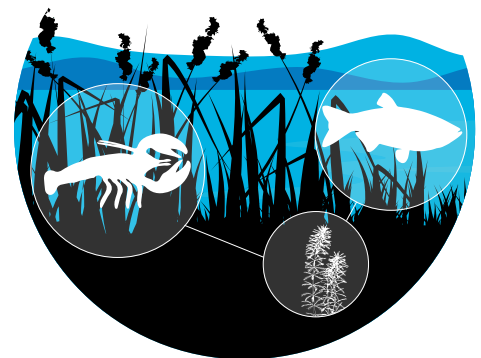
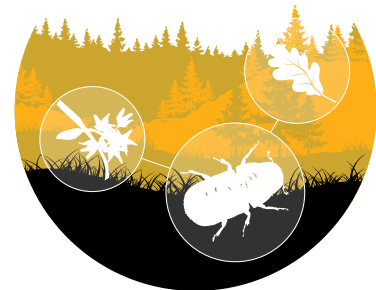
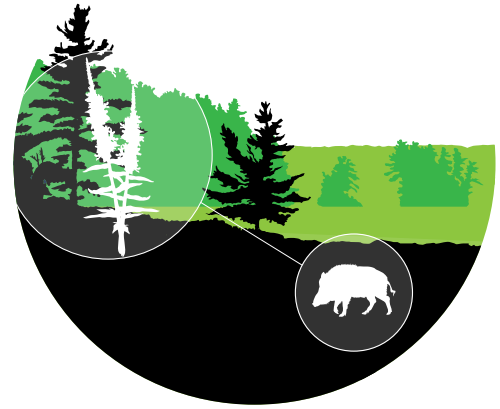


Ontario Invasive Species Strategic Plan: Review of Progress (2012–2022)

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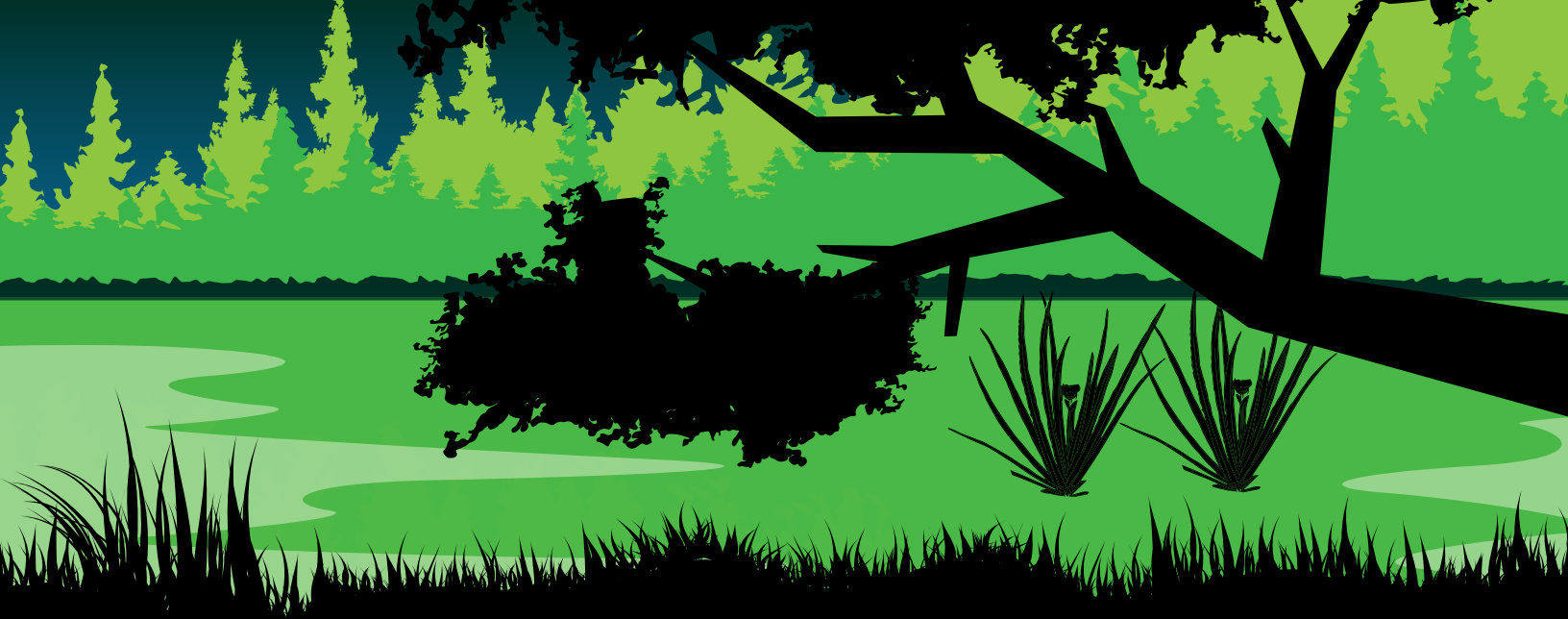


For additional information about invasive species in Ontario, visit: www.ontario.ca/page/managing-invasive-species-ontario

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Introduction

Invasive species affect us all. They threaten Ontario's environment, economy, and the well-being of the people who live here. They are a complex issue, requiring collaboration and coordinated efforts.

In 2012, the *Ontario Invasive Species Strategic Plan* was released to guide invasive species prevention and management in the province, including efforts by lead ministries—Ontario's Ministry of Natural Resources and Forestry (MNRF), Ministry of Agriculture, Food and Rural Affairs (OMAFRA), Ministry of the Environment, Conservation and Parks (MECP), and Ministry of Transportation (MTO).

The goals of the *Ontario Invasive Species Strategic Plan* are to:

1. **Prevent** – prevent harmful introductions before they occur
2. **Detect** – detect and identify invasive species before or immediately after they become established
3. **Respond** – respond rapidly to invasive species before they become established or spread
4. **Manage and Adapt** – implement innovative management actions and take practical steps to protect against impacts of invasive species



Prevent



Detect



Respond



**Manage
and Adapt**

About this review

This review provides an overview of significant milestones and showcases progress in support of the *Ontario Invasive Species Strategic Plan*.

Governments, strategic partners, academia, Indigenous Peoples and communities, and conservationists have all worked together through key actions and tactics in the decade since the plan was released. This review features highlights and success stories from across Ontario related to:

1. **Leadership and coordination**
2. **Legislation, regulation and policy**
3. **Risk analysis**
4. **Monitoring and science**
5. **Management measures**
6. **Communication and outreach**

This review also identifies emerging needs, challenges and future focus to prevent, detect and respond to invasive species in Ontario.

Invasive species are alien species whose introduction or spread threatens the environment, the economy, and/or society including human health. Invasive species may include those species which are native to Ontario but have been introduced to a new geographic region due to human activity.



List of acronyms

COA – The Canada-Ontario Agreement on Great Lakes Water Quality and Ecosystem Health

CORDA – The Canada Ontario Resource Development Agreement

DFO – Fisheries and Oceans Canada, Government of Canada

ESA – *Endangered Species Act, 2007*

ISA – *Invasive Species Act, 2015*

ISC – Invasive Species Centre

MECP – Ministry of the Environment, Conservation and Parks, Government of Ontario

MNRF – Ministry of Natural Resources and Forestry, Government of Ontario

MTO – Ministry of Transportation, Government of Ontario

OFAH – Ontario Federation of Anglers and Hunters

OMAFRA – Ministry of Agriculture, Food and Rural Affairs, Government of Ontario

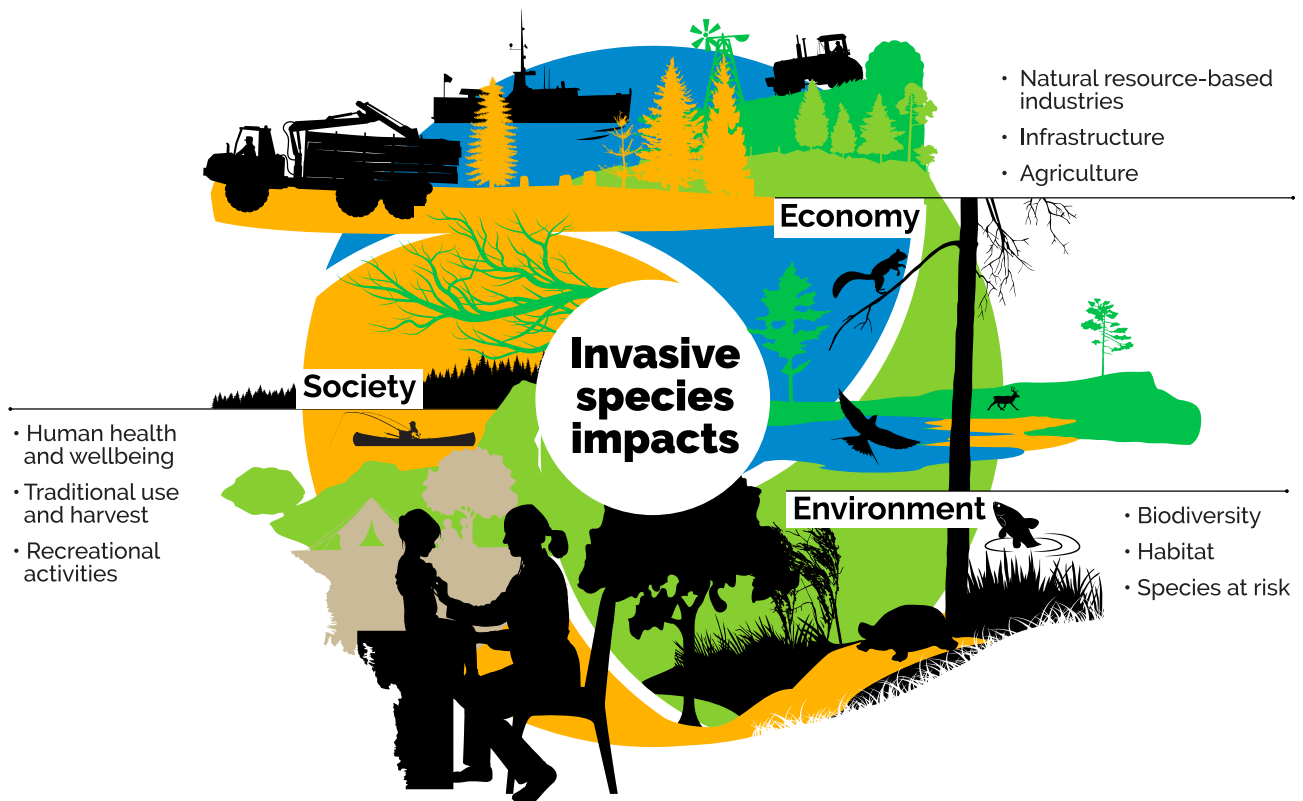
Protecting Ontario's natural environment, society and economy

Ontario continues to be at risk from introductions of new invasive species and accelerated spread of established invasive species. This risk is driven by the province's environmental conditions and geographic location, and the nature of our society and economy. A changing climate is also influencing the risk and spread new invasive species by changing the geographical distribution of organisms.

Invasive species harm biodiversity, impact species at risk and their habitats, and negatively affect recreational activities. They cause significant economic harm. Every year in Ontario, all levels of government, industry, conservation organizations and individuals spend millions of dollars to prevent new invasive species from establishing, and to manage the harmful impacts of invasive species that are already here. Invasive species also threaten

Ontario's natural resource-based industries—including fisheries, forestry, recreation and tourism, and agriculture—which collectively contribute hundreds of thousands of jobs and billions of dollars to our economy.

Global economic losses due to invasive species are estimated to be in the same order of magnitude as those resulting from natural disasters. In Ontario alone, costs are estimated at \$3.6 billion annually from invasive species impacts on agriculture, fisheries, forestry, health-care, tourism and recreation industries.





Milestones

1992

MNR and the Ontario Federation of Anglers and Hunters (OFAH) establish the [Invading Species Awareness Program](#) to increase public awareness of invasive species in Ontario.

1994

The [Canada-Ontario Agreement on Great Lakes Water Quality and Ecosystem Health](#) (COA) includes new commitments motivating actions to address invasive species as a key threat to the Great Lakes Basin.

2004

The Government of Canada releases [An Invasive Alien Species Strategy for Canada](#) outlining goals and objectives to address invasive species across Canada.

2011

The [Invasive Species Centre](#) (ISC) is launched to enhance the coordination of invasive species research, management and education.

2012

[Ontario's Invasive Species Strategic Plan](#) is released.

The bi-national Great Lakes Water Quality Agreement between the United States and Canada included new provisions to address aquatic invasive species.

2013

The Aquatic Invasive Species Partnership Resolution and the Least Wanted List is established through the Great Lakes St. Lawrence Governors, and Premiers, followed by the Aquatic Invasive Species Mutual Aid Agreement one year later.

2014

Together, MNR, OFAH and partners launched the Early Detection and Distribution Mapping System ([EDDMapS](#)) in Ontario.

The Invasive Species Inter-Ministry Working Group comprised of MNR, OMAFRA, MECP, and MTO was established to enhance provincial coordination and collaboration.

2015

The federal government, provinces and territories renewed their commitment for the 2004 *An Invasive Alien Species Strategy for Canada*.

The *Aquatic Invasive Species Regulations* under the *Fisheries Act* were enacted to help protect waterbodies across Canada from the threat of aquatic invasive species.

2020

Municipal Community of Practice was established integrate knowledge of invasive species prevention and management across municipalities and conservation authorities.

The Green Shovels Collaborative is launched by conservation organizations to collectively address invasive species issues, make environmental progress, create jobs and recover the economy.

2016

Ontario's *Invasive Species Act, 2015* came into force, making Ontario the first Canadian jurisdiction to create stand-alone invasive species legislation.

The first species are regulated under Ontario's *Invasive Species Act, 2015*.

2021

The ISC begins awarding grants to support invasive species education, community action and management planning.

2017

The City of London is recognized as a leader for being the first municipal government in Ontario to develop a city-wide invasive plant management *strategy*.

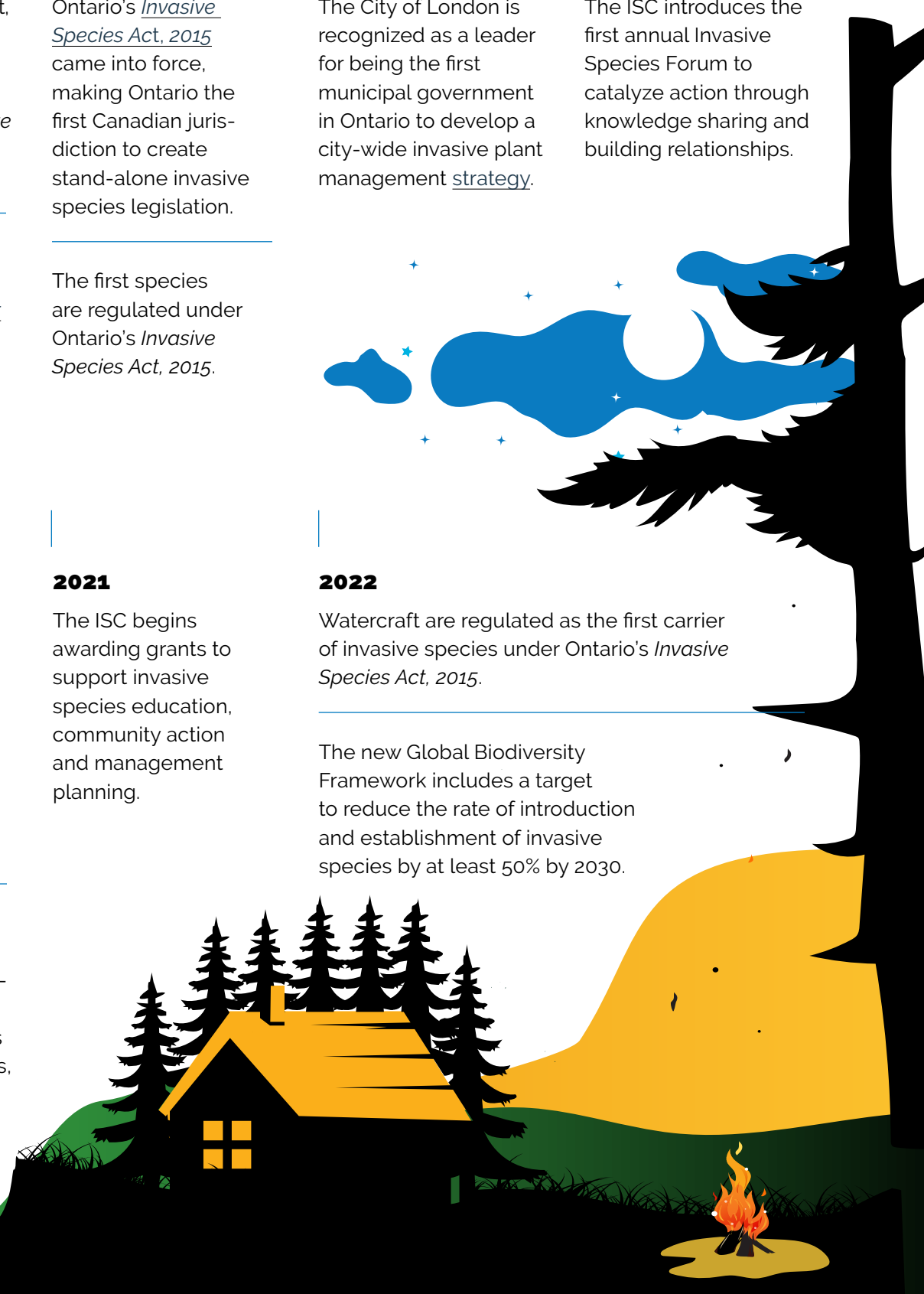
2022

Watercraft are regulated as the first carrier of invasive species under Ontario's *Invasive Species Act, 2015*.

The new Global Biodiversity Framework includes a target to reduce the rate of introduction and establishment of invasive species by at least 50% by 2030.

2018

The ISC introduces the first annual Invasive Species Forum to catalyze action through knowledge sharing and building relationships.





Update on progress

1. Legislation, regulation and policy

Legislation, regulation and policy support invasive species prevention and management by providing guidance, consistency, accountability and clarity on issues related to invasive species. Ontario's laws, compliment federal laws, regulations and other policy approaches like management plans, strategies, and guidance documents, which are all instrumental in addressing invasive species. Efforts should continue to identify and address regulatory and policy gaps across levels of government.

Highlights

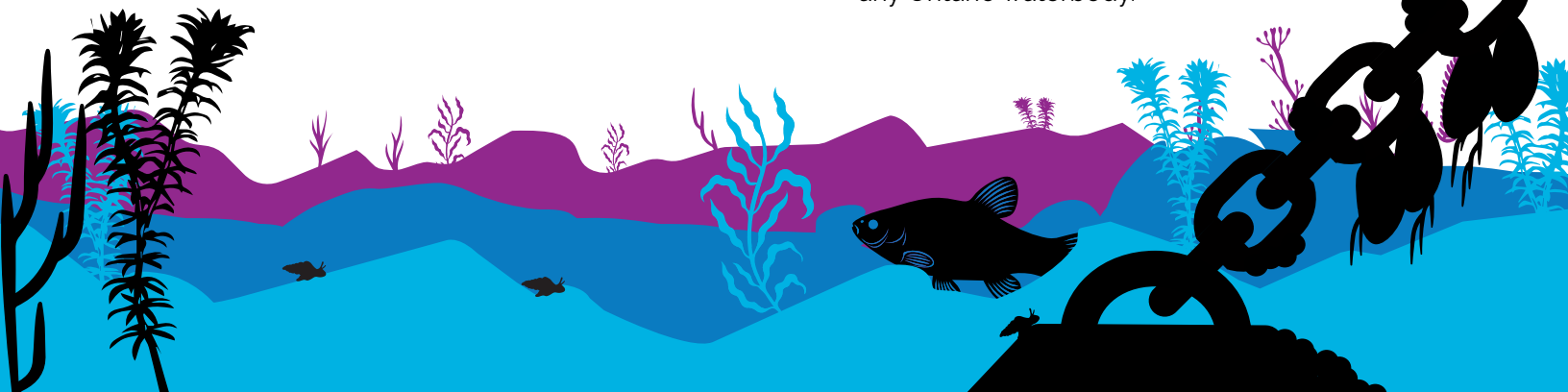
- MNRF's 209 conservation officers **enforce legislation** related to natural resources and invasive species. They spend hundreds of hours a year on outreach and compliance monitoring. More than 1,500 violations related to aquatic invasive species have been detected since 2015. Conservation officers continue to work in conjunction with the Canadian Border Services Agency to prevent entry of invasive species. More than 10,000 people were contacted during planned border checks in 2019–2020.
- Since 2012, more than 50 provincial parks and conservation reserves have developed **management plans** under the *Provincial Parks and Conservation Reserves Act, 2006*. Management plans prioritize maintaining and consider restoring the ecological integrity of protected areas, including the pressures of invasive species on park values. Site-specific information on preventing the introduction of invasive species, detection, monitoring and control is specified on a case-by-case basis.
- In 2012 [Ontario's Great Lakes Strategy](#) was released, outlining Ontario's economic, social and environmental priorities for the Great Lakes region. The Strategy included priority actions and commitments to support invasive species prevention, detection, response and management.
- In 2015, the Ontario Invasive Plant Council and partners developed a framework and training to support the creation of **municipal invasive plant management strategies**.
 - Since then, local direction on invasive species has been published by municipalities (e.g., London, Mississauga and York Region) and conservation authorities (e.g., Toronto Region Conservation Authority and Credit Valley Conservation Authority).

- White-nose syndrome is a condition resulting from a non-native fungus that is responsible for killing millions of bats across North America. Released in 2015, **Ontario's White-nose Syndrome Response Plan** identifies the risk to Ontario bat populations and provides for multi-agency coordination in three key areas: prevention, surveillance and research.
- As of 2015, nine additional species were added to the **Schedule of Noxious Weeds** under the *Weed Control Act*, providing an important province-wide tool for weed inspectors to control weed plants that interfere with agriculture or horticulture. The addition of wild parsnip, an invasive plant with sap that can cause painful skin blisters, has helped municipalities manage the species along roadways. The Act also allows municipalities to designate noxious weeds within their jurisdiction to address the issue at a local level.
- **Ontario's Chronic Wasting Disease Prevention and Response Plan** was updated in 2019, and in 2021 enhanced restrictions were put in place under the *Fish and Wildlife Conservation Act, 1997*, to help protect the socio-economic, ecological and cultural benefits of Ontario's wild deer, moose, elk and caribou. The plan sets out an adaptive, coordinated approach to minimize the threat caused by this non-native disease, which is fatal to infected animals and currently has no treatment or cure.
- European water chestnut and water soldier are invasive perennial aquatic plants that form dense mats of vegetation, impeding recreational activities (e.g., boating, swimming and angling) and interfere with infrastructure. They are regulated under the *Invasive Species Act, 2015*. In 2020, **prevention and response plans** were developed for these species to authorize certain monitoring, management, control and eradication activities.
- The **Ontario Tree Seed Transfer Policy** was updated in 2020 to support the long-term success of forest regeneration activities in a changing climate. Seed transfer can support healthy, resilient forests by promoting forest adaptation, conserving the genetic diversity of native species, and helping tree populations keep pace with changing conditions.
- Over the past 50 years, hemlock woolly adelgid has caused considerable damage and mortality to eastern hemlock in the United States. A warming climate and other factors are expected to facilitate range expansion into Ontario. MNRF collaborated with Natural Resources Canada to develop **silviculture guides** for hemlock trees threatened by hemlock woolly adelgid using the most recent scientific knowledge.
- **Ontario's Strategy to Address the Threat of Invasive Wild Pigs** was launched in 2021 outlining an integrated approach to prevent the establishment of wild pigs in the province. In support of this goal, pigs were regulated as an invasive species under the *Invasive Species Act, 2015* and certain prohibitions came into effect January 1, 2022:
 - It is illegal to release any pig into the natural environment
 - Hunting pigs in Ontario is illegal
 - Live Eurasian wild boar and their hybrids are being phased out of the province
- The Ministry of Transportation (MTO) developed and added restorative native grass and forb seed mixes to the **Ontario Provincial Standard Specification (OPSS) 803—Vegetative Cover**. These mixes have been used on several MTO infrastructure improvement projects. The diversity of the mixes helps to out-compete invasive species and the deep root systems provide excellent long-term erosion prevention and soil stability to support safety along MTO's highways.

- Invasive aquatic species have significant ecological impacts and can hinder the use of shore lands for swimming, boating and other recreational activities. In 2013, regulatory amendments were made under the **Public Lands Act, 1990** to support property owners in the management of invasive aquatic vegetation on adjacent Crown land.
- **Ontario's Provincial Fish Strategy** (2015) is a guiding document for managing fisheries resources in Ontario. The strategy provides over-arching direction and specific tactics to address the threat of invasive species to Ontario fisheries and dependent ecosystems.
- **Ontario's Sustainable Bait Management Strategy** was released in 2020 to reduce the ecological risks associated with the use and

movement of bait, including the risk of bait as a pathway for unintentional spread of fish-based diseases and invasive species.

- Watercraft, including watercraft equipment, is the first **carrier of invasive species** regulated under the *Invasive Species Act, 2015* to address the significant harm of aquatic invasive species being spread between waterbodies. As of January 1, 2022, drain plugs must be removed from watercraft and reasonable measures taken to remove aquatic plants, animals and algae from watercraft upon removal from a waterbody, prior to transporting it overland. In addition, watercraft (including equipment and any vehicle or trailer used to transport them) must be free of all aquatic plants, animals, and algae before being launched into any Ontario waterbody.



Spotlight: ***Invasive Species Act, 2015***

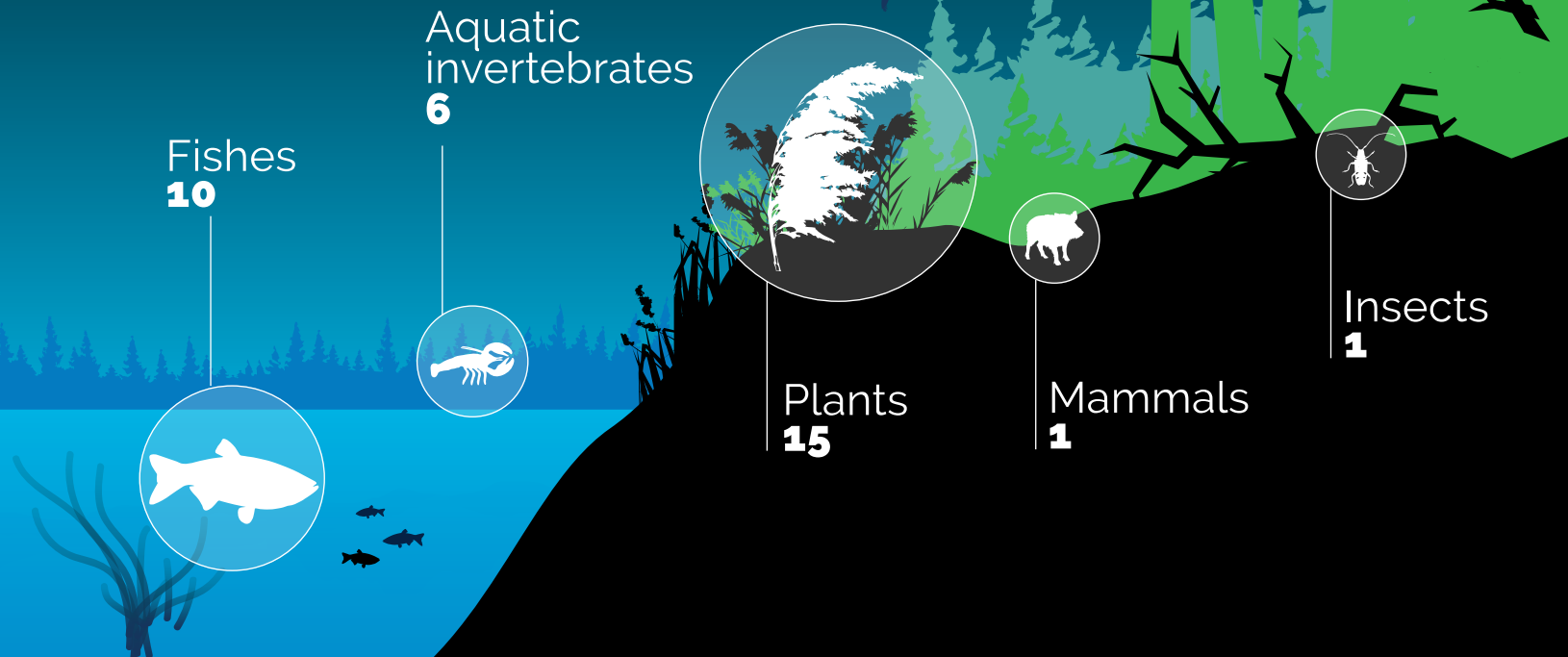
The passing of Ontario's *Invasive Species Act, 2015* along with its first suite of regulations represented a significant milestone for the province. The Act is a cornerstone of Ontario's invasive species management. Because managing invasive species is complex, the Act provides a suite of tools to prevent and control the spread of invasive species, including:

- the ability to ban activities that can introduce or spread certain high risk invasive species (e.g., possessing, transporting, releasing or depositing, and selling)
- restrictions on carriers of invasive species to address the threat of pathways for introduction and spread

- response actions to address urgent threats
- enforcement measures and inspections to support compliance with prohibitions
- promotion of partnerships and shared accountability for managing invasive species

Under the Act, invasive species and carriers, which are organisms or objects that facilitate the spread of invasive species, can be regulated. Certain prohibitions apply to regulated invasive species and carriers to reduce their introduction and spread. As of 2022, 32 species, one group of species (Snakehead family), and one carrier (watercraft, including watercraft equipment) have been regulated ([Ontario Regulation 354/16](#)).

Species or Groups of Species regulated by taxa between 2015 and 2022



2. Leadership and coordination

Leadership and coordination are essential for the prevention, detection, response, and long-term management of invasive species.

Ontario continues to improve coordination by leading and contributing to networks across and within governments. This helps bring together expertise to share information and coordinate measures for certain invasive species and pathways.

Highlights

- Ontario established an inter-ministry invasive species **working group** and also co-chairs the Federal-Provincial-Territorial Invasive Alien Species National Committee to strengthen coordination and foster knowledge sharing and integration

- Ontario's longstanding commitments to **multi-jurisdictional agreements** and committees continue to enhance binational and bilateral efforts on prevention and coordinated response actions
- Ontario continues to strengthen **valuable relationships** with non-government organizations creating synergies and **partnerships** that produce positive actions

While much progress has been made, improved clarification of roles and coordination of activities would enhance the province's performance in addressing the risk of invasive species.



Spotlight: **Bi-lateral leadership**

The prevention and management of invasive species across borders presents challenges due to differing jurisdictional tools, laws and oversight mechanisms. As such, coordinated collaboration among relevant provinces and states is essential to prevent and manage invasive species along Ontario's border with the United States, including the shared responsibility for the Great Lakes.

The **Great Lakes St. Lawrence Governors' and Premiers' Aquatic Invasive Species Task Force** is one example of effective cross-border coordination. The task force plays an important role in addressing the risk of invasive species in the Great Lakes and St. Lawrence River Basin by:

- Managing a list of 'Least Wanted' aquatic invasive species to help coordinate provincial and state management efforts. Since 2013,

the states and provinces have taken as many as 90 separate regulatory actions to restrict these high-risk invasive species from further spread or being introduced. As of 2022, all of the species on the Least Wanted list have been regulated by Ontario under the *Invasive Species Act, 2015*.

- Creating the groundbreaking agreement of mutual aid that facilitates cooperative response actions between jurisdictions in the event of a new aquatic invasive species introduction.
- Supporting the 2017 resolution for participation of states and provinces in the Memorandum of Understanding on Regional Cooperative Enforcement Operations that promotes information sharing and cross-border investigations.

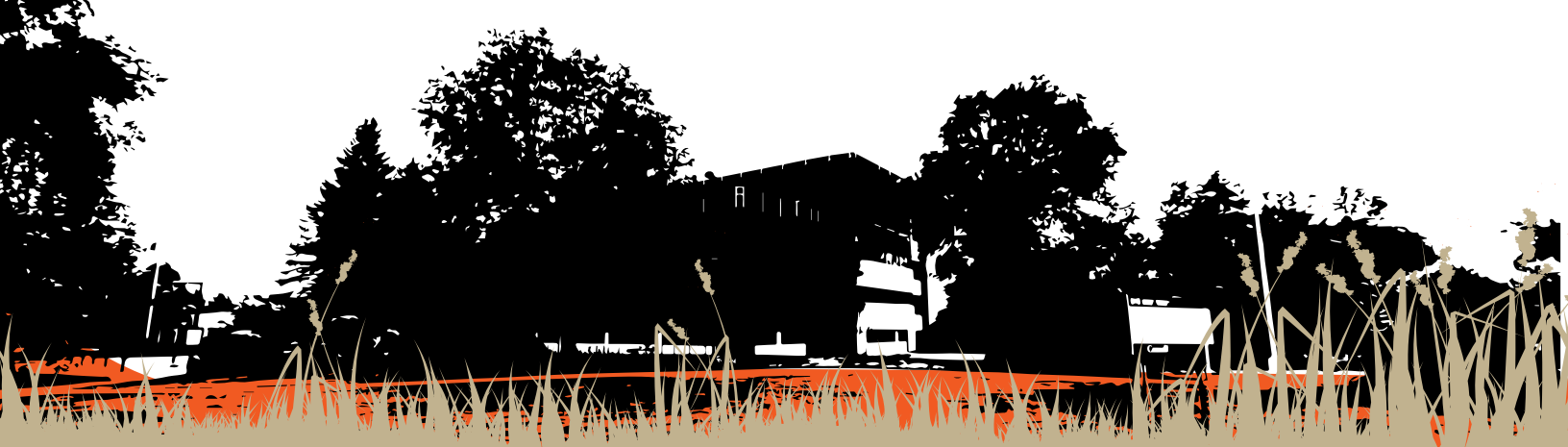


Spotlight: **The Canada-Ontario Agreement on Great Lakes Water Quality and Ecosystem Health**

The Canada-Ontario Agreement on Great Lakes Water Quality and Ecosystem Health (COA) is a federal-provincial agreement that supports the restoration and protection of the Great Lakes basin ecosystem. The importance of invasive species management has been recognized through commitments under the agreement since 1994, and in 2014 this priority was further emphasized by developing a stand-alone annex for aquatic invasive species, which is co-led by MNR and Fisheries and Oceans Canada (DFO). Over the last decade, there has been consistent funding

allocated to invasive species projects, successfully fulfilling actions under this agreement.

For example, since 2014, MNR, Parks Canada Agency, the OFAH and others have partnered to coordinate research, monitoring, control, and prevention strategies for water soldier in the Trent Severn Waterway. Ontario is the primary location of this high-risk species in North America and partners continue to work together to control the population and prevent its spread. To date, more than 720 hectares of water soldier have been treated on the Trent Severn Waterway.



Spotlight: **The Invasive Species Centre – building effective partnerships**

Since its inception in 2011, the ISC has been a respected partner and leader in invasive species science, education and action.

The ISC continues to:

- generate new knowledge and information on invasive species biology, establishment, and spread
- develop new tools, technologies, methodologies and processes for on-the-ground management by professionals, practitioners and landowners
- build capacity among students and young graduates and equip them with skills and experience to lead invasive species efforts
- increase awareness among communities on the harmful attributes of invasive species, encouraging community science and action to prevent and control the spread of invasive species

Building partnerships and fostering collective action is core to the ISC's work. The ISC has worked with over 230 partners on a wide range of projects and initiatives including:

- Establishment of the **Ontario Municipal Community of Practice** with over 65 municipal representatives to enable peer-to-peer knowledge sharing.
- Together with the Ontario Invasive Plant Council, creation of the **Early Detection and Rapid Response Network** to engage youth groups, local environmental and naturalist organizations, schools, outdoor enthusiasts, governments and the public. As a result, communities throughout Ontario have established networks and tools to undertake monitoring and management activities for invasive species.
- Building long-term relationships and providing support for action for Indigenous communities and organizations. In 2022, Cree factsheets on aquatic invasive species were developed for Indigenous partners and funding was provided to projects through the **Microgrants for Invasive Species**. This program recognizes the importance of collaboration to prevent invasive species, by funding individuals, groups or organizations to support invasive species education, community action, and management planning in Ontario. Since 2021, more than 100 projects have been awarded a total of \$171,000.

3. Risk analysis

Risk analysis uses the best available scientific information to make sound decisions about how to prevent possible invaders and manage those that have already arrived. Risk analysis includes risk assessment, risk management and risk communication.

Risk assessment is the process of characterizing the likelihood of introduction and establishment of an invasive species and the magnitude of possible impacts.

MNRF uses risk assessments to evaluate the threat posed by invasive species to Ontario. They are used to identify species for regulatory consideration under the *Invasive Species Act, 2015* and can also inform non-regulatory prevention and management actions. When prioritizing species for risk assessment, MNRF also considers species that have been regulated or assessed in neighbouring Great Lakes or other Canadian jurisdictions, as well as species that have been identified by stakeholders, the public, experts or other partners as being species of emerging concern. Prioritizing the assessment of invasive species that pose the greatest risk continues to be necessary to address the diversity and increasing number of invasive species that threaten the province.

Highlights

- **Guidance for invasive species assessments under the *Invasive Species Act, 2015*** was developed by MNRF in 2016 to describe the process to assess the risk of invasive species. This process includes consideration of:
 - the species' biological characteristics
 - harm the species has had on the natural environment or is likely to have in the future
 - dispersal ability of the species
 - social or economic impacts of the species.
- In 2016, the MNRF developed an **assessment tool for aquatic invasive species** which increased the province's risk assessment capacity by creating a standardized method of evaluating the likelihood of invasion and harmful impacts of a species. Work is underway to modify the tool for use with terrestrial invasive plants.
- To avoid unnecessary duplication or delay, MNRF may use **risk assessments** conducted and accepted by other jurisdictions and by non-government organizations.
 - In 2015, Ontario signed the Michigan–Ohio–Ontario Aquatic Invasive Species Harmonization Project Resolution which has strengthened the collective capacity to conduct, share and adopt risk assessments across jurisdictions.
 - Work by the Ontario Invasive Plant Council and the ISC has informed the risk assessment process for a number of high priority species in the province.
- To increase the accessibility of resources, the ISC created and launched publicly available **databases** including over 1,700 entries for invasive species and pathway risk assessments.



4. Monitoring and science

Effective surveillance and monitoring are essential for detecting new invasive species and tracking the spread of existing ones. This helps in the early detection and management of high-risk invaders before they become firmly established and to limit their spread.

Research improves our understanding of invasive species biology and drives progress in control and monitoring techniques. Given the evolving pressures of invasive species and pathways, the need for research and monitoring, and knowledge integration is ongoing.

Highlights

- In 2014, the OFAH collaborated with the MNRF, ISC and other partners to launch the online **Early Detection and Distribution Mapping System** (EDDMapS) in Ontario. This program, which tracks reports of nearly 200 invasive species, has exponentially increased invasive species reporting and data collection leading to improved province-wide invasive species detection and response.
- MNRF undertook an extensive **modelling study** to evaluate the combined impacts of climate change and human-mediated spread of aquatic invasive species to identify regions of Ontario at high risk for invasions. The modelling tool that was developed will help to inform prevention and management activities.
- MNRF and DFO continue to undertake **surveillance**, monitoring and response for invasive carps in the Great Lakes using techniques such as eDNA sampling, netting and electrofishing. The term invasive carp describes four invasive species of fish including bighead carp, silver carp, black carp, and grass carp which have replaced native species in areas of the Mississippi River and its tributaries.
- Through the MNRF's **Broad-scale Monitoring Program**, hundreds of inland lakes across the province are routinely sampled, providing information on stressors such as aquatic invasive species. Between 2012 and 2017, alien aquatic species were found in 48% of the 689 lakes sampled.
- In 2020, the ISC and MNRF established the Zooplankton Diagnostics Lab to help assess the status of zebra mussel and spiny waterflea in Ontario lakes.
- Extensive beds of invasive *Phragmites* and cattail decrease biodiversity in wetlands. **Research** by MNRF and partners helps inform restoration efforts by studying the impacts of herbicides on native flora, and impacts of invasive species removal on aquatic invertebrate communities and at-risk turtle species.
- As part of a binational effort with the US Fish and Wildlife Service, MNRF conducts early **detection and monitoring** for invasive fish, mussels and *Phragmites* in Lake Superior.
- MNRF and ISC have supported multiple **research projects** at Ontario universities to study management options for a number of aquatic invasive species. For example: MNRF is collaborating with Quebec, DFO, New York State, the Mohawks of Akwesasne, the River Institute, and McGill University to monitor for the spread of Tench in the St. Lawrence River. Tench is an invasive species of fish that has been captured in Lake St. Francis, which straddles the Ontario-Quebec border, but no breeding populations have been detected to date. MNRF has begun to investigate the possible impacts that Tench could have if they were to become established in the Great Lakes.

- Through the Highway Infrastructure Innovation Funding Program (HIIFP), MTO has supported several institution-based **research projects**, including research on the invasive *Phragmites* plant. Research included location mapping and treatment assessments, and piloting native seed mixes to evaluate their competitive effect. Findings have informed ministry guidance, including invasive *Phragmites* control along highway corridors to reduce spread and increase public safety.
- MNRF and partners continue to support **research collaborations** by the University of Toronto and Agriculture Agri-food Canada to develop biocontrol options for established invasive plants, including dog-strangling vine, knotweed, invasive *Phragmites*, garlic mustard and flowering rush.
- Provincial ministries, together with partners and municipalities **funded research** to determine if temperatures of municipal composting facilities sufficiently destroy reproductive structures of invasive plant species. The results informed best management practices related to effective disposal of invasive plants.
- Since 2016, OMAFRA has **surveilled** spotted lanternfly at high-risk locations in southern Ontario. First identified in Pennsylvania, United States, in 2014, this invasive planthopper threatens both agriculture and forestry industries in Canada. Its detection in the United States prompted ongoing education and awareness efforts by OMAFRA.
- The University of Guelph and OMAFRA **conducted research** to inform the management of giant hogweed—originally introduced to North America as an ornamental garden plant reaching 5 feet in height with huge white flowers. Informed management actions are especially critical for this invasive plant, which produces phototoxic sap that can cause severe burns on human skin when exposed to light.
- Ontario's **forest health monitoring program** conducts annual aerial and ground surveys to quantify the extent and severity of major forest disturbances such as weather events, disease damage, and insect outbreaks, including invasive species. Annual reports provide the public with outbreak maps and forecasts, and information on how to manage forest pests and diseases.
- MNRF conducted annual surveys of spongy moth (formerly gypsy moth and *Lymantria dispar dispar* or LDD) during an outbreak that began in 2017 and peaked in 2021 with 1.8 million hectares defoliated, primarily in southern and northeastern Ontario. The outbreak declined significantly in 2022. Outreach and awareness efforts provided background information, defoliation maps and forecasts, and options for managing the species on private property. Localized efforts were also undertaken, including a collaboration in York Region to establish regional monitoring.
- Sleeper species are species that are already present at low abundance within an ecosystem that can become invasive as factors in the environment become more favorable resulting in rapid population growth and spread. The invasive mountain pine beetle is native to forests in western North America where cold winters keep populations in check. To inform management decisions, a **revised climatic suitability assessment** for mountain pine beetle evaluated the mountain pine beetle's accelerated potential to invade pine stands in northwestern Ontario.
- MNRF scientists with the Ontario Forest Research Institute continue to undertake **research and development** on management, detection and impacts of invasive forest diseases and pests (e.g., oak wilt and the beech leaf nematode).



Spotlight: **Invasive wild pigs**

Invasive wild pigs have been coined an 'ecological train wreck' because of the extent and magnitude of damage they cause. They can destroy native ecosystems, wreak havoc on agricultural operations, damage private property, and impact tourism and nature conservation. They pose a health and safety risk to people and can spread diseases. Their tendency to have large litters and ability to reproduce frequently, when paired with high survival, mobility and adaptability means that they can quickly become established in new areas and spread rapidly.

Ontario is proactively managing the risk of invasive wild pigs with the goal of preventing their establishment. In 2021, [Ontario's Strategy to Address the Threat of Invasive Wild Pigs](#) was launched, describing the province's multi-pronged approach to meet this goal. Ontario's approach is grounded in experiences from other jurisdictions and Ontario-based research. For example, [research](#) indicates wild pigs are not currently self-sustaining or breeding in the wild in the province and that sightings are primarily escaped or released domesticated pigs.

- On average, MNR receives over 190 reports of wild pig sightings annually, which includes duplicate reports, carcasses and other pig sign, and low confidence reports.

- When necessary, ministry staff trap and remove wild pigs from the natural environment. Innovative approaches, such as baited trail cameras and drones help support this work. Since 2020, staff have trapped and removed 17 wild pigs from the natural environment and through follow-up investigations have facilitated the recapture of owned escaped pigs.
- In 2022, pigs were regulated as an invasive species under the *Invasive Species Act, 2015* including regulatory approaches to prevent the release of pigs, ban hunting, and phase live Eurasian wild boar and their hybrids out of the province by January 1, 2024.
- Collaboration and coordinated action are key to Ontario's approach, with concerted efforts by MNR, OMAFRA, federal agencies, local governments, industry stakeholders and partners, including OFAH's Wild Pig Surveillance Program which has engaged over 150 volunteers and received over 200,000 photos to aid in the early detection of wild pigs.
- Collaboration in outreach and education opportunities have ensured the success of MNR's sightings program, and has improved public awareness of preventative measures, including pig containment.



Spotlight: **Alien invasive plants in Ontario's protected areas**

In the context of parks and protected areas, invasive species are a direct threat to maintaining ecological integrity. They can spread to and within parks and protected areas through a variety of pathways, for example by humans (e.g., seeds on clothing and footwear or fragments of plants moved by equipment or vehicles) or through natural processes (e.g., seeds dispersed by wind or animals from nearby properties).

In 2021, Ontario Parks released the *State of Ontario's Protected Areas Indicator Report for Alien Invasive Plants* to track the presence of alien invasive plants in Ontario's provincial parks and conservation reserves.

As of 2019, 250 alien and invasive plant species were documented across 157 provincial parks and 22 conservation reserves.

Ontario Parks has conducted significant monitoring and management initiatives for high priority invasive plant species like invasive *Phragmites*, garlic mustard, giant hogweed and wild parsnip, European water chestnut and Japanese stiltgrass, however invasive species continue to spread. Better data and an established list of species of ecological concern can support future management and more effective prevention.



Spotlight: **Environmental DNA (eDNA)**

Environmental DNA (eDNA) refers to the genetic material shed by living or dead organisms into their surrounding environment, including cells from skin, hair, feces and carcasses.

Samples like water or soil collected from the environment are analyzed to identify the presence or absence of different species without directly observing or capturing them. This cutting-edge technology is an important new tool for surveying and monitoring invasive species.

In 2022, MNRF learned that Hydrilla was detected in the U.S. waters of the Niagara River. Hydrilla is an aquatic invasive plant that is regulated under *Ontario's Invasive Species Act, 2015*, spreading easily by fragments of the plant. To date, there are no known occurrences of Hydrilla in Canada.

In response to the U.S. detection and in addition to visual surveys, MNRF used eDNA sampling and analysis to confirm that the species has not yet spread into Ontario waters. Ontario will continue eDNA surveillance, leveraging the efficiency and cost-effectiveness of the tool as an early warning system, enabling quick action to prevent the species from establishing in the province.

MNRF continues to advance efforts in eDNA monitoring, directing efforts to improve methods and expand the use of eDNA, including community eDNA assessments, which can detect many species within the taxa from a single water sample. Community eDNA is currently being piloted on both fish and aquatic plants. This method has strong potential as it could help with earlier detection by identifying unexpected invasive species.

5. Management measures

The best way to reduce the risk of invasive species entering Ontario is to stop introductions before they happen. If prevention efforts fail, management actions can stop establishment, limit spread and manage impacts.

Management actions are integral for addressing the threat of invasive species. For example, building resilient ecosystems can help prevent invasive species from becoming established, and management actions such as containment and control measures can maintain, reduce and/or eradicate invasive species.

Governments, organizations, and members of the public all play critical roles in undertaking invasive species management measures. Efforts to support the prevention and management

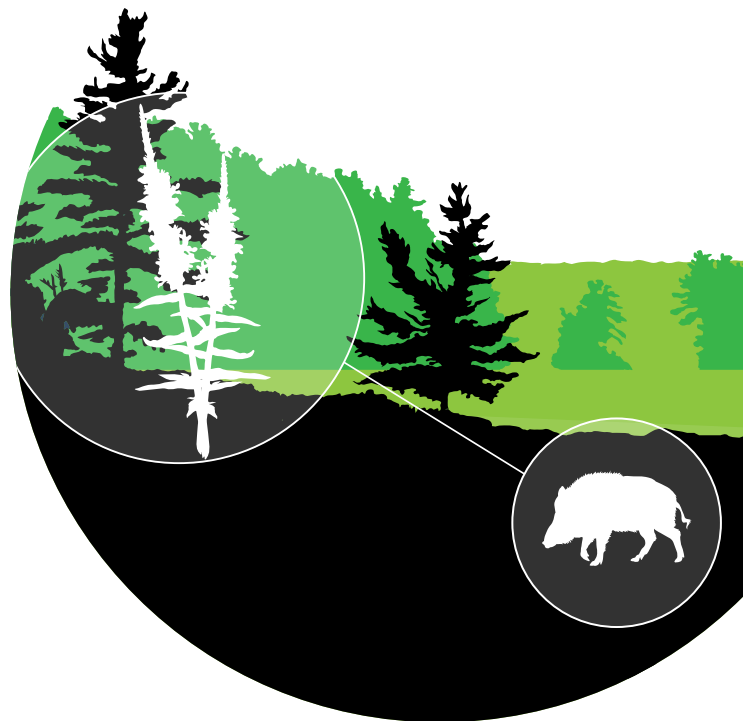
of species that pose the greatest threat to the environment, economy and society continue to be needed.

Best management practices provide recommendations and guidance on how to effectively manage invasive species and the pathways that facilitate their introduction and spread. Developing and promoting best management practices can help land managers and the public feel confident that they are taking the right steps to reduce the risk of introduction and spread of invasive species.



Highlights

- The Ontario Invasive Plant Council has published more than 25 **best management practices guides and technical bulletins** for priority invasive plants in Ontario. These documents provide detailed information on plants and promote an integrated pest management approach to achieve effective, long-term control.
- The ISC has compiled over 240 documents from various jurisdictions in their **Best Management Practices Database** on aquatic and terrestrial invasive species and pathways.
- In 2013, OMAFRA published a **management strategy**: *Managing emerald ash borer and bronze birch borer for landscape trees*. Although the bronze birch borer is native to North America, the emerald ash borer is an invasive insect that was first discovered in Ontario in 2002. The management strategy provides information to improve tree health and suppress pests in urban tree populations.
- MNRF is a collaborative partner on a **control program** for emerald ash borer, an invasive insect that has killed tens of millions of trees in North America. Three species of parasitoid wasps were approved by the Canadian Food Inspection Agency as biological control agents for emerald ash borer, with initial releases in 2013. As of 2018, almost 100,000 wasps have been released at sites in Ontario, Quebec, and New Brunswick.
- Kudzu is an invasive perennial climbing vine that grows amazingly fast and can establish very quickly. The only wild population of kudzu in the country is located on the north shore of Lake Erie. Collaborative **management actions** by a private landowner, the Canadian Food Inspection Agency, OMAFRA, and MNRF, including chemical applications, are ongoing to eradicate and prevent kudzu from spreading to new areas.
- In 2018, box tree moth was detected for the first time in North America in Etobicoke, Ontario. If left unmanaged, box tree moth can completely defoliate boxwood shrubs in a single season. Beginning in 2019, OMAFRA secured registrations for the use of a biopesticide to **control** the species and provided materials for the nursery sector to build awareness and provide education. It is estimated that Ontario's commercial boxwood production is worth approximately \$8 to \$10 million.
- ISC worked with DFO and MNRF to establish the first mobile boat cleaning equipment. The cleaning station has been installed at Iskatewizaagegan #39 Independent First Nation to support the community and watercraft users in **preventing the introduction** and spread of invasive species such as zebra mussels, spiny waterflea, and aquatic plants.





Spotlight: **Management of invasive *Phragmites***

Phragmites australis is a non-native perennial grass that grows primarily in wetlands, beaches, dunes and along road-side ditches. It grows aggressively, outcompeting native plants and degrading fish and wildlife habitats, including habitat for many species at risk. Invasive *Phragmites* also impacts property values, tourism, recreation and agriculture. It can affect road safety by reducing visibility and increasing fire hazards due to the large amount of dry biomass from dead stalks. In 2005, it was named Canada's worst invasive plant by Agriculture and Agri-Food Canada.

Ontario has taken strong action to address the ecological and economic threats of *Phragmites*. In 2016, invasive *Phragmites* was regulated in Ontario as a restricted species under the *Invasive Species Act, 2015* enabling new tools for the management of this plant. Since 2016, [The Long Point Phragmites Action Alliance](#), in partnership with MNRF, the Nature Conservancy of Canada, Ontario Parks, the Canadian Wildlife Service and others, has worked to control *Phragmites* across the entire Long Point region, a UNESCO Biosphere Reserve. More than 1,600 hectares of provincially and globally significant wetlands on private and provincial and federal Crown lands has been restored. Ongoing environmental monitoring has demonstrated effective large-scale control and the return of native plants and wildlife.

Ontario also supports the development of innovative control methods for *Phragmites* through a partnership with Agriculture Agri-food Canada, the University of Toronto, the University of Waterloo and Ducks Unlimited Canada. Researchers are developing biocontrol methods for *Phragmites* with stemborer moth larvae enabling recovery of native plants. This promising work will support future efforts to manage invasive *Phragmites* in the province.

In 2020, Ontario introduced the [Wetlands Conservation Partner Program](#) that provides \$30 million in capital funding over 5 years (\$6 million per year) to restore and enhance wetlands in priority areas across Ontario and supporting municipalities with stormwater management. Funded projects often include *Phragmites* control to reduce further spread into the wetland.

Finally, building on these successes, the ISC's Green Shovels Collaborative developed a strategic framework to guide and inform control activities for *Phragmites* across the province. With assistance from MNRF, the Collaborative is providing funding to communities and organizations seeking to implement invasive *Phragmites* control activities across Ontario.



Spotlight: **Managing invasive species in Ontario Parks**

- In the fall of 2022 spiny waterflea, an invasive zooplankton, was discovered in three lakes in northern Algonquin Provincial Park. Since the discovery, a decontamination station was installed at one access point and biodegradable dishcloths were provided to backcountry visitors. Both initiatives encourage visitors to clean their gear before entering the water and increase general awareness about aquatic invasive species and the threat they pose to Algonquin Provincial Park's unique coldwater ecosystems.
- Early detection of invasive species such as garlic mustard and *Phragmites* in parks in northeastern Ontario has helped Ontario Parks manage populations before they spread, when control tactics are most effective. For example, garlic mustard has been significantly reduced at Grundy Lake Provincial Park because of early and sustained management of a new infestation.
- Japanese chaff flower is a highly invasive plant. In 2018, its discovery on two Lake Erie islands marked the first occurrence of the species in Canada. To prevent the species from spreading to forests of mainland Ontario, Ontario Parks undertakes monitoring along with manual and chemical control annually to eradicate it from East Sister Island Provincial Park.
- In 2019, a new invasive species to Canada was discovered in Short Hills Provincial Park, Japanese stiltgrass. The annual grass spreads aggressively through open areas and forests by producing hundreds of small seeds that are moved by people, animals, and water. It grows in thick mats, outcompeting native species. Ontario Parks is aiming to eradicate the species from the park through annual treatments.
- Recent efforts to remove invasive Scots pine and dog-strangling vine at Peter's Woods Provincial Park have helped restore globally rare oak savannah and woodland habitat. In 2022, over two hectares of savannah and woodland habitat in the park was cleared of invasive Scots pine and dog-strangling vine.
- Efforts to control European water chestnut, an invasive aquatic plant, in Voyageur Provincial Park on the Ottawa River continue with manual removal and the use of specially designed boats that cut and collect the plants. Huge volumes of the plant have been removed from infested bays annually since 2005.
- Ontario Parks regularly posts information about invasive species on their social media channels and educates park visitors through the Discovery Programs. In 2022, Ontario Parks published 24 posts about invasive species and how to prevent their spread, that were viewed over 275,000 times and had over 13,000 interactions. In the same year, Ontario Parks Discovery staff delivered 35 invasive species programs to over 900 visitors.



Spotlight: **Protecting and recovering species at risk through invasive species management**

Invasive species are a serious threat to species at risk, second only to habitat loss. Invasive species can diminish habitat quality, compete for resources like food and habitat, and cause disease. Examples of species at risk in Ontario that are impacted by invasive species include:

- **American ginseng**, a culturally and ecologically important plant species that is at risk in Ontario, is threatened by the invasive garlic mustard plant. Garlic mustard competes with American ginseng for resources. It impacts habitat suitability by altering soil chemistry, and spreads rapidly by producing 60,000 seeds annually. Controlling and preventing garlic mustard from becoming established can help protect and recover American ginseng.
- White-nose syndrome is a condition caused by an invasive fungus that is responsible for killing millions of bats in eastern North America, including four species (i.e., **eastern small-footed myotis, little brown myotis, northern myotis, tri-coloured bat**) that are classified as endangered in Ontario. Actions to detect, research and mitigate white-nose syndrome are key to supporting their recovery.
- **Hoary mountain-mint** is an endangered plant species that consists of a single population in Ontario. Provincial funding contributed to restoration work to remove invasive species and conduct prescribed burns at one site where the species was once considered extirpated. Seeding and planting of hoary mountain-mint were also undertaken. As a result of this work, hoary mountain-mint was subsequently observed growing at the sight which

is significant progress towards its protection and recovery in the province.

- Endangered **red mulberry** trees are under threat from cross-breeding with the invasive white mulberry tree. To address this risk and help recovery, the province has provided financial support to numerous partners for the removal of more than 330 white mulberry and hybrid trees near red mulberry trees in several places across the province. Most of the trees were removed with the assistance of staff at Ontario Parks. Over 500 additional white and hybrid mulberry trees were removed from near red mulberry trees by Parks Canada.

Ontario's *Endangered Species Act, 2007* (ESA) supports addressing the threat of invasive species to species at risk by:

- Developing government response statements that provide policy direction to government and partners about what should be done to recover the species, including relevant actions to address the threat of invasive species
- Enabling ESA authorizations, such as permits or agreements, which may specify actions to improve habitat quality, such as controlling or eradicating invasive species
- Providing funding through the Species at Risk Stewardship Program to encourage people and organizations to get involved in protecting and recovering species at risk and their habitats through stewardship activities. Since 2012, the program has funded 70 projects involving the management or removal of invasive species for the benefit of species at risk



Spotlight: **Canada Ontario Resource Development Agreement program**

The Canada Ontario Resource Development Agreement (CORDA) program is a tripartite initiative between Federal, Provincial and First Nation governments. Each CORDA funded project builds capacity, revitalizes, and strengthens the economic structure of the First Nations communities in Ontario and promotes natural resource development, management, and harvesting and stewardship activities across the province. Over the past 10 years MNRF and Indigenous Services Canada have funded approximately \$790,000 toward 31 CORDA projects aimed to control, remove and/or eradicate invasive species. For example:

- Hiawatha First Nation has conducted invasive species removal and native tree plantings. This project provided positive outcomes for the environment and community by

maintaining the ecological integrity of the culturally significant site Serpent Mounds.

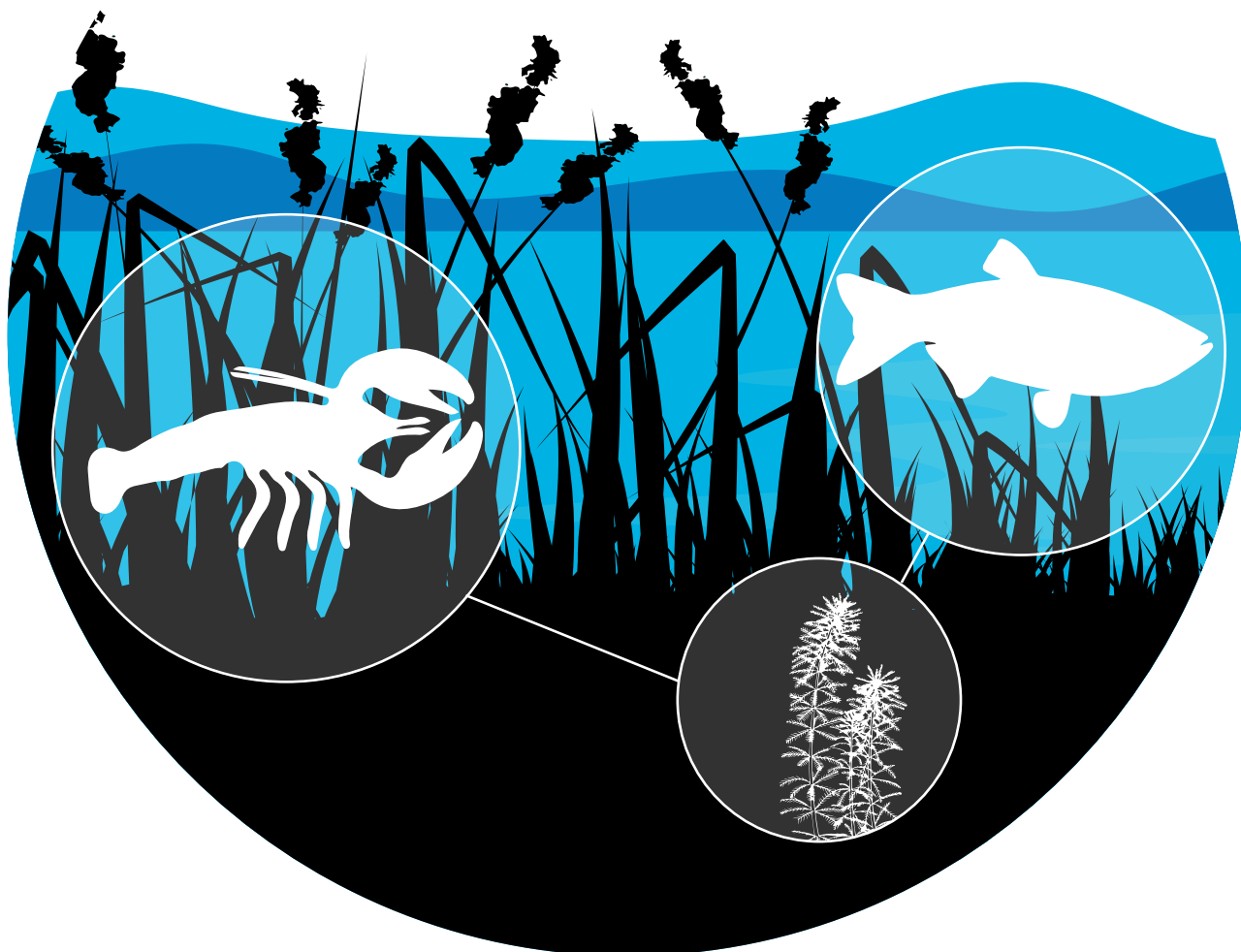
- Ecological restoration organization Kayanase received funds to support the purchase of equipment to expand invasive species management within and outside of its community.
- Aamjiwnaang First Nation, through collaborative efforts with Rural Lambton Stewardship Network, removed invasive *Phragmites* from road ditches and planted native wetland species to reduce the re-establishment of invasive species and create seed collection sites for future use.

6. Communication and outreach

Communication and education are critical components of invasive species management. An understanding about invasive species helps individuals and decision-makers take action. The government of Ontario and its partners communicate about the impacts of invasive species as well as the preventative actions people, industry and governments can take to be part of the solution.

- MNRF promotes [Invasive Species Action Plans](#) to **improve awareness** about how to prevent the introduction and spread of invasive species when participating in recreational activities such as angling, boating, gardening, hiking, or visiting the cottage. The action plans are promoted through the #invasionON communication campaign which includes social media posts and webpages about [invasive species in Ontario](#) and [managing invasive species in Ontario](#).
- Since 2012, several resources have been developed to make it easier for educators to provide formal and informal **teachings** on invasive species.
 - [Curriculum kits](#) and a [virtual classroom](#) are available through OFAH's Invading Species Awareness Program to provide educators and students with engaging, self-guided ways to learn about invasive species, biodiversity and protecting ecosystems. The **virtual classroom** provides learning resources, curriculum-integrated activities, games, pre-recorded video lessons, and more. Teachers can also schedule a virtual classroom presentation where a program expert can engage directly with the students.
 - The ISC continues to maintain a [database](#) of formal and informal **teaching resources** that provides tools and activities to support learning for students from kindergarten to grade 12.
- In 2017, with support from the MNRF, the Federation of Ontario Cottagers' Associations developed and released [A Shoreline Owner's Guide to Invasive Species](#) to **inform** shoreline property owners about invasive species and actions they can take to prevent their introduction and spread.
- The ISC hosts an annual Invasive Species **forum** that brings attention to relevant issues, current research and advances in prevention and management. This virtual event, which began in 2018, is open to the public and has seen over 1,600 participants.
- The Invasive Species Awareness and Monitoring Program for Lakes Education Ontario (IsampleON) is a community science program run by the Federation of Ontario Cottagers' Associations and the ISC. Since 2021, trained community volunteers collect water samples from inland lakes which are analyzed for the presence of invasive zebra and quagga mussels and spiny water flea. Volunteers also **share information** about being vigilant and steps people can take to reduce their risk of spreading invasive species.
- Signage is one of the most effective tools to **educate** boaters about invasive species. Since 2016, MNRF has supported partners to develop and distribute signs at over 500 key boat launches in Ontario.

- ***Grow Me Instead*** guides for southern (updated in 2020) and northern (2014) Ontario, published and promoted by the Ontario Invasive Plant Council, are **educational tools** for invasive-free gardening across the province. The guides show invasive species that are common to the horticulture industry and provide recommendations on alternative native plant species. With more than 70,000 copies distributed and many more downloaded online, the resource is invaluable for both novice and seasoned gardeners.
- OMAFRA continues to provide **annual training** on species of concern, best practices, and enforcement under the *Weed Control Act* for more than 100 inspectors.
- In 2020, MECP established the Great Lakes Local Action Fund to support actions that protect and restore the Great Lakes and has since provided \$3.8 million in funding to 82 community-led projects. Many funding recipients communicate to their audiences through social media, to encourage engagement and active participation in local community events ranging from re-establishing riparian areas, cleaning up shorelines, planting native species, monitoring for aquatic invasive species and undertaking management actions to address the threat of invasive species (e.g., *Phragmites* and European water chestnut).





Spotlight: **Invading Species Awareness Program**

Ontario's **Invading Species Awareness Program** marked its 30th anniversary in 2022. An effort of MNR, the OFAH and others, ISAP generates education and awareness, addresses key pathways contributing to introductions and/or spread, and facilitates monitoring and early detection initiatives for invasive species. These objectives are met through a variety of initiatives and programs. Some highlights include:

- Taking action with the Coalition of Haliburton Property Owners Association and others to address invasive aquatic snails, like the Chinese and banded mystery snails, that have been detected in the region's lakes. More than 500 volunteers have contributed to the removal of more than 700,000 mystery snails from Haliburton area lakes.
- Providing experience to more than 20 students annually each summer, the Invading Species Hit Squad delivers on the ground, community based invasive species outreach by visiting bait retailers, marinas and garden centres.
- Invading Species Awareness Program staff deliver Operation Bait Bucket in the Lake Simcoe watershed where staff engage with ice anglers and affiliated recreational audiences to increase awareness about maintaining lake health and preventing the introduction and spread of invasive species, by buying bait locally and disposing of leftover bait responsibly (i.e., not dumping bait water or minnows into or within 30m of a lake).
- In partnership with the Ontario Invasive Plant Council and Kawartha Conservation, the program has removed more than 5,000 pounds of invasive garlic mustard over the last decade. Garlic mustard is an invasive herb that displaces native wildflowers and other plants from forests.



Future focus

The *Ontario Invasive Species Strategic Plan* guides actions to:

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

To meet the increasing urgency of invasive species prevention and management, including risks from a changing climate, strong momentum continues to be needed. The future of invasive species prevention and management will build on current progress, such as continuing to assess and regulate invasive species and carriers under the *Invasive Species Act, 2015*.

Ontario is not alone in facing the challenges posed by invasive species. Managing the impacts of invasive species is a key target recognized in the Kunming-Montreal Global Biodiversity Framework. Through this international target, it is recognized that the scope and scale of invasive species issues are complex and far-reaching, and that success ultimately hinges on a whole of government and whole of society approach. [*Ontario's Biodiversity Strategy: 2023–2030*](#) emphasizes the serious risk of invasive species on the wide range of goods and services that are provided by Ontario's biodiversity. It calls for strong action to reduce the harmful impacts of invasive species on a provincial scale.

Continued leadership and collaborative action through strengthened and new partnerships is needed to address the ongoing threat of invasive species. Future preventions and management will be enhanced by new and innovative technologies. A focus on prioritizing activities, igniting action and the combined efforts of many will be instrumental in Ontario's continued efforts against invasive species.