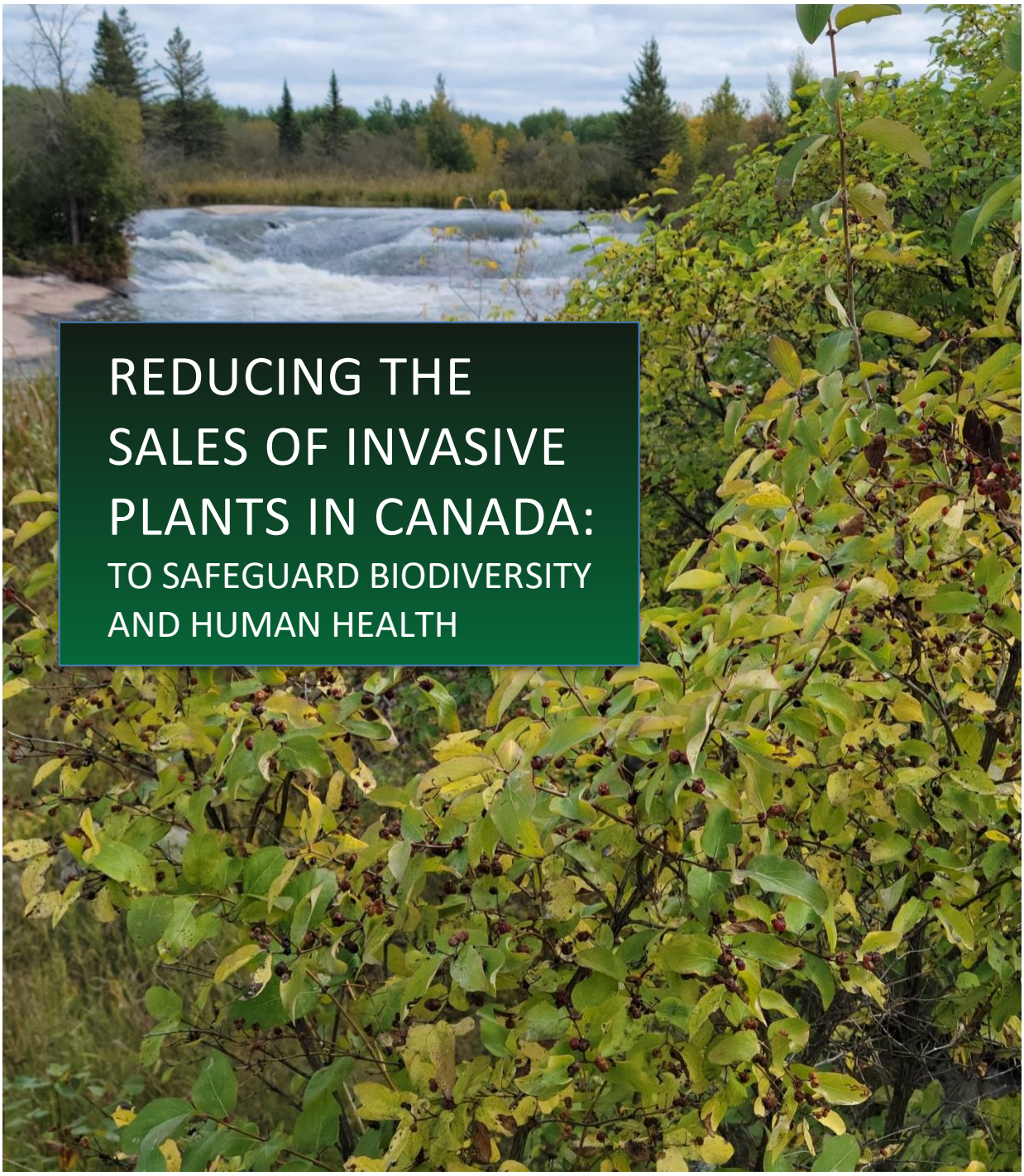

REDUCING THE SALES OF INVASIVE PLANTS IN CANADA:

TO SAFEGUARD BIODIVERSITY AND HUMAN HEALTH

Tatarian honeysuckle (*Lonicera tatarica*) near Pinawa Dam Prov Park Manitoba. Photo by Séraphin Poudrier via iNaturalist CC BY-NC.

Prepared by Cathy Kavassalis and Claudette Sims with editorial assistance from Katherine Baird, Candi Jeronimo, Lynne Patenaude, Renee Sandelowsky, and Freyja Whitten – April 3, 2024.
On behalf of the Canadian Coalition for Invasive Plant Regulation - CCIPR.ca

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ACRONYMS

1: Organizations

CABI	CAB International
CBD	Convention on Biological Diversity & SCBD Secretariat of the CBD
CCIPR	Canadian Coalition for Invasive Plant Regulation
CCIS	Canadian Council on Invasive Species
CESCC	Canadian Endangered Species Conservation Council
CFIA	Canadian Food Inspection Agency
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CMS	Convention on Migratory Species of Wild Animals
COP	Conference of the Parties (CBD)
CTE	Committee on Trade and Environment (WTO)
DFO	Fisheries and Oceans Canada
ECCC	Environment and Climate Change Canada
EPPO	European and Mediterranean Plant Protection Organization
FAO	Food and Agricultural Organization of the United Nations
FPT IAS	Federal-Provincial-Territorial Invasive Alien Species Task Force (replaced by FPT IAS Working Group)
ICRA	International Cultivar Registration Authorities
IPBES	Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Service
IPCC	Intergovernmental Panel on Climate Change
ISC	Invasive Species Centre
ISCBC	Invasive Species Council of British Columbia
IUCN	International Union for Conservation of Nature
MPI	Ministry for Primary Industries (New Zealand)
NAPPO	North American Plant Protection Organization
NRCan	Natural Resources Canada
OIPC	Ontario Invasive Plant Council
PIJAC	Pet Industry Joint Advisory Council of Canada
RISCC	Regional Invasive Species & Climate Change Management Networks
RPPO	Regional Plant Protection Organization
UNEP	United Nations Environment Programme
USDA-ARS	United States Department of Agriculture – Agricultural Research Service
WTO	World Trade Organization
WWF	Worldwide Fund for Nature

2: Regulations, Frameworks, & Initiatives

CEPA	*Canadian Environmental Protection Act, 1999 (S.C. 1999, c. 33)*
GBF	*Kunming-Montréal Global Biodiversity Framework* (DEC/15/4 19 Dec. 2022)
NEWT	National Established Weed Priorities (Australia)
NPPA	*National Plant Pest Accord* (New Zealand, 2001)
PPA	*Plant Protection Act (S.C. 1990, c. 22)*
SPS	*Agreement on the Application of Sanitary and Phytosanitary Measures* (pdf)
WSO	*Weed Seeds Order, 2016 (SOR/2016-93)*
IPPC	International Plant Protection Convention
ISPM	International Sanitary and Phytosanitary Measures

3: Terms

ASW	Agricultural Sleeper Weeds (Australia)
AIS	Aquatic Invasive Species
IAS	Invasive Alien Species
NGO	Non-Governmental Organization
WoNS	Weeds of National Significance (Australia)
WINS	Weed Issues of National Significance (Australia)

4: Databases and Acronyms Associated with Risk Assessment

AqWRA	Aquatic Weed Risk Assessment
EICAT	Environmental Impact Classification for Alien Taxa
GABLIS	German-Austrian Black-List Information System
GBIF	Global Biodiversity Information Facility
GB-NNRA	Great Britain Non-Native Species Risk Assessment
GRID	Global Resource Information Database (UNEP)
GRIN	Germplasm Resources Information Network (USDA-ARS)
GRISS	Global Register of Introduced and Invasive Species
IPNI	International Plant Names Index
ISEIA	Invasive Species Environmental Impact Assessment
ITIS	Integrated Taxonomic Information System
NISIC	National Invasive Species Information Center (U.S.)
POWO	Plants of the World Online
PRA	Pest Risk Analysis
RMD	Risk Management Documents
SEICAT	Socio-Economic Impact Classification for Alien Taxa
TRY	Global Database for Plant Traits
US-RIIS U.S.	United States Register of Introduced and Invasive Species
VASCAN	Database of Canadian Vascular Plants
WRA	Weed Risk Assessment

5: **Provincial and Territory Abbreviations**

AB – Alberta	NS – Nova Scotia	SK – Saskatchewan
BC – British Columbia	NT – Northwest Territories	PE – Prince Edward Island
MB – Manitoba	NU – Nunavut	YT – Yukon
NB– New Brunswick	ON – Ontario	
NL – Newfoundland & Labrador	QC – Quebec	

6: **Border State Abbreviations**

AK – Alaska	MT – Montana	WA – Washington
ID – Idaho	NH – New Hampshire	WI – Wisconsin
ME – Maine	ND – North Dakota	
MI – Michigan	PA – Pennsylvania	
MN – Minnesota	VT– Vermont	

A. CANADA'S INTERNATIONAL OBLIGATIONS: A CLOSER LOOK

The Global Biodiversity Crisis:

> "We are facing an unprecedented biodiversity crisis with more than one million species facing extinction globally, including 640 at-risk species in Canada. This rapid decline of biodiversity has critical implications for humanity, from the collapse of food, economic, and health systems, to the disruption of entire supply chains. The Government of Canada is committed to taking ambitious actions to restore and protect the natural safety net granted by biodiversity." (Minister Guilbeault).[1]

CONVENTION ON BIOLOGICAL DIVERSITY (1992)

Canada has been a party to the *Convention on Biological Diversity* (CBD) since its inception in 1992. The CBD is an international legally binding instrument for the conservation of biological diversity.[2] As a signatory, Canada has agreed to "**Prevent the introduction of, control, or eradicate those alien species which threaten ecosystems, habitats, or species**."[3] Under the CBD, "invasive alien species" is defined as a species whose movement by human agency, indirect or direct, outside of its natural range (past or present) threatens biological diversity.[4]

To meet our obligations under the CBD, Canada developed a *Canadian Biodiversity Strategy* (1995) directing the government to: "take all necessary steps to prevent the introduction of harmful alien

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[1] "This was part of Minister Guilbeault's statement on Canada's commitment to the protection and recovery of species at risk and restoring natural areas and biodiversity (Environment and Climate Change Canada, 2022). His words echo the words of Prof. Josef Settele who co-chaired the recent global assessment of biodiversity and ecosystem services: "Ecosystems, species, wild populations, local varieties and breeds of domesticated plants and animals are shrinking, deteriorating or vanishing. The essential, interconnected web of life on Earth is getting smaller and increasingly frayed. . .. This loss is a direct result of human activity and constitutes a direct threat to human well-being in all regions of the world" (Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), 2019a).

[2] *Convention on Biological Diversity* (CBD), 1992. "The Convention on Biological Diversity (CBD) is the international legal instrument for "the conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources" that has been ratified by 196 nations. Its overall objective is to encourage actions, which will lead to a sustainable future. The conservation of biodiversity is a common concern of humankind" (United Nations, "Convention on Biological Diversity, key international instrument for sustainable development," n.d.).

[3] Secretariat of the Convention on Biological Diversity, "The CBD and Invasive Alien Species," 2021. The CBD definition is distinct from that used by the IPPC. From the International Standards for Phytosanitary Measures (ISPM) glossary: "An invasive alien species is an alien species (CBD) that by its establishment or spread has become injurious to plants, or that by risk analysis (CBD) is shown to be potentially injurious to plants," (ISPM-5, "Glossary of phytosanitary terms," 2023).

[4] CBD COP-6, "Alien species that threaten ecosystems, habitats or species," 2002.

organisms, ensuring that there is **adequate legislation** and enforcement **to control introductions or escapes** of harmful alien organisms and improving preventive mechanisms such as screening standards and **risk assessment** procedures."

Strategic Plan for Biodiversity 2011-2020 and the Aichi Targets (2010)

In 2010, the Conference of the Parties (COP) to the CBD adopted the "*Strategic Plan for Biodiversity 2011–2020 and the Aichi Targets*"[5] to motivate more effective and urgent global actions. In response, Canada prepared matching national biodiversity goals.[6] By 2020, Canada pledged "collective efforts by all governments to identify high **priority pathways** of invasive species into Canada, **improve national and regional regulatory** frameworks, and introduce education and outreach efforts to reduce the introduction and spread of IAPS."

An evaluation of how Canada has executed its national biodiversity strategy reveals that despite most jurisdictions asserting their commitment to biodiversity, there's a noticeable lack of a cohesive strategy within provinces and territories or across the federation. The analysis determined that real progress would require not just **legal reforms** but a comprehensive government-wide approach. This includes adopting a **bio-centric perspective**, embracing innovative governance models (especially those led by Indigenous groups), and ensuring assertive **federal leadership** backed by substantial **financial commitment**.[7]

KUNMING-MONTRÉAL GLOBAL BIODIVERSITY FRAMEWORK (2022):

In December 2022, at the Conference of the Parties to the *Convention on Biological Diversity* (CBD), the adoption of the Kunming-Montréal Global Biodiversity Framework marked a significant step in global efforts to preserve and protect nature and its vital services to people. Central to this framework is Target 6, which focuses on halving the rate of introduction and establishment of invasive alien species (IAS) and effectively managing their impacts by 2030. For Canada, this target spotlights the pressing issue of invasive alien plants, predominantly introduced through the ornamental plant trade.

The preliminary draft of Canada's "2030 National Biodiversity Strategy" by Environment Canada and Climate Change acknowledges the importance of raising awareness, enhancing data sharing, and improving collaborative efforts across jurisdictions to combat IAS.[8] However, this draft falls short in addressing the critical need for robust federal oversight and comprehensive legislative reform.

The 2017 Federal-Provincial-Territorial Task Force on Invasive Alien Species underscored the necessity of national leadership in managing IAS. In addition, interviews conducted with members of the IAS Task Force in late 2015 revealed a consensus on the need for legislative reform to regulate organisms in trade and ensure consistent legislation across jurisdictions. Public consultations for the development of the 2030 Biodiversity Strategy echoed the task force recommendations, yet the draft strategy scarcely

[5] The Aichi biodiversity targets were established by the UN CBD and consist of **20 specific targets to address and mitigate biodiversity loss across the globe**.
[6] Gov. of Canada, "2020 Biodiversity Goals & Targets for Canada," 2016.
[7] Ray, Grimm, & Olive, "The biodiversity crisis in Canada: Failures and challenges of federal and sub-national strategic and legal frameworks'" 2021.
[8] ECCC, "Milestone document," 2024.

touches upon the necessity for legislative reform or the exploration of unified biodiversity or biosecurity legislation.

To effectively meet Target 6 of the CBD with respect to invasive alien plants, Canada must adopt an integrated approach that encompasses legislative, administrative, scientific, educational, and community-based strategies, extending beyond those recognized in the current draft strategy. As discussed in the main body of this paper, key priorities should include:

- **Legislative Reforms**: Urgently update existing laws to regulate the importation, sale, and distribution of potentially invasive plant species, with mandatory risk assessments for new plant imports, and mandatory labeling on all potentially invasive products or those that could serve as vectors for invasive species.
- **National Coordination and Leadership**: Establish a centralized national body responsible for coordinating invasive species management across provinces and territories, drawing lessons from successful biodiversity management models both domestically and internationally.
- **Addressing Research and Knowledge Gaps**: Significantly increase funding for research on the biology, ecology, risk assessment, and management of invasive species. Develop a **virtual invasive species information hub** to inform policy development and practical management strategies.
- **Public Education and Community Engagement:** Launch comprehensive public education campaigns to raise awareness about the risks posed by invasive plants, promote alternatives, and encourage greater community involvement in monitoring, reporting, and managing invasive species.
- **Partnership with Industry**: Collaborate with the horticultural, landscaping, and pet/aquarium industries to develop a national accord on best practices for preventing the spread of invasive species.
- **International Collaboration**: Engage in international forums to share knowledge, experiences, and best practices in invasive species management, ensuring that Canada's efforts align with global standards and contribute to a coordinated global response to biodiversity loss.

To preserve Canada's rich biodiversity and fulfill its commitments under the Kunming-Montréal Global Biodiversity Framework, immediate and decisive action is required. This includes a comprehensive strategy that not only addresses the existing gaps in the draft strategy but also sets a clear and ambitious path forward for managing invasive alien plants effectively.

CCIPR provided input to ECCC.[9] Below is a summary providing further insight into the 23 GBF targets:

TARGETS 1-8: Reducing Threats to Biodiversity through IAS Prevention and Management

Target 1*: bring the loss of areas of high biodiversity importance close to zero by 2030*: Canada has identified 11 federal/provincial/territorial priority areas of high biodiversity value.[10] IAS are considered a key threat to these areas and developing a robust IAS strategy is necessary if Canada is to protect them. Invasive species have also been identified as primary threats to Key Biodiversity Areas and Important

[9] ECCC, "Milestone Document," 2024.
[10] Canada – Environment and Natural Resources, "Overview of the Pan-Canadian approach to transforming species at risk conservation in Canada," 2023.

Bird and Biodiversity Areas.[11] These areas support rare and threatened species and ecosystems, and key natural processes, making prevention measures a priority.

Target 2*: restore at least 30 percent of areas of degraded ecosystems* – Invasive species are both "drivers" of ecosystem change and "passengers" (increasing because of opportunity) in degraded ecosystems.[12] Prevention and management of invasive species is therefore crucial to prevent further degradation of sites and ensure successful restoration.

Target 3*: equitably conserve and manage 30 percent of areas* – Invasive species impact all but the most remote areas, but not all areas have the equal resources or capabilities to address threats. National action is necessary to ensure the equitable control of IAS across Canada.

Target 4*: halt human induced extinction of known threatened species* – IAS contribute to the extinction and decline of many threatened species. Recovery and conservation of these species require that Canada pay careful attention to IAS distribution and impacts. For instance, the genetic diversity of Canada's native red mulberry (*Morus rubra*) is directly threatened by white mulberry (*Morus alba*), common in the nursery trades,[13] yet little attention has been directed to control the sale of white mulberries that can hybridize with the red.

Targets 5*: ensure the use, harvesting and trade of wild species is sustainable* – Sustainable use of wild species can be threatened by IAS in many ways. From altering important processes like nutrient cycling to altering pollination networks, they place food production and gathering at risk. For instance, an invasive plant like giant hogweed whose sap can cause severe burns can interfere with fishing or food gathering.[14] An aquatic invasive plant like European water-chestnut can form dense mats, leading to decreased dissolved oxygen levels, which can kill fish.[15]

Target 6. *Reduce rates of introduction and establishment of invasive alien species by 50 per cent* – In order to know when the 50 per cent reduction is achieved, Canada should first establish baseline data, so progress can be tracked and evaluated. Data would include the number of introduced species, their rate of spread, areas at risk, and population size.[16] These actions require a robust IAS strategy within the overall biodiversity strategy.

Target 7: *Reduce pollution risks* –Invasive species like the emerald ash borer can significantly heighten pollution risks by destroying native trees such as ash, which are crucial for absorbing air pollutants. Additionally, invasive species can introduce 'pathogen pollution' (the human-mediated introduction of pathogens to new hosts or regions)[17] and act as sources of 'biological pollutants,' like the allergenic

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[11] "'Ensuring no invasive species are introduced is essential . . .' notes the KBA Secretariat" (Labbé, "7 places in B.C. classified as key biodiversity hot spots,"2022. Bird's Canada, "Canada's critical places for Nature," 2024.
[12] MacDougall & Turkington, "Are invasive species the drivers or passengers of change in degraded ecosystems?" 2005; Bauer, "Invasive species: "back-seat drivers" of ecosystem change?" 2012; Essl, et al., "Drivers of future alien species impacts: An expert-based assessment," 2020; Caro., et al., "An inconvenient misconception: Climate change is not the principal driver of biodiversity loss," 2022; Britton et al., "Preventing and controlling nonnative species invasions to bend the curve of global freshwater biodiversity loss," 2023;
[13] Parks Canada Agency. "Recovery Strategy for the Red Mulberry (Morus rubra) in Canada," 2011.
[14] Invasive Species Council of BC, "Indigenous Community Toolkit for Managing Invasive Species," 2011.
[15] Ontario Ministry of Natural Resources and Forestry, "Water chestnut," 2022.
[16] Several organization are already tracking plants, e.g., Canadian Endangered Species Conservation Council, "Wild Species 2020: The General Status of Species in Canada," 2021.
[17] Pyšek et al., "Scientists' warning on invasive alien species," 2020; Chinchio, et al., "Invasive alien species and disease risk: An open challenge in public and animal health," 2020.

pollen from the tree-of-heaven. This understudied interaction between invasive species and pollution underscores an urgent need for research to understand and mitigate their combined impact on ecosystems and public health.[18]

Target 8: *Minimize the impact of climate change and ocean acidification on biodiversity* – Climate change and invasive species rank among the primary causes of biodiversity depletion. These factors, when combined, amplify their respective impacts, posing significant challenges to both field conservationists and policymakers.[19]

Both climate change and ocean acidification affect which species can survive habitats. As invasive species disrupt these habitats, they can further drive global change by altering nutrient cycling, modifying hydrology, changing water chemistry or soil properties, degrading habitat structure, and changing fire regimes. These changes can contribute to or worsen climate change[20] and may contribute to localized ocean acidification. For instance, invasive algal mats are associated with "decreased irradiance, sediment trapping, and periods of hyperoxia, hypoxia and acidification."[21] In terrestrial settings, a plant like kudzu can promote eutrophication, the formation of tropospheric ozone, and CO_2 emissions.[22]

Canada's biodiversity strategy must recognize these complex interconnections and prioritize integrated solutions that consider the multifaceted nature of environmental threats. Only through a coordinated and adaptive response can we hope to preserve Canada's rich biodiversity for future generations.

Target 9 - *Manage wild species sustainably to benefit people* – IAS management ensures that the use of wild species remains sustainable by preventing IAS from disrupting ecosystems and processes described above, which are essential for maintaining biodiversity that supports livelihoods.

Target 10*: ensure that areas under agriculture, aquaculture, fisheries, and forestry are managed sustainably* – Sustainable agriculture/aquaculture/fisheries/forestry have already been the focus of most government action on invasive species, but much more needs to be done. Minimizing the presence of invasive plants can lead to a significant decrease in the reliance on unsustainable herbicide applications and labor-intensive eradication efforts. This reduction also carries the added benefit of diminishing the environmental impact associated with these methods.

Target 11: *Restore, maintain, and enhance nature's contributions to people* – Invasive species can affect ecosystem functions and the associated services. Invasive species can impact provisioning services by reducing crop production, reducing the availability and quality of drinking water, reducing timber production, diminishing fishery stocks, etc. Invasive species can disrupt regulating services including pollination, decomposition, water purification, erosion, and flood control, as well as carbon storage, and climate regulation. By changing natural heritage, invasive plants impact cultural services, reducing recreational opportunities, diminishing spiritual or artistic opportunities, and impacting Indigenous relationships with the land. Invasive species can impact fundamental supporting services that sustain ecosystems by impacting photosynthesis, nutrient cycling, the creation of soils, as well as the carbon and water cycles.

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[18] Denóbile, de Castro, & Matos, "Public Health Implications of Invasive Plants: A Scientometric Study," 2023.
[19] Mainka & Howard, "Climate change and invasive species: double jeopardy," 2010.
[20] Turbelin & Catford, "Chapter 25 - Invasive plants and climate change," In Climate Change (third addition), 2021' Pyšek et al., 2020.
[21] Martinez, Smith, & Richmond, "Invasive algal mats degrade coral reef physical habitat quality," 2012.
[22] Sage, "Global change biology: a primer," 2019.

The IPBES IAS report makes clear that the impact of invasive alien species on nature's contributions to people are negative – especially through damage to food supplies.[23] To ensure nature can support people, greater investment in the management of biological invasions is essential.

Target 12: *Enhance green and blue spaces* – Urban ecosystems, frequently identified as hotspots for biological invasions,[24] significantly impact a large portion of Canada's population. By investing in the enhancement and maintenance of green and blue spaces within urban areas, Canada stands to improve public well-being.[25] For instance, a recent study found people who live near natural areas with a greater diversity of bird species were demonstrably happier.[26] Restoring natural infrastructure can also provide employment opportunities. Habitat restoration projects, including invasive species removal, can generate jobs.[27] However, preventing the introduction and spread of invasive plants within green and blue spaces is paramount as the costs of removal and management can be high and represent ongoing drains on resources.[28]

Target 13: *Increase sharing of benefits from genetic resources* – Genetic research on invasive species has been crucial for understanding and managing biological invasions. For instance, genetic research can help identify the origins of invasive species, like *Phragmites australis* one of the worst IAS in Canada. Genetic analysis also can inform management approaches,[29] and such information should be widely available to land managers and policy makers.

Tools and Solutions for Implementation and Mainstreaming IAS Prevention

Target 14: *Integrate biodiversity and decision-making* – It is critical that the impacts to biodiversity be part of the risk analysis processes for IAS and management decisions should reflect a full understanding of those impacts. To effectively align with this target in the context of IAS, **nature valuation** (the process of quantifying the intrinsic, ecological, and economic benefits that natural ecosystems and biodiversity provide to humans and the environment) should play a pivotal role in the screening process. Here's how:

1. **Assess IAS Impacts on Ecosystem Services**: This involves quantifying services like pollination, water purification, and carbon sequestration, and evaluating the costs of disruption.
2. **Use Biodiversity Metrics**: Determine how IAS impact species richness, habitat integrity, and ecosystem connectivity. This can help in understanding the broader ecological consequences of introducing or failing to prevent the spread of a particular invasive species.
3. **Apply the Precautionary Principle**: Given the uncertainties often associated with the introduction of new species, **nature valuation** in the screening process should err on the side of caution, favouring preventative measures when the potential impact on biodiversity is significant or not fully understood.

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[23] IPBES, "Media Release: IPBES Invasive Alien Species Assessment," 2023.
[24] Gaertner, et al., "Non-native species in urban environments: patterns, processes, impacts and challenges," 2017.
[25] Nguyen, et at., "Green space quality and health: Systematic review, 2021; Osei, et al., "The multiple benefits of green infrastructure, 2023.
[26] Methorst, et al. "The importance of species diversity for human well-being in Europe."2020.
[27] "50 ARRA [American Recovery and Reinvestment Act] projects administered by NOAA in the first year and half generated a total of 1409 jobs," (Edwards, Sutton-Grier, & Coyle, "Investing in nature: Restoring coastal habitat blue infrastructure and green job creation," 2012).
[28] "Restoration costs (removal of invasive species) are higher in peri-urban areas," (Vallecillo et al., Spatial alternatives for Green Infrastructure planning across the EU: An ecosystem service perspective," 2018).
[29] Lindsay, et al., "Genetic analysis of North American Phragmites australis guides management approaches," 2022.

4. **Economic Cost-Benefit Analysis**: Incorporate economic analyses that compare the costs of IAS management (prevention, control, eradication) against the economic benefits of preserving ecosystem services and biodiversity. This should include consideration of long-term ecological and economic impacts.
5. **Stakeholder Engagement**: Engage a broad range of stakeholders in the valuation process, including Indigenous communities, local populations, non-governmental organizations, scientists, and industry representatives. This ensures that diverse perspectives and knowledge systems are considered.
6. **Dynamic and Adaptive Management**: Recognize that nature valuation is not a one-time process but requires continuous monitoring and adaptation as new information becomes available about the impacts of IAS on biodiversity and ecosystem services.

By embedding nature valuation into the screening process for IAS, decision-makers can ensure that actions taken are informed by a comprehensive understanding of the potential impacts on biodiversity. This approach supports more informed, effective, and sustainable management decisions that align with the goal of integrating biodiversity considerations into all aspects of decision-making.

Target 15: *Take legal, administrative or policy measures to encourage and enable business, and in particular to ensure that large and transnational companies and financial institutions: (a) Regularly monitor, assess, and transparently disclose their risks, dependencies and impacts on biodiversity* – Currently, the horticultural industry, pet aquarium trade, and various e-commerce sites do not monitor and disclose the risks of introducing invasive species into Canada. Under the New Zealand *Biosecurity Act* 1993, an import health standard (IHS) is required for importation of any biosecurity risk goods,[30] this includes plants and animals that may be invasive and threaten biodiversity. Industry bears the cost of risk analysis.

Global trade of invasive species is increasing, and measures must be put in place to reduce the introduction and spread of pests and disease. Transnational companies must take responsibility to comply with international phytosanitary measures, and all companies should be required to pay for risk assessments when introducing new species or cultivars of plants. Further when an introduced product poses a potential risk to biodiversity, industry should be obliged to inform consumers at point of sale of those risks and the actions required to prevent the product from harming natural ecosystems.

Target 16: *Enable sustainable consumption choices* – A significant number of invasive species gain entry through trade, both intentionally (such as ornamental plants, pets, or aquaculture species) and unintentionally (as unintended passengers in cargo shipments). One key to mitigating this problem lies in fostering sustainable consumption habits. Raising public awareness about the environmental consequences of purchasing certain products is crucial. Educating consumers about responsible ownership and appropriate disposal methods for potentially invasive ornamental plants can help prevent their spread. Implementing mandatory labeling that clearly indicates the potential invasiveness of products can play a pivotal role in guiding consumer choices towards more environmentally responsible options.

Target 17: *Strengthen biosafety and distribute the benefits of biotechnology* – Genetically Modified Organisms (GMOs), as products of advanced biotechnology, have the potential to become invasive if they unintentionally escape into natural environments and either establish new populations or impact the genetic makeup of native species. It is imperative that Canada implement robust biosafety protocols

[30] Ministry for Primary Industries, "Import health standards (IHSs)," 2024.

to prevent such accidental releases, given their potential for significant ecological repercussions. Continuous monitoring, along with the development and refinement of risk assessment procedures, are essential to ensure the safe utilization of GMOs.

Additionally, it is vital to strengthen regulatory frameworks to govern the deployment of these organisms effectively. Safe genetic tools that aid in identifying, monitoring, and controlling invasive species should be made available for utilization across Canada where most needed. Such tools can significantly enhance Canada's capabilities in managing IAS and should be shared responsibly and equitably to maximize their benefits for biodiversity conservation.

Target 18 & 19: *Reduce harmful incentives by at least $500 billion per year & mobilize $200 billion per year for biodiversity* – Canada must critically evaluate its existing subsidies in sectors such as agriculture, forestry, and fisheries to determine if they inadvertently encourage practices that contribute to the spread of invasive species. For instance, subsidies that favour certain crops like sea buckthorn, which is invasive[31] should be stopped. These practices can diminish ecosystem resilience and make them more vulnerable to invasive species.

The redirected funds should focus on preventing the spread of invasive species and supporting the cultivation and propagation of native keystone species. Such initiatives will not only curb the spread of invasive species but also significantly contribute to the preservation and enhancement of Canada's rich biodiversity.

Target 20 & 21: *Strengthen capacity-building, technology transfer, and scientific and technical cooperation for biodiversity . . ..* & *Ensure that knowledge is available and accessible to guide biodiversity action* – These two targets are best addressed together through the creation of a comprehensive virtual information hub. This hub should serve as a central repository for sharing technical information, decision-support tools, and best practices in managing IAS. It would facilitate the dissemination of current research findings, innovative management strategies, and case studies demonstrating successful IAS interventions.

Additionally, the hub should offer interactive platforms for scientists, policymakers, conservation practitioners, and community stakeholders to engage in meaningful dialogue, exchange ideas, and collaborate on projects. This would enhance collective learning and enable the adaptation of strategies to local contexts.

Moreover, the platform could host training modules and educational resources to build capabilities at various levels – from local community groups to national agencies. This would ensure a wide range of stakeholders are equipped with the necessary skills and knowledge to effectively combat IAS.

In terms of technology transfer, the focus should be on making cutting-edge tools and technologies accessible to all stakeholders involved in biodiversity conservation. This includes remote sensing technologies for monitoring ecosystem changes, genetic tools for species identification, and advanced data analytics for predicting invasion risks.

Finally, strengthening scientific and technical cooperation involves fostering partnerships across borders. Invasive species are a global concern, and international collaboration is essential for developing unified strategies, sharing successful intervention models, and conducting joint research initiatives.

[31] Sea buckthorn (*Hippophae rhamnoides* L.) was promoted by Agriculture and Agri-Food Canada, but was ranked 15th in a prioritized list of invasive alien plants of natural habitats in Canada (Catling and Mitrow, "New top of the list," 2005).

It underscores the need for inclusive decision-making in biodiversity conservation, ensuring that knowledge is accessible to a wide array of stakeholders, including Indigenous groups, local communities, and vulnerable populations.

Through these concerted efforts in capacity building, technology transfer, and scientific cooperation, Canada can significantly advance its capabilities in managing Invasive Alien Species (IAS), thereby contributing to the broader goal of global biodiversity conservation. By ensuring that knowledge is accessible to a wide array of stakeholders, including Indigenous peoples, local communities, and vulnerable populations, Canada can facilitate more inclusive decision-making in biodiversity conservation.

Target 22 & 23: *Ensure participation in decision-making and access to justice & Ensure Gender Equality and a gender-responsive approach* – To effectively ensure full, equitable, inclusive, and gender-responsive representation and participation in both decision-making processes and actions related to biodiversity and the management of invasive species, the strategy should:

- **Establish Participatory Platforms**: Create inclusive platforms where Indigenous Peoples, local communities, women, youth, and persons with disabilities can actively participate in discussions and decision-making processes concerning invasive species management and the protection of biodiversity. These platforms should respect and integrate traditional knowledge and practices in managing biodiversity. Consultative approaches can deliver significant benefits, especially when there may be conflicts of interest or mistrust between stakeholders.[32]
- **Enhance Access to Information and Justice**: Ensure that all stakeholders, especially marginalized groups, have access to relevant information about invasive species and their impacts on biodiversity. This includes providing resources and education in accessible formats and languages. Additionally, establish mechanisms for these groups to seek justice in cases where their environmental rights are infringed upon.
- **Capacity Building and Empowerment**: Develop targeted programs to build the capacity of underrepresented groups in invasive species management. This involves training in biodiversity conservation techniques, leadership skills, and legal frameworks related to environmental protection.
- **Gender-Responsive Approaches**: Strategies for preventing biodiversity loss must involve and empower women and **gender-diverse individuals**, acknowledging their unique experiences and needs. It is essential to actively involve these groups in every step of the solution development process. This includes ensuring their representation in decision-making bodies and forums where strategies and policies regarding invasive species management are discussed and formulated. Providing them with access to training, resources, and leadership opportunities is crucial. Overcoming social, economic, and cultural barriers is essential to facilitate their active participation. By empowering women and gender-diverse individuals as key stakeholders and **agents of change,** these approaches would not only enhance biodiversity conservation efforts but also advance gender equality and social justice in environmental governance.
- **Youth Engagement**: Involve children and youth in educational programs about invasive species and biodiversity conservation, fostering a new generation of informed and active environmental stewards.

[32] IPBES, "Chapter 6. Governance and policy options for the management of biological invasions," 2023.

- **Accessibility and Inclusivity in Policy Design**: Design policies and initiatives for invasive species management that are sensitive to the needs of persons with disabilities, ensuring accessibility in both physical and informational aspects.

INTERNATIONAL PLANT PROTECTION CONVENTION (IPPC) (1951)

According to the Secretariat of the *International Plant Protection Convention* (IPPC),

> The IPPC has historically maintained that the adverse consequences of pests, including those concerning uncultivated/unmanaged plants, wild flora, habitats, and ecosystems, are measured in economic terms. References to the terms' economic effects, economic impacts, potential economic importance and economically unacceptable impact and the use of the word economic in the IPPC and in ISPMs [I*nternational Standards for Phytosanitary Measures*] have resulted in some **misunderstanding of the application** of such terms and of the focus of the IPPC.
>
> The scope of the Convention applies to the protection of wild flora resulting in an important contribution to the conservation of biological diversity. However, **it has been misinterpreted** that the IPPC is only commercially focused and limited in scope. It has not been clearly understood that the IPPC can **account for environmental concerns in economic terms**. This has created issues of consistency with other agreements, including the *Convention on Biological Diversity* . . .[33]

To remedy this misinterpretation, the IPPC Secretariat updated their guidelines to clarify that environmental concerns should be accounted for in economic terms **using monetary or non-monetary values**. Further, they asserted that contracting parties have the right to take actions with respect to pests (including invasive plants) for which the economic damages **cannot be easily quantified**.

To better align the IPPC and the CBD, nations should:

- **Enhance plant protection laws and policies**, where needed, to include the protection of wild flora and biodiversity from plants that are invasive alien species; . . .
- Give particular attention, when carrying out **pest risk analysis**, to the possibility that introduced **plants** could act as **invasive** alien species, . . .
- **Improve communication** between national ECCC, the CBD focal point, and the CFIA, the IPPC contact point."[34]

B. OVERVIEW: FEDERAL LEGISLATION AND INVASIVE PLANTS

While several federal departments and/or agencies have responsibilities to prevent the introduction or spread of substances or organisms considered harmful to life, health, property or the environment, the regulation of invasive plants falls primarily to the Canadian Food Inspection Agency (CFIA) (Table 3).

[33] ISPM-5, 2023c, p.28.

[34] Food and Agriculture Organization of the United Nations, "Seventh Interim Commission on Phytosanitary Measures," 2005, 20; Secretariat of the Convention on Biological Diversity', "Notification of National level collaboration between agencies responsible for biodiversity and plant protection," 2006. Included in the FAO: "Recommendation on: Threats to biodiversity posed by alien species: actions within the framework of the IPPC," 2017. p.1-2.

Other departments and agencies have regulations that could apply to invasive plants, but in practice the CFIA has had sole authority over plants under the *Plant Protection Act* and *Seeds Act*. Fisheries and Oceans Canada (DFO) has introduced *Aquatic Invasive Species Regulations*, but they do not currently address invasive aquatic plants.[35] Environment and Climate Change Canada (ECCC) have several laws and regulations to protect the environment, like the *Canadian Environmental Protection Act* (CEPA). As will be discussed further below, no federal regulations are used to restrict the flow of invasive ornamental plants for sale in Canada.

Table 1. Departments and associated laws and regulations that could be applied to invasive plants.

Department or Agency	Federal Legislation with indirect or direct reference to introduced species or substances
Canadian Food Inspection Agency	*Canadian Food Inspection Agency Act* – Establishes the CFIA as responsible for the administration and enforcement of the *Canada Agricultural Products Act, Fish Inspection Act, Health of Animals Act, Plant Protection Act* and *Seeds Act*. The Minister of Agriculture is expressly designated as responsible for the Acts used to regulate invasive plants classified as pests. *Plant Protection Act* – Under this Act, the CFIA has the authority to restrict the import, sale, possession, and movement of certain plant pests. *Seeds Act* – No person shall sell, import, or export in contravention of the regulations any seed that presents a risk of harm to human, animal or plant health or the environment.
Agriculture and Agri-Food Canada	See *Plant Protection Act* and *Seeds Act* above.
Environment and Climate Change Canada	*Canadian Environmental Protection Act* – Specific act for the purpose of preventing pollution or, to put it in other terms, causing the entry into the environment of certain toxic substances. This authority is already applied to plants and other organisms that are covered under the biotechnology provisions of the *New Substances Notification Regulations*. *Canadian Wildlife Act* and *Species at Risk Act* – Both acts provide for measures, where necessary, for the protection of any species of wildlife in danger of extinction. *Migratory Birds Convention Act* – Canada is responsible to take such measures as may be necessary to control the importation of live animals and plants which it determines to be hazardous to the preservation of birds. *Wild Animal and Plant Protection and Regulation of International and Inter-provincial Trade Act* – The responsible minister may make regulations regarding the transport of animals and plants listed under the act between provinces where the minister of the province to where the species is being imported deems it harmful to the environment.
Parks Canada	*Canada National Parks Act* – The Minister is responsible for the maintenance or restoration of ecological integrity, through the protection of natural resources and natural processes.
Fisheries and Oceans Canada	*Fisheries Act* – No person shall deposit or permit the deposit of a deleterious substance of any type in water frequented by fish (36-3). *Aquatic Invasive Species Regulations* – It is prohibited to possess, import or transport listed invasive species, but no plants are yet included. *Coastal Fisheries Protection Act* *Fisheries Development Act*

[35] At a meeting of the Invasive Alien Species National Committee, it was indicated that DFO plans to begin regulating some aquatic plants in the coming years (Oct 2023).

	Oceans Act
Health Canada	*Controlled Drugs and Substances Act* *Pest Control Products Act*
Industry Canada	*National Research Council Act*
Natural Resources	*Department of Natural Resources Act* *Forestry Act* – It is not permitted to release a deleterious substance into water, which would degrade or alter the quality of the water or habitat.
Public Safety and Emergency Preparedness-Canada Border Services Agency	*Customs Act*
Transport Canada	*Transportation of Dangerous Goods Act* – Provides for control of organisms considered by the Governor in Council to be dangerous to life, health, property, or the environment when handled, offered for transport, or transported and prescribed to be included in this class.

C. THE *CANADIAN ENVIRONMENTAL PROTECTION ACT* AS A MODEL FOR INVASIVE PLANT REGULATION

In 1988, the Canadian Environmental Protection Act (CEPA) was established by amalgamating several laws, with subsequent revisions to address emerging environmental concerns. [36] CEPA's core intent is "to protect the environment, including its biological diversity, and human health" from adverse effects caused by toxic substances. The Act's opening declaration underscores this: "The protection of the environment is essential to the well-being of Canadians."

The definition of a toxic substance in CEPA parallels the characteristics of invasive alien plant species. Both can have immediate or long-term detrimental effects on the environment and its biodiversity. This similarity suggests that CEPA's framework could effectively guide the regulation of invasive plants.

Adapting CEPA's Preamble for Invasive Species Legislation:

An edited version of CEPA's Preamble, with strategic substitutions, can illustrate how a Canadian Invasive Species Act might read:

> *Preamble ~~Canadian Environmental Protection Act, 1999~~ [Canadian Invasive Species Act],*
>
> Whereas the Government of Canada seeks to achieve sustainable development that is based on an ecologically efficient use of natural, social, and economic resources and acknowledges the need to integrate environmental, economic and social factors in the making of all decisions by government and private entities;

[36] *Canadian Environmental Protection Act, 1999 (S.C. 1999, c. 33)* (CEPA). Act current to 2023-04-20 and last amended on 2021-05-01 2023; Environment and Climate Change Canada, "Timeline: Major milestones of Environment and Climate Change Canada," 2021.

Whereas the Government of Canada is committed to ~~implementing pollution prevention~~ [supporting biodiversity conservation] as a national goal and as the priority approach to environmental protection;

Whereas the Government of Canada acknowledges the need to virtually eliminate the most persistent and ~~bioaccumulative toxic substances~~ [highly invasive alien species] and the need to control and manage ~~pollutants and wastes~~ [invasive alien species] if their release into the environment cannot be prevented;

Whereas the Government of Canada recognizes the importance of an ecosystem approach;

Whereas the Government of Canada will continue to demonstrate national leadership in establishing environmental standards, ecosystem objectives and environmental quality guidelines and codes of practice;

Whereas the Government of Canada is committed to implementing the precautionary principle that, where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation;

Whereas the Government of Canada recognizes that all governments in Canada have authority that enables them to protect the environment and recognizes that all governments face environmental problems that can benefit from cooperative resolution;

Whereas the Government of Canada recognizes the importance of endeavouring, in cooperation with provinces, territories and Aboriginal peoples, to achieve the highest level of environmental quality for all Canadians and ultimately contribute to sustainable development;

Whereas the Government of Canada recognizes that the risk of ~~toxic substances~~ [invasive alien species] in the environment is a matter of national concern and that ~~toxic substances~~ [invasive alien species], once introduced into the environment, cannot always be contained within geographic boundaries;

Whereas the Government of Canada recognizes the integral role of science, as well as the role of traditional Aboriginal knowledge, in the process of making decisions relating to the protection of the environment and human health and that environmental or health risks and social, economic, and technical matters are to be considered in that process; …

Whereas the Government of Canada is committed to ensuring that its operations and activities on federal and Aboriginal lands are carried out in a manner that is consistent with the principles of ~~pollution prevention~~ [biodiversity conservation] and the protection of the environment and human health;

Whereas the Government of Canada will endeavour to remove threats to biological diversity through ~~pollution prevention~~ [invasive alien species prevention], the control and management of the risk of any adverse effects of the use and release of toxic substances, ~~pollutants and wastes~~ [invasive alien species], and the virtual elimination of ~~toxic substances~~ [highly invasive alien species];

And whereas the Government of Canada must be able to fulfil its international obligations in respect of the environment; …]

As CEPA states: “The Government of Canada must be able to fulfill its international obligations in respect of the environment.” Like federally regulated toxic substances, once introduced into the environment, invasive plant species cannot always be contained within geographic boundaries. New legislation is needed to respect our international obligations under the CBD and to respect our environment.

23,000 Existing Substances Screened:

To comply with CEPA, Environment and Climate Change Canada (ECCC) and Health Canada screened and categorized over 23,000 substances that existed in Canada prior to the Act. By 2006, 4,300 were prioritized for further assessment. Today, the evaluations for those priority substances have largely been

completed.[37] Results are published online in Canada's Existing Substances Assessment Repository (CESAR).[38] In addition, hundreds of new substances not yet in the market are screened annually. "Every year an average of 500 regulatory declarations are submitted for chemicals, polymers and living organisms under subsections 81(1), (3) and (4) and 106(1), (3) and (4) of the *Canadian Environmental Protection Act*, 1999 and around 100 waivers are granted."[39] The risk analysis process and the assessments are publicly accessible.[40] Canada needs to require the same level of screening, assessment and documentation for non-native plants existing and new to Canada.

CEPA's Evolution and Relevance to Invasive Plants:

In 1999 and 2005, CEPA was updated to address concerns about living organisms that are the product of biotechnology. The *New Substances Notification Regulations (Organisms)* SOR/2005-248 requires the assessment of new living organisms, including plants, prior to their introduction into the Canadian marketplace and ensures appropriate measures are taken to manage any potential adverse effects.[41] Under the regulation, invasiveness of these novel organisms is considered as part of the risk analysis process. This assessment process is applicable to invasive plants.

Risk Assessment under the *New Substances Notification Regulations*:

The new substance notification process begins with a pre-import or pre-manufacture notification of the substance, where any company or individual intending to import or manufacture a new substance in Canada must submit a package containing all information prescribed in the regulations. This information is used to conduct a risk assessment and must include:

- Life cycle and life history stages of the organism, including any means to survive environmental stresses, such as dormant stages.
- Reproductive biology, including species with which the organism could interbreed in Canada.
- Involvement in adverse ecological effects including pathogenicity, toxicity, and **invasiveness**.
- Descriptions of the global geographic distribution if not native to Canada
- Potential for dispersal of traits by gene transfer.
- Locations and situations where the organism have caused **adverse ecological effects**.
- Involvement in biogeochemical cycling (e.g., carbon, sulphur, and nitrogen).
- Interactions with other organisms in the environment (e.g., parasites, hosts, predators, prey, symbionts, competitors).
- Conditions required for survival, growth, reproduction, and overwintering.
- Capability of the organism to act as a vector for agents involved in adverse effects.

[37] ECCC (Environment and Climate Change Canada), "UPDATE – Strengthening the Canadian Environmental Protection Act, 1999 and recognizing a right to a healthy environment" 2023.
[38] ECCC and Health Canada. "Chemical substances fact sheets and frequently asked questions," 2022; Organization for Economic Co-operation and Development (OECD), "Canada's Existing Substances Assessment Repository," n.d..
[39] Department of the Environment, "Waiver of information requirements for living organisms (subsection 106(9) of the Canadian Environmental Protection Act, 1999," 2021.
[40] Government of Canada, "Risk assessment of chemical substances," 2022; Organisation for Economic Co-operation and Development (OECD) eChemPortal, "Canada's Existing Substances Assessment Repository," n.d..
[41] ECCC, "Guidelines for the Notification and Testing of New Substances: Organisms," 2010 modified 2022; (Gov. of Canada, "Understanding the *Canadian Environmental Protection Act*, 2022).

- Mechanisms of dispersal of the organism (e.g., its ability to spread to other sites) and modes of interaction with any dispersal agents.[42]

Under the purview of the Minister of Health and the Minister of the Environment, scientists assess new organisms to determine whether they present or may present a risk to the environment or to human health. Decisions are based on a scientific evaluation of the risk posed. This allows the Government of Canada to determine whether a risk management measure is needed, and if so, what type of control is best suited for reducing or preventing the potential harm.[43]

Proposal for Regulatory Expansion and Improved Processes:

In the realm of environmental protection, Canada faces a pivotal decision regarding the regulation of invasive plants. One possible approach would involve re-allocating regulatory responsibilities: ECCC could oversee terrestrial invasive plants under the *CEPA*, while DFO manages aquatic invasive plants, and the CFIA focuses on plants impacting agriculture and forestry.

ECCC stands out for its effective risk assessment procedures, particularly in protecting biodiversity and public health. This department has demonstrated its proficiency in prioritizing and screening environmental threats, as evidenced by its successful screening of over 23,000 existing substances and the assessment of hundreds of new substances each year. Furthermore, ECCC excels in transparency and public accessibility regarding information and policy dissemination. Its track record for open communication and engagement could serve as a model for other departments.

However, if the CFIA retains its current comprehensive authority over all invasive plants, it should consider adopting ECCC's best practices. This would include enhancing its screening processes and improving the transparent disclosure of information. This would include enhancing its screening processes and improving the transparency and disclosure of information. Such steps would not only align with our international obligations under the CBD and the Kunming-Montréal Global Biodiversity Framework but also ensure the protection of Canada's rich biodiversity and public health for future generations.

D.THE CFIA'S CURRENT INVASIVE PLANT PROTECTION PROGRAM

According to the National Manager IAS and Domestic Plant Health Programs:

> The focus of the CFIA's Invasive Plant Program has consistently been on prevention, based on the control costs associated with invasive species once they are introduced. The CFIA's resources have the greatest impact when they are directed toward preventing new pests from entering and establishing in Canada. As such, the CFIA prioritizes species that are **not yet present or present with limited distribution**, so that "official control" is possible.

[42] A key aspect of the information requested is a description of the biological and ecological characteristics of the organism to provide a basic understanding of the organism's behaviour in the environment. The information is that which is known from a review of the scientific literature and from results available in unpublished laboratory or experimental field studies.
[43] ECCC (Environment and Climate Change Canada), "Risk assessment of chemical substances," 2022; ECCC, "Guidelines for the Notification and Testing of New Substances: Organisms," 2022.

The scope of the *Plant Protection Act* includes the **protection of plant life** in Canada. The CFIA's Invasive Plants Policy and plant protection directive D-12-01 confirms the **inclusion of environmental considerations** in its application of the act.

Preliminary evaluations are conducted for **new species related to import requests** as well as species of interest brought to our attention through environmental scanning, including those in the ornamental pathway.

The CFIA exercises authorities according to the Agency and Government of Canada priorities. However, there are limits to legislative authorities. New and existing industry, municipal, provincial/territorial, and invasive species council-led initiatives and programs are critically important to address these areas of concern alongside existing regulations. The **CFIA continues to encourage the adoption of the National Voluntary Code of Conduct for the Ornamental Horticultural Industry and other industry-led initiatives** such as Plant Wise and Grow Me Instead. We do not envision these as a short-term measure, but rather stakeholder-led long-term action.[44]

E. OVERVIEW OF SEED LEGISLATION IN CANADA

Introduction:

Seed legislation in Canada, which includes the *Seeds Act* (RSC 1985, c S-8), *Weed Seeds Order* (WSO)(SOR/2016-93), and *Seeds Regulations* (CRC, c 1400, 2022, plays a vital role in regulating seed quality and safety. Although reducing invasive weed seeds is a benefit of these regulations, their primary purpose is not specifically aimed at controlling the spread of invasive plants.[45] This overview examines how these regulations currently work and how they might be better applied to mitigate the introduction and spread of invasive species.

***Seeds Act*: Ensuring Quality and Safety**

- **Purpose**: The Act aims to protect producers and consumers from low-quality seeds and create a level playing field in seed production.[46]
- **Regulatory Scope**: It encompasses regulations around grading, testing, inspection, naming, labeling, and documentation before seeds are sold.[47]

***Weed Seeds Order*: Preventing Weed Spread**

- **Objective**: The WSO aims to prevent the spread of weed species through seed products, with a focus on human, animal, plant health, and the environment. (RSC 1985, c S-8).[48]
- **Classification of Noxious Weeds**: As of the latest update, 96 plants are identified as Noxious Weeds. These are categorized into five classes based on their **threat level and distribution.**

[44] Emphasis added, "CCIPR Invasive Plant Regulation Follow-up", email communication Nov. 1, 2023.
[45] CFIA, "Invasive plant policy," 2012.
[46] CFIA, "Seed regulatory modernization," 2023
[47] Pham, "Let's Talk About Seeds: Recommendations for More Meaningful Public Participation in Canadian Seed Policy," 2019.
[48] CFIA, "Weed Seeds Order," 2023b. For the purposes of the Act, "seed means any plant part of any species belonging to the plant kingdom, represented, sold or used to grow a plant."

There are 26 Class 1 Prohibited Noxious Weeds, 36 Class 2 Primary Noxious Weeds, 29 Class 3 Secondary Noxious Weeds, five Class 4 Secondary Noxious Weeds, 43 Class 5 Noxious Weeds (Class 5 includes Class 2 species), unspecified Class 6 weeds.

***Seeds Regulations*: Screening Standards**[49]

- **Purpose:** *Seeds Regulations* prescribe minimum standards of purity, germination, and quality including levels of permitted weed seed.
- **Screening Requirements**: All seed products must be screened for the presence of primary noxious weeds (Classes 1 & 2) with varying requirements for other classes.
- **Weeds: Native, Non-Native, Invasive Complexities**

The terms "weed", and "noxious weed" are not defined under the Act. Most plants listed in the WSO are invasive alien species (IAS), like spotted knapweed (*Centaurea stoebe*) and Canada thistle (*Cirsium arvense*). However, some plants are native species.

- **Native noxious weeds**: Poison hemlock (*Conium maculatum*) is an example of a plant native to parts of Canada. All parts of this plant are toxic to humans and livestock. It is classified as a Primary Noxious Weed.
- **Native and non-native variants:** All dodder seed (*Cuscuta* spp.) is prohibited in Canada, though there are several species native to Canada, like *C. campestris*.[50] Distinguishing between the seeds of the species would be arduous for seed distributors, so all dodder seed is regulated. Similarly, *Prunella vulgaris,* commonly known as self-heal or heal-all, is categorized as a noxious weed, even though there is a native variant (*P. vulgaris* var. *lanceolata*) along with the invasive introduced variant (var. *elongata*) and they can hybridize.[51] Designating heal-all as a noxious weed is the most cost-effective way to safeguard seed.
- **Prohibited noxious weeds:** This term is defined as a weed that is not yet present in Canada, or if present is under official control and has not yet reached its full ecological range. [52] Official control includes control by the federal government or by a government-authorized agency or organization.
- **Primary noxious weeds**: This is a weed that is present in Canada but is not under official control and has not reached its full ecological range.[53]

Challenges and Inconsistencies in Regulation:

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[49] *Seeds Regulations* (C.R.C., c. 1400) Schedule 1 (Regulations are current to 2023-04-20 and last amended on 2020-04-23); CFIA, "Weed Seeds Order to Grade Table Cross Reference," 2013.

[50] Dodders are also prohibited under the *Plant Protection Act*, but native species are excluded (CFIA, "D-12-01: Phytosanitary Requirements to Prevent the Introduction of Plants Regulated as Pests in Canada," 2019).
Learn more about dodders: Costea & Tardif, "The biology of Canadian weeds. 133. *Cuscuta campestris* Yuncker, *C. gronovii* Willd. ex Schult., *C. umbrosa* Beyr. ex Hook., *C. epithymum* (L.) L. and *C. epilinum* Weihe," 2006.

[51] The species is regulated as a Class 5 Noxious Weed and is limited as a component of turf seed mixtures and ground cover seed mixtures.

[52] "The active enforcement of mandatory phytosanitary regulations and the application of mandatory phytosanitary procedures with the objective of eradication or containment of quarantine pests or for the management of regulated non-quarantine pests. ISPM No. 5" (CFIA, "Weed Seeds Order Definitions," 2013).

[53] CFIA, 2013.

- **Modernization:** The CFIA is looking to update and improve the *Seeds Regulations*, to protect producers and consumers, by improving responsiveness and consistency while reducing complexity. They intend to strengthen existing requirements, but unfortunately, reducing the spread of invasive plants is not a focus of this review.[54]
- **Inconsistent Regulatory Shifts:** As part of a review of the Weed Seeds Order (WSO) completed in 2016, the CFIA changed the designation of certain weeds, but the shifts in classification were not consistent. Both spotted knapweed (*Centaurea stoebe*) and ox-eye daisy had become more widespread in Canada. Therefore, ox-eye daisy was reclassified from a primary to a secondary noxious weed.[55] In contrast, spotted knapweed remained classified as a Prohibited Noxious Weed because stakeholders expressed that its impact on agriculture was significant.

Aligning Seed Legislation with Invasive Species Management for Biodiversity Protection:

To effectively contribute to Canada's commitments under the *Convention on Biological Diversity* (CBD), Canada's seed legislation needs targeted amendments that focus on invasive species management.

Proposed Amendments and Actions:

1. **Expanding the Act's Objectives**: Amend the *Seeds Act* to explicitly include invasive species management as a core objective. This will ensure the Act contributes to protecting biodiversity by regulating seeds that pose environmental risks.
2. **A Comprehensive List of Invasive Species**: Develop a regularly updated list of invasive plant species primarily spread as contaminants of seed products or as a component of wildflower seed mixes.[56] This list should be publicly accessible and used to guide the regulation of seed sales and distribution.
    a. In the 2008 “Invasive Alien Plants in Canada: Technical Report”, only 15 of the 42 invasive alien plant species primarily introduced as seed contaminants are designated as weeds under the *Seeds Act*[57] This should be corrected.
    b. Ensure regulatory restrictions for seeds of invasive plants that have not reached their full ecological range are maintained if there is the potential for increased environmental harm.
2. **Regulating Wildflower Seed Mixes**: Implement regulatory mechanisms for wildflower seed mixes to ensure they are free of invasive species. Seed companies should be mandated to disclose mix compositions and certify the non-invasiveness of included species.

[54] CFIA, 2013g.
[55] CFIA, 2016b.
[56] Several ornamental invasive species are purposely sold in wildflower seed mixes. These include plants like baby’s breath (*Gypsophila paniculata*), blueweed (*Echium vulgare*), burdocks (*Arctium* spp.), comfrey (*Symphytum officinale*), common mullein (*Verbascum thapsis*), dame’s rocket (*Hesperis matronalis*), foxglove (*Digitalis purpurea*), giant hogweed (*Heracleum mantegazzianum*), bachelor’s button other knapweed species (*Centaurea* spp.), oxeye daisy (*Leucanthemum vulgare*), purple loosestrife (*Lythrum salicaria*), and St John’s wort (*Hypericum perforatum*) (Invasive species Council of British Columbia, "What's in your seed mix?" 2022; PEI Invasive species council, " Invasive alien species of PEI: Wildflower Seed Mixes," n.d.). Only a few are recognized as weeds under the WSO.
[57] CFIA, 2008, p.11.

3. **Public Awareness and Education**: Launch public awareness campaigns and educational initiatives to inform consumers, gardeners, and industry stakeholders about the environmental risks associated with contaminated seed and invasive wildflower seeds.
4. **Enforcement and Compliance**: Strengthen enforcement mechanisms, including regular inspections of seed sellers to ensure adherence to the new regulations.
5. **Engagement with Stakeholders**: Actively engage with various stakeholders, including environmental groups, Indigenous communities, horticulturists, and seed distributors, to ensure broad support and effective implementation of the legislative changes.
6. **Research and Monitoring**: Commit to ongoing research and monitoring programs to assess the impact of these legislative changes and adapt as needed based on new scientific findings.

Conclusion:

By implementing these targeted measures, Canada can significantly strengthen its approach to invasive species management, aligning with international biodiversity conservation efforts and protecting its unique ecological landscapes.

F. FEDERAL PLANT LEGISLATION

Introduction to the *Plant Protection Act* (PPA):

As explained in the main body of the paper, the *Plant Protection Act* (PPA) is pivotal in Canada's efforts to protect its plant health, **agriculture, and forestry sectors**.[58] It is specifically designed to prevent pest importation, exportation, and spread, and plays a crucial role in controlling or eradicating pests within Canada. This legislation is integral to maintaining the ecological and economic health of the nation's diverse landscapes.

Regulated Pest Plants

The PPA regulates a range of plants categorized as pests, detailed in an online publication.[59] As of December 2022, 30 taxa were regulated, including 21 identified as "pest plants" under directive *D-12-01: Phytosanitary Requirements to Prevent the Introduction of Plants Regulated as Pests in Canada*. Another set, hosts to rust diseases, falls under directive , *D-01-04*, tied to the Canadian Barberry Certification Program.

Pest Risk Analysis Process:[60]

The Pest Risk Analysis (PRA) process under the PPA is a multi-staged process prescribed under the *International Standards for Phytosanitary* Measures (ISPMs):[61]

1. **Initiation**: The process begins by evaluating if a plant can become injurious to other plants,

[58] *Plant Protection Act* (S.C. 1990, c. 22).
[59] CFIA, "List of pests regulated by Canada," 2022 (last modified 2022-11-21).
[60] CFIA, "Pest Risk Analysis: How we evaluate fruits, vegetables and plants from new countries of origin," 2020.
[61] Described in detail in ISPM-11, "Pest risk analysis for quarantine pests," 2019. p. 8-26.

focusing primarily on plant health threats.[62] This stage often overlooks broader ecosystem impacts or threats to human health, pointing to the need for a more encompassing approach. Pathways for introduction are also identified at this stage. [63]

2. **Risk Assessment:** This stage assesses the invasion risk and the determines if the plant can be categorized as a quarantine pest.[64] Key factors include the distribution, controllability, and economic impacts.
    a. If a plant cannot establish or spread in Canada, the risk analysis process stops.
    b. If the plant is **widely distributed**, the risk assessment analysis stops.
    c. If there are no **official control**[65] measures in place or potential to put controls in place, the risk analysis process stops.
    d. If there are no potential **economic consequences** (including environmental consequences), the analysis process stops.[66]
3. **Risk Management**: Plants that move forward in the assessment process are designated as a **Quarantine Pest** (QP) or a **Regulated Non-Quarantine Pest** (RNQP).[67] The final stage considers the least trade-restrictive options for managing identified risks.[68] This may range from surveillance to trade prohibitions, with public consultations forming part of the decision-making process. Once feedback is reviewed, a course of action is selected, and a final **Risk Management Document** (RMD) is prepared.

Risk Management Documents:

Few PRAs advance to the risk management stage. On the online *Weed Risk Analysis Documents* webpage, 412 potential invasive plant species are listed that "have come to the attention of the CFIA through requests for import, networking with partners, science scanning, or as a result of new incursions or interceptions"[69] Of the listed potential pest plants, only 26 have RMDs prepared.

Of the prohibited plant species, the majority are agricultural weeds. The Pest Risk Analysis and Invasive Species Panels (PRA ISP) of the North American Plant Protection Organization (NAPPO) have also noted

[62] A plant pest is "Any species, strain or biotype of plant, animal or pathogenic agent injurious to plants or plant products." Note: In the IPPC, "plant pest" is sometimes used for the term "pest" FAO, 1990; revised ISPM 2, 1995; IPPC, 1997; CPM, 2012] ISPM-5, 2023c, p.7; ISPM-5, 2022, p. 32.
[63] Pathways can include natural dispersal, intentional introduction, and or unintentional introduction.
[64] Stage 2 is described in detail in ISPM-11, "Pest risk analysis for quarantine pests," 2019. p. 11-22.
[65] Official Control is defined as "The active enforcement of mandatory phytosanitary regulations and the application of mandatory phytosanitary procedures with the objective of eradication or containment of quarantine pests or for the management of regulated non-quarantine pests [ICPM, 2001]" (ISPM – 5-15, 2022). The concept of "official control" is subject to interpretation. IPPC guidelines state that official control should include efforts to eradicate and/or contain plants in the infested area(s), efforts to monitor populations, as well as efforts to restrict the movement of plants (ISPM 5-24).
[66] An emphasis on environmental consequences is new to the PRA process.
[67] "Plants for planting" includes seeds, bulbs and tubers, and various kinds of vegetative propagating material used for growing plants (e.g., fruits, cut flowers, wood, grain) (ISPM-16, 2021. p. 6.).
[68] ISPM-16, 2021. P. 25.
[69] CFIA, "Weed risk analysis documents," 2021b.

"There are NO AQUATIC PLANTS OR ALGAE regulated under the *Plant Protection Act* and regulations at present."[70]

Only a few of the prohibited plants are of some ornamental/horticultural interest.[71]

Challenges and Limitations:

Table 4 presents excerpts from RMD summaries for giant reed, Paterson's curse, tussock grass, and kudzu.

The RMDs, not uniformly composed and often inaccessible,[72] reveal inconsistencies and an evolving methodology. No ornamental plants, well-established in Canada but still able to spread into new areas and cause further economic harm have been regulated.

The lack of comprehensive risk assessments for aquatic and established high risk invasive ornamental plants underscores significant gaps in the Act's application. This discrepancy can be attributed to resource limitations, scientific capacity gaps, and the absence of a cohesive interdepartmental policy.

Table 2. Justification for regulatory measures presented in the Risk Management Documents

Prohibited plant	Primary justifications for regulatory measures in the Risk Management Documents
2010 – Kudzu (*Pueraria montana*)	Potential economic consequences The greatest impacts of *Pueraria montana* are felt by the forestry industry. . .. Control costs have been estimated at approximately $500 US per hectare per year for five years, which exceeds profits for average 25-year-old pine plantations (Britton et al. 2002; Forseth Jr. and Innis 2004) and results in land being taken out of production . . . Potential environmental and social consequences *Pueraria montana* shades and crushes its competitors, killing native vegetation and forming kudzu monocultures. . ..[73]
2017- Giant Reed (*Arundo donax*) RMD	Potential Economic and Environmental Consequences Risk Rating for Potential Economic and Environmental Consequences Potential economic and environmental consequences are rated "High" for *A. donax,* as it has the potential to cause major damage to the environment (i.e., changes to ecosystem processes, community structure and function, loss of biodiversity), it is difficult and costly to control, and it can negatively impact a variety of water-based industries.[74]
2020 - Paterson's curse (*Echium plantagineum*)	Potential economic impact: At least six potential negative economic impacts have been identified for *Echium plantagineum:* pasture degradation, livestock and crop yield losses, hay and seed contamination, and increased costs of control. Potential environmental impact:

[70] Pest Risk Analysis and Invasive Species Panels of the North American Plant Protection Organization (NAPPO): (PRA-ISP) "DD 02: DD 03: The Role of the NAPPO in Addressing Invasive Alien Species," 2011.
[71] *Arundo donax, Echium plantagineum, Nassella trichotoma, and Pueraria montana* have appeared in the trades in North America and some present risks of hybridizing with other plants in trade, e.g. *N. trichotoma* with *N. tenuissima* (CABI, "*Nassella trichotoma* (serrated tussock grass," 2019).
[72] Risk assessment document must be separately requested by email and are not easily found online.
[73] There was no RMD available in the CFIA online management documents, but a RMD-10-11 (Consultation) Pest Risk Management Document for *Pueraria montana* (kudzu) in Canada is available at Richters, 2010.
[74] CFIA, "RMD-16-02: Pest Risk Management Document for *Arundo donax* (giant reed) in Canada," 2017.

	Echium plantagineum has the potential to have serious impacts on the environment. The most significant of these are the potential negative impacts on animal and human health due to the plant's toxic alkaloids and the potential consequences of herbicide resistance in this species.[75]
2020- Tussock grass (*Nassella trichotoma*)	Potential economic consequences Potential economic impact is not significant. Potential environmental and social consequences Potential environmental impact is high. . .. While this area is very limited . . . these meadows represent a critically endangered ecosystem within Canada.[76]

Towards Legislative Reform:

Canada's approach to invasive species management needs an overhaul, akin to the CEPA framework, emphasizing environmental impacts and public health. A legislative reform mandating comprehensive screening of non-native plants is crucial.

Recommendations for the CFIA:

- Broaden interpretations of IPPC requirements to encompass diverse ecological impacts and recognize the revised definition of 'widely distributed'.
- Address the regulatory void for invasive aquatic plants.
- Include a regulatory mandate to categorize, prioritize and assess all non-native plants identified as 'Present in Canada' and those of concern in the U.S. with potential to spread to Canada.
- Foster interdepartmental collaboration and information sharing.
- Create a public database for accessible risk assessments and management information.

Conclusion:

Revamping the PPA and its application is essential for Canada to align with global standards in biodiversity protection and public health. A more robust, transparent, and comprehensive approach is needed to effectively manage the growing challenges posed by invasive species.

[75] CFIA, "RMD-13-04: Consolidated Pest Risk Management Document for pest plants regulated by Canada Appendix 7A: Pest Risk Assessment Summary for *Echium plantagineum* (Paterson's curse)," 2020a.
[76] The distinction between economic and environmental risk is somewhat inconsistent with ISPM-5, 2023c, p.28. (CFIA, "Appendix 9A: Pest Risk Assessment Summary for *Nassella trichotoma* (serrated tussock)," 2020b.)

G.PROVINCIAL AND TERRITORIAL REGULATIONS

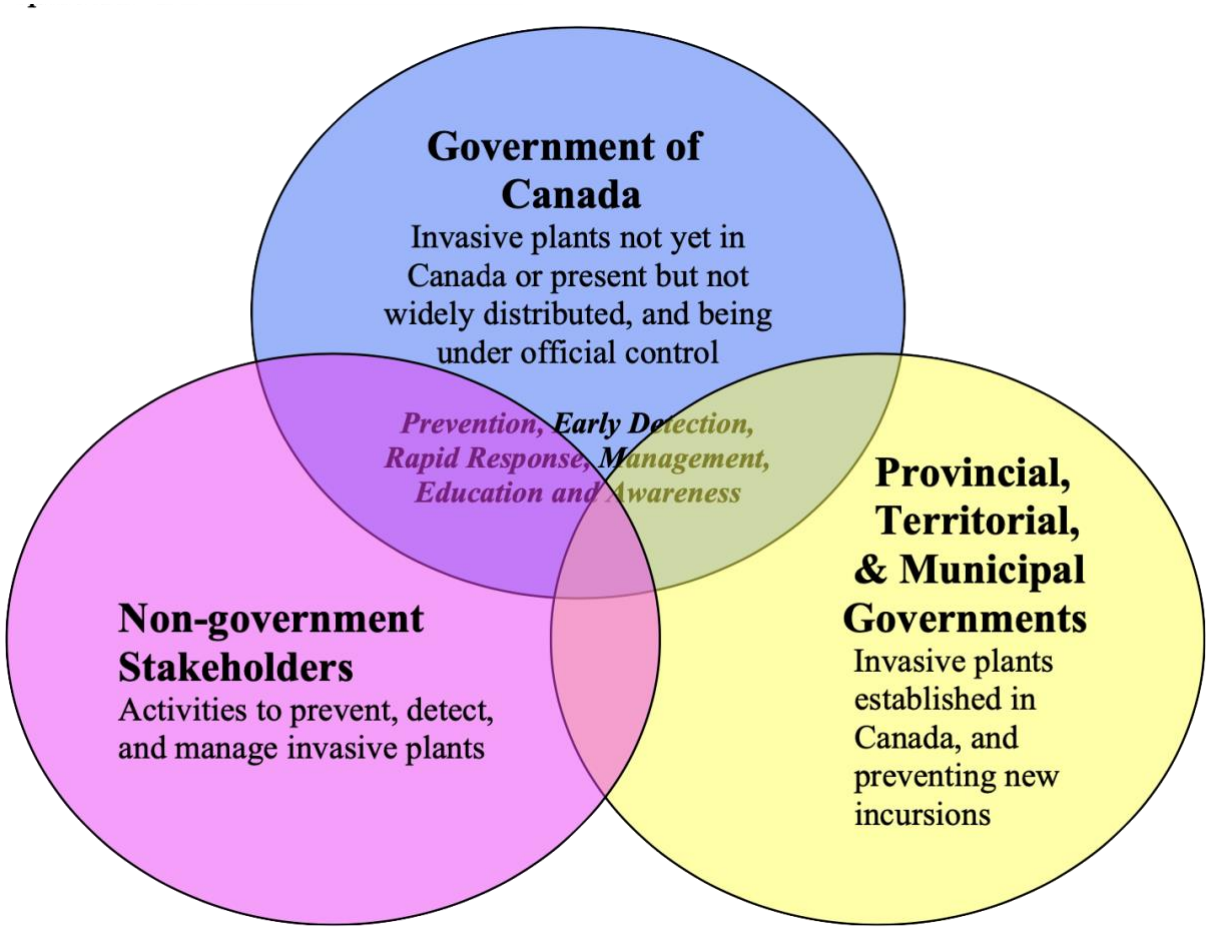

Figure 1. Responding to invasive plants is a shared responsibility. Source. CFIA, 2011.

Introduction

The absence of federal action to regulate invasive plants sold in the horticultural trade pushes the responsibility for management to provincial and territorial authorities (Figure 8).[77] An examination of the regulatory landscape across these jurisdictions reveals significant gaps and disparities in invasive species prevention:

[77] In 2011, a "Canadian Invasive Plant Framework" was developed based on a series of federal, provincial, and territorial workshops. At that time the Government of Canada was given the primary role of preventing the introduction of invasive plants into Canada. Once introduced to Canada, provincial, territorial, and municipal governments were given the responsibility of managing established invasive plants working in collaboration with non-governmental stakeholders, (Venn Diagram credit: Gov. of Canada "Canadian invasive plant framework: A collaborative approach to addressing invasive plants in Canada." 2011, p.15).

Table 3. Federal and Provincial Weed/Invasive Species Regulations

CANADA (CAN) ***Plant Protection Act* (SC 1990, c.22)** ***Seeds Act* (R.S.C., 1985, c.S-8)**	**30 Federally Prohibited Taxa** **96 Noxious Weeds: 26 Class 1 Prohibited, 36 Class 2 Primary, 29 Class 3 Secondary, 5 Class 4 Secondary, 43 Class 5 (this include Class 2 taxa)**
ALBERTA (AB) *Weed Control Act* (SA 2008, c.W-5.1) *Fisheries (Alberta) Act,* (RSA 2000, c.F-16)	80 Noxious Weeds: 44 prohibited, 29 noxious, 7 nuisances 16 invasive aquatic plants prohibited
BRITISH COLUMBIA (BC) *Weed Control Act* ([RSBC 1996] C 487) Spheres of Concurrent Jurisdiction – Environment and Wildlife Regulation, (BC Reg. 144/200)	66 Noxious Weeds: 39 provincial, 27 regional 30 more taxa are identified that may be regulated by municipalities
MANITOBA (MB) *Noxious Weeds Act* (S.M. 2015, c.38) *Water Protection Act* (C.C.S.M. c. W65) Aquatic *Invasive Species Regulation* (S.M. 2015, c.7)	110 Noxious Weeds: 21 Tier 1 prohibited, 18 Tier 2 restricted, 50 Tier 3 (complaint controlled) 21 invasive aquatic plants prohibited
NEW BRUNSWICK (NB) *Weed Control Act* (SNB 1969, c.21) *Plant Health Act* RSNB 2011, c 204	No lists
NEWFOUNDLAND AND LABRADOR (NL) *Plant Protection Act* (R.S.N.L. 1990, c. P-16)	No lists
NORTHWEST TERRITORIES (NT) *Protected Areas Act* (SNWT 2019, c.11)	No lists
NOVA SCOTIA (NS) *Agricultural Weed Control Act* (R.S.N.S. 1989, c.501)	10 Noxious Weeds: 9 Class 1 threats to agricultural or cultivated land; 1 Class 2 threat to health
NUNAVUT (NU) *Wildlife Act* (SNu 2003, c.26)	No lists
ONTARIO (ON) *Weed Control Act* (R.S.O. 1990, c.W.5) *Invasive Species Act* (S.O. 2015, c.22)	25 Noxious Weeds 22 Invasive alien plant taxa: 7 prohibited; 15 restricted
PRINCE EDWARD ISLAND (PE) *Weed Control Act* (Chapter W-2-1) *Purple Loosestrife Control Regulations*	One taxa L*ythrum* spp.
QUÉBEC (QC) *Agricultural Abuses Act* (R.S.Q. c.A-2) repealed	List no longer regulated
SASKATCHEWAN (SK) *Weed Control Act* (Chapter W-11.1 2014, c.19)	60 Noxious Weeds: 23 prohibited, 37 noxious, and five nuisance weeds
YUKON (YT) *Environmental Act* (RSY 2002, c.76)	No lists

Overview of Provincial and Territorial Regulations:

Invasive plant regulation in Canada is characterized by a patchwork of measures, often based on outdated weed control regulations.[78] Significant progress is evident in Ontario and Manitoba, where invasive species regulations have been enacted to prohibit the trade of listed invasive terrestrial and or

[78] Nova Scotia was the first province to establish a weed control regulation – *An ACT to Prevent the Growth and Increafe of Thiftles on Lands in this Province.* The Act allowed for the appointment of inspectors to enforce the control of Canada thistle (*Cirsium vulgare*) (British North America Legislative Database, 1758-1867, "An Act, to prevent the Growth and increase of Thistles on the Lands in this Province," 1791).

aquatic plants. However, legislation in most provinces and territories would require substantial revision to protect biodiversity from the spread of invasive plant species.[79]

- **Inconsistent Weed Control Acts**: Six provinces list regulated noxious weeds without clear criteria for designation, (Alberta, British Columbia, Ontario, Manitoba, Prince Edward Island, and Saskatchewan).[80] These acts typically authorize inspectors to mandate control or destruction of designated weeds. However, there is little alignment across provinces regarding which plants are considered noxious and the measures required or recommended for their control. Table 5 provides a glimpse of inconsistencies between weed control regulations and species lists.
- **Lack of Regulated Plant Lists**: Notably, five jurisdictions (New Brunswick, Newfoundland and Labrador, Northwest Territories, Nunavut,[81] and Quebec) do not have regulated plant lists, with Quebec having repealed its weed control legislation in 2018 without replacement. Nunavut's *Wildlife Act*, while prohibiting the release of non-native species, does not currently recognize invasive plants in the territory.
- **Aquatic**[82] **Plant Regulation**: Recent efforts, particularly from the DFO, have led to increased attention to regulating aquatic invasive plants. Manitoba, Alberta, Ontario, Saskatchewan, and British Columbia have varying extents of regulation in this area. Manitoba, under its updated *Water Protection Act*, prohibits 21 aquatic invasive plants, leading the way in Canada. Non-native invasive aquatic and riparian plants regulated by Canadian provinces are listed in Table 7.
- **Reactive Regulatory Actions**: A common trend is the delayed response in regulating invasive species. For instance, the common reed (*Phragmites australis* subsp. *australis)*, identified as a significant threat in 2005,[83] was only regulated years later after substantial habitat loss.[84] Similarly, the autumn olive (*Elaeagnus umbellata*), despite being recognized as a significant risk, remains unregulated in many provinces.[85]
- **Inconsistencies in Plant Naming**: Discrepancies in plant nomenclature across provinces leads to confusion in identification, distribution tracking, and management. For example, quackgrass is

[79] Lewis, “Protecting Canada's natural ecosystems from invasive alien plant species: Is sub-national weed control legislation up to the task?”, 2006, p. 106.
[80] Some list both native and non-native species. For instance, poison ivy is a native plant and a noxious weed in Ontario.
[81] Nunavut enacted a Wildlife Act prohibiting the release of any species into a habitat in which that species would not naturally occur (SNu 2003, c.26). There are no “officially recognized” invasive plants. In 2008, 16 invasive plants were reported as present in Nunavut (CFIA, "Invasive Alien Plants in Canada," 2008). These do not appear to be officially recognized as invasive (Government of Nunavut., “Non-Native and Invasive Species in Nunavut. Government of Nunavut and Environment Canada,” 2010). In 2020, 21 new taxa were reported on Victoria Island (Saarela, “Vascular plants of Victoria Island (Northwest Territories and Nunavut, Canada): a specimen-based study of an Arctic flora,” 2020).
[82] Aquatic plants grow partially or completely in water. These are species “that normally grow to maturity with at least some photosynthetic organs permanently on (floating) or under (submerged) standing or flowing water” (Seebens, et al., 2020). Some marginal or emergent plants may be adaptable to drier conditions and may also be considered terrestrial or semi-aquatic species. This has implications for regulatory authorities where aquatic plants are regulated separately from terrestrial species.
[83] Catling, P., “New ‘Top of the list’ invasive plants of natural habitats in Canada,” 2005.
[84] Scrivener, L., "*Phragmites australis* is Canada's worst invasive plant," 2012
[85] Autumn olive (*Elaeagnus umbellata*) and the closely related Russian olive (E. angustifolia) are regulated in six and five U.S. border states respectively.

listed under three different scientific names across Canada,[86] and Japanese knotweed is regulated under various names in different provinces.[87] See Table 8: Knotweed regulation across Canada.

- **Plant Health Protection**: While New Brunswick and Newfoundland and Labrador have plant health legislation, these have not been utilized to regulate invasive plants.

Proposed Solutions:

These inconsistencies stem from limited knowledge, unclear legal jurisdictions, and resource constraints, resulting in reactive rather than proactive strategies. The varied and often limited approaches to preventing the spread of invasive plants across Canada can only be solved by implementation of a cohesive national strategy. A national committee to oversee and coordinate regional activity and national regulations would solve some of the issues faced by provinces and territories. A national database with accurate nomenclature and interoperable data is crucial for effective decision-making. Clear guidance on appropriate regulatory and control measures are needed.

> Efforts aimed at managing plant health risks vary across the country—some provinces and territories have more robust systems of risk surveillance, monitoring, and management than others. This unevenness creates gaps. Among the most significant risks identified in the plant health system are the information silos produced by different actors who fail to connect, or whose research remains unknown to each other without a shared information network.[88]

Federal action is needed to unify and harmonize the diverse approaches and to provide regulation for areas where none exists.

Table 4: Ten regulated plants in Canada illustrating inconsistencies across the country.

Scientific name	Common name	Jurisdictions with regulations
Abutilon theophrasti Medik.	Velvetleaf	CAN (S2&5) BC (P) NS (C1)
Acroptilon repens (L.) DC. (=*Centaurea repens* L.)	Knapweed, Russian	BC MB (T1) SK (N)
Aegilops cylindrica Host (=*A. caudata* L.)	Jointed goatgrass	CAN (S1) CAN (PPA) AB (P) BC (P) ON (N) SK (P)
Agropyron repens [BC] (= *Elymus repens* (L.) Gould [CAN]) (=*Elytrigia repens* [SK])	Quackgrass; couchgrass	CAN (S2&5) BC SK (NW)
Ailanthus altissima (Mill.) Swingle	Tree-of-heaven	AB (P), ON

[86] Quackgrass or couchgrass is listed under three different scientific names across Canada: *Agropyron repens* in B.C.; *Elytrigia repens* in SK; and *Elymus repens* L. by the federal government Systematics is fundamental to ecosystem management and biodiversity conservation. The Integrated Taxonomic Information System (ITIS) was developed in the United States to provide access to standardized nomenclature (ITIS.gov) and is being supplanted by the Catalogue of Life, 2024. The World Flora Online (WFO) Plant List is a comprehensive and authoritative source of accepted scientific names for species (WFO Plant List). As is the Royal Botanical Garden's Kew Plants of the World Online (POWO, n.d.).

[87] Japanese knotweed is regulated under the name *Fallopia japonica* in several provinces, *Reynoutria japonica* in Ontario, and is listed as *Polygonum cuspidatum* in several federal weed assessment documents. Himalayan knotweed is prohibited under the Ontario *Invasive Species Act* under the name *Koenigia polystachya* and in British Columbia as *Polygonum polystachyum*. Other authorities recognize the plant as *Persicaria wallichii* Greuter & Burdet.

[88] Council of Canadian Academies, & Bennett, "Cultivating Diversity: The Expert Panel on Plant Health Risks in Canada," 2022, xxiii.

Alliaria petiolata (M. Bieb.) Cavara & Grande	Mustard, garlic	AB (P) MB (T1) SK (P)
Alopecurus myosuroides Huds.	Foxtail, slender	CAN (S1) CAN (PPA)
Amaranthus hybridus L.	Pigweed, smooth	MB (T1)
Amaranthus palmeri S. Watson	Amaranth, Palmer	MB (T1)
Amaranthus retroflexus L.	Pigweed, redroot	BC (N)
Amaranthus tuberculatus (Moq.) J.D. Sauer	Tall water-hemp	CAN (S2&5) MB (T1)
P= prohibited; T=tier; C=control; N=Noxious		
Canada *Seeds Act* – CAN (S Class #,) *Plant Protection Act* CAN(PPA), Alberta – AB, British Columbia – BC, Manitoba – MB, New Brunswick – NB, Newfoundland and Labrador – NL, Northwest Territories – NT, Nova Scotia – NS, Nunavut – NU, Ontario – ON, Prince Edward Island – PE, Quebec – QC, Saskatchewan – SK, Yukon – YT		

Table 5: Non-native invasive aquatic and riparian plants* regulated by Canadian provinces.

Scientific name	Common name	Regulating jurisdictions
Azolla spp.	Water ferns	ON
Butomus umbellatus	Flowering rush	AB, BC(WC/SC), MB(W), ON, SK
Cabomba caroliniana	Fanwort, Carolina fanwort	AB(F), MB(W), ON
Egeria densa	Brazilian waterweed	AB(F), MB(W), ON
Eichhornia crassipes	Water hyacinth	MB(WP)
Hydrilla verticillata	Hydrilla, water thyme	AB(F), BC(SC), MB(W), ON
Hydrocharis morsus-ranae	European frogbit	AB, MB(WP), ON
Impatiens glandulifera	Himalayan balsam	AB, BC(WC/SC), MB(W)
Iris pseudacorus	Yellow flag iris	AB(N), BC(SC), MB(W)
Lagarosiphon major	African oxygenweed	MB(WP) ON
Ludwigia peploides	Floating primrose-willow	ON
Lythrum salicaria	Purple loosestrife	CAN, AB, BC(WC/SC), MB(W), PE, SK
Lythrum spp.	Loosestrifes any variety or species	PE
Myriophyllum aquaticum	Parrot feather	MB(W), ON
Myriophyllum heterophyllum	Variable leaf watermilfoil	AB(F)
Myriophyllum spicatum	Eurasian watermilfoil	AB, BC(SC), MB(W), ON, SK
Najas minor	Brittle waternymph	MB(WP)
Nitellopsis obtusa	Starry stonewort	MB(WP)
Nymphoides peltata	Yellow floating heart	AB, MB(W), ON
Phalaris arundinacea	Reed canary grass	BC(SC)
Phragmites australis subsp. *australis*	European common reed	AB(F), BC(SC), MB(N) & MB(W), ON
Pistia stratiotes	Water lettuce	MB(WP)
Potamogeton crispus	Curly-leaf pondweed	AB(F), BC(SC), MB(W), SK
Salvinia spp.	Watermoss	ON
Salvinia molesta	Giant salvinia	AB(F) ON
Stratiotes aloides	Water soldier	AB(F), MB(W), ON
Tamarisk ramosissima, T. chinensis, T. parviflora or any cultivars, variety, or hybrids	Salt cedar, tamarisk	AB, BC(WC), MB(W), SK
Trapa natans	Water chestnut	AB(F), MB(W), ON
CAN – plants regulated under Canada's *Seeds Act* AB – plants regulated under the Alberta *Weed Control Act*; AB(F) are plants regulated under the *Fisheries Amendment Act (SA 2015, c.7)* (AB FA)		

BC(WC) – plants regulated under British Columbia's *Weed Control* Act**;** BC(SC) – plants identified in the B.C. *Spheres of Concurrent Jurisdiction - Environment and Wildlife Regulation* ON – plants regulated under Ontario's *Invasive Species Act* MB(N) – plants regulated under Manitoba's Noxious Weeds Act; MB(W) – plants regulated under Manitoba's *Water Protection Act* (*MB specifies cultivars, variety**,** or hybrid) PE – plants regulated under Prince Edward Island's *Purple Loosestrife Control Regulations* SK – plants regulated under Saskatchewan's *Weed Control Act*
Native aquatic weeds omitted from the list, (e.g., poison hemlock)
***Additional wetland plants could be added to this list as the distinction between aquatic and riparian plants is unclear. Algae has not been included.**

Table 6. Knotweed regulation across Canada

Knotweed - common name	Scientific name	Synonym listed in regulation (Province)	Regulating jurisdictions
Japanese	*Reynoutria japonica* Houtt.	*Fallopia japonica* (AB BC MB)	AB(F), BC, MB(W), ON
Giant	*Reynoutria sachalinensis* (F. Schmidt) Nakai	*Fallopia sachalinensis* (AB BC)	AB(F), MB(W), ON
Bohemian	*Reynoutria* × *bohemica* Chrtek & Chrtková	*Fallopia x bohemica* (AB BC)	MB(W)
Himalayan	*Koenigia polystachya* (Wall. ex Meisn.) T.M. Schust. & Reveal	*Polygonum polystachyum* (BC)	AB(F), MB(W), ON

A closer look at the provinces and territories. (This section was first drafted in 2022 and not all updates may be reflected in lists below).

BRITISH COLUMBIA (BC):

British Columbia's *Weed Control Act* (RSBC 1996, c 487) requires that "an occupier must control noxious weeds growing or located on land and premises." There are 39 plants designated noxious weeds within all regions of the province and 27 more within specific regions specified on the BC Weed Control Regulation, (BC Reg 66/85). The Act does not mention invasive species or harm to the environment caused by plants.

The province-wide lists include the four highly invasive knotweeds (Japanese, Giant, Bohemian and Himalayan) (Table 8). The scientific names should be updated to be consistent with current accepted nomenclature. Invasive aquatics on the province-wide noxious weed list include only four aquatic plants (see Table 7).

There are additional invasive plants identified under B.C. Reg. 144/2004 SPHERES OF CONCURRENT JURISDICTION — ENVIRONMENT AND WILDLIFE REGULATION (B.C. Reg. 219/2021). Unfortunately, this legislation only lists common names for some plants. This presents problems. For instance, baby's breath or salt cedar may refer to all plants in the *Gypsophila* and *Tamarix* genera respectively, or to specific problematic species. This piece of regulation identifies invasive plants that may be further regulated by municipal governments, pushing the problem to other jurisdictions with fewer knowledge experts and resources.

In 2014, the Inter-Ministry Invasive Species Working Group in British Columbia, encouraged "the **strengthening of federal import regulations and assessments** for the invasive potential of all proposed

new imports e.g., agriculture, horticulture, fish and game stocking, pet and live food trades."[89] The need for a cohesive, comprehensive framework to clarify authority between federal, provincial, local, and Indigenous governments was reiterated in the *Invasive Species Strategy for British Columbia: 2018-2022*, facilitated by the Invasive Species Council of British Columbia.[90] The Federal Government has not yet responded with such a framework, nor is there publicly available information about federal-provincial-territorial working groups.

New regulatory tools that clearly define jurisdictional responsibility, and improved capacity are required. The strategy document specifically recommends the creation of a harmonized provincial *Invasive Species Act* as current regulatory tools are not addressing the problem. They also identify the need for better collaboration with the Federal Government and "neighbouring jurisdictions to close the key pathways of invasive species."

ALBERTA (AB):

In Alberta, the *Weed Control Act* (SA 2008, c.W-5.1) enables the eradication and control of invasive plants. Alberta's *Weed Control Act* is administered by Agriculture, Forestry and Rural Economic Development and enables legislation for eradication and control of invasive plants. Regulated plants include 44 prohibited noxious weeds, which must be destroyed when found. There are another 29 noxious weeds that may be subject to a control program if a local authority feels they may have significant **ecological or economic impact** on lands within their municipality.[91]

Prohibited noxious weeds include the Japanese, giant and Bohemian knotweeds, but fails to recognize the threat posed by Himalayan knotweed (Table 8). The nomenclature requires updating. As mentioned above, Alberta is the only province to recognize the threat posed by Autumn olive (*E. umbellata*).

The *Weed Control Act* includes six aquatic invasive plants: Eurasian watermilfoil, flowering rush, Himalayan balsam, purple loosestrife, several tamarisk species, and yellow flag iris. In addition to those six, another 11 invasive aquatic plants are prohibited plants under the *Fisheries (Alberta) Act Revised Statutes of Alberta 2000* (see Table 7). Having two lists presents some confusion and can make cross border comparisons difficult.

Alberta identified several issues regarding their 2008 legislation:

> In 2010 the Province of Alberta revised its *Weed Control Act*, which in turn required the revision of its list of regulated weeds. Issues that emerged . . . **taxonomic and nomenclatural complexities**; a **lack of information** on species distribution and impacts; the **lack of legal jurisdiction** over aquatic species; the **need for education** and training of those involved in enforcing the Act.[92]

It should be noted there is also a *Pest and Nuisance Control Regulation* (A -184/2001), under the *Agricultural Pests Act* (SA 1984, c A-8.1). The regulation prohibits the import, purchase, or sale of any animals, birds, insects, plants, and/or diseases identified as pests in Part 1 of Schedule 1. However, no plants are listed in the associated Schedule.

[89] Inter-Ministry Invasive Species Working Group in British Columbia, "The BC Government Invasive Species Strategic Plan," 2014.
[90] Bergunder et al., "Invasive Species Strategy FOR BRITISH COLUMBIA 2018 – 2022," 2017.
[91] Alberta, "Provincially regulated weeds," 2023.
[92] McClay, "Revising Alberta's Provincial Weeds List: Experiences and Lessons Learned," 2012, 25.

SASKATCHEWAN (SK):

Saskatchewan's *Weed Control Act* (SS 2010, c W-11.1) describes the requirements for the containment or control of prohibited, noxious, or nuisance weeds. There are currently 23 prohibited, 37 noxious and five nuisance weeds.[93] The Act does not discuss invasive plants that cause harm to the environment.

No knotweeds are regulated, even though the two bordering provinces have listed them. Prohibited aquatic invasive plants include flowering rush, Eurasian watermilfoil, yellow floating heart, curly-leaved pondweed, and **all salt cedar species**, not just the three specified by Alberta and Manitoba (see Table 7).

MANITOBA (MB):

Manitoba's Noxious Weeds Act (CCSM c N110) sets out requirements regarding control or destruction measures for different plants that may "negatively affect any aspect of Manitoba's **economy or environment** or the well-being of residents of the province." They are categorized in tiers, with 21 Tier 1, 18 Tier 2, and 50 Tier 3 plants. Tier 1 weeds must be eradicated without conditions. Tier 2 weeds must be managed according to the size of the infestation. Tier 3 weeds must be controlled if the spread would have a negative impact on the economy, the environment, or the well-being of residents nearby.[94]

Of the invasive knotweeds, only Japanese Knotweed (*Fallopia japonica*) is listed as a Tier 1 plant.

Of the invasive aquatic plants, only one species of salt cedar (*Tamarix ramosissima*) is listed as a Tier 1 weed under the *Noxious Weeds Act*. However, three salt cedar species are prohibited under Manitoba's updated *Water Protection Act* (*C.C.S.M. c. W65*). The Act states: "A person must not (a) possess a member of an aquatic invasive species in Manitoba." The associated *Aquatic Invasive Species Regulation* (*173/2015*) includes **the most extensive list of invasive aquatic species of any province** and currently includes 20 genera (Table 7). This list is also one of the more precise regarding nomenclature.

Missing from the list are plants like variable leaf watermilfoil and giant salvina prohibited in Alberta, as well as others assessed as high-risk by DFO described in the Case of Aquatic Invasive Plants below.

ONTARIO (ON):

Ontario is the only province with an explicit statute to address invasive plant species. The *Invasive Species Act* (S.O. 2015, c.22) has specific provisions to regulate a species that is "harming or is likely to **harm the natural environment** of Ontario, regardless of whether it is present in Ontario or in a part of Ontario." "It is illegal to import, possess, deposit, release, transport, breed/grow, buy, sell, lease or trade prohibited invasive species."

Plant species are classified as invasive based on their biological characteristics, their potential for environmental harm, and their potential socio-economic impacts. Those not yet present in Ontario's natural environment are classified as prohibited and those present are restricted. Currently, there are seven prohibited and 15 restricted invasive plants (O Reg 354/16)[95]

[93] Saskatchewan Minister of Agriculture, "Designation of prohibited noxious and nuisance weeds," 2010.
[94] Manitoba gov., "Controlling Noxious Weeds," 2017.
[95] Ontario Ministry of Natural Resources, "New invasive species proposed for regulation under the Invasive Species Act," 2023; Ontario Newsroom, "Ontario Designates New Invasive Species," 2023.

The seven prohibited taxa are aquatic and are not yet present:

- Brazilian elodea — *Egeria densa*
- European water chestnut — *Trapa natans*
- Hydrilla — *Hydrilla verticillata*
- Oxygen weed – *Lagarosiphon major*
- Parrotfeather — *Myriophyllum aquaticum*
- Water soldier — *Stratiotes aloides*
- Watermoss – All species in the genus *Salvinia*

Seven additional aquatic taxa are restricted and present in the province:

- Water fern – All species in the genus *Azolla*
- Flowering-rush — *Butomus umbellatus*
- Fanwort — *Cabomba caroliniana*
- European frog-bit — *Hydrocharis morsus-ranae*
- Floating primrose-willow – *Ludwigia peploides*
- Eurasian water-milfoil – *Myriophyllum spicatum*
- Yellow Floating Heart — *Nymphoides peltata*

Tree-of heaven now joins the list of restricted terrestrial species that currently includes two dog-strangling vines, phragmites, and four knotweeds (note the scientific names used are distinct from those being used by western provinces Table 8).

Ontario also maintains a ***Weed Control Act*** (R.S.O. 1990, c. W.5). This Act regulates plants that can negatively impact agriculture and horticulture lands. Currently there are 25 species designated as noxious weeds in Ontario (RRO 1990, Reg 1096). Action is complaint driven.

In the 2022 report entitled: "Value-for-Money Audit: Management of Invasive Species," the Ontario Auditor General notes that Ontario has not done enough to regulate the trade of invasive plants used for landscaping and ornamental purposes.[96] The first recommendation states:

> 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.

In general, Ontario lacks expertise and financial resources necessary to perform risk assessments including analysis of ecosystem and related economic impacts. This results in **inaction or long delays** before action is taken. For example, the Ontario Auditor General found that Carolina fanwort—an invasive aquatic plant that crowds out native plants, clogs irrigation systems and interferes with aquatic recreation— was regulated in 2022, almost five years after a complete risk analysis was provided to the

[96] Ontario Auditor General, 2022.

Ministry by a contracted expert and eight years after Fisheries and Ocean's Canada had performed a Canada-wide risk assessment. [97] (See Case of Aquatic Invasive Plants below).

In addition to problems with aquatic plants, the Ontario Auditor General identified 30 terrestrial ornamental plants that should be considered for regulation under the Act.

Table 7. Select unregulated invasive plant species in Ontario and their impacts (from Auditor General's report).

Invasive plant	Impact
Amur maple	Establishes dense shade that suppresses the growth of native shrubs, herbaceous plants, and grasses.
Autumn Olive	Can outcompete and displace native plants by changing the chemistry of the soil around it.
Common buckthorn	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.
Creeping jenny	Thrives in wet soil and creates dense mats that deter the establishment of native plant species.
Dame's rocket	Produces many seeds and crowds out native vegetation.
Daylily	Poses a threat to native plants in fields, meadows, floodplains, moist woods, and forest edges by forming dense patches that displace native plants.
English ivy	Threatens native species, including tree saplings, by outcompeting and impacting photosynthesis.
Garlic mustard	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.
Glossy buckthorn	Produces a large number of seeds, preventing the growth of native plants.
Goutweed	An invasive groundcover that reproduces quickly and outcompetes native species by forming dense patches.
Italian honeysuckle	Can outcompete and smother small saplings and shrubs.
Japanese barberry	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.
Japanese honeysuckle	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.
Japanese spurge	Can spread by rhizomes in difficult growing conditions.
Lily of the valley	Outcompetes native species for resources by forming dense colonies. All parts of the plant are highly poisonous.
Manitoba maple	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.

[97] The threat from invasive aquatic species was recognized by the Canadian Council of Fisheries and Aquaculture, in a report: "A Canadian Action Plan to Address the Threat of Aquatic Invasive Species," in 2004. High-risk invasive aquatic plants in the trades were identified in DFO reports by Marson et al., 2009a; 2009b and later formal risk assessments were again performed by Gantz et al., "Application of an Aquatic Plant Risk Assessment to Non-Indigenous Freshwater Plants in Trade in Canada,"2014." Some of these issues were identified in the "2019 Spring Reports of the Commissioner of the Environment and Sustainable Development," 2019.

Miscanthus	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.
Multiflora rose	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.
Norway maple	Creates dense shade, reducing the amount of light that reaches the forest floor, and replaces native tree species.
Oriental bittersweet	Chokes and girdles native woody plants. Can be spread long distances by birds as it can remain in the stomach for weeks.
Ornamental honeysuckle	Rapidly invades areas, outcompeting native plants by forming dense patches; affects light and nutrient availability of neighbouring plants; and produces toxic chemicals.
Periwinkle	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.
Russian olive	Drinks more water than most plants in dry soil settings and can outgrow and compete with native species.
Sea buckthorn	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.
Spearmint	Can quickly sprawl into surrounding areas and suppress the growth of native plants.
Tree-of-heaven	Outcompetes native trees and is a preferred host for spotted lanternfly, an invasive insect not yet established in Canada.
White mulberry	Poses a threat to the endangered native red mulberry due to the hybridization of the invasive tree with the native tree.
Winged burning bush	Forms dense thickets, which can displace native woody and herbaceous plants.
Wintercreeper	Increases the rates of decomposition and nutrient cycling on the forest floor, altering the soil bacterial community in ways that benefit wintercreeper growth.
Yellow archangel	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.

QUÉBEC (QC):

Québec's *Environment Quality Act* (CQLR c Q-2) states that the Government may make regulations "to regulate or prohibit the growing, sale, use or transportation of specified invasive plant species whose establishment or propagation in the environment is likely to harm the environment or biodiversity" (95.1 -26), but the article has never been applied.

The regulation respecting noxious weeds, Agricultural Abuses Act (R.S.Q., c. A-2, s. 7) was repealed in 2018. La Fondation de la faune du Québec has developed the "Program for the Fight against Invasive Alien Plants" and the Ministère de l'Environnement has developed lists of priority invasive species, but no specific regulations are currently associated with this list.[98] In an article in La Tribune, Nicolas Bousquet (Conseil de gouvernance de l'eau des bassins versants de la rivière Saint-François) states:

> We often talk about it, but there is no solution. Who is going to legislate on this? The province does not want to get involved, it's complicated . . . Is it the MRCs [regional county municipalities]

[98] Fondation del la faune du Québec, "Programme pour la lutte contre les plantes exotiques envahissantes," 2023.

> who have to manage this or the municipalities? It's a bit on a case-by-case basis, who is going to apply that? It is complicated to implement regulations. We are like in a dead end where no one really wants to manage that.[99]

There is a *Plant Protection Regulation* (CQLR c P-42.1, r 2) that focuses on protecting commercial crops from harmful organisms but does not address invasive ornamental plants.

NEW BRUNSWICK (NB):

New Brunswick had a *Weed Control Act* (SNB 1969, C.21) but it was repealed and has been replaced by the *Plant Health Act* (RSNB 2011, c 204). Under the New Brunswick *Plant Health Act*, invasive weed species and weed seed could be designated as pests. No plants are listed as part of the legislation, though it refers to the federal *Seeds Act*.

NOVA SCOTIA (NS):

Nova Scotia regulates two classes of plants in their *Agricultural Weed Control Act* (R.S.N.S. 1989, c. 501). **Class Number One** plants are those that pose threats to cultivated or pasture lands. There are nine species listed in this category including the native common milkweed (*Asclepias syriaca*), which is essential to the native monarch butterfly. **Class Number Two** plants are those capable of inflicting ill health. The only plant listed is thornapple, *Datura* spp. (*Weed Control Regulations*, NS Reg 57/68). Several members of the Datura genus are commonly sold in the horticultural trades and currently no warning label is required to inform consumers that these are poisonous and potentially psychoactive plants.

NEWFOUNDLAND AND LABRADOR (NL):

Newfoundland and Labrador have a *Plant Protection Act* (RSNL1990 Ch 16). It prohibits the exchange or sale of plants that are infected or infested with a pest. A pest is defined as something that causes "damage to a vegetable, a part, product or by-product of a vegetable or a plant material." No list of regulated invasive plants is apparent.

Newfoundland and Labrador hosted the two-day "Exotic and Invasive Alien Species Workshop" in 2008 including a review of legislation.[100] At the time, gaps in regulations, gaps in knowledge, lack of resource availability, and lack of standardized definitions were cited as problems. It was noted that:

- Most of the legislation reviewed federally and provincially was written before the IAS issue was elevated to what it is now.
- Many acts both nationally and provincially deal with substances, and organisms which could be interpreted as invasive alien species.
- Many of these acts were written to deal with specific issues as they relate to an industry or human health (e.g., *Plant Protection Act*).[101]

[99] Pion, "Des plantes envahissantes toujours en vente libre," 2022. (Quote translated from the original French).
[100] NL Fisheries, Forestry and Agriculture, "2008 Exotic and Invasive Alien Species Workshop," 2008.
[101] NL Wildlife Division, Department of Environment and Climate Change, "Legislation Review- Invasive Alien. Presentation," 2008.

They called for better inter-agency cooperation and consideration of legislation.

PRINCE EDWARD ISLAND (PE):

Prince Edward Island's *Weed Control Act* (RSPEI 1988, c W-2.1) allows for the regulation of plants deemed noxious weeds. The Lieutenant Governor may designate a noxious weed as any plant that adversely affects or is likely to adversely affect any person, crop or other desirable plant, animal, or property. Loosestrife (*Lythrum* spp.) is the only taxa listed and there is a specific regulation that makes it an offence "to import, propagate or sell purple loosestrife or any variety or species of the genus *Lythrum*" (*Purple Loosestrife Control Regulations* PEI Reg EC629/91). There is also a *Plant Health Act* (RSPEI 1988, c P-9.1), but this legislation is largely aimed at the control of plant pathogens and does not reference weedy or invasive species.

NORTHWEST TERRITORIES (NT):

The Northwest Territories have no regulation specifically prohibiting invasive plants or noxious weeds. There is a *Protected Areas Act* (SNWT 2019, c. 11) to support and promote the protection, conservation and maintenance of biodiversity, ecological integrity, and cultural continuity of the Northwest Territories. It may be possible through this act to undertake protective measures, where there are threats of serious or irreparable harm to the ecological integrity of an area posed.[102]

NUNAVUT (NU):

In Nunavut, the purpose of the *Wildlife Act* (SNu 2003, c 26) is to "establish a comprehensive regime for the management of wildlife and habitat . . . including the conservation, protection, and recovery of species at risk." In specific reference to invasive species, it states that:

"No person shall release a member of a species into a habitat in which that species does not belong or never naturally occurred." Several guiding principles apply under this act including: *Avatimik Kamattiarniq/Amiginik Avatimik*. This essentially means that "people are stewards of the environment and must treat all of nature holistically and with respect, because humans, wildlife and habitat are inter-connected and each person's actions and intentions towards everything else have consequences, for good or ill."

In 2010, the Canadian Endangered Species Conservation Council (CESCC) identified 14 non-native plant species in Nunavut but stated: "there are currently no known species in Nunavut that can be classified as aquatic or terrestrial invasive species."[103] The CFIA technical report on Invasive Species Canada reported 16 invasive plant species in Nunavut,[104] While the interpretation of invasiveness can be debated, the discrepancy suggests a lack of information sharing between the Federal Government and territorial representatives.

[102] Gov. NWT, "Protected Areas Act," n.d..
[103] Environment Canada, "Non-native & invasive species in Nunavut," 2010.
[104] CFIA, 2008.

YUKON (YT):

The objectives of the *Environmental Act* (RSY 2002, c.76) are "to ensure the maintenance of essential ecological processes and the preservation of biological diversity." It does not explicitly mention IAPS but classifies "organisms prescribed by the Commissioner in Executive Council to be dangerous to life, health, property, or the natural environment" as Class 9 hazardous substances. It is unclear if this Act could be used to regulate sales of IAPS.

SUMMARY:

The above provincial and territorial lists of regulated plants, or lack thereof, tell a story of inconsistency and lack of communication. Significant progress has been made in the regulation of aquatic plants by some provinces due to recent efforts by DFO, but not all provinces and territories have systems in place to address the known threats.

Invasive plant species do not stop at borders. A national coordinating body is needed to facilitate cooperation between regions and to ensure information is broadly shared and resources are used efficiently and effectively.[105] Canada could use the Federal-Provincial-Territorial Invasive Alien Species National Committee established in 2018[106] or create a new biosecurity authority like that in Australia and New Zealand with a broader focus.[107] A coordinating body mandated to protect biological diversity along with the economy, food security, and public health is clearly needed.

In addition to national leadership, a national risk assessment database would go a long way to ensure that regions have access to science-based threat analysis. Many provinces identified lack of information and lack of expertise as obstacles to action. The Federal Government should remove these obstacles. Some plants should be regulated at the national level. As is the case with giant reed, federal regulation can avoid "a province-by-province approach to legislation, which could be less consistent.[108]

H.INVASIVE PLANT REGULATIONS IN THE U.S.

The regulation of invasive plants in the United States is a complex and evolving issue. The regulation of invasive plants is primarily handled at the state level, however, as in Canada there are federal acts to protect seed quality[109] and to protect plants. Unlike in Canada, there is a U.S. National Invasive Species Council (NISC) coordinating federal departments and agencies.

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[105] Gov. of Canada, "Canadian Invasive Plant Framework: A Collaborative Approach to Addressing Invasive Plants in Canada, 2011.

[106] A Federal-Provincial-Territorial Invasive Alien Species National Committee was established in 2018 to increase policy coordination and information sharing about all invasive species, but it does not track implementation of national or international targets on invasive species. It is co-chaired by Environment and Climate Change Canada, who also provides secretariat functions, but its work plan is not a public document and no further information about its plans are available on-line (ECCC, Personal Communication, April 2023); Report releases by FPT IAS "Recommendations of the Invasive Alien Species Task Force," 2017.

[107] Reid et al., "The state of Canada's biosecurity efforts to protect biodiversity from species invasions," 2021.

[108] CFIA, "RMD-16-02: Pest Risk Management Document for *Arundo donax* (giant reed)," 2017a.

[109] The U.S. Federal Seed Act Regulations (7 CFR § 201.28), first enacted in 1939, is used to regulate interstate and foreign commerce in seeds, to prevent "noxious weed seeds" that may be present in seed products.

A National Invasive Species Information Center (NISIC) was developed to support the activities of the council.[110] It provides a wide range of invasive species information; covering federal, state, local, and international sources. Included in the database are up-to-date species lists and laws as well as resources for management and control. This kind of national database is needed in Canada.

At the federal level, the U.S. Department of Agriculture (USDA) is responsible for regulating invasive plants. APHIS (Animal and Plant Health Inspection Service) is a sub-agency of the USDA that like the CFIA is a National Plant Protection Organization under the IPPC. APHIS performs risk assessments in accordance with IPPC standards and maintains a list of plants considered noxious weeds (including invasive plant species). The importation, interstate movement, and release of noxious weeds are regulated under the U.S. *Plant Protection Act* of 2000 (PPA - 7 U.S.C. §7701).

The U.S. PPA consolidated and superseded several laws including the *Federal Noxious Weed Act* of 1974 (as amended).[111] The U.S. act has a broader scope than Canada's act of the same name. While Canada's PPA protects plant health and the agricultural and forestry sectors, the purpose of the U.S. PPA is to protect agriculture, environment, and economy.[112] In addition, in 2014, the U.S. act was amended to better regulate any plant that could potentially be a vector for a plant pest or disease.[113]

Changes to the U.S. PPA include complex import regulations. These are described in the APHIS "Plants for Planting Manual." This document contains an extensive list of regulated plants with specific restrictions. Importation and interstate movement without a permit of those plants designated Federal Noxious Weeds continues to be prohibited.

The Federal Noxious Weed List was last updated in 2010.[114] At that time, 87 terrestrial, 19 aquatic, and 5 parasitic taxa were on the list. The list includes some plants in the ornamental/horticultural trades. While ornamental noxious weeds, like Japanese bloodgrass (*Imperata cylindrica*), cannot be imported or moved from one state to another, vendors can still offer such plants for sale if they were propagated within the state.[115]

Each state can establish its own regulations and management strategies for invasive plants. Most states maintain a list of plants considered noxious weeds within the state. Plants identified may be prohibited or restricted, or control requirements may be prescribed.

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[110] NISC [National Invasive Species Information Center], "About our site," 2023; NISC "Meeting the Invasive Species Challenge: National Invasive Species Management Plan," 2001.

[111] The U.S. *Plant Protection Act* consolidated and superseded several U.S. plant health laws, including *The Act of August 20*, 1912, The Federal *Plant Pest Act;* Section 102 (a)-(e) of the Department of Agriculture *Organic Act* of 1944; The Federal *Noxious Weed Act* of 1974 and several others (Corn & Johnson, "Invasive Species: Major Laws and the Role of Selected Federal Agencies," 2017).

[112] Congressional Research Service, "Invasive Species: Major Laws and the Role of Selected Federal Agencies," 2017, 15.

[113] "The Agriculture Act of 2014; H.R. 2642 / Pub. L. 113-79—became law in June 2014. It authorizes permanent funding for programs (USDA, "Plant Protection Act FY2020 (Annual) Implementation Plan for Section 7721: Plant Pest and Disease Management and Disaster Prevention Programs including the National Clean Plant Network," 2019.).

[114] USDA APHIS, "Noxious Weeds Program Home Page,"2022 list 2010; Gov.info. 7 CFR § 360.200 - Designation of noxious weeds. 2022.

[115] Beaury, Patrick & Bradley "Invaders for sale: the ongoing spread of invasive species by the plant trade industry,", 2021.

Some states explicitly recognize invasive plants in the ornamental and landscaping trades and regulate their sale and or require labels to better inform the public of their harm. As in Canada, there are significant gaps and inconsistencies between states. However, some plants have been recognized in multiple states. Examples are shown in Table 10 below. (A list of 558 plants regulated in Canada and the U.S. border states can be downloaded from CCIPR.ca (pdf).

Table 8: Examples of ornamental plants regulated in four or more North American jurisdictions.

Scientific name	Common name	Jurisdictions regulated	
		U.S. Border States (other states)	Canada
Acer platanoides	Norway maple	ME MN NH NY VT	
Acer tataricum subsp. *ginnala* syn *Acer ginnala*	Amur maple	ME MN VT WI	
Aegopodium podagraria	Goutweed, Bishop's weed	ME OH VT WI	
Ailanthus altissima	Tree of heaven	ME MI NH, OH, PA VT WA WI (DE CT IN MA)	AB ON
Alnus glutinosa	European black alder	ME MN NH WI	
Ampelopsis brevipedunculata	Porcelainberry	ME MN NY OH WI	
Anthriscus sylvestris	Wild chervil, raven's wing	ME NY PA WA WI (MA)	CAN (2&5) BC NS ON SK
Azolla pinnata	Mosquitofern	US ID MN OH PA VT WI	ON
Berberis thunbergii	Japanese barberry	ME MN NH NY PA VT WI (DE IN MN)	CAN (PPA) 11 cultivars excluded
Butomus umbellatus	Flowering rush	ID ME MI MN NH NY VT WA WI	BC AB MB SK
Cabomba caroliniana	Carolina fanwort	ID ME MI MN NH NY VT WA WI	AB MB ON
Celastrus orbiculatus	Asiatic bittersweet	ME MN NH NY OH PA VT WI (DE CT IL MA)	
Cytisus scoparius	Scotch broom	ID OH MT PA WA WI (MD)	BC
Egeria densa	Brazilian elodea	ID ME MN MT NH NY OH PA VT WA WI	AB MB ON
Eichhornia azurea	Water hyacinth	US MN OH PA VT WI	MB
Elaeagnus angustifolia	Russian olive	ME MT OH WA WI (IL)	
Elaeagnus umbellata	Autumn olive	ME MI NH NY OH WI (CT DE MA)	AB
Euonymus alatus	Winged euonymus	ME NH NY PA VT WI (DE MD MA)	
Frangula alnus syn. *Rhamnus frangula*	Buckthorn	ME MN NH NY OH PA VT WI (IL MA)	
Gypsophila paniculata	Baby's breath	PA WA	AB BC MB SK
Hesperis matronalis	Dame's rocket	ME NH OH WI	AB SK
Humulus scandens	Japanese hops	MN NY PA WI	
Hydrilla verticillata	Hydrilla	US ID ME MI MN MT NH NY OH PA VT WA WI	AB BC MB ON
Hydrocharis morsus-ranae	European frog-bit	ID ME MI MN NH NY OH PA VT WA WI	MB ON
Hygrophila polysperma	Hygrophila	US MN NH OH PA VT WI	

Impatiens glandulifera	Ornamental jewelweed	ID ME NH WA WI	AB BC MB
Ipomoea aquatica	Chinese water spinach	US MI MN NH PA VT WI	
Iris pseudacorus	Yellow flag iris	ID ME MN MT NH NY OH, VT WA WI (MA MD OR)	AB BC MB
Lagarosiphon major	African oxygen-weed	US MI MN NH OH PA VT WA WI	MB ON
Leucanthemum vulgare syn. *Chrysanthemum leucanthemum*	Oxeye daisy	ID MT OH WA (AK PA)	CAN (3) AB BC MB SK BC
Ligustrum vulgare	Privet	ME NH NY	
Limnophila sessiloflora	Asian marshweed	US MN NH OH PA VT WI	
Lonicera japonica *L. maackii* *L. morrowii* *L. tatarica* *L. x bella*	Honeysuckle, Japanese Amur or bush Morrow's Tatarian Bella*	ME MN NH NY OH PA* VT WI (DE CT IL) *PA does not regulate *L. japonica*; L. "Bella" is not regulated in ME or OH *L. xylosteum* is on ME list	
Lythrum salicaria	Purple loosestrife	AK ID ME MI MN MT ND NH NY OH PA VT WA WI	AB BC MB PE SK
Lythrum virgatum	Wand loosestrife	OH WA WI	PE SK
Myriophyllum aquaticum	Parrot's feather	ID ME MI MN MT NY OH PA WA WI	MB ON
Myriophyllum spicatum	Eurasian watermilfoil	ID ME MI MN ND NH NY OH VT WA WI	AB BC MB SK
Najas minor	Brittle naiad	ME MN NH OH VT WA WI	MB
Nymphoides peltata	Yellow floating heart	ID ME MI NH NY OH PA VT WA WI	AB MB ON SK
Phellodendron amurense	Amur cork tree	ME NY WI (MA)	
Phragmites australis sbsp *australis*	Common reed grass	ID ME MI MN MT NH NY OH VT WI	AB BC MB ON
Potemogeton crispus	Curly pondweed	ID ME MI MN MT ND NH NY OH VT WA WI	AB BC MB
Pueraria montana	Kudzu	ID MH NY OH PA WA WI	CAN BC
Pyrus calleryana	Callery ("Bradford") pear	ME MN OH PA (MD SC)	
Ranunculus ficaria syn. *Ficaria verna*	Lesser celandine	NY MN OH WA WI (DE CT IL)	
Reynoutria japonica	Japanese knotweed	ID ME MI MN MT NH NY OH PA VT WA WI	BA BC MB ON
Reynoutria sachalinensis	Giant knotweed	ID MN NH NY PA WA WI	AB BC ON
Reynoutria x bohemica	Bohemian knotweed	MN MT NH NY PA WA WI	AB BC ON
Rosa multiflora	Multiflora rose	ME NH, NY OH PA WI (IL MA)	
Salvinia molesta	Giant salvinia	US ID MI MN NH OH PA VT WI	AB ON
Tamarisk ramosissima	Salt cedar	ND WA (IL)	AB MB SK
Trapa natans	European waterchestnut	ID ME MI MN NH NY OH PA VT WA WI	AB MB ON
Vincetoxicum nigrum	Black swallowwort	MN NH NY OH PA VT WI	ON
Vincetoxicum rossicum	Pale swallowwort	MN NY PA VT WI	ON

Most states that border Canada are taking some action to regulate invasive ornamental plants, with states like Maine, Minnesota and Washington leading the way. However, invasive plants are still for sale

in many jurisdictions. "The widespread availability of invasive plants in the U.S. is likely a symptom of **disjointed state regulations** that fail to protect ecosystems and economies."[116] Below is a quick summary of the approach taken by the 13 states bordering Canada from east to west: Maine, New Hampshire, Vermont, New York, Pennsylvania, Ohio, Michigan, Minnesota, North Dakota, Montana, Idaho, Washington, and Alaska.

A closer look at the U.S. border states. (This section was first drafted in 2022 and not all updates may be reflected in lists below).

MAINE (ME):

In the Maine code of rules, the Criteria for Listing Invasive Terrestrial Plants (01-001 C.M.R. Ch. 273) "describes the criteria a plant species must meet to be considered invasive and establishes three lists of plants that regulate the sale of invasive plants in the horticulture trade."[117] The invasive plant lists described in Maine's code are maintained by the Maine Department of Agriculture & Forestry under their Horticulture Program. Sixty-three (63) plants currently appear on the "Do Not Sell Plant List" (Table 11) with 29 more on a watch list.

Table 9: Maine Do Not Sell Plant List (2024).

Scientific name	Common name	Scientific name	Common name
Acer ginnala	Amur maple	*Iris pseudacorus*	Yellow Iris
Acer platanoides	Norway maple	*Ligustrum obtusifolium*	Border privet*
Aegopodium podagraria	Bishop's weed	*Ligustrum vulgare*	Common privet
Ailanthus altissima	Tree of heaven	*Lonicera japonica*	Japanese honeysuckle
Alliaria petiolata	Garlic mustard	*Lonicera maackii*	Amur or bush honeysuckle
Alnus glutinosa	European alder	*Lonicera morrowii*	Morrow's honeysuckle
Amorpha fruticosa	False indigo	*Lonicera tatarica*	Tatarian honeysuckle
Ampelopsis glandulosa	Porcelainberry	*Lonicera xylosteum*	Dwarf honeysuckle
Angelica sylvestris	Woodland angelica	*Lythrum salicaria*	Purple Loosestrife
Anthriscus sylvestris	Wild chervil, raven's wing	*Lythrum virgatum*	Wand loosestrife
Aralia elata	Japanese angelica tree	*Microstegium vimineum*	Stilt Grass
Artemisia vulgaris	Common mugwort	*Miscanthus sacchariflorus*	Amur silvergrass
Berberis thunbergii	Japanese barberry	*Paulownia tomentosa*	Paulownia
Berberis vulgaris	Common barberry	*Persicaria perfoliata*	Mile-a-minute weed
Butomus umbellatus	Flowering rush	*Petasites japonicus*	Fuki, butterbur
Celastrus orbiculatus	Asiatic bittersweet	*Phalaris arundinacea*	Reed canary grass
Elaeagnus angustifolia	Russian olive	*Phellodendron amurense*	Amur cork tree
Elaeagnus umbellata	Autumn olive	*Photinia villosa*	Photinia, Christmas berry
Euonymus alatus	Winged euonymus	*Phragmites australis*	Common reed
Euonymus fortunei	Wintercreeper	*Phyllostachys aurea*	Golden bamboo
Euphorbia cyparissias	Cypress spurge	*Phyllostachys aureosulcata*	Yellow groove bamboo
Fallopia baldschuanica	Chinese bindweed	*Populus alba*	White cottonwood
Fallopia japonica	Japanese knotweed	*Pyrus calleryana*	Callery ("Bradford") pear
Festuca filiformis	Fine-leaved sheep fescue	*Ranunculus repens*	Creeping buttercup

[116] Beaury, "Invaders for sale: The ongoing spread of invasive species by the plant trade industry. ESA, 2020" [YouTube Presentation], 2020.
[117] Maine Dept. Agriculture, Conservation & Forestry, "Horticulture Program: Invasive plants," 2021.

Ficaria verna	Lesser celandine	*Robinia pseudoacacia*	Black locust
Frangula alnus	Glossy buckthorn	*Rosa multiflora*	Multiflora rose
Glaucium flavum	Yellow hornpoppy	*Rubus phoenicolasius*	Wineberry
Glechoma hederacea	Ground ivy	*Silphium perfoliatum*	Cup plant
Glyceria maxima	Great mannagrass	*Sorbus aucuparia*	European mountain-ash
Hesperis matronalis	Dame's Rocket	*Tussilago farfara*	Coltsfoot
Hippophae rhamnoides	Sea buckthorn	*Valeriana officinalis*	Common valerian
Impatiens glandulifera	Ornamental jewelweed		

There is a separate regulatory code for the *Prevention of the spread of invasive aquatic plants* (38 MRSA 419-C which is under the authority of the Maine Dept. of Environmental Protection. This regulation states: "**A person may not: Possess, import, cultivate**, transport or distribute any invasive aquatic plant or parts of **any invasive aquatic plant**, including roots, rhizomes, stems, leaves or seeds, in a manner that could cause the plant to get into any state waters."

Water Gardeners and Aquarium Owners are informed that eleven aquatic plants are prohibited in the state (Table 12).[118]

Table 10. Aquatic plants Illegal to sell in Maine.

Scientific name	Common name	Regulating provinces
Cabomba caroliniana	Fanwort, Carolina fanwort	AB(F), MB(WP), ON
Egeria densa	Brazilian waterweed	AB(F), MB(WP), ON
Hydrilla verticillata	Hydrilla, water thyme	AB(F), BC(SC), MB(WP), ON
Hydrocharis morsus-ranae	European frogbit	AB, MB(WP), ON
Myriophyllum aquaticum	Parrot feather	MB(WP), ON
Myriophyllum heterophyllum	Variable leaf watermilfoil	AB(F)
Myriophyllum spicatum	Eurasian watermilfoil	AB, BC(SC), MB(WP), SK
Najas minor	Brittle waternymph	MB(WP)
Nymphoides peltata	Yellow floating heart	AB, MB(WP), ON
Potamogeton crispus	Curly-leaf pondweed	AB(F), BC(SC), MB(WP), SK
Trapa natans	Water chestnut	AB(F), MB(W)P, ON
***See Table 7 above for provincial regulations (note bordering provinces NB and QB do not regulate these plants).**		

NEW HAMPSHIRE (NH):

New Hampshire has enacted an Invasive Species rule (Ch. Agr 3802.1). "It is illegal in New Hampshire to collect, transport, sell, distribute, propagate or transplant any living or viable portion of any listed **prohibited invasive plant species** including all of their cultivars, varieties, and specified hybrids."[119] The NH Prohibited Invasive Species List includes popular landscaping plants like burning bush (*Euonymus alatus*), Norway maple (*Acer platanoides*), and yellow flag iris (*Iris pseudacorus*).[120]

New Hampshire Invasive Species Council adopted the nationally recognized invasive species evaluation protocol known as NatureServe Invasive Species Impact Rank (I-Rank).[121] It is used to determine which

[118] ME Dept Environment Protection, "Water Gardeners and Aquarium Owners," 2019.
[119] NH Dept. of Agriculture, Markets & Food, "Invasive Plants," 2022.
[120] NH Dept. of Agriculture, Markets & Food, "Fact sheet: Prohibited Invasive Plant Species Rules, Agr 3800," 2017.
[121] NatureServe, "Data Types: Invasive Species Impact Rank," 2022.

non-native plant species pose the most serious threats to native species and ecosystems. These are then evaluated for inclusion on the prohibited species list.

Aquatic invasive plants are addressed by a different regulation. "Since January 1, 1998, the sale, distribution, importation, propagation, transportation and introduction of key exotic aquatic plants has been prohibited (RSA 487:16-a)."[122] The extensive list includes all *Myriophyllum* species. Plants like yellow flag iris are included on both terrestrial and aquatic prohibited lists.

VERMONT (VT):

The state of Vermont "regulates the importation, movement, sale, possession, cultivation and/or distribution of certain plants known to adversely impact the economy, environment, or human or animal health" (VT *Quarantine #3 -Noxious Weeds*). The state Noxious Weed List includes Class A plants that are not yet in the state and Class B plants "that is not native to the state, is of limited distribution statewide, and poses a serious threat to the State, or any other designated noxious weed being managed to reduce its occurrence and impact in the State, including those on the Federal Noxious Weed List (7 C.F.R. 360.200)." The list prohibits the sale of several plants of ornamental interest, e.g., Norway maple (*Acer platanoides*), Japanese barberry (*Berberis thunbergii*), amur maple (*Acer ginnala*). The list also includes invasive aquatic plants like parrot feather (*Myriophyllum aquaticum*).

"**The impacts of these plant species on native ecosystems outweigh their value as ornamental plants** in the nursery and landscaping trades to the extent that the Agency of Agriculture has banned their sale in an effort to prevent their introduction into as yet uninfested areas or slow their further spread across the state through commerce."[123]

The Vermont Invasive Exotic Plant Committee (VIEPC) also maintains a "watch list" that has no regulatory force but is used to educate the public about potentially problematic plants. The plants are periodically reviewed for inclusion on the regulated list. "The VIEPC is composed of representatives from state and Federal Government, non-profit organizations and private industry, as well as concerned individuals."[124]

NEW YORK (NY):

A regulation (6 CRR-NY V C 575 *Prohibited and Regulated Invasive Species*) was adopted in July 2014, that prohibits or regulates select invasive species. "The purpose of this regulation is to help control **invasive species, a form of biological pollution**, by reducing new infestations and spread of existing populations".[125]

Prohibited invasive species include plants of horticultural interest like amur cork tree (*Phellodendron amurense*), amur honeysuckle (*Lonicera maackii)* and Japanese bloodgrass (*Imperata cylindrica*). Prohibited species cannot be possessed with the intent to sell, import, purchase, transport or introduce. There are additional plants in the nursery trade classified as regulated invasive species. This list includes

[122] NH Dept of Environmental Services "Law Prohibits Exotic Aquatic Plants," 2019.
[123] VT Agency of Agric., Food and Markets, "Quarantine #3 – Noxious Weeds (Noxious Weeds Rule) Frequently Asked Questions (FAQs)," 2012.
[124] Spinney, "Vermont's Invasive Exotic Plant Watch List Updated," 2022.
[125] NY Dept. of Environmental Conservation, "Invasive Species Regulations," 2022.

six species: black locust (*Robinia pseudoacacia*), burning bush (*Euonymus alatus*) Norway maple (*Acer platanoides*), Chinese silver grass (*Miscanthus sinensis*), Japanese virgin's bower (*Clematis terniflora*), winter creeper (*Euonymus fortunei*). These regulated species cannot be knowingly introduced into a free-living state.[126] Businesses selling any regulated species are required to label them with a 14-point font warning: **Invasive Species - Harmful to the Environment**.

This regulation was based upon a report prepared by the New York Invasive Species Council entitled "A Regulatory System for Non-Native Species" (2010). The "four-tier system proposed in this report includes:

- a list of prohibited species, which should be unlawful to possess, import, purchase, transport, or introduce except under a permit for disposal, control, research, or education.
- a list of regulated species, which should be legal to possess, sell, buy, and transport but not be introduced into a free-living state.
- a list of unregulated species which are non-native species that should not be subject to regulation; and
- a procedure for the review of a non-native species that is not on the prohibited, regulated, or unregulated lists before the use, distribution, or release of such non-native species."

The *Invasiveness Ranking Form* is a possible assessment tool that could be useful in Canada.

In May 2016, a statewide *Aquatic Invasive Species (AIS) Spread Prevention Regulation* (6 NYCRR Part 576) was adopted to prevent the spread of aquatic invasive species.[127] It does not impact the sale of aquatic invasive plants.

PENNSYLVANIA (PA):

To protect agriculture and ecosystems, Pennsylvania enacted a *Controlled Plant and Noxious Weed Act.* (2017, PA C.S. 3). With those changes, a new Invasive Plant/Noxious Weed List (§ 317-103) was created that incorporates the PA Dept. of Agriculture's Noxious, Invasive and Poisonous Plant Program Class lists and the PA Dept. of Conservation and the Natural Resource's list of "Invasive Plants of Pennsylvania." Weeds are categorized in three classes based on spread and eradication potential. The list includes the Federal Noxious Weeds in Class C. **It is a violation to distribute, cultivate or propagate any noxious weed**. The list includes aquatic plants like European water chestnut (*Trapa natans*) and ornamental terrestrial plants like wild chervil (*Anthriscus sylvestris*) and chocolate vine (*Akebia quinata*).[128]

OHIO (OH):

In 2018, to protect native plant species, Ohio enacted an ***Invasive Plant Species Rule*** (901:5-30-01). Invasive plant species are defined as plant species that are not native to Ohio whose introduction causes or is likely to cause economic or environmental harm, or harm to human health as determined by scientific studies. Under this rule, "**no person shall sell, offer for sale**, propagate, distribute, import or

[126] Introduction in a free-living state means introducing the plant into an unconfined area outside the control of a person, and in particular public lands, lands connected to public lands, natural areas, public waters, waters connected to public waters or water-using facilities that provide access to public waters.
[127] NY Dept. of Environmental Conservation, "Invasive Species Regulations," 2016.
[128] PA Dept. of Agric "Controlled Plant & Noxious Weeds," 2022.

intentionally cause the dissemination of any invasive plant." The list includes ornamental plants like tree-of-heaven (*Ailanthus altissima*), various Asian bush honeysuckle (e.g., *Lonicera japonica*), callery pear (*Pyrus calleryana*) and includes aquatics like water chestnut (*Trapa natans*) and water milfoils (*Myriophyllum* spp.).

There are additional regulations for plants designated "noxious weeds" (901:5-37-01). Prohibited plants include several ornamental invasive plants such as purple loosestrife (*Lythrum salicaria*), kochia (*Bassia scoparia*), Japanese knotweed (*Polygonum cuspidatum*). Yellow groove bamboo (*Phyllostachys aureosculata)* is also prohibited "when the plant has spread from its original premise of planting and is not being maintained."

MICHIGAN (MI):

A limited number of invasive plant species are designated by the State of Michigan as either "prohibited" or "restricted." (*Natural Resources and Environmental Protection Act 451 of 1994* PART 413: *Transgenic and Nonnative Organisms*). The list of regulated species includes mostly aquatic invasive species and two terrestrial species: giant hogweed (*Heracleum mantegazzianum*) and Japanese knotweed (*Fallopia japonica*).[129] If a species is prohibited or restricted, it is unlawful to possess, introduce, import, sell or offer that species for sale.

Michigan also has "**rarely enforced**" noxious weed regulations.[130] Michigan's *Seeds Law* limits the percentage of noxious weed seed in "agricultural, vegetable, lawn, flower, and forest tree seeds" (MI *Seed Law 1995*, *Act 329*; and *Seed Law Implementation 1995*, *Regulation 715*). The MI Department of Agriculture maintains the Prohibited and Restricted Weeds Lists, though the official MI government website does not make it immediately clear which invasive species are regulated.[131]

MINNESOTA (MN):

Minnesota has several state laws intended to minimize the introduction and spread of invasive plant species. In addition to a *Noxious Weed Law* (Agric. Ch. 18), Minnesota has enacted additional statutes and rules to explicitly control invasive species (*Conservation Ch 89D; Natural Resources Department Ch 6216*). This state prohibits many aquatic invasive plants (28 species), including all but one on the federal noxious weed list, and regulates another seven.[132] Many ornamental terrestrial species are regulated as noxious weeds using a four-tiered system. "The Noxious Weed Law affects growing plants. Some plants are noxious because they can harm people, animals, the food we eat, and nature."[133]

There are currently 29 species on the prohibited noxious weed list, 16 on the eradicate list, and 13 on the control list. There are an additional 15 on a restricted list that cannot be sold, and four species that have special regulations. The various lists correspond to the establishment of the plants in the state and the requirements for control.

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[129] Michigan Agriculture & Rural Development, "Prohibited and Restricted Weeds," n.d..
[130] Isleib, "Michigan noxious weed laws, though rarely enforced, define and regulate prohibited/restricted weeds," 2012.
[131] Michigan gov. "Invasive Species," 2022.
[132] MN Dept of Natural Resources, "Minnesota Weed Law," 2022.
[133] MN Dept. of Agric., "Minnesota invasive species laws," 2022b

- **Prohibited – Eradicate**: not yet present. For instance, tree-of-heaven (*Ailanthus altissima*) is not yet present in the state, cannot be sold, and must be eradicated when found.
- **Prohibited – Control**: present and containable. - For example, giant knotweed (*Polygonum sachalinense*) is present in the state. It cannot be sold and must be controlled in a way that prevents its spread by seed or vegetative means where eradication is not possible.
- **Restricted**: widespread, eradication unlikely: These are widespread invasive plants, like the multiflora rose (*Rosa multiflora*) and eradication or control is "not feasible" statewide. These plants may not be sold or intentionally distributed.
- **Specially Regulated**: eradication or control can be enforced under specific conditions: six species are listed under this regulation: amur cork tree, amur maple, Callery pear, Norway maple, poison ivy, and Tartarian maple.

For instance, amur, Tartarian, and Norway maples may be sold, but as in New York, labelling is required.

> Sellers shall affix a label directly to the plant or container packaging that is being sold that advises buyers to only plant [these species and their] cultivars in landscapes where the seedlings will be controlled by mowing or other means. . .. [S]eed is wind dispersed and trees should be planted at least 100 yards from natural areas[134]

Callery pear can be sold up until 2026, as part of a three-year production phase out period. (Winged burning bush was phased out in this manner starting in 2020 and became Restricted in 2023). Plants like poison ivy (a native) must be controlled where it poses a public health hazard.

NORTH DAKOTA (ND):

North Dakota prohibits the sale and intentional distribution of noxious weeds (ND CC § 4.1-47-02). They include ornamentals like purple loosestrife (*Lythrum salicaria* L., *L. virgatum* L. and all cultivars) as well as all salt cedar (*Tamarisk* spp.).

North Dakota prohibits the transport of any aquatic vegetation to or from any waters of the state.[135]

MONTANA (MT):

Montana maintains a noxious and regulated plant list under various agriculture regulations (Ch 4.5; Ch 7). Plants are classified as priority 1A, 1B, 2A, 2B or 3, based on their presence in the state and the management required.[136] As in Minnesota, those not yet present like common reed (*Phragmites australis* ssp. *australis*) require eradication. Those present like the knotweed complex (*Fallopia japonica, F. sachalinensis, F.* × *bohemica*) require eradication or containment.

More common invasive species like yellow flag iris (*Iris pseudacorus*) and Eurasian watermilfoil (*Myriophyllum spicatum, M. spicatum* x *M. sibiricum*) require containment and are prioritized over common species like oxeye daisy (*Leucanthemum vulgare*). There is a final category of regulated but not noxious plants that **cannot be intentionally spread or sold**, and this short list includes aquatic plants like

[134] MN Dept. of Agric., "State Prohibited Noxious Weeds," 2022c.
[135] ND, "Aquatic Nuisance Species." 2008, 30-03-06; ND Game and Fish, ANS Regulations," 2022.
[136] MT Gov., "Montana Noxious Weed List," 2019.

parrot feather watermilfoil (*Myriophyllum aquaticum* or *M. brasiliense*) as well as terrestrials like Russian olive (*Elaeagnus angustifolia*).

IDAHO (ID):

Idaho has two statutes regulating invasive plants, a *Noxious Weeds regulation* (22 Ch 24) and a more recent *Invasive Species Act* (22 Ch19). Under the invasive species regulation, "**No person may** import, export, **purchase, sell, barter,** distribute, propagate, transport or introduce an **invasive species** into or within the state of Idaho." Invasive aquatic and terrestrial species are included with noxious weeds on state lists.[137]

Idaho has 71 weed species and 4 genera designated noxious by state law – 54 of these species are terrestrial.[138] Ornamental brooms and false brooms are all prohibited, from the genera: *Cytisus, Genista, Spartium,* and *Chamaecytisus*. There are an additional 17 aquatic invasive species.[139] It is a tiered system requiring eradication, control, containment and or reporting, depending on how widespread the problem.

WASHINGTON (WA):

Washington State's *Noxious Weed Seed and Plant Quarantine* legislation (WAC 16-752-600) begins:

> Washington agriculture, environmental quality, and natural resources, including waters and wetlands, are threatened by **non-native, aggressive species** of noxious weeds. A number of these noxious weeds are transported and sold within the state of Washington both as **nursery plants and as seeds in packets of flower seeds** or 'wildflower mixes.' Subsequent "escape" of these ornamentals has been a documented source of a number of infestations and has resulted in large public and private expenditures by landowners and land managers, weed boards, and weed districts and the department of agriculture to achieve the control mandated . . . regulation of the sale of these seed packets and plants as 'regulated articles' is necessary to protect Washington agriculture and natural resources and to prevent public and private costs of control.

Under state law establishing the *Noxious Weed Seed and Plant Quarantine rule*, "it is **prohibited to transport, buy, sell, offer for sale**, or to distribute plants or plant parts of the regulated species into or within the state of Washington" (WAC 16-752-620). Regulated species include certain noxious weed species,[140] but not all.

The WA noxious weeds are organized into three classes of weeds: Class A, B, and C. Class A are not widely distributed and must be eradicated where found. Class B are widespread, and containment or reduction is required. Class C weeds are often widespread or are of special interest to the agricultural industry. Control may be required if they pose a threat to agriculture or natural resources.[141] Additions of noxious weeds to the quarantine list within the last six years include: yellow archangel (*Lamiastrum galeobdolon*), butterfly bush (*Buddleja davidii*) except sterile cultivars, oriental clematis (*Clematis*

[137] ID, "Invasive species: Overview," 2022a.
[138] ID, "Invasive species: Terrestrial plants," 2022c.
[139] ID, "Invasive species: Aquatic plants,"2002b.
[140] WA, "Prohibited plants and seeds in Washington State," 2021.
[141] WA Noxious Weed Control Board, "Washington's Noxious Weed Laws," n.d.a.

orientalis), French broom (*Genista monspessulana*), giant reed (*Arundo donax*) (except variegated cultivars), and lesser celandine (*Ficaria verna*).[142]

ALASKA (AK):

Alaska's Department of Natural Resources manages *Prohibited and restricted noxious weeds* (Section 11 AAC 34.020). These are generally weedy species with little ornamental value. There is an *Aquatic Invasive Species regulation* (5 AAC 41.07), but no plants are identified on the list of regulated species.[143]

The Alaska Center for Conservation Science (ACCS) has been working to track all non-native species and has developed an invasive plant ranking system that evaluates the probability of species establishment in three eco-geographic regions of the state based on its worldwide range.[144] The list includes ornamental species like Siberian peashrub (*Caragana arborescens*) with high invasive potential. Hopefully such studies can be used to inform regulations to limit their spread.

SUMMARY

Bradley and colleagues recently summarized the status of the regulatory systems in the United States:

> [I]nvasive plant regulations are **inconsistent and reactive**. Of the 128 plants regulated by one or more states, 54 were regulated by a single state and only 16 were regulated by all six states; regulated species tended to be widespread across the region (not proactive). These outcomes are largely driven by different sets of evaluated species. For example, neighboring states Vermont and New Hampshire evaluated 92 species in total, but only 26 overlapped. In addition, states rarely evaluated species that were absent from the state. Risk assessment protocols varied considerably across states, but consistently included criteria related to ecological impact, potential to establish, dispersal mechanisms, and life history traits.[145]

I. SELECTED CASES STUDIES

The following are a few cases selected to illustrate problems with the current policies, processes, and regulations. They highlight gaps in regulations, inconsistencies, and serious risks posed by invasive plants that are not currently being addressed by any level of government. Many additional cases could be discussed.

[142] WA Noxious Weed Control Board, "Noxious Weeds Index Quarantine List," n.d.b.
[143] AK Dept. of Fish and Game, "Invasive Species Legal Requirements," 2021
[144] ACCS, "Non-Native Plant Species List," 2021.
[145] Bradley et al., "Breaking down barriers to consistent, climate-smart regulation of invasive plants: A case study of US Northeast states," 2022b.

AQUATIC INVASIVE SPECIES – FLOWING THROUGH A GAP

"Aquatic invasive species and their potential damage to Canadian aquatic ecosystems pose a multi-faceted problem with no easy solutions. The scope of the problem, combined with the fact that it will continue to grow if left unchecked, leaves no doubt that immediate steps must be taken."[146]

Early in the 1970s, many aquatic plants were subject to import requirements. Four taxa (*Elodea densa* - Brazilian waterweed, *Hydrilla verticillata* - water-thyme, *Myriophyllum* spp. -watermilfoil, and *Trapa* spp. - European water-chestnut) were prohibited for import into Canada. However, that changed in December 2001, when the CFIA stopped regulating aquatic plants. The decision was justified as follows:

> Some of the aquatic plants that are or may be imported into Canada do not fall under the definition of 'pest' under the *Plant Protection Act*.
>
> The lack of scientific capacity does not allow the Agency to adequately evaluate environmental and plant-pest risks associated with aquatic plants; and the lack of an interdepartmental policy.[147]

In 2007, there appeared to be a sober rethinking of the earlier decision to repeal prohibitions. The CFIA informed the Pet Industry Joint Advisory Council of Canada (PIJAC) that 13 potentially invasive aquatic plants, in Table 13 below, would not be allowed entry into Canada until risk assessments had been completed. "Once completed, the CFIA's aquatic plants policy will be finalized and posted on the CFIA website. Importers of aquatic plants will be notified accordingly."[148]

Of the 13 plants that appeared in the 2007 advisory, ten are not listed among the plants screened by the CFIA. Two assessments were completed, one for European water chestnut and the other for yellow floating heart (discussed in cases to follow). One for swamp stonecrop is pending. to the state of risk management documents being developed by the CFIA. No aquatic plants have been regulated under the *Plant Protection Act*.[149]

Table 11. Aquatic plants identified by the CFIA as requiring risk analysis in 2007.

Species	CFIA Weed Risk Document (PRA)	AqWRA – U.S. Risk
Cardamine impatiens L. (narrowleaf bittercress)	not listed	
Crassula helmsii A. Berger (swamp stonecrop)	PRA pending	70 – High-Risk
Hydrilla verticillata (L. f.) Royle (water-thyme)	not listed**	79 – High-Risk
Limnophila indica (L.) Druce (Indian marshweed)	not listed	17 – Low-Risk
Limnophila sessiliflora (Vahl) Blume (Asian marshweed)	not listed	33 – Intermediate*
Ludwigia grandiflora (M. Micheli) Greuter & Burdet (large-flower primrose-willow)	not listed	
Ludwigia peruviana (L.) Hara (Peruvian primrose-willow)	not listed	61 – High-Risk
Marsilea quadrifolia L. (European waterclover)	not listed	65 – High-Risk
Myriophyllum aquaticum (Vell.) Verde. (parrot feather)	not listed**	66 – High-Risk

[146] Canadian Council of Fisheries and Aquaculture, "A Canadian Action Plan to Address the Threat of Aquatic Invasive Species," 2004.
[147] Champion, Hofstra, & Clayton, "Border control for potential aquatic weeds. Stage 3. Weed risk management," 2007.
[148] Azan, "Invasive Aquatic Plants in the Aquarium and Ornamental Pond Industries," 2011.
[149] Three are listed as *Plants Excluded from the United States Greenhouse Certification Program*, a program that facilitates the trade of greenhouse-grown plants between the United States and Canada (CFIA, 2014).

Najas minor All. (brittle waternymph)	not listed	67 – High-Risk
Nymphoides peltata (Gmel.) O. Kuntze (yellow floating-heart)	PRA / no regulations	74 – High-Risk
Sagittaria sagittifolia L. (arrowhead)	not listed	30 – Low-Risk
Salvinia minima Baker (water fern)	not listed	70 – High-Risk *
Trapa natans L. (European water-chestnut)	PRA / no regulations	66 – High-Risk
* U.S. Fed. Noxious Weed; **Excluded from USGCP		

In 2009, Fisheries and Oceans Canada (DFO) began publishing weed risk assessments for aquatic plants. The DFO identified the water-garden and aquarium trades as a primary source of many non-native invasive aquatic plants in Canada.[150] They identified 88 taxa of the 129 assessed as potentially high-risk, using an Aquatic Weed Risk Assessment protocol (AqWRA).[151]

Table 12: Risk assessments and regulations for invasive aquatic plants with volumes of sale (total number of taxa sold per year) in Canada.

Scientific name	Common name	Sales volume [152]	AqWRA score	USDA lowest hardiness zone[153]	Provinces Regulating	US Federal and States Regulating or Watching Taxa
Eichhornia crassipes	water hyacinth	32633	81	6	MB	Federal Noxious Weed, AL, AR, AZ, CA county, CO watch list, LA, MN, MS, NE, PR, SC, TX, Chicago, WI
Pistia stratiotes	water lettuce	16374	72	7	MB	AL, CA county, CO watch list, FL, LA, MS, PR, SC, TX, WI
Cabomba caroliniana	cabomba, fanwort	6146	67	6	AB, MB, ON, SK	CA, CT, ID, MA, ME, MI, MN, NH, NY, PR, VT, WA, WI,
Egeria densa	Brazilian waterweed	5144	71	5	AB, MB, ON, SK	AL, CA, CO watch list, CT, ID, IL, IN, LA, MA, ME, MI, MN, MS, MT, NE, NH, NY, OH, OR, PR, SC, VT, WA, WI
Myriophyllum aquaticum	parrot feather	4107	75	5	MB, ON	AL, CA county, CO, CT, ID, IL, IN, MA, ME, MI, MN, MT, NE, NH, NY, OH, OR, VT, WA, WI

[150] E.g., Marson et al., "Summary of a Survey of Aquarium Owners in Canada," 2009a; "Summary of a Survey of Water Garden Owners in Canada," 2009b; Azan, "Invasive aquatic plants and the aquarium and ornamental pond industries," 2011; Azan et al., "Invasive aquatic plants in the aquarium and ornamental pond industries: A risk assessment for southern Ontario (Canada)," 2015; Gordon et al., "Weed Risk Assessment for Aquatic Plants: Modification of a New Zealand System for the United States," 2012.

[151] AqWRA is a 'questionnaire-style' risk assessment composed of 38 questions pertaining to the life history, ecology, climate tolerance, and invasion history of each species, (Gantz et al, 2014). 88 taxa of 129 assessed were considered potentially high-risk. "*A priori* classification for test species based upon their status in the U.S. and predicted invasiveness risk level using the USAqWRA system" is available from Gordon et al., 2012.

[152] Marson et al., 2009a; 2009b.

[153] USDA Plant Hardiness Zone are a standard based on the average annual minimum winter temperature.

Iris pseudacorus	yellow flag iris, yellow water iris	2935	58	4	AB, MB, SK	CO watch list, CT, ID, IL, IN, MA, MD, MN, MT, NY, OR, VT, WA, WI
Trapa natans	European water chestnut	360	66	5 (3)[154]	AB, MB, ON	AL, ID, MA, ME, MI, NH, NY, OH, OR, SC, WI
Myriophyllum heterophyllum	Broadleaf watermilfoil	No data	72	5	AB	CT ID MA NH NY VT WA

As Table 14 indicates, many top-selling species in nurseries and in the aquarium-trade are considered high-risk for invasion success. Popular plants like water hyacinth, water lettuce, fanwort, waterweed, and parrot feather all pose high risks to Canada's waterways.[155] As there are no labelling requirements, the public is unaware of the risks when purchasing such plants and are not informed that these plants should not be released into the environment. Of the above plants, only fanwort (*Cabomba*) appears in the Weed Risk Analysis documents maintained by the CFIA.[156]

Even though DFO had performed a risk analysis for many aquatic species in 2009, that information was not widely shared. It took eight years for the potential risk posed by fanwort to reach authorities in Ontario. The Office of the Ontario Auditor General reported:

> 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.[157]

Due to a lack of a shared information database for invasive plants, it took over a decade for regulation at the provincial level to occur. Other provinces and territories still lack the knowledge, resources and/or legislative tools to act. This will be explored further below.

The Ontario experience is reflected in wider issues identified in 2019 by the Auditor General of Canada.

> Overall, . . . Fisheries and Oceans Canada had not determined which species and pathways posed the greatest threats to Canada's environment and economy and to human health and activities, and it had not determined which species were the most important to regulate. . .. We also found that Fisheries and Oceans Canada did not distinguish its regulatory responsibilities from those of the provinces and territories, including clarifying who was responsible for aquatic invasive freshwater plants.[158]

While the DFO is responsible for preventing aquatic invasive species from becoming established in Canadian waters. Authority for the regulation of aquatic invasive plants remains unclear at the federal level. According to the North American Plant Protection Organization, both the U.S. and Canada have

[154] APHIS WRA for *Trapa natans* indicates hardiness zone 3 rather than those reported by Gantz et al, 2014.
[155] Adebayo et al., "Water hyacinth (*Eichhornia crassipes)* and water lettuce (*Pistia stratiotes*) in the Great Lakes: Playing with fire?" 2011.
[156] CFIA, "Weed risk analysis documents," 2021b.
[157] Office of the Auditor General of Ontario, "Value-for-Money Audit: Management of Invasive Species," 2022.
[158] Office of the Auditor General of Canada, "2019 Spring Reports of the Commissioner of the Environment and Sustainable Development to the Parliament of Canada," 2019: 1.23.

authority to regulate some aquatic invasive plants as pests under their respective PPAs, "but only the U.S. has an active program, with 19 aquatic plant species listed as Federal Noxious Weeds."[159] U.S. aquatic Federal Noxious Weeds:

- *Azolla pinnata* R. Brown (mosquito fern, water velvet)
- *Caulerpa taxifolia* (Vahl) C. Agardh, Mediterranean strain (killer algae)
- *Eichhornia azurea* (Swartz) Kunth (water hyacinth)
- *Hydrilla verticillata* (Linnaeus f.) Royle (hydrilla)
- *Hygrophila polysperma* T. Anderson (Miramar weed)
- *Ipomoea aquatica* Forsskal (water-spinach, swamp morning-glory)
- *Lagarosiphon major* (Ridley) Moss; (frog's bit, tape-grass, waternymphs)
- *Limnophila sessiliflora* (Vahl) Blume (ambulia)
- *Melaleuca quinquenervia* (Cavanilles) S.T. Blake (punktree)
- *Monochoria hastata* (Linnaeus) Solms-Laubach (arrow-leaf pondweed)
- *Monochoria vaginalis* (Burman f.) C. Presl (heart shape false pickerelweed)
- *Ottelia alismoides* (L.) Pers. (duck lettuce)
- *Sagittaria sagittifolia* Linnaeus (arrowhead)
- *Salvinia auriculata* Aublet (eared watermoss, giant salvinia)
- *Salvinia biloba* Raddi (giant salvinia, watermoss)
- *Salvinia herzogii* de la Sota (giant salvinia, watermoss)
- *Salvinia molesta* D.S. Mitchell (giant salvinia, kariba weed)
- *Solanum tampicense* Dunal (wetland nightshade); and
- *Sparganium erectum* Linnaeus (exotic bur-reed).

The CFIA could use the PPA or the DFO could use the *Fisheries Act* to regulated aquatic invasive plants but these departments appear to require guidance. Canada must make clear where the authority lies and ensure invasive aquatic plants don't continue to flow through the legislative and policy gaps.

> **As we enter the Anthropocene, humanity is reorganizing the biosphere, and it is alarming that native biota worldwide is also jeopardized by missing, incomplete, and improperly communicated legislation. The costs related with biological invasions are high and to safeguard aquatic ecosystems in the world, invasive aquatic pets [and plants] should be moved to the top, not the bottom, of the government's environmental priorities lists.[160]**

THE CASE OF BARBERRY (*BERBERIS* SPP.)

Barberry presents an interesting case that highlights the problem of the current regulatory system in Canada which focuses on food security and largely ignores the impacts of invasive plants on biodiversity and/or public health.[161] Black stem rust (BSR - *Puccinia graminis*) is a fungal disease that can harm cereal crops and threaten food production. Because barberries (*Berberis* species) were known to carry BSR,

[159] NAPPO, "DD 03: The Role of the North American Plant Protection Organization in Addressing Invasive Alien Species," 2011, 8.
[160] Patoka, et al., "Invasive aquatic pets: failed policies increase risks of harmful invasions," 2018.
[161] E.g., Clark & Seewagen, "Invasive Japanese Barberry, *Berberis thunbergii* (*Ranunculales: Berberidaceae*) is associated with simplified branch-dwelling and leaf-litter arthropod communities in a New York forest," 2019; CABI 2019; Kulhanek & Smith, "Invasive species management: common and Japanese barberry," 2022.

legislative efforts toward barberry eradication began in Canada in 1917[162] and a quarantine regulation prohibiting entry of so-called rust barberry (*B. vulgaris*) into Canada followed.[163] A more general ban on all barberries was put in place between 1966 and 2001.[164]

During that period, the *Plant Protection Regulations* (SOR/95-212, 1990) were created and replaced earlier regulations. Plants that could host BSR or were susceptible to that fungal disease became regulated under the directive D-01-04. Both BSR and plants considered potential vectors for the disease became classified as Quarantine Pests.[165] The import, sale, and distribution of all barberries (*Berberis* species) were banned in Canada.[166]

However, the Canadian Nursery Landscape Association (CNLA) argued that not all banned plants were host to BSR. After extensive lobbying from the CNLA, Canada decided to exempt plants thought to be resistant to the rust.[167] Eleven (11) Japanese barberry cultivars were exempted: 'Aurea Nana,' 'Bailgreen' (Jade Carousel®), 'Bailone' (Ruby Carousel®), 'Concorde,' 'Gentry' (Royal Burgundy®), 'Monlers' (Golden Nugget™), 'Monomb' (Cherry Bomb®), 'Monry' (Sunsation®), 'Rose Glow,' 'Royal Cloak,' and 'Tara' (Emerald Carousel®).[168]

In 2022, the CFIA learned that some exempted cultivars were potentially capable of producing rust susceptible offspring, and some had been misidentified as *B. japonica* when they were hybrids with *B. vulgaris.* They issued a "Notice to industry: Recommendation to prevent movement of 'Concorde', 'Royal Cloak' and 'Tara' (Emerald Carousel®) barberry cultivars, into Alberta, Saskatchewan, and Manitoba." Based on a risk assessment and stakeholder feedback, those three cultivars are likely to "be removed from the list of exempt species and cultivars and their movement will be prohibited."[169] The CIFA is reviewing regulatory changes to "**protect the grain industry**," "**while supporting market opportunities for the horticulture industry**."[170]

In the accompanying pest management document, the CFIA notes barberry has escaped cultivation in several provinces and is invasive.

> Japanese barberry (*Berberis thunbergii*) has escaped or become naturalized locally in Ontario, Québec, New Brunswick, Prince Edward Island and Nova Scotia. . .. Japanese barberry (*Berberis thunbergii*) is considered invasive in most of the eastern Canadian provinces (Nova Scotia, Ontario, Prince Edward Island and Québec) (CABI, 2019), and is regulated as such by some U.S. states (for example, Massachusetts, New Hampshire, Vermont). The invasive nature of Japanese barberry is due to the combination of multiple and effective reproduction mechanisms, a low rate of plant

[162] Fulling, "Plant Life and the Law of Man. IV. Barberry, Currant and Gooseberry, and Cedar Control," 1943.
[163] Britton, "Quarantine restrictions affecting shipments of Connecticut Plants," 1932.
[164] CFIA, "Regulations Amending the Plant Protection Regulations" 2001, In *Canada Gazette* 135(15) 1372-1380.
[165] CFIA, "Consolidation of regulated pests for Canada," 2016.
[166] Ornamental mahonia continue to be sold across Canada. *Mahoberberis* & *Mahonia* are included under *Berberis* in Plants of the World Online (POWO) facilitated by Royal Botanic Gardens, Kew, (2023).
[167] Landscape Trades, "CNLA News: Restrictions lifted on Japanese barberry," 2001.
[168] CFIA, "Technical reference R-004: Japanese Barberry Identification Manual," 2013a; CFIA, "Plant Protection Regulations," 2022d.
[169] CFIA, "Notice to industry: Recommendation to prevent movement of 'Concorde', 'Royal Cloak' and 'Tara' Emerald Carousel barberry cultivars, into Alberta, Saskatchewan and Manitoba," 2022a.
[170] CFIA, "RMD-21-02: Pest risk management document for barberry (*Berberis, Mahoberberis* and *Mahonia* spp.) as a biological obstacle to the control of black stem rust (*Puccinia graminis*)," 2022c.

> mortality (Ehrenfeld 1999), and its capacity to tolerate a wide range of environmental conditions, such as full sun to full shade, severe drought, and extreme winters (CABI 2020).[171]

Even though Japanese barberry is established in parts of Canada, it is classified as a quarantine pest.[172] The "endangered areas" were historically agricultural lands where barberry is considered under official control, i.e., it is monitored in those areas and there are active measures to eradicate it. Control of rust and not protection of the environment has been the primary reason for regulation.

In contrast, many states bordering Canada have enacted regulations prohibiting barberries. *Berberis thunbergii* and hybrids are regulated in seven of the 13 states that border Canada: Maine,[173] Minnesota,[174] New Hampshire,[175] New York,[176] Pennsylvania,[177] Vermont,[178] and Wisconsin,[179] as well as in Massachusetts,[180] Delaware,[181] and Indiana.[182] This is necessary to protect biodiversity and public health in addition to agriculture.

Several states, like Massachusetts, ban all cultivars, varieties, and hybrids. "Until such time that MDAR nursery inspectors are able to clearly recognize that a hybrid, variety, or cultivar of a species on the Prohibited Plant List is truly non-invasive or sterile (does not produce viable seed), these plants will be included in the list."[183]

The Minnesota Department of Agriculture sums up the health concerns:

> Japanese barberry infestations cause many detrimental ecological and economic impacts. It has the unique ability to change the chemistry of the soil beneath the plant, which in turn makes the site more favorable for additional Japanese barberry plants. Over time, the change in soil pH and the higher nutrient levels can contribute to changes in the whole ecosystem of the area, resulting in a decrease of native plant and animal biodiversity. . .. Dense stands of naturalized Japanese barberry could result in public health concerns as well. Research in Connecticut and Maine showed that **black-legged ticks** were twice as numerous in Japanese barberry infestations as in non-invaded areas.[184]

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[171] CFIA, "RMD-21-02: Pest risk management document for barberry (*Berberis, Mahoberberis* and *Mahonia* spp.) as a biological obstacle to the control of black stem rust (*Puccinia graminis*)." 2022c.
[172] A pest of potential economic importance to the area endangered thereby and not yet present there, or present but not widely distributed and being **officially controlled.**
[173] ME CMR 01-001 H Ch. 273 -Criteria for listing invasive terrestrial plants. Current through May 3, 2023.
[174] MN Ch-18-*Noxious Weed Act,* 2022.
[175] NH HB1258-FN-*Invasive Species Law*, 2000.
[176] NY 6 CRR-NY V C 575-*Prohibited and Regulated Invasive Species*, 2015.
[177] PA Ch-15-*Controlled Plants and Noxious Weeds*, n.d..
[178] VT R. 20-031-021-X-*Quarantine #3 -Noxious Weeds*, 2012.
[179] WI Ch NR 40 - *Invasive species rule - NR 40* Species Identification, Classification and Control, n.d..
[180] MA Ch 128 "Massachusetts Prohibited Plant List," 2023.
[181] DE 3 Ch.29 "Invasive and Potentially Invasive Plants," n.d.
[182] IN 312 IAC 18-3-25 *Terrestrial plant rule,* 2019.
[183] MA Gov., "Prohibited Plant List - FAQ," 2001. Other states like New York have exempted certain cultivars thought to be sterile, and therefore of reduced risk. Minnesota explicitly prohibits cultivars approved in Canada like: 'Bailgreen,' 'Bailone,' 'Monomb,' 'Rose Glow,' and 'Tara.' This is because of the environmental harm they cause and the indirect public health risk the plants pose.
[184] MN Dept. Ag. "Japanese barberry," 2022a.

Public health concerns related to barberry infestations are growing. Researchers have found a strong correlation between Japanese barberry, tick populations, and tick-borne diseases (TBD). Deer tick also called "blacklegged tick, *Ixodes scapularis*, is a vector of seven human pathogens, including those causing Lyme disease (LD), anaplasmosis, babesiosis, *Borrelia miyamotoi* disease, Powassan virus disease, and ehrlichiosis associated with *Ehrlichia muris eauclarensis*.[185] Research conducted by the Connecticut Agricultural Experiment Station reported higher populations of deer ticks in areas where Japanese barberry was present.[186] Williams, project director for Mitigating Lyme Disease Risk research, noted at Connecticut locations: "Ticks found in Japanese barberry infestations have been shown to have elevated infection prevalence with the Lyme disease-causing spirochete Borrelia burgdorferi."[187] Dense growth of barberry creates a microhabitat beneficial to all stages of tick development, protects ticks from predators, and increases tick-to-host contact between the nymphal ticks and its primary, first stage host, the white-footed mouse.[188]

> It is now widely acknowledged that the increase in temperature associated with climate change has contributed to a general increase in the number, types, level of activity and geographical distribution of ticks in North America . . . and has directly contributed to the northward spread of blacklegged ticks and LD into Canada. As a result, LD has emerged in Canada and the number of reported cases of Lyme disease continues to rise. . .. [T]here is an opportunity to work on other modifiable risk factors that affect TBDs in Canada, appreciating that this is a complex socio-ecological challenge.[189]

Continual introduction of barberries through the nursery trade adds to propagule pressure and invasion success. With invasion success comes an **increased public health risk**. Managing barberry sales is one way to reduce this risk factor.

To summarize, in Canada, barberries and plants that spread BSR are prohibited because they pose a threat to crop production. That is indeed a valid reason to prohibit them. However, the current process fails to prioritize threats to biodiversity and in this case an additional potential threat to public health from ticks as disease vectors. The discovery that rust-resistant plants may produce progeny that spread rust highlights the need for a precautionary approach to approving cultivars. It is hoped that the CFIA seriously consider **invasiveness as an assessment criterion** before approving any new rust-resistant cultivars.

[185] Eisen & Eisen, "The Blacklegged Tick, *Ixodes scapularis*: An Increasing Public Health Concern," 2018.
[186] E.g., Linske, Lyme disease ecology: effects of habitat and hosts on the density and distribution *of Borrelia burgdorferi*-infected *Ixodes scapularis* 2017; Ward, Comparing effectiveness and impacts of Japanese Barberry (*Berberis thunbergii*) control treatments and herbivory on plant communities 2017; Williams et. al., "Long-term effects of *Berberis thunbergii* (*Ranunculales: Berberidaceae*) management on *Ixodes scapularis* (*Acari: Ixodidae*) abundance and *Borrelia burgdorferi* (*Spirochaetales: Spirochaetaceae*) prevalence in Connecticut, USA," 2017.
[187] Williams, "Mitigating Lyme Disease Risk Through Control of an Invasive Plant Species," 2014.
[188] Kulhanek & Smith, "Invasive Species Management: Common and Japanese Barberry," 2022.
[189] Bouchard et al., "Increased risk of tick-borne diseases with climate and environmental changes," 2019.

THE CASE OF TREE-OF-HEAVEN (*AILANTHUS ALTISSIMA*)

Tree-of-heaven is recognized internationally as a tree with moderate to high invasion potential.[190] It has been established for some time in Canada and was discussed in the CFIA's 2008 technical report on "Invasive Alien Plants in Canada." While a risk analysis is pending, the CFIA has posted the following:

> Once established, tree-of-heaven is difficult to remove, and its powerful roots can damage infrastructure like sewers, foundations, and sidewalks. In some people, tree-of-heaven pollen causes allergic reactions and exposure to tree-of-heaven sap or plant parts can cause skin irritation.
>
> Tree-of-heaven is also the preferred host of the spotted lanternfly, an invasive insect that is regulated in Canada because of its threat to the Canadian grape, fruit tree, and forestry industries, as well as the environment.[191]

The web post states: "**Do not plant tree-of-heaven**," but it is only a recommendation.

The tree is hardy to USDA Zone 4,[192] which means the at-risk area in Canada is potentially large. Tree-of-heaven is recognized as an aggressive invader capable of modifying habitats, changing environmental conditions[193] and poses a potential threat to Canada's native biodiversity. Like barberry, it also serves as an important host for serious pests, like the Brown Marmorated Stink Bug (BMSB)[194] and the Spotted Lanternfly (SLF),[195] which threaten Canada's food security.

Based on risk assessments that predicted the tree would have a major impact on biodiversity and the environment, the European Union prohibited the sale of the tree across Europe. This tree should be a candidate for regulation in Canada. Canada currently appears to lack the policy and legislation needed to protect native ecosystems from species like tree-of-heaven.

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[190] E.g., U.S. Fish and Wildlife Service and Utah State University, 2015; Ma, Clemants, & Moore, "Invasive Plant Inventory and Early Detection Prioritization Tool," 2009; Jacquart, "Indiana non-native plant invasiveness ranking form: *Ailanthus altissima* (Miller) Swingle" 2012; Pergl, "EU Non-native organism risk assessment scheme Ailanthus altissima," 2018; EC, "Invasive alien species," 2022.

[191] CFIA "Tree-of-heaven – *Ailanthus altissima* (Mill.) Swingle," 2022e (web archive).

[192] E.g., Fryer, "*Ailanthus altissima*," 2010; Breen, "Landscape Plants: *Ailanthus altissima*," 2022.

[193] Khapugin, "A global systematic review of publications concerning the invasion biology of four tree species," 2019.

[194] BMSB (*Halyomorpha halys*) which originated in China, is a harmful invasive insect pest in North America and Europe. It poses a serious threat to fruit and vegetable crops worldwide (Haye et al., 2015). Initially, Canada made efforts to stop BMSB, but the CFIA decided not to regulate the pest. "As it is not possible to prevent the spread of *H. halys* to Canada, nor is there a reasonable possibility of sustained eradication if *H. halys* becomes established in Canada, the CFIA has taken the decision not to include *Halyomorpha halys* Stål in the List of Pests Regulated by Canada (CFIA, "RMD-12-02," 2012). BMSB is now established in Canada and spreading.

[195] SLF (*Lycorma delicatula*) is another harmful invasive pest with a preference for the tree-of-heaven. Unlike BMSB, it is not yet present in Canada and is included on the List of Pests Regulated by Canada. "Tree of heaven is the preferred host for SLF and SLF fitness (survival and fecundity) is maximized when feeding on tree of heaven" (Khapugin, "A global systematic review of publications concerning the invasion biology of four tree species," 2019). While SLF feeds on other species, females prefer to lay their eggs on tree-of-heaven and their young are more likely to survive.

THE CASE OF GIANT REED (*ARUNDO DONAX*)

Like Japanese barberry, giant reed is one of the plants federally regulated under the *Plant Protection Act*. Unlike barberry, it is not widespread and only small populations of this invasive species exist in southwestern Ontario. Therefore, it is considered domestically controllable. The species and associated ornamental cultivars are all prohibited for sale in Canada.

According to Canada's NAPPO partner, United States Department of Agriculture Animal and Plant Health Inspection Service (APHIS), giant reed (*A. donax*) is highly invasive.

> Limited mostly by cold temperatures, our analysis indicates that about 2 percent of Canada and 57 percent of the United States is suitable for the establishment of *A. donax*. In Canada, the areas at risk from *A. donax* are southwestern and south-central British Columbia, southern Ontario, and parts of the Maritime provinces. In the United States, much of the area is at risk apart from the coldest areas of central and extreme north-eastern United States (below Plant Hardiness Zone 6) and Alaska.[196]

The Canadian Weed Risk Analysis document identifies multiple serious risks:

> Values potentially at risk . . . include plant and animal diversity in riparian and wetland areas, water quality, water use for recreational activities (e.g., tourism, boating, fishing), irrigation, navigation or hydroelectric power generation, property values in infested areas, visibility along roadsides, flood control, and fire control.

The Impacts on Stakeholders section recommends regulation and identifies the need for a Canada-wide approach:

> The public would be protected from the potential uncontrolled spread of this species. . .. Federal regulation would avoid a province-by-province approach to legislation, which could be less consistent across Canada and more difficult for Canadians to understand and comply with.[197]

While giant reed is prohibited in Canada, plants like tree-of-heaven (hardy to zone 4) and many other invasive plants in the ornamental plant trade with similar or worse risk profiles are not regulated. This inconsistency arises because, according to the CFIA, only plants which are not "widely distributed" and "under official control" can be regulated. This must be addressed.

THE CASE OF KNOTWEEDS – THREATS OF HYBRIDIZATION AND THE NEED FOR A NATIONAL DATABASE

It is clear from looking at the provincially regulated knotweeds that the provinces are not sharing information. Four provinces have recognized at least one knotweed as a high-risk invasive plant: Alberta (three), British Columbia (four), Manitoba (one) and Ontario (four).

Knotweeds are recognized as some of the most invasive plants in the world. "Japanese knotweed, giant knotweed, Himalayan knotweed, and Bohemian knotweed are perennial, rhizomatous plants resembling

[196] APHIS (United States Department of Agriculture Animal and Plant Health Inspection Service), "Weed Risk Assessment for *Arundo donax* L. (*Poaceae*) – Giant reed," 2012a.
[197] CFIA, "RMD-16-02: Pest Risk Management Document for *Arundo donax* (giant reed) in Canada," 2017a.

bamboo with their hollow stems and rapid, aggressive growth habits."[198] These plants were introduced to Canada as ornamentals in the late 1800s and reintroduced multiple times subsequently. Since then, hybridization has led to complex and complicated genetics.

Identifying the species and hybrids can be difficult. Misidentification can increase the likelihood of spread.[199] This is complicated by naming confusion. Real expertise is needed to sort this out. Misunderstandings and misuse of names can lead to confusing legislation and poor coordination across regions.

In the *Canadian Journal of Plant Science*, Japanese knotweed is described as follows:

> *Polygonum cuspidatum* (Japanese knotweed) is an introduced perennial geophyte in the buckwheat family (*Polygonaceae*). The phytogeographic distribution of *P. cuspidatum* in North America suggests a large number of intentional introductions via ornamental plantings from 1870 to 2000, followed by secondary spread from these foci.[200]

While Japanese knotweed in the cited article was identified under the scientific name *Polygonum cuspidatum,* that is no longer the accepted name. The plant is regulated in British Columbia, Alberta, and Manitoba under the name *Fallopia japonica* (Houtt.) Ronse Decr, while Ontario uses *Reynoutria japonica* Houtt. More problematic is inconsistent recognition of the threats posed by hybrids.

The Japanese knotweed invasion can be "viewed as a vast unintentional hybridisation experiment."[201] Arguably, the hybrids pose greater threats to biodiversity than the species. Japanese knotweed can hybridize with giant knotweed *Fallopia sachalinensis* (syn. *Reynoutria sachalinensis* F. Schmidt ex Maxim.). **The hybrid plant, *Fallopia* x *bohemica*, "appears more vigorous and troublesome in terms of invasiveness than either parent."[202]** Hybridization is not a single event. Crosses and back crosses with new introductions are part of a continuous process which can lead to novel threats.[203]

Himalayan knotweed is recognized as high-risk in two provinces, British Columbia, and Ontario. In Ontario, Himalayan knotweed is prohibited under the *Invasive Species Act* and is listed as *Koenigia polystachya*.[204] British Columbia lists Himalayan knotweed as *Polygonum polystachyum*. *Persicaria wallichii* and *Polygonum polystachyum* also appear in literature. Such naming confusion can make it difficult to coordinate action and share information across borders. A central Canadian database, standardized with international databases, would minimize this kind of confusion, and allow provinces to better scan the horizon for potential threats in neighbouring regions and around the globe and share best management practices.

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[198] Parkinson & Mangold, "Knotweed complex," 2017.
[199] Vukovic, et al., "'Flying under the radar'-how misleading distributional data led to wrong appreciation of knotweeds invasion (Reynoutria spp.) in Croatia," 2019.
[200] Barney, et al., "The Biology of Invasive Alien Plants in Canada. 5. *Polygonum cuspidatum* Sieb. & Zucc. [= *Fallopia japonica* (Houtt.) Ronse Decr.]," 2006.
[201] Bailey, "The Japanese knotweed invasion viewed as a vast unintentional hybridisation experiment," 2013.
[202] *Fallopia* x *bohemica* Chrtek & Chrtková) J.P. Bailey syn *Reynoutria* x *bohemica* Chrtek & Chrtková (Bailey, 2013).
[203] One unexpected new hybrid that has emerged as a problem in Europe is *Fallopia* × *conollyana* (*F. japonica* × *F. baldschuanica*) and should be on a Canadian watch list (Bzdęga et al., "A survey of genetic variation and genome evolution within the invasive *Fallopia* complex," 2016).
[204] Naming inconsistency underlies some of the confusion for regulators. Databases were checked in Feb. 15, 2024: *Koenigia polystachya* is the accepted name in ITIS Catalogue of Life, 2024 & Kew Plants of the World Online (n.d.). However, *Koenigia polystachya* is an "unplaced name" according to World Flora Online WFO, 2023.

THE CASE OF PURPLE LOOSESTRIFE (*LYTHRUM SALICARIA*)

Purple loosestrife is a nationally recognized invasive plant that has spread to all provinces, although is not yet reported in the territories. In 2005, it was federally regulated as a Primary Noxious weed, under the *Seeds Act*,[205] a designation indicating loosestrife has not reached its full ecological range. It is not regulated under the *Plant Protection Act* because it is too widespread according to the CFIA. (However, if it has not reached its full ecological range, it is not widespread according to IPPC guidelines).[206]

While no official Pest Risk Analysis (PRA) was completed, the invasive nature of purple loosestrife is not in dispute.[207] There have been many efforts to control populations,[208] including the release of biocontrols. But it still has the capacity to spread and damage wetlands.

This history of purple loosestrife is important to consider as it highlights how horticultural practices can affect invasion success. The origin of purple loosestrife in North America is not known. The species may have been introduced intentionally as an ornamental plant, or accidentally, as a seed contaminant in the 1800s. However, after its first introduction, there were multiple re-introductions. Several species of loosestrife (e.g., *Lythrum salicaria, L. virgatum,* and *L. alatum*) were used to develop new varieties. Sales of these new cultivars led to the development of more robust populations that were better adapted for environmental conditions in North America.[209] This was recognized in Canada and presented in a Natural Resources Canada report in 2002.

> The greatest challenge to the control of purple loosestrife was, and still is in many parts of Canada, its horticultural sale. Numerous cultivars of the purple loosestrife have been developed for use in residential landscaping and gardens . . .. Some were advertised by Agriculture and Agri-Food Canada as ideal perennials for the home garden . . .. Subsequent research showed that all *Lythrum* garden cultivars produce viable pollen and seed and can spread. ... Manitoba added all loosestrifes to its noxious weed list in 1996. **Legally defining all varieties of purple loosestrife as noxious weeds was the biggest step towards implementing an effective purple loosestrife control program**. . ..[210]

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[205] Regulation as a seed contaminant is of questionable efficacy. "In monitoring conducted between 2001 and 2007, one sample in 2001 was found to contain *L. salicaria*" (CFIA, "6.0 Proposed Species Placement and Rationales," 2013f) For a more detailed discussion around species classification, see the "Weed Seeds Order Review Secondary Consultation Document" (CFIA, 2013g) and "Weed Seeds Order Regulatory Impact Analysis" (CFIA, 2016b).

[206] If you are scratching your head, you are not alone. There are a lot of details in policy and law that are difficult to follow. You can read more discussions about definitions in the "Weed Seeds Order (WSO) Review - Proposal for Change" (CFIA, 2013b) and then look for definitions in the ISPM documents related to RNQP (ISPM-16, 2021e).

[207] CFIA, "Weed Seed: *Lythrum salicaria* (Purple loosestrife)," 2017b; Michigan Dept. Ag. & Rural Development, "Weed Risk Assessment for *Lythrum salicaria* L. (*Lythraceae*) – Purple loosestrife," 2016; Pasiecznik, "*Lythrum salicaria* (purple loosestrife)," 2007, CABI.

[208] In 2006, it was estimated that $210,000 CDN per annum (Colautti et al., "Characterised and Projected Costs of Nonindigenous Species in Canada ," 2006, 51). There have been biocontrols released in several areas to try and control the population.

[209] Evidence of hybridization between *Lythrum salicaria* (purple loosestrife) and *L. alatum* (winged loosestrife) in North America. Houghton-Thompson et al., 2005; Anderson, "Throwing Out the Bathwater but Keeping the Baby: Lessons Learned from Purple Loosestrife and Reed Canarygrass," 2019.

[210] It has since been removed from the Noxious Weed list but is now regulated under the *Water Protection Act*.

Unfortunately, the Federal Government failed to prohibit the sale of the plant in 2005 when federal action was considered. In 2012, Canada's foremost expert on purple loosestrife, Cory Lindgren called upon "authorities to develop regulations to prohibit horticultural sales of Purple Loosestrife (to prevent human-mediated dispersal)."[211] Five provinces (British Columbia, Alberta, Manitoba, Saskatchewan[212] and Prince Edward Island) regulate loosestrife,[213] the remaining provinces and territories do not. The species, and in some cases hybrids and cultivars, are regulated in at least 40 U.S. states[214]

Given its hardiness (USDA Plant Hardiness Zones 3-12),[215] purple loosestrife is likely to impact much more of Canada than say giant reed (USDA Plant Hardiness Zones 6-13).[216] Policy, interpretation of the International Standards for Phytosanitary Measures, limitations of resources, and limitations of the law have meant that sales of giant reed can be halted, but plants like loosestrife can be left on the market.

During the sixth Conference of the Parties (COP) to the CBD in 2002, the following guidance was given.

> General Guiding Principle 7 that member states like Canada should not only implement controls for alien species that could become invasive, but also implement controls for alien species that are invasive.
>
> Guiding principle 10 states that '**No** . . . **subsequent introductions** of an alien species already invasive or potentially invasive within a country **should take place** without prior authorization from a competent authority.'[217]

Given the guidance from the IPPC, Canada should take a more proactive stance to stop the continued introductions of non-native invasive species in the horticultural trades. While nurseries recognize the threat of purple loosestrife, and it has disappeared from the marketplace, other similar species, like yellow flag iris, are emerging as threats. Canada needs to stop sales or label these at the national level as soon as the threat is recognized.

THE CASE OF YELLOW FLAG IRIS (*IRIS PSEUDACORUS*)

Yellow flag iris is a highly invasive plant that impacts wetlands. Like purple loosestrife, it is quite hardy (USDA zone 3), and like purple loosestrife, there is no official Pest Risk Analysis (PRA) listed in Canada's Weed Risk Analysis Documents.

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[211] Lindgren & Walker, "Predicting the Spread of Purple Loosestrife (*Lythrum salicaria*) in the Prairies," 2012.
[212] Barnes, "Purple loosestrife: here to stay? 2021; Vadeboncoeur, "'A bad year for purple loosestrife': How the invasive plant species is being fought in Manitoba," 2022.
[213] AB: SA 2008, c W-5.1 - Alta Reg 19/2010; BC: RSBC 1996, c 487 - BC Reg 66/85: SK SS 2010, c W-11.1; PEI has a regulation just for purple loosestrife. Reg EC629/91.
[214] Invasive.org, "purple loosestrife *Lythrum salicaria* L.," 2018.
[215] "Based on three climatic variables, we estimate that about 92 percent of the United States is suitable for the establishment of *Lythrum salicaria*" (MI Dept. Ag, "Weed Risk Assessment for *Lythrum salicaria* L. (*Lythraceae*) – Purple loosestrife," 2016).
[216] Giant reed is projected to impact only 52 percent of the U.S. (APHIS, "Weed Risk Assessment for *Arundo donax* L. (Poaceae) – Giant reed," 2012).
[217] CBD COP-6, 2002.

The plant was brought to North America in the early 1900s as an ornamental plant. A Weed Risk Analysis (WRA) performed by APHIS in 2013 found it to be a high-risk invasive species, and it is predicted to be a major invader. "One hundred percent of the simulated risk scores were in the 'High-Risk'."[218]

In 2013, Fisheries and Oceans Canada (DFO) published an "Application of Aquatic Risk Assessment of Non-indigenous Plants in the Trade in Canada" in which yellow flag iris was identified as a high-risk invasive species.[219] Yet, no federal regulatory actions were taken.

In 2015, the *Aquatic Invasive Species Regulations* (SOR/2015-121) under the *Fisheries Act* were developed to prohibit the possession, transportation, and release of aquatic invasive species, such as invasive carp.[220] However, no plants are included on the list of regulated species. "Fisheries and Oceans Canada was unclear on whether its responsibilities for regulating aquatic invasive species included freshwater plants."[221] Even though DFO recognized invasive aquatic plants posed a threat to Canada's waterways, they took no immediate action.

There have been recent efforts to share the information with provinces and territories. However, as of the November 2022, *Iris pseudacorus* is regulated in only three provinces (British Columbia, Alberta, and Manitoba).

Sales of *Iris pseudacorus* are also prohibited in eight border states: Idaho, Maine, Montana, New Hampshire, New York, Vermont, Washington and Wisconsin (being phased out), and a growing number of other states: Colorado, Connecticut, Illinois, Maryland, and Massachusetts. This widespread recognition of the risk posed by this plant indicates that national action to halt the continued sales of yellow flag iris is warranted in Canada. If it cannot be regulated under the *Plant Protection Act* as it is now being administered, then something needs to change.

THE CASE OF EUROPEAN WATER-CHESTNUT (*TRAPA NATANS*)

European water-chestnut (*Trapa natans*) is one of the few aquatic plants with a listed PRA in Canada's Weed Risk Analysis Documents.[222] The Canadian assessment concluded that the likelihood of establishment and the potential for harmful economic and environmental impacts were HIGH. This plant is quite hardy (USDA zone 3) and has the potential to spread widely in receptive waterways.[223]

The plant was prohibited for import under *D-94-27 -The Plant Protection Import Requirements for True Aquatic Plants* (Sept. 8, 1994). As mentioned in the core document, despite the risk the species poses, this regulation was repealed in 2001 due to lack of policy, lack of expertise, and lack of legislative tools.

According to the CFIA risk assessment, "Water-chestnut was considered absent from Canada until 1998, when a population was observed in Rivière du Sud, a tributary to the Richelieu River in southwestern

[218] United States Department of Agriculture Animal and Plant Health Inspection Service (APHIS), 2013.
[219] DFO, "Application of an Aquatic Plant Risk Assessment to Non-Indigenous Freshwater Plants in Trade in Canada," 2013.
[220] Gov. of Canada. *Aquatic Invasive Species Regulations* (SOR/2015-121). 2015.
[221] Office of the Auditor General, "Report 1—Aquatic Invasive Species," 2019.
[222] Available upon request from CFIA, not published on-line.
[223] APHIS, "Weed Risk Assessment for *Trapa natans* L. (*Lythraceae*) – Water chestnut," 2016b.

Québec. The population has overwintered and continued to spread since 1998." It is now in Ontario waterways and is having a high socio-economic impact in the Great Lakes.[224] Impacts:

> Large infestations of *T. natans* can reduce water flow and even clog waterways and hinder commercial navigation. Infestations can limit or even prevent recreational activities such as boating, fishing, and hunting. The hard, spiny seeds can puncture leather and can cause painful wounds to humans and animals that step on them. These nuts can also wash up and accumulate along the shore, reducing the access to beaches.
>
> The major economic costs associated with water chestnut populations are mechanical or chemical control efforts. Millions of dollars have been spent on mechanical harvesting and manual removal of T. *natans* populations. . .. From 1982-2005 various state organizations spent over $5 million to control it in Lake Champlain. [225]

From 1948 to 2019, it was a crime in the United States to transport water hyacinth, European water-chestnut, and alligator grass (*Transportation of water hyacinths - 18 U.S.C. § 46*). That section of code was repealed in 2019 as it had never been used.[226] It is unfortunate that the U.S. did not make use of that law to reduce the sales of those species. Water-chestnut is listed as a noxious weed in 35 U.S. states.[227] Border states regulating the plant include: Idaho, Michigan, Minnesota, New York, New Hampshire, Ohio, and Wisconsin.[228]

European water-chestnut poses significant threats, and the plant has not reached its full ecological range in Canada. Yet it remains unregulated at the federal level by DFO and the CFIA. The Federal Government needs to clarify authority for regulation of aquatic plants. Policy needs to extend regulatory protections to plants that impact waterways. Risk assessment processes will need to analyze the direct and indirect impacts of non-native aquatic plants as well as terrestrial plants. Tools to do both monetary and non-monetary valuations need to be developed (e.g., "number of species affected, water quality"[229]). Currently, European water-chestnut is regulated in Alberta, Manitoba, and Ontario. Meanwhile, without Federal Government intervention, propagule pressure can continue to build in regions that do not recognize the impending danger.

THE CASE OF MILFOILS (*MYRIOPHYLLUM* SPP.) – A COMPLEX NATIONAL THREAT

As mentioned above, four provinces have taken action to regulate two milfoils, European watermilfoil (*Myriophyllum spicatum*) and parrot feather (*M. aquaticum*). These have likely arrived in Canada both unintentionally in ship ballasts and have been widely sold as oxygenating pond plants.[230] Alarms were sounded about the potential invasiveness of milfoils at the first International symposium on watermilfoil

[224] E.g., Azan, 2011; EDDMapS, "European water chestnut *Trapa natans* L.," 2023; Pfingsten, "*Trapa natans* L.," 2022.
[225] Pfingsten et al., 2022.
[226] Section 46 relating to transportation of water hyacinths was repealed (U.S. Senate, "AN ACT To eliminate unused sections of the United States Code, and for other purposes," 2019).
[227] Naylor, "Water Chestnut (*Trapa natans*) in the Chesapeake Bay watershed: a regional management plan," 2003.
[228] Invasiveatlas.org, "European water chestnut *Trapa natans* L.," 2018b; Pfingsten, 2022.
[229] ISPM-11, 2021.
[230] Moody et al., "Unraveling the biogeographic origins of the Eurasian watermilfoil (*Myriophyllum spicatum*) invasion in North America," 2016.

(*Myriophyllum spicatum)* and related *Haloragaceae* species held in Vancouver, British Columbia, back in 1985. Almost three decades later, using the aquatic invasive plant ranking system (aqWRA), Fisheries and Oceans Canada identified European watermilfoil and parrot feather as high-risk.[231] It is possible other taxa are threats:[232]

Table 13: Milfoils (*Myriophyllum* spp.) risk assessment scores.

Species	AqWRA score	Hardiness Zone (USDA)	Presence in Canada
M. aquaticum:	75 High	5	established
M. heterophyllum:	72 High	5	established (native and introduced)
M. spicatum:	81 High	3	established
M. propinquum:	25 Low	7	not present
M. verrucosum:	34 Low	8	not present
M. spicatum x *M. sibiricum* (hybrid)			not assessed

Like many other invasive aquatic plants, milfoils can have a wide range of negative impacts, they can:

- reduce native diversity.
- degrade water quality.
- change sediment chemistry.
- cause fish die offs from lack of oxygen.
- reduce waterfowl habitat.
- increase flooding risks.
- prevent use of waterways for navigation, fishing, and swimming.

The ability of European watermilfoil (EWM) to hybridize with the native Northern watermilfoil (NWM - *M. sibirica*) has produced plants with novel genetics and new hybrid invaders (HYB). "These results suggest that NWM has the potential for genetic assimilation by EWM and HYB, which if not managed could lead to further declines for this once common species in North America."[233]

Milfoils threaten waterways coast to coast and are arguably a national threat. The Federal Government is not regulating these milfoils and today leaves it to the provinces and territories to act.

> "A control program for *M. spicatum* was initiated in British Columbia in the 1970s; control measures used were primarily manual/mechanical and were initiated when plants had spread to eight lakes in the Okanagan Valley. The program cost over $6 million between 1972 and 1990 . . . and is still ongoing with additional operating costs of over US$4 million between 1990 and 2001."[234]

Despite the growing costs of milfoils in British Columbia, invasive milfoils are not regulated in that province.[235] In the U.S., European watermilfoil has caused considerable damage in lake systems and has

[231] E.g., Gordon et al., 2012; Gantz et al., 2013.
[232] Introduced species such as *M. quitense* and *M. ussuriense* were reported as present in British Columbia, Ceska et al., "*Myriophyllum quitense* and *Myriophyllum ussuriense* (*Haloragaceae)* in British Columbia, Canada," 1986.
[233] Moody et al., "Unraveling the biogeographic origins of the Eurasian watermilfoil (*Myriophyllum spicatum*) invasion in North America," 2016, 716.
[234] Michigan Dept. of Agri. and Rural Development, "Weed Risk Assessment for *Myriophyllum spicatum* L. (*Haloragaceae*) – Eurasian watermilfoil," 2016.
[235] Invasive Species Council of Metro Vancouver, "Best Management Practices for Parrot's Feather in the Metro Vancouver Region," 2021, 4.

driven property values down in some locations.[236] The provinces and territories not recognizing the real threat from these invasive aquatic plants are at risk for future harm and costs that could be avoided if federal action were taken sooner rather than later.

J. EU REGULATION 1143/2014 ON INVASIVE ALIEN SPECIES

As in North America, gardening and other horticultural activities are the primary introduction pathways of invasive plants into Europe.[237] The European and Mediterranean Plant Protection Organization (EPPO) estimated "80% of the invasive alien plants are voluntarily introduced for ornamental purposes, and international trade is increasing yearly."[238] In 2015, new legislation to address invasive alien species in the European Union (EU) came into force.[239] This legislation was necessary to help the EU Member States meet their obligations under the CBD.[240]

For the purposes of *EU regulation 1143/2014*, invasive alien species are defined as those "whose introduction or spread has been found to threaten or adversely impact upon biodiversity and related ecosystem services." Under the EU legislation, species identified as Invasive Alien Species of Union Concern are prohibited across all the Member States. Additionally, Member States may establish their own national lists of species of concern.[241]

Invasive Alien Species of Union Concern include plants that are widespread across European countries. For instance, a native Canadian plant, common milkweed (*Asclepias syriaca*) is on the list.[242] There is a cultivation and sales ban on this species, which has become established outside of cultivation in 13 Member States: Austria, the Czech Republic, Bulgaria, Denmark, France, Croatia, Hungary, Italy, Lithuania, the Netherlands, Poland, Romania, and Slovakia. There are similar cultivation and sales bans on other species that are considered a potential risk in Canada (e.g., tree-of-heaven - *Ailanthus altissima*, water hyacinth - *Eichhornia crassipes*, Carolina fanwort - *Cabomba caroliniana*, parrot's feather - *Myriophyllum aquaticum*).

[236] Property values in Vermont and Wisconsin declined near lakes infested with milfoil (Zhang & Boyle, "The effect of an aquatic invasive species (Eurasian watermilfoil) on lakefront property values," 2010). Reducing the spread of milfoils provides net economic benefits (Hanley & Roberts, "The economic benefits of invasive species management," 2019).
[237] E.g., Niemiera & Holle, "Invasive Plant Species and the Ornamental Horticulture Industry," 2009; Arianoutsou et al., "Alien plants of Europe: introduction pathways, gateways and time trends," 2021.
[238] EPPO, "EPPO / Council of Europe Workshop 'Code of conduct on horticulture and invasive alien plants'," 2009.
[239] REGULATION (EU) No 1143/2014 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 22 October 2014 on the prevention and management of the introduction and spread of invasive alien species.
[240] Target 5 of the EU 2020 Biodiversity Strategy, "By 2020, Invasive Alien Species (IAS) and their pathways are identified and prioritised, priority species are controlled or eradicated, and pathways are managed to prevent the introduction and establishment of new IAS" (European Commission (EC), 2011).
[241] Brundu et al., "Managing plant invasions using legislation tools: an analysis of the national and regional regulations for non-native plants in Italy," 2020.
[242] European Commission, "Invasive alien species," 2022.

EU member states carry out comprehensive analyses. The information gathered is shared through the project Delivering Alien Species Inventories for Europe (DAISIE). Development of this shared database was key to the success of EU regulatory efforts.[243]

All EU Member States have signed the *International Plant Protection Convention* (IPPC) and follow IPPC standards[244] but they have followed the advice of the Standards and Trade Development Facility and enhanced their regulatory process to address the limitations of the *SPS Agreement* to meet their obligations under the CBD.[245] Canada must take similar action to reduce the harm and costs of IAPs.

K. AUSTRALIA'S APPROACH

The problem of invasive plant species in Australia far exceeds that in Canada. There are now more foreign plant species in Australia than native species.[246] At least 66 percent of weed species were imported as garden plants.[247]

Australia combats the spread of invasive plants through a system combining legal, administrative, and community-driven efforts. With its unique ecosystems at risk, the country has implemented various strategies:

Legislation and Regulation:

- **Pre-1996 Measures**: Initially, Australia regulated plant importation under the *Quarantine Act* 1908, which listed prohibited plants.[248]
- *Quarantine Proclamation* 1998: This amendment shifted the focus. It requires all new species to pass a Weed Risk Assessment (WRA) for entry, unless listed on the permitted plant list.[249]
- *Biosecurity Act* 2015: This act subsumed previous proclamations, broadening the scope to manage biosecurity risks, including invasive plants.[250] New plant introductions require authorization and a WRA, aligning with the CBD's principle for preventing invasive alien species introductions.[251]

[243] Arianoutsou et al., "Alien plants of Europe: introduction pathways, gateways and time trends," 2021.
[244] EC, "International Plant Protection Convention (IPPC)," n.d.
[245] Standards and Trade Development Facility (STDF), 2013.
[246] There are approximately 15,800 native plant species (compared to under 4,000 native species in Canada). Close to 29,000 exotic species have been introduced to Australia. Of these introduced plants, over 3,000 species have naturalised and approximately 500 are now considered as noxious weeds under various state/territory legislation, including the 32 WONS (Williams et al, "Australia State of the Environment 2021," 2021).
[247] Groves et al., "Jumping the Garden Fence," 2005; Australian Government, "Reasons for the weed risk assessment system," 2022.
[248] Australia Invasive Plant Council, "Stopping weed invasions: a 'white list' approach," 2009.
[249] Australia Invasive Species Council, "Stopping weed invasions: a 'white list' approach," 2009.
[250] *The Biosecurity (Prohibited and Conditionally Non-prohibited Goods) Determination 2016* specifies prohibited plants and explains the conditions required to permit others for the purpose of the Biosecurity Act. It replaced provisions relating to conditions for importation of goods in the Quarantine Proclamation 1998 (DAFF, 2019a; WTO, 2016).
[251] CBD COP-5 Decision V/8, 2000; Beckie et al., "Agricultural weed assessment calculator: an Australian evaluation," 2020.

- **State and Territory Laws**: Despite no national statutory controls, each region has its own laws for invasive species. This allows for region-specific approaches tailored to local ecosystems and threats. However, it has also led to inconsistency from region to region, and inaction particularly in regulating Weeds of National Significance (WoNS) in the horticultural trades.[252]

Beyond Border Control:

Addressing invasive plants post boarder has been a challenge. It has long been recognized that the horticultural trades are the primary pathway for invasive plants in Australia. In the late 1990s, the Australian government developed "Garden Plants Under the Spotlight: An Australian strategy for invasive garden plants."[253] As part of this initiative the "Garden Plants Under the Spotlight" (GPUTS) report showcased a national list of Australia's 100 worst invasive garden plant and nurseries were asked to stop selling them. This attempt to voluntarily remove invasive garden plants from sale failed, largely because nursery associations did not embrace the initiative.[254]

Between 1999 to 2019, the Commonwealth tried once again with a list of 32 plants as Weeds of National Significance (WoNS).[255] While these plants deemed to be national threats to biosecurity have now been banned across the country through regional legislative actions, state and territorial action was slow[256] and required significant national coordination.[257]

Practices Worth Emulating:

Australia has adopted organizational processes worth copying. The Australian Bureau of Agricultural and Resource Economics and Sciences conducts national surveys of weedy and invasive plants.[258] National surveillance enables early detection of new invasions and is used to track the spread and distribution of invasive plants. Many plant lists have been created including the National Environmental Alert (NEA) list for invasive plants in the early stages of establishment and Agricultural Sleeper Weeds (ASW). This kind of national action is critical and was recommended in 2017 in Canada by Federal-Provincial-Territorial Invasive Alien Species Task Force.[259].

The Australian Plant Census (APC) provides authoritative database of native and naturalised taxa. There are eight more regional plant censuses as well as an Australian **Global Register of Introduced and Invasive Species** (GRIIS)**.** Based on these existing lists, a new unified and standardised dataset including invasion status at the national scale has been developed. Compilation of information will reduce

[252] Commonwealth of Australia, "Turning back the tide-the invasive species challenge Report on the regulation, control and management of invasive species and the Environment Protection and Biodiversity Conservation Amendment (Invasive Species) Bill 2002: Chapter 5 - Management of invasive species within Australia," 2004.
[253] Randall, R.P. "Garden thugs, a national list of invasive and potentially invasive garden plants," 2001.
[254] Heywood & Brunel, "Code of conduct on horticulture and invasive alien plants," 2008.
[255] A list of 20 WoNS was created in 1999 and a further 12 were added in 2012.
[256] By 2002, no change in plant sales was reported, according to the Report on the regulation, control, and management of invasive species. (Australia Senate Environment, Communications, Information Technology and the Arts References Committee, "Turning back the tide – the invasive species challenge," 2004).
[257] Wild Matters Pty. Ltd., "National established weed priorities - towards a national framework," 2020.
[258] Ng, et al., "The state of weeds data collection in Australia,"2021.
[259] FPT IAS, "Recommendations of the Invasive Alien Species Task Force" 2017; Gordon, "FTP Task Force," 2017 – presentation downloads.

inconsistencies in terminology and improve the understanding of plant invasion status.[260] Canada should follow this example.

New Directions:

In 2023, Australia launched a new **National Established Weed Priorities (NEWP) Framework**.[261] Under this framework the WoNS concept was reintroduced to tackle priority established weeds and included in a broader program – Weed Issues of National Significance (WINS). This will be supported by a national information and communications portal (Virtual Weed Information Hub), which will provide access to:

- Best management practices
- WINS/WoNS strategic plans
- Regulatory information
- Training information and webinars
- Nomination portal for WINS and WoNS

This system will support and complement state and territory weed regulation, policies, and programs.[262]

The successes and failures of Australia's approach can offer valuable insights for Canada in managing invasive plant species. The inability of Australia to take federal regulatory action has hampered efforts to control the spread of invasive plants. Canada can do better. At the same time, we can learn from Australia and follow their lead with the development of a shared information system and a national coordinating body[263]

[260] Martín-Forés, Irene, et al., "Towards integrating and standardising information on plant invasions across Australia, 2023.
[261] Australia Government Department of Agriculture, Fisheries and Forestry, "National Established Weed Priorities Framework (NEWP)," 2023.
[262] Australia Dept. of Agriculture, Fisheries and Forestry, "National Established Weed Priorities (NEWP) Framework," 2023.
[263] Invasive Plants and Animals Committee, "Australian Weeds Strategy 2017–2027," 2017; The National Plant Biosecurity Status Report, Plant Health Australia, "The national plant biosecurity status report," 2018.

L. DATABASE DEVELOPMENT AND PLANT RISK ASSESSMENTS

At the Sixth Ordinary Meeting of the Conference of the Parties to the CBD, Canada agreed to Guiding Principle 8 on the Exchange of information.[264] In accordance with this principle, Canada needs to develop a national database for the purpose of compiling and communicating information about non-native invasive plants. Steps to creating an interoperable database for Canada:

- **Data Collection and Aggregation**: Compile existing data from various sources, including government agencies, research institutions, and international databases.
- **Standardization of Data**: Ensure data consistency by standardizing formats and taxonomic information. This would require collaboration with botanists and taxonomy experts.
- **Interoperability Considerations**: Design the database with interoperability in mind, allowing for easy data sharing and integration with other databases, both national and international.
- **Technology and Platform Selection**: Utilize robust database software that supports large data sets and offers user-friendly interfaces for both data input and retrieval.
- **Stakeholder Engagement**: Involve a range of stakeholders in the development process, including ecologists, horticulturists, policymakers, and technology experts.
- **Regular Updates and Maintenance**: Establish protocols for regular database updates and maintenance to ensure data remains current and accurate.
- **Public Access and Education**: Make the database accessible to the public and create educational resources to increase awareness about invasive plants.

Leveraging Technological Advances:

In developing Canada's national database for invasive plants, integrating cutting-edge data management technologies is key. We propose the use of machine learning for predictive analysis of species spread, cloud computing for scalable data handling, and GIS mapping for detailed geographical tracking. Additionally, blockchain technology can ensure the integrity and security of the database.

Fundamental information:

A useful invasive plant database should provide:

- Taxonomic information.
- The history and ecology of invasion (e.g., pathways for introduction, distribution).
- The biological characteristics of the invasive alien species.
- An assessment of impacts to the market economy (e.g., agricultural, forestry, horticultural sectors).
- An assessment of biodiversity impacts at the ecosystem, species, and genetic level.
- An assessment of public health and socio-cultural impacts.
- Consideration of impacts to keystone species and endangered species or habitats.
- The potential effects of future climate scenarios on distribution and impacts.[265]

[264] Sixth Ordinary Meeting of the Conference of the Parties to the Convention on Biological Diversity, Canada - CBD COP-6, 2002.
[265] CBD COP-6, 2002; NAPPO, 2008; Bradley, 2022.

- Best management practices.

Enhancing Risk Assessment Protocols – Case Study for Inspiration: EPPO's System:

A key component are the risk assessments. The CFIA's current Plant Risk Analysis (PRA) process focuses on pre-border screening, and Canada should shift the responsibility and costs for this to the importers, allowing the CFIA to concentrate on plants present in Canada and already in trade.[266] The European and Mediterranean Plant Protection Organization (EPPO) has developed a Prioritisation Process compliant with the new EU regulation.[267] Drawing inspiration from EPPO's successful risk assessment model, Canada can lead in creating a collaborative, effective framework within the North American Plant Protection Organization (NAPPO). The EPPO model showcases the value of shared expertise and data in managing invasive species across multiple countries. Experts from across North America could help share the burden and benefit of a central risk database.[268]

Improving Assessment Systems Through Collaboration

Canada can enhance its assessment system by integrating various tools and protocols considering ecological impacts, native species interactions, and human health. Collaboration with botanical gardens and other institutions could provide valuable data on plant behavior. As mentioned earlier, there are numerous tools and protocols that could be used to improve the Canadian assessment system.[269] Ecological impacts, native species interactions, hybridisation, impacts to society, culture, and human

[266] This would be similar to the requirement placed on pesticide applicants who must "develop a comprehensive database of scientific information that demonstrates the product's value and its effects on the environment and human health." Health Canada, "Pesticides and pest management: Frequently asked questions," 2019.
[267] Tanner et al., "The prioritisation of a short list of alien plants for risk analysis within the framework of the Regulation (EU) No. 1143/2014," 2017.
[268] "Qualitative expert assessment is usually undertaken by decision panels who use their experience to answer broad questions regarding likelihoods of introduction, establishment, impact and management on a qualitative scale (negligible, low, medium and high) and then summarise the overall risk based on these answers" (Hulme, "Weed risk assessment: a way forward or a waste of time?" 2011c).
[269] E.g., Morse et al., "An invasive species assessment protocol," 2001; Catling, "New 'Top of the list' Invasive plants of natural habitats in Canada," 2005; Carlson et al., "Invasiveness ranking system for non-native plants of Alaska," 2008; Nentwig et al., "Advancing impact assessments of non-native species: strategies for strengthening the evidence-base," 2016; Davidson et al., "Development of a risk assessment framework to predict invasive species establishment for multiple taxonomic groups and vectors of introduction," 2017; Hulme et al., "Integrating invasive species policies across ornamental horticulture supply chains to prevent plant invasions," 2017; Roy et al., "Developing a framework of minimum standards for the risk assessment of alien species," 2017; Strubb et al., "Advancing impact assessments of non-native species: strategies for strengthening the evidence-base," 2019; Brunel et al., "PM5/6(1) EPPO Prioritization process for invasive alien plants," 2010; Conser et al., "The Development of a Plant Risk Evaluation (PRE) Tool for Assessing the Invasive Potential of Ornamental Plants," 2015, Branquart et al., "A prioritization process for invasive alien plant species incorporating the requirements of EU Regulation no. 1143/2014," 2016; EPPO, "Guidelines on Pest Risk Analysis," 2017; EPPO, Bartz & Kowarik, "Assessing the environmental impacts of invasive alien plants: A review of assessment approaches," 2019; González-Moreno, "Consistency of impact assessment protocols for non-native species," 2019; Tayeh & Mannino, "Consistency of impact assessment protocols for non-native species," 2019; Vilà et al., 2019; Davidson et al., "Development of a risk assessment framework to predict invasive species establishment for multiple taxonomic groups and vectors of introduction," 2020; European Food Safety Authority et al., "A review of impact assessment protocols of non-native plants," 2021; Bernardo-Madrid et al., "Consistency in impact assessments of invasive species is generally high and depends on protocols and impact types," 2022.

health should all be considered.[270] The history of plants like purple loosestrife, hybrid knotweeds, as well as invasive variants of Phragmites (*Phragmites australis*) indicate a need to recognize that small genetic changes can impact biological traits and invasion success.[271] "For horticultural species, unintentional field trials may already exist in the living collections of botanic gardens and data on the performance of introduced species might be a valuable indicator of behaviour outside the cultivated environment."[272] Therefore, Canada should develop special protocols for evaluating ornamental/horticultural varieties and cultivars.[273] There will be some uncertainty for varieties that have limited history. In such cases, where there is lack of full scientific certainty, the precautionary principle should be followed.[274]

Emphasizing the Importance of Evidence-Based Policy Making

A comprehensive database can serve as a foundation for informed decisions, aiming to reduce the long-term impacts and costs of invasive plants.[275] Much information already exists and just need to be consolidated into a framework where it can be shared.[276] This shared information can then guide management actions and regulatory measures nationally and regionally. Canada's national database will ensure that regions with fewer resources are not disadvantaged, and actions can be coordinated across provinces and territories. This strategic approach, combining technological innovation and collaborative effort to develop an invasive plant information hub will position Canada to effectively manage and mitigate the challenges posed by invasive plant species for generations to come.

M. THE ORNAMENTAL HORTICULTURE SECTOR – COSTS AND OPPORTUNITIES

Introduction to the Canadian Horticultural Industry

Currently, the ornamental horticulture sector in Canada includes the floriculture (primarily cut flowers and potted plants), nursery (field-grown annuals, perennials, shrubs, trees, and vines), Christmas tree, and turf sod industries. In 2021, this sector generated sales of $2.54 billion.[277] The greenhouse production of flowers and plants was the largest revenue generating sub-sector, accounting for 66.2 percent of total sales with potted plant sales contributing most to the bottom line. Most potted plants sold are non-invasive as almost 40 percent are for indoor use, and at least another third are non-

[270] E.g., Roy et al., "Developing a framework of minimum standards for the risk assessment of alien species," 2017; Bernardo-Madrid, 2022; Bradley et al., 2022.
[271] E.g., Catling & Mitrow, "The recent spread and potential distribution of *Phragmites australis* subsp. *australis* in Canada," 2011; Wymore et al., "Genes to ecosystems: exploring the frontiers of ecology with one of the smallest biological units," 2011; Oh et al., "Novel genome characteristics contribute to the invasiveness of *Phragmites australis* (common reed)," 2022.
[272] Hulme, "Weed risk assessment: a way forward or a waste of time?" 2011b,c.
[273] Datta et al., "Identifying safe cultivars of invasive plants: six questions for risk assessment, management, and communication," 2020.
[274] CBD, 1992; CBD COP-6, 2002.
[275] Meyerson, et al., "Moving Toward Global Strategies for Managing Invasive Alien Species," 2022.
[276] For instance, 500 species assessments of North American introduced plants had been completed for NatureServe (Randall et al., 2008) and is available from the Invasive Plant Resource Guide, 2020.
[277] Crops and Horticulture Division Agriculture and Agri-Food Canada, "Statistical overview of the Canadian ornamental industry 2019," 2021.

invasive bedding plants like geraniums and vegetable plants. The percentage of ornamental invasive plants produced by greenhouses is not known but likely low.

Nursery product sales and resales contributed an additional 27.2 percent to the Canadian ornamental industry revenue in 2021. 58% of field grown nursery plants were fruit bushes. It is not known what percentage of field grown or container grown plants are invasive plants like barberry 'Tara', but it is likely a small fraction of overall sales. For instance, in studies of the plant nurseries in the U.S. mid-Atlantic region, only four percent of the taxa sold were considered invasive.[278]

Adapting to Eco-Friendly Practices

The Canadian horticultural industry, while traditionally focused on the cultivation and sale of a wide range of plants, is now facing the pressing challenge of invasive species management. This industry, encompassing everything from floriculture to nursery-grown trees, has had to adapt to evolving regulations and consumer demands for environmentally friendly practices.

One example is the shift in nursery product sales. Nurseries are increasingly focusing on non-invasive, native species, which appeal to a growing segment of environmentally conscious consumers. This shift not only helps combat the spread of invasive species but also opens new market opportunities.

While restrictions on invasive plants can be disruptive in the short term, there are opportunities for innovation – including potential for expanding local markets. Innovative nursery growers can capitalize on regional botanical uniqueness. Importers and breeders should focus on non-invasive non-native plants that support environmental health and native plants.[279] As people look to reduce their impact on the environment, sustainable gardening is trending, and this is a segment that is expected to continue growing.[280] A new ecological approach to horticulture can be transformative for the industry and ultimately benefit all Canadians and global biodiversity.

Impact of Invasive Plants on Nursery Production

Certain invasive plants that have been in production, like the now banned kudzu, can themselves pose a significant challenge to nursery production, primarily by increasing production costs. Their rapid growth and aggressive nature can lead to increased labour and resource expenditure for control and management. These plants can overrun cultivated areas, competing with other nursery plants for nutrients, water, and light, thereby reducing the quality and quantity of nursery products. Additionally, the need to implement and maintain effective control measures for rampant growers adds to the operational expenses of nurseries, impacting their overall profitability. It benefits the industry to remove these plants from production.

[278] Coombs & Gilchrist, "Nursery industry a baseline for future comparisons," 2018; George, Gilchrist & Watson, "An assessment of the native and invasive horticultural plants sold in the mid-Atlantic region," 2020.
[279] Care should be given to plants that could potentially hybridize with native plants like white mulberry (*Morus alba*), hybrid lupins (*Lupinus* spp.), and columbine (*Aquilegia* spp.).
[280] Ng, "Planet-friendly gardening: How small changes can make a huge difference," 2021; Gardiner, "Hottest gardening trends for summer 2022, According to Experts," 2022. Orentas, "Here are the top landscaping trends of 2023," 2022; Sons, "Gardening's hottest trend is here: The big shift to native plants and what it means for your business," 2022.

Debating Responsibility and Regulatory Approaches

Some have pondered: "If invasive species are pollutants, should polluters pay?"[281] Not surprisingly, the landscape industry has not responded favourably to the idea of taxing sellers.[282] However, the industry has responsibility to help solve this problem.

Regulation of sales has been the preferred course of action in many U.S. states. In states where sales bans have been put into effect, growers have been given transitional periods to phase out stock and develop alternatives. For instance, Ohio and South Carolina announced that Callery pear (*Pyrus calleryana*), popular in the trades, will be prohibited for sale in 2023 and 2024 respectively.[283] Consultations with stakeholders need to be part of the regulatory process to reduce the burden on specific actors in the horticultural sector. Gary Fish, responsible for the Maine Horticultural Program, reports the nursery industry has adapted to the new regulations without incident and they continue to work with sellers to phase-in changes responsibly.[284]

Would regulation and labelling requirements be bad for the nursery industry as a whole? The impacts should be relatively small and short term.[285]

> First, . . . **consumers increasingly wish to be informed** of invasive ability so that they can avoid purchasing invaders. If the nursery industry wants to continue to be perceived as a "green" industry, it will have to recognize this trend and respond appropriately to it.
>
> Second, invasive plants are a **small part of the sales** of most nurseries, so removing them from sale is unlikely to have a significant effect on the business's bottom line.
>
> Third, removing invasive plants from sale could **stimulate sales**, if handled correctly, because replacement plants would be promoted and sold.[286]

The Role of Invasive Plant Labeling

Labelling is now required in several U.S. states on certain invasive plants popular in the trades. Following this trend, Canada is likely to implement similar invasive plant labeling requirements. This shift should not be viewed as a regulatory burden, but rather as an opportunity for nurseries to innovate and align with sustainable practices. By clearly identifying plants as 'invasive', 'non-invasive', or 'native', nurseries not only guide consumers to make environmentally responsible choices but also encourage the adoption of alternative, eco-friendly plants. The promotion of alternative plants can lead to an expanded inventory and new sales opportunities. Additionally, active participation in such labeling initiatives enhances the nursery's image as a responsible, environmentally conscious business. Crucially, labelling serves an educational purpose, enhancing public awareness about the ecological impacts of plant choices and contributing to broader efforts in biodiversity conservation.

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[281] Simpson, "Chapter 7: If invasive species are 'pollutants', should polluters pay?," 2009; Barbier et al., "Implementing policies to control invasive plant species," 2013.
[282] Gagliardi, James & Brand, Mark, "Connecticut nursery and landscape industry preferences for solutions to the sale and use of invasive plants," 2007.
[283] Culley, "Invasive pears," 2022.
[284] Correspondence with Gary Fish, State Horticulturist Maine Department of Agriculture, Conservation and Forestry Horticulture, responsible for administering the Horticultural Program "Do Not Sell Plant List," 2022.
[285] Coats, Stack, & Rumpho, "Maine Nursery and Landscape Industry Perspectives on Invasive Plant Issues," 2011.
[286] Reichard & White, "Horticulture as a Pathway of Invasive Plant Introductions in the United States: Most invasive plants have been introduced for horticultural use by nurseries, botanical gardens, and individuals," 2001.

Charting a New Path for Environmental Responsibility in Ornamental Horticulture

The ornamental horticulture industry stands at the forefront of invasive plant prevention. By acknowledging the historic role plant trade has played in the spread of invasive plants, the sector can embrace the problem as "our responsibility, our opportunity" and choose to take a more responsible forward-thinking approach to plant production and sales. Breeders, growers, and sellers can each do their part. Key actions include:

- **Innovation in Breeding**: Breeders can focus on reducing the traits that make plants invasive: "reduced genetic variation in propagules, slowed growth rates, non-flowering, elimination of asexual propagules, lack of pollinator rewards, non-dehiscing fruits (to prevent seed dispersal), lack of edible fruit flesh, lack of seed germination, sterility and programmed death prior to seed production."[287]
- **Growing Non-Invasive Choices**: Growers can produce non-invasive plants at scale and promote these plants to distributers.
- **Eco-Friendly Sales**: Sellers can offer more non-invasive plants and use labelling to steer customers away from invasive varieties toward new market alternatives.

This strategic shift would signify the industry's commitment to being part of the solution, embracing its responsibility for a healthier planet and societal well-being. This approach can improve the reputation and long-term sustainability of the plant trades.

[287] van Kleunen et al., "The changing role of ornamental horticulture in alien plant invasions," 2018.

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