

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. The gathering yielded the Saint Louis Declaration, which consists of two major components:

1. Overarching 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. The draft Voluntary Codes of Conduct were developed recognizing that education must accompany all efforts to address the problem and that some future government regulation may perhaps be needed if such efforts prove insufficient.

Findings

The magnitude of plant dispersal is unprecedented and has allowed dispersal of species that manifest aggressive traits in new areas. 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. The impacts of invasive plant species can occur at times and places far removed from the site of introduction.

Principles ("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.
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.

Voluntary Codes of Conduct for Government

These voluntary codes include requiring risk assessment; fostering international cooperation; collaboration on databases, early warning systems, and monitoring; and enforcing invasive plant species legislation. Governments can lead the development of environmentally sound methods to

control invasive plant species on public lands and promote their control on adjacent private lands; develop partnerships and incentive programs to lessen the impact of invasive plant species, and provide non-invasive restoration materials and education.

Voluntary Codes of Conduct for Nursery Professionals

These voluntary codes include ensuring that invasive potential is assessed prior to introducing and marketing plant species new to North America, when new species are imported follow all laws on importation and quarantine of plant materials across political boundaries; work with regional experts and stakeholders to determine which species in your region are either currently invasive or will become invasive and phase-out existing stocks of those specific invasive species, then identify plants that could be suitable alternatives in your region; and encourage customers to use, and garden writers to promote, non-invasive plants.

Voluntary Codes of Conduct for Gardening Public

These voluntary codes include seeking information on which species are invasive in your area and participating in early warning systems by reporting invasive species you observe; buying only non-invasive species and request that nurseries promote, display and sell only non-invasive species; removing invasive species from your land and replacing them with non-invasive species; asking the media to emphasize the problem of invasive species; inviting speakers knowledgeable on the invasive species issue to speak at meetings and events.

Voluntary Codes of Conduct for Landscape Architects

These voluntary codes include working with local plant ecologists, horticulturists, nurseries, botanic gardens, conservation organizations and others to determine what species in your region are invasive or show aggressive potential; increasing interaction with other professionals and non-professionals to identify alternative plant material and solutions to problems caused by invasive plants; taking advantage of continuing education opportunities; encouraging nurseries and other suppliers to provide landscape contractors and the public with non-invasive plants; and promoting inclusion of invasive species issues in local landscape ordinances.

Voluntary Codes of Conduct for Botanic Gardens and Arboreta

These voluntary codes include establishing an invasive plant assessment procedure with risk assessments and monitoring; considering the removal of invasive species from plant collections; seeking to control harmful invasive species in natural areas; promoting non-invasive alternative plants and educating the public whenever possible; if participating in seed or plant distribution do not distribute known invasive plants except for bona-fide research purposes; participating in early warning systems and the creation of regional lists of concern.; and following all laws on importation, exportation, quarantine, and distribution of plant materials across political boundaries, including foreign countries

Appendix 6: Hazard Analysis and Critical Control Point (HAACP) Planning Information

From: www.haccp-nrm.org/

Managing Natural Resource Pathways Planning Is Everything!

In natural resource work, equipment and organisms are often moved from one location to another. The specific equipment or organism being moved is called the target. Targets could include animals for relocation or stocking for recreation, equipment such as a bulldozers and backhoes, sampling gear such as nets or traps, and even people. Transporting targets provides a potential vector for the spread of non-target species that could potentially invade new habitat. Non-target species are the plants, animals, diseases, pathogens and parasites that are not intended to be moved. As Natural Resource Managers, it is essential that we do our best to remove these hazards from pathways.

Resource management work often creates open pathways that could spread invasive species to unique and critical habitats for already endangered species. Next to habitat loss, invasive species are resource management's biggest challenge. Executive Order 13112, 1998, directs agencies to prevent the spread of invasive species in their work, but few management tools exist to implement this Directive. HACCP planning has been modified from the food industry for natural resource work. Around the world, industry uses the HACCP planning tool to remove product contamination. In natural resource pathways, hitchhiking species are considered contaminants. HACCP's comprehensive planning identifies these species and the risk of contamination while documenting the best management practices used to prevent and remove hitchhikers.

HACCP planning focuses attention on critical control points where non-target species can be removed. Documenting risks and methods used to remove non-target species gives managers a strategic method to make consistent decisions based on identified risks. Planning builds a logical framework of information to weigh risks for species spread against management benefits.

Why? A few errors can have long-lasting affects on agency mission! Additional planning support is available at www.haccp-nrm.org, such as a planning manual, supporting documents, forms and a database of completed HACCP plans.

Appendix 7: Invasive Species Resources

A significant amount of information about invasive species and control methods exists from a variety of sources. Federal and Pennsylvania environmental and conservation agencies administer programs that can fund or provide technical assistance for invasive species surveys, management planning, control and habitat restoration. Within DCNR, individual land managers are gaining experience with invasive species control. Multiple land management teams are already working with partner organizations, and numerous additional potential partners exist. Resources pertinent for DCNR efforts are described here.

SOURCES OF INFORMATION

1. External Agencies

a. Aquatics

Fish, Amphibians, Aquatic Macroinvertebrates, Aquatic Plants: Pennsylvania Fish and Boat Commission, http://www.fishandboat.com/ais.htm

b. Vascular Plants

Noxious Weeds: Pennsylvania Department of Agriculture, Bureau of Plant Industry; link to Noxious Weed list, http://www.portal.state.pa.us/portal/server.pt/gateway/PTARGS_0_2_24476_10297_0_43/http%3B/10.41.0.36/AgWebsite/PublicationDetail.aspx?name=PA-Noxious-Weed-Control-List&navid=11&parentnavid=0&pubid=190&

c. *Animals*

Aquatic Nuisance Species: Pennsylvania Fish and Boat Commission, http://www.fishandboat.com/anglerboater/2001/so2001/leastpostr.pdf

Terrestrial Nuisance Species: Pennsylvania Game Commission, http://www.pgc.state.pa.us/portal/server.pt/community/pgc/9106

2. Information within DCNR

Knowledge on the control, management, prevention and life history of invasive species currently exists within DCNR. Many land managers that are aware of invasive plants have tried particular control methods. In some cases these methods were successful, while in other instances these strategies failed.

Research projects related to invasive species have been conducted on State Park and State Forest land. The Resource Planning and Information section of the Bureau of Forestry monitors research projects conducted on State Forests. Research projects conducted in State Parks are recorded and monitored by Resource Management and Planning Division in the Bureau of State Parks.

Invasive Plants: Ecological Services Section, BOF, 717-787-3444

DCNR, BOF, Division of FPM; Regional Forest Entomologists in District Offices 2, 3, 9, 16, 20

A project funded by the DCNR WRCP created an internet-based tutorial for public land managers that is accessible at www.dcnr.state.pa.us/forestry/invasivetutorial/index.htm. This resource includes identification and management tools for over 60 invasive plant species.

3. Information Sharing

Within DCNR, information sharing on invasive species is informal. Most information about removal strategies, prevention strategies and identification of species is shared when requested from a knowledgeable person within DCNR.

Outside of DCNR there are many resources available for information sharing. Electronic list-serves are a good resource for receiving and giving information. The MA-EPPC (Mid Atlantic Exotic Pest Control Council) maintains a list-serve for members http://tech.groups.yahoo.com/group/ma-eppc/ . Delaware River Invasive Plant Partnership (DRIPP) also maintains a list-serve for information exchange http://groups.yahoo.com/group/DRIPP/ .

4. Ongoing research

Ongoing research on State Park and State Forest lands by external researchers is approved and tracked by each appropriate DCNR Bureau.

PARTNERSHIPS/COOPERATORS

Federal Agencies:

US Army Corps of Engineers:

Philadelphia District (Delaware River Watershed)
Jerry Pasquale, Chief of Environmental Research
Wanamaker Building, Room 600
100 Penn Square East
Philadelphia, PA 19107-3390
Phone: 215-656-6560
Jerry.j.pasquale@usace.army.mil

Baltimore District (Susquehanna River Watershed)
Claire O'Neill, Project Mgr.
PO BOX 1715
Baltimore, MD 21203-1715
Phone: 410-962-0876

Buffalo District (Lake Erie Drainage)
Martin Crosson
1776 Niagara St.
Buffalo, NY 14207
Phone: 716-879-4346

Pittsburgh District (Ohio/Monongahela/Allegheny Rivers)
Central Office Contact:
Bruce Kish
2032 William S. Moorhead Federal Building
1000 Liberty Ave.
Pittsburgh, PA 15222-4186
Phone: 412-395-7205

Field Contact: Pittsburgh District
Conemaugh River Lake Fish and Wildlife Office
1665 Auen Rd Ste A
Saltsburg, PA 15681
Natural Resources Management Branch
Mike Fowles
Fish and Wildlife Specialist
Phone: 724-459-7281
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National Park Service:

Allegheny National Forest
Kevin Elliot, Forest Supervisor
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Warren, PA 16365-0847
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r9_Allegheny_nf@fs.fed.us

Betsy Lyman, Liaison, Northeast Exotic Plant Mgt. Team
National Park Service
Delaware Water Gap NRA
1 River Road
Bushkill, PA 18324
Betsy_lyman@nps.gov
Phone: 570-588-0513

U.S. Department of Interior, The Aquatic Nuisance Species Task Force (an intergovernmental organization dedicated to preventing and controlling aquatic nuisance species) - http://anstaskforce.gov/

US Fish & Wildlife Service:

U.S. Fish and Wildlife Service, National Wildlife Refuge System. Invasive Species Program- http://invasives.fws.gov/ and http://contaminants.fws.gov

US Environmental Protection Agency:

Office of Oceans, Wetlands, and Watersheds
www.epa.gov/owow/invasive_species/links.html

US Geological Survey:

Non-indigenous Aquatic Species (NAS)
This serves as a central repository for spatially referenced, bio-geographic data - http://nas.er.usgs.gov

Natural Resource Conservation Service:

Doug Holy
National Invasive Species Specialist
NRCS-Ecological Sciences Division
PO Box 2890
Washington, D.C. 20250
Phone: 202-720-9096
Doug.holy@usda.gov

NRCS, PA Division
Barry Isaacs
State Biologist
NRCS Pennsylvania State Office
1 Credit Union Place, Suite 340
Harrisburg, PA 17110-2993
Phone: 717-237-2219
Barry.Isaacs@pa.usda.gov

Animal and Plant Health Inspection Service – USDA:

General information web page with links to other USDA and Federal sites,
www.aphis.usda.gov/ppq/index.html

Noxious Weeds
Dr. Alan V. Tasker
Program Manager
301-734-5708
alan.v.tasker@usda.gov

The National Biological Information Infrastructure (NBII). Current Biological Issues: Invasive Species (Hosted by the U.S. Department of Agriculture, this

web site is a gateway to Federal efforts concerning invasive species.) - http://www.invasivespecies.gov/

River Basin Commissions and Sea Grant:

Delaware River Basin Commission
Bob Limbeck
609-883-9500 x-230
Robert.limbeck@drbc.state.nj.us

Susquehanna River Basin Commission
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717-250-3679
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Great Lakes Commission
Eisenhower Corporate Park
2805 S. Industrial Highway, Suite 100
Ann Arbor, MI 48104-6791
734-971-9135

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Interstate Commission on the Potomac River Basin
51 Monroe St., Suite PE-8
Rockville, MD 20850
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Ohio River Basin Commission
Larry Feazall, Executive Director
C/O University of Kentucky
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Pennsylvania Sea Grant
Administrative Office
Pennsylvania Sea Grant
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4701 College Drive
Erie, PA 16563-0101
814-898-6160

Delaware River Watershed Office
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215-806-0894
afaulds@psu.edu

Susquehanna River Watershed Office
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Bethlehem, PA 18015
610-758-6580

Paul Fofonoff
Smithsonian Institute, Marine Invasions Lab
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Non-profit Organizations:

Delaware River Invasive Plant Partnership (DRIPP)
Joanne Steinhart, Coordinator, The Nature Conservancy
jsteinhart@tnc.org

Mid-Atlantic Exotic Pest Plant Council (MA-EPPC)
Steve Young, www.ma-eppc.org/

Alliance for Chesapeake Bay
www.acb-online.org/

National Exotic Marine and Estuarine Species Information System (NEMESIS)
Supported by the Smithsonian Environmental Research Center (SERC)
http://invasions.si.edu/nemesis/index.html, or for general information:
www.serc.si.edu

The Western PA Conservancy
Natural Heritage Program
Charles Bier
412-288-2777

The Nature Conservancy
Director of Freshwater Conservation
Michele DePhilip
717-232-6001

Natural Biodiversity Conservation Strategy
501 15th Street, Suite B
Windber, PA 15963
814-509-6036

Chesapeake Bay Foundation
Harry Campbell, Staff Scientist
The Old Water Works Building
614 N. Front St.

Harrisburg, PA 17101
717-234-5550

Stroud Water Research Center
John K. Jackson
970 Spencer Rd.
Avondale, PA 19311
610-268-2153

The Patrick Center
Dr. Richard McCourt
www.ansp.org
215-299-1139

PA Landscape & Nursery Association
Gregg Robertson
1707 S. Cameron St.
Harrisburg, PA 17104
frobertson@pina.com

INTERNET RESOURCES

Fact Sheets and Identification

Morris Arboretum PA Flora Project www.paflora.org

VA Dept. of Conservation and Recreation, Invasive Alien Plant Species of Virginia www.dcr.state.va.us/dnh/invproj.htm

The Nature Conservancy, Invasive Species Initiative, http://tncweeds.ucdavis.edu/

New England Wild Flower Society, www.newfs.org/invasive/invasive.htm

Plant Conservation Alliance, Alien Plant Working Group, www.nps.gov/plants/alien

National Park Service and U.S. Fish and Wildlife Service, Plant Invaders of Mid-Atlantic Natural Areas

USDA APHIS,
http://www.aphis.usda.gov/oa/invasive/invasive.html

Nonnative Invasive plants of Southern Forests: A field Guide for identification and control,
http://www.srs.fs.usda.gov/pubs/gtr/gtr_srs062/

Invasive Plants Field Guide and Reference: An Ecological Perspective of Plant Invaders of Forests and Woodlands

The Source for Information and Images of Invasive & Exotic Species
www.invasive.org/

Weeds Gone Wild: Alien Plant Invaders of Natural Areas

Non-indigenous Aquatic Species, USGS

Management

Center for Invasive Plant Management, http://www.weedcenter.org/

USDA APHIS, http://www.aphis.usda.gov/oa/invasive/invasive.html

Maryland Native Plant Society, Control of Invasive Non-native Plants,
www.mdflora.org/publications/invasives.htm

Prevention

Center for Invasive Plant Management, www.weedcenter.org/

Hazard Analysis and Critical Control Point (HACCP) Planning,
www.haccp-nrm.org/

General

Federal Interagency Committee for the Management of Noxious and Exotic Weeds (FICMNEW) http://ficmnew.fws.gov

U.S. Geological Survey http://biology.usgs.gov/invasive

Natural Areas Association www.naturalarea.org

A Gateway to Federal and State invasive species activities and programs
http://www.invasivespecies.gov

The National Biological Information Infrastructure, USGS
http://invasivespecies.nbii.gov

Funding

See next page

FUNDING

FUNDING SOURCE	ELIGIBLE GROUPS	DESCRIPTION	WEBSITE
Clean Water Grants Program	(1) community organizations and other nonprofit groups	Creative and innovative projects to teach boaters to reduce their impact on the waters they use, including invasives education.	www.boatus.com/cleanwater/grants/
Aquatic Invasive Species Research and Outreach Program	(1) Individuals (2) institutes of higher education (3) nonprofits (4) businesses (5) State, local and Tribal governments (6) foreign governments and international organizations	Develop information and tools to prevent, monitor and control aquatic invasives of coastal, oceanic and Great Lakes ecosystems.	www.seagrant.noaa.gov/funding/rfp.html
Chesapeake Bay Program Grants	(1) Nonprofits (2) educational institutions (3) State, local and Tribal governments	Reduce and prevent pollution, and improve living resources in the Bay.	www.epa.gov/region3/chesapeake/grants.htm
Great Lakes Program	(1) community/watershed groups (2) nonprofits (3) educational institutions (4) conservation districts (5) Federal, State, local and Tribal governments	Address invasive species issues, protect and restore habitat, correct erosion problems.	www.epa.gov/glnpo/fund/glf.html
FishAmerica Foundation Grants	(1) nonprofits (2) State and local agencies to a lesser degree	Enhance fish populations and improve water quality, including invasives issues.	www.fishamerica.org/grants/index.html
Great Ships Initiative Grants		Offers research services to developers of treatment systems designed to minimize the presence of live organisms in ballast water discharge.	www.nemw.org/GSI/solicitation.htm
Delaware Estuary Watershed Grants	(1) nonprofits (2) State and local governments (3) educational institutions	Provides grants for local organizations that focuses on protecting, improving and taking care of Watersheds in the Delaware Estuary.	www.nfwf.org
Sustainable Watershed Assets Grant	(1) Nonprofits in the greater Philadelphia region	Promote policies, investments and projects that ensure land and water protection.	www.williampennfoundation.org

FUNDING SOURCE	ELIGIBLE GROUPS	DESCRIPTION	WEBSITE
Ballast Water Management Demonstration Program		Supports development, testing and demonstration of technologies that treat ships' ballast water to reduce threat of aquatic invasive species.	www.seagrant.noaa.gov/funding/rfp.html
Watershed Cooperative Agreement Program	(1) Nonprofits with 501(c) 3 status	Restore stream habitat - fishery resources, riparian buffers, pollutant removal.	www.osmre.gov/acsiapplication.htm
Great Lakes Protection Fund	(1) nonprofits (2) for-profits (3) government agencies (4) individuals	Protect and restore the health of the Great Lakes ecosystem.	www.glpf.org/faq/index.html#guidelines
Chesapeake Bay Small Watershed Grants Program	(1) organizations working on a local level	Restore important habitats within the basin, encourage environmentally-sensitive development, land conservation, and land-use planning.	www.nfwf.org
Emergency Watershed Protection	(1) Private landowners (2) conservation districts (3) State and local governments (4) Tribes	Protects against floods, drought, wildfires, etc. Funds for clearing of debris, restoring vegetation and stabilizing river banks.	www.pa.nrcs.usda.gov/programs/ewp.html
Watershed Protection and Flood Prevention Program	(1) conservation districts (2) State, local and Tribal governments	Projects related to erosion and sediment control, wetland creation and restoration and habitat enhancement.	www.pa.nrcs.usda.gov/programs/watershed.html
Wetlands Reserve Program	(1) Landowners (2) Tribes	Provides technical and financial assistance to address wetland, wildlife habitat, soil, water and related natural resource concerns.	www.nrcs.usda.gov/PROGRAMS/wrp
North American Wetlands Conservation Fund	(1) Private or public organizations (2) individuals who have developed partnerships	Restore, manage or enhance wetland ecosystems and other habitat for migratory birds and other wildlife.	www.doi.gov/partnerships/wetlands.html
Partners for Fish and Wildlife Program	(1) Private landowners	Restore habitat, particularly those that protect migratory birds, anadromous fish and species federally-listed as threatened or endangered.	www.fws.gov/partners/index.htm
Floodplain Land Use Assistance Program	(1) municipal governments	Preparation, administration and enforcement of floodplain regulations.	www.newpa.com

FUNDING SOURCE	ELIGIBLE GROUPS	DESCRIPTION	WEBSITE
Coastal Zone Management Grant	(1) state and local governments (2) non-profits; in the Lake Erie or Delaware River watersheds	Funding for wetlands, coastal hazard areas, public access for recreation, non-point source pollution prevention, biodiversity, fisheries management, etc.	www.dep.state.pa.us/river/grants/crmgrants/crmgrants.htm
Coastal Non-Point Pollution Program	(1) state and local governments (2) non-profits; in the Lake Erie or Delaware River watersheds	Improve onsite sewer systems, upgrade marinas, create outreach materials, reduce stormwater impacts.	www.dep.state.pa.us/river/grants/cnpp/cnpp.htm
Coastal and Estuarine Land Conservation Program	(1) state and local governments in the Lake Erie or Delaware River watersheds	Provides matching funds to purchase significant coastal and estuarine lands or conservation easements on such lands.	www.dep.state.pa.us/river/grants/celcp/celcp.htm
Growing Greener Watershed Grants	(1) County and local governments (2) school districts (3) non-profits (4) conservation districts (5) watershed associations	Restore watersheds and streams, remediate acid mine drainage, reclaim mine lands.	www.dep.state.pa.us/grantscenter/ProgramSummary.asp?ID=65
Nonpoint Source Implementation Program	(1) county and municipal governments (2) school districts (3) non-profits (4) conservation districts (5) watershed groups	Funding for abandoned mine drainage, agriculture and urban run-off, streambank stabilization and development of watershed restoration plans.	www.dep.state.pa.us/grantscenter/ProgramSummary.asp?ID=4

FUNDING SOURCE	ELIGIBLE GROUPS	DESCRIPTION	WEBSITE
Bring Back the Natives	(1) nonprofits (2) universities (3) Federal, State, tribal and local governments	Restore native species to their historic range. Preference will be given to projects that will keep sensitive or declining species off of the Endangered Species List, or for listed species that have a chance for recovery and de-listing within 5-10 years.	www.nfwf.org
Treevitalize	(1) community groups and local partnerships	Grants and technical assistance to plant trees in neighborhoods and along streams.	www.treevitalize.net
Grassland Reserve Program	(1) private lands of 40 or more contiguous acres (2) smaller acreage under special circumstances	Helps landowners restore, protect and rehabilitate grassland, rangeland, pastures and shrub land.	www.pa.nrcs.usda.gov/programs/grp/index.html
General Matching Grants Program	(1) Federal, State, local and Tribal governments (2) educational institutions (3) conservation organizations	Address priority actions promoting fish and wildlife conservation and habitats.	www.nfwf.org
Native Plant Conservation Initiative	(1) nonprofits (2) Federal, State and local governments	Restore or protect native plant communities, or conduct inventories and assessments.	www.nfwf.org
Environmental Action Grants	(1) small, grass-roots activist organizations	Build public involvement and support for a specific and focused environmental issue, including biodiversity and ecosystem protection. Must be very action oriented and target the root cause of a problem.	www.patagonia.com/web/us/patagonia.go?assetid=2942
Conservation Reserve Enhancement Program	(1) producers	Land retirement program that protects environmentally sensitive land, decreases erosion, restores wildlife habitat and protects water resources.	www.fsa.usda.gov/FSA
Pulling Together Initiative	(1) nonprofits (2) State and local governments (3) field staff of federal government agencies	Prevent, manage or eradicate invasive and noxious plants and increase public awareness of their adverse impacts.	www.nfwf.org
Environmental Quality Incentive Program Assistance	(1) State and local governments (2) higher education institutions (3) Tribes (4) 501 c3 nonprofits	Projects optimize environmental benefits on farm land that reduce nonpoint source pollution like erosion, and promote at-risk species habitat conservation.	www.pa.nrcs.usda.gov/programs/eqip/Index.html

FUNDING SOURCE	ELIGIBLE GROUPS	DESCRIPTION	WEBSITE
Integrated Research, Education, and Extension Competitive Grants Program	(1) Land grants (2) Cooperative extension offices	Address priority national needs associated with integrated pest management programs. Help pest managers implement IPM methods that will enhance farm conservation efforts and the protection of natural resources.	www.csrees.usda.gov/fo/nationalextensionipmspecialprojectsprogram.cfm
Program of Research on the Economies of Invasive Species Management	(1) public or private research institutions or organizations (2) individuals meeting peer-reviewed professional criteria as economic researchers	Focus on economic issues related to invasive species of agricultural significance or other pests that fall under USDA programs.	www.ers.usda.gov/Briefing/InvasiveSpecies/#Feature
Small Business Innovation Research	(1) Small businesses	Develop new or improved technologies and environmentally sound approaches for wildlife management to reduce the adverse impact of wildlife on agriculture and people (including invasive animal species), and enhance the sustainability of wildlife populations.	www.csrees.usda.gov/fo/fundview.cfm?fonum=1220
Global ReLeaf	(1) government entities (2) private landowners under special circumstances	Fund tree planting on government-owned land (or private land under special circumstances), particularly on larger tracts of land damaged by human or natural causes.	www.americanforests.org/global_releaf/grants
Environmental Initiative Program	(1) nonprofits (2) Local governments	Initiate or implement projects in rural areas to undertake consensus-based activities in environmental stewardship.	www.musserfund.org/enviro.php
Education Foundation of America Grants	(1) Tax-exempt non-profits	The environment, national security issues, the arts, and other interests of the Board members.	www.efaw.org/Inquiry%20Guidelines.htm
Merck Family Fund Grants	(1) non-profits	Protect and restore ecologically valuable land, sustainable forestry.	www.merckff.org/grantguidelines.html
Keystone Initiative Grants	(1) educational institutions (2) Federal, State, Tribal and local governments (3) nonprofits	Engage private landowners, particularly farmers and ranchers, in the conservation of wildlife and natural resources on their lands.	www.nfwf.org
Five Star Restoration Matching Grants Program	(1) any public or private entity, but must include partnership of five organizations	Support community-based wetland, riparian and coastal habitat restoration projects.	www.nfwf.org

FUNDING SOURCE	ELIGIBLE GROUPS	DESCRIPTION	WEBSITE
Matching Awards Program	(1) nonprofits working on or adjacent to National Forests and Grasslands (2) educational institutions	Community-based forestry, watershed health and restoration, wildlife habitat improvement and recreation.	www.natlforests.org/consp_04_map.html
Conservation Innovation Grants	(1) non-Federal governments (2) non-governmental organizations (3) Tribes (4) individuals **project must include producers eligible under EQIP	Stimulate development and adoption of innovative conservation approaches and technologies for environmental enhancement and protection, in conjunction with agricultural production.	www.nrcs.usda.gov/programs/cig
Wildlife Habitat Incentives Program	(1) private landowners (2) owners of Federal land (3) owners of State and local government land on a limited basis (4) owners of Tribal land	Develop and improve wildlife habitat primarily on private lands.	www.nrcs.usda.gov/Programs/whip
Cooperative Endangered Species Conservation Fund Grants	(1) State agencies (2) Private landowners (3) organizations	Aid implementation of various conservation projects and land acquisition to protect Federally listed or endangered species.	www.fws.gov
Landowner Incentive	(1) State agencies with lead management responsibility for fish and wildlife resources	Provide technical or financial assistance to private land-owners to protect, restore, or manage habitat for Federally listed, proposed, or other at-risk species.	http://wsfrprograms.fws.gov/Subpages/GrantPrograms/LIP/LIP.htm
Conservation Technical Assistance	(1) private landowners (2) communities (3) units of State and local governments (4) Federal agencies	Provides conservation technical assistance to participants in USDA cost-share and conservation incentive programs. Can be used for habitat enhancement, wetland improvements and other natural resource issues.	www.nrcs.usda.gov/programs/cta
Private Stewardship Grants Program	(1) Individuals (2) groups	Aid conservation efforts that benefit Federally listed, proposed, or candidate species or other at-risk species.	www.fws.gov/endangered/grants/private_stewardship/index.html
State Wildlife Grants	(1) State agencies with lead management responsibility for fish and wildlife resources that has a comprehensive wildlife conservation plan	Develop and implement programs for the benefit of wildlife and their habitat, including those species not hunted or fished.	http://wsfrprograms.fws.gov/Subpages/GrantPrograms/SWG/SWG.htm
Wildlife Forever Challenge Grant	(1) Conservation groups (2) Sportsmen's groups (3) Outdoor recreation groups	Habitat restoration and acquisition, research and management, and educational projects. Special emphasis on grassroots projects.	www.wildlifeforever.org/grants/overview.aspx

Appendix 8: Glossary of Acronyms in Invasive Species Management Plan

Acronym	Expansion
ALB	Asian longhorned beetle
APHIS	Animal and Plant Health Inspection Service
BBD	Beech bark disease
BOF	Bureau of Forestry
BRC	Bureau of Recreation and Conservation
DCNR	Department of Conservation and Natural Resources
DEP	Department of Environmental Protection
EAB	Emerald ash borer
EDRR	Early Detection and Rapid Response
FIA	USFS Forest Inventory Analysis
FLEP	Forest Lands Enhancement Program
FPM	Division of Forest Pest Management
GM	Gypsy moth
HACCP	Hazard Analysis and Critical Control Point
HWA	Hemlock woolly adelgid
MA-EPPC	Mid-Atlantic Exotic Pest Plant Council
NANPCA	Non-indigenous Aquatic Nuisance Prevention and Control Act
NRCS	Natural Resource Conservation Service
OCS	Office of Conservation Science
PA	Pennsylvania
PCIEP	Pennsylvania Consortium for Interdisciplinary Environmental Policy
PDA	Pennsylvania Department of Agriculture
PNDI	Pennsylvania Natural Diversity Inventory
RCF	Rural and Community Forestry
RMPD	Resource Management and Planning Division
SOD	Sudden oak death
USDA	United States Department of Agriculture
USFS	USDA Forest Service
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
WNV	West Nile Virus
WRCP	Wild Resource Conservation Program

APPENDIX 9: PHOTO CREDITS

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David Lance, USDA APHIS: page 29

David Moorhead, University of Georgia (www.invasive.org): page 33

Florida Department of Agriculture: page 21 (top)

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Invasive.org: page 21 (2nd down), page 22 (top)

Jessica Sprajcar, Pa. DCNR: pages 3 (left), 4 (left), 13, 14 (bottom), 17, 22 (2nd, 3rd and 4th down), 28

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Milan Zubrick (www.forestryimages.org): page 21 (bottom)

Pa. DCNR Bureau of Forestry: pages 20, 21 (3rd and 4th down), 27

Pa. DCNR Bureau of State Parks: page 17 (top), 19, 22 (bottom)

Ralph Campbell, DCNR Bureau of Forestry: page 32

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