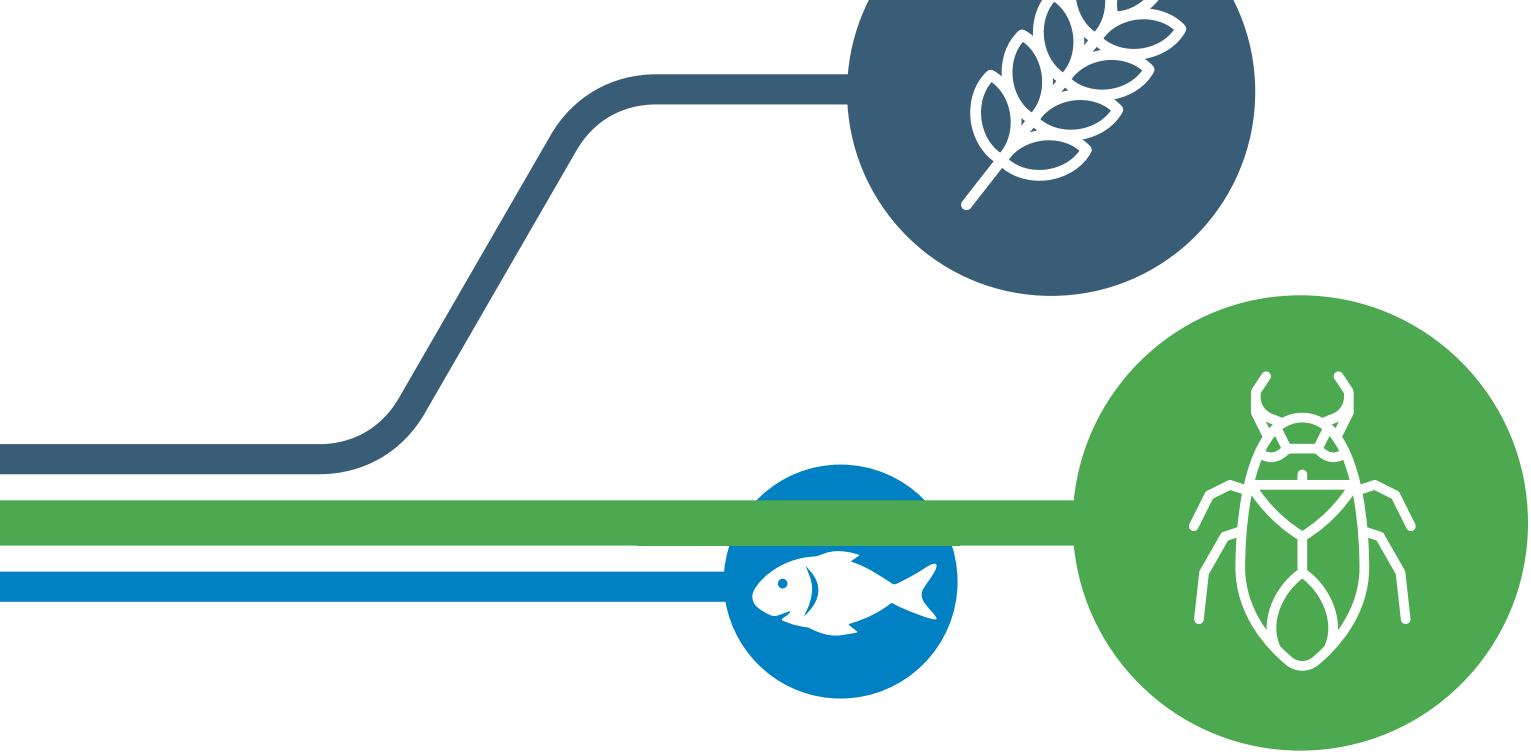
CHAPTER 2
INVASIVE SPECIES MANAGEMENT IN ONTARIO: NEW ACT, LITTLE ACTION



Abstract

The spread of invasive species is one of the biggest threats to biodiversity globally. Ontario has Canada's highest risk of invasions by non-native species (e.g., emerald ash borer, Phragmites, zebra and quagga mussels, and Asian carp).

Ontario's new *Invasive Species Act, 2015*, and the 2012 *Ontario Invasive Species Strategic Plan* are useful tools for managing invasive species. But with few exceptions, there is little indication that the Ontario government is taking concrete actions to prevent the introduction of invaders, detect them early on in an invasion, or manage and monitor species that are already doing damage. The ECO recommends that the Ministry of Natural Resources and Forestry take actions now to:

- restrict known pathways of invasive species spread;
- tackle invasive species in provincial parks;
- establish advisory panels with scientific expertise and local and Aboriginal knowledge to propose species for regulation; and
- report publicly on progress to manage invasive species regulated under the *Invasive Species Act, 2015*.

Executive Summary

What We Examined

The *Invasive Species Act, 2015* comes into force on November 3, 2016. To coincide with the implementation of this new legislation – the first stand-alone invasive species statute in Canada – the Environmental Commissioner of Ontario examined the state of invasive species management in the province. We highlight current threats to Ontario's biodiversity from invaders, discuss who is doing what to manage invasive species, describe effective approaches to combatting invasions, and analyze the opportunities and challenges presented by the new act.

Why We Did This Review

The spread of invasive species is one of the biggest threats to biodiversity globally. There are countless invasive species already present and doing damage to ecosystems in Ontario, including emerald ash borer, Phragmites, and zebra and quagga mussels; and Asian carp present an imminent threat to the Great Lakes.

What We Concluded

Four years after the release of the *Ontario Invasive Species Strategic Plan*, with few exceptions, the Ontario government has done little to prevent, detect or manage invasive species on the ground. The *Invasive Species Act, 2015* gives the Ontario government total discretion to decide whether and when to regulate invasive species and their carriers, and to use any information or rationale it chooses to make those decisions. The act will only be as effective as the regulations made under it.

To make real progress towards managing invasive species, the government should take actions now to restrict known pathways of invasive species spread including prohibiting the sale of invasive plants, requiring boats to be cleaned and inspected before entering new water systems, and banning live bait from protected areas (i.e., provincial parks and conservation reserves). In addition, protected areas – crucial to preserving Ontario's biodiversity and fully within the Ministry of Natural Resources and Forestry's (MNRF's) jurisdiction – should be prioritized for invasive species prevention, detection and management.

The MNRF must use the best available information to choose the most threatening species for regulation, restrict their pathways, and protect the most vulnerable sites without delay. To get this information, the MNRF should establish advisory panels with scientific expertise and local and Aboriginal knowledge to propose species for regulation. Finally, we concluded that the MNRF should report publicly on its progress to manage invasive species regulated under the *Invasive Species Act, 2015* to enable meaningful evaluation of the act's efficacy and allow the public to hold the government accountable for its successes or failures in managing regulated species.

2.0 Introduction

The spread of invasive species is one of the biggest threats to biodiversity globally. Invasive species are (normally) non-native organisms that harm established ecosystems. They are able to disrupt ecosystem processes, introduce diseases, and reduce numbers of native plants and animals because of abilities and characteristics like rapid growth, prolific reproduction, and tolerance for many different environmental conditions.

Ontario has the highest risk of invasions by non-native species in Canada because large amounts of goods and people move within and across the province's borders. Species native to one region of Ontario can be considered invasive in another region if they produce negative effects and have been introduced by human activity, or if their introduction and spread is linked to climate change. Invasive species, especially when added to other threats like climate change and habitat loss, can rapidly reduce biodiversity, and conservation efforts are often not able to keep pace. As much as 66 per cent of Ontario's species at risk are threatened by established invaders such as garlic mustard (a forest herb), Phragmites (a grass), and round goby (a fish).

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Invasive species have negative economic, social and health effects. For example, the Ministry of Natural Resources and Forestry (MNRF) estimates that the total annual economic impact of zebra mussels in Ontario is $75-91 million. The emerald ash borer, a wood boring beetle, is killing millions of ash trees across North America. The total cost in the U.S. could amount to an estimated $25 billion by 2019.

To coincide with Ontario's new *Invasive Species Act, 2015*, which comes into force on November 3, 2016, the ECO examined the state of invasive species management in Ontario. In this report we highlight some of the current threats to Ontario's biodiversity from invaders, discuss who is doing what to manage invasive species, describe effective approaches to combatting invasions, and analyze the opportunities and challenges presented by the new act.

Tree-Killing Beetles: Emerald Ash Borer and Asian Long-Horned Beetle

The emerald ash borer, an invasive wood-boring beetle from Asia, is steadily chewing its way through millions of ash trees across North America, threatening the species' very survival. It likely arrived in larval form, hidden away in ash-wood packing crates from Asia. Various species of ash trees are particularly common in upland deciduous forests, along rivers and creeks, and as a pioneer species on abandoned agricultural fields in southern Ontario. They are also a hardy and commonly planted street tree.

The total extent of emerald ash borer's establishment in Ontario is not known, but the MNRF is certain it has invaded all of southern Ontario, and spread north to Grey County and east through the Ottawa Valley, with satellite populations in Algoma and Thunder Bay. Emerald ash borer is costing city governments and the forestry industry billions of dollars. According to the MNRF, municipal costs were estimated to be in the range of $280 million over 10 years.

The Asian long-horned beetle is another invasive wood-boring beetle from Asia, but eats several species of hardwood trees including maple, birch, poplar and willow. It has the potential to devastate the deciduous and mixed forests of northeastern North America, not to mention the maple syrup industry. Two infestations have been recorded to-date in Ontario: one discovered in 2003 that straddled the border between Toronto and Vaughan, and another detected near Toronto Pearson International Airport shortly after the first infestation was officially declared eradicated. A quarantine is still in place, and the destruction of host trees (over 7,500 and counting) and surveillance is ongoing. So far Ontario has escaped disastrous Asian long-horned beetle infestations such as the one still being suffered in Worcester, Massachusetts, where more than 25,000 trees have been removed from city streets, parks and private property, costing tens of millions of dollars. Asian long-horned beetle also likely arrived in the U.S. in larval form inside wood packing material from China. People losing trees on their private properties, along their streets, and throughout their neighbourhoods are a real demonstration of how invasive species affect our communities and what we value about them.

Emerald ash borer beside a borer hole in ash bark (left) and an Asian long horned beetle (right). Source: Pennsylvania Department of Conservation and Natural Resources - Forestry, Bugwood.org.

2.1 Current Status of Invasive Species Management in Ontario

Invasive species remain a significant and complicated problem. The ECO began calling for strong action from the Ontario government on this issue over ten years ago.

Actions by the Federal and Provincial Governments

When Canada signed the *Convention on Biological Diversity*[1] in 1992, it agreed to work to prevent, control and eradicate invasive species. The federal government completed an *Invasive Alien Species Strategy for Canada* in 2004, and subsequent action plans for aquatic invasive species, and invasive plants and plant pests. Some Ontario legislation, including the *Fish and Wildlife Conservation Act, 1997* and the *Weed Control Act, 1990*, partially address invasive species. However, invasive species remain a significant and complicated problem. The ECO began calling for strong action from the Ontario government on this issue over ten years ago.

The Ontario government released the *Ontario Invasive Species Strategic Plan* in 2012 (see Part 4.2 of the ECO's 2012/2013 Annual Report). It contains 27 strategic actions to manage invasive species, with specific objectives to prevent new invaders, slow and where possible reverse the spread of existing invasive species, and reduce their harmful impacts. The Ontario government recently passed the first stand-alone invasive species legislation in Canada: the *Invasive Species Act, 2015*, which comes into force on November 3, 2016.

Both the *Ontario Invasive Species Strategic Plan* and the new legislation are potentially useful tools for managing invasive species. But with few exceptions, there is little indication that the Ontario government is taking concrete actions to prevent the introduction of invaders, detect them early on in an invasion, or manage and monitor species that are already doing damage. There are no published management plans for priority invasive species in Ontario, no government-produced priority lists (or "watch-lists") of the most damaging invaders already here or those most likely to invade, and no progress reports on the implementation of the 2012 *Ontario Invasive Species Strategic Plan*.

The MNRF is undertaking a number of activities to help implement the *Ontario Invasive Species Strategic Plan*, including:

- The MNRF is working with partners to develop ecological and socio-economic risk assessment methodologies for invasive species, and has undertaken risk assessments on a variety of species, focusing on the *Least Wanted Aquatic Invasive Species List* for the Great Lakes Basin produced by the Conference of Great Lakes and St. Lawrence Governors and Premiers.
- The MNRF surveys for Asian carp in the Great Lakes in partnership with the federal Department of Fisheries and Oceans (DFO).
- The Ontario Federation of Anglers and Hunters, in partnership with the MNRF and the Invasive Species Centre, launched a crowd-sourced online database and map of invasive species in Ontario called EDDMaps (Early Detection and Distribution Mapping System – www.eddmaps.org/ontario).
- The MNRF identified invasive species knowledge as a priority science need for the ministry, including improving methods for detection, prevention and control, and predicted effects of invasive species.
- The MNRF is leading projects to eradicate two invasive aquatic plants: water soldier from the Trent River and Black River, and

Fresh Water Transformers: Zebra and Quagga Mussels, and Round Goby

Zebra and quagga mussels, introduced from Eurasia in ballast water in the 1990s, are extremely efficient at eating plankton – depriving native mussels and plankton-eating fish from their once-abundant food source and making freshwater lakes clearer, forcing light-sensitive fish like walleye into deeper waters and encouraging aquatic vegetation growth. They have also caused native clam populations in Lake Erie and Lake St. Clair to decline significantly by attaching to the clams and hindering their movement, feeding and respiration. Zebra mussels also build up around underwater infrastructure such as outflow and intake pipes, costing millions in cleaning and replacement costs. Unfortunately, these invasive mussels have passed the population tipping point beyond which eradication is impossible. In Ontario, zebra and quagga mussels may be considered naturalized, which means managing them involves preventing their spread beyond existing ranges (which for zebra mussel encompasses all of the Great Lakes, waterways throughout southern Ontario, and north almost to Lake Nipigon), adapting to their effects, and reducing those effects. Eradication of these mussels is not possible with existing techniques.

The round goby is a small, prolific fish also native to Europe and transported to North America in ballast water. It can now be found throughout the Great Lakes and in some inland waters including Lake Simcoe and the Trent River. Round gobies outcompete and prey on small native bottom-dwelling fish and sport fish eggs. They may also contribute to outbreaks of botulism type E in Great Lakes fish and fish-eating birds by transmitting a toxin from the zebra mussels they consume to the goby's predators up the food chain.

Zebra mussels (left), a quagga mussel (centre), and round goby (right). Sources: Amy Benson, U.S. Geological Survey (mussels); and Eric Engbretson, U.S. Fish and Wildlife Service. Bugwood.org.

European water chestnut from Voyageur Provincial Park.
- Ontario signed a Governors' and Premiers' Mutual Aid Agreement to Combat Aquatic Invasive Species Threats to the Great Lakes Basin.
- The MNRF is the co-lead for all commitments in a new annex on Aquatic Invasive Species to the *Canada-Ontario Agreement on Great Lakes Water Quality and Ecosystem Health*, which outlines commitments by both parties to address this threat.
- The MNRF is co-chairing the Conservation and Wildlife Biodiversity Ministers' Invasive Alien Species Task Force to review progress on *An Invasive Alien Species Strategy for Canada*.

While these commitments are in and of themselves positive, they do not reflect the necessary urgency to address the sheer scale and scope of the problems.

Actions by Non-Governmental Organizations

Most invasive species outreach and education in Ontario is provided by a handful of non-governmental organizations. Their activities include providing information on effective detection and control methods, running citizen science monitoring programs and volunteer prevention programs, and providing forums for land managers to learn about and apply management techniques. The organizations include the following:

- The Ontario Federation of Anglers and Hunters Invading Species Awareness Program, which operates with funds from the MNRF, provides public education and awareness campaigns; extensive information on common invasive species through their website (www.invadingspecies.com); runs citizen science monitoring programs for aquatic invasive species; and partnered with the MNRF and the Invasive Species Centre to develop an online early detection and mapping program for invasive species in Ontario (EDDmaps), among other activities.
- The Ontario Invasive Plant Council is a non-profit organization with paying members housed at the Ontario Federation of Anglers and Hunters. It provides leadership, expertise and public education on invasive species, focusing on invasive plants. It also helps develop best management practice documents, delivers webinars, and houses an Ontario Phragmites Working Group.
- The Invasive Species Centre (established as a federal and provincial partnership) disseminates government funds for research, outreach and education; puts on workshops for land and resource managers and other professionals; and hosts websites aggregating information on invasive species including asiancarp.ca and forestinvasives.ca. The *Ontario Invasive Species Strategic Plan* specifically tasked the Invasive Species Centre with implementing many of the Plan's actions.

These organizations are doing essential work, and should be congratulated for their efforts.

Actions by Municipal and Other Land Managers

Municipalities, conservation authorities and private landowners are engaged in invasive species management and control on an ongoing basis. Many of these land managers also mount education and outreach efforts and citizen science programs, sometimes partnering with the organizations listed above. These efforts are costly – requiring substantial investments of staff time and money over the long term in order to have effective and lasting outcomes. For example, the Regional Municipality of York is spending $10 million over 10 years on emerald ash borer and other invasive species management.

Public land managers generally do this work without guidance, co-ordination, expertise or funds from the provincial government (with the exception of projects that may qualify for funding through various programs such as the Species at Risk Stewardship Fund, Land Stewardship Habitat Restoration Program, and Great Lakes Guardian Community Fund). Some of these organizations and landowners are relatively successful despite this lack of provincial support, but ongoing success is always in jeopardy because of their competing priorities for resources.

Persistent Plants: Dog-Strangling Vine and Phragmites

Dog-strangling vine is an invasive twining and trailing plant from Eurasia that out-competes native herbaceous plants and tree seedlings. It can turn a forest floor or field into a mass of impassable knotted stems that prevent native trees and plants from regenerating.[2] Dog-strangling vine can cost a forest manager thousands of dollars to chemically control in a pine plantation in order to enable tree regeneration. Dog-strangling vine also threatens plant biodiversity in natural forests, and can have a negative impact on monarch butterflies – the butterflies mistake dog strangling vine for milkweed and lay their eggs on its leaves, which don't sustain monarch caterpillars. Dog-strangling vine can be found in forests, fields and natural and abandoned areas in southern Ontario, with large concentrations in the greater Toronto and Ottawa areas. It has also invaded urban ravines, blanketed the Don Valley Parkway, and (stealthily) established in many urban backyards.

Phragmites is an invasive reed also from Eurasia that chokes out native plants in wetlands, beaches and on riverbanks, and changes water levels. It grows in dense, monoculture stands that provide poor habitat and food for wildlife. It can also impact agriculture, lower property values by blocking views, and prevent swimming, boating and fishing. The dense, dry stems are also a fire hazard. Phragmites stands are particularly extensive in the Lake Erie, Lake Huron and Huron/Erie Corridor coastal ecosystems, where they could devastate a number of species at risk that depend on habitats that Phragmites takes over and makes unsuitable. Phragmites is also common in ditches, along highways and in wetlands throughout southern Ontario and north into Grey County Muskoka and Parry Sound, the Ottawa Valley and beyond.

Phragmites with full seed heads (left) and a mat of dog-strangling vine (right). Sources: Leslie J. Mehrhoff, University of Connecticut; and David Nisbet, Invasive Species Centre. Bugwood.org.

Actions by the General Public

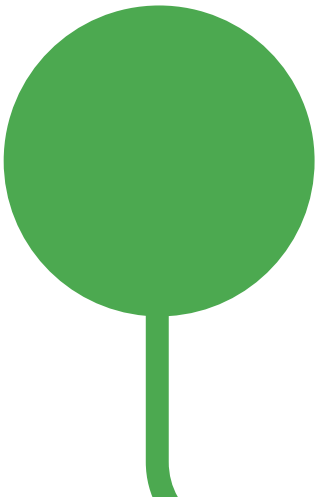
To date, the government has relied heavily on the public's voluntary adoption of prevention and control measures to slow the spread of invasive species in Ontario. For example, through outreach and education, recreational boaters are encouraged to voluntarily use boat-washing stations before entering new waters (many of which are provided through the OFAH Invading Species Awareness Program). No law or policy requires this precaution be taken before entering any waterbody – including in protected areas – even though transient boating poses the greatest risk for spreading aquatic invasive species within Canada.[3] The reliance on voluntary measures alone is unlikely to provide the certainty of protection needed to protect our native aquatic species.

Fighting Phragmites: Lambton Shores Volunteer Group Galvanizes Community to Save their Beaches

A group of dedicated and hardworking volunteers, and municipal and conservation authority employees have been fighting invasive *Phragmites australis* (common reed) on the shores of Lake Huron and the Ausable River in Lambton County since 2009.

Phragmites has been labelled the nation's "worst" invasive plant species by Agriculture and Agri-food Canada. Phragmites spreads very quickly along shores, edges of wetlands and roadside ditches. This reed forms dense monocultures up to five metres tall, with dense root systems, often blocking out all other plant and animal species, including species at risk. Phragmites has severe, long-term detrimental effects not only on wildlife habitat, but on recreational opportunities and property values too, since it often completely blocks off access to water and views.

The Lambton Shores Phragmites Community Group has a viable and comprehensive management approach and some good successes with controlling infestations of Phragmites. They also have good working relationships with local municipal and county agencies, with several Ontario ministries, cottage associations and the support of many community residents. They have obtained funding year to year through a variety of grants. What they don't have is any ongoing multi-year funding to allow them to monitor and quickly catch small re-infestations of cleaned up areas. Only the smallest infestations can be eradicated with spades, so early detection and rapid response is critical. This means a broad public awareness and education campaign would be key, to ensure more alert eyes on the ground. But the working group still relies largely on volunteer co-ordination by a few determined retirees, who find themselves battling not only Phragmites in the ditches, but also thickets of paperwork for approvals and work permits. The group sees a need for a dedicated agency that could act as a Phragmites Control Centre – and could offer affected communities an integrated, one-stop shop of solutions.



2.2 Effective Approaches to Managing Invasive Species

Prevention and Early Detection and Control

The longer an invasion is allowed to progress, the more widespread the populations of invaders become, until the invasion reaches a tipping point where it worsens, often exponentially, and the invader becomes established or naturalized (Figure 1). Eradication is not possible after this tipping point, and management efforts can only focus on minimizing damage and adapting to the invader's effects. The cost of management and control efforts also climbs precipitously as time goes on. However, if action is taken at an early enough stage of invasion, invasive species can be kept from harming ecosystems, society and the economy, and control efforts are feasible.

Actions to prevent invasive species from becoming established are usually the most cost effective because they avoid the economic,

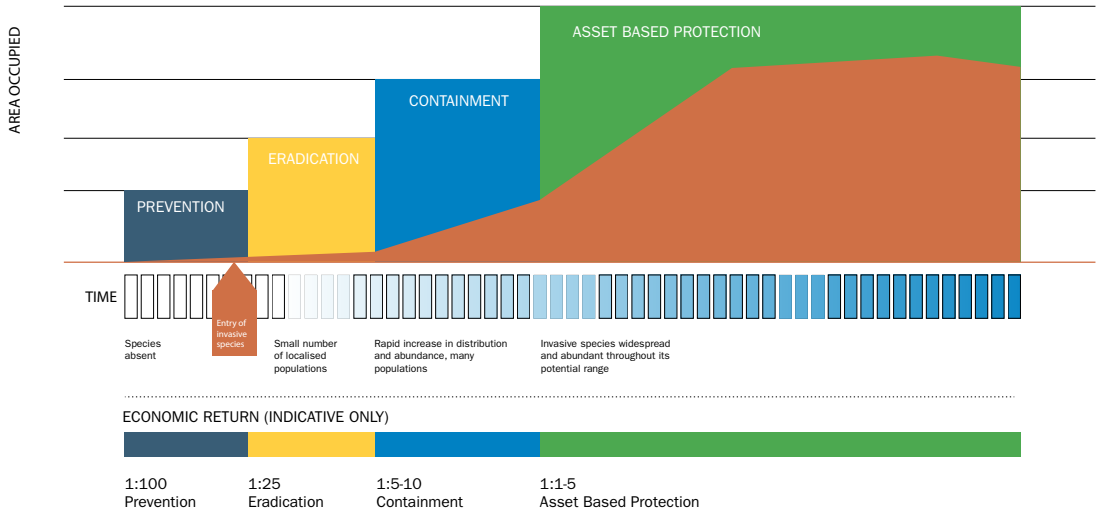


Figure 1. The degree of infestation rises with time since invasion, until only local control is possible – and at a high cost. Source: © State of Victoria, Department of Economic Development, Jobs, Transport and Resources. Reproduced with permission.

If action is taken at an early enough stage of invasion, invasive species can be kept from harming ecosystems, society and the economy, and control efforts are feasible.

environmental and social costs the invaders would cause. For example, the Sea Lamprey Control Program for the Great Lakes, implemented in 1955 to control the invasive sea lamprey and mitigate its devastating effects on native fish, has successfully reduced lamprey populations by 90 per cent – but it costs Canada and the U.S. $22 million every year. Where prevention fails or was not attempted, detecting invasive species populations at an early stage of invasion allows quick eradication efforts to take place, which can be very successful. Examples of successful detection and eradication efforts within Ontario include an ongoing water chestnut (an invasive aquatic plant) eradication program at Voyageur Provincial Park on the Ottawa River, which has resulted in an annual reduction in population size;[4] and the successful eradication of an Asian long-horned beetle population from Toronto and York Region in the 2000s.

Biological Control of Invasive Species

Biological control may help eradicate or suppress established populations of invasive species, and it has been commonly and effectively used for invasive plants and insects. Biological control entails using a living organism, usually from the invasive species' native range, to combat its population by eating it or causing it to become diseased.

There have been documented successes in Ontario, including the suppression of the invasive wetland plant purple loosestrife by two leaf-eating beetle species. Current biocontrol efforts ongoing in Ontario include the release of parasitic wasps that lay their eggs on the emerald ash borer's larvae, and a defoliating moth that feeds exclusively on dog-strangling vine.

The research, risk assessment, and approvals process to use biological control can be very time consuming because of the complicated and wide-ranging potential consequences of introducing a non-native organism. As a result, the introduction of a biocontrol often occurs long after severe environmental, economic and social damage has already been done by the invasive species. When possible, resources are more efficiently spent on prevention, early detection and rapid response, because the cumulative costs of biocontrol can be much higher.

Purple loosestrife. Source: Steve Dewey, Utah State University, Bugwood.org.

Prioritizing Species, Pathways and Sites

Prioritizing the most threatening invasive species and invasion pathways as well as the most sensitive and susceptible sites to invasive species is crucial to allocating resources effectively and achieving successful prevention and/or control. Aichi Target 9 of the *Strategic Plan for Biodiversity 2011-2020*, adopted by the Conference of the Parties to the United Nations Convention on Biological Diversity (including Canada), includes the prioritization of species and pathways.

The fact that no new aquatic invasive species have been found in the Great Lakes since 2006 when Canada and the U.S. passed regulations governing ballast water control and management exemplifies that success can be achieved by appropriate regulation of invasive pathways. Some researchers suggest the integrated prioritizing of pathways, sites and species may provide the best outcomes and efficiencies.

A 2012 MNRF review of bait management in Ontario warned that harvesting and using live bait in protected areas may introduce invasive species.

The spread of emerald ash borer provides an unfortunate example of what can happen when government fails to correctly identify and prioritize invasion pathways. When emerald ash borer was detected in 2002, the federal Canadian Food Inspection Agency (CFIA) cut down approximately 150,000 ash trees in southwestern Ontario in an unsuccessful attempt to slow the beetle's spread northward by creating a buffer between the known infestation and the rest of the province. This natural dispersal pathway was targeted despite the fact that the wood-boring beetles generally do not move from the immediate area where they emerge. Meanwhile, the emerald ash borer continued to spread rapidly in firewood and other untreated ash wood products, moved by humans along major transportation corridors. This pathway had not been prioritized. The CFIA established and continually expanded quarantine areas around confirmed infestations, but it proved too late to prevent emerald ash borer from spreading across all of southern Ontario and into central Ontario and Quebec.

An example of a known pathway of invasive species introduction in Ontario that could be prioritized (but does not seem to be) is anglers moving live bait including potentially invasive fish and earthworms around the province. Anglers sometimes dump extra bait worms on land; small invasive aquatic organisms can travel in bait buckets, which are often illegally emptied into a waterbody; and invasive organisms can also be transported on gear for harvesting wild bait. The national *Action Plan for Aquatic Invasive Species* notes that anglers sometimes release baitfish into water bodies at the end of fishing trips despite prohibitions on such releases, and states that "compliance and enforcement remain major issues." A 2012 MNRF review of bait management in Ontario warned that harvesting and using live bait in protected areas may introduce invasive species, and called for a broad review of commercial bait harvesting on protected areas of Crown land.

The need for more preventative and proactive research and management actions is not limited to aquatic invasive species; a 2014 report by the Canadian Council of Forest Ministers stated that "the ability to practise proactive forest pest management…may be compromised or threatened if research and management efforts remain focused strictly on responding reactively to new introductions or to uncertainties around native pests."

As the ECO noted in our 2012/2013 Annual Report, the *Ontario Invasive Species Strategic Plan* is thorough, detailed, and action-oriented. The fact that little on-the-ground action has been undertaken by the MNRF and other ministries could be a symptom of not knowing where to start. Risk assessments of species, pathways and sites, the results of which would feed into an integrated prioritization scheme for prevention and control efforts, could break such a standstill. There are examples of prioritization schemes that can be applied to species across or within taxonomic groups – some of which are in use in Europe – as well as for pathways and sites. The *Convention on Biological Diversity* suggests escape pathways such as horticulture; transport contaminants (invaders that arrive in packaged goods); and transport stowaways (invaders that arrive in transport vessels) are invasion pathways that can be universally prioritized, regardless of country or region.

Asian Carp Threaten the Great Lakes

Invasive Asian carp species including grass, silver, bighead and black carp were originally introduced to the southern U.S. in the early 1970s to control algae, plants and snails in aquaculture ponds. Carp escaped into the Mississippi River system during flooding, and silver and bigheaded carp have since travelled as far as the Illinois River and its tributaries, leaving ecological devastation in their wake. For example:

- their comparatively prolific breeding has crowded out native fish species, and in some areas they now make up as much as 80 per cent of the biomass – causing a significant loss of biodiversity;
- Asian carp's voracious appetite severely reduces the abundance of phytoplankton and zooplankton in waters in which they establish, leaving little for native fish to eat;
- declines in aquatic plants as a result of their feeding decreases cover for young native fish and reduces potential spawning habitat; and
- silver carp (which can grow to more than 40 kilograms) jump from the water when startled, damaging commercial fishing gear and potentially harming boaters and anglers.

Asian carp grow fast, produce many offspring, often outgrow any predators, and are very adaptable to different habitat conditions. They are, in short, hard to kill.

Asian carp are a serious threat to the Great Lakes – all five lakes provide suitable spawning conditions and habitat for Asian carp, and if as few as 10 females and 10 males are present in a waterway together, they have a 50 per cent chance of successfully spawning annually. Preventing such an establishment is the focus of the federal DFO Asian Carp Program, in which Ontario's MNRF is a partner. The program was initiated in 2012 with a goal of preventing the introduction of all four species of Asian carp. It includes early detection and monitoring efforts, research to determine the best methods of control should a population reach the Great Lakes, and inspections of live fish shipments (it is illegal to buy, sell or possess live Asian carp).

The MNRF's role includes enforcing the prohibition on live Asian carp, which were historically imported to the province to sell at fish markets. According to one media report, Ontario conservation officers working with Canada Border Services agents intercepted over 40,000 pounds of live Asian carp between 2005 and 2013, but no seizures have been made and no charges have been laid since 2013. The MNRF also works with the DFO to establish and monitor early detection sites throughout the Great Lakes (34 have been established to date), and participates in and helps develop readiness training should detections occur. The province is also working on an Asian carp surveillance plan, and to clarify response actions when Asian carp is detected. The Invading Species Awareness Program, run by the Ontario Federation of Anglers and Hunters with financial support from the MNRF, is engaged in public education and outreach to prevent introductions.

The most imminent Asian carp threat to the Great Lakes is from populations in the upper Illinois River and Chicago Area Waterway System, which are linked to the Great Lakes basin. Electrical barriers have been installed in one of the Chicago Area waterways, and the Chicago Area Waterway System Advisory Committee recently requested funding from the U.S. government to study a permanent system of locks as control points between the two basins. Some experts believe that installing such a hydrologic barrier would be the most effective preventative measure, with a cost ten to one hundred times less than the cost of Asian carp becoming established in the Great Lakes.

In summer 2015, nine grass carp were caught in Ontario waters in and connected to Lake Ontario and Lake Erie. Six of the fish were fertile grass carp – the first fertile Asian carp ever caught in Canadian waters. The response efforts by the DFO, the MNRF and the Toronto and Region Conservation Authority included over 550 man hours of onsite activity including electrofishing and various netting operations to detect any other Asian carp specimens. Analysis conducted on the specimens confirmed that all the fish captured were born in hatcheries and introduced to the wild (some U.S. states still allow grass carp cultivation and stocking of sterile fish in private ponds). The DFO states that there is no evidence of an established grass carp population in Canadian waters. However, new evidence that grass carp is successfully spawning in the Sandusky River, a major U.S. tributary to Lake Erie, is cause for grave concern.

The MNRF and the DFO continue to survey for Asian carp in the Great Lakes. Additionally, the Toronto and Region Conservation Authority launched a surveillance program for Asian carp.

Silver carp leaping from the water (left). Source: jhy5187/Shutterstock. Grass carp (right). Source: Eric Engbretson, US Fish and Wildlife Service, Bugwood.org.

2.3 Priority Sites for Invasive Species Management in Ontario

Provincial Parks and Conservation Reserves

The 2011 *State of Ontario's Protected Areas Report* warns that invasive species, including zebra mussels, feral pets, and plants such as buckthorn and garlic mustard, remain a significant problem for many protected areas, and are identified as a concern in 50 provincial parks. Protected areas – which include Ontario's provincial parks and conservation reserves – are ecologically important refuges for native wildlife and are protectors of rare ecosystems, landforms and species. As a result, they are particularly sensitive to the effects of invasive species. Parks can also be especially vulnerable to invasion because of the often significant numbers of people that travel to them from different regions, who may accidentally bring invasive species with them – for example, as larvae in firewood, seeds on their bikes or hiking shoes, or as live bait for fishing.

Algonquin Provincial Park, Ontario's flagship protected area, is besieged by invasive species. Activities associated with the use of motorboats and access roads, and cottage activities such as gardening, construction and maintenance, are major pathways for invasive species, according to a 2013 MNRF study. Anglers and boaters have introduced aquatic invasive species to Algonquin Provincial Park, including smallmouth bass. Some of these species were even introduced via intentional government stocking programs. Shockingly, about a quarter of the park's plant species are non-native.

Protected areas should be prioritized for invasive species management, yet there is no overall invasive species management strategy, policy or direction for Ontario's provincial parks and conservation reserves. Individual park management plans, despite some-

What You Can Do to Fight Invasive Species

Prevent

- **Plant native species**
  Purchase native plants and trees for your garden and avoid invasive plants and trees at all costs – check out the Ontario Invasive Plant Council's *Grow Me Instead* guides for southern and northern Ontario for which plants to avoid, and which native plants make good substitutes (many garden centres and nurseries sell invasive plants and trees – so don't assume that just because it's for sale, it's not invasive).
- **Don't move firewood**
  Firewood is a major carrier of invasive insects like emerald ash borer and Asian long horned beetle that can survive in larval stage inside cut wood. Make sure to purchase firewood where you intend to burn it, and ask about its origins before you purchase it.
- **Don't release bait**
  Never release live baitfish into or near a water body – they could establish where you release them.
- **Clean equipment, vehicles, pets, and yourself**
  - Clean boats, including motor propellers, of organisms and plants on dry land before moving to another water body to avoid spreading aquatic invasive plants and organisms.
  - Clean bikes, including tire treads, gears and spokes of dirt and plant materials; bikes are terrific carriers of invasive plant seeds in the muck and soil they pick up from the trail.
  - Clean all-terrain vehicles, including the under-carriage, of muck, soil and plant parts (for guidance, see the Ontario Invasive Plant Council's comprehensive *Clean Equipment Protocol*) before moving to a different area.
  - Clean the soles of your shoes of muck and soil and check your clothing for clinging seeds and plant material after hiking and before moving to a different area.
  - Brush dogs and horses to free any clinging seeds or plant material before leaving a natural area.
- **Don't liberate pets**
  - Never release fish or other creatures into water bodies or storm management ponds.

Detect

- **Report** suspected or known invasive species using EDDMaps Ontario online or on your phone, or by calling the Ontario Invading Species Hotline at 1-800-563-7711.
- **Learn** to identify invasive species and teach others.
- **Tell** your local municipality and conservation authority about invasive species you find on their properties.

Control

- **Remove invasive plants** on your property – for guidance on methods and help from agencies and professionals, check out the Ontario Invasive Plant Council's best management practice guides.
- **Volunteer** with community groups, stewardship teams or your local conservation authority to help remove invasive species from and restore degraded natural areas.

Sources: Ontario Federation of Anglers and Hunters Invading Species Awareness Program, Ontario Invasive Sepcies Council, Ministry of Natural Resources and Forestry.

Algonquin Provincial Park, Ontario's flagship protected area, is besieged by invasive species.

times identifying invasive species as threats to ecological integrity, rarely commit to explicit action (although individual parks may have control and public education programs for specific species). Another barrier to ongoing and strategic invasive species management is the lack of dedicated funds for ecological restoration in protected areas.

Northern Ontario

Northern Ontario presents an opportunity to prevent invasive species from altering relatively intact ecosystems, but it is increasingly susceptible to species invasions due to climate change, and more roads, human activity and resource extraction.

There are about 1,000 non-native species present in the Canadian boreal zone, including over 600 insects, 10 earthworms, 303 vascular plants and 3 birds. Humans are the main facilitators of species invasions into the boreal, whether via commercial transport, on-person (e.g., seeds on shoes or pets), or on vehicles; and by disturbing intact habitats (making them more susceptible to invasion) and abandoning bait.

Conducting risk assessments of species already present in Ontario's boreal, or present in other boreal landscapes in North America (e.g., Alberta, Alaska), should be a priority. Examples of potential priority boreal invaders include non-native earthworms, slugs, insects, plants and pathogens.

As development and resource extraction pressures mount, it is imperative to examine the vulnerability of pathways such as roads, clearcuts and pipelines in order to target actions to prevent priority invaders or contain their spread. However the 2012 *Ontario Invasive Species Strategic Plan* does not mention the boreal or northern Ontario as worthy of special or more urgent consideration, and the ECO is unaware of any northern-Ontario-focused plans or strategies.

MNRF Inaction

The Ministry of Natural Resources and Forestry has made few strides towards implementing the 2012 *Ontario Invasive Species Strategic Plan*, and engaged in few concrete actions to prevent or slow the spread of damaging invasive species in Ontario.

The MNRF has the mandate, knows the need, and thanks to the new *Invasive Species Act, 2015*, it has the necessary powers. But thus far, it seems to have chosen to expend its resources on other things.

2.4 Ontario's New *Invasive Species Act, 2015*

In 2013, the MNRF released an *Invasive Species Discussion Paper* (Environmental Registry #011-9780) that listed the challenges to preventing and controlling invasive species. The ministry stated that the feedback it received on the discussion paper "identified the need for a stronger legislative framework," leading the government to propose and pass the *Invasive Species Act, 2015*.

Although the act is the first stand-alone invasive species legislation in Canada, other jurisdictions including Japan, New Zealand, New York State and the State of Victoria in Australia have also made or are currently proposing invasive species management legislation.

New Powers to Prevent and Manage Invasive Species

Ontario's new *Invasive Species Act, 2015* sets out a legislative framework for restricting the possession, transfer, sale, release or propagation of invasive species that threaten Ontario's natural environment. The provisions of the new act address many of the challenges currently faced by the MNRF in managing invasive species, and include new powers to:

- search for and seize species under certain circumstances;
- protect parks and conservation reserves;
- establish invasive species control areas and restrict movement and activities within those areas;
- prohibit or restrict the possession, sale and release of regulated species; and
- regulate carriers of invasive species (even if the species they could harbour is not prescribed).

These powers should help the government prevent, detect and control invasive species, as long as it identifies and regulates species before they invade or at an early stage of invasion, and commits sufficient resources to exercising its powers.

Ontario's new *Invasive Species Act, 2015* sets out a legislative framework for restricting the possession, transfer, sale, release or propagation of invasive species that threaten Ontario's natural environment.

In order to impose restrictions on a species, the government must prescribe the species in regulation. The government classifies a species as either "prohibited" or "restricted," depending on whether and how long it has been in Ontario, as well as its biological characteristics, dispersal ability, social and economic impacts, and the harm it poses to the natural environment. Prohibited species would be illegal to possess, transfer, buy, sell, release or propagate anywhere in Ontario except in prescribed areas. Restricted species would be illegal to possess in provincial parks and conservation reserves, and illegal to deposit (e.g., in the case of plants or plant parts) or release anywhere in the province. The government can restrict the transfer, sale, purchase, possession, release and/or propagation of a restricted species through regulation.

The first such regulation was proposed in September 2016 (Environmental Registry #012-8310), which, if enacted, would classify the 16 species identified on the Conference of Great Lakes and St. Lawrence Governors and Premiers *Least Wanted Aquatic Species List* and all species in the family *Channidae* (snakeheads) as prohibited, and classify Phragmites, dog-strangling vine and Japanese knotweed as restricted.

For most of the act's powers to actually have any impact, species must first be regulated by the government.

The government can also make regulations to designate certain areas as "invasive species control areas" and to specify control measures within these areas, including restricting movement of a species or its carriers, and certain activities that could cause a species to spread.

Ministerial Powers to Designate Species, and Require Prevention and Response Plans

In cases where immediate action is required to protect the environment from an invasive species, the Minister of Natural Resources and Forestry can temporarily designate a species by ministerial order, thereby immediately prohibiting its possession, transfer, purchase, sale, release and propagation.

The minister can also require the preparation of a prevention and response plan for an invasive species, which could involve strategies for early detection, control or monitoring, and enter into agreements (theoretically with extra-governmental agencies or organizations) in order to prepare such plans, or to detect, prevent, control, or monitor an invasive species, or assess the level of risk it poses for Ontario. The minister can also authorize a person or organization to possess a prescribed invasive species and to carry out the activities set out in the plan.

Compliance and Enforcement Powers

Inspectors can investigate to determine compliance with: the act or its regulations; conditions of authorizations to engage with a prescribed species; or orders made under the act. Inspectors can also make orders to contain species they suspect are invasive, and declare a space to be invaded if they suspect a prohibited invasive species is present[5] in order to prevent its spread or control or remove it.

The act sets penalties for a first offence by a person at up to $250,000 in fines or up to one year imprisonment. A first offence by a corporation is punishable by up to $1 million in fines, while subsequent offences may result in fines of up to $2 million.

Little Guidance for Species Regulation

While the act affords powers that could curb the spread of invasive species, for most of the act's powers to actually have any impact, species must first be regulated by the government. However, the act does not set out processes for when or how the government will choose species for regulation, and it does not require the government to consider scientific or local knowledge. It does not specify any events that would automatically trigger the government to consider regulating a species, such as the presence of a recognized invasive species in a neighbouring province or state, or the inclusion of a species on a federal list of invasive species. There is also no process by which members of the public or an expert panel could request that a species be considered for regulation. In September 2016, the MNRF released a policy that sets out high-level guidance for conducting species assessments.

Automatic Prohibitions on Regulated Species, but not Prescribed Carriers

The law enables the government to impose restrictions on "carriers" of invasive species, which are plants, animals, organisms, conveyances (e.g., vehicle, boat or aircraft) or other things (e.g., firewood) that could host an invasive species and help it move from one place to another. However the prohibitions on the possession, transport, sale, etc. of a regulated species do not automatically extend to carriers of those species.

By contrast, under the *Invasive Species Management Act* currently proposed by the State of Victoria in Australia, prescribing a carrier causes automatic prohibitions on the transport of that carrier to come into effect. If Ontario had a law similar to the act proposed in Victoria when the emerald ash borer was introduced, and ash firewood (known to have played a major role in transporting live larvae throughout North America) had been prescribed as a carrier, the transport of ash fire-

wood within Ontario would have automatically been prohibited, perhaps helping to slow the spread of the wood-boring beetle.

Law More Reactive than Precautionary

The new law only applies to prescribed or designated species and carriers, and to be prescribed or designated, a species must be known to cause harm to the environment, economy and/or society. This is a reactive approach, and precludes the act from being used to prevent the introduction of non-native species whose effects on Ontario's environment are unknown, and which could turn out to be invasive. Legislation in other jurisdictions, such as New Zealand's *Hazardous Substances and New Organisms Act, 1996*, prohibits any alien species from importation or release except in accordance with approvals issued under the law.

In addition, once a species is regulated under the *Invasive Species Act, 2015*, the government or minister can still choose whether or not to use several of the act's tools — for example to designate an invasive species control area, or cause the development of a prevention or response plan.

Lastly, the act does not obligate the government to report on the status of regulated or designated invasive species, depriving the public of any knowledge of whether government actions to control invasive species are making an impact.

Wild Boars on the Horizon

Wild boars, also known as feral pigs, cost $1.5 billion every year in damage and control costs in the U.S. Probably first brought to North America by Spanish explorers, wild boars have spread to at least 39 states over the past 30 years, causing damage to crops, property and natural resources, and even killing young livestock. They also carry diseases that threaten other animals and people, destroy natural habitats by rooting, wallowing and grazing, and compete with native wildlife. Wild boars are already a problem in Saskatchewan and Alberta, and sightings of wild boars, probably escapees from licensed farms, have been recorded in southern Ontario for the past few years. In the United Counties of Prescott and Russell in southeastern Ontario, the MNRF authorizes hunters with small game licences to kill feral wild boars. Wild boars continue to be observed in small numbers in the area of Voyageur Provincial Park, and the park has an approach to manage them, according to MNRF staff.

Wild boars (also called feral pigs). Source: Billy Higginbotham, Texas AgriLife Extension Service, Bugwood.org.

2.5 Conclusion and ECO Comment

Biodiversity is declining at a planetary scale. Biodiversity loss threatens the world's ecosystems, which all living things, including humans, depend on for their survival. Invasive species, climate change and habitat loss are three of the most serious threats to biodiversity. The Ontario government has committed to conserving the province's biodiversity. To fulfill that commitment, the government must take concrete action now to prevent, detect and manage invasive species.

With the passage of the *Invasive Species Act, 2015*, the government has new tools to combat the introduction and spread of invasive species. The *Ontario Invasive Species Strategic Plan*, finalized four years ago, is another tool. But the Ministry of Natural Resources and Forestry has so far made little concrete progress. Instead, municipalities, conservation authorities and the public are doing their best to tackle invasions, often without dedicated funds, a mandate or expert support. The MNRF's decision in 2013 to eliminate funding for 45 community-based Stewardship Councils along with the stewardship coordinator positions tasked with supporting those councils took away an ideal forum and base of support for local invasive species management.[6] The ministry must do more to help land managers, such as conservation authorities and municipalities, and to co-ordinate and prioritize actions to combat invasive species.

The MNRF has retreated from being a hands-on resource manager in recent years. In our 2012/2013 Annual Report, the ECO warned that the MNRF's new emphasis on "risk management" and a "landscape approach" is a step backwards for real on-the-ground conservation and stewardship in Ontario. The threat of invasive species and their already devastating effects on Ontario's biodiversity demands decisive leadership and concrete action. The challenge of managing invasive species is an opportunity for the government to prove that taking a broader landscape approach to natural resource management does not mean passing the responsibility to other jurisdictions and bodies.

The ECO recommends that the Ontario government take actions now to restrict known pathways of invasive species spread, including:

- **prohibiting the sale of invasive plants;**
- **requiring boats to be cleaned and inspected before entering new water systems; and**
- **banning live bait from protected areas.**

The ministry must do more to help land managers, such as conservation authorities and municipalities, and to co-ordinate and prioritize actions to combat invasive species.

Protected areas are crucial to maintaining biodiversity and should be prioritized for invasive species prevention, detection and management. It may not be possible to protect all of Ontario from invasive species, but it is possible to significantly reduce their impacts on a network of parks already under the direct management of the Ministry of Natural Resources and Forestry. The ministry has the expertise to carry out management efforts and a mandate to maintain ecological integrity in protected areas. The MNRF needs to step up and lead by example.

The ECO recommends that the Ministry of Natural Resources and Forestry combat invasive species in parks now by:

- **assessing and documenting the invasive species threats to each protected area;**
- **developing prevention, detection and management plans; and**
- **allocating funds for ecological restoration that are not tied to visitor revenue.**

The Ontario government deserves praise for introducing and passing the first standalone invasive species legislation in Canada. The *Invasive Species Act, 2015* gives the government the tools to prevent or slow the spread of invasive species in Ontario. However, the effectiveness of the law depends entirely on whether the government enacts sound regulations that prohibit or restrict the possession and transfer of specific invasive species and their carriers.

The law also gives the government total discretion to decide whether and when to regulate invasive species and their carriers, and to use any information or rationale it chooses to make those decisions. But time is the enemy in invasive species management; the longer a species is allowed to establish without intervention, the less successful an intervention is likely to be, and the more expensive it is going to get. That is why the government must act now to use the best available information to: regulate invasive species that are the most threatening to Ontario's environment; restrict the pathways and carriers by which they spread; and protect sites that are the most vulnerable to their effects.

To that end, the government's framework and process for assessing the risk of invasive species and prioritizing their regulation[7] must make use of existing local and Aboriginal knowledge and scientific expertise. **The ECO recommends that the Ministry of Natural Resources and Forestry establish and consult with regional advisory groups with scientific expertise and local and Aboriginal knowledge to propose species and carriers for regulation.** This would provide a pool of credible knowledge the government can draw from to determine which invasive species would have (or are having) the most devastating environmental, economic, and social impacts to the province.

Finally the new act does not require the government to report on the status of regulated invasive species. This could prevent meaningful evaluation of the act's efficacy and limit the government's accountability for its successes and failures in managing regulated species. **The ECO recommends that the Ontario government report publicly on progress to manage invasive species regulated under the *Invasive Species Act, 2015*.**

2.5.1 Recommendations

The Ontario government should take actions now to restrict known pathways of invasive species spread, including:

- prohibiting the sale of invasive plants;
- requiring boats to be cleaned and inspected before entering new water systems; and
- banning live bait from protected areas.

The Ministry of Natural Resources and Forestry should tackle invasive species in parks now by:

- assessing and documenting the invasive species threats to each protected area;
- developing prevention, detection and management plans; and
- allocating funds for ecological restoration that are not tied to visitor revenue.

The Ministry of Natural Resources and Forestry should establish advisory panels with scientific expertise and local and Aboriginal knowledge to propose species for regulation.

The Ontario government should report publicly on progress to manage invasive species regulated under the *Invasive Species Act, 2015.*

Appendix 2: Ministry Comments

Comments from the Ministry of Natural Resources and Forestry

The *Invasive Species Act, 2015* (*ISA*) represents a significant step forward in enhancing the suite of management tools available in Ontario to address the broad range of threats and impacts presented by invasive species. The *ISA* is the only stand-alone legislation in Canada and provides a framework for addressing threats posed by invasive species in Ontario.

In preparation for the implementation of the *ISA*, which takes effect on November 3, MNRF has posted to the Environmental Registry a list of 19 species proposed to be subject to restrictions and prohibitions under the act, including Grass Carp, Water Soldier and Phragmites. The ministry will prioritize further species for potential regulatory action under the *ISA* in accordance with the methodological guidelines detailed in "Guidance for Invasive Species Assessments under the *ISA, 2015*", a technical document posted to the ER for public comment in June 2016.

MNRF acknowledges that legislation and regulatory actions can only go so far in managing invasive species. A variety of complementary tools and actions must also be supported to effectively prevent the introduction of new invasive species and reduce the impacts of those that are already established. This multi-faceted approach is reinforced by the wide variety of actions that are identified in the Ontario Invasive Species Strategic Plan, 2012 (OISSP).

Ontario continues to support existing partnerships to address the broader actions set out in the OISSP. Examples include the programs being led by the Invasive Species Centre, the Ontario Federation of Anglers and Hunters (OFAH) Invasive Species Awareness Program and the Ontario Invasive Plant Council.

Combined, these partners received $1.35 million from MNRF in 2015/16 to develop education and awareness programs, enhance detection and monitoring efforts, and to fund research activities and control actions. These partnerships continue to increase Ontario's understanding of the broad impacts of invasive species while also improving public awareness of these impacts and the pathways that contribute to their spread.

MNRF continues to support partners such as Nature Conservancy of Canada, OFAH, and Ducks Unlimited in implementing control actions targeting established species, including NCC's Phragmites control pilot project in Rondeau and Long Point provincial parks, scheduled for Fall 2016. In addition, MNRF continues to provide funding to support research into new control methods such as bio-control where existing methods are ineffective or inefficient.

MNRF continues to make progress towards reducing the ecological risks associated with the bait pathway through the provincial bait review. The ministry has worked with an external advisory group and posted four Environmental Registry notices associated with the review including one focused on provincial parks and conservation reserves.

Responding to the threat of invasive species in Ontario is a shared responsibility, as invasive species do not respect political boundaries. MNRF will continue to work collaboratively with the Canadian federal government, provincial governments and jurisdictions within the Great Lakes Basin to respond to invasive species.

These actions continue to form the core of MNRF's response to the threat of invasive species and will be enhanced through the implementation of the *ISA*.

Endnotes

[1] For information on Ontario's obligations to conserve biodiversity, see the ECO's Special Report, *Biodiversity: A Nation's Commitment, An Obligation for Ontario*.

[2] The Ontario Government recently designated dog-strangling vine as a noxious weed under the *Weed Control Act*, which made it illegal to plant anywhere in the province, and requiring landowners to destroy it and its seeds if it is impacting agricultural or horticultural lands. See Part 5.5 of the ECO's 2014/2015 Annual Report for more details.

[3] Canadian Council of Fisheries and Aquaculture Ministers Aquatic Invasive Species Task Group. Department of Fisheries and Oceans Canada (2004). *A Canadian Action Plan to Address the Threat of Aquatic Invasive Species*.

[4] The ECO awarded Ontario Parks staff working on the Water Chestnut program the ECO Recognition Award in 2014.

[5] Inspectors can declare a space to be invaded by a restricted invasive species if the species is prescribed in regulation for this purpose.

[6] For a detailed review of the changes to Ontario's stewardship model, see Part 3.3.1 of the ECO's 2012/2013 Annual Report.

[7] In September 2016, the MNRF released its *Guidance for Invasive Species Assessments Under the Invasive Species Act, 2015* (Environmental Registry #012-7673).