Biosecurity and Invasive Species

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The role of primary and secondary introduction pathway management in effective biosecurity

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The North American Invasive Species Management Association (NAISMA) advocates for the protection of North American biodiversity, agricultural, and natural resources from invasive species impacts, and calls for prioritizing and enacting legislation, policies, and funding initiatives to mitigate the threats posed by invasive species. This policy paper provides a series of recommendations to support pathway management as it relates to effective biosecurity.

Non-native species are being introduced to new areas globally at an unprecedented rate (1). Invasive species are those non-native species whose introduction causes significant harm to the economy, environment, or human, animal, or plant health (Executive Order 13751). Between 1960 and 2020, the United States (US) incurred $4.51 trillion in costs and losses from invasive species (2). Globally, invasive species have contributed to 60% of all recorded extinctions, severely impacting biodiversity (1). It is well-established that prevention and early detection of invasive species can avert severe ecological and socioeconomic damage, saving billions of dollars in economic costs (3). Since invasive species are moved across the world and within an invaded region by a myriad of human activities, i.e., introduction pathways, effective prevention requires coordinated action across international, federal, tribal, state, local, and private jurisdictions, supported by adequate resources to implement effective, science-based strategies.

A robust national biosecurity system is essential for preventing the introduction and spread of harmful organisms while protecting the U.S. economy, ecosystems, and public health from the ever increasing threat of invasive species. Biosecurity encompasses policies and procedures, supported by research, aimed at preventing the introduction, establishment and spread of harmful organisms (e.g., viruses, bacteria, plants, animals, etc.), including invasive species (4). Globally, biosecurity measures have been implemented that pertain to the global movement of invasive species, such as the Ballast Water Management Convention, which mandates that ships comply with ballast water management standards (5) to reduce the movement of aquatic organisms, and the International Standard for Phytosanitary Measures No. 15, which requires treatment of solid wood packaging (e.g. pallets, crates)

to reduce the international transport and spread of insects and diseases that infest trees and forests (6).

Introduction pathway management is a critical component of biosecurity. 'Introduction pathways' refer to the various means by which non-native species are transported between discrete locations that give rise to a subsequent intentional or unintentional introduction (7), including both the transport vector (e.g., vehicles, wood products, nursery material) and the geographical route taken (8). Introduction pathways can be either primary, where non-native species cross jurisdictional or biogeographic boundaries, or as secondary, where they spread within these boundaries after an initial introduction (i.e., secondary dispersal) (**Figure 1**; **Table 1**) (9). Biosecurity measures addressing introduction pathways into the US include conducting horizon scans to identify unknown invasive species threats and their pathways to inform invasive

[1] Non-native species are organisms that are present outside their natural range and whose presence is the result of deliberate or accidental human activities.

[2] Safeguarding the Nation from the Impacts of Invasive Species U.S. Fed. Registrar (C.F.R.), 81 (2016), pp. 88609-88614

species watch lists; 'blacklisting' of *known* species of concern through regulations, like injurious listing under 18 U.S.C. 42 of the Lacey Act and the Federal Noxious Weed List, which prohibit the importation and interstate transport of listed species; port of entry inspection and enforcement by US Customs and Border Protection (USCBP) and US Department of Agriculture Animal and Plant Health Inspection Service (USDA-APHIS), including prohibition of the entry of high risk items from high risk geographics (such as some meat and poultry products, or live plants for planting), and surveillance and monitoring by USDA-APHIS, National Oceanic and Atmospheric Administration (NOAA) and the U.S. Fish and Wildlife Service (USFWS).

It is important to recognize differences between managing primary vs. secondary pathways. Generally, primary pathway management is applied at the national level (e.g., import regulations pre-border and inspections and enforcement actions at-the-border) and secondary pathway management occurs post-border at the state, tribal, and federal level (**Table 1)** (10). While significant progress has been made in regulating and monitoring primary pathways, such as those in international trade, transportation, and tourism, secondary pathways remain an often overlooked, yet extremely important component of biosecurity. Management of secondary pathways is often hindered because of inadequate funding, a lack of clear communication across jurisdictions, a lack of statutory authorities, and the reality that state and tribal jurisdictional boundaries very rarely align with the biogeographic patterns of biological invasions. This misalignment can result in fragmented management efforts, with invasive species control measures halting abruptly at state or jurisdictional boundaries, despite the species spreading across them. For example, invasive species regulatory lists often vary significantly between neighboring states, indicating that the current approach to plant and plant pest regulation is unlikely to effectively prevent ongoing and future secondary invasions (11; 12; 13). Further, the distinction between primary and secondary pathways is often an artificial construct; its applicability may vary depending on geopolitical boundaries and natural barriers (e.g., continental divides, archipelagos).

We at NAISMA make the following recommendations to improve the US biosecurity response including secondary pathways management. These recommendations apply to Federal and State regulatory bodies and other parties responsible for the management of invasive species in the US:

1. **Improve horizon scanning, risk analysis, and management planning including augmented risks coming from global change and extreme weather events with a focus on data sharing and improved implementation of findings to more effectively prevent the spread of invasive species (14).**

2. **Enhance surveillance to enable early detection and rapid response (EDRR) when new detections of potential invasive species are observed. This includes continued support for and expansion of the National EDRR Framework, which focuses on the creation of watch lists, targeted and broad scale surveillance, risk and feasibility assessments, and implementation of response measures, but is currently limited to a select group of taxa, mostly consisting of aquatic invasive species. Expansion should include all taxonomic groups and give equal consideration to both terrestrial and aquatic habitats.**

3. **Increase dedicated funding to support rapid eradication or containment efforts upon the detection of a new invasive species, as early intervention is the most cost-effective strategy to prevent long-term ecological and economic damage.**

4. **Develop proactive regulations that support the containment of invasive species, strengthen existing regulations, and strive for more cohesion of regulatory lists and**

activities between jurisdictions.

5. **Support the implementation of cross-jurisdictional containment and prevention strategies (e.g., mandatory watercraft inspection and decontamination) and develop legal frameworks and science-based standards (e.g., Weed Free Products, regulatory harmonization plans) to stop the spread of invasive species.**

6. **Enhance collaboration among federal, state, municipal, and tribal agencies by establishing inter-agency agreements to address biosecurity risks effectively. This includes forming centralized working groups to coordinate and implement comprehensive, ecologically informed responses to invasions (15).**

7. **Continue support for public outreach programs such as PlayCleanGo, Weed Free Products, Don't Let it Loose, and Don't Move Firewood.**

NAISMA is the only international organization devoted exclusively to supporting invasive species management. Thus, NAISMA can help foster collaborative partnerships, develop standards for reporting species, lead inter-jurisdictional cross-training exercises, offer networking and professional development opportunities, increase public awareness, and provide various other services. Notably, NAISMA members are also empowered to take direct, on-the-ground action to stop the spread of invasive species through effective pathway management.

[3] The Federal Noxious Weed Act, enacted in 1975, established a federal program to control the spread of noxious weeds.

[4] a coordinated set of actions to find and eradicate potential invasive species in a specific location before they spread and cause harm.

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Table 1. Differences between the management of primary and secondary pathways including the definitions, focus, scale, governance, and a sampling of management interventions.

	Primary Pathways	**Secondary Pathways**
Definition	the human-driven processes that facilitate the movement of non-native species across jurisdictional or biogeographical borders	the human-driven and natural processes that facilitate the movement of non-native species within the jurisdictional or biogeographical areas where they have been introduced
Focus	Preventing initial introduction; eradication	Containing and mitigating further spread
Scale	International and national; includes between continental US and US Territories, offshore islands, and US Affiliated Islands	Regional and local
Governance	Primarily federal	Federal, state, tribal, and local
Key Strategies	Horizon scanning and risk analysis, policy setting (e.g. trade agreements and standards), enforcement of international and federal law, inspection and monitoring, regulatory frameworks, EDRR, biosecurity measures, public awareness campaigns	Detection and surveillance, inspection and monitoring, quarantine and movement restrictions, EDRR, best management practices, public awareness campaigns

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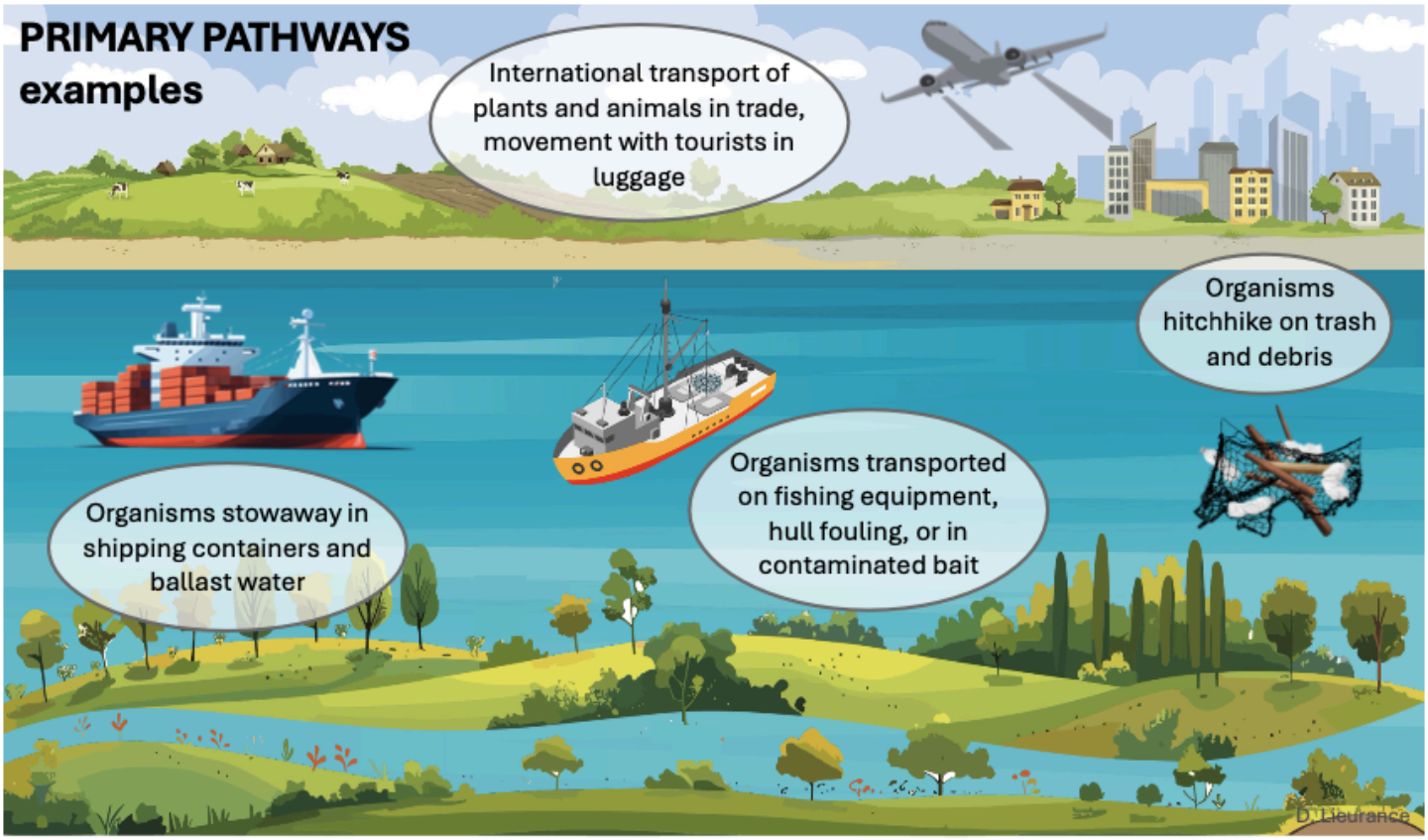
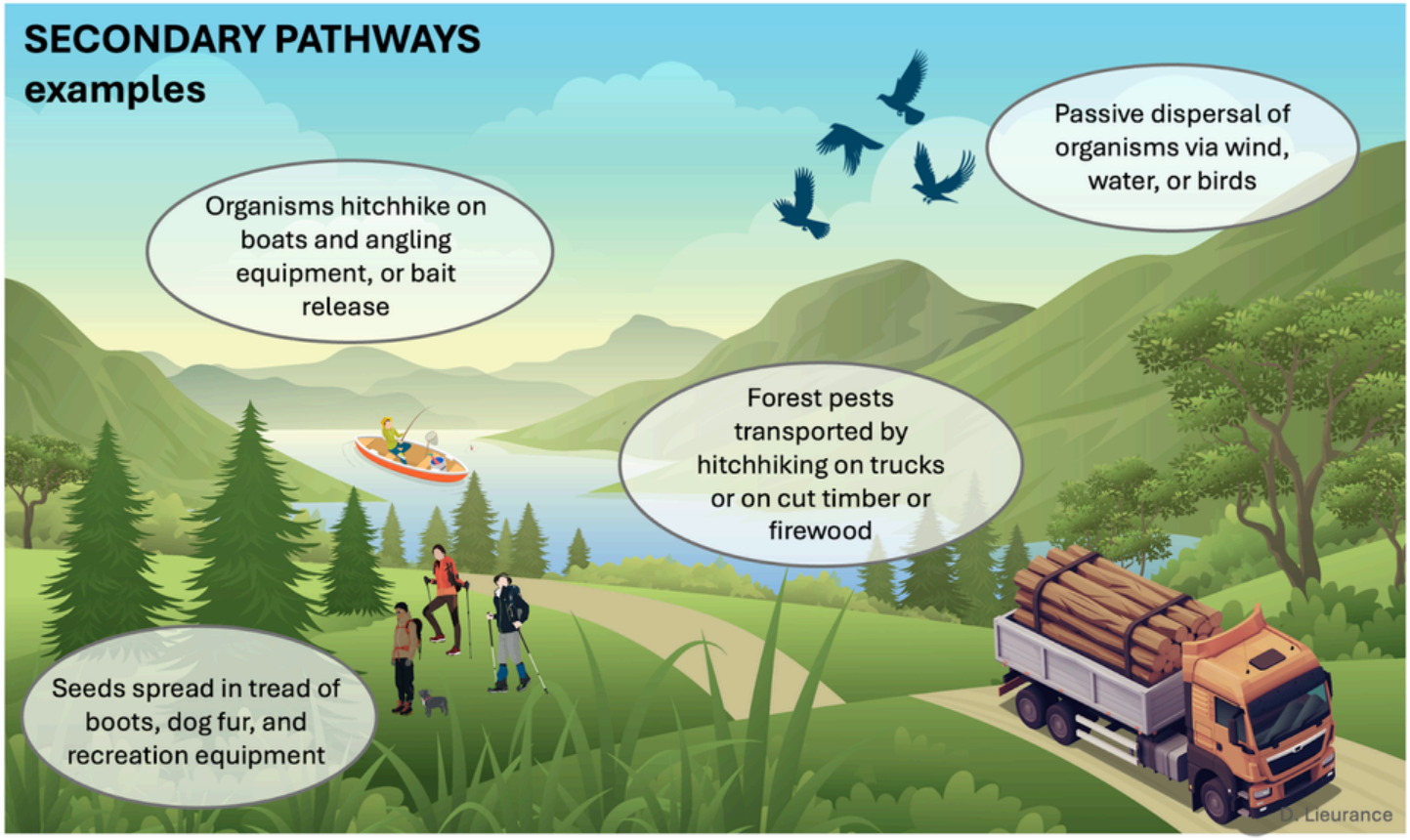


Pre-border:

- Horizon scanning and pest risk analysis
- Trade regulations and voluntary standards
- Pre-treatment of goods (pesticides, heat treatment)
- Public Campaigns (Don't Pack a Pest)

At the border:

- Baggage, mail, cargo, and conveyance inspections and enforcement
- Quarantine and inspection stations
- Corrective measures (decontamination)
- Voluntary disposal of restricted items



Post-border biosecurity

- Detection and surveillance (eDNA, public reporting, state and local monitoring)
- Quarantine and movement restrictions
- Certification of forage, mulch, and gravel to limit the spread of noxious weeds (Weed Free Products)
- Public campaigns (Don't Move Firewood, PlayCleanGo, Clean Drain Dry, Don't Let it Loose)

Figure 1. Examples of primary and secondary pathways, including some management interventions pre-border, at-the-border, and post-border.