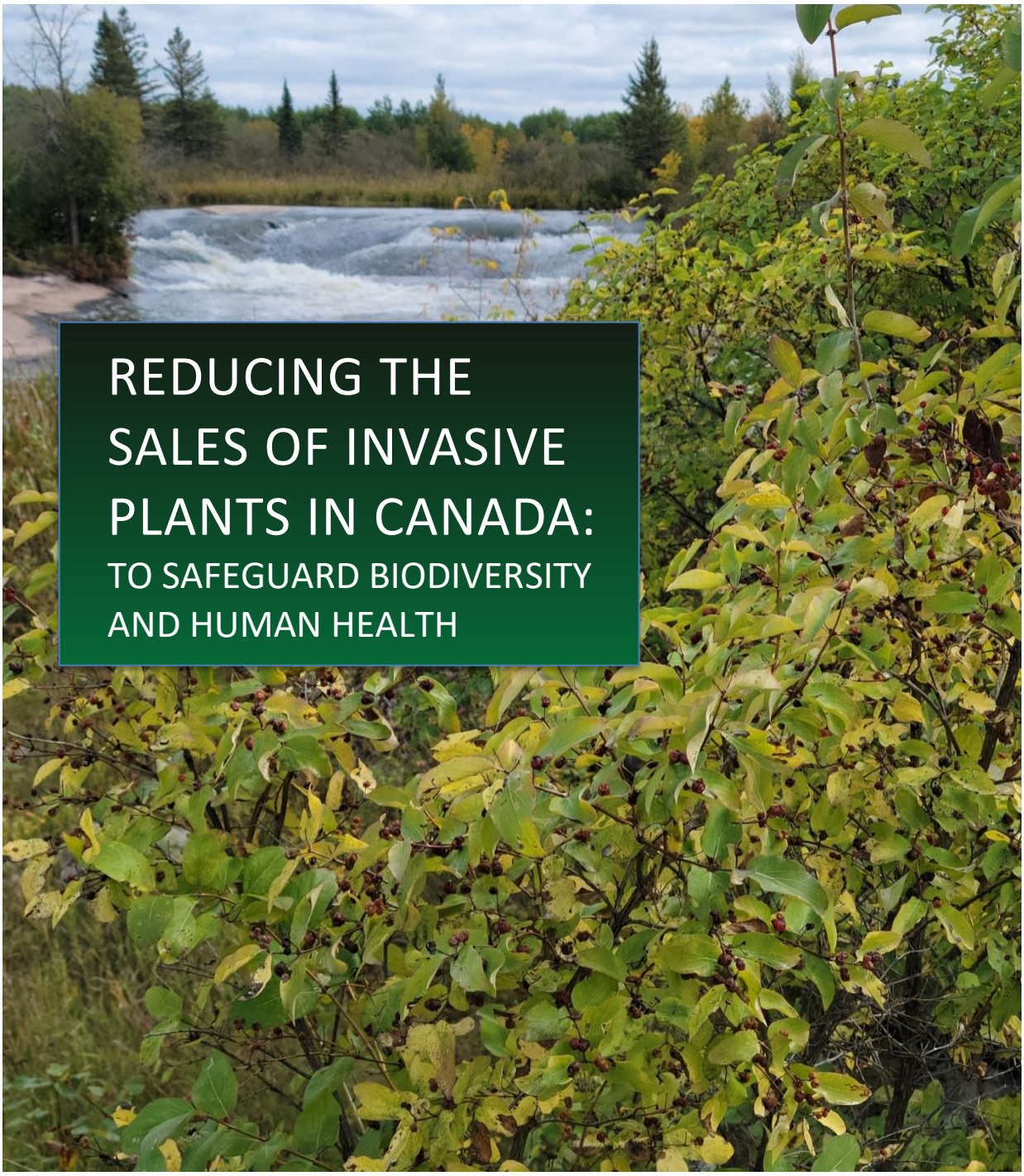

REDUCING THE SALES OF INVASIVE PLANTS IN CANADA:

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

EXECUTIVE SUMMARY

Invasive alien species pose a significant threat to **biodiversity, human health and well-being, as well as the economy** in Canada. To protect our natural ecosystems and ensure a sustainable future, it is imperative to reduce the introduction and establishment of invasive species by at least 50 percent by 2030.[i]

The Significance of Biodiversity

Biodiversity is the foundation of ecosystem health, providing essential services like food, medicine, and natural resources. It also enhances our cultural experiences and recreational activities. Recognizing its importance,[ii] Canada has committed to halt and reverse biodiversity loss for the benefit of all living things, including people.[iii] To achieve this critical mission, Canada must address the challenges posed by invasive species.

Urgent Action Required

Invasive species are a major threat to public health and a relentless driver of biodiversity loss. In Canada, the spread of invasive plant species is escalating, a trend that is likely to intensify with ongoing climate change. Immediate action is imperative to mitigate severe environmental damage, significant public health risks, and soaring management costs[iv]

Identifying Pathways

Target 11 of the *2020 Biodiversity Goals and Targets for Canada* stated, "By 2020, pathways of invasive alien species introductions are identified, and risk-based intervention or management plans are in place for priority pathways and species."[v]

The ornamental/horticultural industry has been identified as the primary pathway for the introduction of non-native invasive plants. Canada must now act on this knowledge and

[i] This is Target 6 in the Kunming-Montréal Global Biodiversity Framework – GBF (Convention on Biological Diversity – 15th Conference of the Parties [CBD COP-15.], 2022).

[ii] Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Service (IPBES), "Summary for Policymakers of the Thematic Assessment Report on Invasive Alien Species and their Control of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services," 2023; World Health Organization (WHO), "Biodiversity and Health," 2015.

[iii] Environment and Climate Change Canada (ECCC), "Milestone document, 2024.

[iv] The rate of introduction and number of new invasive plants continues to increase with no signs of slowing, (IPBES, "Global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services," 2019, p. 126; Laginhas, Fertakos, & Bradley, "We don't know what we're missing: Evidence of a vastly under sampled invasive plant pool, 2022). Invasion increases with the rate at which propagules (plants and plant parts capable of reproducing) are introduced," (Early et. al., "Global threats from invasive alien species in the twenty-first century and national response capacities," 2016). In Canada non-native species now represent more than a 26% of vascular plants in Canada. This increased by 120 species between 2010 and 2020, (Canadian Endangered Species Conservation Council, "Wild Species: The general status of species in Canada," n.d.). Between 10 and 25% of these non-native plants have invasive potential (Spear et al., "The Invasion Ecology of Sleeper Populations: Prevalence, Persistence, and Abrupt Shifts," 2021).

[v] Environment and Climate Change Canada, 2016.

develop a more comprehensive strategy to prevent the introduction and spread of invasive species through nurseries, the pet/aquarium trade, and e-commerce channels.

Key Recommendations

Recognizing the urgent need **to safeguard biodiversity** and reduce the spread of invasive plants, the Canadian Coalition for Invasive Plant Regulation (CCIPR) proposes the following measures:

1. **Enhance Governance**: Canada's approach to managing invasive plants is disjointed and lacks unified oversight, leading to gaps in protection and response. **Action required:** Canada must establish a permanent body dedicated to overarching, inter-jurisdictional coordination for invasive species prevention and management.[vi] This organization should aim to refine and extend Canada's regulatory framework to better protect biodiversity, ecosystem integrity, public health, and safety. Its mandate would include ensuring that the strategies for managing invasive species benefit all communities equitably, with special attention to the most vulnerable and Indigenous populations.
2. **Create a Virtual Information Hub**: Lack of information and resources hamper efforts to combat invasive species. **Action required:** Develop a central repository for sharing information on plants and their distribution, other technical information, decision-support tools, and best management practices related to invasive plants. Enhanced federal support for knowledge-building and centralized information sharing is essential for transparency, fairness, and equity.[vii]
3. **Mandate Risk Assessments**: Currently, only a small number of both newly imported and existing non-native plants undergo screening for invasiveness. **Action required:** Require risk assessments for all new plant imports and screen existing non-native plants for potential environmental and socio-economic risks, as is required under the *Canadian Environmental Protection Act* (CEPA) for potentially harmful substances.[viii] Early recognition and proactive prevention of invasive plants are crucial for saving costs and minimizing damages.
4. **Reform Legislation**: Canada's invasive plant regulatory tools are aimed at safeguarding Canada's food supply and plant resources but fall short of adequately protecting public health and the environment, especially with regard to plants in the horticultural trades. **Action required:** Ban the sale and movement of high-risk invasive plant species and

[vi] This key need was identified by the Federal-Provincial-Territorial Invasive Alien Species Task Force ("Recommendations to Improve INVASIVE ALIEN SPECIES Prevention and Management in Canada," 2017, p. 12).
[vii] Target 20 & 21of the GBF require that Canada strengthens capacity-building, technology transfer, and scientific and technical cooperation for biodiversity conservation and ensure that knowledge Is available and accessible to guide biodiversity action (2022).
[viii] 23,000 substances have been examined for their impacts on the environment and human health by the Departments of the Environment and of Health under CEPA 1999 (Environment and Climate Change Canada (ECCC), "Fact sheet on human health and the Canadian Environmental Protection Act," 2017). Only 36 of the 1,372 introduced plants in Canada have been assessed by the Canadian Food Inspection Agency, of those 9 are regulated (Canadian Endangered Species Conservation Council, "Wild Species 2020: The general status of species in Canada," 2020, p. 19; CFIA, Weed Risk Analysis Documents, 2023).

introduce point-of-sale labeling for plants that pose potential risks. Establishing clear regulations ensures fairness within the marketplace, providing a level playing field for all participants in the horticultural industry.

5. **Develop a National Invasive Plant Accord**: Canada has not sufficiently engaged with industry leaders to reduce the spread of invasive plants through the nursery trade. **Action Required**: Establish a collaborative agreement among federal, provincial, and territorial governments, together with the garden and nursery industry and other concerned stakeholders.[ix] The participants in this agreement will work together to create a definitive list of harmful plants to be prohibited from sale, propagation, and distribution nationwide. Additionally, they will develop a 'watch list' of species that, while not banned, require clear labeling to inform consumers of potential risks. This accord, informed by science, promises to ensure consistency across Canada while improving awareness among consumers and industry stakeholders and thereby improving regulatory compliance.
6. **Increase Public Education and Outreach**: Educational programs are crucial to the success of Canada's strategy against invasive plants, yet their effectiveness is compromised by inconsistent funding, infrequent revisions of educational materials, and uneven distribution across regions. **Action required:** Allocate and expand financial support for targeted educational campaigns that inform both the public and the nursery industry about invasive plants and necessary prevention and mitigation measures. Such investment will not only heighten the efficacy of these programs but also ensure a more equitable implementation of prevention measures across the country.

A Call to Action

CCIPR believes that improving legislation and oversight, building a knowledge base, and providing education and awareness programs can all form the basis of a successful strategy to safeguard living creatures and our natural world from the devastating damage caused by invasive plants.

By acknowledging the urgency of the invasive species issue and adopting these recommendations, Canada can take meaningful steps toward preserving its biodiversity and securing a healthier, more sustainable future.

[ix] Modelled after New Zealand's *National Plant Pest Accord* (New Zealand Ministry for Primary Industries, "National Pest Plant Accord for preventing the sale of invasive weeds in NZ," 2021).

Figure 1. Yellow iris (*Iris pseudacorus*) Victoria County, NS. Photo Bethsheila Kent via iNaturalist CC BY NC.

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ACRONYMS

1: Organizations

CBD	Convention on Biological Diversity & SCBD Secretariat of the CBD
CCIPR	Canadian Coalition for Invasive Plant Regulation
CCIS	Canadian Council on Invasive Species
CFIA	Canadian Food Inspection Agency
COP	Conference of the Parties of the CBD
DFO	Fisheries and Oceans Canada
ECCC	Environment and Climate Change Canada
EPPO	European and Mediterranean Plant Protection Organization
FPT IAS	Federal-Provincial-Territorial Invasive Alien Species Task Force (replaced by FPT IAS Working Group)
IPBES	Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Service
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
UNEP	United Nations Environment Programme
WTO	World Trade Organization

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)*

3: Terms

AIS	Aquatic Invasive Species
IAS	Invasive Alien Species
NGO	Non-Governmental Organization
NPPO	National Plant Protection 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
PRA	Pest Risk Analysis
RMD	Risk Management Documents
SEICAT	Socio-Economic Impact Classification for Alien Taxa
WRA	Weed Risk Assessment

PART 1: BACKGROUND

WHAT IS AN INVASIVE PLANT?

Definition of Invasive Plant:

According to the *Invasive Alien Species Strategy for Canada* (2004), invasive alien species are those harmful alien plants, animals, and micro-organisms whose introduction or spread threatens the environment, the economy, or society, including human health.[1]

Approximately 30 percent of plants in Canada are not native and have been introduced from somewhere around the globe.[2] Many of these introduced plants, for instance most food crops, benefit Canadians and do not pose significant threats. However, those introduced plant species that cause harm or have the potential to cause harm are classified as Invasive Alien Species (IAS) by the Government of Canada.[3] The spread of these invasive species poses grave risks to biological diversity, reduces food security, impacts our quality of life and even human health.[4] There are well over 500 invasive plants documented in Canada's natural areas, and the numbers of invasive plants in Canada are steadily increasing.[5]

Biological Traits:

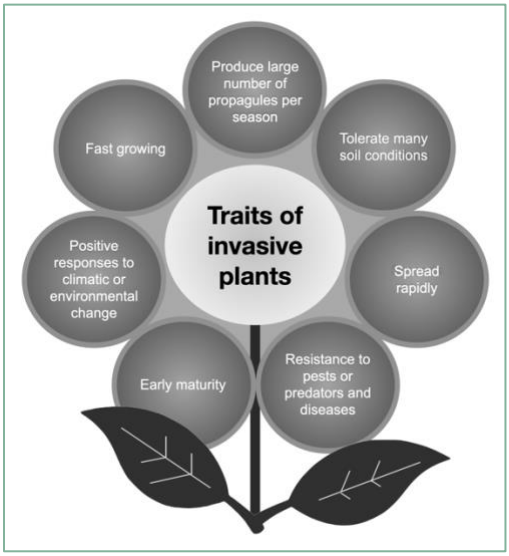

Figure 2. Traits of invasive plants. Adapted from: Ratnayake, 2014.

While the traits that make non-native invasive plants successful are diverse, there are several common characteristics:[6]

- **Aggressive Propagation:** Invasive plants exhibit high rates of seed production and/or vegetative spread and can form dense monocultures.
- **Early Season Vigor**: They can display rapid growth early in the growing season, maturing faster than more desirable plants.
- **Environmental Alteration**: Some invasive plants possess the ability to modify their invaded environment, causing changes in soil or water chemistry, adjustments to nutrient cycling processes, impacts on water availability, and often creating conditions more conducive to further invasion.
- **Limited Natural Predators**: Due to their origins in different geographic locations, introduced plants often have few co-occurring herbivores, parasites, and/or pathogens to regulate their populations.
- **Adaptability**: Invasive plants that can thrive in a wide range of environmental and climatic conditions pose the greatest risks.

The Role of the Horticultural Industry in Plant Selection:

The horticultural industry continues to actively search the globe for new plants that may be of interest to consumers, but those plants are often introduced without testing for invasive tendencies.[7] In addition, plant breeders pursuing desirable attributes like improved hardiness and better flower production (which can mean greater seed production) can inadvertently select for plants better equipped to become invasive.[8] There is an urgent need for enhanced awareness and more stringent risk assessment protocols to strike a balance between horticultural innovation and environmental protection.

PATHWAYS TO INVASION

Understanding the pathways to invasion is critical for effectively managing invasive species. According to Canada's Federal-Provincial-Territorial Biodiversity Working Group, "the key to dealing with invasive species is to **identify the pathways** of introduction - the routes they take to spread to new areas - **and cut them off**."[9]

Studies from around the globe indicate that the ornamental/horticultural[10] pathways are **THE PRIMARY ROUTES** for invasive plant introductions (Figure 3).[11] This has been confirmed in Canada by the Canadian Food Inspection Agency (CFIA).[12]

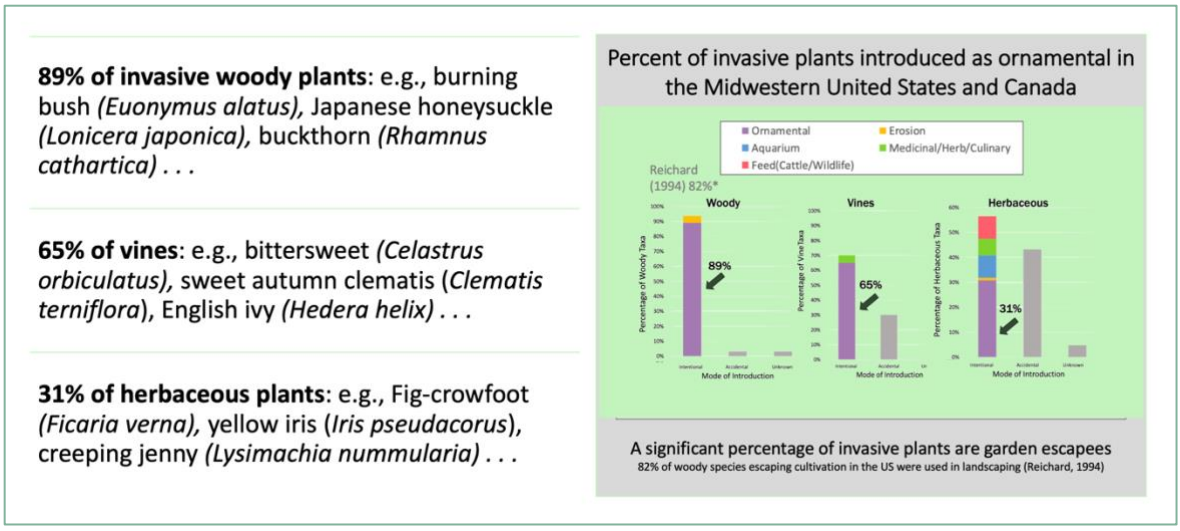

Figure 3. Gardens are the primary pathway for invasive plants. Adapted from "Update of Reichard's (1994) Review." Source: Culley et al, 2020.

Intentional and Unintentional Spread:

The spread of invasive ornamental plants involves a dual mechanism, driven by both intentional and unintentional actions. Initially, invasive plants are sold and utilized by people for their desirable attributes. Generous gardeners may then share plants with neighbours and friends. However, it is in the subsequent unintentional spread that the true challenge arises.

People may discard unwanted plant material allowing it to take root in natural areas. Additionally, seeds and plant parts can be spread by wind, water, birds and mammals, or hitchhike on vehicles, people, and pets (Figure 4).

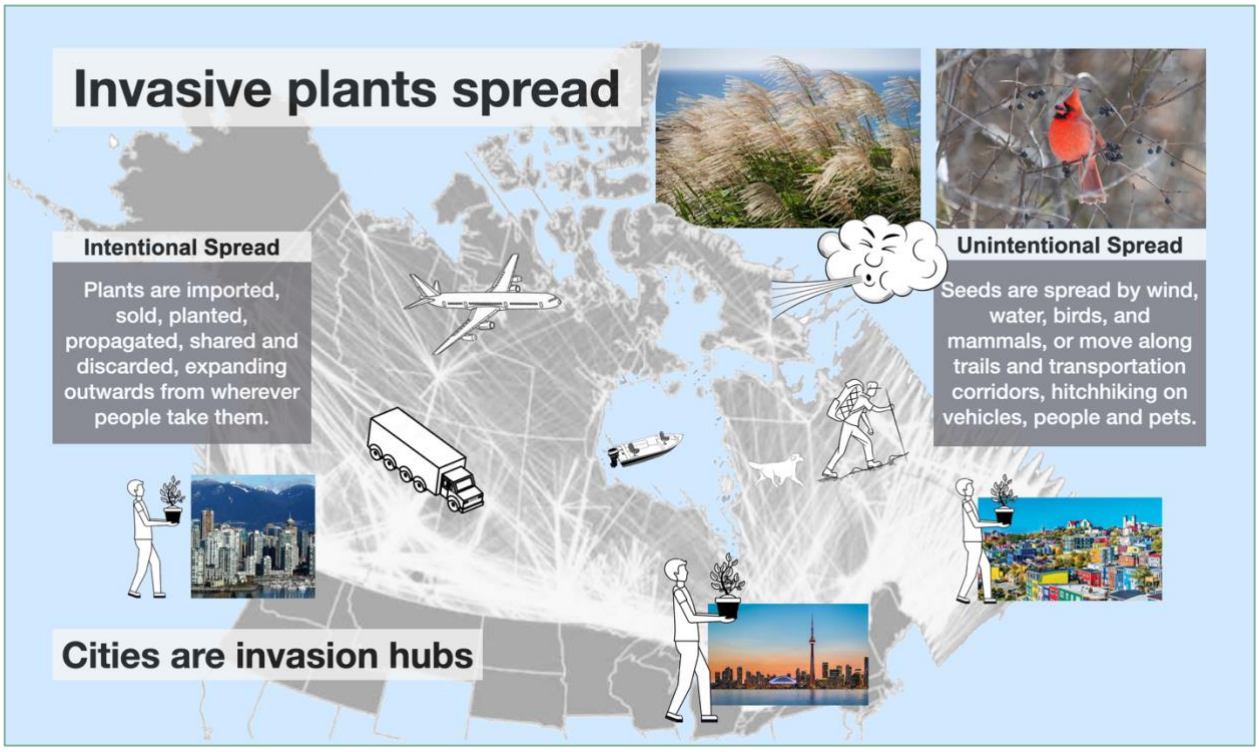

Figure 4. Intentional and unintentional pathways. Source: C. Kavassalis, 2022.

The Silent Spread: Understanding Lag Times in Biological Invasions:

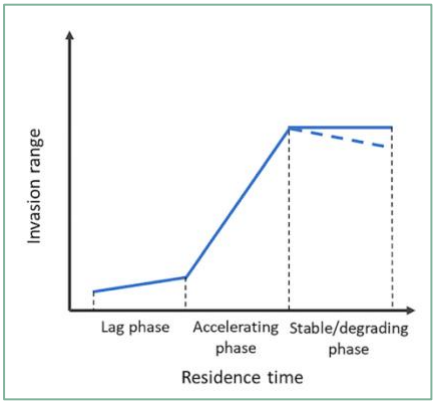

Figure 5. Three Phases of Invasion. Source: Ni, 2022.

An invasive plant may spread slowly for long periods of time from its initial introduction.[13] This lag phase can be a deceptively tranquil period, masking the potential for the later explosion in population and range. For this reason, invasive species often go unnoticed until they reach an **accelerating phase**, during which they spread rapidly and the window for easy management has passed (Figure 5).[14] Understanding the lag phase is pivotal in invasive species management, as this stage offers the best opportunity for early intervention and prevention of future ecological disruption.

Lag times are shaped by a constellation of factors, both **biological and environmental**. Biological traits such as reproductive rate, genetic adaptability, and competition strategies play a role. For instance, a species with a high reproductive rate may have a shorter lag time. Invasive honeysuckles (*Lonicera tatarica*) serve as a prime example. This species produces abundant fruit, and its

seeds are dispersed widely by birds, resulting in a faster initial spread. In contrast, an invasive species like the orange daylily (*Hemerocallis fulva*) presents a different case. It may produce little or no seeds and spreads gradually but steadily, owing to its robust rhizomatous root system. On the environmental front, factors like climate compatibility, availability of suitable habitat, and the presence of natural predators or barriers can prolong or shorten the lag phase.[15]

The **Propagule Pressure Hypothesis** offers further insight. Research shows that the **frequency and volume** of new individuals entering the ecosystem — the 'propagule pressure' — directly correlate with the invasive species' likelihood of establishing and expanding.[16] The greater the frequency of introduction events and the greater the number of plants/seeds introduced at each event, the greater the propagule pressure, and the greater the invasion success.[17]

The Numbers Game: Curbing Sales to Combat the Spread of Invasive Plants

The concept of propagule pressure is fundamental in predicting the success of biological invasions. It is essentially a 'numbers game' where the likelihood of an invasive plant establishing itself in a new environment increases with both the frequency of its planting and the volume of its sales.[18] Each transaction involving invasive plant species, such as sales, sharing, planting, and even improper disposal, amplifies the potential for these plants to spread and establish populations in natural habitats.

Recent statistics from the United States underscore the scale and risks associated with this phenomenon:

- A staggering 60% of invasive plant introductions have been deliberate.
- A significant 83% of these plants, once imported for horticultural use, remain commercially available.
- Alarmingly, 97% of these invasive species are expected to expand their range as climate change alters ecosystems.
- The current trends in horticulture not only perpetuate but are set to accelerate the spread of invasive species.[19]

The implications of these findings are profound. The lag times between plant introduction and the onset of invasiveness means that the invasive potential of plant species is often missed by gardeners, land managers, and policymakers.[20] This oversight is particularly concerning when the biological characteristics of an ornamental plant, along with its native biogeography and history of invasion, **signal a high risk** of it becoming invasive.

Non-native plants represent well over a quarter of the vascular plant species present in Canada’s natural spaces. In 2008, the Canadian Food Inspection Agency noted that 486 of the reported 1,229 alien plants were classified as weedy or invasive.[21] Since then, over 140 new species have escaped cultivation or been accidently introduced.[22] It is estimated that between 10% and 25% of non-native plants that enter natural areas can become highly abundant and exhibit significant ecological and economic impacts.[23]

To mitigate this risk, it is important to intervene to reduce propagule pressure. **This means halting the sale of high-risk plants and educating consumers about the potential dangers of invasive plants.** Such pre-emptive actions are essential to prevent and curtail the exponential growth of invasive plant populations that can lead to lasting ecological damage and drains on the economy.[24]

IMPACTS OF INVASIVE PLANTS

The Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES) has issued a compelling report on "Invasive Alien Species and their Control," making clear the profound threat posed by invasive alien species to nature, the well-being of humanity, and the overall quality of life.[25] This alarming global issue is projected to persistently worsen in the foreseeable future.

The Serious Consequences of Invasive Plants:

Invasive plants can have serious and long-lasting impacts, including directly threatening human health and contributing to food insecurity by reducing agricultural productivity and crop yields.[26] They also harm biodiversity and ecosystem functions,[27] which in turn have associated socio-economic costs and can result in cultural losses.[28] Some impacts, such as the loss of native flora and fauna or degraded soil health, can be irreversible.[29]

As invasive plants spread, they damage Canada's natural assets and interfere with the critical services[30] provided by healthy well-functioning natural systems. Invasive plants can do great harm through:

- **Displacement of Native Habitats**: Invasive plants encroach upon and suppress native plant species, diminishing precious native habitats.
- **Disruption of Food Webs**: They disrupt vital food webs, adversely affecting wildlife; for example, by outcompeting native plants that certain animal species rely on for food and habitat, they can lead to a decline in these animal populations and alter the entire ecosystem.
- **Alteration of Soil**: Invasive plants modify soil formation, composition, and chemistry, and diminish the abundance and diversity of soil organisms thereby, eliminating the specific growth and survival requirements of some native plants.
- **Resource Depletion**: They reduce the availability of crucial resources such as water and nutrients, required by native plants and wildlife.
- **Impairment of Ecosystem Services**: Invasive plants impair essential ecosystem functions and services. This includes disruption of pollination processes, as many pollinators are specialized to interact with specific native plants. When native pollen sources are displaced by invasive plants, pollinators may also decline or disappear.
- **Loss of Diversity**: They contribute to the reduction of genetic diversity and global biodiversity. By outcompeting and displacing native plant species, they lead to a homogenization of plant communities, reducing the variety of genes and species

present in an ecosystem. As the variety of foods and habitats available for wildlife diminish, the entire biological diversity of a region can decrease.

- **Health Hazards**: Invasive plants pose risks to human health, causing poisonings, allergies, dermatitis, injuries, and increased risk of diseases like Lyme disease and West Nile virus.
- **Threats to Food Production**: Invasive plants can compete with crops for essential resources, reducing agricultural yields. Moreover, they can amplify the risk of crop diseases, alter soil conditions, and drive-up production costs, collectively undermining the stability, cost, and availability of food resources.
- **Diminished Recreational Opportunities**: They curtail recreational activities such as bird watching, hiking, camping, swimming, and the use of urban green spaces.
- **Transformation of Natural Heritage**: Invasive plants transform Canada's unique natural legacy, impacting Indigenous cultural heritage, national parks,[31] wildlife areas, maple sugar production, and the aesthetic appeal of Canadian landscapes.
- **Negative Impact on Mental Health**: They adversely affect the mental health of individuals who experience a sense of loss due to landscape change. In addition, the challenges and often futile efforts involved in managing invasive plants can lead to feelings of helplessness and stress, particularly for those who are directly responsible for land management or whose livelihoods depend on the health of local ecosystems.
- **Financial and Time Burden**: Their control, removal, and restoration entail an ongoing financial burden.
- **Economic Losses**: They reduce revenues in agriculture, forestry, fisheries, tourism, hunting, fishing, and recreation sectors.
- **Infrastructure Damage**: Invasive plants cause harm to infrastructure and lead to increased maintenance costs by affecting drainage systems, transportation corridors, and other critical facilities.
- **Heightened Risks**: Invasive plants increase the risks of fires, erosion, and property damage. Additionally, altered carbon sequestration regimes and increased fire risks can potentially contribute to global warming.

Examples of Plants Known to Cause Harm:

The following plants were introduced through the ornamental or pet/aquarium trades:

- **Giant hogweed (*Heracleum mantegazzianum*)** can displace native understory and wetland species and poses a direct threat to human health due to its phytotoxins, which can cause severe skin burns.[32]
- **Japanese barberry (*Berberis japonicum*)**, known for hosting a rust disease that can harm grain production, jeopardizes food security.[33] It also contributes to the proliferation of Lyme disease-carrying ticks[34] and disrupts ecosystems.[35]
- **Salt cedar (*Tamarix* spp.)** capable of lowering water tables and depositing excessive salt in the soil, poses a risk to water quality and availability, impacting both agriculture and ecosystems.[36]

- **Multiflora rose (*Rosa multiflora*)** forms dense thickets that threaten various habitats, ecosystems, and Species at Risk, while also contributing to an increase in tick populations.[37]
- **Bohemian knotweed (*Reynoutria* x *bohemica*)** reduces biodiversity and causes damage to infrastructure, making it a costly invasive species to manage.[38]
- **Amur honeysuckle (*Lonicera maackii*)** puts Species at Risk in jeopardy[39] and boosts mosquito populations, which act as vectors for West Nile.[40]
- **Carolina fanwort (*Cabomba caroliniana*)** creates dense mats that displace native aquatic plants, impeding recreational activities and navigation in aquatic ecosystems.[41]
- **Norway maple (*Acer platanoides*)** alters landscapes, displacing native understory plants and seedlings of iconic species like sugar maple, impacting Canada's cultural identity and the lifeways of Indigenous and local communities.[42]
- **Tree-of-heaven (*Ailanthus altissima*)** serves as a vector for pests that can damage crops, produces copious pollen aggravating allergies, and disrupts ecosystems.

The Urgent Imperative of Addressing Invasive Plant Threats:

While there are numerous ways that invasive plants can cause harm, the displacement of native plants and the resulting loss of biodiversity and ecosystem function are a major concern.[43] Canada is not adequately addressing these threats.[44] To accurately determine the costs to society, we must recognize the full range of potential harm they can cause. [45]

THE COSTS OF INVASIVE PLANTS

Biological invasions cost trillions of dollars globally by driving biodiversity loss, reducing crop yields, damaging infrastructure, disrupting ecosystem service provisioning, and impacting human health.[46] The costs of invasive plants in Canada are **massive and under-reported**.[47] This lack of awareness has led to insufficient funding and delayed action. **Delays in preventing the spread of invasive plants will cost Canadians billions and cause untold harm**.

National Expenditures:

In 2008, the CFIA reported yield loss to invasive plants and invasive plant control costs of approximately $2.2 billion annually in the agricultural sector alone.[48] The breakdown of costs associated specifically with plants of ornamental origin is not readily available. A broader accounting of many invasive species (animals, plants, pathogens) in Canada has been made available in the public database InvaCost, but there is insufficient data specific to all invasive plants.[49] Using the available data, it has been determined that Canada has directed at least USD $12.1 billion since 1960 toward invasive plant management, with the majority expended over the last two decades.[50] The management costs across all invasive species appear to be doubling every six years.[51]

Municipal Expenditures and Volunteer Efforts:

Within the provinces and territories, costs often fall on municipalities and non-governmental stakeholders.[52] The total annual expenditures by municipalities in Canada is difficult to

determine. Based on a survey conducted in 2021, the estimated total annual expenditure by municipal governments choosing to address invasive species ranges between $95.8 and $400.0 million. Plants of ornamental origin like Japanese knotweed, giant hogweed, milfoil, buckthorn, and English ivy are reported as high priority species.[53] The survey did "not include expenditures from parks, Indigenous communities or conservation authorities." Often small communities and local groups are forced to fundraise to mitigate invasive plant infestations.[54] Currently, such costs are not well reported[55] to provincial or federal databases and volunteer hours are not quantified.

A Call for Improvement - **Better Accounting**:

In the 2008 *Invasive Alien Plants in Canada Technical Report*, the Canadian Food Inspection Agency (CFIA) states that "a comprehensive, nationwide estimate of the economic impacts of invasive alien plants, and of invasive alien species in general is needed in Canada."[56] **To date, no such assessment has been carried out.**

Accounting of direct economic impacts should include the costs from a variety of stakeholders including:

- The agricultural and forestry sectors – protecting plant resources.
- The transportation sector – ensuring safe transit corridors on land and water.
- The recreation sector – maintaining attractive, safe, accessible spaces.
- The hunting and fishing sectors – safeguarding wildlife and fishing areas.
- The Canadian power and utilities sectors – responsible for removing invasive plants that could cause fire, erosion, and flooding.
- Land managers – responsible for the removal of invasive plant species from parks, green spaces, and waterways.
- Not for profit organizations – volunteers investing time and resources to mitigate invasive plant impacts.
- Private landowners – trying to manage infested private properties.

While a price tag can be attached to the equipment or labour required to remove invasive plants, or for restoration efforts, a true costing of the impact of invasive plants would need to include an assessment of the **environmental damage**, in particular damage to **biodiversity,** as well as impacts to **public health**[57] and to **cultural heritage**.[58]

Tools to Value Nature: Bridging the Gap in Biodiversity Policy and Practice

The Kunming-Montréal Global Biodiversity Framework calls on Canada to ***ensure the full integration of biodiversity and its multiple values into policies, regulations, planning*** (Target 14).[59] A number of modern tools[60] exist to recognize the value of nature and nature's contributions to people.[61] For instance, the International Union for Conservation of Nature (IUCN) uses the well-reviewed Environmental Impact Classification for Alien Taxa (EICAT) to help quantify impacts to nature.[62] A more recent companion scheme to assess the impacts of invasive plants on human well-being and social structures has also been developed.[63]

Unfortunately, Canada currently does not use these risk assessment tools. Consequently, damages are undervalued and investments in prevention are under-prioritized.

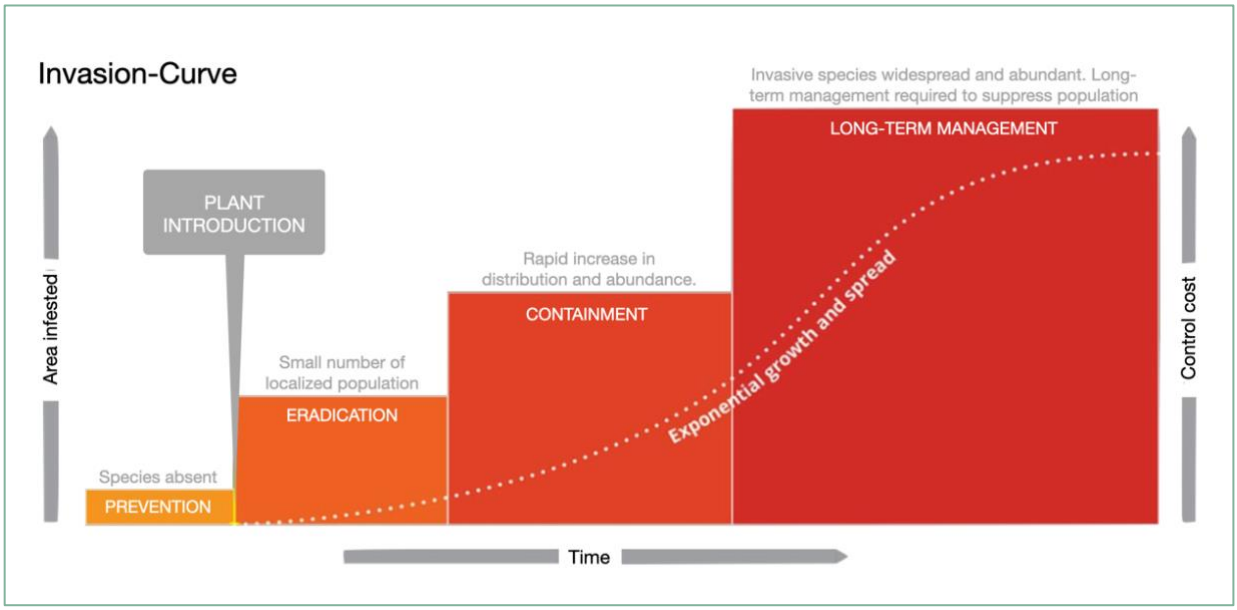

Figure 6: Invasion curve illustrating how costs rise with time and spread. Source: F. Herald, 2022

Managing the Problem Saves Long-Term Costs

In the battle against invasive plant species, the evidence is clear: **proactive management and prevention are not just prudent but fiscally responsible**. We know the costs of invasive species management steadily rise over time, making early intervention crucial (Figure 6).[64] The striking statistic that each $1 invested in management saves a staggering $53.5 in damages underscores the economic imperative of addressing this issue promptly.[65]

Although a comprehensive assessment of the full impact of invasive plants may be challenging, the wisdom of preventing the introduction and spread of invasive plants cannot be overstated. Canada must allocate greater resources toward evaluating the risks posed by non-native plants using modern tools to better quantify potential impacts to both nature and society. This is key to not only curbing the problem but also realizing substantial cost savings.

PART 2: REGULATIONS IN CANADA

WHO'S IN CHARGE?

In Canada, the responsibility for preventing the introduction and spread of invasive plants is complex, involving multiple government agencies and stakeholders. A lack of coordination among various departments and agencies coupled with weak or absent legislation, has resulted in a lack of accountability.[66] Lack of capacity, reliance on outdated tools and gaps in mandates have resulted in slow responses to existing and emerging pathways such as the internet and mail order, the pet and aquarium trade, and others.

Federal Involvement and Accountability:

Several departments are charged with invasive species prevention and management. The key departments are:

- **Environment and Climate Change Canada (ECCC**): ECCC, whose focus is on protecting the environment, developed the *Invasive Alien Species Strategy for Canada* in 2004.[67] As the federal lead for biodiversity in Canada, the ECCC played a key role in the development of the recent Kunming-Montréal Global Biodiversity Framework (2022) in which **Canada pledged a 50 percent reduction in the rate of introduction and establishment of invasive species.** While ECCC plays a pivotal role in biodiversity matters, Canada's international commitments and regulating terrestrial Species at Risk, **it lacks explicit regulatory authority over invasive plants.**
- **Fisheries and Oceans Canada (DFO):** Recognizing the threat posed by invasive species to healthy functional water systems, DFO updated the *Fisheries Act* to provide that department the necessary regulatory authority to restrict the spread of invasive aquatic species. In 2015, a list of prohibited aquatic invasive species was published as part of the *Aquatic Invasive Species Regulations* (SOR/2015-121). However, no invasive plants appeared on that list. Even though DFO recognized the threat posed by invasive plants,[68] and regulates aquatic Species at Risk, **the responsibility for regulating aquatic plants is still not clear today**.
- **Natural Resources Canada (NRCan):** The Department of Natural Resources was identified as a federal lead in invasive species prevention in Canada's 2004 IAS strategy for Canada.[69] With a focus on the forestry sector, NRCan contributes to research efforts by developing tools for detecting, identifying, and monitoring pests (largely insect pests) that impact the forestry sector. **However, NRCan takes no direct regulatory action to prevent the spread of invasive alien plants.**
- **Parks Canada:** To protect Canada's natural heritage, Parks Canada must manage non-native invasive plants that have escaped from cultivation. They have identified horticultural plants like scotch broom, toadflax, St. John's wort, Himalayan blackberry as species of particular concern.[70] While the expense for control comes out of the Parks Canada budget and the taxpayers' purse, **this department does not have authority to stop the sales and trade of these plants.**
- **Canadian Food Inspection Agency (CFIA):** CFIA has the primary authority for the regulation of plant health, including invasive plants and other pests.[71] The historical focus of the CFIA has been to protect food security and prevent noxious weeds and other pests that impact agriculture.[72] While the CFIA has acknowledged the importance of protecting the environment, **current policies and regulatory tools (the *Plant Protection Act* and *Seeds Act*) are not adequate to meet Canada's biodiversity commitments and are not sufficient to meet the many challenges posed by invasive plants.**

To guide efforts in managing invasive plants in Canada, CFIA developed the "Canadian Invasive Plant Framework" (CIPF).[73] Under this framework, CFIA assumes responsibility for limiting invasive plants that are "not yet present in Canada or are present but not widely distributed." **This means that invasive plants that are considered established in Canada, including those causing harm in federal parks, are not federally regulated.** Responsibility for managing these plants is pushed to other stakeholders including provincial and regional governments, Indigenous communities, and non-governmental organizations, where resources and tools are limited.

Challenges and Gaps:

Over the past two decades, the CFIA has reported being hampered by a lack of legislative tools, scientific capacity (including a shortage of skilled personnel and a lack of effective collaboration and data management systems), and a lack of clear interdepartmental policies.[74]

In 2019, the Office of the Auditor General of Canada noted serious gaps in oversight of invasive species. The report recommended that the Federal Government develop a more cohesive national approach to invasive species prevention and management.[75] This echoed the recommendations of the Invasive Alien Species Task Force that called for improved federal leadership, coordination, and regulatory tools in 2017.[76]

The Federal-Provincial-Territorial Invasive Alien Species National Committee was established in 2018 to increase policy coordination and information sharing about all invasive species. However, it does not track implementation of national or international targets on invasive species. **Its work plan is not a public document and no further information about its plans or activities are available to the public, so it is impossible to tell if any policy coordination has been achieved.**[77]

The Need for Improved Federal Biosecurity:

The public is not being served consistently or equitably across jurisdictions. For the public good, Canada must improve its federal biosecurity efforts to protect natural ecosystems, along with the economy and public health.[78] The Canadian Coalition for Invasive Plant Regulation (CCIPR) is looking for the Federal Government to deliver on its commitments under the 2022 *Convention on Biological Diversity* and believes that change is urgently needed.

INTERNATIONAL OBLIGATIONS

The *Convention on Biological Diversity*

Established in 1992, the *Convention on Biological Diversity* (CBD), is an important global agreement. Under Article 8(h), the CBD mandates that signatories actively prevent the introduction of, and control or eradicate, alien species that pose a threat to ecosystems, habitats, or native species.[79] In 2004, to align national efforts with CBD goals, Environment Canada developed "An Invasive Alien Species Strategy for Canada." While some progress has been made on invasive species prevention, there remain serious gaps.

Such gaps can be illustrated by looking at the invasive plants used as examples in Canada's strategy document. Two decades ago, yellow floating heart was recognized as a significant national threat. Plant sales remain the primary pathway for its introduction, yet this highly invasive plant can still be imported into Canada and may be sold in many provinces and territories. The report called on federal departments and agencies to "develop legal and regulatory tools and amend existing legislation and regulations to strengthen measures to prevent, detect, respond, and manage invasive alien species." **To date no new federal regulatory tools have been developed to stop the sales of highly invasive plants.**

The Kunming-Montréal Global Biodiversity Framework:

To halt and reverse biodiversity loss in the next ten years, all CBD parties (member countries) recently committed to a ground-breaking biodiversity framework. This *Global Biodiversity Framework* sets forth a comprehensive strategy which includes 23 targets. Notably, Target 6 ambitiously aims for a 50% reduction in the rate of invasive species introductions by 2030.

Effective regulation and management of invasive species are pivotal to Canada's commitment to meet biodiversity targets. Only by preventing the introduction and spread of invasive plants can Canada "bring the loss of areas of high biodiversity importance" close to zero (Target 1), restore degraded ecosystems (Target 2), and manage the introduction and spread of alien species, especially through the horticultural trade (Target 6). This approach is also integral to maintaining healthy ecosystems for sustainable use and preservation of wild species (Targets 5 and 9), ensuring sustainable practices in agriculture and forestry (Target 10), and enhancing the quality of green and blue spaces (Target 12). Furthermore, a comprehensive strategy that includes public awareness, improved legislation, and transparent data reporting is essential for integrating biodiversity protection into policymaking (Targets 14 and 15), and for enabling consumers to make informed, sustainable choices (Target 16).

Canada's commitment to the *Kunming-Montréal Global Biodiversity Framework* is more than a promise — it's **an urgent call to action**. Invasive plant prevention and management must therefore be prominent in Canada's "2030 Biodiversity Strategy."[80] It will require significant changes to address gaps and inconsistencies in the current regulatory system.

Other International Agreements that Impact Invasive Plant Regulation

The *International Plant Protection Convention* (IPPC, established in 1951) and the World Trade Organization's *Agreement on the Application of Sanitary and Phytosanitary Measures* (SPS Agreement, introduced in 1995) are instrumental in shaping Canada's approach to invasive plant prevention. Like the *Convention on Biological Diversity* (CBD), these complex international agreements legally obligate Canada to adopt specific practices. While they facilitate global cooperation in limiting the spread of invasive plants, they also present unique challenges to Canada's capacity to effectively regulate invasive plants.

The *International Plant Protection Convention*

Recognizing that the spread of pests caused by the global trade of goods was an international problem, countries around the world entered into the *International Plant Protection Convention*

(IPPC) – **to protect plants, agricultural products, and natural resources from plant pests**.[81] The IPPC allows and encourages nations to restrict the trade of products including plants that could carry pests or are themselves pests (weeds and or invasive plants).

Under the IPPC, each member country must establish a national organization responsible for plant protection. In Canada that is the **Canadian Food Inspection Agency** (CFIA). The CFIA is tasked with implementing various measures and procedures to identify pests and prevent their introduction and spread including:

- Conducting **Pest Risk Analysis.**
- Developing **Surveillance and Reporting** systems for plant pests within Canada.
- Establishing **Regulation and Control** to manage the risk of pest introduction and spread.
- Facilitating **Collaboration and Communication** including **Public Education.**
- Engaging in **Research and Development** related to plant health and pest management.

Under the IPPC, standards known as the *International Standards for Phytosanitary Measures* (ISPMs)[82] were developed to control the movement of pests. Initially the IPPC focused solely on preventing the spread of plant pathogens (diseases of crops), and other organisms (insects, mites, nematodes, snails) that could harm plants in cultivation and threaten food security or forestry products. It was not until 2001 that the definition of "pest" was broadened to include "plants as pests".[83]

Over the last two decades, guidelines have been continually updated to better recognize the threat of invasive species and better protect native flora. Under revised IPPC guidelines, the CFIA can prohibit the import and sale of invasive species that threaten native plants. However, application of phytosanitary (plant health) measures that restrict trade are limited by the *SPS Agreement*.

The *SPS Agreement* and Trade

The *SPS Agreement (Sanitary and Phytosanitary Measures Agreement)* introduces a nuanced complexity to the regulation of invasive plants. Primarily aiming to prevent unjustified trade restrictions under the pretext of food safety or plant and animal health, the Agreement requires that any measures taken to prevent the spread of pests, including invasive plants, be **scientifically justified, and transparently implemented**. Measures taken must be considered proportionate to the risks involved.[84]

While countries are permitted to set their own standards, the WTO encourages adherence to international standards and guidelines, notably those developed by the IPPC, to promote consistency and transparency in global trade. This alignment can help prevent, and be used to resolve, disputes over trade restrictions that may be considered baseless. A case in point occurred in June 2005 when the WTO dispute resolution panels ruled against Japan's restriction on U.S. apple imports, which had been implemented citing disease concerns but was found to lack adequate scientific evidence.[85] Decisions like this underscore the need for robust scientific grounding in trade-related health measures.

To apply IPPC standards and comply with the *SPS Agreement*, the CFIA must conduct a comprehensive pest risk analysis before implementing phytosanitary measures to restrict the

trade of an invasive plant.[86] As part of this analysis, CFIA is required to assess the likelihood of the plant's introduction and spread, as well as its potential economic impacts.

It is also necessary to identify areas that are currently free from the invasive species but could be endangered by its spread. Resources must be allocated for monitoring the distribution of the plant and implementing strategies to eradicate, contain, or manage it in infested areas. Once a plant is identified as a risk, a WTO Member must adopt the least trade-restrictive measure necessary to achieve the **plant health protection** objective. Regulatory measures, like import prohibitions or sales bans, must be based on scientific evidence.

Because of resource constraints, the CFIA prioritizes the prevention of new imports of pests not yet present in Canada. The problem of invasive plants already present in Canada has been pushed to regional governments, non-governmental organizations, Indigenous Peoples, and other stakeholders.[87] This **responsibility-shifting** means the welfare of regions and peoples without the capacity to address the problem is jeopardized. Thus, invasive plants have fallen through regulatory and policy gaps.

Recognizing Gaps and Inconsistencies

While there are global efforts to improve multilateral agreements, it falls on the Canadian Government to recognize that there is **a national invasive species problem.** Responsibility for invasive species is fragmented in Canada. Environment and Climate Change Canada has the responsibility for strategic planning related to meeting CBD commitments. IPPC and SPS-related functions are handled under the Departments of Agriculture and Health. But other departments such as Fisheries and Oceans Canada and Parks Canada also handle invasive species regulation and management as it relates to their mandates. This disjointed approach has led to lack of clear jurisdiction, overlap of responsibilities, and duplication of efforts. The result is a failure to act in response to known threats.

This can most clearly be seen by the failure of the federal government to regulate the flow of invasive aquatic plants through the water garden, pet aquarium trades, and ecommerce. At one time, aquatic plants like yellow floating heart, hydrilla, and water-chestnuts (*Trapa* spp.) were prohibited for import in Canada.[88] Despite recognizing the high-risk posed to Canada's water resources and biodiversity, the import ban was lifted in 2001. The CFIA cited "a lack of an interdepartmental policy" and a need to harmonize practice and international obligations under the IPPC and SPS Agreement.[89] Withdrawal of restrictions allowed renewed trade of invasive aquatic plants that have now become serious problems across Canada.

FEDERAL LAW

The Canadian Food Inspection Agency (CFIA) employs two key federal laws —the *Seeds Act*[90] and the *Plant Protection Act* (PPA)[91] — to regulate invasive plants. These laws were originally crafted with an agricultural focus.[92] This predominant agricultural focus, coupled with resource constraints, specific agency policies, and misinterpretations of international guidelines, have resulted in limited regulatory action to control the spread of invasive plants present in Canada.

Seeds Act – Reducing Accidental Introductions of Invasive Plants

Since 1905, Canada has been regulating the quality of seed sold in Canada to reduce the spread of weeds and disease.[93] The current *Seeds Act* continues to be instrumental in ensuring seed products are not contaminated by noxious weed seeds including the seeds of invasive plants.[94] The *Weed Seeds Order*, integral to the Act, specifically identifies weed species for regulation in terms of seed import, sale, and grading.[95] This law serves an important role in preventing the accidental introduction of invasive plants via seed contamination.[96]

While preventing the accidental spread of seeds is imperative, plants escaping from horticultural trades, including the sale of flower seeds, pose greater ecological threats.[97] The *Seeds Act* is not used to ensure wildflower seed mixes are free of invasive plants.[98] Some wildflower seed mixes sold in Canada do contain plants that are regulated as weeds, like oxeye daisy. It is not clear if this is due to lack of awareness, limited resources for monitoring and enforcement or if this falls outside of the central purpose of the regulation – to ensure seed quality.

Purple Loosestrife and the *Seeds Act*

Purple loosestrife is a case in point. It is regulated as a Primary Noxious Weed under the *Seeds Act*. This means only very minimal quantities of loosestrife seed are allowed in seed products.[99] It is in fact a very rare contaminant of seed products.[100] Accidental contamination of seed is not the primary pathway for the spread of this plant. Its proliferation has occurred primarily through nursery trade of the plant. This underscores the significant limitation of the *Seeds Act*: its inability to address the spread of invasive plants through non-seed-based pathways.

Plant Protection Act: Agricultural Interests vs. Environmental and Public Health Concerns

The PPA was established "to protect plant life **and the agricultural and forestry sectors**," and historically has emphasized the protection of agricultural and horticultural interests.[101] This focus has overshadowed broader environmental and public health considerations. A pertinent instance highlighting this imbalance is the regulation of Japanese barberry (*Berberis thunbergii*). It was initially banned in the early 1900s due to its role as a host for a rust disease harmful to grain crops. That prohibition has been maintained under the PPA, but with notable exceptions influenced by the horticultural industry.

In 2001, certain rust-resistant barberry cultivars[102] were exempted from the ban following industry lobbying.[103] Recent research findings indicate that the offspring of these cultivars can be hosts for rust disease, prompting a re-evaluation of barberry exemptions.[104]

Given the potential threat to agriculture, the CFIA drafted a pest Risk Management Document in 2022. [105] While the document recognized barberry's invasiveness in Canada, the focus was on agriculture and horticulture. It did not describe or quantify ecological impacts, nor did it include recent evidence that barberry infestations increase tick populations and exacerbate the spread of Lyme disease.[106]

The CFIA considered several management options including **banning all barberry** species and cultivars. This option was deemed **excessively restrictive for addressing the black stem rust**

risk. This response shows that environmental harm, biodiversity loss, and public health concerns were neither considered nor evaluated. Ultimately, the CFIA opted for a strategy that involved revising the list of exempt species and cultivars, incorporating criteria like black stem rust resistance and possibly the potential for invasiveness. The stated benefit of this option was **to protect the grain industry and accommodate the horticulture market**.

This decision raises critical concerns: **Is this strategy sufficient to support biodiversity and public health?** While the CFIA's risk analysis process allows for the consideration of environmental impacts, in the case of barberry, protection of native flora does not appear to be given much weight. Furthermore, the PPA does not primarily address human health risks, focusing instead on plant health. This means that plants like barberry or like giant hogweed (*Heracleum mantegazzianum*), which can pose significant public health risks, fall outside the PPA's primary scope.[107] Therefore, while the Act is effective in regulating certain plant pests affecting plant health, it does not adequately address those impacting human health and broader ecological integrity.

Weed (Pest) Risk Assessments and Management Options: Criteria and Limitations

To understand why the CFIA chooses not to regulate certain plant pests, we need to understand the risk management process. Before an invasive plant can be regulated under the *Plant Protection Act*, the CFIA must first assess and categorize it as a **quarantine pest** and consider a variety of management options to determine the least trade-restrictive action needed to prevent economic harm. IPPC guidelines prescribe a three-stage pest risk analysis process.[108] The process includes:

1) Determining if an invasive plant is a pest under international standards.
2) Categorizing it as a quarantine pest.
3) Creating a Risk Management Document (RMD) that presents management options.[109]

The definition of pest is quite broad and can apply to any plant **injurious to plants or plant products**. The CFIA uses the term “weed” and “pest” interchangeably in regard to risk assessments of plants considered to be pests.[110] Any invasive alien plant, which is by definition harmful, like Japanese barberry discussed above, meets the definition of “plant that is a pest”. However, categorizing an invasive plant as a quarantine pest is not so easy.

To be a **quarantine pest**,[111] an invasive plant must cause impacts of **economic importance**. In addition, the plant must either not be present in Canada or be **limited in distribution** with **control** efforts in place.[112] Under current policy and interpretation of international guidelines, few invasive plants present in Canada satisfy these requirements, and consequently, few risk assessments including the preparation of management documents are completed.[113]

Currently, the CFIA posts a list of available weed risk documents.[114] Of the 433 plants that the CFIA recognizes as potential risks,[115] only 6% have completed official Risk Management Documents and only 21 plants have been prohibited in Canada as quarantine pests.[116] To understand why so few plants are assessed and regulated, it can help to look at cases.

Case Studies: Kudzu vs. Purple Loosestrife

Kudzu (*Pueraria montana*) is an invasive vine that is a designated quarantine pest. First recognized in Canada in 2009, the plant has **limited distribution** in southwestern Ontario. As part of the risk analysis process, evidence was provided to show that kudzu could harm industries reliant on shrub and tree production. In addition to **negative economic impacts** on industries, the assessment noted potential environmental and social consequences including "negative effects on biodiversity in infested areas, altered soil nutrient cycles, and decreased air quality." Four options were presented in the Pest Risk Management Document that ranged from no action to regulation under both the *Plant Protection Act* and the *Seeds Act*. Given its limited distribution and the serious risk to the economy and to biodiversity, a nationwide ban of kudzu under both federal regulations was the chosen option.[117]

In contrast, purple loosestrife is an invasive plant that predominately impacts wetlands. It has been present in North America since the 1800s. The **environmental harm** caused by purple loosestrife and the **high economic costs** associated with its control are widely recognized.[118] However, a Weed Risk Assessment and Risk Management Documents have not been prepared for purple loosestrife. This is because the CFIA considers purple loosestrife to be "**widely distributed**" and therefore it cannot be categorized as a quarantine pest and cannot be regulated under the PPA. This case shows the importance of the interpretation of **limited in distribution** or **widely distributed**.

Ironically, if an invasive plant has impacts of economic importance but is considered "widespread" in Canada, no federal measures are developed under the PPA, and it can continue to do harm unabated by federal regulatory action.

Misinterpretation of Global Standards Causing Widespread Environmental Harm

The IPPC has stated that misunderstandings and misinterpretations of critical terms in the International Standards for Phytosanitary Measures (ISPMs) has led to invasive plants not being recognized as quarantine pests. The IPPC has now provided clearer guidelines on the meaning of 'limited distribution', 'economic loss', and 'official control'. It is imperative for the CFIA to align its policies and practices with these updated interpretations.

- **Limited distribution**: If an invasive plant can still **spread into new areas** and can cause economic loss, the plant is **not widely distributed**.[119]
- **Economic loss**: The IPPC emphasizes that economic assessments should include environmental impacts, addressing previous inconsistencies with the *Convention on Biological Diversity*.[120]
- **Official control**: This extends beyond regulatory enforcement to include monitoring the spread of an invasive plant, with measures aimed at eradication or containment, which may involve public awareness initiatives.[121]

Is purple loosestrife widely distributed under IPPC standards? No. It has not yet reached its potential ecological range in Canada, and it can cause environmental harm and economic loss in

areas currently free from this pest.[122] This plant should be classified as a quarantine pest and federal control strategies considered.

To meet invasive species targets, it is crucial for the government to revise its working definition of 'widespread' and to develop management options for invasive plants present in Canada.

Addressing the Oversight of Aquatic Invasive Plants: The Yellow Floating Heart Dilemma

The situation with yellow floating heart starkly highlights the considerable regulatory gap in managing aquatic invasive plants in Canada. In 2007, the CFIA stopped the import of 13 aquatic species pending risk assessments.[123] Currently, yellow floating is one of only six aquatic plants categorized by the CFIA as potential pests in the Weed Risk Assessment Documents.[124] It is **the only aquatic plant** to undergo a full risk assessment.[125]

In 2008, CFIA concluded yellow floating heart posed a high-risk to Canada's ecosystems and economy. The plant met all the criteria to be classified as a quarantine pest and the assessment report recommended a sales prohibition and an import ban.[126] The CFIA took no regulatory action because the plant had negligible impact on agriculture and forestry. The CFIA considered aquatic invasive plants the responsibility of Fisheries and Oceans Canada, (DFO had requested the assessment). It remains unclear which department will take regulatory responsibility for aquatic invasive plants.[127]

Consequently, the unchecked sale and distribution of yellow floating heart has continued across Canada. Escaping from water gardens, deliberate plantings, or aquarium releases, it has now established itself in at least six provinces, causing significant ecological disruptions.[128] **This invasive species undermines the health and recreational value of Canadian waterways, underscoring the urgent need for regulatory change and governance reforms.**

PROVINCIAL AND TERRITORIAL REGULATIONS

The responsibility for managing invasive plants that escape from gardens lies with provincial and territorial governments. However, this effort is significantly undermined by inconsistencies in regulatory frameworks and lack of resources. This has led to a patchwork of approaches that are disjointed and often reactive rather than proactive. [129]

- Six jurisdictions—New Brunswick, Newfoundland and Labrador, Northwest Territories, Nunavut,[130] Quebec, and the Yukon— lack any regulated invasive plant lists.
- Seven provinces—Alberta, British Columbia, Manitoba, Nova Scotia, Ontario, Prince Edward Island, and Saskatchewan—have noxious weed regulations. These operate on a complaint-driven basis, obligating landowners or local authorities to take action to control or eradicate noxious weeds. The prairie provinces (Alberta, Manitoba, Saskatchewan) feature tiered lists of noxious weeds, with certain high-risk invasive plants designated for mandatory eradication without exceptions. However, apart from Prince Edward Island, which has implemented the *Purple Loosestrife Control Regulation*

that uniquely prohibits the sale of this invasive species, these regulations across the mentioned provinces do not explicitly restrict the sale of noxious weeds.[131]

- Ontario stands out as the only province that has enacted both a *Noxious Weed Control Act* and an *Invasive Species Act*, the latter forbidding the purchase, sale, lease, or trade of specified invasive species.[132]
- Manitoba and Alberta restrict the spread of invasive aquatic plants under separate regulations.[133] The sales of aquatic invasive plants are explicitly prohibited under Manitoba's forward thinking *Water Protection Act*.

A widespread issue is the deficiency in **knowledge and information**, including confusion over names, lack of standardized definitions, and uncertainties regarding the distribution and impacts of invasive species.[134] Most provinces report a lack of financial and human resources.[135]

Approximately 238 plants are regulated across Canada including over 96 plants regulated under the *Seeds Act*. The 13 U.S. states that border Canada regulate an additional 320 plants. CCIPR has identified over 50 **plants of potential national concern** in the horticultural trades that have been regulated in at least five jurisdictions.[136] These plants are only sporadically regulated across Canada, if at all (ten examples are included in Table 1 below). Invasive species councils and other authorities, like the Ontario Auditor General (Table 2), have identified additional ornamental plants as significant threats. Provinces and territories may not be aware of these potential threats and/or do not have the resources or legislative capacity to act.

Table 1. Ten invasive plants of potential national concern

Common name	Scientific name	Jurisdictions regulated	
		U.S. Border States (other states)	Canada
Tree of heaven	*Ailanthus altissima*	ME MI NH, OH, PA VT WA WI (DE CT IN MA)	AB ON
Japanese barberry	*Berberis thunbergii*	ME MN NH NY PA VT WI (DE IN MN)	CAN (PPA)
Asiatic bittersweet	*Celastrus orbiculatus*	ME MN NH NY OH PA VT WI (DE CT IL MA)	
Scotch broom	*Cytisus scoparius*	ID OH MT PA WA WI (MD)	BC
Brazilian elodea	*Egeria densa*	ID ME MN MT NH NY OH PA VT WA WI	AB MB ON
Autumn olive	*Elaeagnus umbellata*	ME MI NH NY OH WI (CT DE MA)	AB
Winged euonymus	*Euonymus alatus*	ME NH NY PA VT WI (DE MD MA)	
Yellow flag iris	*Iris pseudacorus*	ID ME MN MT NH NY OH, VT WA WI (MA MD OR)	AB BC MB
Honeysuckle, Amur	*L. maackii*	ME MN NH NY OH PA VT WI (DE CT IL)	
Parrot's feather	*Myriophyllum aquaticum*	ID ME MI MN MT NY OH PA WA WI	MB ON

Table 2: Ontario Auditor General's Do Not Sell List[137]

Ontario Auditor General: DO NOT PLANT OR SELL LIST			
Amur maple *Acer ginnala*	English ivy *Hedera helix*	Lily of the valley *Convallaria majalis*	Periwinkle *Vinca minor*
Autumn & Russian olive *Elaeagnus* spp.	Garlic mustard *Alliaria petiolata*	Miscanthus *Miscanthus* spp.	Sea buckthorn *Hippophae rhamnoides*
Burning bush *Euonymus alatus*	Glossy buckthorn *Frangula alnus*	Multiflora rose *Rosa multiflora*	Spearmint *Mentha spicata*

Common buckthorn *Rhamnus cathartica*	Goutweed *Aegopodium podagraria*	Norway maple *Acer platanoides*	Tree-of-heaven *Ailanthus altissima*
Creeping jenny *Lysimachia nummularia*	Italian honeysuckle *Lonicera caprifolium*	Oriental bittersweet *Celastrus orbiculatus*	White mulberry *Morus alba*
Dame's rocket *Hesperis matronalis*	Japanese barberry *Berberis thunbergii*	Ornamental honeysuckles *Lonicera* spp.	Wintercreeper *Euonymus fortunei*
Daylily *Hemerocallis fulva*	Japanese honeysuckle *Lonicera japonica*	Pachysandra *Pachysandra terminalis*	Yellow archangel *Lamium galeobdolon*

A Cry for National Action

The issue of invasive plants in Canada is a complex and significant challenge, with horticulture and the pet/aquarium trades being primary vectors for the introduction and spread of these species. While the Federal Government has largely delegated the management of plants within these trades to provincial and territorial authorities, these governments find themselves under-equipped to tackle such a widespread problem effectively. This situation underscores the urgent need for a more cohesive and national approach to managing invasive plants.

PART 3: RECOMMENDATIONS

RECOMMENDATIONS FOR LEGISLATIVE CHANGE

Canada's Commitment to Reducing Invasive Species

As a nation, Canada has pledged to reduce the introduction and establishment of non-native invasive species by at least 50 percent by 2030.[138] This commitment echoes the objectives set in the 2015 "Biodiversity Goals and Targets for Canada," which emphasized developing risk-based intervention plans for primary pathways of invasion.[139] However, progress in managing the most significant pathway, **the ornamental/horticultural sector**, has been limited. Addressing this pathway is crucial to meeting our current biodiversity and environmental sustainability targets. The first step is improving governance.

Improved Governance

Presently, the task of preventing and managing invasive species in Canada is distributed among various departments and agencies at multiple government levels. This distribution leads to a lack of clear understanding regarding the specific duties and inter-agency responsibilities. Canada must improve governance mechanisms to ensure structures, systems, and practices are in place to **reduce the spread of invasive species more effectively**.[140] To achieve this, Canada must:

- **Integrate Policy and Program Delivery:** Invasive species issues **cross administrative boundaries** and therefore require a coherent multi-faceted approach. Canada must develop and adopt new effective **cohesive national initiatives** drawing lessons from successful invasive plant management models from around the globe, some of which are described below.

- **Establish a Clear Oversight Body**: The 2017 Federal-Provincial-Territorial Task Force on Invasive Alien Species called for strong central leadership and the establishment of a centralized national body responsible for coordinating invasive species prevention and management across departments and with various stakeholders at multiple jurisdictional levels.[141] This body should have clear authority to delegate responsibilities and ensure all parties are aware of their own and others' roles.
- **Report and Share**: For effective management of invasive plants, the designated oversight body should prioritize the creation of **an information-sharing system**. This system would serve as a much-needed central repository for all relevant data concerning the impacts, distribution, and management strategies of invasive plants. It can also be a portal for tracking progress towards reducing the introduction and spread of species. Making information easily available to stakeholders, including government bodies, environmental groups, and the public, will support a more collaborative and informed approach to tackling invasive species. Regular reporting by the oversight body will not only ensure accountability but also facilitate the timely adjustment of strategies and actions based on the latest insights and developments.
- **Support, fund, and mobilize**: An oversight body is pivotal in distributing resources, particularly where assets are limited. This entity should guarantee the strategic channeling of resources towards prevention, innovation, and research, focusing on priorities pinpointed by scientists and stakeholders. This approach ensures that critical challenges are tackled both efficiently and fairly.

Regulatory Reform – The CEPA Model

The *Canadian Environmental Protection Act* (CEPA) declares that the protection of the environment is essential to the well-being of Canadians and establishes the legal mechanism to regulate harmful substances, including requirements for labelling of potentially harmful products.[142] Like toxic substances, invasive species pose **a significant threat to Canada's environment and human health**. The CEPA model could be adapted to address this threat in the following manner:

- **Risk Assessment for Importation**: A systematic risk analysis should be required for all plants proposed for importation into Canada, like the assessment of new chemical substances under CEPA.
- **Regulatory Framework:** The government should establish regulations like the *Prohibition of Certain Toxic Substances Regulations,* targeting invasive plants of national concern. This would involve banning or restricting the import, sale, cultivation, and distribution of high-risk plants.
- **Information and Reporting Requirements**: Importers and sellers of plants would be required to provide detailed information about the species, its origin, and potential environmental impact, to inform risk assessments and regulatory decisions.
- **Mitigation Measures**: The government should mandate specific measures to manage or mitigate the risks associated with the cultivation or sale of certain plants deemed

potentially harmful. This would include **labelling requirements** to clearly explain the need for containment, strategies to prevent escape into the wild, and recommendations for the use of alternative, non-invasive species. (See labelling section for a more fulsome discussion).

- **Enforcement and Penalties**: Just as under CEPA, there is need for enforcement mechanisms to ensure compliance with the regulations, including penalties for violations.

Highly invasive plants, like giant hogweed and yellow flag iris, are organisms that cause long-term deleterious alterations to the environment and harm human well-being. **New invasive alien species legislation** should ensure such plants are placed on a list of harmful plants of national concern. This legislation could mirror the CEPA model or CEPA itself could be expanded to include invasive plant management. Either initiative would significantly enhance Canada's ability to protect Canada's ecosystems and the public good.

Regulatory Reform – Expanding the Scope of the *Plant Protection Act* and *Seeds Act*

An alternative to expanding CEPA, or to creating entirely new invasive species legislation, would be to maintain invasive plant regulation under the auspices of the CFIA and to broaden the scope of the *Plant Protection Act* and the *Seeds Act*.

The *Plant Protection Act* could be amended to explicitly include the protection of the ecosystem services within its mandate.[143] This enhancement would enable the Act to tackle not only the direct threats to plant health from pests and diseases but also the **broader ecological and health impacts** of invasive species.

Similarly, the *Seeds Act* could be amended to explicitly include invasive species management as a core objective. This would empower the CFIA to better regulate the sales of ornamental and wildflower seed mixes that can spread invasive plants like blueweed (*Echium vulgare*), baby's breath (*Gypsophila paniculata*), and giant hogweed (*Heracleum mantegazzianum*) that have been distributed in wildflower seed mixes.[144]

To effectively execute its expanded mandates, the CFIA must receive a substantial boost in resources. Remember, every dollar spent in this endeavor can avert more than fifty dollars in damages, underscoring the efficiency and necessity of these investments for improved risk analysis capabilities.[145] Reforming regulations and fortifying the CFIA ensures that Canada remains a steadfast participant in global food safety and plant health systems, while reinforcing its commitment to protecting both the environment public well-being.

LEARNING FROM INTERNATIONAL FRAMEWORKS

Regulatory Reform – The European Union Model

In 2014, the European Union implemented Regulation (EU) No 1143/2014, a critical legislative measure aimed at **preventing and managing the introduction and spread of invasive alien species**. This regulation was a direct response to the EU's commitment to the *Convention on Biological Diversity*, specifically Article 8(h), which mandates parties prevent, control, or

eradicate alien species that threaten ecosystems, habitats, or species.'[146] The law addresses previous legislative gaps and policy inconsistencies, streamlining efforts across member states to effectively manage invasive species.[147]

The regulation establishes comprehensive rules to prevent, minimize, and mitigate the adverse impacts on biodiversity from both intentional and unintentional introductions of invasive alien species within the EU. Ensuring compatibility with international trade laws, such as the SPS Agreement, it employs risk assessments based on standardized EU criteria. To prevent redundancies of effort, this approach is harmonized with the EU's *Protective Measures Against Plant Pests* (EU 2016/2031), which is similar to Canada's *Plant Protection Act*.[148]

A key feature of this law is the establishment of a 'black list' of invasive species of Union concern, which mandates specific prevention, early detection, rapid eradication for new infestations or management protocols for established populations. This empowers the EU to control the trade and spread of invasive plants, such as oriental bittersweet, tree-of-heaven, and Carolina fanwort, across all member states.[149]

The Case of Tree-of-Heaven

Tree-of-heaven, scientifically known as *Ailanthus altissima*, is an aggressive invasive tree known for its detrimental impact on biodiversity, infrastructure damage, public health threats, and risks to agriculture. Moreover, once established, it proves both difficult and costly to eradicate.

Like the CFIA, the European Plant Protection Organization (EPPO), categorizes pest plants using IPPC protocols. Due to its widespread occurrence in the EU, tree-of-heaven was not categorized as a 'quarantine pest' and was not regulated as a plant pest under the EU's *Protective Measures Against Plant Pests*.[150] However, it is regulated under EU 1143/2014 as an **Invasive Alien Species of Union Concern**. Backed by specified technical and scientific standards, the invasive species law allows for a comprehensive ban on the keeping, importing, selling, breeding, and growing of tree-of-heaven.[151]

In 2001, the CFIA issued a public notice advising against the planting of tree-of-heaven, [152] but stopped short of taking any action to prevent its import and sale of the species was allowed to continue. The sale of this species is currently prohibited in eight U.S. border states[153] and two provinces (Alberta and Ontario),[154] however, most other provinces and territories have no mechanism to prevent sales. Canada must adopt more robust and enforceable measures like those of the EU for **fair and effective management** of high-risk invasive plants like tree-of-heaven.

Regulatory Reform – New Zealand's Biosecurity Strategy

New Zealand is an acknowledged leader in biosecurity. *The Biosecurity Act* of 1993 establishes a legal framework enabling the Ministry for Primary Industries (MPI) and other organizations to prevent harmful organisms, including pathogens, parasites, and invasive species, from entering the country.[155] The nation has pioneered biosecurity policy developments, particularly in combating plant invasions, with a multifaceted approach:

- **National Permitted List**: A 'white list' system allows only approved plant imports.

- **Approval Process for Non-Native Plants**: This includes mandatory, importer-funded assessments for all proposed new introductions.
- **Prohibitions**: There are strict bans on the sale, distribution, or propagation of certain non-native plant species ('black list').
- **Management Strategies**: There are comprehensive processes for handling established invasive plants.

Just as CEPA required the Government of Canada in 1999 to identify substances used in commerce,[156] New Zealand mandated the creation of an exhaustive database to identify all plant species (native and non-native) through its Act. This **Plants Biosecurity Index** includes non-native plants in cultivation and those established outside of cultivation. Any **unlisted plant** proposed for import undergoes an **extensive risk assessment**, scrutinizing its potential impacts on the environment, human health, societal dynamics, Indigenous Peoples, and the market economy.[157]

A standout initiative is the **National Plant Pest Accord,** a memorandum of understanding between the Nursery and Garden Industry Association (NGIA), the Department of Conservation, regional councils, and the Ministry for Primary Industries.[158] This Accord enables the horticultural industry to participate in creating the list of **'unwanted organisms'** (blacklisted) under the *Biosecurity Act*, effectively curbing the spread of identified invasive plants via casual or nursery trade. New Zealand has prevented the sale, distribution, and propagation of more ornamental non-native species than any other nation, setting a benchmark in invasive species management.[159]

The New Zealand *Biosecurity Act* laid the groundwork for vital tools like the **Plant Biosecurity Index**, a thorough **risk analysis** process, and the **National Plant Pest Accord**. Combined, these mechanisms under the Act's framework form an effective shield against harmful organisms and serve as examples of best practices in biosecurity.

Centralized Coordination and Information Sharing – The Australia Model

Australia, much like New Zealand, has developed a multifaceted strategy for managing invasive species. The Commonwealth (federal government), states and territories play distinct yet complementary roles in the Australian system. While the Commonwealth coordinates biosecurity efforts nationally, including rigorous pre-border and post border screening processes, under the *Australia Biosecurity Act* 2015,[160] states and territories are responsible for regulating and managing established invasive plants within their jurisdictions.

To enhance and support this cooperative framework, the Commonwealth of Australia established a **National Categorisation System for Invasive Species**, serving multiple purposes:[161]

a. **Early Detection and Rapid Response**: It provides criteria for creating and **updating lists of high-risk species** for surveillance and priority resource allocation.
b. **Limiting Spread within Australia**: It provides guidelines for managing invasive plant populations and potential 'sleeper' species.

c. **Identification of Significant Species**: It establishes criteria used to identify invasive species of national importance.

d. **Management Guidance and International Compliance**: The system outlines roles and responsibilities in managing invasive species, ensuring Australia meets its international treaty obligations and contributes to global environmental and trade efforts, such as **regulations on the keeping, sale, and trade of invasive species.**

Based on a national assessment framework, a list of **Weeds of National Significance** (WoNS) was jointly agreed upon by Australian governments.[162] All six states plus two territories prohibit the sales and movement of WoNS and regulate over 1,000 additional invasive plants identified as threats in the various jurisdictions.[163]

Recognizing gaps in its system, Australia recently developed a new **National Established Weed Priorities** (NEWP) **Framework**[164] to better prioritize and address established weed issues in a strategic and nationally coordinated manner. It aims to centralize information and resources through the creation of a **Virtual Weed Information Hub**, that will provide comprehensive support for invasive plant prevention and management. These initiatives can serve as models for federal action in Canada to improve our response to the broad biosecurity threats posed by invasive ornamental plants.

CCIPR PROPOSES A UNIFIED CANADIAN APPROACH

Despite the recognition that certain invasive plants like tree-of-heaven pose significant national biosecurity threats, Canada has yet to implement a unified federal strategy that would prevent the sale of this and other high-risk invasive plants. The lack of comprehensive federal action in conjunction with inadequate regional regulations, [165] has led to large gaps in Canada's biosecurity framework.

To address this, Canada must urgently establish a cohesive national strategy for invasive plant management, drawing inspiration from effective international models. In summary, this strategy should include:

- **National Leadership and Coordination:** Emulate the success of New Zealand and Australia in synchronizing efforts across jurisdictions.
- **Enhanced Legal Framework**: Develop comprehensive invasive species legislation similar to the EU's model that could, for instance, work in harmony with the current *Plant Protection Act* to address invasive species prevention and management more fully.
- **Comprehensive Plant Database**: Create a detailed database akin to New Zealand's Plant **Biosecurity Index** to establish a list of known non-native plants.
- **Stringent Pre-Border Risk Assessments**: Implement rigorous assessment processes as seen in Australia to prevent the entry of invasive species.
- **Plants of Concern**: Establish a **National Categorisation System** for invasive plants present in Canada to identify priorities for regulation and management.

- **Industry Collaboration**: Establish **a National Accord** and framework to identify invasive plants that should be subject to national or regional prohibitions on importation, sale, propagation, and cultivation. Identify plants that pose uncertain risks that should be subject to **labelling requirements**.
- **An Information Hub**: Develop a platform for resource and information sharing to strengthen nationwide regulatory and management efforts.

Adopting this unified approach is not only vital for preserving Canada's rich biodiversity and environment but also necessary for safeguarding Canada's public health and economic interests. It's time for Canada to take decisive action.

LABELLING – CONSUMERS RIGHT TO KNOW:

Canadians have a clear right to know how their purchases impact the environment and human health. Under Health Canada's *Consumer Product Safety Act* (S.C. 2010, c. 21), products must be labeled to inform consumers about potential risks and to provide guidelines for proper handling. In a similar vein, the Departments of Environment and Health are moving towards stricter labeling requirements for products with toxic substances, aiming to minimize their environmental and health impacts.[166] These steps towards greater transparency highlight the growing importance placed on product information and the public's right to be well-informed about their purchases. Extending this approach to include **labeling for invasive plants is a crucial next step**. It ensures that Canadians are equally informed about the risks posed by these species and have guidance to help minimize or prevent potential harm.

Consumers Right to Clear and Accurate Information

Consumers have a right to be protected from misleading information or labelling. A landowner in Ontario went to a nursery looking for a native tree and came home with a 'red maple'. They were aghast to learn that the 'Royal Red Maple' they purchased was a cultivar of the invasive Norway Maple (*Acer platanoides*) and not the locally native Red Maple (*Acer rubrum*).[167] The colourful label nowhere informed the purchaser of this distinction and the potential risks this tree posed to the local woodlands. In New York State (NYS), this tree would require an additional tag to help the shopper make a more informed decision.[168]

> ***Acer platanoides* - NYS DEC [Department of Environmental Conservation] has deemed this plant an Invasive Species – Harmful to the Environment. Alternatives include Red Maple, Sugar Maple, Eastern Redbud, European Beech. To help prevent the spread of this regulated plant into natural areas:**
>
> - **Do not place this plant near wild or natural areas.**
> - **When possible, deadhead or remove seed debris.**
> - **Dispose of plant or plant debris responsibly.**
> - **Do not share seeds, seedlings, or cuttings with other gardeners.**

Another consumer was misled by a yellow flag iris (*Iris pseudacorus*) labelled "Grown Locally." They purchased the "Grown Locally" plant thinking that it meant it was native to the area and were frustrated to learn the plant was in fact invasive.

Labeling for Risk Management

A robust labeling system is essential for managing invasive plant species. If sold, high-risk plants should be clearly marked with a "Red label" to indicate danger, while plants with potential risks should carry an "Amber" label to signify caution.[169] This system should extend to all levels of the ornamental and horticultural supply chains, ensuring that consumers are fully informed at the point of sale. This is particularly important for species that are harmless in controlled environments but become invasive in the wild.

For example, consider the Carolina fanwort, an aquatic plant that is relatively harmless when kept in aquariums but highly invasive in Canadian waterways.[170] If invasive plants are offered for sale, warning labels at the point of sale can play a crucial role in educating consumers about the risks. A label for Carolina fanwort should clearly state:

> **This plant poses a threat to Canada's environment and waterways. Only use in aquariums, do not use outdoors, do not dispose of aquarium waste into ponds or watercourses. Keep this label with your plant.[171]**

Such proactive labeling helps prevent unintended introductions of invasive species into natural habitats, thereby reducing the need and costs for subsequent mitigation and restoration efforts.

Harnessing Labeling to Drive Market Change:

Canada has a history of using labeling as a powerful tool to influence consumer behaviour and promote public health and environmental sustainability. Notable examples include cigarette packaging warnings and EnerGuide labels, both of which have successfully heightened public awareness and steered consumer preferences away from potentially harmful products.[172]

Applying similar strategies to the horticultural sector, clear and informative labeling on plants could guide consumers towards environmentally friendly choices, significantly reducing the demand for invasive species. This approach would encourage the industry to innovate, promoting a shift towards offering a wider variety of non-invasive plant options. Additionally, it could inspire the emergence of new garden centers specializing exclusively in non-invasive plants, using this focus as a unique marketing angle.

Long-Term Savings and Benefits:

Implementing a labeling system for invasive plants will help to safeguard the environment and offer long-term economic benefits. An informed public will aid in reducing the spread of invasive plants, thus protecting ecosystems and conserving nature's essential services. Canadians will save on costs otherwise needed for invasive plant management and environmental restoration. Furthermore, this approach can yield savings for the horticultural industry itself, as it aligns with evolving consumer preferences for non-invasive plants and opens new market opportunities.

The upfront costs of labeling are a strategic investment that safeguards not only Canada's ecosystems but also contributes to the economic resilience of the horticultural sector and public financial health. Thus, labeling can be seen as an essential component of a broader policy

framework, preventing the spread of invasive species, protecting the public's right to know, safeguarding the environment, and steering the horticultural industry toward a more sustainable future.[173]

BUILDING RISK ASSESSMENT CAPACITY

Improving Canada's Risk Assessment Framework

To mitigate environmental damage and manage control costs effectively, Canada urgently needs to improve its approach to assessing the invasiveness of non-native plants, both pre and post border. This is not only crucial for minimizing unnecessary damages and associated costs but is also pivotal for Canada to meet its obligation to halve the rate of introductions and spread of invasive plants (Target 6 of the Global Biodiversity Framework).

Pre-Border Screening for New Introductions - Industry Responsibility

While Canada does screen some plant imports, very few plants and cultivars introduced through the horticultural trades are assessed for their potential impact on biodiversity. Screening in Canada should be expanded to include all new nursery stock, including new varieties.[174] To defray costs in New Zealand, importers are required to pay fees on a cost-recovery basis to ensure all new plants are assessed.[175]

Post-Border Assessments – Establishing a Baseline and Prioritizing High-Risk Plants

Assessing the invasiveness of non-native species present in Canada's natural lands and in Canadian gardens is a foundational step for tracking progress towards achieving Target 6. Canada must undertake a systematic process to identify and establish baseline numbers for plants in Canada. In the "Wild Species 2020 Report," 1,372 non-native plants were identified in natural habitats across Canada.[176] These must be screened for potential invasiveness. Additionally, those in cultivation in gardens and landscapes should be evaluated to determine if they pose threats to Canada's biosecurity.

Under CEPA, ECCC successfully screened over 23,000 chemicals used in Canada and provided detailed assessments of 4,300 substances identified as risks. Using a similar process, Canada should screen existing non-native plants and establish a priority list for more thorough evaluation.[177] Many plants in the horticultural trades have already been flagged by federal agencies, regional governments, conservation organizations, public gardens, and invasive species councils. Many are currently regulated by U.S. border states. For these priority species, labelling should be required until full risk assessments are prepared, and more stringent regulations applied where risk analysis indicate a high-risk.[178]

Given climate change, it is expected that certain non-native plants may become invasive and certain invasive plants may expand their range.[179] For this reason, populations of non-native plants should be monitored for change. Potential "sleeper species" should be noted and periodically re-evaluated.[180] Where there is concern about sleeper species, labelling should be required in accordance with the precautionary principle.[181]

Best Practices

Plants presenting potential major risks should undergo risk analysis using internationally recognized best practices. Minimum standards should include:

1. Species Description:
   - Scientific and common names of the species.
   - Morphological characteristics.
   - Biological traits including lifecycle and reproductive strategies.
2. Distribution and Spread:
   - Current known geographic distribution.
   - Patterns and rates of spread, both historical and current.
   - Potential for further spread based on biological traits and environmental adaptability.
3. Pathways of Introduction:
   - Potential for intentional introduction (e.g., trade, ornamental use).
   - Potential for unintentional introduction.
4. Likelihood of Invasion:
   - Environmental suitability in new areas.
   - Assessment of natural and human-assisted dispersal mechanisms.
5. Impact Assessment:
   - Effects on biodiversity, including specific impacts on native species and habitats.
   - Impacts on ecosystem functions and services.
   - Consequences for society, including effects on Indigenous cultures and practices.
   - Economic implications, considering both direct and indirect costs.
   - Analysis of species or habitats under threat.
6. Climate Change Considerations:
   - Predicted effects of future climate change on the distribution and impact of the invasive species.
7. Management and Control Options:
   - The feasibility and effectiveness of potential control measures to assess overall risk.
8. Information Sources:
   - Detailed references to scientific studies, reports, and other relevant documents.
   - Inclusion of traditional ecological knowledge where applicable.
9. Summary and Interpretation:
   - A clear and concise summary in a consistent format that is easily interpretable.
   - A categorization of the risk level based on the gathered information.
   - Key findings and recommendations for management and control.
10. Uncertainty in the assessment
    - Identification of gaps in knowledge. [182]

Effective Communication and Information Accessibility

Risk assessments provide the critical foundation for national and/or regional regulatory actions and can be used to guide other management options, including reducing overall costs to society. During the process, effective communication with stakeholders is essential. To be most effective, information gathered in the risk assessments must be easily discoverable and accessible electronically.

DEVELOPING A NATIONAL DATABASE

A Global Call to Action:

IPBES is calling on nations around the globe to develop and strengthen open information systems to facilitate the management of biological invasions and reduce the costs of management.[183]

Challenges of Information Accessibility and Associated Costs:

Timely access to essential information on invasive plants and their management is currently a major challenge, significantly impacting regulatory practices, management strategies, and associated costs. Vital data is widely dispersed across various platforms, including academic journals, obscure government documents, and reports from local and regional environmental organizations.[184]

Additionally, valuable insights in gray literature, such as internal reports, along with traditional ecological knowledge from Indigenous and local communities, often remain overlooked. This fragmented and uncoordinated state of information hampers the early identification of invasive species threats, leading to delayed responses and inadequately informed decisions. Such delays not only aggravate the ecological and economic impacts of invasive species but also drive management costs higher. Therefore, streamlining access to and integrating these disparate sources of information is essential for more effective, efficient, and cost-effective management and regulatory actions.

Towards an Invasive Plant Database and Information Hub:

The establishment of a national database should initially involve creating an inventory akin to New Zealand's Plants Biosecurity Index. This is a catalogue of all plants present in New Zealand. A Canadian information hub should offer basic data, including the correct botanical name of each invasive plant as well as all known common names. It should detail known biological traits, distribution, and potential risk rankings. By leveraging information from existing systems like Natural Resources Canada's Plant Hardiness and Canadensis, [185] and incorporating existing risk assessments from Canadian authorities, as well as North American and global databases, a robust system can be developed. Public accessibility to this data, including distribution data from web-based mapping systems like EDDMapS, iMapInvasives, and iNaturalist is imperative.[186]

The aim is to create a comprehensive central information hub, like those proposed in Australia and developed in the United States by the National Invasive Species Information Center (NISIC).

This hub would serve as a national repository for basic plant information, risk assessments, and best management practices.

To enhance the efficacy of this database, it is also important to include the distribution of native plants. Understanding where native species are located provides essential context for assessing the impact of invasive plants on native flora and local ecosystems. By integrating data on both invasive and native plant distributions, the database can offer a more complete picture of plant community dynamics. This dual focus will significantly improve our ability to identify areas at risk and tailor management practices to protect native biodiversity. Such an inclusive approach aligns with global best practices in invasive species management and biodiversity conservation efforts.

Meeting Stakeholder Needs:

A diverse range of stakeholders - from the ornamental, horticultural, aquarium, and pet trade industries to NGOs, government agencies, as well as consumers and gardeners - require reliable information for decision-making. Industry professionals need this data to adapt production, sales, and landscaping designs. Land managers can use it to prioritize actions and stay vigilant against potential threats. In 2017, the Federal-Provincial-Territorial Invasive Alien Species Task Force urged the Federal Government to enhance its capacity for information and data sharing. Establishing a national database is not only a key national priority but also integral to the regulation of the plant trade.[187]

Cost Savings and Efficiency Gains:

The development of a national invasive plant database represents not just a strategic environmental initiative but also a significant economic opportunity. By consolidating information into a single, accessible hub, governments can significantly reduce redundant efforts across various departments and agencies. This integration leads to more coordinated and effective management strategies, directly translating into cost savings for both the government and therefore the taxpayers.

Furthermore, by providing timely and accurate information, the database would enable quicker response times to invasive species threats and prevent the escalation of management costs that typically arise from delayed action. In essence, this centralized system offers a proactive approach to invasive species management, minimizing long-term financial burdens and maximizing the efficacy of resources allocated to environmental protection. In this way, the national database not only serves ecological goals but also supports fiscal responsibility and efficient use of public funds, aligning environmental stewardship with economic prudence.

EDUCATION AND VOLUNTARY ACTION

Canada's strategy to prevent the spread of invasive plants leans heavily on educational programs and the voluntary efforts of individuals, community groups, and NGOs.[188] National campaigns like *Plant Wise*, *Grow Me Instead, Play Clean Go*, *Don't Let it Loose* and *Clean Drain Dry* ask the public to take action to curb the sale, movement, and uncontrolled spread of

invasive species. Despite increasing public awareness,[189] these efforts face significant limitations, notably an "Intention-Action Gap." [190] Research shows that a desire to protect the environment and awareness that invasive plants cause harm does not necessarily translate into action. While education and voluntary action are vital components of an invasive plant strategy, their limitations underscore the need for a more coordinated, strategic regulatory-backed approach. The ongoing sales of high-risk invasive plants confuses consumers and undermines efforts to educate the public.

Figure 7: Invasive Species Educational Campaigns.

Lists Without Regulatory Backing Fail to Significantly Change Behaviour:

Many government agencies like Parks Canada and the Department of Fisheries and Oceans and organizations like the Canadian Council on Invasive Species (CCIS) have prepared lists of invasive plants in the horticultural trades. For instance, CCIS has posted a list of “Canada's unwanted invasive plants.”[191] Despite this, invasive plants like Norway maple, scotch broom, common water hyacinth, and yellow flag iris continue to be sold through nurseries across Canada.

Do sharing these lists with the public make a difference? Studies show that lists and recommendations for alternative plants do change some behaviour, but they are not sufficient to significantly reduce plant sales.[192]

- ***Why is this sold?*** On the Master Gardeners of Ontario (MGOI) Facebook forum lists like “Canada's unwanted invasive plants” are regularly posted and discussed. [193] Members often ask, “why are they sold?” While some state they will voluntarily choose

alternatives; others equivocate believing if **government regulatory authorities** allow the sale of the plants, they must consider them "safe" to plant.

- ***What are you going to do about it***? In 2020, MGOI forum members started calling for action to either make it illegal to sell invasive plants or to label invasive plants with warnings like those on cigarette packages. Members asked Master Gardeners to address the problem and the Canadian Coalition for Invasive Plant Regulation (CCIPR) was born.[194]
- ***It is okay to sell.*** Once CCIPR was formed in 2022, CCIPR supporters began to reach out to nurseries to ask them to stop selling invasive plants. When advised they were selling one of Canada's most unwanted invasive plants, yellow floating heart, one nursery responded that it was **not prohibited**, so they would continue to sell it to customers.[195] The nursery subsequently removed the plant from sale in Ontario, but only when they were informed it was restricted under Ontario's *Invasive Species Act*.
- ***A newcomer's frustration:*** Despite her intentions to cultivate a healthy backyard, one newcomer to Canada encountered the harsh reality of a yard filled with invasive species. Her journey to eradicate those plants was costly and time-consuming.[196] When seeking replacements, she was frustrated to discover that nurseries were selling many of the same invasive plants she had just been advised to remove, and there were no labels to warn her which plants could also do harm. Her experience led her to submit a petition to parliament asking **to ban the sales of known invasive plant species in retail outlets in Canada**.[197] While the petition did not move forward, her story highlights the significant shortcomings of our current system and the significant difficulties faced by immigrants to Canada who have little experience with Canada's natural heritage and have even less ability to determine what plants are ecologically appropriate.

Regulating plants through prohibitions and labelling is needed to clarify which plants do harm, reduce confusion in the marketplace, and reinforce the message of responsible environmental stewardship conveyed through current government-initiated programs.

Equity, Sustainability, & Consistency:

When invasive species like yellow flag iris are sold at nurseries, planted into landscapes, and escape into natural areas, management costs grow alarmingly. New York State, for instance, projected that one acre of yellow flag iris required more than 100 person-hours/year for at least five years to suppress.[198] To reduce costs of managing such infestations, volunteers are often sought to do removal for free. This raises a range of issues related to equity, sustainability, and consistency.

The current reliance on private citizens and NGOs for control of invasive species results in a patchwork of efforts that vary significantly across the country. Initiatives are often concentrated in areas where NGOs have a strong presence, leading to unequal contributions and impacts across different regions.

In addition, the operations of NGOs can be marked by significant fluctuations, as illustrated by the inactivity of the Invasive Species Council of Manitoba from 2018 to 2024 and the current financial uncertainties faced by the Ontario Invasive Plant Council.[199] These challenges

compromise the ability of organizations to engage in long-term planning and maintain invasive species prevention programs.

Furthermore, effectively combating invasive species demands expertise in ecological management, species identification, and habitat restoration. While some NGOs are well-equipped with this knowledge, others lack the resources and structured programs needed to adequately train and deploy volunteers.

The establishment of a national coordinating body stands as a critical step towards ensuring equity, sustainability, and consistency in efforts across the country. Such a body could not only help facilitate the strategic distribution of resources and expertise but also guide volunteers toward actions that offer the highest ecological returns.

By shifting the focus from reactive removal to proactive prevention, Canada can significantly reduce the reliance on volunteer efforts, thereby minimizing the economic and environmental toll of invasive species. This approach promises a more equitable and effective management strategy, safeguarding Canada's natural heritage for future generations while optimizing the use of financial and human resources.

National Voluntary Code of Conduct for the Ornamental Horticulture Industry:

In 2019, the Canadian Council on Invasive Species (CCIS), in collaboration with industry partners, launched the National Voluntary Code of Conduct for the Ornamental Horticulture Industry, endorsed by the Canadian Food Inspection Agency (CFIA). [200] The aim is to curb the trade of invasive plants and their use by professional landscapers. CCIS supports a Recognized Retailer initiative. However, no plant nurseries are currently participating.[201] The absence of a definitive list of high-risk plants[202] along with the lack of a compliance tracking mechanism and an incentivization system cast grave doubts about the ability of this voluntary code to curb the trade of invasive plants.[203]

To raise industry awareness and better promote the voluntary code of conduct, CCIS recently hosted the *Pathways to Change: Horticulture & Invasive Species National Conference*, (2023). The conference saw low attendance and minimal industry interest.[204]

To transform this well-meaning initiative into a more impactful measure would require the creation of a comprehensive database that clearly identifies high-risk species. Such a database could inform concrete legislative measures to remove invasive plants from the market and inform labelling requirements.[205] A legally binding list of invasive plants would provide clarity for the industry and create a level playing field.

New Zealand's National Plant Pest Accord (NPPA) – A Model Forward:

Transitioning to a model akin to New Zealand's NPPA could significantly improve Canada's approach. As described earlier, the NPPA is a collaborative effort between various levels of government and the nursery and garden industry, focused on preventing the sale, distribution, or propagation of specific harmful plants. "The NPPA is heralded by all parties as a model of industry working with the regulators to ensure proactive engagement and even-handed regulation."[206] Key elements of the NPPA include:

- **List Development:** Under the NPPA, scientific assessments are reviewed, and high-risk plants are identified and recommended for prohibition under the *Biosecurity Act*. This list is regularly updated to ensure it remains relevant and effective.
- **Surveillance:** Regional councils play a crucial role in monitoring the list of pest plants, integrating them into their regional pest management strategies, ensuring ongoing vigilance.
- **Inspection & Enforcement:** Regional council staff carry out surveillance and inspections of plant nurseries. Non-compliance incurs legal consequences.
- **Government Involvement:** The federal government's clear regulatory role ensures consistency and fairness across New Zealand, setting a standard for nationwide implementation.
- **Clarity and Effectiveness:** The Accord's detailed outline of responsibilities and engagement with stakeholders fosters high compliance rates. Its enforcement mechanisms, including defined penalties, deter non-compliance effectively.

Transitioning to a model like New Zealand's NPPA would provide Canada with a more effective and enforceable approach to managing invasive species in partnership with the horticultural industry. This shift would not only address the current shortcomings of the Canadian approach but also align with international best practices in invasive species management.

CONCLUSION: CHARTING A PATH FORWARD IN INVASIVE PLANT MANAGEMENT

This comprehensive analysis of invasive plant management in Canada, informed by international frameworks and national case studies, clearly underscores the urgent need for a transformative change to Canada's invasive species strategy. While Canada has made strides in recognizing and addressing the threat of certain invasive species, there remains a significant gap between current efforts and actions required to effectively safeguard biodiversity and human health. This is particularly true with respect to regulating the sale of ornamental plants.

The examples set by the European Union, New Zealand, and Australia demonstrate the effectiveness of robust regulatory frameworks, comprehensive databases, and strong national coordination of invasive species management. These models provide valuable blueprints for Canada to emulate. They emphasize the need for an integrated strategy that combines legislative action with proactive market-based approaches and public education.

A new national approach must prioritize:

- **Enhanced Federal Leadership**: Establish clear jurisdiction and streamline efforts across provinces and territories, ensuring consistency and effectiveness in tackling invasive plant threats.
- **Legislative and Policy Reform**: Introduce laws and policies that align with international obligations and effectively regulate the trade and management of invasive plants.

- **Sales Bans and Trade Regulations**: Implement stringent restrictions on the import and trade of high-risk invasive ornamental plants pre- and post-border.
- **Risk Assessment and Industry Engagement**: Involve the horticultural and pet/aquarium industries in assessment-based list development to improve engagement and responsible trade practices.
- **Public Education and Awareness**: Inform Canadians about the risks of invasive plants and the importance of choosing non-invasive alternatives through education and point of sale labelling.
- **Creation of a Comprehensive National Database**: Centralize information, facilitate access to data, and support decision-making processes.

As Canada confronts the growing challenge of invasive species, the lessons learned from global efforts must inform and inspire Canada's progress as it renews its commitment to halt and reverse biodiversity loss. By adopting a unified, comprehensive, and proactive strategy, Canada can effectively protect its diverse ecosystems, promote healthy communities, and uphold its international obligations. This is not just a policy imperative but a moral responsibility to future generations, ensuring the preservation of Canada's natural heritage and the well-being of its citizens.

ENDNOTES

[1] Government of Canada, "An Invasive Alien Species Strategy for Canada," 2004, 1.
[2] There are approximately 3,858 species of native vascular plants in Canada and over 1,400 introduced. (Canadian Food Inspection Agency [CFIA], "Invasive alien plants in Canada: technical report," 2008a, 3). Introduced species have increased by 15% over the last decade. 555 were classified as invasive in 2019 an increase from 486 reported in 2008 (Castro, et al., "An updated status of introduced and invasive plants in Canada," 2019, 106).
[3] There is some controversy over the use of terms like "alien" and "invasive." Some argue for a more neutral terminology (e.g., Colautti & MacIsaac, "A neutral terminology to define 'invasive' species," 2004; Warren, 2007; Iannone et al., "Perspectives on the `alien' versus `native' species debate: a critique of concepts, language and practice," 2020). "Invasive alien species" is used by the federal government and international bodies. We will follow that protocol but will use the more neutral term non-native in place of alien when description is required and simply use the phrase "invasive plants" or harmful plants when speaking of non-native invasive plants.
[4] Convention on Biological Diversity COP-6 Decision VI/23, "Alien species that threaten ecosystems, habitats or species," 2002.
[5] The CFIA estimated that during the past century, 0.58 new invasive plant species established per year in Canada. (CFIA, 2008a, 20). The decade later that rate had increased (Castro et al, 2019). Over that period 109 new plants were identified in natural areas, and 69 new plants were designative invasive.
[6] See for instance: Ratnayake, "Why plant species become invasive? Characters related to successful biological invasion," 2014; Pyšek et al., "Naturalization of central European plants in North America: species traits, habitats, propagule pressure, residence time," 2015; Divíšek et al., "Similarity of introduced plant species to native ones facilitates naturalization, but differences enhance invasion success," 2018; Ni et al., "Invasion success and impacts depend on different characteristics in non-native plants," 2021.
[7] Drew, Anderson, & Andow, "Conundrums of a complex vector for invasive species control: a detailed examination of the horticultural industry," 2010, 2837.
[8] See for instance Smith et al., "Global gene flow releases invasive plants from environmental constraints on genetic diversity,"2020. Other specific examples include: Kitajima et al., "Cultivar selection prior to introduction may increase invasiveness: evidence from *Ardisia crenata*, 2006; Culley & Hardiman, "The Beginning of a New Invasive Plant: A History of the Ornamental Callery Pear in the United States," 2007.
[9] Biodivcanada, "Canada Target 11. By 2020, pathways of invasive alien species introductions are identified, and risk-based intervention or management plans are in place for priority pathways and species," 2016.
[10] Under the *Convention on Biodiversity* there are two distinct but closely connected pathways - **Ornamental and Horticultural**. It can be difficult to determine if plants initially escaped from commercial cultivation (horticultural pathway: e.g., cut/decorative flowers, medicine, plants for domestic markets, etc.), or from landscapes and gardens (ornamental pathway) (Harrower et al., "Guidance for interpretation of CBD categories on introduction pathways," 2018, 13-15).
[11] Invasive plant species enter Canada through multiple routes— land, air, and sea/water. They are introduced both **unintentionally** as contaminants of imported goods or hitchhikers (e.g., on livestock, vehicles, clothing), and **intentionally** as plants for ornamental landscaping, agricultural purposes, herbal/medical purposes, erosion control, and research, etc. However, ornamental horticulture is "the most important pathway for plant invasions world-wide" (Dehnen-Schmutz, "Determining non-invasiveness in ornamental plants to build green lists," 2011, 1374). This has been confirmed by many researchers, e.g., 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, 103; Environment and Climate Change Canada, 2004, 15; Dehnen-Schmutz et al., "The horticultural trade and ornamental plant invasions in Britain," 2007, 224; Niemiera & Holle, "Invasive plant species and the ornamental horticulture industry," 2009; Bradley et al., "Global change, global trade, and the next wave of plant invasions," 2012; Pergl et al., "Troubling travellers: are ecologically

harmful alien species associated with particular introduction pathways?," 2017; van Kleunen et al., "The changing role of ornamental horticulture in alien plant invasions," 2018; Arianoutsou et al., "Alien plants of Europe: introduction pathways, gateways and time trends," 2021; McGrannachan et al, "A multiregional assessment of transnational pathways of introduction," 2021; European and Mediterranean Plant Protection Organization (EPPO), "EPPO activities on Invasive Alien Plants," 2021, Culley et al., "The potential role of public gardens as sentinels of plant invasion," 2022.

[12] Canadian Food Inspection Agency, 2008a, 10.

[13] This has been observed with plants like purple loosestrife (Welk, "Constraints in range predictions of invasive plant species due to non-equilibrium distribution patterns: Purple loosestrife (*Lythrum salicaria)* in North America," 2004) and Brazilian peppertree (Prince, "How long until a new species becomes invasive? Let's talk about the lag phase! ,"2022), and confirmed with a comprehensive review of herbarium records (Ni, "Herbarium records reveal multiple phases in the relationship between minimum residence time and invasion ranges of alien plant species," 2022).

[14] Ni, 2022.

[15] It should be noted that many introduced plants have historically posed little risk in Canada because they are not sufficiently hardy to overwinter. Over time, selection pressures and a changing climate can make plants with biological traits that have proven invasive in other climate zones a future risk in Canada (Bradley et al., "Breaking down barriers to consistent, climate-smart regulation of invasive plants: A case study of US Northeast states," 2022a; Bradley et al., "Invasive Species Policy Must Embrace a Changing Climate,"2022b).

[16] Jeschke & Heger, "Propagule pressure hypothesis," 2018.

[17] E.g., Rouget & Richardson, "Inferring Process from Pattern in Plant Invasions: A Semimechanistic Model Incorporating Propagule Pressure and Environmental Factors," 2004, Rejmanek et al., "Ecology of invasive plants: State of the art," 2005; Dehnen-Schmutz et al., 2007; 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; Pyšek et al., "Planting intensity, residence time, and species traits determine invasion success of alien woody species," 2009; Ricciardi et al., "Expanding the propagule pressure concept to understand the impact of biological invasions," 2011; Maurel et al., "Introduction bias affects relationships between the characteristics of ornamental alien plants and their naturalization success," 2016; Duncan, "Time lags and the invasion debt in plant naturalisations," 2021; Block et al., "Ecological lags govern the pace and outcome of plant community responses to 21st-century climate change," 2022.

[18] "Propagule pressure is difficult to measure directly, but indirect measures have been used successfully for different species groups. For ornamental species, these include marketing time, planting frequency in a sample of gardens, volume, market frequency, and plant and seed prices . . .. (Dehnen-Schmutz, "Determining non-invasiveness in ornamental plants to build green lists," 2011, 1376). See also Downey & Glanznig, "Understanding and managing the risk of garden escapes to Australia's native flora: which future weed candidates are already here?," 2006, Pyšek et al., "Czech alien flora and the historical pattern of its formation: What came first to Central Europe?," 2003, Sullivan et al., "People and time explain the distribution of naturalized plants in New Zealand ," 2004; Early et. al., 2016. See Appendices: The Case of Purple Loosestrife as an example.

[19] Beaury, et al. "Horticulture could facilitate invasive plant range infilling and range expansion with climate change." 2023.

[20] "There is considerable evidence that keeping propagule pressure low can drastically reduce establishment probability of potential invasive species (Stringham & Lockwood, "Managing propagule pressure to prevent invasive species establishments: propagule size, number, and risk-release curve," 2021). Whereas current policies often focus solely on the species that are already recognized as invasive and the prevention of potential further invasions from new introductions, attention to non-invasive species that are already in the country and widely used may considerably advance policies for dealing with invasive ornamental species" (Dehnen-Schmutz, 2011). "[B]e aware that we're now dealing with a backlog of potential invasive plants introduced" (Bean, "Lag times in plant invasions: here today, everywhere tomorrow," 2015).

[21] 125 of vascular plants were recorded as "Exotic" in 2010, representing 24% of vascular plants found in the Canada (Canadian Endangered Species Conservation Council, "Wild Species 2010," 2011, p. 52). This is consistent with the 1,229 alien vascular plant species in Canada reported in the earlier "Invasive Alien Plants in Canada" (Canadian Food Inspection Agency. 2008a, p. vii).
[22] Canadian Endangered Species Conservation Council, "Wild Species 2020,"2021, p. 48.
[23] Spear et al., "The Invasion Ecology of Sleeper Populations: Prevalence, Persistence, and Abrupt Shifts," 2021, p.9
[24] See for instance: Herald, "The invasion curve explained," 2022; Mack & Erneberg, "The United States naturalized flora: largely the product of deliberate introductions," 2002; Leung et al., "An ounce of prevention or a pound of cure: bioeconomic risk analysis of invasive species," 2002.
[25] IPBES, "Summary for Policymakers of the Thematic Assessment Report on Invasive Alien Species and their Control of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services," 2023.
[26] While dermatitis, allergies, and poisoning are recognized, the ability of invasive plants to serve as vectors for disease is often overlooked (Denóbile et al., "Public health implications of invasive plants: a scientometric study," 2023).
[27] An ecosystem is "a dynamic complex of plant, animal and microorganism communities and their abiotic environment interacting as a functional unit" (IPPC Secretariat, "Glossary of phytosanitary terms," 2022, 12).
[28] The impacts of invasive plants can be compounded by pollution, land use change, over-exploitation of resources, and climate change.
[29] Local extinction of native species can produce irreversible changes in the structure of communities and the composition of ecosystems. This can impact social or economic activity and may impact human health (Kendig et al., "Scanning the horizon for invasive plant threats using a data-driven approach," 2022). (Also see Bellard et al., "Looming extinctions due to invasive species: Irreversible loss of ecological strategy and evolutionary history Running title: Functional and phylogenetic extinctions due to biological invasions," 2021.)
[30] As well as causing disservices, e.g., Shackleton et al., "Unpacking pandora's box: understanding and categorising ecosystem disservices for environmental management and human wellbeing," 2016; Diaz et al., "Assessing nature's contributions to people," 2018; Wu et al., "Classifying ecosystem disservices and comparing their effects with ecosystem services in Beijing, China," 2020.
[31] Most of Canada's national wildlife areas list invasive plants as a top risk (Environment and Climate Change Canada (ECCC), "Ecological integrity of national parks," 2022; Parks Canada, "Non-native plants: rooting out the invaders," 2022)
[32] Page et al., "The Biology of Invasive Alien Plants in Canada. 4. *Heracleum mantegazzianum.* Sommier & Levier," 2006.
[33] Canadian Food Inspection Agency, "Technical reference R-004: Japanese barberry identification manual," 2013.
[34] E.g., Linske, "Lyme disease ecology: effects of habitat and hosts on the density and distribution of Borrelia burgdorferi-infected Ixodes scapularis," 2017; Ward et al., "Comparing effectiveness and Impacts of Japanese barberry (*Berberis thunbergii*) control treatments and herbivory on plant communities," 2013; 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.; MN Dept. Ag. "Japanese barberry," 2022a.
[35] See Appendices: The Case of Barberry (*Berberis* spp.).
[36] Lindgren et al., "The Biology of Invasive Alien Plants in Canada. 11. *Tamarix ramosissima* Ledeb., *T. chinensis* Lour. and hybrids," 2008; U.S.D.A. National Invasive Species Information Center, Saltcedar, n.d..
[37] Warne, "Multiflora Rose (*Rosa multiflora*) Best Management Practices in Ontario," 2018.
[38] Invasive Species Centre, "Bohemian Knotweed (*Reynoutria x bohemica*)," 2023.
[39] Tassie & Sherman, "Invasive Honeysuckles (*Lonicera* spp.)." 2014, Ontario Invasive Plant Council.
[40] Gardner et al., "Asymmetric effects of native and exotic invasive shrubs on ecology of the West Nile virus vector *Culex pipiens* (Diptera: *Culicidae*)," 2015.
[41] Wilson et al., "The Biology of Invasive Alien Plants in Canada. 7. *Cabomba caroliniana* A. Gray," 2007.

[42] E.g., Roussy, "The sexual and vegetative propagation of sugar maple and its threat from Norway maple," 2014; Sloan, "The ecological effects of Norway Maple (*Acer platanoides)* on local plant diversity,"2010; related read: Cuerrier et al., "Cultural keystone places," 2015.
[43] Biodiversity loss represents a direct threat to Canada's well-being (IPBES, "UN Report: Nature's Dangerous Decline 'Unprecedented'; Species Extinction Rates 'Accelerating'," 2019a.
[44] Regional-scale loss and degradation of species and their habitats has been largely ignored as have meeting Aichi targets aimed at reducing invasive species (Ray et al., "The biodiversity crisis in Canada: failures and challenges of federal and sub-national strategic and legal frameworks," 2021).
[45] See for instance Smith et al., "Global gene flow releases invasive plants from environmental constraints on genetic diversity,"2020. Other specific examples include: Kitajima et al., "Cultivar selection prior to introduction may increase invasiveness: evidence from *Ardisia crenata*, 2006; Culley & Hardiman, "The Beginning of a New Invasive Plant: A History of the Ornamental Callery Pear in the United States," 2007.
[46] Cuthbert, "Advances in economic cost assessments of biological invasions," 2023.
[47] Haubrock, "Using the InvaCost project to infer implications of monetary impacts of invasive alien species in Canada," 2022. (In Session 1-B: "Risks, impacts, and innovative solutions." Haubrock begins at the 23min. mark).
[48] CFIA, 2008a, vii.
[49] Diagne et al., "High and rising economic costs of biological invasions worldwide," 2021.
[50] Haubrock, 2022.
[51] Crystal-Ornelas et al., "Economic costs of biological invasions within North America," 2021.
[52] Non-governmental stakeholders include national organizations (e.g., Invasive Species Centre, Canadian Council on Invasive Species, Nature Conservancy, Ducks Unlimited etc.), regional groups (e.g., Coastal Invasive Species Committee, South East Alberta Watershed Alliance (SEAWA), Nature Trust of New Brunswick etc.), small community initiates like University of Waterloo Ecology Lab Buckthorn Pull, and private landowners.
[53] "The estimated total expenditure accounts only for expenditures by municipalities and does not include expenditures on invasive species by provincial governments, territorial governments, or the federal government." According to the surveys, the top five priority invasive species included Japanese knotweed (24.7%), giant hogweed (18.6%), milfoil (12.1%), buckthorn (6.5 %), common tansy (4.8%), and English ivy (3%) (Vyn, "Estimated annual expenditures on invasive species by Canadian municipalities: 2021 national survey results," 2022. P.8).
[54] For instance, to address milfoil problem in lakes, local groups have had to fundraise to pay for control programs, like the Drag and Spruce Lakes Property Owners Association in Haliburton Ontario, (DSLPOA, "Info updates - April 27/23," 2022), or the Lac Bernard Property Owners Association working with La Pêche municipality in Québec (L'agence de bassin versant des 7 [ABV des 7],"Delimitation of Eurasian watermilfoil beds at Lake Bernard, MRC des Collines-de-l'Outaouais," 2021).
[55] Efforts are hampered by lack of reporting, lack of standardised measurement, and a difficulty in placing a value on goods or services not traded in the marketplace, (e.g., Cuthbert et al., "Biological invasion costs reveal insufficient proactive management worldwide," 2022; Crystal-Ornelas et al., "Economic costs of biological invasions within North America.," 2021; Braat & Brink (Eds.), "The Cost of Policy Inaction," 2008).
[56] CFIA, 2008a.
[57] Denóbile, et al., "Public health implications of invasive plants: A scientometric Study," 2023.
[58] E.g., Australia Biological Diversity Advisory Committee, Land & Water Australia, "Making economic valuation work for biodiversity conservation," 2005; Pimental, et al., "Update on the environmental and economic costs associated with alien-invasive species in the United States," 2005; Coulatti et al., "Characterised and projected costs of nonindigenous Species in Canada," 2006; Diagne et al., "High and rising economic costs of biological invasions worldwide," 2021; Haubrock, 2022; Turbelin et al., "Introduction pathways of economically costly invasive alien species," 2022; Zenni et al., "The EPPO prioritization process for invasive alien plants," 2021.
[59] CBD COP-15, "Kunming-Montréal Global Biodiversity framework: Draft decision submitted by the President. Conference of the Parties to the CBD," (2022).

[60] EPPO-PRI (Brunel et al., "The EPPO prioritization process for invasive alien plants," 2010), GB-NNRA (Mumford et al., "Invasive species risk assessment in Great Britain," 2010). These include questions about diverse impact types: environment, biodiversity, native species interactions, hybridization, economic losses, and human health. There are a number of well-reviewed assessment protocols: EICAT (Hawkins et al., "Framework and guidelines for implementing the proposed IUCN environmental impact classification for alien taxa (EICAT)," 2015), GISS (Nentwig et al., "A generic impact-scoring system applied to alien mammals in Europe," 2016) GABLIS (Essl et al., "Review of risk assessment systems of IAS in Europe and introducing the German–Austrian Black List Information System (GABLIS)," 2011), HARMONIA (D'hondt et al., "Harmonia+ and Pandora+: risk screening tools for potentially invasive plants, animals and their pathogens," 2015), EPPO-EIA (Kenis et al. "New protocols to assess the environmental impact of pests in the EPPO decision-support scheme for pest risk analysis*," 2012), ISEIA (Branquart et al. "ISEIA, a Belgian non-native species assessment protocol ," 2009). CEPA provides the framework for the identification, prioritization and assessment of existing substances that could be adapted for invasive plants (ECCC, "Assessment of substances under the *Canadian Environmental Protection Act*, 1999," 2022).
[61] Anderson et al., "Values assessment chapter 2: Conceptualizing the diverse values of nature and their contributions to people Intergovernmental," In: Methodological Assessment Report on the Diverse Values and Valuation of Nature of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), 2022b.
[62] The International Union for the Conservation of Nature (IUCN) is the world's oldest and largest conservation organization. Canadian Wildlife Service, Environment Canada, Fisheries and Oceans Canada are participating members (IUCN, "A unique and powerful Union," 2021). "The Environmental Impact Classification for Alien Taxa (EICAT) is the IUCN global standard for measuring the severity of environmental impacts caused by animals, fungi and plants living outside their natural range" (IUNC, "Environmental Impact Classification for Alien Taxa," 2023). The merits of this protocol are discussed by Vila et al., "A review of impact assessment protocols of non-native plants," 2019; EC Directorate-General for Environment, "Study on Invasive Alien Species – Development of risk assessments to tackle priority species and enhance prevention," 2020; and in Bernardo-Madrid et al.," Consistency in impact assessments of invasive species is generally high and depends on protocols and impact types," 2022.
[63] The Socio-Economic Impact Classification for Alien Taxa (SEICAT) framework has been developed to support the decision making process under the new EU Regulation (1143/2014) on invasive alien species (Roy et al. "Developing a framework of minimum standards for the risk assessment of alien species," 2017; Bacher et al. "Socio-economic impact classification of alien taxa (SEICAT) ," 2018).
[64] Leung et al. "An Ounce of Prevention Or a Pound of Cure: Bioeconomic Risk Analysis of Invasive Species," 2002; Rouget & Richardson, 2004; Burt et al., "Preventing horticultural introductions of invasive plants: Potential efficacy of voluntary initiatives," 2007; Beaury, Patrick & Bradley," Invaders for sale: the ongoing spread of invasive species by the plant trade industry," 2021; Bradley et al., "Breaking down barriers to consistent, climate-smart regulation of invasive plants: A case study of US Northeast states,"2022b.
[65] Cuthbert, "Biological invasion costs reveal insufficient proactive management worldwide," 2022; Cuthbert, 2023.
[66] Gov. of Canada, 2004, 18.
[67] Gov. of Canada, 2004, p.39.
[68] Gantz, Mandrak, & Keller, "Application of an Aquatic Plant Risk Assessment to Non-Indigenous Freshwater Plants in Trade in Canada," 2013.
[69] Natural Resources Canada (NRC), "Responding to invasive and alien forest pests," 2023.
[70] Parks Canada, "Non-native plants: rooting out the invaders," 2023; Parks Canada, "Care for the land: Parks Canada works to control invasive alien species," 2023.
[71] Office of the Auditor General of Canada, "Report 1—Aquatic Invasive Species," 2019, 1.42.
[72] Gov. of Canada, "Mandates and Roles of Canadian Federal Food Safety Partners," 2020. The *CFIA Act* (S.C. 1997) states the departments of Agriculture and Agri-Food, Fisheries and Oceans and Health are responsible for the costs of the agency and the Ministers of Health and Agriculture have administrative responsibilities. There is a

disconnect with the Environment and Climate Change Canada and environmental biosecurity has been a low priority.

[73] Government of Canada, Lindgren, & Gauthier, "Canadian Invasive Plant Framework: A Collaborative Approach to Addressing Plants in Canada," 2011.

[74] Conversations with the CFIA Plant Health Directorate and mentioned in Champion, Hofstra, & Clayton, "Border control for potential aquatic weeds. Stage 3. Weed risk management," 2007. See Appendices: Case of Aquatic Plants, Case of Milfoils, Case of European Water-chestnut.

[75] Office of the Auditor General of Canada, "Report 1—Aquatic Invasive Species," 2019, 1.42.

[76] FPT IAS, "Recommendations of the Invasive Alien Species Task Force," 2017.

[77] ECCC, Personal Communication, April 2023.

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

[79] The phrase "alien species" appears in Article 8(h) in the original text of the Convention on Biological Diversity of 5 June 1992 (1760 U.N.T.S. 69), but not the term "invasive." The Convention of the Parties (COP) subsequently defined invasive alien species, adopted guiding principles and decisions to address the threat posed by invasive alien species (COP 6 Decision VI/23. "Alien species that threaten ecosystems, habitats or species;" 2020). Most recently Decision 15/4 - Kunming-Montreal Framework (referred to as the Global Biodiversity Framework), and Decision 15/27 - Invasive Alien Species (specifically addressing ecommerce) were adopted during COP 15 (2022).

[80] Gov. of Canada – ECCC, "Canada's 2030 National Biodiversity Strategy," 2023; Gov. of Canada - Biodiversity Canada, "Toward a 2030 Biodiversity Strategy for Canada: Halting and reversing nature loss," 2023.

[81] Food and Agriculture Organisation (FAO) - IPPC, "Overview," n.d.

[82] WTO "Understanding the WTO *Agreement on Sanitary and Phytosanitary Measures*," 1998; ISPMs are non-binding guidelines for measures signatories to the convention can take to limit the risks of pest introduction. With the introduction of the binding *SPS Agreement*, Canada elected to use ISPMs as the international standard (FAO-IPPC, "Adopted Standards (ISPMs)," 2022; IPPC, "IPPC and International Trade," n.d.); WTO, "Sanitary and Phytosanitary Measures: text of the agreement," 1995.

[83] The IPPC recognized the need to develop risk analysis processes for weeds and invasive plants in 1999 but standards did not emerge until 2001. Even then, how to assess impacts on the environment was unclear. "In principle, risk analysis for the environmental hazards of plant pests can include weeds if the interpretation of the term 'environment' is extended to include agricultural systems, but because weeds are so important to agricultural ecosystems, two standards may be considered." (Interim Commission on Phytosanitary Measures (ICPM), "Standard setting priorities," 2001). The ISPMs use the term plants as pests to include both weeds and invasive plants. "'Invasive plants' are often taken to mean invasive alien species in the CBD sense (see ISPM 5-31, Appendix 1). The term "weed" usually refers to pests of cultivated plants. However, some countries use the term "weed" irrespective of whether cultivated plants or wild flora are at risk, and other countries use the term "noxious weed", "landscape weed", "environmental weed" or similar terms to distinguish them from plants only affecting crops." (IPPC ISMP-11 "Pest risk analysis for quarantine pests," 2017).

[84] The *SPS Agreement* (WTO, 1998; 2010; 2022).

[85] The Pest Risk Assessment conducted by Japan failed to evaluate the likelihood of entry, establishment, and or spread of fire blight through apple fruit (Clavin & Krissoff, "Resolution of the U.S.-Japan Apple Dispute New Opportunities for Trade," 2005).

[86] Guidelines for Pest Risk Assessments are provided in the FAO-IPPC, "Adopted Standards (ISPMs)," 2023.

[87] "Existing law often "focuses on the front lines but pays little attention to the enemy that has arrived and is spreading within" (Miller, 1999). Constraints are . . . linked to institutional fragmentation, narrow mandates and lack of a strategic framework for prioritized remedial action," (Secretariat of the Convention on Biological Diversity, "CBD Technical Series No. 2: Review of the efficiency and efficacy of existing legal instruments applicable to Invasive Alien Species," 2001).

[88] These plants were prohibited under the *Plant Quarantine Act* in the 1970s and this was continued under the *Plant Protection Act*, which subsumed the earlier Act in 1990. The CFIA performed a Pest Risk Assessment (PRA) for

Trapa natans in 2001 and concluded: "The overall risk associated with water-chestnut is calculated to be "HIGH", which indicates that specific phytosanitary measures are strongly recommended. As a result of this assessment, it is recommended that water-chestnut remain on the list of aquatic weeds that are currently prohibited from Canada. Cited in the PRA were the following existing directives, letters, and circulars: D-94-27 - The Plant Protection Import Requirements for True Aquatic Plants (Sept 8, 1994); Directive 04-0 - the entry of aquatic plants into Canada (Operational Directive 16-6-86); D-84-29 - Rooted Aquatic Plants Associated with Plant Debris or Contaminated with Soil or Soil-Like Materials (Aug 16, 1984); D-83-2 - Revision of Quarantine Directive and Memorandum for Plant Commodities Controlled under the Plant Quarantine Act (Jan 10, 1983); Permit Letter 10 Notice to Importers of Aquatic Plants (01/10/81); and Circular No. 18C - Plant Quarantine Circular No. 18C (Feb. 22, 1978) (Wilson, Claire, "Weed risk assessment European water-chestnut *Trapa natans*," 2001).

[89] Champion et al., "Border control for potential aquatic weeds," 2007, 36.

[90] *Seeds Act* (R.S.C., 1985, c. S-8); See Appendices: *Seeds Act* for more complete description.

[91] *Plant Protection Act* (S.C. 1990, c. 22) – "An Act is to protect plant life and the agricultural and forestry sectors of the Canadian economy by preventing the importation, exportation and spread of pests and by controlling or eradicating pests in Canada."

[92] The first federal legislation pertaining to pests in Canada was the *San Jose Scale Act* of 1898. By 1906, laws had been passed by the Dominion calling for the destruction of agricultural weeds and the elimination of weed seeds from crop seeds via the *Seed Control Act* 1904-5 (Clark & Fletcher, Farm Weeds of Canada," 1906; Stewart, "The archival concept of competence: a case study of the federal administration of agriculture in Canada, 1867-1989," 1994). As more pests were recognized the *San Jose Scale Act* was quickly subsumed by the *Destructive Insect and Pest Act* of 1910 and then by the *Plant Quarantine Act* in the 1970s. These were administered by the Dept. of Agriculture (Anstey, "One hundred harvests: Research Branch, Agriculture Canada, 1886-1986," 1986). In the 1990s the *Plant Protection Act* came into force and the authority for administration was moved from the Dept. of Agriculture to the CFIA in 1997, when the *Canadian Food Inspection Agency Act* (S.C. 1997, c. 6). The *CFIA Act* established a new agency reporting to both the Ministries of Agriculture and Health. This agency fulfilled the role of a National Plant Protection Organization under the IPPC and was given responsibility for the implementation of technical requirements for the international movement of product.

[93] The *Seed Control Act* in 1905 (S.C. 1905, c. 4. s. 3) prohibited persons from selling seed unless it was free from certain weed seeds and ergot (Lewis, G., "Protecting Canada's natural ecosystems from invasive alien plant species: Is sub-national weed control legislation up to the task?" 2006).

[94] The term "weed" has no legal definition in the *Seeds Act* (R.S.C., 1985, c. S-8) or the associated Weed Seeds Order, 2016 (SOR/2016-93). Historically, the term weeds was used by farmers to refer to "any injurious, troublesome, or unsightly plant that is at the same time useless or comparatively so" (Clark & Fletcher, J., "Farm Weeds of Canada," 1906). "In spite of the lack of a scientific definition for the word 'weed', experts have been able to agree on what plant species should be designated as such in regard to agro-ecosystems. This has been reflected in the ever-evolving list of plants labelled "weeds" under the federal *Weed Seed Order* and provincial weed control legislation (Lewis, G., "Protecting Canada's natural ecosystems from invasive alien plant species: Is sub-national weed control legislation up to the task?" 2006).

[95] There is no legal definition of weed. These are simply plants growing where they are unwanted. Weed Seeds Order, 2016 (SOR/2016-93); CFIA, "Questions and Answers: Weed Seeds Order, 2016" 2017.

[96] The annual average cost per plant introduced as 'contaminants' is higher compared to other pathways plants (Turbelin et al., 2022).

[97] Turbelin et al., 2022.

[98] Plants like ox-eye daisy and baby's breath are commonly sold in wildflower seeds. Ox-eye daisy is a secondary noxious weed and should not be sold. Baby's breath has not been included in the Weed Seeds Order, 2016 (SOR/2016-93).

[99] "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," 2013).

[100] "In monitoring conducted between 2001 and 2007, one sample in 2001 was found to contain *L. salicaria*" (CFIA, "Weed Seeds Order Review - Proposal for Change," 2013). See Appendices: The Case of Purple Loosestrife.
[101] By contrast the U.S. *Plant Protection Act* has a broader scope and applies to the protection of the agriculture, environment, and economy of the United States (Pest Risk Analysis and Invasive Species Panels of the North American Plant Protection Organization, "DD 02: DD 03: The Role of the NAPPO in Addressing Invasive Alien Species," 2011).
[102] A cultivar is a contraction of "cultivated variety." It refers to selected variety of plant with distinct characteristics that are retained from generation to generation when propagated by appropriate means. In horticulture, it is officially defined as "an assemblage of plants that (a) has been selected for a particular character or combination of characters, (b) is distinct, uniform and stable in those characters, and (c) when propagated by appropriate means, retains those characters. Brickell et al., "International Code of Nomenclature for Cultivated Plants," 2016.
[103] Cultivars are varieties of plants that have been produced in cultivation by selective breeding. Japanese barberry (*Berberis japonica*) cultivars sold in Canada include: '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®) (See: CFIA, "Technical reference R-004: Japanese Barberry Identification Manual," 2013a; CFIA, "Plant Protection Regulations (SOR/95-212) Prohibited Movement Within Canada," 2022d).
[104] CFIA, "Notice to industry: Recommendation to prevent movement of 'Concorde', 'Royal Cloak' and 'Tara' Emerald Carousel barberry cultivars, into Alberta, Saskatchewan and Manitoba," 2022a; CFIA, "Technical reference R-004: Japanese Barberry Identification Manual," 2013a; CFIA, "Plant Protection Regulations," 2024.
[105] 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*)," 2022.
[106] See Appendices: Case of Japanese barberry.
[107] Regarding a request for an impact study on giant hogweed, a CFIA representative responded "I've inquired with a few colleagues, and we don't think we would be able to pursue a socioeconomic study, given the nature of giant hogweed and the human health risk component. The CFIA's plant health mandate focuses on impacts to plants and plant health rather than (non-food) human health. There is also the issue of the species already being well established in Canada, whereas our invasive plants program focuses on new and emerging species."
[108] The CFIA conducts weed risk analyses in accordance with international guidelines for pest risk analysis. The three stages: initiation, pest risk assessment and pest risk management are described in ISPM-11 (FAO-IPPC, "Pest risk analysis for quarantine pests,"2021).
[109] Some "Pest Risk Management Documents" can be found here: CFIA 2019. However others, like RMD-10-11 for *Pueraria montana* (kudzu) must be requested, (though it is available from Richters, 2010).
[110] While all invasive alien plants are weeds, not all weeds are invasive alien plants. Historically a weed is "any injurious, troublesome, or unsightly plant that is at the same time useless or comparatively so" (Clark & Fletcher, Farm Weeds of Canada," 1906). The term "weed" is not defined by the CFIA or in IPPC guidelines but ISPM 11 states that both weeds and invasive plants can be considered 'plants as pests' (FAO-IPPC, "Pest risk analysis for quarantine pests," 2017, ISPM 11-32).
[111] QUARANTINE PEST: 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** [FAO, 1990; revised FAO, 1995; IPPC 1997] (ISPM-5, "Glossary of phytosanitary terms," 2023c).
[112] ISPM-5, 2023c.
[113] CFIA, "Weed risk analysis documents," 2021b.
[114] CFIA, "Weed risk analysis documents," 2023.
[115] Plants come to the attention of the CFIA via "requests for import, networking with partners, science scanning, or as a result of new incursions or interceptions CFIA (Weed risk analysis documents," 2023).
[116] Of the 21 plants regulated as invasive plants under the PPA, only three have significant ornamental interest. Most regulated plants primarily impact agriculture. Plants regulated under the *Plant Protection Act* are published

in a Guidance Document Repository along with all pests (insects, molluscs, viruses etc.). As of Dec. 2023, there were 28 regulated taxa listed in the Weed Risk Analysis Documents. Only 26 Risk Management Documents (RMDs) have been prepared (CFIA, "Weed risk management documents," 2021b). Most species are regulated under directive *D-12-01*. Another group of plants, which are host to rust diseases, are regulated under directive, *D-01-04.* A complete list of species regulated under the *Plant Protection Act* is presented in a database, 2022. There is an older *Consolidated list of Federally Regulated Plants* available (2016), which includes Noxious Weeds (including non-regulated quarantine pests). Of the regulated species, 70% impact agriculture like the three parasitic dodders (*Cuscuta* spp.). Two were introduced as ornamentals, common reed (*Arundo donax),* and kudzu (*Pueraria montana*). Compare the few plants regulated under the PPA with 63 prohibited terrestrial horticultural plants in the state of Maine and 11 prohibited aquatic plants (Maine Dept. of Agriculture, Conservation & Forestry, "invasive Plants," 2021).

[117] 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.

[118] Prior to the risk assessment, Coulauti and colleagues reported the provinces of Alberta, Saskatchewan, and Ontario were expending cumulatively about CDN$210,000 per annum for the eradication and control of purple loosestrife ("Characterised and projected costs of nonindigenous species in Canada, 2006). Loosestrife currently a prohibited plant in Alberta (AB Provincially Regulated Weeds, 2023) and Prince Edward Island (PEI *Weed Control Act Purple Loosestrife Control Regulations*, 2004). It is a Noxious Weed in British Columbia (BC Reg. 143/2011). It is regulated as an aquatic invasive plant in Manitoba (MB Water Protection Act C.C.S.M. c. W65). Control efforts are in place in Ontario (e.g., Louis, Stastny & Sargent, "The impacts of biological control on the performance of *Lythrum salicaria* 20 years post-release," 2020). Control projects in Alberta, Saskatchewan and Ontario cost $210,000 (Colautti et al., "Characterised and Projected Costs of Nonindigenous Species in Canada," 2006). In the U.S., loosestrife "has been spreading at a rate of 115,000 ha/year and is changing the basic structure of most of the wetlands it has invaded . . .. Competitive stands of purple loosestrife have reduced the biomass of 44 native plants and endangered wildlife, like the bog turtle and several duck species, that depend on these native plants" (Pimental, Zuniga, & Morrison, "Update on the environmental and economic costs associated with alien-invasive species in the United States," 2004, 275). From Plant Health Risk Assessor – Botany, the CFIA email communication, Jan 11, 2023. "We have not done a formal pest risk analysis on purple loosestrife. The reason for this is that it would not have qualified as a quarantine pest since this plant is already well established and widely distributed in Canada. For the same reason, this plant cannot be prohibited under the *Plant Protection Act*."

[119] "When a quarantine pest is considered not widely distributed, this means that the pest is limited to parts of its potential distribution and there are areas free from the pest that are at risk of economic loss from its introduction or spread," (FAO-IPPC, "ISPM-5 Glossary of phytosanitary terms," 2023c, 25).

[120] "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*" (ISPM 5, 2023c, 27).

[121] "Official control includes: -eradication and/or containment in the infested area(s); surveillance in the endangered area(s); restrictions related to the movement into and within the regulated area(s) including phytosanitary measures applied at import," (ISPM 5, 2023c, 25).

[122] Recently, the CFIA classified purple loosestrife as a Primary Noxious Weed, which means they have determined it has not reached its potential ecological range (CFIA, "3.0 Weed Seeds Order Definitions," 2013b; CFIA, "6.0 Proposed Species Placement and Rationales," 2013f; Lindgren & Walker, "Predicting the Spread of Purple Loosestrife (*Lythrum salicaria*) in the Prairies,"2012).

[123] Azan, "Invasive Aquatic Plants in the Aquarium and Ornamental Pond Industries," 2011.

[124] CFIA, 2023.

[125] This assessment was requested by the DFO (CFIA Plant Health Risk Assessment Unit, "WEED RISK ASSESSMENT PHD REQUEST: *Nymphoides peltata* (S. G. Gmel.) Kuntze (yellow floating heart) PRA #2006-33", July 2008 - Available upon request).
[126] "The overall risk associated with yellow floating heart is calculated to be "HIGH", . . . it is recommended that the importation and sale of yellow floating heart in Canada be prohibited." (CFIA Plant Health Risk Assessment Unit, "Weed Risk Assessment: *Nymphoides peltata* (S. G. Gmel.) Kuntze (yellow floating heart) PRA #2006-33," 2008 available upon request). Floating heart is now regulated in AB, MB, ON, and SK but remains for sale in other regions (See "Aquatic Invasive Species – Flowing through a Gap" below – p. 63).
[127] Office of the Auditor General, "Report 1—Aquatic Invasive Species," 2019.
[128] Azan, "Invasive aquatic plants and the aquarium and ornamental pond industries," 2011, p.145-147.
[129] Lewis, "Protecting Canada's natural ecosystems from invasive alien plant species: Is sub-national weed control legislation up to the task?", 2006; Environment Canada, 2004.; McClay, "Revising Alberta's Provincial Weeds List: Experiences and Lessons Learned," 2012; Bergunder et al., "Invasive Species Strategy FOR BRITISH COLUMBIA," 2017; Reid et al., "The state of Canada's biosecurity efforts to protect biodiversity from species invasions," 2021; Council of Canadian Academies & Bennet, "Cultivating Diversity: The Expert Panel on Plant Health Risks in Canada," 2022.
[130] Unique in its approach, Nunavut's *Wildlife Act* prohibits introducing any species into an environment where it does not naturally occur or has never existed naturally, aiming to prevent the misuse of invasive plants in landscaping (*Wildlife Act, SNu 2003, c 26*).
[131] Alberta *Weed Control Act* (SA 2008, c.W-5.1); British Columbia *Weed Control Act*, (RSBC 1996, c 487); Manitoba *The Noxious Weeds Act* (CCSM c N110); Ontario *Weed Control Act* (RSO 1990, c W.5), Saskatchewan *The Weed Control Act* (SS 2010, c W-11.1), Prince Edward Island *Weed Control Act* (RSPEI 1988, c W-2.1) & Purple Loosestrife Control Regulations (PEI Reg EC629/91).
[132] Ontario *Invasive Species Act* (2015, SO 2015, c 22).
[133] *Fisheries (Alberta) Act* (RSA 2000, c F-16); Manitoba *The Water Protection Act* (CCSM c W65).
[134] Lewis, 2006; Newfoundland and Labrador Wildlife Division, "Legislative review - invasive alien species," 2008; Pion, "Des plantes envahissantes toujours en vente libre," 2022.
[135] From the Auditor General's Report: "Conservation officers are insufficiently trained on invasive species and perform related enforcement activities infrequently and inconsistently. As of March 31, 2022, zero charges and only 11 warnings had been issued under the Invasive Species Act, 2015" (Office of the Auditor General of Ontario, "Value-for-Money Audit: Management of Invasive Species," 2022, p.4). See more in Appendices: Legislation in Provinces and Territories.
[136] Download spreadsheet from CCIPR Canadian Invasive Plant Lists page, 2023.
[137] Office of the Auditor General of Ontario, "Value-for-Money Audit: Management of Invasive Species," 2022.
[138] Target 6 of the historic Kunming-Montréal Global Biodiversity (agreed at the 15th meeting of the Conference of Parties to the UN Convention on Biological Diversity (SCBD, "A New Global Framework for Managing Nature Through 2030," 2022; Target 6, CBD COP-15, 2022).
[139] In 2015, Canada set Target 11 "By 2020, pathways of invasive alien species introductions are identified, and risk-based intervention or management plans are in place for priority pathways and species," (Gov. of Canada, "Biodiversity Goals and Targets for Canada," 2015). However, regulations to limit invasive plant introductions through the ornamental/horticultural pathway have not been put in place.
[140] An integrated governance approach for biological invasions is described in detail in the IPBES report on IAS (IPBES, 2023, pp 38-42; IPBES, "Chapter 6. Governance and policy options for the management of biological invasions," 2023; pp. 32-33.
[141] Federal-Provincial-Territorial Invasive Alien Species Task Force. "Recommendations to Improve Invasive Alien Species Prevention and Management in Canada, 2017, p.12.

[142] ECCC, "Guidelines for the Notification and Testing of New Substances: Organisms," 2010 modified 2022; (*Canadian Environmental Protection Act*, 1999, S.C. 1999, c. 33; Gov. of Canada, *Canadian Environmental Protection Act*, 1999 (S.C. 1999, c. 33), 1999; "Understanding the *Canadian Environmental Protection Act*, 2022.
[143] Ecosystem services include provisioning, regulating, cultural, and supporting services (Office of the Auditor General of Canada, "Report of the Commissioner of the Environment and Sustainable Development CHAPTER 1 Backgrounder on Biological Diversity," 2013).
[144] Invasive Species of BC, "Seed Mixtures," 2021.
[145] Cuthbert, 2022; Cuthbert, 2023.
[146] The EU regulation was proposed in light of Target 5 of the EU 2020 Biodiversity Strategy (2011). The EU Target 5 like Canada's Target 11 set out in the 2020 Biodiversity Goals & Targets for Canada (Environment and Climate Change, 2016) required that risk-based intervention be put in place for priority pathways, like the ornamental/horticultural trades.
[147] European Commission, "Commission Staff Working Document - Impact assessment accompanying the document Proposal for a Council and European Parliament Regulation on the prevention and management of the introduction and spread of invasive alien species," 2013.
[148] To prevent redundancy, the plant health regulation applies only to plants not covered under the invasive species regulation (EU No 1143/2014) that pose phytosanitary risks which would have a severe economic, social, and environmental impact on the Union territory (Regulation (EU) 2016/2031 of the European Parliament of the Council of 26 October 2016 on protective measures against pests of plants - Article 1: Subject matter and scope (2), 2016).
[149] The *Invasive Alien Species Regulation (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) aims to address the negative impact of non-native invasive species on biodiversity and ecosystem services (European Commission [EC], "Invasive alien species," 2023). In addition EU member countries are able to create their own regional lists (Brundu et al., "Managing plant invasions using legislation tools: an analysis of the national and regional regulations for non-native plants in Italy," 2020).
[150] The European and Mediterranean Plant Protection Organization (EPPO) is the Regional Plant Protection Organization (RPPO) for the Euro-Mediterranean region. Not all EU countries have National Plant Protection Organizations, like the CFIA, and EPPO provides risk analysis services across the region. Based on IPPC standards, EPPO develops lists of pests recommended for regulation as quarantine pests (EPPO. "PPO A1/A2 Lists of pests recommended for regulation as quarantine pests, 2023). The prioritization process used by EPPO to categorize invasive plants considers the spread potential as part of the Pest Risk Analysis criteria (Brunel, et al., "The EPPO prioritization process for invasive alien plants." 2010).
[151] EU Member States may submit requests for the inclusion of invasive alien species on the Union list according to Regulation 1143/2014, Article 4. The following technical and scientific evidence was provided to support the prohibition of tree-of-heaven (Brundu, "Information on measures and related costs in relation to species considered for inclusion on the Union list: *Ailanthus altissima*," 2017).
[152] The notice is no longer publicly available (CFIA, "Tree-of-heaven – *Ailanthus altissima* (Mill.) Swingle," 2021, web.archive).
[153] Learn more about the U.S. regulatory process in the Appendices.
[154] Ontario recently restricted tree-of-heaven under its *Invasive Species Act* and joins Alberta is banning sales (Ontario Communications Services, "Ontario designates new invasive species," 2023; Government of Alberta, "Provincially regulated weeds," 2023).
[155] New Zealand Ministry for Primary Industries, "Introduction to biosecurity legislation," 2016; Hulme et al, "Plant invasions in New Zealand: global lessons in prevention, eradication and control." 2020.
[156] Government of Canada, "Canadian Environmental Protection Act, 1999: assessment of existing substances," 2017.

[157] New Zealand Ministry for Primary Industries, "Importing plants, flowers, seeds, and plant-growing products," n.d.; Hulme et al, "Plant invasions in New Zealand: global lessons in prevention, eradication and control." 2020.
[158] The original Accord enacted in 2001, included councils and biosecurity departments but did not include representatives from the horticultural industry. The Nursery and Garden Association joined the Accord in 2006. (New Zealand, "National Pest Plant Accord," 2001; New Zealand Ministry for Primary Industries, "National Pest Plant Accord," 2020; New Zealand Ministry for Primary Industries, "Overview of the pest plant accord," 2021).
[159] Hulme, 2020.
[160] The *Biosecurity Act*, Australia Dept. of Agric., Fisheries, & Forestry, 2021. The provision that deals with the import of plants is the *Biosecurity (Conditionally Non-prohibited Goods) Determination 2021* which replaced the previous *Quarantine Proclamation* 1998.
[161] Australia, "Government weed strategies and lists,"2021; Australia Environment and Invasives Committee, "NEWP – National Established Weed Priorities," 2023.
[162] The WoNS initiative ran from 1999-2019 and is being reinvigorated under the new 'National Established Weed Priorities Framework' (Invasive Plants and Animals Committee, "Australian Weeds Strategy 2017 to 2027," 2016; Wild Matters Pty. Ltd. for the Department of Agriculture, Water and the Environment, "National established weed priorities – Towards a national framework," 2020; Australia Dept. of Ag., Fisheries and Forestry, "National Established Weed Priorities Framework (NEWP)" 2023).
[163] Maher et. al, "Weed wide web: characterising illegal online trade of invasive plants in Australia," 2023.
[164] Australia Department of Agriculture, Fisheries and Forestry, "National Established Weed Priorities Framework (NEWP)," 2023.
[165] This argument was given to justify the national prohibition for Giant Reed (*Arundo donax*), (CFIA, "RMD-16-02: Pest Risk Management Document for *Arundo donax* (giant reed) in Canada," 2017).
[166] "**Canadians deserve and want to know** what substances are in the products they purchase and use in their everyday lives, whether at home or at work, especially if these substances can have **impacts on the environment or human health**. . .. to improve Canadians' awareness of hazardous chemicals. . .. [the Standing Committee on Environment and Sustainable Development] recommended mandatory labelling and greater transparency under the Act for toxic substances in products" (Dept. of the Envir. & Dept of Heath, 2023).
[167] Master Gardeners of Ontario Facebook Group, August 21 Post, 2022.
[168] While New York allows the sale of Norway maple with labelling, other states like Maine, New Hampshire and Vermont prohibit all sales. NYS labelling requirements are described here: "Invasive species regulations," n.d.
[169] The precautionary approach is in the preamble of the *Canadian Environment Protection Act* 1999 (Dept. of Justice, 2023) echoing the preambular text to the Convention on Biological Diversity (CBD, 1992). "*Where there is a threat of significant reduction or loss of biological diversity, lack of full scientific certainty should not be used as a reason for postponing measures to avoid or minimize such a threat"* (Principle 15 of the *Rio Declaration on Environment and Development,* 1992). This principle has been fundamental in subsequent decisions (e.g., Decision II/10, COP-2. 1995; Decision V/6, COP-6, 2002; Decision VII/12, COP-7, 2004).
[170] Many research studies indicate water garden and aquarium trades are a primary source of aquatic invasive species in Canada, 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. See Appendices: Aquatic Invasive Species – flowing through a gap.
[171] Kelly, "Horticulture Code of Good Practice," 2012.
[172] Energy Efficiency Regulations, 2016 (SOR/2016-311) were introduced in 1995 under the *Energy Efficiency Act.* Government of Canada, "Canada Gazette, Part I, Volume 150, Number 18: Energy Efficiency Regulations, 2016: Regulatory impact analysis statement," 2016.

[173] Point of sale labelling can be an effective approach (Hulme et al., "Integrating invasive species policies across ornamental horticulture supply chains to prevent plant invasions," 2017; Hulme, "Plant invasions in New Zealand: global lessons in prevention, eradication and control," 2020).
[174] Datta et al., "Identifying safe cultivars of invasive plants: six questions for risk assessment, management, and communication," 2020.
[175] New Zealand Ministry for Primary Industries, "Fees and charges when importing nursery stock," (2020).
[176] Canadian Endangered Species Conservation Council, 2020, p. 19.
[177] E.g., Brunel et al., "PM5/6(1) EPPO Prioritization process for invasive alien plants," 2010; Branquart et al., "A prioritization process for invasive alien plant species incorporating the requirements of EU Regulation no. 1143/2014," 2016; Rockwell-Postel, Bradley, & Laginhas, "Supporting proactive management in the context of climate change: Prioritizing range-shifting invasive plants based on impact," 2020.
[178] CCIPR has compiled a partial list of known threats across Canada as identified by Canadian authorities and posted this to our website (2023). "Uncertain species would continue to be sold but labelled as intermediate risk ("Amber" labelling) until more information becomes available to point to higher or lower risk. Monitoring to ensure there was no evidence of establishment in natural areas would be key to species retaining "Amber" labelling" (Hulme et al., "Integrating invasive species policies across ornamental horticulture supply-chains to prevent plant invasions," 2017).
[179] E.g., Bradley, Wilcove, & Oppenheimer, "Climate change increases risk of plant invasion in the Eastern United States," 2011; Bradley et al., "Breaking down barriers to consistent, climate-smart regulation of invasive plants: A case study of US Northeast states," 2022b; Sun et al., "Addressing Climate Change: What Can Plant Invasion Science and Weed Science Learn From Each Other?" 2021; Meyerson et al., "Moving Toward Global Strategies for Managing Invasive Alien Species," 2022.
[180] Sleeper species are non-native species already present in an ecosystem that have potential to be invasive, but are limited by factors such as climate or other species (Invasive Species Centre, "Invasive species in a changing climate," 2023). Regional Invasive Species & Climate Change Management Networks (RISCCs) are assessing invasive plants given climate change, e.g., Northeast News: "Management Challenge - Do Not Sell! Ornamental Plants to Avoid with Climate Change;" "Sleeper Species coffee talk recording - Sept 13, 2022," 2023. See also: Rockwell-Postel, Bradley & Laginhas, 2020; Lopez et al., "Invasive Species Policy Must Embrace a Changing Climate," 2022; Beaury, Bradley, & Patrick, 2021.
[181] "Lack of scientific certainty about the environmental, social and economic risk posed by a potentially invasive alien species or by a potential pathway should not be used as a reason for not taking preventative action against the introduction of potentially invasive alien species" (CBD, "COP Decision: Alien species that threaten ecosystems, habitats or species,"2000).
[182] This framework was developed by Roy et al., (2017) to meet requirements of the *EU Regulation on IAS (1143/2014)* and international agreements including the SPS, CBD and IPPC.
[183] IPBES, 2023, p.41.
[184] Ricciardi et al., "Toward a Global Information System for Invasive Species," 2000.
[185] Plant Hardiness of Canada has been developed by Natural Resources Canada, 2022, while Canadensys is operated from the Université de Montréal Biodiversity Centre (2023), which also hosts the Database of Canadian Vascular Plants (VASCAN), a searchable checklist of up-to-date scientific and vernacular names. (Brouillet et al., 2010+). Other taxonomy and nomenclature databases include: World Flora Online; Integrated Taxonomic Information System (ITIS); International Plant Names Index (IPNI), Global Biodiversity Information Facility (GRIF); The Germplasm Resources Information Network (GRIN); Index *Nominum Genericorum* (ING); the Index *Nominum Supragenericorum Plantarum Vascularium*; International Cultivar Registration Authority (ICRA).
[186] Many researchers have identified key traits of invasive plants, e.g., "TRY, a global database for plant traits," (Kattge et al., 2011). Global Biodiversity Information Facility (GBIF) has been up and down over the years but is one of the international databases that has been created to track invasive plants. From the U.S. government: the U.S. National Invasive Species Information Center Databases (2022), the U.S. Register of Introduced and Invasive

Species (US-RIIS), the U.S. Dept of the Interior, NAS - Nonindigenous Aquatic Species (n.d.). and USDA PLANTS Database (2023) are all examples of systems under development. There are additional databases like the Invasive Plant Atlas, which provides information on over 1000 invasive plants, 2018. The Ontario Natural Heritage Information Centre (NHIC) and the NatureServe evaluate species and plant communities and assign conservation status ranks. A national system that provided this information and included invasive status as well would be most helpful (NHIC, "Natural heritage methodology," 2021). NatureServe developed an Invasive Species Impact Rank system (e.g., NatureServe, "Data Types: Invasive Species Impact Rank" n.d.a; NatureServe, "Tools for Understanding Impacts to Biodiversity," n.d.b; Morse, et al., "An Invasive Species Assessment Protocol," 2004; Randall, et al., "The Invasive Species Assessment Protocol," 2008). INaturalist has several programs on invasive plants and is interfacing with iMapInvasives, a web-based mapping system for documenting invasive species distribution (n.d.; 2023). EDDMapS performs a similar service 2023.

[187] Federal-Provincial-Territorial Invasive Alien Species Task Force (FPT IAS), "Recommendations of the Invasive Alien Species Task Force," 2017.

[188] This is a pillar of the Canadian Invasive Species Framework developed by CFIA (Government of Canada, Lindgren, & Gauthier, 2011).

[189] Ken Donnelly, a consultant, specializing in behavior change, community engagement, public policy and strategic planning has conducted several surveys in Canada to monitor effectiveness of initiatives invasive species prevention campaigns and has found they do increased awareness, but that did not translate into behavioural change. (Donnelly, "National Invasive Species Recreational Pathways Survey - Results and Report," 2018; Donnelly, "2021 Invasive Species Programs and Behaviour Survey Report", 2021; Donnelly, "Behaviour Change," 2022 (video 46min mark); Donnelly "Gardeners Have Spoken What we learned from a survey of Canadian Gardeners," 2023.

[190] In a recent survey conducted in B.C., where there are mature *Plant Wise, Grow Me Instead* and *Clean Drain Dry* programs, "41% of BC gardeners would knowingly have invasive plants in their gardens, while 91% of BC residents (and 92% of gardeners) feel it is important to prevent the spread of invasive species. This contradiction is an example of the Intention-Action Gap, whereby people knowing the right action don't always take it. . .. For those active, 68% indicated that they never or only occasionally check their equipment for invasive species, and 78% indicated that they never or only occasionally remove invasive plants and animals from their recreational equipment." (Donnelly, 2021).

[191] Canadian Council on Invasive Species, "Canada's Unwanted Invasive Plants," 2022.

[192] "[I]t seems unlikely that alternative species promotion would have dramatic impacts on the rate of horticultural invasive species introductions," (Crochetiere, "Investigating the efficacy of voluntary initiatives for reducing horticultural introductions of invasive species," 2012); "[I]t can be acclaimed that attitude change alone is simply not enough to curtail landscape use of invasive ornamentals" (Wilson et al., "Summary of 26 Heavenly Bamboo Selections Evaluated for Invasive Potential in Florida." 2021).

[193] Here is a small sample of MGOI FB Group discussions: "Invasive Plant List Update (edited)," 2020; "I don't mean to make a controversial post," 2020; "Why invasive plants are sold?," 2020; "Invasive? Not-in-my-yard! The Concepts and Controversies of Introduced Species," 2020; "Invasive Species: Concepts and Controversies continued," 2020.

[194] MGOI FB Administrator, "Invasive Plant Regulatory Proposal," 2021.

[195] Correspondence was published on CCIPR's Facebook forum in 2023.

[196] Bassiri, "Dealing with invasive plants – My backyard story," 2022.

[197] Bassiri, "Petition to ban the sales of known invasive plant species in retail stores: petition e-4071," 2022.

[198] Ma et al., "New York non-native plant invasiveness ranking form: *Iris Pseudacorus*," 2008.

[199] Ontario Invasive Plant Council Inc., "Notes to the Financial Statements March 31, 2023," 2023.

[200] National Horticulture Invasive Plants Working Group, "National Horticultural Code of Conduct," 2019.

[201] As of March 12, 2024, only five pet and aquarium retailers are shown as participating across Canada (Canadian Council on Invasive Species, "Recognized Retailer Program," 2024).

[202] The Canadian Council on Invasive Species (CCIS) developed a national list of high-risk species. However, they explicitly state that the list "is not a prerequisite" for adherence to the code (CCIS, "Canada's unwanted invasive plants," 2022; "Plant Wise: Canada's Unwanted Invasive Plants List," 2023).
[203] Government-industry agreements and verifiable, industry codes of conducts have been recommended (e.g., Hulme et al. "Integrating invasive species policies across ornamental horticulture supply-chains to prevent plant invasions," 2017), but there is little evidence these are effective (e.g., Abbott & Snidal, "Hard and Soft Law in International Governance," 2000; Dietz et al., "Is private sustainability governance a myth? Evaluating major sustainability certifications in primary production: A mixed methods meta-study," 2022; Miteva, "Beyond the traditional: Voluntary market-based initiatives to promote land tenure security," 2021). For instance, voluntary forestry certification has declined over the past five years (Natural Resources Canada, "The State of Canada's forests: Annual report 2017," 2017; "The State of Canada's forests: Annual report 2022," 2022). Australia was unsuccessful with "its attempt to voluntarily remove from sale 52 species of garden plant" (Heywood & Brunel, "Code of conduct on horticulture and invasive alien plants," 2008). The St. Louis Voluntary Codes of Conduct developed in North America in 2002, had very poor uptake in Canada (Crochetiere, 2012), and sales of invasive plants continue in the U.S. despite calls for improved outreach (Burt, J., et al., "Preventing horticultural introductions of invasive plants: Potential efficacy of voluntary initiatives," 2007; Beaury, Bradley, & Patrick, "Invaders for sale: the ongoing spread of invasive species by the plant trade industry," 2021).
[204] In a presentation given at the Ontario Invasive Plant Council Annual General Meeting, Rebecca Lord, Executive Director of CCIS, reported that 120 attended the National Conference, including 26 speakers (2023). An approximate count taken on the first morning by CCIPR attendees indicated under a dozen represented the horticultural industry. Low attendance could be attributed to several possible factors including limited industry interest, inadequate marketing, high attendance costs, perceived lack of relevant content, and poor organization.
[205] In the IPBES "Invasive Alien Species Assessment," voluntary codes of conduct for the horticultural industry, are recommended as complements to bans on the sales of invasive alien plants considered to be high-risk, (2023, p. 25).
[206] New Zealand Plant Producers Incorporated (NZPPI), "National Pest Plant Accord (NPPA)," 2015.

“Life is a struggle", said the strangled large white trillium (*Trillium grandiflorum*) to the invasive periwinkle (*Vinca minor*), who casually responded "really, I hadn't noticed. (Andy's Northern Ontario Wildflowers, Facebook post from Inglis Falls, May 17, 2023).