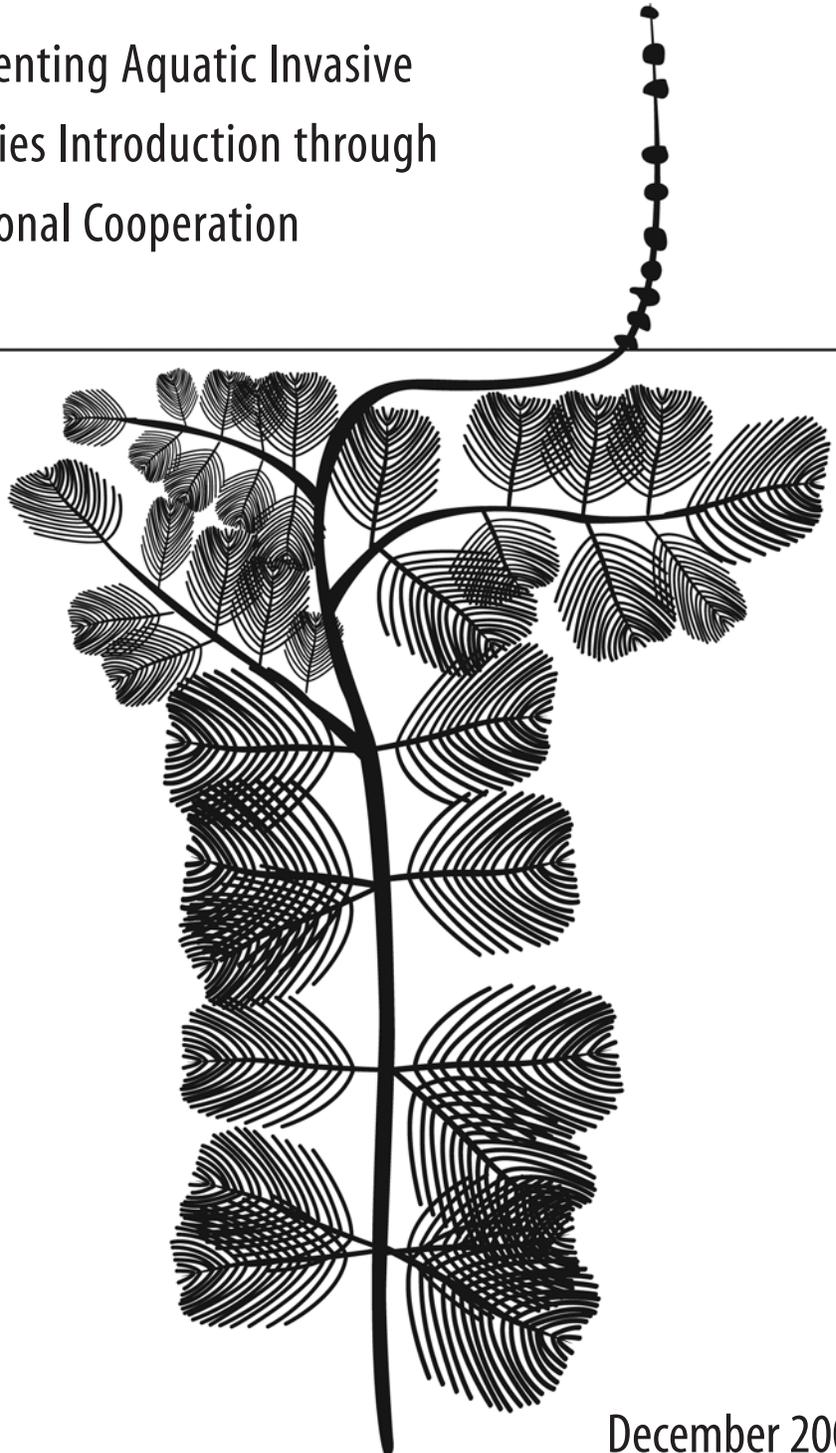


Halting the Invasion in the Chesapeake Bay

Preventing Aquatic Invasive
Species Introduction through
Regional Cooperation



Halting the Invasion in the Chesapeake Bay: Preventing Aquatic Invasive Species Introduction through Regional Cooperation

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Preventing Aquatic Invasive Species Introduction through Regional Cooperation*

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Abbreviations

AIS	Aquatic invasive species
ANSTF	Aquatic Nuisance Species Task Force
CBC	Chesapeake Bay Commission
CBP	Chesapeake Bay Program
ICPRB	Interstate Commission on the Potomac River Basin
ISC	Invasive species council (generally)
ISWG	Invasive Species Working Group (of the CBP)
LRC	Living Resources Committee (of the CBP)
MAP	Mid-Atlantic Panel on Aquatic Invasive Species
MDA	Maryland Department of Agriculture
MDNR	Maryland Department of Natural Resources
MISC	Maryland Invasive Species Council
PDA	Pennsylvania Department of Agriculture
PFBC	Pennsylvania Fish and Boat Commission
PGC	Pennsylvania Game Commission
PISC	Pennsylvania Invasive Species Council
SRBC	Susquehanna River Basin Commission
USDA-APHIS	United States Department of Agriculture – Animal and Plant Health Inspection Service
VDACS	Virginia Department of Agriculture and Consumer Services
VDGIF	Virginia Department of Game and Inland Fisheries
VISWG	Virginia Invasive Species Working Group
VMRC	Virginia Marine Resources Commission

Executive Summary

The Chesapeake Bay is a unique ecosystem cherished for its exceptional biodiversity, recreational opportunities, and economic value. Species such as the eastern oyster and blue crab are valued not only for their commercial importance, but also their historical and cultural significance to the Bay community. Despite widespread recognition of the Bay's importance, however, its biological resources have been degraded over past decades as a result of myriad factors, including the establishment and spread of aquatic invasive species.

Aquatic invasive species (AIS) are introduced to the Chesapeake through a variety of pathways, including but not limited to shipping, the pet trade, and water gardening. Prevention of AIS introduction is the most cost-effective strategy for responding to the threats posed by these species. By comparison, control and management efforts are expensive in both time and manpower and are unlikely to fully remediate damage caused by introduced species.

Effective prevention requires both consistent, strong legal regimes and dedicated institutions with sufficient resources to implement legal standards. Currently, states use similar legal tools to address invasive species prevention. In most states, responsible agencies develop lists of species that pose an invasion threat. Lists are associated with restrictions on importation, release, and escape of these species. However, lists differ from state to state and no state's list includes all well-recognized invasive species threats. In addition, states have created varying limitations on permitted uses of listed species and these limitations are not always designed to prevent introduction of species into the environment. These complex, inconsistent legal systems undermine even the best-intentioned state invasive species prevention efforts.

In practice, each state's invasive species prevention laws and regulations are implemented by multiple agencies. The effectiveness of these laws can be increased by coordinating prevention actions on both an interagency and a regional basis. Regional cooperation ensures the efficient use of limited funding for prevention activities by allowing states to combine their resources and share information. Unfortunately, coordination is difficult because regulatory structures differ from state to state and all agencies operate under significant manpower and financial limitations.

The federal government can and should address the inconsistencies and regulatory gaps identified in this report through the passage of comprehensive invasive species legislation. Moreover, increased state and federal funding is needed to support research, hiring of invasive species council staff and enforcement personnel, data collection, and rulemaking. Unfortunately, neither new federal regulation nor increased federal funding and support are likely to materialize in the near future, except in a few key areas. Immediate action is nonetheless needed to address prevention. This report therefore recommends steps to improve invasive species prevention in the Bay region that do not rely on increased federal support but are instead targeted at state and regional action. ELI has identified six categories of recommendations that states and regional bodies can implement to improve regional cooperation.

1. Enhance regional body interactions.

- A. *Require the Chesapeake Bay Program (CBP) to respond to recommendations from the Mid-Atlantic Panel on Aquatic Invasive Species (MAP).* CBP is well-funded and has access to decision-makers, while MAP, an interagency body of aquatic invasive species experts and managers, lacks significant funding or access to policy-makers. The strengths of these organizations can be combined by requiring the CBP to respond to MAP recommendations, which are already prepared and presented to CBP on an annual basis.
- B. *Engage the Chesapeake Bay Commission (CBC) in AIS prevention policy harmonization.* CBC promotes uniform state standards on environmental issues affecting the Bay environment. Unfortunately, it has not focused on AIS prevention to date. State AIS prevention laws are disparate and need to be harmonized in several key areas. CBC should focus on AIS prevention and support harmonization of state laws and regulations.
- C. *Integrate river basin commissions into regional AIS prevention bodies.* Several of the Chesapeake Bay's major rivers are managed by interstate commissions. To date, these commissions have not included AIS prevention as an aspect of water quality, but they are begin-

ning to recognize the importance of AIS issues. The commissions should modify their missions to explicitly include AIS, and regional bodies should encourage the commissions to participate in prevention activities.

2. Encourage interstate collaboration.

- A. *Establish a collaborative invasive species council workgroup.* While each state has established an invasive species management council, these councils need permanent staff and funding. With that funding, the councils should establish a workgroup to facilitate interstate information sharing and collaboration.
- B. *Integrate all headwater states and agencies into regional AIS prevention bodies.* Some headwaters states and agencies do not participate actively in regional bodies such as the Chesapeake Bay Commission, Chesapeake Bay Program, and the Mid-Atlantic Panel on Aquatic Invasive Species. These states and agencies should be encouraged to participate in these bodies.
- C. *Undertake cooperative research on AIS prevention methods.* States should combine their available resources to support collaborative research specifically focused on invasive species prevention.

3. Address weaknesses in existing prevention authorities.

- A. *Consolidate state AIS lists in one location.* State invasive species councils should maintain a single list of all species listed by each state agency in order to simplify interagency and interstate information-sharing on existing restrictions.
- B. *Harmonize and strengthen AIS lists.* A regional body should maintain a list of all species listed by each Bay state. Such a list would allow states to efficiently identify existing and potential AIS threats and to share research on those species. Legislatures and state agencies should rely on this regional work to bring their existing lists up to date, using existing research to reduce the administrative burdens of listing.

C. *Harmonize and strengthen import, release, and escape restrictions.* Each state prohibits a different suite of uses for listed species. State legislatures should work to identify which omissions are inadvertent and to close regulatory gaps in order to prevent importation, release, and escape of listed species.

4. Develop new legal authorities to address pathways of concern.

- A. *Enact strong ballast water laws.* Ballast water is a key invasion pathway that requires stronger laws. Bay states should enact strong laws modeled on those enacted by other states to prevent introduction of AIS through ballast water.
- B. *Regulate the recreational vessel pathway.* Recreational vessels are an under-regulated AIS invasion pathway. The Chesapeake Bay Commission should draft a model law requiring bilge pumping and vessel washing which could be adopted by states.
- C. *Strengthen horticulture, water gardening, and aquarium plant regulation.* Plant species are underrepresented on AIS lists, despite the fact that they are among the more notorious invasive species. State agriculture agencies should work to increase the representation of these invasive aquatic plant species on their noxious weed lists.
- D. *Address emerging pathways.* Global trade opens new invasion pathways that are used by new species of concern. State invasive species councils should monitor and collect information on new pathways and potential invasive species in order to assist state agency personnel in addressing emerging threats before they become established.

5. Facilitate compliance with and enforcement of AIS prevention authorities.

- A. *Increase financial penalties for noncompliance.* Strong laws and regulations are only useful if they are observed in practice. Limited agency enforcement resources suggest that increased penalties may be necessary to ensure compliance. As a result, agencies should work together to ensure that robust penalties apply across the Bay region.
- B. *Develop and harmonize new enforcement methods.* States should ensure that facilities that benefit economically from AIS comply with facility design requirements by adopting permitting, inspection, and bonding provisions. States should also work together to develop methods, such as microchipping, to tie owners to individual AIS that escape or are released into the wild.

6. Plan for AIS prevention on a regional level.

- A. *Develop and fund AIS plans.* States that have not established invasive species management plans should initiate planning, paying attention to prevention. States with plans should ensure that those plans include objective prevention benchmarks for evaluation of their success. States with plans should also seek funding for permanent invasive species staff.
- B. *Develop a region-wide AIS prevention plan.* Bay states should develop a regional AIS prevention plan using existing federal financial resources available through the Aquatic Nuisance Species Task Force. The Chesapeake Bay Program should also seek the inclusion of objective benchmarks for prevention in the upcoming amendments to the *Chesapeake 2000* agreement.

Implementation of these recommendations will improve prevention of aquatic invasive species introductions in the Bay region. The costs of inaction far outweigh those required for effective invasive species prevention: invasive species to prevent degradation of the Bay's extraordinary biodiversity, recreational opportunities, and economic value.

I. Introduction

Aquatic invasive species are a growing problem throughout the United States and threaten the Chesapeake Bay ecosystem.¹ Federal invasive species laws are diffuse and fragmented, which has prompted many states to pass laws and regulations designed to address the invasive species problem more comprehensively. A suite of state legal and policy tools exist for this purpose, including prevention of new infestations, regulation of species introduced intentionally, and control and management of invasive species that have successfully established and spread. These laws also provide for enforcement against violators, funding for implementation of protective laws and policies, and coordination between responsible agencies and organizations.²

Over the long term, preventing the introduction and establishment of invasive species is the most effective and cost-efficient strategy and is essential to state and regional efforts to combat invasive species.³ Prevention authorities are therefore essential to state and regional efforts to combat invasive species. However, invasive species do not abide by political boundaries, and movement from one state or region to the next has the potential to confound state efforts to prevent costly invasions. In effect, inconsistent legal authorities may hinder states' abilities to prevent both introductions and the spread of invasive species that have become established in other jurisdictions. States and regions facing similar invasive species issues, especially in multi-jurisdictional ecosystems such as the Chesapeake Bay, can prevent invasions more consistently, efficiently, and effectively by combining efforts under some of their existing laws and regulations.

In the Chesapeake Bay, aquatic invasive species (AIS) result from introduction through the pet trade, importation of aquarium fish, aquaculture, and other commercial enterprises. These AIS present a significant threat that has not received widespread attention to date. With a larger goal of assisting states in improving their AIS prevention efforts in the Chesapeake Bay, this report seeks to examine the extent of coordination among selected states by:

- Identifying and reviewing the legal authorities in Maryland, Virginia, and Pennsylvania relevant to AIS prevention, including: the wildlife trade, fish trade,⁴ aquaculture, horticulture,⁵ and shipping; and
- Identifying opportunities for improved coordination among states to prevent AIS under existing authorities that pertain to these common commercial vectors.

The federal government – both Congress and responsible agencies – play an important role in strengthening AIS prevention on a national and regional level. The federal government has yet to enact or implement adequate prevention laws and regulations, however, nor has it provided adequate funding or logistical support to permit states and regional bodies to adequately address prevention on their own. These conditions are unlikely to change in the foreseeable future, but AIS prevention is a task demanding immediate action. As a result, this report describes opportunities for coordination that states and regional bodies can implement in the near future without significant additional federal assistance. Despite the importance of federal support, states can make significant improvements to AIS prevention policy and practice in the Bay region. Some recommendations require no legislative or regulatory action by any state and therefore can be implemented immediately. Other opportunities, however, would require harmonization of legal authorities through legislative or regulatory action. Although these measures may require additional time and political will prior to implementation, they may present the surest and most effective solutions.

Part II of this report summarizes the AIS problem in the Chesapeake and the common pathways leading to the introduction of new invasive species. Part III describes common regulatory mechanisms that states use to combat the introduction of AIS through known pathways. Part IV discusses AIS prevention laws and regulations adopted by Maryland, Pennsylvania, and Virginia, as well as coordinated interstate AIS prevention efforts that are underway among these and other states in the Bay region. Part V concludes by identifying policy recommendations for improving interstate coordination of AIS prevention efforts. Finally, Appendices A and B provide detailed descriptions of the state and regional laws, regulations, and other provisions governing AIS prevention in the study states and compare the content of each state's AIS lists.

Notes

1. Aquatic invasive species, also known as aquatic nuisance species, are defined as nonindigenous species that threaten the diversity or abundance of native species of the ecological stability of infested waters, or commercial, agricultural, or recreational activities dependent upon such waters. National Aquatic Nuisance Prevention and Control Act of 1990 (NANPCA), 16 U.S.C. § 4702. For the purposes of this report, “aquatic” is intended to include freshwater, marine, estuarine, and wetland species.
2. *See* ENVIRONMENTAL LAW INSTITUTE, HALTING THE INVASION: STATE TOOLS FOR INVASIVE SPECIES MANAGEMENT (2002) [HALTING THE INVASION].
3. National Invasive Species Council, Meeting the Invasive Species Challenge: National Invasive Species Management Plan 29 (2001). *See also* Keller, Reuben P. et al., *Risk Assessment for Invasive Species Produces Net Bioeconomic Benefits*, 104 PROC. NAT’L ACAD. SCI. 203 (2007) (determining that implementation of risk assessments in most cases would yield economic benefits).
4. The fish trade generally includes the purposeful movement of live fish in trade for aquaria, bait, food, and other purposes. Other uses may be less recognized, such as the use of invasive algae as packing material for other products. Because state regulations are keyed to species, not vectors, any movement of species in trade – regardless of its specific purpose – triggers regulatory action. As a result, we do not describe the numerous fish trade vectors in detail.
5. Horticulture and water-gardening were considered but are not addressed in depth in this report due to a dearth of provisions applicable to AIS species introduced through these pathways.

II. Aquatic Invasive Species in the Chesapeake Bay

The Chesapeake Bay is a unique estuarine ecosystem, justly famous for its recreational and economic value, productivity, biodiversity, and beauty. The Bay's assemblage of habitats and ecosystems is threatened, however, by a wide variety of non-native aquatic species, including mammals, birds, fish, invertebrates, and plants. These species alter the appearance and function of habitats and change the population dynamics among species, thus threatening the numerous ecosystem services provided by the Bay, including the production of commercial goods, such as fish and seafood; ecosystem regulation, such as waste treatment, flood control, disease regulation, and water purification; recreation and tourism opportunities; and other cultural, spiritual, and aesthetic functions. These species also threaten native biodiversity by out-competing or injuring threatened and endangered species in the Bay.¹

AIS arrive in the Chesapeake both intentionally and unintentionally via several well-known pathways.² Many species have been introduced intentionally for economic or ornamental reasons. The horticulture, aquaculture, capture fishery, and fur farming industries have each introduced serious AIS threats. The most notorious invasive aquatic plant species, for example – purple loosestrife, invasive *Phragmites* varieties, *Hydrilla*, and water chestnut – were imported intentionally for ornamental or medicinal purposes. Animal species, notably the mute swan and nutria, were also imported intentionally as decorative waterfowl³ and for fur farming, respectively. Invasive invertebrate and fish species, meanwhile, have arrived via the aquaculture, capture fishery, and pet trades and have also been used for ornamentation.

In addition to the variety of pathways for intentional introduction of AIS to the Chesapeake Bay watershed, species are also often introduced accidentally – i.e., escape and unsanctioned release by private citizens and companies. Two lethal oyster parasites, for example, “MSX” (*Haplosporidium nelsoni*) and “Dermo” (*Perkinsus marinus*) are considered the leading cause of native oyster mortality in the Chesapeake and may have been introduced accidentally as the result of unsanctioned introduction of a non-native oyster, *Crassostrea gigas* in the Delaware Bay.⁴

The most notable source of unintentional AIS introduction is ballast water. For example, the zebra mussel, a commonly-cited example of the spread of invasive species through ballast, is established in the upper Bay watershed,⁵ and the Chinese mitten crab – another well-known potential invader – may already be established in the Bay.⁶ Similarly, unintentional escape of bait and unsanctioned intentional releases of large aquatic organisms such as the snakehead and aquarium plants and animals have garnered headlines in recent years.

AIS prevention efforts in the Bay are complicated by the large number of states whose marine and fresh waters feed into the estuary. Three rivers – the Susquehanna, James, and Potomac – provide 70 to 80 percent of the freshwater inflows into the Bay.⁷ The combined watersheds of these rivers – and therefore the area from which potential invasive species could be introduced by downriver migration or transport – include portions of New York, Pennsylvania, Delaware, West Virginia, Maryland, and Virginia. Similarly, marine invaders may spread along the coastlines from additional nearby jurisdictions.

Infestations of AIS have prompted extensive and expensive manual (e.g., cutting, burning), chemical (e.g., pesticides, herbicides, piscicides), and biological (e.g., biocontrol) management programs and activities. Control and management costs can be expected to increase in the future because the AIS subject to existing control programs in the Chesapeake represent only a small percentage of the aquatic species that could invade or have already invaded the region.⁸ Prevention of AIS introduction to limit future response costs is therefore extremely important for future AIS control efforts in the Bay.

Notes

1. For a summary of the threats posed by invasive species, see ENVIRONMENTAL LAW INSTITUTE, HALTING THE INVASION: STATE TOOLS FOR INVASIVE SPECIES MANAGEMENT 13 *et seq.* (2002).
2. For a complete overview of potential aquatic species invasion pathways, see National Invasive Species Council & Aquatic Nuisance Species Task Force, Focus Group Conference Report and Pathways Ranking Guide 19 *et seq.* (2005).
3. Mute swans were imported from Europe to beautify estates, parks, and zoos. See Chesapeake Bay Mute Swan Working Group, Mute Swan (*Cygnus olor*) in the Chesapeake Bay: A Draft Bay-Wide Management Plan 3 (2003).
4. Eugene M. Burreson, *Molecular diagnostics for the oyster pathogens Haplosporidium nelsoni (MSX Disease) and Perkinsus marinus (Dermo Disease) in Chesapeake Bay, Virginia, USA*, in DNA-based Molecular Diagnostic Techniques: Research Needs for Standardization and Validation of the Detection of Aquatic Animal Pathogens and Diseases 71, 71 (Peter Walker and Rohana Subasinghe, eds. 1999); Molecular Chesapeake Bay Program, Backgrounder: Non-Native Oysters and the Chesapeake Bay (2003).
5. At least one established population of zebra mussels is present in the upper Susquehanna River watershed in New York State. Additional sightings have occurred in other states, but have not resulted established populations. See CBP Regional *Dreissena polymorpha* Working Group, Zebra Mussels (*Dreissena polymorpha*) in the Chesapeake Bay Watershed: A Regional Management Plan 5-6 (2004)
6. Katherine Boyle, *Invasive Species: Return of the Mitten Crabs Poses Threat to Eastern Waters*, Land Letter (Aug. 9, 2007).
7. Ocean Studies Board, Nonnative Oysters in the Chesapeake Bay 22 (2004).
8. Only six species-specific management plans have been developed to date by regional AIS managers (the Chesapeake Bay Program's Invasive Species Workgroup). See MAP, AIS of the Mid-Atlantic – Management Plans and Programs, at <http://www.midatlanticpanel.org/ais/mgtplans.htm>. Other species may, however, be addressed more generally in state invasive species management plans.

III. The Regulatory Framework

Each Bay state has adopted laws regulating a number of important invasion pathways. Each state law is implemented by a responsible agency, which then issues regulations spelling out the precise importation and release provisions used to prevent AIS introductions. These state laws and regulations provide the backbone of AIS prevention authority in the Bay. The various state and federal laws, regulations policies addressing AIS prevention differ to some extent, but they all share three essential components. Comprehensive prevention policies seek to prevent:

1. Importation of potential AIS;
2. Intentional release of potential AIS that have been imported into or are otherwise present in the state; and
3. Escape of potential AIS from captivity.¹

While the goals of all AIS programs are identical, each jurisdiction has enacted multiple, diverse laws to carry out these goals for various species and pathways. These complex laws appear dissimilar at first glance, but close examination of their provisions reveals that they utilize similar regulatory mechanisms to accomplish their goals. As a result, it is worthwhile to understand the laws' shared mechanics before discussing the specific provisions of each individual law.

Federal, State, and Regional Interaction

State laws and regulations do not exist in a vacuum, but rather interact with federal standards in complex ways. Federal laws independently restrict or regulate importation and release of some species and also regulate pathways. These federal laws may preempt state laws in a subject area,² but more commonly, states refer to and supplement federal standards to suit local conditions, in many cases imposing more stringent limits than those imposed by federal regulators. *See Box on Harmonization and Federalization, this page.*

In addition to providing policy guidance, federal laws and regulations also provide financial and manpower support to state and regional agencies. The Chesapeake Bay Program, for example, is housed within the U.S. Environmental Protection Agency pursuant to the federal Clean Water Act.³ Thus, federal and state agencies interact on both regulatory and management levels.

Harmonization and Federalization

Legal harmonization is a term of art that refers to the modification of existing, conflicting legal regimes and can take several forms:

- *Legal transplantation* requires legal systems (states or nations) to unilaterally adopt statutes, rules, or customs from other jurisdictions.
- *Legal harmonization* occurs when multiple legal systems unify their legal systems through coordinated amendment of internal laws to fulfill a chosen set of objectives and targets.
- *Legal unification* occurs when legal systems agree to replace their existing rules with a new, unified set of rules.*

Federal laws play a legal unification role when they preempt differing state laws. Not only does this report assume that comprehensive federal action on AIS prevention is unlikely, but also it notes that national unification is not always beneficial. For example, a species may be native in some states but invasive in others – making nationwide listing problematic. Legal harmonization on a regional level may avoid such issues and allow legal responses to be tailored to the needs of a given state or region.

* Emanuela Carbonara & Francesco Parisi, *The Paradox of Legal Harmonization*, Geo. Mason Univ. School of Law, Law & Economics Res. Paper No. 05-40 (2007).

In addition to working within the constraints of federal laws, states interact through interstate compacts.⁴ Compacts are binding on participating states, and signatory states cannot override compact provisions by later legislative action.⁵ Compacts thus provide unified legal standards that apply equally in all signatory states and enable the creation of interstate administrative bodies, including the Chesapeake Bay Commission.

Listing

Most invasive species prevention laws, including those in the Bay states, use lists to classify species. Listing is a regulatory tool used to identify species that are subject to the substantive prohibitions in a given law (e.g., import, release, or escape bans). Two types of listing provisions are used to identify harmful species: “clean” (or “white”) lists and “dirty” (or “black”) lists. Dirty lists, which are more common, apply the law’s substantive restrictions *only* to *listed* species, leaving all unlisted species free from regulation. This approach assigns to regulators the burden of determining whether a species is harmful, often resulting in lengthy listing delays during which species may be introduced and become established. In contrast, clean lists specifically identify allowed species, applying the law’s restrictions to species that *do not* appear on the list. This approach generally assigns the burden of showing that a species will not pose an economic or environmental threat to the regulated community, which is best informed about the species and whose members will benefit from the use of the species. In addition to lessening regulatory burdens on overworked agencies, clean lists are advantageous because they require screening of species prior to import or release, resulting in comprehensive coverage of potentially harmful species before those species can become established.

In addition to differences in their form, state listing provisions vary in the extent of their application. In some cases lists apply only to a specific law – for example, cage design standards may apply only to listed venomous reptiles under the jurisdiction of a state game agency. As in the case of venomous reptiles, these lists may be intended to affect activities other than AIS prevention – in this case, public safety. As a result, the restrictions on listed species may not consider invasiveness. For example, the effectiveness of a hypothetical law that restricted importation of listed venomous species without a permit would be ineffective to address AIS threats if permits were granted once an applicant posted a bond, regardless of invasive potential.⁶

Lists may be used by more than one agency or may refer to more than one type of management activity. For example, a state agriculture department could

prohibit aquaculture of any species by the state fisheries agency. While such cooperative approaches to listing are most common between state agencies, some state laws also adopt lists created by regional, federal, or international bodies. Finally, many states combine different types of lists from different sources to create a tiered listing system that can be applied to different categories of species based on their potential harm.

Use Limitations

Invasive species lists are meaningless without substantive limitations governing the importation, introduction, and escape of listed species. States tailor their lists in complex ways to achieve their goals of preventing the establishment of unwanted species while facilitating trade in species that pose lesser risks. To accomplish this balance, state authorities generally restrict how owners can use listed species. These restrictions may be tailored not only to the potential risks posed by species but also by industry and by the identity of the owner.

There are several ways to limit the permitted uses of listed species. In the most stringent cases, states prohibit all activity involving listed invasive species, regardless of the nature of the intended use. More commonly, however, restrictions limit only those uses of problematic species that are correlated with pathways of concern. While outright bans are fundamentally more inclusive than partial bans, the latter approach may also be effective, provided that the law explicitly mentions all potentially problematic uses. Thus, such laws should at a minimum restrict the (1) importation; (2) transport; (3) release; (4) introduction; (5) possession; (6) use; (7) purchase; (8) sale; or (9) propagation or breeding of invasive species. States vary in the categories of restrictions that are imposed on species, however, and in many cases have omitted important categories.

Omissions in the restricted uses of listed species may be intentional when tied to particular industries or owners who may pose less of a concern to regulators. For example, captive wildlife policies may seek to avoid or limit the importation of potentially invasive wildlife only in settings where release is likely, such as the pet trade. This type of limitation avoids undue interference with wildlife importation assumed to pose a lesser risk, such as for well-regulated zoos

and research facilities. Similarly, escape prevention regulations may apply only to particularly troublesome pathways, such as aquaculture, requiring those facilities to comply with specific design standards or operating procedures. Omissions may be inadvertent or optimistic, however. For example, a state may prohibit importation of an invasive species in the pet trade but not propagation or sale of that species. Whether such an omission is intentional (e.g. based on an assessment of the number of individuals currently in the state) or inadvertent, it may contribute to the establishment of non-native species in the state.

Compliance and Enforcement Provisions

States share similar methods for promoting compliance with the restrictions they impose on importation, release, and escape of AIS. The most common compliance provisions require permitting and inspection of facilities. Permitting may be required as a prerequisite to importation, propagation, transport, sale, purchase, or other uses of wildlife (invasive or not). Facilities seeking to use animals or plants – such as aquaculture facilities, game farms, and horticulture facilities – are often subject to inspection to ensure compliance with permit conditions. In some cases, particularly for venomous reptiles and other species dangerous to humans, non-commercial owners may also be subject to inspection.

Inspections and permits provide regulators with some information about who owns problematic animals and plants and how those organisms are housed. In addition, they promote compliance with inspection, release, and escape laws because failure to meet inspection standards or to acquire the proper permit can result in administrative or criminal penalties. Unfortunately, funding and other limitations on the effectiveness of permits and inspections may decrease the efficacy of these provisions in preventing AIS introduction. As a result, some states – although not those studied in this report – have begun to implement additional regulatory tools to promote compliance. These include, for example, mandatory payments by importers to support inspections⁷ and implantation of identification markers upon sale of problematic species.⁸

Notes

1. Other policies, such as education, data sharing, and pre-planning for invasion can also be categorized as preventing the introduction of invasive species. See ENVIRONMENTAL LAW INSTITUTE, HALTING THE INVASION: STATE TOOLS FOR INVASIVE SPECIES MANAGEMENT 8 (2002). Because this report focuses on coordination of direct responses, these indirect tools are not considered here.
2. The most controversial area for preemption is the regulation of ballast water. The validity of state ballast regulation is uncertain at the moment, but is likely to be clarified by either legislative or judicial action in the near future.
3. 33 U.S.C. § 1267.
4. Interstate compacts are essentially treaties or contracts between state governments. Pursuant to the United States constitution, compacts may be approved by Congress, in which case they become federal law. U.S. Const., Art. 1 sec. 10 cl. 3. Not all compacts, however, require congressional approval. *Cuyler v. Adams*, 449 U.S. 433 (1981).
5. See William S. Morrow, Jr., *The Case for an Interstate APA*, 29 Admin & Reg. L. News 12 (No. 2 2004) (citing cases).
6. For a real-world application, see N.Y. Evtl. Conserv. Law § 11-0507(1), which prohibits placement of any fish or eggs in waters without a permit but does not establish permitting requirements.
7. See Haw. S. 1066 (2007) (requiring \$1 payment per cargo container imported into Hawaii, with proceeds supporting inspections).
8. See Fl. Admin. Code Ann. r. 68A-6.0072 (effective Jan. 1, 2007) (requiring the implantation of identifying microchips in listed “reptiles of concern” owned as pets).

IV. State and Regional AIS Prevention Provisions

This report examines the three states most intimately connected to the Chesapeake Bay: Maryland, Virginia, and Pennsylvania. These states have the largest impact on environmental conditions in the Bay and coordination of their laws is thus a productive starting point for improving AIS prevention in the region. A specific analysis of existing laws in the remaining Chesapeake Bay states – Delaware, New York, and West Virginia – would no doubt also be beneficial. Nonetheless, the recommendations presented in this study are intended to apply equally to all Chesapeake Bay states.

Maryland, Pennsylvania, and Virginia each maintain different laws and regulations pertaining to AIS prevention, and each state allocates authority among its agencies somewhat differently. In addition, regional cooperative entities are endowed with different legal and policy authorities that may play key roles in AIS prevention.¹ All relevant state and regional legal provisions were analyzed to determine:

- Agency responsibility for regulating each type of AIS and each pathway of concern, including the wildlife, fish, and plant trades, aquaculture, and shipping;
- Presence and type of AIS lists;
- Presence and strength of specific import, release, and escape restrictions; and
- Presence and strength of specific provisions applicable to industries and owners of concern.

The results of this study are presented in exhaustive form in Appendix A. This legal analysis was used along with personal communication with selected agency representatives to determine instances where variations among state agency and regional body laws and programs hinder AIS prevention efforts. *See also Table 1, pp. 12–13.*

Maryland

Maryland's AIS laws are implemented primarily through the Department of Natural Resources (MDNR). MDNR has unified authority to address all invasion pathways and all types of organisms, with the exception of the horticultural industry, which is regulated by the Maryland Department of Agriculture (MDA) under the state noxious weed law. MDA uses a dirty list approach to address noxious weeds but

has not listed any aquatic plants to date. MDNR has created both clean and dirty lists for wildlife and fish that limit the uses of listed species according to their threats to the environment or public health and safety. MDNR uses a dirty list to govern natural area weeds but has not used this authority to list any aquatic weeds to date. MDNR also regulates aquaculture and shipping.

Maryland has also established a state invasive species council (MISC) to assist in interagency cooperation. Unlike other state councils, MISC is an ad hoc body not created through either legislative or gubernatorial action, and its membership is diverse as a result, including federal, state, and local government representatives and private individuals and entities. Befitting its structure, MISC lacks governmental authority and has no permanent staff or budget. It is thus primarily an information-sharing entity and has not produced an AIS management plan to date.

Virginia

Virginia's AIS regulatory authority is split between three agencies. The Department of Game and Inland Fisheries (VDGIF) regulates the wildlife and freshwater fish trades through multiple clean and dirty lists, and has limited the import, release, and escape of some AIS species. VDGIF also regulates freshwater aquaculture and requires pre-approval to stock non-native fish. The Marine Resources Commission (VMRC) regulates marine fish through a clean listing approach, but addresses solely importation of non-native species. VMRC also regulates importation for marine aquaculture and regulates ballast water. The Department of Agriculture and Consumer Services (VDACS) regulates noxious plants and plant pests through a dirty list and cooperates with the U.S. Department of Agriculture's Animal and Plant Health Inspection Service (USDA-APHIS) on control actions. Finally, the Department of Conservation and Recreation (VDCR) does not have regulatory authority, but has worked frequently on invasive plant issues and has developed a dirty list for plants and recommended native alternatives. Virginia has also established an invasive species working group (VISWG), which has developed and obtained federal approval for a statewide management plan.²

Table 1. AIS Prevention Restrictions by Pathway and Agency

Pathway	State	Agencies Responsible	Listing	Import	Intentional Release	Unintentional Escape	
Wildlife Trade	Maryland	MDNR	Clean and Dirty	Non-native wildlife species prohibited without permit	Non-native wildlife species prohibited without permit		
	Virginia	VDGIF	Clean and Dirty	Import, possession of wildlife unlawful unless specifically authorized; listed, predatory, and undesirable species prohibited without permit; non-listed species importation is authorized	Release of wildlife unlawful unless specifically authorized; release of non-native wildlife species prohibited regardless of listing	Unlawful to permit reptiles to roam at large or to be kept in a manner that permits escape	
	Pennsylvania	PFBC (reptiles and amphibians)	Clean	Importers must institute appropriate safeguards to prevent introductions prior to importing listed species.	Propagation of non-listed species is unlawful; propagation of reptiles and amphibians outside of pet or hobby stores requires PDA permit; release of non-native species outlawed	Registration with PDA required; propagation facilities must be designed to avoid escape and must maintain an escape response plan	
		PGC	Adopts other laws; Dirty	Unlawful to import or transport species if prohibited by other federal or state law; unlawful to import listed species except zoos, circuses, and permit-holders	Unlawful to release species if prohibited by other federal or state law; unlawful for any entity but zoo, circus, or permit-holder to possess or purchase listed species without permit; unlawful to release listed species without permit	Wildlife must be kept in facilities meeting standards to prevent escape; permit required to propagate species.	
	Fish and Plant Trade	Maryland	MDNR	Dirty (several tiers)	Any live fish listed or not indigenous to nontidal waters is prohibited	Any live fish listed or not indigenous to nontidal waters is prohibited	Permits for possession of listed species available only if securely housed
			MDA	Dirty	Import and transport of listed noxious weeds in any form capable of growth is unlawful	Unlawful to contaminate uninfested land with a listed noxious weed	
Virginia		VDGIF (freshwater)	Dirty	Knowing introduction of listed freshwater species unlawful without permit			
		VMRC (marine)	Clean	Fish, shellfish, crustacean importation prohibited for placement in state waters unless on clean list; others not regulated			
		VDACS	Dirty	Permit required for import or transport of noxious weeds within state			
Pennsylvania		PDA	Dirty	Import, transport of listed noxious weeds, noxious weed seeds prohibited; aquatic animal dealers must register with department and can import only PFBC-approved species from approved sources; hobby breeders not required to register but subject to PFBC list	Propagation or sale of listed noxious weeds, noxious weed seeds prohibited		
		PFBC	Dirty (tiered)	Listed species may not be imported or transported between drainage basins in the state (except tropical fish not dangerous to native fish species)	Listed species may not be possessed, released, or transported for release (except tropical fish not dangerous to native fish species)		

Table 1. (continued)

Pathway	State	Agencies Responsible	Listing	Import	Intentional Release	Unintentional Escape
Aquaculture Regulation	Maryland	MDNR	No additional limitations, but permit required	No shellfish from outside state waters without permit; fish imports require permit and health screening		Facilities must be constructed to avoid escape; located in non-tidal areas only
	Virginia	VDGIF (fresh-water);		Written approval required to stock non-native fish in inland waters		
		VMRC (marine)	Clean	Fish, shellfish, crustacean importation prohibited unless on clean list		
	Pennsylvania	PDA				
PFBC		Clean (by watershed)	Listed species can only be cultured in listed watersheds			Unlawful to propagate unlisted fish except in closed systems with PDA approval; facilities must be designed to avoid escape and must have an escape plan
Shipping/Water Transfer	Maryland	MDNR			No deposit of ballast or oysters into Chesapeake Bay above Sandy Point	Watercraft containing listed species cannot be used; no transfer or diversion of infested waters
	Virginia	VMRC				Adopts federal guidelines requiring reporting and voluntary exchange
	Pennsylvania	None				

Pennsylvania

Pennsylvania, unlike Maryland and Virginia, does not directly border the Bay. Although it is a headwater state, its provisions are especially important for AIS in the Bay because the Susquehanna River, as the Bay's primary freshwater input,³ drains large parts of Pennsylvania directly into the upper Bay. The primacy of Pennsylvania's effects on the Bay environment is reflected in its participation, along with Virginia and Maryland, in the Chesapeake Bay Commission and other regional bodies.

Pennsylvania's AIS jurisdiction is split among three agencies by taxonomy and pathway. The Fish and Boat Commission (PFBC) has jurisdiction over reptiles and amphibians in the wildlife trade and over

all fish in trade. It regulates these species through separate clean and dirty lists. As part of its fish trade responsibility, PFBC regulates the aquaculture trade in cooperation with the Pennsylvania Department of Agriculture (PDA). PDA's aquaculture responsibilities are limited to permitting and inspection of aquaculture facilities. PDA is also responsible for the regulation of plant species, for which it uses a dirty list. Finally, the Game Commission (PGC) regulates the wildlife trade for species other than reptiles and amphibians through the use of dirty lists. Like Virginia, Pennsylvania has established an invasive species council (PISC), which has completed and obtained ANSTF approval for its management plan.

Regional Bodies

In addition to individual state provisions governing importation, release, and escape of AIS, the Bay area is home to several regional efforts to improve the regional environment. The Chesapeake Bay Commission (CBC) was created by interstate compact to provide policy support to state legislatures to assist in Bay restoration. The CBC is made up of state legislators, state agency representatives, and selected citizen representatives.⁴

The Chesapeake Bay Program (CBP) was created in 1983 the Chesapeake Bay Agreement, which is a joint management agreement signed by the federal government, Bay states, and the CBC to guide recovery of the Bay ecosystem.⁵ The CBP is intended to provide advice on and assist in implementation of the Agreement, which has been periodically revised. Pursuant to the Clean Water Act, CBP is housed under the U.S. Environmental Protection Agency. To date, the CBP has primarily focused on remediating non-biological water quality indicators, but has also taken action to address AIS in the Bay, including by developing a Living Resources Committee (LRC) and by hosting a regional AIS panel, the Mid-Atlantic Panel on Aquatic Invasive Species (MAP).

MAP, a regional panel under the national Aquatic Nuisance Species Task Force (ANSTF), promotes regional cooperation on AIS issues among mid-Atlantic states.⁶ MAP provides a forum for discussion among state, federal and non-governmental groups and businesses about cooperation, coordination and communication on AIS issues.⁷ AIS prevention has not been a focus of MAP efforts to date, but is likely to be considered more fully in the near future.

In addition, two of the Bay's main source rivers are subject to basin-specific management programs. The Susquehanna River Basin Commission (SRBC) and Interstate Commission on the Potomac River Basin (ICPRB) seek to improve cooperation among jurisdictions within their respective watersheds. To date, neither commission has focused on AIS issues, although their role is likely to increase in the future. SRBC, for example, has begun to participate in MAP.

Notes

1. As this report is predicated on assisting states with improving AIS prevention in the absence of increased federal support, it does not consider a number of purely federal programs, such as the National Oceanic and Atmospheric Agency's Chesapeake Bay Program. This is not intended as a slight, but rather is intended to narrow the focus of the report.

2. The Federal Aquatic Nuisance Species Task Force (ANSTF) approves state plans, which makes those plans eligible to receive federal funds. In practice, these funds may be extremely limited.

3. See Pennsylvania Department of Environmental Protection, Pennsylvania's Chesapeake Bay Tributary Strategy, at i (2004) (noting that the Susquehanna provides more than half of the freshwater inputs to the bay).

4. See Chesapeake Bay Commission, *Policy for the Bay*, at <http://www.chesbay.state.va.us/> (2007)

5. See Chesapeake Bay Program, *Overview of the Bay Program*, at <http://www.chesapeakebay.net/overview.htm> (2007). Citizen groups also participate in the CBP.

6. MAP includes state members from ranging from North Carolina to New York. Its geographic scope is thus larger than the Chesapeake Bay watershed. Nonetheless, most of its members are within the Chesapeake Bay watershed and the Bay is naturally important in much of the panel's work.

7. MAP, *About Us*, at <http://www.midatlanticpanel.org/about.htm>.

V. Recommendations

The significant differences among state AIS prevention laws and regulations present opportunities for improving prevention efforts throughout the Bay region. States should consider the following recommendations to improve both in-state and regional AIS prevention activities. This section includes several recommendations to amend existing laws and regulations and create new legal structures. These recommendations will undoubtedly require legislation and/or formal rulemaking. We recognize that rulemaking and legislation may be difficult in some states due to monetary and temporal constraints or a lack of political will, but we encourage these formal changes nonetheless because they are likely to have immediate and lasting impacts on AIS prevention.

This section also provides recommendations for promoting the implementation of existing AIS prevention laws and regulations by states and regional bodies. While these recommendations seek to increase the efficiency of state efforts, strengthening on-the-ground prevention efforts may nonetheless require continued or increased funding for state agencies and regional bodies, whether through appropriation or other means.¹ Furthermore, agencies must dedicate funding increases to AIS prevention rather than to control or management of established invasive species. Dedication of limited manpower and funding to AIS prevention is extremely economically beneficial, making such investments worthwhile for both legislatures and agencies.² Although prevention requires investment before AIS species become established – and thus may be politically difficult – investment in prevention avoids higher future costs for control and management after AIS become established.

1. Enhance Regional Body Interactions

A. Require CBP to Respond to MAP Recommendations

The MAP and CBP each have strengths and weaknesses that offer opportunities for effective collaboration. MAP is an inter-jurisdictional body composed of dedicated experts interested in AIS prevention and management. It is thus well placed to consider the effectiveness of state and federal laws, regulations, and on-the-ground efforts and to make practical recommendations for improving their function. On the other hand, MAP members are not endowed with poli-

cy-making powers, and MAP itself lacks the funding or influence with policy-makers to implement the policy changes that its members may identify. CBP is both better funded and more influential with policymakers, particularly with respect to implementation of actions on a regional level. Its members, however – even those on its living resources committee (LRC) – are not focused on AIS issues, nor are they as knowledgeable as the MAP members about invasive species.

As noted in Appendix A, CBP and MAP are linked both because CBP serves as the administrative host for MAP and because MAP reports to the LRC on a yearly basis. These connections can be strengthened. In particular, the LRC does not currently respond to MAP's reports, making it difficult for MAP, its members, and the public to know how the LRC – and the CBP as a whole – will address MAP's recommendations. This situation presents difficulties to MAP, which cannot know which, if any, of its efforts are likely to bear fruit. Moreover, the LRC's silence decreases the perceived effectiveness of CBP's efforts to address the health of the Bay, a subject of recent criticism by policymakers and the public.

The LRC should provide feedback to MAP on MAP's annual reports. This feedback would provide valuable information to MAP and the states, assisting them in developing future prevention strategies and in making resource allocation decisions. Whether CBP institutes a reporting requirement voluntarily or such a provision is created through amendment of the Chesapeake Bay Agreement, formalization of this important link between MAP and CBP is needed to strengthen cooperation in the region.

B. Engage CBC in AIS Prevention Policy Harmonization

CBC is the most influential voice for policy development in the Bay region, particularly on the state level. As a result, CBC is likely to play a pivotal role in the development of coordinated policy solutions for AIS prevention. To date, however, it has not focused on AIS prevention, instead directing its attention primarily to non-biological indicators of water quality. For states to effectively harmonize their laws, CBC must engage more fully with states to develop uniform AIS prevention laws.

C. Integrate River Basin Commissions into AIS Prevention

Although important river basin compacts exist for several major freshwater sources in the Chesapeake Bay region, the commissions created by those compacts (*e.g.*, the Susquehanna River Basin Commission and the Interstate Commission on the Potomac River Basin) have not been fully incorporated into state or regional AIS prevention efforts, although the SRBC does attend MAP meetings and both may be engaged in AIS management and control efforts. These commissions have significant on-the-ground expertise in river basin conditions but have not been engaged with AIS issues, instead focusing on their primary mission to improve traditional water quality measurements and address water allocation. AIS are increasingly recognized as an important element of water quality in their own right, and expansion of the commissions' participation in regional AIS bodies would improve the utility of AIS prevention efforts.

Engagement of the river commissions would require amendment of the strategic goals and river management plans that govern the commissions' roles. Although these plans do not currently mention AIS prevention, amendments would allow commissions to participate fully in MAP and other regional bodies, to establish formal links with state AIS agencies in the watershed, and to take advantage of potential co-management project and research opportunities.

2. Encourage Interstate Collaboration

A. Establish a Collaborative ISC Workgroup

Each of the study states has established an ISC. To date, however, the ISCs have focused solely on intrastate issues, often due to a lack of resources. Prevention planning by ISCs could be strengthened by considering—or simply being aware of—efforts undertaken by neighboring jurisdictions. Once fully funded with permanent staff, ISCs should establish contacts with other state ISCs and regional bodies. An interstate AIS prevention workgroup consisting of ISC directors from each state could be formed, either independently or in cooperation with MAP and/or CBP. This workgroup would convene on a regular basis to discuss species of concern, emerging pathways, listing issues, and other AIS topics. If formed, this workgroup should maximize its impact by including senior-

level staff who can either make substantive decisions directly or, at a minimum, significantly affect policy.

B. Integrate All Headwater States into AIS Prevention

Headwater states are an important part of AIS prevention in the Chesapeake Bay, especially for freshwater species. Not all headwater states and state agencies, however, participate consistently in CBC, CBP, or MAP activities. This lack of participation may be attributed to membership limitations (for the CBC), limited funding, varying potential invasion rates and commitment to AIS prevention on the state and agency level, and the vast geographical expanse of the Bay watershed. These variables heighten the difficulty of crafting comprehensive prevention standards that effectively address AIS across state lines. Within the limits of their foundational texts, regional bodies should actively seek participation by authorities that do not currently participate.

In particular, the CBP should seek definitive commitments to address AIS prevention from each state in the Chesapeake Bay watershed, as it has done with respect to other ecosystem-wide issues. For example, all of the Bay states signed a memorandum of understanding (MOU) committing them to implement effluent reduction targets to address water quality in the Bay. CBP should seek agreement by each of the Bay states on a similar MOU requiring implementation of AIS prevention standards.

C. Undertake Cooperative Research on AIS Prevention

Although each of the states and regional bodies in the Bay area can take immediate steps to improve AIS prevention, further research is needed on risk assessment, pathways analysis, and other relevant issues, especially in light of changing climatic, biotic, and economic variables. As a result, MAP, states, and the CBP should use institutional resources and expertise to support ongoing research such as the Smithsonian Environmental Research Center's (SERC) GIS mapping and reporting initiative. Ideally, these efforts will support the development of a region-wide adaptive risk assessment and screening system that can be used to predict probable AIS invasions. Risk assessment tools could then be directly integrated into policy by influencing listing decisions.

3. Address Weaknesses in Existing AIS Prevention Authorities

A. Consolidate AIS Lists

Each of the Bay states uses some form of AIS listing. Furthermore, each agency within a state may maintain separate lists for different taxonomic groups or for different pathways, and may refer to lists adopted by other jurisdictions, such as the federal government. Due to the multiplicity of listing provisions, regulators have found it difficult to determine which species are listed or regulated in neighboring jurisdictions. The complexity of state listing provisions is an informational hurdle that hinders coordination of lists among states. Each state should therefore *consolidate* its various AIS lists for ease of reference. A regulatory system that lists all species in a single place would simplify interstate coordination of lists by allowing direct comparison of lists among states, highlighting gaps, strengths, and areas of taxonomic disagreement. State invasive species councils are in a good position to provide this service due to their interagency membership and informational role. Councils should post each agency's lists in a central location (such as the council website) and highlight new and potential future additions to lists in regular meetings of agency staff.

B. Harmonize and Strengthen AIS Lists

Not only does each state maintain multiple lists, but the content of those lists differs from state to state.³ As a result of these differences, species may be freely imported in some states but banned or otherwise restricted in others. To remedy these inconsistencies, states, with the help of regional bodies, should seek to *harmonize* their lists as much as possible. There are several ways to harmonize, including:

- Using clean lists;
- Updating existing dirty lists based on information obtained from neighboring states; or
- Adopting by reference any species listed in neighboring states or by the federal government.

Using Clean Lists. Of these options, the use of clean lists is preferable because such lists offer robust substantive protections against AIS introductions and shift listing burdens to importers and users of non-native species. In the absence of clean listing language, however, states must seek ways to improve the operation of their existing dirty lists.

Updating Existing Dirty Lists. The most obvious way to harmonize dirty lists is for each state to undertake a renewed listing effort. As shown in Appendix B, each state's existing AIS list lacks species that have been listed by its neighbors.⁴ In addition, AIS databases identify a multitude of known invasive species that have not yet been listed by any state. At a minimum, state agencies should consult nearby state lists and databases to identify and list known AIS. In addition to determining omissions from state lists, such comparisons will indicate species whose taxonomic information should be updated. For example, Virginia's AIS list includes several genera of piranhas that are no longer recognized as distinct species or which have been reclassified as different genera.

While beneficial, harmonized listing would retain the flaws undermining current intrastate listing efforts. Not only is the current listing process laborious and costly, but lists require ongoing maintenance because species and genera are moving targets. Molecular and genetic methods are increasingly used to clarify problematic evolutionary relationships, necessitating continual taxonomic revision. Moreover, species ranges constantly shift in response to environmental and anthropogenic factors, such as climate change. These changes necessitate ongoing additions to and maintenance of lists, with their attendant costs.

In the absence of a clean listing approach, a new, collaborative approach to listing would address these systemic problems. A designated regional body, such as MAP, should develop a master list of species of concern to member states, along with the listing status of each species in each state.⁵ The centralized, informal nature of regional list development could facilitate interagency debate about controversial species.⁶ States may not all agree as to whether certain species, such as non-native oysters, should be listed. Regional discussion of these species would allow states to reach consensus on a unified approach to their importation and management.⁷

With the master list in hand, the regional body could facilitate the work of its member states and of the federal government to gather known information about species of concern. The information collected by the member states would be available for use in all states' listing processes – whether regulatory or legislative. This centralized information-gathering would allow states to avoid duplicative work and enable them to share work, thus reducing the financial and temporal burdens of listing. By reducing the barriers to regulatory action, regional cooperation could thus encourage more active listing processes at the state level. Nonetheless, even with a master list the states and their agencies would remain responsible for funding and carrying out listing processes.

Adding Species By Reference. The regional information-gathering process described above would likely result in improved harmonization of dirty lists, reducing the regulatory ineffectiveness that currently saps state AIS listing efforts. It nonetheless requires states to take independent regulatory or legislative action to implement the lists – a requirement that could be simplified by amendment of the Chesapeake Bay compact. Amendment of the compact could provide for automatic listing of each species identified by a specified regional body in each signatory state. The existing CBC, as a quasi-legislative, interstate body, could provide legitimacy to a joint-listing provision. Nonetheless, it is likely that individual states would retain the authority to reject individual species additions with justification.

Listing could also be eased by amendment of the Lacey Act to hasten federal listing processes or automatic listing of species identified as invasive by other states or by the federal government. For example, states could automatically designate as invasive any species listed by the federal government under the Lacey Act (prohibiting imports of listed animal species), the noxious weed act, or other relevant statutes. Given the current regulatory and budgetary climate, however, the more modest facilitative proposal offered above seems a reasonable – and achievable – first step.

C. Harmonize and Strengthen Import, Release, and Escape Restrictions for AIS

AIS lists – whether clean or dirty – are only as effective as the restrictions imposed on listed species. States must ensure that listing is an effective prevention tool by harmonizing and strengthening those restrictions, whether they are found in laws specifically aimed at addressing the AIS threat or laws of more general applicability, such as boat registration or bait fish dealer licensing.

Various states have limited the import, transport, use, possession, propagation, introduction, release, purchase, sale, or gift of listed species. The existing differences among these restrictions can lead to the introduction and establishment of AIS in one state through pathways deemed illegal in neighboring jurisdictions. For example, Maryland specifically prohibits the release or introduction of listed species, but Virginia does not, potentially allowing AIS released in Virginia to spread into Maryland. To avoid this situation, states should ensure that their laws include, at a minimum, all of the existing restrictions imposed by their neighbors, unless they have a valid policy justification for an omission. Regional bodies – either MAP or CBP – should take a lead role in the promoting the sharing of information about the existing state restrictions delineated in this report and work to determine whether additional restrictions are needed to halt AIS introduction through known pathways – including but not limited to the pet and aquarium trades and aquaculture. Omissions should be analyzed to determine whether the omission is warranted based on the risk posed by the species, owner, or industry. If not, state agencies should remedy the omission through legislation or rulemaking. Even in the absence of comprehensive comparative research on omissions, this report provides sufficient information for states to address some gaps immediately.

4. Develop New AIS Prevention Authorities

A. Develop Ballast Water Exchange Laws

Commercial vessel ballast exchange is a well-known vector for AIS introduction, but prevention of ballast-borne introductions has proven difficult. Ballast water exchange and treatment are currently regulated by both federal and state laws, but existing authorities are voluntary and do not address the problem effectively. Although the need for new regulation is well-recognized, the Bay states have not yet sought to strengthen their ballast laws or to harmonize them on a regional level. By contrast, the ballast problem is widely recognized in the Great Lakes region, where some states – notably Michigan – have both strengthened their own laws and lobbied to create strong federal standards without limiting state powers to regulate ballast exchange or treatment in their waters.⁸ Michigan's strict ballast law could serve as a model for Chesapeake states given the similar complexity of AIS issues in the Great Lakes and the Chesapeake.⁹ Bay states – particularly Pennsylvania, which is both a Bay state and Great Lakes state – should follow this example by enacting robust state ballast laws.

In addition to legislative reform, states should participate in the ongoing, active debate in Congress over the adoption of a new federal ballast exchange and treatment law.¹⁰ CBC is ideally placed to serve as a policy voice to lobby on behalf of Bay states seeking adoption of a comprehensive, robust federal ballast law that does not preempt more stringent state laws.¹¹

B. Develop Recreational Vessel Laws

While ballast is an important pathway for vessel-borne AIS introductions, it is not the only source. Recreational vessels are a well-recognized vector for the spread of AIS among states and watersheds, but no Bay state has adequately addressed this pathway. State legislative or regulatory action is needed to address the problem. To move forward, the CBC should develop a model recreational vessel washing law that could then be adopted by states with little additional modification.

Substantively, a model law should include elements such as mandatory boat-washing and bilge-pumping for all recreational vessels prior to transfer between water-bodies. While funding and manpower con-

straints may limit the active enforcement of such a law, relatively inexpensive methods such as education during boat registration, signage, and spot checks in high-traffic areas could promote compliance while imposing relatively small fiscal and regulatory burdens.

C. Strengthen Horticulture, Water Gardening, and Aquarium Plant Regulations

Plant species are underrepresented on AIS lists, despite the fact that species such as water chestnut, water hyacinth, hydrilla, and purple loosestrife are among the more notorious invasive species. In many cases, prevention and control of invasive plants is managed by state agriculture agencies – not by the wildlife agencies that generally manage other AIS species. Agriculture agencies generally focus their efforts on terrestrial plant pests and pathogens that affect crops.¹² Aquatic invasive plant species thus fall between the expertise of the agencies that manage aquatic invasive wildlife and those that address invasive plants. Prevention requires integration of agency expertise for effective listing and regulation of known invasive aquatic plants on both the intrastate and interstate levels. MAP should take the initiative to encourage its member states to consider and address the threats posed by invasive aquatic plants, particularly with respect to the water gardening industry.

D. Proactively Address Emerging Pathways

AIS pathways are not static, but rather develop in tandem with changing economic and environmental conditions, providing new opportunities for AIS invasion. Prevention therefore requires ongoing vigilance with respect to both on-the-ground monitoring for new invaders and prospective identification of new species and pathways of concern. State agencies, conservation organizations, and academics have worked to assess emerging threats, and their experience should be made accessible to other agencies and states. Provided that they can obtain permanent funding, state ISCs are suited to serve as a clearinghouse for information on new species and pathways because they can leverage expertise across disciplines – including non-agency staff in some states.

5. Facilitate Compliance with and Enforcement of AIS Prevention Authorities

A. Increase Financial Penalties for Noncompliance

Robust AIS prevention authorities are necessary, but not sufficient, elements of an effective regulatory scheme. Legal authorities are effective only if regulated entities comply with their provisions. State agencies, however, have only limited enforcement resources – a fact that violators may consider when choosing to engage in unlawful behavior. Compliance can be increased despite enforcement limitations by increasing financial penalties for violators. States agencies should share enforcement data when setting penalties in an attempt to determine the precise relationship of penalties and behavior. Even without comprehensive economic analysis, however, the ease of state-to-state movement of AIS in the Bay and ongoing introduction fo AIS into the Bay suggest that consistent, enhanced penalties are needed on a region-wide basis.

B. Develop and Harmonize New Enforcement Methods

Agencies should seek to implement programs that identify facilities or individuals that either release AIS or allow them to escape. First, industrial facilities that use AIS species – notably, aquaculture and pet trade facilities – should be subject to permitting and inspection requirements as a condition of their use of those species. Inspection ensures that facilities comply with design standards and other regulations intended to prevent introduction and escape. States should also jointly consider a pilot project to require such facilities to post financial bonds in case of escape. These provisions should be harmonized across the region due to the high risk of state-to-state transmission within watersheds.

Second, agencies should seek ways to connect individual AIS organisms with their owners by requiring microchip implantation or other tracking mechanisms.¹³ Identification encourages compliance by non-industrial owners of AIS species by facilitating enforcement should a pet owner release an unwanted individual. Implementation of such measures requires action on a regional basis because owners may effectively resist identification through cross-border sales. States should work together to identify candidate species for use in pilot projects that could test the feasibility of these measures.

6. Plan for AIS Prevention on a Regional Level

A. Develop and Fund AIS Plans

As described above, both Virginia and Pennsylvania have produced invasive species management plans with AIS prevention components. Development of a plan is an important first step for coordinating AIS prevention activities on an intrastate level. Thus, states without such plans – notably Maryland – should initiate plan development and ensure that prevention is adequately considered in the planning process. States with plans, meanwhile, should seek Aquatic Nuisance Species Task Force (ANSTF) approval for those plans to establish eligibility for federal funding of plan implementation. Finally, states with approved plans – Virginia and Pennsylvania – should aggressively seek funding for permanent staffing and plan implementation from their state legislatures.

While development, approval, and implementation of plans are important first steps toward AIS prevention, it is also important to recognize that planning is useless unless the plan is current. Thus, AIS planning efforts must provide for periodic review of plan provisions to consider the impacts of changing conditions and expansion of established AIS in nearby jurisdictions. Plans should also contain specific prevention benchmarks and feedback mechanism for use in evaluating progress in strengthening prevention. AIS plan reviews should use these benchmarks to ensure that agencies are making substantive progress toward meeting AIS prevention goals.

B. Develop a Region-wide AIS Plan Using State and Regional Resources

A regional AIS prevention plan that includes all states in the Chesapeake Bay watershed would strengthen interstate efforts to address invasive species across state lines by facilitating information-sharing about encroaching threats and emerging pathways and combining and leveraging limited resources to more efficiently address AIS problems. The regional *Chesapeake 2000* management plan was designed to promote cohesive management of Bay restoration efforts through the identification of specific action items. This CBP-directed planning effort has provided a roadmap for interagency efforts and a forum for discussion and interaction among representatives

from multiple jurisdictions. Unfortunately, although six species-specific regional AIS control plans were created under *Chesapeake 2000*, the agreement did not identify the creation of an AIS *prevention* plan as a priority action. The development of a Bay-wide AIS prevention plan should be the focus of any AIS-related revisions to *Chesapeake 2000*.

Significant institutional resources are available to implement inter-jurisdictional AIS planning in the Bay regardless of the planner's identity or its connection to the Chesapeake Bay Agreement. First, the prevention components of existing Bay state AIS plans could serve as a baseline for developing a regional prevention plan. In addition, the combined expertise of MAP, state Invasive Species Councils (ISCs), and federal sources such as ANSTF should be available to aid CBP in the creation of a regional AIS-prevention plan.

The Lake Champlain Basin Program (LCBP) may serve as a model for Bay regional planning efforts. LCBP, a regional agency similar to CBP that has identified non-native nuisance species as an action priority for future management, operates according to a comprehensive, AIS-specific management plan created jointly by Vermont and New York.¹⁴ The LCPB was approved by ANSTF pursuant to the National Invasive Species Act of 1996 (NISA), which authorizes ANSTF to approve and fund interjurisdictional AIS management plans for watersheds that overlap state boundaries – a description that includes both Lake Champlain basin and the Chesapeake Bay watershed.¹⁵ Interested states should consider leveraging federal support to develop a regional AIS plan under NISA, particularly if upcoming revisions to *Chesapeake 2000* are unsatisfactory from an AIS prevention standpoint.

Notes

1. Many state agencies – notably, fish and game departments – are supported primarily through the sale of fishing and hunting licenses, boat registrations, and other means, including federal grants.
2. See, e.g. Keller, Reuben P. et al., *Risk Assessment for Invasive Species Produces Net Bioeconomic Benefits*, 104 PROC. NAT'L ACAD. SCI. 203 (2007) (determining that implementation of risk assessments in most cases would yield economic benefits).
3. See App. B (state AIS lists).
4. Some species are native in one state but invasive in others. This recommendation refers to species that are invasive in multiple states – the vast majority of invasive threats in the Chesapeake.
5. The lists provided in the appendix to this report could serve as a starting point for such an effort, as could the Virginia Department of Conservation and Recreation's list of potentially invasive plants. See Va. Dep't of Conserv. & Rec., *Invasive Alien Plant Species of Virginia*, available at www.dcr.virginia.gov/natural_heritage/documents/invlist.pdf (2003).
6. The presence of such species should not hinder the overall harmonization effort as to the overwhelming majority of species that are not controversial.
7. This is a different concern than invasiveness, which varies from state to state for each species. Not all species are likely to be of equal concern in every state from an invasiveness perspective – a tropical species, for example, is unlikely to thrive in a cold-weather state. These species should still be listed, however, because species may be imported into one state but later transported across state lines. States may currently avoid listing these species to avoid the regulatory burdens that accompany listing – a valid concern. However, avoidance of the financial burdens of listing does not justify outright failure to list. Instead, states should lift the monitoring and control burdens that accompany listing for species that are unlikely to be established but which nonetheless warrant listing to protect nearby states.
8. The interaction of state ballast laws with the Clean Water Act and the preemption of state laws are important and contentious questions. See, e.g. *Fednav, Ltd. v. Chester*, No. 07-11116 (E.D. Mich 2007) (dismissing implied preemption challenge to Michigan's ballast law). These issues should be closely considered by state and federal regulators, but their resolution is beyond the scope of this report.
9. 2005 Mich. Pub. Acts 33 (requiring ballast exchange and permit for all saltwater vessels seeking to use Michigan ports).
10. See GAO, *Invasive Species: Clearer Focus and Greater Commitment Needed to Effectively Manage the Problem*, GAO-03-01 (2002).
11. See, e.g. H.R. 2423, 100th Cong. (2007)
12. See generally ENVIRONMENTAL LAW INSTITUTE, *HALTING THE INVASION: STATE TOOLS FOR INVASIVE SPECIES MANAGEMENT* (2002).
13. The development of microchip identification is currently used in Florida and could be implemented in other states for selected species. Many species, from plants to small fish, may not be amenable to this technology. For such species, agencies should track the development of new identification methodologies, whether genetic, physical, or technological.
14. Lake Champlain Steering Committee, *Opportunities for Action: An Evolving Plan for the Future of the Lake Champlain Basin* 53 (2003).
15. 16 U.S.C. § 4724.

Appendix A

State and Regional AIS Authorities

Maryland

Maryland's AIS authority is relatively consolidated, as a single agency has regulatory authority over the full taxonomic spectrum of potential AIS. The Department of Natural Resources (MDNR), regulates wildlife and aquatic organisms, including invertebrates, fish, and aquatic plants. MDNR also has jurisdiction over Maryland's limited ballast management law. MDNR, however, is not the only agency with invasive species responsibilities in the state. The Department of Agriculture (MDA) governs invasive plants and aquaculture marketing¹ but has not exercised its regulatory authority in the AIS context.² In addition, several other public and private entities are active in AIS prevention, including but not limited to: the Maryland Invasive Species Council;³ the University of Maryland Home and Garden Center; and the Maryland Sea Grant Center. These entities lack regulatory authority over AIS, and therefore are not discussed in detail below.

Maryland Department of Natural Resources

MDNR has primary regulatory authority over most aquatic and some terrestrial exotic (non-native) species.⁴ As part of this authority, MDNR regulates captive wildlife – that is, mammals, birds, reptiles, and amphibians – to prevent the introduction of pests that could harm or compete with native species.⁵ Thus, it is illegal to import, possess, breed, sell, or release any non-native wildlife species without a permit from MDNR.⁶ Permits are available only if the animal to be imported is both free of disease and will not be “inimical” to native species.⁷ Permits are not required for laboratories, exhibitions, “other uses which require that the wildlife is available in captivity,” and uses in field trials or for training hunting dogs.⁸ The department thus uses a clean listing approach for wildlife but exempts an array of users from its regulations. The legislature has also mandated specific requirements for nutria (requiring eradication plan),⁹ mute swans (requiring population management),¹⁰ and non-native reptiles and amphibians (prohibiting release only).¹¹

In addition to wildlife, MDNR also regulates “aquatic organisms,” including fish, shellfish, and aquatic plants.¹² State law gives the department authority to ban the importation, possession, or introduction of non-native aquatic species into state waters.¹³ In

addition, the state legislature has listed three harmful species of non-native crabs and has authorized MDNR to promulgate additional regulations limiting their import, possession, and use.¹⁴

To implement these authorities, MDNR prohibits the introduction, importation, and possession for introduction of any live fish species not indigenous to nontidal state waters.¹⁵ MDNR has also adopted specific regulations banning the unpermitted import, possession, propagation, or release – whether accidental or intentional – of certain listed aquatic organisms.¹⁶ A second subset of listed species is subject to fewer restrictions – they may not be transported without a permit, but the statute does not explicitly permit their import, possession, or release.¹⁷ Importation and possession permits are available only if a screening shows that the organisms are free of infectious diseases and if the applicant demonstrates that they will be housed securely.¹⁸ In addition, Maryland law and MDNR regulations address several specific AIS species, including zebra and quagga mussels,¹⁹ non-native oysters,²⁰ snakeheads,²¹ and *Phragmites*.²² MDNR thus uses a dirty list approach to govern the intentional importation and subsequent release of AIS.

MDNR's powers are limited in some respects. Most notably, the department may not ban all use of non-native fish in aquaculture operations. While it cannot ban the use of species, however, MDNR enforces construction requirements for such facilities through permit and inspection requirements. State statutes require that aquaculture facilities must be located in “nontidal ponds, lakes, or impoundments” and must be “constructed in a manner that assures that non-native stocks are *precluded* from entering the tidal waters or contaminating the native species of the State.”²³ MDNR thus has broad authority to restrict aquaculture operations that use non-native species in the state. The department has implemented its authority to prohibit the unpermitted importation or possession of shellfish (i.e., live oysters, seed oysters, oyster shells, live hard-shell clams, live softshell clams, and clam shells) taken from waters outside state waters for planting in state waters.²⁴

MDNR regulations also contain unique provisions to further guard against the accidental transport and release of AIS. Specifically, the use of watercraft

containing prohibited species is not allowed in state waters,²⁵ and water from AIS-infested locations may not be diverted or transported.²⁶

Finally, MDNR implements the state boat act, which prohibits the deposit of ballast, oysters, and other items into certain areas, including into the Chesapeake Bay above Sandy Point.²⁷ Maryland law contains no other ballast provisions.²⁸

Notes

1. MDNR enforces all aquaculture laws and regulations, but MDA is the lead agency for promoting the industry and coordinating the permitting process. Md. Code Ann., Agric. § 10-1301. Neither the legislature nor MDA has provided limitations on the practice of aquaculture in the state. MDNR, however, does require a permit. *See* Md. Regs. Code, tit. 8 § 08.02.14.04.
2. MDA is permitted to prohibit or regulate any plant species that adversely affects or threatens agricultural production. Md. Code Ann., Agric. § 9-402. While this authority is intended to apply primarily in terrestrial settings, it does not exclude the possibility that aquatic plant species such as the water chestnut could also be listed. *See* Md. Regs. Code tit. 15, § 15.06.02.12 (listing dangerously injurious and harmful plant pests, diseases, and weeds). MDA, however, has not listed or regulated any AIS to date.
3. Council members include both state agency representatives and private entities. Although the council maintains a website, it has not developed a statewide invasive species management plan such as those adopted in other Chesapeake Bay region states. As a result, its coordinating role appears extremely limited.
4. Md. Code Ann., Nat. Res. § 10-202. Note that some MDNR powers were previously housed in the now-defunct departments of Game and Inland Fish and Fish and Wildlife Administration. All authorities previously allocated to these departments are now exercised by MDNR. Md. Code Ann., Nat. Res. § 10-203. In addition, MDNR is allowed to cooperate with both local and federal authorities. Md. Code Ann., Nat. Res. §§ 10-202, 10-208, 10-904.
5. Md. Code Ann., Nat. Res. §§ 10-901, 10-903.
6. Md. Regs. Code tit. 8, § 08.03.09.04.
7. *Id.* “Inimical” is not defined in the statute, and is thus likely interpreted according to its dictionary definition.
8. *Id.*
9. Md. Code Ann., Nat. Res. § 10-202.1.
10. Md. Code Ann., Nat. Res. § 10-211.
11. Md. Regs. Code tit. 8, § 08.03.11.10. Maryland uses a clean list to establish the species of reptiles and amphibians considered native to the state. Md. Regs. Code tit. 8, § 08.03.11.03.
12. Md. Code Ann., Nat. Res. § 4-202, 4-205.1.
13. Md. Code Ann., Nat. Res. § 4-205.1.
14. Listed species include green crabs, Japanese shore crabs, and Chinese mitten crabs. Md. Code Ann., Nat. Res. § 4-816.
15. Md. Regs. Code tit. 8, § 08.02.11.04.
16. Md. Regs. Code tit. 8, § 08.02.19.04 (listing species). *See also* Md. Regs. Code tit. 8, § 08.02.19.02 (defining “release” to include both intentional and unintentional release).
17. Md. Regs. Code tit. 8, § 08.02.19.04. Known invasive pests, including the water chestnut, are included on this second list.
18. *Id.*; MDNR, Maryland Fish Health Import Requirements (2007).
19. The law that pertains specifically to zebra and quagga mussels prohibits importation or possession of any living life stage or reproductive products of mussels of the genus *Dreissena* without a permit from the Secretary of MDNR. MDNR also administers and enforces a regulation to ensure that live aquatic bait grown in an aquaculture operation and purchased from certified dealers is free of zebra mussels. Md. Regs. Code tit. 8, § 08.02.11.11. Chesapeake Bay Program, Zebra Mussels (*Dreissena polymorpha*) in the Chesapeake Bay Watershed: A Regional Management Plan 11 (2004).
20. Md. Code Ann., Nat. Res. § 4-11A-12 (prohibiting the culture of any oysters other than the native species).
21. Md. Regs. Code tit. 8, § 08.02.19.06 (prohibiting import, possession, breeding, sale, transport).
22. Md. Code Ann., Nat. Res. § 8-2101 *et seq.* (declaring phragmites a nuisance and requiring study and control on department-owned lands).
23. Md. Code Ann., Nat. Res. § 4-11A-02 (emphasis added).
24. Md. Regs. Code tit. 8, § 08.02.08.01.
25. This provision is largely unenforceable, as it requires repeated inspection of all recreational watercraft.
26. Md. Regs. Code tit. 8, § 08.02.19.05.
27. Md. Regs. Code tit. 8, § 8-726.1.
28. The Department of the Environment was previously authorized to control ballast water regulation in Maryland. *See* Md. Code Ann., Envir. § 5-5A-01 *et seq.* The ballast water management law, however, was repealed in 2005. 2005 Md. Laws, ch. 232, § 1.

Virginia

Several state agencies are authorized to take actions to prevent the introduction, release, or escape of different types of AIS in Virginia. These agencies include the Department of Game and Inland Fisheries (VDGIF), the Marine Resources Commission (VMRC), and the Department of Agriculture and Consumer Services (VDACS). In addition, various other agencies, such as the Department of Conservation and Recreation (VDCR), implement provisions intended to address control and management and other aspects of the AIS problem. These agencies' responsibilities are not discussed below because they are unrelated to prevention, but we note that they play important roles in the broader AIS arena.

Representatives from VDGIF, VMRC, VDACS, and VDCR, among other agencies, participated on the Virginia Invasive Species Council (VISC), which was established to prepare a uniform, statewide strategy for the prevention and management of invasive species, including AIS.¹ These agencies also participate on the Virginia Invasive Species Working Group (VISWG), which has been charged with implementing the state plan.

Virginia Department of Game and Inland Fisheries

VDGIF has primary responsibility for regulating exotic wildlife in Virginia, including regulation of freshwater fish and invertebrates. It carries out this responsibility by limiting the importation, possession, and sale of non-native animals in the state. VDGIF is also empowered by the state Nonindigenous Aquatic Nuisance Species Act (NANSA) to identify and regulate such species. VDGIF therefore may rely on a variety of authorities to address AIS prevention.

VDGIF has sole control over the importation, possession, transfer, and transportation of wildlife in Virginia.² The agency has utilized this authority to criminalize the possession, transport, importation, sale, or liberation of any wild bird, animal, or fish unless specifically permitted by another provision of the law – a clean-listing approach.³ The agency has paired this provision with specific prohibitions on the importation, possession, and release of listed “predatory or undesirable” species – a dirty list.⁴ Prohibited species may, however, be imported and possessed with a permit from VDGIF, which may only be granted if

the animal has been certified as disease-free.⁵ This ban on possession, importation, and release without a permit also applies (through a second dirty list) to the importation, possession, or sale of non-native species – including several aquatic species – that are not otherwise listed as predatory or undesirable.⁶

Although the pairing of clean and dirty lists is reasonable, the dirty list provision limits the restrictions imposed on importation and possession under the clean listing section. The statutory “predatory and undesirable” species provision specifically legalizes importation of *nonpredatory* species so long as the imported wildlife was taken in compliance with game laws.⁷ This provision thus permits some wildlife to be imported, but it does not loosen prohibitions on sale, possession, or release once imported. VDGIF regulations, however, expressly allow the importation, possession, and sale of non-listed exotic species. Fortunately, release of these species is unaffected and remains strictly regulated: it is illegal to intentionally release *any* non-native species or wildlife species.⁸

VDGIF has separate, additional authority to regulate the importation, possession, and sale of AIS under NANSA. NANSA applies to designated “nonindigenous freshwater animal species whose presence in state waters poses or is likely to pose” a threat to the diversity or abundance of native species, ecological stability in state waters, or the beneficial uses of state waters.⁹ VDGIF is authorized to list species in addition to those identified by statute and to take action to “suppress, control, eradicate, prevent, or retard the spread of” listed species.¹⁰ In carrying out these actions, VDGIF may cooperate with any federal, state, or local entity.¹¹

In addition to giving VDGIF authority to prevent the establishment of AIS, NANSA also prohibits the knowing importation, possession, transport, sale, purchase, gift, or introduction of listed species by any person in the state without a permit from VDGIF.¹² Although these permits are “rarely granted” for personal or commercial use,¹³ VDGIF is directed to issue permits to recognized academic institutions and government agencies for research purposes upon assurance that the institution seeking to house the species has instituted safeguards against the escape of the species.¹⁴ VDGIF has rights of inspection to enforce the

prohibitions established by NANSAs.¹⁵ Written departmental approval is also required to stock fish in inland waters, except native fish in private ponds and lakes.¹⁶

Finally, VDGIF's enabling law provides a general protection against the escape of reptiles not native to the state. It is unlawful for such reptiles to be allowed to run at large or to be kept in a manner that will permit the reptile to escape.¹⁷

Virginia Marine Resources Commission

VMRC is responsible for the regulation of marine fisheries in Virginia. As part of this authority, VMRC regulates the marine aquaculture industry and the importation of marine fish, shellfish, and crustaceans into the state. Virginia law prohibits the importation of fish, shellfish, and crustaceans for placement in state waters unless the species to be imported is on a clean list of approved species or the importer has received written permission from VMRC.¹⁸ VMRC lists permitted organisms in cooperation with the Virginia Institute of Marine Science (VIMS), a research institution.¹⁹ Although these regulations do not limit the release or escape of marine species under VMRC jurisdiction, the agency's use of a clean list largely precludes concerns about legally-permissible intentional or unintentional releases of AIS species in state waters.

In addition to its fisheries-related duties, VMRC also regulates ballast water exchange in Virginia. Virginia law requires VMRC to adopt the federal guidelines governing voluntary ballast water management practices.²⁰ These voluntary guidelines ask ship owners to retain their ballast waters or exchange them outside the United States' exclusive economic zone to avoid discharge or exotic species into Virginia waters.²¹ In addition, VMRC requests that owners: manage ballast uptake to avoid or minimize carriage of AIS, clean tanks regularly, discharge the minimum amount necessary, and take other steps to minimize the uptake and carriage of invasive species.²² These provisions, though voluntary, are coordinated with federal requirements.

Virginia Department of Agriculture and Consumer Services

VDACS has primary responsibility for managing plants and plant pests and inspecting nurseries and horticulture facilities.²³ While most of its duties are terrestrial, the agency is also authorized to prevent and manage aquatic plant species under the state noxious weed law.²⁴ VDACS maintains a dirty list of noxious weeds based on this law. It can add plants to the list based on the damage they cause to surface waters and lakes, among other criteria.²⁵ Listed, noxious weeds may not be moved into or within Virginia without a permit. Permits are available only if the weed is already established or if the importer seeks to use the weed for scientific research purposes and has established safeguards against its escape.²⁶ VDACS is authorized to enforce these provisions by stopping, seizing, and destroying deliveries of noxious weeds.²⁷

To date, one noxious weed has been listed: purple loosestrife (*Lythrum salicaria*, *Lythrum virgatum*, and all of their hybrids and cultivars).²⁸ Although VDACS has not used its noxious weed authorities aggressively in the AIS context, it could do so to prevent the importation of additional, potentially invasive aquatic plant species.

Virginia Department of Conservation and Recreation

VDCR is charged with protecting the biological diversity of Virginia.²⁹ Under this authority, VDCR's Natural Heritage Program worked on invasive plant issues since the early 1990s. Most notably, VDCR, with cooperation from the Virginia Native Plant Society and various industry representatives, has developed and maintained an invasive plant list.³⁰ The agency has also developed lists of native plants that serve as alternatives to invasive species. Finally, VDCR serves as the staff agency to the Virginia Invasive Species Working Group and liaison to the federal Aquatic Nuisance Species Task Force (ANSTF).

Virginia Invasive Species Council and Working Group

VISC was established by the Invasive Species Council Act of 2003³¹ to “provide state leadership of invasive species issues in the Commonwealth and to prepare an invasive species management plan.”³² VISC has since produced an ANSTF-approved plan that includes prevention goals and addresses both aquatic and terrestrial threats.³³ Legislation establishing the VISC included a sunset provision that took effect in 2006.

Governor Kaine issued an Executive Directive in 2006 (continued in 2007) establishing the Virginia Invasive Species Working Group. VISWG comprises the same state agencies as VISC, as well as the U.S. Fish and Wildlife Service, Virginia Tech University, Virginia Institute of Marine Sciences, The Nature Conservancy, and Dominion Power. VISWG is charged with implementing the state invasive species management plan.³⁴ The working group meets twice per year but faces challenges due to a lack of funding from the state or federal government. Nonetheless, eventual full implementation of the management plan is likely, so we consider the plan’s coordination provisions next.

The invasive species management plan, while focused on the State of Virginia, does recognize the need to look beyond political boundaries in seeking solutions. Regional and national coordination is included as an overarching need.³⁵ The plan identifies 47 specific actions to combat invasive species. Lead agencies, time frames, and initial cost estimates are identified for 20 actions.³⁶ The Nature Conservancy and various state agencies committed minimal start-up funds, and the state is currently seeking federal funding for continued implementation.

The plan includes descriptions of priority invasive species for the State of Virginia and profiles the dimensions of the problem through a discussion of introduction pathways, prevention, early detection, rapid response, control and management, research and risk assessment, and education and outreach. The VISWG, through a series of subcommittees, is working to tackle the fundamental tasks identified in the plan for 2007-2008.³⁷ Success of the plan depends most upon whether sufficient funding will be provided to address the problem.³⁸

With respect to prevention, the Virginia plan notes the need for a comprehensive analysis of invasion pathways in coordination with the federal government and for the development of management plans that address prevention through attention to high-risk pathways.³⁹ Coordinated pathways analysis is an excellent first step in preventing AIS, and Virginia should also seek coordination with other states in this task. In addition, the state, presumably through future updates to the plan, should recognize the existence of known, effective prevention measures and set forth specific benchmarks for their adoption.

Notes

1. VISC, Virginia Invasive Species Management Plan (2005).
2. Title 29.1 of the state code addresses wildlife management. VDGIIF’s authority excludes plants and threatened and endangered insects. *See* Va. Code Ann. § 29.1-100
3. Va. Code Ann. §§ 29.1-521, 29.1-531; 4 Va. Admin. Code § 15-30-10.
4. Va. Code Ann. § 29.1-542. This provision appears to exclude fish, as it specifically prohibits only “birds and animals” but later provides for the importation of “nonpredatory birds, animals, or fish.” *Id.* This issue is likely unimportant, however, due to the additional authority to prohibit fish possession, importation, and release under NANSAs.
5. 4 Va. Admin. Code § 15-30-20. Predatory and undesirable species include coyotes, wolves, house mice, Norway rats, black rats, feral hogs, nutria, woodchucks, European starlings, English sparrows, and pigeons. Va. Code Ann. § 29.1-542; 4 Va. Admin. Code § 15-20-160. The possession, sale, or release of nutria is also specifically banned by statute. Va. Code Ann. § 29.1-545. In addition, VDGIIF has adopted the list of migratory bird species promulgated by the federal government under the Migratory Bird Treaty Reform Act. *See* 50 C.F.R. § 10.13. These migratory birds may thus not be imported, possessed, or released in Virginia.
6. *See* 4 Va. Admin. Code § 15-30-40. For example, listed species include, but are not limited to, marine toads, mute swans, piranhas, several carp species, zebra and quagga mussels, crocodiles, and several crayfish species.
7. Va. Code Ann. § 29.1-542.
8. 4 Va. Admin. Code § 15-30-40 (“All other nonnative (exotic) animals . . . may be possessed, purchased, and sold; provided, that such animals shall be subject to all applicable local, state, and federal laws and regulations, including those that apply to threatened/ endangered species, and further provided, that such animals shall not be liberated within the Commonwealth.”). It should be noted that VDGIIF regulations generally prohibit the possession, transport, or sale of unlisted wildlife species without specific authorization. 4 Va. Admin. Code § 15-20-160. This provision, however, is overridden by the specific permission granted by section 15-30-40.
9. Va. Code Ann. § 29.1-571. Species listed as meeting these criteria include the zebra mussel, quagga mussel, snakehead, black carp, New Zealand mudsnail, and rusty crayfish. *Id.*; 4 Va. Admin. Code § 15-20-210. *See also* 4 Va. Admin. Code § 15-360-70 (prohibiting the sale of any species of crayfish).
10. Va. Code Ann. § 29.1-573.

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11. *Id.*
 12. Va. Code Ann. § 29.1-574; 4 Va. Admin. Code § 15-20-210.
 13. *See* VISC, VISMP (stating that permits are “rarely granted”).
 14. Va. Code Ann. § 29.1-575.
 15. Va. Code Ann. § 29.1-576.
 16. 4 Va. Admin. Code § 15-320-60.
 17. Va. Code Ann. § 29.1-569.
 18. Va. Code Ann. § 28.2-825.
 19. *Id.* In addition to permitting the placement of triploid (sterile) non-native oysters on submerged state lands, *see* Va. Code Ann. § 28.2-826, VMRC regulations allow for the importation of disease-free individuals from various non-invasive shellfish and crab broodstocks. 4 Va. Admin. Code § 20-754-30.
 20. Va. Code Ann. § 28.2-111.
 21. 4 Va. Admin. Code § 20-398-30.
 22. *Id.*
 23. *See* Va. Code Ann. § 3.1-135 *et seq.*
 24. Va. Code Ann. § 3.1-296.11 *et seq.*
 25. Va. Code Ann. § 3.1-296.12. Although several sources, including the VISC management report, state that purple loosestrife is regulated under the noxious weed act, the VDACS regulations do not appear to list the species. *See* 2 Va. Admin. Code § 5-390-20.
 26. Va. Code Ann. § 3.1-296.16.
 27. Va. Code Ann. § 3.1-296.17.
 28. 2000 Va. Acts ch. 372.
 29. Va. Code Ann. § 10.1-211.
 30. Va. Dep’t of Conserv. & Rec., Invasive Alien Plant Species of Virginia, *available at* www.dcr.virginia.gov/natural_heritage/documents/invlist.pdf (2003).
 31. Va. Code § 10.1-2600.
 32. *See* VISC, *supra* note 1, at iv.
 33. The Virginia Plan was approved by the Invasive Species Council and Governor’s office in December 2005, and approved by ANSTF in February 2007.
 34. Commonwealth of Virginia, Executive Directive 2: Establishing the Invasive Species Working Group (2006).
 35. VISC, *supra* note 1, at 5.
 36. VISC, *supra* note 1, at 16-19.
 37. *See* VISC, *supra* note 1, at 6-15 (steps include: (1) develop high priority invasive species and early detection lists; (2) initiate a public education effort; (3) conduct a legal review beginning with existing Virginia laws and regulations in phase I and regional national in phase II for use in improving existing laws and regulations; (4) conduct pathway and early detection program analyses centered around the species identified in step 1; (5) catalog existing rapid response plans and assess need for additional plans; and (6) develop an invasive species survey protocol to be implemented by state agencies as called for in Executive Order 2).
 38. Tom Smith, Nat’l Heritage Director, Va. Dep’t of Conserv. & Rec., (Sep. 25, 2007).

Pennsylvania

Several Pennsylvania agencies are active in the prevention of AIS introduction by limiting the importation, release, and escape of AIS. These agencies include the Department of Agriculture (PDA), the Fish and Boat Commission (PFBC), and the Game Commission (PGC). In addition, Pennsylvania has established an invasive species council (PISC) that facilitates interactions between state agencies and non-governmental entities active in AIS prevention. PISC has also created an AIS management plan.¹

Pennsylvania Department of Agriculture

PDA is responsible for the maintenance and protection of Pennsylvania agriculture, including preventing AIS plant introductions in the state. To this end, PDA's Bureau of Plant Industry administers the state Noxious Weed Control Law, Plant Pest Act, and Seed Act. The department also regulates aquaculture facilities in conjunction with PFBC.

PDA maintains a dirty list of noxious weeds and of noxious weed seeds, which are subject to limitations on importation and sale.² Although the list deals primarily with agricultural pests, purple loosestrife is listed, and other aquatic species are eligible to be added to the list.³ The propagation, sale, or movement of any plant on the state Noxious Weed Control List is prohibited. In addition, the Pennsylvania Seed Act prohibits noxious weed seeds from being present in seed sold in Pennsylvania. To enforce these provisions, the agency inspects horticulture facilities and certifies them as pest-free.⁴

PDA, in cooperation with PFBC, also has regulatory authority for aquaculture facilities and issues permits for the artificial propagation, sale, and distribution of live aquatic animals. The state Aquacultural Development Law⁵ authorizes PDA to register aquaculture facilities based on lists of approved species issued by PFBC.⁶ While hobby fish breeders need not register, they may nonetheless propagate only permitted species.⁷ The law also requires dealers in aquatic animal species to register with the department. These dealers are permitted to sell only approved fish species and may import solely from preapproved sources deemed to be free of disease.⁸ According to the state AIS management plan, PDA has also provided training on aquatic invasive species for bait dealers and hatchery operators in cooperation with Pennsylvania Sea Grant.⁹

Pennsylvania Fish and Boat Commission

PFBC is responsible for regulating fishing and boating activities in Pennsylvania. Although its regulatory efforts are primarily aimed at safe operation of watercraft and the regulation of fishing, the commission also regulates the propagation and transport of fish, reptiles, and amphibians. Several PFBC regulations specifically address known invasion pathways, including escapes from aquaculture and herpetofauna facilities.

PFBC's regulation of fish propagation is extensive, protecting against the unintentional escape or release of several known AIS. The Commission maintains a clean list of species that may be propagated in aquaculture facilities.¹⁰ The propagation of other species in the state is prohibited except in PDA-approved closed systems.¹¹ The approved list is maintained on a watershed-by-watershed basis, so certain species may be cultured solely in specified regions of the state.¹² In addition, PFBC has established a dirty list containing species that are banned from importation, introduction into state waters (i.e., release), or possession in the state. Several listed species may not be possessed, introduced, or imported.¹³ The same species may not be transported into or through the state in interstate commerce.¹⁴ Other listed species may not be introduced but may be possessed and imported,¹⁵ or may be introduced or imported only within the constraints of a departmental research project.¹⁶ Finally, PFBC has established a blanket prohibition on the transport into the state and liberation in any watershed of the state of certain species of live fish (except tropical fish "not dangerous to native fish species or to man") without prior written permission from the Commission.¹⁷ The same provision prohibits transport of fish between drainage basins in the state unless those fish are naturally present in the receiving basin.¹⁸

PFBC also regulates the design of aquaculture facilities to prevent escapes. The law separates such facilities into closed and open facilities. Closed systems may not take from or discharge into state waters.¹⁹ Similarly, escape of fish is prohibited, so neither live fish nor fish eggs are permitted to escape from the facilities, and potential escapes must be contained within the facility pursuant to a written discharge plan. If discharges do occur, facilities must notify

the Commission and PDA immediately.²⁰ It should be noted that the Commission does not itself prescribe specific guidance for the design of these facilities, but it does require the facilities to register with PDA and invites PDA to prescribe the design of such facilities.²¹ While it does not register the facilities, the Commission does inspect them.²²

PFBC's reptile and amphibian regulations similarly govern the dealing, importation, and escape of certain listed species. Propagation of reptiles or amphibians outside of pet or hobby stores requires registration with PDA in the same manner as an aquaculture facility.²³ In no case, however, is it legal to propagate species that have not been approved by PFBC.²⁴ PFBC therefore maintains clean lists of approved species that may be propagated in an open or a closed system.²⁵ Although open systems are not subject to specific design provisions, closed systems must be maintained in a manner specified in the regulations to avoid escape of the species by land or water. Furthermore, all escape is specifically prohibited, and each operation must develop a written plan for containing and recovering any escaped individuals.²⁶ The commission is permitted to inspect these facilities to ensure that they are designed to prevent escape.

In addition to limits on the propagation of reptile and amphibian species, PFBC has also outlawed the introduction of non-native herpetofauna into the state's natural environment.²⁷ As a result, individuals who import non-native reptile and amphibian species must "institute appropriate safeguards" to prevent the introduction of the species into the wild.²⁸ PFBC thereby renders unlawful the intentional release of non-native reptiles and amphibians.

Pennsylvania Game Commission

PGC regulates wildlife species in Pennsylvania.²⁹ State law makes it unlawful for any person to import or transport into the state, or release in the state, any species whose importation or release is contrary to any federal or state law or any PGC regulation.³⁰ In turn, the Commission is authorized to prohibit importation, possession, sale, and release of any wildlife species as necessary to safeguard native wildlife species.³¹ PGC has promulgated a dirty list of wildlife species that may not be imported, possessed, sold, or released in Pennsylvania, including nutria.³² Zoos with

public funding, circuses, and exotic wildlife permit-holders are exempt from these limitations.³³ In addition, no wildlife species (regardless of its presence on the dirty list) may be released intentionally without a permit from PGC.³⁴

PGC issues permits for "exotic wildlife" dealers, propagators, and purchasers and for menageries.³⁵ Exotic wildlife dealer permits allow holders to import, possess, sell, or "otherwise dispose of" exotic wildlife. Purchaser permits are required to purchase or possess exotic wildlife.³⁶ Importation of exotic wildlife by any person without a permit is illegal, and it is unlawful in all instances to release wildlife or fail to exercise due care in protecting the public from attack by wildlife.³⁷ Wildlife propagation facilities similarly require a permit and must be designed to avoid escapes.³⁸ Finally, "menageries"³⁹ must be permitted and must comply with PGC regulations regarding appropriate housing and disposal of the birds and wildlife kept there. The applicable regulations prescribe proper design for a variety of species to prevent escapes.⁴⁰ As for private wildlife owners, menageries are prohibited from releasing wildlife or failing to protect the public from attack.⁴¹ Permits are similarly needed for dealers, purchasers, or menageries to propagate wildlife.⁴² None of the above provisions, however, applies to public zoos, accredited private zoos, or "nationally recognized" circuses.⁴³

Pennsylvania Invasive Species Council

Pennsylvania, like Virginia, has produced an AIS management plan that has a prevention component.⁴⁴ This planning effort was overseen by the Pennsylvania Invasive Species Council (PISC), which was created by executive order of the governor in 2004 to create a statewide invasive species management strategy and provide advice on invasive species issues.⁴⁵ PISC consists of both state agency representatives and public groups. The council remains in its formative stages, and its priority actions include hiring of dedicated invasive species coordination staff and procurement of adequate funding and resources to address the substantive challenges of preventing and managing invasive species in the state.⁴⁶ PISC's future goals include coordination of invasive species efforts, including AIS efforts, on federal, state, and local levels and identification of vectors to minimize the introduction of new species in the state.⁴⁷

The state AIS plan was completed and approved by the governor in late 2006, and has since been approved by the federal Aquatic Nuisance Species Task Force (ANSTF). PISC must now seek funding for plan implementation.⁴⁸ The plan identifies several types of AIS introduction pathways in the state, including: unintentional introductions through ballast water exchange, other ship-borne pathways, and contamination of articles in trade; introductions resulting from intentional importation, such as trade in and release of wildlife and plants, whether intentional and unintentional; and introductions resulting from the elimination of natural barriers to entry, such as through the creation of canals.⁴⁹ To address these pathways, the AIS plan anticipates the initiation of a scientifically-based risk assessment process to determine the potential for species to become invasive in the state in the future and to determine the most likely pathways through which those species will enter the state. It then proposes the development of plans to reduce the risk of invasion through high-risk pathways, including for ecologically sensitive areas. Finally, the plan proposes the development and implementation of species-specific prevention actions to address high-priority species prior to their introduction. Such actions may include non-regulatory options such as best management practices, codes of conduct, or certification, or could include “watch” lists or other regulatory action. These voluntary actions are unlikely to effectively prevent threats to the Bay ecosystem, however. Thankfully, the Pennsylvania plan explicitly recognizes the need for Pennsylvania state agencies to coordinate with other state and federal agencies⁵⁰ and recognizes the need to improve existing laws and regulations to enhance their effectiveness. To this end, the plan proposes a comparison of existing laws against a model AIS law and gap identification and identification of opportunities for improved cooperation among agencies and other entities.⁵¹

Notes

1. Other agencies, including the Department of Conservation and Natural Resources (PDCNR), the Department of Health, and the Department of Transportation also have responsibilities related to AIS, but are not active in preventing invasions through regulatory action. These agencies are particularly active in the control and management of AIS. Non-regulatory actors active in AIS issues include the Delaware River Invasive Plant Partnership and Pennsylvania Sea Grant. *See* PISC, Aquatic Invasive Species Management Plan 13 (2006).
2. 3 P. S. § 255.3(b); 7 Pa. Code § 110.1 (noxious weeds); 7 Pa. Code 111.21 – 111.23 (seeds).
3. 7 Pa. Code § 110.1. PDA also actively manages some invasive species, including purple loosestrife.
4. 7 Pa. Code § 119.1 – 119.6.
5. 3 Pa. Cons. Stat. § 4201 *et seq.*
6. *Id.* at 4219-4220.
7. 3 Pa. Cons. Stat. § 4223.
8. 3 Pa. Cons. Stat. § 4222.
9. PISC, Aquatic Invasive Species Management Plan 11 (2006).
10. 58 Pa. Code § 71.2. Prior to 1998, the PFBC issued propagation and transport licenses for live fish, bait fish, and baitfish dealers. The legislature turned these duties over to the PDA at that time, restricting the PFBC’s role to species identification in open- and closed-circulation facilities, respectively. PFBC, Proposed Rulemaking: Propagation of Fish, 31 Pa. Bull. 3412 (2001).
11. 58 Pa. Code § 71.3. This section requires that “closed systems” be approved by PDA. PFBC, however, is permitted to inspect facilities prior to approval and at any time thereafter to ensure that the facilities meet its other standards, which are themselves subject to updates from PDA’s advisory committee. *Id.* at § 71.3(a)(6)-(7). In addition to designating construction standards, this section makes escapes from closed facilities unlawful. *Id.* at § 71.3(c).
12. *See* PFBC, Species By Watershed Approved For Open System (Flow Through) Propagation And Introductions (2007).
13. 58 Pa. Code § 71.6(d). These include snakeheads, black, big-head, and silver carp, zebra and quagga mussels, round and tubenose gobies, the European rudd, rusty crayfish, and ruffe.
14. 58 Pa. Code § 73.1.
15. *Id.* at § 71.6(b) (tilapia).
16. 58 Pa. Code §§ 71.6(a), (c) (grass carp).
17. 58 Pa. Code § 73.1. Stocking of native fish in farm ponds and licensed fee fishing ponds is also not required.
18. *Id.* In addition, PFBC recently issued a temporary change to these regulations prohibiting any transportation of live fish out of the Lake Erie watershed. PFBC, Notice: Temporary Changes to Fishing Regulations: Transportation of Live Fish Out of Lake Erie Watershed (2007). Formal rulemaking action on this issue is forthcoming.
19. Pa. Code § 71.3.
20. *Id.*
21. It does not appear that PDA has taken any such actions as to open facilities.
22. *Id.*

23. 58 Pa. Code § 79.8. Note that the reptile and amphibian regulations have recently been adopted.
24. *Id.*
25. *Id.*
26. *Id.*
27. 58 Pa. Code § 79.11.
28. *Id.*
29. In Pennsylvania, “wildlife” does not include reptiles or amphibians.
30. 34 Pa. Cons. Stat. § 2163.
31. *Id.*
32. 58 Pa. Code 137.1.
33. *Id.*
34. 58 Pa. Code § 137.2.
35. 34 Pa. Cons. Stat. § 2962. Exotic wildlife is defined to include, but not be limited to, “bears, coyotes, lions, tigers, leopards, jaguars, cheetahs, cougars, wolves and any crossbreed of these animals which have similar characteristics in appearance or features. The definition is applicable whether or not the birds or animals were bred or reared in captivity or imported from another state or nation.” 34 Pa. Cons. Stat. § 2961. The lack of clarity in this definition obfuscates the extent of PGC’s regulatory authority under this section, but it is clear that, in this context, “exotic” and “nonindigenous” are not synonyms.
36. 34 Pa. Cons. Stat. § 2963.
37. 34 Pa. Cons. Stat. § 2962.
38. 58 Pa. Code § 147.201 *et seq.*
39. Menageries are defined as “[a]ny place where one or more wild birds or wild animals, or one or more birds or animals which have similar characteristics and appearance to birds or animals wild by nature, are kept in captivity for the evident purpose of exhibition with or without charge.” 34 Pa. Cons. Stat. § 2961.
40. 58 Pa. Code § 147.241 *et seq.*
41. 34 Pa. Cons. Stat. § 2964.
42. 34 Pa. Cons. Stat. § 2930.
43. 34 Pa. Cons. Stat. § 2965.
44. PISC, Aquatic Invasive Species Management Plan (2006). The terrestrial component of the state’s comprehensive statewide invasive species plan remains under development.
45. Pa. Exec. Order 2004-1 (Sep. 18, 2006), as amended. PISC is chaired by the state Department of Agriculture and includes representatives both from agencies responsible for invasive species management and from private agricultural, environmental, and educational interests active in invasive species research and outreach. *See Id.*; PISC, *supra* note 44.
46. *Id.* at 6.
47. PISC, Status Report to the Governor: December 2006 5 (2006).
48. *Id.* at 4.
49. PISC, *supra* note 44, at 18.
50. *Id.* at 33-34.
51. *Id.* at 34.

Region-wide Efforts at Collaboration

In addition to the state-specific laws and regulations delineated above, states have made several significant efforts to coordinate their AIS prevention efforts on a region-wide basis as part of larger efforts to remediate the Bay and maintain its ecological productivity.

The most significant such effort is the Chesapeake Bay Commission (CBC), a group made up of lawmakers and executive branch representatives from Virginia, Maryland, and Pennsylvania as well as representatives from the U.S. Environmental Protection Agency (EPA), and other groups. The CBC is a collaborative body intended to enhance the development of uniform laws and policies in participating states to remediate the Chesapeake Bay environment. Although it lacks independent regulatory authority, the CBC serves as a clearinghouse and forum for coordinating the legislative efforts of member states. AIS are within the CBC's purview, but the issue has not been in the forefront of the commission agenda, which has focused primarily on nutrient outflow management to date.

The CBC is also a member of the Chesapeake Bay Program (CBP), along with Maryland, Pennsylvania, and Virginia, the District of Columbia, EPA, and local citizen advisory groups.¹ The CBP was established by agreement in 1983 to fund and support research for Bay restoration and to implement designated management goals. CBP's efforts are currently guided by *Chesapeake 2000*, which identifies management actions that are intended to improve the bay environment.² CBP is divided into committees that oversee implementation of *Chesapeake 2000*, including the living resources committee that is responsible for AIS issues.

The effectiveness of CBP's on-the-ground efforts under *Chesapeake 2000* has been criticized,³ but CBP has undertaken several prevention-oriented institutional development projects called for by the agreement. First, CBP established a ballast water task force intended to work cooperatively with the Coast Guard and other federal interests, the shipping industry, and the environmental community to address the introduction of exotic species through ballast water.⁴ However, Congress has not yet been enacted legislation strengthening ballast water practices, and it is unclear how effective the CBP task force has been in

the ongoing debate on the issue at the federal level. Second, CBP created an Invasive Species Workgroup (ISW) to "identify and rank non-native, invasive aquatic and terrestrial species which are causing or have the potential to cause significant negative impacts to the Bay's aquatic ecosystem," as called for by *Chesapeake 2000*.⁵ The ISW was tasked with identifying established AIS in the bay and developing management plans for each species but was not asked to address prevention specifically.⁶ While ISW had no prevention role, its actions stimulated further institutional development.

The ISW management plans were eventually completed and turned over to the newly-constituted Mid-Atlantic Panel on Aquatic Invasive Species (MAP).⁷ MAP, an extension of ISW proposed by CBP⁸ and authorized under the Nonindigenous Aquatic Nuisance Prevention and Control Act (NANPCA),⁹ was established in 2003 to enhance collaboration for the prevention and control of AIS in the Mid-Atlantic region. Composed of state, federal, and non-governmental organization, and academic representatives, MAP is a sub-panel of ANSTF and has a focus broader than solely Chesapeake Bay issues. It receives limited funding from ANSTF, is administratively housed within CBP, and is coordinated by a U.S. Fish and Wildlife Service staff member. It has established working groups focused on policy, education and outreach, and science and management. MAP has yet to publish material addressing AIS prevention, but has identified prevention as one of its key future responsibilities.¹⁰ Substantively, MAP reports annually to CBP's living resources committee. The committee accepts MAP's reports but has never responded to or followed up with MAP regarding their contents.

Finally, two of the Bay's major freshwater sources are managed by interstate compacts, both of which interface with the CBP. Because it is the source of roughly half of the Bay's freshwater input and because its watershed abuts that of the Great Lakes, the Susquehanna River is an important vector for downstream AIS introductions. The river and its resources are managed not only by the states in its watershed, but also by interstate compact. The Susquehanna River Basin Commission (SRBC) compact was enacted by Congress in 1972 and simultaneously adopted by the Pennsylvania, Maryland, and New York state legis-

latures.¹¹ Representatives of each of these states and the federal government comprise the SRBC, whose mission is to manage the Susquehanna River water resources. SRBC operates pursuant to its compact, comprehensive river management plan, and strategic plan, which together provide a broad management mandate to address issues ranging from water allocation to water quality. None of SRBC's authorizing documents, however, mention invasive species, so the commission has not actively engaged with AIS issues. SRBC, however, does participate in MAP, is aware of the AIS problem, and is likely to address AIS in its upcoming revision of the comprehensive river management plan.¹²

The Interstate Commission on the Potomac River Basin (ICPRB) is similar in form and function to SRBC. ICPRB was created by congressional and state action in 1940.¹³ Its members include the federal government, Virginia, Pennsylvania, Maryland, West Virginia, and the District of Columbia.¹⁴ Like SRBC, ICPRB is tasked with improving the water quality and addressing other water resource challenges in the Potomac River watershed through interjurisdictional cooperation. Although ICPRB's mandate permits the commission to address AIS issues, it has not to date addressed AIS in its programmatic activities or identified AIS as an issue of concern in its strategic plan. Indeed, a recent ICPRB newsletter includes statements lauding the benefits of exotic species such as hydrilla and carp¹⁵ — both of which have been identified as species of concern by many states, including ICPRB members.¹⁶ These statements reveal a need for education and attention to AIS issues at ICPRB.

Notes

1. Chesapeake Bay Program, *About the Bay Program*, at http://www.chesapeakebay.net/index_cbp.cfm.
2. See CBP, *Chesapeake 2000*, available at <http://www.chesapeakebay.net/pubs/chesapeake2000agreement.pdf> [hereinafter *Chesapeake 2000*].
3. A 2005 study conducted by the U.S. Government Accountability Office (GAO) reports a lack of integration among CBP members in evaluating and determining progress towards restoration of the bay, ineffective communication of the actual health of the bay (beyond reporting compliance with management goals), and ineffective coordination and management of the restoration effort. See U.S. General Accounting Office, *Chesapeake Bay Program: Improved Strategies are Needed to Better Assess, Report, and Manage Restoration Progress* (2005).
4. *Id.* at 2-3.
5. *Chesapeake 2000*, *supra* note 2.
6. See CBP, Invasive Species Working Group, *Invasive Species in the Chesapeake Bay Watershed* (2002) (Moser, Fredrika, ed.).
7. Because MAP does not address terrestrial invasives and ISW has disbanded, no body addresses terrestrial species on a regional basis.
8. See CBP, Mid-Atlantic Regional Aquatic Nuisance Species Panel: Organizational Proposal (2003).
9. 16 U.S.C. § 4723(c).
10. See MAP, Panel Work Plan Development, at http://www.chesapeakebay.net/pubs/calendar/marp_03-31-05_Presentation_8_6079.pdf.
11. SRBC, *Susquehanna River Basin Compact* (1972).
12. Interview with David W. Heicher, Chief, Watershed Assessment & Protection, SRBC (Apr. 24, 2007).
13. The legal authority for the compact was originally based on a 1940 resolution. Pub. L. 76-93, 54 Stat. 748 (1940). Congress amended this authority in 1970. Pub. L. 91-407, 84 Stat. 856 (1970).
14. Pub. L. 91-407.
15. ICPRB, *Potomac Basin Reporter* 60(3) (May/June 2004) (including articles on snakeheads and non-native catfish).
16. See, e.g. MISC, *Invasive Species of Concern in Maryland: Aquatic Plants*, at http://www.mdinvasivesp.org/species/aquatic_plants/Hydrilla.html (2007); Virginia Department of Conservation and Resources, *Invasive Alien Plant Species of Virginia: Hydrilla (*Hydrilla verticillata*)* (1997); MISC, *Invasive Species of Concern in Maryland: Grass Carp*, at http://www.mdinvasivesp.org/species/vertebrates/Grass_Carp.html (2007).

Appendix B

State AIS Lists

Table B-1: Maryland Listed Aquatic Invasive Species

Taxonomic Group	Species	Type	Restrictions	Agency	Authority
Fish	<i>Channidae</i> (family) all species (snakeheads)	P	I, U, T, S, R	MDNR	Md. Regs. Code tit. 8, § 08.02.19.06
	<i>Clarius batrachus</i> (walking catfish)	P	I, U, T, S, R	MDNR	Md. Regs. Code tit. 8, § 08.02.19.04
	<i>Ctenopharyngodon idella</i> (grass carp)	P	I, U, T, S, R	MDNR	Md. Regs. Code tit. 8, § 08.02.19.04
	<i>Gymnocephalus cernuus</i> (Eurasian ruffe)	P	I, U, T, S, R	MDNR	Md. Regs. Code tit. 8, § 08.02.19.04
	<i>Hypophthalmichthys nobilis</i> (bighead carp)	P	I, U, T, S, R	MDNR	Md. Regs. Code tit. 8, § 08.02.19.04
	<i>Hypophthalmichthys molitrix</i> (silver carp)	P	I, U, T, S, R	MDNR	Md. Regs. Code tit. 8, § 08.02.19.04
	<i>Ictalurus furcatus</i> (blue catfish)	P	T	MDNR	Md. Regs. Code tit. 8, § 08.02.19.04
	<i>Monopterus albus</i> (Asian swamp eel) [†]	P	I, U, T, S, R	MDNR	Md. Regs. Code tit. 8, § 08.02.19.04
	<i>Mylopharyngodon piceus</i> (black carp) [†]	P	I, U, T, S, R	MDNR	Md. Regs. Code tit. 8, § 08.02.19.04
	<i>Neogobius melanostomus</i> (round goby)	P	I, U, T, S, R	MDNR	Md. Regs. Code tit. 8, § 08.02.19.04
	<i>Pylodictis olivaris</i> (flathead catfish)	P	T	MDNR	Md. Regs. Code tit. 8, § 08.02.19.04
	<i>Vandellia cirrhosa</i> (candiru)	P	I, U, T, S, R	MDNR	Md. Regs. Code tit. 8, § 08.02.19.04
Invertebrates	<i>Carcinus maenas</i> (European green crab) [†]	P	T	MDNR	Md. Regs. Code tit. 8, § 08.02.19.04
	<i>Dreissena bugensis</i> (quagga mussel)	P	I, U, T, S, R	MDNR	Md. Regs. Code tit. 8, § 08.02.19.04
	<i>Dreissena polymorpha</i> (zebra mussel)	P	I, U, T, S, R	MDNR	Md. Regs. Code tit. 8, § 08.02.19.04
	<i>Eriocheir sinensis</i> (Chinese mitten crab)	P	I, U, T, S, R	MDNR	Md. Regs. Code tit. 8, § 08.02.19.04
	<i>Hemigrapsus sanguineus</i> (Asian shore crab)	P	T	MDNR	Md. Regs. Code tit. 8, § 08.02.19.04
	<i>Orconectes rusticus</i> (rusty crayfish)	P	I, U, T, S, R	MDNR	Md. Regs. Code tit. 8, § 08.02.19.04
	<i>Orconectes virilis</i> (virile crayfish)	P	T	MDNR	Md. Regs. Code tit. 8, § 08.02.19.04
	<i>Procambarus clarkia</i> (red swamp crayfish)	P	T	MDNR	Md. Regs. Code tit. 8, § 08.02.19.04
Herpetofauna	All non-native reptiles and amphibians	PH	R	MDNR	Md. Regs. Code tit. 8 § 08.03.11.10
Wildlife	All non-native wildlife species	P	I, U	MDNR	Md. Regs. Code tit. 8, § 08.03.09.04
Plants	<i>Caulerpa taxifolia</i> (green caulerpa seaweed)	P	I, U, T, S, R	MDNR	Md. Regs. Code tit. 8, § 08.02.19.04
	<i>Hydrilla verticillata</i> (hydrilla)	P	T	MDNR	Md. Regs. Code tit. 8, § 08.02.19.04
	<i>Salvinia molesta</i> (giant salvinia)	P	I, U, T, S, R	MDNR	Md. Regs. Code tit. 8, § 08.02.19.04
	<i>Trapa natans</i> (water chestnut)	P	T	MDNR	Md. Regs. Code tit. 8, § 08.02.19.04

Type: A = Approved P = Permit Required PH = Prohibited, no permit available

Restrictions: I = Import U = Use/Possession/Propagation T = Transport S = Purchase/Sale R = Release/Introduce

† Species name is incorrectly identified by state.

Table B-2: Virginia Listed Aquatic Invasive Species

Taxonomic Group	Species	Type	Restrictions	Agency	Authority
Fish	<i>Channidae</i> (family) all species of <i>Channa</i> and <i>Parachanna</i> (snakeheads)	P	I, U, T, S, R	VDGIF	4 Va. Admin. Code § 15-30-40
	<i>Clariidae</i> (family) all species (air-breathing catfish)	P	I, U, S	VDGIF	4 Va. Admin. Code § 15-30-40
	<i>Ctenopharyngodon idella</i> (grass carp/white amur)	P	I, U, S	VDGIF	4 Va. Admin. Code § 15-30-40
	<i>Cyprinella lutrensis</i> (red shiner)	P	I, U, S	VDGIF	4 Va. Admin. Code § 15-30-40
	<i>Gymnocephalus cernuus</i> (Eurasian ruffe)	P	I, U, S	VDGIF	4 Va. Admin. Code § 15-30-40
	<i>Hypophthalmichthys molitrix</i> (silver carp)	P	I, U, S	VDGIF	4 Va. Admin. Code § 15-30-40
	<i>Hypophthalmichthys nobilis</i> (bighead carp) [†]	P	I, U, S	VDGIF	4 Va. Admin. Code § 15-30-40
	<i>Ictiobus cyprinellus</i> (bigmouth buffalo)	P	I, U, S	VDGIF	4 Va. Admin. Code § 15-30-40
	<i>Ictiobus bubalus</i> (smallmouth buffalo)	P	I, U, S	VDGIF	4 Va. Admin. Code § 15-30-40
	<i>Ictiobus niger</i> (black buffalo)	P	I, U, S	VDGIF	4 Va. Admin. Code § 15-30-40
	<i>Monopterus albus</i> (Asian swamp eel)	P	I, U, S	VDGIF	4 Va. Admin. Code § 15-30-40
	<i>Mylopharyngodon piceus</i> (black carp)	P	I, U, S	VDGIF	4 Va. Admin. Code § 15-30-40 4 Va. Admin. Code § 15-20-210
	<i>Neogobius melanostomus</i> (round goby)	P	I, U, S	VDGIF	4 Va. Admin. Code § 15-30-40
	<i>Proterorhinus marmoratus</i> (tubenose goby)	P	I, U, S	VDGIF	4 Va. Admin. Code § 15-30-40
	<i>Scardinius erythrophthalmus</i> (rudd)	P	I, U, S	VDGIF	4 Va. Admin. Code § 15-30-40
	<i>Serrasalminae</i> (subfamily), some genera (piranhas) [†]	P	I, U, S	VDGIF	4 Va. Admin. Code § 15-30-40
	<i>Tilapia spp.</i> (tilapia)	P	I, U, S	VDGIF	4 Va. Admin. Code § 15-30-40
<i>Tinca tinca</i> (tench)	P	I, U, S	VDGIF	4 Va. Admin. Code § 15-30-40	
Invertebrates	Unapproved marine fish, shellfish, and crustacea	P	I	VMRC	4 Va. Admin. Code § 20-754-30
	<i>Astacoidea</i> (superfamily) all species (crayfish)	PH	U	VDGIF	4 Va. Admin. Code § 15-360-70
	<i>Cherax spp.</i> (Australian crayfish)	P	I, U, S	VDGIF	4 Va. Admin. Code § 15-30-40
	<i>Crassostrea ariakensis</i> (Asian oyster)	P	I, U, R	VMRC	Va. Code Ann. § 28.2-826
	<i>Dreissena bugensis</i> (quagga mussel)	P	I, U, S	VDGIF	4 Va. Admin. Code § 15-30-40
	<i>Dreissena polymorpha</i> (zebra mussel)	P	I, U, S	VDGIF	4 Va. Admin. Code § 15-30-40
	<i>Orconectes rusticus</i> (rusty crayfish)	P	I, U, S	VDGIF	4 Va. Admin. Code § 15-30-40 4 Va. Admin. Code § 15-20-210
	<i>Potamopyrgus antipodarum</i> (New Zealand mudsnail)	P	I, U, S	VDGIF	4 Va. Admin. Code § 15-30-40 4 Va. Admin. Code § 15-20-210

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Restrictions: I = Import U = Use/Possession/Propagation T = Transport S = Purchase/Sale R = Release/Introduce

† Species name is incorrectly identified by state.

Table B-2: (continued)

Taxonomic Group	Species	Type	Restrictions	Agency	Authority
Herpetofauna	All Reptiles	PH	R	VDGIF	Va. Code Ann. § 29.1-569
	<i>Alligatoridae</i> all species (alligator)	P	I, U, S	VDGIF	4 Va. Admin. Code § 15-30-40
	<i>Bufo marinus</i> (cane/giant toad)	P	I, U, S	VDGIF	4 Va. Admin. Code § 15-30-40
	<i>Crocodylidae</i> all species (crocodile)	P	I, U, S	VDGIF	4 Va. Admin. Code § 15-30-40
	<i>Gavialidae</i> all species (gavial)	P	I, U, S	VDGIF	4 Va. Admin. Code § 15-30-40
	<i>Noturus sp.</i> (madtom)	PH	S	VDGIF	4 Va. Admin. Code § 15-360-60
	<i>Salamandridae</i> all species except non-native newts (salamander)	PH	S	VDGIF	4 Va. Admin. Code § 15-360-60
	<i>Xenopus spp.</i> (African clawed frog)	P	I, U, S	VDGIF	4 Va. Admin. Code § 15-30-40
Wildlife	Non-game, non-furbearing wildlife species		U, T, S	VDGIF	4 Va. Admin. Code § 15-20-160
	<i>Cygnus olor</i> (mute swan)	P	I, U, S	VDGIF	4 Va. Admin. Code § 15-30-40
	<i>Myocastor coypus</i> (nutria)	P	I, U, S	VDGIF	4 Va. Admin. Code § 15-20-160
Plants	<i>Lythrum salicaria</i> , <i>Lythrum virgatu</i> , and all of their hybrids and cultivars (purple loosestrife)	P	I,U,T,S,R	VDACS	2000 Va. Acts ch. 372

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Table B-3: Pennsylvania Listed Aquatic Invasive Species

Taxonomic Group	Species	Type	Restrictions	Agency	Authority
Fish	Non-native fish species	P	I, R		58 Pa. Code § 73.1
	Tropical fish sp. not dangerous to native species	A			58 Pa. Code § 73.1
	<i>Carassius auratus</i> (Goldfish)	P	I	PFBC	58 Pa. Code § 73.1
	<i>Channidae</i> (family) all species (snakehead)	PH	I, U, T, R	PFBC	58 Pa. Code §§ 71.6, 73.1
	<i>Ctenopharyngodon idella</i> (grass carp)	PH, P (triploid)	I, T, R	PFBC	58 Pa. Code §§ 71.1, 71.6, 73.1
	<i>Gymnocephalus cernuus</i> (Eurasian ruffe)	PH	I, U, T, R	PFBC	58 Pa. Code §§ 71.6
	<i>Hypophthalmichthys molitrix</i> (silver carp) [†]	PH	I, U, T, R	PFBC	58 Pa. Code §§ 71.6
	<i>Hypophthalmichthys nobilis</i> (bighead carp) [†]	PH	I, U, T, R	PFBC	58 Pa. Code §§ 71.6
	<i>Leuciscus idus</i> (orfe)	P	I	PFBC	58 Pa. Code § 73.1
	<i>Mylopharyngodon piceus</i> (black carp)	PH	I, U, T, R	PFBC	58 Pa. Code §§ 71.6
	<i>Neogobius melanostomus</i> (round goby)	PH	I, U, T, R	PFBC	58 Pa. Code §§ 71.6
	<i>Proterorhinus marmoratus</i> (tubenose goby)	PH	I, U, T, R	PFBC	58 Pa. Code §§ 71.6
	<i>Scardinius erythrophthalmus</i> (rudd) [†]	PH	I, U, T, R	PFBC	58 Pa. Code §§ 71.6
	<i>Tilapia spp.</i> (tilapia)	PH	R	PFBC	58 Pa. Code § 71.6
Invertebrates	<i>Dreissena polymorpha</i> (zebra mussel)	PH	I, U, T, R	PFBC	58 Pa. Code §§ 71.6
	<i>Dreissena bugensis</i> (quagga mussel)	PH	I, U, T, R	PFBC	58 Pa. Code §§ 71.6
	<i>Orconectes rusticus</i> (rusty crayfish)	PH	I, U, T, R	PFBC	58 Pa. Code §§ 71.6
Herpetofauna	All non-native species	PH	I, T, R	PFBC	58 Pa. Code § 79.11
	Species not on approved list	P	U	PFBC	58 Pa. Code § 79.8
Wildlife	Species prohibited by federal law	PH	I, R	PGC	34 Pa. Cons. Stat. § 2163
	Non-listed species of wildlife and game	P	I, U, S, R	PGC	58 Pa. Code 137.1
	“Exotic” wildlife	P	I, U, S, R	PGC	34 Pa. Cons. Stat. § 2962
	<i>Myocastor coypus</i> (nutria)	P	I, U, S, R	PGC	58 Pa. Code 137.1
Plants	<i>Lythrum salicaria spp.</i> (Purple loosestrife)	P	U, T, S, R	PDA	7 Pa. Code § 110.1

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† Species name is incorrectly identified by state.

Table B-4: Listed Aquatic Invasive Species by Scientific Name

Scientific Name	Common Name	Maryland	Virginia	Pennsylvania
<i>Alligatoridae</i> (family)	Alligator		VDGIF	
<i>Astacoidea</i> (superfamily)	Crayfish		VDGIF	
<i>Bufo marinus</i>	Cane toad (giant, marine)		VDGIF	
<i>Carassius auratus</i>	Goldfish			PFBC
<i>Carcinus maenas</i>	Green crab	MDNR		
<i>Caulerpa taxifolia</i>	Green caulerpa	MDNR		
<i>Channidae</i> (family)	Snakehead	MDNR	VDGIF	PFBC
<i>Cherax spp.</i>	Australian crayfish		VDGIF	
<i>Clarius batrachus</i>	Walking catfish	MDNR		
<i>Clariidae</i> (family)	Air-breathing catfish		VDGIF	
<i>Crassostrea ariakensis</i>	Asian oyster		VMRC	
<i>Crocodylidae</i> (family)	Crocodile		VDGIF	
<i>Ctenopharyngodon idella</i>	Grass carp (white amur)	MDNR	VDGIF	PFBC
<i>Cygnus olor</i>	Mute swan		VDGIF	
<i>Cyprinella lutrensis</i>	Red shiner		VDGIF	
<i>Dreissena bugensis</i>	Quagga mussel	MDNR	VDGIF	PFBC
<i>Dreissena polymorpha</i>	Zebra mussel	MDNR	VDGIF	PFBC
<i>Eriocheir sinensis</i>	Chinese mitten crab	MDNR		
<i>Gavialidae</i> (family)	Gavial		VDGIF	
<i>Gymnocephalus cernuus</i>	Eurasian ruffe	MDNR	VDGIF	PFBC
<i>Hemigrapsus sanguineus</i>	Japanese shore crab	MDNR		
<i>Hydrilla verticillata</i>	Hydrilla	MDNR		
<i>Hypophthalmichthys molitrix</i>	Silver carp	MDNR	VDGIF	PFBC
<i>Hypophthalmichthys nobilis</i>	Bighead carp	MDNR	VDGIF	PFBC

Table B-4: (continued)

Scientific Name	Common Name	Maryland	Virginia	Pennsylvania
<i>Ictiobus bubalus</i>	Smallmouth buffalo		VDGIF	
<i>Ictiobus cyprinellus</i>	Bigmouth buffalo		VDGIF	
<i>Ictiobus niger</i>	Black buffalo		VDGIF	
<i>Ictalurus furcatus</i>	Blue catfish	MDNR		
<i>Leuciscus idus</i>	Orfe			PFBC
<i>Lythrum salicaria</i>	Purple loosestrife		VDACS	PDA
<i>Lythrum virgatu</i>	Purple loosestrife		VDACS	
<i>Monopterus albus</i>	Asian swamp eel	MDNR	VDGIF	
<i>Mya arenaria</i>	Soft shell clam		VMRC	
<i>Mylopharyngodon piceus</i>	Black carp	MDNR	VDGIF	PFBC
<i>Myocastor coypus</i>	Nutria		VDGIF	PGC
<i>Neogobius melanostomus</i>	Round goby	MDNR	VDGIF	PFBC
<i>Noturus sp.</i>	Madtom		VDGIF	
<i>Orconectes rusticus</i>	Rusty crayfish	MDNR	VDGIF	PFBC
<i>Orconectes virilis</i>	Virile crayfish	MDNR		
<i>Potamopyrgus antipodarum</i>	New Zealand mudsnail		VDGIF	
<i>Procambarus clarkia</i>	Red swamp crayfish	MDNR		
<i>Proterorhinus marmoratus</i>	Tubenose goby		VDGIF	PFBC
<i>Pylodictis olivaris</i>	Flathead catfish	MDNR		
<i>Salamandridae</i> (family)	Salamanders		VDGIF	
<i>Salvinia molesta</i>	Giant salvinia	MDNR		
<i>Scardinius erythrophthalmus</i>	Rudd		VDGIF	PFBC
<i>Serrasalminae</i> (subfamily)	Piranhas		VDGIF	
<i>Tilapia spp.</i>	Tilapia		VDGIF	PFBC
<i>Tinca tinca</i>	Tench		VDGIF	
<i>Trapa natans</i>	Water chestnut	MDNR		
<i>Vandellia cirrhosa</i>	Candiru	MDNR		
<i>Xenopus spp.</i>	African clawed frog		VDGIF	

Table B-5: Listed Aquatic Invasive Species by Common Name

Scientific Name	Common Name	Maryland	Virginia	Pennsylvania
<i>Xenopus spp.</i>	African clawed frog		VDGIF	
<i>Clariidae</i> (family)	Air-breathing catfish		VDGIF	
<i>Alligatoridae</i> (family)	Alligator		VDGIF	
<i>Crassostrea ariakensis</i>	Asian oyster		VMRC	
<i>Monopterus albus</i>	Asian swamp eel	MDNR	VDGIF	
<i>Cherax spp.</i>	Australian crayfish		VDGIF	
<i>Hypophthalmichthys nobilis</i>	Bighead carp	MDNR	VDGIF	PFBC
<i>Ictiobus cyprinellus</i>	Bigmouth buffalo		VDGIF	
<i>Ictiobus niger</i>	Black buffalo		VDGIF	
<i>Mylopharyngodon piceus</i>	Black carp	MDNR	VDGIF	PFBC
<i>Ictalurus furcatus</i>	Blue catfish	MDNR		
<i>Vandellia cirrhosa</i>	Candiru	MDNR		
<i>Bufo marinus</i>	Cane toad (giant, marine)		VDGIF	
<i>Eriocheir sinensis</i>	Chinese mitten crab	MDNR		
<i>Astacoidea</i> (family)	Crayfish		VDGIF	
<i>Crocodylidae</i> (family)	Crocodile		VDGIF	
<i>Gymnocephalus cernuus</i>	Eurasian river ruffe	MDNR	VDGIF	PFBC
<i>Pylodictis olivaris</i>	Flathead catfish	MDNR		
<i>Gavialidae</i> (family)	Gavial		VDGIF	
<i>Salvinia molesta</i>	Giant salvinia	MDNR		
<i>Leuciscus idus</i>	Golden orfe			PFBC
<i>Carassius auratus</i>	Goldfish			PFBC
<i>Ctenopharyngodon idella</i>	Grass carp (white amur)	MDNR	VDGIF	PFBC
<i>Caulerpa taxifolia</i>	Green caulerpa	MDNR		
<i>Carcinus manenas</i>	Green crab	MDNR		
<i>Hydrilla verticillata</i>	Hydrilla	MDNR		
<i>Hemigrapsus sanguineus</i>	Japanese shore crab	MDNR		

Table B-5: (continued)

Scientific Name	Common Name	Maryland	Virginia	Pennsylvania
<i>Noturus sp.</i>	Madtom		VDGIF	
<i>Cygnus olor</i>	Mute swan		VDGIF	
<i>Potamopygus antipodarum</i>	New Zealand mudsnail		VDGIF	
<i>Myocastor coypus</i>	Nutria		VDGIF	PGC
<i>Serrasalminae (subfamily)</i>	Piranhas		VDGIF	
<i>Lythrum salicaria</i>	Purple loosestrife		VDACS	PDA
<i>Lythrum virgatu</i>	Purple loosestrife		VDACS	
<i>Dreissena bugensis</i>	Quagga mussel	MDNR	VDGIF	PFBC
<i>Cyprinella lutrensis</i>	Red shiner		VDGIF	
<i>Procambarus clarkia</i>	Red swamp crayfish	MDNR		
<i>Neogobius melanostomus</i>	Round goby	MDNR	VDGIF	PFBC
<i>Scardinius erythrophthalmus</i>	Rudd		VDGIF	PFBC
<i>Orconectes rusticus</i>	Rusty crayfish	MDNR	VDGIF	PFBC
<i>Salamandridae (family)</i>	Salamanders		VDGIF	
<i>Hypophthalmichthys molitrix</i>	Silver carp	MDNR	VDGIF	PFBC
<i>Ictiobus bubalus</i>	Smallmouth buffalo		VDGIF	
<i>Channidae (family)</i>	Snakehead	MDNR	VDGIF	PFBC
<i>Mya arenaria</i>	Soft shell clam		VMRC	
<i>Tinca tinca</i>	Tench		VDGIF	
<i>Tilapia spp.</i>	Tilapia		VDGIF	PFBC
<i>Proterorhinus marmoratus</i>	Tubenose goby		VDGIF	PFBC
<i>Orconectes virilis</i>	Virile crayfish	MDNR		
<i>Clarius batrachus</i>	Walking catfish	MDNR		
<i>Trapa natans</i>	Water chestnut	MDNR		
<i>Dreissena polymorpha</i>	Zebra mussel	MDNR	VDGIF	PFBC

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Environmental Law Institute

2000 L Street, N.W., Suite 620

Washington, D.C. 20036

Telephone: (202) 939-3800

Fax: (202) 939-3868

www.eli.org

