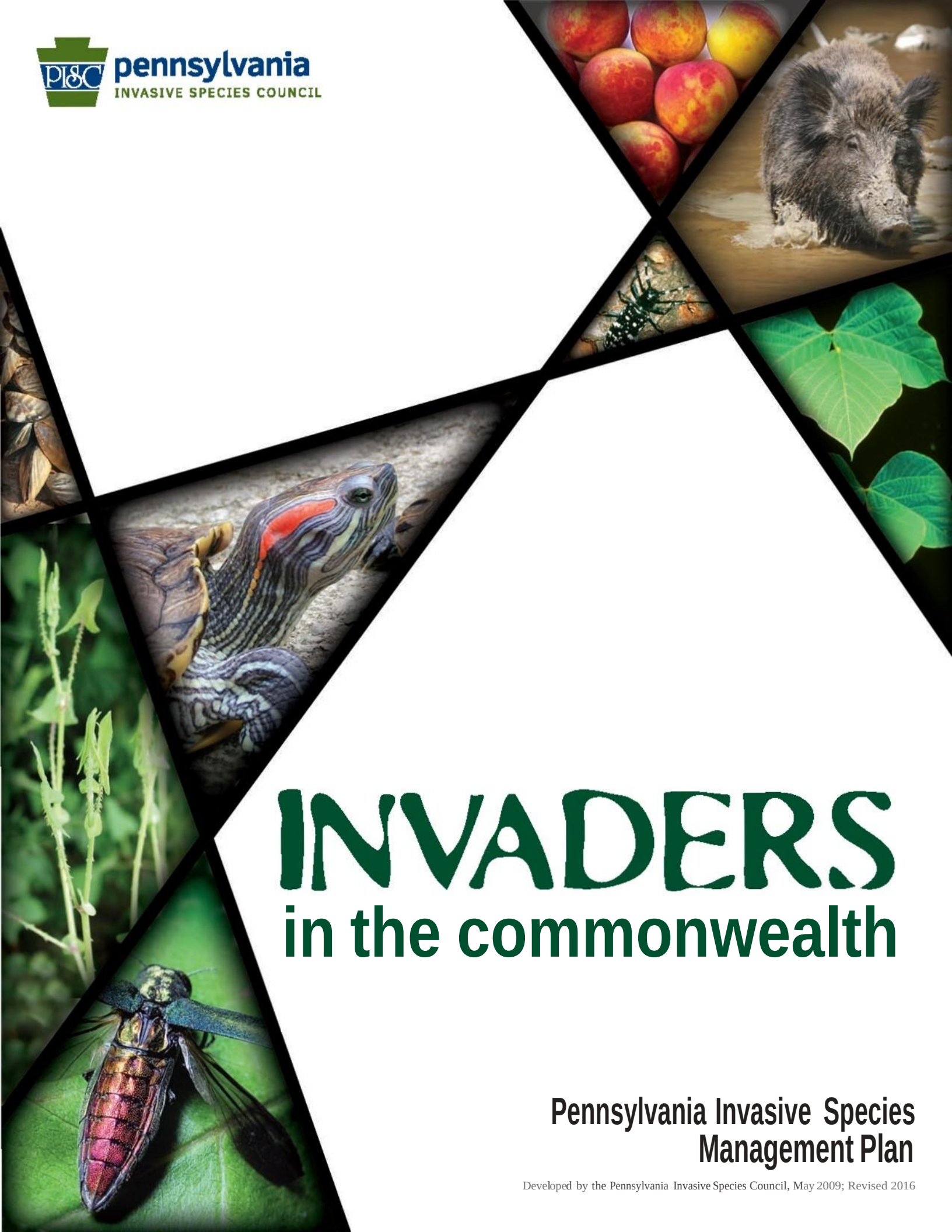
pennsylvania
INVASIVE SPECIES COUNCIL



# INVADERS
## in the commonwealth

## Pennsylvania Invasive Species Management Plan

Developed by the Pennsylvania Invasive Species Council, May 2009; Revised 2016

# This comprehensive invasive species management plan for Pennsylvania was prepared for submission to Governor Tom Wolf on behalf of the Pennsylvania Invasive Species Council.

## Writing Group

**Ashley Walter,** Invasive Species Council Coordinator – Pennsylvania Department of Agriculture

**Melissa Bravo,** Botanist/Weed Specialist – Pennsylvania Department of Agriculture

**Sarah Whitney,** Associate Director, Susquehanna River Watershed Office – Pennsylvania Sea Grant

**Donald A. Eggen,** PhD, Forest Health Manager, Bureau of Forestry Division of Forest Health – Pennsylvania Department of Conservation and Natural Resources

Reviewed and updated by Pennsylvania Invasive Species Council Members and Alternates

2016 Update Writing Group:

Andrew Rohrbaugh, Botanist – Bureau of Forestry Division of Conservation Science and Ecological Services – Department of Conservation and Natural Resources

Trilby Libhart, Botanist/Weed Specialist – Bureau of Plant Industry - Pennsylvania Department of Agriculture

Donald A. Eggen, Ph.D., Forest Health Manager, Bureau of Forestry Division of Forest Health – Pennsylvania Department of Conservation and Natural Resources

## Cover Photos

Plum pox virus on peaches – Ruth Welliver, Pennsylvania Department of Agriculture
Feral swine – Richard Bartz, Makro Freak, Wikimedia Commons
Kudzu leaves – Ted Bodner, Southern Weed Science Society, www.forestryimages.org
Asian longhorned beetle – Kenneth R. Law, USDA APHIS PPQ, www.forestryimage.org
Red eared slider – Lugiadoom, Wikimedia Commons
Emerald Ash Borer – David Cappaert, Michigan State University, www.forestryimages.org
Mile-a-minute vine – Leslie J. Mehrhoff, University of Connecticut, www.forestryimages.org
Zebra mussels – Whitney Cranshaw, Colorado State University, www.forestryimages.org

# Table of Contents

# PA Invasive Species Management Plan Executive Summary

Pennsylvania's diverse geography is home to thousands of different plant, animal, and invertebrate species. Unfortunately, not all of these organisms are beneficial. Pennsylvania's natural resources and economy are threatened by unwanted invaders in the Commonwealth – nonnative invasive species.

Invasive species are defined by Executive Order 13112 as "an alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health". From kudzu to zebra mussels, emerald ash borer to feral swine, invasive species are constantly making their way into Pennsylvania. Often, they are unintentionally introduced through the everyday activities of citizens – hiding in firewood, attached to boats and other gear, or concealed in merchandise. Sometimes they are deliberately introduced, and sometimes they make it here under their own power. However they arrive, once established, they have the potential to change Pennsylvania forever.

Colton Point State Park, Tioga County, PA
(Ruhrfisch, Wikimedia Commons)

Invasive species are a threat to Pennsylvania's economy, environment, and health and well-being of its citizens. Commonwealth citizens pay millions of dollars to identify, prevent, eradicate, and control invasive species each year. These invaders threaten our native plants and wildlife by outcompeting with them for resources and habitat. Invasive species are the cause of costly damages to agricultural crops and infrastructure. Some even impact human health directly by vectoring diseases such as the West Nile Virus. The value of Pennsylvania's natural and economic resources and the need to protect the health of Commonwealth citizens demands a comprehensive response to the threats posed by invasive species.

After the creation of the National Invasive Species Council (EO 13112) in 1999, Governor Edward Rendell created the Pennsylvania Invasive Species Council (PA EO 2004-1) in 2006, heretofore known as PISC. To provide a framework for efforts to minimize the harmful ecological, economic and human health impacts of invasive species, PISC has created a Pennsylvania Invasive Species Management Plan for the Commonwealth. This dynamic document identifies goals and actions critical to protecting our state's resources, both now and into the future.

To learn more about the Pennsylvania Invasive Species Council, please visit the website at http://www.invasivespeciescouncil.com.

## Urgent Recommendations

While the full management plan contains many important proposals for action (i.e., see 'The Framework for Response' for a comprehensive list), PISC has identified the following three goals as immediate

priorities: Prevention, Education & Outreach, and Funding. Each goal is explained in detail and includes a list of key action items that are proposed to achieve each goal.

**Prevention**: The Commonwealth should continue to investigate and address the introduction of individual species as well as the sources and pathways of introduction including: containerized cargo, hull fouling, ship ballast, intentional sale and release of unwanted pets and plants, the unintentional release through the movement of materials and equipment (soil, firewood, gear, etc.), and sales of live organisms in commercial trade.

1. Establish and prioritize: 1) a list of invasive species not present in Pennsylvania that should be prevented from entry, and 2) a list of invasive species with limited occurrence in Pennsylvania for which the prevention of expansion is intended. List these species on the PISC website and communicate about them to lawmakers, various program managers, and the public.

2. Establish and prioritize the list of sources and pathways used by invasive species to gain entry into Pennsylvania. Recommend solutions that will address the sources and pathways of new and continuing introductions.

3. Improve interstate and regional coordination in the development and implementation of risk management partnerships at all ports of entry, and other suitable pathway points.

4. Create and post a list of sound nonnative invasive species prevention practices on the PISC website for state agencies and industry groups to adopt for their own operations, including pre-treatment of infestations, cleaning of equipment and vehicles, and follow-up spot treatment of new infestations.

**Education & Outreach**: The Commonwealth should create unified messages for use by all state agencies and member organizations of PISC regarding the prevention and control of invasive species. Additionally, there needs to be a proactive approach to educate the public and people involved in business, trade, research, and government so these groups do not accidentally facilitate the introduction or spread of invasive species.

1. Identify a list of 25 invasive species that cause the most harm to the Commonwealth. (*In this case, "harm" indicates not only economic losses, but also declines in biodiversity, damage caused to ecological processes, and danger presented to human health*.) Create new or modify existing fact sheets for each of these species and distribute to target audiences.

2. Create a new and improved PISC website that is compatible with all internet browsers and is mobile-friendly. Site will be maintained on a frequent basis to ensure outdated information is removed and meeting minutes from quarterly Council meetings are posted to site in a timely manner. Additional additions/edits should be expected to occur on a quarterly basis.

3. Utilize social media to inform the public about the impact of invasive species on their lives.

**Funding**: Work with the Governor's office, legislature, partners, industry, and federal entities to identify permanent funding sources needed to implement nonnative invasive species programs in the Commonwealth, as recommended by the action items listed in this plan. As the **first** step towards achieving the above objectives (Prevention and Education & Outreach), the following recommended

actions have been identified as priorities by PISC. These recommended actions will assist in developing guidance for the prevention and control of invasive species as well as early detection and rapid response to new infestations, and will therefore be the focus for immediate action.

1. Write a letter to the Governor's office requesting the establishment of permanent funding for the prevention, control, and management of invasive species in the Commonwealth of Pennsylvania. Deliver this letter to the Governor prior to the end of 2017. (This letter can either be separate or combined with the regular annual letter already being sent to the Governor.)

2. Create an emergency fund for rapid response activities that can be directed to the lead agency, as well as cooperating organizations, in response to a newly detected infestation in the Commonwealth.

3. Provide funding for the development and implementation of training for appropriate field staff, key stakeholders, and volunteers in the identification and early detection of invasive species.

# 2017 Update of the Pennsylvania Invasive Species Management Plan

The concept of a statewide invasive species management plan for Pennsylvania grew out of several initiatives, including the Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990,[1] which called for states to develop aquatic invasive species management plans, and President Clinton's 1999 Federal Executive Order 13112[2] which established the National Invasive Species Council. The National Council is directed to provide national leadership and oversight on invasive species, to see that Federal agency activities are coordinated and effective, to work in partnership with states, and to provide for public input and participation. Following the lead of the National Council, Governor Edward Rendell issued Executive Order 2004-1,[3] creating the Pennsylvania Invasive Species Council in recognition that the commonwealth would benefit from the advice and counsel of an official body of natural resource managers, policy makers, and researchers engaged in abating the introduction and spread of nonnative invasive species. The Governor's executive order charges the council with the following:

- Advising the Governor on and directing the development and implementation of a state nonnative invasive species management plan.
- Providing guidance on prevention, control, and rapid response initiatives.

The Order also charges the council with the following responsibilities:

- Develop and implement a comprehensive nonnative invasive species management plan for the Commonwealth of Pennsylvania and revise the plan at regular five year intervals or as needed.
- Provide guidance on prevention and control of nonnative invasive species and rapid response to new infestations.

• Facilitate coordination among federal, regional, state, and local initiatives and organizations engaged in the management of nonnative invasive species.

Out of the Pennsylvania Invasive Species Council grew a number of plans that provided a framework for rapid response to new invaders and helped Pennsylvania to acquire funding for invasive species work. These include:

- Pennsylvania Aquatic Invasive Species Management Plan, approved in 2006
- Pennsylvania Invasive Species Management Plan, or PA-ISMP, approved in 2010
- Pennsylvania Aquatic Invasive Species Rapid Response Plan, approved in 2014

The Aquatic Invasive Species Management Plan has been both necessary and beneficial in obtaining large grants like that of the Great Lakes Restoration Initiative, which has provided federal funding to address coordination and leadership, outreach and education, rapid response and biosecurity preparedness, and on-the-ground management of invasive species in Pennsylvania's Lake Erie region and smaller amounts of funding from the US Fish and Wildlife Service to implement portions of the AISMP such as prevention outreach. In addition, the interactions provided by the Council have proven to be instrumental in coordinating cooperative responses to such invaders as the Emerald Ash Borer, Giant Hogweed, Feral Swine and Asian Carp. In fact, the framework provided in the comprehensive PA-ISMP is guiding the response to Pennsylvania's latest heavy impact player, the Spotted Lanternfly (*Lycorma delicatula*), first found in Pennsylvania in 2014.

In this new iteration of the Pennsylvania Invasive Species Management Plan, the Council seeks to improve upon the 2010 plan. Though the original Framework for Response was well-addressed, key challenges continually stand in the way of providing the preventative measures, early detection and rapid response, and leadership and coordination necessary to stop invaders from becoming a major issue in Pennsylvania. This latest version of the plan will seek to address these challenges, and will reflect the ongoing efforts of the Council to minimize the impacts of invasive species on Pennsylvania's economy and ecology and the health of its citizens and visitors.

[1] 1990. Nonindigenous Aquatic Nuisance Prevention and Control Act. Public Laws No. 101-646
[2] 1999. Office of the President of the United States. "Presidential Executive Order 13112"
[3] 2004. Office of the Governor of the Commonwealth of Pennsylvania. "Governor's Executive Order 2004-1"

# What is an Invasive Species?

A nonnative or exotic species is defined in this document as a species that is not indigenous to the ecosystem under consideration. These species can be any type of organism: plant, fish, invertebrate, mammal, bird, disease or pathogen. An invasive species, as defined by the Federal Executive Order 13112, is a nonnative species "whose introduction does or is likely to cause economic or environmental harm or harm to human health". The term "invasive" is a biological attribute, meaning that the species under consideration can establish itself outside of its native range and effectively compete with native species, severely disrupting the stability of the affected ecosystem (Mack et al. 2000). The word "invasive" is not a legal term, unlike the words injurious, nuisance, noxious, or harmful which are regulatory terms and are

defined by laws, acts, statutes or regulations. However, the term “invasive” still carries weight, and so the use of the term on a nonnative species is carefully considered.

## GLOBAL CLIMATE CHANGE

Climate change is affecting the habitats and distributions of plants and animals worldwide, including those of nonnative invasive species. As the environment changes, species are able to occupy areas that used to be inhospitable. This means that species previously unable to establish populations in Pennsylvania will become able to do so, while species in Pennsylvania may find their ranges shifted. Science is only beginning to understand the long term implications of these changes, yet those engaged in managing invasive species need to be prepared.

**Our Changing World**
(NASA, Wikimedia Commons)

Starting in the late 16th century, the Spanish, British, French, Swedes, and Dutch began to colonize North America, bringing with them many nonnative plant species such as wheat, rice and other food crops as well as cattle, poultry, and other livestock. These exotic species are now considered an integral part of our way of life and make up most of the United States agricultural system. Settlers to North America also brought with them many landscape plants from their countries of origin. We continue to introduce exotic species for production agriculture and through the horticulture industry.

Exotic plant species are now being evaluated as potential sources for biofuel, which is considered a viable alternative to fossil fuels. It is important to understand that not all nonnative species become invasive pests.

There are approximately 50,000 exotic species in the United States. Researchers at Cornell University estimated that one in seven of these exotic species become invasive pests, once established (Pimentel et al.2000). Another commonly used device is the “Tens Rule” estimate, which is based on the statistical analysis of a number of British animals and plants. The rule states that, on average, one in ten species introduced (either intentionally or accidentally) will escape from cultivation. One in ten of these escaped species will become naturalized and establish a population. In turn, one in ten of these naturalized species will likely become invasive (Williamson and Fitter 1996).

# Why the Current Concern?

Invasive species may adversely impact Pennsylvania’s economy, environment or the health of commonwealth citizens. There is every indication that this problem will continue to worsen through growing numbers of introductions. Increases in global trade have created opportunities for many organisms to be transported to new countries where they can establish. As recently as the end of

1999, goods worth $6.2 trillion were traded globally per year (World Trade Organization 2000). By 2007, trade volume doubled with more than 10 billion tons of merchandise worth $13.6 trillion circulated yearly (World Trade Organization 2008). Global climate change is also contributing to the introduction and establishment of new pests by changing maximum and minimum seasonal temperatures in regions of the world. By disturbing natural ecosystems, global climate change may facilitate a shift to dominance by nonnative species, accelerating the homogenization of the global biota (Stachowicz et al. 2002). Problems caused by invasive species will multiply as global trade and global climate change continue to increase.

As trade and climate change increase, the potential for invasive species to become established and the cost of treating their effects will also increase. Therefore, preventing new introductions and rapidly responding to novel infestations is more economically and environmentally feasible than delaying action until after an invasive species has become firmly established. For example, $65 million was spent to eradicate Asian longhorned beetle from Chicago, but the estimated cost to North American forests if action was not taken could have been $350 billion (Government Accountability Office 2006). Unfortunately, there are still some small infestations of Asian longhorned beetle currently under quarantine and treatment elsewhere in North America. In order to protect the stonefruit industry in the commonwealth, Pennsylvania has spent $4.5 million since 1999 in efforts to eradicate the plum pox virus. Since 2000, Pennsylvania has spent more than $39 million on the West Nile Virus Surveillance Program to protect the health of commonwealth citizens. Prevention, defined as the actions necessary to keep potentially invasive species from entering previously un-infested areas, is the most cost effective and least environmentally damaging approach. This is accomplished through disrupting the pathways invasive species utilize to spread. Without prevention or effective response to invasive species, the future will see significantly higher costs to Pennsylvania's environment and economy.

# How Do Invasive Species Get Here?

Although extremes in weather and the movement of wind-borne or water-borne organisms are recognized pathways of invasion, most new introductions of invasive species occur as a result of human activity. Expanded shipping and air traffic over the last century has facilitated the movement of nonnative species. The establishment of canals opened pathways between previously unconnected bodies of water, allowing introduced species ready access to new ecosystems. Today the movement of organisms continues, only at a much faster pace (Wittenberg and Cock 2001, Liebhold et al. 2006). The growing volume of transported goods, increasing efficiency and speed of transportation, advancing technologies for transportation, and expanding international trade agreements are all key factors in this increase (Loope and Howarth 2002). As the United States continues to import more goods, invasive species will continue to have opportunities to find their way into Pennsylvania.

The following is a list of some of the known pathways related to human activity that can transport and spread invasive species into the United States and specifically into Pennsylvania:

**Contamination of products in channels of trade:** Products themselves may unintentionally transport organisms. Shipments of food or trade items can be contaminated with undetected organisms or pathogens, and items such as packing materials shipped along with the cargo may unintentionally

transport invasive species by harboring organisms. Containerized cargo provides additional opportunities for organisms to hitchhike to new ecosystems with a decreased likelihood of being intercepted at ports of entry.


**Hull fouling:** Aquatic organisms can attach to ships' hulls or become entangled in submerged components of ships and be transported, creating the potential to become dislodged in a new area.

**Ship ballast:** This is a primary pathway for long distance movement of aquatic organisms. Aquatic organisms ranging from microscopic plants and animals to fish and associated pathogens can be transported to new areas through release of ballast water.

**Discarded live fish bait:** The movement and eventual discarding of live fish bait may introduce species and the pathogens they may harbor into new bodies of water.

**Intentional release:** Releasing pets, plants, and other organisms into the wild, rather than disposing of them in a proper manner, can introduce a new species into an area.

**Escape from Cultivation:** Species introduced for cultivation may escape management and the traits that were desirable in captivity may facilitate invasion of the natural environment.

**Movement of materials and equipment:** Soil, compost, tanbark, firewood, nursery stock, watercraft, construction equipment, fishing and hunting gear and other commonly transported items can harbor numerous insects, disease agents, plant seeds, and other undesirable organisms, allowing for accidental long distance movement. Travelers can even unintentionally move life forms on the soles of their shoes or the wheel wells of their cars.

**Unregulated sale of organisms:** Major unregulated sources for live organisms include mail order and internet sales, flea markets and farmers' markets. These activities can pose a major threat for long distance movement of organisms.

**Smuggling activities:** When entering another country, people may purposefully conceal organisms in baggage, vehicles, or on their person.

**Hobby trading:** Hobbyists and collectors often have opportunities to trade specimens (both plants and animals), and such activities can result in long distance movement of nonnative organisms.

# Examples of Invaders in Pennsylvania

There are two main subsets of invasive species in Pennsylvania that impact two very distinct types of ecosystems: aquatic and terrestrial. Below are examples of invaders from both ecosystems. Unfortunately, they are by no means the only invasive species present in the commonwealth. For more information on invasive species found in Pennsylvania, visit the Pennsylvania Invasive Species Council web site at http://www.invasivespeciescouncil.com/.

## Aquatic Invasive Species (AIS)

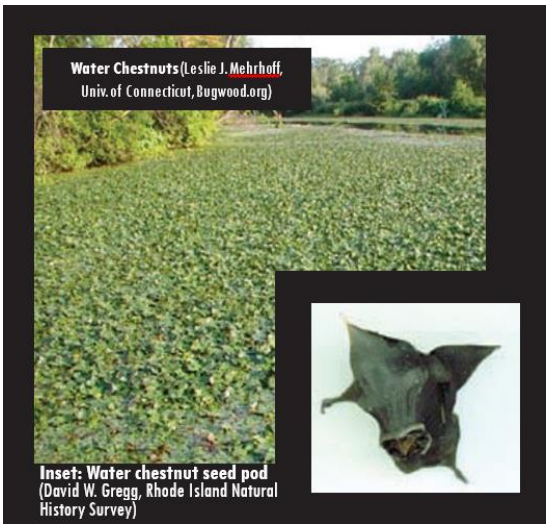
Aquatic invasive species are defined in this document as nonnative species that threaten the diversity or abundance of native species, the ecological stability of the infested waters, human health and safety, or commercial, agriculture, aquaculture, or recreational activities dependent on such waters. The commonwealth's varied geology and topography contribute to the large variety of aquatic and estuarine habitats. Pennsylvania encompasses six different landforms, ranging from coastal plain to the Appalachian Mountains. The commonwealth hosts more than 86,000 miles of streams and shares five major watersheds with other states and Canada. According to the National Wetland Inventory, there are a total of 729,535 wetland acres found in more than 160,000 wetlands across Pennsylvania. The following species of limited distribution are included as examples of invertebrates, fish, aquatic plants, and viruses that are affecting aquatic ecosystems in the commonwealth:

**Hydrilla**, a federally noxious weed, is known in plant management circles as "the almost perfect weed". Hydrilla is known to cause significant use impairments where it becomes established. These impairments include loss of boating and swimming access, decreased dissolved oxygen concentrations, loss of aquatic habitat, reduction of biodiversity, negative impact on fisheries, loss of tourism, as well as others. Recently a novel cyanobacteria associated with hydrilla has been found in some Georgia and Arkansas reservoirs. This novel cyanobacteria, known as *Aetokthonos hydrillicola*, has been associated with waterfowl and bald eagle die-offs from avian vacuolar myelinopath. Hydrilla is a relatively new threat to the north. Historically considered a southern issue, hydrilla has been on a steady northward march toward the Great Lakes. Pennsylvania, in addition to surrounding states is considered one of the last lines of defense against invasion of the Great Lakes. Hydrilla differs from other submerged aquatic invasives commonly encountered by its ability to grow very quickly (~1" per day per stem), cover thousands of contiguous acres with dense mats of vegetation, and inhabit areas usually not suitable for submerged aquatic vegetation. The biology of monoecious hydrilla and the risks listed above is well-summarized in a recent literature review developed for the NE Aquatic Nuisance Species Panel (http://www.northeastans.org/docs/hydrillalitsearch12.31.12.pdf). The broader ecological and economic impacts of aquatic invasive plants such as hydrilla have also been summarized in recent literature. "Florida spends about $14.5 million each year on hydrilla control (Center et al. 1997). Nevertheless, hydrilla infestations in just 2 Florida lakes have caused an estimated $10 million in recreational losses in the lakes annually (Center et al. 1997)." (Pimentel D. et al. 1999).

**Zebra and Quagga mussels** are fingernail-sized freshwater mollusks native to the Black and Caspian Sea drainages of Eastern Europe and Western Asia. Both are highly opportunistic, reproduce rapidly, consume microscopic aquatic plants and animals from the water column in large quantities, and colonize several substrate types. Zebra mussels are established in several water bodies in northwestern Pennsylvania, including Lake Erie, Edinboro Lake, Conneauttee Creek, Sandy Lake, Conewango Creek, and the upper Allegheny River. Zebra mussels are also present in the Susquehanna watershed, lower Allegheny, Monongahela and upper Ohio rivers near Pittsburgh and even in a few diving quarries located hundreds of miles from the original source populations. In Lake Erie, the quagga mussel is now present in higher numbers than the zebra mussel. It is illegal in Pennsylvania to sell, purchase, barter, possess, introduce, import or transport zebra or quagga mussels.


**Northern snakehead** is a predatory fish that will compete with other fish for forage and habitat at such an aggressive rate that destabilization of the local native fish population is possible. Northern snakeheads are air breathers; this trait allows them to survive for a time out of water and increases the risk of spread to new bodies of water. Northern snakehead was first confirmed in Pennsylvania in July 2004 in a park in South Philadelphia. Since then, northern snakeheads have also been caught in the lower Schuylkill and Delaware rivers. It is illegal in Pennsylvania to sell, purchase, barter, possess, introduce, import, or transport northern snakehead.

**Water chestnut** is an annual aquatic plant with both surfacing and submersed leaves. Fruits are nut-like and "woody" with typically four barbed spines that are sharp enough to penetrate shoes. Long cord-like stems can attain lengths of up to 16 feet, forming dense floating mats and making the waters inaccessible to recreational activities. The plant also severely limits the passage of light into the water, reduces water oxygen levels, out-competes native vegetation, and is of little value to wildfowl. Water chestnut grows in freshwater lakes and ponds and slow-moving streams and rivers. As of 2006, water chestnut infests six water bodies in eastern Pennsylvania.



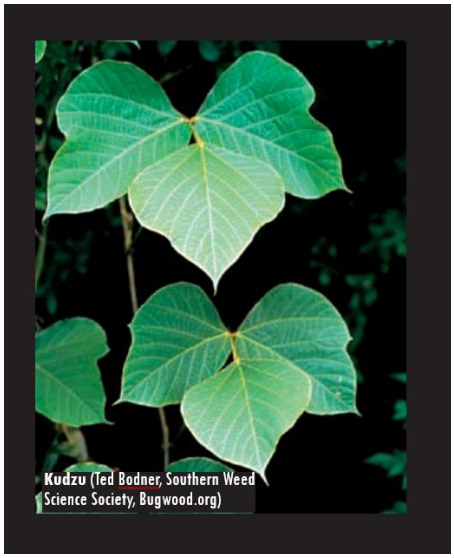
**Viral hemorrhagic septicemia (VHS)** is a federally regulated animal disease of freshwater fish in the Great Lakes region of the U.S. and Canada. VHS is caused by a rhabdovirus and has caused great damage to fisheries in Europe. While VHS has not yet been documented in Pennsylvania waters, the Great Lakes isolate may be a new substrain of the North American genotype and has caused mortality in Muskellunge, Drum, Walleye, several salmonid species, and several species of bait fish in the Great Lakes. Emerald Shiners, an abundant nonnative bait fish present in the Great Lakes, have been discovered to be infected with VHS and may pose an additional concern as a vector to spread this disease through the bait industry. To prevent VHS from spreading into new waters, federal and state governments have imposed stringent restrictions on the export and movement of fish from and within Great Lakes states.


## Terrestrial Invasive Species (TIS)

Terrestrial invasive species are defined in this document as nonnative species that complete their lifecycle on land instead of in an aquatic environment and whose introduction does or is likely to cause economic or environmental harm or harm to human health. Pennsylvania has three general climate regions and its 44,817 square miles are located in the mid temperate zone of North America making it a habitable place for invasive species whose cold tolerance ranges from -20º F to 0º F. Terrestrial ecosystems in Pennsylvania include a rich variety of community types and cover a range extending from nearly aquatic wetlands along our coasts and rivers, lakes and streams, to mountain tops. Four groups of organisms have been particularly successful in adapting to terrestrial environments: arthropods, vascular plants, higher vertebrates and pathogens. We have included the following invasive species of limited distribution in the commonwealth as examples of invertebrates, plants, vertebrates and viruses that can affect terrestrial ecosystems:


**Emerald ash borer (EAB)** is a wood boring beetle that was first found in Wayne County, Michigan in June 2002. EAB attacks all native species of ash (Fraxinus spp.) as well as the white fringetree (Chionanthus virginicus), which is in the same family (Oleaceae) as ash species. Infested trees have a 99 percent mortality rate. By 2016, hundreds of millions of ash trees have been killed in North America in 28 states and two Canadian Provinces. If discovered in an area, immediate quarantines of all ash related materials have been implemented. In 2007, EAB was discovered in Pennsylvania but had been present since 1999 or 2000. As of September 2016, 62 counties in Pennsylvania are infested. The Commonwealth's 323 million ash trees are all vulnerable to mortality from this insect.

**Kudzu** is a perennial, semi-woody climbing leguminous vine originally introduced into the United States as an ornamental plant at the Philadelphia Centennial Exposition of 1876. It was heavily planted in the 1950s throughout the U.S. to prevent erosion, particularly in the south, until its tendency to completely replace existing vegetation was noted. Kudzu was added to the state noxious weed list in 1989 and a pilot eradication program was launched in 2006. As of 2008, more than 89 spatially distinct populations of kudzu have been confirmed at sites throughout Pennsylvania.


Kudzu (Ted Bodner, Southern Weed Science Society, Bugwood.org)

**Feral swine** cause considerable damage following accidental or intentional introductions. Since 2007, the United States Department of Agriculture has gathered evidence that feral swine are establishing small breeding populations in at least five Pennsylvania counties. There is concern that their numbers may be increasing by escapes from shooting preserves within the commonwealth and through deliberate importation and illegal and intentional release of swine brought from other states. In addition, several feral swine populations in other states have proven to be infected with brucellosis and pseudorabies. The Secretary of the Pennsylvania Department of Agriculture and the Executive Director of the Pennsylvania Game Commission co-chair a task force to address this serious threat. Jurisdictional authority for feral swine was delegated to the Pennsylvania Game Commission by a Pennsylvania Supreme Court Ruling.


Feral Swine (USDA)

**Phytophthora ramorum** is the cause of both Sudden Oak Death, a forest disease that has resulted in widespread dieback of forest trees in California and Oregon, and Ramorum blight, which affects the leaves and twigs of many other plants in forests and nurseries. In Pennsylvania, the pathogen has been intercepted several times on nursery stock from other states, but has never been found established. Consequences to Pennsylvania landscapes and forests if this disease organism takes hold are not known, but with its wide host range, it is likely to be able to establish and cause considerable damage along the Appalachian Mountain chain.


Plum Pox Virus Symptoms (John Hammond, USDA Agricultural Research Service, Bugwood.org)

# The Need for an Invasive Species Management Plan

Invasive species do not recognize jurisdictional boundaries, thereby creating a need for enhanced coordination between local, state, regional, and federal entities to respond to new discoveries effectively and expediently. Disseminating up-to-date information regarding invasive species across those jurisdictional lines to field staff, key stakeholders and the general public is crucial to the successful implementation of invasive species programs. Another challenge is that there are a growing number of nonnative invasive species that fall outside the parameters of existing statutes, laws, acts, and regulations, in addition to the many species already being addressed by regulatory authorities. A comprehensive approach is needed to address these challenges and prevent unnecessary expenditure and duplication of efforts that drain the budgets and staff resources of state and federal agencies.

## Traditional Roles of Government

There is no single state statute that deals specifically with the management and control of invasive species in Pennsylvania. Responsibilities for protecting Pennsylvania from organisms or pests deemed Injurious, nuisance, noxious, or harmful are shared by several state agencies, and supported by the efforts of many of Pennsylvania's NGO's and private sector organizations. The commonwealth is governed by multiple separate legislative and regulatory provisions, the majority of which are derived from agencies' general statutory authority. As far back as 1862, state government was charged with the destruction, detection, and prevention of foreign pests deemed injurious to Pennsylvania's agricultural system.


State and Federal agencies with regulatory authority regarding invasive species are discussed further in Appendix 4.

## Non-Traditional Roles: Addressing the Issue of Invasive Species

There are a growing number of invasive species that fall outside the traditional role that state agencies have in protecting the resources of the commonwealth. It is impossible for state agencies to address all invasive species alone, especially those that have become widely established. This nonnative invasive species management plan will aid in facilitating rapid, coordinated actions among state agencies, private industry, public stakeholders, and individual land owners engaged in preventing the introduction and spread of invasive species. This plan reflects the ongoing efforts of the council to develop a framework that

identifies strategies and actions to minimize the impacts of nonnative invasive species and facilitate addressing species that fall outside of traditional jurisdictions.

# The Framework for Response

The Pennsylvania Invasive Species Council developed this framework for response that will aid in avoiding and minimizing the harmful ecological, economic, and human health impacts of nonnative invasive species through the prevention and management of their introduction, expansion and dispersal into, within and from Pennsylvania. This framework represents the council's ongoing efforts to outline responsibilities, standardized actions, and communication for managing current invasive species infestations and for responding when a new invasive species is identified within the commonwealth. The Pennsylvania Invasive Species Council recommends that the commonwealth work with all relevant stakeholders to accomplish the following goals:

**Preliminary Risk Assessments:** Utilize preliminary risk assessments to prioritize invasive species management and expedite response at the first indication of a new or likely introduction.

**Prevention:** Identify, evaluate, and address pathways used by invasive species in order to avoid, or at least minimize, their introduction and spread into and throughout the commonwealth.

**Early Detection and Rapid Response:** Detect new introductions of invasive species quickly and control or contain target species before they can become permanently established in the commonwealth or move into areas in which they previously did not exist.

**Control:** Prioritize invasive species on which to focus control and anti-dispersal efforts, and, when feasible, control established invasive species that have significant impacts in Pennsylvania.

**Restoration:** Integrate restoration efforts whenever feasible into control and management activities as well as other activities which may disturb ecosystems and facilitate colonization by invasive species.

**Survey and Monitoring:** Expand survey and monitoring efforts of invasive species in Pennsylvania.

**Data Management:** Develop a statewide invasive species database clearinghouse or information sharing system linking data from various state, federal, and non-governmental entities.

**Research:** Support research efforts on invasive species issues and impacts in Pennsylvania and work with partners to facilitate the dissemination of data and information generated from these efforts.

**Key Personnel:** Identify key personnel needed to coordinate invasive species issues among local, state, and federal agencies and organizations.

**Education and Outreach:** Educate the general public and key target audiences about invasive species issues so that they do not facilitate the introduction and spread of these organisms through their activities.

**Communication and Coordination:** Facilitate communication and coordination across jurisdictional boundaries to ensure that state policy effectively promotes the prevention, early detection, and control of invasive species in Pennsylvania.

**Funding:** Work with the Governor's office, legislature, partners, industry, and federal entities to identify permanent funding sources for invasive species programs in the commonwealth.

## Preliminary Risk Assessments

Goal: Utilize preliminary risk assessments or conduct new evaluations to prioritize nonnative invasive species introduction potential, management issues and expedite response at the first indication of a new or likely introduction.

Background: A risk assessment is a science-based process commonly used to predict the potential establishment, spread, and impacts of invasive species. Risk assessments can be used to aid in prioritizing prevention, early detection, control and restoration efforts. Species-specific risk assessments already developed by experts elsewhere should be reviewed first. If unavailable, preliminary species-specific risk assessments should be developed to determine the threat level of an invasive species to the commonwealth. If needed, species-specific task forces should be formed to facilitate this process.

Proposed Actions

1. Utilize previously developed risk assessments from international, federal, state, and local sources to guide development of new risk assessments for invasive species and pathways in Pennsylvania.

2. Use monitoring data collected within Pennsylvania, neighboring states, and elsewhere in the United States to formulate the development of new risk assessments for invasive species and their pathways.

3. PDA and USDA will leverage educational institutions with research grant money, in order to evaluate organisms sold in commercial trade that have the potential to persist in Pennsylvania outside of captivity or cultivation.

4. Once a short list of the most significant or harmful invasive species is created, use maps of known locations and treatments to prioritize and organize future treatments. The list of prioritized treatments, as well as all species risk assessments and evaluations, will be easily accessible through the PISC website.

## Prevention

Goal: Identify, evaluate, and address sources and pathways used by nonnative invasive species to avoid their introduction and minimize their spread into and throughout the commonwealth.

Background: Prevention, defined as the actions necessary to keep potentially invasive species from entering Pennsylvania and previously un-infested areas within the state, should serve as the first line of defense as it is the most cost effective and least environmentally damaging approach. Once a species becomes established in an area, control will likely require significant and sustained expenditures. A recent study on the weed risk assessment process used in Australia to restrict the entry of invasive species into the country has shown that the cost of the program is more than paid for by saving the country the costs of

treating those invasive species (Keller et al. 2007). Investment in prevention tools, resources, and infrastructure are indispensable in protecting human health, agriculture and natural resources.

Proposed Actions

1. Establish and prioritize: a) a list of invasive species not present in Pennsylvania and that should be prevented from entry, and b) a list of invasive species with occurrences in Pennsylvania and for which the prevention of expansion is intended. List these species on the PISC website and communicate them to lawmakers, various program managers, and the public.

2. Utilize PDA's statutory authority to prohibit the sale of invasive or potentially invasive plants.

3. Include a link on the PISC website to DCNR's planting and seeding guidelines, which call out both invasive plants to avoid as well as native plant species that can be used for restoration efforts.

4. Establish and prioritize the list of sources and pathways of invasive species introductions into Pennsylvania. Recommend solutions that will address the sources and pathways of new and continuing introductions.

5. Agencies (PGC, DCNR, PFBC) will establish or strengthen dialogue with corresponding agencies in neighboring states, in order to discuss regional invasive species issues and BMP's.

6. Review existing programs and policies which address the prevention of invasive species and the mitigation of pathways in Pennsylvania and identify opportunities for improving their effectiveness and restoring habitat disturbances that help invasive species gain a foothold.

7. PDA will work with USDA to improve interstate and regional coordination in the development and implementation of risk management partnerships at all ports of entry and other suitable pathway points.

8. State agencies and industry groups will adopt sound nonnative invasive species prevention practices for their own operations, including pre-treatment of infestations, cleaning of equipment and vehicles, and follow-up spot treatment of new infestations.

9. DCNR will ensure that all community forestry plans include invasive species as a management criteria (i.e., prevention, inventory, prioritization, treatment).

10. DCNR, PDA, PGC, and any other agency that works in the public/private partnerships will include invasive species as a mandatory part of any state-funded land management project. This would include the following components: 1) prevention, 2) inventory, 3) prioritization, and 4) treatment.

## Early Detection and Rapid Response

Goal: Detect new introductions of nonnative invasive species quickly and control or contain target species before they become permanently established in the commonwealth or move into areas in which they previously did not exist.

Background: Even the best prevention efforts cannot stop all nonnative invasive species from entering the commonwealth. Early detection of and rapid response to new infestations greatly increases the possibility that localized invasive populations will be contained and eradicated from areas before they can spread. Early detection and rapid response are the most cost-effective and environmentally sound methods for responding to new invasions as they reduce the scale of expensive, long-term control efforts and minimize

impacts on ecosystem health and function. Early detection and rapid response can also slow the spread of invasive species established in one region from expanding into new areas of the commonwealth.

Proposed Actions

1. Create a watch list of invasive species not yet known or of limited distribution in the commonwealth. This list will be placed on the PISC website and checked on an annual basis to ensure it is up to date and comprehensive.

2. Establish a hotline number or web site for the public to report sightings of suspected invasive species.

3. Establish or use existing reporting systems for managing invasive species sightings and disseminate data to relevant agencies, partners, and stakeholders in a timely fashion.

4. Develop specific action plans for EDRR species and locations for dissemination on the PISC website.

5. Work to identify and involve stakeholders in early detection and rapid response planning efforts, including government agencies, private landholders, watershed organizations and other volunteer groups, along with bordering states.

6. Identify and support personnel training needs and interagency partnerships for successful early detection and rapid response operations.

7. Develop quarantine orders when and where needed for successful rapid response. Jurisdictional agencies should have licenses and permits necessary for specified control techniques (mechanical, biological and chemical), and contract authority required for purchased services and agreements necessary for mutual aid with other states and federal agencies for successful rapid response.

8. Identify taxonomic, geographic, or jurisdictional areas where early detection efforts are still needed and support their development.

## Control

Goal: Prioritize nonnative invasive species and populations on which to focus control efforts, and when feasible, control established nonnative invasive species that have significant impacts in Pennsylvania.

Background: Eradication should always be considered when an invasive species is first detected in a new area of the commonwealth. Unfortunately, the eradication of invasive species that are well established and widespread is generally not economically or environmentally feasible. Instead, long term management efforts should be considered that attempt to slow the rate of spread or suppress widespread populations, thus lessening environmental and economic impacts over time.

Proposed Actions

1. Review ongoing management programs to increase program efficiency and routinely evaluate non-target impacts. Disseminate evaluations to relevant agencies, partners, and stakeholders in a timely fashion.

2. Develop action plans for 3-5 high priority species known to be infesting specific places in Pennsylvania. Plans can be made for species occurring on either public or private property. Ensure that funding is

available to follow through with these action plans. Identify one or more groups which will coordinate the implementation of these plans.

Develop action plans for 3-5 ecologically important areas within the Commonwealth which are currently being impacted by invasive species. Plans can be made for areas located on either public or private property. Ensure that funding is available to follow through with these action plans. Identify one or more groups which will coordinate the implementation of these plans.

3. Support the development of control and containment techniques which include a comparison to the potential economic, environmental, and/or human health impacts of a “no action” alternative.

4. Support the development of special use permits for control options that are not currently authorized in Pennsylvania.

5. Recommend a statewide strategy to facilitate coordination and cooperation on invasive species control among all stakeholders whose rights-of-way, or personal, business, or state-owned properties border highways, byways and riparian corridors.

6. Where lacking, compile, consolidate, and distribute literature to assist the public in control efforts.

7. Create a master directory of contractors, analysts and consultants in private, public and non-profit sectors who can provide technical services or recommendations for an identified invasive species management problem.

## Restoration

Goal: When feasible, integrate restoration efforts into control and management activities as well as ecologically disruptive activities that may be conducive to invasive species colonization.

Background: The term restoration encompasses the activities required to reinstate ecosystem structure and function in habitats that have been disrupted by invasive species and disturbances. With effort, ecosystems can sometimes recover following the eradication or control of invasive species. It is both cost-effective and environmentally sound to integrate restoration efforts into control and management plans since without the stability afforded by restoration, areas may become re-infested by the same or additional nonnative invasive species.

Proposed Actions

1. Review contracts, partnerships and projects to incorporate restoration measures wherever possible to prevent colonization by invasive species.

2. Develop incentive programs for private landowners for the restoration of ecosystems vulnerable to invasion and make recommendations to establish/enhance these programs to the Legislature.

3. Create a master directory of existing efforts and key groups that focus on restoration of native habitats.

## Survey and Monitoring

Goal: Expand survey and monitoring efforts of nonnative invasive species in Pennsylvania.

Background: Survey and monitoring efforts provide the data necessary to make informed decisions about programs targeting nonnative invasive species. Surveying helps to determine where populations of invasive species are located geographically as well as the extent of the infestations. Monitoring populations of invasive species targeted by prevention, rapid response, control, and restoration programs aids in determining the impact of those programs. Survey and monitoring efforts are an integral part of any targeted invasive species program.

Proposed Actions

1. Petition for increased funding to agencies for surveying and monitoring efforts.

2. Conduct monitoring surveys to assess the threat to critical habitats and their species from invasion and address their protection through policy when needed.

3. Incorporate invasive species monitoring protocols into existing state and federal water quality monitoring programs.

3. Incorporate long term monitoring into eradication and control programs to ensure success.

4. Create and/or identify a clearinghouse for the purpose of sharing invasive species location data.

5. Develop a centralized citizen science program for reporting infestations, and provide training to the public.

6. Establish a hotline number or website for the public to report sightings of suspected invasive species. Assign an agency, organization, or group of people to monitor reports coming in and establish a way to verify the credibility of each report.

7. Create a communications flowchart detailing appropriate contacts when a new invasive species is discovered within the Commonwealth.

8. Conduct surveys for 3-5 high priority species to better understand their distribution in the Commonwealth.

## Data Management

Goal: Develop a statewide nonnative invasive species database clearinghouse or information sharing system linking data from various state, federal, and non-governmental entities.

Background: Accurate and current data are a critical need of managers, researchers, and decision makers dealing with nonnative invasive species. Access to statewide information and databases, especially geographic location of invasive species data, is critical to the prevention, detection, survey, management, and restoration components of an invasive species program.

Currently in Pennsylvania, data on invasive species is collected by single agencies or organizations, each with various purposes. For example, the Pennsylvania Department of Conservation and Natural Resources collects geo-referenced information on invasive plants. Data on invasive plants is also collected by the Morris Arboretum (PA Flora) and the Pennsylvania Department of Agriculture. The Western Pennsylvania

Conservancy (iMapInvasives) and the Center for Invasive Species and Ecosystem Health (EDDMapS) both collect data on all taxa of invasive species. Additionally, management efforts such as surveys and treatments are documentable in iMapInvasives.

Accessibility to the data varies, from more open access to data online (iMapInvasives and EDDMapS) to limited access to data due to firewalls and privacy concerns (agencies). Program managers in the state agencies often have a difficult time knowing what data and information exist in other agencies.

A role of the clearinghouse database would be to provide contact information for the program managers, researchers, and personnel who work with the various invasive species in Pennsylvania as well as providing links to useful technical information. For specific invasive species of critical importance, data from various agencies would be combined into a geographic information system (GIS) format to allow for analysis, mapping, predicting rates of spread, and developing risk assessments.

The National Invasive Species Council is charged with establishing a coordinated information sharing system that emphasizes the use of the internet for documenting, evaluating and monitoring invasive species. To assist in the national effort, Pennsylvania will need to inventory the various databases that already exist within the commonwealth and to facilitate the coordination of this data with federal, state, and non-governmental organizations. Because these factors are highly variable, readily available data from relevant sources are critical if intervention is to be both effective and economical.

Proposed Actions

1. Inventory the various invasive species reporting databases that already exist in the Commonwealth.

2. Support the development or adoption of a central clearinghouse database, including geo-referenced data, technical information, and contact information.

3. Facilitate the coordination of data management with federal, state, and non-government organizations.

4. Establish a new or use an existing reporting system for managing invasive species sightings (from both citizen scientists and natural resource professionals) and disseminate data to relevant agencies, partners, and stakeholders in a timely fashion.

## Research

Goal: Support prioritized research efforts on nonnative invasive species issues and impacts in Pennsylvania and work with partners to facilitate the dissemination of data generated from these efforts.

Background: New invasions of invasive species often require novel ways to effectively address them. Continued research on the impacts of invasive species on biodiversity and on control and eradication methodologies specific to the geography, climate and ecology of Pennsylvania is needed. Because of the lack of data about invasive species in the commonwealth, research projects ranging from basic investigations with broad application to highly targeted applied efforts are required to enable invasive species programs and actions.

Proposed Actions

1. Develop a prioritized list of research needs to address the most important aspects of invasive species risk, prevention, eradication and control.

2. Encourage and support collaboration on invasive species research between state and federal agencies, universities, and other non-governmental organizations.

3. Facilitate the collection and dispersal of information, research and data about Pennsylvania invasive species.

4. Open a dialogue between PISC and USDA APHIS to determine how Pennsylvania can encourage research into biological controls. This can include coordination of biological control programs, providing research grant opportunities for educational institutions, or conducting monitoring programs to ensure that existing biological control agents are widespread and effective.

## Key Personnel

Goal: Identify key personnel needed to coordinate nonnative invasive species issues among local, state, and federal agencies and organizations.

Background: Invasive species programs are effectively developed and implemented through the leadership of knowledgeable personnel who can support them. However, lack of available staff is often cited as a reason for program failure. In the past decade, hiring freezes and complement issues have left vacant key positions in the commonwealth. In other cases, state agencies do not have relevant positions within their complement and need support to create them.

Proposed Actions

1. Establish permanent funding for the Pennsylvania Invasive Species Council Coordinator position, which will be used to help coordinate and oversee the execution of the council's plans.

2. Create and permanently fund positions to facilitate outreach and education about invasive species.

3. Identify existing personnel resources for regional or county-level invasive species coordinator positions through agreements between The Pennsylvania State University Cooperative Extension Service and local and state government to meet the demand for expertise at the local level for implementing rapid response measures as well as outreach and education strategies.

4. Each agency (DCNR, DEP, PGC, PFBC, PDA) and private organization belonging to PISC will identify gaps in personnel dealing with invasive species, and support the creation of permanent positions to address them.

5. Supplement PISC membership with representatives from additional state or federal agencies and private organizations. (e.g., PA Association of Conservation Districts, etc.)

## Education and Outreach

Goal: Educate the general public and key target audiences about nonnative invasive species issues in order that they do not facilitate the introduction and spread of these organisms through their activities.

Background: Education is critical to preventing and limiting the spread of invasive species. Many people are unaware that that their own actions can result in the introduction and spread of these organisms. Raising awareness of the problem is a critical component of any prevention, early detection, control, or monitoring program of invasive species. Persuading people to act in ways that reduce the threats posed by invasive

species and to avoid contributing to the problem is the key to long-term success in invasive species programs.

Proposed Actions

1. Assist the agencies in developing unified messages regarding invasive species prevention and control.

2. Support and encourage local, community-based programs that target invasive species; this will include the development of training modules for volunteer programs that can assist with invasive species prevention, identification, monitoring, and control with the appropriate oversight.

3. Encourage citizen groups in Pennsylvania to become active in outreach and education about invasive species. They should be encouraged to address their legislators about concerns in their communities.

4. Support the development of training programs to certify field staff in identification and reporting of invasive species. In the future, this training should be required for all appropriate state agency field staff.

5. Provide educational briefings on the threats, economic impacts and solutions to decision-makers, legislators and advisory councils and keep them abreast of invasive species issues and concerns. Encourage legislators and decision makers to meet with the Pennsylvania Invasive Species Council on an annual basis to be brought up-to-date on invasive species issues.

6. Identify a list of 25 invasive species considered to be the most significant or harmful to the commonwealth. Create new or modify existing fact sheets for each of these species and distribute to target audiences. Also, include this list on the PISC website.

7. Update fact sheets specific to Pennsylvania on invasive species (created by Seagrant and DCNR Bureau of Forestry) and distribute to target audiences. Where lacking, compile, consolidate and distribute literature to assist the public in control efforts. Ensure that the PISC website provides links to the updated versions of these factsheets.

8. Identify a list of 25 invasive species that cause the most harm to the Commonwealth. (In this case, “harm” indicates not only economic losses, but also declines in biodiversity, damage caused to ecological processes, and danger presented to human health.) Create new or modify existing fact sheets for each of these species and distribute to target audiences.

## Communication and Coordination

Goals: Facilitate communication and coordination across jurisdictional boundaries to ensure that state policy effectively promotes the prevention, early detection, and control of nonnative invasive species in Pennsylvania.

Background: Invasive species do not recognize political boundaries and frequently cross jurisdictional lines. This necessitates enhanced communication and coordination for successful prevention, response and control efforts. Many gaps currently exist in the communication process. There is confusion even among state agencies about who to contact when unidentified organisms are discovered. State agencies typically have response procedures in place within their own organization, but those procedures are not always known to other agencies within the state or to other states. As a result, regional coordination with adjacent states does not always occur in a timely fashion.

Proposed Actions

1. Create a communications flowchart detailing appropriate contacts when a new invasive species is discovered within the commonwealth.

2. Partner with neighboring states to share data and coordinate management activities.

3. Partner with the National Invasive Species Council and regional invasive species panels in order to develop and host events during National Invasive Species Awareness Week.

4. Review, edit, revise and adopt laws, regulations, statutes, acts and/or quarantines that facilitate prevention, early detection and rapid response to introductions of invasive species.

5. Support the efforts of the three active Cooperative Weed Management Areas (CWMAs) and Cooperative Pest Management Areas (Southern Laurel Highlands, Lake Erie, and Sinnemahoning) to address identified problems in regions of the commonwealth. Develop dialogue with the two inactive CWMA's (Juniata and Delaware River). Where needed, support the formation of new CWMAs (Genessee). For more information, please visit http://www.mipn.org/cwma-resources/.

6. The PISC coordinator will update the PISC website on a biannual basis, and ensure that it is promoted on the websites of PISC members.

7. Utilize social media sources such as Facebook to help create awareness of the impact of invasive species on ecosystems , the economy and human health.

## Funding

Goal: Work with the Governor's office, legislature, partners, stakeholders, industry, and federal entities to identify and establish a business plan for the Council that will result in permanent funding sources for nonnative invasive species programs in the commonwealth.

Background: Prevention and early detection/rapid response are the most economically and environmentally feasible approaches to dealing with invasive species. Efforts to prevent the entry of and respond to newly detected invasive species are often greatly hindered by the lack of adequate funding. As it currently stands, most funds are allocated to specific, established species and programs and cannot be used for new prevention efforts.

Current funding levels are also inadequate for early detection of new invasions and monitoring efforts, which require equipment, personnel and training. Initiating a rapid response to a novel threat often requires a substantial level of funding, and the commonwealth often lacks the ability to respond quickly and effectively because funds are already dedicated to pre-existing known invasive species.

There is no adequate source of funding for long term management activities to mitigate the impact of established populations and there is often little money left for the restoration of damaged ecosystems. Education and outreach also require funding for implementation of successful social marketing campaigns and the development and distribution of materials.

Proposed Actions

1. Write a letter to the Governor's Office, requesting the establishment of permanent funding for the prevention, control, and management of invasive species. Deliver this letter to the Governor prior to the end of 2017, so that any response can be made prior to National Invasive Species Awareness Week in 2018 (typically held in late February).

2. Create a business plan which outlines several high priority species to be surveyed and treated within the Commonwealth and the costs associated to do this work. Present this business plan to individuals in the Legislature as a compliment to the Council's request for a permanent funding source to support invasive species work in Pennsylvania.

3. Invite officials from New York state to talk to PISC, in order to determine what specific actions they took to obtain consistent funding for invasive species.

4. Hold educational meetings with legislators about the threat invasive species pose to Pennsylvania and how PISC intends to move forward. Set up field trips to show lawmakers infestations within their districts.

5. Create an emergency fund for rapid response activities that can be directed by request of the council to the lead agency in response to a newly detected infestation in the commonwealth and/or an existing high priority infestation.

6. Provide funding for the development and implementation of training for appropriate field staff, key stakeholders and volunteers in the identification and early detection of invasive species

7. Encourage and develop research funding sources.

8. Make funding available for organizations that work in the restoration of damaged ecosystems.

9. Request that the Legislative Budget and Finance Committee fund a study and create a report on the economic impacts of nonnative invasive species on the commonwealth.

# Moving Forward

Management plans that are not dynamic quickly lose their usefulness due to the inherently changeable nature of invasive species issues. It is the responsibility of the Pennsylvania Invasive Species Council to review and update the comprehensive invasive species management plan in its entirety at least every five years. Accomplishments of prioritized actions should be analyzed at least every two years to ensure that progress is being made towards the goals and objectives of the plan. Revisions and recommendations will be developed through the following processes:

### Quarterly Business Meetings of the Pennsylvania Invasive Species Council

The quarterly business meetings of the council provide members with a forum to work on specific action items listed in the plan, or to constructively think about ways in which members of the Council can collaborate to fulfill PISC goals. Council meetings also afford the opportunity to develop new recommendations when obstacles are encountered throughout the implementation process.

### Council Work Groups

The work groups of the council will be given specific tasks to facilitate implementation of the plan. Work group chairs should rely on the council coordinator to direct the flow of communications to and from the council. It will be up to the work groups to implement tasks.

### Council Progress Reports

Annual reports will continue to be submitted to the Governor. Starting in 2018, progress reports are to be submitted to the legislature within the commonwealth to keep them abreast of activities and needs regarding invasive species. These progress reports will also be incorporated onto the council website.

### Council Website

The council website will continue to evolve to reflect the management plan objectives, actions and recommendations and will continue to dispense information on current invasive species activities in the commonwealth. Most importantly, the website will be the tool to provide outreach and education on invasive species as Pennsylvania specific fact sheets and watch lists are developed.

# Appendix 1 – Glossary

The following terms are used in this document:

**Alien:** a species that is not indigenous to the ecosystem under consideration.

**Aquatic invasive species:** non-native species that threaten the diversity or abundance of native species, the ecological stability of infested waters, human health and safety, or commercial, agricultural, aquacultural or recreational activities dependent on such waters.

**Baitfish:** fish species commonly sold for use as bait for recreational fishing.

**Ballast water:** any water and associated sediments used on-board a ship to manipulate the trim and stability of a vessel.

**Biological control (or Biocontrol):** the use of living organisms, such as predators, parasites, parasitoids and pathogens to control pest species.

**Control:** as appropriate, eradicating, suppressing, reducing or managing invasive species populations, preventing spread of invasive species from areas where they are present and taking steps such as restoration of native species and habitats to reduce the effects of invasive species and to prevent further invasions.

**Ecosystem:** the complex of a community of organisms and its environment.

**Eradicate:** the act or process of eliminating a nonnative invasive species.

**Exotic:** a species that is from another country or that is not native to the ecosystem under consideration.

**Great Lakes:** Lake Ontario, Lake Erie, Lake Huron (including Lake St. Clair), Lake Michigan, Lake Superior, and the connecting channels (Saint Mary's River, Saint Clair River, Detroit River, Niagara River, and Saint Lawrence River to the Canadian Border), and includes all other bodies of water within the drainage basin of such lakes and connecting channels.

**Infested:** any unmanaged area where a population of nonnative invasive species is known to occur.

**Introduction:** the intentional or unintentional escape, release, dissemination or placement of a species into an ecosystem as a result of human activity.

**Invasive species:** an alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health.

**Native species:** with respect to a particular ecosystem, a species that, other than as a result of an introduction, historically occurred or currently occurs in that ecosystem.

**Nonnative invasive species:** with respect to a particular ecosystem, a species that, other than as a result of an introduction, historically did not occur in that ecosystem whose introduction does or is likely to cause economic or environmental harm or harm to human health.

**Nonnative species:** with respect to a particular ecosystem, a species that, other than as a result of an introduction, historically did not occur in that ecosystem.

**Pathways:** natural and human connections and mechanisms that allow movement of organisms, or their reproductive materials, such as seeds, spores or eggs from place to place.

**Pathogen:** a microbe or other organism that causes disease.

**Pest:** An organism that causes or is capable of causing injury or damage.

**Risk assessment:** a science-based process to evaluate the economic and/or environmental risk(s) of invasive species.

**Species:** a group of organisms all of which have a high degree of physical and genetic similarity, generally interbreed only among themselves, and show persistent differences from members of allied groups of organisms.

**Stakeholders:** state, tribal, and local government agencies, academic institutions, the scientific community, nongovernmental entities including environmental, agricultural and conservation organizations, trade groups, commercial interests, private landowners and other interested parties.

**Terrestrial invasive species:** a species living or growing on land 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.

**United States:** the 50 States, District of Columbia, Puerto Rico, Guam and all possessions, territories, and the territorial sea of the United States.

**Watershed:** the geographic area that drains to a single water body or hydrographic unit such as a lake, stream reach or estuary.

# Appendix 2 – References


Keller, R.P., Lodge, D.M. and Finnoff, D.C. 2007. Risk assessment for invasive species produces net bioeconomic benefits. Proceedings of the National Academy of Sciences of the United States of America. 104(1): 203-207.

Liebhold, A.M. Work, T.T. McCullough, D.G. Cavey, J.F. 2006. Airline baggage as a pathway for alien insect species invading the United States. American entomologist. Spring. 52(1): 48-54.

Loope, L.L. and Howarth, F.G. 2002. Globalization and Pest Invasion: where will we be in five years? Available on-line at <http://www.bugwood.org/arthropod/day1/loope.pdf> [Accessed 16/09/08]

Mack, R.N., Simberloff, D. Lonsdlae, M.W., Evans, H., Clout, M., and Bazzaz, F. 2000. Biotic Invasions: causes, epidemiology, global consequences, and control. Issues in Ecology. 5:2-20.

National Invasive Species Council. 2001. Meeting the Invasive Species Challenge: National Invasive Species Management Plan. (Washington D.C.: National Invasive Species Council).

National Invasive Species Council. 2008. Meeting the Invasive Species Challenge: National Invasive Species Management Plan. (Washington D.C.: National Invasive Species Council).

Pimentel, D., Lach, L., Zuniga, R., and Morrison, D. 2000. Environmental and Economic Costs of Nonindigenous Species in the United States. Bioscience, 50(1):53-65.

Stachowicz, John J., Terwin, Jeffrey R., Whitlatch, Robert B., and Osman, Richard W. 2002. Linking climate change and biological invasions: Ocean warming facilitates nonindigenous species invasions. Proceedings of the National Academy of Sciences of the United States of America. 99(24):15497–15500.

United States Congress Government Accountability Office. 2006. Invasive Forest Pests: Lessons Learned from Three Recent Infestations May Aid in Managing Future Efforts. GAO-06-353, (Washington D.C.: GAO).

Williamson, M., Fitter, A. 1996. The varying success of invaders. Ecology 77:1661-1665.

Wittenberg, R.; Cock, M.J.W. 2001. Invasive alien species. How to address one of the greatest threats to biodiversity: A toolkit of best prevention and management practices. CAB International, Wallingford, Oxon, UK

World Trade Organization. 2000. World Trade in 1999 - Overview. <http://www.wto.org/english/res_e/statis_e/chp_1_e.pdf> [Accessed 16/09/08]

World Trade Organization. 2008. World Trade in 2007 - Overview. <http://www.wto.org/english/res_e/statis_e/its2008_e/its08_world_trade_dev_e.pdf [Accessed 25/11/08]

# Appendix 3 – Council Members

The Pennsylvania Invasive Species Council is chaired by the Secretary of Agriculture and includes agency heads of this commonwealth responsible for the conservation of agriculture and natural resources, and the protection of public health, and public members representing agriculture and natural resource organizations and educational institutions conducting invasive species research and outreach.

## Heads of State Agencies

- Department of Agriculture - Russell C. Redding, Secretary
- Fish and Boat Commission - John A. Arway, Executive Director
- Department of Transportation - Leslie S. Richards, Secretary
- Department of Conservation & Natural Resources - Cindy Adams Dunn, Secretary
- Department of Health - Dr. Karen M. Murphy, Secretary
- Department of Environmental Protection - Patrick Mc Donnell, Secretary
- Game Commission - Matt Hough, Executive Director

## Public Members

- Pennsylvania State University - John Tooker, Associate Professor of Entomology and Extension Specialist, College of Agricultural Sciences
- Pennsylvania Sea Grant - Sarah Whitney, Associate Director
- University of Pennsylvania - Lisa A. Murphy, VMD, School of Veterinary Medicine
- Western Pennsylvania Conservancy - Charles W. Bier, Senior Director of Conservation Science
- The Nature Conservancy - Ronald Ramsey, Senior Policy Advisor
- PennAg Industries Association - Mary Beth Ruh, Manager, Seed Division, F.M. Brown's & Son
- Pennsylvania Landscape and Nursery Association - Gloria Day, Director PLNA and Owner of Pretty Dirty Ladies Inc.
- Pennsylvania Forest Products Association - Paul Lyskava, Executive Director
- Pennsylvania Farm Bureau - Andrew L. Ernst, Owner of Ernst Conservation Seeds
- Pennsylvania Lake Management Society - Kerilynn Frey, Executive Director

## State Agencies Council Member Alternates

- Pennsylvania Department of Agriculture
  - Fred Strathmeyer, Jr. (Chair), Deputy Secretary of Consumer Protection and Regulatory Affairs
  - Ruth Welliver, Director, Bureau of Plant Industry
- Pennsylvania Fish and Boat Commission
  - Mark Hartle, Chief, Aquatic Resources Section
  - Robert T. Morgan, Conservation Planning Biologist, Bureau of Fisheries

- Pennsylvania Department of Transportation
  - Joseph S. Demko, Roadside Manager
- Pennsylvania Department of Conservation and Natural Resources
  - Donald A. Eggen, Ph.D, Chief, Division of Forest Pest Management
  - Andrew Rohrbaugh, Botanist, Ecological Services Division
- Pennsylvania Department of Health
  - Dr. Enzo Campagnolo, Career Epidemiology Field Officer and Acting State Health Veterinarian
- Pennsylvania Department of Environmental Protection
  - James L. Grazio, Great Lakes Biologist, Office of the Great Lakes
  - Diane Wilson, Environmental Group Manager
- Pennsylvania Game Commission
  - H. Eric Miller, Chief, Public Lands Habitat Section

## Public Council Member Alternates

- Western Pennsylvania Conservancy
  - Jeffrey Wagner, Director, Pennsylvania National Heritage Program
  - William (Rocky) Gleason, Eastern Region Inventory Coordinator
- The Nature Conservancy
  - Not yet designated
- Pennsylvania Landscape and Nursery Association
  - Gregg Robertson, Government Relations
- Pennsylvania Forest Products Association
  - Not yet designated
- Pennsylvania State University
  - Not yet designated
- Pennsylvania Sea Grant
  - Sara Stahlman, Coastal Outreach Specialist
- PennAg Industries Association
  - Mindy Fleetwood, Assistant Vice President
- Pennsylvania Farm Bureau
  - Not yet designated
- University of Pennsylvania, Morris Arboretum
  - Timothy Block, Ph.D, Director of Botany

## Council Support

- Trilby Libhart, Council Coordinator
- OITS Web Group, Webpage Administrator

# Appendix 4: Regulatory Authorities

## State Agencies

### Pennsylvania Department of Agriculture (PDA)

The 1895 legislation that created the Department of Agriculture transferred to it the three basic functions the state board of Agriculture had previously held: law enforcement, education and prevention of plant and animal disease. The department provides services to maintain and protect Pennsylvania agriculture through consumer protection and product regulation. This includes detection, identification and control of destructive plant pests (diseases, pathogens, insects and weeds - both native and exotic). Among others, the department administers the state's Noxious Weed Control Law, the Plant Pest Act, the Seed Act, and the commonwealth's Domestic Animal Law.

### Pennsylvania Game Commission (PGC)

The Game Commission is responsible for enforcing the commonwealth's game laws relating to the management, protection and preservation of game, birds and fur-bearing animals. The commission regulates the hunting and trapping of game, sets bag limits, operates game farms and employs game protectors. Created in 1895 as the Board of Game Commissioners, it was renamed the Pennsylvania Game Commission in 1937. The commission is authorized to prohibit the introduction, sale and release of any wildlife species of birds or mammals which are considered harmful to the public or wildlife of Pennsylvania under Title 34 Game and Wildlife Code and Title 58 Pennsylvania Code.

### Pennsylvania Fish and Boat Commission (PFBC)

The Fish and Boat Commission has its origins in legislation from 1866 designed to protect fish. The legislation created a Commissioner of Fisheries empowered to force dam builders on the Susquehanna to pay for passageways through which anadromous fish, especially shad, could continue their natural annual upstream spawning journey. The commission is charged through Title 58 Pennsylvania Code Part II with ensuring the protection, propagation, and distribution of game fish, fish bait, baitfish, amphibians, reptiles and aquatic organisms and managing recreational boating in the commonwealth.

### Pennsylvania Department of Environmental Protection (DEP)

The Department of Environmental Protection was created by Act 1995-18 which split the Department of Environmental Resources into the Department of Environmental Protection and the Department of Conservation and Natural Resources. The Department of Environmental Protection is charged with responsibility for development of a balanced ecological system incorporating social, cultural, and economic needs of the commonwealth

through development and protection. It is responsible for the state's land, air and water management programs, as well as other aspects of environmental protection and the regulation of mining operations.

### Pennsylvania Department of Conservation and Natural Resources (DCNR)

The Department of Conservation and Natural Resources was created by the Act 1995-18 on June 28, 1995. Act 18 gives the Bureau of Forestry the responsibility for the protection of "all forestland" in the commonwealth from "fungi, insects, and other enemies". The Wild Resource Conservation Act directs the Department of Conservation and Natural Resources to conduct an investigation to determine the status of wild plants, creates an enforcement system to protect endangered, threatened, and vulnerable wild plant species, creates a permit procedure for persons interested in wild plant management, creates a commercial license procedure for persons who purchase vulnerable plants with the intent to sell them, and authorizes the agency to create a statewide system of private wild plant sanctuaries. The department has also created an agency-wide invasive species management plan available on their website (www.dcnr.state.pa.us/ocs/invasivespecie/invasiveplan).

### Pennsylvania Department of Health (DOH)

The Department of Health was created by the Act of April 27, 1905 (P.L. 312) to replace the State Board of Health and Vital Statistics that was originally established in 1885. The department has the authority to enforce all statutes pertaining to public health and the rules and regulations passed by Pennsylvania's Advisory Health Board. In addition to enforcing statutes and regulations pertaining to public health matters, the department works to prevent and suppress outbreaks of disease. Through the use of community-based strategies, the department of Health has successfully reduced the number of serious illnesses, injuries and deaths due to major health threats, tobacco-related diseases, infectious diseases, and accidental injuries.

### Pennsylvania Department of Transportation (PennDOT)

The Pennsylvania Department of Transportation is a major partner in the prevention of nonnative invasive species as our highways and byways are a recognized pathway of spread. The Pennsylvania Department of Transportation's history stretches back to 1903, when it was first established as the Department of Highways. In the 1950s, the department began laying the foundation for Pennsylvania's current interstate highway system. During the interstate project, it was renamed the Pennsylvania Department of Transportation on May 6, 1970. The Pennsylvania Department of Transportation controls noxious and problematic vegetation on rights of way across the commonwealth and actively supports research on management and control.

# Federal Agencies

### USDA-APHIS

"Protecting American agriculture" is the charge of the U.S. Department of Agriculture's (USDA) Animal and Plant Health Inspection Service (APHIS). APHIS provides leadership in ensuring the health and care of animals and plants. The agency improves agricultural productivity and competitiveness and contributes to the national economy and public health. USDA APHIS regulates pests through the Plant Protection Act, the Federal Noxious Weed Act, the Noxious Weed List and Federal Domestic Quarantines.

### USDA Forest Service

The U.S. Department of Agriculture Forest Service is a Federal agency that manages public lands in national forests and grasslands. The Forest Service was authorized by the Cooperative Forestry Assistance Act of 1978 and amended by the 1995 Farm Bill to assist states in conducting forest health management activities on non-federal forest lands to achieve healthy sustainable forests.
The goal is to protect state forest lands from significant loss of economic, ecological, or aesthetic value due to insects, diseases, and other stressors.

### U.S. Environmental Protection Agency

The mission of the Environmental Protection Agency is to protect human health and the environment. Since 1970, EPA has been working for a cleaner, healthier environment for the American people. The EPA is currently reviewing its authorities under the Clean Water Act relative to invasive species, especially in regards to ballast water.

### U.S. Coast Guard

The United States Coast Guard works to prevent future introductions of harmful aquatic non-indigenous species and control existing populations through the Non-indigenous Aquatic Nuisance Prevention and Control Act and the Federal Ballast Water Regulations.

### U.S. Fish and Wildlife Service

The United States Fish and Wildlife Service is the government agency dedicated to the conservation, protection, and enhancement of fish, wildlife, and plants, and their habitats. The U.S.F.W.S. regulates the import of specified injurious wildlife species through the Injurious Provisions of the Lacey Act.

## Local Authorities

Local government in Pennsylvania is a mosaic of 5,128 individual units, all established by the state or Provincial government, that operate under laws of the commonwealth. Each unit is distinct and independent of other local units, although they may overlap geographically and may act together to serve the public.

As of 2015, there were 67 counties, 56 cities, 957 boroughs, one incorporated town, 1,547 townships (93 first class, 1,456 second class), 500 school districts and 2,000 authorities (active and inactive). The number of local units has remained fairly stable for the past few decades with two major exceptions. After passage of school district legislation in 1963 and 1965, the number of school districts diminished radically. Authorities, born as local units during the depression years of the 1930s, have proliferated at a phenomenal pace since then. There are 67 counties in Pennsylvania, including the consolidated city-county of Philadelphia, and each inhabitant of the state lives in and comes under the jurisdiction of one of them. (Bogden, 2016)

## County Conservation Districts

In 1945, Pennsylvania state legislators recognized the need to support grass-roots conservation efforts. As a result, the Conservation District Law was passed, and county conservation districts were created. Today there is a conservation district established in every Pennsylvania county except Philadelphia.

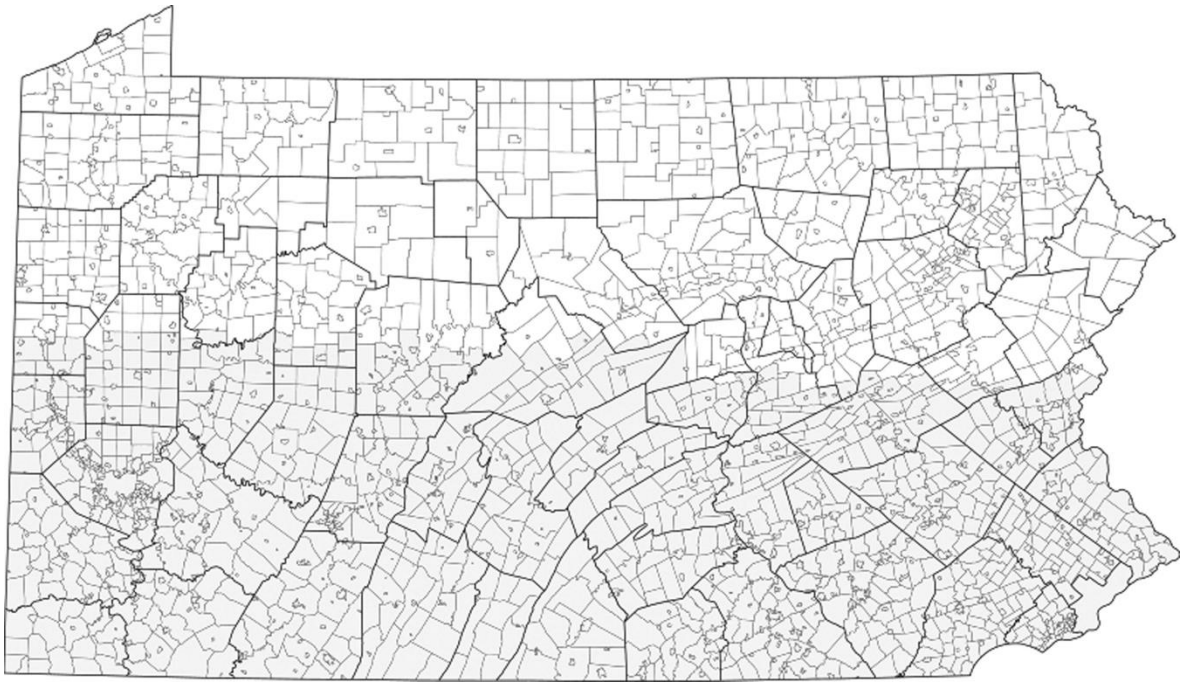
Conservation districts implement a variety of programs, and provide assistance for a range of issues unique to their county, such as:

- Abandoned Mines
- Agricultural Land Preservation
- Chesapeake Bay Program
- Dirt & Gravel Roads Program
- Environmental Education
- Erosion & Sedimentation Pollution Control
- Floodplain Management
- Forest Management
- Nutrient Management Program

- Stormwater Management
- Waterway Protection
- West Nile Virus Surveillance Program
- Wildlife Management

Each Conservation District is led by a Board of Directors made up of local people from all walks of life. These volunteers study county natural resource issues and make decisions which enhance and protect the local community.

Contact your local Conservation District for information on programs in your area. (pacd.org)



# Appendix 5 – Plan Development

The Pennsylvania Invasive Species Council was charged with developing a state comprehensive nonnative invasive species management plan by Executive Order 2004-1. Beginning in 2005, council members and stakeholders involved in invasive species issues in Pennsylvania have met quarterly to develop the framework of that plan. In addition, Pennsylvania Sea Grant organized the workshop "Setting the Roadmap," in 2005 which provided additional guidance to the council. As noted in the Governor's Executive Order, the Federal Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 provides federal funding to states with an approved aquatic invasive species management plan. In order to secure that funding, the council first developed an Aquatic Invasive Species Management Plan in 2006 which was submitted to the Federal Aquatic Nuisance Species Task Force and approved in February 2007. In preparation for the development of the commonwealth's comprehensive management plan, a draft Terrestrial Invasive Species (TIS) Component was developed and submitted with the status report to the Governor in December 2006. The text of the TIS document became the background material for the first version of the council website[1], launched in January 2008.

This document has served as the first submission of a comprehensive invasive species management plan for the Commonwealth of Pennsylvania. Key elements from the approved Aquatic Invasive Species Management Plan for Pennsylvania (October 2006), the draft Terrestrial Invasive Species Component (December 2006), and more recent attempts to address the issue of feral swine in the Pennsylvania Feral Swine Background Paper (April 2008) and Appendix to the Background Paper (November 2008) have been identified in this document as essential to the comprehensive management of invasive species. Efforts in other states have also been reviewed, particularly Oregon, New York, Delaware, Idaho, Virginia, Hawaii, Washington and Indiana.

The interim council coordinating team, composed of Melissa Bravo of the Pennsylvania Department of Agriculture, Sarah Whitney of the Pennsylvania Sea Grant, and Melanie Wertz of the Department of Environmental Protection, began the process of developing a comprehensive invasive species management plan in 2005. In July of 2008, four state agencies (the Departments of Environmental Protection, Agriculture, Transportation, and Conservation and Natural Resources) pooled resources to hire an Invasive Species Council Coordinator to complete the development of the plan. The Pennsylvania Game Commission later became the fifth state agency to commit resources for the Coordinator position.

The Pennsylvania Invasive Species Council was created to provide guidance to the Governor and the commonwealth on prevention, control, and rapid response initiatives as well as to facilitate cooperation and coordination among federal, regional, state and local efforts regarding nonnative invasive species. This document reflects the ongoing efforts of the council to develop a framework that identifies strategies and actions that will minimize the harmful ecological, economic, and human health impacts of nonnative invasive species in Pennsylvania and facilitate addressing these threats in a logical, coordinated fashion.

Throughout the development process of this document, it has been reviewed multiple times by the members and alternates of the Pennsylvania Invasive Species Council. We would like to take this opportunity to thank everyone for their input and hard work.

2016 Update: This plan was updated in 2016 by Trilby Libhart of the Pennsylvania Department of Agriculture and Donald A. Eggen and Andrew Rohrbaugh of the Department of Conservation and Natural Resources. Significant changes include updating the language for Proposed Actions to make responsibilities more clear and updating the Introduction and Examples of Invasive Species. Special thanks go to staff at the Western Pennsylvania Conservancy for their time and effort in reviewing and editing the plan.

[1]http://www.agriculture.state.pa.us/PISC

# Appendix 6 – Past Achievements

## Council Member Achievements from 2010-2015:

### Pennsylvania Department of Conservation and Natural Resources (DCNR)

-DCNR has increased outreach to its staff about invasive plants, which has included the following: selecting an Invasive Coordinator in each forest district, increasing training outreach and providing a yearly field workshop, and creation of an Invasive Plant Species Identification Manual.

-DCNR updated its list of Invasive Plants in 2013, and created an Invasive Tutorial online for the public. This resource provides guidance on identification, prevention, and control of invasive plants. Other outreach to the public has included the distribution of educational pamphlets on invasives and educational trainings/presentations to the public, and information on invasive plant control and NRCS cost-share opportunities via service foresters.

-DCNR has provided informed, field-tested BMP's to the 2015 Governors Pipeline Infrastructure Task Force regarding invasive plant management on pipeline corridors. DCNR has also adopted new, more stringent protocols for dealing with invasives on leased lands and right-of-ways.

-Starting in 2012, DCNR has monitored all gas-infrastructure for invasive plant impacts via an early detection, rapid response format.

-DCNR has also assisted research into new biocontrols (*Verticillium albo-atrum* for tree-of-heaven) and continued the spread of existing biocontrols across the state (*Larinus obtusus* and *Cyphocleonus achates* for spotted knapweed, and *Rhinocomimus latipes* for mile-a-minute).

-The Bureau of Forestry has monitored populations of walnut twig beetle (*Pityophthorus juglandis*), the vector for thousand cankers disease (*Geosmitha morbida*), within five quarantined counties as designated by the Pennsylvania Department of Agriculture. Traps were set up in Bucks, Chester, Delaware, Lancaster, and Montgomery Counties annually. The only positive trap capture of walnut twig beetle throughout the life of the project was confined to a specialty wood working area, and this has since been remedied. Since 2016, surveys were based of examining black walnut trees for visual symptoms of thousand cankers disease in August, which is the ideal time to detect disease activity. Trees were surveyed in Bucks, Delaware, Montgomery, Chester, and Lancaster Counties, which are the quarantined counties for thousand cankers disease. Neither walnut twig beetle or thousand cankers disease were reported in any of the surveys.

- Sudden oak death (*Phytophthora ramorum*) stream surveys have been conducted since 2006. Presently there is no indication of *P. ramorum* showing up in surveyed streams in Pennsylvania from 2006-2016.

- Starting in 2009, native butternut (*Juglans cinera*) and hybrids of Asian walnut (*Juglans ailantifolia*) were located across the Commonwealth of Pennsylvania. Specimens of butternut representing twenty-nine counties were genetically tested to verify pedigree. Similarly, pure butternut and butternut hybrids have been genetically identified in twenty counties across the same survey area. One-hundred-ninety-four trees were suitable selected for genetic testing; of these 121 were determined to be pure butternut, and 54 were genetic hybrids. Results were inconclusive for 19 specimens. A seed orchard of pure butternuts was planted in Greenwood Furnace State Park. Also pure butternut ramets were shared with participating agencies funded through the grant to ensure that trees from Pennsylvania are maintained at multiple locations to serve as scion and seed sources for future conservation research and conservation projects. Mortality within the seed orchard remains an ongoing problem but sufficient material is surviving to support butternut seed production. Genetic testing of seed cohorts to ensure genetic purity will be considered for seed and seedlings produced randomly and through specific breeding crosses to test for butternut canker disease resistance. A butternut orchard to screen for butternut canker resistance has been established at the Connecticut Agricultural Experiment Station to evaluate trees from the Northern region for disease resistance. Sources of genetic material have been assembled from Connecticut, Pennsylvania, Vermont, Missouri, and Iowa for disease resistance screening. The pathology orchard was established by Dr. Sandy Anagnostakis in 2012-2014 and consists of eight (8) Vermont families; thirteen (13) Pennsylvania families; three (3) Iowa families; one Missouri family, and two Connecticut families.

- Traps for bark beetles were set up and monitored throughout the 12 week field season, with focus on determining if any novel non-native species were present. Throughout the life of the project, the species makeup of the trap captures is similar for each year, although the ratios of each insect captured varies. To date, no exotic bark beetles of concern have been captured via the EDRR traps.

- Mapped 559,706 acres in 2010, 71,145 in 2011, 41,256 in 2012, 476,481 in 2013, 353,208 in 2014, and 814,837 in 2015.

### Pennsylvania Game Commission (PGC)

-Since 2006 USDA-Wildlife Services, the Pennsylvania Game Commission and the Pennsylvania Department of Agriculture have actively to control feral swine issues within the common wealth. Since 2010 29 feral swine have been removed. As well Pennsylvania landowners, sportsmen,

and cooperating agency personnel (Pennsylvania Game Commission) have removed over 30 animals during that time period. Disease samples (with the focus on Classic Swine Fever, Pseudorabies and Swine Brucellosis) have been collected from these animals as part of state and national testing efforts (over 200 different samples). In 2016 2 animals tested positive for pseudorabies, this is a disease of concern to the Pennsylvania Department of Agriculture due to the potential impacts it could have on the domestic swine industry. The Pennsylvania Game Commission and WS have worked to investigate numerous feral swine reports, determine sources, and work to increase access for control efforts to be initiated.

-In 2014 a National Feral Swine Management Program was initiated, which provided additional funds to tackle the feral swine problem in the Commonwealth. This has allowed our program to increase surveillance and control efforts, identify and confirm areas where swine have been eradicated within the state, investigate escapes from shooting preserves, as well as preform site visits of preserves that house and breed feral swine to better understand the industry and the risks factors associated with potential escapes.

-Increased education efforts have also been initiated, including presentations at state and national conferences, agency meetings, workshops, and to the general public. This has included handing out over 6,000 leaflets on feral swine and reporting and over 50,000 participants.

-Between 2010 and 2015 removed 3,000 acres of invasive vegetation from the State Game Lands System using their own equipment and contracted another 11,000 acres via contractors.

-PGC has successfully trained and certified 147 pesticide applicators in its work force as a means of safely and effectively combatting invasive vegetation on State Game Lands.

-PGC initiated biocontrol techniques in order to combat mile-a-minute and purple loosestrife infestations on the State Game Lands System.

## Pennsylvania Sea Grant

-Provided information about how to prevent the spread of AIS to more than 30,000 people through in-person presentations, webinars, trainings, and participation in events and trade-shows.

-Developed and disseminated education and outreach materials on aquatic invasive species and the stop aquatic hitchhikers campaign including watch cards, AIS attack packs and give-away items such as key floats, bobbers, temporary tattoos, and more. These materials were distributed to stakeholders and partner agencies and organizations for use in their own AIS outreach and programming efforts.

-Developed approximately 30 Pennsylvania-specific AIS fact sheets on species such as Eurasian watermilfoil, red-eared slider, curly leaf pondweed, and Asian clam; and on pathways such as boating, angling, scuba diving, waterfowl hunting, and aquarium ownership.

-Partnered with state agencies and organizations to provide AIS prevention signage that highlights the "Clean Your Gear" message at boat launches and water access points throughout the Commonwealth.

-Created The Pennsylvania Field Guide to Aquatic Invasive Species, which was designed to assist science professionals in early detection and rapid response of potential new invasive species infestations. The field guide includes approximately 60 species profiles for invasive plants, fish, invertebrates, pathogens, and reptiles. The first edition of the guide was released in 2013 and more than 1,000 copies were distributed to regional biologists and water conservation officers in the state. The guide has been requested from more than 17 states and two Canadian Provinces. In 2015, an updated version of the field guide was developed which included six additional species. More than 2,000 copies of the updated version were printed. The field guide is available on the PA Sea Grant website: http://seagrant.psu.edu/topics/aquatic-invasive-species/projects/ais-field-guides

-Coordinated the Pennsylvania Zebra and Quagga Mussel Monitoring Network which tracks the movement and introduction of invasive mussels throughout Pennsylvania. Collected data is compiled into maps and reports, and shared with other invasive species databases, such as the Pennsylvania Fish and Boat Commission internal database and iMap Invasives.

-Led the development of *Rapid Response Plan and Procedures for Responding to Aquatic Invasive Species in Pennsylvania*. This rapid response plan was developed as an inter-agency decision support tool to help regulatory agencies conduct coordinated responses to new AIS infestations in the Commonwealth. It serves as a guide for determining when a response is appropriate and what types of responses should be considered. The rapid response plan is available on the PA Sea Grant website: http://seagrant.psu.edu/sites/default/files/PA%20Rapid%20Response%20Plan_Final.pdf

-Provided rapid response trainings to help introduce agency staff to the rapid response plan.

-Held a mock exercise in October, 2015 to respond to a starry stonewort infestation in Presque Isle Bay. Participants walked through the rapid response plan and learned how to report, identify, conduct a site-assessment, collect samples, and brainstorm possible response options. More information on the starry stonewort mock rapid response exercise is available in the after action report: http://seagrant.psu.edu/topics/pa-sea-grant-holds-mock-rapid-response-exercise-responding-ais.

-Participated in and provided leadership for the Great Lakes and Mid-Atlantic Aquatic Invasive Species Regional Panels by serving on committees, reviewing grant proposals, and developing research and outreach strategies.

-Conducted research on how climate change can impact non-native species introductions and establishment throughout Pennsylvania. Using existing AIS databases, climate projections, and predictive modeling software, the establishment potential of risky invasive species was estimated in various future climate scenarios. This research identified four high-risk species to consider in Pennsylvania as temperatures continue to warm. These findings have been shared at state and national meetings and workshops, and two international conferences. This work also led to revisions to existing AIS student curriculum, to now incorporate climate change concepts into classroom AIS studies. Ten lessons now include climate change information and have been distributed to more than 1,750 teachers throughout the Great Lakes region.

### Pennsylvania Lake Management Society (PALMS)

-PALMS funded aquatic invasive species management projects through a limited mini-grant project. Funds for the mini-grant program were provided by the Pa Department of Environmental Protection. Projects included management of *Myriophyllum spicatum L*. and *Hydrilla verticillata*

-PALMS annually provided nationally known speakers on aquatic invasive species management as well as prevention measures at the annual Pennsylvania Lake Management Society Conferences.

-PALMS provided technical support for both identification and management efforts of monecious *Hydrilla verticillata* as well as other aquatic invasive plants within the commonwealth.

### Western Pennsylvania Conservancy (WPC)

-In 2013, the Western Pennsylvania Conservancy, in conjunction with the Pennsylvania Natural Heritage Program, launched an online invasive species tracking database known as iMapInvasives. The purpose of iMapInvasives is to assist natural resource professionals and citizen scientists by advancing their knowledge of species distributions across Pennsylvania and to provide a tool which stores both location and management details. Additionally, administrative staff of Pennsylvania iMapInvasives strive to promote early detection and rapid response efforts by communicating with Pennsylvania agencies and NGOs when confirmed reports of new or high priority invasive species found in Pennsylvania are reported to iMapInvasives.

-The iMapInvasives program (a program of the Western Pennsylvania Conservancy/PA Natural Heritage Program) created and maintains a list of early detection and high priority

invasive species to be on the lookout for in Pennsylvania. This list is available on the Pennsylvania iMapInvasives website at www.paimapinvasives.org/tracked-species.

### The Nature Conservancy (TNC)

-The Nature Conservancy and the US Forest Service started the High Allegheny Hemlock Conservation Partnership in 2012, bringing together a diverse group of private and public partners (including PISC members DCNR and PGC) across the landscape of northwestern Pennsylvania to address the threat of hemlock woolly adelgid and potential impacts to eastern hemlock. The Partnership has prioritized hemlock of the High Allegheny, conducted outreach and education, started a volunteer monitoring program, set permanent hemlock health monitoring plots across various landforms, and supported partners in acting to conserve hemlock resources such as chemical treatments, silvicultural operations, and underplantings in hemlock-dominated stands.

-The Nature Conservancy and Philadelphia Parks and Recreation staff began working together in 2016 on an eastern hemlock conservation plan for the Wissahickon Valley Park. Along with Friends of the Wissahickon, a very active volunteer group, hemlocks in priority areas of the Park are being inventoried and planned for treatment in 2017.

### Pennsylvania Department of Environmental Protection (DEP)

-Environmental Education and Information Center – works to educate the public about non-native invasive species by distributing information at large educational outreach events, such as Ag Progress Days in Rock Springs and the Pennsylvania Farm Show which annually reaches upwards of 500,000 people annually. DEP's Environmental Education Grants Program also funds EE projects focused on incorporating native plants, integrated pest management and invasive species into their grant funded projects

-Regional Offices - DEP has six regional offices located in: Harrisburg; Williamsport; Wilkes-Barre; Norristown; Meadville; and Pittsburgh. Regional staff collect and identify invasive species. They have been reporting them to the appropriate agency that tracks those occurrences and data is entered the iMap Invasives database.

-Pennsylvania's Coastal Resources Management Program has specific policies related to the management of aquatic nuisance species included in its approved Coastal Resources Management Plan. Key points in the management program include:

- The management plan and associated policies apply to specific coastal zone areas along Pennsylvania's Delaware Estuary and Lake Erie coasts.
- These policies provide for technical assistance and funding to encourage research and outreach programs that will reduce the impact of aquatic nuisance species on Pennsylvania's coastal resources.
- In addition to research and outreach, the Coastal Resources Management Program assists local municipalities and their partners

with invasive species planning and removal projects on public lands, through the awarding of Coastal Resources Management grants.

- Examples of projects include assisting Morrisville Borough with Japanese Knotweed removal on a newly acquired open space parcel along the tidal Delaware River, and supporting the Regional Science Consortium in researching the impacts of the round goby on native habitats and fish populations.
- The Coastal Resources Management Program also promotes the use of native terrestrial species for Lake Erie bluff management through outreach, direct technical assistance, and the distribution of the booklet Vegetative Best Management Practices – A Manual for Pennsylvania/Lake Erie Bluff Landowners.

-Growing Greener Watershed Protection and Restoration Grants funds grantees in the identification and control of invasive species and includes a Healthy Waters special consideration component. The Healthy Waters component addresses support for control of invasive species. Some examples of a Growing Greener Grant Recipient that deals with invasive species identification and control are described below:

- Healthy Waters-Tom's Run in Michaux State Forest, Cumberland County

-The Nature Conservancy (TNC) received a Growing Greener grant for work to be done on Tom's Run, an Exceptional Value native trout stream in Michaux State Forest. DEP and TNC are partnering with DCNR to put together an invasive species removal plan for the project. In addition to being of rich ecological and recreational significance, the Tom's Run site has great historical importance; it was the site of a WWII POW Camp. There are areas where Japanese Stiltgrass, Multiflora Rose, and other invasive weeds are the dominate species and they will be targeted for control as part of the proposed work. The work should be completed in 2018.

- Pennsylvania Lake Management Society (PALMS) which funds aquatic invasive species management projects through a limited mini-grant project. Projects included management of Myriophyllum spicatum L. and Hydrilla verticillata. In addition:

-Section 319 Nonpoint Source Program

- Maintains the Watershed Specialist program in County Conservation District Offices. Numerous Watershed Specialists are actively involved with invasive species control projects.
- Directly supports county conservation districts with funding and/or personnel to work on several projects to survey and remove invasive species. These include efforts aimed at controlling water chestnut (Trapa natans) at sites in Bucks, Chester, and Warren counties.
- Supports program partners' efforts to survey and monitor hydrilla (Hydrilla verticillata) in Crawford and Luzerne counties.

-Examples of DEP working with partners to thwart the spread and impact of invasive species

- Water Chestnut, Lake Towhee, Bucks County
  DEP assisted the Bucks County Conservation District in removing invasive water chestnut plants from Lake Towhee since 2009. Staff worked with local volunteers using kayaks and boats to manually remove these exotic and invasive plants. The work occurred annually in July as the high water and air temperatures help to ensure safety and because this is before the plants impart seeds into the water column. The charts below indicate that significant effort has taken place and is on the increase. The result of these efforts is improved habitat at Lake

Towhee to the point of restoring fishable conditions as surface water has been reclaimed as the floating shell of water chestnut plants is removed and kept in check. While this project has been successful at restoring over half of the lake, the shallow upstream area requires significant attention. Known as "Paddle with a Purpose", this effort has resulted in 300 citizen volunteers donating a total of more than 2,000 hours. That time and effort lead to the removal of 30 dump truck loads (approximately 150 cubic yards) of wet plant material and seeds. Lake Towhee is owned by Bucks County and is part of the county park system. The county parks department provides a disposal site for the plants at an offsite location where the plants are composted so that neither the seeds nor the composted nutrients can contaminate the lake. The county is presently considering available options for future control of this invasive species

- Water Chestnut, Warren County
  Audubon Sanctuary, just across the Pennsylvania border in New York, and within the valley of Conewango Creek is the likely source of the water chestnut populations that have been popping up in Warren County. The discovery of water chestnut at the Audubon Sanctuary caught the attention of members in the Conewango Creek Watershed Association. Several members of the group partnering with the Warren County Conservation District acted quickly to limit the spread of this invasive species. Elsewhere in Warren County and around the same time as the Audubon Sanctuary discovery, water chestnut was found at some privately-owned ponds and at Akeley Swamp, a property in the care of the Pennsylvania Game Commission on State Game Lands 282. The infestations at these two sites were dealt with promptly by hand weeding all plants from the sites. These were the first confirmed occurrences of water chestnut in western Pennsylvania. In a 2014 follow-up visit to Akeley Swamp only 14 water chestnut plants were found and pulled, and in 2015 an additional 25 were found and removed during two searches. In July 2015, a manageable colony of water chestnuts was found on the back channel of Mead Island in the Allegheny River. Volunteers removed all the plants in that colony and plan to monitor the site next summer and respond as necessary.

- Rusty Crayfish, Susquehanna and Juniata Rivers
  In 2010 DEP began an ongoing study of rusty crayfish from two Susquehanna River sites and from several sites in Armstrong Creek, a tributary to the Susquehanna River in Dauphin County. Whole crayfish and crayfish tail meat were tested for metals. The purpose of the metal analysis was to determine the extent to which crayfish consumption might contribute metals to the fish that feed on them; a second purpose of the study was to assess the potential human health risk of crayfish consumption. Crayfish are a favored food of many commonwealth citizens. In the years since this study began, thousands of rusty crayfish have been collected from the Susquehanna River from Sunbury to Middletown with McKee's Half-Falls and the Clemson's Island area being the primary collection sites. In 2012 the study was expanded to include the Juniata River because observations indicated that many crayfish in that river were being collected by the public for human consumption. Rusty crayfish were collected at three points in the

Raystown Branch of the Juniata River. Tests for mercury showed the crayfish did not have high levels of mercury in the tail meat. During the four years of research on the Susquehanna and Juniata River, no native crayfish appeared in the collections. In 2015 the Pennsylvania Fish and Boat Commission banned the sale, barter, possession or transportation of the species and thereby substantially decreasing much of the collecting for consumption by the public.

- White River Crayfish, Blackjack Swamp, Crawford County and Lake Towhee, Bucks County
  DEP partnered with DCNR and FBC to conduct a study on the non-native White River Crayfish (Procambarus acutus) in and near Blackjack Swamp. Blackjack Swamp is a Natural Area of 725 acres and is part of Pymatuning State Park in Linesville, Mercer County. Specimen identification was verified by the FBC. Several adult and juvenile specimens were also given to the Tom Ridge Environmental Center (TREC) in Erie PA. They have been preserved and added to the TREC Natural History Collections. There is some concern that the White River Crayfish could be disruptive to the natural habitat since they are not native to the area. The Blackjack Swamp crayfish population appears to be well-established, as more than 100 individuals were captured and no other crayfish species was collected in the netting efforts or with three traps deployed overnight in the two-day survey.

- Hydrilla, Crawford and Luzerne Counties
  Hydrilla (*Hydrilla verticillata*) was recently found in Pymatuning Reservoir, Crawford County and Harvey's Lake, Luzerne County. Pymatuning Reservoir was surveyed during the summer of 2015 by boat crews from several agencies and stakeholder groups. The project is led, organized and coordinated by the Crawford County Conservation District. Hydrilla locations have been mapped for both Pymatuning Reservoir and Harvey's Lake. Planning and strategy development to contain the spread and reduce the population of hydrilla using herbicides at both sites is presently underway. Field work will occur during the plants growing season is projected to take place over the next three years or more if necessary.

-Bureau of Clean Water (BCW) Lake Assessment and Management Program identifies invasive aquatic species during routine monitoring of lakes statewide. BCW staff also responds to requests on how to proceed with newly discovered infestations, referring folks to Morris Arboretum for identification and documentation. Staff also assist local entities in finding resources to combat invasive species. Some examples follow:

- DEP documented the plant species in Lake Arthur (Moraine State Park, Butler Co.) where it was known to have shoreline coverage comprised mainly of Hydrilla. By rake density, the main shoreline plants were: Hydrilla (63% of the species), Eurasian milfoil (11%) and coontail (11%).
- The DEP Northeast Regional Office responded to a request from residents at Lake Alden (aka Long Pond, Wayne Co.) and mapped the coverage of Hydrilla. In the shallower areas with a mucky bottom the Hydrilla was dense. Hydrilla was spotty in rocky substrate and towards the middle of the lake, but not totally absent. The Hydrilla was mixed with a Potamogeton in some areas. The submersed plants grew along with the floating plants, thick wherever the sunshine can get through.

- BCW staff partnered with Department of Conservation and Natural Resources with two Biobase equipped boats to record the coverage of Hydrilla in Lake Marburg, Codorus State Park York County. Hydrilla, along with Eurasian watermilfoil, was pervasive in the upper 3/4th of the lake, with the densest coverage in the upper reservoir embayments. Rake density data was collected in the lower half of reservoir only, where the dominant plants were Eurasian watermilfoil (54%), Najas sp. (22%) and Hydrilla (8%). Hydrilla and E. milfoil are expected to dominate the entire lake shorelines within a few short years.
- Harveys Lake obtained local funding to treat the outlet of the lake for hydrilla in and received state funds for the first year's chemical treatment with Sonar.
- Hydrilla was discovered to be pervasive in Conowingo Pond on the lower Susquehanna River during vegetation mapping in late summer 2016. In preliminary data, Hydrilla dominated the rake data sets (62%), with coontail the second most common species (36%).

-Conservation Reserve Enhancement Program and Invasive Species (CREP) is a partnership among government agencies and private groups that works with landowners to establish and maintain approved conservation practices to improve water quality and enhance wildlife habitat. DEP works with the U.S. Department of Agriculture Farm Service Agency (FSA) to provide cost share for the establishment of the conservation practices. Landowners voluntarily sign 10-15 year contracts to establish and maintain the conservation practices on environmentally sensitive lands. All CREP contract holders are required to control noxious and invasive species on all conservation practices. DEP and FSA provide cost share to landowners to assist with noxious and invasive weed control on riparian forest buffers established through CREP.

For more details on information presented in this Plan, please contact Andrew Rohrbaugh at anrohrbaug@pa.gov or (717) 705-2823