

2020

# DIVISION OF FISH & WILDLIFE TERRESTRIAL INVASIVE SPECIES PLAN



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On the Cover: Feral hog piglets with sow at a wallow in Indiana (DNR file photo).

# 1. Introduction to the Problem

An “invasive species” is defined as a species that is non-native to the ecosystem under consideration and whose introduction causes or is likely to cause economic or environmental harm or harm to human health (Invasive Species Advisory Council, 2006). For a non-native organism to be considered an invasive species, ISAC goes on to say that the negative effects that the organism causes or is likely to cause are deemed to outweigh any beneficial effects.

Under the ISAC definition, only non-native species can be considered invasive. Native species that have undesirable characteristics are referred to using different terminology, such as nuisance, aggressive, or problematic species. Poison ivy can be an aggressive plant that is native to Indiana and nearly everyone who is allergic to the plant’s oil, and has suffered rashes as a result, would classify poison ivy as a nuisance. Poison ivy, no matter how despised it is, does not meet the definition of invasive because it is a native species. For the purposes of this document, the term invasive species will strictly be used to describe non-native organisms of concern, not native nuisance or problematic species.

Terms such as exotic, introduced, alien, non-indigenous, foreign, and non-native are occasionally used interchangeably with the word invasive. These terms classify that a species is not native to a particular location; however, they do not identify the negative consequences that must be met to define a species as invasive. There are many non-native species found in Indiana that are benign, provide benefits to society, and play substantial roles in our economy such as corn, soybeans, or cattle and are therefore not referred to as invasive species. For the purposes of this document, any term identifying species as not native to Indiana landscapes is not synonymous to the word invasive that, by definition, infers negative consequences.

The National Invasive Species Council’s 2016-2018 Management Plan clearly identifies the great threat of invasive species and is therefore a call to action to stem the invasions and expansions of invasive species (National Invasive Species Council, 2016):

*Invasive species represent one of the most significant threats to ecosystems, human and animal health, infrastructure, the economy, and cultural resources. Alarmingly, the threat is growing. Climate change and the globalization of trade, travel, and transport are greatly increasing the number and type of species moved around the world, as well as the rate of movement. Simultaneously, changes in land use and climate are rendering some habitats more susceptible to the establishment of non-native species and may amplify the adverse impacts of biological invasion.*

The introduction of invasive species into Indiana is a source of biological pollution that threatens not only the ecology of the region and state’s resources, but also the economic, societal, and public health conditions of the region and state. Indiana’s total outdoor recreation value calculated in 2017 was determined to be nearly \$9.7 billion in consumer spending annually (U.S.

Bureau of Economic Analysis, 2019). A significant segment of outdoor recreational opportunities such as hunting, hiking, wildlife viewing, camping, mountain biking, and overall quality of life can be negatively impacted by terrestrial invasive species.

The Indiana forest industry provides approximately \$8 billion to Indiana's economy each year and directly supports the employment of more than 38,000 people (DNR Division of Forestry website). Forest quality and its economic impact is at risk as a result of invasive plant establishment and spread, which can impact forest regeneration of valued hardwood species. Forest quality also aligns closely with wildlife diversity and abundance. Many invasive trees, shrubs, and herbaceous plants that invade forests impact wildlife food sources and the plant associations that they depend on.

Indiana Division of Fish & Wildlife (DFW) recognizes the negative impact of invasive species and has been developing plans to address invasive species in the state. The 2015 Indiana State Wildlife Action Plan (SWAP) identified invasive and other problematic species and genes as the most significant threat to fish and wildlife habitats within Indiana at the statewide level. In general, actions to restore natural habitats, reestablish disturbance regimes, control invasive species, and reduce further loss of habitats were identified as important conservation actions to take in Indiana. SWAP also identified the need to form and facilitate partnerships, alliances, and networks of organizations to address invasive species in the state.

This plan only addresses terrestrial invasive species. There is a companion Indiana Aquatic Nuisance Species Management Plan (2003) that was in the process of being updated at the time this document was written. The aquatic plan covers fish, aquatic invertebrates, aquatic pathogens, and plants that are classified as obligate wetland plants. All other invasive species are therefore considered a part of this terrestrial invasive species plan.

The purpose of this invasive species management plan is to guide the implementation of current and future actions of the DFW to minimize the harmful effects of invasive species on Indiana's wildlife species. The goals of the plan that were agreed upon by DFW staff include:

- I. Preventing the introduction of invasive species.
- II. Effective early detection of invading species.
- III. Rapid response to eliminate new invasive species.
- IV. Management and control of established invasive species.

It is anticipated that the Indiana Terrestrial Invasive Species Plan will guide necessary invasive species management activities through 2030. Annual tracking of progress of the goals will take place, including documentation of successes, challenges, and failures. A mid-course evaluation of the plan will occur at the end of 2025 to determine if the plan continues to properly guide invasive species activities and should continue through the decade, or whether it should be revised at that point to establish more appropriate goals, strategies, and actions.

## 2. Existing Authorities and Programs

There are a wide variety of federal, state, and local entities that have a significant role in invasive species coordination, regulatory authority, management, and funding. The invasive species activities of those entities are described below. For Indiana to be successful in combating invasive species, we need to maximize involvement with potential partners and programs.

### Federal Role

The U.S. Fish and Wildlife Service (USFWS) administers the Lacey Act, which regulates the import of any species protected by international or domestic law. Relative to the invasive species issue, the Lacey Act also prevents the importation and shipment between states and U.S. territories of invasive species, including offspring and eggs, designated through regulation to be injurious to the health and welfare of humans, the interests of agriculture, horticulture or forestry, and the welfare and survival of wildlife resources of the United States. Wild mammals, wild birds, fish, mollusks, crustaceans, amphibians, and reptiles are the only organisms that can be added to the injurious wildlife list. The list of injurious terrestrial species is found in Appendix A (US Fish & Wildlife Service, March 2019).

USFWS is not just a regulatory agency. It also plays an important role in the management of invasive species. USFWS is the only agency of the U.S. Government whose primary responsibility is the conservation of the nation's fish, wildlife, and plants. Because of those responsibilities, USFWS is invested in reducing and preventing negative impacts that invasive species are having across the nation. Wildlife and Sportfish Restoration authorized through the Pittman-Robertson Act and Dingell-Johnson Act provide funding to state fish and wildlife agencies for the selection, restoration, rehabilitation, and improvement of habitat through various means, including controlling invasive species. USFWS also has several other programs with invasive species components, including Partners for Wildlife Program, Coastal Program, Neotropical Migratory Bird Conservation Act Program, and North American Wetlands Conservation Act grant program.

The U.S. Forest Service (USFS) is actively involved in invasive species issues. The continuing mission of the USFS is to sustain the health, diversity, and productivity of the nation's forests and grasslands to meet the needs of present and future generations. The USFS strives nationally, regionally, and locally within Indiana to reduce, minimize, or eliminate the potential for introduction, establishment, spread, and impact of aquatic and terrestrial invasive species (including plants, pathogens, vertebrates, invertebrates, fungi, algae, etc.) across all landscapes and ownerships. USFS invasive species management specialists are stationed at national, regional, and local offices throughout the country, including within Indiana. As a major land manager, USFS is an organization with which engagement needs to be strengthened to better manage all taxa of invasive species, not just terrestrial invasive species.

The U.S. Department of Agriculture's Animal and Plant Health Inspection Service (USDA APHIS) regulates the importation and interstate transport of invasive plants, plant pests, and



pathogens. The Plant Protection and Quarantine (PPQ) program safeguards agriculture and natural resources from the risks associated with the entry, establishment, or spread of animal and plant pests and noxious weeds to ensure an abundant, high-quality, and varied food supply. PPQ regulates several insects and mites, mollusks, nematodes, plant diseases, and federal noxious weeds.

USDA APHIS also has a Wildlife Services program whose role is to provide federal leadership and expertise to resolve wildlife conflicts to allow people and wildlife to coexist. Wildlife Services conducts program delivery, research, and other activities through its regional and state offices, the National Wildlife Research Center (NWRC) and its field stations, and through its national programs. A number of species that Wildlife Services addresses are invasive species.

USDA's Natural Resources Conservation Service (NRCS) has several programs that specifically target the management and control of invasive species. Programs under the 2018 Farm Bill continue its strong support for conservation efforts. NRCS offers financial and technical assistance to agricultural producers for implementation of conservation practices, activities, and enhancements that help reach the producer's goals and benefit the natural ecosystem. The Environmental Quality Incentives Program (EQIP) and Conservation Stewardship Program (CSP) set aside specific funding for invasive species removal. Most Farm Bill programs have invasive species components that either require invasive species control on enrolled lands or have a financial assistance component geared toward controlling invasive species. Such programs currently include Conservation Innovation Grants (CIG), Conservation Reserve Program (CRP), Regional Conservation Partnership Program (RCPP), Voluntary Public Access and Habitat Incentive Program (VPA-HIP), and Wetland Reserve and Enhancement Program (WREP).

The Great Lakes Restoration Initiative (GLRI) is a program implemented by the U.S. Environmental Protection Agency in 2010 to accelerate efforts to protect and restore the Great Lakes and their watershed, and to provide additional resources to make progress toward the most critical long-term goals for this important ecosystem. GLRI has five focus areas, one of which is preventing and controlling invasive species. The invasive species objectives include: (1) preventing introductions of new invasive species, (2) controlling established invasive species, and (3) developing invasive species control technologies and refine management techniques (GLRI, 2019). While a considerable portion of the invasive species focus of GLRI is on aquatic and wetland species, invasive species control in all habitats are priorities, especially when those invasive species are found in rare or sensitive habitats.

## **State Role**

DFW is the agency responsible for the conservation of the state's fish and wildlife resources. Although DFW has used its authority to regulate invasive fish, aquatic invertebrates, and some terrestrial animals, few invasive terrestrial animals are currently regulated in Indiana, and those that are include feral hogs and mute swans. The greatest involvement by DFW in terrestrial

invasive species issues centers on the management of our water, land, and plant communities to maintain or improve Indiana wildlife populations and diversity. On DFW-owned or managed properties, staff initiates invasive species control projects when invasive plants prevent the achievement of wildlife management goals. On private land, biologists work with landowners to develop habitat management plans with a large focus on invasive species control and strive to connect landowners with various state and federal funding programs that have an invasive plant control component. DFW staff involvement in terrestrial invasive species issues is mostly funded through a combination of federal Pittman-Robertson Act and state fish and wildlife funds.

The mission of the Indiana Department of Natural Resources Division of Entomology & Plant Pathology (DEPP) is to manage plant pests for the preservation and protection of Indiana's cultivated and natural resources, to facilitate trade, and to enhance the quality of our environment. This division has the largest role in the regulation of invasive species in state government. DEPP has the authority to regulate plants, insects and some other invertebrates, and plant pathogens of concern. DEPP works with a wide range of cooperators and stakeholders, including USDA, Purdue University, other states, other Indiana and local government agencies, and private landowners to protect our state's natural resources from invasive species and other harmful pests. DEPP also regulates the approval and release of beneficial biocontrol organisms, pests, or pathogens that are mostly used for invasive species control. The agency performs pest inspections of nursery products, beekeeping, and export of agricultural materials; monitors for populations of pests; and administers control programs for certain high-priority invasive species. Some of their most noteworthy and successful control programs include the "Slow the Spread" treatment program for gypsy moths and kudzu eradication efforts.

The majority of DNR's landholding divisions have no regulatory authority regarding invasive species. Those divisions include Forestry, Nature Preserves, Outdoor Recreation, and State Parks. Despite not having regulatory authority, those divisions have a focus on invasive species prevention and control to achieve their missions. Each division may approach the task of invasive species control using different tools and with different motivations. For example, the Division of Forestry is focused on forest health; the Division of Nature Preserves is tasked with improving species diversity and protecting rare species; and the Division of State Parks manages land to maximize positive interactions between our public constituents and our native ecosystems. Despite these varying motivations, each division has the common goal of fostering stable plant and animal communities that are threatened by the establishment and spread of invasive species.

The Classified Forest and Wildlands Program is administered by the Division of Forestry. This program provides financial incentive for private landowners willing to enroll at least 10 contiguous acres of forest or non-forest wildlife habitat to provide good stewardship of the land and its natural resources. In return, the State of Indiana agrees to see that the assessed value of the land is significantly reduced and taxed on that preferential assessment. The land is managed for timber production, wildlife habitat, and the protection of watersheds, while conserving other natural resources and values. The program involves the development of a written management

plan prepared by a forester or wildlife biologist and commonly involves an invasive species control component so that property management goals can be achieved.

Invasive species management also intersects with the mission of the Indiana State Board of Animal Health (BOAH), which focuses on domestic animals. It is well documented that, when near livestock, invasive species can facilitate the spread of pathogens into farms. Because of their potential to carry several diseases and parasites that can infect domestic livestock herds, feral swine (aka wild hogs) are one of the species of greatest concern. Management of this species by DFW could help prevent devastating diseases from spreading through livestock operations. BOAH also regulates the importation of fish into Indiana from other Great Lakes states to prevent the introduction of viral hemorrhagic septicemia to Indiana fish farms or wild populations. Biosecurity of farms and aquaculture facilities is a priority for BOAH that the DFW has the ability to influence.

The Indiana Invasive Species Council (IISC) was established in 2009 by the state legislature to enhance the ability of government agencies to detect, prevent, monitor, and manage new and long-established invasions, as well as increase public awareness about invasive species. IISC membership as defined in law is composed of State agencies including Purdue University College of Agriculture, Indiana Department of Agriculture, Indiana Department of Transportation, BOAH, DFW, and DEPP. Additional governor-appointed membership on the council includes one individual representing invasive species research; two individuals representing the hardwood tree industry, horticulture industry, agriculture industry, or aquaculture industry; and two individuals representing organizations or local governmental agencies such as land trusts, conservation organizations, or parks and recreation. Although IISC has no regulatory authority, recommendations are generated by the group to spur the potential development of invasive species rules and laws. IISC and its membership played a leading role in advocating for and initiating the use of the early detection and monitoring platform known as EDDMapS in Indiana. This tool is used for monitoring and reporting the spread of invasive species.

## **Local Role**

State law allows counties to establish county weed boards under IC 15-16-7. Membership on the board includes a township trustee, the soil and water conservation district supervisor, a member of the agricultural community, county highway department member, and a member from the county's Purdue Cooperative Extension Service. Few county weed boards continue to function.

Cooperative Invasive Species Management Areas (CISMAs) and Cooperative Weed Management Areas (CWMAs) are local organized groups that bring together landowners and land managers; local, state and federal agencies; tribes, individuals, and various interested groups to coordinate action and share expertise and resources to manage invasive species. The Southern Indiana Cooperative Invasives Management (SICIM) group and the Indiana Chapter of The Nature Conservancy (TNC) secured funding through NRCS that has been used to lead efforts to develop and support CISMAs across the state. These local collaborative efforts enable CISMAs and CWMAs to pool resources and knowledge to address mutual invasive species issues. Each



group develops a comprehensive plan that addresses the management or prevention of invasive species within its boundaries. As of the fall of 2020 there are CISMAs established in 29 of the 92 counties, 16 counties are in the organizational stages, and 23 counties are expected to organize in the future.

### **3. Invasive Species Prioritization**

During the development of this plan, an effort was made to identify statewide DFW invasive species management priorities. All DFW biologists within the Office of Private Lands and property managers in the Office of Public Lands were asked to rate the Indiana Invasive Species Council's list of [94 terrestrial invasive plants](#). Because the division focuses on fish, wildlife and their habitats, staff were asked to think about how each invasive plant impacts wildlife species, their habitats, and water quality for aquatic life. The following ratings were used:

- 1- High wildlife/water quality concerns, should be controlled in nearly all instances when observed
- 2 - Moderate concern that wildlife and water quality could suffer, urge control if funding is available
- 3 - Not a great threat but should be controlled when found in the more distinctive and special environments
- 4 - Seems to become a relatively benign part of the plant community
- NA - unfamiliar with the plant species and therefore not aware of its potential impacts

A total of 28 staff of approximately 80 solicited responded to the ratings request. Since not all staff are aware of all the species or are not familiar with the harm they cause, not all plants were rated by each person. Staff were also allowed to add species to the list; however, those species were not able to be rated by everyone.

Responses using the above ratings were averaged. Responses that indicated the staff member was unfamiliar with a species were not included in the average score. The 68 species with 10 or more ratings were sorted from highest priority to lowest to demonstrate which invasive plant species are a priority within the division. More than two dozen of the rated species elicited fewer than 10 scores, which indicated most staff were not familiar with the damage the species could cause to wildlife or their habitats. Species with fewer than 10 ratings were simply ordered by number of staff rating the species. Full survey results are presented in Appendix B.

The top "dirty dozen" invasive species with average scores from 1.23 to 1.60 are a mix of species of a variety of plant types. They include two canopy trees, five shrubs, four herbaceous plants, and a vine (Table 1). Most of the top-ranked species invaded years ago and are well established and widely spread across the Indiana landscape. Exceptions include kudzu, callery pear, and giant hogweed, which are relatively new in Indiana's invasion history. In fact, giant hogweed has had few small populations in the state. Those have been under eradication and have not yet had a noticeable impact on wildlife or ecosystems. While the majority of the most-

threatening species are purely terrestrial, some species such as phragmites, purple loosestrife, and reed canarygrass are better known for their ability to overtake wetlands, turning them into invasive species monocultures and crowding out beneficial native wildlife habitat.

The percent of staff who responded to the survey and rated each species as one with high wildlife or water-quality concerns and that should be controlled in nearly all instances when observed was calculated. Seven species had 50% or more of staff rating them as high concern, including Amur honeysuckle, kudzu, phragmites, purple loosestrife, callery pear, reed canarygrass, and autumn olive. This inferred broad agreement among staff that these species are highly destructive to wildlife, their habitats, or water quality.

**Table 1. Top terrestrial invasive plants of concern as rated by DFW staff.**

<u>Common Name</u>	<u>Latin Name</u>
Amur honeysuckle	<i>Lonicera maacki</i>
Morrow's honeysuckle	<i>Lonicera morrowii</i>
Tatarian honeysuckle	<i>Lonicera tatarica</i>
kudzu	<i>Pueraria montana</i>
phragmites/common reed	<i>Phragmites australis</i>
Bell's honeysuckle	<i>Lonicera x bella</i>
purple loosestrife	<i>Lythrum salicaria</i>
callery pear	<i>Pyrus calleryana</i>
reed canarygrass	<i>Phalaris arundinacea</i>
tree-of-heaven	<i>Ailanthus altissima</i>
autumn olive	<i>Eleagnus umbellata</i>
giant hogweed	<i>Heracleum mantegazzianum</i>

DFW staff recognizes that management of invasive plant species should not focus only on those species for which there have thus far been documented negative impacts on Indiana wildlife because these impacts may not be known for many of the newer invaders or species yet to arrive in the state. Consideration of impacts resulting from invasions in other states with similar community types and climate to Indiana's can help DFW predict how Indiana's wildlife populations and ecosystems may be affected. This review of invasions and impacts elsewhere may also help us understand the urgency for implementing controls.



*Bush honeysuckle dominates the understory of an Indiana forest (DNR file photo).*

This prioritization shows the interface between wildlife managers, habitat, and species management and demonstrates the current top invasive species of concern to DFW at the statewide level; however, local priorities may not match the statewide view since individual property management goals have to be considered. For example, at a property where wetland management is prioritized, little effort may be put into control of upland forest invasive species, such as bush honeysuckle, with most resources put into controlling invasive species colonizing the wetland ecosystem.

Other agencies may have differing priorities than wildlife habitat such as plant biodiversity, agricultural interests, and disease or pest control. While funding that DFW may use to support invasive plant control efforts may not be suitable to fund invasive species controls that address the priorities of other agencies, we should nevertheless support other agencies' management objectives and invasive species control efforts.

All DFW biologists and property management staff were asked to identify terrestrial invasive wildlife and pathogens of concern (excluding insects, since DFW has no authority). They were asked to consider species that are causing or have the potential to cause considerable harm to native wildlife and habitats in Indiana (Table 2). Most of the animals listed have relatively small and still manageable populations in Indiana like the wall lizard, feral hogs, and mute swans. Nutria have never established in the state, but there is still concern about them due to the wetland damage they can inflict if they become established. Domestic cats are certainly the most widespread of the animals on the list, but those of concern are not cats that exclusively live in people's houses. Rather, the threat lies with cats that have access to the outdoor environment and prey upon songbirds and other small animals. Widespread and well-established invasive bird species such as European starlings and house sparrows and Old-World rats and mice were not identified as species of concern, perhaps because participants viewed those species as uncontrollable. The only pathogens identified were a fungus that causes white-nose syndrome

that is responsible for considerable bat mortality, amphibian chytridiomycosis (“chytrid”) caused by a fungus that has been linked to global amphibian declines and extinctions, and Chronic Wasting Disease (CWD), which is a prion disease that has the potential to negatively impact Indiana’s deer herd.

<b>Table 2. Invasive animals and pathogens of concern as identified by DFW staff.</b>	
<b><u>Common Name</u></b>	<b><u>Latin Name</u></b>
Amphibian Chytridiomycosis	<i>Batrachochytrium dendrobatidis</i> and <i>B. salamandivorans</i>
Chronic Wasting Disease	transmissible spongiform encephalopathy or prion disease
Common Wall Lizard	<i>Podarcis muralis</i>
Domestic Cats	<i>Felis catus</i>
Feral Hogs	<i>Sus scrofa</i>
Mute Swan	<i>Cygnus olor</i>
Nutria	<i>Myocastor coypus</i>
White-nose Syndrome in bats	<i>Psuedogymnoascus destructans</i>

Continued warming temperatures and climate trends could make conditions in Indiana suitable for colonization by a greater number of species or allow species that have already colonized Indiana to exhibit more invasive tendencies than they currently do. As a result, invasive species priorities will continue to evolve and should be assessed at regular intervals.



*Mute swan numbers are increasing in Indiana lakes (DNR file photo).*

## 4. Goals, Strategies, and Actions

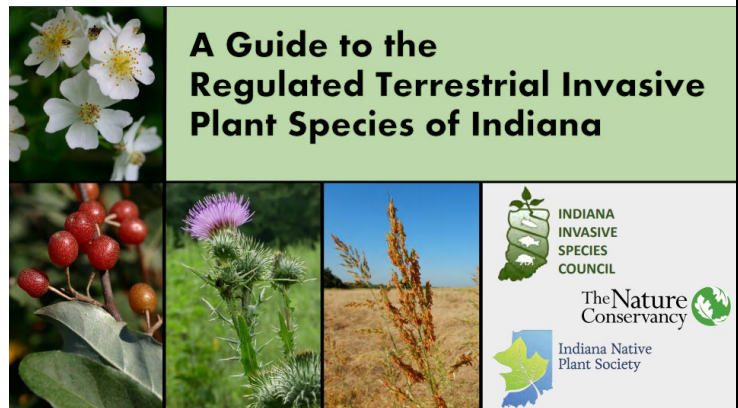
### Goal I: PREVENT THE INTRODUCTION OF INVASIVE SPECIES

**Problem Description:** Invasive species may be difficult or impossible to eradicate once they become established. Prevention is the most effective, efficient, and economical means to avoid the damage caused by invasive species. Often the costs associated with managing a new species are not known or are difficult to quantify, making it difficult to raise support for prevention actions, especially if they limit commercial or recreational activities. Although we may have to accept some impacts of established invasive species, we should make every attempt to prevent the introduction of new invasive species.

- ❖ **Strategy I.A:** Increase coordination with federal, regional, state and local agencies in preventing the introduction and movement of invasive species.
  - **Action I.A.1:** Hire a full-time statewide terrestrial invasive species biologist to implement this plan.
  - **Action I.A.2:** Explore new and expand the use of existing federal and state invasive species funding opportunities.
  - **Action I.A.3:** Work with the Indiana Invasive Species Council to coordinate efforts on managing invasive species.
  - **Action I.A.4:** Engage with state, regional, and national invasive species organizations and agencies, as well as with invasive species collaborative efforts.
  - **Action I.A.5:** Influence regional and national policies by informing decisionmakers of ways in which Indiana’s ability to prevent and control invasive species are affected by regional, federal, and international jurisdiction, policies, and regulations.
  - **Action I.A.6:** Track invasive species movements and identify nearby population establishments to prioritize prevention efforts.
  - **Action I.A.7:** Coordinate with state and regional permitting and conservation law enforcement groups to evaluate regional invasive species enforcement strategies and regional regulation changes.



- ❖ **Strategy I.B:** Reduce the number of invasive species in trade.
  - **Action I.B.1:** Use risk assessments to evaluate invasive potential for species currently in trade or proposed for introduction.
  - **Action I.B.2:** Seek support for and establish regulations for invasive wildlife species to prevent new introductions.





- **Action I.B.3:** For invasive species taxa for which DFW has no authority, assist in the development of regulations being proposed by other DNR divisions or other agencies.
  - **Action I.B.4:** Develop enforcement support to uphold laws, rules, and policies pertaining to invasive species.
- ❖ **Strategy I.C:** Target specific pathways by which invasive species may be introduced into Indiana.
- **Action I.C.1:** Identify control points where intervention could prevent transmission or establishment.
  - **Action I.C.2:** Establish biosecurity protocols on DNR properties to prevent the introduction of new invasive species.
  - **Action I.C.3:** Develop and incorporate best management practices to reduce the likelihood of introducing invasive species through pathways like outdoor recreation, transportation, development, mining, utilities, etc.
  - **Action I.C.4:** Include conditions in all relevant DNR and DFW permits and contracts that provide for appropriate invasive species prevention and control measures.
- ❖ **Strategy I.D:** Engage the public in preventing the introduction and spread of invasive species.
- **Action I.D.1:** Evaluate the current awareness of invasive species issues and regulations by the public.
  - **Action I.D.2:** Build capacity within professional and citizen organizations to represent and address invasive species information needs.
  - **Action I.D.3:** Use national or regional invasive species prevention campaign materials (i.e., “PlayCleanGo”, “Habitattitude”, “Don’t Move Firewood”, etc.).





## Goal II: EFFECTIVE EARLY DETECTION OF INVASIVE SPECIES

**Problem Description:** Monitoring programs for species not yet established often receive limited consideration in prioritization of agency or organizational activities due to the delay in realizing their benefits; however, cost-effective control or eradication of a new invasive species or a new isolated population can be successful only with an active and effective early detection system. Various agencies and organizations monitor invasive species for their own purposes. Coordination between these efforts would maximize the use of limited resources. Because costly or controversial eradication or enforcement may result, training is essential to verify that a species is properly identified during monitoring efforts.

- ❖ **Strategy II.A:** Maximize detection of invasive species by expanding the network of partners.
  - **Action II.A.1:** Increase detection capacity by training biologists, foresters, naturalists, and other land stewards to identify priority invasive species.
  - **Action II.A.2:** Support SICIM and TNC in growing the CISMAs and CWMAAs to increase citizen scientists to assist in detection efforts.
  - **Action II.A.3:** Develop coordination mechanisms to reduce duplication of effort or gaps in coverage.
  - **Action II.A.4:** Develop training materials for all terrestrial invasive species taxa with emphasis on newly establishing species.
  
- ❖ **Strategy II.B:** Share knowledge on discoveries of invasive species to allow for an appropriate and timely response.
  - **Action II.B.1:** Require all staff to report findings to either the EDDMapS website or the Great Lakes Early Detection Network (GLEDN) smartphone applications.
  - **Action II.B.2:** Develop institutional capacity or access to individuals who can verify identification of critical invasive species.
  - **Action II.B.3:** Ensure confirmed reports are immediately relayed to appropriate staff who can lead response actions.
  
- ❖ **Strategy II.C:** Invest in research to improve detection methods with decreased cost and increased effectiveness.
  - **Action II.C.1:** Create a monitoring protocol to evaluate detection methods and determine the most effective way to look for invasive species.
  - **Action II.C.2:** Support research into alternative detection methods such as environmental DNA (eDNA), remote sensing, etc.



## **Goal III: RAPID RESPONSE TO ELIMINATE NEW INVASIVE SPECIES**

**Problem Description:** Many techniques for eradicating or controlling invasive species are either labor intensive in their implementation or non-selective causing considerable collateral damage to non-target species. It is much more cost effective and acceptable to apply these control techniques when the infested area remains confined, and the target population is small. While eradication may not always be possible, containment and control to prevent further spread is often an acceptable outcome that can be achieved with rapid action. The nature of control methods may require significant education of the public to obtain their approval, may involve intrusion on private property, and commonly requires intensive coordination between agencies with differing authorities. If the plans are not developed and approved before emergency use, the conflicts, confusion, and delays that result could severely hamper the implementation and effectiveness of rapid response actions.

- ❖ **Strategy III.A:** Develop institutional capacity for rapid response activities.
  - **Action III.A.1:** Review response plans from other states and coordinate the plans with efforts of other regional organizations.
  - **Action III.A.2:** Identify and address all regulatory, financial, and administrative hurdles to facilitate effective and timely response to invasive species on public and private property.
  - **Action III.A.3:** Identify a lead agency and the responsibilities of other cooperating agencies for each invasive species taxa.
  - **Action III.A.4:** Inventory staff, equipment, and other resources available for rapid response actions in each region of the state.
  - **Action III.A.5:** Plan and conduct mock tabletop exercises with staff likely to be involved in rapid response efforts.
  
- ❖ **Strategy III.B:** Develop, implement, evaluate, and adjust rapid-response plans for high-risk invasive species to effectively control new invasions.
  - **Action III.B.1:** Identify, classify, and prioritize species that under certain conditions may be amenable to eradication through rapid-response actions.
  - **Action III.B.2:** Inventory all available chemical, physical, mechanical, and biological control options for each high-priority species and evaluate whether the impacts of the control options on non-target organisms are commensurate with the negative effects if the target invasive species become established.

- **Action III.B.3:** Select and implement the most appropriate methods given physical, institutional, and social constraints.
- **Action III.B.4:** Use monitoring to evaluate the success of control measures and adjust response plans to ensure success in future endeavors.



*Kudzu population in Indiana (DNR file photo).*

- ❖ **Strategy III.C:** Inform and educate the public on planned rapid-response actions.
  - **Action III.C.1:** Develop website content and outreach materials to educate the public on the dangers related to the establishment of invasive species that may be subject to rapid-response actions.
  - **Action III.C.2:** Hold public meetings in advance of potentially controversial invasive species rapid-response actions.
  - **Action III.C.3:** Make plans available on website when they are finalized and before implementation.

## **Goal IV: MANAGEMENT AND CONTROL OF ESTABLISHED INVASIVE SPECIES**

**Problem Description:** Many terrestrial invasive species have become widely established on the Indiana landscape. Once this occurs and eradication is no longer feasible, the strategy shifts to managing species to an acceptable level to reduce the risk of irreversible changes to the ecosystem in terms of wildlife habitat and population diversity and abundance. Successful management and control of invasive species often involves a suite of tools known collectively as integrated pest management (IPM). Management activities should be prioritized based on the ecological and public value of the resource being threatened. Finally, once a species is brought under control or even eliminated from an area, the longevity of that success can be extended by implementing public education on best management practices to prevent the return of the species.

- ❖ **Strategy IV.A:** Identify and prioritize species and locations requiring control.
  - **Action IV.A.1:** Use risk-analysis tools and public input to identify high-priority species for control.
  - **Action IV.A.2:** Prioritize control efforts that target invasive species that reduce the quality of resources that are maintained by public funds (e.g., threatened and endangered species, wildlife species, public properties) and accessible to the public.

- ❖ **Strategy IV.B:** Determine non-target impacts of control actions implemented.
  - **Action IV.B.1:** Conduct surveys on native communities adequate to predict and track the unintended impacts of control measures on non-target species.
  - **Action IV.B.2:** Evaluate short- and long-term impacts on target and non-target species and implement controls that ensure that impacts on native species do not outweigh the cost of establishment of the invasive species.
  - **Action IV.B.3:** Explore methods of conservation of rare plant species where treatment of invasive plants occurs.
  
- ❖ **Strategy IV.C:** Develop management plans for private property owners that include invasive species management.
  - **Action IV.C.1:** Provide invasive species control recommendations while emphasizing establishing diverse native communities on private property based on the wildlife management goals.
  - **Action IV.C.2:** Promote federal and state invasive species funding opportunities that property owners can participate in.
  
- ❖ **Strategy IV.D:** Develop and implement an invasive species management plan for each DFW owned and managed property to improve the quality of native plant and wildlife communities.
  - **Action IV.D.1:** Identify priority invasive species to target for management for each property.
  - **Action IV.D.2:** Maintain at least one certified pesticide applicator on each property so that infestations can be quickly addressed.
  - **Action IV.D.3:** Implement cultural controls to prevent the spread of invasive species on a property.
  - **Action IV.D.4:** Allow biological control research and testing to take place on DFW properties.
  
- ❖ **Strategy IV.E:** Support the statewide development of CISMAs and CWMAAs.
  - **Action IV.E.1:** Identify priority invasive species to target for each cooperative area based on wildlife habitat threats.
  - **Action IV.E.2:** Statewide terrestrial invasive species biologist and regional DFW wildlife biologists should actively participate with CISMAs and CWMAAs so that wildlife needs are heard.



*Garlic mustard is a widespread invasive in Indiana (DNR file photo).*

- ❖ **Strategy IV.F:** Inform and educate the public on control programs.
  - **Action IV.F.1:** Develop a sense of ownership by incorporating the public directly into implementation and management of invasive species control projects and native species restoration whenever feasible.
  - **Action IV.F.2:** Expand existing capacity to add educational institutions, land stewardship entities, and other organizations in volunteer biocontrol projects.
  - **Action IV.F.3:** Inform the public on legal and effective means of controlling invasive species.
  - **Action IV.F.4:** Educate the public on ecological effects on non-target species when non-selective tools are used to control invasive species.
  - **Action IV.F.5:** Share information on the likelihood of eradication and cost of control to provide a realistic picture of what control work can accomplish.

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*Callery pear trees are widely planted in Indiana landscapes and are now escaping into natural areas (DNR file photo).*



## 6. Appendices

### Appendix A: Summary of Species Currently Listed as Injurious Wildlife under the Lacey Act (18 U.S.C. 42).

MAMMALS (§16.11)	Genus or Species	Number of Species	Effective Date
Bats, fruit (flying foxes; genus)	<i>Pteropus</i> spp.	65	August 13, 1952
Dhole (Indian wild dog, red dog)	<i>Cuon</i> sp	1	January 1, 1966
Dog, raccoon	<i>Nyctereutes procyonoides</i>	1	January 17, 1983
Mongoose, meerkats (genera)	<i>Atilax</i> , <i>Cynictis</i> , <i>Helogale</i> , <i>Herpestes</i> , <i>Ichneumia</i> , <i>Mungos</i> , and <i>Suricata</i>	18	January 1, 1966
Possum, brushtail	<i>Trichosurus vulpecula</i>	1	July 11, 2002
Rabbit, European	<i>Oryctolagus</i> sp.	1	August 13, 1952
Rats (or Mice), multimammate	<i>Mastomys</i> spp.	8	January 1, 1966

BIRDS (§16.12)	Species	Number of Species	Effective Date
Bulbul, red-whiskered	<i>Pycnonotus jocosus</i>	1	July 1, 1968
Dioch (including subspecies)	<i>Quelea quelea</i>	1	July 1, 1968
Sparrow, Java	<i>Padda oryzivora</i>	1	July 1, 1968
Starling, pink (rosy pastor)	<i>Sturnus roseus</i>	1	January 1, 1966

<b>AMPHIBIANS (§16.14)</b>	<b>Genus</b>	<b>Number of Species</b>	<b>Effective Date</b>
Salamanders (due to risk of Bsal; genera)	<i>Chioglossa, Cynops, Euproctus, Hydromantes, Hynobius, Ichthyosaura, Lissotriton, Neurergus, Notophthalmus, Onychodactylus, Paramesotriton, Plethodon, Pleurodeles, Salamandra, Salamandrella, Salamandrina, Siren, Taricha, Triturus, and Tylototriton</i>	201	January 28, 2016

<b>REPTILES (§16.15)</b>	<b>Species</b>	<b>Number of Species</b>	<b>Effective Date</b>
Anaconda, Beni	<i>Eunectes beniensis</i>	1	April 9, 2015
Anaconda, DeSchauensee's	<i>Eunectes deschauenseei</i>	1	April 9, 2015
Anaconda, green	<i>Eunectes murinus</i>	1	April 9, 2015
Anaconda, yellow	<i>Eunectes notaeus</i>	1	March 23, 2012
Python, Burmese	<i>Python bivittatus</i> (originally listed as <i>Python molurus</i> )	1	March 23, 2012
Python, Indian	<i>Python molurus</i>	1	March 23, 2012
Python, northern African	<i>Python sebae</i>	1	March 23, 2012
Python, reticulated	<i>Python reticulatus</i> (or <i>Broghammerus reticulatus</i> , or <i>Malayopython reticulatus</i> )	1	April 9, 2015
Python, southern African	<i>Python natalensis</i>	1	March 23, 2012
Snake, brown tree	<i>Boiga irregularis</i>	1	December 13, 1991

**Appendix B. Invasive plant species rated by DFW Private Lands biologists and Public Lands property managers.**

<u>Common Name</u>	<u>Latin Name</u>	<u>Average Rating</u>	<u># Responses</u>	<u>% Rate as Highest Priority</u>
Amur honeysuckle	<i>Lonicera maackii</i>	1.23	22	64.3%
Morrow's honeysuckle	<i>Lonicera morrowii</i>	1.23	13	39.3%
Tatarian honeysuckle	<i>Lonicera tatarica</i>	1.29	14	39.3%
kudzu	<i>Pueraria montana</i>	1.29	24	67.9%
phragmites/common reed	<i>Phragmites australis</i>	1.30	27	67.9%
Bell's honeysuckle	<i>Lonicera x bella</i>	1.33	12	32.1%
purple loosestrife	<i>Lythrum salicaria</i>	1.41	27	64.3%
callery pear	<i>Pyrus calleryana</i>	1.48	25	60.7%
reed canarygrass	<i>Phalaris arundinacea</i>	1.52	23	50.0%
tree-of-heaven	<i>Ailanthus altissima</i>	1.54	24	42.9%
autumn olive	<i>Eleagnus umbellata</i>	1.56	27	60.7%
giant hogweed	<i>Heracleum mantegazzianum</i>	1.60	20	35.7%
Japanese stiltgrass	<i>Microstegium vimineum</i>	1.64	22	42.9%
Russian olive	<i>Eleagnus angustifolia</i>	1.65	20	35.7%
garlic mustard	<i>Alliaria petiolata</i>	1.67	24	42.9%
sericea lespedeza	<i>Lespedeza cuneata</i>	1.70	23	39.3%
Chinese privet	<i>Ligustrum sinense</i>	1.70	10	17.9%
mile-a-minute Vine	<i>Polygonum perfoliatum</i>	1.72	18	28.6%
wintercreeper	<i>Euonymus fortunei</i>	1.82	17	32.1%
Chinese maiden grass	<i>Miscanthus sinensis</i>	1.90	10	14.3%
tall fescue	<i>Schenodorus arundinacea</i>	1.92	24	28.6%
glossy buckthorn	<i>Frangula alnus</i>	1.93	15	21.4%
Asian bittersweet	<i>Celastrus orbiculatus</i>	1.95	19	25.0%
Canada thistle	<i>Cirsium arvense</i>	1.96	26	32.1%
Japanese honeysuckle	<i>Lonicera japonica</i>	1.96	26	35.7%
common buckthorn	<i>Rhamnus cathartica</i>	2.00	15	25.0%
common privet	<i>Ligustrum vulgare</i>	2.00	11	17.9%
Japanese knotweed	<i>Fallopia japonica</i>	2.05	20	21.4%
giant reed	<i>Arundo donax</i>	2.09	11	10.7%

miscanthus hybrid	<i>Miscanthus x gigantea</i>	2.10	10	14.3%
spotted knapweed	<i>Centaurea stoebe</i>	2.14	14	10.7%
burning bush	<i>Euonymus alatus</i>	2.16	25	32.1%
cut-leaved teasel	<i>Dipsacus laciniatus</i>	2.20	15	7.1%
common teasel	<i>Dipsacus fullonum</i>	2.21	24	7.1%
Japanese barberry	<i>Berberis thunbergii</i>	2.21	14	10.7%
narrow-leaved cattail	<i>Typha angustifolia</i>	2.28	18	14.3%
hybrid cattail	<i>Typha x glauca</i>	2.29	21	7.1%
Johnson grass	<i>Sorghum halepense</i>	2.29	24	17.9%
periwinkle	<i>Vinca minor</i>	2.29	17	14.3%
poison hemlock	<i>Conium maculatum</i>	2.30	23	21.4%
multiflora rose	<i>Rosa multiflora</i>	2.33	27	17.9%
English ivy	<i>Hedera helix</i>	2.35	20	7.1%
sweet autumn clematis	<i>Clematis terniflora</i>	2.36	11	7.1%
common barberry	<i>Berberis vulgaris</i>	2.38	13	7.1%
crown vetch	<i>Coronilla varia</i>	2.40	25	17.9%
wisteria	<i>Wisteria sinensis</i>	2.45	11	7.1%
vetch	<i>Vicia cracca</i>	2.56	16	7.1%
striate lespedeza	<i>Kummerowia striata</i>	2.67	12	8.3%
bicolor lespedeza	<i>Lespedeza bicolor</i>	2.70	20	3.6%
musk thistle	<i>Carduus nutans</i>	2.72	18	7.1%
wild parsnip	<i>Pastinaca sativa</i>	2.72	18	16.7%
white mulberry	<i>Morus alba</i>	2.75	20	3.6%
field bindweed	<i>Convolvulus arvensis</i>	2.75	16	7.1%
Siberian elm	<i>Ulmus pumila</i>	2.78	18	7.1%
bull thistle	<i>Cirsium vulgare</i>	2.90	21	3.6%
Korean lespedeza	<i>Kummerowia stipulacea</i>	3.00	19	3.6%
creeping charlie	<i>Glechoma hederacea</i>	3.00	16	3.6%
sawtooth oak	<i>Quercus acutissima</i>	3.00	14	0.0%
highbush cranberry	<i>Viburnum opulus v. opulus</i>	3.07	14	3.6%
black alder	<i>Alnus glutinosa</i>	3.08	13	3.6%
yellow iris	<i>Iris pseudacorus</i>	3.08	13	3.6%
dame's rocket	<i>Hesperis matronalis</i>	3.18	17	3.6%

white sweet clover	<i>Melilotus alba</i>	3.20	20	0.0%
yellow sweet clover	<i>Melilotus officinalis</i>	3.20	20	0.0%
Norway maple	<i>Acer platanoides</i>	3.25	20	3.6%
Queen Anne's Lace	<i>Daucus carota</i>	3.58	24	0.0%
St. John's wort	<i>Hypericum perforatum</i>	3.64	11	0.0%
bouncing bet	<i>Saponaria officinalis</i>	3.64	11	0.0%
princess tree	<i>Paulownia tomentosa</i>	1.88	8	10.7%
leafy spurge	<i>Euphorbia esula</i>	2.63	8	7.1%
pepperweed	<i>Lepidium latifolium</i>	3.25	8	3.6%
Amur privet	<i>Ligustrum amurense</i>	1.57	7	14.3%
blunt leaved privet	<i>Ligustrum obtusifolium</i>	1.57	7	14.3%
Amur cork tree	<i>Phellodendron amurense</i>	2.00	7	10.7%
Japanese hops	<i>Humulus japonicus</i>	2.57	7	3.6%
large-leaved periwinkle	<i>Vinca major</i>	2.57	7	3.6%
goatsrue	<i>Galega officinalis</i>	3.29	7	0.0%
California privet	<i>Ligustrum ovalifolium</i>	1.67	6	10.7%
narrowleaf bittercress	<i>Cardamine impatiens</i>	3.17	6	0.0%
Japanese meadowsweet	<i>Spiraea japonica</i>	2.60	5	3.6%
small carpetgrass	<i>Arthraxon hispidus</i>	3.00	5	3.6%
wine raspberry	<i>Rubus phoenicolasius</i>	3.40	5	0.0%
Japanese chaff flower	<i>Achyranthes japonica</i>	2.00	4	7.1%
spiny plumeless thistle	<i>Carduus acanthoides</i>	2.00	4	7.1%
black swallow-wort	<i>Cynanchum louiseae</i>	2.00	4	7.1%
mugwort	<i>Artemisia vulgaris</i>	2.25	4	7.1%
pale swallow-wort	<i>Cynanchum rossicum</i>	2.25	4	7.1%
Chinese yam	<i>Dioscorea polystachya (oppositifolia)</i>	2.25	4	7.1%
lesser celandine	<i>Ranunculus ficaria</i>	2.50	4	3.6%
Japanese hedge parsley	<i>Torilis japonica</i>	2.33	3	3.6%
spreading hedge parsley	<i>Torilis arvensis</i>	2.67	3	3.6%
jetbead	<i>Rhodotypos scandens</i>	3.00	3	3.6%
porcelain berry	<i>Ampelopsis brevipedunculata</i>	3.67	3	0.0%
lyme grass	<i>Leymus arenarius</i>	3.50	2	0.0%

redtop	<i>Agrostis gigantea</i>
smooth brome	<i>Bromus inermis</i>
orchard grass	<i>Dactylis glomerata</i>
lesser celadine	<i>Ficaria verna (Ranunculus ficaria)</i>
orange day lily	<i>Hemerocallis fulva</i>
perennial ryegrass	<i>Lolium perenne</i>
moneywort (creeping Jenny)	<i>Lysimachia nummularia</i>
sacred bamboo	<i>Nandina domestica</i>
yellow groove bamboo	<i>Phyllostachys aureosulcata</i>
Canada blue grass	<i>Poa compressa</i>
Kentucky blue grass	<i>Poa pratensis</i>
Chinese tallow tree	<i>Triadica sebifera</i>
common mullein	<i>Verbascum thapsus</i>
<i>More than 10 of 28 biologist knowledgeable about the species and its negative traits on wildlife habitat</i>	
<i>Fewer than 10 biologists aware of the species</i>	
<i>Other potentially invasive species suggested by biologists but not ranked.</i>	