Virginia Invasive Species Management Plan 2018

Prepared by
Virginia Invasive Species Advisory Committee

Prepared for
Virginia Invasive Species Working Group

Virginia Invasive Species Management Plan
2018

Prepared by
Virginia Invasive Species Advisory Committee

Prepared for
Virginia Invasive Species Working Group

Citation:
Virginia Invasive Species Advisory Committee. 2018. Virginia Invasive Species Management Plan. Virginia Department of Conservation and Recreation. Natural Heritage Technical Document 18-09. Richmond, VA. 33 pages, plus appendices.

Photo credits: Cover: spotted lanternfly, Lawrence Barringer, Pennsylvania Department of Agriculture, Bugwood.org; Figure 1: kudzu, Patricia M. Ciesla, Forest Health Management International, Bugwood.org; Figure 2: *Phragmites,* Dot Field, VDCR; Figure 3: wavyleaf grass, Kevin Heffernan, VDCR; Figure 4: spotted lanternfly, Lawrence Barringer, Pennsylvania Department of Agriculture, Bugwood.org; Figure 5: emerald ash borer, Howard Russell, Michigan State University, Bugwood.org; Figure 6: feral hogs, USDA-APHIS.

VIRGINIA INVASIVE SPECIES MANAGEMENT PLAN 2018

TABLE OF CONTENTS

EXECUTIVE SUMMARY

Invasive species are nonnative plant, animal, or microbial species that cause, or are likely to cause, economic or ecological harm or harm to human health (Presidential Executive Order 13112). "Nonnative" (or "alien," "exotic," or "nonindigenous") means they have been introduced by human action, intentionally or accidentally, into a region outside their natural geographic range. Introductions occur through a variety of pathways, including intentional transport for commercial purposes or accidental movement through the ballast water of oceangoing vessels.

Annual economic losses due to invasive species in the U.S. are estimated at more than $120 billion (Pimentel et al. 2005). This figure includes damage to crops and pasture, forest losses, damage from insect and invertebrate pests, human diseases, and associated control costs. Losses due to invasive species in Virginia may be as high as $1 billion annually (Pimentel et al. 2005).

Ecological harm caused by invasive species can include near extirpation of native species, as in the cases of chestnut blight and hemlock woolly adelgid, and alteration of natural ecological communities, as with zebra mussel and Phragmites. Almost 80 percent of 1,421 imperiled or federally listed species were found to be directly threatened by competition with or predation by invasive species (Evans et al. 2016). The Virginia Department of Game and Inland Fisheries identifies management of invasive species as one of four major actions (along with habitat protection, habitat restoration, and pollution reduction) required to prevent further species loss (VDGIF 2015).

Local, state, and federal agencies and nonprofit organizations are conducting a wide variety of invasive species efforts in Virginia. Efforts by state agencies include monitoring and public education for spotted lanternfly, a pest on crops and timber; a public–private partnership obtaining funds to control wavyleaf grass on national parklands; health officials monitoring exotic mosquitoes capable of transmitting pathogens that harm humans; wildlife biologists tracking the spread of feral hogs; foresters suppressing gypsy moth infestations; natural area stewards working to control Phragmites in hundreds of acres of coastal plain marshes; and partnering with private citizens and federal agencies to educate and empower landowners regarding invasive plant management.

Due to the many program-specific management priorities, limited resources, and the abundance of invasive threats, a statewide plan is essential for the efficient coordination of the many interested stakeholders toward shared goals. Therefore, the Virginia Invasive Species Management Plan (hereafter referred to as the Plan) was developed by the Virginia Invasive Species Advisory Committee (VISAC) in cooperation with the Virginia Invasive Species Working Group (VISWG) using model plans from other states and the federal government.

The scope of the Plan covers all invasive species, terrestrial and aquatic, from microbes to mammals, in Virginia. The purpose of the Plan is to provide a framework for state agency action to minimize economic, environmental, and human harm from invasive

species by acting on the seven goals of coordination, prevention, early detection, rapid response, control, research, and education:

1. Coordination. Coordinate state, federal, and stakeholder prevention and management of invasive species infestations.
2. Prevention. Prevent known and potential invasive species from entering the state through detecting and interrupting all unauthorized species introductions.
3. Early detection. Promote and enhance professional and volunteer invasive species early detection through education and reporting tools.
4. Rapid response. Enhance rapid response capability to implement eradication or containment procedures for target species through planning.
5. Control and management. Provide control of priority invasive species through containment, abatement, and other management strategies—including habitat restoration and use of native species—to minimize environmental and economic impacts.
6. Research and risk assessment. Support or conduct research and risk assessment necessary for assessing, prioritizing, and control of invasive species.
7. Education and outreach. Provide current information on invasive species, their negative impacts to environmental and economic resources, and methods of prevention and control to the general public, environmental nongovernmental organization, special interest groups, and K–12 science teachers.

The Plan identifies a range of strategies and actions that are required to achieve each of the goals. Actions are listed in an implementation table. Key actions necessary for immediate implementation are listed with lead agencies and a time frame for completion.

I. INTRODUCTION

What Are Invasive Species?

Invasive species are nonnative plant, animal, or microbial species that cause, or are likely to cause, economic or ecological harm or harm to human health (Presidential Executive Order 13112). "Nonnative" (or "alien," "exotic," or "nonindigenous") means they have been introduced by human action, intentionally or accidentally, into a region outside their natural geographic range. Introductions occur along a variety of pathways, or vectors, such as through intentional trade of a species, or by accidental means, as in the case of stowaway species found in the ballast water of oceangoing vessels. "Aquatic nuisance species" are a subset of invasive species that impact aquatic ecosystems (U.S. Congress 1990).

Many intentional nonnative species introductions are economically beneficial, as with the majority of agricultural and horticultural species. Species escaping cultivation or accidentally introduced usually have no negative impact in their new landscape (Pimentel et al. 2005). But the species that do become invasive wreak significant ecological and economic harm. Invasive species have decimated forests, hampered agricultural production, threatened endangered species, and caused direct harm and even death to people (World Resources Institute 2005). Examples are provided in the Invasive Species Case Histories section.

Why Do We Care?

Significant ecological and economic harm arises from invasive species. Annual economic losses due to invasive species in the U.S. are estimated at more than $120 billion (Pimentel et al. 2005). This figure includes damage to crops and pasture, forest losses, damage from insect and other invertebrate pests, human diseases, and associated control costs. Losses due to invasive species in Virginia are estimated to exceed $1 billion annually (Pimentel et al. 2005). As international trade and travel continue to expand and increase, new organisms will continue to find their way into novel habitats and cause additional problems. Further, impacts of invasive species are exacerbated by climate change (Mooney and Hobbs 2000; Ruiz and Carlton 2003; Vila et al. 2011; Lowry et al. 2013).

Ecological harm caused by invasive species can include near extirpation of native species, as in the cases of chestnut blight and hemlock woolly adelgid, and alteration of natural ecological communities, as with the snakehead fish, zebra mussel, and Phragmites. Nationally, almost 80% of 1,421 species listed under the Endangered Species Act (ESA) are directly threatened by competition with or predation by invasive species (Evans et al. 2016). Furthermore, these threats have increased since the ESA was enacted in 1973. In Virginia, the Virginia Department of Game and Inland Fisheries (VDGIF) identifies controlling invasive species as one of four major actions (along with habitat protection, habitat restoration, and pollution reduction) required to prevent further species loss (VDGIF 2015).

Throughout evolutionary history, organisms have moved around the planet gradually, modifying their native ranges and adapting to meet new conditions. However, human actions in North America since the time of Columbus have transplanted species from

their native ranges into new habitats at a dramatically increasing rate, with resulting establishment in new habitats. Many of these established transplants have become invasive. Unchecked, invasive species propagate and spread to the detriment of native species, which have not evolved competitive strategies or immunity that allow them to compete with the newly introduced species. When these invasions are not detected until the species are firmly established, they no longer respond to eradication efforts, except at tightly defined sites (Lodge et al. 2006; Bock et al. 2015).

Invasive Species Case Histories

A brief overview of 12 invasive species follows. These are not necessarily considered the priority species in Virginia; rather they were selected to illustrate the variety of invasions that have occurred. Many types of organisms, from viruses to mammals, may become invasive species. Each example illustrates a dimension of the problems posed by invasive species and underscores the need for concerted action to control established invasive species and prevent new ones from becoming established. All these species are either found in Virginia or have the potential to become established here.

Kudzu (*Pueraria montana*) is an invasive plant. Intentionally introduced to the U.S. from its native Japan for use in soil stabilization, kudzu became the "vine that ate the South." Kudzu rapidly grows up and over all other vegetation and creates a dense canopy with its large leaves, blocking sunlight from reaching other plant species. Complex natural communities are replaced by tangled stands of kudzu. In 2002, 7 million acres of land in the U.S. were infested with kudzu (Britton 2002). Although used as forage, it produces low yields. Annual expenditures for the control of kudzu by power companies in the southeastern U.S. have been estimated at $1.5 million (Britton 2002).

Figure 1. Kuzdu overtops trees and buildings.

Less than 100 years ago, the American chestnut (*Castanea dentata*) was a dominant tree species in the Appalachian Mountains from Maine to Mississippi. It was a valued timber tree and produced a bounty of edible nuts. **Chestnut blight fungus** (*Cryphonectria parasitica*) was first noted on trees in New York City in 1904. The blight, introduced from Asia, kills the aboveground part of the tree and by 1926 had spread throughout the tree's range (Anagnostakis 2000). Surviving trees were reduced to shrubby stems that rarely reproduce. The industries that were dependent on American chestnut disappeared.

Northern snakehead (*Channa argus*) has become a concern in the mid-Atlantic states since being discovered in Maryland ponds in 2002 and the Potomac River in 2004 (Courtenay and Williams 2004). A voracious predator with sharp teeth and a body up to four feet long, snakeheads have the potential to drastically alter freshwater ecosystems by

outcompeting native fish species, although such impacts have not yet been documented. Snakeheads prey on fish, frogs, crustaceans, and aquatic insects (Lapointe et al. 2018). Many species of snakehead, including northern snakehead, can breathe air and survive in low-oxygen waters. Northern snakehead is widely sold as live fish food, even in states where its sale is illegal. Its native range suggests it could become established throughout the contiguous United States (Courtney and Williams 2004).

In 1990, one could visit Shenandoah National Park and walk under the huge old eastern hemlock trees in an areas known as the Limberlost. Spared from timbering before the establishment of the park, the stand was true old-growth forest. Today, most of the hemlock at the Limberlost are dead and Virginia's hemlock population is in decline. The ancient giants were brought to their demise by an aphid-like invasive insect, the **hemlock woolly adelgid** (*Adelges tsugae*). The adelgid settles at the base of hemlock needles and feeds on tree sap. The hemlock woolly adelgid first appeared in Virginia in 1950, and is native to Asia. A number of management strategies are available, including promising biological control options, but the adelgid continues to spread throughout the eastern U.S., causing tree mortality and population declines (USFS 2004; Salmon 2016). Loss of eastern hemlock significantly changes the character of natural communities in Virginia's mountains and may lead to an increase in soil erosion and stream sedimentation.

Phragmites (*Phragmites australis*), is a tall grass species found in many parts of the world, with regional genetic variations. At least one genotype was introduced into the U.S. and has become an aggressive invader of brackish wetlands in eastern and midwestern states (Saltonstall 2002). Phragmites overwhelms other marsh plants from above and below with tall stems that may be 15 feet in height and fast-growing rhizomes (underground stems) that form new shoots and a thick tangled mat. By forming tall dense stands with few other plant species, Phragmites creates a habitat that lacks value to wildlife. Once established, it is very difficult and expensive to control (Marks et al. 1993; Meyerson et al. 2009). The Virginia Department of Conservation and Recreation (VDCR) mapped more than 12,000 acres of Phragmites that has invaded wetlands of the Chesapeake Bay, Back Bay, and the seaside and barrier islands of Virginia's Eastern Shore.

Figure 2. Phragmites completely alters marsh vegetation.

Detected in the New York City area in 1999, **West Nile virus** is a disease-causing virus that affects birds and mammals, including humans. It was first identified in Uganda in 1937 (Hayes et al. 2005). Since it was discovered in North America, it has spread at an astonishing rate. By 2004, West Nile virus had spread to California, north into Canada, and south into Central America and the Caribbean (Hayes et al. 2005). West Nile virus is

transmitted by mosquitoes and can cause West Nile fever (a mild flulike condition), meningitis, encephalitis, or even a polio-like paralysis, and death. From 1999 to 2016, more than 46,000 cases of West Nile virus disease were reported in the U.S., of which 2,017 cases resulted in death (Centers for Disease Control and Prevention 2018). Most people infected with the virus, however, never get sick, and some experience only mild flulike symptoms. West Nile virus also affects many wild and captive bird species, which are the primary means of dispersal (Hayes et al. 2005). Certain species, such as crows and jays, are particularly vulnerable and experience high rates of mortality. The virus is transmitted from birds to humans via mosquitoes. Recent research also suggests that the virus may be transmitted by blood transfusion, organ transplants, and breast milk (Hayes et al. 2005). The most likely pathway for the virus into the U.S. is via birds in zoos or the commercial and pet trade, although this has not been proved (Hayes et al. 2005; Marra et al. 2004; Rappapole et al. 2000).

Zebra mussel (*Dreissena polymorpha*), a freshwater bivalve native of Russia, spread during the 19th century to western Europe via trade through open waterways and canals. It probably arrived in the U.S. in the ballast of a transatlantic ship. It was first identified in 1988 in Lake St. Claire in Michigan, which connects Lake Huron and Lake Erie. Less than 10 years later, the zebra mussel was found in all five Great Lakes and the Mississippi, Tennessee, Hudson, and Ohio river basins. Adult zebra mussels grow to 2 inches in length and form dense colonies of as many as 1 million individuals per square meter (Benson et al. 2018). Colonies form on any hard surface, living or inanimate. Boats, pipes, piers, docks, plants, clams, and even other zebra mussels serve as viable substrate for this species. The zebra mussel's proliferation in U.S. waters has had negative economic and ecological impacts. The U.S. Fish and Wildlife Service has estimated $5 billion economic impact over a 10-year period. Costs are associated with activities such as cleaning and maintenance of water intake pipes, removal of shell buildup on recreational beaches, and control efforts (Benson et al. 2018). In 2002, the zebra mussel was discovered in a quarry pond in Northern Virginia. VDGIF led control efforts and successfully eradicated the invading mollusk in 2006 (Fernald and Watson 2013).

Figure 3. Wavyleaf carpets the forest floor.

Wavyleaf grass (*Oplismenus undulatifolius*) forms dense carpets of vegetation in shaded forest habitat and blocks growth of many other species, including tree seedlings. Long-term, it may alter forest structure by preventing native species from replacing themselves. Wavyleaf produces numerous sticky seeds that are moved to new habitat by animals and people. It has infested thousands of acres in Maryland, where it was first discovered in 1996 (Beauchamp et al. 2013). In Virginia, it is has been found at more than 50 sites in Northern Virginia and counties along the Appalachian Trail, from Loudoun to Augusta counties, since its initial detection

in Shenandoah National Park in 2005 (Heffernan 2017). Localities, state and federal agencies, and nonprofit organizations are conducting control efforts.

Spotted lanternfly (*Lycorma delicatula*). The spotted lanternfly (SLF) is a planthopper that is native to China, India, Japan, Korea, and Vietnam. The first detection of SLF in the U.S. was in 2014, when it was confirmed in Pennsylvania. Its range has expanded since then, and it was discovered in Virginia in January 2018. The SLF is highly invasive and can spread rapidly to new areas. It feeds on more than 70 host plants including grapes, peaches, hops, and apples, and is commonly associated with tree-of-heaven, *Ailanthus altissima*. The insect causes damage to plants by sucking sap from young stems and leaves and then producing honeydew, a by-product of their feeding, that serves as a medium for fungal growth. SLF has the potential to be a serious pest of agriculture and home gardens in Virginia (VCE 2018).

Figure 4. Spotted lanternfly feeds on crops such as grapes, peaches, hops, and apples.

Ramorum blight (*Phytophthora ramorum*), a fungal pathogen of unknown origin (Cave et al. 2005), causes damage to trees and shrubs. It is responsible for **sudden oak death** in California and Oregon, killing tanoak (*Lithocarpus densiflorus*), coast live oak (*Quercus agrifolia*), and Californian black oak (*Q. kellogii*). The fungus causes a wide range of symptoms on oak and rhododendron species, including many horticultural species. It has been detected in an ever-increasing number of nurseries in the U.S. and Europe (Cave et al. 2005) but so far has not been found in native forests in the eastern U.S. Nevertheless, *P. ramorum* remains of very high concern for foresters and the nursery industry. Many believe it is just a matter of time before it is found in high-risk areas of Virginia and other states where known host plant species are widespread and climate conditions are favorable for its growth and dispersal (COMTF 2004; Cave et al. 2005). The only control methods known are quarantine and destruction of host plants.

Emerald ash borer (*Agrilus planipennis*; EAB) is a small beetle discovered in Michigan in 2002. EAB probably arrived in solid-wood packing material carried on cargo ships or airplanes originating in its native range in Asia. The adult beetle does little damage, but the larvae (immature stage) feed on the inner bark of ash trees, disrupting the tree's ability to transport water and nutrients. EAB has become established in large areas of the U.S. and has killed many millions of ash trees, costing municipalities, property owners, nursery operators, and forest-product industries billions of dollars (Snydor et al. 2007). The U.S. Department of Agriculture (USDA) and state agencies have instituted quarantines and fines to prevent potentially infested ash trees, logs or hardwood firewood from being moved out of areas where EAB occurs (Emerald Ash Borer Information

Figure 5. Emerald ash borer is a small insect with a billion-dollar impact to forestry.

Network 2018). Due to the extent of the outbreak and the challenges of locating and eradicating new infestations, regulatory agencies are seeking methods for managing this destructive pest throughout North America. EAB was first detected in Virginia in 2003 on infested nursery stock shipped illegally from Michigan to Maryland and planted in Virginia. As of August 2012, the entire state of Virginia came under state and federal EAB quarantines. As of 2018, EAB is found in 33 states (Emerald Ash Borer Information Network 2018).

Feral hogs (*Sus scrofa*) are defined in the *Code of Virginia* as "any swine that are wild or for which no proof of ownership can be made (*Code of Virginia* § 29.1-100)." In the southeastern U.S., feral hog populations have been growing since the 1980s, likely due to intentional movement and establishment of wild populations for sport hunting. Feral hogs damage crops and native plant communities. They are known to carry multiple diseases that threaten domestic farm animals. Feral hogs cost the U.S. $1.5 billion annually in damages and control costs (USDA-APHIS 2018). Sport hunting does not provide control of feral hogs. DGIF is the lead state agency addressing the feral hog problem. In partnership with U.S. Department of Agriculture Animal and Plant Health Inspection Service (USDA-APHIS), they have conducted field surveys, an education campaign, and animal removal with a goal of eradicating feral hog populations in Virginia (VDGIF 2018b).

Figure 6. Feral hogs destroy crops.

Geographic Extent of the Plan

The Plan covers all lands and waters within the commonwealth of Virginia, as well as the Virginia waters of the Chesapeake Bay, and near-shore waters of the Atlantic Ocean. It must be understood, however, that invasive species are not limited by political boundaries. Therefore, elements of the Plan call for coordination and partnerships with regional and national efforts to prevent and control invasive species infestations.

Scope, Purpose, and Goals of the Invasive Species Management Plan

The scope of the Plan covers all invasive species, terrestrial and aquatic, in Virginia. The purpose of the Plan is to provide a framework for state agency action to minimize economic, environmental, and human harm from invasive species by acting on the seven

goals of coordination, prevention, early detection, rapid response, control, research, and education.

Planning Process

The Virginia Invasive Species Advisory Committee developed the Plan through coordination with the Invasive Species Working Group. The Advisory Committee includes representatives of Virginia's natural-resource agencies, the departments of Transportation and of Health and Human Services, academic researchers, private citizens, nonprofit conservation organizations, and private business associations. Complete lists of Working Group and Committee members and their affiliations can be found in Appendices C and D, respectively.

The Plan is an evolving document that will be revised every four years. Ongoing accomplishments and new information will guide refinement and revision of goals and strategies in future versions of the Plan.

II. INVASIVE SPECIES AUTHORITIES

Invasive species are addressed by a variety of laws and regulations overseen by a number of agencies. At the federal level, Executive Order 13112, the Lacy Act, and the Animal Health Protection Act, and the National Invasive Species Act of 1996, among many others, direct invasive species management actions for the protection of agricultural and natural resources. In Virginia, the Virginia Pest Law, the Nonindigenous Aquatic Nuisance Species Act, and the Noxious Weed Law are but a few of the instruments used to prevent, regulate, and control invasive species. It must be noted that what are now often referred to as "invasive species" are sometimes, but not always, referred to as pest, nuisance, or noxious species. However, the latter designations may include native species. See Appendix I for a table of invasive species laws and regulations.

Most laws protecting agricultural and silvicultural interests are concerned with "plant pests," which can include weeds, insects, and plant pathogens such as rusts or viruses. A subcategory of plant pests is "noxious weed." Plant pest laws restrict importation and release of species identified as a threat and provide authority for eradication.

Other state laws and regulations specifically address impacts of predatory or undesirable species on native fish and wildlife resources or of invasive aquatic species that may pose a significant threat of harm to the diversity or abundance of native species, the ecological stability of state waters, or the commercial, industrial, agricultural, municipal, recreational, aquacultural, or other beneficial uses of state waters.

Broad statements in laws concerning the protection and propagation of wildlife or protection of the natural diversity of biological resources provide grounds for action to prevent or control invasive species. For example, VDGIF has among its responsibilities to "conduct operations for the preservation and propagation of game birds, game animals, fish and other wildlife in order to increase, replenish and restock the lands and inland waters of the Commonwealth" (§ 29.1-103). Further, it may "exercise powers it may deem advisable for conserving, protecting, replenishing, propagating and increasing the supply of game birds, game animals, fish and other wildlife of the Commonwealth" (§ 29.1-103). In another example, the *Code of Virginia* directs VDCR to "preserve the natural diversity of biological resources of the Commonwealth" (*Code of Virginia* §10.1-211).

Invasive species often cross jurisdictional boundaries. Therefore, government agencies (federal, state, and local), private businesses, and nonprofit organizations have formed broad partnerships to more effectively address the impacts of invasive species.

State Agency Authorities and Programs

Invasive Species Working Group (ISWG) was created by the Virginia General Assembly in 2009 (*Code of Virginia* § 2.2-220.2). The ISWG is chaired by the Secretary of Natural Resources, and the Secretary of Agriculture and Forestry serves as vice chair. The secretaries are directed to "coordinate the development of strategic actions to be taken by the Commonwealth, individual state and federal agencies, private businesses,

and landowners related to invasive species prevention, early detection, rapid response, control and management, research and risk assessment, and education and outreach."

Members of the ISWG include the Virginia departments of Conservation and Recreation; Game and Inland Fisheries; Environmental Quality; Forestry; Agriculture and Consumer Services; Health; and Transportation; the Marine Resources Commission; Virginia Cooperative Extension; the Virginia Institute of Marine Science; representatives of the agriculture and forest industries; the conservation community; interested federal agencies; academic institutions; and commercial interests. See Appendix C for a full list of ISWG members.

The ISWG is required to develop a state invasive species management plan and a list of invasive species that pose the greatest threat to the commonwealth. General goals outlined in the enabling legislation include:

1. Prevent additional introductions of invasive species.
2. Procure, use, and maintain native species to replace invasive species.
3. Implement targeted control efforts on those invasive species that are present in the Commonwealth and are susceptible to such actions.
4. Identify and report the appearance of invasive species before they can become established and control becomes less feasible.
5. Implement immediate control measures if a new invasive species is discovered in Virginia, with the aim of eradicating that species from Virginia's lands and waters if feasible given the degree of infestation.
6. Recommend legislative actions or pursue federal grants to implement the plan. No new funding is allocated for the actions of the ISWG. VDCR provides staff for the ISWG.

ISWG continues work begun by previous legislation and executive directives. In 2003, the Invasive Species Council Act (ISCA) was passed into law by the General Assembly establishing the Virginia Invasive Species Council (VISC) to provide state leadership regarding invasive species issues in the Commonwealth and to prepare an invasive species management plan (*Code of Virginia* § 10.1-2600). The Secretary of Natural Resources chaired the Council, and membership was similar to that of the current Working Group.

The ISCA also called for establishment of an "advisory committee of stakeholders to provide information and advice for consideration by the Council" and to "recommend actions that may be taken at local, state, regional, and ecosystem-based levels to achieve the goals and objectives of the management plan…." (*Code of Virginia* § 10.1-2605). Members of the advisory committee represent local, state, and federal government, academia, private citizens, private conservation organizations, and the business community.

When the ISCA expired in 2006, the governor continued the body by issuing two executive directives and changed the name to the Invasive Species Working Group.

Virginia Department of Agriculture and Consumer Services (VDACS). The Tree and Crop Pest Law, the Plant and Plant Products Inspection Law, and the Noxious Weed Law

grant VDACS most of its authority and responsibility for responding to invasive species issues.

The Tree and Crop Pest Law authorizes VDACS to "protect the agricultural, horticultural, and other interests of the Commonwealth from plant pests" (*Code of Virginia* § 3.2-701). Toward that end, the law empowers VDACS to "direct abundance surveys for plant pests and may carry out operations or measures to locate, suppress, control, eradicate, prevent or retard the spread of pests" (*Code of Virginia* § 3.2-702). Organisms covered by this law include: insects, diseases, parasitic plants, or other organisms of any character causing or capable of causing injury or damage to any plant or part thereof. The law also grants quarantine authority: VDACS may "quarantine this Commonwealth or any portion thereof when they determine that such action is necessary to prevent or retard the spread of a pest into, within, or from this Commonwealth" (*Code of Virginia* § 3.2-703). Further, the law makes any violation of the law, including a quarantine violation, a Class 1 misdemeanor *Code of Virginia* (§ 3.2-710).

A quarantine prohibits the movement or sale of "regulated articles" into or out of the quarantined area. Regulated articles are defined as products capable of carrying the target pest out of the quarantined area. VDACS may designate a quarantine as temporary or permanent. Quarantines may be directed toward the entire state or any part thereof.

The Plant and Plant Products Inspection Law confers upon VDACS the duty to "protect the agricultural, horticultural, and other interests of the Commonwealth from plant pests" (*Code of Virginia* § 3.2-3801). The law authorizes VDACS to certify and inspect nurseries and nursery stock and defines a plant pest as "any living stage of insects, mites, nematodes, slugs, snails, protozoa, other invertebrate animals, bacteria, fungi, other parasitic plants, parasitic plant parts, viruses, any other similar organism, or any infectious substances that can injure, infect, or damage any plant or plant products" (*Code of Virginia* § 3.2-3800). The law grants VDACS the authority to inspect nursery stock and to "stop delivery or sale, treat, or order returned to the point of origin any nursery stock or plant products for sale or distribution if a plant pest infection or the visual symptoms of infestation are found" (*Code of Virginia* § 3.2-3808). Plant material found to be infected will be "seized, destroyed, treated or returned to the point of origin at the owner's expense" (*Code of Virginia* § 3.2-3809). The law makes any person who imports a plant pest into Virginia without a permit from VDACS guilty of a Class 1 misdemeanor (*Code of Virginia* § 3.2-3810).

The Noxious Weed Law allows the VDACS board to declare as a "noxious weed"

> any living plant, or part thereof, declared by the Board through regulations under this chapter to be detrimental to crops, surface waters, including lakes, or other desirable plants, livestock, land, or other property, or to be injurious to public health, the environment, or the economy, except when in-state production of such living plant, or part thereof, is commercially viable or such living plant is commercially propagated in Virginia. (*Code of Virginia* § 3.2-800)

The board may adopt regulations pertaining to regulated articles and conditions governing their movement in order to eradicate or suppress and prevent the dissemination

of noxious weeds (*Code of Virginia* § 3.2-802). In order to prevent the introduction or spread of noxious weeds, VDACS' commissioner is authorized to "stop delivery, stop sale, seize, destroy, treat, or order returned to the point of origin, at the owner's expense, any noxious weed, article, or substance whatsoever, if transported or moved within the Commonwealth, or if existing on any premise, or brought into the Commonwealth from any place outside thereof, if such is found by him to be infested with any noxious weed" (*Code of Virginia* § 3.2-805). Species designated as noxious weeds in Virginia are listed in Table 1. An updated list can be found at: http://www.vdacs.virginia.gov//plant-industry-services-noxious-weeds.shtml.

Table 1. Noxious weed species listed by VDACS.

	Common name	**Scientific name**
Tier 1	Giant salvinia	*Salvinia molesta*
	Tropical soda apple	*Solanum viarum*
	Giant hogweed	*Heracleum mantegazzianum*
Tier 2	Cogon grass	*Imperata cylindrica*
	Purple loosestrife	*Lythrum salicaria*
	Water spinach	*Ipomoea aquatica*
	Beach vitex	*Vitex rotundifolia*
	Wavyleaf grass	*Oplismenus undulatifolius*

Virginia Department of Forestry. Through the Insect Infestation and Diseases of Forest Trees Law, VDOF "is authorized and responsible for (i) investigating insect infestations and disease infections which affect stands of forest trees, and (ii) devising and demonstrating control measures to interested persons" (*Code of Virginia* § 10.1-1177). The law defines an "infection" as "any disease affecting forest trees which is declared by the State Forester to be dangerously injurious to forest trees," an "infestation as "any insect which is declared by the State Forester to be dangerously injurious to forest trees," and a "person" as including "an individual, partnership, corporation, company, society or association" (*Code of Virginia* § 10.1-1178).

The law directs the State Forester to investigate any instance of infestation or infection where believed to exist. If an infection or infestation is found, the state forester must notify "each landowner within the affected area, advising him on the nature of the infestation or infection, and the recommended control measures, and offering him technical advice on methods of carrying out control measures" (*Code of Virginia* § 10.1-1179). VDOF does not have authority to establish quarantines.

Virginia Department of Health (DH). The Department of Health's Division of Environmental Epidemiology (DHDEE) works "to prevent and control human diseases and conditions due to exposure to chemical and biological agents in the environment and transmission from animals to humans." Some of these diseases and the biological agents that spread them are considered invasive species. An example of a disease that effects humans and animals is West Nile virus, which originated in Africa. West Nile virus is spread by birds and nonnative mosquitoes, particularly the Asian tiger mosquito. DHDEE

conducts surveillance of and reports on disease outbreaks that may be due to such environmental factors.

Virginia Department of Game and Inland Fisheries. VDGIF is charged with protection of the state's game birds, game animals, fish, and other wildlife, except for species legally designated threatened or endangered species of the Class Insecta, which are the jurisdiction of VDACS. The state definition of "wildlife" does not include plant species; therefore, management of invasive plant species extends from management for wildlife habitat. VDGIF has discretionary authority to "conduct operations for the preservation and propagation of wild animals in order to increase, replenish and restock the lands and inland waters of the Commonwealth" (*Code of Virginia* § 29.1-103).

The Nonindigenous Aquatic Nuisance Species Act (*Code of Virginia* § 29.1-571-577) authorizes DGIF to classify nuisance species and to "conduct operations and measures to suppress, control, eradicate, prevent, or retard the spread of any nonindigenous aquatic nuisance species" (*Code of Virginia* § 29.1-572-573). The Act defines "nonindigenous aquatic nuisance species" as "a nonindigenous aquatic freshwater animal species whose presence in state waters poses or is likely to pose a significant threat of harm to (i) the diversity or abundance of any species indigenous to state waters; (ii) the ecological stability of state waters; or (iii) the commercial, industrial, agricultural, municipal, recreational, aquacultural, or other beneficial uses of state waters" (*Code of Virginia* § 29.1-571). See Table 2 for a list of nonindigenous aquatic species currently listed by VDGIF.

VDGIF is given discretionary power to "control, eradicate, prevent, or retard the spread of any nonindigenous aquatic nuisance species" (*Code of Virginia* § 29.1-573). The act places prohibitions on the public, stating, "No person shall knowingly import, possess, transport, sell, purchase, give, receive, or introduce into the Commonwealth any member of a species designated as a nonindigenous aquatic nuisance species without a permit from the Director [of VDGIF]" (*Code of Virginia* § 29.1-574). An exception is made for anyone who catches a snakehead fish, provided the fish is killed and DGIF is notified as soon as practical. Any person who violates this Act may be fined no more than $25,000.

Table 2. Nonindigenous aquatic nuisance species listed by VDGIF.

Common name	**Scientific name**
Snakehead fish	*Channa* spp.
Zebra mussel	*Dreissena polymorpha*
Quagga mussel	*Dreissena bugensis*
Chinese mitten crab	*Eriocheir sinensis*
Black carp	*Mylopharyngodon piceus*
New Zealand mudsnail	*Potamopyrgus antipodarum*
Marbled crayfish	Procambarus *fallax*. f. *virginalis*
Rusty crayfish	*Orconectes rusticus*

Virginia Marine Resources Commission. VMRC is charged with protecting tidal waters "to promote the general welfare of the seafood industry and to conserve and

promote the marine resources of the Commonwealth" (*Code of Virginia* § 28.2-201[1]). VMRC regulates the importation of "live fish, shellfish, and crustacea into the Commonwealth" when the intention is to place "such fish, shellfish, or crustacea in to waters of the Commonwealth" (*Code of Virginia* § 28.2-825). Specific conditions, including the concurrence of the director of the Virginia Institute of Marine Science, must be met before an introduction is permitted.

Virginia Institute of Marine Science. VIMS is empowered to study and investigate matters affecting marine resources. VIMS is responsible for advising the VMRC, other state agencies, and private groups on marine resource issues (*Code of Virginia* § 28.2-1100). VIMS is authorized to administer and monitor protected estuarine and coastal lands in support of coastal resource management efforts (*Code of Virginia* § 28.2-1103).

Virginia Department of Conservation and Recreation. VDCR manages 37 state parks and 63 natural area preserves together encompassing more than 116,000 acres. Its invasive species jurisdiction is limited to these lands. For natural area preserves, VDCR is authorized to "preserve the natural diversity of biological resources of the Commonwealth" in all natural area preserves (§ 10.1-211). On these and other public and private conservation lands, VDCR conducts or assists with invasive species detection, control, monitoring, and restoration. In partnership with the Virginia Native Plant Society, VDCR conducts public outreach and education on invasive plants through brochures, fact sheets, agency web pages, and public presentations.

As directed by the 2009 invasive species law, VDCR serves as staff for the Invasive Species Working Group (*Code of Virginia* § 2.2-220.2).

Federal Agencies and Entities with Invasive Species Authority

The **National Invasive Species Council** (NISC) was established in 1999 by Executive Order 13112. Thirteen department heads sit on the council, which is co-chaired by the directors of the departments of the Interior, Commerce, and Agriculture. NISC serves to coordinate federal invasive species management efforts. E.O. 13112 established the now widely used definition of "invasive species" as alien (or nonnative) species that "does or or are likely to cause economic or environmental harm or harm to humans." It also directs the council to develop a national invasive species management plan.

The **U.S. Department of Agriculture Animal and Plant Health Inspection Service** (USDA-APHIS) is charged with protection of America's agriculture and natural resources from agricultural pests and diseases. Its authority comes from numerous laws, including the Animal Health Protection Act (7 U.S.C. § 8301), the Plant Health Protection Act (7 U.S.C. § 7701), the Animal Damage Control Act (7 U.S.C. §§ 426-426c, March 2, 1931, as amended 1987 and 1991), and the Lacey Act (16 U.S.C. § 3371). USDA-APHIS is represented in the Commonwealth by the Animal Care, Plant Protection and Quarantine, Veterinary Services, and Wildlife Services programs. APHIS programs work at U.S. borders and ports to prevent accidental or intentional importation of pests or diseases and respond to invasive species infestations within their respective program areas. In Virginia, APHIS is partnered with VDGIF to monitor and control nutria and feral hogs.

The **U.S. Fish and Wildlife Service** (USFWS) is the agency of the Federal Government whose primary responsibility is the conservation of the nation's fish, wildlife, and plants. Nationwide, invasive species are a threat to native floral faunal populations and the concerted efforts to protect them. The USFWS National Wildlife Refuge System operates 545 Refuges, encompassing approximately 96 million acres of wildlife habitat while protected land and water totals over 150 million acres. Invasive species management activities occur on Virginia's fourteen Refuges. The USFWS operates 14 national wildlife refuges and two ecological services offices in Virginia. Most of the USFWS's invasive species management activities occur on refuges, which total more than 123,000 acres in Virginia.

Different programs within the USFWS are involved in addressing invasive species in various capacities:

- The Aquatic Nuisance Species (ANS) Program is housed under the Division of Fish and Aquatic Conservation at the headquarters level in Falls Church, Virginia and leads the Service's Aquatic Nuisance Species (ANS) Program. The ANS Task Force (ANSTF) facilitates invasive species planning and action through its six Regional Panels and coordinates education programs such as the Stop Aquatic Hitchhikers! (SAH) and Habitattitude public awareness campaigns, and the 100th Meridian Initiative. The Virginia Fish and Wildlife Conservation Office (VFWCO) established the SAH! campaign in the Commonwealth and was instrumental in the adoption of the Don't Dump Bait campaign to help prevent the transport and spread of nuisance species.

- Authority regarding invasive species is derived from Executive Order 13112, the Lacey Act (16 U.S.C. § 3371), the Nonindigenous Aquatic Nuisance Prevention and Control Act, and the Nutria Eradication and Control Act. USFWS Fish and Aquatic Conservation program supports policy implementation throughout the Mid-Atlantic region via the Mid-Atlantic Panel on Aquatic Invasive Species (MAPAIS), an ANSTF Regional Panel. MAPAIS assists state and federal agencies and other stakeholders in developing and implementing strategic, coordinated, and action-oriented approaches to prevention and control. The program funds on-the-ground projects in Virginia and other states addressing outreach/education, control, early detection and rapid response, monitoring or surveys, and risk assessment.

- The Branch of Invasive Species conducts activities related to the listing of organisms as Injurious Wildlife under the Lacey Act (18 U.S.C. 42). The law authorizes the Secretary of the Interior to prohibit the importation and shipment between the continental United States, the District of Columbia, Hawaii, the Commonwealth of Puerto Rico, or any possession of the United States of species regulated to be injurious to human welfare, agricultural, horticultural or forestry

interests, and the survival of wildlife resources of the United States. An injurious wildlife listing would not prohibit intrastate transport or possession of that species within a State where those activities are not prohibited by the State.

- Service programs are involved in the Habitat Restoration of degraded wildlife habitats included those impacted by invasive species. In the summer of 2002, zebra mussels were discovered in Millbrook Quarry, a recreational diving facility in Prince William County. This infestation was documented as the first and only population in the Commonwealth. In the face of ecological and economic threats these mussels posed, VFWCO provided technical assistance serving on the Millbrook Quarry Zebra Mussel Workgroup representing academia and other federal, state, and local agencies. A major concern was the existing zebra mussel population's ability to immediately impact Lake Manassas, the primary water supply for the City of Manassas and surrounding municipalities. Occoquan Reservoir was at risk also providing water resources to over one million people in northern Virginia at the time. Through consistent federal and state cooperation and dedication led by the Virginia Department of Game and Inland Fisheries, the zebra mussel population was successfully eradicated from Millbrook Quarry (Fernald and Watson 2013).

- The Endangered Species Program is involved in the recovery of listed (threatened and endangered) species and the ecosystems on which they depend. Invasive species are often part of the reason these species are threatened.

- The Division of Environmental Quality addresses invasive species issues through its work on Integrated Pest Management, its work to promote the use of native plants as part of its efforts to protect Pollinators, and its work on biocontrol.

- The Service's Office of Law Enforcement, using wildlife inspectors at 32 major U.S. airports, ocean ports, and border crossings, seeks to prevent the introduction of injurious wildlife through its wildlife inspection program.

The **National Park Service** (NPS) was created by the National Park Service Organic Act of 1916. NPS manages the National Park System "to conserve the scenery and the natural and historic objects and wildlife therein, and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations" (16 U.S.C. 1). In Virginia, NPS manages more than 300,000 acres that include Shenandoah National Park, Prince William Forest Park, the Blue Ridge Parkway, and other units such as national battlefield memorial parks. On these lands, NPS conducts invasive species surveys, control, and monitoring.

The **U.S. Forest Service** (USFS), an agency of the USDA, manages 155 national forests and 20 national grasslands. Its mission is to "sustain the health, diversity, and productivity of the Nation's forests and grasslands to meet the needs of present and future generations." Additional authority for the control of invasive plants comes from the

Federal Noxious Weed Act of 1974, as amended, requiring cooperation with state, local, and other federal agencies in the application and enforcement of all laws and regulations relating to management and control of noxious weeds. The George Washington and Jefferson national forests manage about 1.6 million acres of National Forest System lands in the Commonwealth. USFS inventories lands for a variety of aquatic and terrestrial nonnative invasive species. It has implemented control treatments for species such as gypsy moth, hemlock woolly adelgid, tree-of-heaven, autumn olive, and mile-a-minute weed. Annually, USFS treats 1,000–2,000 acres of nonnative invasive plants in Virginia.

Nonprofit Organizations

While lacking the regulatory authority of governmental agencies, nonprofit organizations have long played an important role in addressing the threats posed by invasive species on public and private lands. In particular, The Nature Conservancy, the Virginia Native Plant Society, and the Virginia Nursery & Landscape Association have done much to support and promote the goals of this plan.

Since the 2012 management plan was published, a new type of public–private organization has come on the scene: Partnerships for Regional Invasive Species Management (PRISMs), sometimes also known as cooperative weed management areas (CWMAs). Founded in 2014, the Blue Ridge PRISM followed an organizational model developed in western states. It has quickly become a vital part of the task of educating landowners and encouraging management of invasive plants. Inspired by their success, new PRISMs are being formed around the state. New strategies in this plan seek to highlight and encourage the efforts of these organizations.

II. INVASIVE SPECIES MANAGEMENT PLAN GOALS AND STRATEGIES

1. COORDINATION

The scope and complexity of the invasive species management challenge is such that it summons the strengths of different government agencies and private organizations in different ways. Not all stakeholders conduct control or restoration activities, nor do all engage in prevention measures. All stakeholders will not always agree on all issues. Nevertheless, the goals of the Plan require understanding of the views and roles of each stakeholder and ongoing cooperation, communication, and dialogue. Monitoring and evaluation will provide measures of success toward reaching goals and information for future iterations of this plan.

Goal 1. Coordinate state, federal, and stakeholder prevention and management of invasive species infestations.

Strategy 1.1. Strengthen invasive species coordination at the state level, between local and federal agencies, and with other stakeholders.

Action 1.1.1. Continue the Virginia Invasive Species Working Group (VISWG) as a permanent body and fund key positions and activities to help integrate and coordinate Virginia-wide agency invasive species actions, link them to national invasive species efforts, and outline procedures that will help resolve jurisdictional and other agency issues regarding invasive species programs.

Action 1.1.2. Maintain Virginia Invasive Species Advisory Committee (VISAC) to serve the VISWG and as the primary forum for stakeholder dialogue and coordination between state, federal and private organizations.

Action 1.1.3. Establish a subcommittee for oversight of each of the goals of this plan. Each subcommittee should present an annual summary of activities undertaken and progress toward the plan goals to the VISWG.

Action 1.1.4. Strengthen state partnerships with local governments, federal agencies, and other stakeholders—such as business associations, conservation organizations, and PRISMs—through memoranda of understanding where appropriate.

Action 1.1.5. As needed, address major policy differences between agencies and other stakeholders within the VISAC.

Strategy 1.2. Identify potential legislation revisions to close potential gaps or reduce duplication.

Action 1.2.1. Identify jurisdictional and legislative needs for invasive species prevention, detection, response, control, research, and education.

Action 1.2.2. Identify funding needs for invasive species prevention, detection, response, control, research, and education.

Strategy 1.3. Establish monitoring and evaluation of Plan implementation.

Action 1.3.1. Define clear, quantifiable outcomes for management actions.

Action 1.3.2. Report progress and accomplishments in the implementation of Plan strategies and actions.

2. PREVENTION

Preventing introduction of invasive species is the most cost-effective means of averting or reducing the risk of harmful infestations. Investment in prevention avoids the long-term economic, environmental, and social costs associated with invasive species infestations. Preventive actions seek to verify authorized introductions and to detect and interrupt illegal or accidental introductions by monitoring key pathways. Prevention requires state agency support and cooperation with federal agencies tasked with similar responsibilities beyond state lines. Implementation of preventive measures may require broadening legislative mandates, strengthening the capacity of some departments, and refining or consolidating legislative and regulatory tools. Prevention also includes increased public awareness of the invasive species issues. Educating key resource user groups is an important part of prevention efforts addressed in Goal 7.

Goal 2. Prevent known and potentially invasive species from entering the state through detecting and interrupting all unauthorized species introductions.

Strategy 2.1. Identify, support, or conduct invasive species pathway analysis and prioritize pathways according to risk.

Action 2.1.1. Coordinate with federal efforts, such as those of the NISC and ANSTF, to ensure that assessments are conducted of all pathways and potential pathways of intentional and unintentional introductions, including commodities and transportation vectors.

Strategy 2.2. Develop and implement plans for managing both intentional and accidental high-risk pathways, working with existing regulatory authorities as appropriate.

Action 2.2.1. Identify authors or teams who will create pathway management plans.

Action 2.2.2. Ensure that plans identify additional funding and legal authority, if needed.

Action 2.2.3. Encourage cooperation between federal and state agencies in the development and implementation of invasive species risk management partnerships at all significant ports of entry in Virginia.

3. EARLY DETECTION, IDENTIFICATION, AND REPORTING

When invasive species elude preventive actions and enter Virginia, early detection is the next line of defense. Early detection consists of monitoring for invasive species around critical pathways, protected areas, and urban and agricultural ecosystems. Monitoring of invasive species also supports several other strategic needs: it evaluates prevention and control programs and provides information on invasion patterns and future management needs.

Formal responsibility for early detection of new invasions is distributed across several state agencies with dedicated staff who survey or monitor for invasive species: VDACS and VDOF conduct surveys for plant pests; VDGIF monitors nuisance species, invasive plants on DGIF lands and facilities, and terrestrial and aquatic (freshwater) invasive species; VMRC aquatic (saltwater) species; and VDH monitors nonnative mosquitoes that carry human pathogens. Other state and federal agencies with technical expertise and roles that place professional staff in the position of making early detections are VDCR, VIMS, VMRC, VDEQ, and the Cooperative Extension Service at the state level, and USDA-APHIS, NPS, USFS, and USFWS at the federal level. Localities and nonprofit conservation organizations also have resource professionals that play an important role in early detection. Clear detection targets and reporting protocol will enable more agency staff to recognize and report early detections of species of high concern.

Volunteers who regularly use and enjoy Virginia's natural resources offer another opportunity for enhancing early detection capability through directed surveys and chance encounters. Effective participation of volunteers in early detection requires outreach, training, and tools that assist in identifying and reporting potential invasive species. The following strategies and actions will enhance both professional and volunteer participation in early detection.

Verification of a suspected new invasive species requires taxonomic expertise. Once verified, information about the infestation needs to get to the appropriate agency. Data collection protocol and data collection forms will help ensure that useful data are collected at the time of the first detection. Sharing early detection data as soon as possible with the wider network will help increase alertness to the species in question and signal the need for next steps in the rapid response process. See Figure 7.

Goal 3. Promote and enhance early detection of invasive species, by professionals and volunteers, through education and reporting tools.

Strategy 3.1. Enhance the likelihood of early detection and reporting of suspected new species by supporting volunteers and professionals with information and tools designed to detect and report invasive species of high concern.

Action 3.1.1. Develop a targeted list of 15–20 species of high concern for early-detection training and education.

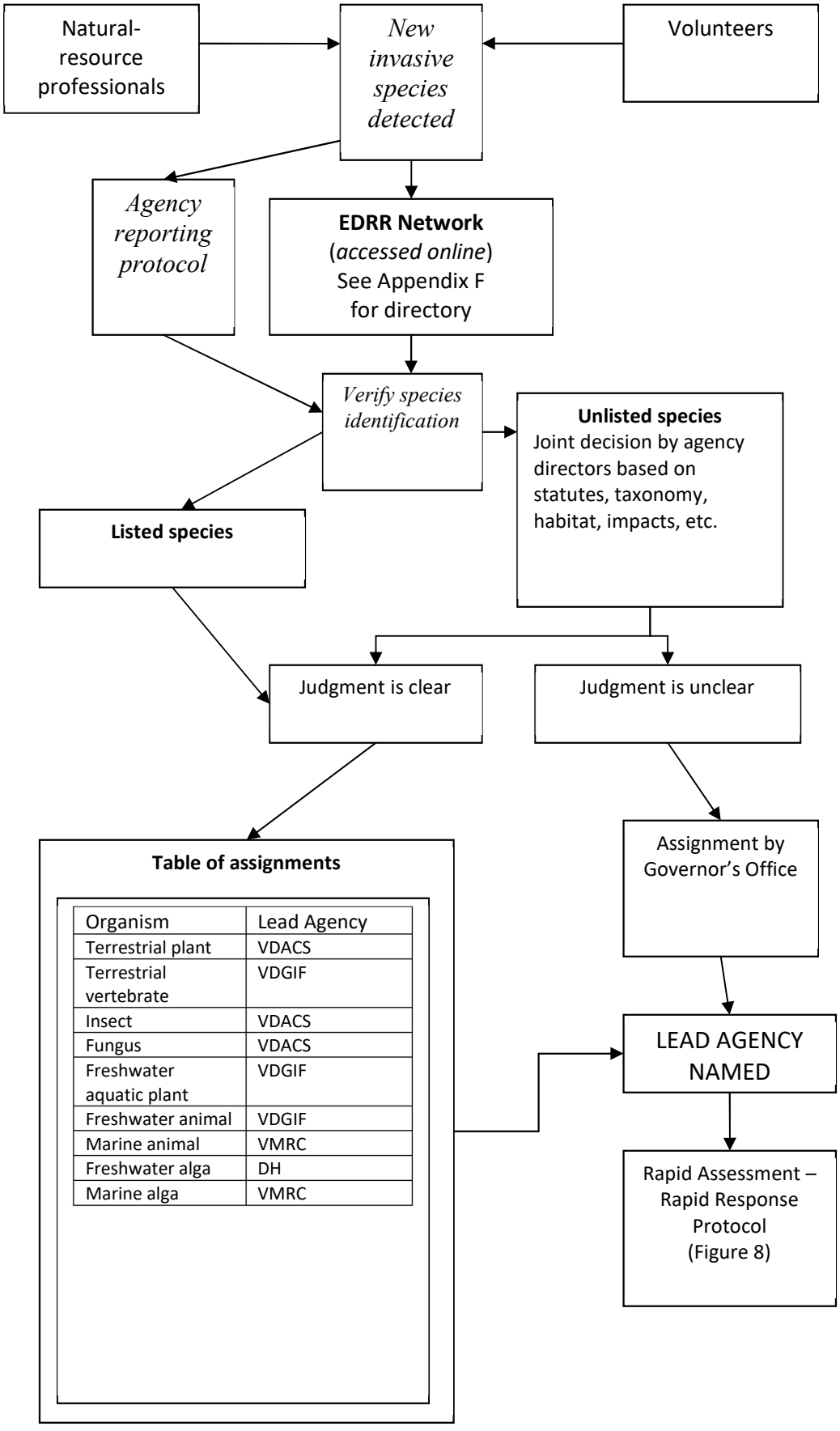
Action 3.1.2. Maintain an early-detection network directory on www.vainvasivespecies.org. See Appendix F.

Action 3.1.3. Create an early-detection Listserv for professional resource staff.

Action 3.1.4. Provide early-detection training materials and workshops for Virginia Master Naturalists and other citizen groups so that they may train others in early detection.
Action 3.1.5. Maintain an online early-detection species-identification guide.
Action 3.1.6. Post and promote an online early-detection reporting tool.
Action 3.1.7. Encourage and support personnel at Cooperative Extension offices to act as contacts for an early-detection network. Virginia Cooperative Extension agents in particular are well positioned to implement this action.
Action 3.1.8. Provide training and information to allow resource professionals to enhance their knowledge of early-detection species-identification and reporting protocols.

Strategy 3.2. Ensure the timely identification and reporting of newly introduced species.

Action 3.2.1. Encourage the use of an early-detection data-collection protocol.
Action 3.2.2. Ensure access to taxonomic expertise such as those at Virginia Cooperative Extension Diagnostic and Laboratory Services.
Action 3.2.3. Use the Early Detection and Distribution Mapping System (www.eddmaps.org) to report, map, and catalog new species introductions.
Action 3.2.4. Make use of ArcGIS Online for sharing specific invasive species data sets between agencies and with the public.
Action 3.2.5. Encourage archiving of confirmed new species introductions at appropriate institutions.
Action 3.2.6. Report confirmed new introductions to the Invasive Species Working Group and Advisory Committee.
Action 3.2.7. Facilitate media coverage of new introductions.



Organism	Lead Agency
Terrestrial plant	VDACS
Terrestrial vertebrate	VDGIF
Insect	VDACS
Fungus	VDACS
Freshwater aquatic plant	VDGIF
Freshwater animal	VDGIF
Marine animal	VMRC
Freshwater alga	DH
Marine alga	VMRC

Figure 7. Early-detection process

4. RAPID ASSESSMENT AND RAPID RESPONSE

When new invasive species are discovered, it is essential to respond rapidly, before they become established, spread, and cause harm. Delay in response can lead to profoundly higher costs of control and management. Integrated rapid-response programs are required. The objective of rapid response is containment or eradication of the target species. State, federal, and local agencies and nongovernmental organizations need to coordinate response activities. Rapid-response programs must be guided by contingency plans, seek approval for likely management actions, and be supported with emergency funding. When a species is detected for which a plan has not been prepared, a rapid-assessment process is recommended.

Goal 4. Enhance rapid-response capability to implement eradication or containment procedures for target species through planning.

Strategy 4.1. Develop contingency/emergency response plans for potential invasive species of high concern most likely to be introduced. The *Pest Plant Emergency Action Plan* prepared by the VDACS Office of Pest Plant Industry Services provides a model for such plans. See Appendix E.

Action 4.1.1. Form planning teams for specific life form types (e.g., mammals, fish, mosquitoes, plant pathogens.).

Action 4.1.2. Prepare response plans, and incorporate these plans into the state emergency plan under the state homeland security system.

Action 4.1.3. Seek approval for anticipated management actions from regulatory agencies.

Action 4.1.4. Develop and test a generic rapid-response plan with a mock-invasion scenario.

Strategy 4.2. Identify available funds or funding sources for rapid-response implementation and assess needs for more funding authority.

Strategy 4.3. Encourage interagency and public–private partnerships for successful rapid-response operations.

Strategy 4.4. Facilitate media coverage of rapid-response actions.

Strategy 4.5. When early detection identifies an invasive species of high concern for which no plan has been prepared, conduct rapid assessment. Generally, a team will be required to rapidly assess the species and situation to determine next actions. Assessment will determine jurisdictional purview, regulatory status, permitting needs, etc. Federal agencies may be helpful at this stage to provide technical assistance and possibly emergency funding.

Action 4.5.1. Identify staff for rapid-assessment teams. Identify partnering potential with watermen, recreational fishermen, others.

Action 4.5.2. Conduct rapid assessment to determine potential invasiveness and economic and ecological threats posed by verified new species.

Action 4.5.3. Determine appropriate regulatory status of new species.

Action 4.5.4. Seek technical and other assistance from federal agencies.

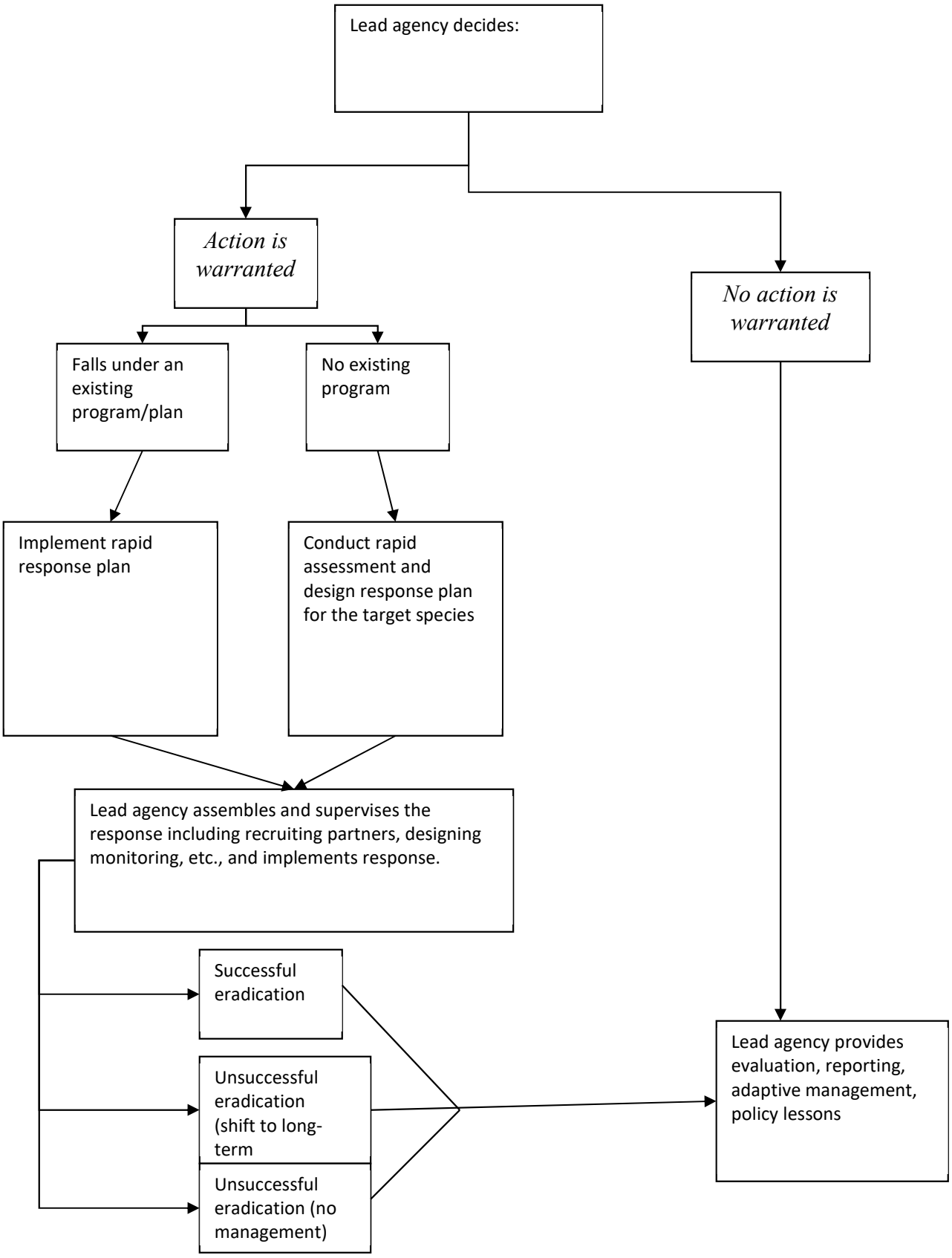


Figure 8. Rapid-response process

5. CONTROL AND MANAGEMENT

Established invasive species require control through containment, abatement, or other management strategies to minimize environmental and economic impacts. Management objectives may include population suppression, limiting spread, and reducing impacts. Control measures may include mechanical, chemical, biological, or integrated pest management strategies. In managed ecosystems, restoration is an essential component of control for preventing an invader from reinvading a site or new invaders from becoming established. Adequate funding, public awareness, and management expertise are critical to success.

Invasive species do not recognize political boundaries or agency jurisdictions. Therefore, an ecosystem approach should be used to manage invasive species within Virginia and across state lines. State agencies, federal agencies, and private organizations will need to coordinate efforts within the state and the region.

Invasive species should be prioritized for targeted management and research activities. Risk assessment, cost–benefit analysis, and other tools can be used to identify and select appropriate control measures. This need is addressed in Goal 6: Research and Risk Assessment.

Goal 5. Provide control of priority invasive species through containment, abatement, or other management strategies—including habitat restoration and use of native species—to minimize environmental and economic impacts.

Strategy 5.1: Prepare and implement management plans for abating environmental and economic impacts of established high-priority invasive-species infestations (as identified in Action 6.2.1).

- **Action 5.1.1.** Develop and implement management plans for *established* high-priority invasive species through a partnership/stewardship approach.
- **Action 5.1.2.** Develop and implement restoration plans for vulnerable wildland, aquatic, and agricultural ecosystems to provide conditions more suitable for native biota and to prevent reinfestation by invasive species.
- **Action 5.1.3.** When feasible, encourage the procurement and use of native species for restoration, soil conservation, and landscaping.
- **Action 5.1.4.** Identify information, staff, research, and budget needs for improving invasive species management in Virginia.

Strategy 5.2. Develop programs and information and establish funding to assist private landowners in control of invasive species.

- **Action 5.2.1.** Evaluate potential incentive programs or assistance for private landowners for the control of invasive species and make recommendations to the General Assembly to establish or enhance these programs.
- **Action 5.2.2.** Evaluate potential incentive programs or assistance for private landowners for the restoration of ecosystems vulnerable to invasion.

Strategy 5.3. Encourage and support the formation of PRISMs/CWMAs.

- **Action 5.3.1.** Create opportunities for PRISM representatives to participate in meetings, on panels, and cooperative projects.

6. RESEARCH, MONITORING, AND RISK ASSESSMENT

Research supports all facets of the management plan and is necessary to increase the effectiveness of prevention, detection, response, and control and management of invasive species. Science-based risk-assessment tools are needed to evaluate potential invasive species before they reach Virginia's borders and to prioritize appropriate responses once they do. Significant research and monitoring efforts are under way at federal agencies (chiefly USDA, DOI, and EPA) and universities. The principal role of state agencies will be to partner with these institutions regarding research, monitoring, and risk assessment needs and to provide feedback on the efficacy of current management tools.

Research needs are both basic and applied. Science support for monitoring includes identifying statistically sound and repeatable standard techniques that can be applied to invasive plants and animals and can be used in multiple habitats (terrestrial, freshwater, and marine). The development of models designed to increase the ability of monitoring to accurately predict the distribution and impacts of invasive species is also a key need. Finally, risk assessment is a decision-support tool critical to the prevention, early-detection, rapid-response, and control components of this plan.

Goal 6. Support or conduct research, monitoring, and risk assessment needed to assess, prioritize, and control invasive species.

Strategy 6.1. Building on existing state, federal, and university programs, establish and coordinate a state invasive species research network. This network will develop and collaborate on long- and short-term research capacity and will communicate invasive species research needs to other institutions.

Action 6.1.1. Identify ongoing research, monitoring, and risk assessment efforts being conducted by other states, federal agencies, and universities and coordinate with these institutions. Support priority needs with adequate staff and funding in appropriate Virginia agencies and encourage collaboration with other states, federal agencies, and universities.

Action 6.1.2. Identify priority research needs. These priorities should address invasive species research, monitoring, and risk assessment needs in terrestrial, freshwater, and marine habitats.

Strategy 6.2. Increase invasive-species risk-assessment capacity.

Action 6.2.1. Identify risk assessments completed for invasive species established in Virginia and identify needs for further analysis. This process should result in a list of established high priority invasive species, which are 1) established in Virginia and 2) recognized as a threat to ecological or economic resources.

Action 6.2.2. Participate with federal agencies and nongovernmental stakeholders in development of a fair and comprehensive screening system for evaluating new intentional nonnative species introductions.

Action 6.2.3. Implement a process for assessing likely but not yet introduced invasive species for which rapid response tools will be necessary.

Action 6.2.4. Develop environmental and economic indicators for evaluating impacts of invasive species on Virginia's economy and environment.

Action 6.2.5. Implement and promote the VDACS Noxious Weed Assessment Tool.

7. EDUCATION AND OUTREACH

Education and outreach are vital to all the other goals in this Plan. Educating specific constituencies, such as commercial importers, agricultural producers, hikers, and anglers, on the impacts of invasive species will result in more citizen involvement. General outreach and specialized training programs are required to support other goals of this Plan.

Goal 7. Provide current information on invasive species, their negative impacts to environmental and economic resources, and methods of their prevention and control to the general public, environmental nongovernmental organization, special interest groups and K–12 science teachers.

Strategy 7.1. Develop and implement a coordinated public-awareness campaign emphasizing public and private partnerships for addressing invasive species challenges.

Action 7.1.1. Develop programming for Master Naturalists and others to take into schools.

Action 7.1.2. Using the Internet, distribute educational information and materials that raise awareness of the need to prevent future introductions of invasive species.

Action 7.1.3. When feasible, emphasize involvement through on-the-ground action to directly involve communities in management of invasive species.

Action 7.1.4. Ensure that Cooperative Extension agents have training, tools, and information for educating the public on invasive species.

Strategy 7.2. Work with conservation and professional societies and gardening associations to guide awareness and capacity for education and outreach.

Action 7.2.1. Create a Listserv or other social media channels for distributing invasive species news and information among interested stakeholders.

Action 7.2.2. Connect to a wider circle of agencies and organizations engaged in invasive species actions and education. Examples include garden clubs, horticultural programs, botanical gardens, and landscape architects' associations.

Strategy 7.3. Create and deliver training programs for presentation by professionals and volunteers on identifying, mapping, and reporting invasive species occurrences.

Action 7.3.1. Offer training on species identification.

Action 7.3.2. Offer workshops on collecting field data, GPS and GIS tools, and reporting methods (eddmaps.org and MAEDN app, vainvasivespecies.org, ArcGIS Online, and Collector app)

Strategy 7.4. Invite targeted members of the public to participate or assist in an invasive species risk assessment.

Action 7.4.1. Create and deliver risk assessment workshops for targeted groups (university biology programs, Master Naturalists, Tree Stewards, etc.) to encourage use of the Noxious Weed Assessment Tool.

V. CITATIONS

Anagnostakis, S.L. 2001. Revitalization of the majestic chestnut: chestnut blight disease. APSnet website. Available at: http://www.apsnet.org/publications/apsnetfeatures/Pages/ChestnutBlightDisease.aspx [Accessed May 22, 2018].

Beauchamp, V.B., S.M. Koontz, C. Suss, C. Hawkins, K.L. Kyde, and J.L. Schnase. 2013. An introduction to *Oplismenus undulatifolius* (Ard.) Roem. & Schult. (wavyleaf basketgrass), a recent invader in mid-Atlantic forest understories. Journal of the Torrey Botanical Society, 140(4):391–413.

Benson, A.J., D. Raikow, J. Larson, A. Fusaro, A., and A.K. Bogdanoff. 2018. *Dreissena polymorpha* (Pallas, 1771): U.S. Geological Survey, Nonindigenous Aquatic Species Database, Gainesville, FL, and NOAA Great Lakes Aquatic Nonindigenous Species Information System, Ann Arbor, MI. Available at: https://nas.er.usgs.gov/queries/greatlakes/FactSheet.aspx?SpeciesID=5&Potential=N&Type=0, Revision Date: 2/13/2018, [Accessed May 22, 2018].

Bock, D.G., C. Caseys, R.G. Cousens, M.A. Hahn, S.M. Heredia, S. Hubner, K.G. Turner, K.D. Whitney, and L.H. Rieseberg. 2015. What we still don't know about invasion genetics. Molecular Ecology 24:2277–2297.

Britton, K. 2002. Kudzu. Pages 325–330 in R. Van Driesche, B. Blossey, M. Hoddle, and R. Reardon (editors). *Biological Control of Invasive Plants in the Eastern United States.* Publication FHTET-2002-04. USDA Forest Service.

Cave, G.L. B Randall-Schedel, and S.C. Redlin. Risk analysis for *Phytophthora ramorum* Werres, de Cock and In't Veld, causal agent of *Phytophthora* canker (sudden oak death), ramorum leaf blight, and ramorum dieback. U.S. Geological Survey Animal and Plant Inspection Service, Plant Protection and Quarantine, Center for Plant Health Science and Technology, Raleigh, NC.

Centers for Disease Control and Prevention. 2018. Final Cumulative Maps and Data for 1999-2016. Available at: https://www.cdc.gov/westnile/statsmaps/cumMapsData.html. [Accessed July 27, 2018].

[COMTF] California Oak Mortality Task Force. 2004. *Phytophthora ramorum*: a review of North American and European activity. Available at: http://www.suddenoakdeath.org/ [Accessed May 22, 2018].

Courtenay, W.R., and J.D. Williams. 2004. *Snakehead (Pisces, Channidae): A Biological Synopsis and Risk Assessment*. Circular 1251. U.S. Geological Survey.

[VDCR] Virginia Department of Conservation and Recreation, Division of Natural Heritage. 2018. *Invasive plant alert: wavyleaf grass.* Available at:

http://www.dcr.virginia.gov/natural-heritage/document/fswavy.pdf [Accessed May 22 2018]. VDCR, Richmond, VA.

Emerald Ash Borer Information Network. 2018. A collaborative website administered by Michigan State University with support from the USDA Forest Service. Available at: http://www.emeraldashborer.info/ [Accessed May 22, 2018].

Fairfax County. 2005. Emerald ash borer. Fairfax County website. Available at: https://www.fairfaxcounty.gov/publicworks/emerald-ash-borer-fairfax-county [Accessed May 22, 2018].

Federal Interagency Committee for the Management of Noxious and Exotic Weeds. 2003. *A National Early Detection and Rapid Response System for Invasive Plants in the United States*. Washington, DC.

Fernald, R.T., and B.T. Watson. 2013. Eradication of Zebra Mussels (*Dreissena polymorpha*) from Millbrook Quarry, Virginia: *Rapid Response in the Real World*. In*: Quagga and Zebra Mussels; Biology, Impacts, and Control.* 2nd Edn., T.F. Nalepa and D. W. Schloesser, eds., pp. 195-213. Boca Raton, FL: CRC Press.

GAO. 2002. Invasive species: clearer focus and greater commitment needed to effectively manage the problem. USGAO. GAO-03-1. 102 p.

Hayes, E.B., N. Komar, R.S. Nasci, S.P. Montgomery, D.R. O'Leary, and G.L. Campbell. 2005. Epidemiology and transmission dynamics of West Nile virus disease. Emerging Infectious Diseases 11:8 1167–1173.

Heffernan, K.E., and R.K. Myers. 2017. Progress report: Virginia wavyleaf grass control, monitoring, and outreach. Natural Heritage Technical Report. Virginia Department of Conservation and Recreation, Division of Natural Heritage, Richmond.

Lapointe, N.W.R., P.L. Angermeier, Y. Jiao, and B. Murphy. 2018. Northern snakehead fish. Available at: https://www.fishwild.vt.edu/snakeheads/index.html [Accessed May 22, 2018].

Lodge D.M., S. Williams, H.J. MacIsaac, K.R. Hayes, B. Leung, S. Richard, R.N. Mack, et al. 2006. Biological invasions: recommendations for U.S. policy and management. Ecological Applications 16(6):2035–2054.

Lowry, E., E.J. Rollinson, A.J. Laybourn, T.E. Scott, M.E. Aiello-Lammens, S.M. Gray, J. Mickley, and J. Gurevitch. 2013. Biological invasions: a field synopsis, systematic review, and database of the literature. Ecology and Evolution 3:182–196.

Marks, M., B. Lapin,and J. Randall. 1993. Element stewardship abstract for *Phragmites australis,* common reed. The Nature Conservancy. Available at: https://www.invasive.org/gist/esadocs/documnts/phraaus.pdf [Accessed May 22, 2018].

Marra, P.P., S. Griffing, C. Caffrey, A.M. Kilpatrick, R. McLean, C. Brand, E. Saito, A.P. Dupuis, L. Kramer, and R. Novak. 2004. West Nile virus and wildlife. BioScience 54(5):393–402.

Meyerson, L.A., K. Saltonstall, and R.M. Chambers. 2009. *Phragmites australis* in eastern North America: a historical and ecological perspective. Pages 57–82 in B.R. Silliman, E.D. Grosholz, and M.D. Bertness (editors). *Human Impacts on Salt Marshes: A Global Perspective*. University of California Press.

Mooney, H.A., and R.J. Hobbs. 2000. *Invasive Species in a Changing World*. Island Press, Washington, D.C.

Myers, R.K., K.E. Heffernan, J.T. Weber, and D.R. Young. 2004. Mapping and monitoring of *Phragmites* on the seaside of Virginia's Eastern Shore. Natural Heritage Technical Report #04-15. Virginia Department of Conservation and Recreation, Division of Natural Heritage, Richmond, VA.

National Aquatic Nuisance Species Task Force. *Guidance for State and Interstate Aquatic Nuisance Species Management Plans*. Available at: https://www.anstaskforce.gov/State%20Plans/State%20Plan%20Guidelines.pdf [Accessed May 22, 2018].

[NISC] National Invasive Species Council. 2016. *National Invasive Species Council Management Plan: 2016-2018*. U.S. Department of the Interior. Washington, D.C. Available at: https://www.doi.gov/sites/doi.gov/files/uploads/2016-2018-nisc-management-plan.pdf [Accessed May 22, 2018].

Pimentel, D., L. Lach, R. Zuniga, and D. Morrison. 2005. Update on the environmental and economic costs associated with alien invasive species in the United States. Ecological Economics 52:273–288.

Rappole, J.H., S.R. Derrickson, and Z. Hubalek. 2000. Migratory birds and the spread of West Nile virus in the western hemisphere. Emerging Infectious Diseases 6(4):319–328.

Ruiz, G.M., and J.T. Carlton. 2003. *Invasive Species: Vectors and Management Strategies*. Island Press, Washington, D.C.

Salmon, S., and E.R. Day. 2016. Hemlock woolly adelgid. Virginia Polytechnic Institute and State University, Virginia Cooperative Extension. Available at: https://pubs.ext.vt.edu/content/dam/pubs_ext_vt_edu/3006/3006-1451/3006-1451_pdf.pdf [Accessed May 22, 2018].

Saltonstall, K. 2002. Cryptic invasion by a nonnative genotype of the common reed, *Phragmites australis,* into North America. PNAS 99(4):2445–2449.

Snydor, D., M. Bumgardner, and A. Todd. 2007. Potential economic impacts of emerald ash borer (*Agrilus planipennis*) on Ohio, U.S., communities. Aboriculture and Urban Forestry 2007 33(1):48–54.

Wilcove, D.S., D. Rothstein, J. Dubow, A. Phillips, and E. Losos. 2000. Leading threats to biodiversity. Pages 239–254 in B.A. Stein, L.S. Kutner, and J.S. Adams (editors). *Precious Heritage: The Status of Biodiversity in America.* Oxford University Press, New York.

World Resources Institute. 2005. *Millennium Ecosystem Assessment: Ecosystems and Human Well-Being: Synthesis*. World Resources Institute. Available at: https://www.millenniumassessment.org/en/Synthesis.html [Accessed May 1, 2018].

U.S. Congress. 1990. Nonindigenous aquatic nuisance prevention and control act of 1990. 16 U.S.C. 4701-4741.

U.S. Department of Agriculture Animal and Plant Inspection Service. 2018. Feral Swine Damage. Web page available at: http://www.aphis.usda.gov/aphis/resources/pests-diseases/feral-swine/feral-swine-damage [Accessed May 21, 2018].

U.S. Fish and Wildlife Service. 2016. Northern Snakehead. Web page available at: https://www.fws.gov/northeast/marylandfisheries/Fish%20Facts/Northern%20snakehead.html [Accessed May 22, 2018].

[USFS] U.S. Forest Service. 2004. *Eastern Hemlock Forests: Guidelines to Minimize the Impacts of Hemlock Woolly Adelgid*. USDA Forest Service Forest Health Protection website. Available at: https://www.fs.usda.gov/naspf/sites/default/files/publications/eastern_hemlock_0.pdf [Accessed may 22, 2018].

[VCE] Virginia Cooperative Extension. 2018. Spotted lanternfly. Fact sheet, available at: https://pubs.ext.vt.edu/content/dam/pubs_ext_vt_edu/ENTO/ENTO-180/ENTO-264.pdf. [Accessed May 22, 2018].

[VDGIF] Virginia Department of Game and Inland Fisheries. 2018b. Feral hogs. Available at: https://www.dgif.virginia.gov/wildlife/feral-hogs/hunting-faq/ [Accessed May 21, 2018. VDGIF, Richmond, VA.

[VDGIF] Virginia Department of Game and Inland Fisheries. 2015. *Virginia's Wildlife Action Plan*. Available at: http://bewildvirginia.org/wildlife-action-plan/pdf/2015-Virginia-Wildlife-Action-Plan.pdf [Accessed May 22, 2018]. VDGIF, Richmond, VA.

Vilà, M., J.L. Espinar, M. Hejda, P.E. Hulme, V. Jarošík, J.L. Maron, J. Pergl, U. Schaffner, Y. Sun, and P. Pyšek. 2011. Ecological impacts of invasive alien plants: a meta-analysis of their effects on species, communities, and ecosystems. Ecology Letters 14:702–708.

APPENDICES

Appendix A

GLOSSARY

aquatic nuisance species are a subset of invasive species that impact aquatic ecosystems (U.S. Congress 1990).

ecosystem (or ecological system) comprises all the living organisms and nonliving components within a specified area of the Earth.

invasive species are nonnative plant, animal, or microbial species that cause, or are likely to cause, economic or ecological harm or harm to human health (Presidential Executive Order 13112). *Established* invasive species are present in a specific region of interest to the extent that eradication is not feasible. *Early detection* invasive species are considered to have a high likelihood of becoming invasive in a specific region, are not yet established, and their establishment may be prevented through early detection and rapid-response efforts.

native (or indigenous) species have evolved within a specific geographic region or expanded their range naturally, i.e., without the benefit of intentional or accidental human transport.

nonnative (or alien, exotic, or nonindigenous) species have been transplanted from their native range by intentional or accidental human action.

pathway (or vector) is the artificial means by which species are transported from their native range into new regions. Ballast water, shipping containers, and tourist luggage are examples of species pathways.

risk assessment is "a process for organizing and analyzing data, assumptions, and uncertainties to evaluate the likelihood of adverse ecological effects that may occur or are occurring as a result of exposure to one or more stressors." (Source: "Ecological Risk Assessment in the Federal Government," 1999, CENR/5-99/001. Available at https://cfpub.epa.gov/si/si_public_file_download.cfm?p_download_id=36384&Lab=NCEA)

Appendix B

2009 Invasive Species Working Group Enabling Legislation

Code of Virginia

§§ 2.2-220.2. Development of strategies to prevent the introduction of, to control, and to eradicate invasive species.

A. The Secretaries of Natural Resources and Agriculture and Forestry shall coordinate the development of strategic actions to be taken by the Commonwealth, individual state and federal agencies, private businesses, and landowners related to invasive species prevention, early detection and rapid response, control and management, research and risk assessment, and education and outreach. Such strategic actions shall include the development of a state invasive species management plan. The plan shall include a list of invasive species that pose the greatest threat to the Commonwealth. The primary purposes of the plan shall be to address the rising cost of invasive species, to improve coordination among state and federal agencies' efforts regarding invasive species prevention and management and information exchange, and to educate the public on related matters. The Secretaries of Natural Resources and Agriculture and Forestry shall update the state invasive species management plan at least once every four years. The Department of Conservation and Recreation shall provide staff support.

B. The Secretary of Natural Resources shall establish and serve as chair of an advisory group to develop an invasive species management plan and shall coordinate and implement recommendations of that plan. Other members of the advisory group shall include the Departments of Conservation and Recreation, Game and Inland Fisheries, Environmental Quality, Forestry, Agriculture and Consumer Services, Health, and Transportation; the Marine Resources Commission; the Virginia Cooperative Extension; the Virginia Institute of Marine Science; representatives of the agriculture and forestry industries; the conservation community; interested federal agencies; academic institutions; and commercial interests. The Secretary of Agriculture and Forestry shall serve as the vice-chair of the advisory group. The advisory group shall meet at least twice per year and shall utilize ad hoc committees as necessary with special emphasis on working with affected industries, landowners, and citizens, and shall assist the Secretary to:

1. Prevent additional introductions of invasive species to the lands and waters of the Commonwealth;
2. Procure, use, and maintain native species to replace invasive species;
3. Implement targeted control efforts on those invasive species that are present in the Commonwealth but are susceptible to such management actions;
4. Identify and report the appearance of invasive species before they can become established and control becomes less feasible;
5. Implement immediate control measures if a new invasive species is introduced in Virginia, with the aim of eradicating that species from Virginia's lands and waters if feasible given the degree of infestation; and
6. Recommend legislative actions or pursue federal grants to implement the plan.

C. As used in this section, “invasive species” means a species, including its seeds, eggs, spores or other biological material capable of propagating that species, that is not native to the ecosystem and whose introduction causes or is likely to cause economic or environmental harm or harm to human health; however, this definition shall not include (i) any agricultural crop generally recognized by the United States Department of Agriculture or the Virginia Department of Agriculture and Consumer Services as suitable to be grown in the Commonwealth, or (ii) any aquacultural organism recognized by the Marine Resources Commission or the Department of Game and Inland Fisheries as suitable to be propagated in the Commonwealth.

Nothing in this section shall affect the authorities of any agency represented on the advisory group with respect to invasive species.

Appendix C

Virginia Invasive Species Working Group Members and Alternates

The Honorable Matthew Strickler
Chairman of the Working Group
Secretary of Natural Resources
Patrick Henry Building
1111 East Broad Street
Richmond, VA 23219
(804) 786-0044
Matthew.Strickler@Governor.Virginia.Gov

The Honorable Bettina Ring
Vice Chair of the Working Group
Secretary of Agriculture and Forestry
Patrick Henry Building
1111 East Broad Street
Richmond, VA 23219
(804) 692-2512, Agriculture.Forestry@Governor.virginia.gov

Karen Canody; Commercial
Dominion Energy
5000 Dominion Boulevard
Glen Allen, VA 23060
(804) 273-3893, Karen.K.Canody@dom.com

Paul Munn; Agriculture Industry
Virginia Nursery & Landscape Association
P.O. Box 987, VA 22980-0987
(540) 946-3800, paulmunn@waynesboronurseries.com

Nicole Rovner; Conservation Community
The Nature Conservancy
530 E. Main Street, Suite 800
Richmond, VA 23219
(804) 644-5800, ext. 121, nrovner@tnc.org

Troy Morris; U.S. Forest Service
George Washington and Jefferson National Forests
110 Southpark Drive
Blacksburg, VA 24060
540-953-3560, troymorris@fs.fed.us

Jacob Barney, Ph.D.; Virginia Polytechnic Institute and State University
Department of Plant Pathology, Physiology and Weed Science
Glade Road Research Center (0330)

Blacksburg, VA 24061-0330
(540) 231-6323, jnbarney@vt.edu

Jewel Bronaugh, Commissioner
Virginia Department of Agriculture and Consumer Services
1100 Bank Street
Richmond, VA 23219
(804) 786-3501, Jewel.Bronaugh@vdacs.virginia.gov
Fax: (804) 371-2945
Alternate: Larry Nichols
(804) 786-3515, Larry.Nichols@vdacs.virginia.gov

Rob Farrell, State Forester
Virginia Department of Forestry
Fontaine Research Park
900 Natural Resources Drive, Suite 800
Charlottesville, VA 22903
(434) 977-6555, Rob.Farrell@dof.virginia.gov
Fax: (434) 296-2369
Alternate: Lori Chamberlin
(434) 220-9026, Lori.Chamberlin@dof.virginia.gov

Clyde Cristman, Director
Virginia Department of Conservation and Recreation
600 East Main Street, 24th Floor
Richmond, VA 23219
(804) 786-2123, Clyde.Cristman@dcr.virginia.gov
Fax: (804) 786-6141

David Paylor, Director
Virginia Department of Environmental Quality
1111 East Main St., Suite 1400
P.O. Box 1105
Richmond, VA 23219
(804) 698-4020, David.Paylor@deq.virginia.gov
Fax: (804) 698-4019

Steven G. Bowman, Commissioner
Virginia Marine Resources Commission
2600 Washington Avenue, Third Floor
Newport News, VA 23607
(757) 247-2200, Steve.Bowman@mrc.virginia.gov
Fax: (757) 247-2020
Alternate: Robert O'Reilly
(757) 247-2200, Rob.O'Reilly@mrc.virginia.gov

Dr. M. Norman Oliver, Commissioner
Virginia Department of Health
James Madison Building
Richmond, VA 23219
(804) 864-7009, norm.oliver@vdh.virginia.gov
Alternate: Julia Murphy, State Public Health Veterinarian
Julia.Murphy@vdh.virginia.gov

Stephen C. Brich, Commissioner
Virginia Department of Transportation
1401 East Broad Street
Richmond, VA 23219
(804) 786-2701, Stephen.Brich@vdot.virginia.gov
Fax: (804) 786-2940
Alternate: Brian Waymack
(804) 786-0967, Brian.Waymack@vdot.virginia.gov

Bob Duncan, Director
Virginia Department of Game and Inland Fisheries
7870 Villa Park Drive, Suite 400
Henrico, VA 23228
(804) 367-9231, Bob.Duncan@dgif.virginia.gov
Alternate: Ray Fernald
(804) 367-8364, Ray.Fernald@dgif.virginia.gov

John T. Wells, Director
Virginia Institute of Marine Science
P.O. Box 1346
Gloucester Point, Virginia 23062-1346
(804) 684-7103, wells@vims.edu
Fax: (804) 684-7097
Alternate: Roger Mann
(804) 684-7360, rmann@vims.edu

Appendix D

Virginia Invasive Species Advisory Committee

Seanna Anker, Virginia Nursery & Landscape Association

Jacob Barney, Virginia Polytechnic Institute and State University, Department of Plant Pathology, Physiology and Weed Science

Scott Barras, U.S. Department of Agriculture, Animal and Plant Health Inspection Service

Jason Bulluck, Virginia Department of Conservation and Recreation

Lori Chamberlin, Virginia Department of Forestry

Margaret Chatham, Virginia Native Plant Society

Ruth Douglas, Ph.D., Virginia Native Plant Society

Ray Fernald, Virginia Department of Game and Inland Fisheries

Jan Ferrigan, Arlington City Cooperative Extension

Ashton Fischer, Blue Ridge Partnership for Invasive Species Management

Greg Garman, Ph.D., Virginia Commonwealth University, Center for Environmental Studies

Kevin Heffernan, Chair of VISAC; Virginia Department of Conservation and Recreation

Sujan Henkanaththegedara, Ph.D., Longwood University

Roger L. Mann, Ph.D., Virginia Institute of Marine Science, College of William and Mary

Debra Martin, Virginia Department of Agriculture and Consumer Services, Office of Plant and Pest Services

Lisa Moss, U.S. Fish and Wildlife Service, Virginia Fish and Wildlife Conservation Office

Rick Myers, Ph.D., Virginia Department of Conservation and Recreation

Erin Stockschlader, Fairfax County Parks and Recreation

Bill Tanger, Friends of the Rivers of Virginia

Celia Vuocolo, Piedmont Environmental Council

Brian Waymack, Virginia Department of Transportation

Carrie Wu, Ph.D., University of Richmond

APPENDIX E

Summary of the Virginia Plant Pest Emergency Action Plan

The *Virginia Plant Pest Emergency Action Plan* provides guidance to state and federal agencies for the coordinated response to plant health emergencies arising from natural, accidental, or intentional introduction of plant pests, diseases, or other plant health issues that threaten Virginia's agricultural, horticultural, and forest resources. VDACS and USDA-APHIS-PPQ have primary jurisdiction for enforcement of plant pest laws and regulations and have designated personnel for leadership roles in coordinating state and federal response to emergencies. Other cooperating agencies include USFWS, Department of Homeland Security Customs and Border Protection, Federal Emergency Management Agency, Virginia Tech Cooperative Extension Service, VDOF, VDGIF, VDOT, VDCR, VDEQ, and VISC.

The goals of the plan are to prevent, control, or eradicate plant pests that threaten Virginia's agricultural, horticultural, and forest resources.

The objectives of the plan are to:

- Develop and maintain procedures and protocols in the event of an agricultural emergency.
- Define roles and responsibilities of each agency through a cooperative agreement or memorandum of understanding.
- Coordinate a response to the agricultural community to effectively convey information as to the nature, extent, and relevancy of an emergency.
- Provide resources.
- Enforce laws and regulations relevant to an emergency.

In support of these goals and objectives, plant health surveillance and pest detection systems have been developed. Information on pest detection is available to cooperators and the public through the VDACS Plant Industry Services website (http://www.vdacs.virginia.gov/plant&pest/index.html) and websites of other cooperating agencies. The plan includes protocol for the activation of emergency response actions, a communication plan, specimen sampling and pest quarantine procedures. VDACS and USDA-APHIS-PPQ annually review and revise the plan using new information and feedback from cooperating agencies.

This plan ensures that state and federal resources are utilized in an effective and efficient manner in addressing exotic plant pests threatening Virginia. A coordinated response eliminates duplication of efforts, while targeted detection surveys based upon pest risk analysis ensure early pest detection and containment, thereby greatly increasing the potential success of eradication efforts. The *Virginia Plant Pest Emergency Action Plan* is a component of VDACS' Emergency Response Manual and the Commonwealth of Virginia's Emergency Operations Plan.

Appendix F

Early Detection Network Contacts

Type of Organism	Agency
Plants	VDACS, VDOF, VDGIF, VDCR, VT
Insects	VDACS, VDOF, VT
Terrestrial vertebrates	VDGIF, VT
Aquatic species	VDGIF, VMRC, VIMS, VT

VDCR. Virginia Department of Conservation and Recreation
Insects, plants, or animals that threaten Virginia Natural Heritage resources
Kevin Heffernan
(804) 786-9112
kevin.heffernan@dcr.virginia.gov

VDACS. Virginia Department of Agriculture and Consumer Services, Plant Industry Services
Invasive plants, insects, and pathogens that are plant pests
Debra Martin
debra.martin@vdacs.virginia.gov
(804) 786-3515

VDGIF. Virginia Department of Game and Inland Fisheries
Animals or plants, terrestrial or aquatic, that threaten Virginia wildlife
Ray Fernald
ray.fernald@dgif.virginia.gov
(804) 367-8364

VDOF. Virginia Department of Forestry
Insects, plants, or plant pathogens that threaten Virginia Forests
Lori Chamberlin
lori.chamberlin@dof.virginia.gov
(434) 977-6555

VIMS. Virginia Institute of Marine Science
Aquatic plants or animals
Roger Mann, Ph.D.
rmann@vims.edu
(804) 684-7360

VT. Virginia Polytechnic and State University
Plants that threaten natural or agricultural resources
Jacob Barney, Ph.D.
jnbarney@vt.edu
(540) 449-7775

Appendix G

LIST OF ACRONYMS USED IN THE INVASIVE SPECIES MANAGEMENT PLAN

ANSTF	Aquatic Nuisance Species Task Force
APRCR	Arlington Parks, Recreation & Community Resources
BRPRISM	Blue Ridge Partnership for Regional Invasive Species Management
CWMA	Cooperative Weed Management Area
FCPA	Fairfax County Park Authority
MAPAIS	Mid-Atlantic Panel on Aquatic Invasive Species
NISC	National Invasive Species Council
NPS	National Park Service
PRISM	Partnership for Regional Invasive Species Management
USDA-APHIS	U.S. Department of Agriculture Animal and Plant Health Inspection Service
USFWS	U.S. Fish and Wildlife Service
USGS-VCFWU	U.S. Geological Survey, Virginia Polytechnic Institute Cooperative Fish & Wildlife Unit
VCE	Virginia Cooperative Extension
VDACS	Virginia Department of Agriculture and Consumer Services
VDCR	Virginia Department of Conservation and Recreation
VDGIF	Virginia Department Game and Inland Fisheries
VDH	Virginia Department of Health
VDOT	Virginia Department of Transportation
VGIC	Virginia Green Industry Council
VIMS	Virginia Institute of Marine Science
VISAC	Virginia Invasive Species Advisory Committee
VISWG	Virginia Invasive Species Working Group
VMN	Virginia Master Naturalists
VMRC	Virginia Marine Resources Commission
VNANS	Virginia Nonindigenous Aquatic Nuisance Species Act
VNLA	Virginia Nursery & Landscape Association
VNPS	Virginia Native Plant Society

Appendix H
Selected Invasive Species Actively Managed or Monitored in Virginia

These species are managed or monitored in Virginia or are discussed in the Plan. This list is not a complete list of all invasive species in Virginia nor all invasives receiving management.

Common name	Scientific name	Life form	Habitat
Asian clam	*Corbicula fluminea*	animal	aquatic
black carp	*Mylopharyngodo piceus*	animal	aquatic
blue catfish	*Ictalurus furcatus*	animal	aquatic
giant salvinia	*Salvinia molesta*	plant	aquatic
MSX disease	*Haplosporidium nelsoni*	protozoan	aquatic
Mute Swan	*Cygnus olor*	animal	aquatic
New Zealand mudsnail	*Potamopyrgus antipodarum*	animal	aquatic
nutria	*Myocaster coypus*	animal	aquatic
Phragmites	*Phragmites australis*	plant	aquatic
purple loosestrife	*Lythrum salicaria*	plant	aquatic
quagga mussel	*Dreissena bugensis*	animal	aquatic
rapa whelk	*Rapana venosa*	animal	aquatic
rusty crayfish	*Orconectes rusticus*	animal	aquatic
snakehead fishes	*Channa* spp.	animal	aquatic
water chestnut	*Trapa nutans*	plant	aquatic
zebra mussel	*Dreissena polymorpha*	animal	aquatic
mosquitoes	*Aedes albopictus*; *Ochlerotatus japonicus*	animal	aquatic[1]
West Nile virus	*Flavivirus* sp.	virus	aquatic[1]
Asian longhorn beetle	*Anoplophora glabripennis*	animal	terrestrial
chronic wasting disease	transmissible spongiform encephalopathies (TSEs)	prion	terrestrial
clover broomrape	*Orobanche minor*	plant	terrestrial
emerald ash borer	*Agrilus planipennis*	animal	terrestrial
giant hogweed	*Heracleum mantegazzianum*	plant	terrestrial
gypsy moth	*Lymantria dispar*	animal	terrestrial
hemlock wooly adelgid	*Adelges tsugae*	animal	terrestrial
imported fire ant	*Solenopsis invicta*	animal	terrestrial
inula	*Inula brittanica*	plant	terrestrial
Japanese knotweed	*Polygonum cuspidatum*	plant	terrestrial
Japanese stilt-grass	*Microstegium vimineum*	plant	terrestrial
Johnson grass	*Sorghum halepense*	plant	terrestrial
kudzu	*Pueraria montana*	plant	terrestrial
mile-a-minute weed	*Polygonum perfoliatum*	plant	terrestrial
pine shoot beetle	*Tomicus piniperda*	animal	terrestrial
Siberian moth	*Dendrolimus sibiricus*	animal	terrestrial
spotted lanternfly	*Lycorma delicatula*	animal	terrestrial
sudden oak death	*Phytophthora ramorum*	fungus	terrestrial
thistles	*Cirsium vulgare, C. arvense*	plant	terrestrial
tree-of-heaven	*Ailanthus altissima*	plant	terrestrial
feral hog	*Sus scrofa*	animal	terrestrial
wavyleaf grass	*Oplismenus undulatifolius*	plant	terrestrial

APPENDIX I

Summary Table of Virginia Invasive Species Laws

Law	Relevant code/regulation sections	Responsible agency	Covered life forms	Description and important statutory provisions
Musk Thistle and Curled Thistle	§§ 3.1-177 to 177.1	VDACS; local governments	Musk thistle, curled thistle	Permits counties, cities, or towns to enact ordinances to control musk thistle and curled thistle.
Virginia Tree and Crop Pest Law	§ 3.1-188.20	VDACS	Any insect, disease, parasitic plant, vertebrate or invertebrate animal capable of damaging plants or products derived from plants; any such life form creating a public nuisance	Authorizes VDACS to "protect the agricultural, horticultural, and other interests of the Commonwealth from plant pests." § 3.2-701. Empowers VDACS to "direct abundance surveys for plant pests and . . . to carry out operations or measures to locate, to suppress, control, or eradicate, or to prevent or retard the spread of pests." § 3.2-702. Quarantine authority: VDACS may "quarantine this Commonwealth or any portion thereof when they determine that such action is necessary to prevent or retard the spread of a pest into, within or from this Commonwealth. . . . Following the establishment of a quarantine, no person shall move any regulated article described in the quarantine or move the pest against which the quarantine is

				established, within, from, into, or through this Commonwealth contrary to regulations." § 3.2-703.
Pine Shoot Beetle Regulations and Quarantine	2 Va. Admin. Code §§ 5-325-10 to -120	VDACS	Pine shoot beetle	Restrictions and quarantine imposed under the Virginia Pest Law
Gypsy Moth Regulations and Quarantine	2 Va. Admin. Code §§ 5-330-10 to -90	VDACS	Gypsy moth	Restrictions and quarantine imposed under the Virginia Pest Law
Cotton Boll Weevil Regulations and Quarantine	2 Va. Admin. Code §§ 5-440-10 to -110	VDACS	Cotton boll weevil	Restrictions and quarantine imposed under the Virginia Pest Law
Plants and Plant Products Inspection Law	§ 3.2-3800	VDACS	Any insect, invertebrate animal, parasitic plant, or pathogen capable of damaging plants or products derived from plants	Authorizes VDACS to regulate and inspect nurseries and nursery stock for plant pests. "It shall be the duty of the Commissioner [of VDACS] to protect the agricultural, horticultural, and other interests of the Commonwealth from plant pests . . . ." § 3.2-3801 Penalty: Any person who imports a plant pest into Virginia is guilty of a Class 1 misdemeanor. § 3.2-3810
European Black Currant Quarantine	2 Va. Admin. Code § 4-450- 10	VDACS	European black currant	Quarantine imposed under the Plants and Plant Products Inspection Law and Virginia Pest Law
Noxious Weed Law	§§ 3.2-800 to .809	VDACS	Any plant declared to be detrimental to crops, surface waters, desirable	Provides that VDACS "shall make surveys for noxious weeds." § 3.2-801 Quarantine authority: VDACS authorized to impose statewide quarantines in order to eradicate or prevent the spread of a

			plants, livestock, land, or property	noxious weed. § 3.2-802 Penalty: Any person who imports a plant pest into Virginia is guilty of a Class 1 misdemeanor. § 3.2-809.
Control of Avian Influenza	§§ 3.1-741.3 to .6; 2 Va. Admin. Code §§ 5-190-10 to 5-195-180.	VDACS	Any avian species or egg from an area where H5 or H7 avian influenza has been found	Empowers VDACS to promulgate and enforce regulations designed to prevent the spread of avian influenza.
Powers of Department of Conservation and Recreations Officers	§§ 10.1-104, -116 to -117.	VDCR		VDCR "may promulgate regulations necessary to to carry out the purposes and provisions of [§§ 10.1-100 to -1026]. A violation of any regulation shall constitute a Class 1 misdemeanor unless a different penalty is prescribed . . . ." § 10.1-100(B). Conservation officers have jurisdiction to enforce Virginia law and VDCR regulations on all lands and waters under the management or control of VDCR.
Virginia Natural Preserves Act	§§ 10.1-209 to -211	VDCR		VDCR is authorized to "[p]reserve the natural diversity of biological resources of the Commonwealth" in all natural preserve areas. § 10.1-211(1).
Insect Infestation and Diseases of Forest Trees	§§ 10.1-1177 to -1181	VDOF	Any insect or pathogen capable of damaging forest trees	Authorizes VDOF to investigate and "devise and demonstrate" recommended control measures for insect infestations and diseases affecting stands of forest trees. § 10.1-1177 When infestation or infection involves forests on private land, VDOF's authority

				is limited to giving advice and recommendations to the land owner. Authority to set quarantines exclusively in VDACS. §§ 10.1-1177, -1170. Creates "Control of Forest Tree Insects and Diseases Fund" to support VDOF's forest infestation and disease eradication efforts. § 10.1-1181.
Invasive Species Working Group	§ 2.2-220.2	Natural resource and agriculture agencies	All invasive species	Calls for the Secretary of Natural Resources to lead the development of strategies to prevent the introduction of, to control, and to eradicate invasive species. § 2.2-220.2.
Introduction of Snakehead Fish or Zebra Mussel	§§ 18.2-313.2, 29.1-574	All state law enforcement agencies	Snakehead fish, zebra mussels	Makes it a Class 1 misdemeanor for any person to knowingly introduce a snakehead fish of family Channideae or a zebra mussel into Virginia. § 18.2- 313.2 Requires any person who catches a snakehead fish in Virginia waters to kill the fish and notify VDGIF. § 29.574.
Ballast Water Discharge	§§ 28.2-109 to -111	VMRC	Aquatic species capable of being transported in the ballast water tanks of ships	Authorizes VMRC to promulgate regulations for the reporting and management of ballast water discharges from ocean-going vessels in Virginia waters. "'Ballast water' means any water or matter taken on board a vessel to control or maintain trim, draft, stability or stresses of the vessel . . . ." § 28.2-109. Requires VMRC to "adopt the federal guidelines [33 C.F.R. pt. 151] governing

				voluntary ballast water management practices to be followed by the operators of commercial vessels. § 28.2-111(A).
Fisheries and Habitat of Tidal Waters General Provisions	§§ 28.2-201, -202, -210	VMRC	Aquatic species	Authorizes VMRC to "[p]romulgate regulations . . . necessary to promote the general welfare of the seafood industry and to conserve and promote the marine resources of the Commonwealth." § 28.2-201(1). Permits VMRC to issue temporary emergency regulations without following normal process if "necessary for the . . . protection of the seafood industry, natural resources or marine resources." § 28.2-210.
Control of Foreign Fish, Shellfish, or Crustacea	§ 28.2-825	VMRC	Nonnative fish, shellfish, or crustaceans	Prohibits the introduction of most non-native fish, shellfish, or crustaceans into Virginia waters. Penalty: Any person who introduces a prohibited fish, shellfish, or crustacean into Virginia waters is guilty of a Class 1 misdemeanor. § 28.2-825(B).
Virginia Institute of Marine Science	§§ 28.2-1100 to -1102	VIMS	Aquatic Species	Continues VIMS, which is empowered to study and investigate matters affecting marine resources. VIMS is responsible for advising the VMRC, other state agencies, and private groups on marine resource issues.
Virginia Estuarine and Coastal	§ 28.2-1103	VIMS	Aquatic and terrestrial species	Authorizes VIMS to administer and monitor protected estuarine and coastal

Research Reserve System				lands in support of Virginia's coastal resource management efforts.
Powers of Department of Game and Inland Fisheries	§ 29.1-103 to 103.1, -109	VDGIF	All wildlife and freshwater fish, including vertebrates and invertebrates	Empowers VDGIF to "[c]onduct operations for the preservation and propagation of game birds, game animals, fish and other wildlife in order to increase, replenish and restock the lands and inland waters of the Commonwealth. § 29.1-103. Permits VDGIF to "promulgate regulations pertaining to diseases in wildlife populations. The regulations shall include, but not be limited to, (i) measures to be implemented to eradicate or prevent the spread of such diseases and (ii) procedures for the condemnation and indemnification of captive wildlife." § 29.1-103.1. Authorizes VDGIF to "[e]nforce or cause to be enforced all laws for the protection, propagation and preservation of game birds and game animals of the Commonwealth and all fish in the inland waters thereof." § 29.1- 109(B)(1).
Nuisance Species	§§ 29.1-100, -511.	VDGIF	All wildlife constituting a nuisance	"Nuisance species" are defined as "blackbirds, crows, cowbirds, grackles, English sparrows, starlings, or those species designated as such by regulations of the Board, and those species found committing or about to commit depredation upon ornamental or shade

				trees, agricultural crops, wildlife, livestock or other property or when concentrated in numbers and manners as to constitute a health hazard or other nuisance." § 29.1-100. "There shall be a continuous open season for killing nuisance species of wild birds and wild animals as defined in § 29.1-100." § 29.1-511.
Importation of Predatory or Undesirable Game or Fish	§§ 29.1-542, -545.	VDGIF	Predatory or undesirable birds or animals	Prohibits the importation or liberation of predatory or undesirable birds or animals, except by permit. § 29.1-542. Prohibits the possession of nutria in the Virginia. § 29.1- 545.
Nonindigenous Aquatic Nuisance Species Act	§§ 29.1-571 to -577; 4 Va. Admin. Code §§ 15-20-210, 15-30-40	VDGIF	Any aquatic freshwater animal species designated by VDGIF as a nuisance	Authorizes VDGIF to classify nuisance species and to "conduct operations and measures to suppress, control, eradicate, prevent, or retard the spread of any nonindigenous aquatic nuisance species." § 29.1-572, -573(A). "Nonindigenous aquatic nuisance species" is defined as "a nonindigenous aquatic freshwater animal species whose presence in state waters poses or is likely to pose a significant threat of harm to (i) the diversity or abundance of any species indigenous to state waters; (ii) the ecological stability of state waters; or (iii) the commercial, industrial, agricultural, municipal, recreational, aquacultural, or other beneficial uses of state waters.

				Nonindigenous aquatic nuisance species shall include the zebra mussel, quagga mussel, and all species of snakehead fishes of the family Channidae." § 29.1-571. Other listed species: black carp (*Mylopharyngodon piceus*); New Zealand mudsnail (*Potamopyrgus antipodarum*); Rusty crayfish (*Orconectes rusticus*). 4 Va. Admin. Code § 15-20-210. Penalty: Any person who violates this provision is subject to a civil fine of $25,000 and is liable for the costs incurred by any government body as a result of the violator's actions. § 29.1-577.

*All statutory citations are to the Virginia Code Annotated, unless otherwise indicated.

† Acronyms used are as follows:

VDCR – Virginia Department of Conservation and Recreation
VDACS – Virginia Department of Agriculture and Consumer Services
VDGIF – Virginia Department of Game and Inland Fisheries
VDOF – Virginia Department of Forestry
VIMS – Virginia Institute of Marine Science
VMRC – Virginia Marine Resources Commission

‡ The maximum penalty for a Class 1 misdemeanor is 12 months in jail and a $2,500 fine. Va. Code Ann. § 18.2-11.