MARYLAND
DEPARTMENT OF
NATURAL RESOURCES

Larry Hogan, Governor
Boyd Rutherford, Lt. Governor
Mark Belton, Secretary
Joanne Throwe, Deputy Secretary

January 14, 2016

The Honorable Joan Carter Conway
Chair, Senate Education, Health and Environmental Affairs Committee
Miller Senate Office Building, 2 West Wing
Annapolis, Maryland 21401

The Honorable Kumar P. Barve
Chair, House Environment and Transportation Committee
House Office Building, Room 251
Annapolis, Maryland 21401

RE: Submission of Report on Aquatic Invasive Species in State-owned and Managed Lakes
Agency: Maryland Department of Natural Resources
Report Authority: Section 2(c) of Chapter 461 (HB 860) of the Acts of 2015 (MSAR #10610)

Dear Senator Conway and Delegate Barve:

I am pleased to provide you with the enclosed report, which contains the analysis and recommendations of the workgroup that was created to evaluate actions that reduce the spread of aquatic invasive species from vessels placed in lakes that are owned or managed by the State. The workgroup was created pursuant to section 2 of Chapter 461 (HB 860) of the Acts of 2015, the State Lakes Invasive Species Act of 2015.

Should you have any questions or comments regarding this report, please feel free to contact our Resource Assessment Service Director, Bruce Michael, directly at 410-260-8672, or by email at bruce.michael@maryland.gov.

Sincerely,

Mark Belton
Secretary

enclosure

cc: Sarah Albert (5 copies)
Ryane M. Necessary
T. Patrick Tracy

Workgroup to Evaluate Actions that Reduce the Spread of Aquatic Invasive Species from Vessels Placed in Lakes that are Owned or Managed by the State


Hydrilla


Zebra Mussel


Curly Pondweed


Spiny Waterflea


Virile Crayfish


Northern Snakehead

Report to the Senate Education, Health, & Environmental Affairs Committee & the House Environment & Transportation Committee

December 2015

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Executive Summary

In 2015, the General Assembly passed House Bill 860, entitled the State Lakes Invasive Species Act of 2015 (hereafter "the Act"), which provides that "after April 1, 2017, an owner of a vessel may not place the vessel or have the vessel placed in a lake at a public launch or public dock unless the owner has cleaned the vessel and removed all visible organic material." The Act also directed the Department of Natural Resources (hereafter, "the Department") to convene a workgroup (hereafter, "the Workgroup") to evaluate actions that could reduce the risk of the introduction and spread of aquatic invasive species in Maryland state-owned-and-managed lakes. On June 25, 2015, the Workgroup convened for the first time and met regularly throughout the summer and fall 2015 to compile the recommendations and information in this report.

Impacts of Aquatic Invasive Species

Aquatic invasive species (AIS) have been shown to create significant economic and ecological harm, including the loss of biodiversity, altered aquatic food webs, reduced water quality, reduced public safety and health, a decline in fisheries, damage to infrastructure, reduced boating, fishing, and other recreational opportunities, and a loss of tourism revenue to local communities. Mitigating these impacts can be extremely costly. In the U.S. alone, damage mitigation and control of the spread of AIS cost approximately $8 billion per year.

Several AIS have already negatively impacted the productivity and biodiversity of Maryland waters, impacting native species and aquatic resources. Some notable AIS that have been introduced to Maryland waters include blue catfish, northern snakehead, rusty crayfish, zebra mussel, and Hydrilla, the latter most recently discovered in Deep Creek Lake in 2013 and Lake Habeeb in 2015. There is a growing list of other AIS that pose a significant ecological and economic risk if introduced into Maryland waters.

Pathways of AIS Introductions

Recreational boating is one of the major pathways responsible for the transport of AIS between waterbodies. AIS are introduced when they are inadvertently carried between waterbodies in bilge water, engine cooling systems, live wells, or attached/entangled to hulls, trailers, or other surfaces. Because recreational boats and associated gear can be transported by trailers over great distances, contaminated watercraft can be a source of new AIS to a region. Recreational boating is the likely pathway responsible for the introduction of Hydrilla and other invasive plants in Deep Creek Lake and other Maryland lakes.

Following the discovery of Hydrilla in Deep Creek Lake in 2013, the Department implemented a voluntary inspection pilot program using launch stewards for vessels launching at Deep Creek Lake State Park. The Department also increased education and outreach efforts to increase AIS awareness among boaters and to encourage them to clean their vessels before entering and when leaving lakes and take other preventive measures to minimize the threat of AIS introduction.

Workgroup Recommendations

- Following an analysis of the economics and the effectiveness of the options, the Workgroup recommends that the Department apply a toolbox-like approach to AIS prevention whereby lake managers would evaluate, on a lake-by-lake basis, the most appropriate prevention approaches (or tools) to use given the level of AIS risk, available resources for implementation (such as, existing staff and funding), logistics, and other criteria.

- The AIS Prevention Toolbox includes the following approaches:
    - Education and Outreach
    - Watercraft Self-Inspection Certification (Mandatory)
    - Launch Steward Watercraft Inspection (Voluntary)
    - Launch Steward Watercraft Inspection (Mandatory)
    - Launch Steward Watercraft Inspection and Decontamination (Mandatory)

- Additionally, the Workgroup recognizes the value of both the education and outreach and prevention gained by the pilot program implemented in 2014 at Deep Creek Lake. The Workgroup recommends that these efforts continue if funds are available without affecting other core functions of the Department.

- The Workgroup also recognizes the importance of monitoring Maryland lakes for AIS and recommends that the Department continue survey efforts already initiated of the 16 lakes as time, mission, and funding allows.

Recommended Funding Sources for AIS Prevention

The biggest challenge to implementing several of the approaches evaluated by the Workgroup is funding, which is needed for infrastructure, program implementation, and personnel costs. Currently the Department does not have a dedicated AIS funding source or budget allocation. Efforts to date were performed by various staff when needed, often at the expense of other priorities and functions.

Most states combating AIS have created dedicated funding mechanisms to partially or fully fund their AIS programs, often creating innovative partnerships with local governments, nonprofits, and businesses. Examples of these are provided on page 28 of this report. Depending on the AIS toolbox approach selected by lake managers, the Workgroup recommends considering the use of similar techniques or partnerships as long as the sources of AIS funds do not impact other core Department functions.

Implementation Plan

The Workgroup developed a plan to implement the AIS prevention recommendations by July 1, 2016 as funding allows. This plan includes the following:

- Deep Creek Lake State Park will continue the voluntary launch steward watercraft inspection program during the 2016 boating season.

- The Department will develop education and outreach materials describing new restrictions listed under HB 860 to be distributed to Maryland boaters at all state owned lakes to increase their awareness of the new law.

- The Department will develop and seek funding to produce additional AIS education and outreach resources, including signage for boat launches, flyers, and other materials to be distributed at state lakes.

- The management unit responsible for managing each lake will work with the Invasive Species Matrix Team (ISMT) to review which of the recommended options are appropriate for their lake, estimate costs, review options for funding and implement the necessary measures if approved by the Department Leadership. The Department will compile all recommendations, seek efficiencies of scale where possible, and work with park managers to achieve the best AIS prevention strategy with available funds.

- Working in-house, the Maryland Park Service can utilize staff with resource management and interpretative backgrounds to generate plans and programs without added costs or extensive operational encumbrances.

- Resource Assessment Service staff will provide training to lake managers and staff on the identification of AIS of concern.

- Dependent on funding, the Resource Assessment Service staff, working with other Department Units where appropriate, will resume surveys of state-owned lakes and share results with lake managers to inform management decisions and prevention efforts. Currently, 4 out of the 16 State owned or managed lakes have been surveyed for aquatic invasive plants.

Introduction

House Bill 860, entitled the State Lakes Invasive Species Act of 2015, directed the Maryland Department of Natural Resources (hereafter, "the Department") to convene a workgroup to evaluate actions that could reduce the risk of the introduction and spread of aquatic invasive species in Maryland state-owned-and-managed lakes. The Act states that the workgroup "shall make recommendations on the most appropriate actions to reduce the spread of aquatic invasive species from vessels placed in lakes that are owned or managed by the State, including: recommended budget items; recommended funding sources; and prioritized activities and resources; and include a plan in the report required under subsection of this section to implement the recommendations of the workgroup by July 1, 2016." Furthermore, "on or before December 31, 2015, the workgroup shall report its recommendations to the Senate Education, Health, and Environmental Affairs Committee and the House Environment and Transportation Committee." On June 25, 2015, the Department convened the Aquatic Invasive Species (AIS) Workgroup (hereafter, "the Workgroup"), which met regularly throughout the summer and fall of 2015 to compile the recommendations and information in this report. Minutes, presentations, and supporting resources from these Workgroup meetings can be found at the following website: http://dnr.maryland.gov/bay/ais/index.htm

Workgroup Members

Maryland Department of Natural Resources

Resource Assessment Service
Bruce Michael, Chair
Mark Lewandowski*
Matt Ashton*
Jay Kilian*

Wildlife and Heritage
Jonathan McKnight*

Park Service
Eric Null
Julie Bortz
Gary Burnett
Seth Metheny
Sarah Milbourne

Fisheries
Dr. Joseph Love*

Natural Resources Police
Kelley Johnson

Boating Services
Donna Morrow

Integrated Policy Review
Elliott Campbell
Mike Naylor

DNR Legislative Office
Lisa Eutsler

DNR Legal
Mark Talty
Jennifer Wazenski

External Representation

Deep Creek Lake Marina Operator/Owner
Carol Jacobs

Public Interest
Barbara Beelar (Friends of Deep Creek Lake)

Legislative Representative
Dana Stein, MD House of Delegates
Staffer, Margie Brassil

Expert consultant on boat cleaning and decontamination programs
Dee Davis (Pacific States Marine Fisheries Commission)
Clark Howells (Baltimore City Department of Public Works)

* Member of the Department's Invasive Species Matrix Team (ISMT)

Current Maryland Law on Aquatic Invasive Species Control and Prevention

In direct response to the discovery of a snakehead fish in a Crofton pond in 2002, the Maryland Legislature adopted § 4-205.1 of the Natural Resources Article. *See* 2003 Md. Laws, ch. 373. That statute explicitly authorizes the Secretary of Natural Resources to adopt regulations to "[p]rohibit the importation, possession, or introduction into State waters of a nonnative aquatic organism in order to prevent an adverse impact on an aquatic ecosystem or the productivity of State waters." NR § 4-205.1(b)(1)(i). Furthermore, the legislation authorizes the Department to "enter and inspect a property to determine whether a state of nuisance exists" as long as the Department has provided reasonable notice of its intent to do so. NR § 4-205.1(c)(1). The statute defines a "state of nuisance" as "a condition in which a nuisance organism will foreseeably alter and threaten to harm the ecosystem or the abundance and diversity of native or naturalized fish and other organisms." NR § 4-205.1(a)(9). The statute does not, however, explicitly address the inspection of vessels.

The Department issued new regulations in 2004 pursuant to its expanded authority. The stated purpose of the regulations "is to control the importation, possession, propagation, transport, purchase, sale, or introduction into State waters of certain nonnative aquatic organisms that if accidentally or deliberately introduced into or further spread in the waters of the State would alter and threaten to harm the ecosystem, the abundance and diversity of native or naturalized aquatic organisms, or the productivity of State waters." COMAR 08.02.19.01. The regulations explicitly prohibit a person from "plac[ing] or attempt[ing] to place upon or into State waters a watercraft or associated equipment with attached or contained aquatic plants, zebra mussels, or other prohibited species of nonnative organisms." COMAR 08.02.19.05A;. Furthermore, "[w]ater taken from waters infested by prohibited nonnative species may not be diverted, appropriated, or transported on public roads," except in a declared emergency or by permit. COMAR 08.02.19.05B.

In 2011, the Department of Natural Resources again exercised its regulatory authority under NR § 4-205.1(b) and banned the use of felt-soled waders and boots "in State waters or within five feet of State waters." COMAR 08.02.19.07. The Department implemented the ban in an effort to prevent the spread of *Didymo*, which resource managers across North America had discovered was being transported from stream to stream on the felt-soled waders of fly fisherman.

Maryland's invasive species laws and regulations carry significant penalty provisions. Any person who violates the AIS provisions of NR § 4-205.1 or a regulation adopted under that section is guilty of a misdemeanor. Upon conviction, a person is subject to imprisonment not exceeding 30 days or a fine not exceeding $2,500 or both. NR § 4-205.1(i).

Statutory Power to Inspect Vessels and Prevent Them from Entering a Lake

The enactment of NR § 4-205.1(b)(1) permits the Department to issue any regulations that would "[p]rohibit the importation, possession, or introduction into State waters of a nonnative aquatic organism in order to prevent an adverse impact on an aquatic ecosystem or the productivity of State waters." Although the Department's exercise of that authority must be "consistent with the letter and spirit of the law under which the agency acts," *Christ*, 335 Md. at 437, the Department's regulatory prohibition on placing or attempting to place AIS-contaminated vessels into State waters is undoubtedly consistent with NR § 4-205.1(b)(1).

The Department's Natural Resources Police (NRP) "is charged with enforcing the natural resource and conservation laws of the State." NR § 1-204(a). In fact, NRP officers are given "all the powers conferred upon police officers of the State," and they have "statewide authority" to exercise those powers. *Id.*; *see also* NR § 1-201.1(a). NRP officers are thus charged with enforcing *all* natural resources laws and regulations, including the regulatory prohibition against "plac[ing] or attempt[ing] to place upon or into State waters a watercraft or associated equipment with attached or contained aquatic plants, zebra mussels, or other prohibited species of nonnative organisms." COMAR 08.02.19.05A.

Law Specific to Deep Creek Lake

Both the Maryland Code and Department regulations make clear that DNR has broad authority to regulate the use of Deep Creek Lake. The State bought and owns the lake, "including the land under the lake and the buffer strip." COMAR 08.08.01.01B.[1] The Department's Secretary, along with the Deep Creek Lake Policy and Review Board, must prepare "a plan that provides for the wise use, protection, and management of the natural and recreational resources of [the lake]," and the Department may adopt regulations to "[p]rotect the . . . natural resources and the environment" or to implement the plan. NR § 5-215.1(b)(1), (d); *see also* COMAR 08.08.01.01C ("The Department has authority and responsibility under State law to regulate many public, recreational uses of natural resources in and around the lake, such as boating and fishing."). In fact, the Department's regulations make clear that the use of the lake is a *privilege*, not a right: "The Department has allowed and will allow the public and surrounding landowners to use, and in certain instances to occupy, the waters of the lake, the land beneath the lake, and the buffer strip, but only as a matter of privilege." COMAR 08.08.01.01B.[2]

[1] A history of the lake and the State's purchase of it can be found on DNR's website, at http://dnr2.maryland.gov/publiclands/Pages/western/deepcreeknrma.aspx

[2] DNR already imposes a number of conditions on the use of the lake. *See*, *e.g.*, § 5-215(c) (boat ramp fee); COMAR 08.18.03.03 (noise limits); 08.18.03.08 (use of a muffler); 08.18.33.03 (speed limits); and 08.18.33.02 (permissible types of vessels and date, time and location restrictions).

Conclusions of the Attorney General's Opinion

In an opinion issued in February 2015, the Attorney General concluded that, based on current statute and regulations, no further legislation was needed to authorize NRP officers to carry out vessel inspections as a means of implementing the prohibition on introducing AIS to State waters. According to the Attorney General's opinion, "the inspection of a vessel[3] for AIS before it is launched is a reasonable and effective method of enforcing the statutory and regulatory prohibition on introducing AIS into the waters of the State and, thus, falls within the existing powers of the Natural Resources Police." 100 Opinions of the Attorney General 3, 9 (2015).

He further concluded, however, that additional regulations would clarify DNR's authority to proceed, without a warrant, to inspect a vessel for AIS and prevent the operator from launching it into the lake. *See* 100 Opinions of the Attorney General at 29.

In addition, the Attorney General wrote, "the State may condition the use of the lake, which the State owns, on the operator's express consent to the inspection and, if necessary, on the de-contamination of any vessel and equipment, such as anchors, that someone has brought to the lake for use there." Such a condition could be imposed by the Department, pursuant to its authority to issue regulations to prevent the introduction of AIS into State waters, *see* NR § 4-205.1(b) and to protect the lake, *see* NR § 5-215.1. If AIS searches are likely to extend to parts of a vessel that are not already subject to inspection under the fishing laws and the State Boat Act of 1960, the Department may bolster the legality of such searches by issuing and publicizing regulations that put boat owners on notice of the areas likely to be searched at the boat ramps.

HB 860: "State Lakes Invasive Species Act of 2015"

Earlier this year, the General Assembly enacted House Bill 860, entitled the "State Lakes Invasive Species Act of 2015." The law, which applies to any vessel that is operated in a lake owned or managed by the State, provides that, "after April 1, 2017, an owner of a vessel may not place the vessel or have the vessel placed in a lake at a public launch or public dock unless the owner has cleaned the vessel and removed all visible organic material" NR § 8-703.3(a) & (b). A vessel owner who violates this requirement will be subject to civil penalties starting at $100 for the first offense and increasing to $250 for a second offense and $500 for subsequent violations. NR § 8-703.3(c).

The law directed the Department to convene "a workgroup consisting of the Department, at least one expert in boat cleaning and decontamination programs, and other stakeholders representative of interested parties to evaluate actions that reduce the spread of aquatic invasive species from vessels placed in lakes that are owned or managed by the State." HB 860, sec. 2(a).

[3] The term "vessel" is defined by statute to mean "every description of watercraft, including an ice boat but not including a seaplane, that is used or capable of being used as a means of transportation on water or ice." NR § 8-701(s). The term "includes the motor, spars, sails, and accessories of a vessel." *Id*.; *see also* COMAR 08.04.01.01B(28).

The Workgroup is directed by these provisions to : "(1) make recommendations on the most appropriate actions to reduce the spread of aquatic invasive species from vessels placed in lakes that are owned or managed by the State, including: (i) recommended budget items; (ii) recommended funding sources; and (iii) prioritized activities and resources; and (2) include a plan in the report required under subsection (c) of this section to implement the recommendations of the workgroup by July 1, 2016." *Id*., sec. 2(b).

Finally, the law directs that, "[o]n or before December 31, 2015, the workgroup shall report its recommendations to the Senate Education, Health, and Environmental Affairs Committee and the House Environment and Transportation Committee, in accordance with § 2–1246 of the State Government Article." *Id*., sec. 2(c).

Background

Ecological and Economical Impacts of AIS in the United States

Aquatic invasive species have been linked to significant economic and ecological damage throughout the United States, with the capacity to:

- reduce biodiversity and simplify aquatic food webs
- impact imperiled species
- dramatically change primary productivity and nutrient cycling in aquatic habitats
- decrease habitat value and water quality
- spread disease
- deteriorate gene pools of native species
- impact important fisheries, industrial infrastructure, power generation, and public safety and health. [4]

Damage and Mitigation Costs

Mitigating impacts of AIS introductions can be economically costly. In the United States alone, damages and mitigation associated with aquatic invasive species cost approximately $8 billion per year (Pimentel et al. 2005). The state of Florida has extensive AIS invasions and spent $14.4 million in FY 2013-2014 on aquatic invasive weed control (Florida Fish and Wildlife Commission 2014). AIS control exceeds $12 million per year in Wisconsin.

The Great Lakes Fishery Commission, a partnership between the U.S. and Canadian federal governments, spends an additional $34 million annually on AIS in the Great Lakes region, an area subject to numerous AIS introductions (Rosean et al. 2012, GLFC 2015). The spread of zebra mussel (*Dreissena polymorpha*) within this region has caused significant impacts to industry – clogging intake pipes and disrupting operations of power plants and municipal water treatment plants. Total costs associated with zebra mussel control at Great Lakes power plants are approximately $130 million per year, and in some cases, the cost is over $1 million per year for a single power plant (Rosean et al. 2012). Similarly, Phillips et al. (2005) estimated zebra and quagga mussel (*Dreissena bugensis*) control costs to be approximately $100,000 per year for each hydroelectric dam in the Columbia River basin.

[4] Sources: Moyle and Light 1996; Kolar and Lodge 2002; Lodge et al. 2006; Hardin and Hill 2012; Tyus and Saunders 2000; Ricciardi 2005; Vitule et al. 2009; Wilcove et al. 1998; Nicholls et al. 1999; Radonski et al. 1984; Hill 2011; Philipp et al. 1983; Philipp et al. 2002; Laikre et al. 2010; Moyle 1986.

Damage to Property and Recreation

Aquatic invasive species can also affect property values and recreation. The impact of aquatic invasive species on home values varies by species, location, and extent of invasion. In some cases, the presence of AIS can have a positive influence on property values that are adjacent to an invaded waterbody. For example, Johnson and Meder (2013) noted a 1-10% increase in property values for houses adjacent to a lake in Wisconsin, which they attributed to increased water clarity resulting from an invasion of zebra mussels.

However, AIS introductions are also linked to reduced property values. For example, the value of houses adjacent to waters invaded by Eurasian milfoil (*Myriophyllum spicatum*) have, in some cases, declined by as much as 16% (Horsch and Lewis 2009, Zhang and Boyle 2010, Holden and Tamayo 2014).

The impact of AIS on recreation depends on a variety of factors, such as the type of species, the extension of the infestation, and the geographic region of occurrence. Some AIS introductions have resulted in favorable changes to fish habitat and recreational fishing, improving regional economies (Henderson et al. 2003). However, AIS often negatively impacts fishing and boating in invaded waters. Zebra mussels in the Great Lakes cause an estimated $47 million in damages to recreational fishing and boating industries (Marbek 2010). Efforts to control AIS can sometimes mitigate these impacts and improve fishing and boater access. In a study of thirteen lakes in Florida, Adams and Lee (2007) found that Hydrilla control programs created $65.7 million in benefits to anglers in the form of additional fishing opportunities.

Government Response

Given the extent of economical and ecological impacts associated with AIS, preventing their introduction and spread has become a top priority for federal, state, and local governments in the United States (CCPR 2014). Although no prevention approach is 100% effective, reducing the risk of the establishment or spread of AIS can circumvent ecological and economic impacts and minimize the future cost of control and mitigation. In some cases, prevention efforts have focused on a single species (such as, zebra mussels); however, efforts in recent years have focused on the various pathways of introduction as a cost-effective means to interdict multiple species.

Some of the pathways responsible for the introduction and spread of AIS in the inland waters of the United States include aquaculture, recreational boating, private aquarium/pet release, the use and release of live bait by anglers, and water gardening. Of these, the recreational boating pathway has received greatest attention among state, local, and regional jurisdictions due to its role in the spread of zebra and quagga mussels and other AIS throughout much of the continental United States.

The Role of Recreational Boating in AIS Introductions and Spread

The use of small motor boats, sailboats, pontoons, jet skis, canoes, kayaks, and other watercraft is an increasingly common pathway associated with the spread of AIS in inland waters. The introduction of AIS occurs when AIS are inadvertently carried between waterbodies in bilge water, engine cooling systems, live wells, or attached/entangled to hulls, trailers, or other surfaces. Because recreational boats and associated gear can be transported by trailers over great distances, the use of contaminated watercraft can be a source of new AIS to a region. Recreational boating can also transfer AIS between nearby waterbodies (Kerr et al. 2005). This pathway is believed to be responsible for the spread of problematic plants (such as, Eurasian watermilfoil and Hydrilla) and animals (for example, spiny waterflea, *Bythotrephes longimanus*). It is the main pathway responsible for the spread of zebra and quagga mussels from the Great Lakes throughout the United States. This has prompted many states to take strong, preemptive actions to minimize recreational boating-related introductions of AIS.

States and other jurisdictions concerned with the risk of introducing AIS through recreational boating have typically employed a number of preventive approaches (see the "Potential Funding Options" section for specific case studies). Most states dealing with AIS issues conduct education and outreach to improve AIS awareness among boaters and to encourage them to take preventive measures such as cleaning, draining, and drying their watercraft and trailer – efforts to reduce the potential that AIS are transported between waterbodies.

Along with education and outreach, some states have taken additional restrictive approaches, recommending or requiring watercraft inspections, and in some cases, decontamination. For example, the Lake George Park Commission created a mandatory inspection program at Lake George, NY, in 2010. This program consists of seven inspection locations around the lake staffed seasonally from May to September and from dawn to dusk. From 2014 to 2015, over 41,000 boats were inspected as part of this program prior to their launch on the lake. These inspections were successful at detecting AIS on 12% of the boats in 2014 and 16% of the boats in 2015. Boats on which AIS were detected were then required to undergo a high-pressure decontamination cleaning before they were allowed to launch – effectively removing AIS. The cost of the program was $668,000 in 2014 and $576,000 for 2015 (LGPC 2015).

AIS in Maryland Lakes

Maryland waters, including sixteen state-owned-and-managed lakes (see Table 2 and Figure 1), are popular tourist destinations among recreational boaters, kayakers, and canoeists. Deep Creek Lake is Maryland's largest lake and one of the most visited parks in the Maryland State Park system. The lake drives the local economy with recreational, commercial, and rental opportunities that rely on tourism. Nine other lakes lie within the State Park system's boundaries and are managed by the Park Service, including Lake Habeeb, which is part of the Rocky Gap Casino facility. Four state lakes are managed by the state Fisheries Service as Fisheries Management Areas, and two lakes are located within Wildlife Management Areas, managed by the state Wildlife and Heritage Service.

Each of these waterbodies is unique, so the local environment and surrounding communities dictate the lake's use. Deep Creek Lake and Lake Habeeb are popular vacation destinations, whereas Greenbrier and Tuckahoe State parks are primarily fishing destinations. All sixteen have hard launches for vessels, and most have soft launches for canoes and kayaks. Every park has an intrinsic value to its local community, and it is the Department's responsibility to maintain the financial and recreational value to these communities.

Many boaters using Maryland lakes come from adjacent states. Some boaters, however, bring their watercraft from as far west as Utah and as far south as Florida, which highlights the large geographic scope of this potential pathway. The heavy boat usage of Maryland lakes indicates that there is a significant level of risk for AIS introductions. This pathway has played an important role in the spread of Eurasian milfoil and Hydrilla in Maryland lakes, particularly Deep Creek Lake. These two invasive plant species form dense mats that can suppress native plant populations and negatively affect swimming, fishing, and other recreational activities in invaded waters (Pimentel et al. 2005). Recreational boating also has the potential to spread zebra mussels beyond their current range in the freshwater portions of the Lower Susquehanna River and upper Chesapeake Bay.

Table 1 State-Owned Lakes Managed by the Department

County	Public Lake	Public Launch
Allegany	Lake Habeeb	Rocky Gap State Park Boat Ramp
Caroline	Smithville Lake	Fisheries Service
Charles	Myrtle Grove Lake	Myrtle Grove WMA
Frederick	Cunningham Falls Lake	Cunningham Falls State Park Boat Ramp, Soft Launch
Garrett	Deep Creek Lake	Deep Creek Lake State Park Boat Ramp & Soft Launch
Garrett	Herrington Manor Lake	Herrington Manor State Park Boat Ramp
Garrett	New Germany Lake	New Germany State Park Boat Ramp
Garrett	Savage River Reservoir	Big Run State Park Boat Ramp
Kent	Urieville Lake	Urieville Lake Boat Ramp
Montgomery	Clopper Lake	Seneca Creek State Park Boat Ramp, Soft Launch
Queen Anne's	Tuckahoe Lake	Tuckahoe State Park Soft Launch
Queen Anne's	Unicorn Millpond Lake	Fisheries Service Soft Launch
Queen Anne's	Wye Mills Lake	Fisheries Service Soft Launch
St. Mary's	St. Mary's Lake	St. Mary's State Park
Washington	Blairs Valley Lake	Fisheries Service Soft Launch
Washington	Greenbrier Lake	Greenbrier State Park Boat Ramp

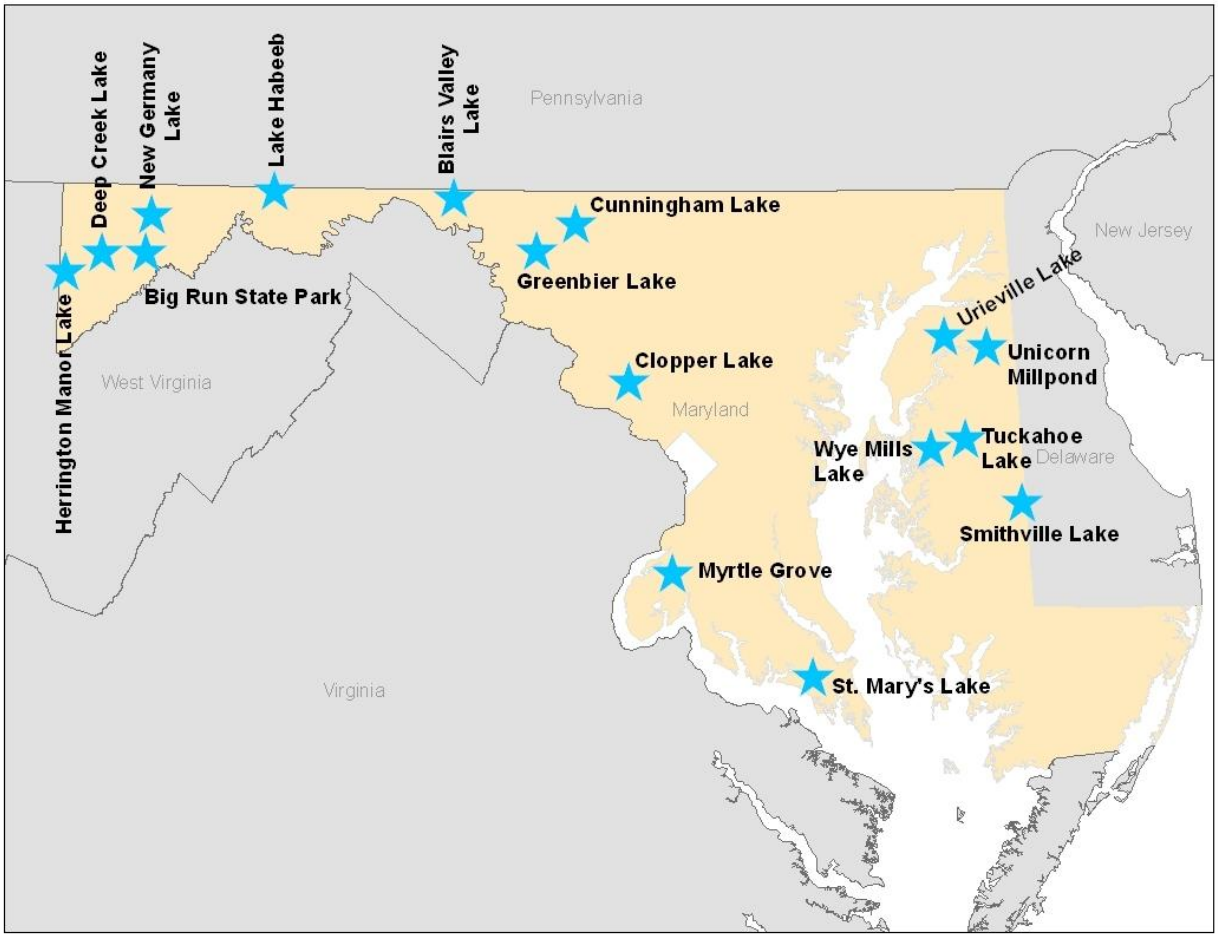

Figure 1. State-owned lakes managed by the Maryland Department of Natural Resources

AIS Prevention and Control in Maryland

A number of AIS have already adversely impacted the productivity and biodiversity of Maryland waters, causing potential harm to native species and aquatic resources, and there is a growing list of other AIS that pose a significant risk if introduced into state waters (see the list in Appendix 1). Notable problematic introductions that have already occurred include blue catfish (*Ictalurus furcatus*) and northern snakehead (*Channa argus*) in the Potomac River, the invasive alga didymo (*Didymosphenia geminata*) in the Gunpowder River, rusty crayfish (*Orconectes rusticus*) in the Middle Potomac and Lower Susquehanna River, zebra mussel in tributaries to the upper Chesapeake Bay, and Hydrilla in Deep Creek Lake and Lake Habeeb. The Department has increased its efforts over the past 10 to 15 years to address established populations of these invaders as well as other AIS in Maryland waters and to prevent new introductions in the State waters.

In January, 2009, the Mid-Atlantic Panel on Aquatic Invasive Species and Maryland SeaGrant produced "Rapid Response Planning for Aquatic Invasive Species: A Maryland Example"

(Smith and Moser 2009). This planning guide was modeled after the National Incident Management System's Incident Command System. The planning guide details specific steps that ensure an efficient response from initial discovery of a new invader through management actions and follow up adaptive management. The Department used this approach when Hydrilla was discovered in Deep Creek Lake.

Invasive Species Matrix Team

In September 2007, the Department created the Invasive Species Matrix Team (hereafter, ISMT), made up of Department staff. The mission of the ISMT is to "study and direct scientifically-based policy and management responses to the ecological, economic, and public health threats of invasive species in Maryland's native ecosystems." The ISMT is a multi-disciplinary DNR team that advises the Department in all aspects of invasive species management, control, prevention, and response. In practice, the ISMT functions on an ad-hoc-committee basis, and workgroups are formed to accomplish specific tasks. A number of members of the ISMT participated in the Workgroup that formulated this report.

The formative objectives of the ISMT are to

1) provide recommendations to the Secretary on invasive species policies and regulations;
2) develop a framework for surveillance and monitoring programs designed to detect invasive species introductions and track their dispersal;
3) coordinate rapid response efforts when new invasive species are detected;
4) recommend agency actions and public education programs to prevent new introductions and control the increase/spread of invasive species into non-infested landscapes/waters;
5) develop a list of non-native species introductions into Maryland;
6) share and interpret data, knowledge, and experience on invasive species with other state, local, interstate, and federal agencies; and
7) develop an Invasive Species Management Plan for Maryland, in cooperation with other organizations, that provides a coordinated, multi-agency strategy to achieve the objectives listed above.

The ISMT along with several units of the Department, have worked to further reduce the risk of AIS introductions in Maryland waters through regulations (see Current Law on AIS Control and Prevention section for details), education and outreach, research, and monitoring.

Department Efforts to Prevent the Spread of AIS

Deep Creek Lake, in Garrett County, is the largest of the Maryland lakes and in recent years has been the site of increased focus on AIS prevention and control efforts. There are four AIS that the Department has found in Deep Creek Lake: crayfish has been long established; Eurasian watermilfoil, which has probably been present in the lake for at least a decade; Hydrilla, discovered in 2013; and curly leaf pondweed, which was found in 2015.

Following the discovery of Hydrilla in Deep Creek Lake in 2013, the Department initiated a voluntary vessel inspection pilot program, placing launch stewards (seasonal contractual employees) at the Deep Creek Lake State Park boat ramp for most of the boating season. In 2014, launch stewards inspected 1,066 vessels between June 3rd and September 23rd. Of those boats inspected, 23 vessels (2.2%) were carrying potential AIS. That year, the direct cost of the program was $10,000, to pay for the seasonal employees.

In 2015, launch stewards working full time between Memorial Day and Labor Day inspected 2,219 vessels with a 98.4% compliance rate for the voluntary inspection. The 2015 launch steward program, which was a partnership with Garrett Community College's Environmental Science Program, cost $28,000, which was paid for by the Deep Creek Lake Natural Resource Management Area. In addition, Department staff time was allocated during both years for program development, training, and supervision of the launch stewards.

The discovery of substantial Hydrilla infestation at Lake Habeeb at Rocky Gap State Park in 2015 will create new demands for allocation of state funds to support an AIS control program. The Department is currently working to develop a plan and locate funding necessary for this effort.

The Department has focused on other efforts to prevent the spread of AIS through recreational boating at state lakes, including:

- Development of a mobile app/database for logging watercraft inspection data
- Production of a Clean, Drain, and Dry video public service announcement
- Printing and posting signs at all lake boat launches
- Establishment of a 1-800 hotline to report AIS
- Increased messaging on social media
- Information on its website
- Distribution of AIS flyers at lake boat launches

Additional actions by the Department to prevent the spread of AIS throughout the state would further protect state lakes and would also safeguard the spread of AIS to neighboring states. Preventing additional introductions of AIS into state lakes would also reduce the future, more expensive costs of controlling and mitigating their potential impacts to ecological resources, property values, infrastructure, recreation, and local economies.

Existing Funding to Support AIS Prevention

There is currently no dedicated or consistent funding source to support the Department's AIS prevention efforts, nor are funds currently available to support a full-time staff person focused on AIS prevention. All Department efforts to date have been performed by staff when needed, often at the expense of other priorities and functions. The Department currently spends approximately $722,050 per year on prevention and control of aquatic invasive species (see Table 2). In 2015, $205,000 of that total was spent on herbicides to control Hydrilla in Deep Creek Lake.

Table 2 Department spending on AIS prevention and control

Prevention and Control Action	Current Costs
Fisheries Service staff time	$17,500
Tidal Fisheries staff time	$77,600
Resource Assessment Service staff time	$11,950
Wildlife and Heritage staff time	$100,000
Invasive species control at Wildlife Management Areas	$75,000
Maryland Nutria Project	$60,000
Phragmites Control Program	$50,000
Hydrilla Control Program herbicide and application	$205,000
Hydrilla Control Program resources and staff time	$125,000
Total	**$722,050**

Deep Creek Lake AIS Expenditures, 2014-2015

Deep Creek Lake, located in western Maryland, is the largest of the Maryland lakes and is responsible for generating the bulk of the economy in Garrett County, Maryland. In 2013, state biologists found Hydrilla, an invasive aquatic plant, in the lake. After convening a nationwide panel of experts to evaluate alternatives strategies for controlling Hydrilla, the Department decided to use herbicides to control the spread of the plant. The Department developed a control program and hired a contractor to apply herbicides on the Hydrilla beds during the 2014 and 2015 seasons. An additional 5 to 7 years of herbicidal application are necessary to secure maximum benefit.

The Deep Creek Lake State Park Management Office has spent approximately $480,000 on Hydrilla monitoring, control and education. In 2014 it contributed approximately $225,000 and in 2015 it contributed approximately $255,000 to the Hydrilla Control Program. Most Department Units or Programs are appropriated a fixed amount of funding each year to cover salaries, operations and projects. Without additional state funding, the Lake Management Office would have to sustain this expenditure for the next 5 to 7 years if Hydrilla is to be controlled. At the same time, eradication of the Hydrilla in Deep Creek Lake is unlikely if other sources of Hydrilla (such as at Lake Habeeb) are not also controlled. Since incurring this expense, the Lake Management Office has had to reduce management activities. All future projects and studies that the Lake Management Office had planned to perform have had to be cancelled.

The Hydrilla Control Program makes up less than 15% of the Lake Management Office's total management responsibilities. However, this program currently uses 40% of the office's available budget, meaning that several core lake management functions have been reduced or discontinued. As costs increase, the Lake Management Office will have to explore cutting key management features of Deep Creek Lake, raising lake permit and user fees, and/or abandoning the Hydrilla Control Program. This program is not sustainable using only the Lake Management Budget. Table 3 depicts the aspects of

the Hydrilla Control Program and the cuts to the Lake Management Office's functions that had to occur to afford the Hydrilla Control Program.

Table 3 Reductions to Deep Creek Lake Management Office Operations Sustained to Support the Hydrilla Control Program

Hydrilla Control Program	Operational Cuts Sustained (2014-2015)
Dye Study to determine herbicide movement Hydrilla Control – herbicide application Hydrilla Monitoring Boat Launch Stewards Other Educational Components (signs, pamphlets, etc.)	Buffer Strip Use Permit Annual Inspections Loss of two seasonal staff and no funding for full time staff Cancellation of boating surveys Cancellation of Boating Carrying Capacity Study Cancellation of submerged aquatic vegetation program Expansion, excluding Hydrilla Public outreach for permit holders cut by 50% Other future projects have been cancelled No expansion of Lake Management Programs Loss of Buffer Strip Educational Programs

Analysis of Options for Implementing HB 860

The Workgroup compiled information on various approaches that have been used nationwide to prevent AIS introductions from recreational boating. Information on AIS prevention was gleaned from published literature, other state and local agencies involved with AIS prevention, and personal communication with recognized national experts in AIS prevention. From these efforts, five general approaches were identified:

1) education and outreach
2) watercraft self-inspection and certification
3) voluntary watercraft inspection by a launch steward
4) mandatory watercraft inspection by a launch steward
5) mandatory watercraft inspection and decontamination (WID)

These five approaches, along with the approach of no further action (meaning, the Department maintains current level of AIS prevention) were evaluated by the Workgroup as options to potentially implement at state lakes. Data on the implementation and operating costs, efficacy, impacts to lake users, and impacts to local communities of each approach were compiled (Table 4). In addition, a cost-benefit analysis was conducted on three of these approaches to examine the strengths and weaknesses under different AIS risk scenarios. Details of this economic analysis are provided in Appendix 2.

Each of the five approaches examined by the Workgroup varies in cost, efficacy, and impacts to lake users and local communities. Each approach would be most effective if implemented equally at all public and private boat launches located on each lake. If implementation does not occur at all access points, then their effectiveness declines and the risk of introducing AIS becomes more likely.

Table 4 Cost matrix of AIS prevention approaches including an assessment of the burden to lake users and local community if each program was implemented. Cost estimates are for implementation of each approach at all 16 state-managed lakes

	No Further Action	Education and Outreach	Mandatory Self-Inspection and Certification	Launch Steward Watercraft Inspection (Voluntary)	Launch Steward Watercraft Inspection without WID (Mandatory)	Launch Steward Watercraft Inspection with WID (Mandatory)
Cost to agency (setup)	$0	$15,000[1]	$15,000[1]	$15,000[1]	$15,000[1]	$768,460[2]-$4,768,460[3]
Cost to agency (operating)	$0	$112,000-$224,000[4]	$5,000[5]	$448,000[6]	$496,000[7]	$1,184,000[8]
Burden on the lake users	Decreased lake access	None	Time to conduct inspection	Time to conduct inspection Delays at boat ramp	Time to conduct inspection Delays at boat ramp, increased traffic	Time to conduct inspection and decontamination Delays at boat ramp, increased noise and traffic
Burden on the local community	Loss of habitat, ecosystem function[9]	Loss of habitat, ecosystem function[9]	Loss of habitat, ecosystem function[9]	Increased traffic, Loss of habitat, ecosystem function[9]	Loss of tourism Increased traffic Loss of habitat, ecosystem function[9]	Loss of tourism Increased noise and traffic Loss of habitat, ecosystem function[9]

[1] Salary of Natural Resource Biologist (0.25 FTE)

[2] Based on the Pacific States Marine Fishery Commission costs to train all launch stewards and the cost for two Watercraft Inspection and Decontamination units (WID) ($23,780 each) per lake

[3] Estimated cost to retro-fit the Deep Creek Lake State Park launch to accommodate wash station and maintain traffic flow. Costs at other facilities are assumed to be equal or less due to the complexity of retro-fitting the Deep Creek launch.

[4] Estimated cost of education/outreach activities ($5,000-$10,000/launch) and staff salaries per lake ($2,000-$4,000)

[5] Administrative costs including printing, mailings, and staff time

[6] Estimated costs based on the launch steward program implemented at Deep Creek Lake in 2015

[7] Estimated costs of a launch steward program and Natural Resource Police enforcement ($54/response for a land unit; $100/response by boat) -$3,000 per park

[8] Estimate includes salary (two technicians) of stewards and annual maintenance ($1,000/lake) and Natural Resource Police enforcement

[9] Because no AIS prevention approach is 100% effective, there is some level of risk of introduction. Any invasion would result in loss of habitat and ecosystem function (such as, nutrient cycling, food-web dynamics, and fish assemblage structure). The exact magnitude of habitat and ecosystem function loss is unknown, but is assumed to decrease as prevention efficacy increases.

No Further Action (Maintain Current Levels of AIS Prevention)

Currently, AIS prevention includes the development and implementation of existing regulations and education and outreach aimed at preventing AIS introductions via various pathways (such as, recreational boating, live seafood trade, live bait trade). Although the education and outreach and regulatory efforts taken by the Department to date have likely improved public awareness and may have prevented some AIS introductions, the frequency of new discoveries of non-native species in state waters indicate that current efforts have not been sufficient. As a result, the Department has had to redirect significant resources to invasive species *control* (of Hydrilla, northern snakehead, water chestnut) rather than direct its limited available resources to AIS *prevention*. It is estimated that the Department currently devotes an estimated $722,050 annually to invasive species management – much of which goes to control of established populations.

The efficacy of this approach is considered to be low because the current levels of AIS prevention would likely mean future introductions of AIS into state lakes or other Maryland waters.

Education and Outreach

The prevention of further AIS introductions into state-managed lakes through recreational boating requires an informed and vigilant boating community. To achieve this, education-and-outreach efforts must be targeted at both in-state and out-of-state boaters who use state-managed lakes. The goal of such efforts would be to

- increase their general awareness of AIS issues;
- inform them of new requirements under the State Lakes Invasive Species Act of 2015; and
- compel them to take the necessary (and required) steps to prevent AIS introductions before launching and prior to leaving each lake.

Efforts would also be focused on identifying and communicating with specific high-risk boaters –those who frequent multiple lakes within a week, fishing guides, etc.– who are most likely to transport AIS between waterbodies (Rothlisberger et al. 2008).

A single exposure to education materials (such as brochures or mailings) is largely ineffective at influencing boater behavior (Lee et al. 2015). To be effective, an education and outreach approach must be conducted continually over many years (often decades) to raise awareness among the boating community and to create the peer-to-peer pressures and social norms necessary to effect the desired change in boater behavior (McKenzie-Mohr 2000; Lee et al. 2015).

Education and outreach to prevent AIS introduction in Maryland lakes would require consistent funding over many years. This funding would support the development of messaging, production of materials, and use of various media (e.g., internet, radio, newspapers, etc.) to reach the large number of boaters that use state lakes. Although a cost-benefit analysis could not be conducted on this approach because its efficacy in reducing AIS introductions could not be

reasonably estimated, the Workgroup acknowledged that education and outreach are the foundation of any AIS prevention effort.

Under this approach, if sufficient funding were available, the Department would develop new materials, including brochures, signs, education kiosks, public service announcements (online videos), and direct mailings, etc. These materials would utilize the nationally recognized and tested messaging developed by the Stop Aquatic Hitchhiker and Clean, Drain, Dry campaigns. Units within the Department, including the Office of Communications, Boating Services, Resource Assessment Service, Park Service, and Fisheries Service, would develop a strategy to effectively distribute these materials to lake users. The Department would develop partnerships with the local lake communities including local businesses, marinas, bait and tackle shops, and user groups to assist in distributing these materials to more effectively inform lake users and encourage preventive actions.

Estimated costs for a targeted education and outreach approach implemented would be $5,000-$7,000 per park ($104,000-$208,000 for all 16 state lakes) with $15,000 in up front agency cost. The initial development of education and outreach materials and strategy to distribute these materials would be more costly the first year of implementation, but these costs would likely decrease in subsequent years once these materials are developed.

Watercraft Self-Inspection Certification (Mandatory)

The State Lakes Invasive Species Act of 2015 makes it unlawful, as of April 2017, to place a vessel on a state-managed lake unless the owner has cleaned and removed all visible organic material from the vessel. In essence, this Act mandates that all boaters using state lakes conduct a self-inspection of their vessels prior to launch. A mandatory self-inspection certification program builds upon this mandate by requiring boaters to complete a survey questionnaire, follow appropriate AIS preventive actions (such as, clean, drain, dry) listed in the questionnaire, and display either a sticker on their boat or a signed certification form on the dashboard of their tow vehicle indicating that the appropriate steps have been taken prior to launch.

Several states and jurisdictions including Utah, Glacier National Park, and the Blackfeet Nation (Montana) have successfully implemented this approach. There are no published studies of the efficacy of this approach in AIS prevention. However, visual inspection has been shown to be 87% effective at removing vegetation and 70% effective at removing small-bodied AIS organisms from boats and trailers (Rothlisberger et al. 2008). By requiring boaters to read and sign a questionnaire prior to each boat launch, this approach is likely to be very effective at increasing AIS awareness and reinforcing in boaters the need to take preventive actions prior to each launch. The effectiveness of this approach at lowering the risk of introduction of AIS is dependent on the level of compliance among lake users. However, compliance can be enforced and monitored with the required use of visible stickers or dashboard -displayed certification forms.

The cost-benefit analysis of a mandatory self-inspection approach indicates that the benefits of this approach would be greater than the costs in all but one of the scenarios examined. The self-

inspection option allows more boats to undergo an inspection at a lower cost with a similar efficacy in removing potential AIS, yielding a benefit-cost ratio greater than the other approaches examined (the mandatory launch steward inspection with and without WID; see Appendix 2 for the cost-benefit analysis).

The cost to implement a mandatory self-inspection certification approach are estimated to be approximately $20,000 per year. Implementation costs include staff time for the development of the self-certification questionnaires, printing of the questionnaires, and the building of online web access and/or kiosks to distribute the certification forms at state lakes where necessary. Following the initial year of implementation, costs to maintain this approach will likely decline in subsequent years. There are no monetary costs to lake users associated with this approach. However, there are associated impacts to boaters in the time needed to take the prescribed actions and to sign the required certification form prior to each launch.

Launch Steward Watercraft Inspection (Voluntary)

Under this approach, a visual inspection of a boat and trailer is offered to each boater on a voluntary basis. Boaters who choose to use the service give permission to launch stewards, trained and employed by the Department, to visually inspect all external surfaces of each boat and trailer for attached AIS and other organic material. Boaters whose boats/trailers pass inspection are allowed to proceed with launching. When AIS and/or organic material are found attached or entangled on a boat or trailer, launching is denied until the vessel is appropriately cleaned and organic material is removed. Ideally, each boat ramp is staffed with launch stewards during prime boating hours (dusk to dawn) throughout the boating season (June 1 – September 30).

As mentioned previously, visual inspection can be highly effective at preventing the introduction of AIS. However, as a voluntary approach, boaters can deny inspections, limiting its effectiveness. The effectiveness of this approach depends on a high rate of compliance among boaters. Since 2014, the Department has conducted a voluntary vessel inspection pilot program at Deep Creek Lake State Park. To date, compliance has been high – with approximately 98% of the boaters using the state park launch agreeing to inspection. Data on compliance at each lake should be monitored and evaluated annually to ensure that year-to-year compliance rates remain high, assuring high protection from potential AIS invasions.

The cost of implementing a voluntary vessel inspection approach per launch site is at least $28,000, annually, or a total of $448,000 for 16 lakes. These costs include a training course and salary for launch stewards. There are no monetary costs to lake users using this approach. However, this approach would delay launching especially during peak use time periods.

Delays associated with voluntary inspections could be minimized with the simultaneous implementation of a wire-seal or similar program. Under this type of program, a wire seal or other tag is attached to a boat and trailer as a boater exits a lake. Upon the boat's return to the same lake, an intact seal or tag indicates to a launch steward that the boat/trailer has undergone a previous inspection and that further inspection is not necessary. This program expedites

launching for boaters that frequently use a single lake throughout a boating season. The Department, if sufficient funding were available, could also support off-site inspections to further reduce traffic and delays at boat launches, but at an additional cost.

Launch Steward Watercraft Inspection without WID (Mandatory)

Under this approach, all boats and trailers must undergo inspection by launch stewards prior to launch, but a Watercraft Inspection and Decontamination (WID) station is not provided at the site by Department. All external surfaces of each boat and trailer are visually inspected for attached AIS and other organic material. When AIS and/or organic material are found attached or entangled, boaters are prohibited from launching until the owner has properly cleaned their boat and trailer. Each boat ramp is staffed with launch stewards during prime boating hours (dusk to dawn) throughout the boating season (June 1 – September 30) and boat launches are closed when inspections are not available to ensure the greatest protection against AIS introductions.

In theory, mandatory inspection should equate to 100% compliance among the boaters using a given lake, provided launch stewards are placed at all launches. Efficacy of this mandatory approach can be higher than self-certification or voluntary inspection approaches, where compliance can be less than 100%.

The cost-benefit analysis of this approach indicates that the costs would be greater than the benefits in all of the scenarios examined (see Appendix 2). Implementation costs of a mandatory inspection approach at a boat launch are approximately, $496,000, which is $28,000 for the launch stewards with an additional $3,000 per park for enforcement (Natural Resource Police) response (approximately $50-100/response).The cost includes a training course and salary for launch stewards.

There are no monetary costs to lake users associated with this approach. However, as with voluntary inspections, this approach would delay launching especially during peak use time periods if a large proportion of boats are found to have AIS. Delays associated with mandatory inspections could be minimized with the simultaneous implementation of a wire-seal tag or similar program, in which boats used only on a single lake are sealed or tagged.

As with the voluntary inspection approach, the Department could also support off-site mandatory inspections to further reduce traffic at boat launches and expedite the launching process. Mandatory inspections may frustrate boaters and reduce lake usage, causing economic impacts to the local community in the form of lost tourism. This approach would likely also send boaters to other access points, such as marina ramps, if there were not mandatory inspections at all entry points. However, the magnitude of these economic impacts is unknown.

Launch Steward Watercraft Inspection and Decontamination (Mandatory)

A mandatory launch steward watercraft inspection and decontamination (WID) approach is identical to the mandatory inspection approach described above in that all external surfaces of boats and trailers must be visually inspected by launch stewards prior to launch. A WID approach, however, further requires high risk boats and trailers – those that fail visual inspection to undergo on site decontamination.– However, under this approach, the Department provides an on-site decontamination station adjacent to each boat launch. Decontamination stations consist of high-pressure washers used to clean all boat and trailer surfaces within a closed wastewater containment system. Boaters refusing decontamination are not permitted to launch their boat.

Overall, decontamination stations are very effective at removing AIS from watercraft and trailers and represent the most protective approach reviewed by the Workgroup. AIS removal efficacy by high-pressure decontamination stations ranges from 85% to 90% (Rothlisberger et al. 2008) and can approach 99% with the use of hot water (Anderson et al. 2015).

The cost-benefit analysis of this approach indicates that the costs would be greater than the benefits in all of the scenarios examined (see Appendix 2). The cost of implementation of a mandatory WID approach is approximately $1,952,460, which is $122,000 per ramp. These costs include a fixed cost to agency for the training course ($7,500) for all employees that is divided among all of the parks. The salary/fringe for two launch technicians ($70,000), purchase of two decontamination stations per launch ($47,560), maintenance ($1,000) with enforcement response ($48,000) per park. Implementation of this approach would also include additional costs associated with necessary infrastructure improvements in the form of re-engineering of traffic patterns, electrical and water supply installation, and waste water containment and disposal. These costs would vary by state lake and launch setting. Costs for infrastructure improvements needed for installation of a decontamination station at Deep Creek Lake State Park were estimated to be approximately $4,000,000.

There are no monetary costs to lake users associated with this approach, unless a fee is instituted for use of and to help pay for the decontamination station. However, mandatory WID will delay launching especially during peak use time periods. Delays associated with mandatory inspections and decontamination could be minimized with the simultaneous implementation of a wire seal tag or similar program. The Department could also encourage private, off-site WID facilities (such as, local car wash or marinas) to further reduce traffic at boat launches and expedite the launching process. Mandatory WID may frustrate boaters and reduce lake usage, causing economic impacts to the local community in the form of lost tourism. However, the magnitude of these economic impacts is unknown.

Recommendations

Although all sixteen state lakes are accessible to boaters (that is, they have at least one boat launch), the lakes differ in the number of boaters who use them and therefore vary in their relative risk to future introductions through the recreational boating. Similarly, state lakes vary in their importance to local communities, in the recreational fisheries and other opportunities that they support, and in their importance as habitats for rare species and other aquatic biota. As such, the threat AIS introduction poses to local economies, fisheries, and aquatic resources also varies lake to lake. Because there are serious threats from AIS introduction to public waters, the Workgroup does not recommend a "no further action" approach.

Because of the many differences among the lakes, the Workgroup recommends that the Department apply a toolbox-like method to AIS prevention whereby lake managers would evaluate, on a lake-by-lake basis, the most appropriate prevention approaches (or tools) to use given the level of AIS risk, resources available for implementation (such as, staff and funding), logistics, and other criteria.

The AIS Prevention Toolbox includes the following approaches:

- Education and Outreach
- Watercraft Self-Inspection Certification (Mandatory)
- Launch Steward Watercraft Inspection (Voluntary)
- Launch Steward Watercraft Inspection (Mandatory)
- Launch Steward Watercraft Inspection and Decontamination (Mandatory)

Regarding Deep Creek Lake, the Workgroup also agreed that there was some utility in the education and outreach and prevention gained by the voluntary launch steward inspection pilot program implemented in 2014 and 2015. The Workgroup recommends that these efforts continue if funds were available without affecting other core functions of the Department.

As part of any approach, the Workgroup recognizes the importance of monitoring state lakes to 1) establish a baseline understanding of the AIS present and their relative abundance in each lake; 2) detect new invasions early to maximize the potential for successful control or eradication; and 3) identify which state lakes could serve as sources of AIS to other Maryland waters. In 2015, the Department's Resource Assessment Service initiated surveys of state lakes – surveying four lakes for invasive aquatic plants. The Workgroup supports these efforts and recommends that further surveys include additional taxa (e.g., fishes, mussels, and other invertebrates) and water quality and habitat assessments as time, mission, and funding allows.

Implementation Plan

From January 1, 2016, to June 30, 2016, the Department will take the following steps towards implementing the recommendations of the Workgroup provided that sufficient staff time and funding are available.

- Deep Creek Lake State Park and Resource Assessment Service staff will initiate plans for continuing the voluntary vessel inspection program during the 2016 boating season. The Department will coordinate with Garrett Community College on the hiring and training of launch stewards.

- The Department will develop education and outreach materials describing the new restrictions instituted under HB 860 to be distributed to Maryland boaters to increase their awareness of the new law.

- As needed, the Department will develop and seek funding to produce additional AIS education and outreach resources, including signage for boat launches, flyers, and other materials to be distributed at state lakes.

- The management unit responsible for managing each lake will work with the Invasive Species Matrix Team (ISMT) to review which of the recommended options are appropriate for their lake, estimate costs, review options for funding and implement the necessary measures if approved by the Department Leadership. The Department will compile all recommendations, seek efficiencies of scale where possible, and work with park managers to achieve the best AIS prevention with available funds.

- Resource Assessment Service staff will provide training to lake managers and staff on the identification of AIS of concern.

- Beginning in April 2016, Resource Assessment Service staff will resume surveys of state-owned lakes to assess AIS presence and abundance. The level of monitoring and assessment will depend on the amount of funding available. Results of these surveys will be shared with lake managers and staff to inform management decisions and prevention efforts.

Potential Funding Options and Approaches

The biggest challenge to implementing several of the approaches evaluated by the Workgroup is funding, which is needed for infrastructure, program implementation, and personnel costs. Currently the State of Maryland does not have a dedicated AIS funding source or budget allocation. What has been done in support of AIS prevention and education to date has been limited by the lack of available funds and the necessity of borrowing staff time from other programs not dedicated to AIS prevention and control. While some federal funding is potentially available in support of AIS prevention and control, it is highly competitive, usually short-term and requires grant submissions. The costs of an effective AIS program would far exceed any federal money the state might obtain. Most states combating AIS have created various dedicated funding mechanisms to partially or fully fund their AIS programs, often creating innovative partnerships with local governments, nonprofits, and businesses. Some funding mechanisms partially place the financial burden on the boating community through user fees.

The following case studies provide examples of how other states and jurisdictions have funded the implementation of AIS approaches similar to the ones reviewed by the Workgroup. There is a lack of available literature on state expenditures for implementing AIS control programs. The information presented is derived from a number of sources, including personal communications, and represents only a fraction of what other states are doing in support of AIS prevention and control.

Case Study 1-New York State ($550,000- $1.5 million annually per region of state)

There are over 7,600 lakes within the state of New York and well over 150 individual AIS programs throughout the state (Rogers, 2015). In 2003, the state began developing a comprehensive AIS program by forming an AIS Task Force. Due to the geographical differences of the state, the state was divided into 8 regions or PRISMS (Partnerships for Regional Invasive Species Management) for management purposes (Pistolee 2015). Each PRISM has different aquatic species of concern, therefore each uses a variety of approaches for AIS programs and control. Funds for these programs come from a multitude of sources including state and federal governments, as well as non-profits, local municipalities, and local businesses (Pistolee, 2015).

Funding for AIS programs in New York State in 2015 (not including controls costs) range from $30,000 annually to implement voluntary boat inspections on one lake (Conesus Lake), to $285,000 annually to fund an AIS Stewardship Program in a portion of NY State Parks, to over $1.5 million annually for the Adirondack Watershed Institute Stewardship Program. Programs range in size and scale from voluntary boat inspections by stewards to mandatory boat inspections and decontamination/boat wash stations. In the case of Conesus Lake, no state funding was obtained so funds came from local municipalities. At the larger scale, NY State Parks was able to secure federal funding via the Great Lakes Restoration Initiative and the Ocean and Great Lakes Funds ($285,000 in 2015) for their voluntary stewardship program at a portion of state parks primarily in the Great Lakes region (Phillips 2015). In the case of the Adirondack Watershed Institute Stewardship Program, which costs nearly $1.5 million dollars annually for

stewards to oversee 56 sites and 11 decontamination stations for the roughly 700 lakes in the Adirondack region, funding has largely been provided by state funds via a budget earmark from the Governor and the NY State Department of Environmental Conservation. Additional funding in 2015 came from a $1 million line item in the NYS Environmental Protection Fund to initiate a much broader voluntary inspection and decontamination program throughout the Adirondack region. For 2016, New York State has committed $2 million statewide to a grant program for aquatic invasive species prevention as well (Wick 2015).

One of the most well-known AIS programs in the state and region is employed at Lake George, NY which is implemented through the Lake George Park Commission (a New York State agency). This program has been evolving since 2007. It started as a voluntary inspection station using boat stewards and in 2014, became a mandatory boat inspection and decontamination program by adding 7 decontamination and wash stations around the lake. Costs for this program ran $668,000 in 2014 and $576,000 in 2015, with a one-time up-front equipment cost of $300,000 for the decontamination/wash stations (Wick, 2015). The program represents a true cost share between the state and local entities, with the state contributing $350,000 annually, the county roughly $150,000 annually and the towns and villages contributing another $254,000 in each of the first two years of the mandatory inspection program (Wick 2015).

David Wick, Executive Director of the Lake George Park Commission, in an interview stated that these funds are strictly for "AIS prevention" to include inspections and decontamination and does not include an additional $400,000 spent on Eurasian watermilfoil (*Myriophyllum spicatum*) control in 2015 alone. He estimated that the state has spent over $7.3 million on total AIS control over the past 20 years (Wick 2015). The main driving force for the state funding in support of both AIS prevention and control is the New York State Environmental Protection Fund which was developed in the 1993 to provide state funding in support of environmental improvement projects. It is funded through a statewide transfer tax imposed on real estate purchases. In the 20 years it has been in existence, the fund is estimated to have garnered over $2.76 billion dollars in environmental funds, which can and are used in support of AIS projects (New York State Department of Environmental Conservation 2014). The Lake George effort is really a success story in the sense that the commission, largely through education, public meetings and partnerships, has been able to garner the support of the local counties, communities, businesses and general public in addition to the state government, further raising awareness of the problem.

Case Study 2 – Lake Tahoe ($1,400,000 annually between California and Nevada)

Due to its astounding water clarity, Lake Tahoe was designated as Outstanding National Resource Water (ONRW) under the Clean Water Act (CWA Section 106) (TRPA 2014). About two-thirds of the lake is located in California with the remaining third in Nevada. Because of this, a bi-state regional planning agency (Tahoe Regional Planning Agency or TRPA) was developed in the 1960s to manage the lake and region (Cartwright 2015). TRPA is the lead on the AIS program at Lake Tahoe with the Tahoe Resource Conservation District (TRCD) dealing with project implementation.

Their AIS program began in 2007 as a voluntary inspection program staffed by boat stewards. In 2009, the program began mandatory boat inspections and offered decontamination/wash stations. With close to 20 boat launches around the lake, the program moved the boat stewards/inspection stations from the launches to off-site locations at four of the five main interstates that bring traffic into the region. There boaters must either come with their boat "sealed" or have their boat inspected and sealed via the decontamination/wash station, which uses similar technology as that of other western states like Colorado and Utah (Cartwright 2015).

Funding for the program initially came from the federal Southern Nevada Land Management Act, but as those funds diminished, the states have started to contribute the bulk of the nearly $1.4 million dollar annual operation budget needed to run the AIS program (not including control costs). Federal funds currently cover less than 10% of the estimated operating costs (Cartwright 2015) with the states picking up the remaining 90%. Both California and Nevada use a combination of user fees and dedicated state budget allocations to fund the program.

If boats do not arrive at the inspection station "banded and sealed," they pay a $35 fee to have their boat inspected, decontaminated, and sealed. Another option is to purchase annual inspection/decontamination passes that vary based on boat length and cost the user $35-$121 annually. These user fees account for about half of the state funding for the program with the other half coming from programs such as California's Quagga and Zebra Mussel "sticker program" that helps to generate additional state funds. The state of California also monitors water quality and AIS potential at nearby state-owned lakes for AIS through the California Department of Fish and Wildlife, a process that had begun prior to the Lake Tahoe AIS Program, which has expanded since its creation (Cartwright, 2015). The Lake Tahoe AIS Program demonstrates how states can work together in a region to not only share the management burden, but the cost of maintaining a successful AIS Program.

Case Study 3: Other States (Fees, Funds, and Accounts)

The following is a summary of what other states are doing to provide dedicated funds for AIS programs each year. It is by no means a complete representation but offers some ideas as to how other states have been able to create a sustainable funding stream for AIS prevention and control. These examples do not include "user fees" that many states charge at the inspection or decontamination stations, but represent larger state-wide fees that have been used in support of a particular AIS activity or funds. All information was derived from The National Sea Grant Law Center's October 2014 Report "From Theory to Practice: A Comparison of State Watercraft Inspection and Decontamination Programs to Model Legislative Provisions" (Janasie and Showalter, 2014)

Fees, Licensing, and Titles

Several states, including California, Wyoming, Iowa, Arizona, Minnesota and Nevada, impose registration and titling fees as a means of creating a funding stream for AIS prevention and

control. As earlier mentioned, California imposes a Quagga and Zebra Mussel Infestation Prevention Fee, collected through watercraft registration fees. The monies from which go into the Harbors and Watercraft Revolving Fund and can be used to cover some AIS programmatic costs and to provide financial assistance to entities implementing zebra mussel infestation prevention plans.

Wyoming also charges an annual fee assessed on watercraft (represented as an AIS decal) whereby funds are deposited in a dedicated account within the Game and Fish Fund for costs associated with the AIS program. In Iowa, the legislature mandated that the revenue generated by the 2007 boat registration fee increase be used only for AIS and water safety. According to Iowa DNR sources, the fee increase generated about $500,000 per program. Similarly, Arizona contributes about 65% of watercraft titling revenues into the Watercraft Licensing Fund, which may be used to administer its boating program, boater safety education, and AIS program.

Minnesota and Nevada use funds generated by civil penalties to help fund AIS programming. The Minnesota legislature created an Invasive Species Account Fund that receives money from surcharges on watercraft licenses, civil penalties, and service provider permits. Funds in this account are to be used for management of invasive species. Nevada ensures that civil penalties imposed for AIS violations must be deposited in the Wildlife Fund Account to defray Nevada Department of Wildlife eradication and restoration costs.

Dedicated Funds and Accounts

In Colorado, Idaho, Oregon, Montana, and Washington, their respective legislatures created dedicated funds or accounts in support of AIS prevention and control. In Colorado, a "Division of Parks and Outdoor Recreation Aquatic Nuisance Species Fund" and "Division of Wildlife Aquatic Nuisance Species Fund" were created to support AIS programming and implementation. Idaho established an Invasive Species Fund to support activities related to the prevention, detection, control, and management of invasive species. Oregon established an Aquatic Invasive Species Fund to provide funding for administering the AIS permit program and preventing and controlling AIS.

Montana has an invasive species account that is administered by the Montana Department of Fish, Wildlife, and Parks. Money in the account, with the exception of that contributed by private donations, must be used for projects that prevent or control nonnative, aquatic invasive species. The State of Washington established an Aquatic Invasive Species Prevention Account and an Aquatic Invasive Species Enforcement Account whereby funds from each account may only be used for the implementation of AIS provisions or in support of the state's enforcement of AIS (funds for training state patrol employees or actual patrolling to inspect aquatic conveyances required to stop at port of entry weigh stations or to inspect conveyances).

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Glossary of Terms

Aquatic invasive species (AIS) are aquatic, non-native organisms whose presence in the environment causes economic or environmental harm or harm to human health.

Control is managing the population of a species by eradication, harvest or biomass reduction, and/or prevention of the natural or human-induced spread of the species.

Economic Harm is defined as a loss to revenue caused by mitigation that is directly or indirectly related to the ecological consequences from an aquatic nuisance species.

Environmental Harm is biologically significant decreases in native species populations; alterations of plant and animal communities; or changes in ecological processes that native species and other desirable plants and animals and humans depend on for survival.

Established is a population that persists in an environment because of sufficient levels of natural reproduction and sufficiently low levels of total mortality (across generations).

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

Native species are species that occurred pre-colonially or occurs in a particular ecosystem.

Non-native is a synonym for exotic, nonindigenous, or alien and describes a species that is not native to the ecosystem.

Pathway is a single or series of methodological steps that lead to the introduction of a non-native species.

Rapid Response is a systematic effort to eradicate, or contain ANS while infestations are still localized. The most effective efforts to control newly introduced organisms are those which are mounted soon after introduction.

Stakeholder is an individual or organization that is relevant to a goal or mission and can include local, county, regional, State, or Federal governments, along with non-governmental organizations and the general public.

Appendix 1
Aquatic Invasive Species of Concern in Maryland*

Common name	Scientific name
Eel swimbladder nematode	*Anguillicola crassus*
Canada goose (non-migratory)	*Branta canadensis*
Spiny water flea	*Bythotrephes cederstroemi*
Goldfish	*Carassius auratus*
Green Crab	*Carcinus maenas*
Asiatic sand sedge	*Carex kobomugi*
Marine macroalgae	*Caulerpa taxifolia*
Fishhook water flea	*Cercopagis pengoi*
Northern snakehead	*Channa argus*
Codium; Dead-man's Fingers; Sputnikweed; Oyster Thief; Spaghetti-Grass	*Codium fragile spp tomentosoides*
Asian clam	*Corbicula fluminea*
Grass carp (diploid)	*Ctenopharyngodon idella*
Mute swan	*Cygnus olor*
Daphnia	*Daphnia lumholtzi*
Striped sea anemone	*Diadumene lineate*
Didymo	*Didymosphenia geminata*
Quagga mussel	*Dreissena bugensis*
Zebra mussel	*Dreissena polymorpha*
Brazilian elodea	*Egeria densa (formerly Elodea densa)*
Water hyacinth	*Eichhornia crassipes*
Chinese mitten crab	*Eriocheir sinensis*
Eastern mosquitofish	*Gambusia affinis*
Red alga	*Gracilaria vermiculophylla*
Japanese shore crab	*Hemigrapsus sanguineus*
Giant hogweed	*Heracleum mantegazzianum*
Hydrilla	*Hydrilla verticillata*
Asian carps	*Hypophthalmichthys spp.*
Blue catfish	*Ictalurus furcatus*
Peruvian primrose	*Ludwigia peruviana*
Purple loosestrife	*Lythrum salicaria*
Japanese stiltgrass	*Microstegium vimineum*
Nutria	*Myocastor coypus*
Parrot feather	*Myriophyllum aquaticum (formerly brasiliense)*
Eurasian milfoil	*Myriophyllum spicatum*
Whirling disease	*Myxobolus cerebralis*
Round goby	*Neogobis melanostomus*
Rusty Crayfish	*Orconectes rusticus*
Virile Crayfish	*Orconectes virilis*

Phragmites	*Phragmites australis*
Japanese knotweed	*Polygonum cuspidatum*
Asiatic tearthumb	*Polygonum perfoliatum*
Curly-leaved pondweed	*Potamogeton crispus*
New Zealand mudsnail	*Potamopyrgus antipodarum*
Red swamp crawfish	*Procambarus clarkii*
Red lionfish	*Pterois volitans*
Flathead catfish	*Pylodictis olivaris*
Rapa Whelk	*Rapana venosa*
Giant Salvinia	*Salvinia molesta*
Red-eared slider	*Trachemys scripta elegans*
Water chestnut	*Trapa natans*
Beach vitex	*Vitex rotundifolia*

*This list was compiled by the Mid-Atlantic Panel on Aquatic Invasive Species, a collaborative body of regional federal and state agencies authorized by the Aquatic Nuisance Species Task Force under the Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990. This list is not a complete list of all potential AIS in Maryland.

Appendix 2
Economic Analysis of AIS Prevention Approaches

Invasive species are thought to have a significant economic cost, according to Pimentel et al. 2005, who estimated the total cost of invasive species management in the United States as $120 billion per year. Of that total, almost $8 billion in costs can be attributed to AIS. This is a broad sum of damages, prevention costs, and treatment costs. However, a more complicated picture of costs, and in some cases benefits, emerges when AIS impacts are assessed on a case by case basis.

This economic analysis considered three approaches for implementing a program to enforce HB860. The other two approaches (no further action and education and outreach) were not analyzed because their efficacy in reducing AIS introductions could not be reasonably estimated. The approaches analyzed included:

1) mandatory inspections of all boats prior to entering state waters with a state-owned Watercraft Inspection and Decontamination (WID) station;

2) mandatory inspection of all boats prior to entering state waters without a state-owned WID station; and

3) mandatory self-inspection.

The associated costs of these options were evaluated along with their expected effectiveness in reducing the risk of aquatic invasive species introductions. No options were considered 100% effective at preventing the spread of AIS, in part because HB860 only addresses visible organic matter on vessels and does not require the boat to be drained and dry. Many AIS of concern are not visible and could potentially live in water stored in the boat (such as, spiny water flea--*Bythotrephes longimanus*—and zebra or quagga mussel veligers). Because no options are 100% effective and because of uncertainty in calculating potential economic impacts of aquatic invasive species nationwide, the following economic analyses were based on current costs to control existing invasions in Maryland public waters.

Methods

The benefit of instituting an AIS inspection program is assumed to be the avoidance of costs associated with potential future AIS invasions. The costs are the various expenditures associated with establishing and operating a mandatory inspection program. Analyses are presented for the 16 public launches on lakes in Maryland, but also specify Deep Creek Lake, as it is the largest and most economically important lake in the state. Approximately 15,000-18,500 boats are launched on Deep Creek Lake every year, and of that total, approximately 2,250 boats are launched per year at the state park public launch. Approximately 10,000 boats are launched per year from 16 public launches around the State (including Deep Creek Lake State Park). Mandatory self-inspection would apply to all boaters launching on state-owned lakes, amounting

to 24,000 per year (the 10,000 boats launched from public launches and an estimated 14,000 boats from private launches on DCL). The results are presented in terms of the ratio of benefits of the different approaches to the cost of implementing the approach. If the ratio is less than one, the costs are greater than benefits; if greater than one, the benefits outweigh the costs.

Based on data from the voluntary launch steward program at Deep Creek State Park (2014-2015), only 1.8% of boats were found to have visible organic matter and 0.2% of boats inspected had AIS. This is a lower percentage than is often observed for boats carrying AIS in other states (LGPC 2015; TRPA 2014). To conduct the economic analysis, four potential levels of AIS occurrence were considered: 0.2%, 0.5%, 1.0% and 1.6%; the last of which is the percentage observed by the Lake George AIS inspection program (LGPC 2015).

In order to generate a benefits to cost ratio, several assumptions were made:

1) of boats undergoing inspection, mandatory inspections are 88% effective at removing plant material and self-inspection is 87% effective (Rothlisberger et al. 2008);

2) of boats launched, 90% conduct self-inspection (Jensen 2010);

3) of AIS species introduced to the lake, only 1% become established;

4) the cost of controlling a single AIS is $200,000.

This $200,000 estimate is the approximate current cost of Hydrilla control in Deep Creek Lake. Hydrilla is used as a model AIS organism in this analysis because both its introduction pathways and economic consequences are well understood in Maryland, making it suitable for this case study. The estimated efficacy and capture rate of the three options analyzed are summarized in Table 1. Some potential costs of an AIS invasion, such as a decrease in recreational activity or home values, are difficult to quantify and are not considered in this economic analysis. This analysis also does not consider all options for enforcing HB860 or all potential costs and benefits associated with these options.

Table 1 Estimated Efficacy of AIS Inspection and Decontamination Options

Inspection Options	Inspection Efficacy (%)	Vessels Inspected (%)	AIS Avoided (%)
Mandatory Inspection with WID	88	100	88
Mandatory Inspection without WID	88	100	88
Mandatory Self Inspection	87	90	78

Source: Rothlisberger et al. 2008.

The cost of a mandatory inspection and WID washing program at the Deep Creek Lake State Park public launch was estimated to be $344,461 per year, with the following components

- Annual cost of labor: $71,000
- Cost of improving the parking lot at Deep Creek Lake State Park: $273,461 ($4,000,000 annualized over 15 years)
- WID equipment: $332,920 ($47,560 annualized over 7 years).

The total cost of a mandatory inspection program without an on-site decontamination unit is estimated to be $33,000 with

- Salary for two launch stewards: $28,500
- Cost born by the public to wash boats out of compliance: $4,500 (45 cleanings at $100 per cleaning).

The cost of a mandatory inspection and WID washing program at all 16 public launches on lakes in Maryland (Table 2) is estimated to be the annual costs for labor and equipment multiplied by 16 (see Table 4 in report) and consists of:

- Cost of washing born by the public: $20,000 per year (200 cleanings at $100 per cleaning).
- Cost for mandatory inspection at the 16 launches:
    - $1,512,424 per year with WID
    - $476,000 without WID
- Mandatory self-inspection-$176,000 (cost consists of web hosting, staff time, and education and outreach.

It is assumed that additional education and outreach will be necessary to make boaters aware of the mandatory self-inspection program and more likely to comply.

All of these costs are summarized in Table 2.

Table 2 Estimated Costs for AIS Prevention Approaches at Deep Creek Lake and All State-Owned Lakes

	Site Preparation	Equipment	Maintenance/ Labor Costs	Cost to Public	Education and Outreach	Total
Deep Creek Lake						
Mandatory Inspection with WID	$266,667	$6,794	$71,000	$0	$0	$344,461
Mandatory Inspection without WID	$0	$0	$28,500	$4,500	$0	$33,000
All State-Owned Launches						
Mandatory Inspection with WID	$266,667	$109,757	$1,136,000	$0	$0	$1,512,424
Mandatory Inspection without WID	$0	$0	$456,000	$20,000	$0	$476,000
Mandatory Self Inspection	$0	$15,000	$5,000	$0	$156,000	$176,000

Results

The values in Tables 3 and 4 are calculated in the following way:

- Invasions prevented per year = invasions without an inspection program - invasions with instituting a program
- Additional cost of control = invasions without instituting an inspection program × yearly cost per invasion ($200,000).
- Cost avoided = invasions prevented × cost per invasion.
- Benefit Cost Ratio = benefits of the program / cost of program implementation. If the ratio is less than one the costs are greater than benefits; if greater than one, the benefits outweigh the costs.

Table 3 Analysis of AIS inspection approaches for Deep Creek Lake*

	Percent of Incoming Vessels Carrying AIS			
	0.20%**	**0.50%**	**1%**	**1.60%*****
Additional Cost of Control Added per Year, No Action Taken	$9,000	$22,500	$45,000	$72,000
Invasions Per Year Prevented	0.04	0.10	0.20	0.32
Cost Avoided Benefit of Program	$7,920	$19,800	$39,600	$63,360
Benefit-Cost Ratio of Mandatory Inspection w/ WID	0.02	0.06	0.11	0.18
Benefit-Cost Ratio of Mandatory Inspection w/o WID	0.24	0.60	1.20	1.92

* Results are presented in terms of ratio of benefits to costs. If the ratio is less than one, the costs are greater than the benefits; if greater than one, the benefits outweigh the costs.

** Percentage of inspections which yielded AIS at Deep Creek Lake, MD (unpublished data, MDNR)

***Percentage of inspections which yielded AIS at Lake George, NY (LGPC 2015)

Table 4 Analysis of AIS Inspection Approaches for the 16 State Lake Boat Launches*

	Percent of Incoming Vessels Carrying AIS			
	0.20%**	**0.50%**	**1%**	**1.60%*****
Additional Cost of Control Added per Year, No Action Taken	$40,000	$100,000	$200,000	$320,000
Invasions Per Year Prevented	0.18	0.44	0.88	1.41
Cost Avoided Benefit of Program	$35,200	$88,000	$176,000	$281,600
Benefit-Cost Ratio of Mandatory Inspection w/ WID	0.02	0.06	0.12	0.19
Benefit-Cost Ratio of Mandatory Inspection w/o WID	0.07	0.18	0.37	0.59
Benefit-Cost Ratio Mandatory Self Inspection	0.41	1.02	2.04	3.26

*The results are presented in terms of the ratio of benefits of the different programs to the cost of program implementation. If the ratio is less than one, the costs are greater than the benefits; if greater than one, the benefits outweigh the costs.

** Percentage of inspections which yielded AIS at Deep Creek Lake, MD (unpublished data, MDNR)

*** Percentage of inspections which yielded AIS at Lake George, NY (LGPC 2015)

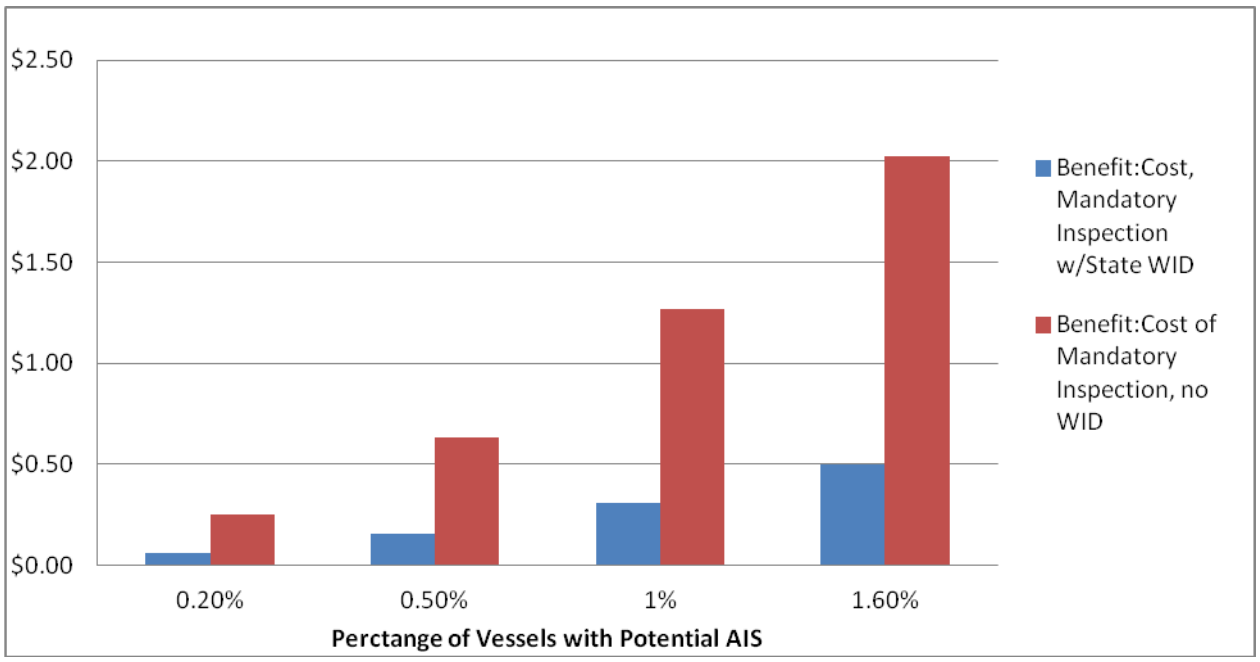

Figure 1 Comparison of AIS Inspection Benefit-Cost Ratios for Deep Creek Lake

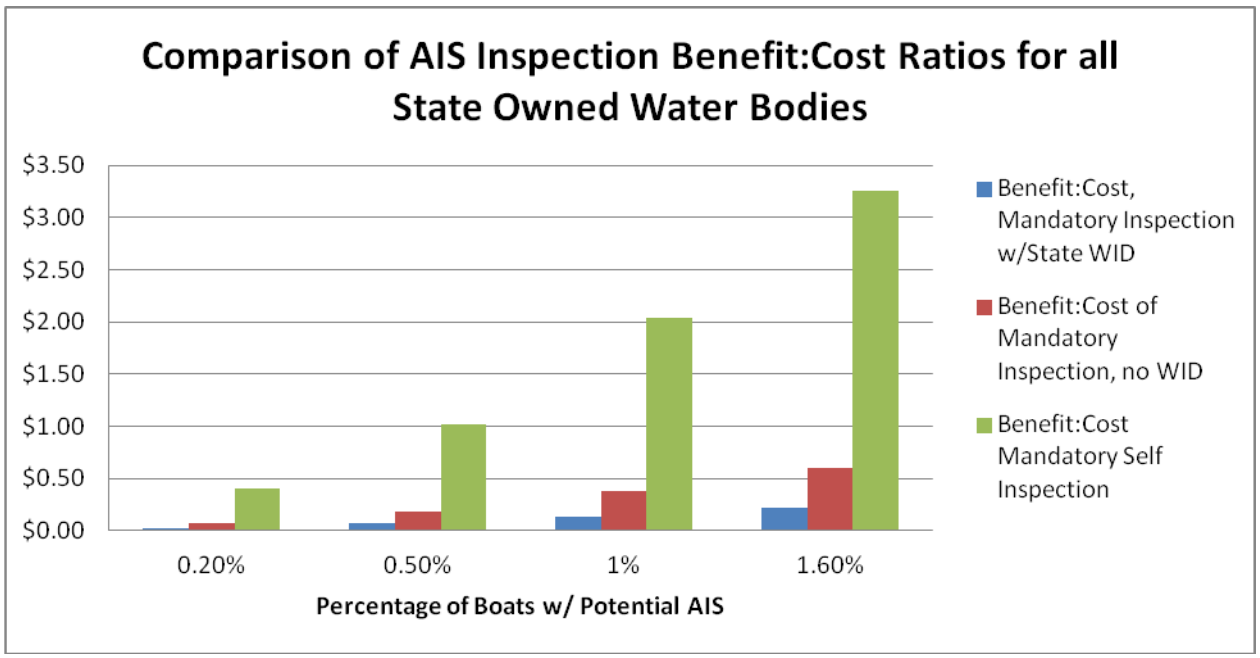

Figure 2 Comparison of AIS Inspection Benefit-Cost Ratios for All State-Owned Lakes

The costs outweigh the benefits for the mandatory inspection with WID option in all scenarios (Figure 1).

When a WID is not used, benefits are greater than costs for mandatory inspections at Deep Creek Lake if 1% and 1.6% of boats carry AIS. Costs are larger than benefits for all other scenarios for the WID option. Mandatory self-inspections have benefits greater than costs in all scenarios except when the percentage of boats with AIS is very low (0.2%; Figure 2).

Conclusions

The benefit provided by an AIS prevention program is dependent on the number of additional invasions avoided, which is contingent on how many boats are being launched, the efficacy of the inspection/cleaning program, and the percentage of boats carrying AIS. The results of the economic analysis indicate that a potential AIS inspection program should prioritize high-traffic launches to maximize the efficiency of funds expended. Prioritizing boat launches where the proportion of vessels carrying AIS is relatively high would also increase the cost efficiency of a program, but these data are unknown for boat launches at state-owned lakes other than Deep Creek Lake.

Mandatory self-inspections have benefits greater than costs in all scenarios except for the lowest percent of boats with AIS (0.2%) scenario. The self-inspection option allows more boats to undergo an inspection at a lower cost with a similar efficacy in removing potential AIS, yielding a benefit-cost ratio greater than the other inspection options. A potentially complicating factor is that while surveys indicate that 90% of boaters are willing to take action to decrease AIS introductions, such as self-inspection, this may not align with behavior. Some additional costs associated with enforcing this option not currently considered would likely be necessary to implement this option.

Some potential costs of an AIS invasion, such as a decrease in recreational activity or home values, were not considered here due to uncertainty of economic impact in Maryland. A decrease in the risk of incurring these costs would be potential benefits of an AIS inspection program, making all the prevention options more attractive. This analysis was by no means wholly inclusive of the different options Maryland has for enforcing HB 860 or all potential costs and benefits associated with these options, but seeks to present a plausible cost benefit analysis for three options based on reasonable assumptions and available data. Additionally, it is likely that if mandatory inspections are only implemented at state park launches, with boaters free to launch uninspected from private launches, the benefits estimated here will not be realized due to AIS invasions through these alternative vectors.