



Office of the Auditor General of Ontario

Value-for-Money Audit:  
Management of  
Invasive Species



*November 2022*



# Management of Invasive Species

## 1.0 Summary

Animals, plants and micro-organisms that are introduced to new environments from other countries, regions or ecosystems often act as predators, competitors, parasites or diseases that put native species and their habitats at risk. Once in their new habitat, these invasive species can establish, spread and cause harm to the local environment, economy and/or society, including people's health.

According to the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services, invasive species is one of the five biggest threats to biodiversity, along with changes in land and sea use, direct exploitation of organisms, climate change and pollution. Of the Canadian provinces, Ontario is among those at the highest risk for new introductions and has the most invasive species, with at least 441 invasive plants and 191 non-native and invasive aquatic species in the Great Lakes. This is largely due to Ontario's proximity to major international shipping channels, multiple land and water entry points, and high volume of imported goods.

Invasive species can have devastating environmental and economic impacts. For example, sea lamprey, alewife, zebra mussel and round goby caused the historic collapses of lake trout, lake whitefish and cisco stocks in the Great Lakes, as well as significant impacts to other commercially harvested native fish species. According to a study commissioned by the Invasive Species Centre in 2017, the economic impacts

of invasive species to Ontario's agriculture, forestry, fisheries, health care, tourism and recreation are an estimated \$3.6 billion each year.

Invasive species can negatively impact Ontario's tourism and recreational activities. For example, phragmites, the costliest invasive plant that has established in the province, can form dense, five-metre-tall thickets that restrict people's access to water for swimming and trails for hiking, while obstructing visibility for hunting and birdwatching. Other species, like the Asian tiger mosquito, serve as vectors for diseases such as Zika virus, West Nile virus and Dengue fever. Some invasive species pose further threats to human health and quality of life—for example, sap from the invasive plant giant hogweed can cause severe skin burns, painful blisters and even temporary blindness. Some invasive carp species, while not yet established in Ontario waters, pose a significant threat to the Great Lakes because of their potential to outcompete native species, consume large amounts of aquatic vegetation, decrease water quality, and injure boaters with their jumping behaviour.

With the global COVID-19 pandemic, people now understand the urgent need to act when a dangerous new virus or other biological threat emerges. The same is the case for responding to invasive species: preventing their introduction is the most effective and economical solution for managing them. Scientific studies estimate that investing in preventing introductions generally provides economic returns that are many times higher than trying to manage invasive species after they have arrived. Once a species is introduced and

established, management costs increase and eradication becomes extremely challenging, if not impossible. Invasive species-related costs incurred in 2021/22 by Ontario municipalities and conservation authorities (mostly spent on control and management) are estimated to be over \$50 million. By comparison, the Ministry of Natural Resources and Forestry (Natural Resources Ministry; formerly the Ministry of Northern Development, Mines, Natural Resources and Forestry) dedicates less than \$4 million each year toward invasive species programming.

The federal government is responsible for preventing the entry of invasive species into Canada and their movement between provinces. It does this by regulating key pathways including ship ballast water; fisheries; and the movement of wildlife, pathogens and pests. The federal government also conducts various research and monitoring, risk assessment, co-ordination and management activities related to invasive species. In Ontario, the Natural Resources Ministry leads the implementation of Ontario's Invasive Species Strategic Plan (2012) and administers the *Invasive Species Act, 2015* (Act), which provides the Ministry with legislative and regulatory powers to prevent and control the spread of invasive species across the province.

As the provincial lead, the Natural Resources Ministry collaborates with other ministries, the federal government, partners and stakeholders to co-ordinate activities to combat invasive species. The Ministry also provides about \$1.4 to \$2.2 million in annual funding to organizations to support invasive species programs, research and other initiatives. When federal and provincial efforts to prevent and eradicate invasive species are unsuccessful, the impacts and costs to society generally flow downstream to municipalities; property owners; and park, lake and forest managers. Indigenous communities can also be impacted by invasive species.

Overall, our audit found that the Natural Resources Ministry is not effectively monitoring and managing the introduction and spread of harmful invasive species in Ontario. The following are some of our most significant findings:

- **The Ministry's lengthy delays in regulating invasive species has increased the risk of introduction and spread.** Assessing the risks posed by invasive species is a key step to determining whether they should be regulated under the Act. If an assessment shows that a species poses a substantial risk to Ontario's environment, then it should be regulated promptly. However, risk assessments for the 12 invasive species newly regulated in January 2022 (excluding wild pigs, which followed a separate process) were completed on average almost four years before the species were ultimately listed and regulated. The Natural Resources Ministry has only one staff member regularly performing risk assessment work, contributing to the delays in regulating invasive species. These delays have meant that penalties to deter the importation, trade and release of these species were not in place for several years. For example, we found that Carolina fanwort—an invasive aquatic plant that crowds out native plants, clogs irrigation systems and interferes with aquatic recreation—was not regulated until almost five years after a substantially complete risk assessment was provided to the Ministry by a contracted expert.
- **Harmful invasive plants are unregulated and several are available to buy in Ontario.** The Ministry has left at least 30 harmful terrestrial invasive plants (plants that grow on land) and their pathways unassessed and unregulated. One example is the tree-of-heaven, a favoured host of the spotted lanternfly, which is a federally regulated invasive insect that threatens vineyards, the fruit and vegetable sector, and the hardwood industry. There are hundreds of confirmed tree-of-heaven detections in southern Ontario. However, Ontario does not regulate the species' spread despite the Province's role as an important line of defense. Further, 52% of all intentional introductions of invasive plants in Canada occur through imports of plants used for landscaping or ornamental purposes, yet the Ministry has not regulated horticultural

pathways (such as the movement of soil within the province) or any other terrestrial invasive species pathways. We found at least six of the 30 terrestrial invasive plants mentioned above (specifically, creeping jenny, goutweed, Norway maple, periwinkle, spearmint and winter-creeper) are available for purchase at local garden centres, nurseries and/or home improvement retailers.

- **The Ministry lacks information to detect and processes to monitor potentially harmful invasive species.** The Ministry's monitoring programs mainly rely on incidental observations instead of a regular and risk-based approach to invasive species surveillance. Furthermore, we found that 33 invasive species identified as high risk by nearby jurisdictions were not systematically tracked by the Ministry and have been found in Ontario. In addition, the Ministry has not fully leveraged the efficiency and cost-effectiveness of environmental DNA (eDNA), a modern detection tool for systemically monitoring species, by widely expanding its use.
- **The Ministry does not clearly define roles and responsibilities of partner organizations.** Therefore, it assigns tasks on a case-by-case basis but has no processes or protocols to ensure that actions are implemented for all invasive species and regions of the province. Based on a survey we conducted, 79% of the 135 responding municipalities and 89% of the 27 responding conservation authorities indicated that roles and responsibilities related to Ontario's invasive species response are not clearly defined. Further, 85% of municipality respondents and 74% of conservation authority respondents do not know their overall role as part of Ontario's invasive species response.
- **Gaps in collaboration between Ministry and federal partners have led to inadequate management of invasive species.** According to the Canadian Food Inspection Agency (CFIA), the CFIA has been working since 2019 to engage the provinces to support collaborative action on hemlock woolly adelgid, an invasive insect that kills hemlock trees. Specifically, the CFIA has reported seeking support on response measures to preserve hemlock resources in accordance with the Hemlock Woolly Adelgid Management Plan for Canada (2018), an information report that outlines potential management tactics. CFIA staff told us that it believes Ministry leadership has been lacking with respect to inventorying this species, supporting the development of insecticides, creating a strategy to use predatory beetles as a biological control, and organizing an immediate response to the known infestations in southern Ontario. According to the CFIA, the Ministry has not responded to or undertaken the CFIA's recommendations or calls to action. The Ministry informed us that it is currently collaborating with the CFIA and others on science activities to support the monitoring and management of hemlock woolly adelgid in Ontario, and that decisions to do more are weighed against other priorities in allocating limited resources. In October 2021, the species was confirmed in Fort Erie, Ontario.
- **Invasive species work is not well co-ordinated by the Ministry.** Despite being the dedicated lead on implementing Ontario's Invasive Species Strategic Plan (2012), the Ministry lacks an implementation plan for executing invasive species work, and does not provide comprehensive and organized direction to municipalities, conservation authorities and stakeholder organizations across the province to combat invasive species threats. In the absence of this direction, these stakeholders must develop and implement their own strategies, but this rarely actually happens. Specifically, our survey results indicated that 70% of responding municipalities have not developed any invasive species management plans to guide relevant activities.
- **Program partners lack funding to sufficiently combat invasive species.** When federal and provincial efforts fail to prevent the introduction and spread of invasive species, land managers

such as municipalities and conservation authorities are saddled with managing these species. The burden on these land managers is significant, and we noted that the combined amount spent by municipalities, conservation authorities and the Ministry of Transportation in 2021/22 on phragmites management alone was higher than the total the Ministry spent that year on all invasive species programming. We also found that Ontario municipalities are insufficiently resourced to manage these threats compared to their counterparts in other provinces. In our survey of municipalities and conservation authorities, 81% of each group's respondents indicated that they receive no Ministry support to help address invasive species. Similarly, a 2022 survey commissioned by the Invasive Species Centre found that municipalities in Ontario reported lower per-capita expenditures than those in other provinces, and were more likely to report insufficient funding to manage invasive species.

- **Funding delays and single-year funding agreements negatively impact invasive species work.** The Ministry is regularly delayed in approving annual funding for transfer payment recipients (such as the Invasive Species Centre and the Ontario Federation of Anglers and Hunters), limiting the invasive species planning and work done in the crucial spring/summer months when many such species are best tackled. Moreover, due to the lack of multi-year funding agreements and certainty of funding, organizations struggle to retain the staff needed to conduct invasive species work.
- **Conservation officers are insufficiently trained on invasive species and perform related enforcement activities infrequently and inconsistently.** As of March 31, 2022, zero charges and only 11 warnings had been issued under the *Invasive Species Act, 2015*. In addition, while invasive species-related hours are assigned to conservation officers, these can in

many cases be fulfilled through activities irrelevant to regulated invasive species under the Act (for example, patrols to ensure anglers have valid fishing licences and comply with catch and possession limits, which is more relevant to federally regulated invasive species such as gobies). We also found that the training provided to these officers included minimal visual aids and practice identifying regulated species, and that many officers have not received this training. As a result, many would be unable to identify invasive species encountered during patrols, necessitating external expert support to assist in identification when responding to tips. The number of conservation officers has decreased since 1998, from 281 to 238 officers. Meanwhile, the legislation they must enforce has expanded from at least 22 acts to 27, resulting in less resources available to commit to work for which they are responsible under each individual piece of legislation.

- **The Ministry has acknowledged that it lacks sufficient staff to effectively administer the *Invasive Species Act, 2015*.** In 2014/15, and again in 2017/18, the Ministry requested funding from the Treasury Board/Management Board of Cabinet (TB/MBC) to address inadequate staffing levels for invasive species work. The TB/MBC did not provide the requested funding. However, it directed the Ministry to divert the necessary funding from other programs to address this shortage. The Ministry did not follow this instruction and did not fill these positions. As a result, programming continues with inadequate human resources to effectively administer the Act.

Our audit also found that the Invasive Species Centre, a major transfer payment recipient of the Ministry, is using funds received from the Province for their intended purposes.

This report contains 12 recommendations, with 37 action items, to address our audit findings.

## Overall Conclusion

The Natural Resources Ministry is responsible for leading the implementation of Ontario's Invasive Species Strategic Plan and administering the *Invasive Species Act, 2015* (Act), but lacks sufficient information about potentially harmful invasive species to inform its decision-making on funding and prioritizing activities to respond to invasive species threats. Specifically, the Province does not have a listing of all invasive species known to be present in Ontario, a watch list of emerging invasive species detected in neighbouring jurisdictions, or a risk-based surveillance program to monitor the introduction and spread of invasive species. The Ministry also lacks current information about the damage to ecosystems and related economic impacts, and the number of human health and safety incidents, caused by invasive species each year.

We also found that the Ministry is missing key opportunities to find and eradicate invasive species before they become established. Specifically, delays in identifying, assessing and regulating some species have negatively impacted Ontario's ability to prevent their introduction and spread.

We also found that provincial conservation officers are not sufficiently trained to enforce the Act. Current invasive species-related inspections do not target several significant, high-risk pathways—such as garden centres, baitfish retailers and fish markets—to curb the introduction and spread of invasive species.

Further, Ontario's Invasive Species Strategic Plan has not been updated since 2012 and lacks a co-ordinated provincial implementation plan, which has led to largely fragmented and localized activities across the province. While the Ministry is the dedicated provincial lead, it does not provide sufficient direction, guidance, co-ordination and resource support to other ministries, municipalities, conservation authorities and other key organizations to effectively prevent and minimize the spread of invasive species.

Without immediate corrective actions, new invasive species will continue to establish and spread in Ontario, becoming costlier and more difficult to eradicate and creating worsening negative impacts to the environment, the economy and human health.

## MINISTRY OVERALL RESPONSE

The Ministry of Natural Resources and Forestry (Ministry) thanks the Auditor General for the audit report and recommendations. Invasive species are an established and growing ecological and economic threat that are negatively impacting the lives of Ontarians and reducing the province's resiliency to climate change.

The Ministry and our partners have taken significant strides to address these impacts through the development of the *Invasive Species Act, 2015*; ongoing eradication and control of priority species such as water soldier, European water chestnut and phragmites; and ongoing public outreach and education. However, despite these efforts, the Ministry recognizes the impacts of established invasive species and threat of new introductions is increasing.

Given the breadth of this challenge, the Ministry is committed to continue working with established partners and to seeking opportunities for enhanced collaboration to prevent, respond to, and manage invasive species. Key to this will be a review and renewal of the Ontario Invasive Species Strategic Plan, which will help guide Ontario's invasive species management actions into the future.

The findings of the Auditor General's report acknowledge the significant challenges faced by the Ministry and the need for enhanced leadership on the national and international stages.

The Ministry is committed to continue its efforts to reduce the impacts of invasive species in Ontario, while seeking ways to enable and better support the efforts of partners at all levels in tackling this growing challenge.

## INVASIVE SPECIES CENTRE OVERALL RESPONSE

The Invasive Species Centre would like to thank the Auditor General of Ontario and her team for this report. We agree that invasive species are a growing threat to lands and waters in Ontario, with economic, environmental and social impacts.

We are pleased that the audit found that the Invasive Species Centre is using funds for the purposes intended in order to help prevent introductions and help reduce the spread and harmful impacts of invasive species.

The Invasive Species Centre works with many partners to help prevent the introduction and spread of invasive species. We work collaboratively to catalyze action, share knowledge and build the case for needed investments in invasive species. We thank the Auditor General and team for drawing attention to the critical issue of invasive species and look forward to discussing the recommendations with partners.

## 2.0 Background

### 2.1 Invasive Species Is a Costly Global Issue

Invasive species are non-native plants, animals or micro-organisms that have been introduced—intentionally or unintentionally—to new environments from other countries, regions or ecosystems and that cause significant harm to the local environment, economy and/or society, including human health. The impacts of invasive species on native ecosystems, habitats and species can be severe and often irreversible, causing billions of dollars in damages in Canada each year.

In 2019, the United Nations' Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services reported that across 21 countries around the world, the number of invasive species per country has increased by an average of 70% since 1970. In terms of the associated global costs, a 2021 study published in *Nature*, a leading scientific journal, found that invasive species created at least \$1.288 trillion USD in such costs from 1970 to 2017.

The economic impacts of invasive species include significant control and management costs; reduced productivity in the forestry, agriculture and fishing sectors; export and import trade restrictions; and

reduced property values. Invasive species can also have negative societal impacts by, for example, reducing land and water recreational opportunities, and causing disease and harm to both humans and wildlife.

### 2.2 The Impacts of Invasive Species in Canada

A 2004 study by the Government of Canada estimated that the annual impact in Canada of 16 invasive species, for which published information is available, is between \$13 billion and \$35 billion. A 2017 study published in the journal *Global Ecology and Biogeography*, which used 2016 data from the Global Invasive Species Database and two other major global databases, found that Canada ranks 10th amongst all tracked countries in the highest number of recorded invasive alien species. In 2002, researchers estimated that there were at least 1,442 invasive species in Canada.

Among the Canadian provinces, Ontario is estimated to have the most invasive species, with at least 441 invasive plants (as per 2008 data) and 191 non-native and invasive aquatic species in the Great Lakes (as per 2020 data). Ontario also has a high risk of new introductions due to its multiple land and water entry points, large and in some places highly dense human populations, high volume of imported goods, proximity to major international shipping channels, and degraded habitats, which create favourable conditions for invasive species to enter and become established in the province.

A 2017 study commissioned by the Invasive Species Centre found that the economic impacts of invasive species to Ontario's agriculture, forestry, fisheries, health care, tourism and recreation are estimated to be \$3.6 billion each year. **Figure 1** discusses how invasive species negatively affect these sectors.

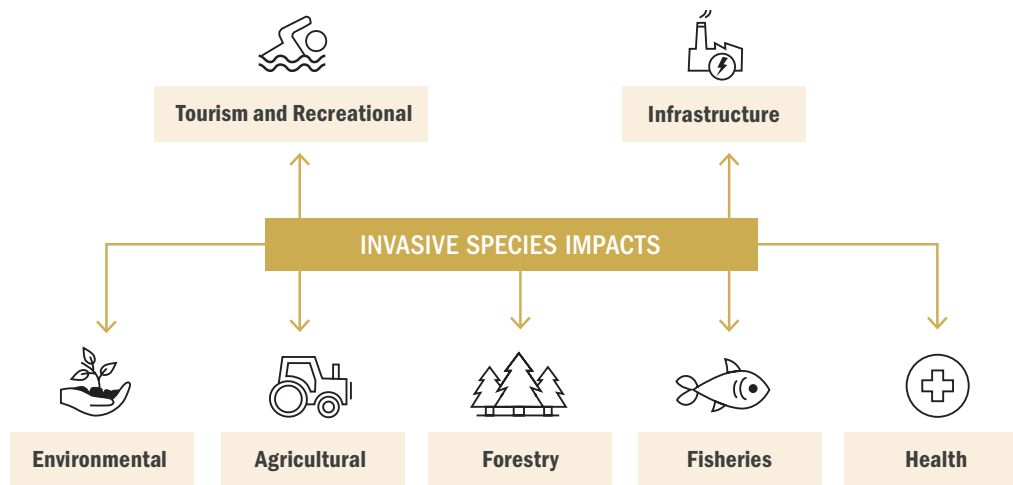
### 2.3 How Invasive Species Spread

Invasive species are primarily spread by human activities. The rise in global trade has resulted in increased transportation via air, land and sea of both goods and people—including a threefold increase in travel from



**Figure 1: Invasive Species Impacts**

Prepared by the Office of the Auditor General of Ontario



**Environmental Impacts**

Invasive species can negatively impact the environment by affecting biodiversity, causing local and even global species extinctions, creating soil degradation and erosion, and altering forest fire cycles. By altering ecosystem structure and function, invasive species can negatively impact the beneficial and economically valuable services that otherwise healthy ecosystems provide to the environment (such as water purification, carbon sequestration and climate regulation). According to the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services, invasive species are a top threat to biodiversity. For example, a single disease-causing fungus is a threat to nearly 400 amphibian species worldwide and has already caused a number of extinctions.



**Forestry Impacts**

In 2004, Canada’s annual timber losses through reduced wood supply and quality caused by invasive species were estimated at 61 million cubic metres, equivalent to \$720 million in losses per the Canadian Food Inspection Agency. Ontario’s forest sector, which is responsible for over 148,000 direct and indirect jobs across the province, can be threatened by the impacts of invasive species. For example, the emerald ash borer, a wood-boring beetle, has killed millions of ash trees in Canada and is the most costly invasive species for Ontario municipalities and conservation authorities. Spongy moth caterpillars defoliated (removed the leaves from) a record-breaking 1.78 million hectares of Ontario forest in 2021. In Ontario’s Haliburton Forest, most beech trees are infected by beech bark disease, which cost an estimated \$5 million dollars in lost product value between 2017 and 2025.



**Agricultural Impacts**

According to the Canadian Food Inspection Agency, the estimated annual economic impact of invasive plants on Canadian agriculture due to damage to crops and pastures, and costs of controlling weeds, is \$2.2 billion. Invasive plants can act as new or additional hosts for crop diseases and pests. They can reduce crop yields and require greater use of pesticides to control them, increasing the costs for farmers while decreasing crop values. For example, Canada thistle can severely decrease the yields of many crops including barley, canola and wheat. Some invasive plants can endanger livestock and diminish the growth of edible vegetation. In addition, the government of Canada’s August 2022 *Canada in a Changing Climate: Regional Perspectives Report* noted that climate change will lead to increased movement and establishment of invasive species, including pests, disease and competing plants, which will threaten agricultural production.



**Fisheries Impacts**

Invasive species frequently have strong negative impacts on fish populations and the fisheries they support. For example, invasive species such as sea lamprey, alewife, zebra mussel and round goby have had significant impacts on native fish communities in the Great Lakes, causing the historic collapses of lake trout, lake whitefish and cisco stocks in the Great Lakes. The economic impacts of invasive species on commercial and recreational fisheries, and the dollars spent by all levels of government to rehabilitate and propagate the affected fisheries, are estimated to be in the billions of dollars.

### Health Impacts

Invasive species can negatively impact human health by infecting humans with new diseases; serving as vectors (or pathways) to transmit existing diseases; or causing wounds through bites, stings, allergens or other toxins. For example, the Asian tiger mosquito, often considered the most invasive mosquito in the world, serves as a vector for many diseases including Zika virus, West Nile virus and Dengue fever. This species was found in Windsor-Essex County in 2017, and local health officials believe it is becoming established in southern Ontario. Other examples of harmful invasive species are the Africanized honey bee, which is known to attack humans and domestic animals in large swarms and over long distances, and the European fire ant, which can inflict extremely painful stings. Some invasive plants, like giant hogweed, can cause severe skin burns, painful blisters and even temporary blindness if its sap contacts the eyes.

### Tourism and Recreational Impacts

Invasive species can negatively impact people's ability to use affected lakes, rivers and other waterbodies for recreational activities such as fishing, boating and swimming. Some invasive species have the potential to depress sportfish populations, reducing recreational fishing opportunities and damaging local economies. Water soldier (a plant) forms dense floating mats that directly impede boating and have sharp, serrated leaf edges that can cut swimmers. Other invasive plants may reduce native plant biodiversity and dense vegetation can impede access to natural areas, affecting activities such as forestry and hiking. Phragmites (a tall grass species) can take over wetlands and beaches; reduce native wildlife populations including species at risk; and negatively impact recreational activities such as swimming, birdwatching, fishing and hunting. These impacts can cause economic hardship for Ontario's tourism and recreation industry.

### Infrastructure Impacts

Invasive species can cause significant damage and costs for repairs to damaged infrastructure as well as a loss in value of assets. For example, zebra mussels in the Great Lakes can rapidly cover submerged surfaces (such as those of boats, docks, rocks, native mussels and plants), and clog water intakes for water treatment and electric power generation facilities, costing at least an estimated \$500 million USD on management efforts across the Great Lakes basin.

Municipalities spent an estimated \$4.5 million in 2021/22 to prevent and respond to the impacts of zebra mussels, such as actions to prevent these mussels from clogging water intake pipes at municipal water treatment facilities, while Ontario Power Generation spent an estimated \$520,000 in 2021/22 to prevent generating station outages associated with mussels fouling water cooling facilities. Some terrestrial invasive plants, such as Japanese knotweed, can creep onto home properties, inhibiting garden plants and posing threats to walls and foundations of homes.

developed and developing countries—in turn, significantly increasing the risk of invasive species spread. **Figure 2** shows the most common examples of human-assisted invasive species pathways. “Pathways” are the routes by which an invasive species is transferred from one area or ecosystem to another (see **Appendix 1** for definitions of key terms in this report).

Climate change can accelerate the introduction and spread of many invasive species. Weather conditions

such as changing temperature, humidity and rainfall can affect species' life cycles and create favourable conditions for increased invasive species spread. For example, where cold temperatures previously killed up to 98% of the population of mountain pine beetles, a species native to western Canada, warming winters have resulted in decreased mortality, allowing these beetles to spread beyond their historical range. As these beetles invade and kill nearly all species of pine trees,

**Figure 2: Human-Assisted Invasive Species Pathways**

Prepared by the Office of the Auditor General of Ontario, adapted from Environment and Climate Change Canada

Examples of Aquatic Species Pathways	Examples of Species
<p><b>Shipping</b> Many species have been introduced to the Great Lakes and other waterbodies through shipping. Ocean-going ships hold water in their ballast (a compartment at the base of the ship) for balance and stability during their voyage. When ships discharge ballast water, often taken on in distant parts of the world, they can release numerous non-native species.</p>	European green crab, barnacles, bloody red shrimp
<p><b>Recreational and Commercial Boating</b> Boats can inadvertently help spread invasive species. Invasive weeds can get attached to boat trailers. New recreational wake boats have water ballasts that take on water and can transport invasive species.</p>	Zebra mussels, spiny and fish hook water flea, Eurasian watermilfoil
<p><b>Live Bait and Unauthorized Introductions</b> Live bait used for fishing that is released into lakes and rivers are responsible for the movement of several species. Other species native to Ontario have been purposely released into waterbodies where they do not belong.</p>	Rusty crayfish, round goby, yellow perch, northern pike, smallmouth bass, rock bass, black crappie
<p><b>Aquarium and Water Garden Trade</b> Invasive fish and plants can be offered for sale as pets or decorations in the aquarium and water garden trades. Products may also unknowingly be contaminated with invasive species.</p>	Water hyacinth, lionfish, goldfish, yellow floating heart, purple loosestrife
<p><b>Live Food Fish</b> Many species of fish are also imported live as food. If released into the wild, some of these species become invasive.</p>	Invasive carp, northern snakehead
<p><b>Canals and Water Diversions</b> The construction of canals and water diversions has allowed species to move into new waterbodies where they do not belong.</p>	Sea lamprey
Examples of Terrestrial Species Pathways	Examples of Species
<p><b>Transport</b> Cargo containers are sometimes contaminated with living plants, animals and insects that become invasive alien species. The transport of firewood, Christmas trees, and other wood products can also introduce invasive insect species to new (uninfested) areas.</p>	Emerald ash borer, Asian longhorned beetle
<p><b>Horticultural Planting</b> Many varieties of garden plants and herbs are imported into Canada but become invasive once escaping the confines of a garden.</p>	English ivy
<p><b>Accidental Release</b> A number of terrestrial species have escaped captivity or been released into the wild and become invasive.</p>	Wild pigs

they could devastate Ontario's boreal forest if current control activities in western provinces are unsuccessful and the species arrives in Ontario. Similarly, the geographic range of blacklegged (or deer) ticks, which can transmit the pathogen that causes Lyme disease, was once limited by cold winters. However, with climate change, these ticks have expanded northward into numerous parts of Canada, including Ontario, increasing the risk of Lyme disease for Ontarians.

## 2.4 Managing Invasive Species: Federal, Provincial and Municipal Roles and Responsibilities

In Canada, all three levels of government are involved in the prevention and management of invasive species spread. **Appendix 2** summarizes the roles and responsibilities of the federal, provincial and municipal governments, as well as those of other key players, in

this work. Additional details and other key stakeholders are discussed in **Appendix 3**.

### 2.4.1 Federal Role and Responsibilities

Canada is responsible for preventing the entry of invasive species into Canada and their movement between provinces. Federal legislation plays a role in regulating key invasive species pathways including ship ballast water; fisheries (e.g., use of bait); and the movement of wildlife, pathogens and pests—all of which contribute to prevention and management efforts.

For example, the federal *Plant Protection Act, 1990* includes regulations to prevent the import, export and spread of invasive species (plant pests) such as insects, snails and viruses that threaten plant life and the agricultural and forestry sectors of the Canadian economy. Similarly, the federal Ontario Fishery Regulations and Aquatic Invasive Species Regulations under the federal *Fisheries Act* regulate the import and handling of invasive species such as specified fish, mussels and crayfish that threaten Ontario's fisheries. These federal laws are enforced in Ontario by designated officers, which in the case of the Aquatic Invasive Species Regulations includes Ontario's conservation officers.

Also relevant to Ontario, the Canada-Ontario Agreement on Great Lakes Water Quality and Ecosystem Health supports the restoration and protection of the Great Lakes basin ecosystem. The Agreement outlines how the governments of Canada and Ontario will co-operate and co-ordinate their efforts to restore, protect and conserve this ecosystem, with defined roles and responsibilities related to preparing for and responding to aquatic invasive species.

Depending on the type of species and its regulatory status, federal agencies may also have a role in research and monitoring, risk assessment, co-ordination and management activities.

### 2.4.2 Provincial Role and Responsibilities

The Ministry of Natural Resources and Forestry (Natural Resources Ministry) leads the implementation

of Ontario's Invasive Species Strategic Plan, a multi-ministry plan released in 2012 that aims to prevent new invasive species from arriving and surviving, slow or reverse the spread of existing invasive species, and reduce the harmful impacts of existing species (see **Appendix 4** for more on the Strategic Plan). In this role, the Ministry is responsible for working with and providing guidance to other ministries, partners and stakeholders in Ontario to co-ordinate actions that address the threats posed by invasive species.

The Natural Resources Ministry also administers the *Invasive Species Act, 2015* (Act), the main piece of legislation regulating the management of invasive species in the province (**Appendix 5** compares invasive species laws across Canada). The Act gives the Ministry inspection and enforcement powers to regulate invasive species prevention and management. It also sets out a legislative framework for prohibiting or restricting the possession, transfer, sale, release and propagation of listed invasive species that threaten Ontario's natural environment. **Appendix 6** lists the 33 species regulated under the Act and the harm they do to ecosystems. The Act also requires watercraft users to clean and drain watercraft and watercraft equipment to ensure they are free of all aquatic plants, animals and algae before being placed into waterbodies. **Appendix 7** summarizes other federal and Ontario legislation and regulations relevant to invasive species.

### 2.4.3 Municipal Role and Responsibilities

Municipalities are responsible for protecting street trees; public parks; municipal roadways; and municipally designated forests, woodlands and natural areas from invasive species. Some municipalities have developed an invasive species management plan while others have provided training to their parks and forestry personnel on detecting and managing invasive species. In addition, some invasive weeds are controlled by local bylaws.

## 2.4.4 Conservation Authorities' Role and Responsibilities

Conservation authorities are local public-sector organizations, established by the *Conservation Authorities Act* (administered by the Ministry of the Environment, Conservation and Parks), to develop and deliver local, watershed-based resource management programs on behalf of the Province and municipalities. Conservation authorities partner with others to undertake invasive species prevention and management activities, mostly using municipal funding, to protect and manage water and other natural resources.

## 2.5 The Four Stages of Invasive Species Management

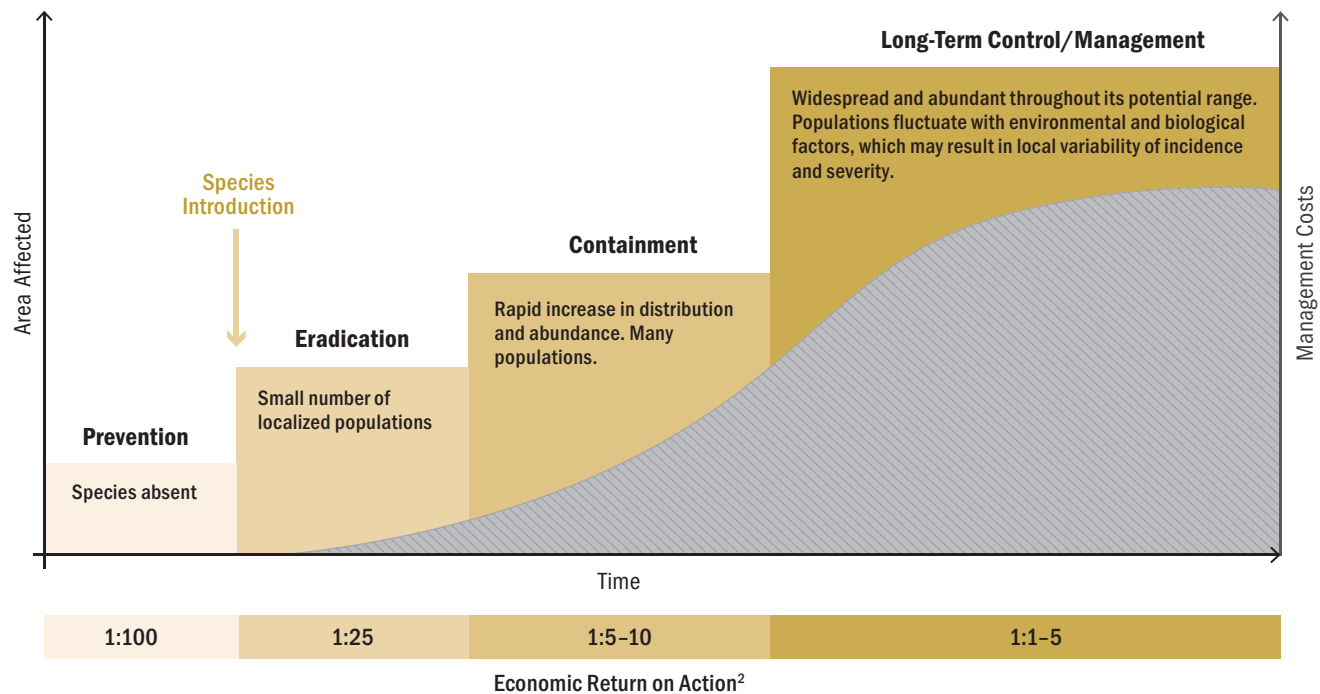
The invasion curve shown in **Figure 3** is a tool for understanding the four stages of invasive species

management: prevention, eradication, containment and long-term control.

Preventing introduction in the first place is the most effective and economical solution for managing invasive species—investing in prevention is generally estimated to provide economic returns that are many times higher than trying to manage a species after it arrives. Where prevention fails, detecting and controlling invasive species populations at an early stage of invasion often increases the chance of cost-effective eradication (removal of a species population in its entirety followed by its continued absence). If a species population is small and localized, eradication may be possible. However, once a species is introduced, management costs increase, and the likelihood of eradication decreases as time passes and the population grows. At this stage, priorities shift to containment (preventing further spread). When eradication is unlikely or impossible, the focus then becomes long-term

**Figure 3: The Generalized Invasive Species Invasion Curve<sup>1</sup>**

Prepared by the Office of the Auditor General of Ontario, adapted from the State of Victoria



1. The shaded curve indicates that, as time passes, the geographic area affected by an invasive species, and the costs associated with managing that species, initially increase exponentially.
2. The amounts shown for economic returns are for illustrative purposes only rather than precise and guaranteed returns. Investing in prevention generally provides economic returns that are many times higher than trying to manage a species after it arrives. Once a species is introduced, management costs increase and the likelihood of eradication typically decreases as time passes.

control—i.e., limiting the species' further spread and establishment while reducing its negative impacts on native species and ecosystems.

## 2.6 Invasive Species Work in Ontario

As the provincial lead on invasive species, the Natural Resources Ministry provides funding each year to a number of organizations to carry out invasive species management work—key transfer payments include \$1.2 million (2021/22) to the Invasive Species Centre (see **Section 2.6.3**) and \$275,000 (2021/22) to the Ontario Federation of Anglers and Hunters (see **Section 2.6.2**). Ontario uses a risk-based approach to regulate and allocate resources to manage those species it determines are the greatest risk to the province. The Ministry also collaborates with other ministries, municipalities, conservation authorities, and other partners and stakeholders to co-ordinate activities to help address invasive species. **Appendix 2** and **Appendix 3** provide more details on these key players and stakeholders.

**Figure 4** shows that invasive species-related costs incurred in 2021/22 by provincial ministries, municipalities and conservation authorities alone are estimated to be over \$58 million.

### 2.6.1 Preventing the Introduction and Spread of Invasive Species

Preventing the harmful introduction of invasive species into Ontario is largely a federal responsibility. For example, the Canadian Food Inspection Agency, Fisheries and Oceans Canada, and Environment and Climate Change Canada each have import prohibitions for travellers and commercial importers for this purpose. The Canada Border Services Agency assists with the enforcement of these import prohibitions on certain types of food, plant and animal products (outlined in **Figure 5**).

Ontario is responsible for preventing the introduction and spread of provincially regulated invasive species, and assessing the threat posed by new and potential invaders. Specifically, the Natural Resources

Ministry has a responsibility to co-ordinate with the federal and other provincial governments, as well as neighbouring US states, to prevent, detect and respond to invasive species that impact the natural environment and cross or border on jurisdictional boundaries.

In addition, the Ministry's Enforcement Branch has appointed 238 conservation officers (209 of which are active in the field) to enforce various mandated acts—including the *Invasive Species Act, 2015*—by, for example, inspecting vehicles, boats and aircraft for the presence of invasive species and issuing orders to help prevent invasive species spread. These officers also respond to non-compliance under the Act and can obtain warrants to conduct searches and tests, seize evidence, and arrest suspected offenders. While park wardens under the Ministry of the Environment, Conservation and Parks are also considered enforcement officers by the Act, there had been no relevant activities (such as the laying charges or issuing of warrants and warnings) conducted by park wardens at the time of our audit.

### 2.6.2 Detecting, Assessing, and Regulating Harmful Invasive Species

To facilitate the monitoring and early detection of invasive species, two key tools were implemented by the Invading Species Awareness Program—established by the Natural Resources Ministry in partnership with the Ontario Federation of Anglers and Hunters (OFAH), a non-profit, charitable fish and wildlife conservation organization. Specifically, the Invading Species Hotline (1-800-563-7711) is a tool that allows members of the public to speak with an invasive species expert to report a sighting or inquire about invasive species information. Reports can also be submitted online through the Early Detection and Distribution Mapping System for Ontario (EDDMapS), a web-based mapping tool for documenting invasive species occurrences across Ontario.

Further, the Ministry has developed and is using tools for environmental DNA (eDNA)—genetic material (DNA) that is shed into the environment by living or dead organisms—which allows scientists

**Figure 4: Invasive Species Expenditures in Ontario by Fiscal Year, 2017/18–2021/22 (\$ 000)**

Prepared by the Office of the Auditor General of Ontario

Spending and Transferred Funds	2017/18	2018/19	2019/20	2020/21	2021/22
<b>Ministry of Natural Resources and Forestry</b>					
Invasive Species Centre <sup>1</sup>	1,043	943	893	1,243	1,243
Ministry staff salaries and employee benefits <sup>2</sup>	1,239	1,248	1,086	1,179	1,226
Canada-Ontario Agreement on Great Lakes Water Quality and Ecosystem Health <sup>3</sup>	403	680	387	575	630
Ontario Federation of Anglers and Hunters	550	350	200	275	275
University of Waterloo <sup>4</sup>	205	190	190	190	150
Ducks Unlimited Canada	80	100	20	49	75
Ontario Invasive Plant Council <sup>5</sup>	150	100	-	9	17
Kudzu eradication	7	7	11	8	7
Federation of Ontario Cottagers' Associations <sup>6</sup>	50	50	-	-	5
Communications and marketing campaigns	30	-	50	-	-
Other funding recipients <sup>7</sup>	151	86	116	150	91
<b>Total Ministry of Natural Resources and Forestry Transferred Funds</b>	<b>3,909</b>	<b>3,755</b>	<b>2,954</b>	<b>3,679</b>	<b>3,719</b>
<b>Ministry of Transportation</b>					
Roadside invasive plant management	1,790	559	1,497	2,220	3,280
<b>Ministry of Agriculture, Food and Rural Affairs</b>					
Agricultural plant and pest management	666	574	1,421	917	584
<b>Ministry of the Environment, Conservation and Parks</b>					
Provincial park and conservation reserve management	218	228	275	229	297
<b>Municipalities<sup>8</sup></b>					
Prevention, detection, control and management	42,300	42,300	42,300	42,300	42,300
<b>Conservation Authorities<sup>8</sup></b>					
Prevention, detection, control and management	8,400	8,400	8,400	8,400	8,400
<b>Total Ontario Invasive Species Spending and Transferred Funds<sup>9</sup></b>	<b>57,283</b>	<b>55,816</b>	<b>56,847</b>	<b>57,745</b>	<b>58,581</b>

Note: Totals may differ from the sums of above amounts due to rounding.

- The amount to the Invasive Species Centre includes approximately \$43,000 per year from the Ministry's Science and Research Branch to fund an insect diagnostician.
- The amount includes the salaries and employee benefits paid to staff in the Biodiversity and Invasive Species Section, as well as the estimated salaries and employee benefits for staff in other ministry departments (based on the portion of time these staff spent performing invasive species-related work among their other duties).
- This represents spending on co-operative and co-ordinated efforts to reduce the threat of aquatic invasive species to Great Lakes water quality and ecosystem health.
- The University of Waterloo received funding for phragmites management and environmental remediation in the Long Point region.
- The Ontario Invasive Plant Council was funded to update best management practice and technical documents, host annual invasive species awareness webinars, support relevant working groups, and hire two full-time project-based staff, as well as an Executive Director.
- The Federation of Ontario Cottagers' Associations was funded to promote best management practices, create and distribute educational signs, increase education and outreach through social media awareness, work with member associations aimed at aquatic invasive species eradication at a local level, and hire two consultants/biologists.
- Various other recipients have received funding for invasive species-related activities.
- Municipalities' and conservation authorities' spending related to invasive species are based on estimates provided in a 2019 report commissioned by the Invasive Species Centre. Most of these estimated costs are for invasive species control and management. The Centre indicated that actual expenditures are likely higher than the estimated amounts.
- Various other non-governmental and conservation organizations perform work on invasive species that receive funding from federal grants, donations and other funding sources.

**Figure 5: Canadian Border Controls to Prevent the Importation of Invasive Species**

Prepared by the Office of the Auditor General of Ontario, adapted from the Canada Border Services Agency

Prohibited Items	Responsible Agency	Importation Prohibition
<b>Firewood</b>	Canadian Food Inspection Agency	As firewood can contain invasive insects and diseases, it can only be imported into Canada with a permit from the Canadian Food Inspection Agency and a Phytosanitary Certificate.
<b>Invasive Carp (formerly called Asian Carp)</b>	Fisheries and Oceans Canada	Invasive carp, while not yet established in Canada, pose a significant threat because of their potential to have a devastating impact on the Great Lakes. Importation of live invasive carp is illegal in Canada.
<b>Zebra and Quagga Mussels</b>	Fisheries and Oceans Canada	Zebra and quagga mussels are freshwater species that can cause serious environmental and economic impacts. Travellers towing mussel-carrying watercraft and equipment across borders may be refused entry into Canada or required to follow decontamination and/or quarantine procedures.
<b>Bait for Recreational Fishing</b>	Canadian Food Inspection Agency	Importing susceptible species and their products for use as bait, live or dead (including fresh and frozen), requires a Canadian Food Inspection Agency import permit. Bringing earthworms, insects and leeches into Canada also requires special authorizations and documentation.
<b>Other Aquatic Invasive Species</b>	Fisheries and Oceans Canada	Canada prohibits the importation of other aquatic invasive species such as the Eurasian watermilfoil, sea lamprey, European green crab and smallmouth bass.
<b>Salamanders, Frogs and Toads</b>	Environment and Climate Change Canada	All species of salamanders, frogs and toads that do not have proper documentation are refused entry into Canada.
<b>Wood Packaging Material</b>	Canadian Food Inspection Agency	Strict requirements for the importation of wood packaging material are in place to protect Canadian forestry from non-native pests that could be found in these materials.
<b>Goods/Vehicles Contaminated with Soil</b>	Canadian Food Inspection Agency	All goods found to be contaminated with soil are inadmissible and will be refused entry or ordered removed from Canada. All motor vehicles entering Canada are also subject to inspection to ensure they are clean and free of pests and/or soil.

to detect invasive species in an environment even if they are present in low numbers, acting as an early warning system.

To address new reports of invasive species, in April 2018, the Ministry developed an Invasive Species Response Framework, which outlines two stages to guide response actions. In stage one, the Ministry confirms the identification and status of a potential new invasive species, uses risk assessments to determine the threat of an invasive species infestation to Ontario's natural environment, and determines whether the species falls under the Ministry's mandate. Based

on these assessments and the extent of infestation, program staff make recommendations as to the level of response required. Stage two is for managing higher-risk invasive species that require more robust measures to address the threat. Here, the Ministry forms a multi-divisional team to develop response and implementation plans, which may evaluate and recommend containment, prevention, control, eradication and/or monitoring measures. As part of this process, program staff may identify candidate invasive species to be regulated under the Act.



### 2.6.3 Controlling and Increasing Awareness of Invasive Species

Once an invasive species is established, there are five common types of controls to manage and reduce the harm it can do: mechanical, physical, chemical, biological and integrated control (see **Appendix 1** for the definitions of these terms).

As invasive species are primarily spread by human activities, public education and outreach about invasive species can help reduce their spread. This may be achieved by increasing the public's awareness (for example, recognizing which species are harmful and invasive) and knowledge (for example, understanding invasive species and their impact) of such species.

As the provincial lead on invasive species, the Natural Resources Ministry funds other organizations to support this work. For example, the Invasive Species Centre (Centre), a not-for-profit organization founded in 2011 and funded by the governments of Canada and Ontario, acts as a hub for information on invasive species. It also brings stakeholders and partners (e.g., governments, municipalities, academia, industry, Indigenous communities/organizations) together to collaborate on invasive species research, response planning, mitigation and rehabilitation. The Centre's activities include:

- developing best management practices to help individuals and organizations prevent and manage invasive species;
- engaging communities to report and/or manage invasive species;
- maintaining a database to consolidate risk assessments for various invasive species and pathways;
- assessing applications and providing micro-grants for local education, prevention and management initiatives;
- supporting or leading research, communications and outreach initiatives;
- answering questions from the public, organizations and media;
- providing leadership on the co-ordination of invasive species work, and assisting with such work; and

- supporting policy development through policy recommendations and technical advisory committee participation.

## 3.0 Audit Objective and Scope

Our audit objective was to assess whether the Ministry of Natural Resources and Forestry (Ministry) has a long-term strategy, and cost-effective and efficient systems and processes, to:

- prevent introductions of harmful invasive species before they occur;
- promptly detect, identify, respond to and manage invasive species in Ontario;
- reduce the spread and harmful impacts of invasive species;
- oversee the use of funds by transfer payment recipients; and
- measure and publicly report on progress toward preventing, detecting, identifying, responding to, managing and reducing the spread and impacts of invasive species.

In addition, this audit assessed whether the Invasive Species Centre is using the funds received from the Province for the purposes for which they are intended in order to help prevent introductions and help reduce the spread and harmful impacts of invasive species.

In planning for our work, we identified the audit criteria (see **Appendix 8**) we would use to address our audit objective. We established these criteria based on a review of applicable legislation, policies and procedures; internal and external studies; and best practices. The senior management of both the Ministry and Invasive Species Centre reviewed and agreed with the suitability of our objectives and associated criteria.

We conducted our audit between January 2022 to September 2022. We obtained written representation from both Ministry and Invasive Species Centre management that, effective November 21, 2022, they had provided us with all the information they were aware of that could significantly affect the findings or the conclusions of this report.

Our audit work was conducted remotely and at the Invasive Species Centre's Sault Ste. Marie office. Through video-conferencing and other forms of electronic communication, we engaged staff of the Ministry, the Invasive Species Centre, and other stakeholders including Ducks Unlimited, the Ontario Invasive Plant Council, the Ontario Federation of Anglers and Hunters, the Nature Conservancy of Canada, the Canadian Food Inspection Agency, Natural Resources Canada, the Ontario Ministry of Transportation, the Canadian Council on Invasive Species, the Federation of Ontario Cottagers' Associations, Ontario Power Generation and the Ontario Conservation Officers Association. We interviewed senior management, staff and conservation officers, and reviewed relevant data and documents, from both the Ministry and Invasive Species Centre.

We also contracted a national survey company to ask Ontarians about their awareness of invasive species programs and the reporting of invasive species sightings in Ontario. In addition, we conducted surveys of Ontario's 444 municipalities and 36 conservation authorities to gain insights on their experiences with invasive species, as well as priorities, risks, challenges and opportunities in carrying out invasive species work. We received 135 and 27 responses (for a 30% and 75% response rate) from these municipalities and conservation authorities, respectively.

To identify best practices, we reviewed scientific literature and international standards about invasive species prevention and management. We also interviewed experts in invasive species policies and science.

We conducted our work and reported on the results of our examination in accordance with the applicable Canadian Standards on Assurance Engagements—Direct Engagements issued by the Auditing and Assurance Standards Board of the Chartered Professional Accountants of Canada. These standards involve conducting the tests and other procedures that we consider necessary, including obtaining advice from external experts when appropriate, to obtain a reasonable level of assurance.

The Office of the Auditor General of Ontario adheres to the Canadian Standard on Quality Control

and, as a result, maintains a comprehensive quality control system that includes documented policies and procedures with respect to compliance with rules of professional conduct, professional standards and applicable legal and regulatory requirements.

We have complied with the independence and other ethical requirements of the Code of Professional Conduct of the Chartered Professional Accountants of Ontario, which are founded on fundamental principles of integrity, objectivity, professional competence and due care, confidentiality and professional behaviour.

## 4.0 Detailed Audit Observations

### 4.1 Invasive Species Are Not Assessed and Regulated in a Timely Manner

The Natural Resources Ministry uses risk assessments to evaluate the threats posed by non-native species to Ontario and to identify species it may need to regulate. These assessments draw upon literature reviews that summarize relevant information for a species, such as its biology and life cycle, invasion history, and pathways of introduction or spread. The Ministry considers factors such as the species' ecological risks (e.g., impact on food chains), socio-economic risks (e.g., impact on recreational fishing) and regulatory risks (e.g., impact on businesses).

These assessments are either developed by Ministry staff, contracted to experts, or adopted from other jurisdictions if their risk assessments meet the Ministry's needs. The Ministry regulates species in batches rather than individually once risk assessments are completed. Since the *Invasive Species Act, 2015* (Act) was passed, the Ministry has completed risk assessments to inform two regulatory updates: in the first update (November 2016), 19 individual invasive species and all species belonging to the snakehead family (a type of freshwater fish) were regulated; in the second (January 2022), 13 more species were regulated.

To list a new species under Ontario Regulation 354/16 of the Act, the Ministry must complete both

the species' risk assessment and a regulation development and approval process. **Appendix 9** lists the steps for each of these processes, and provides guidelines on how many months it should take to regulate a new species. The length of time to complete risk assessments can vary depending on the complexity of the work required to address each species.

#### 4.1.1 Delays in Regulating Invasive Species Increase the Risk of Introduction and Spread

We found that the Natural Resources Ministry took a significant amount of time to complete risk assessments for several now-regulated invasive species. The resulting delays in regulating these species negatively impacted Ontario's ability to promptly prevent their introduction and spread, increasing the likelihood of ecological, social and economic harm and management costs.

The Ministry has acknowledged the importance of conducting risk assessments in managing invasive species. For example, in the 2012 Invasive Species Strategic Plan, the Ministry stated that, with so many invasive species and pathways to consider, it is important to establish priorities through risk assessments in order to estimate the likelihood of an invasive species being introduced and evaluate the potential consequences of that introduction.

However, we noted that the Ministry had only the equivalent of one permanent staff member performing this work at the time of our audit, with additional capacity being provided on an as-needed basis through agreements with partners and experts. Also, the Ministry does not have a list of all recognized invasive species in the province to prioritize and shortlist, but rather an incomplete workbook of compiled information from various sources for some species. Furthermore, the Ministry has not tracked when assessed species were identified and how long the various steps in the assessment and listing process took, nor has it maintained a list of invasive species that are pending risk assessment. The Ministry indicated that it does not formally track these steps since there is no requirement for completing them within specific timelines. As a result, the Ministry cannot

determine whether risk assessments are completed in a timely manner or estimate the size of the backlog of species requiring assessments.

In contrast, we noted that the US state of Maine maintains a clearly defined list of species that require review. Recently Maine's Department of Agriculture, Conservation and Forestry developed a list of 171 invasive plants that were found to pose a threat to habitats and natural resources in the state. From this list, it prioritized 81 plants in 2021 to be considered for evaluation to inform whether the sale of those species should be restricted. Maine also maintains a "watch list" of other invasive plants that meet some of the criteria for restricting their trade, but for which evidence is currently insufficient to list them for review. This watch list will be revisited during its next update to determine whether sufficient information is available to review additional species to restrict their sale. Maine's rules require a review of these listings every five years at a minimum, and citizens can submit petitions to add species to or delete species from the list, which are reviewed by a stakeholder committee.

The *Invasive Species Act, 2015* (Act) does not mandate a timeline for regulating invasive species. In contrast, the *Endangered Species Act, 2007* requires a committee to assess at-risk species and summarize in an annual report any newly classified species and changes to the classification of listed species (as identified in **Section 2.7.1** of our Protecting and Recovering Species at Risk audit in our *2021 Annual Report*). Within a year of receiving the annual report, the Environment Minister must update the Species at Risk in Ontario List to regulate the classified species. There is no requirement for a similar annual report on the identification of invasive species. Ministry staff indicated that, while an annual report may not be appropriate for reporting newly assessed invasive species for regulatory consideration, a predictable and consistent schedule for updating the regulated list of species in Ontario Regulation 354/16 would help ensure that completed high-risk assessments translate into the regulation of invasive species on a regular basis.

The Ministry has an internal timeline that targets completing the regulatory process within 7 to 13 months (depending on when regulations can next come into force per Ontario's Twice Annual Effective Date policy, which is January 1 and July 1 of each year) after the risk assessment is completed. Since the Act was passed in November 2015 and came into force in November 2016, all initially listed species were regulated in a reasonable time frame. However, for the 12 species that were newly regulated in January 2022 (excluding wild pigs, which were assessed and regulated through a separate process), the Ministry took on average 46 months to list and regulate those species after they were assessed (see **Figure 6**). According to the Ministry, these delays were a result of limited staff capacity, staff transitioning to working remotely during the COVID-19 pandemic, and limited opportunities for external consultation as public and stakeholder attention was largely on the pandemic and industry sectors. Moreover, the Ministry indicated that it required additional consultation and engagement to determine the regulatory approach for wild pigs (see **Appendix 10**), Ontario's first regulated invasive mammal. In contrast to the lengthy delays experienced in Ontario, Maine's reviews of the 81 terrestrial plant species noted above were completed in early 2022. From these reviews, it listed an additional 30 terrestrial plants to the 33 already listed on the state's Do Not Sell Invasive Plant List, and these 30 species will be effectively banned from trade starting January 1, 2024.

For some species, the delay in regulation has meant that control measures that could have reduced the risk of their spread were not in place for several years. For example, Carolina fanwort (an aquatic plant) was not regulated until almost five years after a Ministry consultant identified, in a draft risk assessment to the Ministry in 2017, that the species can cause significant harm to Ontario's natural environment (e.g., by out-competing native vegetation) and negatively impact recreational activities like boating, fishing and swimming. We noted that this draft risk assessment is very similar (and in some sections identical) to the final risk assessment used to inform regulatory consideration for the species. Despite the draft (and final) risk

assessment identifying that Carolina fanwort has a high risk of becoming widely invasive, the Ministry did not finalize the risk assessment or consider the species for regulation until 2020.

We also noted that four other invasive species (bohemian and giant knotweed, European frog-bit, and red swamp crayfish) already had risk assessments completed by other parties (the State of New York, the State of Michigan, and the US Fish and Wildlife Service, respectively) prior to the Act coming into force in 2016, which the Ministry adopted to inform its recent regulatory update. However, the Ministry took over six years (74 months) to regulate these species from when those assessments were first available for adoption. While a risk assessment in another jurisdiction does not inherently initiate a timeline in which the Ministry must review and regulate a species, this time lag does represent a period of years in which relevant risk information was available but not acted upon by the Ministry. The Ministry told us that it did not regulate these species initially because they were not in the Conference of Great Lakes and St. Lawrence Governors and Premiers' "least wanted species" list, and limited information was available regarding both their presence in Ontario and import and sales volumes in Ontario's horticultural sector.

However, according to the adopted risk assessments, all four species are considered high risk. In Ontario, sightings were confirmed for three of these species prior to their regulation, with European frog-bit having almost 1,500 confirmed reports. European frog-bit is an invasive aquatic plant that resembles native waterlilies and can produce dense mats of floating vegetation that outcompete native species by reducing available light for submerged plants. Large areas of these plants may die and decompose in the fall, decreasing a waterbody's oxygen levels and negatively impacting aquatic life. Since European frog-bit is now well-established in Ontario—including in the Rideau and Ottawa river systems, Kawartha Lakes, and other lakes and rivers in south central and southwestern Ontario—its impacts are likely much more widespread than they otherwise may have been had the Ministry acted sooner to restrict its movement.

**Figure 6: Months from Risk Assessment Completion to Regulation by Species, 2016 and 2022**

Prepared by the Office of the Auditor General of Ontario

Year Regulated	Species Type	Species Common Name	Months from Risk Assessment Completion to Regulation (target: 7–13 months) <sup>1</sup>
2022	Aquatic invertebrates	Marbled crayfish	23
		New Zealand mud snail	23
		Red swamp crayfish	74
	Fish	Prussian carp	36
		Tench	25
	Insects	Mountain pine beetle	59
	Mammals	Pig	n/a <sup>2</sup>
	Plants	Bohemian knotweed	74
		Carolina fanwort <sup>3</sup>	57
		European frog-bit	74
		Giant knotweed	74
		Himalayan knotweed	25
		Yellow floating heart	13
	<b>Avg # of Months from Assessment Completion to Regulation (2022)</b>		
2016	Aquatic invertebrates	Common yabby	12
		Golden mussel	12
		Killer shrimp	6
	Fish	Bighead carp	12
		Black carp	12
		Grass carp	12
		Silver carp	12
		Snakehead, all species in the snakehead family	12
		Stone moroko	12
		Wels catfish	9
		Zander	12
	Plants	Black dog-strangling vine	12
		Brazilian elodea	7
		Dog-strangling vine	12
		European water chestnut	12
		Hydrilla	4
		Japanese knotweed	12
		Parrot feather	5
Phragmites	12		
Water soldier	12		
<b>Avg # of Months from Assessment Completion to Regulation (2016)</b>			<b>11</b>

- Months are measured from the month that the relevant ecological risk assessment was completed and the month the *Invasive Species Act, 2015* was passed to the month when the species was actually regulated under O. Reg 354/16. This is done so that months where the Act did not exist are not counted, as it was not possible to regulate these species without the Act. Socio-economic impact assessments are not considered in this analysis as the Ministry's goal is to complete them at the same time as ecological risk assessments (as per **Appendix 9**).
- Pigs were assessed and regulated through a separate process from that used for other species (outlined in **Appendix 9**). As a result, there is no comparable risk assessment completion date to measure from for this species.
- The timeline for Carolina fanwort is measured from the date that a consultant submitted a draft ecological risk assessment to the Ministry. This draft was similar to (and in many sections indistinguishable from) the final version used to inform regulatory consideration.

## RECOMMENDATION 1

So that harmful invasive species are more promptly regulated, and to help prevent their introduction and spread, we recommend that the Ministry of Natural Resources and Forestry:

- track the duration and ongoing status of various steps in its risk assessment and listing processes;
- maintain a list of invasive species pending risk assessment to determine the size of the backlog and implement measures to reduce the backlog;
- determine and document the reasons for delays in assessments and listings and implement effective actions to avoid these delays; and
- establish a timely and consistent schedule for regulatory updates to Ontario Regulation 354/16 and submit regulatory proposals accordingly.

## MINISTRY RESPONSE

The Ministry of Natural Resources and Forestry (Ministry) agrees with developing and consulting on regulation proposals for newly identified high-risk invasive species where regulations would contribute to preventing their introduction or spread.

The Ministry will continue to examine the current risk assessment process for opportunities to reduce timelines and track progress, while maintaining an evidence-based approach that considers ecological and socio-economic impacts of invasive species in Ontario.

Decisions to regulate an invasive species must consider how the application of prohibitions would support or impede management objectives, as well as the impact of prohibitions on individuals and businesses in Ontario.

Given the diversity of species, impacts and management priorities, timelines for completing ecological risk assessments, and consulting the public, regulation development can vary. The Ministry is committed to regularly considering regulation changes and will continue to maintain and update a list of species for future consideration with the understanding that

timelines may change in response to species or carrier-specific issues.

### 4.1.2 Ministry Does Not Sufficiently Assess and Regulate Terrestrial Invasive Species and Their Known Pathways, Like the Horticultural Trade

Our audit found that terrestrial invasive species receive insufficient focus and assessment by the Ministry, including terrestrial plant species (and their pathways) and, more specifically, terrestrial vascular plants that are of concern or known to be invasive. This lack of focus increases the risk that new introductions and spread will occur in Ontario.

We found that, in 2016, the Ministry developed an ecological risk assessment tool to evaluate the probability of invasion and ecological impacts of aquatic invasive species in Ontario. This tool considers factors that influence the likelihood of a species' arrival, survival, establishment and spread, as well as the magnitude of the species' potential impacts. The Ministry uses this information to determine which aquatic invasive species should be prioritized for regulatory consideration. In contrast, the Ministry has not yet implemented a similar tool for terrestrial invasive species. However, during our audit the Ministry adapted the aquatic tool to assess the ecological risk of invasive terrestrial plants. Ministry staff told us that these novel tools are designed to inform consistent, evidence-based and systematic processes to improve upon past practices for assessing ecological risk. The Ministry plans to test and validate the tool in the third and fourth quarter of the 2022/23 fiscal year.

In addition, the Ministry has not collaborated with stakeholders to compile a list of "least wanted" terrestrial species to facilitate the risk assessment process. To select species for initial risk assessment and regulation, the Ministry has largely used the "least wanted" invasive species list created by the Great Lakes and St. Lawrence Governors and Premiers' Invasive Species Task Force. However, the 21 invasive species on this list are exclusively aquatic species, as the task force was formed to unite the chief executives from Ontario, Quebec and eight US states to stop the introduction

and spread of invasive species in the Great Lakes–St. Lawrence River Basin. No equivalent collaboration exists at this time to identify and list shared terrestrial invasive species threats. To date, 47% of species selected for assessment and 64% of all regulated species under the Act have come from that aquatic species list.

Several terrestrial plant species and their pathways that are of concern or known to be invasive have also been left unassessed and/or unregulated. We reviewed the comments made by stakeholders and members of the public on the Environmental Registry of Ontario

in response to the most recent public notice of regulations under the Act, and found concerns raised about the Ministry not regulating several terrestrial plant species. Based on these concerns and those expressed by the Ontario Invasive Plant Council (OIPC), as well as species identified in the OIPC's Grow Me Instead guides, we identified 30 additional terrestrial plant species that should be considered for regulation under the Act (see **Figure 7** for details). One example is the tree-of-heaven (a tree native to China and Taiwan), which is invasive in North America and the favoured

**Figure 7: Select Unregulated Invasive Plant Species in Ontario and Their Impacts**

Prepared by the Office of the Auditor General of Ontario

Invasive Plant Species	Impacts
<b>Amur maple</b>	Establishes dense shade that suppresses the growth of native shrubs, herbaceous plants and grasses.
<b>Autumn Olive</b>	Can outcompete and displace native plants by changing the chemistry of the soil around it.
<b>Common buckthorn</b>	Forms dense thickets that crowd and shade out native plants, alters nitrogen levels in the soil, and produces a large number of seeds that germinate quickly and prevent the natural growth of native plants. Can host the fungus oat crown rust.
<b>Creeping jenny</b>	Thrives in wet soil and creates dense mats that deter the establishment of native plant species.
<b>Dame's rocket</b>	Produces a large number of seeds and crowds out native vegetation.
<b>Daylily</b>	Poses a threat to native plants in fields, meadows, floodplains, moist woods and forest edges by forming dense patches that displace native plants.
<b>English ivy</b>	Threatens native species, including tree saplings, by outcompeting and impacting photosynthesis.
<b>Garlic mustard</b>	Actively displaces native spring ephemeral wildflowers, has chemicals produced in roots that prevent the growth of other plants, and changes the composition of the litter layer of the forest floor.
<b>Glossy buckthorn</b>	Produces a large number of seeds, preventing the growth of native plants.
<b>Goutweed</b>	An invasive groundcover that reproduces quickly and outcompetes native species by forming dense patches.
<b>Italian honeysuckle</b>	Can outcompete and smother small saplings and shrubs.
<b>Japanese barberry</b>	Forms dense thickets that reduce wildlife habitat, affect native plants, restrict recreational activities along trails, and shade out other native species. Can invade undisturbed forests and hybridize with the common barberry; and can impact agriculture by spreading black stem rust, a disease capable of causing major damage to grain crops.
<b>Japanese honeysuckle</b>	Twines around stems of shrubs, herbaceous plants and other vertical supports; forms large tangles that smother and kill vegetation; and kills shrubs and saplings by girdling.
<b>Japanese spurge</b>	Can spread by rhizomes in difficult growing conditions.
<b>Lily of the valley</b>	Outcompetes native species for resources by forming dense colonies. All parts of the plant are highly poisonous.
<b>Manitoba maple</b>	Quickly establishes itself along riverbeds and in disturbed areas, but can also grow rapidly in a variety of soil types where they create weak, hazardous and short-lived dense canopies that shade out native species.

Invasive Plant Species	Impacts
<b>Miscanthus</b>	Forms thick bunches, displacing native plant communities and reducing light availability to other plants at the soil surface; creates fire hazards as dense, dry stands are highly flammable; and decomposes on the ground, limiting the amount of nutrients returned to the soil.
<b>Multiflora rose</b>	Overtakes the landscape, shading and outcompeting native species for light and nutrients; modifies the structure of the habitat it invades; and uses other trees and plants as scaffolding, overgrowing the plant and thereby suppressing its growth and/or killing it.
<b>Norway maple</b>	Creates dense shade, reducing the amount of light that reaches the forest floor, and replaces native tree species.
<b>Oriental bittersweet</b>	Chokes and girdles native woody plants. Can be spread long distances by birds as it can remain in the stomach for weeks.
<b>Ornamental honeysuckle</b>	Rapidly invades areas, outcompeting native plants by forming dense patches; affects light and nutrient availability of neighbouring plants; and produces toxic chemicals.
<b>Periwinkle</b>	Can escape cultivation and spread rapidly, quickly becoming a dominant plant in the forest understory, and outcompeting and displacing native plant species and tree seedlings.
<b>Russian olive</b>	Drinks more water than most plants in dry soil settings and can outgrow and compete with native species.
<b>Sea buckthorn</b>	Poses a threat to the native vegetation of sand dunes by forming dense thickets that shade out native dune plants and alter the nutrient status of the soil where it grows.
<b>Spearmint</b>	Can quickly sprawl into surrounding areas and suppress the growth of native plants.
<b>Tree-of-heaven</b>	Outcompetes native trees and is a preferred host for spotted lanternfly, an invasive insect not yet established in Canada.
<b>White mulberry</b>	Poses a threat to the endangered native red mulberry due to the hybridization of the invasive tree with the native tree.
<b>Winged burning bush</b>	Forms dense thickets, which can displace native woody and herbaceous plants.
<b>Wintercreeper</b>	Increases the rates of decomposition and nutrient cycling on the forest floor, altering the soil bacterial community in ways that benefit wintercreeper growth.
<b>Yellow archangel</b>	Can easily escape cultivation and establish in a variety of habitats, surviving robust and extreme conditions where it can reproduce through several means and dominate the forest floor.

host of the spotted lanternfly, a federally regulated invasive pest that threatens the grape, fruit tree and forestry industries in Canada. While the Ministry contracted the OIPC to conduct a literature review for the tree-of-heaven in 2021/22 to help inform a risk assessment, the risk assessment itself was not complete at the time of our audit. According to the OIPC, if the Ministry prohibited Ontarians from purchasing and planting the tree-of-heaven, the impacts of the spotted lanternfly would be reduced. The OIPC also recommended the regulation of other species that crowd out native plants, such as white mulberry, winged burning bush and Norway maple. The Ministry indicated that for some of these species, increased public awareness

of their invasiveness has generally led to their elimination or reduced demand in the horticultural sector, and factsheets and best management practice documents have been developed to support landowner awareness. However, no formal risk assessment of these species has been performed. In contrast to Ontario, we noted that Maine has listed 63 invasive terrestrial plants on its Do Not Sell Invasive Plant List, which is almost double the 33 combined aquatic and terrestrial species currently regulated by Ontario's *Invasive Species Act, 2015*.

In addition, we noted that the Natural Resources Ministry has not regulated any pathways associated with the spread of terrestrial invasive plant species to date. A Canadian Food Inspection Agency (CFIA)



analysis showed that 58% of invasive plant introductions have been intentional, and therefore preventable. Specifically, imports of plants used for landscaping or ornamental purposes represent a pathway that accounts for about 52% of all intentional introductions of invasive plants in Canada. Despite this analysis being publicly available since 2008, the Ministry has not regulated any pathways of terrestrial invasive plants (such as the movement of soil) other than restricting the trade of those plants regulated under the Act. For example, we found that at least six of the 30 unregulated terrestrial invasive plant species discussed above—namely creeping jenny, goutweed, Norway maple, periwinkle, spearmint and wintercreeper—are available for purchase at various nurseries, garden centres, and/or home improvement retailers such as Home Depot, Lowe’s, and Rona (see **Figure 8** for photographs of these species). This is particularly concerning because plants introduced through the ornamental trade can be extremely difficult to eradicate. For example, kudzu is a federally regulated terrestrial invasive plant that is referred to as “the vine that ate the South” for its rapid spread in southern states after being introduced to the US for landscaping purposes. Kudzu can grow up to 30 centimetres in a single day and its taproots can weigh more than 45 kilograms, blanketing affected areas and making eradication extremely difficult. Kudzu was discovered in Essex County, Ontario, in 2009, and though contained to roughly a 6,000 square metre patch, has not been eradicated despite persistent efforts by the CFIA and Ministry to do so.

In the absence of regulating terrestrial invasive species pathways, the Ministry has opted to work with industry and partners to educate the public about invasive species in this sector, and highlight plants that look similar to invasive ones through Grow Me Instead guides. We noted that Maine’s Department of Agriculture, Conservation and Forestry has adopted a more direct approach through recently amended legislation, requiring that a specific terrestrial invasive plant (*Rosa rugosa*) available for sale must be accompanied by a label or sign that denotes its invasiveness and directs customers to ask the vendor for alternatives, which helps to deter its spread throughout the state.

To help prevent the introduction and spread of aquatic invasive species in Ontario, a regulation was updated in January 2022 requiring boaters to drain water from their watercraft and watercraft equipment and to remove all aquatic plants, animals and algae from watercraft, watercraft equipment, vehicles and trailers before placing them into waterbodies or risk being fined up to \$350.

Finally, despite terrestrial vascular plants (plants with complex tissues that transport nutrients and water throughout the plant) representing at least 36% of all invasive species in Ontario, the Ministry has only assessed and/or regulated a small portion of them. Although neither the Ministry nor any of the organizations involved in invasive species work have an updated, comprehensive estimate of the total number of invasive species in the province, the Canadian Endangered Species Conservation Council’s National General Status Working Group has estimated that over 1,780 non-native species have made their home in Ontario (not all of which are necessarily invasive), with 1,079 (over 60%) of these being vascular plants (as per data used to prepare the working group’s most recent report, *Wild Species 2015: The General Status of Species in Canada*). Based on cross-referenced data between this listing and a 2008 CFIA listing of all invasive plants in Canada, we identified that at least 398 invasive terrestrial vascular plants reside in Ontario. However, only 16% and 21% of species the Ministry has assessed (including adopted assessments) and regulated, respectively, are terrestrial vascular plants.

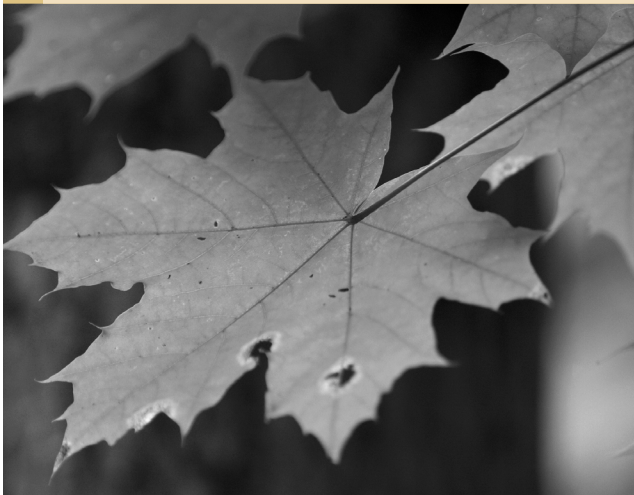
## RECOMMENDATION 2

So that harmful terrestrial species and their pathways are promptly regulated, in line with the goals and objectives of Ontario’s Invasive Species Strategic Plan (2012), we recommend that the Ministry of Natural Resources and Forestry:

- develop and employ a standardized risk-assessment tool for terrestrial species;
- collaborate with stakeholders to identify potential terrestrial plant invasive species for regulation; and
- assess and address the need to regulate pathways for terrestrial invasive species.

**Figure 8: Some Unregulated Invasive Plants Sold in Ontario**

Photo credit: iStock by Getty Images

**Goutweed****Creeping Jenny****Norway Maple****Spearmint****Periwinkle****Wintercreeper**

## MINISTRY RESPONSE

The Ministry of Natural Resources and Forestry (Ministry) agrees with the importance of identifying and regulating terrestrial invasive species and their pathways that have been identified as high risk and where regulations would prevent introduction or spread. As reported in the Auditor General's report, the Ministry is currently adapting its ecological risk assessment tool for aquatic invasive species to apply to terrestrial invasive species. This version of the tool is currently undergoing peer review and testing with the expectation that the tool will be ready for use by 2023.

The Ministry will continue to collaborate with stakeholders, neighbouring jurisdictions and the Government of Canada to identify and prioritize terrestrial invasive species and pathways for regulatory consideration that are within the Ministry's mandate and jurisdiction.

## 4.2 Province Lacks Information to Detect and Monitor Potentially Harmful Invasive Species

Data from systematic monitoring programs is needed to accurately assess changes in invasive species populations over time and space. Knowing these changes helps determine the need to regulate certain species and inform management actions and policies. The main monitoring tool used by the Ministry is the Early Detection and Distribution Mapping System (EDDMapS), launched in 2014 to track information on invasive species occurrences and distributions in Ontario. This is supplemented by targeted monitoring of specific areas and species of concern. For example, the Ministry has been monitoring the hectares of phragmites treated in the Long Point region since 2016.

The Ministry identified four monitoring-specific actions in its Invasive Species Strategic Plan, which are summarized below:

- undertake surveillance activities in geographic areas at high risk of invasive species introductions;

- improve existing invasive species monitoring programs and develop a network of experts to identify species;
- strengthen data management and reporting for invasive species; and
- engage science support to design appropriate surveillance protocols.

**Sections 4.2.1, 4.2.2 and 4.2.3** below outline the limited effectiveness of existing monitoring programs in achieving these goals and identify opportunities for improvement.

### 4.2.1 Invasive Species Tracking Process Omits 33 High-Risk Species

We found that 33 high-risk invasive species have been detected in Ontario but are not being systematically tracked and reported.

The Ministry funds the Ontario Federation of Anglers and Hunters (OFAH) to collect and record reported community invasive species sightings, confirm species identification, and upload the sightings reports to EDDMapS if the confirmed species is on a predefined list. Species tracked through EDDMapS that are not on the predefined list are not reported to the Ministry except for those species that are newly detected in the province.

Prior to 2014, the Ministry drafted, in tandem with Fisheries and Oceans Canada and the Canadian Food Inspection Agency (CFIA), a list of 196 species for the OFAH to track on EDDMapS. Of these 196 species, the Ministry selected 98 for the OFAH to report back on if there is a confirmed sighting in Ontario (a further three species are reported only to the CFIA). In drafting the list, the Ministry considered various factors such as whether the species was: an established species that could spread to new areas of the province, regulated federally or provincially, known to exist in Ontario, and/or highly likely to cause harm to Ontario's natural environment.

Based on our review of other nearby jurisdictions' risk assessments, we identified 33 species that are considered high risk and not reported by the OFAH to the Ministry when sightings occur (see **Figure 9**). All 33 species are not federally regulated and have been

**Figure 9: Unregulated High-Risk Invasive Species in Ontario and Their Impacts**

Prepared by the Office of the Auditor General of Ontario

<b>Invasive Species</b>	<b>Impacts</b>	<b>Assessed as High Risk In/By:</b>
<b>Aquatic Invertebrates</b>		
<b>Faucet snail</b>	Hosts parasites that can cause death and disease in waterfowl that consume infected snails. May also clog water intake pipes, infest municipal water supplies and compete with native snails for resources.	New York
<b>Birds</b>		
<b>Mute swan</b>	Uproots submerged aquatic plants in marshes, lakes and rivers while feeding, potentially altering ecosystems by reducing food and habitat for native waterfowl and other wildlife.	New York
<b>Fish</b>		
<b>Common carp</b>	Destroys habitat for native species and decreases water quality as a result of burrowing into lake sediment and uprooting aquatic vegetation, thereby increasing water cloudiness and releasing sediment-bound nutrients that stimulate algal blooms.	New York
<b>Plants</b>		
<b>Amur cork tree</b>	Forms dense populations of juvenile trees that are large enough to cast significant shade, suppressing the growth of native understory species and the regrowth of canopy species. Can alter soil bacteria, suppressing the sprouting and growth of other species.	New York
<b>Baby's breath</b>	Outcompetes native grasses and reduces usable food for livestock in pastures, roadsides and grasslands.	California
<b>Bristly starbur</b>	Competes with crops for water and nutrients, impedes harvesting and is toxic to animals.	USDA*
<b>Butterfly bush</b>	Fast growing and spreads rapidly into disturbed, open areas and along coastal forest edges, roadsides and riverbanks, replacing native plants.	California
<b>Caper spurge</b>	Self-seeding and difficult to remove. Causes skin irritation in humans and is toxic if eaten by people, pets or livestock.	California
<b>Common mugwort</b>	Causes allergic reactions in some people; outcompetes desirable plants.	New York
<b>Creeping bentgrass</b>	Forms dense stands and outcompetes other grasses and broadleaf weeds.	USDA*
<b>Cutleaf teasel</b>	Forms large stands that inhibit the growth of desirable plant species, especially in riverbank areas; reduces food available for livestock; degrades wildlife habitat; and competes with native species.	New York
<b>Cypress spurge</b>	Reduces abundance of desired vegetation, cattle-grazing or hay-production capacity; causes dermatitis or skin blistering; and irritates the eyes.	New York
<b>False-brome</b>	Can quickly become the dominant species in forest understories and open grasslands, creates a good habitat for rodents that damage tree seedlings, has low palatability for wildlife and livestock, and may increase fire risks due to the build-up of a heavy layer of thatch.	New York
<b>Field bindweed</b>	Reduces land value and precludes the planting of many vegetable crops.	Indiana
<b>Field pennycress</b>	Reduces wheat yields in cultivation fields, reduces populations of native plants and increases the density of vegetation in disturbed and waste areas.	USDA*
<b>Goatsrue</b>	Outcompetes native species, decreases biodiversity and can contaminate alfalfa. Contains a chemical compound that can be toxic to livestock, and reduces yield value and forage potential of livestock by forming dense thickets.	Oregon
<b>Gum succory</b>	Reduces livestock and wildlife forage potential, can cause problems with crop harvest machinery and provides limited value.	USDA*
<b>Hoary alyssum</b>	Outcompetes native species; decreases forage value; and is toxic to horses if eaten, leading to serious illness or death.	California
<b>Horsenettle</b>	Reduces crop yields and is poisonous to livestock.	California

Invasive Species	Impacts	Assessed as High Risk In/By:
Japanese angelica tree	Grows rapidly and forms dense thickets that exclude native plants.	New York
Johnsongrass	Reduces native plant diversity in grasslands and is a refuge for a variety of agricultural pests and viral plant diseases.	Indiana
Matgrass	An invasive perennial grass that is competitive and unpalatable to most livestock. It spreads commonly through mud attached to the hooves of grazing animals.	California
Meadow foxtail	An invasive plant that can outcompete native species for resources.	California
Musk thistle	Grows rapidly into dense vegetation, outcompeting native species. Reduces usable food for livestock, which tend to avoid grazing near this plant due to its numerous spines.	Indiana
North Africa grass	Increases erosion, reduces usable livestock forage, decreases crop production and displaces native vegetation.	California
Palmer amaranth	Impacts crop yield, especially of cotton, maize, soybean and sweet potatoes. Highly competitive and adaptive, it can produce a large biomass and develop resistance to herbicides.	USDA*
Perennial pepperweed	Grows persistently and densely, displacing native plants and infesting entire stream corridors and riverbank areas. Uptakes and excretes salt, depositing it on surface soil.	New York
Poison hemlock	Outcompetes native vegetation and is extremely poisonous. Eating a small amount can kill humans, livestock and wildlife, and dead plants can remain toxic for years.	Indiana
Scentless chamomile	Forms dense vegetation and semi-permanent stands which negatively impact grain fields, pastures, hayfields, cultivated crops and disturbed areas.	USDA*
Silky bent grass	Competes with winter wheat and fall rye for soil water, light, space and nutrients. Reduces wheat and rye yields and slows harvest.	USDA*
Spear thistle	Has a high seed production and grows aggressively, competing with and displacing crops and native species in pastures, rangelands and agricultural fields.	Indiana
Spiny plumeless thistle	Grows rapidly, replaces native vegetation and reduces the availability of grasses grazed upon by animals.	Indiana
Sweet autumn clematis	An aggressive, self-seeding plant that can cause skin irritation in humans and is toxic to cats, dogs and horses.	New York

\* United States Department of Agriculture

detected in Ontario per data used to prepare Wild Species 2015: The General Status of Species in Canada, the most recent report published by the Canadian Endangered Species Conservation Council's National General Status Working Group. For example, the faucet snail, which is native to Europe, is ranked as high risk by a New York State risk assessment. This species alters native ecosystem dynamics and may carry multiple parasites that can kill waterfowl when consumed. Only recently has the full extent of the faucet snail's distribution been characterized in the Great Lakes and surrounding wetlands, including recent detections of the snail in new parts of Ontario.

In April 2018, the Natural Resources Ministry developed a *Response Framework for New Invasive Species* to provide internal guidance on the processes

and criteria to consider when deciding to undertake response efforts for invasive species that are newly detected in the province or new to a part of the province and pose a risk to the natural environment. While the Ministry has used the framework since then to guide response actions on invasive species—such as zebra mussels (see **Appendix 11**) in a new region of Ontario, Japanese stilt-grass and bristly locust plants—it did not employ the framework on any of the aforementioned 33 high-risk species.

The Ministry indicated that these species are known to be established in Ontario, in many cases for decades, and thus it would not use the response framework as they are not new to the province. However, since the spread of an invasive species to new parts of the province provides a basis to employ the framework, the

Ministry should closely monitor the spread of these species and undertake appropriate responses if new locations are affected.

#### 4.2.2 Ministry Does Not Consolidate and Store Invasive Species Data Collected by Different Organizations

A best management practice for invasive species programs identified in the scientific literature is developing plans for data management, storage and sharing within and among organizations involved in the work. This includes having shared databases and standardized methods for collecting data to maximize the use and analysis of the data, and improve the delivery of invasive species programs.

However, the Natural Resources Ministry does not effectively manage invasive species data. Specifically, it does not collate and consolidate the data collected by different organizations, including transfer payment recipients or other program partners such as municipalities and conservation authorities. In our review of the Ministry's funding agreements with external partners since 2015/16, we noted that the Ministry did not collate or consolidate the data collected in 22 invasive species-related projects it funded. These projects include surveys of European water chestnut, water soldier and invasive phragmites as well as management projects and studies of dog-strangling vine, the emerald ash borer (see **Appendix 12**), garlic mustard, water soldier and Japanese knotweed.

Further, while some external partners have created and maintain their own separate databases, none of their funding agreements with the Ministry specify requirements or protocols for collecting, managing and transferring relevant data to the Ministry. The Ministry indicated that the individual documents and reports it collects from its partners, while not collated, meet its needs. If programs are expanded in the future to include additional species and larger geographies, the Ministry intends to make additional efforts at that time to support data management.

However, as a result of not collating the data, the Ministry does not ensure its central database

(EDDMapS) is populated with all available and relevant invasive species data for the province. Compiling and analyzing data from different sources would help the Ministry inform and improve actions and tactics to achieve the Ontario Invasive Species Strategic Plan's objectives. For example, the Ministry could compare and contrast management activities, such as phragmites-removal activities performed by Ducks Unlimited Canada in 2019 and a biological-control activity targeting phragmites performed by the University of Toronto in 2017, to determine the most cost-effective steps to take in protecting the province against the impacts of invasive species.

In our 2020 value-for-money audit on Setting Indicators and Targets, and Monitoring Ontario's Environment, we recommended that the Natural Resources Ministry develop and implement data and information management plans for its monitoring programs. We continue to put forward this recommendation as the absence of such plans increases the risk that data collected from multiple individual projects will not be available or in a usable format for future use.

#### 4.2.3 Ministry's Monitoring Programs Mainly Rely on Aggregated Incidental Observations and Do Not Allow for Reliable Analyses of Trends

None of the Natural Resources Ministry's monitoring programs are designed to consistently detect or monitor invasive species introductions and spread on a province-wide scale. Instead, the Ministry mainly relies on aggregated incidental observations, which do not allow for reliable analyses of trends over time and space.

The Early Detection and Distribution Mapping System (EDDMapS) is the main tool used by the Ministry to collect and analyze invasive species-related information. EDDMapS is limited in scope to reports that are voluntarily submitted by concerned organizations and members of the general public. Due to the higher population density in southern Ontario, there is an inherent bias in having more reporting from this area relative to the rest of the province. Further, a 2021 Ministry study on wild pig sightings in Ontario found

that the number and frequency of public reports cannot accurately measure changes in the size and location of invasive wild pig populations. This is because the public is more likely to report sightings after it has been exposed to relevant media events, with reports spiking in response to outreach efforts.

Best practices for invasive species programs include incorporating standardized survey protocols in public reporting of invasive species. One example of a program that takes this approach is that of the Alaska Department of Fish and Game in southcentral Alaska. Since 2008, the Department has applied a piscicide (a chemical substance that is poisonous to fish) to combat invasive pike in invaded waterbodies. The Department has monitored these waterbodies through gillnet sampling, which uses wide mesh nets to catch fish, and more recently through environmental DNA (eDNA) sampling, which helps confirm whether pike have been chemically eradicated or still remain. Between 2010 and 2020, this invasive species was successfully eradicated from over 20 lakes and creeks.

One of the actions identified in the Ontario Invasive Species Strategic Plan is to undertake surveillance activities in geographic areas at high risk of invasive species introductions. However, 24 (or 73%) of the 33 species regulated under the Act have not been systematically monitored in such areas. Only bighead carp, black carp, European water chestnut, grass carp, phragmites, silver carp, tench, wild pig and water soldier have systematic monitoring programs in place.

Volunteer surveillance programs can be used to boost invasive species monitoring efforts. In Ontario, as part of a recent pilot project to assess the effectiveness of community science sampling and facilitate early detection, the Invasive Species Centre and Federation of Ontario Cottagers' Associations trained volunteers to collect water samples from 25 Ontario lakes. These samples were then analyzed to determine whether larval zebra and quagga mussels, as well as spiny waterfleas, were present. Volunteers also collected water samples to detect eDNA and compare the accuracy between the two sampling methods in detecting the presence or absence of zebra and quagga mussels. Volunteers were provided with sampling protocols for

each sampling method, based on Ministry recommendations. This program encourages community science, environmental stewardship and increased awareness of invasive species threats, and complements the Ministry's broad-scale fisheries monitoring program.

While this provides a scalable and replicable model that engages volunteers to conduct meaningful surveillance in a cost-effective manner, the scientific literature highlights that a lack of standardized data collection is a weakness of this approach. Therefore, to ensure volunteer sample collection can be scaled up effectively, the Ministry should provide guidance on which locations to inspect, which species to look for, and how often to reperform an inspection.

Systematic monitoring of invasive species can also help to evaluate the effectiveness of management actions and reduce management costs. For example, one study found that implementing a standardized survey optimized for detecting and trapping wood borers and bark beetles in New Zealand could reduce the costs associated with these species by 39% over a 30-year period, when compared to management without surveillance in place. More specifically, surveillance and trapping enable early detection and eradication efforts. The study found that a robust \$54-million surveillance program would reduce the net present value of expected eradication, urban forest damage, and plantation forest damage by about \$110,000, \$200 million, and \$154 million, respectively, generating a total savings with a net present value of about \$300 million (all amounts in USD).

Given the importance of such monitoring efforts, in our 2020 value-for-money audit on Setting Indicators and Targets, and Monitoring Ontario's Environment, we recommended that the Natural Resources Ministry develop an integrated, broad-scale monitoring program for all aspects of Ontario's biodiversity. Such a monitoring program could be leveraged to also include systematic monitoring of invasive species in high-risk areas. To date, this has not been completed, though the Ministry has taken steps in this direction (see our 2022 Follow-up Report).

While it may be impractical for the Ministry to expand from fragmented monitoring efforts to

measuring all invasive species across the entire province, especially given Ontario's large size and limited resources, steps in this direction are needed so that the Ministry has crucial information on the spread and impacts of invasive species to inform prioritization of its management activities.

### RECOMMENDATION 3

So that Ontario's invasive species are effectively monitored to inform management actions and policies, we recommend that the Ministry of Natural Resources and Forestry (Ministry):

- require staff to adhere to the Ministry's *Response Framework for New Invasive Species* for all known instances of species that are likely to cause harm to the environment and are new to Ontario or regions of Ontario;
- regularly review and consider risk assessments from other jurisdictions when determining which species sightings need to be tracked;
- work with relevant invasive species partners, including municipalities and conservation authorities, to obtain and consolidate available invasive species monitoring and surveillance data; and
- where no suitable data exists, develop and implement risk-based monitoring programs that systematically detect and monitor potentially harmful invasive species within each Ministry district.

### MINISTRY RESPONSE

The Ministry of Natural Resources and Forestry (Ministry) recognizes the ecological and economic benefits of early detection and response. The Ministry will apply Ontario's *Response Framework for New Invasive Species* to assess the risk of a new invasive species (to Ontario or to a part of Ontario) to the natural environment and to identify and implement response actions where opportunities exist for effective control of the invasive species.

The Ministry will review and consider risk assessments from ecologically and geographically

relevant jurisdictions such as Great Lakes states when identifying species for risk assessment and regulatory consideration in Ontario.

The Ministry will continue to engage partners and monitor invasive species occurrence information collected by neighbouring jurisdictions, community science, and Ministry monitoring programs, while also exploring opportunities to develop and enhance monitoring for invasive species.

## 4.3 Levels of Ministry Engagement with Program Partners Are Insufficient to Combat Invasive Species

### 4.3.1 Gaps in Collaboration Between Ministry and Federal Partners Have Led to Inadequate Invasive Species Management

Despite both federal and provincial roles in regulating invasive species, our audit found that the introduction and spread of harmful invasive species in Ontario has not been adequately managed due to gaps in federal and provincial collaboration.

The federal government is the gatekeeper charged with preventing invasive species from entering Canadian ecosystems, but past reports show that it has not adequately fulfilled this role. The federal Commissioner of the Environment and Sustainable Development found in 2002 that only 1% to 2% of global trade shipments arriving at Canada's borders are inspected for invasive species, and that "[d]espite continuing efforts to protect agriculture crops and forest trees, invasive pests gained access to Canada in the past, sometimes with devastating ecological impacts." More recently, in its 2019 audit on aquatic invasive species, the federal Commissioner of the Environment and Sustainable Development found that Fisheries and Oceans Canada did not implement sufficient measures to prevent aquatic invasive species from becoming established in Canadian waters. Similarly, it found that the Canada Border Services Agency did not implement adequate measures to help enforce relevant regulations at international borders.



Once a species becomes established, federal departments and agencies will generally focus on preventing the introductions of other species. For example, federal efforts to actively manage emerald ash borers and zebra mussels halted once eradication no longer seemed possible. This puts the burden of managing an increasing number of established species on provinces and municipalities. In contrast to its federal counterpart, Ontario's ability to prevent new introductions to the province is limited, as the Natural Resources Ministry has no role in regulating international borders or controlling pathways of invasion such as imported commodities; transportation vectors (e.g., ships, planes, trains); international tourism; and movement through shared canals and other waterways.

Further, the Ministry does not receive any funding support from the federal government for invasive species work, and has only five staff in its Biodiversity and Invasive Species Section dedicated to full-time invasive species work. These staff plan, fund and oversee relevant invasive species activities; educate the public about invasive species; inform policymaking; and co-ordinate with other Ministry staff from other divisions and branches to support invasive species science and research as well as the enforcement of the Act, but are not involved in implementing on-the-ground actions.

The Ministry and its federal partners did not always collaborate with each other when bilateral involvement was needed to respond to invasive species threats. For example, the Ministry did not respond to the Canadian Food Inspection Agency (CFIA) on collaborating, delineating responsibilities and developing a strategy to address hemlock woolly adelgid, an invasive insect that kills hemlock trees and was recently introduced to several locations in southern Ontario. According to the CFIA, the agency has been seeking provincial support for years on response measures to preserve hemlock resources in accordance with the Hemlock Woolly Adelgid Management Plan for Canada (2018), an information report that outlines potential management tactics. CFIA staff told us that it believes Ministry leadership has been lacking with respect to inventorying this species, supporting the development

of insecticides, creating a strategy to use predatory beetles as a biological control, and organizing an immediate response to the known infestations in southern Ontario.

More specifically, in June 2016, the Hemlock Woolly Adelgid Interagency Task Force—which included members from the Canadian Forest Service (CFS); the CFIA; the Natural Resources Ministry; and the Ministry of Agriculture, Food and Rural Affairs (Agriculture Ministry)—made recommendations, including one for a firm commitment between these agencies and ministries to pursue a collaborative response to future detections of this species. The CFIA also identified priorities for collective action with the Canadian Forest Service, highlighting the need for leadership from the Natural Resources Ministry on preserving hemlock trees and taking risk-mitigation measures. In 2020, the CFIA noted moderate to high hemlock woolly adelgid populations in Wainfleet, and issued a call to action focused on surveillance, inventorying hemlock trees, containing hemlock woolly adelgid populations, supporting research for long-term management including biological control and defining a management strategy for Ontario. Although the Ministry has undertaken some scientific, advisory and policy work, it has not clearly indicated the activities it will perform, and has not undertaken the items listed above. In September 2021, the CFIA summarized the efforts made to date, and outlined short-, medium- and long-term recommendations that require Ministry involvement. Again, according to the CFIA, there has been no Ministry response to the CFIA's recommendations and call to action. The Ministry informed us that it is currently collaborating with the CFIA and others on science activities to support the monitoring and management of hemlock woolly adelgid in Ontario, and that decisions to do more are weighed against other priorities in allocating limited resources.

In October 2021, the CFIA confirmed that this species was found in Fort Erie, Ontario. In the absence of Ministry involvement, the insects continue to spread without any co-ordinated control actions, risk assessments, hemlock inventories, research, communications and outreach efforts to manage it. In contrast, Nova Scotia

has partnered with the CFIA, the Canadian Forest Service and Parks Canada to test the effectiveness of insecticides and stand thinning (leaving space between trees to decrease density and insect spread), and to search for an effective biological control to address this problem.

In another example, the Department of Fisheries and Oceans Canada declined to participate in a binational St. Lawrence River Tench working group to co-ordinate tench surveillance and research with the Ministry. Tench are invasive fish that outcompete native fish species and can potentially carry diseases that can impact fishing and wildlife if they enter and establish in Ontario. If federal and provincial players continue operating without shared priorities, they will miss opportunities to collaborate, pool resources, share knowledge, and most importantly, implement meaningful management actions to address invasive species threats on a broad scale.

#### RECOMMENDATION 4

To effectively prevent harmful invasive species from entering and establishing in Ontario, we recommend that the Ministry of Natural Resources and Forestry (Ministry):

- assess the need to work with federal departments and agencies to develop collaborative and timely responses to specific invasive species threats;
- provide a written response when solicited to support federal invasive species efforts;
- document the Ministry's justification for whether and how it plans to provide support for federal invasive species efforts; and
- request federal funding and resources to support the Ministry and its partners in the management of invasive species within the province.

#### MINISTRY RESPONSE

Invasive species do not recognize jurisdictional boundaries; therefore, effective collaboration with other jurisdictions including federal departments in Canada is essential for invasive species prevention

and management objectives to be achieved. The Ministry of Natural Resources and Forestry (Ministry) will continue to collaborate with federal departments through established mechanisms such as the Federal-Provincial-Territorial Invasive Alien Species National Committee, and through the ongoing collaborative partnership with the Invasive Species Centre. In addition, the Ministry will continue to participate on species-specific working groups and committees to support ongoing research and management activities while also seeking opportunities to increase investment and collaboration on invasive species prevention and management.

#### 4.3.2 Roles and Responsibilities of Provincial Players Are Not Clearly Defined

With few exceptions, the roles and responsibilities of relevant organizations in responding to invasive species threats are not formally defined by Ontario's Invasive Species Strategic Plan (Strategic Plan). While the Natural Resources Ministry is the dedicated lead on implementing the Strategic Plan, it has not formalized roles to provide clarity for key players in the province on what invasive species work they should undertake.

Specifically, the Strategic Plan identifies that the Ministry will lead Ontario's invasive species response, with support from the Ministries of the Environment (now Environment, Conservation and Parks); Transportation; and Agriculture, Food and Rural Affairs. It further states that the Invasive Species Centre's role is "to facilitate and improve coordination, collaboration and decision-making on invasive species issues, so available resources can be used in the most effective and efficient manner." However, these broadly defined roles do not specify which organizations will actually conduct on-the-ground eradication, management and monitoring activities as invasive species are detected, nor are any expectations outlined for how quickly a response should be mobilized.

Further, the Ministry has not clearly assigned a party to create and maintain best management practices for invasive species in the province, and those

practices that have been developed do not meet the needs of all potential users. For example:

- In 2011, the Natural Resources Ministry developed a best management practice guide for managing invasive phragmites.
- In 2020, the Ministry of the Environment, Conservation and Parks funded the Ontario Invasive Plant Council to update its best practices guide for managing invasive phragmites, incorporating considerations for species at risk.
- In 2022, the Ministry of Transportation was developing its own best practices to provide its contractors with agency-specific guidance on managing phragmites on provincial highways.

As the provincial lead on invasive species prevention and management, the Natural Resources Ministry should clearly outline the party responsible for developing and updating best management practices for invasive phragmites and ensure these meet the needs of all relevant parties.

Our Office surveyed Ontario's 36 conservation authorities and 444 municipalities, and found that 89% of the 27 conservation authority respondents and 79% of the 135 municipality respondents indicated that roles and responsibilities related to Ontario's invasive species response are not clearly defined. Further, 74% of conservation authority respondents and 85% of municipality respondents do not know their overall role as part of Ontario's invasive species response.

### 4.3.3 Invasive Species Work Is Not Well Co-ordinated by the Ministry

In the absence of defined roles and responsibilities with respect to invasive species work, the Ministry assigns tasks to its partners on a case-by-case basis covering specific species. While case-by-case assignment ensures that prevention and management activities are assigned with clear consideration for the best party to conduct them, there is no process or protocols in place to ensure this actually happens for all species and regions of the province.

In contrast to Ontario, for example, British Columbia established a Plant Protection Advisory Council

(the Council) in 1973, which organizes and mobilizes stakeholders to respond to invasive species that threaten British Columbia's agriculture and forestry. The Council has processes in place to bring together government, industry and academic organizations and gather consensus; recommend actions; and rapidly respond to invasions by assigning organizations to lead, support and monitoring roles. As a result, at the first sign of a threat, and even in the absence of complete information, these organizations are formally engaged to clearly delineate roles and responsibilities on a case-by-case basis and take immediate action.

For example, spongy moths (formerly called gypsy moths) are frequently introduced in British Columbia, and the Council works primarily with the Canadian Food Inspection Agency (CFIA) and the BC Ministry of Forests to organize an effective surveillance and eradication response. The CFIA is the designated lead on surveillance and prevention activities, while the BC Ministry of Forests is the lead for eradication programs. Natural Resources Canada is the lead organization fulfilling research activities, and defined support roles are performed by all partner organizations. A study conducted on this co-ordinated response found that the program's expected annual economic benefits (gained through preventing damage to trees and vegetation and avoiding regulatory trade costs) were 3.4 to 8.3 times higher than the program's estimated annual costs.

In Ontario, no such response framework exists to identify the presence of invasive species and mobilize partners and resources at the first sign of a threat. Instead, a number of piecemeal monitoring and management programs are taking place. For example:

- The closest thing Ontario has to a widespread monitoring system is the Early Detection and Distribution Mapping System (EDDMapS). Through EDDMapS, invasive species sightings can be reported by anyone in the province in an ad hoc fashion. However, 66% of Ontarians responding to a survey contracted by our Office indicated that they did not know where to report invasive species sightings.
- Through the Early Detection and Rapid Response (EDRR) Network Ontario, a project

co-developed by the Invasive Species Centre and the Ontario Invasive Plant Council, management projects such as an annual invasive spongy moth Egg Mass Scraping Contest have been organized with interested members of the public participating. While the EDRR Network Ontario organizes some small, localized management activities, most of the network's activities relate to equipping volunteers with the skills to identify and report invasive species and enhance their invasive species detection and monitoring skills in their communities, and are not intended to help organize province-wide responses.

- Ontario Power Generation (OPG) manages invasive species, such as zebra mussels and invasive phragmites, on its properties. In 2021, OPG collaborated with a local farmer to deploy 34 goats to eat invasive phragmites at its Sir Adam Beck Pump Generating Station in Niagara Falls. These goats removed more than 140,000 square feet of phragmites in only a few weeks. This initiative was organized without any input or guidance from other parties, including the Natural Resources Ministry. Moreover, no assessment has been conducted to determine whether this management control method has been effective and can be used elsewhere in the province.

#### 4.3.4 Municipalities and Conservation Authorities Require More Guidance and Direction on Invasive Species Work

The Ministry does not provide guidance (outside of publicly available best management practices) or adequate direction to municipalities and conservation authorities on invasive species work. This is despite Ontario's Invasive Species Strategic Plan stating: "Ontario needs to establish provincial interests and clear objectives that will be supported with strong cooperation at all levels of government and with a wide variety of partners ... and which engage stakeholders and the public."

In the absence of Ministry direction, municipalities and conservation authorities that wish to conduct

invasive species work must independently develop and implement their own strategies, but this rarely actually happens. According to the Invasive Species Centre, only five of Ontario's 444 municipalities have developed overarching municipal management plans, with four more municipalities having either species-specific plans or substantial invasive species consideration in other plans (such as biodiversity plans). Our survey results indicated that 70% of municipality respondents had not developed any invasive species management plans.

Furthermore, one of the objectives of the Invasive Species Centre is to "continue engagement with municipalities in Ontario to better understand their invasive species management challenges, develop resources, and provide learning opportunities in response to these challenges." At the time of our audit, 57 of Ontario's municipalities (less than 13%) were voluntarily enrolled as part of the Invasive Species Centre's Municipal Community of Practice, which launched in September 2020. Through this platform, representatives from each member municipality can collaborate through discussion and the exchange of resources and expertise related to invasive species prevention, detection and control.

Conservation authorities experience many of these same challenges. Without guidance or direction beyond broad goals outlined in the Strategic Plan, conservation authorities that are willing and able to do invasive species work within their watershed must develop their own plans and priorities. Credit Valley Conservation Authority (CVCA) is one of the few conservation authorities that responded to our survey to have formally developed its own invasive species strategy, which it created in 2009 (recently updated in 2020) and has used to help guide its actions since. Our survey results indicate that 78% of conservation authority respondents had not developed an overarching invasive species management plan to address all threats in their watershed, while 52% had not even developed any species- or area-specific management plans.

Further, our 2020 value-for-money audit on Conserving the Natural Environment with Protected Areas found that the Province does not ensure sufficient invasive species management on even its own lands. That

audit found that one-third of the provincial park management plans we reviewed did not outline actions to identify, prevent and manage invasive species in these protected areas. During that audit, our Office visited Sharbot Lake Provincial Park and observed a very high number of invasive spongy moths. The 1988 management plan for the park states that staff historically used an aerial biological insecticide to minimize the spread of the spongy moth. However, the Ministry told us that no insecticide applications have been completed since 2000, and no other management occurs in the park to control this invasive species. Further, no other management actions are taken to control spongy moths in provincial parks. At the time of our follow-up, the Ministry was working to implement measures intended to improve invasive species data collection and monitoring in provincial parks, but it had not determined timelines for the project.

Thus, the Ministry needs to have better processes in place to identify and communicate priorities, co-ordinate action and provide direction to its program partners to effectively combat invasive species threats.

## RECOMMENDATION 5

To have an effective and co-ordinated approach to preventing and managing invasive species in Ontario, we recommend that the Ministry of Natural Resources and Forestry (Ministry):

- specify the roles and responsibilities of program partners and key stakeholders, including the responsibility for developing and updating best management practices;
- establish and formalize an accountability framework where the Ministry leads, co-ordinates and collaborates with all levels of government and a wide variety of program partners for invasive species prevention and management activities; and
- work with municipalities and conservation authorities to provide the guidance and direction they need to develop and implement their own invasive species strategic and implementation plans.

## MINISTRY RESPONSE

The Ministry of Natural Resources and Forestry (Ministry) agrees with this recommendation and intends to proceed with a review of progress and update to the Ontario Invasive Species Strategic Plan.

This review will provide an opportunity for the Ministry to work with program partners, municipalities, conservation authorities, Indigenous communities and others to identify opportunities for improved collaboration, shared priorities and capacity to support effective invasive species management in Ontario.

The review will also enable the Ministry to clarify roles and opportunities for invasive species management and result in new actions such as enhanced guidance and knowledge transfer for municipalities as required to support the objectives of the Strategic Plan.

### 4.3.5 Ministry Has Not Leveraged Existing Reporting Tools Nor Planned for Widespread Use of Emerging Monitoring Methods

The Natural Resources Ministry has significant opportunities to expand the use of modern detection tools, and to work with key partners and the general public to develop a collaborative response when detections of invasive species do occur. However, the Ministry has not planned for the widespread use of such tools or leveraged its existing reporting tools effectively. For example:

- **Early Detection and Distribution Mapping System (EDDMapS) Reporting**—EDDMapS is the primary tool used in the province for mapping and managing invasive species occurrence data. It is co-ordinated in the province by the Ontario Federation of Anglers and Hunters (OFAH), and run through the University of Georgia, Center for Invasive Species and Ecosystem Health. Anyone can submit a report with the name and location of the species observed, the date of the observation, and photographs

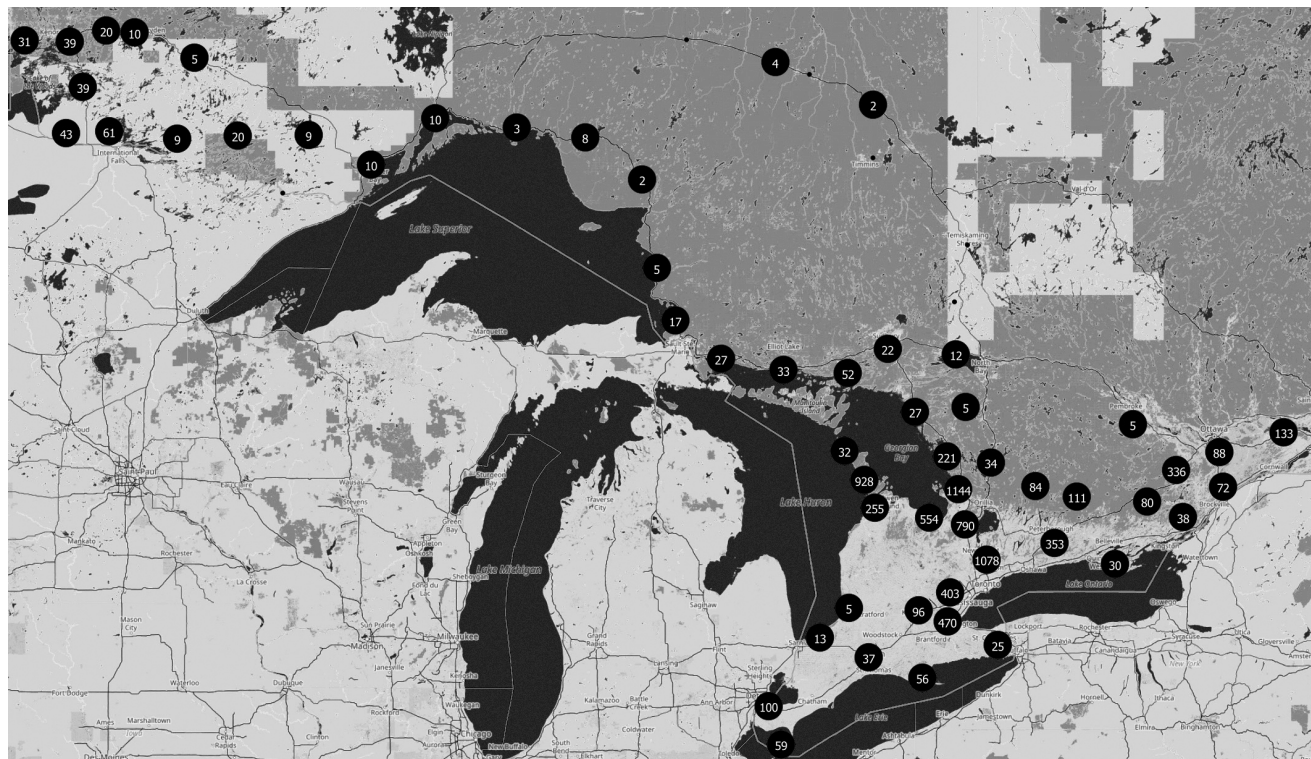
of the species for verification purposes. In addition, the OFAH continues to operate the toll-free Invasive Species Hotline, allowing users to report invasive species by phone. Once verified, OFAH staff enter the occurrence into EDDMapS. This provides a meaningful opportunity for interested Ontarians to contribute to invasive species detection efforts. However, while EDDMapS has an option to record treated areas, it has limited data on the treatment and control actions taken. Specifically, **Figure 10** shows EDDMapS reports of invasive phragmites across southern Ontario, but treatment actions to manage these species were only logged in areas near Collingwood and the Bruce Peninsula. While the Ministry admits that EDDMapS control data is not a fair or accurate representation of invasive species control efforts across the province, and that the Ministry tracks some treatment actions in an

unaggregated manner, no better representation of these actions throughout the province exists. As a result, it is unclear how many management actions are being conducted but unreported in EDDMapS.

- **Public Engagement**—Ontarians are not always engaged on how to protect their communities from harmful invasive species. In particular, when submitting EDDMapS reports, no guidance is provided at that time as to what individuals can do to treat the reported invasive species on the spot. **Figure 11** shows a map of historical spongy moth reports in Ontario, but there are no records on EDDMapS of actions taken to manage or eradicate them. Since many of these reports relate to spongy moth egg masses, which can be scraped off trees and controlled by Ontarians, Ontario is missing an opportunity to educate individuals who report sightings and to prompt

**Figure 10: Map of Reported Southern Ontario Phragmites Detections (as of July 20, 2022)\***

Source of data: Early Detection and Distribution Mapping System (EDDMapS), 2022. The University of Georgia - Center for Invasive Species and Ecosystem Health.

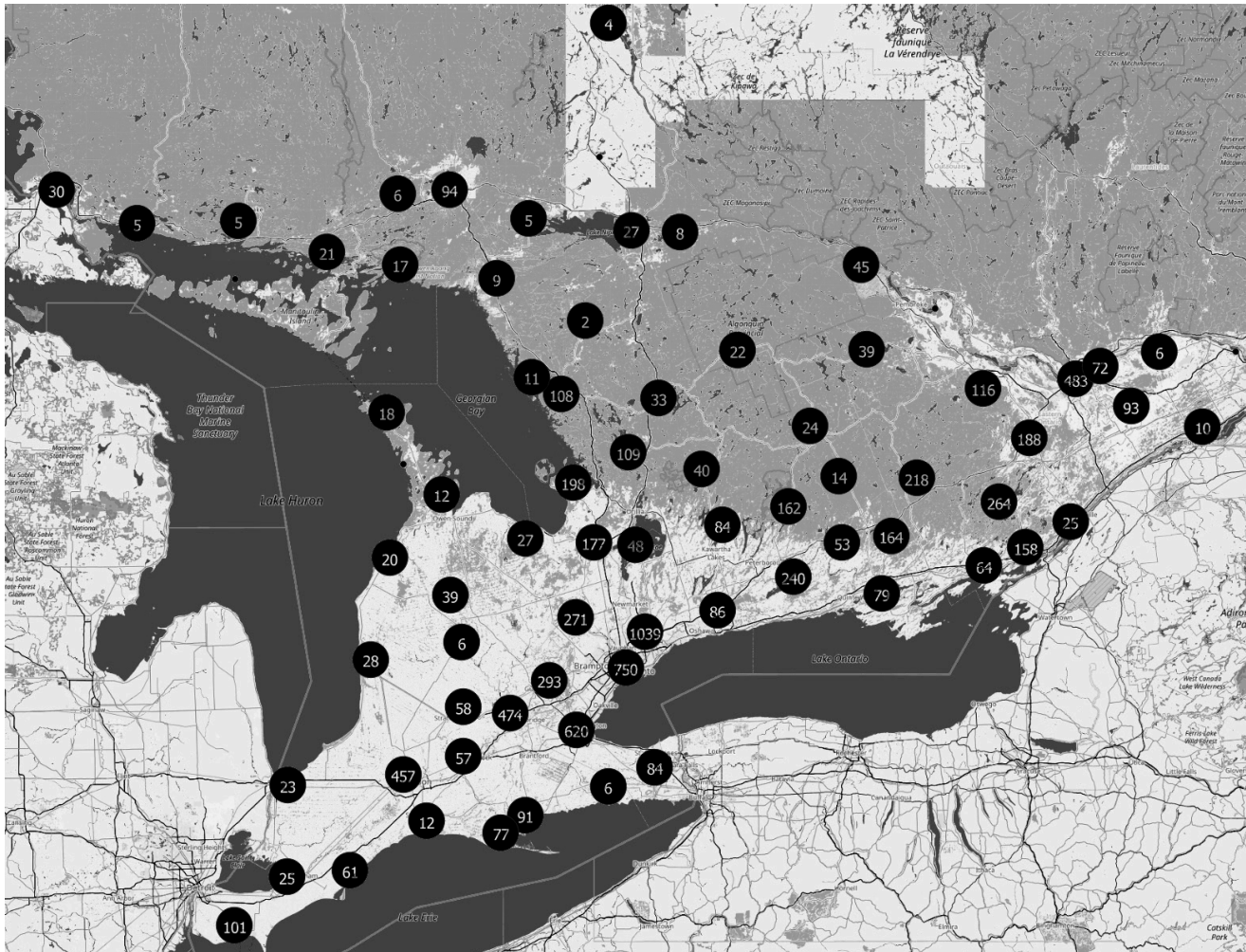


Note: This figure presents all historical reports in Ontario of phragmites to EDDMapS, which are based on voluntary submissions. Phragmites reports in an area do not necessarily indicate that the species still resides in that area, while areas without reports may contain phragmites populations.

\* Black-shaded bubbles represent confirmed detections of phragmites. Each bubble consolidates reports within 75 kilometres.

**Figure 11: Map of Reported Southern Ontario Spongy Moth Detections (as of July 20, 2022)\***

Source of data: Early Detection and Distribution Mapping System (EDDMapS), 2022. The University of Georgia - Center for Invasive Species and Ecosystem Health.



Note: This figure presents all historical reports in Ontario of spongy moth to EDDMapS, which are based on voluntary submissions. Spongy moth reports in an area do not necessarily indicate that the species still resides in that area, while areas without reports may contain spongy moth populations.

\* Black-shaded bubbles represent confirmed detections of spongy moth. Each bubble consolidates reports within 50 kilometres.

them to act—for example, by developing resources and capacity within the OFAH to provide these prompts and encourage reporting and action.

- **eDNA Monitoring**—In a recent IsampleON (Invasive Species Awareness and Monitoring Program for Lakes Education Ontario) pilot project, trained volunteers collected water samples from 25 Ontario lakes in order to detect larval zebra and quagga mussels, as well as spiny waterfleas. Volunteers also collected water samples for environmental DNA (eDNA) analysis to confirm the accuracy between the two sampling methods in detecting the presence

or absence of zebra and quagga mussels and help inform future monitoring strategies. eDNA allows scientists to detect invasive species in an environment even if they are present in low numbers, acting as an early warning system. However, the Ministry has not attempted to further mobilize interested Ontarians to implement recurring eDNA sampling across the province to systematically track the introduction and spread of invasive species, despite sample collection and testing being simple and cost effective, volunteers being available, and many laboratories showing an interest in conducting

eDNA testing. Ministry staff informed us that this is because funding is not available to support broad testing of eDNA samples.

- If the Ministry acts on opportunities to more effectively leverage its existing reporting tools and implement greater use of emerging monitoring methods, it will be better equipped to find and eradicate invasive species before they become established. However, at the time of our audit, the Ministry did not have a plan to update and better leverage the functionality of EDDMapS nor to scale eDNA monitoring for widespread use.

## RECOMMENDATION 6

To avoid missed opportunities to find and eradicate invasive species before they become established, we recommend that the Ministry of Natural Resources and Forestry:

- provide guidance on steps the public can take on the spot to manage invasive species when they report sightings; and
- explore and implement approaches to expand eDNA sampling and other emerging technologies across the province to systematically track the introduction and spread of invasive species.

## MINISTRY RESPONSE

The Ministry of Natural Resources and Forestry (Ministry) recognizes the benefits of quickly responding to new introductions of high-risk invasive species and supporting actions to manage established invasive species where effective tools are available.

The Ministry will work with the Ontario Federation of Anglers and Hunters to examine the potential for enhancing the information provided to the reporters of invasive species sightings, as part of the ongoing support for EDDMapS Ontario and the Invasive Species Hotline.

The use of eDNA and other emerging technologies, such as remote sensing, are generally still in the research and development stage and

not available for wide-spread operational use in invasive species detection and management. The Ministry continues to contribute to the development and use of eDNA in invasive species management and has developed the expertise and capacity to conduct all required analyses for the Ministry's current eDNA surveillance activities, while also working to expand the use of this tool to detect additional species.

The Ministry will also continue to work with researchers and industry partners to identify and assess the potential use of remote sensing and drones to support invasive species detection and management. For example, the Ministry recently partnered with Hydro One on the use of a thermal-imaging-equipped drone to look for wild pigs in an inaccessible area of eastern Ontario.

## 4.4 Ministry Funding for Invasive Species Work Is Neither Sufficient Nor Timely

### 4.4.1 Program Partners Lack Funding to Sufficiently Combat Invasive Species

Federal departments and agencies, and the Natural Resources Ministry, represent the first and second lines of defense, respectively, for preventing the introduction and spread of invasive species in the province. When they fail to do so, land managers such as municipalities and conservation authorities face the consequences and are saddled with the responsibility of managing those species. However, while many organizations in Ontario are available and willing to perform invasive species work, many do not have enough funding to do so.

Despite Ontario being among the highest-risk provinces for new invasive species introductions in Canada, its municipalities report greater challenges in paying for necessary invasive species work than those in other provinces. Specifically, a report published by the Invasive Species Centre in 2022 reported that, based on a Canada-wide survey of 2020 expenses, Ontario municipalities were struggling more than their counterparts in other provinces and territories to



finance invasive species management work, with 91% of Ontario respondents (20 out of 22 municipalities) reporting they had insufficient funding (municipality responses elsewhere ranged from 25% in the territories to 81% in British Columbia). In addition, the report noted that the \$1.07 per-capita expenditure by Ontario municipalities on invasive species activities—including prevention, detection, control and management, habitat restoration, and research and science—significantly trails spending in, for example, Manitoba (\$7.54), Alberta (\$5.45), Quebec (\$4.83), and Saskatchewan (\$3.46). The report also revealed that 43 out of 231 responding municipalities across Canada reported receiving provincial funding in 2020 (ranging from an average of \$22,473 in Quebec to \$108,817 in Alberta), but none of these municipalities were in Ontario.

The 36 conservation authorities in Ontario experience similar funding challenges as municipalities, spending an estimated combined average of \$8.4 million each year on combatting invasive species. Current programs and services related to biodiversity (e.g., invasive species management and associated education programming) are not eligible for the usual municipal levy funding support that mandatory programs receive. Therefore, not all conservation authorities have the resources to manage invasive species in their watersheds. For example, Credit Valley Conservation Authority's invasive species strategy identifies 31 priority actions, but its staff informed us that it does not have the funding nor staffing resources to undertake a comprehensive approach to managing invasive species within the Credit River watershed. Instead, it can only perform small pockets of work focused on specific species in particular areas. As a result, invasive species can continue to negatively impact biodiversity, increase economic costs, and even create hazards to human health. For example, the giant hogweed (see **Appendix 13**), an invasive plant spreading within the watershed, can burn and blister skin after contact.

When we surveyed Ontario municipalities and conservation authorities, the majority of respondents indicated that the Ministry is not effectively preventing

the introduction and spread of invasive species through its own actions and through the support it provides to municipalities and conservation authorities to manage invasive species. Specifically, 81% of respondents from both groups indicated that the Ministry provides them with no support at all (while an additional 5% of municipality respondents and the remaining 19% of conservation authority respondents indicated that the Ministry provides insufficient support).

Without sufficient funding from the Ministry, many municipalities, conservation authorities and other stakeholders continue to see invasive species establish and spread in their areas with little resources to proactively detect and eradicate them before long-term controls and management actions are required. This is demonstrated by the costs these parties spend each year managing invasive phragmites, the costliest invasive plant that has established in the province. Per an analysis funded by the Invasive Species Centre, municipalities and conservation authorities spend approximately \$2.8 million and \$350,000 each year, respectively, combating invasive phragmites alone (see **Figure 12**). In addition, due to the rapid spread of phragmites along roadsides, the Ministry of Transportation spent over \$2.7 million to manage this species in 2021/22. These combined phragmites-management costs are higher than the amount that the Natural Resources Ministry spends on all invasive species activities annually. It is clear that the Ministry's failure to organize and fund sufficient activities to prevent the spread of phragmites has resulted in significant long-term management and control costs for others.

We observed that bordering US states, like Michigan and New York, oversee invasive species grant programs amounting to about \$3.6 million and \$2.8 million, respectively, which are each greater than the amount the Natural Resources Ministry spends annually on invasive species programming altogether (excluding internal staff salaries and benefits). This is concerning because Ontario has a larger landmass to manage than the two aforementioned states combined.

While the Ministry itself does not have a grant program like these US states, the Invasive Species Centre began facilitating a microgrant program in

**Figure 12: Estimated Annual Minimum Expenditures on Preventing, Detecting and Managing Select Invasive Species, by Ontario Municipalities and Conservation Authorities, July 2019 (\$)**

Source of data: Invasive Species Centre

Invasive Species	Expenditures		
	Municipalities	Conservation Authorities	Total
Emerald ash borer	22,426,763	7,300,615	<b>29,727,378</b>
Zebra mussel	4,486,761	-	<b>4,486,761</b>
Spongy moth (formerly called gypsy moth)	4,474,562	-	<b>4,474,562</b>
Quagga mussel	4,458,250	-	<b>4,458,250</b>
Phragmites	2,806,166	349,098	<b>3,155,264</b>
Wild parsnip	1,081,183	4,736	<b>1,085,919</b>
European buckthorn	832,318	206,561	<b>1,038,880</b>
Dutch elm disease	587,569	-	<b>587,569</b>
Dog strangling vine	88,813	234,956	<b>323,770</b>
Giant hogweed	209,416	21,974	<b>231,390</b>
Asian longhorned beetle	227,778	-	<b>227,778</b>
Autumn olive	205,649	6,761	<b>212,410</b>
Japanese knotweed	163,851	18,596	<b>182,448</b>
Sea lamprey	-	108,181	<b>108,181</b>
Garlic mustard	55,385	39,151	<b>94,536</b>
Invasive carp (formerly called Asian carp)	-	67,613	<b>67,613</b>
Linden bark borer	61,695	-	<b>61,695</b>
Oak wilt	50,874	3,381	<b>54,255</b>
Beech bark disease	23,711	28,060	<b>51,770</b>
Hemlock woolly adelgid	10,829	28,736	<b>39,565</b>
Brown spruce longhorned beetle	30,508	-	<b>30,508</b>
Glossy buckthorn	29,378	-	<b>29,378</b>
Manitoba maple	11,299	-	<b>11,299</b>
European chafer	11,299	-	<b>11,299</b>
Scots pine	11,209	-	<b>11,209</b>
<b>Total</b>	<b>42,345,268</b>	<b>8,418,420</b>	<b>50,763,687</b>

Note: The analysis funded by the Invasive Species Centre recognizes these expenditures are likely underestimated. Totals may slightly differ from the sum of the above amounts due to rounding.

2020/21 as part of its transfer payment agreement with the Ministry. Through this program, the Centre solicits proposals for invasive-species related education activities, community action and management planning, and awarded grants of \$1,000 to successful applicants in 2020/21, which increased to be as high as \$5,000 (depending on the scope of the project) in 2021/22. A total of \$24,000 in grants was provided across 24 projects in 2020/21, and increased to \$120,000 across 60 projects in 2021/22. This small amount of funding

enabled various activities such as removing phragmites and planting native species on a Niagara College campus, conducting drone surveillance and monitoring of invasive phragmites in Nipissing First Nation to inform eradication activities, and deploying zebra mussel samplers (surfaces on which mussels will settle after completing their larval stage) to serve as an early detection method in the traditional waters of 28 First Nations communities.

However, the amount of funding provided through this program is considerably less than the grants provided by Ontario's neighbouring US states and through a similar grant program in Ontario called the Ontario Species at Risk Stewardship Program (over \$4 million each year). In addition, we noted that, while the Centre has an established process with evolving selection criteria to evaluate microgrants, it did not identify a list of high-priority species or geographic areas for targeted action despite insufficient funding to finance all eligible projects. In comparison, the Ontario Species at Risk Stewardship Program specifically identifies annual project funding priorities (including high-risk species and habitats), eligible activities and detailed assessment criteria.

The capacity of Ontario stakeholders to independently plan and co-ordinate work to achieve invasive species goals could be strengthened if funding is made available to solicit proposals from invasive species partners. For example, the Green Shovels Collaborative (GSC) is a coalition of six conservation organizations working together on "shovel-ready" projects that create jobs, conserve the natural environment and benefit local communities. These six partners include Ducks Unlimited Canada, the Federation of Ontario Cottagers' Associations, the Invasive Species Centre, the Nature Conservancy of Canada, the Ontario Federation of Anglers and Hunters, and the Ontario Turtle Conservation Centre. The GSC developed its initial proposals for these projects independently of Natural Resources Ministry input, funding and guidance. The GSC has approached the Ministry and received funding for several of these projects to date, despite there being no request-for-proposals process at the Ministry to solicit project ideas for funding consideration. The GSC has proposed additional invasive species-related projects for Ministry consideration, and if funded, could further help prevent and manage invasive species in Ontario. For example, the GSC proposed purchasing and installing boat-washing stations in strategic communities to clean invasive species such as zebra mussels off boats, which would help Ontarians comply with the Ministry's regulations for watercraft (see **Section 2.4.2** for details).

A Ministry grant program to solicit and award funding through a competitive process could leverage the ideas and capacity of interested parties and help implement actions in line with Ministry priorities to prevent invasive species from spreading in the province.

#### 4.4.2 Ministry Discontinued Funding to Organizations that Perform Significant Invasive Species Work

The Natural Resources Ministry has reduced its engagement with external partners despite the long-standing and positive relationships it has had with these parties. For example, in 2019, the Ministry abruptly discontinued funding to the Ontario Invasive Plant Council (OIPC) and the Federation of Ontario Cottagers' Associations (FOCA). While the Ministry acted in response to financial pressures, the abrupt communication of these funding decisions has harmed these partners' capacity to perform valuable invasive species work.

Specifically, the Natural Resources Ministry discontinued transfer payment funding to the OIPC after providing it with about \$300,000 over the prior three years. OIPC used a major portion of that funding to build its capacity to take on a greater role in Ontario's response to invasive species, and to establish long-term contracts with additional employees.

However, without any warning or discussion, the Ministry decided to discontinue funding the OIPC in response to budgetary pressures, despite the Ministry acknowledging in its internal documentation that the OIPC is "the primary coordinating body for invasive plant management and control in the province," that it had a history of delivering "value for money and effective products," and that elimination of Ministry funding would "pose a threat to OIPC and provincial efforts to address invasive plants."

By discontinuing this relationship, the Ministry has moved away from working with a key partner named in its strategic plan, while also disregarding the plan's tactics to "continue to support the work of the [OIPC] on invasive plant management" and "foster the efforts of the [OIPC] on invasive species outreach and

communication through continued support.” Since this discontinuation of funding, the OIPC has scaled back its activities; reduced the internal capacity it had built; and has been unable to update its best management practices, guides and technical documents with new information.

Similarly, the Natural Resources Ministry abruptly discontinued its previously recurring transfer payment funding to FOCA due to financial pressures. In the previous two years, FOCA had used the \$100,000 funding it received from the Ministry to successfully organize invasive species education, detection and management activities in various townships across the province. By engaging its membership through a small grant program, FOCA was able to leverage roughly \$20,000 in each of those two years as part of a call for proposals process to mobilize hundreds of volunteer hours to support invasive species efforts. These activities include distributing 468 signs with aquatic invasive species prevention messaging in 77 townships, organizing volunteers to remove invasive phragmites in 27 locations around Eagle Lake, and setting up a boat-washing station at Lake St. Peter Provincial Park.

Without continued engagement with partners in delivering invasive species-related work, the Ministry is missing opportunities to further develop and leverage the capacity it built with past partners.

## RECOMMENDATION 7

To improve the sufficiency of financial resources available for actions to prevent and manage invasive species, we recommend that the Ministry of Natural Resources and Forestry, with input from relevant stakeholders and experts, as applicable:

- assess and prioritize the activities that are needed to eradicate, control and prevent the introduction or spread of harmful invasive species;
- estimate the costs and make funding available to organizations and/or individuals to perform prioritized activities; and
- guide, support and monitor the implementation of those activities.

## MINISTRY RESPONSE

The Ministry of Natural Resources and Forestry (Ministry) agrees with the importance of prioritizing the activities needed to prevent and manage invasive species, and funding and supporting the implementation of prioritized activities. Given the diversity of invasive species established in or threatening Ontario, the significant management costs, and the availability of effective control tools, the Ministry will continue to focus available resources on the management of recently introduced, high-risk invasive species that are within the Ministry’s jurisdictional mandate.

The Ministry will also seek to improve collaboration with federal departments, while exploring opportunities to increase investment in invasive species management. Should new opportunities arise, the Ministry will work with partners to identify priority species and plan for the implementation of various management activities.

### 4.4.3 Funding Delays and Single-Year Funding Agreements Negatively Impact Invasive Species Work

We found that there were annual delays in funding projects to help address invasive species, as the Ministry regularly approves transfer payment recipients’ annual funding months after the fiscal year begins. Due to the lack of multi-year funding agreements and certainty of funding, organizations have difficulty performing long-term planning and retaining the staff needed to conduct invasive species work.

As part of our audit, we reviewed transfer payment agreements awarded for this work from 2011/12 to 2021/22. We found that, on average, the Ministry signed transfer payment agreements for the Invasive Species Centre and the Ontario Federation of Anglers and Hunters (OFAH) more than two months after the prior agreement lapsed. These agreements expire each year on March 31, but are generally not signed and in effect until mid-June to mid-July. This gives the funding recipients only about nine months to complete

and report on the work, limiting their ability to successfully perform the specified activities.

On-time funding would also allow organizations to determine the number of seasonal staff they can hire based on the approved budget. Earlier confirmation of funding in the winter or early spring would facilitate improved project planning and staffing. The months of April to June are especially important in planning activities since many invasive species' ecological windows fall between May and October each year. For example, it is best to tackle many herbaceous invasive plants (like phragmites and giant hogweed) in the spring and summer when they are just starting to grow to prevent them from producing seeds and becoming fully established. For other woody invasive species (like autumn olive, buckthorn and honeysuckle), early fall is the best time to undertake management activities.

However, in reviewing transfer payment agreements for the past 10 years, we found that Ministry funding was typically not confirmed until well into the summer months. For example, in 2021/22, the Invasive Species Centre's transfer payment agreement was not signed until the beginning of July, limiting the Centre's ability to begin organizing the launch of its Phragmites Fund to support local phragmites-management activities. Shifting this launch from spring to late summer made it difficult for some projects to fit phragmites control efforts into the appropriate time window. Further, other funding recipients needed to adapt activities from on-the-ground control to mapping, communications and outreach.

Timely confirmation of funding is also critical to enable third parties to obtain the necessary permits (e.g., for specialized equipment) and other authorizations to conduct invasive species work. Delays in these approvals can cause further delays in beginning contracted work. In a 2021 phragmites-specific report, the Green Shovels Collaborative (detailed further in **Section 4.4.1**) identified that phragmites management practitioners "report that delays in receiving authorizations can cause substantial challenges in implementing projects and introduces uncertainty to project delivery." For example, the use of herbicides to combat phragmites can require provincial, municipal

and landowner permissions, and this permitting and approvals process can be held up further when funding to pursue phragmites management arrives late. Similarly, in 2019, Ducks Unlimited Canada was entering into the final year of a Canada–Ontario funding agreement for European water chestnut control, but due to uncertainty over the agreement, it paused the time-sensitive program until alternative funding was secured. Had it waited until the government funding was ultimately approved in August, it would have been too late to begin conducting work effectively.

Without funding guarantees, organizations must put planning and commitments on hold. While recurring transfer payment recipients could operate with the assumption that Ministry funding will arrive eventually, this has not always been the case, as the Ministry discontinued transfer payment funding entirely to the Ontario Invasive Plant Council and the Federation of Ontario Cottagers' Associations (FOCA) in 2019 (see **Section 4.4.2** for details).

Invasive species organizations we spoke with described their struggles to retain qualified staff because jobs could not be guaranteed through annual funding agreements. For example:

- The OFAH's Invasive Species Hit Squad—a team of approximately 20–25 summer staff hired to deliver community-level outreach, monitoring and/or management activities across Ontario—experienced an unforeseen reduction of \$150,000 (or 43%) of its funding in 2019/20. As a result, the OFAH cancelled the squad. Work that was lost included monitoring waterbodies along the Trent River for water soldier, creating EDDMapS reports for multiple invasive species in various regions, and controlling and removing invasive plants. This funding reduction was not communicated to the OFAH until mid-April, after staff contracts had already been signed. Thus, the OFAH had to cancel those contracts after being informed about the funding reduction. Although the Invasive Species Hit Squad was reinstated in 2021 after a two-year hiatus, it consisted of only 14 staff members, a decrease of 6–11 staff.

- The OFAH's inability to guarantee jobs and pay staff salaries has directly reduced its ability to hire and retain qualified staff. In 2019/20, it had to decline approved funding for 30 invasive species projects as it was unable to pay staff to perform the work due to budgetary constraints. The OFAH had to instead reallocate staff time to fundraising.
- The Invasive Species Centre has lost long-standing team members who want more stability and certainty in their employment, which one-year funding cannot provide. In addition, the Centre has delayed formally hiring candidates until funding is confirmed, reducing the talent pool from which it can hire. This impacts projects because the work often relies on the expertise and capacity of the in-house team.

The Ministry has acknowledged the benefit of multi-year funding guarantees and the value of its key partners. In the Ministry's 2020/21 review of its Invasive Species Centre Transfer Payment Program, it noted that the Centre plays a key role in helping to achieve the Ontario government's mandate to address invasive species. The Ministry identified that a multi-year funding agreement would enable more efficient, effective and strategic longer-term planning; enhance Ontario's ability to respond to emerging invasive species threats; leverage additional funding opportunities for and improve collaboration with partners on strategic long-term projects; and support ongoing and effective implementation of the *Invasive Species Act, 2015*.

However, the Ministry again signed a one-year funding agreement with the Centre in July 2021/22. Prior to having its funding guaranteed, the Centre had to hold agreements and payments with project partners until the Ministry's funding agreement was signed and payment was made, which took four months during the crucial ecological window of time. As a result, activities for some of these projects were compressed into a shorter period (six versus 10 months) or redirected

from on-the-ground control to communication and outreach activities.

In contrast, for example, British Columbia switched from a single- to multi-year funding model in 2018 to fund activities that prevent the spread of invasive plants. In 2018 alone, that province provided \$7.7 million at the beginning of the year to 34 grant recipients, guaranteeing them continued funding for over two to three years. Similarly, Fisheries and Oceans Canada provided federal funding to the Invasive Species Centre over a four-year term covering the 2018/19 to 2021/22 fiscal years, which was recently updated and renewed for five more years.

In further contrast to the activities led by the Ministry, the Canadian Food Inspection Agency (CFIA) initiated efforts in 2010 to eradicate the first and only known wild Canadian population of kudzu in Essex County, Ontario, along the edge of Lake Erie. Kudzu is an invasive plant with massive roots that rapidly grows and spreads, outcompeting native vegetation and completely blanketing infested areas. Through a decade-long collaborative funding agreement beginning in 2015, the CFIA works with Ontario's Ministry of Agriculture, Food and Rural Affairs; the Natural Resources Ministry; and an affected landowner to chemically eradicate kudzu and prevent its establishment and spread in Ontario. The Natural Resources Ministry acknowledges the success of this collaborative agreement, and could pursue similar results with dedicated long-term funding for priority projects.

In its transfer payment agreements with the Centre and the OFAH for the 2022/23 fiscal year, the Ministry expressed its intent to work with these organizations over a three-year period. However, these agreements did not initially specify the amount of funding these parties would receive beyond the first year, which can hinder planning on multi-year projects. In September 2022, during the completion of this audit, the Ministry issued amendments to these agreements to specify that funding would be provided over the full three-year period. Because invasive species are an ongoing

problem that can be best managed through long-term funding commitments rather than a series of single-year agreements, we encourage the Ministry to continue multi-year funding for invasive species work.

## RECOMMENDATION 8

So that transfer payment recipients can effectively plan, staff up and implement invasive species work that is needed during critical times of each year, we recommend that the Ministry of Natural Resources and Forestry:

- develop invasive species program funding agreements with a long-term view, where appropriate; and
- approve and transfer funds under agreements prior to the beginning of the funding year.

## MINISTRY RESPONSE

The Ministry of Natural Resources and Forestry (Ministry) agrees with this recommendation and has committed to providing funding to the Invasive Species Centre and the Ontario Federation of Anglers and Hunters until March 2025. These multi-year agreements acknowledge the benefits longer-term planning provides for invasive species management actions, as well as increased certainty for program staff and additional partners.

Multi-year agreements also support ongoing management of priority invasive species, such as water soldier and European water chestnut, while also enabling existing grant programs to commit multi-year funding to additional partner organizations.

The agreements specify reporting and payment schedules that will ensure partners receive funds as required to continue implementing critical activities. The Ministry also commits to reviewing these agreements in late 2024 prior to the expiry of current agreements.

## 4.5 Invasive Species Strategy is Outdated and Does Not Enable Sufficient Implementation of Needed Activities

### 4.5.1 Ministry Has an Outdated Invasive Species Strategy and No Implementation Plan

To be successful at meeting its goals, a strategic plan should include specific, detailed tactics (supported by action and/or implementation plans with timelines and assigned parties) that will be used to effectively and efficiently achieve desired outcomes. It should also outline requirements for measuring and reporting on progress and updating the plan so it stays current and relevant. However, Ontario's 2012 Invasive Species Strategic Plan (Strategic Plan) does not include these elements.

We found that the Strategic Plan provides broad overall goals and objectives, as well as imprecise actions and tactics, but no detailed roadmap toward implementing the on-the-ground activities necessary to prevent and manage invasive species spread. The draft version of the Strategic Plan, originally posted on the Environmental Registry of Ontario in 2011, noted that many of the actions and tactics identified in the Strategic Plan are high level, and indicated the Natural Resources Ministry would co-ordinate the development of an annual implementation plan to identify and articulate priorities.

However, the Ministry never developed an implementation or action plan after the final release of the Strategic Plan. When the Strategic Plan was first released, the former Office of the Environmental Commissioner of Ontario noted in its 2012/2013 Annual Report the same concern and concluded that the Strategic Plan “lacks the specifics necessary to instil confidence that all of the responsible players will do what is required to ensure success.” The report noted that actions in the Strategic Plan “lack timelines for completion,” “fail to specify targets and indicators for measuring progress,” and “contain no public reporting requirements.”

The Natural Resources Ministry uses the very general and high-level Strategic Plan to work with partners and stakeholders to make decisions on key priorities for action. Instead of developing an annual (or multi-year) implementation plan, the Ministry has opted to conduct annual work planning and priority-setting exercises. Our Office reviewed all work plans the Ministry developed from 2012/13 to 2021/22, and found that these plans were limited to being activity lists; mostly focused on policy development, collaboration and communication rather than on planning and implementing prevention and management activities; and altogether insufficient and lacking in detail to effectively implement and achieve the goals of the Strategic Plan. For example, the 2021/22 work plan consisted of a five-page slide deck with a single sentence describing each planned activity (see **Appendix 14**).

We further noted that planning with a one-year time horizon has left activities unfinished: for example, the Ministry recognized that its risk assessments were not publicly accessible, so in 2016/17 it tasked the Invasive Species Centre with developing a risk assessment database to consolidate available risk assessments from various jurisdictions in one place. The database now includes over 1,700 risk assessments and 19 pathway assessments, including many by the Canadian Food Inspection Agency; the Department of Fisheries and Oceans Canada; and other provinces, states and countries. However, at the time of our audit, the Ministry had still not provided its completed risk assessments to the Centre to include in this database. The Ministry informed us that it was instead focused on other priorities, but would revisit including its risk assessments going forward.

In comparison, the US Department of Agriculture Forest Service's Alaska Region Invasive Species Strategy 2006–2010 specifically lists the action items, responsible party and outcome measures for each goal and objective the strategy identifies. Similarly, the municipality of Mississauga's Invasive Species Management Plan and Implementation Strategy includes a table summarizing the different objectives, action items, targets and implementation timelines.

We also found that the Ministry's Strategic Plan has never been updated since its creation in 2012. While Ministry staff indicated that the 10-year anniversary of the plan has prompted internal discussion to review and update it, this had not been committed to and timelines had not been established at the time of our audit. The current Strategic Plan predates the *Invasive Species Act, 2015* (Act) and the use of modern tools for detecting and responding to invasive species, and therefore does not provide any direction on how and when to use them. Specifically:

- The Act empowers conservation officers to issue penalties when invasive species-related offences (e.g., possessing, trading or releasing regulated species) are committed. However, since the Strategic Plan predates the Act, it does not provide guidance on the role of these penalties, describe what offences should be prioritized for enforcement work, or define the terms of a successful enforcement system to measure results against.
- Environmental DNA (eDNA) monitoring is a modern tool that can determine the presence (or absence) of a species in an area through detecting that species' DNA in a sample. Currently, the Ministry uses only two laboratories to perform eDNA testing. However, staff at many other laboratories are interested in performing this work, and could be leveraged to perform testing if eDNA testing moves into commercial use and plays a larger role in invasive species monitoring in the future.
- Aerial mapping is a cost-effective monitoring technique using aircraft (such as drones) to collect overhead images of a large area, which can then be examined using software to interpret the images and identify the presence of some invasive species or their impacts, such as the defoliation of trees. This technique is used by the Natural Resources Ministry to measure the impacts of forest pests such as the invasive emerald ash borer and the native forest tent caterpillar. However, the Ministry is currently not using aerial mapping to measure the spread and impacts of any species regulated under the Act.



- While the Ministry informed us that it intends to review and update the Strategic Plan in the future, this exercise will be undermined if it lacks the accompanying implementation plan and resources to execute the work needed to achieve the Strategic Plan's goals.

## RECOMMENDATION 9

To effectively, efficiently and accountably achieve successful outcomes for invasive species prevention and management, we recommend that the Ministry of Natural Resources and Forestry:

- develop a detailed implementation plan that lists specific action items, responsible parties, required human and financial resources, outcome measures and implementation time-lines for each goal and objective identified in the Ontario Invasive Species Strategic Plan (Strategic Plan);
- regularly update the Strategic Plan, through public consultation, to keep it current and relevant; and
- publicly report on the progress toward the implementation of the Strategic Plan on an annual basis.

## MINISTRY RESPONSE

The Ministry of Natural Resources and Forestry (Ministry) agrees with this recommendation and intends to proceed with a review of progress and update to the Ontario Invasive Species Strategic Plan (Strategic Plan).

This review and update will include consultation with program partners, municipalities, conservation authorities, Indigenous communities, and the public to inform the development of actions and tactics and associated implementation planning. Implementation plans will support efforts to clarify roles and responsibilities, as well as any requests for required human and financial resources.

The Ministry will also work with partners to explore opportunities to publicly report on joint

efforts and progress on the implementation of the Strategic Plan.

### 4.5.2 Public Awareness on Invasive Species Is Low Despite Ministry Funding Education and Outreach Activities

The Ministry funds a number of public outreach and education activities. However, the results of our Office's survey of Ontarians suggests that Ontario's invasive species public education and awareness programs have not reached most people across the province.

Specifically, we found that 18 out of 35 projects the Ministry funded through transfer payment agreements in 2021/22 involved education and outreach activities. These activities include organizing invasive species education and outreach committee meetings; writing invasive species blog posts for the Biodiversity Education and Awareness Network; and hosting monthly webinar series to highlight invasive species risks, management tools and success stories.

Many of the activities funded through the Invasive Species Centre (Centre) relate to education and outreach, and the Centre plays an integral role in communicating information on invasive species to the public. However, we engaged a polling firm and found that 74% of 1,001 surveyed Ontarians had never heard of the Centre before. Furthermore, only 13% of respondents were able to correctly identify that the Centre tracks/identifies/records invasive species; 9% correctly identified that the Centre eradicates/removes invasive species; and 6% correctly identified that the Centre controls invasive species and prevents their spread. Only 3% of respondents correctly identified that the Centre educates the public and shares information about invasive species, which represents a substantial portion of the Centre's work.

We also found that 70% of respondents had never heard of the Ontario Federation of Anglers and Hunters' Invading Species Awareness Program. While 34% of those surveyed indicated how they might go about reporting invasive species sightings in Ontario, most of the methods mentioned were inappropriate

(e.g., calling animal control, contacting the Ministry/city/local municipality/town hall). These findings are in line with past surveys on environmental topics, which note low public awareness of environmental issues, organizations and roles.

We also noted that some of the Ministry's educational materials needed improvements. For example, the Ministry posts a summary of fishing regulations each year to help educate the public on fishing rules and guidelines. While the 2022 summary included a listing of all the regulated aquatic invasive species in Ontario, it only provided visual aids for two invasive species: one labelled, black-and-white illustration of a round goby, and one full colour advertisement showing a tench. Since the 2022 summary did not have photographs and/or labelled illustrations of other invasive species, the Ministry is missing a valuable opportunity to educate anglers on how to spot other invasive species through publications they are expected to read.

Importantly, while public education and outreach are essential components of any invasive species program, the capacity these activities build is wasted if they do not result in actual on-the-ground prevention, detection and management outcomes. Our concerns about Ontario's focus on funding education and outreach over necessary on-the-ground activities mirror those raised in a 2008/09 evaluation of Environment Canada's Invasive Alien Species Partnership Program (conducted by Environment Canada's Evaluation Division), which identified "the need to focus more on an action-oriented approach to addressing [invasive alien species] in Canada, as opposed to focusing on education and outreach."

## RECOMMENDATION 10

To improve public awareness of invasive species, and to have effective education and outreach activities that achieve intended outcomes, we recommend that the Ministry of Natural Resources and Forestry work with partners, including the Ontario Federation of Anglers and Hunters and the Invasive Species Centre, to develop and implement a strategy for public education and outreach, and for tracking the effectiveness of efforts to raise

public awareness on how to report invasive species sightings.

## MINISTRY RESPONSE

The Ministry of Natural Resources and Forestry (Ministry) recognizes that, despite significant past and ongoing education efforts, public awareness in Ontario of invasive species and the *Invasive Species Act, 2015* is still limited.

Public awareness is essential to achieving broader prevention and management objectives. The Ministry will continue to work with key partners to assess the effectiveness of current awareness actions and to develop a strategy to improve public awareness of invasive species and pathways in Ontario.

## 4.6 Enforcement Resources and Activities Are Limited

### 4.6.1 Ministry Staffing Is Insufficient to Administer the *Invasive Species Act, 2015*

Since 1998, the number of environmental laws that conservation officers must enforce has increased from at least 22 to 27 acts, while the number of such officers has decreased from 281 to 238 (15%) during the same period (25 of whom were hired in 2021/22 after the Natural Resources Ministry acknowledged that it did not have enough officers). Ministry staff have previously identified inadequate staffing levels and requested funding for additional full-time staff. For example, when the *Invasive Species Act, 2015* (Act) was being developed, the Ministry submitted a business case to the Treasury Board/Management Board of Cabinet (TB/MBC) ahead of the 2014/15 fiscal year, seeking "approval for specific financial provisions necessary to implement the legislation," including additional funding and full-time staff. Specifically, the Ministry requested \$10 million over the next four years and six staff (two in the Biodiversity Branch, one in the Forestry Branch, and three in the Enforcement Branch). The TB/MBC instructed the Ministry to divert the necessary funding from existing programs.

However, the Ministry did not divert the funding and increase staffing, and therefore these policy and enforcement positions were not filled.

Similarly, the Natural Resources Ministry sought to increase its staff again in the 2017/18 fiscal year. As part of its submission, the Ministry identified that it would “be critical to expand its capacity beyond its current level to enable more focus and effort on preventing new invasive species from arriving and establishing in Ontario.” The Ministry requested the addition of eight permanent full-time equivalent staff to work in policy development and four permanent full-time equivalent staff to improve compliance and enforcement activities. The TB/MBC approved an increase of three full-time equivalent staff “for additional capacity required to support the implementation of the new Invasive Species Act,” and directed the Ministry to manage the funding requirements for these staff within its existing budget allocation. However, the Ministry again did not divert resources to staff these three positions.

Further, the Ministry does not provide comparable support for its conservation officers to enforce the Act as it does for other laws. For example, the Ministry’s Regional Operations Division, which manages the implementation and delivery of provincial programs on local, regional and division levels, currently has a limited role in performing work under the Act. Per internal Ministry documentation, the “[Regional Operations Division’s] approach to implementation of the [Act] will be based on leveraging existing partnerships and existing resources.” While the Regional Operations Division will collaborate with others to respond to wild pig sightings, it is otherwise hands-off and directs individuals with other invasive species-related inquiries to partner organizations and existing Ministry resources.

#### **4.6.2 Training for Conservation Officers Does Not Enable Reliable Species Identification and Effective Enforcement**

While the Act came into force in 2016, the earliest relevant conservation officer training related to understanding the law and how it applies in the field

occurred in 2017. The training presentation included a single slide that showed all the regulated invasive species but only labelled and named four. Moreover, only 19 conservation officers attended this training. It was not until May 2018 that training was provided (by the Invasive Species Centre) with a focus on invasive species identification; however, this training was only provided in two small sessions, with 10 and 23 conservation officers in attendance, respectively.

During 2021/22, two identification-related training sessions were held in April 2021, with a greater focus on aquatic invasive species identification; two legislative controls sessions were held in May 2021; and two sessions on updates to the Act were delivered in February 2022. While these sessions had a much greater turnout (111, 67 and 106 conservation officers attending each pairing of sessions, respectively), they were again not mandatory. As a result, more than five years after the Act came into force, not all conservation officers have been trained to identify invasive species.

In addition, helpful resources to carry in the field, such as labelled visual aids for each of Ontario’s 33 regulated invasive species, have not yet been developed and distributed to conservation officers to help them independently identify invasive species. The Natural Resources Ministry informed us that it is planning to develop such resources in 2022/23.

Without comprehensive and mandatory training, we found instances where conservation officers required the assistance of experts to help them identify invasive species in the field. In the Ontario Invasive Species Strategic Plan, one Ministry tactic is to “develop a network of experts that can be called upon for technical expertise ... related to taxonomic identification.” However, the difficulty in obtaining expert support has delayed enforcement work and taken away time that conservation officers could have spent doing other on-the-ground patrols and inspections. For example:

- On October 16, 2019, a conservation officer responded to a public tip of water soldier (an invasive aquatic plant) in backyard ponds close to the Lake Erie shoreline. The officer recognized the need for water soldier-identification

expertise, but the Ministry's Regional Operations Division indicated that it would not be involved in supporting this search. As per Ministry staff, the division "does not currently have an active role in implementing the [Act]" and "does not broadly support implementation of the Act." The officer then contacted the Ministry's Enforcement Services Section two days later to request an expert, and was again unsuccessful; they then began initial conversations with the Ministry's Biodiversity Section. On October 24, the officer again emailed the Biodiversity Section, stating their intent to perform the inspection "as soon as possible." While the Biodiversity Section provided contact information for an expert at the Ontario Federation of Anglers and Hunters, the inspection had to be deferred to November 5 due to scheduling conflicts. During this inspection, water soldier was positively identified and seized. This 20-day delay could have been avoided if officers were sufficiently trained, or if there were protocols and on-call experts in place to help identify invasive species.

- On May 28, 2020, a conservation officer responded to a public tip claiming a worm farm was selling topsoil containing Japanese knotweed, an invasive species. The officer took pictures and samples and determined that an inspection with expert support was required to confirm whether Japanese knotweed was present. The Regional Operations Division again did not provide support as it does not help implement the Act. The officer contacted the Natural Resources Ministry which provided the officer with an expert contact at the Ministry of the Environment, Conservation and Parks. This expert supported the officer's inspection, 14 days after the tip was first received, and identified the invasive species present in the soil as phragmites (not Japanese knotweed). During this time, the farm was not directed to discontinue operating, advertising or selling the compromised soil.

#### 4.6.3 Conservation Officers Do Not Fully Use Enforcement Powers Granted by the *Invasive Species Act*, with No Charges Laid and Only 11 Warnings Issued

We found that conservation officers are not fully using the inspection tools and enforcement powers available to them under the *Invasive Species Act, 2015* (Act).

From 2015/16 to 2021/22, the Natural Resources Ministry's Enforcement Branch recorded 1,032 invasive species-related inspections. Of these inspections, we reviewed the ones where invasive species-related offences were detected, and found that many targeted the general public rather than high-risk pathways or activities. As well, many of these inspections pertained to Ontario's legal use of live baitfish, which most other provinces do not allow because (among other reasons) the release of baitfish into non-native ecosystems has the potential to start an invasion. Invasive species such as gobies can be mixed with, and difficult to distinguish from, minnows commonly used in angling, and may thus be transported throughout the province to baitfish retailers and individual anglers.

However, the Ministry conducted a three-year monitoring program of baitfish retailers from 2015/16 to 2017/18, which showed significant non-compliance rates in 2015/16 (34%) and the first quarter of 2016/17 (67%), the period in which reliable compliance data was tracked. Despite the success of this program in detecting non-compliance, the Ministry stopped collecting reliable compliance data midway through the program and no such systematic monitoring is organized provincially today. The Ministry informed us that due to reporting and capacity limitations, it could not determine whether the baitfish retailers were revisited to ensure their behaviour improved.

Similar to the Ministry's prioritization of aquatic species in its risk assessments and regulation of invasive species, we found that the Ministry has also focused on aquatic over terrestrial invasive species in its inspections. As of year-end 2021/22, 100% of charges and 97.3% of warnings issued across relevant

laws since 2015/16 were related to aquatic invasive species. Further, the Ministry confirmed that, while conservation officers began inspecting garden centres in 2021/22, these inspections were ineffective in detecting invasive plants because conservation officers are not adequately trained to identify them (as noted in **Section 4.6.2**).

A more effective use of the limited conservation officers available could be to focus on inspections of high-volume distributors, such as baitfish retailers, which may transport and sell invasive fish, and garden centres, which may transport and sell invasive plants. Indeed, in its 2020/21 and 2021/22 published plans, the Ministry identified the need to target compliance in specific invasive species pathways such as angler bait use, fish markets and restaurants. A targeted approach could better prevent significant movement of invasive species across the province, and may be much more impactful than targeting individual Ontarians participating in angling or gardening.

Our review of inspection files and discussions with conservation officers also showed that the Natural Resources Ministry has not pursued laying any charges or issuing fines or penalties. From 2015/16 to 2021/22, only 11 warnings and no charges were laid under the Act. For example:

- As indicated in the first example in **Section 4.6.2**, invasive water soldier plants (a prohibited species) were found in the backyard ponds of a private property during an inspection. The invasive plants were seized and the conservation officer issued verbal warnings and educated the homeowner rather than pursuing charges. The Ministry informed us that it did not pursue charges because its initial approach to non-compliance is focused on promoting awareness of the rules and encouraging voluntary compliance.
- As indicated in the second example in **Section 4.6.2**, a conservation officer found a farm was selling topsoil containing phragmites (an invasive plant). As selling a regulated invasive species meets the definition of an offence under the Act, the officer planned to issue a

compliance order and charge the farm. However, after consultation with the Ministry's Regulatory Support Unit and Legal Services Branch, the decision was made to take no enforcement action. The Ministry interpreted this situation as the business operator not directly selling the invasive species but only the soil that contained it, and no further actions were taken to prevent these sales from going forward.

Similarly, despite the fact that the Act allows officers to obtain inspection and search warrants, no warrants had ever been issued as of March 31, 2022.

#### 4.6.4 Conservation Officers Are Not Required to Perform Invasive Species-Related Patrols and Inspections in a Consistent and Reliable Manner

The Natural Resources Ministry establishes which enforcement activities to prioritize annually. These priorities are then considered when the Ministry's Enforcement Branch budgets conservation officer hours. However, there is no standard across the province for how officers should track their enforcement work to show the prioritized activities are being performed. For example, conservation officers conduct sport fish patrols to ensure anglers have valid fishing licences and comply with catch and possession limits. One officer might record four hours of sport fish patrols as aquatic invasive species work, while another might record them as sport fish or baitfish patrol work. Refining how invasive species hours are assigned, tracked and overseen would help the Ministry ensure that relevant and meaningful patrols and inspections are actually performed and logged in a consistent manner by conservation officers.

We also noted some deficiencies in inspectors' powers that limit their effectiveness in preventing the introduction and spread of aquatic invasive species. For example, while baitfish harvesters must submit a Hazard Analysis and Critical Control Point Plan to the Ministry outlining the steps they will take to prevent the spread of invasive species, there is no follow-up to ensure their actions actually adhere to this plan. Including this as a condition in licences would

allow inspectors to check whether baitfish harvesters are complying with the commitments made when acquiring their baitfish harvesting licences. Baitfish harvesters and dealers are also required to submit annual reports to the Natural Resources Ministry outlining how many dozens, gallons or pounds of baitfish and leeches they harvested and sold. With few exceptions, harvesters and dealers are not required to disclose holding locations. Requiring licensed parties to disclose where their offsite bait is stored as a mandatory licence condition would allow inspectors to visit these locations, detect any invasive species not found and removed during harvesting/transport to the location, and take appropriate actions.

Furthermore, unlike other provinces, Ontario has not made watercraft inspections for invasive species mandatory. Aquatic invasive species are most likely to establish at locations with high shipping and boating activities, such as ports, marinas, harbours and boat launches. In particular, moving watercraft overland is a major risk for transporting aquatic invasive species to uninvaded waterbodies. Therefore, an effective way to prevent the introduction and spread of some aquatic invasive species would be through the use of watercraft inspections at high-risk locations such as border crossings or between regions.

Currently, Ontario boaters are required to drain water from their watercraft and watercraft equipment and remove aquatic plants, animals and algae from watercraft, watercraft equipment, vehicles and trailers before placing them into waterbodies. However, there is no process in place to routinely ensure compliance with this law. In comparison, for example, Alberta, Manitoba, British Columbia, Saskatchewan and the Canada–US border in those provinces have established mandatory watercraft inspection stations in response to the threat of aquatic invasive species invasion and/or spread. All carriers of water-based vessels must stop at all open watercraft inspection stations to be checked for aquatic invasive species on boats, trailers and other water-related equipment. In addition, Alberta and British Columbia use trained dogs to detect invasive mussels as part of their watercraft inspections. If invasive species are suspected or found, a decontamination

(thorough cleaning) is required and the watercraft may also be subject to quarantine.

## RECOMMENDATION 11

So that the *Invasive Species Act, 2015* is effectively enforced to detect invasive species and reduce their spread, we recommend that the Ministry of Natural Resources and Forestry:

- assess and ensure the sufficiency of enforcement resources, including training requirements, the availability of specialist support and the number of field conservation officers;
- develop and implement a risk-based approach to inspections, focusing on high-risk species, pathways and activities;
- assign, track and review hours assigned to conservation officers for invasive species work to make sure relevant work is performed;
- explore and implement cost-effective ways to ensure compliance with Ontario's watercraft laws, particularly in high-risk areas;
- update licence requirements for baitfish retailers and harvesters to include disclosure of where bait is stored; and
- require baitfish retailers to adhere to the steps outlined in their Hazard Analysis and Critical Control Point Plans to prevent the spread of invasive species.

## MINISTRY RESPONSE

The Ministry of Natural Resources and Forestry (Ministry) agrees with the importance of inspections and enforcement to detect and reduce the spread of invasive species. Over the past two years, the Ministry has recruited an additional 25 conservation officers to increase the number of field officers to 209. As part of the new-recruit training curriculum, the Ministry extended the time spent on enforcement of the *Invasive Species Act, 2015* (Act) and is in the process of circulating additional information that articulates new rules around watercraft to assist conservation officers with education and outreach when they are in the field. Plans also

include other quick reference tools to aid conservation officers in identifying invasive species.

The Ministry will investigate sustainable ways to extend compliance authority under the Act to other areas of the Ministry as resources allow. The Ministry agrees that accessible and available specialist support is required for conservation officers to be sufficiently supported when investigating invasive species cases and will work to create a referral list to ensure supports are available upon request within a reasonable amount of time.

Consistent with professional law enforcement practices, the Ministry will continue to take a risk-based approach to prioritize enforcement activities. The Ministry commits to continually improving the annual process of assigning conservation officer time to enforcement priorities to ensure relevant work associated with the Act continues to be performed.

In 2020, the Province finalized Ontario's Sustainable Bait Management Strategy, which establishes a new approach to the management of baitfish across the province. Ontario's approach aims to reduce the spread of invasive species and diseases and protect Ontario's vibrant fisheries and the industries that rely on them while also providing flexibility and certainty to the bait industry and anglers.

## 4.7 Ministry Lacks Performance Measurement and Reporting for Invasive Species Work

The Natural Resources Ministry has not developed a performance measurement framework to assess whether its activities aimed at preventing the introduction and spread of invasive species are effective. As a result, decision-makers and the public are also not aware whether invasive species introductions are prevented and managed in an effective and efficient manner. This lack of performance measurement also limits the Ministry's ability to identify, prioritize and respond to new and existing threats while ensuring

effective prevention and control measures are adopted and expanded. The Ministry indicated that it has not developed a performance framework because it would be difficult to establish such monitoring in a province as large as Ontario.

The Treasury Board Secretariat (Secretariat) establishes policies and standards for organizational practices across the provincial government. The Secretariat has provided guidance to ministries emphasizing the importance of developing key performance indicators and targets to track performance, report on progress and drive continuous improvement. For over a decade, the Secretariat has also encouraged ministries to develop performance measurement frameworks—consistent processes to collect, analyze and report information on how programs are performing and whether they are achieving their intended outcomes.

The lack of meaningful performance indicators and reporting by the Natural Resources Ministry has been identified repeatedly over the last decade with no observed improvement. For example:

- In its 2015/2016 Annual Report, the former Office of the Environmental Commissioner of Ontario recommended that the Natural Resources Ministry should “report publicly on 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.”
- Our 2021 value-for-money audit on Reporting on Ontario's Environment found that the Ministry had not publicly released regular reports on its progress preventing the spread of invasive species.

While the Ministry did not have any performance metrics in place, we noted that occurrences of some invasive species in some parts of the province are reported through its State of Ontario's Natural Resources reports, its Forest Health Conditions in Ontario reports, and the Ontario Biodiversity Council's State of Ontario's Biodiversity reports. However, we found that none of these reports assess whether Ontario's current invasive species strategy and programming

are effective. For example, none quantify the effects of existing interventions aimed at curbing the spread of invasive species, nor do they provide details on the extent and location of terrestrial invasive species spread. Data related to invasive plants, animals and pathogens is inadequate and not consistently reported. For example, the area affected by the emerald ash borer, the most economically damaging invasive species for Canadian municipalities, was not reported for several recent years (2017 and 2019) per Ontario's State of Ontario's Natural Resources Report 2021. Unlike reporting for some federally regulated invasive species, none of these reports include any species-specific reporting to show the spread of any invasive species regulated under the Act.

It is best practice to have performance measures that show whether current actions are working in order to drive progress. These measures also inform which corrective actions ministries should take to improve the individual and collective statuses of invasive species. Without collecting and reporting on indicators relevant to invasive species, the Ministry does not know the extent to which actions have been successful in preventing and managing these species. Such data collection and reporting are only happening in very specific circumstances, such as with the actions taken to control phragmites in the Long Point region.

In addition, the Ministry has no progress reports on the implementation of the Act or Ontario's Invasive Species Strategic Plan. The purpose of progress reports would be to update the public on the Ministry's progress made toward achieving invasive species-related goals and objectives and to facilitate monitoring. They would also help identify additional techniques and lessons learned to improve invasive species management.

For example, the municipality of Mississauga aims to complete a progress report every five years. The New York State Invasive Species Comprehensive Management Plan proposes that an annual report card be prepared to show the outcomes of various metrics for

different action items organized by priorities. Other jurisdictions such as New South Wales and Michigan state also develop and track performance indicators, and publicly report on them. See **Appendix 15** for examples of invasive species performance indicators from other jurisdictions that could be applicable in Ontario. Notably, the metrics in New York State include the number of permanent monitoring points established for tracking invasive species. A targeted expansion of monitoring in Ontario against a similar metric would provide baseline data with growing geographical coverage to measure the success of invasive species prevention and management activities.

## RECOMMENDATION 12

To measure the effectiveness of its invasive species program at preventing and controlling the spread of invasive species and its impacts, we recommend that the Ministry of Natural Resources and Forestry:

- develop a performance measurement framework for the Province's overall invasive species program, including meaningful, measurable, and outcome-oriented performance indicators with targets and timelines; and
- document invasive species management and outcomes, and publicly report on the status of the performance measures as part of an annual report.

## MINISTRY RESPONSE

The Ministry of Natural Resources and Forestry (Ministry) agrees with exploring mechanisms to measure the effectiveness of its invasive species program during the review of progress and update to the Ontario Invasive Species Strategic Plan.

During this review and update, the Ministry will engage with program partners, stakeholders, and others on the development of a performance management framework and associated public reporting as an action in the updated strategic plan.



## Appendix 1: Glossary of Terms

Prepared by the Office of the Auditor General of Ontario

Term	Definition
<b>Ballast</b>	A heavy substance placed in such a way as to improve stability and control of a ship or the ship's buoyancy.
<b>Biodiversity</b>	The variety of life on Earth—it includes plants, animals and all other living things, as well as how they interact with one another and their environment.
<b>Biological control</b>	The process of using biological pesticides (containing a bacterial or viral agent) or living organisms (particularly insects, mites, nematodes, bacteria, viruses or other organisms) to control the growth of invasive species.
<b>Chemical control</b>	The process of using pesticides, herbicides, insecticides and fungicides to control or eradicate invasive species on contact or indirectly by suppressing regeneration and damaging their essential life processes or ability to reproduce.
<b>Climate change</b>	The long-term shift in global or regional climate patterns.
<b>Conservation authorities</b>	Local public sector organizations that develop and deliver local, watershed-based resource management programs on behalf of the Province and municipalities. Conservation authorities are established by the Province and governed by the <i>Conservation Authorities Act</i> , which is administered by the Ministry of the Environment, Conservation and Parks.
<b>Conservation reserve</b>	An area that protects significant natural and cultural features while providing opportunities for a variety of compatible traditional activities (e.g., fishing, hunting, trapping).
<b>Ecological window</b>	The optimal period of time, from a biological perspective, for invasive species management practices.
<b>Ecosystem</b>	A dynamic complex of plant, animal and micro-organism communities and their non-living, abiotic environment interacting as a functional unit.
<b>Environmental DNA (eDNA)</b>	The nuclear or mitochondrial DNA that is released from an organism into the environment. Sources of eDNA include secreted feces, mucous and gametes; shed skin and hair; and carcasses. eDNA can be detected in cellular or extracellular (dissolved DNA) form.
<b>Extinction</b>	The dying out of a species.
<b>Habitat loss</b>	The elimination or alteration of the conditions necessary for animals and plants to survive. Habitat loss not only impacts individual species but the health of the global ecosystem.
<b>Integrated control</b>	An approach that considers the biology and life cycle of the invasive species to be managed and involves the use of a combination of mechanical, biological and chemical control methods, as well as changes in land use practices and preventative methods (e.g., habitat rehabilitation) to control invasive species and prevent their recolonization.
<b>Invasive species / Invasive alien species</b>	Harmful alien species whose introduction or spread threatens the environment, the economy, or society, including human health. Alien bacteria, viruses, fungi, aquatic and terrestrial plants, animals, birds, reptiles, amphibians, fish and invertebrates (including insects and molluscs) can all become invaders.
<b>Invasive species detection</b>	The process of finding and identifying the presence or existence of an invasive species.
<b>Invasive species identification</b>	The process of recognizing or distinguishing a species and confirming whether it is native to Ontario.
<b>Mechanical control</b>	The process of removing an invasive species from its environment such as by hoeing, tilling, girdling, chopping or constructing barriers using tools or machines.

<b>Term</b>	<b>Definition</b>
<b>Native species</b>	A species that originated and developed in its surrounding habitat and has adapted to living in that particular environment.
<b>Organism</b>	A living thing made up of one or more cells that is able to carry out the activities of life.
<b>Pathogen</b>	An organism that causes disease.
<b>Pathways</b>	Routes by which an invasive species is transferred from one ecosystem to another.
<b>Pest</b>	Any injurious, noxious or troublesome plant or animal life. While invasive species are limited to species that are not native to the area in which they are causing harm to native species or the natural environment, pests can be attributed to both non-native and native species that cause harm or damage to native species.
<b>Physical control</b>	The process of manually removing an invasive species from its environment, which includes the process of physically removing an invasive species by hand-pulling, digging, flooding, mulching, or manual destruction or removal of nests, egg masses, or other life stages; generally includes the destruction of invasive species by hand.
<b>Prohibited species</b>	Species that are illegal to import, possess, deposit, release, transport, breed/grow, buy, sell, lease or trade anywhere in Ontario.
<b>Propagation</b>	The increase in the population of and/or area occupied by an organism.
<b>Protected areas</b>	Areas that are defined to protect natural and cultural features, maintain biodiversity and provide opportunities for compatible recreation. These areas may contain old-growth forest, lakes, habitats for rare and endangered species, archaeological sites or other cultural values.
<b>Restricted species</b>	Species that are illegal to import, deposit, release, breed/grow, buy, sell, lease or trade anywhere in Ontario.
<b>Risk assessment</b>	A consideration of the likelihood that a non-native species will be introduced, become established and spread, combined with the projected impact of its establishment on biodiversity and socio-economics.
<b>Soil degradation</b>	The decline in soil condition caused by its improper use or poor management, usually for agricultural, industrial or urban purposes.
<b>Species</b>	From a biological perspective, a group of living organisms that are similar to one another and are capable of reproducing with one another to make offspring that are capable of reproducing with one another.
<b>Terrestrial species</b>	Animals and plants that live predominantly or entirely on land.
<b>Vascular plants</b>	Plants whose tissue transports water, nutrients and sugars to the rest of the plant.
<b>Waterbody</b>	Any body of surface water, such as a lake, river, or pond.
<b>Watercraft</b>	Any conveyance used or designed for navigation on water, including any motorboat, rowboat, canoe, punt, sailboat or raft.
<b>Watercraft equipment</b>	Anything used to aid in the operation, movement or navigation of a watercraft, including ropes, fenders and anchors.
<b>Wetland</b>	Lands that are seasonally or permanently covered by shallow water, as well as lands where the water table is close to or at the surface. In either case, the presence of abundant water has caused the formation of very wet soils and has favoured the dominance of either plants that grow partly or totally submerged in water or water-tolerant plants. The four major types of wetlands are swamps, marshes, bogs and fens.

## Appendix 2: Roles and Responsibilities of Key Players in Invasive Species Prevention and Management

Prepared by the Office of the Auditor General of Ontario

### Government Organizations

#### Federal Departments and Agencies

- Regulate the import and movement into Canada of invasive species and goods that could contain them.
- Enter into agreements with provincial, municipal, Indigenous and other organizations to address invasive species.
- Co-ordinate and implement on-the-ground management activities for priority invasive species.

#### Ministry of Natural Resources and Forestry (formerly Ministry of Northern Development, Mines, Natural Resources and Forestry)

- Administers the *Invasive Species Act, 2015* and its associated regulations.
- Developed and leads the implementation of the Ontario Invasive Species Strategic Plan (2012).
- Funds organizations, programs, research and initiatives to understand, prevent, detect and manage invasive species.

#### Other Provincial Ministries

The Ministries of the Environment, Conservation and Parks; Agriculture, Food and Rural Affairs; and Transportation address invasive species by regulating pesticides, regulating noxious weeds, and managing roadside invasive species, respectively.

#### Municipalities

- Fund various stakeholders and local conservation authorities to prevent and manage local invasive species.
- Support on-the-ground invasive species prevention, detection and management activities to address local priorities.

### Other Key Players

#### Conservation Authorities

- Public-sector organizations established by the Province to develop and deliver watershed-based resource management programs.
- Perform invasive species prevention and management activities using mostly municipal funding.

#### Invasive Species Centre

A non-profit organization established as a federal and provincial partnership to connect stakeholders, knowledge and technology to prevent the introduction and spread of invasive species that harm Canada's environment, economy and society.

#### Ontario Federation of Anglers and Hunters

- A non-profit organization that represents anglers and hunters, and champions wildlife conservation to ensure the enhancement of hunting and fishing opportunities.
- Leads the Invading Species Awareness Program to monitor and educate Ontarians on invasive species.

#### Ducks Unlimited Canada

Conducts wetland restoration activities, with provincial funding tied to monitoring and physical removal of European water chestnuts and parrot feather, and monitoring of phragmites populations prior to the introduction of a biological control.

#### Other Non-Government Organizations

Other organizations, such as the Ontario Invasive Plant Council and the Nature Conservancy of Canada, provide public education, develop best practice guidelines and co-ordinate activities to prevent and manage invasive species throughout the province.

## Appendix 3: Agencies and Organizations with Invasive Species Relevance

Prepared by the Office of the Auditor General of Ontario, adapted from the Invasive Species Centre and the Ontario Invasive Plant Council

Agency/Organization	Jurisdiction	Roles and Responsibilities
<b>Provincial Agencies</b>		
<b>Ministry of Natural Resources and Forestry</b> (formerly Ministry of Northern Development, Mines, Natural Resources and Forestry)	Forests, fisheries, wildlife, water, oil, gas, salt and aggregates resources in Crown lands and waters	<ul style="list-style-type: none"> <li>• Leads the Ontario Invasive Species Strategic Plan.</li> <li>• Administers the <i>Invasive Species Act, 2015</i> and the Ontario Fishery Regulations, 2007 (SOR/2007-237) under the <i>Fisheries Act</i>.</li> <li>• Administers the <i>Fish and Wildlife Conservation Act, 1997</i>.</li> <li>• Administers the <i>Crown Forest Sustainability Act, 1994</i> and <i>Forestry Act</i>.</li> <li>• Regulates aquatic invasive plant removal under the <i>Public Lands Act</i>.</li> <li>• Issues Letter of Opinion for Natural Resource Exception of the Cosmetic Pesticides Ban (O. Reg. 63/09) to enable the control of invasive plants using certain pesticides.</li> </ul>
<b>Ministry of the Environment, Conservation and Parks</b>	Pesticide regulations for lakes, ponds, rivers, streams and wetlands	<ul style="list-style-type: none"> <li>• Regulates the sale, use, licensing, transportation, storage and disposal of pesticides under the <i>Pesticides Act</i> and O. Reg. 63/09.</li> <li>• Supports the Ontario Invasive Species Strategic Plan.</li> <li>• Provincial parks may implement their own invasive species management strategies.</li> <li>• Administers the <i>Provincial Parks and Conservation Reserves Act, 2006</i>.</li> <li>• Administers the <i>Endangered Species Act, 2007</i>.</li> <li>• Administers the <i>Great Lakes Protection Act, 2015</i>.</li> <li>• Provincial lead ministry for the <i>Canada-Ontario Agreement on Great Lakes Water Quality and Ecosystem Health, 2021</i>.</li> <li>• Administers the <i>Lake Simcoe Protection Act, 2008</i>.</li> <li>• Administers the <i>Conservation Authorities Act</i>.</li> </ul>
<b>Ministry of Transportation</b>	Transportation network of highways and other transportation corridors	<ul style="list-style-type: none"> <li>• Supports the Ontario Invasive Species Strategic Plan.</li> </ul>
<b>Ministry of Agriculture, Food and Rural Affairs</b>	Invasive weeds that impact the agriculture and horticulture industries	<ul style="list-style-type: none"> <li>• Supports the Ontario Invasive Species Strategic Plan.</li> <li>• Enforces the <i>Weed Control Act</i> and maintains the Noxious Weed List.</li> </ul>
<b>Ministry of Health</b>	Vector-borne and zoonotic diseases (those that can be transferred between animals to humans) that constitute a risk to public health	<ul style="list-style-type: none"> <li>• Administers the <i>Provincial Framework and Action Plan concerning Emerging Vector-Borne Diseases Act, 2015</i>.</li> </ul>
<b>Federal Agencies</b>		
<b>Agriculture and Agri-Food Canada</b>	Canadian agriculture and agri-food sector	<ul style="list-style-type: none"> <li>• Supports research and development of invasive species biological control agents.</li> </ul>
<b>Parks Canada</b>	National parks	<ul style="list-style-type: none"> <li>• Parks implement their own invasive species management strategies.</li> </ul>

Agency/Organization	Jurisdiction	Roles and Responsibilities
<b>Environment and Climate Change Canada</b>	National wildlife areas (NWAs) and migratory bird sanctuaries (MBSs)	<ul style="list-style-type: none"> <li>Some NWAs and MBSs implement their own invasive plant management strategies.</li> <li>Leads the Invasive Alien Species Strategy for Canada.</li> </ul>
<b>Canadian Food Inspection Agency (CFIA)</b>	Animal health, plant health and international market access	<ul style="list-style-type: none"> <li>Administers the <i>Plant Protection Act, 1990</i>, the <i>Seeds Act</i> and the <i>Health of Animals Act</i>.</li> <li>Manages the importation, exportation, spread, control, and eradication of pests, including invasive species.</li> </ul>
<b>Pest Management Regulatory Agency (PMRA)</b>	Pesticide regulations	<ul style="list-style-type: none"> <li>Administers the <i>Pest Control Products Act, 2002</i>.</li> </ul>
<b>Fisheries and Oceans Canada</b>	All waters in the fishing zones of Canada, in the territorial sea of Canada and all internal waters of Canada	<ul style="list-style-type: none"> <li>Administers the <i>Fisheries Act</i>, the Aquatic Invasive Species Regulations SOR/2015-121, and the <i>Great Lakes Fisheries Convention Act</i>.</li> <li>Has proposed new federal regulations to manage and control aquatic invasive species in Canada.</li> </ul>
<b>Transport Canada</b>	International and inter-provincial transportation	<ul style="list-style-type: none"> <li>Administers the <i>Canada Shipping Act, 2001</i> and the Ballast Water Regulations (SOR/2021-120).</li> </ul>
<b>Canadian Forest Service (CFS)</b> [under Natural Resources Canada]	Canada's natural resources	<ul style="list-style-type: none"> <li>Administers the <i>Forestry Act</i>.</li> <li>Supports research on invasive forest pests in Canada.</li> </ul>
<b>Canadian Border Services Agency (CBSA)</b>	International border control	<ul style="list-style-type: none"> <li>Assists with enforcing import prohibitions on invasive species.</li> </ul>
<b>All federal departments and agencies</b>	Federal lands	<ul style="list-style-type: none"> <li>Conducts vegetation control where needed.</li> </ul>
<b>Local Governments</b>		
<b>Municipalities</b>	Lands within municipal boundaries	<ul style="list-style-type: none"> <li>Some implement their own invasive management strategies, which may include bylaws and regulations.</li> <li>Can designate locally noxious weeds impacting the <i>Weed Control Act</i>.</li> <li>Responsible for enforcing the <i>Weed Control Act</i> through municipal weed inspectors.</li> </ul>
<b>Regional municipalities</b>	Lands within regional municipality boundaries, including municipalities.	<ul style="list-style-type: none"> <li>Same as municipalities.</li> </ul>
<b>Indigenous Communities</b>		
<b>Indigenous communities</b>	First Nation reserves and treaty lands	<ul style="list-style-type: none"> <li>Nations, councils or bands may implement their own invasive species management strategies.</li> </ul>
<b>Utility, Gas and Railroad Companies</b>		
<b>Utility, gas and railroad companies</b>	Management on rights of way	<ul style="list-style-type: none"> <li>E.g., Hydro One, Ontario Power Generation, Ontario Hydro, Via Rail Canada.</li> <li>Manage rights of way of nuisance vegetation including some invasive plants.</li> </ul>
<b>Non-profit Organizations</b>		
<b>Conservation authorities</b>	Regulated areas within their jurisdictions	<ul style="list-style-type: none"> <li>Local watershed management agencies that partner with others to conduct activities, including those related to invasive species, to protect and manage water and natural resources.</li> </ul>

Agency/Organization	Jurisdiction	Roles and Responsibilities
<b>Invasive Species Centre</b>	Canada	<ul style="list-style-type: none"> <li>• Connects stakeholders, knowledge and technology to prevent and reduce the spread of invasive species that harm Canada's environment, economy and society.</li> </ul>
<b>Trail councils</b>	Trails within their authority	<ul style="list-style-type: none"> <li>• May be responsible for managing trails within their authority.</li> </ul>
<b>Ontario Invasive Plant Council</b>	Ontario	<ul style="list-style-type: none"> <li>• Multi-agency organization that provides leadership expertise and a forum for Ontarians to take action on invasive plant issues.</li> </ul>
<b>Ontario Biodiversity Council</b>	Ontario	<ul style="list-style-type: none"> <li>• Reports on the state of Ontario's biodiversity every five years, including invasive species indicators.</li> </ul>
<b>Invading Species Awareness Program</b> (partnership between Natural Resources Ministry and the Ontario Federation of Anglers and Hunters)	Ontario	<ul style="list-style-type: none"> <li>• Addresses invasive threats through education and awareness.</li> <li>• Tracks invasive species occurrences in Ontario.</li> </ul>
<b>Community groups with land management authority</b>	Lands under their management authority	<ul style="list-style-type: none"> <li>• E.g., Ducks Unlimited, The Nature Conservancy of Canada, Ontario Nature.</li> <li>• Conduct active management of invasive species to protect lands under their management authority.</li> </ul>
<b>Stewardship groups</b>	Variable	<ul style="list-style-type: none"> <li>• E.g., Wildlife Conservation Society Canada, Field Naturalists, Friends of the Rouge Valley Watershed.</li> <li>• May be responsible for managing a natural area or park or partaking in invasive species removal.</li> </ul>

## Appendix 4: Ontario Invasive Species Strategic Plan, 2012

Prepared by the Office of the Auditor General of Ontario

The Ontario Invasive Species Strategic Plan is guided by the following four strategic goals:

<b>1. Prevent:</b> Prevent harmful introductions of invasive species before they occur	<b>2. Detect:</b> Detect and identify invasive species before or immediately after they become established
<b>3. Respond:</b> Respond rapidly to invasive species before they become established or spread	<b>4. Manage and Adapt:</b> Implement innovative management actions and take practical steps to protect against the impacts of invasive species

The Province commits to achieving these goals through the following activities and actions:

Activity	Action(s)
<b>Leadership and Co-ordination</b>	<ul style="list-style-type: none"> <li>• Clarify the roles of key federal departments/agencies and provincial ministries</li> <li>• Improve communication co-ordination across jurisdictions and governments</li> <li>• Build effective communication networks with partners</li> <li>• Improve the effectiveness of existing committees</li> <li>• Establish new inter-jurisdictional committees to address gaps</li> </ul>
<b>Legislation and Policy</b>	<ul style="list-style-type: none"> <li>• Examine provincial legislation and policy frameworks</li> <li>• Support and strengthen existing legislation</li> <li>• Review and enhance policies</li> <li>• Enhance enforcement efforts</li> <li>• Develop rapid response protocols</li> <li>• Identify obstacles to prevention, rapid response and management</li> </ul>
<b>Risk Analysis</b>	<ul style="list-style-type: none"> <li>• Increase capacity for conducting risk assessments and analyses</li> </ul>
<b>Monitoring and Science</b>	<ul style="list-style-type: none"> <li>• Undertake surveillance in high-risk areas</li> <li>• Improve monitoring programs and develop a network of experts</li> <li>• Strengthen data management</li> <li>• Provide scientific support for surveillance protocols</li> <li>• Influence research priorities</li> <li>• Improve research on the control of invasive species</li> <li>• Conduct research on the impacts of invasive species</li> <li>• Conduct research on the impacts of climate change on invasive species</li> <li>• Build science capacity to support risk assessments</li> </ul>
<b>Management Measures</b>	<ul style="list-style-type: none"> <li>• Manage key pathways</li> <li>• Develop and implement best management practices and plans using a partnership approach</li> </ul>
<b>Communication and Outreach</b>	<ul style="list-style-type: none"> <li>• Evaluate existing communication initiatives</li> <li>• Expand initiatives to address gaps and improve communication on high-risk pathways</li> <li>• Build new communication networks</li> </ul>

## Appendix 5: Invasive Species Laws in Canada

Prepared by the Office of the Auditor General of Ontario

Ontario is the only province in Canada with comprehensive, standalone invasive species legislation that applies to both invasive plant and animal species. Nova Scotia recently enacted its *Biodiversity Act, 2021*, but has yet to establish a complete regulatory regime for invasive species management under this legislation. Additionally, federal and other provincial legislation contribute to the regulation and control of invasive species and establish comparable elements to Ontario. New Brunswick and Newfoundland and Labrador do not have distinct legislative regimes for regulating invasive plant or animal species, while Prince Edward Island has a legislative regime for invasive plants only.

Law	ON	Canada	AB	BC	MB	NS*	PE	QC	SK
Invasive species legislation	Invasive Species Act, 2015	Fisheries Act; Canada Wildlife Act; Plant Protection Act	Fisheries (Alberta) Act; Weed Control Act	Wildlife Act; Weed Control Act; Forest and Range Practices Act	The Water Protection Act; The Forest Health Protection Act	Biodiversity Act, also Agricultural Weed Control Act; Forests Act; Wildlife Act; Fisheries and Coastal Resources Act	Weed Control Act	Environment Quality Act; Act Respecting the Conservation and Development of Wildlife	The Wildlife Act; The Weed Control Act; The Fisheries (Saskatchewan) Act
<b>Management Oversight</b>									
Centralized, single-ministry oversight	✓							✓	
Regulation of invasive plant species	✓	✓	✓	✓	✓		✓	✓	✓
Regulation of invasive animal species	✓	✓	✓	✓	✓			✓	✓
<b>Species-Specific Rules</b>									
Invasive species designation or listing	✓	✓	✓	✓	✓		✓	✓	✓
Prohibition to possess, transport or release	✓	✓	✓	✓	✓		✓	✓	✓
Prohibition to breed or grow	✓	✓	✓	✓	✓		✓	✓	✓
Prohibition to buy, sell or trade	✓			✓			✓	✓	
Regulation of vectors of spread (watercraft)	✓	✓	✓	✓	✓			✓	✓





	ON	Canada	AB	BC	MB	NS*	PE	QC	SK
<b>Fines and Penalties</b>									
Maximum prescribed fines for corporations ≥\$500,000	✓	✓	✓	✓	✓				
Maximum prescribed fines for individuals ≥\$100,000	✓	✓	✓	✓	✓			✓	✓
Penalty of imprisonment included	✓	✓	✓	✓	✓		✓	✓	✓

\* The checked box in this chart for Nova Scotia relates to the *Biodiversity Act*, which has provisions related to invasive species. Other Nova Scotia laws do not reference invasive species, but may have provisions that regulate some species incidentally.

## Appendix 6: The Impacts of Prohibited and Restricted Invasive Species Regulated under the *Invasive Species Act, 2015*

Prepared by the Office of the Auditor General of Ontario

Common Name	Scientific Name	Impact
<b>Prohibited Invasive Species</b>		
<b>Fish</b>		
Bighead carp	<i>Hypophthalmichthys nobilis</i>	Bighead carp constantly filter the water of plankton, outcompeting native species and decreasing water quality, which causes negative environmental, social and economic impacts.
Black carp	<i>Mylopharyngodon piceus</i>	Black carp consume molluscs and threaten our already at-risk native mussel population. Their feeding behaviour would also cause negative impacts to biodiversity, the economy and society.
Grass carp	<i>Ctenopharyngodon idella</i>	Grass carp consume up to 40% of their bodyweight daily in aquatic vegetation, allowing them to destroy wetlands, which would cause negative environmental, social and economic impacts.
Prussian carp	<i>Carassius gibelio</i>	An extremely hardy species, Prussian carp are highly tolerant of various environmental conditions, threatening and outcompeting native species for habitat and food.
Silver carp	<i>Hypophthalmichthys molitrix</i>	Silver carp constantly filter the water of plankton, outcompeting native species and decreasing water quality, which causes negative environmental, social and economic impacts. Their jumping behaviour is a health and safety risk to boaters.
Snakehead (all species)	All species in the family <i>Channidae</i>	A family of fishes, some of which are aggressive and pose a serious threat to native fish and the fishing industry as they are an adaptable species with no known long-term natural predators in the Great Lakes. All 28 species of snakehead are regulated to prevent establishment in Ontario waters.
Stone moroko	<i>Pseudorasbora parva</i>	Fast-growing and adaptable fish that impact biodiversity by decreasing dissolved oxygen due to increased algae and plant life levels as a result of their preference for larger planktonic crustaceans.
Tench	<i>Tinca tinca</i>	Invasive fish that outcompete native fishes and serve as a potential vector for disease, which could impact fishing and wildlife.
Wels catfish	<i>Silurus glanis</i>	As one of the world's largest freshwater fish species, these opportunistic and non-selective feeders eat large amounts of other fish, mammals and vegetation, and are extremely successful breeders. If they enter Canada, they could put native biodiversity at risk and create a competitive ecosystem.
Zander	<i>Sander lucioperca</i>	Not currently in Canada, this popular game fish preys upon and competes with native fish species, which reduces biodiversity. There is a concern for hybridization with native fish species in the Great Lakes.
<b>Insects</b>		
Mountain pine beetle	<i>Dendroctonus ponderosae</i>	An insect native to British Columbia that has expanded into and caused significant tree mortality in Alberta and Saskatchewan and if introduced, would cause significant harm to Ontario's forests.

Common Name	Scientific Name	Impact
<b>Aquatic Invertebrates</b>		
Common yabby	<i>Cherax destructor</i>	Not yet introduced in North America, this freshwater crayfish species has a high tolerance to a variety of conditions. They are opportunistic feeders and prolific breeders that outcompete and displace native species.
Golden mussel	<i>Limnoperna fortunei</i>	Freshwater golden mussels can form dense populations that alter water quality (e.g., by filtering and removing important phytoplankton populations) and damage infrastructure by blocking pipes, intakes, etc.
Killer shrimp	<i>Dikerogammarus villosus</i>	Aggressive freshwater feeders that kill native species (sometimes killing more than it can consume), which reduces aquatic biodiversity and alters food webs.
Marmorkreb or marbled crayfish	<i>Procambarus virginalis</i>	Invasive freshwater crayfish that reproduce quickly through cloning and outcompete native species with their large populations and aggressive behaviour.
New Zealand mud snail	<i>Potamopyrgus antipodarum</i>	An invasive snail that forms extremely large populations and feeds on algae, which alters ecosystem functioning and impacts entire food webs.
Red swamp crayfish	<i>Procambarus clarkii</i>	Large, aggressive crayfish that dominate waterbodies and reduce native fish habitat by being quick and prolific reproducers that feed on large amounts of vegetation and fish eggs, subsequently reducing fish populations.
<b>Plants</b>		
Brazilian elodea	<i>Egeria densa</i>	This invasive aquatic plant forms dense floating mats that reduce water temperature, light penetration and oxygen availability, leading to a loss of essential fish habitats and reduced biodiversity.
European water chestnut	<i>Trapa natans</i>	This invasive aquatic plant severely reduces recreational value as well as plant biodiversity by forming into very thick floating mats that shade out vegetation and leave behind sharp, hard, spiny seeds that can cause injury.
Hydrilla	<i>Hydrilla verticillata</i>	Not yet detected in Canada, this invasive aquatic plant grows aggressively, shading out other native submerged plants and slowing water movement—affecting recreational value such as boating and swimming and leaving behind ideal habitats for mosquito breeding.
Parrot feather	<i>Myriophyllum aquaticum</i>	A perennial aquatic plant that can clog waterways, impact recreation, displace native species and increase breeding ground for mosquitoes by creating areas of stagnant water.
Water soldier	<i>Stratiotes aloides</i>	An invasive aquatic plant that forms dense stands, crowding out native vegetation, impacting aquatic biodiversity and hindering recreational value.
<b>Restricted Invasive Species</b>		
<b>Mammals</b>		
Wild pigs	<i>Sus scrofa</i>	A catch-all term referring to escaped wild boar, feral domestic pigs and hybrids. Wild pigs reproduce quickly, compete with native species for resources, can spread disease and are costly to control.

Common Name	Scientific Name	Impact
<b>Plants</b>		
Black dog-strangling vine	<i>Cynanchum louiseae</i>	An invasive vine that spreads easily and can overtake the understory, outcompeting and choking out native plants and small trees, and create a tripping hazard for humans.
Bohemian knotweed	<i>Reynoutria × bohemica</i>	An invasive plant hybrid of Japanese and giant knotweed that forms dense stands, pushing out native vegetation and causing damage to infrastructure.
Carolina fanwort	<i>Cabomba caroliniana</i>	An invasive aquatic plant that produces large floating-vegetation mats, outcompeting native species for light. Dense mats clog and interrupt infrastructure such as drainage and irrigation systems.
Dog-strangling vine	<i>Cynanchum rossicum</i>	An invasive vine that spreads easily and can overtake the understory, outcompeting and choking out native plants and small trees, and create a tripping hazard for humans.
European frog-bit	<i>Hydrocharis morsus-ranae</i>	An invasive aquatic plant that forms floating masses that block sunlight from reaching submerged vegetation, entangles native plants, and reduces biodiversity. When colonies die, they deoxygenate the water, harming native fish and aquatic species.
Giant knotweed	<i>Reynoutria sachalinensis</i>	A very large and tall invasive plant that rapidly colonizes a diverse range of habitats, shading out and displacing native plants and reducing biodiversity.
Himalayan knotweed	<i>Koenigia polystachya</i>	An invasive plant that aggressively and easily reproduces in dense colonies, replacing native vegetation and inflicting damage to riparian habitats.
Japanese knotweed	<i>Reynoutria japonica</i>	An invasive plant with a deep root system that is extremely difficult to control and can cause damage to infrastructure and reduce biodiversity.
Phragmites	<i>Phragmites australis</i> subsp. <i>australis</i>	A highly invasive plant that can harm biodiversity and at-risk species; impact tourism, recreation and agriculture; reduce water quality; impede line of sight on roadways; and may pose a fire risk due to remaining dead plant material.
Yellow floating heart	<i>Nymphoides peltata</i>	An invasive aquatic plant that reduces light penetration, oxygen levels and waterflow by forming thick floating mats of leaves. Its habitat versatility puts native aquatic biodiversity at risk and impedes recreational activities.

## Appendix 7: Relevant Federal and Ontario Legislation and Regulations

Prepared by the Office of the Auditor General of Ontario

Legislation	Description
<b>Federal Laws</b>	
<i>Environmental Violations Administrative Monetary Penalties Act, 2009</i>	This act was created to establish a monetary penalty system to enforce federal environmental acts—several of which contribute to the regulation of invasive species.
<i>Canada Shipping Act, 2001</i>	This act allows Canada's government to regulate the control and management of ballast water in marine (ocean) environments. Ballast water regulation is critical in preventing the arrival of aquatic invasive species via shipping and trade.
<i>Health of Animals Act, 1990</i>	While this act does not directly reference invasive species, it does cover the importation, possession, movement and export of wildlife, pathogens and other biological agents. The act helps prevent the introduction of invasive species by giving Canada's government the right to regulate the movement of wildlife.
<i>Plant Protection Act, 1990</i>	Invasive species are not directly referenced in this act but can be covered by the act's definition of "pest" as "any thing that is injurious or potentially injurious whether directly or indirectly, to plants or to products or by-products of plants." Regulations related to pest importation and possession are critical in preventing the introduction of invasive species to Canada.
<i>Fisheries Act, 1985</i>	This act allows Canada's government to establish a list of aquatic invasive species and create regulations related to the management and control of these species. These include regulations regarding the prevention, possession, release, handling, treatment and eradication of aquatic invasive species. Regulations under the act are critical in preventing the introduction of aquatic invasive species to Canada's waters.
<i>Great Lakes Fisheries Convention Act, 1985</i>	This act was written to form a convention (an agreement between countries) between Canada and the United States on fisheries in the Great Lakes. The Great Lakes Fishery Commission, established under this act, is in charge of minimizing and/or eradicating sea lamprey populations in the Great Lakes and its tributaries.
<b>Provincial Laws and Regulations</b>	
<i>Invasive Species Act, 2015</i>	This act explicitly regulates the prevention and management of invasive species in Ontario. Twenty-two species are prohibited under the act, meaning it is illegal to import, possess, transport or release these species anywhere in Ontario. Eleven additional species are restricted, meaning it is illegal to bring them into provincial parks or conservation reserves and illegal to release them anywhere in Ontario. These species are listed in <b>Appendix 6</b> . Under this act, the Ontario government has the right to regulate prevention, early detection and rapid response, control, eradication, monitoring and reporting, education and research, risk assessment, and prevention and response plans related to invasive species.
Ontario Regulation 354/16	This regulation contains lists of prohibited and restricted invasive species that are regulated by the <i>Invasive Species Act, 2015</i> . These species are listed in <b>Appendix 6</b> .
<i>Great Lakes Protection Act, 2015</i>	This act was written to protect and restore the Great Lakes–St. Lawrence River Basin, in recognizing their importance for human health, biodiversity and Indigenous communities. The act regulates measures to monitor, manage and restore this area, including monitoring and reporting on invasive species.

Legislation	Description
<i>Lake Simcoe Protection Act, 2008</i>	This act requires the Lieutenant Governor in Council to establish the Lake Simcoe Protection Plan and review it at least once every 10 years. One objective of this plan is to respond to adverse effects related to invasive species and, where possible, to prevent invasive species from entering the Lake Simcoe watershed.
<i>Fish and Wildlife Conservation Act, 1997</i>	This act does not directly mention invasive species, but regulates the release of wildlife, aquaculture and wildlife disease control and surveillance in the province. Specifically, it prohibits the release of farmed animals, game wildlife or specially protected wildlife kept in captivity, unless in accordance with ministerial authorization or prescribed circumstances under the regulations. The act also prohibits aquaculture unless the cultured fish belong to a species prescribed by the regulations and are cultured under the authority of a licence.
<i>Forestry Act</i>	This act regulates forest management, control and sale in Ontario. It includes invasive species (referred to as an “infestation”) in Section 7, whereby the Ministry of Natural Resources and Forestry can prevent, manage or eradicate forest infestations as it sees fit.
<i>Weed Control Act</i>	This act regulates the designation and management of noxious (harmful, destructive) weeds in Ontario. Currently, 25 species are listed as noxious weeds in Ontario, including invasive species such as dog-strangling vine, European buckthorn, giant hogweed and wild parsnip.

## Appendix 8: Audit Criteria

Prepared by the Office of the Auditor General of Ontario

### Audit Criteria for the Ministry of Natural Resources and Forestry (formerly the Ministry of Northern Development, Mines, Natural Resources and Forestry)

1. Roles and responsibilities for preventing, detecting, identifying, managing, researching, monitoring and progress reporting on invasive species and their pathways are clearly defined, and accountability requirements are established.
2. The Ministry has accurate, timely and sufficient information on potentially harmful invasive species and their pathways to inform effective decision-making.
3. Invasive species and their pathways are effectively detected, identified and assessed using the best available scientific information and community knowledge. Invasive species and pathways with high potential for social, economic, or environmental impacts are promptly and effectively regulated.
4. Effective oversight and accountability frameworks are in place to ensure that transfer payment recipients deliver successful programs to prevent, detect, identify, respond to, and manage invasive species. These programs are prioritized, sufficiently and promptly funded, based on best practices, and include appropriate goals, objectives and timelines, and are collectively sufficient to stop the introduction and spread of invasive species.
5. Effective processes and procedures exist to provide leadership, guidance and co-ordination within the Ministry, and with partner ministries and other relevant stakeholders on invasive species work. Best practices and knowledge are shared through effective and sufficient collaboration with partner ministries and other stakeholders, such as municipalities and conservation authorities.
6. Meaningful performance measures and targets are established, progress is regularly monitored and publicly reported on, and corrective actions are taken on a timely basis when issues are identified.

### Audit Criteria for the Invasive Species Centre

1. Funds are used effectively, efficiently, and for the purposes for which they were intended.
2. Reports are completed and submitted to the Ministry in accordance with the content and timeline requirements outlined in the transfer payment agreements.
3. Meaningful performance indicators and targets are established for invasive species activities funded by the Ministry. Results are monitored and compared against targets to ensure that intended outcomes are achieved.



## Appendix 9: Risk Assessment and Regulatory Approval Process

Source: Ministry of Natural Resources and Forestry

### Invasive Species Risk Assessment Process

Step in the Process	Month						
	1	2	3	4	5	6	7
<b>Maintain potential invasive species list</b> (ongoing process)							
<b>Conduct screening-level ecological risk assessment/jurisdictional scan</b> The Ministry of Natural Resources and Forestry (Natural Resources Ministry) engages with other jurisdictions and performs preliminary screening on an invasive species.	●	●					
<b>Conduct species literature review</b> The Natural Resources Ministry seeks approval to procure non-consulting services and solicits invitations for quotes from taxa experts to conduct a literature review for the species of interest.		●	●				
<b>Hold initial stakeholder/public consultations</b> To collect preliminary feedback on the idea for a proposed regulation, the Natural Resources Ministry consults the public through the Environmental Registry (45-day posting) and directly engages with relevant stakeholders, Indigenous communities, provincial ministries, and the government of Canada. This feedback may support the completion of the following two steps.			●	●	●		
<b>Complete ecological risk assessment</b> The Natural Resources Ministry incorporates literature review findings, consultation comments and other relevant information into a detailed ecological risk assessment.				●	●	●	
<b>Complete species socio-economic impact assessment</b> The Natural Resources Ministry incorporates literature review findings, consultation comments and other relevant information into a species socio-economic impact assessment.					●	●	
<b>Prepare regulatory proposal</b> The Natural Resources Ministry seeks Cabinet Office direction or approval in principle to prepare a regulatory proposal for the species of concern.							●

## Invasive Species Regulation Development/Approval Process

Step in the Process	Month							
	7	8	9	10	11	12	13	14
<b>Gain direction or approval in principle to proceed</b> Cabinet Office approves the preparation of the regulatory proposal, as needed. (This is usually not required, but may be required if, for example, the proposal is a significant change in approach/practice or very high profile.)	●							
<b>Draft regulatory impact assessment for open for business*</b> The Natural Resources Ministry estimates the time and cost burden to business that may be impacted by the new invasive species regulation. Cabinet Office reviews the draft.		●			●			
<b>Draft regulation</b> The Natural Resources Ministry prepares the draft regulation. Timing of the regulation's approval depends on its complexity and scope of changes, and availability of legislative counsel.		●	●	●	●			
<b>Consult on the regulation</b> (dependent on content of proposal) The Natural Resources Ministry consults the public and stakeholders on the proposed regulation's draft wording through the Environmental Registry, regulatory registry (45 days), letters to stakeholders and Indigenous communities and/or in-person meetings.			●	●				
<b>Seek direction from Minister's office on approach</b> (as needed) Based on the above consultation, the Natural Resources Ministry engages other ministries, the Premier's Office and central agencies on whether and how to move forward with the proposed regulation (as needed).				●	●			
<b>Develop, review and approve Legislation and Regulations Committee (LRC) submission</b> Other ministries and central agencies review and/or approve the LRC submission (as needed).					●	●		
<b>Attain LRC and Cabinet approvals</b> LRC-Cabinet approves and ratifies items on the same day, unless complex/contentious (rare) LRC dates are requested by the Ministry and approved by the LRC.						●	●	
<b>Provide public notice of regulation approval</b> (Twice Annual Effective Date: January 1 or July 1) The Natural Resources Ministry publishes notices online (e.g., environmental and regulatory registries, the Canada Gazette) of the regulation's approval.								●
<b>Implement regulation and disseminate knowledge</b> The Natural Resources Ministry creates and disseminates communications products on the species (e.g., summaries, fact sheets, webinars); updates its website; and develops program delivery policies.						●	●	●

Note: This figure represents the processes that were used to support the development and approval of the regulatory amendments that came into force January 1, 2022. The Ministry informed us that these processes are being reviewed and are subject to change.

\* The gap between Months 8 and 11 reflects a pause in developing a regulatory impact assessment to consult the public on the regulation, after which the assessment is reviewed and updated.

## Appendix 10: One of The Most Damaging Invasive Species—Wild Pigs

Prepared by the Office of the Auditor General of Ontario

**INVASIVE WILD PIGS** (domesticated pigs, including pot-bellied pigs, that have escaped; and Eurasian wild boar and their hybrids) are among the most invasive terrestrial mammals worldwide. They were first introduced to Canada from Europe in the 1980s and 1990s as alternative livestock for meat. Since then, wild pigs have established populations in Saskatchewan, Alberta and Manitoba, with scattered reports of sightings in British Columbia, Ontario and Quebec. Wild pigs are elusive animals that tend to be nocturnal (active at night), which can make them difficult to detect. They have a broad geographic range and can quickly adapt and survive in new environments due to their ability to produce many offspring, early sexual maturity, varied diet, long lifespans and highly adaptive nature. Although not documented in Canada, wild pigs may demonstrate aggressive behaviour, and their attacks on humans and pets can be severe and sometimes fatal.

The most significant ecological impact of wild pigs is from damage caused by their rooting and trampling behaviour, which can cause damage by preventing new tree seedlings from establishing, reducing seed survival and success, and displacing soil leading to erosion and alteration of habitat structure and quality. Other impacts include the transmission of viral and bacterial pathogens and parasites leading to diseases in livestock, pets and humans; damage to crops, grasslands and pasturelands; and competition with and predation of native species. Overall, this leads to increased costs for farmers due to damaged crops, lost production, and losing or treating infected livestock. Farmers also incur the costs of taking control measures, including building fence barriers to keep wild pigs out. In addition, although it has not been introduced in North America, wild pigs can potentially carry and introduce African

### Wild Pigs

Photo credit: Dr. Ryan Brook, University of Saskatchewan



swine fever to Canada, which could rapidly spread to domestic pigs and have significant impacts on the Canadian pork industry. While the economic impacts of wild pigs in Ontario are unknown, these costs, along with management and control costs, are expected to become extremely high if wild pigs become established in the province. In 2007, wild pigs were estimated to cause more than \$1.5 billion each year in damages and control costs in the United States. These figures were based on an estimated \$300 in damages per wild pig and a population of 5 million wild pigs in the US at that time. Given that the current number of wild pigs in the US is estimated at over 6 million, the estimated cost of damages would now be over \$1.8 billion USD per year.

## Appendix 11: Fresh Water Transformers—Zebra and Quagga Mussels

Prepared by the Office of the Auditor General of Ontario

**ZEBRA AND QUAGGA MUSSELS** are small aquatic molluscs from Eurasia. They arrived in Canada in ships' ballast water in the late 1980s and are now found in many lakes throughout southern, central and eastern Ontario. They filter plankton from water, which depletes this food source for native species. Zebra and quagga mussels form dense colonies on many surfaces—including those of boats, docks and beaches—and their sharp shells can cut the feet of swimmers. These colonies threaten native species by preventing fish from effectively reproducing and by affecting fish spawning areas, depleting food, and encouraging aquatic vegetation growth. They also play a role in increasing the growth of hazardous algal blooms. By filtering water and making it clearer, zebra mussels force light-sensitive fish, like walleye, into deeper waters and encourage aquatic vegetation growth. They can also colonize on underwater infrastructure, such as outflow and intake pipes, reducing pumping capabilities and leading to significant cleaning and replacement costs. A recent estimate of total economic costs from invasive mussels in electric generation and water treatment facilities was \$267 million dollars from 1989 to 2004 in Canada and the United States.

According to the Invasive Species Centre, based on survey results, municipalities spend approximately

### Zebra Mussels

Photo credit: iStock by Getty Images



\$9 million annually preventing and managing these invaders. Once established, existing techniques cannot eradicate zebra mussels; however, these invasive species can be prevented from entering new waterbodies by cleaning and draining boats and other vessels when moving them from one body of water to another. As of January 1, 2022, it is mandatory under the *Invasive Species Act, 2015* to remove aquatic plants, animals and algae attached to watercraft, watercraft equipment, vehicles and trailers before placing them into a body of water.

## Appendix 12: Tree-Killing Beetles—Emerald Ash Borers

Prepared by the Office of the Auditor General of Ontario

**THE EMERALD ASH BORER** is an invasive wood-boring beetle from Asia. It was first detected in Windsor in 2002 and has since spread throughout southern and eastern Ontario, with sightings reported in Ottawa, North Bay and Thunder Bay. This species continues to spread eastward. It chews through ash trees and lays eggs in their trunks; hatched larvae then tunnel through the tree's vascular system, disrupting the flow of water and nutrients. Once an ash tree is infested, it

### Emerald Ash Borer

Photo credit: Invasive Species Centre



is almost certain to die. Emerald ash borers have killed millions of ash trees in Canada, negatively affecting the forestry industry, reducing the shade and beauty these trees provide, and creating significant costs to safely remove dead trees and plant new ones in their place. The Invasive Species Centre, based on a 2019 survey, estimates that the emerald ash borer is responsible for the majority of invasive species expenditures by municipalities and conservation authorities in Ontario, costing up to an estimated \$29.7 million annually.

In January 2022, black ash trees were listed as an endangered species under the *Endangered Species Act, 2007*, with emerald ash borers being the primary threat—these beetles are projected to reduce black ash tree populations by over 70% over the next 100 years. Natural predators of the emerald ash borer, such as woodpeckers, have been ineffective in stopping the spread of this invasive species. The main method used to control their populations is insecticides approved by the Health Canada Pest Management Regulatory Agency. The insecticides help to protect trees from mortality caused by the emerald ash borer but are not suitable to eradicate populations. In addition, four species of non-native wasps were approved by the Canadian Food Inspection Agency in 2013, and three were introduced into Canada as biological controls for the emerald ash borer.

## Appendix 13: Toxic Perennials—Giant Hogweed

Prepared by the Office of the Auditor General of Ontario

**GIANT HOGWEED** is an invasive plant native to the Caucasus Mountains in southwest Asia. It likely first arrived in Canada as a garden plant in the 1900s, and was first confirmed in Ontario in 1949. It has since spread to many parts of southern and central Ontario, and can grow more than five metres tall under ideal conditions. This invasive species can be difficult to identify given its similar appearance to the native cow parsnip. Giant hogweed poses a significant threat to human health. The clear watery sap of giant hogweed contains toxins that can cause severe dermatitis (inflammation of the skin). Ultraviolet radiation activates compounds in the sap, resulting in severe burns when exposed to the sun. Symptoms occur within 48 hours and consist of painful blisters. Purplish scars may form that can last for many years. It can also outcompete native plants, reducing biodiversity in areas where it is present.

The Invasive Species Centre found that municipalities and conservation authorities in Ontario spend an estimated \$230,000 annually dealing with giant hogweed. Giant hogweed is regulated as a noxious weed under the *Weed Control Act*, meaning that landowners have a legal obligation to manage them if they are found to be negatively affecting agriculture or horticulture. Giant hogweed can be controlled by digging to uproot the plant, which is best done early

### Giant Hogweed

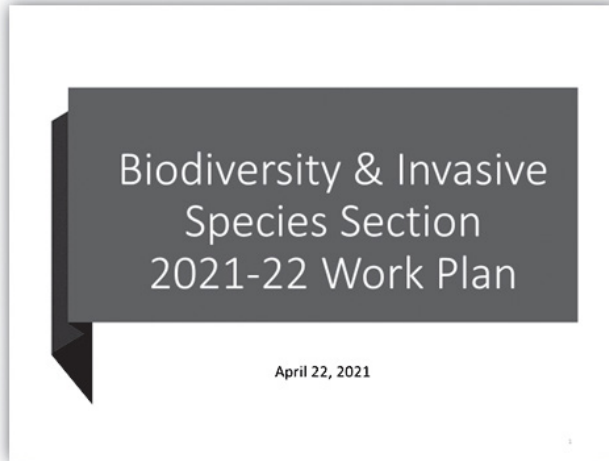
Photo credit: iStock by Getty Images



in its lifecycle as its taproot can exceed one metre in mature plants. However, extreme care needs to be taken to remove giant hogweed. Given the health concerns associated with giant hogweed and similar plants with phototoxic properties, it is highly recommended that private landowners hire a licensed professional to remove the plant to ensure safe procedures are followed.

# Appendix 14: Ministry of Natural Resources and Forestry's Invasive Species Work Plan, 2021/22\*

Source: Ministry of Natural Resources and Forestry



### 2021-22 Invasive Species Priorities

**Goal:** To prevent new invaders from arriving and surviving in Ontario, to slow, and where possible reverse, the spread of existing invasive species, and to reduce the harmful impacts of existing invasive species.

**Policy Development**

**Invasive Species Act (ISA) Implementation**

**Species and Carrier Regulations**

- Complete ongoing ecological and socio-economic risk assessments
- Consult and finalize species/carrier regulations
- Initiate identification of next species/carriers for regulatory consideration

**Policy and Procedure**

- Finalize procedure and prepare authorizations
- Determine if PR plans are appropriate for newly regulated species
- Review ISA for classification under the EBR
- Assess MNRF staff awareness and training needs for response framework and work with ROD to facilitate
- Develop policy guidance on application and use of various inspection powers provided in the ISA
- Consider designation of non-EB inspectors under the ISA
- Update set fines for watercraft carrier

### 2021-22 Invasive Species Priorities

Collaboration	Communication
<p><b>Transfer Payment Agreements</b></p> <ul style="list-style-type: none"> <li>• Invasive Species Centre (Green Shovels)</li> <li>• Ontario Federation of Anglers and Hunters</li> <li>• Invasive Species Centre TPA Review as part of Multi-Year Planning</li> </ul> <p><b>Canada-Ontario Agreement (COA) Implementation</b></p> <ul style="list-style-type: none"> <li>• Delivery of Annex 7 projects and support COA re-prioritization and performance measurement</li> </ul> <p><b>Research and Tool Development</b></p> <ul style="list-style-type: none"> <li>• Develop MOU and participate in advisory role for multi-year projects to support invasive species science (SRB)</li> <li>• Analysis of plankton hauls from BSM and dissemination of results</li> </ul> <p><b>Support Variety of Working Groups</b></p> <ul style="list-style-type: none"> <li>• Inter-ministry working group, IASNC, NAISC, CCIS, Great Lakes St. Lawrence Governors AIS Partnership and Mutual Aid Agreement, ACRCC – among others</li> </ul>	<p><b>Social media and website content</b></p> <ul style="list-style-type: none"> <li>• Support CSB/CO InvasionON campaign, CSB social media communications, website updates</li> </ul> <p><b>Regulated species communication materials</b></p> <ul style="list-style-type: none"> <li>• Assess need and develop/update factsheets, BMPs as necessary in collaboration with relevant partners</li> </ul> <p><b>Support stakeholder/partner communication efforts</b></p> <ul style="list-style-type: none"> <li>• Coordinate activities with CSB, Ontario Parks and others as appropriate</li> <li>• Monitor and support work on emerging issues</li> </ul>

### 2021-22 Invasive Species Priorities

**Species Specific Action**

**Wild pigs**

- Consult on and finalize Ontario's Strategy to Address the Threat of Invasive Wild Pigs and work with partners to initiate implementation
- Support ongoing communications, as well as detection, response and control actions

**Asian Carp**

- Participate in bi-national work to manage invasive carp in the Great Lakes basin
- Coordinate Asian Carp Manager's Committee and ongoing work with DFO and PSD

**Phragmites**

- Support implementation of Phragmites control work at Long Point and Rondeau in partnership with Nature Conservancy Canada, MECP Ontario Parks, and University of Waterloo
- Continue working with Green Shovels collaboration on the development and implementation of the Phragmites management strategy and seek opportunities to support this work through federal nature based solutions funding

**Invasive Aquatic Plants**

- Support eradication efforts for invasive aquatic plants including water soldier, water chestnut and parrotfeather, working with key partners

Others – Tench, Zebra Mussel (NW Ontario), ISA compliance

\* Ministry staff informed us that this (and other) work plans are for internal purposes, are subject to change throughout the year, and do not represent binding commitments to measure its efforts against.

## Appendix 15: Invasive Species Management Performance Indicators Tracked or Proposed in Other Jurisdictions

Prepared by the Office of the Auditor General of Ontario

Jurisdiction	Metrics	Performance Indicators Tracked/Proposed
<b>Michigan, United States</b>	Tracked and publicly reported metrics	<p>Number of counties covered by Cooperative Invasive Species Management Areas (partnerships of groups and individuals that work to address invasive species impacts on the environment, economy and human health within a defined region)</p> <hr/> <p>Number of early detection sites responded to</p> <hr/> <p>Number of citizens reached through outreach efforts</p> <hr/> <p>Acres controlled for terrestrial and aquatic invasive species</p>
<b>New South Wales (NSW), Australia</b>	Tracked and publicly reported metrics	<p>Cumulative number of invasive weeds and pest animals detected in NSW, on an aggregate level and by region</p> <hr/> <p>Percentage of NSW's geography (as the percentage of five-kilometre grid cells covered) in which select invasive weeds and pest animals are established</p> <hr/> <p>Expert-predicted impact distribution (from minimal to massive) that select invasive species will have on threatened species or ecological communities</p>
<b>New York State, United States</b>	Select proposed metrics per November 2018 plan <sup>1</sup>	<p>Number of invasive species evaluated and prioritized through the Horizon Scanning Committee<sup>2</sup></p> <hr/> <p>Number of priority species or ecosystems assessed through economic impact evaluations</p> <hr/> <p>Number of permanent invasive species monitoring points established</p> <hr/> <p>Number of new infestations detected</p> <hr/> <p>Number of certified labs established (to provide reliable environmental DNA [eDNA] results)</p>

1. New York State Invasive Species Comprehensive Management Plan.

2. A committee intended to set state-level priorities for invasive species that pose the greatest threats to New York's environment, economy, and public health, as well as location-based priorities for areas with high conservation or agricultural value.





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