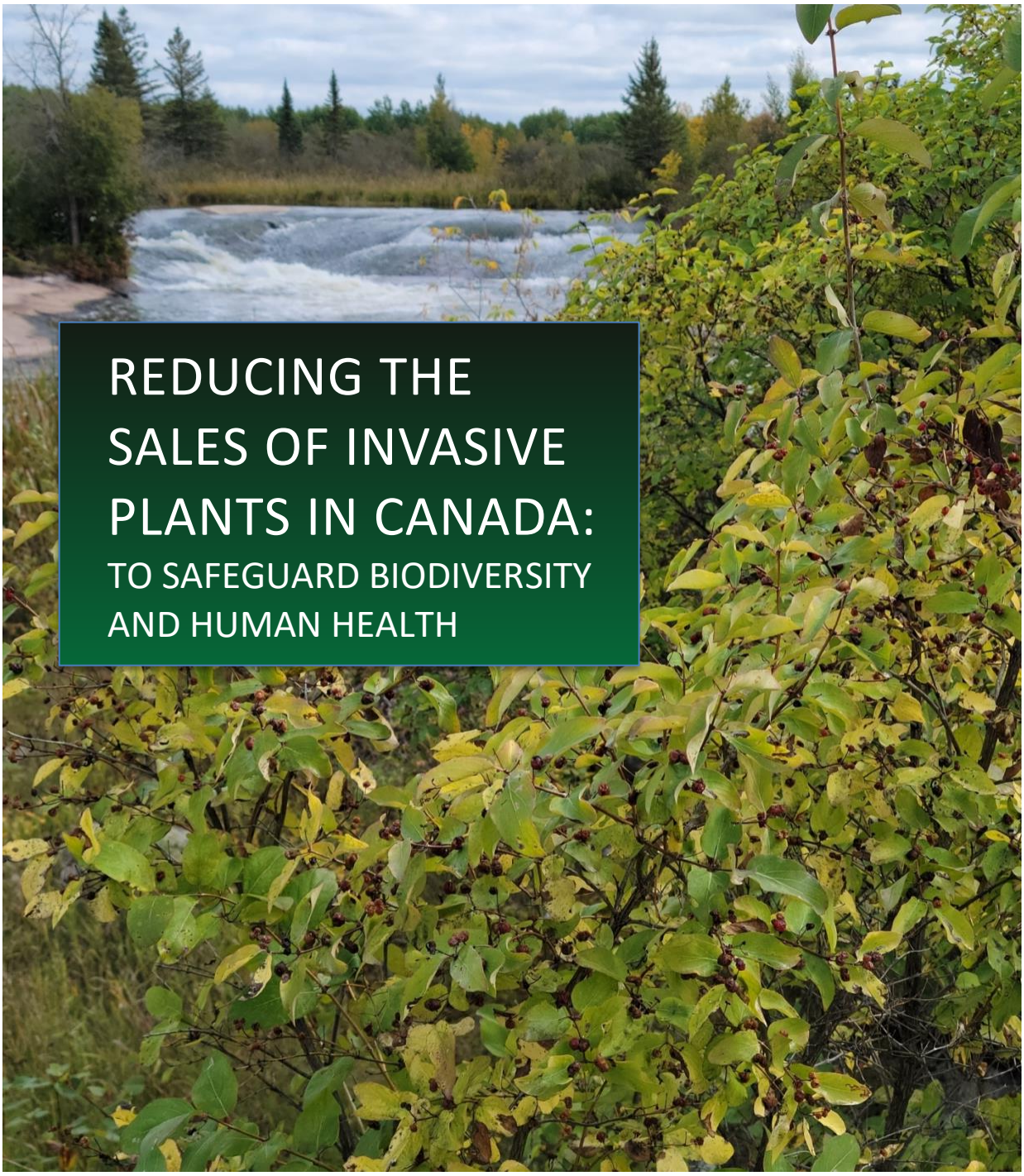

REDUCING THE SALES OF INVASIVE PLANTS IN CANADA:

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.

TABLE OF CONTENTS

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:

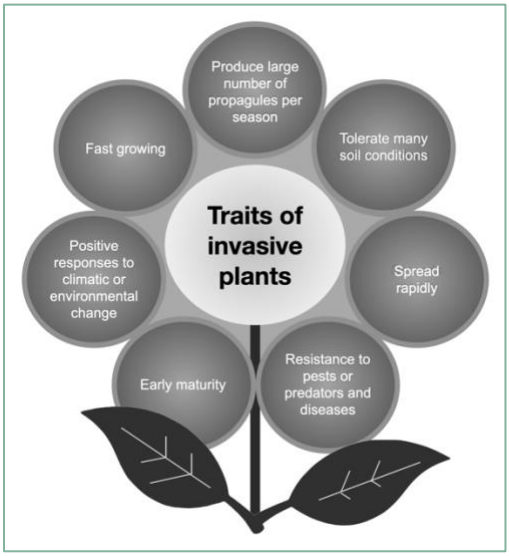

Figure 2. Traits of invasive plants. Adapted from: Ratnayake, 2014.

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]

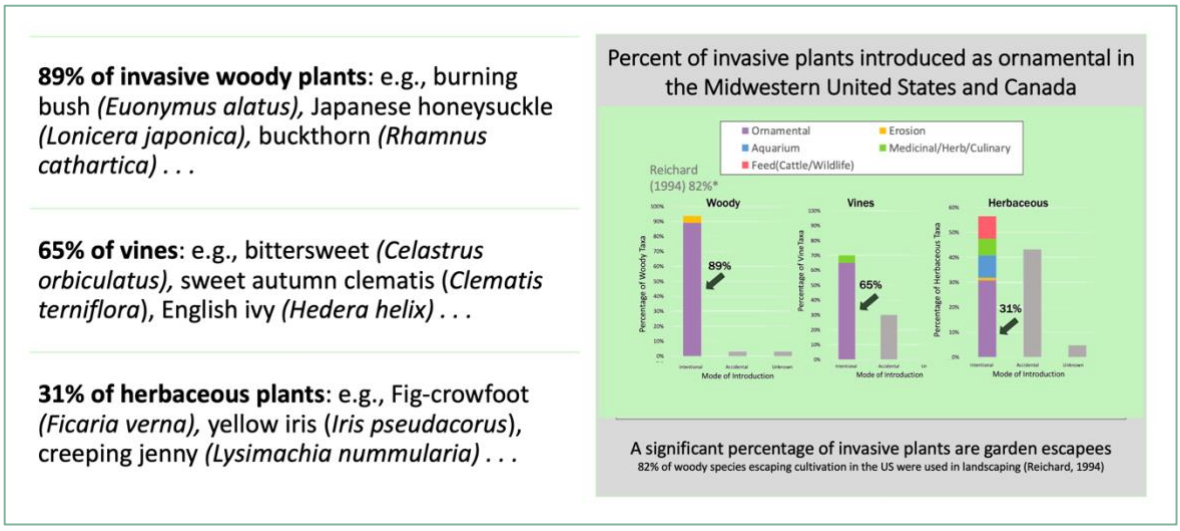

Figure 3. Gardens are the primary pathway for invasive plants. Adapted from "Update of Reichard's (1994) Review." Source: Culley et al, 2020.

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).

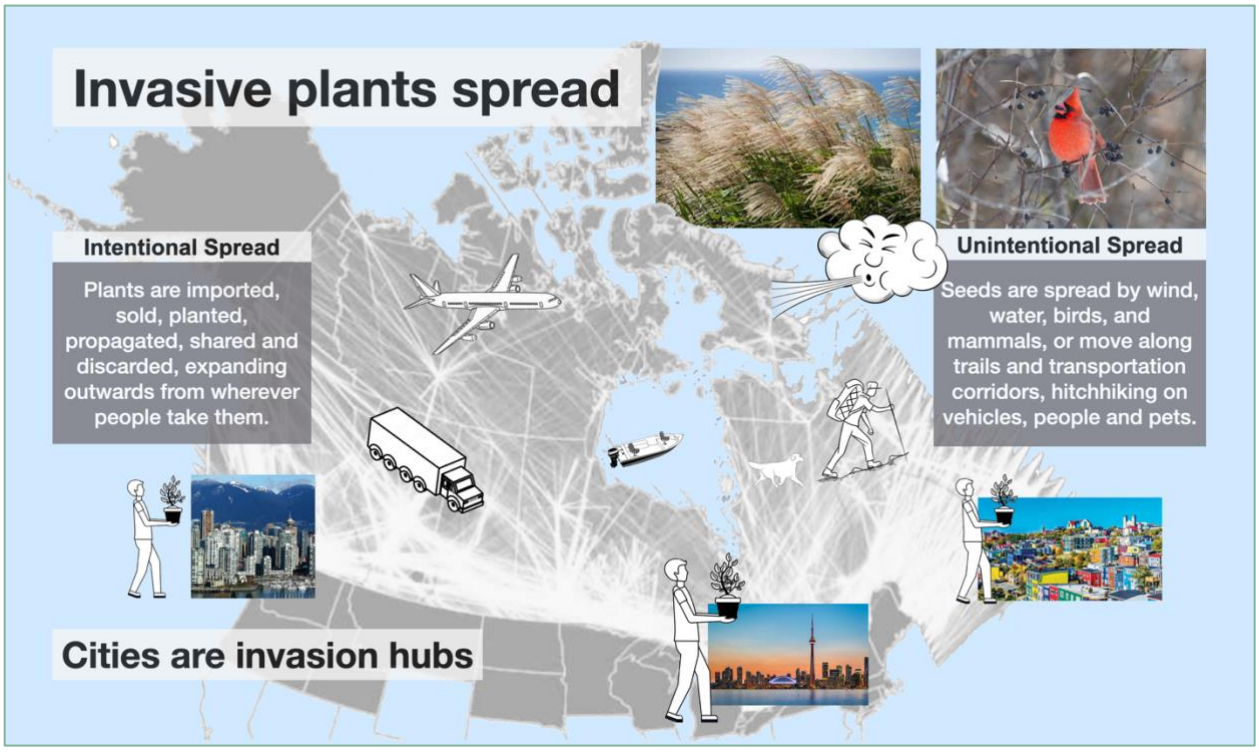

Figure 4. Intentional and unintentional pathways. Source: C. Kavassalis, 2022.

The Silent Spread: Understanding Lag Times in Biological Invasions:

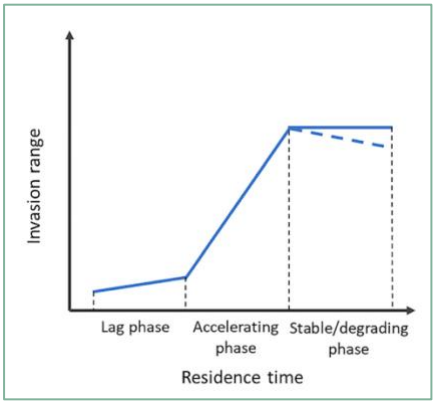

Figure 5. Three Phases of Invasion. Source: Ni, 2022.

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.

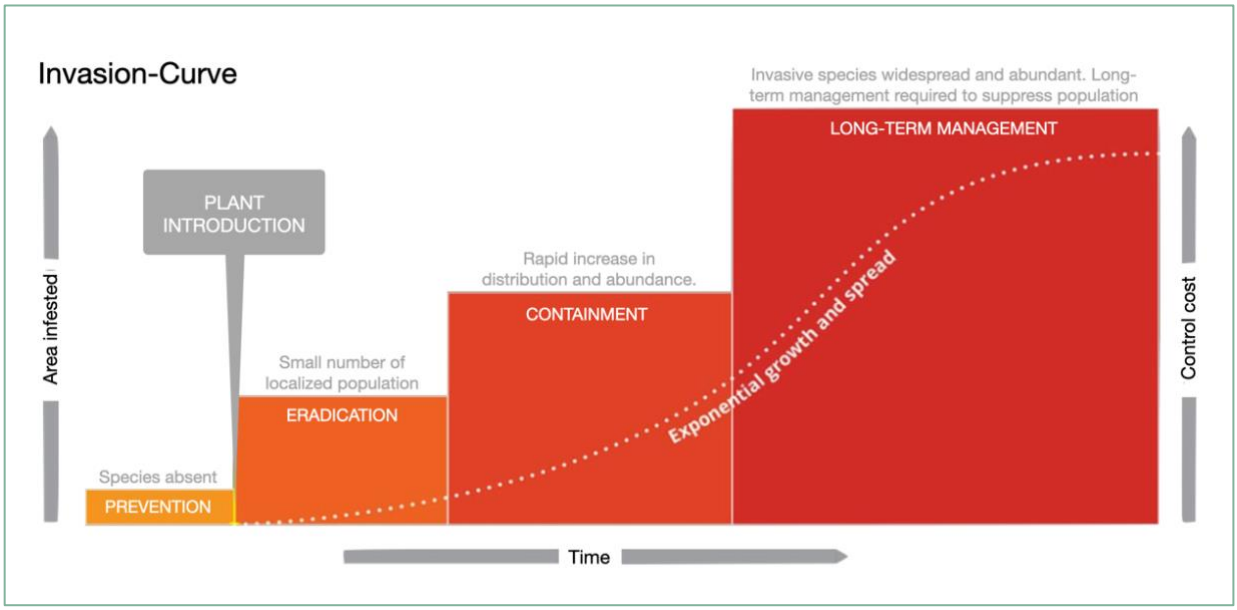

Figure 6: Invasion curve illustrating how costs rise with time and spread. Source: F. Herald, 2022

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.

APPENDICES

TABLE OF CONTENTS

FIGURES:

TABLES:

ACRONYMS

1: Organizations

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

2: Regulations, Frameworks, & Initiatives

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

3: Terms

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

4: Databases and Acronyms Associated with Risk Assessment

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

5: **Provincial and Territory Abbreviations**

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

6: **Border State Abbreviations**

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

A. CANADA'S INTERNATIONAL OBLIGATIONS: A CLOSER LOOK

The Global Biodiversity Crisis:

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

CONVENTION ON BIOLOGICAL DIVERSITY (1992)

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

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

---

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

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

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

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

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

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

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

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

KUNMING-MONTRÉAL GLOBAL BIODIVERSITY FRAMEWORK (2022):

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

---

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

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

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

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

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

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

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

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

---

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

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

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

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

Tools and Solutions for Implementation and Mainstreaming IAS Prevention

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

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

---

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

INTERNATIONAL PLANT PROTECTION CONVENTION (IPPC) (1951)

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

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

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

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

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

B. OVERVIEW: FEDERAL LEGISLATION AND INVASIVE PLANTS

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

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

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

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

Table 3. Departments and associated laws and regulations that could be applied to invasive plants.

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

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

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

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

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

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

Adapting CEPA's Preamble for Invasive Species Legislation:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

23,000 Existing Substances Screened:

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

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

CEPA's Evolution and Relevance to Invasive Plants:

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

Risk Assessment under the *New Substances Notification Regulations*:

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

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

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

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

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

Proposal for Regulatory Expansion and Improved Processes:

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

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

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

D.THE CFIA'S CURRENT INVASIVE PLANT PROTECTION PROGRAM

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

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

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

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

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

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

E. OVERVIEW OF SEED LEGISLATION IN CANADA

Introduction:

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

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

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

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

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

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

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

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

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

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

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

Challenges and Inconsistencies in Regulation:

---

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

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

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

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

[53] CFIA, 2013.

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

Aligning Seed Legislation with Invasive Species Management for Biodiversity Protection:

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

Proposed Amendments and Actions:

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

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

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

Conclusion:

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

F. FEDERAL PLANT LEGISLATION

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

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

Regulated Pest Plants

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

Pest Risk Analysis Process:[60]

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

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

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

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

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

Risk Management Documents:

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

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

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

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

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

Challenges and Limitations:

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

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

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

Table 4. Justification for regulatory measures presented in the Risk Management Documents

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

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

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

Towards Legislative Reform:

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

Recommendations for the CFIA:

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

Conclusion:

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

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

G.PROVINCIAL AND TERRITORIAL REGULATIONS

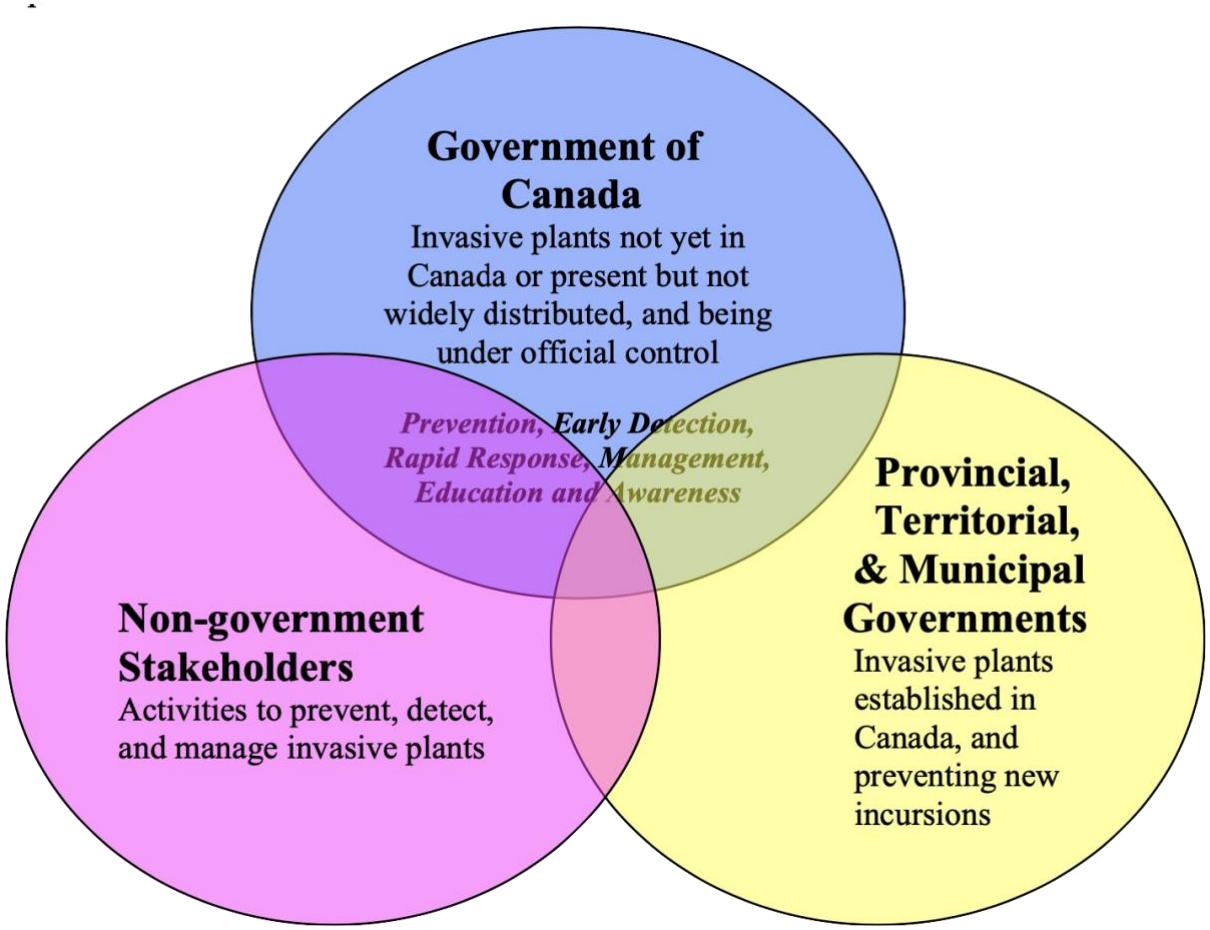

Figure 8. Responding to invasive plants is a shared responsibility. Source. CFIA, 2011.

Introduction

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

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

Table 5. Federal and Provincial Weed/Invasive Species Regulations

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

Overview of Provincial and Territorial Regulations:

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

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

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

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

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

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

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

Proposed Solutions:

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

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

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

Table 6: Ten regulated plants in Canada illustrating inconsistencies across the country.

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

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

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

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

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

Table 7: Non-native invasive aquatic and riparian plants* regulated by Canadian provinces.

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

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

Table 8. Knotweed regulation across Canada

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

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

BRITISH COLUMBIA (BC):

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

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

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

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

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

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

ALBERTA (AB):

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

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

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

Alberta identified several issues regarding their 2008 legislation:

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

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

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

SASKATCHEWAN (SK):

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

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

MANITOBA (MB):

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

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

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

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

ONTARIO (ON):

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

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

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

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

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

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

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

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

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

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

> So that harmful terrestrial species and their pathways are promptly regulated, in line with the goals and objectives of Ontario's *Invasive Species Strategic Plan* (2012), we recommend that the Ministry of Natural Resources and Forestry:
>
> - develop and employ a standardized risk-assessment tool for terrestrial species.
> - collaborate with stakeholders to identify potential terrestrial plant invasive species for regulation; and
> - assess and address the need to regulate pathways for terrestrial invasive species.

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

[96] Ontario Auditor General, 2022.

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

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

Table 9. Select unregulated invasive plant species in Ontario and their impacts (from Auditor General's report).

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

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

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

QUÉBEC (QC):

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

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

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

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

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

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

NEW BRUNSWICK (NB):

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

NOVA SCOTIA (NS):

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

NEWFOUNDLAND AND LABRADOR (NL):

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

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

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

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

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

PRINCE EDWARD ISLAND (PE):

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

NORTHWEST TERRITORIES (NT):

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

NUNAVUT (NU):

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

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

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

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

YUKON (YT):

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

SUMMARY:

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

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

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

H.INVASIVE PLANT REGULATIONS IN THE U.S.

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

---

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

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

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

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

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

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

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

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

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

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

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

---

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

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

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

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

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

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

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

Table 10: Examples of ornamental plants regulated in four or more North American jurisdictions.

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

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

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

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

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

MAINE (ME):

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

Table 11: Maine Do Not Sell Plant List (2024).

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

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

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

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

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

Table 12. Aquatic plants Illegal to sell in Maine.

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

NEW HAMPSHIRE (NH):

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

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

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

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

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

VERMONT (VT):

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

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

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

NEW YORK (NY):

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

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

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

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

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

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

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

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

PENNSYLVANIA (PA):

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

OHIO (OH):

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

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

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

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

MICHIGAN (MI):

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

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

MINNESOTA (MN):

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

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

---

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

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

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

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

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

NORTH DAKOTA (ND):

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

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

MONTANA (MT):

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

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

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

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

IDAHO (ID):

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

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

WASHINGTON (WA):

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

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

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

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

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

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

ALASKA (AK):

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

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

SUMMARY

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

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

I. SELECTED CASES STUDIES

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

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

AQUATIC INVASIVE SPECIES – FLOWING THROUGH A GAP

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

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

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

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

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

Table 13. Aquatic plants identified by the CFIA as requiring risk analysis in 2007.

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

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

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

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

Table 14: Risk assessments and regulations for invasive aquatic plants with volumes of sale (total number of taxa sold per year) in Canada.

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

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

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

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

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

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

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

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

> Carolina fanwort (an aquatic plant) was not regulated until almost five years after a Ministry consultant identified, in a draft risk assessment to the Ministry in 2017, that the species can cause significant harm to Ontario's natural environment (e.g., by out-competing native vegetation) and negatively impact recreational activities like boating, fishing, and swimming. We noted that this draft risk assessment is very similar (and in some sections identical) to the final risk assessment used to inform regulatory consideration for the species.[157]

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

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

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

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

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

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

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

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

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

THE CASE OF BARBERRY (*BERBERIS* SPP.)

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

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

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

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

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

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

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

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

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

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

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

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

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

The Minnesota Department of Agriculture sums up the health concerns:

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

---

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

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

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

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

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

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

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

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

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

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

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

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

---

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

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

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

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

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

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

THE CASE OF GIANT REED (*ARUNDO DONAX*)

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

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

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

The Canadian Weed Risk Analysis document identifies multiple serious risks:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

---

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

THE CASE OF PURPLE LOOSESTRIFE (*LYTHRUM SALICARIA*)

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

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

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

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

---

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

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

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

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

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

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

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

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

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

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

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

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

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

---

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Table 15: Milfoils (*Myriophyllum* spp.) risk assessment scores.

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

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

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

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

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

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

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

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

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

J. EU REGULATION 1143/2014 ON INVASIVE ALIEN SPECIES

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

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

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

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

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

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

K. AUSTRALIA'S APPROACH

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

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

Legislation and Regulation:

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

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

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

Beyond Border Control:

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

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

Practices Worth Emulating:

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

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

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

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

New Directions:

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

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

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

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

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

L. DATABASE DEVELOPMENT AND PLANT RISK ASSESSMENTS

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

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

Leveraging Technological Advances:

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

Fundamental information:

A useful invasive plant database should provide:

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

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

- Best management practices.

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

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

Improving Assessment Systems Through Collaboration

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

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

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

Emphasizing the Importance of Evidence-Based Policy Making

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

M. THE ORNAMENTAL HORTICULTURE SECTOR – COSTS AND OPPORTUNITIES

Introduction to the Canadian Horticultural Industry

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

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

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

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

Adapting to Eco-Friendly Practices

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

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

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

Impact of Invasive Plants on Nursery Production

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

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

Debating Responsibility and Regulatory Approaches

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

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

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

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

The Role of Invasive Plant Labeling

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

---

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

Charting a New Path for Environmental Responsibility in Ornamental Horticulture

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

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

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

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

REFERENCES AND RESOURCES

Abbott, K. W., & Snidal, D. (2000). Hard and Soft Law in International Governance. International Organization, 54(3), 421–456. Retrieved May 8, 2023, from https://www.researchgate.net/publication/4770665_Hard_and_Soft_Law_in_International_Governance

Adebayo, A., Briski, E., Kalaci, O., Hernandez, M., Ghabooli, S., Beric, B., et al. 2011. Water hyacinth (Eichhornia crassipes) and water lettuce (Pistia stratiotes) in the Great Lakes: playing with fire? Aquatic Invasions, 6, 91-96. Retrieved May 8, 2023, from https://scholar.uwindsor.ca/cgi/viewcontent.cgi?article=2166&context=biologypub

Agreement on the Application of Sanitary and Phytosanitary Measures [hereinafter SPS Agreement] (1994). World Trade Organization. Retrieved May 8, 2023, from https://www.wto.org/english/docs_e/legal_e/15-sps.pdf

Ahmed, A., Hudgins, E., Cuthbert, R., Kourantidou, M., Diagne, C., Haubrock, P., Leung, B., Liu, C., Leroy, B., Petrovskii, S., Beidas, A., & Courchamp, F. (2022). Managing biological invasions: the cost of inaction. Biological Invasions, 24. Retrieved May 8, 2023, from https://www.researchgate.net/publication/359312773_Managing_biological_invasions_the_cost_of_inaction

Alaska Center for Conservation Science. (2021). Non-Native Plant Species List. University of Alaska Anchorage. Retrieved May 8, 2023, from https://accs.uaa.alaska.edu/invasive-species/non-native-plant-species-list/

Alaska code Section 11 AAC 34.020 - Prohibited and restricted noxious weeds. Retrieved May 8, 2023, from https://regulations.justia.com/states/alaska/title-11/part-4/chapter-34/article-1/section-11-aac-34-020/

Alaska code 5 AK Admin Code 5 AAC 41.075 Classification of banned invasive species. Retrieved May 8, 2023, from https://regulations.justia.com/states/alaska/title-5/part-1/chapter-41/article-3/section-5-aac-41-075/

Alaska Dept. of Fish and Game. (2021). Invasive Species. Retrieved May 8, 2023, from http://www.adfg.alaska.gov/index.cfm?adfg=invasive.regulations

Alaska Dept. of Natural Resources Division of Agric. (n.d.). Invasive Plants and Agricultural Pest Management. Retrieved May 8, 2023, from https://plants.alaska.gov/invasives/noxious-weeds.htm

Alberta code Agricultural Pests Act, SA 1984, c A-8.1 Retrieved May 8, 2023, from https://www.canlii.org/en/ab/laws/astat/sa-1984-c-a-8.1/latest/sa-1984-c-a-8.1.html

Alberta Environment and Parks. (2018). Aquatic Invasive Species Pocket Guide. Government of Alberta. Retrieved May 8, 2023, from https://open.alberta.ca/dataset/ed4ad469-dc64-4847-9a58-3904818c14d3/resource/539876aa-9f84-402b-917c-f4eb46ac2dc9/download/aispocketguide-jul2018.pdf

Alberta Fisheries Act, RSA 2000, c F-16 Retrieved May 8, 2023, from https://www.canlii.org/en/ab/laws/stat/rsa-2000-c-f-16/latest/rsa-2000-c-f-16.html

Alberta Government. (2023). Provincially regulated weeds. Retrieved April 3, 2024, from https://www.alberta.ca/provincially-regulated-weeds

Alberta Weed Control Act, SA 2008, c W-5.1. Retrieved May 8, 2023, from https://www.canlii.org/en/ab/laws/stat/sa-2008-c-w-5.1/latest/sa-2008-c-w-5.1.html

Allen, J., Beaury, E., Mazzuchi, J., Nelson, M., O'Uhuru, A., & Bradley, B. (2022). Regional Invasive Species & Climate Change Management Challenge: Do not sell? Ornamental Invasive plants to avoid with climate change. Univ. Massachusetts Amherst Environmental Conservation Education Materials. Retrieved May 8, 2023, from https://scholarworks.umass.edu/eco_ed_materials/14/

Allen, K., 2019. Ford government slashes funding to programs aimed at fighting spread of invasive species. Toronto Star. May 30. Retrieved May 8, 2023, from https://www.thestar.com/politics/provincial/2019/05/30/ford-government-slashes-funding-to-programs-aimed-at-fighting-spread-of-invasive-species.html

Anderson, C.B., Athayde, S., Raymond, C.M., Vatn, A., Arias, P., Gould, R.K., Kenter, J., Muraca, B., Sachdeva, S., Samakov, A., Zent, E., Lenzi, D., Murali, R., Amin, A., and Cantú-Fernández, M. (2022). Chapter 2:

Conceptualizing the diverse values of nature and their contributions to people. In: Methodological Assessment Report on the Diverse Values and Valuation of Nature of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. Balvanera, P., Pascual, U., Christie, M., Baptiste, B., and González-Jiménez, D. (eds). IPBES secretariat, Bonn, Germany. Retrieved May 8, 2023, from https://zenodo.org/record/7701874#.ZAzcLS_72_t

Anderson, Neil. (2019). Workshop: Throwing Out the Bathwater but Keeping the Baby: Lessons Learned from Purple Loosestrife and Reed Canarygrass. Hort Technology, 29, 1-10. 10.21273/HORTTECH04307-19. Retrieved May 8, 2023, from https://journals.ashs.org/horttech/view/journals/horttech/29/5/article-p539.xml

Anstey, "One hundred harvests: Research Branch, Agriculture Canada, 1886-1986," 1986. Retrieved April 3, 2025, from https://publications.gc.ca/site/archivee-archived.html?url=https://publications.gc.ca/collections/collection_2016/aac-aafc/agrhist/A54-2-27-1986-eng.pdf

APHIS (Animal and Plant Health Inspection Service). (2012a). Weed Risk Assessment for *Arundo donax* L. (*Poaceae*) – Giant reed. USDA. Retrieved May 8, 2023, from https://www.aphis.usda.gov/plant_health/plant_pest_info/weeds/downloads/wra/Arundo_donax_WRA.pdf

APHIS (Animal and Plant Health Inspection Service). (2012b). Weed Risk Assessment for *Trapa natans* L. (*Lythraceae*) – Water chestnut. USDA. Retrieved May 8, 2023, from https://www.aphis.usda.gov/plant_health/plant_pest_info/weeds/downloads/wra/Trapa-natans.pdf

APHIS (Animal and Plant Health Inspection Service). (2012c). Weed Risk Assessment for Iris pseudacorus L. (Iracaceae) – Yellow flag iris. USDA. Retrieved May 8, 2023, from https://www.aphis.usda.gov/plant_health/plant_pest_info/weeds/downloads/wra/Iris_pseudacorus_WRA.pdf

APHIS (Animal and Plant Health Inspection Service). (2021). U.S.-Canada Greenhouse-Grown Plant Certification Program. USDA. Retrieved May 8, 2023, from https://www.aphis.usda.gov/aphis/ourfocus/planthealth/import-information/accreditation-certification/GCP

Arianoutsou M., Bazos I., Christopoulou A., Kokkoris Y., Zikos A., Zervou S, Delipetrou P, Cardoso AC, Deriu I, Gervasini E, Tsiamis K. (2021). Alien plants of Europe: Introduction pathways, gateways, and time trends. PeerJ. 9. Retrieved May 8, 2023, from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8176916/

Atwell, Tom. (2022). Maine Gardener: Sixty-three plant species could be banned for sale under a new state proposal. Press Herald. Jan 10. Retrieved May 8, 2023, from https://www.pressherald.com/2022/01/09/sixty-three-plant-species-could-be-banned-for-sale-under-a-new-state-proposal/?fbclid=IwAR2q3XcH_NRs9fIPx-2B39WX0ODa6Z9YXxBtsfXNuCt3tzySx_ibJuKUu-o

Australia Biological Diversity Advisory Committee, Land & Water Australia. (2005). Making economic valuation work for biodiversity conservation. Land & Water Australia, Canberra, ACT. Retrieved May 8, 2023, from https://www.cbd.int/financial/values/australia-valuation.pdf

Australia Biosecurity Act 2015 C2021C00355. Retrieved May 8, 2023, from https://www.legislation.gov.au/Details/C2021C00355

Australia Dept. of Agric., Fisheries and Forestry. (2019). Development of the Weed Risk Assessment (WRA) system. Australian Government. Retrieved May 8, 2023, from https://www.agriculture.gov.au/biosecurity-trade/policy/risk-analysis/weeds/development

Australia Dept. of Agric., Fisheries and Forestry. (2023) National Established Weed Priorities Framework (NEWP). Australian Government. Retrieved Dec. 14, 2023, from https://www.agriculture.gov.au/biosecurity-trade/pests-diseases-weeds/pest-animals-and-weeds/newp

Australia Dept. of Agric., Fisheries and Forestry. (2021). The Biosecurity Act 2015. Retrieved May 8, 2023, from https://www.agriculture.gov.au/biosecurity-trade/policy/legislation/biosecurity-legislation

Australia Invasive Plants and Animals Committee. (2016). Strategy 2017 to 2027, Australian Government Department of Agriculture and Water Resources, Canberra. Retrieved May 8, 2023, from

https://www.agriculture.gov.au/sites/default/files/sitecollectiondocuments/pests-diseases-weeds/consultation/aws-final.pdf

Australia Invasive Species Council. (2009). Stopping weed invasions: a 'whitelist' approach. Retrieved May 8, 2023, from https://invasives.org.au/wp-content/uploads/2014/02/fs_weedwhitelist.pdf

Australia Invasive Species Council. (2018). Protect Australia from deadly invasive species: Election priorities for national environmental biosecurity 2019. Invasive Species Council. Fairfield, Victoria. Retrieved May 8, 2023, from https://treasury.gov.au/sites/default/files/2019-03/invasive_species_council.pdf

Australian Biosecurity Group. (2005). Invasive Weeds, Pests and Diseases: Solutions to Secure Australia. CRC for Pest Animal Control, CRC for Australian Weed Management and WWF – Australia, Canberra. Retrieved May 8, 2023, from https://pestsmart.org.au/wp-content/uploads/sites/3/2020/06/InvSp-web3.pdf

Azan, S. (2011). Invasive aquatic plants and the aquarium and ornamental pond industries" Theses and dissertations. Ryerson. Paper 818. Retrieved May 8, 2023, from https://rshare.library.torontomu.ca/articles/journal_contribution/Invasive_Aquatic_Plants_in_the_Aquarium_and_Ornamental_Pond_Industries/19189244

Azan, S., Bardecki, M., & Laursen, A. (2015). Invasive aquatic plants in the aquarium and ornamental pond industries: A risk assessment for southern Ontario (Canada). Weed Research, 55. Retrieved May 8, 2023, from https://www.researchgate.net/publication/270967701_Invasive_aquatic_plants_in_the_aquarium_and_ornamental_pond_industries_A_risk_assessment_for_southern_Ontario_Canada

Bacher, S., Blackburn, T., Essl, F., Genovesi, P., Heikkilä, J., Jeschke, J., Jones, G., Keller, R., Kenis, M., Kueffer, C., Martinou, A., Nentwig, W., Pergl, J., Pyšek, P., Rabitsch, W., Richardson, D., Roy, H., Saul, W., Scalera, R., & Kumschick, S. (2018). Socio-economic impact classification of alien taxa (SEICAT). Methods in Ecology and Evolution. 9, 159–168. Retrieved May 8, 2023, from https://besjournals.onlinelibrary.wiley.com/doi/10.1111/2041-210X.12844

Bacher S, Blackburn TM, Essl F et al (2018) Socio-economic impact classification of alien taxa (SEICAT). Methods Ecol Evol 9:159–168. Retrieved May 8, 2023, from https://besjournals.onlinelibrary.wiley.com/doi/10.1111/2041-210X.12844

Bailey, J. (2013). The Japanese knotweed invasion viewed as a vast unintentional hybridisation experiment. Heredity, 110, 105-110. Retrieved May 8, 2023, from https://www.nature.com/articles/hdy201298

Barbier, E.B., Knowler, D., Gwatipedza, J., Reichard, S.H., Hodges, A.R. (2013). Implementing Policies to Control Invasive Plant Species, BioScience, 63(2), 132–138. Retrieved May 8, 2023, from https://academic.oup.com/bioscience/article/63/2/132/534021

Barney, J., Tharayil, N., DiTommaso, A., & Bhowmik, P. (2006). The Biology of Invasive Alien Plants in Canada. 5. Polygonum cuspidatum Sieb. & Zucc. [= Fallopia japonica (Houtt.) Ronse Decr.]. Canadian journal of plant science, 86, 887-905. Retrieved May 8, 2023, from https://cdnsciencepub.com/doi/10.4141/P05-170

Barney, J.N., Tekiela D.R., Barrios-Garcia M.N., Dimarco R.D., Hufbauer R.A., Leipzig-Scott P., Nuñez M.A., Pauchard A., Pyšek P., Vítková M., & Maxwell B.D. (2015). Global Invader Impact Network (GIIN): toward standardized evaluation of the ecological impacts of invasive plants. Ecol Evol. 5(14):2878-89. Retrieved May 8, 2023, from https://onlinelibrary.wiley.com/doi/full/10.1002/ece3.1551

Bartz, R., & Kowarik, I. (2019). Assessing the environmental impacts of invasive alien plants: A review of assessment approaches. NeoBiota. 43, 69-99. Retrieved May 8, 2023, from https://neobiota.pensoft.net/article/30122/

Bean, T., 2015. Lag times in plant invasions: here today, everywhere tomorrow. UC Weed Science. Retrieved May 8, 2023, from https://ucanr.edu/blogs/blogcore/postdetail.cfm?postnum=18530

Beaury, E. (2020). Video - Invaders for sale: The ongoing spread of invasive species by the plant trade industry. ESA, 2020. Retrieved May 8, 2023, from https://www.youtube.com/watch?v=fQDjM5KBM-o

Beaury, E. M., Bradley, B. A., Patrick, M. (2021). Invaders for sale: the ongoing spread of invasive species by the plant trade industry. Frontiers in Ecology and Environment, 19(10):550-556 Retrieved May 8, 2023, from https://scholarworks.umass.edu/cgi/viewcontent.cgi?article=1432&context=nrc_faculty_pubs

Beaury, E., Allen, J., Evans, A., Fertakos, M., Pfadenhauer, W., & Bradley, B. (2023). Horticulture could facilitate invasive plant range infilling and range expansion with climate change. BioScience. 73. 10.1093/biosci/biad069.

Beck, K. G., Zimmerman, K., Schardt, J. D., Stone, J., Lukens, R. R., Reichard, S., et al. (2008). Invasive species defined in a policy context: Recommendations from the Federal Invasive Species Advisory Committee. Invasive Plant Science and Management, 1(4), 414-421. Retrieved May 8, 2023, from https://www.doi.gov/sites/doi.gov/files/uploads/invasive_species_defined_in_a_policy_context.pdf

Beckie, H., Owen, M., Borger, C., Gill, G., Widderick, M. (2020). Agricultural Weed Assessment Calculator: An Australian Evaluation. Plants, 9. 1737. Retrieved May 8, 2023, from https://www.researchgate.net/publication/347585292_Agricultural_Weed_Assessment_Calculator_An_Australian_Evaluation

Bell C., Wilen, C., Santon, A. (2003). Invasive plants of horticultural origin. Hortscience 38, 14-16. Retrieved May 8, 2023, from https://journals.ashs.org/hortsci/view/journals/hortsci/38/1/article-p14.xml

Bellard, C., Bernery, C. & Leclerc. (2021). Looming extinctions due to invasive species: Irreversible loss of ecological strategy and evolutionary history Running title: Functional and phylogenetic extinctions due to biological invasions. Global Change Biology. Retrieved May 8, 2023, from https://hal.science/hal-03312166/file/MS_14.pdf

Bergunder, N., Greenberg, C., Higgins, R., Hillary, D., Miller V., Schweb, S., Sigg, D., Watkins, C., et al. (2017). Invasive Species Strategy for British Columbia: 2018-.2022. Retrieved May 8, 2023, from https://bcinvasives.ca/wp-content/uploads/2021/01/Invasive_Species_Strategy_for_BC-2018-180117-WEB.pdf

Bernardo-Madrid R., González-Moreno P., Gallardo B., Bacher S., & Vilà M. (2022) Consistency in impact assessments of invasive species is generally high and depends on protocols and impact types. In: Giannetto D, Piria M, Tarkan AS, Zięba G (Eds) Recent advancements in the risk screening of freshwater and terrestrial non-native species. NeoBiota, 76, 163-190. Retrieved May 8, 2023, from https://doi.org/10.3897/neobiota.76.83028

Biodivcanada. (2016). Canada Target 11. In 2020 Biodiversity Goals and Targets for Canada. Minister of Environment and Climate Change. Retrieved May 8, 2023, from https://www.biodivcanada.ca/national-biodiversity-strategy-and-action-plan/2020-biodiversity-goals-and-targets-for-canada/canada-target-11

Block, S., Maechler, M., Levine, J., Alexander, J., Pellissier, L., & Levine, J. (2022). Ecological lags govern the pace and outcome of plant community responses to 21st-century climate change. Ecology Letters. 25(10): 2156-2166). Retrieved May 8, 2023, from https://www.researchgate.net/publication/362986398_Ecological_lags_govern_the_pace_and_outcome_of_plant_community_responses_to_21st-century_climate_change

Bouchard C., Dibernardo A., Koffi J., Wood H., Leighton P.A., & Lindsay L.R. (2019). Increased risk of tick-borne diseases with climate and environmental changes. Can Commun Dis Rep., 45(4), 83-89. Retrieved May 8, 2023, from https://www.canada.ca/content/dam/phac-aspc/documents/services/reports-publications/canada-communicable-disease-report-ccdr/monthly-issue/2019-45/issue-4-april-4-2019/ccdrv45i04a02-eng.pdf

Bradley, B., Beaury, E., Fusco, E., & Lopez, B. (2022a). Invasive Species Policy Must Embrace a Changing Climate, BioScience. Retrieved May 8, 2023, from https://academic.oup.com/bioscience/advance-article-abstract/doi/10.1093/biosci/biac097/6840621

Bradley, B., Beaury, E., Fusco, E., Munro, L., Brown-Lima, C., Coville, W. Kesler, B., Olmstead, N., & Parker, J. (2022b). Breaking down barriers to consistent, climate-smart regulation of invasive. Ecosphere, 13(5). Retrieved May 8, 2023, from https://esajournals.onlinelibrary.wiley.com/doi/full/10.1002/ecs2.4014]

Bradley, B., Blumenthal, D., Early, R., Grosholz, E., Lawler, J., Miller, L., Sorte, C., D'Antonio, C., Diez, J., Dukes, J., Ibanez, I., & Olden, J. (2011). Global change, global trade, and the next wave of plant invasions. Frontiers

in Ecology and the Environment. Retrieved May 8, 2023, from https://www.researchgate.net/publication/233729618_Global_change_global_trade_and_the_next_wave_of_plant_invasions

Bradley, B.A., Wilcove, D.S. & Oppenheimer, M. (2010). Climate change increases risk of plant invasion in the Eastern United States. Biol Invasions, 12, 1855–1872. Retrieved May 8, 2023, from https://people.umass.edu/bethanyb/Bradley%20et%20al.,%202010%20Biol%20Invasions.pdf

Branquart, E., Brundu, G., Buholzer, S., Ehret, P., Fried, G., Starfinger, U., van Valkenburg, J, & Tanner, R. (2016). A prioritisation process for invasive alien plant species compliant with Regulation (EU) No. 1143/2014. EPPO Bulletin, 46, 603–617. Retrieved May 8, 2023, from https://www.researchgate.net/publication/309732342_A_prioritization_process_for_invasive_alien_plant_species_incorporating_the_requirements_of_EU_Regulation_no_11432014

Branquart, E., Verreyken, H., Vanderhoeven, S., & Rossum, F.V. (2009). ISEIA, a Belgian non-native species assessment protocol. Science facing aliens. Retrieved May 8, 2023, from https://ias.biodiversty.be/meetings/200905_science_facing_aliens/session3_01.pdf

Breen, P. (2022). *Ailanthus altissima*. Oregon State University College of Agricultural Sciences - Department of Horticulture - Landscape Plants. Retrieved May 8, 2023, from https://landscapeplants.oregonstate.edu/plants/ailanthus-altissima

Brickell, C.D., Alexander, C., Cubey, J., David, J., Hoffmann, M., Leslie, A., Malécot, V. & Jin, X. (2016). International Code of Nomenclature for Cultivated Plants. Retrieved April 3, 2024, from https://www.ishs.org/sites/default/files/static/sh_18_Sample_chapters.pdf

Brière, S. C. (2009). Biosecurity: Protecting Canada from Invasive Alien Species. CFIA. Retrieved May 8, 2023, from https://www.mcgill.ca/macdonald/files/macdonald/CFIA_Biosecurity_Stephan_Briere_2009.pdf

British Columbia Weed Control Act, RSBC 1996, c 487. Retrieved May 8, 2023, from fromhttps://www.canlii.org/en/bc/laws/stat/rsbc-1996-c-487/latest/rsbc-1996-c-487.html

British Columbia Weed Control Regulation, BC Reg 66/85. Retrieved May 8, 2023, from fromhttps://www.canlii.org/en/bc/laws/regu/bc-reg-66-85/latest/bc-reg-66-85.html

Britton, W.E., 1930. Regulations Concerning the Transportation of Nursery Stock in the United States and Canada. Connecticut Experimental Station Circular 71. Retrieved May 8, 2023, from https://portal.ct.gov/-/media/CAES/DOCUMENTS/Publications/Circulars/C71pdf.pdf

Brouillet, L., Desmet, P., Coursol, F., Meades, S.J., Favreau, M., Anions, M., Bélisle, P., Gendreau, C., Shorthouse, D., & contributors (2010+). (2010). Database of Vascular Plants of Canada (VASCAN). Retrieved May 8, 2023, from http://data.canadensys.net/vascan and http://www.gbif.org/dataset/3f8a1297-3259-4700-91fc-acc4170b27ce

Brundu, G. (2017). Information on measures and related costs in relation to species considered for inclusion on the Union list: *Ailanthus altissima*. Technical note prepared by IUCN for the European Commission. Retrieved May 8, 2023, from https://circabc.europa.eu/sd/a/c5681406-f3d4-4288-bfb3-40322df5c013/TSSR-2016-003%20Measures%20and%20Costs%20-%20Ailanthus%20altissima.pdf

Brundu, G., Brunel, S., Heywood, & Vernon. (2011). The European Code of Conduct on Horticulture and Invasive Alien Plants. In book: E. Rindos (ed.), Plant Invasions: Policies, Politics, and Practices, Proceedings of the 2010 Weeds Across Borders Conference, 1–4 June 2010, National Conservation Training Center, Shepherdstown, West Virginia. Bozeman, Montana: Montana State University, Center for Invasive Plant Management. (pp.32-36) Publisher: Montana State University, Center for Invasive Plant Management. Retrieved May 8, 2023, from https://www.researchgate.net/publication/346082197_The_European_Code_of_Conduct_on_Horticulture_and_Invasive_Alien_Plants

Brundu, G., Minicante, S., Barni, E., Bolpagni, R., Caddeo, A., Celesti-Grapow, L., Cogoni, A., Galasso, G., Iiriti, G., Lazzaro, L., Loi, M., Lozano, V., Marignani, M., Montagnani, C., & Siniscalco, C. (2020). Managing plant invasions using legislation tools: an analysis of the national and regional regulations for non-native plants in Italy. Retrieved May 8, 2023, from https://www.researchgate.net/publication/340429631_

Managing_plant_invasions_using_legislation_tools_an_analysis_of_the_national_and_regional_regulations_for_non-native_plants_in_Italy

Brunel, S., Branquart, E., Fried, G., van Valkenburg, J., Brundu, G., Starfinger, U., Buholzer, S., Uludag, A., Josefsson, M., & Baker, R. (2010). PM5/6(1) EPPO Prioritization process for invasive alien plants. EPPO Bulletin. 40. 407 - 422. Retrieved May 8, 2023, from https://www.researchgate.net/publication/227726571_PM561_EPPO_Prioritization_process_for_invasive_alien_plants

Burt, J., Muir, A., Piovia-Scott, J., & Veblen, K. (2005). Perspectives of Nursery Professionals on Invasive Plants and the St. Louis Voluntary Codes of Conduct. https://www.cal-ipc.org/wp-content/uploads/2017/12/IGERTposter2005.pdf

Burt, J.W., Muir, A.A., & Piovia-Scott, J. Burt, Veblen, K, Chang, A., Grossman, J., Weiskel, H. (2007). Preventing horticultural introductions of invasive plants: Potential efficacy of voluntary initiatives. Biological Invasions 9(8), 909-923. Retrieved May 8, 2023, from https://www.researchgate.net/publication/225948999_Preventing_horticultural_introductions_of_invasive_plants_Potential_efficacy_of_voluntary_initiatives

Bzdęga, K., Janiak, A., Książczyk, T., Lewandowska, A., Gancarek, M., Sliwinska, E., & Tokarska-Guzik, Barbara. (2016). A Survey of Genetic Variation and Genome Evolution within the Invasive *Fallopia* Complex. PloS one. 11. e0161854. 10.1371/journal.pone.0161854. https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0161854

CABI ISC Invasive Species Compendium. Retrieved May 8, 2023, from https://www.cabi.org/publishing-products/invasive-species-compendium/

CABI. (2007). *Lythrum salicaria* (purple loosestrife). CABI Compendium. Wallingford, UK: CAB International. Retrieved May 8, 2023, from https://www.cabidigitallibrary.org/doi/10.1079/cabicompendium.31890

CABI. (2008). *Miscanthus sinensis* (eulalia). CABI Compendium. Wallingford, UK: CAB International. Retrieved May 8, 2023, from https://www.cabidigitallibrary.org/doi/10.1079/cabicompendium.34269

CABI. (2009). *Celastrus orbiculatus* (Asiatic bittersweet). CABI Compendium. Wallingford, UK: CAB International. Retrieved May 8, 2023, from https://www.cabidigitallibrary.org/doi/10.1079/cabicompendium.12009

CABI. (2019). *Berberis thunbergii* (Japanese barberry). CABI Compendium. Wallingford, UK: CAB International. Retrieved May 8, 2023, from https://www.cabidigitallibrary.org/doi/full/10.1079/cabicompendium.8808

Canada Wildlife Act, RSC 1985, c W-9. Retrieved May 8, 2023, from https://www.canlii.org/en/ca/laws/stat/rsc-1985-c-w-9/latest/rsc-1985-c-w-9.html

Canadian Coalition for Invasive Plant Regulation (CCIPR). (2024). Website retrieved April 3, 2024, from https://ccipr.ca

Canadian Council on Invasive Species Group. (2019). A cooperative initiative with National Horticultural Invasive Plants Working, Canadian Society of Landscape Architects, Canadian Nursery Landscape Association Retrieved May 8, 2023, from https://canadainvasives.ca/wp-content/uploads/2019/06/2019-01-16_CCIS_Code_of_Conduct_FINAL.pdf

Canadian Council of Fisheries and Aquaculture Ministers Aquatic Invasive Species Task Group. (2004). Canadian Action Plan to Address the Threat of Aquatic Invasive Species. Fisheries and Oceans Canada. Retrieved May 8, 2023, from https://www.dfo-mpo.gc.ca/species-especes/publications/ais-eae/plan/page01-eng.html

Canadian Endangered Species Conservation Council. (2005). Wild Species 2005: The general status of species in Canada. National General Status Working Group. Retrieved Jan 16, 2024, from https://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry/publications/wild-species-2005.html

Canadian Endangered Species Conservation Council. (2010). Wild Species 2010: The general status of species in Canada. National General Status Working Group. Retrieved Jan 16, 2024, from https://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry/publications/wild-species-2010.html#

Canadian Endangered Species Conservation Council. (2015). Wild Species 2015: The general status of species in Canada. National General Status Working Group. Retrieved Jan 16, 2024, from https://wildlife-species.canada.ca/species-risk-registry/virtual_sara/files/reports/Wild%20Species%202015.pdf

Canadian Endangered Species Conservation Council. (2020). Wild Species 2020: The general status of species in Canada. National General Status Working Group. Retrieved Jan 16, 2024, from https://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry/general-status/wild-species-2020.html

Canadian Society of Landscape Architects (CSLA). (2020). Canadian Landscape Standard 2nd edition. Retrieved May 8, 2023, from https://www.reminetwork.com/articles/canadian-landscape-standard-2nd-released/

Canadian Nursery Landscape Association. (2001). Restrictions lifted on Japanese barberry. CNLA News. Retrieved May 8, 2023, from https://landscapetrades.com/cnla-news-brrestrictions-lifted-on-japanese-barberry

Carlson, M.L., Lapina, I.V., Shephard, M., Conn, J., Densmore, R., Spencer, P., Heys, J. Riley, J., & Nielsen, J. (2008). Invasiveness Ranking System for Non-Native Plants of Alaska. USDA. Retrieved May 8, 2023, from https://accs.uaa.alaska.edu/wp-content/uploads/Invasiveness_Ranking_System_for_Non-Native_Plants_Alaska.pdf

Castro, K., McClay, A., Wilson, C., & Sissons, A. (2019). An updated status of introduced and invasive plants in Canada. Poster no. 15. In Proceeding 15th International Conference on Ecology and Management of Alien Plant invasions. Prague Czech Republic. 9-13 September. Retrieved May 8, 2023, from https://www.ibot.cas.cz/invasions/EMAPi_conferences/pdf/2019_book_of_abstracts2.pdf

Catford, J., Jansson, R., & Nilsson, C. (2009). Reducing redundancy in invasion ecology by integrating hypotheses into a single theoretical framework. Diversity and Distributions, 15, 22-40. Retrieved May 8, 2023, from https://onlinelibrary.wiley.com/doi/full/10.1111/j.1472-4642.2008.00521.x

Catling, Paul. (2005). New "Top of the list" invasive plants of natural habitats in Canada. Biodiversity, National Program on Environmental Health, Agriculture and Agri-food Canada, Ottawa, Ontario. Retrieved May 8, 2023, from https://www.ou.edu/cas/botany-micro/ben/ben345.html

Catling, Paul & Mitrow, Gisele. (2011). The Recent Spread and Potential Distribution of *Phragmites australis* subsp. *australis* in Canada. Canadian Field Naturalist. 125. Retrieved May 8, 2023, from https://www.researchgate.net/publication/277750535_The_Recent_Spread_and_Potential_Distribution_of_Phragmites_australis_subsp_australis_in_Canada

CBD Convention on Biological Diversity (1992). 1760 U.N.T.S. 79, 31 I.L.M. 818. Retrieved May 8, 2023, from https://www.cbd.int/doc/legal/cbd-en.pdf

CBD (Convention on Biological Diversity). 2010). What are Invasive Alien Species? Convention on Biological Diversity. Retrieved May 8, 2023, from https://www.cbd.int/invasive/WhatareIAS.shtml

CBD (Convention on Biological Diversity). (2021a). Natural Capital. Retrieved May 8, 2023, from https://www.cbd.int/business/projects/natcap.shtml

CBD (Convention on Biological Diversity). (2021b). What are Invasive Alien Species? Retrieved May 8, 2023, from https://www.cbd.int/idb/2009/about/what/

CBD (Convention on Biological Diversity). (2022). Invasive Alien Species. Retrieved May 8, 2023, from https://www.cbd.int/invasive/

CBD COP-5 (Convention on Biological Diversity - Fifth Conference of the Parties). (2000). COP 5 Decision V/8 Alien species that threaten ecosystems, habitats, or species. Retrieved May 8, 2023, from https://www.cbd.int/decision/cop/?id=7150

CBD COP-6 (Convention on Biological Diversity - Sixth Conference of the Parties). (2002). COP 6 Decision VI/23 - Alien species that threaten ecosystems, habitats, or species. The Hague, the Netherlands, 7–19 April. Retrieved May 8, 2023, from https://www.cbd.int/decision/cop/?id=7197

CBD COP-15. (Convention on Biological Diversity – 15th Conference of the Parties). (2022). Kunming-Montréal Global biodiversity framework: Draft decision submitted by the President. Conference of the Parties to

the CBD 18 Dec. 2022. Retrieved May 8, 2023, from https://www.cbd.int/doc/c/e6d3/cd1d/daf663719a03902a9b116c34/cop-15-l-25-en.pdf

CESCC (Canadian Endangered Species Conservation Council). (2010.) Non-native & invasive species in Nunavut. Environment Canada. Retrieved May 8, 2023, from https://www.gov.nu.ca/sites/default/files/invasive_poster_english_jan31-4.pdf

Ceska, O., Ceska, A., & Warrington, P. (1986). *Myriophyllum quitense* and *Myriophyllum ussuriense* (*Haloragaceae*) in British Columbia, Canada. Brittonia. 38. 73-81. Retrieved May 8, 2023, from https://www.researchgate.net/publication/225606716_Myriophyllum_Quitense_and_Myriophyllum_Ussuriense_Haloragaceae_in_British_Columbia_Canada

CESCC (The Canadian Endangered Species Conservation Council). (2010). Non-Native & invasive species in Nunavut. Retrieved Nov. 27, 2023, from https://gov.nu.ca/sites/default/files/brochure_english_jan31-4_1.pdf

CFIA (Canadian Food Inspection Agency). (2001a). Regulations Amending the Plant Protection Regulations. Canada Gazette Part 1. 135(15): 1372-1380. Retrieved May 8, 2023, from https://canadagazette.gc.ca/rp-pr/p1/2001/2001-04-14/pdf/g1-13515.pdf

CFIA (Canadian Food Inspection Agency). (2001b). Weed Risk Assessment: European water-chestnut (*Trapa natans* L. Plant Health Risk Assessment Unit Science Division Nepean, Ontario. Retrieved Nov. 21, 2021, via email from Plant Health Risk Assessor Canadian Food Inspection Agency.

CFIA (Canadian Food Inspection Agency). (2008a). Invasive Alien Plants in Canada - Technical Report. Ottawa (ON). Retrieved May 8, 2023, from https://publications.gc.ca/collections/collection_2008/inspection/A104-74-2008E.pdf

CFIA (Canadian Food Inspection Agency). (2008b). Action Plan for Alien Terrestrial Plants and Plant Pests. Ottawa (ON). Retrieved May 8, 2023, from https://publications.gc.ca/collections/collection_2008/inspection/A104-68-2008E.pdf

CFIA (Canadian Food Inspection Agency). (2012). Invasive Plants Policy. Guidance Document Repository (GDR) CFIA. Retrieved May 8, 2023, from https://inspection.canada.ca/plant-health/invasive-species/invasive-plants/policy/eng/1328298038970/1328298211382

CFIA (Canadian Food Inspection Agency). (2013a). Technical reference R-004: Japanese Barberry Identification Manual. Retrieved May 8, 2023, from https://inspection.canada.ca/plant-health/horticulture/horticulture-manuals/technical-reference-r-004/eng/1383066164013/1383066257157

CFIA (Canadian Food Inspection Agency). (2013b). Weed Seeds Order (WSO) Review - Proposal for Change. Retrieved May 8, 2023, from https://inspection.canada.ca/plant-health/seeds/weed-seeds-order/proposal-for-change/eng/1382373850660/1382373924402

CFIA. (2013c). WSO Review 2.0 Background (2013c). https://inspection.canada.ca/plant-health/seeds/weed-seeds-order/proposal-for-change/eng/1382373850660/1382373924402?chap=2#s1c2

CFIA. (2013d). WSO Review 3.0 Weed Seeds Order Definitions. Retrieved May 8, 2023, from https://inspection.canada.ca/plant-health/seeds/weed-seeds-order/proposal-for-change/eng/1382373850660/1382373924402?chap=3

CFIA. (2013e). WSO Review 5.0 Weed Seeds Order to Grade Table Cross Reference. Retrieved May 8, 2023, from https://inspection.canada.ca/plant-health/seeds/weed-seeds-order/proposal-for-change/eng/1382373850660/1382373924402?chap=5

CFIA. (2013f). WSO Review 6.0 Proposed Species Placement and Rationale. Retrieved May 8, 2023, from https://inspection.canada.ca/plant-health/seeds/weed-seeds-order/proposal-for-change/eng/1382373850660/1382373924402?chap=6

CFIA (Canadian Food Inspection Agency). (2013g). WSO Review Secondary Consultation Document. Retrieved May 8, 2023, from https://inspection.canada.ca/plant-health/seeds/weed-seeds-order/secondary-consultation-document/eng/1383166033687/1383167061443

CFIA (Canadian Food Inspection Agency). (2014). Appendix 4- Plants Excluded from the United States Greenhouse Certification Program (USGCP) for Export to Canada. Retrieved May 8, 2023, from https://inspection.canada.ca/plant-health/invasive-species/directives/imports/d-08-04/appendix-4/eng/1324621977086/1324622066526

CFIA (Canadian Food Inspection Agency). (2015). Archived - Evaluation of the Plant Protection Program. Ottawa (ON). Retrieved May 8, 2023, from https://inspection.canada.ca/about-cfia/transparency/corporate-management-reporting/audits-reviews-and-evaluations/evaluation-of-ppp/eng/1437589825296/1437589825859

CFIA (Canadian Food Inspection Agency). (2016a). Consolidation of regulated pests for Canada. Retrieved May 8, 2023, from https://assets.ippc.int/static/media/files/reportingobligation/2016/04/19/CFIA_ACIA-2930771-v8-PHBD-PLANT_PROTECTION-LIST-Consolidated_Regulated_Pests_for_Canada.pdf

CFIA (Canadian Food Inspection Agency). (2016b). Weed Seeds Order (WSO) - Regulatory impact analysis. Canada Gazette Part 1. 150(5): 1372-1380. Retrieved May 8, 2023, from https://gazette.gc.ca/rp-pr/p1/2016/2016-01-30/html/reg1-eng.html

CFIA (Canadian Food Inspection Agency). (2017a). RMD-16-02: Pest Risk Management Document for Arundo donax (giant reed) in Canada. Ottawa (ON). Retrieved May 8, 2023, from https://inspection.canada.ca/plant-health/invasive-species/directives/pest-risk-management/rmd-16-02/eng/1480113538475/1480113602164

CFIA (Canadian Food Inspection Agency). (2017b). Weed Seed *Lythrum salicaria* (Purple loosestrife). Ottawa (ON). Retrieved May 8, 2023, from https://inspection.canada.ca/plant-health/seeds/seed-testing-and-grading/seeds-identification/lythrum-salicaria/eng/1476283862539/1476283862851

CFIA (Canadian Food Inspection Agency). (2017c). Why invasive alien species are a problem. Retrieved May 8, 2023, from https://www.canada.ca/en/environment-climate-change/services/biodiversity/why-invasive-alien-species-are-problem.html

CFIA (Canadian Food Inspection Agency). (2018). Buying, Selling, and Trading of Plants and Other Organisms. Retrieved May 8, 2023, from https://inspection.canada.ca/plant-health/invasive-species/buying-selling-and-trading/eng/1537451230024/1537451230445 .

CFIA (Canadian Food Inspection Agency). (2019a). Giant Reed *Arundo donax* L. (*Poaceae*). [Factsheet]. Ottawa (ON). Retrieved May 8, 2023, from https://inspection.canada.ca/DAM/DAM-plants-vegetaux/STAGING/text-texte/giant_reed_canne_de_provence_1557940067050_eng.pdf

CFIA (Canadian Food Inspection Agency). (2019b). Weed Seeds Order. Ottawa (ON). Retrieved May 8, 2023, from https://inspection.canada.ca/plant-health/seeds/weed-seeds-order/eng/1463453027786/1463453028410

CFIA (Canadian Food Inspection Agency). (2020). RMD-13-04: Consolidated Pest Risk Management Document for pest plants regulated by Canada. Date modified: 2020-07-03. Ottawa (ON): CFIA. Retrieved May 8, 2023, from https://inspection.canada.ca/plant-health/invasive-species/directives/pest-risk-management/rmd-13-04/eng/1405604253368/1405604308682?chap=0

CFIA (Canadian Food Inspection Agency). (2021a). Tree-of-heaven – *Ailanthus altissima* (Mill.) Swingle. Retrieved May 8, 2023, from https://inspection.canada.ca/plant-health/invasive-species/invasive-plants/invasive-plants/tree-of-heaven/eng/1612898593817/1612898594354

CFIA (Canadian Food Inspection Agency). (2021b). Weed risk analysis documents. Retrieved May 8, 2023, from https://inspection.canada.ca/plant-health/invasive-species/invasive-plants/weed-risk-analysis-documents/eng/1427387489015/1427397156216

CFIA (Canadian Food Inspection Agency). (2022a). Notice to industry: Recommendation to prevent movement of 'Concorde', 'Royal Cloak' and 'Tara' Emerald Carousel barberry cultivars, into Alberta, Saskatchewan, and Manitoba. Ottawa (ON). Retrieved May 8, 2023, from https://inspection.canada.ca/plant-health/invasive-species/directives/pest-risk-management/rmd-21-02/notice-to-industry/eng/1653420323729/1653420324010

CFIA (Canadian Food Inspection Agency). (2022b). List of Pests Regulated by Canada. Retrieved May 8, 2023, from https://inspection.canada.ca/plant-health/invasive-species/regulated-pests/eng/1363317115207/1363317187811#a

CFIA (Canadian Food Inspection Agency). (2022c). 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*). Ottawa (ON). Retrieved May 8, 2023, from https://inspection.canada.ca/plant-health/invasive-species/directives/pest-risk-management/rmd-21-02/eng/1653418602687/1653418603218

CFIA (Canadian Food Inspection Agency). (2022d). Plant Protection Regulations (SOR/95-212) [Barberry - Prohibited Movement within Canada]. Ottawa (ON). Retrieved May 8, 2023, from https://laws-lois.justice.gc.ca/eng/regulations/SOR-95-212/page-5.html#h-972903

CFIA (Canadian Food Inspection Agency). (2022e). Tree-of-heaven – *Ailanthus altissima* (Mill.) Swingle. Ottawa (ON). Retrieved May 8, 2023, from https://inspection.canada.ca/plant-health/invasive-species/invasive-plants/invasive-plants/tree-of-heaven/eng/1612898593817/1612898594354

CFIA (Canadian Food Inspection Agency). (2022f). Weed risk analysis documents. Ottawa (ON). Retrieved May 8, 2023, from https://inspection.canada.ca/plant-health/invasive-species/invasive-plants/weed-risk-analysis-documents/eng/1427387489015/1427397156216

Champion, P., Clayton, J., Petroeschevsky, A., & Newfield, M. (2010a). Risk assessment for the New Zealand National Pest Plant Accord: which species should be banned from sale? Plant Protection Quarterly. 25(2). 75-78. Retrieved Jan. 27, 2024, from https://caws.org.nz/PPQ2526/PPQ%2025-2%20pp075-78%20Newfield.pdf

Champion, P., Clayton, J., Petroeschevsky, A., & Newfield, M. (2010b). Using the New Zealand aquatic weed risk assessment model to manage potential weeds in the aquarium/ pond plant trade. Plant Protection Quarterly 25(2) 49-51. Retrieved Jan. 27, 2024, from https://caws.org.nz/PPQ2526/PPQ%2025-2%20pp049-51%20Champion.pdf

Champion, P., Hofstra, D., & Clayton, J. (2007). Border control for potential aquatic weeds: Stage 3. Weed risk management. Science for Conservation 271. Retrieved May 8, 2023, from https://niwa.co.nz/sites/niwa.co.nz/files/sfc271.pdf

Charles, H., & Dukes, J.S. (2008). Impacts of Invasive Species on Ecosystem Services. In: Nentwig, W. (eds) Biological Invasions. Ecological Studies, 193. Springer, Berlin, Heidelberg. Retrieved May 8, 2023, from https://www.dnr.sc.gov/education/Envirothon/pdf/2016CostofInvasives.pdf

Clark, R., & Seewagen, C. (2019). Invasive Japanese barberry, *Berberis thunbergii* (*Ranunculales: Berberidaceae)* Is Associated with Simplified Branch-Dwelling and Leaf-Litter Arthropod Communities in a New York Forest. Environmental Entomology, 48(5), 1071-1078. Retrieved May 8, 2023, from https://www.researchgate.net/publication/335505504_Invasive_Japanese_Barberry_Berberis_thunbergii_Ranunculales_Berberidaceae_Is_Associated_With_Simplified_Branch-Dwelling_and_Leaf-Litter_Arthropod_Communities_in_a_New_York_Forest

Clavin, L., & Krissoff, B. (2005). Resolution of the U.S.-Japan apple dispute: New 0pportunities for trade. Retrieved April 3, 2024, from https://www.ers.usda.gov/webdocs/outlooks/37018/29630_fts31801_002.pdf?v=844.1

Coats, V., Stack, L., & Rumpho, M. (2011). Maine Nursery and Landscape Industry Perspectives on Invasive Plant Issues. Invasive Plant Science and Management, 4(4), 378-389. Retrieved May 8, 2023, from https://bioone.org/journals/invasive-plant-science-and-management/volume-4/issue-4/IPSM-D-10-00086.1/Maine-Nursery-and-Landscape-Industry-Perspectives-on-Invasive-Plant-Issues/10.1614/IPSM-D-10-00086.1.short

Colautti, R. I., Bailey, S.A., van Overdijk, C.D., Amundsen, K., & MacIsaac, H.J. (2006). Characterised and projected costs of nonindigenous species in Canada. Biological Invasions, 8, 45–59. Retrieved May 8, 2023, from

https://www.researchgate.net/publication/227335702_Characterised_and_Projected_Costs_of_Nonindigenous_Species_in_Canada

Colautti, R.I., & MacIsaac, H.J. (2004). A neutral terminology to define 'invasive' species. Diversity and Distribution, 10(2), 135–141. Retrieved May 8, 2023, from https://onlinelibrary.wiley.com/doi/full/10.1111/j.1366-9516.2004.00061.x

Colorado Dept. of Agric. (2022). Noxious Weed Species ID. Retrieved May 8, 2023, from https://ag.colorado.gov/conservation/noxious-weeds/species-id

Commission on Phytosanitary Measures (ICPM). (2001). Standard setting priorities. Retrieved April 3, 2024 from https://www.ippc.int/en/cpm-2001/

Congressional Research Service. (2017, January 17). Invasive Species: Major Laws and the Role of Selected Federal Agencies. Version 7. United State Government. Retrieved May 8, 2023, from https://crsreports.congress.gov/product/pdf/R/R43258

Connecticut General Assembly. (2019) Ch 446i* Water resources. Invasive Plants. Retrieved May 8, 2023, from https://www.cga.ct.gov/current/pub/chap_446i.htm

Conser C., Seebacher L., Fujino D.W., Reichard S., & DiTomaso J.M. (2015). The Development of a Plant Risk Evaluation (PRE) Tool for Assessing the Invasive Potential of Ornamental Plants. Plos One, 10, Retrieved May 8, 2023, from https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0121053

Cook, R., Ward, S., Liebhold, A., & Fei, S. (2021). Spatial dynamics of spotted lanternfly, *Lycorma delicatula*, invasion of the Northeastern United States. NeoBiota, 70, 23-42. Retrieved May 8, 2023, from https://neobiota.pensoft.net/article/67950/

Coombs, G., Gilchrist, D. (2017 updated 2018). Native and Invasive Plants Sold by the Mid-Atlantic Nursery Industry A Baseline for Future Comparisons. Mt. Cuba Center. Retrieved May 8, 2023, from https://mtcubacenter.org/wp-content/uploads/2018/03/Native-and-Invasive-Plants-Report-Public-Version.pdf

Coombs, G., Gilchrist, D., & Watson, P. (2020). An assessment of the native and invasive horticultural plants in the Atlantic region. Native Plants Journal University of Wisconsin Press. 21(1). Retrieved May 8, 2023, from https://muse.jhu.edu/pub/19/article/754415/pdf

Couch, R., & E. Nelson. (1985). *Myriophyllum spicatum* in North America. In Proceedings of the First International Symposium on Watermilfoil (*Myriophyllum spicatum*) and Related Haloragaceae Species, July 23 and 24, 1985, Vancouver, British Columbia, Canada, 8–18. Aquatic Plant Management Society, Gainesville, Florida, USA. Retrieved May 8, 2023, from https://apms.org/wp-content/uploads/2021/10/APMS-1985-Proceedings-Milfoil.pdf

Council of Canadian Academies, & Bennett, A. (2022). Cultivating Diversity, Ottawa (ON). The Expert Panel on Plant Health Risks in Canada, Council of Canadian Academies. Retrieved May 8, 2023, from https://www.researchgate.net/publication/358906891_Cultivating_Diversity_The_Expert_Panel_on_Plant_Health_Risks_in_Canada

Colautti, Robert & Bailey, Sarah & Overdijk, Colin & Amundsen, Keri & MacIsaac, Hugh. (2006). Characterised and Projected Costs of Nonindigenous Species in Canada. Biological Invasions. 8. 45-59. Retrieved May 8, 2023, from https://www.researchgate.net/publication/227335702_Characterised_and_Projected_Costs_of_Nonindigenous_Species_in_Canada

Couthbert, Ross. (2023). Advances in economic cost assessments of biological invasions. Pathways to Change: Horticulture and Invasive Species National Conference Nov 8-9. Canada Invasive Species Council.

Crochetiere, H. (2012). Investigating the efficacy of voluntary initiatives for reducing horticultural introductions of invasive species. UWSpace. Retrieved April 3, 2024, from https://uwspace.uwaterloo.ca/handle/10012/6562

Cuthbert RN, Diagne C, Hudgins EJ, Turbelin A, Ahmed DA, Albert C, Bodey TW, Briski E, Essl F, Haubrock PJ, Gozlan RE, Kirichenko N, Kourantidou M, Kramer AM, & Courchamp F. (2022). Biological invasion costs reveal

insufficient proactive management worldwide. Sci Total Environ. 819:153404. doi: 10.1016/j.scitotenv.2022.153404. Epub 2022 Feb 8. PMID: 35148893. Retrieved Nov. 10, 2023, from https://pubmed.ncbi.nlm.nih.gov/35148893/

Crooks, J., & Soulé, M. (1999). Lag Times in Population Explosions of Invasive Species: Causes and Implications. Retrieved May 8, 2023, from https://www.researchgate.net/publication/286831388_Lag_Times_in_Population_Explosions_of_Invasive_Species_Causes_and_Implications

Crops and Horticulture Division Agriculture and Agri-Food Canada September (2020). Statistical Overview of the Canadian Ornamental Industry 2019. Gov. of Canada. Retrieved May 8, 2023, from https://publications.gc.ca/collections/collection_2020/aac-aafc/A71-42-2019-eng.pdf

Crystal-Ornelas, R., Hudgins, E., Cuthbert, R., Haubrock, P., Fantle-Lepczyk, J., Angulo, E., Kramer, A., Ballesteros-Mejia, L., Leroy, B., Leung, B., López-López, E., Diagne, E., & Courchamp, F. (2021). Economic costs of biological invasions within North America. NeoBiota. 485-510. Retrieved May 8, 2023, from https://oceanrep.geomar.de/id/eprint/53651/

Culley, T. (2022). Invasive Pears. The Culley Lab. Retrieved May 8, 2023, from https://culleylab.com/home-page/research/invasive-pears/

Culley, T., Hardiman, N., (2007). The Beginning of a New Invasive Plant: A History of the Ornamental Callery Pear in the United States, BioScience, 57(11), 954-964. Retrieved May 8, 2023, from https://academic.oup.com/bioscience/article/57/11/956/234351

Culley, T., Dreisilker, Kurt M., Ryan, C., Schuler, J., Cavallin, N., Gettig, R., Havens, K., Landel, H., & Shultz, B. (2020). The Role of Public Gardens as Sentinels of Plant Invasion – Presentation. Retrieved May 8, 2023, from https://www.cal-ipc.org/wp-content/uploads/2020/12/Cal_IPC_Symposium_2020_Theresa-Culley_The-role-of-public-gardens-as-sentinels-of-plant-invasion.pdf

Culley, T., Dreisilker, Kurt M., Ryan, C., Schuler, J., Cavallin, N., Gettig, R., Havens, K., Landel, H., & Shultz, B. (2022). The potential role of public gardens as sentinels of plant invasion. Biodiversity and Conservation. 31:1-16. Retrieved May 8, 2023, from https://link.springer.com/article/10.1007/s10531-022-02391-z

Cuerrier, A., Turner, N., Gomes, T., Garibaldi, A., & Downing, A. (2015). Cultural Keystone Places: Conservation and Restoration in Cultural Landscapes. Journal of Ethnobiology. 35. 427. https://www.researchgate.net/publication/282869625_Cultural_Keystone_Places_Conservation_and_Restoration_in_Cultural_Landscapes

Cuthbert, R., Diagne, C., Hudgins, E., Turbelin, A., Ali Ahmed, D., Albert, C., Bodey, T., Briski, E., Essl, F., Haubrock, P., Gozlan, R., Kirichenko, N., Kourantidou, M., Kramer, A., & Courchamp, F. (2021). Biological Invasion Costs Reveal Insufficient Proactive Management Worldwide. Science of The Total Environment, 819. Retrieved May 8, 2023, from https://www.sciencedirect.com/science/article/pii/S004896972200496X

D-12-01: Phytosanitary Requirements to Prevent the Introduction of Plants Regulated as Pests in Canada (2019). Retrieved May 8, 2023, from https://inspection.canada.ca/plant-health/invasive-species/directives/date/d-12-01/eng/1380720513797/1380721302921#a24

Datta, A., Kumschick, S., Geerts, S., & Wilson, J. (2020). Regulating and managing cultivars Identifying safe cultivars of invasive plants: six questions for risk assessment, management, and communication. NeoBiota, 62, 10.3897/neobiota.62.51635. Retrieved May 8, 2023, from https://neobiota.pensoft.net/article/51635/

Davidson, D., Fusaro, A., Sturtevant, R., Rutherford, E., & Kashian, D. (2017). Development of a risk assessment framework to predict invasive species establishment for multiple taxonomic groups and vectors of introduction. Management of Biological Invasions, 8(1), 25-36. Retrieved May 8, 2023, from https://digitalcommons.wayne.edu/cgi/viewcontent.cgi?article=1013&context=biosci_frp

Dehnen-Schmutz, K., Touza, A., Perrings, C., & Williamson M. (2007). The horticultural trade and ornamental plant invasions in Britain. Conservation Biology, 21, 224–231. Retrieved May 8, 2023, from https://www.researchgate.net/publication/6505941_The_Horticultural_Trade_and_Ornamental_Plant_Invasions_in_Britain

Dehnen-Schmutz, K., Holdenrieder, O., Jeger, M.J. & Pautasso, M. (2010). Structural change in the inter- national horticultural industry: Some implications for plant health. Scientia Horticulturae 125, 1–15. Retrieved May 8, 2023, from https://www.researchgate.net/publication/235751786_Structural_change_in_the_international_horticultural_industry_Some_implications_for_plant_health

Dehnen-Schmutz, K. (2011). Determining non-invasiveness in ornamental plants to build green lists. Journal of Applied Ecology, 48, 1374 - 1380. Retrieved May 8, 2023, from https://www.researchgate.net/publication/230285629_Determining_non-invasiveness_in_ornamental_plants_to_build_green_lists

Dehnen-Schmutz, K. & Conroy, J. (2018). Working with gardeners to identify potential invasive ornamental garden plants: testing a citizen science approach. Biol Invasions 20, 3069–3077. Retrieved May 8, 2023, from https://www.researchgate.net/publication/325093211_Working_with_gardeners_to_identify_potential_invasive_ornamental_garden_plants_testing_a_citizen_science_approach

Delaware Ch. 29. Invasive and Potentially Invasive Plants. Retrieved May 8, 2023, from https://delcode.delaware.gov/title3/c029/index.html

Denóbile, C., Chiba de Castro, W.A., & Silva Matos, D. (2023). Public health implications of invasive plants: A scientometric study. Plants (Basel). 12(3):661. Retrieved May 8, 2023, from https://www.mdpi.com/2223-7747/12/3/661

Department of the Environment. (2021). Waiver of information requirements for living organisms (subsection 106(9) of the Canadian Environmental Protection Act, 1999. Canada Gazette, Part I, 155(17). Retrieved May 8, 2023, from https://canadagazette.gc.ca/rp-pr/p1/2021/2021-04-24/html/notice-avis-eng.html

D'hondt B., Vanderhoeven S., Roelandt S., Mayer F., Versteirt V., Adriaens T., Ducheyne E., San Martin G., Grégoire J-C., Stiers I., Quoilin S., Cigar J., Heughebaert A., & Branquart E. (2015) Harmonia+ and Pandora+: Risk screening tools for potentially invasive plants, animals, and their pathogens. Biological Invasions 17(6): 1869–1883. Retrieved May 8, 2023, from https://www.researchgate.net/publication/271844555_Harmonia_and_Pandora_risk_screening_tools_for_potentially_invasive_plants_animals_and_their_pathogens

Diagne, C., Leroy, B., Gozlan, R.E., Vaissère, A.C., Assailly, C., Nuninger, L., Roiz, D., Jourdain, F., Jarić, I. & Courchamp, F. (2020). InvaCost, a public database of the economic costs of biological invasions worldwide. Sci Data, 7, 277. Retrieved May 8, 2023, from https://www.nature.com/articles/s41597-020-00586-z

Diagne, C., Leroy, B., Gozlan, R.E., Vaissère, A.C., Gozlan, R., Roiz, D., Jarić, I., Salles, J., Bradshaw, C., & Courchamp, F. (2021). High and rising economic costs of biological invasions worldwide. Nature, 592, Retrieved May 8, 2023, from https://www.researchgate.net/publication/350524847_High_and_rising_economic_costs_of_biological_invasions_worldwide

Diaz, Sandra & Pascual, Unai & Stenseke, Marie & Martín-López, Berta & Watson, Robert & Molnár, Zsolt & Hill, Rosemary & Chan, Kai & Baste, Ivar & Brauman, Kate & Polasky, Stephen & Church, Andrew & Lonsdale, Mark & Larigauderie, Anne & Leadley, Paul & van Oudenhoven, Alexander & Plaat, Felice & Schröter, Matthias & Lavorel, Sandra & Shirayama, Yoshihisa. (2018). Assessing nature's contributions to people. Science. 359. 270-272. Retrieved May 8, 2023, from https://www.researchgate.net/publication/322582117_Assessing_nature%27s_contributions_to_people

Dietz, T., Biber-Freudenberger, L., Deal, L., & Börner, J. (2022). Is private sustainability governance a myth? Evaluating major sustainability certifications in primary production: A mixed methods meta-study. Ecological Economics, 201(4), 107546 Retrieved May 8, 2023, from https://www.sciencedirect.com/science/article/abs/pii/S0921800922002087

DiTomaso, J. M., Monaco, T. A., James, J. J., & Firn, J. (2017). Invasive plant species and novel rangeland systems. Rangeland systems: processes, management, and challenges, 429-465. Retrieved May 8, 2023, from Invasive plant species and novel rangeland systems (pdf).

Divíšek, J., Chytry, M., Beckage, B., Gotelli, N., Lososová, Z., Pyšek, P., Richardson, D., & Molofsky, J. (2018). Similarity of introduced plant species to native ones facilitates naturalization, but differences enhance

invasion success. Nature Communications, 9. Retrieved May 8, 2023, from https://www.researchgate.net/publication/328770555_Similarity_of_introduced_plant_species_to_native_ones_facilitates_naturalization_but_differences_enhance_invasion_success

Donnelly, K. (2018). National Invasive Species Recreational Pathways Survey - Results and Report. Canadian Council on Invasive Species Report. Retrieved Feb 10, 2024, from https://canadainvasives.ca/wp-content/uploads/2020/05/2018-07_National-Invasive-Species-Recreational-Pathways-Survey_FINAL.pdf

Donnelly, K. (2021). 2021 Invasive Species Programs and Behaviour Survey Report. Invasive Species Council of B.C. Retrieved Feb 10, 2024, from https://canadainvasives.ca/wp-content/uploads/2020/05/2018-07_National-Invasive-Species-Recreational-Pathways-Survey_FINAL.pdf

Donnelly, K. (2022). Behaviour Change. Invasive Species Centre 2022 Invasive Species Forum. Retrieved Feb 10, 2024, from https://www.youtube.com/watch?v=PlLJcGYfiDQ&list=PLdxRdOLT-h0htPqmBtXv9eIcZ3suwC0ZL&index=11 (Video begins at the 46min. mark).

Donnelly, K. (2023). Gardeners Have Spoken What we learned from a survey of Canadian Gardeners. Presentation at the National Horticulture and Invasive Species Conference, hosted by the Canadian Council on Invasive Species in partnership with the Ontario Invasive Plant Council and industry. Video not available.

Downey, P., & Glanznig, A. (2006). Understanding and managing the risk of garden escapes to Australia's native flora: which future weed candidates are already here? Conference Paper in The Proceedings of the 15th Australian Weeds Conference at Adelaide. pp. 723-726. Retrieved May 8, 2023, from https://www.researchgate.net/publication/276412030_Understanding_and_managing_the_risk_of_garden_escapes_to_Australia%27s_native_flora_which_future_weed_candidates_are_already_here

Drag & Spruce Lakes Property Owners Association. (2022). Eurasian Watermilfoil updates. Retrieved May 8, 2023, from https://dragandsprucelakes.ca

Drew, J., Anderson, N. & Andow, D. (2010). Conundrums of a complex vector for invasive species control: a detailed examination of the horticultural industry. Biol Invasions, 12, 2837–2851 Retrieved May 8, 2023, from https://doi.org/10.1007/s10530-010-9689-8

Ducks Unlimited. (2016). Working to eradicate the European water chestnut. Story / The Great Lakes & St. Lawrence, Wetlands. Retrieved May 8, 2023, from https://www.ducks.ca/stories/the-great-lakes-st-lawrence/working-eradicate-european-water-chestnut/

Duncan, Richard. (2021). Time lags and the invasion debt in plant naturalisations. https://www.researchgate.net/publication/349232898_Time_lags_and_the_invasion_debt_in_plant_naturalisations

Early, R., Bradley, B., Dukes, J. et al. (2016). Global threats from invasive alien species in the twenty-first century and national response capacities. Nat Commun 7, 12485 Retrieved Jan 18, 2024, from https://doi.org/10.1038/ncomms12485

EC (European Commission). (n.d.). International Plant Protection Convention (IPPC) Retrieved May 8, 2023, from https://food.ec.europa.eu/horizontal-topics/international-affairs/international-standards/international-plant-protection-convention-ippc_en

EC (European Commission). (2011). The EU Biodiversity Strategy to 2020. Retrieved May 8, 2023, from https://ec.europa.eu/environment/nature/info/pubs/docs/brochures/2020%20Biod%20brochure%20final%20lowres.pdf

EC (European Commission). (2022). List of Invasive Alien Species of Union concern. Retrieved May 8, 2023, from https://ec.europa.eu/environment/nature/invasivealien/list/index_en.htm

EC Directorate-General for Environment. (2020). Study on Invasive Alien Species – Development of risk assessments to tackle priority species and enhance prevention. Retrieved May 8, 2023, from https://purews.inbo.be/ws/portalfiles/portal/18211925/KH0420137ENN.en.pdf

EDDMapS (Early Detection & Distribution Mapping System). (2023) European water chestnut *Trapa natans* L. University of Georgia. Retrieved May 8, 2023, from https://www.eddmaps.org/distribution/viewmap.cfm?sub=3499

Eisen RJ, Eisen L. (2018). The Blacklegged Tick, *Ixodes scapularis*: An Increasing Public Health Concern. Trends Parasitol, 34(4), 295-309. Retrieved May 8, 2023, from https://pubmed.ncbi.nlm.nih.gov/29336985/

Ellstrand, N., Heredia, S., Leak-Garcia, J., Heraty, J., Burger, J., Yao, L., Nohzadeh-Malakshah, S. & Ridley, C. (2010). Crops gone wild: Evolution of weeds and invasives from domesticated ancestors. Evolutionary Applications, 3, 494-504. Retrieved May 8, 2023, from https://onlinelibrary.wiley.com/doi/10.1111/j.1752-4571.2010.00140.x

ECCC (Environment and Climate Change Canada). (2004). An Invasive Alien Species Strategy for Canada. Government of Canada. Retrieved May 8, 2023, from https://publications.gc.ca/collections/collection_2014/ec/CW66-394-2004-eng.pdf

ECCC (Environment and Climate Change Canada). (2016). 2020 Biodiversity goals & targets for Canada. Government of Canada. Retrieved May 8, 2023, from https://publications.gc.ca/collections/collection_2016/eccc/CW66-524-2016-eng.pdf

ECCC (Environment and Climate Change Canada). (2021). Timeline: Major milestones of Environment and Climate Change Canada. Government of Canada. Retrieved May 8, 2023, from https://www.canada.ca/en/environment-climate-change/campaigns/50-years-environmental-action/eccc-timeline.html

ECCC (Environment and Climate Change Canada). (2022a). Assessment of substances under the Canadian Environmental Protection Act, 1999. Retrieved May 8, 2023, from https://www.canada.ca/en/environment-climate-change/services/canadian-environmental-protection-act-registry/substances-list/assessment.html

ECCC (Environment and Climate Change Canada). (2022b). Guidelines for the Notification and Testing of New Substances: Organisms," 2010 modified 2022. Retrieved May 8, 2023, from https://www.canada.ca/en/environment-climate-change/services/managing-pollution/evaluating-new-substances/biotechnology-living-organisms/guidelines.html#toc12

ECCC (Environment and Climate Change Canada). (2022c). Risk assessment of chemical substances. Retrieved May 8, 2023, from https://www.canada.ca/en/health-canada/services/chemical-substances/canada-approach-chemicals/risk-assessment.html

ECCC (Environment and Climate Change Canada). (2022d). Ecological integrity of national parks. Retrieved April 3, 2024, from https://www.canada.ca/en/environment-climate-change/services/environmental-indicators/ecological-integrity-national-parks.html#

ECCC (Environment and Climate Change Canada). (2023). UPDATE – Strengthening the Canadian Environmental Protection Act, 1999 and recognizing a right to a healthy environment. Retrieved May 8, 2023, from https://www.canada.ca/en/environment-climate-change/news/2023/02/update--strengthening-the-canadian-environmental-protection-act-1999-and-recognizing-a-right-to-a-healthy-environment.html

EDDMapS. (n.d.) Website University of Georgia- Center for Invasive Species and Ecosystem Health. Retrieved April 3, 2024, from https://www.eddmaps.org

Energy Efficiency Regulations. 2016 (SOR/2016-311) https://laws-lois.justice.gc.ca/eng/regulations/SOR-2016-311/index.html

EPPO (European and Mediterranean Plant Protection Organization). (2009) Council of Europe Workshop 'Code of conduct on horticulture and invasive alien plants.' Retrieved May 8, 2023, from https://www.eppo.int/MEETINGS/2009_meetings/wk_code_of_conduct

EPPO. (2011). Guidelines on Pest Risk Analysis: Decision support scheme for quarantine pests. European and Mediterranean Plant Protection Organization. Retrieved May 8, 2023, from https://www.eppo.int/media/uploaded_images/RESOURCES/eppo_standards/pm5/pm5-03-05-en.pdf

EPPO. (2019) IAP-RISK - Mitigating the threat of invasive alien plants in the EU through pest risk analysis to support the EU Regulation 1143/2014. Retrieved May 8, 2023, from http://www.iap-risk.eu/

EPPO. (2021) EPPO Panel on Invasive Alien Plants. Retrieved May 8, 2023, from https://www.eppo.int/ACTIVITIES/iap_activities

Essl F., Nehring S., Klingenstein F., Milasowszky N., Nowack C., & Rabitsch W. (2011). Review of risk assessment systems of IAS in Europe and introducing the German–Austrian Blacklist Information System (GABLIS). Journal for Nature Conservation 19(6): 339–350. https://www.academia.edu/26528534/Review_of_risk_assessment_systems_of_IAS_in_Europe_and_introducing_the_German_Austrian_Black_List_Information_System_GABLIS_

European Food Safety Authority (EFSA), Tayeh, C., & Mannino, M. (2021). A review of ranking systems for new plant threats in EU Member States and Third Countries: concepts and applications. EFSA Supporting Publications. Retrieved May 8, 2023, from https://efsa.onlinelibrary.wiley.com/doi/pdf/10.2903/sp.efsa.2021.EN-1615

European and Mediterranean Plant Protection Organization (2023). "EPPO activities on Invasive Alien Plants." Retrieved May 8, 2023, from https://www.eppo.int/ACTIVITIES/iap_activities

EU (European Union). (2014). Regulation (EU) No 1143/2014 of the European Parliament and of the Council on the prevention and management of the introduction and spread of invasive alien species. Official Journal of the European Union. 2014; L315:35–55. Retrieved May 8, 2023, from https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014R1143&rid=5

EU. (2016). Regulation (EU) 2016/2031 of the European Parliament of the Council of 26 October 2016 on protective measures against pests of plants. Official Journal of the European Union, L317/4. Retrieved May 8, 2023, from https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32016R2031&from=EN

EU. (2019). Commission Implementing Regulation (EU) 2019/1262 of 25 July 2019 amending Implementing Regulation (EU) 2016/1141 to update the list of invasive alien species of Union concern. Retrieved May 8, 2023, from http://data.europa.eu/eli/reg_impl/2019/1262/oj

Fang, W., & Wang, X. (2020). A field experimental study on the impact of *Acer platanoides*, an urban tree invader, on forest ecosystem processes in North America. Ecol Process, 9(9), Retrieved May 8, 2023, from https://www.researchgate.net/publication/339647789_A_field_experimental_study_on_the_impact_of_Acer_platanoides_an_urban_tree_invader_on_forest_ecosystem_processes_in_North_America

FAO (Food and Agric. Organization of the United Nations). (2015). History of the IPPC - International Plant Protection Convention. Retrieved May 8, 2023, from https://www.ippc.int/en/history-of-the-ippc/

Federal Interagency Committee for the Management of Noxious and Exotic Weeds & Westbrooks, R. (1998). Invasive Plants: Changing the Landscape of America. All U.S. Government Documents (Utah Regional Depository). 490. Retrieved May 8, 2023, from https://digitalcommons.usu.edu/govdocs/490

Fish, G. (2022). Private Correspondence regarding impact of Maine Plant Regulations on the Industry. State Horticulturist: Maine Department of Agriculture, Conservation and Forestry

Fisheries Act, RSC 1985, c F-14. Retrieved May 8, 2023, from https://www.canlii.org/en/ca/laws/stat/rsc-1985-c-f-14/latest/rsc-1985-c-f-14.html

Fletcher, RA, Brooks, RK, Lakoba, VT, et al. Invasive plants negatively impact native, but not exotic, animals. Glob Change Biol. 2019; 25: 3694– 3705. Retrieved May 8, 2023, from https://onlinelibrary.wiley.com/doi/abs/10.1111/gcb.14752

Fondation de la faune du Québec (2022). Programme pour la lutte contre les plantes exotiques envahissaantes. Retrieved May 8, 2023, from https://fondationdelafaune.qc.ca/programmes-daide-financiere/programme-pour-la-lutte-contre-les-plantes-exotiques-envahissantes/

Forner, Walter & Zalba, Sergio & Guadagnin, Demétrio. (2022). Methods for Prioritizing Invasive Plants in Protected Areas: A Systematic Review. Natural Areas Journal. 42. 10.3375/20-47. Retrieved May 8, 2023, from https://bioone.org/journals/natural-areas-journal/volume-42/issue-1/20-47/Methods-for-Prioritizing-Invasive-Plants-in-Protected-Areas--A/10.3375/20-47.short

FPT IAS (Federal-Provincial-Territorial Invasive Alien Species Task Force). (2017). Recommendations to Improve Invasive Alien Species Prevention and Management in Canada. Biodiversity Steering Group. Biodivcanada. Retrieved May 8, 2023, from https://www.biodivcanada.ca/national-biodiversity-strategy-and-action-plan/other-related-strategies/recommendations-of-the-invasive-alien-species-task-force

Frid, L., D. Knowler, C. Murray, J. Myers, & L. Scott. (2009). Economic Impacts of Invasive Plants in British Columbia. Prepared for the Invasive Plant Council of BC by ESSA Technologies Ltd., Vancouver, BC. IPCBC Rep. #12. 105 pp. Retrieved May 8, 2023, from http://rem-main.rem.sfu.ca/papers/knowler/Report12_Econ_Impacts.pdf

Frost, C., Allen, W., Courchamp, F., Jeschke, J., Saul, W., & Wardle, D (2019). Using Network Theory to Understand and Predict Biological Invasions. Trends in Ecology & Evolution, 34. Retrieved May 8, 2023, from https://www.biodiversitydynamics.fr/wp-content/uploads/2020/01/Network.pdf

Fryer, Janet L. (2010). Ailanthus altissima. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Retrieved May 8, 2023, from https://www.fs.usda.gov/database/feis/plants/tree/ailalt/all.html

Fulling, E. (1943). Plant life and the law of man. IV. Barberry, currant, and gooseberry, and cedar control. Botanical Review. 9(8): 483-592. Retrieved May 8, 2023, from https://www.jstor.org/stable/4353292

Gagliardi, J., & Brand, M. (2007). Connecticut Nursery and Landscape Industry Preferences for Solutions to the Sale and Use of Invasive Plants. HortTechnology. 17. 10.21273/HORTTECH.17.1.39. Retrieved May 8, 2023, from https://journals.ashs.org/horttech/view/journals/horttech/17/1/article-p39.xml

Gantz, C.A., Mandrak, N.E., & Keller, R.P. (2013). Application of an Aquatic Plant Risk Assessment to Non-Indigenous Freshwater Plants in Trade in Canada. Canadian Science Advisory Secretariat (CSAS). Retrieved May 8, 2023, from https://waves-vagues.dfo-mpo.gc.ca/library-bibliotheque/361289.pdf

Gardiner, A. (2022). Hottest Gardening Trends for Summer 2022, According to Experts. Newsweek 4/16/2022. Retrieved May 8, 2023, from https://www.newsweek.com/gardening-trends-summer-2022-wild-biodiversity-bees-1696281

Gardner, A., Allan, B., Frisbie, L., & Muturi, E. (2015). Asymmetric effects of native and exotic invasive shrubs on ecology of the West Nile virus vector *Culex pipiens* (*Diptera: Culicidae*)," Parasites & Vectors. https://parasitesandvectors.biomedcentral.com/articles/10.1186/s13071-015-0941-z

Glanzing, A., McLachlan, K., & Kessal, O. (2004). Garden Plants that are Invasive Plants of National Importance: an overview of their legal status, commercial availability, and risk status. World Wildlife Fund. Retrieved May 8, 2023, from https://www.semanticscholar.org/paper/Garden-Plants-that-are-Invasive-Plants-of-National-Glanznig-McLachlan/17b49f82330f52fe7ccd605e5947517a7e40b507

Global Invasive Species Database. (2021). Species profile: *Cynanchum rossicum.* Retrieved May 8, 2023, from http://www.iucngisd.org/gisd/speciesname/Cynanchum+rossicum

GNWT (Government of the Northwest Territories Department of Environment and Natural Resources (ENR). (nd) Legislative Initiative: Protected Areas Act. Retrieved May 8, 2023, from https://www.enr.gov.nt.ca/en/services/legislative-initiatives/protected-areas-act

Goehring, D. (2021). NORTH DAKOTA'S NOXIOUS WEED LAW AND REGULATIONS. North Dakoda Agriculture Commissioner. Retrieved May 8, 2023, from https://www.ndda.nd.gov/sites/www/files/documents/files/2021%20Noxious%20Weeds%20Book.pdf

González-Moreno, P., Lazzaro, et al., & Kenis, M. (2019). Consistency of impact assessment protocols for non-native species. NeoBiota 44: 1-25. Retrieved May 8, 2023, from https://doi.org/10.3897/neobiota.44.31650

Gordon, D.R., Gantz, C.A., Jerde, C.L., Chadderton, W.L., Keller, R.P., & Champion, P.D. (2012). Weed Risk Assessment for Aquatic Plants: Modification of a New Zealand System for the United States. PLoS ONE, 7(7). Retrieved May 8, 2023, from https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0040031

Government of Canada. (1995). Canadian biodiversity strategy: Canada's response to the convention on biological diversity 1995. [online]: Retrieved May 8, 2023, from https://publications.gc.ca/collections/collection_2014/ec/En21-134-1995-eng.pdf

Government of Canada. (2004). An Invasive Alien Species Strategy for Canada. Retrieved May 8, 2023, from https://www.canada.ca/en/environment-climate-change/services/biodiversity/invasive-alien-species-strategy.html

Government of Canada, Lindgren, C., & Gauthier, M. (2011). Canadian Invasive Plant Framework: A Collaborative Approach to Addressing Plants in Canada. Winnipeg, Manitoba: Canadian Food Inspection Agency. - not available online. Copy requested from the CFIA Plant Health Directorate.

Government of Canada (2016) Energy Efficiency Regulations, 2016: Regulatory impact analysis statement. Canada Gazette, Part I.150(18). Retrieved May 8, 2023, from https://canadagazette.gc.ca/rp-pr/p1/2016/2016-04-30/html/reg1-eng.html

Government of Canada. (2020). Mandates and Roles of Canadian Federal Food Safety Partners Date modified: 2020-06-25. Retrieved May 8, 2023, from https://science.gc.ca/site/science/en/blogs/cultivating-science/review-state-knowledge-verotoxigenic-escherichia-coli-and-role-whole-genome-sequencing-emerging/mandates-and-roles-canadian-federal-food-safety-partners

Government of Canada. (2022). Understanding the Canadian Environmental Protection Act. Retrieved May 8, 2023, from https://www.canada.ca/en/services/environment/pollution-waste-management/understanding-environmental-protection-act.html

Grice, A., Friedel, M., Marshall, N., & Van Klinken, R. (2011). Tackling Contentious Invasive Plant Species: A Case Study of Buffel Grass in Australia. Environmental management. 49. 285-94. https://www.researchgate.net/publication/51774144_Tackling_Contentious_Invasive_Plant_Species_A_Case_Study_of_Buffel_Grass_in_Australia

Groves, R.H., Boden, R. & Lonsdale, W.M. (2005). 'Jumping the garden fence: invasive garden plants in Australia and their environmental and agricultural impacts'. A CSIRO report for WWF-Australia. Retrieved May 8, 2023, from https://www.spiffa.org.au/uploads/2/6/7/5/2675656/jumping_the_garden_fence.pdf

Halford, M., Heemers, L., Wesemael, D. Mathys, C., Wallens, S., Branquart, E., Vanderhoeven, S., Monty, A., & Mahy, G. (2014). The voluntary Code of conduct on invasive alien plants in Belgium: Results and lessons learned from the AlterIAS LIFE+ project. EPPO Bulletin. 44. Retrieved May 8, 2023, from https://www.researchgate.net/publication/263510474_The_voluntary_Code_of_conduct_on_invasive_alien_plants_in_Belgium_Results_and_lessons_learned_from_the_AlterIAS_LIFE_project

Hanley, Nick & Roberts, Michaela. (2019). The economic benefits of invasive species management. People and Nature. 1. 124-137. Retrieved May 8, 2023, from https://core.ac.uk/download/pdf/296217426.pdf

Harris, S., Elliott, C., Woolnough, A., & Barclay, C. (2018). A heuristic framework for invasive species research planning and measurement. Developing an invasive species research strategy in Tasmania. Record of the Queen Victoria Museum and Art Gallery 117. Launceston, Tasmania, Australia 7250. Retrieved May 8, 2023, from https://www.researchgate.net/publication/329800047_A_heuristic_framework_for_invasive_species_research_planning_and_measurement_Developing_an_invasive_species_research_strategy_in_Tasmania

Harrower C.A., Scalera R., Pagad S., Schonrogge K., & Roy H.E. (2018). Guidance for interpretation of CBD categories on introduction pathways. Convention on Biological Diversity UNEP. Retrieved May 8, 2023, from https://www.cbd.int/doc/c/9d85/3bc5/d640f059d03acd717602cd76/sbstta-22-inf-09-en.pdf

Haubrock, P. (2022). Using the InvaCost project to infer implications of monetary impacts of invasive species in Canada. Invasive Species Centre Conference Feb. 1-3. Session 1-B: Risks, impacts, and innovative solutions. Video begins 23min mark. Retrieved May 8, 2023, from https://www.youtube.com/watch?v=IHfzDQYSz7s&list=PLdxRdOLT-h0htPqmBtXv9eIcZ3suwC0ZL&index=2

Hawkins C.L., Bacher S., Essl F., Hulme P.E., Jeschke J.M., Kühn I., Kumschick S., Nentwig W., Pergl J., Pyšek P., Rabitsch W., Richardson D.M., Vilà M., Wilson J., Genovesi P., & Blackburn T.M. (2015). Framework and guidelines for implementing the proposed IUCN Environmental Impact Classification for Alien Taxa (EICAT). Diversity & Distributions 21(11): 1360–1363. Retrieved May 8, 2023, from https://onlinelibrary.wiley.com/doi/10.1111/ddi.12379

Haye, T., Gariepy, T., Hoelmer, K., Rossi, J., Streito, J., Tassus, X., & Desneux, N. (2015). Range expansion of the invasive brown marmorated stinkbug, *Halyomorpha halys*: an increasing threat to field, fruit, and vegetable crops worldwide. Journal of Pest Science. 5. Retrieved May 8, 2023, from https://www.researchgate.net/publication/275956708_Range_expansion_of_the_invasive_brown_marmorated_stinkbug_Halyomorpha_halys_an_increasing_threat_to_field_fruit_and_vegetable_crops_worldwide

Hayes, K. & Barry, S. (2008). Are there any consistent predictors of invasion success? Biol Inv. Biological Invasions. 10. Retrieved May 8, 2023, from https://www.researchgate.net/publication/225567176_Are_there_any_consistent_predictors_of_invasion_success_Biol_Inv

Health Canada. (2022) Chemical substances fact sheets and frequently asked questions. Retrieved May 8, 2023, from https://www.canada.ca/en/health-canada/services/chemical-substances/fact-sheets.html

Herald, F. (2022). The invasion curve explained. Australia: Invasive Species Council. Retrieved May 8, 2023, from https://invasives.org.au/blog/the-invasion-curve-explained/

Hettinger, N. (2001). Exotic species, naturalisation, and biological nativism. Environmental Values, 10(2), 193–224. Retrieved May 8, 2023, from https://www.semanticscholar.org/paper/Exotic-Species%2C-Naturalisation%2C-and-Biological-Hettinger/f33cf657c4d33d2d006540cac55f7b9025a0a2b9

Hettinger, N. (2021). Understanding and defending the preference for native species. In B. Bovenkerk & J. Keulartz (Eds.), Animals in our midst: The challenges of co-existing with animals in the Anthropocene (pp. 399–424). Springer. Retrieved May 8, 2023, from https://www.researchgate.net/publication/351205815_Understanding_and_Defending_the_Preference_for_Native_Species

Heywood, V., Brunel, S. (2008). Code of conduct on horticulture and invasive alien plants. Convention on the Conservation of European Wildlife and Natural Habitats. Strasbourg. Retrieved May 8, 2023, from https://rm.coe.int/1680746a50

Hobbs, R. J., & Humphries, S.E. (1995). An integrated approach to the ecology and management of plant invasions. Conservation Biology 9:761–770. Retrieved May 8, 2023, from http://www.stoppinginvasives.org/dotAsset/4271e44c-d7bb-4658-9681-47fd99e8ac7c.pdf

Houghton-Thompson, J., Prince, H.H., Smith, J.J., & Hancock, J.F. (2005). Evidence of hybridization between *Lythrum salicaria* (purple loosestrife) and *L. alatum* (winged loosestrife) in North America. Ann Bot. 96(5):877-85. Retrieved May 8, 2023, from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4247054/

Hulme, P. (2011c). Weed risk assessment: A way forward or a waste of time? Journal of Applied Ecology. 49. 10-19. Retrieved May 8, 2023, from https://besjournals.onlinelibrary.wiley.com/doi/10.1111/j.1365-2664.2011.02069.x

Hulme, P. (2011a). Biosecurity: the changing face of invasion biology. Fifty Years of Invasion Ecology – The Legacy of Charles Elton (ed. D.M. Richardson), pp. 301–314. Blackwells, Oxford. Retrieved May 8, 2023, from https://www.esf.edu/efb/parry/502_reading/elton%20at%2050.pdf

Hulme, P. (2011b). Addressing the threat to biodiversity from botanic gardens. Trends in Ecology and Evolution, 26:168-174. Retrieved May 8, 2023, from https://www.sciencedirect.com/science/article/abs/pii/S0169534711000206

Hulme, P.E. (2020). Plant invasions in New Zealand: global lessons in prevention, eradication, and control. Biol Invasions 22:1539–1562. Retrieved May 8, 2023, from https://link.springer.com/article/10.1007/s10530-020-02224-6#citeas

Hulme, P. & Bernard-Verdier, Maud. (2017). Comparing traits of native and alien plants: Can we do better? Functional Ecology. 32. Retrieved May 8, 2023, from https://www.researchgate.net/publication/319346388_Comparing_traits_of_native_and_alien_plants_Can_we_do_better

Hulme, P., Brundu, G., Carboni, M., Dehnen-Schmutz, K., Early, R., Dullinger, S., Essl, F., J., Pyšek, P., Seebens, H., Tanner, R., Touza, J., van Kleunen, M., & Verbrugge, L. (2017). Integrating invasive species policies across ornamental horticulture supply-chains to prevent plant invasions. Journal of Applied Ecology. 55. Retrieved May 8, 2023, from https://www.researchgate.net/publication/318119398_Integrating_invasive_species_policies_across_ornamental_horticulture_supply-chains_to_prevent_plant_invasions

Iannone, B., Carnevale, S., Main, M., Hill, J., McConnell, J., Johnson, S., Enloe, S., Andreu, M., Bell, E. C., Cuda, J. P., & Baker, S. M. (2020). Invasive Species Terminology: Standardizing for Stakeholder Education. The Journal of Extension, 58(3), Article 27. Retrieved May 8, 2023, from https://tigerprints.clemson.edu/cgi/viewcontent.cgi?article=1110&context=joe

Idaho code. Title 22 Agriculture and Horticulture Ch 19 The Idaho Invasive Species Act of 2008. Retrieved May 8, 2023, from https://legislature.idaho.gov/statutesrules/idstat/Title22/T22CH19/

Idaho code. Title 22 Agriculture and Horticulture Ch 19. Noxious Weeds. Retrieved May 8, 2023, from https://legislature.idaho.gov/statutesrules/idstat/Title22/T22CH24/

Idaho gov. (2022a). Invasive species. Retrieved May 8, 2023, from https://invasivespecies.idaho.gov/invasivespecies-overview

Idaho gov. (2022b). Invasive Species of Idaho. Aquatic Plants. Retrieved May 8, 2023, from https://invasivespecies.idaho.gov/aquatic-plants

Idaho gov. (2022c). Invasive Species of Idaho. Terrestrial Plants. Retrieved May 8, 2023, from https://invasivespecies.idaho.gov/terrestrial-plants

IMISWG (Inter-Ministry Invasive Species Working Group). (2014). Invasive Species Strategic Plan. British Columbia. Retrieved May 8, 2023, from https://www2.gov.bc.ca/assets/gov/environment/plants-animals-and-ecosystems/invasive-species/imiswg/prov_is_strategy.pdf?v=1671398208986

Indiana Depart. of Agric. (2019). Terrestrial Plant Rule. Retrieved May 8, 2023, from https://www.in.gov/dnr/rules-and-regulations/invasive-species/terrestrial-invasive-species-plants/

Invasive Species Centre. (2023). Bohemian Knotweed (*Reynoutria* x *bohemica*). Retrieved May 8, 2023, from https://www.invasivespeciescentre.ca/invasive-species/meet-the-species/invasive-plants/bohemian-knotweed/

Invasive Species Centre. (2023). Invasive species in a changing climate. Retrieved May 8, 2023, from https://www.invasivespeciescentre.ca/invasive-species/what-is-at-risk/climate-change/

Invasive.org. (Center for Invasive Species and Ecosystem Health) (2018b). Purple loosestrife *Lythrum salicaria* L. Retrieved May 8, 2023, from https://www.invasive.org/browse/subinfo.cfm?sub=3047

Invasive.org (Center for Invasive Species and Ecosystem Health) (2018). European water chestnut *Trapa natans* L. Retrieved May 8, 2023, from https://www.invasive.org/browse/subinfo.cfm?sub=3499

IPBES (Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Service). (2019a). Nature's dangerous decline 'unprecedented,' species extinction rates 'accelerating'. Life on Land, Press Material. Retrieved May 8, 2023, from https://www.un.org/sustainabledevelopment/blog/2019/05/nature-decline-unprecedented-report/

IPBES (Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Service). (2019b). Summary for policymakers of the global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. Eds. S. Díaz, J. Settele, E. S. Brondízio, H. T. Ngo, M. Guèze, J. Agard, A. Arneth, P. Balvanera, K. A. Brauman, S. H. M. Butchart, K. M. A. Chan, L. A. Garibaldi, K. Ichii, J. Liu, S. M. Subramanian, G. F. Midgley, P. Miloslavich, Z. Molnár, D. Obura, A. Pfaff, S. Polasky, A. Purvis, J. Razzaque, B. Reyers, R. Roy Chowdhury, Y. J. Shin, I. J. Visseren-

Hamakers, K. J. Willis, and C. N. Zayas (eds.). IPBES secretariat, Bonn, Germany. 56 pp. Retrieved May 8, 2023, from https://ipbes.net/global-assessment

IPBES (Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Service). (2019c) Global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. Eds E. S. Brondizio, J. Settele, S. Díaz, H. T. Ngo (IPBES Secretariat, Bonn, Germany), p 1149 pages. Retrieved May 8, 2023, from https://www.ipbes.net/global-assessment

IPBES (Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Service). (2022). Report of the Plenary of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services on the work of its ninth session. Retrieved May 8, 2023, from https://ipbes.net/events/ipbes-9-plenary

IPBES (Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Service). (2023). 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. Roy, H. E., Pauchard, A., Stoett, P., Renard Truong, T., Bacher, S., Galil, B. S., Hulme, P. E., Ikeda, T., Sankaran, K. V., McGeoch, M. A., Meyerson, L. A., Nuñez, M. A., Ordonez, A., Rahlao, S. J., Schwindt, E., Seebens, H., Sheppard, A. W., and Vandvik, V. (eds.). IPBES secretariat, Bonn, Germany. Retrieved Nov 10, 2023, from https://www.ipbes.net/ias

IPPC (International Plant Protection Convention). (1951 revised 1997). Rome: Food and Agriculture Organization (FAO) of the United Nations. Retrieved May 8, 2023, from https://www.ippc.int/en/core-activities/governance/convention-text/

IPPC (The International Plant Protection Convention). (2003). Identification of risks and management of invasive alien species using the IPPC framework. Proceedings of the workshop on invasive alien species and the International Plant Protection Convention, Braunschweig, Germany, 22–26 September 2003. Rome, Italy, FAO. xii + 301 pp. Retrieved May 8, 2023, from https://www.ippc.int/en/publications/2110/

IPPC (The International Plant Protection Convention). (2005). Report of the Seventh meeting of the Interim Commission on Phytosanitary Measures. FAO. Retrieved May 8, 2023, from https://www.ippc.int/static/media/files/publication/en/2016/11/Report_ICPM-7-2005_Apr_2005-11-25.pdf

IPPC (The International Plant Protection Convention). (2012a). The International Plant Protection Convention Generic Flyer. Retrieved May 8, 2023, from https://www.ippc.int/static/media/files/mediakit/IPPCGenericFlyer-en.pdf

IPPC (The International Plant Protection Convention). (2012b). Strategic framework 2012-2019. Retrieved May 8, 2023, from https://www.ippc.int/static/media/files/mediakit/IPPCStrategicFramework-en.pdf

IPPC (The International Plant Protection Convention). (2012c). Internet Trade (e-Commerce) in Plants - Potential Phytosanitary Risks [DRAFT]. Retrieved May 8, 2023, from https://www.ippc.int/largefiles/2013/Internet_trade_of_plants.pdf

IPPC (The International Plant Protection Convention). (2016). Framework for pest risk analysis. IPPC Secretariat, FAO, Rome. Retrieved May 8, 2023, from https://www.ippc.int/static/media/files/publication/en/2016/01/ISPM_02_2007_En_2015-12-22_PostCPM10_InkAmReformatted.pdf

IPPC (The International Plant Protection Convention). (n.d.) Overview. Retrieved May 8, 2023, from https://www.ippc.int/en/about/overview/

ISC (Invasive Species Centre). (2021). Annual Report Fiscal Year 2021. Retrieved May 8, 2023, from https://www.invasivespeciescentre.ca/wp-content/uploads/2021/11/AnnualReport_WEB.pdf

ISCBC (Invasive Species Council of British Columbia). (2017). Invasive Species Britton, W.E., 1930. Regulations Concerning the Transportation of Nursery Stock in the United States and Canada. Connecticut Experimental Station Circular 71. Retrieved May 8, 2023, from https://portal.ct.gov/-/media/CAES/DOCUMENTS/Publications/Circulars/C71pdf.pdf

ISCBC (Invasive Species Council of British Columbia). (2021) Best Management Practices for Parrot's Feather in the Metro Vancouver Region. Metro Vancouver's Regional Planning Advisory Committee. Retrieved May 8,

2023, from www.metrovancouver.org/services/regional-planning/PlanningPublications/ParrotsFeatherBMP.pdf

Isleib, J. (2012). Michigan noxious weed laws, though rarely enforced, define, and regulate prohibited/restricted weeds. Michigan State University Extension. Retrieved May 8, 2023, from https://www.canr.msu.edu/news/michigan_noxious_weed_laws_though_rarely_enforced_define_and_regulate_prohi

ISPM (International Standards for Phytosanitary Measures). (2005). Rome, IPPC, FAO. Retrieved May 8, 2023, from https://www.fao.org/3/a0450e/a0450e.pdf

ISPM (International Standards for Phytosanitary Measures). (2021a). Adopted Standards. Rome, IPPC, FAO. Retrieved May 8, 2023, from https://www.ippc.int/en/core-activities/standards-setting/ispms/

ISPM-1. (2021b). Phytosanitary principles for the protection of plants and the application of phytosanitary measures in international trade. Rome, IPPC, FAO. Retrieved May 8, 2023, from https://www.fao.org/3/j7483e/j7483e.pdf

ISPM-5. (2023c). ISPM 5: Glossary of Terms. Rome, IPPC, FAO. Retrieved May 8, 2023, from https://www.ippc.int/en/publications/622/

ISPM-11. (2021d). ISPM 11. Pest risk analysis for quarantine pests. Rome, IPPC, FAO. Retrieved May 8, 2023, from https://www.ippc.int/en/publications/639/

ISPM-16. (2021e). ISPM 16. Regulated non-quarantine pests: concept and application. Rome, IPPC, FAO. Retrieved May 8, 2023, from https://www.ippc.int/en/publications/605/

IUCN (The International Union for Conservation of Nature). (2022). CONSERVATION TOOL Environmental Impact Classification for Alien Taxa (EICAT). Retrieved May 8, 2023, from https://www.iucn.org/resources/conservation-tool/environmental-impact-classification-alien-taxa-eicat

Jacquart, E.M. (2012). Invasiveness ranking system for non-native plants of Indiana. Unpublished. Invasive Plant Advisory Committee (IPAC) to the Indiana Invasive Species Council, Indianapolis, IN. Retrieved May 8, 2023, from https://www.entm.purdue.edu/iisc/pdf/plants/Ailanthus_altissima.pdf

Janick, J., & Warrington, I. (2005). Ethics and horticulture. Chronica Horticulturae. 55(2). Retrieved May 8, 2023, from https://www.ishs.org/system/files/chronica-documents/ch5502.pdf

Jelincic, D., & Tišma, S. (2020). Ensuring sustainability of cultural heritage through effective public policies. Urbani izziv. 31. 78-87. 10.5379/urbani-izziv-en-2020-31-02-002. Retrieved May 8, 2023, from https://www.researchgate.net/publication/347852464_Ensuring_sustainability_of_cultural_heritage_through_effective_public_policies/citation/download

Jeschke, J., & Starzer, J. (2018). 'Propagule pressure hypothesis.', CABI Invasives Series. CABI International. May 8, 2023, from https://www.cabidigitallibrary.org/doi/abs/10.1079/9781780647647.0147

Johnson, S. B. (2016). Why the polluter pays principle is not a policy panacea for weedy but commercially valuable plant species either. In 20th Australasian Weeds Conference, Perth, Western Australia, 11-15 September 2016 (pp. 309-312). Weeds Society of Western Australia. Retrieved May 8, 2023, from https://caws.org.nz/old-site/awc/2016/awc201613091.pdf

Johnson, S., Cherry, H., & Boorman, D. (2020). Plant Sure: An environmentally safe ornamental plant scheme. Conference: Proceedings of the 19th NSW Weeds Conference At: Armidale, NSW Australia. Retrieved May 8, 2023, from https://www.researchgate.net/publication/341372517_Plant_Sure_An_environmentally_safe_ornamental_plant_scheme

Johnston, E., Piola, R., & Clark, G. (2009). The Role of Propagule Pressure in Invasion Success. 10.1007/978-3-540-79236-9_7. Retrieved May 8, 2023, from https://www.researchgate.net/publication/225247190_The_Role_of_Propagule_Pressure_in_Invasion_Success

Jordan, M.J., G. Moore and T.W. Weldy. (2008). Invasiveness ranking system for non-native plants of New York. Unpublished. The Nature Conservancy, Cold Spring Harbor, NY; Brooklyn Botanic Garden, Brooklyn, NY; The Nature Conservancy, Albany, NY. Retrieved May 8, 2023, from https://nyis.info/wp-content/uploads/20218/01/36162_Ailanthus.altissima.NYS_.pdf

Justo-Hanani, R., & Dayan, T. (2021). Risk regulation and precaution in Europe and the United States: the case of bioinvasion. Policy Sci 54, 3–20. Retrieved May 8, 2023, from https://link.springer.com/article/10.1007/s11077-020-09409-9

Kattge, J., et al. (2011) TRY—A Global Database of Plant Traits. Global Change Biology, 17, 2905-2935. Retrieved May 8, 2023, from https://onlinelibrary.wiley.com/doi/full/10.1111/j.1365-2486.2011.02451.x

Kaushik, P., Pati, P., Khan, & M., Khare, P. (2022). Plant functional traits best explain invasive species' performance within a dynamic ecosystem - A review. Trees Forests and People. 8. Retrieved May 8, 2023, from https://www.sciencedirect.com/science/article/pii/S266671932200067X

Kehoe, R., Frago, E., Sanders, D. (2020). Cascading extinctions as a hidden driver of insect decline. Ecological Entomology, 46. Retrieved May 8, 2023, from https://www.researchgate.net/publication/347275686_Cascading_extinctions_as_a_hidden_driver_of_insect_decline

Keller, R., Lodge, D., & Finnoff, D. (2007). Risk Assessment for Invasive Species Produces Net Bioeconomic Benefits. Proceedings of the National Academy of Sciences of the United States of America, 104, 203-7. Retrieved May 8, 2023, from https://www.researchgate.net/publication/6609403_Risk_Assessment_for_Invasive_Species_Produces_Net_Bioeconomic_Benefits

Keller, R., & Springborn, M. (2013). Closing the Screen Door to New Invasions. Conservation Letters. 7. Retrieved May 8, 2023, from https://conbio.onlinelibrary.wiley.com/doi/pdf/10.1111/conl.12071

Kelly, J. (2012). Horticulture Code of Good Practice. The Northern Ireland Environment Agency and the National Parks and Wildlife Service. Retrieved May 8, 2023, from https://invasivespeciesireland.com/wp-content/uploads/2010/07/Horticulture-Code-Final.pdf

Kenis M, Bacher S, Baker RHA, Branquart E, Brunel S, Holt J, Hulme PE, MacLeod A, Pergl J, Petter F, Pyšek P, Schrader G, Sissons A, Starfinger U, Schaffner U (2012) New protocols to assess the environmental impact of pests in the EPPO decision-support scheme for pest risk analysis. Bulletin OEPP. EPPO Bulletin. European and Mediterranean Plant Protection Organisation 42(1): 21–27. Retrieved May 8, 2023, from https://onlinelibrary.wiley.com/doi/10.1111/j.1365-2338.2012.02527.x

Kendig, A., Canavan, S., Anderson, P., Flory, L., Gettys, L., Gordon, D., III, B., Kunzer, J., Petri, T., Pfingsten, I. & Lieurance, D. (2022). Scanning the horizon for invasive plant threats using a data-driven approach. NeoBiota. 74. 129-154. Retrieved May 8, 2023, from https://www.researchgate.net/publication/362028952_Scanning_the_horizon_for_invasive_plant_threats_using_a_data-driven_approach

Khapugin, A. (2019). A global systematic review of publications concerning the invasion biology of four tree species. Hacquetia. 18. 233–270. Retrieved May 8, 2023, from https://www.researchgate.net/publication/335378717_A_global_systematic_review_of_publications_concerning_the_invasion_biology_of_four_tree_species

Kitajima, K., Fox, A.M., Sato, T.et al. (2006). Cultivar selection prior to introduction may increase invasiveness: evidence from *Ardisia crenata*. Biol Invasions, 8, 1471–1482. Retrieved May 8, 2023, from https://link.springer.com/article/10.1007/s10530-005-5839-9

Kulhanek, A., & Smith, K. (2022). Invasive Species Management: Common and Japanese Barberry. Ohio State Univ. Extension. Retrieved May 8, 2023, from https://ohioline.osu.edu/factsheet/anr-0106

Kumschick, S., Wilson, J.R.U., & Foxcroft, L.C. (2020). A framework to support alien species regulation: the Risk Analysis for Alien Taxa (RAAT). In: Wilson JR, Bacher S, Daehler CC, Groom QJ, Kumschick S, Lockwood JL, Robinson TB, Zengeya TA, Richardson DM. NeoBiota 62: 213-239. Retrieved May 8, 2023, from https://doi.org/10.3897/neobiota.62.51031

Lac Bernard Property Owners Association. (2021). Milfoil. Invasive Aquatic Weeds: Milfoil. (Milfoil Poster). Website. Retrieved May 8, 2023, from http://lacbernard.ca/environment/milfoil.htm

Lafontaine, R., Beudels-Jamar, R., Delsinne, T., & Robert, H. (2013). Risk analysis of the Variable Watermilfoil *Myriophyllum heterophyllum* Michaux. - Risk analysis report of non-native organisms in Belgium from the Royal Belgian Institute of Natural Sciences for the Federal Public Service Health, Food chain safety and

Environment. Retrieved May 8, 2023, from https://www.researchgate.net/publication/266617477_Risk_analysis_of_the_Variable_Watermilfoil_Myriophyllum_heterophyllum_Michaux_-_Risk_analysis_report_of_non-native_organisms_in_Belgium_from_the_Royal_Belgian_Institute_of_Natural_Sciences_for_the_Fed

Laginhas B., Fertakos M., & Bradley B. (2023). We don't know what we're missing: Evidence of a vastly undersampled invasive plant pool. Ecol Appl. 33(2). Retrieved Jan. 16, 2024, from https://esajournals.onlinelibrary.wiley.com/doi/abs/10.1002/eap.2776

Landscape Trades. (2001). CNLA News: Restrictions lifted on Japanese barberry Liebhold. Retrieved May 8, 2023, from https://landscapetrades.com/cnla-news-brrestrictions-lifted-on-japanese-barberry

Leung B., Lodge D., Finnoff D., Shogren A., Lewis M., & Lamberti G. (2002). An ounce of prevention or a pound of cure: bioeconomic risk analysis of invasive species. Proc R Soc Lond B Biol Sci 269:2407–2413. Retrieved May 8, 2023, from https://www.researchgate.net/publication/10978379_An_Ounce_of_Prevention_Or_a_Pound_of_Cure_Bioeconomic_Risk_Analysis_of_Invasive_Species

Lewis, C. (2022). Canada Is Hiding its Inaction Behind Certification. Blog prepared for NRDC (Natural Resources Defense Council). Retrieved May 8, 2023, from https://www.nrdc.org/experts/courtenay-lewis/canada-hiding-its-inaction-behind-certification

Lindgren, C. (2002). Manitoba Purple Loosestrife Project: Partnerships and Initiatives in Alien invaders in Canada's waters, wetlands, and forests. pp. 259- 267. Eds Claudia, R., Nantel, P., & Muckle-Jeffs, E. Canadian Forest Service. Natural Resources Canada, Ottawa, ON. Retrieved May 8, 2023, from https://publications.gc.ca/collections/collection_2014/rncan-nrcan/Fo42-329-2002-eng.pdf

Lindgren, C., & Wilson, C. (2008). Responding to Invasive Plants in Canada (2005–2008). In: Weeds Across Borders 2008 Conference Proceedings of the Weeds Across Borders 2008 Conference May 27–30, 2008 — Banff, Alberta, Canada. Retrieved May 8, 2023, from https://www.researchgate.net/profile/Rodney-Kott/publication/242515912_VEGETATIVE_MANAGEMENT_USING_CONTROLLED_SHEEP_GRAZING_-_THE_MONTANA_SHEEP_INSTITUTE/links/556dcb1908aeab7772262eb5/VEGETATIVE-MANAGEMENT-USING-CONTROLLED-SHEEP-GRAZING-THE-MONTANA-SHEEP-INSTITUTE.pdf#page=19

Lindgren, Cory & Walker, David. (2012). Predicting the Spread of Purple Loosestrife (*Lythrum salicaria*) in the Prairies. Canadian Field-Naturalist. 126. Retrieved May 8, 2023, from https://www.canadianfieldnaturalist.ca/index.php/cfn/article/view/1376

Linske, M., Williams, S., Ward, J., Stafford, K. (2018). Indirect Effects of Japanese Barberry Infestations on White-Footed Mice Exposure to *Borrelia burgdorferi*. Environmental entomology. 47. Retrieved May 8, 2023, from https://www.researchgate.net/publication/325499429_Indirect_Effects_of_Japanese_Barberry_Infestations_on_White-Footed_Mice_Exposure_to_Borrelia_burgdorferi

Livingstone, S.W., Isaac, M.E., Cadotte, M.W. (2020). Invasive dominance and resident diversity: unpacking the impact of plant invasion on biodiversity and ecosystem function Ecological Monographs 90(4). Retrieved May 8, 2023, from https://esajournals.onlinelibrary.wiley.com/doi/abs/10.1002/ecm.1425

Lodge, D.M., Simonin, P.W., Burgiel, S.W., Keller, R.P., Bossenbroek, J.M., Jerde, C.L., Kramer, A.M., Rutherford, E.S., Barnes, M.A., Wittmann, M.E., Chadderton, W.L., Apriesnig, J.L., Beletsky, D., Cooke, R.M., Drake, J.M., Egan, S.P., Finnoff, D.C., Gantz, C.A., Grey, E.K., Hoff, M.H., Howeth, J.G., Jensen, R., Larson, E.R., Mandrak, N.E., Mason, D.M., Martinez, F.A., Newcomb, T.J., Rothlisberger, J.D., Tucker, A.J., Warziniack, T., & Zhang, H. (2016). Risk Analysis and Bioeconomics of Invasive Species to Inform Policy and Management. Annual Review of Environment and Resources, 41, 453-488. Retrieved May 8, 2023, from https://www.annualreviews.org/doi/abs/10.1146/annurev-environ-110615-085532

Lopez, B., Allen, J. M., Dukes, J. S., Lenoir, J., Vilà, M., Blumenthal, D. M., et al. (2022). Global environmental changes more frequently offset than intensify detrimental effects of biological invasions. Proceedings of the National Academy of Sciences, 119(22). Retrieved May 8, 2023, from http://doi.org/10.1073/pnas.2117389119

Ma, J., Clemants, S., & Moore, G. (2009). *Ailanthus altissima* - New York non-native plant invasiveness ranking form. New York State Department of Environmental Conservation. Retrieved May 8, 2023, from https://nyis.info/wp-content/uploads/20218/01/36162_Ailanthus.altissima.NYS_.pdf

Mack, R.N., & Erneberg M. (2002) The United States naturalized flora: largely the product of deliberate introductions. Ann Mo Bot Gard 89:176–189. Retrieved May 8, 2023, from https://www.jstor.org/stable/3298562?origin=crossref

Mack, R.N., & Simberloff D., Lonsdale WM, Evans H, Clout M, Bazzaz FA. (2000) Biotic invasions: causes, epidemiology, global consequences, and control. Ecol Appl 10:689–710. Retrieved May 8, 2023, from https://www.researchgate.net/publication/201999174_Biotic_Invasions_Causes_Epidemiology_Global_Consequences_and_Control

Mack R, Smith M (2011) Invasive plants as catalysts for the spread of human parasites. NeoBiota 9: 13-29. Retrieved May 8, 2023, from https://neobiota.pensoft.net/article/1208/list/9/

Macleod, A., Pautasso, M., Jeger, M., Haines-Young, R. (2010). Evolution of the international regulation of plant pest and challenges for future plant health. Food Security. 2. 10.1007/s12571-010-0054-7. Retrieved May 8, 2023, from https://www.researchgate.net/publication/235751766_Evolution_of_the_international_regulation_of_plant_pest_and_challenges_for_future_plant_health

Maher J, Stringham OC, Moncayo S, Wood L, Lassaline CR, Virtue J, Cassey P (2023) Weed wide web: characterising illegal online trade of invasive plants in Australia. NeoBiota 87: 45-72. Retrieved Dec. 14, 2023, from https://doi.org/10.3897/neobiota.87.104472

Maine Code CMR 01-001 c 273 Criteria for listing invasive terrestrial plants. Retrieved May 8, 2023, from https://www.law.cornell.edu/regulations/maine/department-01/division-001/chapter-273

Maine Code 38 MRSA 419-C Prevention of the spread of invasive aquatic plants Retrieved May 8, 2023, from https://legislature.maine.gov/statutes/38/title38sec419-C.html

Maine Department of Agriculture, Conservation and Forestry. (2021). Invasive Plants. Retrieved May 8, 2023, from https://www.maine.gov/dacf/php/horticulture/invasiveplants.shtml

Maine Department of Agriculture, Conservation and Forestry. (n.d.). Invasive terrestrial plants prohibited from sale in Maine. Retrieved May 8, 2023, from https://www.maine.gov/dacf/php/horticulture/documents/InvasivePlantPoster.pdf

Maine Department of Environmental Protection. (2019). Materials and Maine Laws involving Invasive Aquatic Plants. Retrieved May 8, 2023, from https://www.maine.gov/dep/water/invasives/invmaterial.html

Maine Department of Environmental Protection. (2019). Water Gardeners and Aquarium Owners. Retrieved May 8, 2023, from https://www.maine.gov/dep/water/invasives/invaquarium.html

Manitoba government. (2017). Controlling Noxious Weeds. Retrieved May 8, 2023, from https://www.gov.mb.ca/agriculture/crops/weeds/pubs/controlling-noxious-weeds.pdf

Manitoba The Noxious Weeds Act, CCSM c N110. Retrieved May 8, 2023, from https://web2.gov.mb.ca/laws/regs/current/_pdf-regs.php?reg=42/2017

Manitoba Water Protection Act (C.C.S.M. c. W65) Retrieved May 8, 2023, from https://web2.gov.mb.ca/laws/regs/current/_pdf-regs.php?reg=173/2015

Marson, D., Cudmore, B., Drake, D., & Mandrak, N. (2009a). Summary of a survey of aquarium owners in Canada. Can. Manuscr. Rep. Fish. Aquat. Sci. 2905: iv + 20 p. Retrieved May 8, 2023, from https://waves-vagues.dfo-mpo.gc.ca/library-bibliotheque/339425.pdf

Marson, D., Cudmore, B., Drake, D., & Mandrak, N. (2009b). Summary of a survey of water garden owners in Canada. Can. Manuscr. Rep. Fish. Aquat. Sci. 2906: v + 23 p. Retrieved May 8, 2023, from https://waves-vagues.dfo-mpo.gc.ca/library-bibliotheque/339424.pdf]

Martin P, Verbeek M, Thomson S, Martin J, (2005) The costs and benefits of a proposed mandatory invasive species labelling scheme, a discussion paper prepared for WWF-Australia by the Australian Centre for Agriculture and Law, University of New England. WWF-Australia, Sydney. 30 pp. Retrieved May 8, 2023,

from https://rune.une.edu.au/web/handle/1959.11/1054 (The following opens pdf). https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&ved=2ahUKEwiS5YKtv8r8AhXymGoFHczRDsYQFnoECAcQAQ&url=https%3A%2F%2Fwww.wwf.org.au%2FArticleDocuments%2F353%2Fpub-invasive-species-mandatory-labelling-scheme-1sep05.pdf.aspx&usg=AOvVaw2JN5FmKqElCbMHRA3tFYBt

Maryland Dept. of Agric. (2020). Invasive Plant List. Retrieved May 8, 2023, from https://mda.maryland.gov/plants-pests/Documents/Invasive-Plant-List-March-2020.pdf

Maryland Dept. Agriculture. (2019). Weed Risk Assessment for *Aralia elata* (Miq.) Seem. (*Araliaceae*) – Japanese angelica tree. Retrieved May 8, 2023, from https://mda.maryland.gov/plants-pests/Documents/Aralia-Elata-Maryland-Weed-Risk-Assessment.pdf

Maryland Dept. of Agric. (2019). Weed Risk Assessment for *Berberis thunbergii* DC (*Berberidaceae*) – Japanese barberry. Retrieved May 8, 2023, from https://mda.maryland.gov/plants-pests/Documents/Berberis-Thunbergii-Maryland-Weed-Risk-Assessment.pdf

Marzono, M., Dunn, M., Green, S. (2021). Perceptions of biosecurity-based accreditation in the plant trade: a UK example. Forests. 12(12): 1741. Retrieved May 8, 2023, from https://cdn.forestresearch.gov.uk/2015/11/nursery_accreditation_2021.pdf

Massachusetts government. (2021). Prohibited Plant List - FAQ Frequently Asked Questions about the Massachusetts Prohibited Plant List. Retrieved May 8, 2023, from https://www.mass.gov/service-details/prohibited-plant-list-faq

Massachusetts government. (2022). Massachusetts Prohibited Plant List. Retrieved May 8, 2023, from https://www.mass.gov/massachusetts-prohibited-plant-list

Master Gardeners of Ontario (MGOI). (2024). Website. Retrieved April 3, 2024, from https://mgoi.ca

Master Gardeners of Ontario (MGOI) Facebook Group (2024) Retrieved April 3, 2024, from https://www.facebook.com/groups/MasterGardenersofOntario/

Mathiesen, K. 2016. Australia's worst invasive plant species available for import on Amazon and eBay. The Guardian. May 23. Retrieved May 8, 2023, from https://www.theguardian.com/environment/2016/may/23/australias-worst-invasive-species-available-for-import-on-amazon-and-ebay

Maurel, N., Hanspach, J., Kuhn, I., Pyšek, P. & Kleunen, M. van. (2016). Introduction bias affects relationships between the characteristics of ornamental alien plants and their naturalization success. Global Ecology and Biogeography 25, 1500–1509. Retrieved May 8, 2023, from https://www.researchgate.net/publication/308647854_Introduction_bias_affects_relationships_between_the_characteristics_of_ornamental_alien_plants_and_their_naturalization_success

McClay, Alec. (2012). Revising Alberta's Provincial Weeds List: Experiences and Lessons Learned. Retrieved May 8, 2023, from https://www.researchgate.net/publication/260907986_Revising_Alberta%27s_Provincial_Weeds_List_Experiences_and_Lessons_Learned

McGeoch, M.A., Genovesi, P., Bellingham, P.J., Costello, J., McGrannachan, C., & Sheppard, A. (2016). Prioritizing species, pathways, and sites to achieve conservation targets for biological invasion. Biol Invasions 18, 299–314. Retrieved May 8, 2023, from https://link.springer.com/article/10.1007/s10530-015-1013-1

McGrannachan C.M., Pagad S., & McGeoch M.A. (2021) A multiregional assessment of transnational pathways of introduction. NeoBiota 64: 43–67. Retrieved May 8, 2023, from https://doi.org/10.3897/neobiota.64.60642

Mcneish, R., & McEwan, R. (2016). A review on the invasion ecology of Amur honeysuckle (*Lonicera maackii, Caprifoliaceae*) a case study of ecological impacts at multiple scales. The Journal of the Torrey Botanical Society. 143. 367-385. Retrieved May 8, 2023, from https://www.researchgate.net/publication/305786297_A_review_on_the_invasion_ecology_of_Amur_honeysuckle_Lonicera_maackii_Caprifoliaceae_a_case_study_of_ecological_impacts_at_multiple_scales

M.E.A. (Millennium Ecosystem Assessment). (2005). A Report of the Millennium Ecosystem Assessment. Ecosystems and Human Well-Being. Island Press, Washington DC. Retrieved May 8, 2023, from https://www.millenniumassessment.org/documents/document.356.aspx.pdf

Mengist, W., Soromessa, T. & Feyisa, G.L. (2020). A global view of regulatory ecosystem services: existed knowledge, trends, and research gaps. Ecol Process 9(40). Retrieved May 8, 2023, from https://ecologicalprocesses.springeropen.com/articles/10.1186/s13717-020-00241-w#citeas

Meyerson, L., Pauchard, A., Brundu, G., Carlton, J., Hierro, J., Kueffer, C., Pandit, M., Pyšek, P., Richardson, D., & Packer, J. (2022). Moving Toward Global Strategies for Managing Invasive Alien Species. Retrieved May 8, 2023, from http://www.lib.udec.cl/wp-content/uploads/2022/08/Meyerson_et_al_2022.pdf

Michigan code Natural Resources and Environmental Protection Act (excerpt) Act 451 of 1994 PART 413 Transgenic and Nonnative Organisms. Retrieved May 8, 2023, from www.legislature.mi.gov/(S(dol44qjsrrieya45sgjptg45))/documents/mcl/pdf/mcl-451-1994-III-2-1-WILDLIFE-CONSERVATION-413.pdf

Michigan code Seed Law Act 329 of 1965. Retrieved May 8, 2023, from https://www.legislature.mi.gov/documents/mcl/pdf/mcl-Act-329-of-1965.pdf

Michigan code Regulation No. 715 - Seed Law Implementation Section R. 285.715.7 - Prohibited and restricted noxious weeds. Retrieved May 8, 2023, from https://casetext.com/regulation/michigan-administrative-code/department-agriculture-and-rural-development/pesticide-and-plant-pesticide-management-division/regulation-no-715-seed-law-implementation

Michigan Dept. of Agri. and Rural Development. (2016). Weed Risk Assessment for *Lythrum salicaria* L. (*Lythracea*e) – Purple loosestrife. Retrieved May 8, 2023, from https://www.michigan.gov/-/media/Project/Websites/invasives/Documents/ID/Plants/Aquatic/WRA_PurpleLoosestrife.pdf?rev=4054bfd431f448a7861eb04913a81378

Michigan Dept. of Agri. and Rural Development. Weed Risk Assessment for M*yriophyllum spicatum* L. (*Haloragaceae*) – Eurasian watermilfoil. Retrieved May 8, 2023, from https://www.michigan.gov/-/media/Project/Websites/invasives/Documents/ID/Plants/Aquatic/WRA_EurasianWatermilfoil.pdf?rev=0d65f311fd174327849119cf53c81e6c

Michigan gov. Invasive Species: Plants (n.d.). Retrieved May 8, 2023, from https://www.michigan.gov/invasives/id-report/plants

Michigan Invasive Species. (2022). Michigan's Prohibited and Restricted Species. Retrieved May 8, 2023, from https://www.michigan.gov/invasives/id-report/prohibitedrestricted

Michigan Invasive Species State laws and regulations. Retrieved May 8, 2023, from https://www.michigan.gov/invasives/laws/state-laws-and-regulations

Migratory Birds Convention Act, 1994, SC 1994, c 22. Retrieved May 8, 2023, from https://www.canlii.org/en/ca/laws/stat/sc-1994-c-22/latest/sc-1994-c-22.html

Minnesota code Agriculture Chapter 18 Noxious Weed Law 2020 Retrieved May 8, 2023, from https://www.revisor.mn.gov/statutes/2022/cite/18?keyword_type=all&keyword_sg=statute&keyword=weeds

Minnesota code Conservation Chapter 84D Invasive. Species Retrieved May 8, 2023, from https://www.revisor.mn.gov/statutes/cite/84D

Minnesota Department of Agriculture. (2022a). Japanese Barberry. Retrieved May 8, 2023, from https://www.mda.state.mn.us/plants/pestmanagement/weedcontrol/noxiouslist/japanesebarberry

Minnesota Dept. of Natural Resources. (2022a) Minnesota invasive species laws. Retrieved May 8, 2023, from https://www.dnr.state.mn.us/invasives/laws.html

Minnesota Department of Agriculture. (2022b). Minnesota Noxious Weed Law. Retrieved May 8, 2023, from https://www.mda.state.mn.us/plants/pestmanagement/weedcontrol/fsmnwp

Minnesota Department of Agriculture. (2022c). Minnesota Noxious Weed List. Retrieved May 8, 2023, from https://www.mda.state.mn.us/plants-insects/minnesota-noxious-weed-list

Miteva, D., Fortmann, L., & McNab, R. (2021). Beyond the Traditional: Voluntary Market-Based Initiatives to Promote Land Tenure Security. Retrieved May 8, 2023, from https://link.springer.com/chapter/10.1007/978-3-030-81881-4_13

Mogomotsi, G., Mogomotsi, P., & O Moeti, O. (2022). WTO Law and Jurisprudence on Invasive Alien Species in the Global South, Chinese Journal of Environmental Law, 6(1), 63-86. Retrieved May 8, 2023, from https://brill.com/view/journals/cjel/6/1/article-p63_3.xml?ebody=pdf-60564

Monahan, K., McFatridge, S., & Whittaker-Cumming A. (2018). Do environmental regulations cost as much as we think they do? Smart Prosperity Institute. Retrieved May 8, 2023, from https://institute.smartprosperity.ca/sites/default/files/regulations-2018december-10.pdf

Montana code Title 80 Agriculture subch 4.5.2. Designation of Noxious Weeds. Retrieved May 8, 2023, from https://rules.mt.gov/gateway/ChapterHome.asp?Chapter=4%2E5

Montana code Title 80 Agriculture Ch 7 Disease, pest and weed control. Retrieved May 8, 2023, from https://leg.mt.gov/bills/mca/title_0800/chapter_0070/parts_index.html

Montana gov. (nd) Aquatic Noxious Weed Program. Retrieved May 8, 2023, from https://agr.mt.gov/Topics/N-P/Noxious-Weeds-Pages/Aquatic-Invasive-Species-Program

Montana gov. (2019). Montana Noxious Weed List. Retrieved May 8, 2023, from https://agr.mt.gov/_docs/weeds-docs/2019-Montana-Noxious-Weed-List.pdf

Montana State University Extension. (2022). Montana Noxious Weed Information. Retrieved May 8, 2023, from https://www.montana.edu/extension/invasiveplants/noxioussub.html

Moody, M., Palomino, N., Weyl, P., Coetzee, J., Newman, R., Harms, N., Liu, X., & Thum, R. (2016). Unraveling the biogeographic origins of the Eurasian watermilfoil (*Myriophyllum spicatum*) invasion in North America. American Journal of Botany. 103. 10.3732/ajb.1500476. Retrieved May 8, 2023, from https://www.researchgate.net/publication/299541532_Unraveling_the_biogeographic_origins_of_the_Eurasian_watermilfoil_Myriophyllum_spicatum_invasion_in_North_America

Moravcová, L., Pyšek, P., Jarošík, V. & Pergl, J. (2015). Getting the Right Traits: Reproductive and Dispersal Characteristics Predict the Invasiveness of Herbaceous Plant Species. PloS one. 10. Retrieved May 8, 2023, from https://www.researchgate.net/publication/275357926_Getting_the_Right_Traits_Reproductive_and_Dispersal_Characteristics_Predict_the_Invasiveness_of_Herbaceous_Plant_Species

Morse, L.E., J.M. Randall, N. Benton, R. Hiebert, & S. Lu. 2004. An Invasive Species Assessment Protocol: Evaluating Non-Native Plants for Their Impact on Biodiversity. Version 1. NatureServe, Arlington, Virginia. Retrieved May 8, 2023, from https://www.natureserve.org/sites/default/files/invasive_species_assessment_protocol.pdf

Mumford J, Booy O, Baker RMA et al (2010) Invasive non-native species risk assessment in Great Britain. Aspects Appl Biol 104:49–54. Retrieved May 8, 2023, from https://www.researchgate.net/publication/283413548_Invasive_species_risk_assessment_in_Great_Britain

Murphy H.T., & van Leeuwen S. (2021). Biodiversity: Invasive species, problematic native species, and diseases. In: Australia State of the environment 2021, Australian Government Department of Agriculture, Water and the Environment, Canberra. Retrieved May 8, 2023, from https://soe.dcceew.gov.au/biodiversity/pressures/invasive-species-problematic-native-species-and-diseases

NAPPO (North American Plant Protection Organization). (2008) Invasive Species Panel. Pre-Import Invasiveness Screening of Plants for Planting Discussion Paper. Retrieved May 8, 2023, from https://nappo.org/application/files/4215/8341/5783/DD_01_IS-ScreeningTool-15-07-09-e.pdf

NAPPO (North American Plant Protection Organization). (2011a). Discussion Documents: DD 02: Climate Change and Pest Risk Analysis. Retrieved May 8, 2023, from https://nappo.org/application/files/8015/8341/5785/DD_03_NAPPO_IAS_Discussion_Doc_03_12-07-2012-e.pdf

NAPPO (North American Plant Protection Organization). (2011b). Discussion Documents: DD 03: The Role of the North American Plant Protection Organization in Addressing Invasive Alien Species. Retrieved May 8,

2023, from https://nappo.org/application/files/8015/8341/5785/DD_03_NAPPO_IAS_Discussion_Doc_03_12-07-2012-e.pdf

NAPPO (North American Plant Protection Organization). (2022a). Introduction to NAPPO. Retrieved May 8, 2023, from https://nappo.org/english/about-us/introduction-nappo

NAPPO (North American Plant Protection Organization). (2022b). North American Plant Protection Organization Strategic Plan for 2022-2026. Retrieved May 8, 2023, from https://nappo.org/application/files/8616/5790/1282/20220713_-_NAPPO_Strategic_Plan_2022-2026_final-e.pdf

NAPPO. (2023) Regional Standards for Phytosanitary Measures. Retrieved May 8, 2023, from https://nappo.org/english/products/regional-standards-phytosanitary-measures-rspm

National Horticulture Invasive Plant Working Group. (2019). A cooperative initiative with National Horticultural Invasive Plants Working, Canadian Society of Landscape Architects, Canadian Nursery Landscape Association Retrieved May 8, 2023, from https://canadainvasives.ca/wp-content/uploads/2019/06/2019-01-16_CCIS_Code_of_Conduct_FINAL.pdf

National Invasive Species Information Center, Saltcedar, n.d. Retrieved May 8, 2023, from https://www.invasivespeciesinfo.gov/terrestrial/plants/saltcedar

National Wildlife Federation. (n.d.) Ecosystem Services. Merrifield, VA. Retrieved May 8, 2023, from https://www.nwf.org/Educational-Resources/Wildlife-Guide/Understanding-Conservation/Ecosystem-Services#:~:text=Ecosystems%20themselves%20couldn%27t%20be,alone%20whole%20ecosystems%20and%20people

Natural Resource Council (NRC) (2002) Predicting invasions of nonindigenous plants and plant pests. National Academy Press, Washington. Retrieved May 8, 2023, from https://books.google.ca/books?hl=en&lr=&id=HmmdAgAAQBAJ&oi=fnd&pg=PT19&ots=19sHf77Z_-&sig=7ZFFece_EkDa7fjT6v_OUv7m9ac&redir_esc=y#v=onepage&q&f=false

Natural Resources Canada. (2017). The State of Canada's Forests: Annual Report 2017. Canadian Forestry Service. Retrieved May 8, 2023, from https://cfs.nrcan.gc.ca/pubwarehouse/pdfs/38871.pdf

Natural Resources Canada. (2022). The State of Canada's Forests: Annual Report 2022. Canadian Forestry Service. Retrieved May 8, 2023, from https://www.nrcan.gc.ca/sites/nrcan/files/forest/sof2022/SoF_Annual2022_EN_access.pdf

NatureServe Canada. (2023) Website: About; Invasive Species Impact Rank Retrieved May 8, 2023, from https://www.natureserve.org/canada

Naylor, M. 2003. Water Chestnut (Trapa natans) in the Chesapeake Bay Watershed: A Regional Management Plan. Maryland Department of Natural Resources. Retrieved May 8, 2023, from www.midatlanticpanel.org/wp-content/uploads/2016/04/waterchestnut_122003.pdf

Nentwig W, Kühnel E, Bacher S (2010) A generic impact-scoring system applied to alien mammals in Europe. Conservation Biology 24(1): 302–311. https://www.researchgate.net/publication/26672739_A_Generic_Impact-Scoring_System_Applied_to_Alien_Mammals_in_Europe

Nentwig, W., Bacher, S., Pyšek, P., Vilà, M., & Kumschick, S. (2016) The generic impact scoring system (GISS): a standardized tool to quantify the impacts of alien species. Environmental Monitoring and Assessment. 188: 1–13. Retrieved May 8, 2023, from https://www.researchgate.net/publication/301740972_The_generic_impact_scoring_system_GISS_a_standardized_tool_to_quantify_the_impacts_of_alien_species

New Brunswick Plant Health Act, SNB 1998, c P-9.01. Retrieved May 8, 2023, from https://www.canlii.org/en/nb/laws/stat/snb-1998-c-p-9.01/latest/snb-1998-c-p-9.01.html

New Brunswick Weed Control act, RSNB1973, Ch W-7, [Repealed, spent or not in force]. Retrieved May 8, 2023, from https://www.canlii.org/en/nb/laws/astat/snb-1969-c-21/latest/snb-1969-c-21.html#noteup

New Hampshire Code Invasive Species Act ch 88 HB 1258-FN. Retrieved May 8, 2023, from https://www.chesapeakenetwork.org/wp-content/uploads/2013/11/NH-statute-re-ISC-HB-1258-FN.pdf

New Hampshire Code ch Agr 3802.1. Invasive Species rule. Retrieved May 8, 2023, from https://www.gencourt.state.nh.us/rules/state_agencies/agr3800.html

New Hampshire Code Admin. R. Env-Wq 1302.06 Exotic aquatic weeds. Retrieved May 8, 2023, from https://www.des.nh.gov/sites/g/files/ehbemt341/files/documents/2020-01/Env-Wq%201300.pdf

New Hampshire Code Title L – Water Management and Protection ch 487 Control of Marine Pollution and Aquatic growth. Retrieved May 8, 2023, from https://law.justia.com/codes/new-hampshire/2016/title-l/chapter-487/

New Hampshire Dept. of Agri. Markets & Food Plant. (2014). Invasive Plants. Retrieved May 8, 2023, from https://www.agriculture.nh.gov/divisions/plant-industry/invasive-plants.htm

New Hampshire Dept. of Agri. Markets & Food. (2017). Fact Sheet: New Hampshire Prohibited Invasive Plant Species Rules, Agric 3800. Retrieved May 8, 2023, from https://www.agriculture.nh.gov/publications-forms/documents/prohibited-invasive-species.pdf

New Hampshire Dept. of Agri., Markets & Food (2017). Prohibited Invasive Plant Species Rules, Agric 3800. Retrieved May 8, 2023, from https://www.agriculture.nh.gov/publications-forms/documents/prohibited-invasive-species.pdf

New Hampshire Dept. of Environmental Services. (2019). Law Prohibits Exotic Aquatic Plants. Retrieved May 8, 2023, from https://www.des.nh.gov/sites/g/files/ehbemt341/files/documents/2020-01/bb-40.pdf

New York Invasive Species Council. (2010). A Regulatory System for Non-Native Species. Retrieved May 8, 2023, from https://www.dec.ny.gov/docs/lands_forests_pdf/invasive062910.pdf

New York Invasive Species Program. (2014). New York State Prohibited and Regulation Invasive Plants. Cornell University. Retrieved May 8, 2023, from https://www.dec.ny.gov/docs/lands_forests_pdf/isprohibitedplants2.pdf

New York Code Aquatic Invasive Species (AIS) Spread Prevention regulation 6 CRR-NY V C 576. Retrieved May 8, 2023, from https://govt.westlaw.com/nycrr/Browse/Home/NewYork/NewYorkCodesRulesandRegulations?guid=I8b66f3801eb611e6953efe3aa3ee32e4&originationContext=documenttoc&transitionType=Default&contextData=(sc.Default)

New York Code Prohibited and Regulated Invasive Species 6 CRR-NY V C 575. Retrieved May 8, 2023, from https://govt.westlaw.com/nycrr/Browse/Home/NewYork/NewYorkCodesRulesandRegulations?guid=Ie8d3e7b0339611e4baa20000845b8d3e&originationContext=documenttoc&transitionType=Default&contextData=(sc.Default)&bhcp=1

New York Dept. of Environmental Conservation. (2016). Invasive Species Regulations. Retrieved May 8, 2023, from https://www.dec.ny.gov/animals/99141.html

New York Dept. of Environmental Conservation (2014) New York State Prohibited and Regulated Invasive. Retrieved May 8, 2023, from https://www.dec.ny.gov/docs/lands_forests_pdf/isprohibitedplants2.pdf

New York Dept. of Environmental Conservation. (2014). 6 NYCRR Part 575 Prohibited and Regulated Invasive Species. Retrieved May 8, 2023, from https://www.dec.ny.gov/docs/lands_forests_pdf/islist.pdf

Newfoundland Labrador Dept. of Environment and Conservation. (n.d.). Exotic Species Regulations: Travel, Possession, and Import. [flyer]. Retrieved May 8, 2023, from https://www.gov.nl.ca/ffa/files/wildlife-biodiversity-invasive-alien-species-travel-possession-import-brochure.pdf

Newfoundland and Labrador Fisheries, Forestry and Agriculture. (2008). Exotic and Invasive Alien Species Workshop National Initiatives Presentations. On NL-FFA webportal. Retrieved May 8, 2023, from https://www.gov.nl.ca/ffa/publications/wildlife/#exoticworkshop Downloadable presentations:

- CFIA Canadian Invasive Plant Framework (1.4 MB)
- Canadian Wildlife Service Canada's Invasive Alien Species Strategy (1.5 MB)
- NL Canadian Wildlife Service Invasive Alien Species Partnership Program (1.5 MB)
- NL Wildlife Division, Department of Environment and Climate Change Legislation Review: Invasive Alien Species1.3 MB).

Newfoundland and Labrador Plant Protection Act RSNL1990 CHAPTER P-16. Retrieved May 8, 2023, from https://www.assembly.nl.ca/legislation/sr/statutes/p16.htm#3_

New Zealand Ministry for Primary Industries. (n.d.) Importing plants, flowers, seeds, and plant-growing products Importing plants, flowers, seeds, and plant-growing product. Retrieved May 8, 2023, from https://www.mpi.govt.nz/import/plants-flowers-seeds-plant-growing-products/

New Zealand Ministry for Primary Industries. (2020). Fees and charges when importing nursery stock. Retrieved May 8, 2023, from https://www.mpi.govt.nz/import/plants-flowers-seeds-plant-growing-products/nursery-stock/fees-and-charges-when-importing-nursery-stock/

Ng, K. (2021). Planet-friendly gardening: How small changes can make a huge difference. Independent. Dec. 17, 2021. Retrieved May 8, 2023, from https://www.independent.co.uk/climate-change/sustainable-living/gardening-trends-2022-planet-friendly-b1978261.html

Ni, Ming. 2022. Herbarium records reveal multiple phases in the relationship between minimum residence time and invasion ranges of alien plant species. Plants People Planet. Retrieved May 8, 2023, from https://www.researchgate.net/publication/363413844_Herbarium_records_reveal_multiple_phases_in_the_relationship_between_minimum_residence_time_and_invasion_ranges_of_alien_plant_species

Ni, M., Deane, D., Li, S., Wu, Y., Sui, X., Xu, H., Chu, C., He, F., & Fang, S. (2021). Invasion success and impacts depend on different characteristics in non-native plants. Diversity and Distributions. 27. 1-14. Retrieved May 8, 2023, from https://onlinelibrary.wiley.com/doi/full/10.1111/ddi.13267

Niemiera A., & Holle B. (2009) Invasive Plant Species and the Ornamental Horticulture Industry. In: Inderjit (eds) Management of Invasive Weeds. Invading Nature – Springer Series in Invasion Ecology, vol 5. Springer, Dordrecht. Retrieved May 2023, https://www.researchgate.net/publication/226980189_Invasive_Plant_Species_and_the_Ornamental_Horticulture_Industry

Niemiera, A.X., & Phillips, G. (2006). The invasive plant debate: a horticulture perspective. Horticultural Reviews 32, 379–445. Retrieved May 8, 2023, from https://sciences.ucf.edu/biology/vonholle/wp-content/uploads/sites/4/2013/03/Niemiera_VonHolle_2010-1.pdf

Nixon, L., Leach, H., Barnes, C., Urban, J., Kirkpatrick, D., Ludwick, D., Short, B., Pfeiffer, D., & Leskey, T. (2020). Development of Behaviorally Based Monitoring and Biosurveillance Tools for the Invasive Spotted Lanternfly (Hemiptera: *Fulgoridae*). Environmental entomology. 49. Retrieved May 8, 2023, from https://academic.oup.com/ee/article/49/5/1117/5895233

North Dakoda code ND CC § 4.1-47-02 Noxious Weed Control. Retrieved May 8, 2023, from https://casetext.com/statute/north-dakota-century-code/title-41-agriculture/chapter-41-47-noxious-weed-control

North Dakoda (2022). Noxious Weeds. Retrieved May 8, 2023, from https://www.ndda.nd.gov/divisions/plant-industries/noxious-weeds

Northwest Territories. Protected Areas Act, SNWT 2019, c 11. Retrieved May 8, 2023, from https://www.canlii.org/en/nt/laws/stat/snwt-2019-c-11/latest/snwt-2019-c-11.html

Nova Scotia Agricultural Weed Control Act R.S.N.S. 1989, c. 501. Retrieved May 8, 2023, from https://www.canlii.org/en/ns/laws/stat/rsns-1989-c-501/latest/rsns-1989-c-501.html

Nova Scotia Weed Control Regulations, NS Reg 57/68. Retrieved May 8, 2023, from https://novascotia.ca/just/regulations/regs/WControl.htm

Nunavut Government. (2010). Non-Native and Invasive Species in Nunavut. Government of Nunavut and Environment Canada. Retrieved Nov. 27, 2023, from http://www.gov.nu.ca/sites/default/files/brochure_english_jan31-4_1.pdf

Nunavut Wildlife Act, SNu 2003, c 26. Retrieved May 8, 2023, from https://www.canlii.org/en/nu/laws/stat/snu-2003-c-26/latest/snu-2003-c-26.html

O'Loughlin L. S., & Green P. T. (2017). Secondary invasion: When invasion success is contingent on other invaders altering the properties of recipient ecosystems. Ecology and Evolution. 7(19):7628-7637. Retrieved May 8,

2023, from https://www.researchgate.net/publication/319163379_Secondary_invasion_When_invasion_success_is_contingent_on_other_invaders_altering_the_properties_of_recipient_ecosystems

Oh, D., Kowalkski, K., Quach, Q., Wijesinghege, C., Tanford, P., Dassanayake, M., & Clay, K. (2022). Novel genome characteristics contribute to the invasiveness of Phragmites australis (common reed). Molecular Ecology 31(4), 1142-1159. Retrieved May 8, 2023, from https://onlinelibrary.wiley.com/doi/full/10.1111/mec.16293

Ohio code Rule 901:5-30-01 | Invasive Plant Species. Retrieved May 8, 2023, from https://codes.ohio.gov/ohio-administrative-code/rule-901:5-30-01

Ohio code Rule 901:5-37-01 | Prohibited noxious weeds. Retrieved May 8, 2023, from https://codes.ohio.gov/ohio-administrative-code/rule-901:5-37-01

Office of the Auditor General of Ontario. (2019). 2019 Spring Reports of the Commissioner of the Environment and Sustainable Development to the Parliament of Canada Report 1—Aquatic Invasive Species. Retrieved May 8, 2023, from https://www.oag-bvg.gc.ca/internet/English/parl_cesd_201904_01_e_43307.html

Office of the Auditor General of Ontario. (2022). Value-for-Money Audit: Management of Invasive Species. Toronto, Ontario. Retrieved May 8, 2023, from https://www.auditor.on.ca/en/content/annualreports/arreports/en22/ENV_ProvMgmtInvasiveSpecies_en22.pdf?fbclid=IwAR1iUK2bQEPOCWebU9xaztnV0Bp60B02Tq4yl-tGVTuMUCVqI3TAQWuazgo

Olden, J., Chen, K., García-Berthou, E., King, A., South, J., & Vitule, J. (2021). Invasive Species in Streams and Rivers. Retrieved May 8, 2023, from https://www.researchgate.net/publication/355787312_Invasive_Species_in_Streams_and_Rivers

Ontario *Invasive Species Act*, 2015, SO 2015, c. Retrieved May 8, 2023, from https://www.canlii.org/en/on/laws/stat/so-2015-c-22/latest/so-2015-c-22.html

Ontario General, O Reg 354/16.[Invasive Species to Which the Invasive Species Act Applies] Retrieved May 8, 2023, from https://www.canlii.org/en/on/laws/regu/o-reg-354-16/latest/o-reg-354-16.html

Ontario General, RRO 1990, Reg 1096 [designated as noxious weeds]. Retrieved May 8, 2023, from https://www.canlii.org/en/on/laws/regu/o-reg-354-16/latest/o-reg-354-16.html https://www.canlii.org/en/on/laws/regu/rro-1990-reg-1096/latest/rro-1990-reg-1096.html

Ontario Ministry of Natural Resources and Forestry. (2022). Remove invasive aquatic plants. Retrieved May 8, 2023, from https://www.ontario.ca/page/remove-invasive-aquatic-plants

Ontario Weed Control Act, RSO 1990, c W.5. Retrieved May 8, 2023, from https://www.canlii.org/en/on/laws/stat/rso-1990-c-w5/latest/rso-1990-c-w5.html

Oorschot, M. van, Braat, ten Brink, B., Walpole, M., Kettunen, M., Peralta, Bezerra, N. & Jeuken M. (2008) "Chapter 4: Changes in Biodiversity," in L. Braat and P. ten Brink (eds.) The cost of policy inaction: the case of not meeting the 2010 biodiversity target. Study for the European Commission, DG Environment under contract: ENV.G.1/ETU/2007/0044 (Official Journal reference: 2007 / S 95 – 116033). Retrieved May 8, 2023, from https://www.cbd.int/financial/doc/copi-2008.pdf

Orentas, G., & Saddler, L. (2022) Here are the top landscaping trends of 2022. Forbes. Sept 26, 2022. Retrieved May 8, 2023, from https://www.forbes.com/home-improvement/outdoor/top-landscaping-trends-2022/

Organization for Economic Co-operation and Development (OECD). (n.d.). Canada's Existing Substances Assessment Repository. Retrieved May 8, 2023, from https://www.echemportal.org/echemportal/content/participants/3

Ormsby, M., & Brenton-Rule, E. (2017). A review of global instruments to combat invasive alien species in forestry. Biological Invasions. 19. 10.1007/s10530-017-1426-0. Retrieved May 8, 2023, from https://www.researchgate.net/publication/315805291_A_review_of_global_instruments_to_combat_invasive_alien_species_in_forestry

Oswalt, S., Oswalt, C., Crall, A., Rabaglia, R., Schwartz, M., & Kerns, B. (2021). Inventory and Monitoring of Invasive Species. 10.1007/978-3-030-45367-1_10. Retrieved May 8, 2023, from https://www.fs.usda.gov/research/publications/book/invasiveSpecies/invasiveSpeciesChap10.pdf

Page NA, Wall RE, Darbyshire SJ, Mulligan GA, 2006. The biology of invasive alien plants in Canada. 4. *Heracleum mantegazzianum* Sommier & Levier. Canadian Journal of Plant Science, 86(2):569-589. Retrieved May 8, 2023, from https://cdnsciencepub.com/doi/10.4141/P05-158

Parkinson, H. & Mangold, J. (2017). Biology, Ecology and Management of the Knotweed Complex (*Fallopia* and *Persicaria* spp.). Montana State Extension. Retrieved May 8, 2023, from https://www.montana.edu/extension/invasiveplants/documents/publications/extension_publications/Knotweed%20complex_EB0196.pdf

Patoka, J., Magalhães, A., Kouba, A., Faulkes, Z., Jerikho, R., & Vitule, J. (2018). Invasive aquatic pets: failed policies increase risks of harmful invasions. Biodiversity and Conservation. 27. 3037-3046. 10.1007/s10531-018-1581-3. Retrieved May 8, 2023, from https://www.researchgate.net/publication/325827283_Invasive_aquatic_pets_failed_policies_increase_risks_of_harmful_invasions

Pennsylvania Code Controlled Plant and Noxious Weed Act 3 PA CS Sections 1501 et seq- Retrieved May 8, 2023, from https://www.legis.state.pa.us/cfdocs/legis/li/uconsCheck.cfm?act=46&sessInd=0&yr=2017

Pennsylvania Code Ch 317 Invasive plants and noxious weeds. Retrieved May 8, 2023, from https://codelibrary.amlegal.com/codes/readingpa/latest/reading_pa/0-0-0-33144

Pennsylvania Department of Agric. (2022). Controlled Plant & Noxious Weeds. Retrieved May 8, 2023, from https://www.agriculture.pa.gov/Plants_Land_Water/PlantIndustry/NIPPP/Pages/Controlled-Plant-Noxious-Weed.aspx

Pergl, J., Pyšek, P., Backer, S. Franz, F., Genovesi, P., Harrower, C., Hulme, P., Jonathan, J., Marc, K., Kühn, I., Perglová, I., & Rabitsch, W., Roques, A., Roy, D.B., et al. (2017) Troubling travellers: Are ecologically harmful alien species associated with particular introduction pathways? NeoBiota. 32. 1-20. Retrieved May 8, 2023, from https://neobiota.pensoft.net/articles.php?id=10199

Pest Risk Analysis and Invasive Species Panels (PRA-IAS) of the North American Plant Protection Organization (NAPPO). (2011a). Discussion Documents: DD 02: Climate Change and Pest Risk Analysis. North American Plant Protection Organization. Retrieved May 8, 2023, from https://nappo.org/application/files/5415/8341/5783/DD_02_Climate_Change_Discussion_DocumentRev-07-08-12-e.pdf

Pest Risk Analysis and Invasive Species Panels (PRA-IAS) of the North American Plant Protection Organization (NAPPO). (2011b). Discussion Documents: DD 03: The Role of the North American Plant Protection Organization in Addressing Invasive Alien Species. North American Plant Protection Organization. Retrieved May 8, 2023, from https://nappo.org/application/files/8015/8341/5785/DD_03_NAPPO_IAS_Discussion_Doc_03_12-07-2012-e.pdf

Peters, W.L., Meyer, M.H. & Anderson, N.O. (2006). Minnesota horticultural industry survey on invasive plants. Euphytica 148, 75–8. Retrieved May 8, 2023, from https://www.researchgate.net/publication/325827283_Invasive_aquatic_pets_failed_policies_increase_risks_of_harmful_invasions

Pfingsten, I.A., Cao, L., Berent. L., Wishah, L.O. & Morningstar, C.R. (2022). *Trapa natans* L.: U.S. Geological Survey, Nonindigenous Aquatic Species Database, Gainesville, FL, and NOAA Great Lakes Aquatic Nonindigenous Species Information System, Ann Arbor, MI. Retrieved May 8, 2023, from https://nas.er.usgs.gov/queries/greatlakes/FactSheet.aspx?Species_ID=263

Pham, N. (2019). Let's Talk About Seeds: Recommendations for More Meaningful Public Participation in Canadian Seed Policy. MES Major Paper, Faculty of Environmental Studies, York University. Retrieved May 8, 2023, from https://foodpolicyforcanada.info.yorku.ca/seeds-and-plants/

Pimentel D, Lach L., Zuniga R, & Morrison D. (2000) Environmental and economic costs of nonindigenous species in the United States. Bioscience 50(1):53–65. Retrieved May 8, 2023, from https://www.researchgate.net/publication/259640053_Environmental_and_Economic_Costs_of_Nonindigenous_Species_in_the_United_States

Pimentel D., Zuniga R., & Morrison D. (2005) Update on the environmental and economic costs associated with alien-invasive species in the United States. Ecol Econ 52:273–288. Summary. Retrieved May 8, 2023, from https://www.sciencedirect.com/science/article/abs/pii/S0921800904003027

Pion, I. (2022). Des plantes envahissmantes toujours en vente libre. La Tribune. 21 octobre. Retrieved May 8, 2023, from https://www.latribune.ca/2022/10/21/des-plantes-envahissantes-toujours-en-vente-libre-656e9ae6e01c9532079a777e76546cb0

Plant Protection Act (R.S.C. 1990, c. 22). Retrieved May 8, 2023, from https://www.canlii.org/en/ca/laws/stat/sc-1990-c-22/latest/sc-1990-c-22.html

Powles, E. (2006). Studies on the population dynamics of the invasive aquatic macrophyte Trapa natans, European water chestnut, as applied to controlling range expansion and rate of spread in the Great Lakes. Electronic Theses and Dissertations 3643. Retrieved May 8, 2023, from https://scholar.uwindsor.ca/etd/3643

POWO (Plants of the World Online). (2023). Facilitated by the Royal Botanic Gardens, Kew. Retrieved 26 November 2023 from http://www.plantsoftheworldonline.org/

Prince, C. (2022). How Long Until a New Species Becomes Invasive? Let's Talk About the Lag Phase. UF/IFAS Agronomy department. Retrieved May 8, 2023, from https://blogs.ifas.ufl.edu/caip/2022/05/10/how-long-until-a-new-species-becomes-invasive-lets-talk-about-the-lag-phase/

Prince Edward Island Weed Control Act, RSPEI 1988, c W-2.1. Retrieved May 8, 2023, from https://www.canlii.org/en/pe/laws/stat/rspei-1988-c-w-2.1/latest/rspei-1988-c-w-2.1.html

Prince Edward Island Plant Health Act, RSPEI 1988, c P-9.1. Retrieved May 8, 2023, from https://www.canlii.org/en/pe/laws/stat/rspei-1988-c-p-9.1/149577/rspei-1988-c-p-9.1.html

Prince Edward Island Purple Loosestrife Control Regulations, PEI Reg EC629/91. Retrieved May 8, 2023, from https://www.canlii.org/en/pe/laws/regu/pei-reg-ec629-91/latest/pei-reg-ec629-91.html

Probert, A.F., Volery L., Kumschick, S., Vimercati, G., & Bacher, S. (2020). Understanding uncertainty in the Impact Classification for Alien Taxa (ICAT) assessments. In: Wilson, J.R., Bacher, S., Daehler, C.C., Groom, Q.J., Kumschick, S., Lockwood, J.L., Robinson, T.B., Zengeya, T.A., & Richardson, D.M. NeoBiota 62: 387-405. Retrieved May 8, 2023, from https://doi.org/10.3897/neobiota.62.52010

Prostak, R., (2016). What are other states doing? Massachusetts Invasive Plant Advisory Group. Presentation CIPWG: Invasive Plant Symposium October 11, 2016. Retrieved May 8, 2023, from https://cipwg.uconn.edu/wp-content/uploads/sites/244/2016/10/PPT-PDF-Randy-Prostak-Session-1.pdf

Pyšek, P., Křivánek M. & Jarošík V. (2009). Planting intensity, residence time, and species traits determine invasion success of alien woody species. Ecology, 90, 2734–2744. Retrieved May 8, 2023, from http://www.ibot.cas.cz/personal/pysek/pdf/Pysek,%20Krivanek,%20Jarosik-Invasion%20success%20of%20woody%20plants_Ecology2009.pdf

Pyšek, P., Hulme, P.E., Simberloff, D., Bacher, S., Blackburn, T.M., Carlton, J.T., Dawson, W., Essl, F., Foxcroft, L.C., Genovesi, P., Jeschke, J.M., Kühn, I., Liebhold, A.M., Mandrak, N.E., Meyerson, L.A., Pauchard, A., Pergl, J., Roy, H.E., Seebens, H., van Kleunen, M., Vilà, M., Wingfield, M.J. and Richardson, D.M. (2020), Scientists' warning on invasive alien species. Biol Rev, 95: 1511-1534. Retrieved May 8, 2023, from https://doi.org/10.1111/brv.12627

Pyšek, P., Manceur, A.M., Alba, C., McGregor, K.F., Pergl, J., Štajerová, K., Chytrý, M., Danihelka, J., Kartesz, J.T., Klimešová, J., Lučanová, M., Moravcová, L., Nishino, M., Sádlo, J., Suda, J., Tichý, L., & Kühn, I. (2015). Naturalization of central European plants in North America: species traits, habitats, propagule pressure, residence time. Ecology, 96 3, 762-74. Retrieved May 8, 2023, from https://esajournals.onlinelibrary.wiley.com/doi/10.1890/14-1005.1

Pyšek, P., Sádlo, J., Mandák, B. & Jarosík, V. (2003). Czech alien flora and the historical pattern of its formation: what came first to Central Europe? Oecologia 135, 122-30. Retrieved May 8, 2023, from https://www.researchgate.net/publication/10847474_Czech_alien_flora_and_the_historical_pattern_of_its_formation_What_came_first_to_Central_Europe

Québec Agricultural Abuses Act, CQLR c A-2 [repealed 2018-06-13]. Retrieved May 8, 2023, from https://www.canlii.org/en/qc/laws/stat/cqlr-c-a-2/latest/cqlr-c-a-2.html

Québec Environment Quality Act, CQLR c Q-2. Retrieved May 8, 2023, from https://www.canlii.org/en/qc/laws/stat/cqlr-c-q-2/latest/cqlr-c-q-2.html

Québec Ministère de l'Environnement et de la Lutte contre les changements climatiques. (2021). Liste des espèces floristiques exotiques envahissantes prioritaires. Retrieved May 8, 2023, from https://www.environnement.gouv.qc.ca/biodiversite/especes-exotiques-envahissantes/liste-EFEE-prioritaires.pdf

Québec Plant Protection Regulation, CQLR c P-42.1, r 2. Retrieved May 8, 2023, from https://www.canlii.org/en/qc/laws/regu/cqlr-c-p-42.1-r-2/latest/cqlr-c-p-42.1-r-2.html?searchUrlHash=AAAAAQAQUGxhbnQgUHJvdGVjdGlvbgAAAAAB&resultIndex=5

Quinn, L. D., Barney, J. B., McCubbins, J. S., & Endres, A. B. (2013). Navigating the "Noxious" and "Invasive" Regulatory Landscape: Suggestions for Improved Regulation. BioScience. 63(2): 124–131. Retrieved May 8, 2023, from https://academic.oup.com/bioscience/article/63/2/124/533654

Randall MJ, Morse LE, Benton N, Hiebert R, Lu S, Killeffer T (2008) The invasive species assessment protocol: a tool for creating regional and national lists of invasive nonnative plants that negatively impact biodiversity. Invasive Plant Science and Management 1: 36– 49. Retrieved May 8, 2023, from https://www.researchgate.net/publication/232693482_The_Invasive_Species_Assessment_Protocol_A_Tool_for_Creating_Regional_and_National_Lists_of_Invasive_Nonnative_Plants_That_Negatively_Impact_Biodiversity

Ratnayake, R M C S. (2014). Why plant species become invasive? Characters related to successful biological invasion. Conference: National Symposium on Invasive alien Species (IAS 2014). At: Colombo. Sri LankaVolume: 1. Retrieved May 8, 2023, from https://www.researchgate.net/publication/273453131_Why_plant_species_become_invasive_Characters_related_to_successful_biological_invasion

Ray, J., Grimm, J., & Olive, A. (2021). The biodiversity crisis in Canada: Failures and challenges of federal and sub-national strategic and legal frameworks. FACETS. 6. 1044-1068. Retrieved May 8, 2023, from https://www.facetsjournal.com/doi/10.1139/facets-2020-0075

Reaser J. (2001). Invasive alien species prevention and control: the art and science of managing people. In: McNeely J. A. (ed). The great reshuffling. Human dimensions of invasive alien species. IUCN, The World Conservation Union, Gland, pp 89-104. Retrieved May 8, 2023, from https://portals.iucn.org/library/sites/library/files/documents/2001-002.pdf

Reaser, J., Meyerson, L., Van Holle, B. et al. (2008). Saving camels from straws: how propagule pressure-based prevention policies can reduce the risk of unintentional introductions. Biol Invasions 10:1085–1098. Retrieved May 8, 2023, from https://www.researchgate.net/publication/226764949_Saving_camels_from_straws_How_propagule_pressure-based_prevention_policies_can_reduce_the_risk_of_biological_invasion

Reaser, J., Witt, A., Tabor, G., Hudson, P., & Plowright, R. (2021). Ecological Countermeasures for Preventing Zoonotic Disease Outbreaks: When Ecological Restoration is a Human Health Imperative. Restoration Ecology. 29. 10.1111/rec.13357. Retrieved May 8, 2023, from https://onlinelibrary.wiley.com/doi/full/10.1111/rec.13357#

Reichard, S. H. (1994). Assessing the potential of invasiveness in woody plants introduced in North America. University of Washington Ph.D. dissertation. Retrieved May 8, 2023, from https://www.proquest.com/openview/0794fefeaf639fdc8b0931b2780cccf1/1?pq-origsite=gscholar&cbl=18750&diss=y

Reichard S. H. (2004) Conflicting values and common goals: codes of conduct to reduce the threat of invasive species. Weed Technology 18:1503-1507. Retrieved May 8, 2023, from https://www.researchgate.net/publication/232673298_Conflicting_Values_and_Common_Goals_Codes_of_Conduct_to_Reduce_the_Threat_of_Invasive_Species1

Reichard S. H., & White P. (2001). Horticulture as a pathway of invasive plant introductions in the United States. BioScience 51:103–113. Retrieved May 8, 2023, from https://academic.oup.com/bioscience/article/51/2/103/390610

Reichard, S., Schmitz, C., Simberloff, D., Morrison, D., Lehtonen, P., Windle, P., Chavarría, G., & Mezitt, R. (2005). The Tragedy of the Commons Revisited: Invasive Species. Frontiers in Ecology and the Environment. 3.. Retrieved May 8, 2023, from https://www.researchgate.net/publication/261794700_The_Tragedy_of_the_Commons_Revisited_Invasive_Species

Reichard, S., & White, P. (2009). Horticulture as a Pathway of Invasive Plant Introductions in the United States. BioScience. 51. 103-113. Retrieved May 8, 2023, from https://academic.oup.com/bioscience/article/51/2/103/390610

Reid, C.H., Hudgins, E.J. Guay, J.D., Patterson, S. Medd, A.M. Coke, S.J. & Bennett, J.R. (2021). The state of Canada's biosecurity efforts to protect biodiversity from species invasions. FACETS 6: 1922–1954. Retrieved May 8, 2023, from www.fecpl.ca/wp-content/uploads/2021/10/facets-2021-0012.pdf

Rejmánek, M., Richardson, D., Higgins, S.I., Pitcairn, M., & Grotkopp, E. (2005). Ecology of invasive plants: State of the art. Invasive Alien Species: A New Synthesis. 104-162. https://www.researchgate.net/publication/313724722_Ecology_of_invasive_plants_State_of_the_art

Rhone, G., Clarke, D. & Webb, K. (2004). Two voluntary approaches to sustainable forestry practices. In K. Webb (Ed.), Voluntary codes: Private governance, the public interest, and innovation (pp. 249-272). Carleton Research Unit for Innovation, Science and Environment, Carleton University. Retrieved May 8, 2023, from https://www.researchgate.net/publication/242441380_Two_Voluntary_Approaches_to_Sustainable_Forestry_Practices

Regional Invasive Species & Climate Change Management Networks (RISCC). Retrieved May 8, 2023, from https://www.risccnetwork.org

Regional Invasive Species & Climate Change Management Networks (RISCC). (2022). Do Not Sell coffee talk recording - Oct 19, 2022. Retrieved May 8, 2023, from https://www.risccnetwork.org/northeast

Ricciardi, A., Jones, L., Kestrup, A., Ward, J. (2011). Expanding the Propagule Pressure Concept to Understand the Impact of Biological Invasions. 10.1002/9781444329988.ch17. Retrieved May 8, 2023, from https://redpath-staff.mcgill.ca/ricciardi/Ricciardi_Elton_C17.pdf

Ricciardi, A., Steiner, W., Mack, R., & Simberloff, D. (2000). Toward a Global Information System for Invasive Species, BioScience, 50: 3. Retrieved Dec 15, 2023, from https://doi.org/10.1641/0006-3568(2000)050[0239:TAGISF]2.3.CO;2

Riley, S. (2008). Invasive alien species and the protection of biodiversity: The role of quarantine laws in resolving inadequacies in the international legal regime. Thesis. Univ. Sydney. Retrieved May 8, 2023, from https://unsworks.unsw.edu.au/entities/publication/46e1c61c-2a11-4e30-819e-dc2c27e0a962

Rixon, C.A.M., Duggan, I.C., Bergeron, N.M.N., Ricciardi, A., and MacIsaac, H.J. 2005. Invasion risks posed by the aquarium trade and live fish markets on the Laurentian Great Lakes. Biodiversity and Conserv. 14:1365-1381. Retrieved May 8, 2023, from https://www.researchgate.net/publication/225975925_Invasion_risks_posed_by_the_aquarium_trade_and_live_fish_markets_on_the_Laurentian_Great_Lakes

Rockwell-Postel, M., Bradley, B., & Laginhas, B. B. (2020). Supporting proactive management in the context of climate change: Prioritizaing range-shifting invasive plants based on impact. Biological Invasions, 22. Retrieved May 8, 2023, from https://scholarworks.umass.edu/nrc_faculty_pubs/421/

Rouget, M., & Richardson, D. (2004). Inferring Process from Pattern in Plant Invasions: A Semimechanistic Model Incorporating Propagule Pressure and Environmental Factors. The American naturalist. 162. 713-24. 10.1086/379204. Retrieved May 8, 2023, from https://www.researchgate.net/publication/8907255_Inferring_Process_from_Pattern_in_Plant_Invasions_A_Semimechanistic_Model_Incorporating_Propagule_Pressure_and_Environmental_Factors

Roussy, Anne-Marie. (2014). The Sexual and Vegetative Propagation of Sugar Maple and its Threat from Norway Maple. Thesis. Guelph Univ. Retrieved May 8, 2023, from https://www.uoguelph.ca/canpolin/Publications/Roussy%20thesis.pdf

Roy, H., Rabitsch, W., Scalera, R., Stewart, A., Gallardo, B., Genovesi, P., Essl, F., Adriaens, T., Bacher, S., Booy, O., Branquart, E., Brunel, S., Copp, G., Dean, H., D'hondt, B., Josefsson, M., Kenis, M., Kettunen, M., Linnamagi, M., Zenetos, A. (2017). Developing a framework of minimum standards for the risk assessment of alien species. Journal of Applied Ecology. 55. Retrieved May 8, 2023, from https://besjournals.onlinelibrary.wiley.com/doi/10.1111/1365-2664.13025

Roy, H., Vilà, M., Winter, M., & Nentwig, W. (2017). Troubling travellers: Are ecologically harmful alien species associated with particular introduction pathways? NeoBiota. 32. 1-20. 10.3897/neobiota.32.10199. NeoBiota 32: 1–20. Retrieved May 8, 2023, from https://www.researchgate.net/publication/312056317_Troubling_travellers_Are_ecologically_harmful_alien_species_associated_with_particular_introduction_pathways

Russo, E. (2015). Lyme Disease in the Northeast: Altered Ecosystems and Public Health Impacts. Student Theses 13. Fordham University. Retrieved May 8, 2023, from https://fordham.bepress.com/environ_2015/13

Samson, P., Baker, M., Varlet, A., Jean, T., & Ouellet, J-F. (2021). Delimitation of Eurasian watermilfoil beds at Lake Bernard, MRC des Collines-de-l'Outaouais. Presented to the Owners' and Residents' Association of Lake Bernard. Retrieved May 8, 2023, from http://lacbernard.ca/environment/2021.11.00_abv7_milfoil.pdf

Saarela JM, Sokoloff PC, Gillespie LJ, Bull RD, Bennett BA, & Ponomarenko S. (2020). Vascular plants of Victoria Island (Northwest Territories and Nunavut, Canada): a specimen-based study of an Arctic flora. PhytoKeys. 141:1-330. Doi: 10.3897/phytokeys.141.48810. PMID: 32201471; PMCID: PMC7070024. Retrieved No. 27, 2023 from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7070024/

Saskatchewan The Weed Control Act, SS 2010, c W-11.1. Retrieved May 8, 2023, from https://www.canlii.org/en/sk/laws/stat/ss-2010-c-w-11.1/latest/ss-2010-c-w-11.1.html

SK (Saskatchewan). (2010). Designation of prohibited noxious and nuisance weeds. Retrieved May 8, 2023, from https://www.npss.sk.ca/docs/2_pdf/The_Weed_Control_Act_-_Plant_List.pdf

SCBD (Secretariat of the Convention on Biological Diversity). (2006a). Global Biodiversity Outlook 2. Montreal, 81 + vii pages. Retrieved May 8, 2023, from https://www.cbd.int/doc/gbo/gbo2/cbd-gbo2-en.pdf

SCBD (Secretariat of the Convention on Biological Diversity). (2006b). Subject: National level collaboration between agencies responsible for biodiversity and plant protection. United Nations Environment Programme (UNEP). Retrieved May 8, 2023, from https://www.cbd.int/doc/notifications/2006/ntf-2006-129-plant-en.pdf

SCBD (Secretariat of the Convention on Biological Diversity, & United Nations Environment Programme) (2011). Strategic Plan for Biodiversity 2011–2020 and the Aichi Targets: Living in Harmony with Nature. Retrieved May 8, 2023, from https://www.cbd.int/doc/strategic-plan/2011-2020/Aichi-Targets-EN.pdf

SCBD (Secretariat of the Convention on Biological Diversity, & United Nations Environment Programme) (2022). A New Global Framework for Managing Nature Through 2030. Retrieved May 8, 2023, from https://www.cbd.int/article/draft-1-global-biodiversity-framework

Scrievener, L. (2012). Phragmites australis is Canada's worst invasive plant. Toronto Star Aug 12. Retrieved Nov. 27, 2023 from https://www.thestar.com/news/insight/phragmites-australis-is-canada-s-worst-invasive-plant/article_7eea4e42-87ca-5879-9614-527861ff27ce.html

Seebens, H., Bacher, S., Blackburn, T., Capinha, C., Dawson, W., Dullinger, S., Lenzner, B., A., Liebhold, A., Pattison, Z., Pergl, J., Pyšek, P., Winter, M., & Essl, F. (2020). Projecting the continental accumulation of alien species through to 2050. Global Change Biology. 27. 16. 10.1111/gcb.15333. Retrieved Nov. 27, 2023 from https://www.researchgate.net/publication/344442219_Projecting_the_continental_accumulation_of_alien_species_through_to_2050

Seeds Act (R.S.C. 1985, c. S-8) Retrieved May 8, 2023, from https://www.canlii.org/en/ca/laws/stat/rsc-1985-c-s-8/latest/rsc-1985-c-s-8.html

Shackleton, R.T., Richardson, D.M., Shackleton, C.M., Bennett, B.M., Crowley, S.L., Dehnen-Schmutz, K., Estévez, R.A., Fischer, A., Kueffer, C., Kull, C.A., Marchante, E., Nóvoa, A., Potgieter, L.J., Vaas, J., Vaz, A.S., & Larson, B.M. (2019). Explaining people's perceptions of invasive alien species: A conceptual framework. Journal of environmental management, 229, 10-26. Retrieved May 8, 2023, from https://www.semanticscholar.org/paper/Explaining-people%27s-perceptions-of-invasive-alien-A-Shackleton-Richardson/5d0c4db8f32d5ae857f7a4841d22550831133a65

Shackleton, C., Ruwanza, S., Sinasson, G., Bennett, S., Lacy, P., Modipa, R., Mtati, N., Dalu, M. & Thondhlana, G. (2016). Unpacking pandora's box: understanding and categorising ecosystem disservices for environmental management and human wellbeing. Ecosystems. 19. 587-600. Retrieved May 8, 2023, from https://www.researchgate.net/publication/289378539_Unpacking_Pandora%27s_Box_Understanding_and_Categorising_Ecosystem_Disservices_for_Environmental_Management_and_Human_Wellbeing

Shine, C., Williams, N., & Gündling, L. (2000). A guide to designing legal and institutional frameworks on alien invasive species. IUCN - The World Conservation Union. Retrieved May 8, 2023, from https://www.nobanis.org/globalassets/articlesreports/a-guide-to-designing-legal-framework-on-ias.pdf

Shine, C. (2003) Overview of the management of invasive alien species from the environmental perspective. In IPPC Secretariat (2005) Identification of risks and management of invasive alien species using the IPPC framework. Proceedings of the workshop on invasive alien species and the International Plant Protection Convention, Braunschweig, Germany, 22–26 September 2003. Rome, Italy, FAO. 301 pp. Retrieved May 8, 2023, from https://www.ippc.int/sites/default/files/documents/1065703408882_FRANCE_IUCN_Clare_Shine_1.pdf

Shine, C. (2007). Invasive species in an international context: IPPC, CBD, European Strategy on Invasive Alien Species and other legal instruments. Bulletin OEPP/EPPO Bulletin, 37(1), 103-113. Retrieved May 8, 2023, from https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1365-2338.2007.01087.x

Schnelle, M. A., & Gettys, L. A. (2021). Nuisance to Invasive Ornamentals: Proceedings from the ASHS Invasive Plants Research Group 2020 Workshop, HortTechnology hortte, 31(4), 339-342. Retrieved May 8, 2023, from https://journals.ashs.org/horttech/view/journals/horttech/31/4/article-p339.xml

Simkovic, Vicki. (2020). European Frog-Bit (*Hydrocharis morsus-ranae*): Best Management Practices in Ontario. Ontario Invasive Plant Council, Peterborough, ON. Retrieved May 8, 2023, from https://www.ontarioinvasiveplants.ca/wp-content/uploads/2021/01/EuropeanFrog-Bit_Edn1.0_March2020.pdf

Simpson, R. D. (2009). Chapter 7: If Invasive Species are "Pollutants", Should Polluters Pay? In C. Perrings, H. Mooney, & M. Williamson (eds). Bioinvasions and Globalization: Ecology, Economics, Management, and Policy. Oxford Academic Retrieved May 8, 2023, from https://academic.oup.com/book/8412/chapter-abstract/154166245?redirectedFrom=fulltext

Sloan, M., (2010). The ecological effects of Norway Maple (Acer platanoides) on local plant diversity. Master's Thesis York University. Retrieved April 3, 2024, from https://central.bac-lac.gc.ca/.item?id=MR62435&op=pdf&app=Library&oclc_number=759029148

Smith, A.L., Bazely, D.R. & Yan, N. (2014). Are legislative frameworks in Canada and Ontario up to the task of addressing invasive alien species? Biol Invasions 16, 1325–1344. Retrieved May 8, 2023, from https://www.researchgate.net/publication/258845234_Are_legislative_frameworks_in_Canada_and_Ontario_up_to_the_task_of_addressing_invasive_alien_species

Smith, A., Hodkinson, T., Villellas, J., Catford, J., Csergő, A., et al., & Buckley, Y. (2020). Global gene flow releases invasive plants from environmental constraints on genetic diversity. Proceedings of the National Academy of Sciences, 117(8), 4218-4227. Retrieved May 8, 2023, from https://www.pnas.org/doi/10.1073/pnas.1915848117

Sloan, M. (2010). The Ecological Effects of Norway Maple (*Acer platanoides*) on local plant diversity. Thesis York University. https://central.bac-lac.gc.ca/.item?id=MR62435&op=pdf&app=Library&is_thesis=1&oclc_number=759029148

Sons, T. (2022). Gardening's hottest trend is here: The big shift to native plants and what it means for business. Forbes. Feb 3, 2022. Retrieved May 8, 2023, from https://www.forbes.com/sites/forbesbusinesscouncil/2022/02/03/gardenings-hottest-trend-is-here-the-big-shift-to-native-plants-and-what-it-means-for-your-business/?sh=2d6c3e7e2ffe

Sosa, A., Jiménez, N., Faltlhauser, A., Righetti, T., Kay, F., Bruzzone, O., Stiers, I., & Fernández Souto, A. (2021). The educational community and its knowledge and perceptions of native and invasive alien species. Scientific Reports. 11. Retrieved May 8, 2023, from https://www.nature.com/articles/s41598-021-00683-y#citeas

Spear, M., Walsh, J., Ricciardi, A. & Vander Zanden, Jake. (2021). The Invasion Ecology of Sleeper Populations: Prevalence, Persistence, and Abrupt Shifts. BioScience. 71. 10.1093/biosci/biaa168. Retrieved Jan. 14, 2024, from https://academic.oup.com/bioscience/article/71/4/357/6102677

Species at Risk Act, SC 2002, c 29. Retrieved May 8, 2023, from https://www.canlii.org/en/ca/laws/stat/sc-2002-c-29/latest/sc-2002-c-29.html

Spinney, E. (2022). Vermont's Invasive Exotic Plant Watch List Updated. Vermont Invasive Exotic Plant Committee (VIEPC). Retrieved May 8, 2023, from https://www.vtinvasives.org/news-events/news/vermont's-invasive-exotic-plant-watch-list-updated

Starfinger, Uwe & Schrader, Gritta. (2021). Invasive alien plants in plant health revisited: another 10 years. Bulletin OEPP/EPPO Bulletin. 51. 1-7. Retrieved May 8, 2023, from https://onlinelibrary.wiley.com/doi/full/10.1111/epp.12787

STDF (Standards and Trade Development Facility). (2013) International Trade and Invasive Alien Species. Retrieved May 8, 2023, from https://standardsfacility.org/sites/default/files/STDF_IAS_EN_0.pdf

Stewart, K. (1994). The archival concept of competence: a case study of the federal administration of agriculture in Canada, 1867-1989. Thesis Univ. British Columbia. Retrieved April 3, 2024, from https://open.library.ubc.ca/soa/cIRcle/collections/ubctheses/831/items/1.0087416

Stockholm+50. (2022). Stockholm+50: a healthy planet for the prosperity of all – our responsibility, our opportunity. UNEP. Retrieved May 8, 2023, from https://www.stockholm50.global

Stoett, P. J. (2009). Scaled Linkage in Policy Coordination: Catching Invasive Alien Species in a Global Governance. Presented to the 2009 Amsterdam Conference on the Human Dimensions of Global Environmental Change. Retrieved May 8, 2023, from https://citeseerx.ist.psu.edu/document?repid=rep1&type=pdf&doi=c1adb5d5282387fc999c902f2b33a291d40c480d

Stoett, P. J. (2011). Bioinvasion and global environmental governance: the transnational policy network on invasive alien species. Retrieved May 8, 2023, from https://www.cbd.int/invasive/doc/legislation/Canada.pdf

Stoett, P. J. (2012). Framing Bioinvasion: Biodiversity, Climate Change, Security, Trade, and Global Governance. Global Governance. 16. Retrieved May 8, 2023, from https://www.researchgate.net/publication/280813442_Framing_Bioinvasion_Biodiversity_Climate_Change_Security_Trade_and_Global_Governance

Stringham, O., & Lockwood, J. (2021). Managing propagule pressure to prevent invasive species establishments: propagule size, number, and risk-release curve. Ecological Applications. 31. Retrieved May 8, 2023, from https://www.researchgate.net/publication/349651523_Managing_propagule_pressure_to_prevent_invasive_species_establishments_propagule_size_number_and_risk-release_curve

Strubbe, D., White, R., Edelaar, P., Rahbek, C., & Shwartz, A. (2019). Advancing impact assessments of non-native species: strategies for strengthening the evidence-base. NeoBiota 51: 41-64. Retrieved May 8, 2023, from https://neobiota.pensoft.net/article/35940/list/1/

Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA). (2022). Alien species: guiding principles for the prevention, introduction and mitigation of impacts. Convention on Biological Diversity (CBD). Retrieved May 8, 2023, from https://www.cbd.int/kb/record/recommendation/7021?Event=SBSTTA-05

Sullivan, J.J., Williams, P.A., Cameron, E.K. & Timmins, S.M. (2004). People and time explain the distribution of naturalized plants in New Zealand. Weed Technology, 18, 1330-3. Retrieved May 8, 2023, from https://www.jstor.org/stable/3989645

Sun, Y., Pourmorad, B., Oveisi, M. & Müller-Schärer, H. (2021). Addressing Climate Change: What Can Plant Invasion Science and Weed Science Learn From Each Other? Frontiers in Agronomy. 2. Retrieved May 8, 2023, from https://www.researchgate.net/publication/348098388_Addressing_Climate_Change_What_Can_Plant_Invasion_Science_and_Weed_Science_Learn_From_Each_Other

Tanner, R.A., Branquart, E., Brundu, G., Buholzer, S., Chapman, D.S., Ehret, P., Fried, G., Starfinger, U., & Valkenburg, J.V. (2017). The prioritisation of a short list of alien plants for risk analysis within the framework of the Regulation (EU) No. 1143/2014. NeoBiota, 35, 87–118. Retrieved May 8, 2023, from https://pdfs.semanticscholar.org/03c6/c33f2704d03ec85fea9a142eb02f2dd3eb0e.pdf?_ga=2.217343894.1606384193.1669853763-1274337417.1667485677

Tassie, D. & Sherman, K. (2014). Invasive Honeysuckles (*Lonicera* spp.) Best Management Practices in Ontario. Ontario Invasive Plant Council, Peterborough, ON. Retrieved May 8, 2023, from https://www.ontarioinvasiveplants.ca/wp-content/uploads/2016/06/OIPC_BMP_Honeysuckle.pdf

Tinker, C. (1995). Responsibility for biological diversity conservation under international law. Vand. J. Transnat'l L., 28, 777. Retrieved May 8, 2023, from https://scholarship.law.vanderbilt.edu/cgi/viewcontent.cgi?article=1898&context=vjtl

Tollington, S., Turbé, A., Rabitsch, W., Groombridge, J., Scalera, R., Essl, F., Roy, H. & Shwartz, A. (2015). Making the EU Legislation on Invasive Species a Conservation Success. Conservation Letters. Retrieved May 8, 2023, from https://conbio.onlinelibrary.wiley.com/doi/full/10.1111/conl.12214

Conservation Letters. 10. n/a-n/a. 10.1111/conl.12214. Turbelin, A., & Catford, J. (2021). Invasive plants and climate change. In Climate Change: Observed Impacts on Planet Earth. Retrieved May 8, 2023, from https://doi.org/10.1016/B978-0-12-821575-3.00025-6

Turbelin, A.J., Diagne, C., & Hudgins, E.J. et al. (2022). Introduction pathways of economically costly invasive alien species. Biol Invasions, 24, 2061–2079. Retrieved May 8, 2023, from https://link.springer.com/article/10.1007/s10530-022-02796-5

United States Transportation of water hyacinths - 18 U.S.C. § 46 (2013) Retrieved May 8, 2023, from https://law.justia.com/codes/us/2013/title-18/part-i/chapter-3/section-46/

United States Code. Designation of noxious weeds. 7 CFR § 360.200. Retrieved May 8, 2023, from https://www.law.cornell.edu/cfr/text/7/360.200

United States Code Federal Seed Act Regulations 7 CFR § 201.28 Retrieved May 8, 2023, from https://www.govinfo.gov/app/details/CFR-2017-title7-vol3/CFR-2017-title7-vol3-sec201-28

United States Code. Plant Protection 7 U.S. Code § 7701. Retrieved May 8, 2023, from https://www.govinfo.gov/app/details/USCODE-2020-title7/USCODE-2020-title7-chap104-sec7701/summary

United States Invasive Plant Council. 2001. Meeting the Invasive Species Challenge: Management Plan. Retrieved May 8, 2023, from https://www.doi.gov/sites/doi.gov/files/migrated/invasivespecies/upload/2001-Invasive-Species-National-Management-Plan.pdf

United States Senate. (2019). H. R. 498 AN ACT To eliminate unused sections of the United States Code. 116TH CONGRESS 1ST SESSION. Retrieved May 8, 2023, from https://www.govinfo.gov/content/pkg/BILLS-116hr498rfs/pdf/BILLS-116hr498rfs.pdf

U.S. Fish and Wildlife Service and Utah State University. (2015). Invasive plant inventory and early detection prioritization tool: a user's guide, version 4.0, February 2018. USFWS, National Wildlife Refuge System, Pacific Southwest Region, Inventory and Monitoring Program, Sacramento, CA. 136pp. Retrieved May 8, 2023, from https://ecos.fws.gov/ServCat/DownloadFile/192142

University of Illinois Extension Forestry (2015). Illinois Regulations Regarding Invasive Plant Species. Retrieved May 8, 2023, from https://extension.illinois.edu/sites/default/files/illinois_regulations_regarding_invasive_species_updated_2015.pdf

Vagnon, C., Rohr, R., Bersier, L-F., Cattanéo, F., Guillard, J., et al. (2022). Combining food web theory and population dynamics to assess the impact of invasive species. Frontiers in Ecology and Evolution, 10: 1-12. Retrieved May 8, 2023, from https://hal.inrae.fr/hal-03789356/document

van Kleunen, M., Essl, F., Pergl, J., Brundu, G., Carboni, M., Dullinger, S., Early, R., González-Moreno, P., Groom, Q., Hulme, P., Kueffer, C., Kühn, I., Máguas, C., Maurel, N., Novoa, A., Parepa, M., Pyšek, P., Seebens, H., Tanner, R., Dehnen-Schmutz, K. (2018). The changing role of ornamental horticulture in alien plant invasions. Biological Reviews. Retrieved May 8, 2023, from https://www.researchgate.net/publication/323551625_The_changing_role_of_ornamental_horticulture_in_alien_plant_invasions

van Kleunen, M., Weber, E., & Fischer, M. (2009). A Meta-Analysis of Trait Differences Between Invasive and Non-Invasive Plant Species. Ecology letters. 13. 235-45. Retrieved May 8, 2023, from https://www.researchgate.net/publication/40680378_A_Meta-Analysis_of_Trait_Differences_Between_Invasive_and_Non-Invasive_Plant_Species

Vanderhoeven, A., Adriaens, T., D'hondt, B., Van Gossum, H., Vandegehuchte, M., Verreycken, H., Cigar, J., & Branquart, E. (2015). A science-based approach to tackle invasive alien species in Belgium – the role of the ISEIA protocol and the Harmonia information system as decision support tools. Management of Biological Invasions. 6. Retrieved May 8, 2023, from https://www.researchgate.net/publication/277656830_A_science-based_approach_to_tackle_invasive_alien_species_in_Belgium_-_the_role_of_the_ISEIA_protocol_and_the_Harmonia_information_system_as_decision_support_tools

Vanderhoeven, S., Piqueray, J., Halford, M., Nulens, G., Vincke, J., & Mahy, G. (2011). Perception and Understanding of Invasive Alien Species Issues by Nature Conservation and Horticulture Professionals in Belgium. Environmental management. 47. 425-42. Retrieved May 8, 2023, from https://www.researchgate.net/publication/49851220_Perception_and_Understanding_of_Invasive_Alien_Species_Issues_by_Nature_Conservation_and_Horticulture_Professionals_in_Belgium

Vermont Agency of Agric., Food and Markets. (2012). Quarantine #3 – Noxious Weeds (Noxious Weeds Rule) Frequently Asked Questions (FAQs). Retrieved May 8, 2023, from https://agriculture.vermont.gov/sites/agriculture/files/documents/PHARM/Plant_Pest/Amended_Weed_Rule_NoxWeedsFaq.pdf

Vermont Agency of Agric., Food & Markets. (n.d.) Quarantine #3 -Noxious Weeds Retrieved May 8, 2023, from https://agriculture.vermont.gov/sites/agriculture/files/documents/PHARM/Plant_Pest/NoxiousWeedsQuarantine1.pdf

Vermont Code R. 20-031-021-X Quarantine #3 Noxious Weeds. Retrieved May 8, 2023, from https://www.law.cornell.edu/regulations/vermont/20-021-Code-Vt-R-20-031-021-X

Vermont Invasives. (n.d.). Aquatic Invasive Species Regulations. Retrieved May 8, 2023, from https://www.vtinvasives.org/water/aquatic_species_regulations

Victorian Government. Invasive Plants and Animals Policy Framework. Retrieved May 8, 2023, from https://agriculture.vic.gov.au/__data/assets/pdf_file/0009/582255/Invasive-Plants-and-Animals-Policy-Framework-IPAPF.pdf

Vilà, M., Gallardo, B., Preda, C., García-Berthou, E., Essl, F., Kenis, M., Roy, H., & González-Moreno, P. (2019). A review of impact assessment protocols of non-native plants. Biological Invasions, 21:709-723. Retrieved May 8, 2023, from https://link.springer.com/article/10.1007/s10530-018-1872-3

von Mirbach, M. (1997). Demanding good wood: some current approaches to forest certification are dubious merit, and even the best have significant limitations. Alternatives 23(3). Retrieved May 8, 2023, from https://go.gale.com/ps/i.do?p=AONE&u=googlescholar&id=GALE%7CA19908790&v=2.1&it=r&sid=googleScholar&asid=85326eb6

Vukovic, N., Šegota, V., Alegro, A., Koletić, N., Rimac, A. & Dekanić, Stjepan. (2019). "Flying under the radar"-how misleading distributional data led to wrong appreciation of knotweeds invasion (Reynoutria spp.) in Croatia. BioInvasions Records. 8. 175-189. Retrieved May 8, 2023, from https://www.researchgate.net/publication/331045625_Flying_under_the_radar-how_misleading_distributional_data_led_to_wrong_appreciation_of_knotweeds_invasion_Reynoutria_spp_in_Croatia

Vyn, Richard. (2019). Estimated Expenditures on Invasive Species in Ontario: 2019 Survey Results. Report prepared for the Invasive Species Centre. Retrieved May 8, 2023, from https://www.invasivespeciescentre.ca/wp-content/uploads/2020/02/Final-Report-2019-Survey-Results-No-Appendix-A.pdf & https://yorkpublishing.escribemeetings.com/filestream.ashx?DocumentId=8474

Vyn, R. (2022). Estimated Annual Expenditures on Invasive Species by Canadian Municipalities: 2021 National Survey Results. Report prepared for the Invasive Species Centre. Retrieved May 8, 2023, from https://www.invasivespeciescentre.ca/wp-content/uploads/2022/04/Final-Report-2021-National-Survey-Results-Final-Version.pdf

Ward, J. S., Williams, S., Worthley, T. (2013). Comparing effectiveness and impacts of Japanese barberry (*Berberis thunbergii)* control treatments and herbivory on plant communities. Invas. Plant Sci. Manag. 6: 459–469. Retrieved May 8, 2023, from https://www.researchgate.net/publication/268445532_Comparing_Effectiveness_and_Impacts_of_Japanese_Barberry_Berberis_thunbergii_Control_Treatments_and_Herbivory_on_Plant_Communities

Warren, C.R. (2007). Perspectives on the 'alien' versus 'native' species debate: a critique of concepts, language and practice. Prog. Hum. Geog. 31, 427–446. Retrieved May 8, 2023, from https://journals.sagepub.com/doi/pdf/10.1177/0309132507079499

Warren, C.R. (2021). Beyond 'Native V. Alien': Critiques of the Native/alien Paradigm in the Anthropocene, and Their Implications. Ethics, Policy & Environment. 10.1080/21550085.2021.1961200. Retrieved May 8, 2023, from https://www.researchgate.net/publication/353565994_Beyond_%27Native_V_Alien%27_Critiques_of_the_Nativealien_Paradigm_in_the_Anthropocene_and_Their_Implications

Warne, Amanda. 2018. Multiflora rose (Rosa multiflora) Best Management Practices in Ontario. Ontario Invasive Plant Council, Peterborough, ON. https://www.ontarioinvasiveplants.ca/wp-content/uploads/2020/10/MultifloraRose_BMP.pdf

Washington code RCW Chapter 17.10 Noxious Weeds-Control Boards. Retrieved May 8, 2023, from https://app.leg.wa.gov/RCW/default.aspx?cite=17.10

Washington code RCW Chapter 17.24 Insect Pest and Plant Diseases. Retrieved May 8, 2023, from https://app.leg.wa.gov/RCW/default.aspx?cite=17.24

Washington code WAC 16-752-600 Establishing the noxious weed seed and plant quarantine. Retrieved May 8, 2023, from https://app.leg.wa.gov/wac/default.aspx?cite=16-752-600

Washington code WAC 16-752-620 Prohibited acts. Retrieved May 8, 2023, from https://app.leg.wa.gov/WAC/default.aspx?cite=16-752-620

Washington State Dept. of Agric. (2021). Prohibited Plants and seeds in Washington State. Retrieved May 8, 2023, from https://cms.agr.wa.gov/getmedia/9e83eb5b-8131-48a9-9066-aa76f077a219/brochureprohibitedplants.pdf

Washington State Noxious Weed Control Board. (n.d.). Washington's Noxious Weed Index. Retrieved May 8, 2023, from https://www.nwcb.wa.gov/noxious-weed-quarantine-list

Washington State Noxious Weed Control Board. (n.d.). Washington's Noxious Weed Laws. Retrieved May 8, 2023, from https://www.nwcb.wa.gov/washingtons-noxious-weed-laws

Weber, E. (2004). HORTICULTURE AND THE INVASIVE PLANT SPECIES ISSUE. Acta Hortic. 643, 25-30. Retrieved May 8, 2023, from https://academic.oup.com/bioscience/article/51/2/103/390610

Weeds Australia. (2021). "Government weed strategies and lists," Centre for Invasive Species Solutions (CISS). Retrieve April 3, 2024, from https://weeds.org.au/overview/lists-strategies/

Weeds Across Borders 2010 Coordinating Committee. (2010). Plant Invasions: Policies, Politics, and Practices. Proceedings of the 2010 Weeds Across Borders Conference, 1–4 June 2010, E. Rindos, ed. National Conservation Training Center, Shepherdstown, West Virginia. Bozeman, Montana: Montana State University, Center for Invasive Plant Management. Retrieved May 8, 2023, from https://files.cfc.umt.edu/cesu/FWS/2010/10Galli-Noble_Weeds_Across_Boarders%20_Proceedings.pdf

Welk, Erik. (2004). Constraints in range predictions of invasive plant species due to non-equilibrium distribution patterns: purple loosestrife (*Lythrum salicaria*) in North America. Ecological Modelling. 179. 551-567. Retrieved May 8, 2023, from https://www.researchgate.net/publication/222987487_Constraints_in_range_predictions_of_invasive_plant_species_due_to_non-equilibrium_distribution_patterns_Purple_loosestrife_Lythrum_salicaria_in_North_America

Westbrooks, Randy. (2011). Federal Interagency Coordination for Invasive Plant Issues – The Federal Interagency Committee for the Management of Noxious and Exotic Weeds (FICMNEW). Retrieved May 8, 2023, from https://pubs.acs.org/doi/10.1021/bk-2011-1073.ch011

De Wet, J.M.J. & Harlan, J.R. (1975). Weeds and Domesticates: Evolution in the man-made habitat. Econ Bot 29, 99–108 (1975). https://doi.org/10.1007/BF02863309.

White, D. J., Haber, E., & Keddy, C. (1993). Invasive plants of natural habitats in Canada: An integrated review of wetland and upland species and legislation governing their control. Ottawa, Canada: Canadian Wildlife Service, Environment Canada, and Canadian Museum of Nature. Retrieved May 8, 2023, from https://publications.gc.ca/collections/collection_2019/eccc/CW66-127-1993-eng.pdf

Whitney, Kenneth & Gabler, Christopher. (2008). Rapid evolution in introduced species, 'invasive traits' and recipient communities: Challenges for predicting invasive potential. Diversity and Distributions. 14. 569 - 580. Retrieved May 8, 2023, from https://onlinelibrary.wiley.com/doi/full/10.1111/j.1472-4642.2008.00473.x

WHO (World Health Organization). (2015). Biodiversity and Health. Retrieved May 8, 2023, from https://www.who.int/news-room/fact-sheets/detail/biodiversity-and-health

Wild Matters Pty. Ltd. (2020). National established weed priorities - Towards a national framework; for the Australia Department of Agriculture, Water and the Environment. Retrieved May 8, 2023, from https://weeds.org.au/wp-content/uploads/2021/05/DRAFT-National-Established-Weed-Priorities-Towards-a-National-Framework.pdf

Williams, F., Constantine, K. L., Ali, A. A. et al. (2021). An assessment of the capacity and responsiveness of a national system to address the threat of invasive species: a systems approach. CABI Agric Biosci 2, 42. Retrieved May 8, 2023, from https://cabiagbio.biomedcentral.com/articles/10.1186/s43170-021-00062-7

Williams, K., Hunter, B., Schmidt, B., Woodward, E., & Cresswell, I. (2021). Australia state of the environment 2021: land, independent report to the Australian Government Minister for the Environment, Commonwealth of Australia, Canberra. Retrieved May 8, 2023, from https://soe.dcceew.gov.au/sites/default/files/2022-07/soe2021-land.pdf

Williams, S.C., Linske, M., & Ward, J. (2017). Long-Term Effects of *Berberis thunbergii* (*Ranunculales: Berberidaceae*) Management on Ixodes scapularis (Acari: Ixodidae) Abundance and Borrelia burgdorferi (*Spirochaetales: Spirochaetaceae*) Prevalence in Connecticut, USA. Environmental Entomology. 46(6):1329-1338. 10.1093/ee/nvx146. Retrieved May 8, 2023, from https://www.researchgate.net/publication/320254326_Long-Term_Effects_of_Berberis_thunbergii_Ranunculales_Berberidaceae_Management_on_Ixodes_scapularis_Acari_Ixodidae_Abundance_and_Borrelia_burgdorferi_Spirochaetales_Spirochaetaceae_Prevalence_in_Conne

Williams, S.C., Ward, J., Worthley, E., & Stafford III, K. (2009). Managing Japanese barberry (*Ranunculales: Berberidaceae*) infestations reduces black-legged tick (*Acari: Ixodidae*) abundance and infection prevalence with *Borrelia burgdorferi* (*Spirochaetales: Spirochaetaceae*). Environ. Entomol. 38: 977–984. Retrieved May 8, 2023, from https://www.academia.edu/15053431/Managing_Japanese_Barberry_Ranunculales_Berberidaceae_Infestations_Reduces_Blacklegged_Tick_Acari_Ixodidae_Abundance_and_Infection_Prevalence_With_I_Borrelia_burgdorferi_I_Spirochaetales_Spirochaetaceae_

Wilson, Claire & Darbyshire, Stephen & Jones, Rosita. (2007). The Biology of Invasive Alien Plants in Canada. 7. Cabomba caroliniana A. Gray. Canadian Journal of Plant Science. 87. 615-638. Retrieved May 8, 2023, from https://cdnsciencepub.com/doi/10.4141/P06-068

Wilson, J., Richardson, D., Rouget, M., Procheş, S., Amis, M., Henderson, L., & Thuiller, Wilfried. (2007). Residence time and potential range: Crucial considerations in modelling plant invasions. Diversity and Distributions. 13. 11 - 22. Retrieved May 8, 2023, from https://www.researchgate.net/publication/227708308_Residence_time_and_potential_range_Crucial_considerations_in_modelling_plant_invasions

Wisconsin Ch NR 40 Invasive species identification, classification, and control. Retrieved May 8, 2023, from https://casetext.com/regulation/wisconsin-administrative-code/agency-department-of-natural-resources/fish-game-and-enforcement-forestry-and-recreation/chapter-nr-40-invasive-species-identification-classification-and-control

Wisconsin Department of Natural Resources (2015). NR 40 Invasive species list – plants only. Retrieved May 8, 2023, from https://dnr.wi.gov/topic/invasives/documents/NR40plantlist.pdf

WTO (World Trade Organization). (1998). SANITARY AND PHYTOSANITARY MEASURES: INTRODUCTION - Understanding the WTO Agreement on Sanitary and Phytosanitary Measures. Retrieved May 8, 2023, from https://www.wto.org/english/tratop_e/sps_e/spsund_e.htm

WTO (World Trade Organization). (2010). Sanitary and Phytosanitary Measures. Agreements Series. Switzerland. Retrieved May 8, 2023, from https://www.wto.org/english/res_e/booksp_e/agrmntseries4_sps_e.pdf

WTO (World Trade Organization). (2022). WTO ANALYTICAL INDEX SPS Agreement – Article 5 (Jurisprudence) Current as of: June 2022. Retrieved May 8, 2023, from https://www.wto.org/english/res_e/publications_e/ai17_e/sps_art5_jur.pdf

WTO (World Trade Organization). (n.d.). The WTO Agreement on the Application of Sanitary and Phytosanitary Measures (SPS Agreement). Retrieved May 8, 2023, from https://www.wto.org/english/tratop_e/sps_e/spsagr_e.htm

WTO (World Trade Organization). (n.d.). The WTO and the International Plant Protection Convention (IPPC). Retrieved May 8, 2023, from https://www.wto.org/english/thewto_e/coher_e/wto_ippc_e.htm

Wu, S., Huang, J. & Li, S. (2020). Classifying ecosystem disservices and comparing their effects with ecosystem services in Beijing, China. Retrieved May 8, 2023, from https://www.researchgate.net/publication/338421110_Classifying_ecosystem_disservices_and_comparing_their_effects_with_ecosystem_services_in_Beijing_China

Wymore, A., Keeley, A., Yturralde, K., Schroer, M., Propper, C., & Whitham, T. (2011). Genes to ecosystems: exploring the frontiers of ecology with one of the smallest biological units. The New phytologist, 191, 19-36. Retrieved May 8, 2023, from https://nph.onlinelibrary.wiley.com/doi/10.1111/j.1469-8137.2011.03730.x

Yukon Environment Act, RSY 2002, c 76. Retrieved May 8, 2023, from https://www.canlii.org/en/yk/laws/stat/rsy-2002-c-76/latest/rsy-2002-c-76.html

Zhang, Congwen & Boyle, Kevin. (2010). The effect of an aquatic invasive species (Eurasian watermilfoil) on lakefront property values. Ecological Economics. 70. 394-404. Retrieved May 8, 2023, from https://www.researchgate.net/publication/227414480_The_effect_of_an_aquatic_invasive_species_Eurasian_watermilfoil_on_lakefront_property_values

Zenni, R., Essl, F., García-Berthou, E., & McDermott, S. (2021). The economic costs of biological invasions around the world. NeoBiota. 67, 1-9. Retrieved May 8, 2023, from https://neobiota.pensoft.net/article/69971/

Ziller, S.R., Dechoum, M.S., Silveira, R.A.D., da Rosa, H.M., Motta, M.S., da Silva, L.F., Oliveira, B.C.M., & Zenni, R.D. (2020). A priority-setting scheme for the management of invasive non-native species in protected areas. In: Wilson, J.R., Bacher, S., Daehler, C.C., Groom, Q.J., Kumschick, S., Lockwood, J.L., Robinson, T.B., Zengeya, T.A., Richardson, D.M. NeoBiota 62: 591-606. Retrieved May 8, 2023, from https://doi.org/10.3897/neobiota.62.52633