Invasive species in Ontario: The threat, the strategy, and the law

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ABSTRACT

As international communities and economies become increasingly inter-connected, introductions of non-native species have the potential to increase in frequency. With more and more real-world examples demonstrating the ecological and economic impacts that invasive non-native species can have, governments around the globe are becoming increasingly aware that action is necessary to address these threats. This paper reviews some of the key actions that Ontario has recently undertaken to tackle the invasive species issue, including implementing the Ontario Invasive Species Strategic Plan, and putting into force the Invasive Species Act. For this special issue on forest pathogens, several invasive pathogens of concern in Ontario are highlighted, with a brief discussion of how these new provincial policies could play a role in protecting forest health moving forward.

Key words: invasive species policy, Ontario Invasive Species Strategic Plan, Invasive Species Act, invasive forest pathogens

RÉSUMÉ

À mesure que les communautés et les économies internationales deviennent de plus en plus interdépendantes, les chances augmentent de voir se multiplier les introductions d'espèces exotiques. Avec un nombre croissant d'exemples montrant à quel point les espèces exotiques envahissantes peuvent nuire à l'économie et à l'environnement, les gouvernements de partout sur la planète se rendent compte de plus en plus qu'ils ont des gestes à poser pour contrer cette menace. Cet article porte sur les actions prises par l'Ontario dernièrement pour remédier au problème des espèces envahissantes, soit la mise en œuvre du Plan stratégique de l'Ontario contre les espèces envahissantes et l'application de la Loi sur les espèces envahissantes. Dans ce numéro spécial sur les agents pathogènes forestiers, nous faisons le point sur plusieurs agents pathogènes envahissants qui préoccupent l'Ontario en tentant de voir dans quelle mesure les nouvelles politiques provinciales pourraient contribuer à protéger la santé des forêts.

Mots-clés : politique sur les espèces envahissantes, Plan stratégique de l'Ontario contre les espèces envahissantes, Loi sur les espèces envahissantes, agents pathogènes forestiers envahissants

Invasive Species in an Ontario Context

Canada's wealth of natural resources is essential to supporting a diversity of ecosystems and economies. However, it is precisely these beneficial resources—including our vast forests and extensive freshwater resources—that are under threat from invasive species, putting our environment and economy at risk (Environment Canada 2012). Within Canada, the province of Ontario not only has the highest number of invasive species, but is also at the greatest risk of new species invasions (Ontario Ministry of Natural Resources 2012). This is in part because Ontario's large, diverse population is both locally and globally mobile, and supports an active, growing economy that imports goods from all over the world (Ontario Ministry of Natural Resources 2012). Ontario is also an important economic and transportation hub, with a location contiguous to major international shipping routes, including the Great Lakes – St. Lawrence Seaway (Ontario Ministry of Natural Resources 2012). These factors combine to create numerous opportunities and points of entry for the introduction and spread of

invasive species. In addition, much of the landscape in southern Ontario has been altered or disturbed, further increasing susceptibility to new invasions. Finally, climate change may pose an additional threat that could facilitate new invasions into Ontario and promote the spread of invasive species that are already established (Rahel and Olden 2008).

The impacts of invasive species to Ontario's natural biodiversity and its species at risk are significant—second only to habitat loss (Ontario Biodiversity Council 2011). In fact, it is estimated that invasive species represent a threat to the recovery of more than 40% of species listed under Canada's Species at Risk Act (McCune *et al.* 2013). The ecological effects of established invasive species can be irreversible, the costs of control are significant, and even with sustained efforts eradication may not always be possible (Ontario Ministry of Natural Resources 2012). Federal, provincial, municipal, private, and even individual expenditures to manage damaging invasive species in the province have been substantial. Without preventative action, it is anticipated that these economic impacts will only increase. For example, if

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Asian carp were to invade the Great Lakes, they would threaten the commercial and recreational fishing industries in the lakes which currently contribute nearly \$800 million annually to the Canadian economy (Hayder 2014). Furthermore, the impact of invasive species on timber supply and harvesting has been identified as one of the most pressing threats to Canadian forest industries (reviewed in Yemshanov *et al.* 2009). Invasive species can also have significant economic impacts to trade as a result of controls and quarantines (Government of Canada 2004).

The Ontario Invasive Species Strategic Plan

The Ontario government is well aware of the very real threat that invasive species pose to the environment, economy and society. Over the past several decades, the province has actively worked with federal and municipal governments, conservation authorities, Aboriginal communities, the private sector and members of the public to help stop the introduction and spread of invasive species. Based on input from these groups, and in response to the increasing threat of invasive species impacts in the province, the Ontario government released the Ontario Invasive Species Strategic Plan (OISSP) in 2012 (Ontario Ministry of Natural Resources 2012). The ultimate goals of the Strategic Plan are 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.

The OISSP was developed in order to set out a coordinated approach for Ontario to prevent, respond to, and manage the presence of invasive species. The Strategic Plan summarizes the threats that invasive species pose to Ontario, and highlights some of the important work that has been undertaken by the government, non-government organizations and members of the public to combat these threats. More importantly, it provides both a conceptual framework for tackling the issue of invasive species in Ontario, and sets out specific actions and tactics to strengthen existing initiatives and fill gaps. These actions provide direction for achieving the intended outcomes of the Strategic Plan, and help to inform priorities in provincial strategies aimed at control of particular species.

The scale and complexity of the invasive species issue in Ontario demands a significant number of actions and tactics, with implementation extending over a period of years. Some of the key actions identified in the Strategic Plan include clarifying roles and responsibilities across agencies for invasive species prevention, response and management in Ontario, reviewing and enhancing invasive species policies, increasing the capacity for risk assessments to inform prevention and management actions, strengthening and supporting monitoring programs and scientific research, developing management measures for pathways and species, and expanding communication and outreach initiatives.

The complexity of invasive species issues in Ontario also requires effective communication, collaboration, and coordination with neighbouring provinces and states, and with the federal government in particular, especially in the areas of research, monitoring, and enforcement. To be successful in preventing the introduction and spread of invasive species, the Strategic Plan also emphasizes that non-governmental organizations, stakeholders, municipal-level government

agencies, and members of the general public must also be involved. Finally, it is identified that partnerships will continue to be essential in implementing the OISSP and achieving key outcomes.

The Role of Partnerships in Implementing the OISSP

Given that the complex nature of invasive species management is far beyond what any single organization can handle alone, Ontario has partnered with invasive species experts across the province in order to implement the OISSP. Within the Ontario government, invasive species management is supported by a number of ministries which allocate funding through various programs. The Ministry of Natural Resources and Forestry (MNRF), as a lead player in Ontario's fight against invasive species, has made significant investments through on-going funding agreements with key partners in order to help with public awareness, research and management.

For example, Ontario has invested more than \$11 million to support the establishment and operation of the Invasive Species Centre (ISC) in Sault Ste. Marie, and the province continues to provide approximately \$1 million per year in operational funding. The ISC plays a pivotal role in the delivery of key actions identified in the Ontario Invasive Species Strategic Plan, particularly in coordinating collaborative work between provincial and federal agencies. As a case in point, the ISC has been instrumental in facilitating discussion and collaboration to help prevent the introduction and spread of invasive forest pests of national and provincial significance (e.g., oak wilt disease, hemlock woolly adelgid). The ISC also supports the development and delivery of science focused on priority research studies targeting detection, control, and eradication, and has developed expertise in the field of ecological and socio-economic risk assessments for invasive species (Invasive Species Centre 2016).

Since 1992, MNRF has partnered with the Ontario Federation of Anglers and Hunters (OFAH) to deliver the Invading Species Awareness Program (ISAP) through annual funding contributions. Key objectives of the Program include generating education and awareness, monitoring and tracking the spread of new invaders found in Ontario, and addressing key pathways contributing to invasive species spread. The recent launch of the Early Detection and Distribution Mapping System (EDDMapS Ontario) has been an especially successful initiative of the ISAP, enhancing monitoring and early detection of invasive species in the province (EDDMapS 2018). Ontario's partnership with OFAH has also been fundamental to implementing important education and outreach initiatives identified in the OISSP, with a specific focus on delivering education and outreach geared towards key outdoor recreation pathways contributing to the spread of invasive species (e.g., boating, angling). Furthermore, OFAH plays an active role in helping the province to manage existing invasive species. Notably, under the ISAP, provincial support has helped launch eradication programs for water soldier and European water chestnut in Ontario.

The Ontario Invasive Plant Council (OIPC) has proven to be an essential partner in the coordination of invasive plant management efforts within the province, playing a key role with respect to educating the public on invasive plant issues. This has included the development of Grow Me Instead outreach materials as well as Best Management Practice Guide-

lines for a number of invasive plant species. The OIPC is well positioned to support the province in the ongoing implementation of the OISSP through continued public education and outreach, especially by engaging and empowering municipalities in invasive species management through the development of municipal invasive plant management strategies (OIPC 2018).

These partnerships have offered an efficient and cost-effective means to enhance the reach of invasive species management, eradication and prevention programs in the province. As a result of working closely with these and other partners, Ontario has made significant strides in implementing the OISSP and in working towards achieving its key goals. Through ongoing financial support, the province will continue to work collaboratively with our partners to prevent, detect, respond, manage and adapt to invasive species.

Ontario's Invasive Species Act

The Strategic Plan outlines a number of key actions relating to invasive species legislation, regulation and policy. In particular, it was recognized that there was a need to review existing federal and provincial legislation relating to invasive species to identify regulatory gaps and inconsistencies, and to enhance invasive species policies and their enforcement in Ontario. Having completed this regulatory review, Smith *et al.* (2013) identified that Ontario's legislative framework for responding to invasive species threats was rather fragmented, involving a patchwork of provincial and federal acts. Of these, 20 federal and 12 Ontario acts were found to intentionally or incidentally cover invasive species, though none were designed to specifically direct action on prevention, early detection and response. Furthermore, gaps in regulatory tools to address certain activities and types of invasive species (e.g., aquatic plants and forests pests which are native to other parts of Canada) were leaving the province vulnerable.

Recognizing that there were a number of gaps in Ontario's legislative framework to address invasive species, Ontario passed the Invasive Species Act (ISA) in November 2015 (Invasive Species Act 2015). The Act is Canada's first stand-alone invasive species legislation. It provides the province an enabling legislative framework to regulate invasive species that threaten Ontario's natural environment, to prevent their introduction and spread, and to support detection, control and eradication efforts. Under the Act, an invasive species is defined as "a species that is not native to Ontario, or to a part of Ontario, and is harming the natural environment of Ontario or of the part of Ontario in which it is present, or is likely to harm the natural environment of Ontario or of a part of Ontario, regardless of whether it is present in Ontario or in a part of Ontario". The definition includes plants, animals, and/or micro-organisms (e.g., a virus, fungus).

The Act provides the power to make regulations to list invasive species as either prohibited or restricted based on a number of considerations, including the species' biological characteristics, risk of harm to the natural environment, dispersal ability, and social or economic impacts assessed through the application of risk assessments. These regulations may, for example, prohibit the possession, transport, propagation, buying, selling, leasing or trading of listed invasive species. Beyond individual species, the Act also provides the power to regulate carriers, defined as "things capable of mov-

ing or facilitating the movement of an invasive species from one place to another". Carriers can include a plant, animal or other organism capable of being a host to an invasive species, or a conveyance (i.e., pathway). This regulatory power could be used where a threat can be better managed or eliminated by regulating the carrier (pathway) rather than an individual species or groups of species. Examples of pathways could include cargo transportation by land, sea and air; movement of heavy machinery from infested areas; recreational boating; firewood and wood movement.

In addition to the regulation of species and carriers, the Act also provides the power to designate areas of Ontario as Invasive Species Control Areas, allowing for measures to control or prevent the spread of an invasive species within, to or from the designated area. This could include regulating or prohibiting the movement of the invasive species or its carriers within or from outside of the Invasive Species Control Area, or regulating activities that are likely to contribute to the spread of the invasive species to or from the area.

Ontario's new Invasive Species Act also sets out details for inspections and related provisions. The Act establishes the authority for an inspector designated by the Minister to conduct surveys on both public and private land for the purpose of detection, confirmation, and/or to monitor invasive species. Furthermore, inspectors have the power to issue a written order declaring land, a building, a structure or a conveyance to be an invaded place. The purpose of this order is to allow an inspector to essentially quarantine an area or thing when action is required to prevent an invasive species from spreading to other areas, or to be able to take action to control, remove or eradicate the invasive species that is on or in the invaded place.

Finally, in order to reflect the importance of addressing invasive species threats and to ensure effective implementation of policy, the Act includes a comprehensive set of enforcement provisions. Enforcement officers can write tickets with pre-set fines for minor offences, while for more serious offences, the courts are responsible for imposing fines or imprisonment. For a first offence, individuals could be fined up to \$250 000 or face a jail term of up to a year (or some combination of both), while a corporation can be fined up to \$1 million. For any further offences, the maximum possible fine for individuals and corporations doubles. Enforcement provisions also allow for a fine levied to be multiplied by the number of individual animals, plants or organisms that were involved.

It is important to note that the new provincial Act does not replace or supersede existing legislation; rather it is designed to complement the role of the federal government in managing invasive species. The responsibility for prevention and control of invasive species is, of course, shared by both federal and provincial jurisdictions. However, the ISA does equip the province with new tools to ban the possession and transportation of certain invasive species, allowing for earlier intervention and rapid response to keep invasive species from spreading. In addition, the new legislation helps ensure compliance through modernized inspection and enforcement measures.

Ontario's Invasive Species Act came into force on November 3, 2016, one year after having received Royal Assent. At the same time, Ontario Regulation 354/16, which included

the initial list of 20 species to be regulated under the Act, came into force (O. Reg. 5354/16, 2016). The selection of these initial species for regulation followed a Premier's 2013 commitment to the Conference of Great Lakes and St. Lawrence Governors and Premiers that Ontario would take action to address the 16 species identified on the Great Lakes aquatic invasive species "Least Wanted List". This list of species was developed by all member jurisdictions. In addition, four additional species were regulated as restricted species with the objective of reducing their ecological, social and economic impacts in Ontario. The species identified in this first listing were assessed in accordance with the process outlined in the document "Guidance for Invasive Species Assessments under the Invasive Species Act, 2015" which was finalized in August 2016 (Ontario Ministry of Natural Resources and Forestry 2016a). This document describes the risk assessment process that Ontario is using to inform decisions to recommend species for regulation under the Invasive Species Act, 2015.

The species that Ontario has initially regulated represent a small segment of the total number of invasive species that could be introduced into Ontario or have already become established in Ontario. Listing these species is a significant first step in the province's use of regulatory powers to prevent the introduction or spread of invasive species. Ontario will continue to research the impacts of these species and work with partners and stakeholders to identify other species that could benefit from regulatory action under the Act.

Ontario's Forests and the Threat of Invasive Pathogens

Ontario has 71 million hectares of forest, most of which exists on publicly-owned Crown lands (Ontario Ministry of Natural Resources and Forestry 2016b). The forest sector plays an important role in Ontario's economy by supporting employment in communities and providing revenue to the government. Between 2009 and 2013, Ontario's forest sector supported an annual average of 51 660 direct jobs (Ontario Ministry of Natural Resources and Forestry 2016b), while forestry and forestry-related industries contributed more than \$13 billion to provincial GDP in 2015 alone (Natural Resources Canada 2017).

In addition to our Crown forests, urban forests also provide a variety of benefits to Ontarians, including energy conservation, carbon sequestration, enhanced property values, and social well-being (Hotte *et al.* 2015). As a result, urban trees are also a highly valued resource. For instance, the trees in the City of Toronto's urban forest are worth an estimated \$7 billion (i.e., replacement value) (Alexander and McDonald 2014), and provide an estimated \$60 million in ecosystem services annually (City of Toronto Parks, Forestry & Recreation, Urban Forestry 2013).

Both Ontario's Crown and urban forests are at risk from invasive pests and disease. Invasive forest pathogens and fungi can have significant impacts on native species by damaging or killing their tree hosts, damaging major forest ecosystems, and eliminating populations with impacts to ecosystem services (Boyd *et al.* 2013). Ontario's forests are under threat from a number of these destructive invaders, which could have significant impacts on both the province's biodiversity and economy. For example, of the six tree species listed as endangered in Ontario, three, butternut (*Juglans*

cinerea L.), eastern flowering dogwood (*Cornus florida* L.), and American chestnut (*Castanea dentate* (Marsh.) Borkh.), are endangered due to invasive forest diseases: butternut canker (Poisson and Ursic 2013), dogwood anthracnose (Bickerton and Thompson-Black 2010), and chestnut blight (Boland *et al.* 2012), respectively. The threat posed by these species is significant. As an illustration, approximately one third of Ontario's butternut trees have already been killed as a result of butternut canker disease, and estimates suggest that more than 90% of the remaining trees are infected (Forest Invasives Canada 2015) and will eventually be lost.

White pine blister rust is another invasive forest disease of concern in Ontario. This disease is caused by the fungus *Cronartium ribicola* J.C. Fishc. in Rabh. and has had a significant impact on eastern white pine in the province. While it is not new to Ontario—indeed, early warnings of the emerging threat posed by this invader were published more than one hundred years ago (Gussow 1916)—this pathogen continues to be a concern in protected natural areas such as Quetico Provincial Park (Champaigne-Klassen 2016). In addition, concerns regarding the threat of the disease have led to a reluctance to reforest sites with eastern white pine (Ostry *et al.* 2010).

For over a century, beech bark disease (BBD) in northeastern North America has been killing and severely damaging beech trees. BBD is a complex of two invasive species, a scale insect and a fungal pathogen (McLaughlin and Greifenhagen 2012). Its arrival in Ontario (1989) has been challenging, requiring forest and park managers to juggle a wide array of issues including: loss of biodiversity, wildlife concerns, forest composition, and safety issues, as well as necessitating the development of silviculture management practices, all in an attempt to manage the disease. Forest management efforts of primary concern are focused on approaches to control competing beech advance regeneration, reducing the proportion of beech basal area, and in maintaining diversity and beech's important ecological values. BBD continues to spread and is found almost throughout the entire range of beech in Ontario (Ontario Ministry of Natural Resources and Forestry 2016b).

More recently, oak wilt has become an imminent invasive threat to Ontario and Canada. Whereas this fungal pathogen is not yet known to occur in Canada, it has been killing oak trees throughout the eastern and midwestern United States, including within the Great Lakes Basin, as well as in Texas, (Juzwik *et al.* 2011). In 2016, oak wilt was found on Belle Isle Island (USA) in the St. Clair River, approximately 500 metres from the City of Windsor, Ontario. Oak wilt is a federally regulated pest, and as such, the Canadian Food Inspection Agency (CFIA) regulates the importation of oak materials. Detection surveys continue to be conducted by the MNRF and CFIA.

In general, the Canadian Food Inspection Agency, which also serves as Canada's National Plant Protection Organization (NPPO), maintains primary responsibility for preventing the introduction and establishment of invasive species not native to Canada. The CFIA has clear mandates for forests and plant pests, and through the Plant Protection Act, plays the lead role in preventing the introduction of pests (insects, pathogens and plants) that pose a threat to plant resources. However, the CFIA focuses its efforts on pests which are not native to Canada and have impacts on international trade.

With the passing of the ISA, forest pests that are native to a part of Canada, but not native to Ontario, can now be considered under the new legislation. In addition, new provincial tools which allow for the regulation of carriers or for the establishment of Invasive Species Control Areas—zones where the transport of invasive species and carriers out of the zone is controlled—could be a major step toward slowing the spread of these destructive invasive species.

Finally, inter-jurisdictional coordination mechanisms with a focus on forest pests will also continue to enhance efforts to prevent and respond to these invasive species in Ontario. For example, the Canadian Council of Forest Ministers' (CCFM) Forest Pests Working group provides a forum for ongoing discussion and collaboration between federal, provincial and territorial forest pest management agencies in Canada (Canadian Council of Forest Ministers 2018). As an active member and participant of the committee, Ontario will continue to support the efforts of the working group to prioritize resources and achieve effective, collaborative decision-making in the resolution of current and future forest pest problems (Ontario Ministry of Natural Resources 2012) as well as to disseminate best practices to facilitate forecasting for preparedness and coordination of pest management activities in Canada (Canadian Council of Forest Ministers 2012).

Conclusion

The Ontario Invasive Species Strategic Plan outlines the province's commitment 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. The recent passing of the Invasive Species Act has been a major milestone in implementing the OISSP as it was recognized that a strong, strategic legislative framework was necessary to address the complex challenges posed by invasive species. The Act provides an enabling legislative framework to better prevent, detect, respond to and where feasible, eradicate invasive species, and promotes a shared accountability for managing invasive species. The federal government in particular plays a key role in the prevention, control, and management of invasive species, so achieving the goals of the OISSP will require continued collaboration and coordination with federal agencies. This is especially true for invasive species of national significance, including many forest pests and pathogens. Finally, to be successful in preventing the introduction and spread of invasive species, non-government organizations, stakeholders, municipal level government agencies, and members of the general public must also be involved, which is why collaborative partnerships will continue to be instrumental in Ontario's fight against invasive species.

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