North American Invasive Species Network


*Mission:* A consortium that uses a coordinated network to advance science-based understanding of, and effective response to, invasive species in North America.
Executive Summary

Many of the continent’s wetland and upland ecosystems are mere remnants of natural systems that once stretched from coast to coast. Many of these ecosystems are also highly disturbed and being further degraded and diminished by invasive species. These invasions are causing significant economic impacts especially in agricultural lands, forests, rangelands, and fisheries. Because of expanded global trade and its associated intentionally imported species or associated hitchhikers, invasions have increased in recent years. To battle these biological invasions, a number of local, state, provincial, and federal regulations and programs in Canada, Mexico, and the US exist to restrict the introduction of harmful invaders and eradicate or manage established ones. Unfortunately, present policies, management operations, and research efforts in North America are not working adequately to control or prevent biological invasions. Government agencies are faced with the daunting task of developing and implementing effective invasive species preventive and management strategies in a complex environment that does not currently work effectively across all jurisdictional lines.

The newly formed North American Invasive Species Network (NAISN) brings new science and information capacity to invasive species management and will work to unite, build, and draw upon the ten core services that are essential in invasive species management in North America. To enhance existing governmental, First Nations, and private landowners’ management of invasive species in North America, NAISN will work to establish and/or expand efforts to develop innovative approaches for invasive species monitoring and surveillance, to adapt information technology to aid invasive species management, to integrate databases, to coordinate rapid assessment teams, to compile statistical information about invasive species, to develop watch lists, and to help establish Cooperative Invasive Species Management Areas where they are lacking in North America.

As fundamental operating principles, NAISN will work to restore sustainability of North America’s fish and wildlife populations, protect ecosystem health, and build social responsibility through environmental stewardship. The organization will also work with a broad array of invasive species organizations, the public, the news media, and policy makers and engage natural resource managers to help them articulate and prioritize their science and information needs. NAISN will work to provide relevant science and information services to enhance existing invasive species efforts and to increase public awareness.

Invasive Species: As per US Executive Order 13112, an “invasive species” is defined as a species that is: 1) non-native (or alien) to the ecosystem under consideration and 2) whose introduction causes or is likely to cause economic or environmental harm or harm to human health.
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Introduction

Over the past two centuries, human population growth substantially altered a majority of waterways and what remains of the natural landscape in North America. Many of the continent’s wetland and upland ecosystems, that were once contiguous from coast to coast, are mere remnants and/or highly disturbed due to human activities. They are now being further degraded and diminished by invasive species. These invasions have increased because of expanded global trade and its associated intentionally imported species or associated biological hitchhikers. These biological invasions exacerbate the problem of conserving what remains of North America’s biological heritage, especially on public conservation lands.

Invasive species have contributed to the decline of 42 percent of US endangered and threatened species. At least three of the 24 known extinctions of species listed under the US Endangered Species Act were wholly or partially caused by hybridization between closely related non-native and native species. After habitat destruction, introduced species are considered the second greatest cause of species endangerment and decline worldwide—far exceeding all forms of harvest. As the eminent Harvard University biologist E. O. Wilson once put it, "Extinction by habitat destruction is like death in an automobile accident: easy to see and assess. Extinction by the invasion of exotic species is like death by disease: gradual, insidious, requiring scientific methods to diagnose."

Other negative effects on private and public lands are more obvious. The spread of fire-adapted invasive plants that burn easily increases the frequency and severity of fires to the detriment of property, human safety, and native flora and fauna. In 1991, in the hills overlooking Oakland and Berkeley, California, a 1,700-acre fire propagated by Eucalyptus trees planted early in this century destroyed 3,400 houses and killed 23 people. In the eastern US, fire is often used as a method of land management. Cogongrass (Imperta cylindrica), a native to Southeast Asia, poses a significant threat to the ecology of the southeastern US public lands and to the forest productivity of private lands. Once cogon-grass has invaded an area, the grass can alter the fire regime. A major land management problem is that both wildfires and prescribed burns for land management encourage the spread of cogon grass. In western rangelands, cheatgrass (Bromus tectorum) also alters fire regimes by increasing fire frequency and intensity.

According to a 1993 report by the (now defunct) US Congressional Office of Technology Assessment, lack of legislative and public concern about the harm these invasions cause costs the United States hundreds of millions, if not billions, of dollars annually. This includes higher agricultural prices, loss of recreational use of public lands and waterways, and even major human health consequences. An estimate published by David Pimentel, a Cornell University scientist, determined (in 2002) that the global cost of biological invasions was $1.4 trillion dollars. Contrast that with the estimated cost of $190 billion dollars for natural disasters as determined by Rodriguez et al. in 2009. Pimentel’s work calculated the US annual economic impact of biological invasions at more than $130 billion, primarily caused by losses in agricultural lands, forests, rangelands, and fisheries.

Canada’s projected annual losses for 2015 range from $13.3 to $34.5 billion for just the top 16 invasive species alone. These estimates are generally believed to be conservative because they do not include environmental losses,
such as losses in bio-diversity, or direct human costs. It is difficult to calculate the cost inflicted by conditions such as allergic reactions to an invasive plant or injuries from bites of a South American fire ant (Solenopsis invicta). However, these invasions and economic costs are expected to increase with climate change and growing international trade, the single greatest pathway for harmful introduced species.

To battle these invasions, a number of local, state, provincial, and federal regulations and programs in Canada, Mexico, and the US exist to restrict harmful invaders and eradicate or manage established ones. Unfortunately, present policies, management operations, and research efforts in North America are not working adequately to control or prevent biological invasions. A recent review of legislation in Canada identified invasive species policy gaps due, in large part, to inadequate acts and regulations that are decades old and whose primary intent was not directed at invasive species. For example, “invasive species” is rarely found in Canadian legislation; rather, the word “pests” tends to be used where additions have been made in an attempt to haphazardly address issues as they arose. In Mexico, invasive species management efforts have been limited and focused mainly on islands, aquatic species, and those species important for both agriculture or forestry and the environmental sector. During the most recent country biodiversity assessment, “The Natural Capital of Mexico,” the problem of invasive species was identified as the third cause of biodiversity loss within the country.

Several extensive studies in the US have documented specific problems such as: insufficient interaction between scientists, policy-makers, and resource and agricultural managers; lack of a framework for rapid responses to new invasions; ineffective use of existing information; numerous jurisdictional disputes and turf issues; and few direct means to inform the public about biological invasions. To address these issues in the US, a Presidential Executive Order established the interagency National Invasive Species Council in 1999. This important first step led to the country’s first National Invasive Species Management Plan in 2001. However, the Council lacks the infrastructure, support, resources, and mechanisms to implement the plan and to help coordinate approximately 650 federal and state programs and non-profit organizations that work to prevent, manage, and research invasive species nationwide. According to a 2001 US General Accounting Office Report, the major factors that interfere the most with managing invasive species in the US are:

- Lack of a national system to rapidly address new invasive species;
- Lack of federal funds for state invasive species management efforts in natural areas;
- Lack of public awareness and outreach;
- Inadequate federal and state coordination, and inadequate regional coordination—a multi-jurisdictional issue;
- Inadequate invasive species information, research, and technical assistance;
- Lack of a single federal agency responsible for invasive species within the US.

Canada has agreed to prevent the introduction and spread of invasive species by establishing a National Plant Protection Organization (NPPO) as a result of the International Plant Protection Convention. The Canadian Food Inspection Agency (CFIA) is Canada’s NPPO in charge of risk assessment for invasive species. CFIA’s responsibilities also include the preparation of phytosanitary certificates, surveillance and inspection, invasive species control, protection of endangered species, implementation of phytosanitary security areas and designation, and maintenance and surveillance of invasive species-free areas and areas of low invasive species prevalence. In 2004, the Canadian federal government, working in cooperation with its provincial and territorial counterparts, developed An Invasive Alien Species Strategy for Canada. Currently, there are a total of 13 provincial Invasive Species Councils and Committees across Canada. These organizations are mostly responsible for information exchange and public outreach. Some provinces have developed or are in the process of developing their own invasive species strategies, and Ontario has taken a lead in building capacity in academia through sponsoring a research chair-ship program and by working with the federal government to establish an Invasive Species Centre; but, in general, funding is scarce and there is a clear disconnect and lack of coordination among organizations.

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1Hubs are regionally- or internationally-based organizations and agencies that address invasive species through research, coordination, or management missions/efforts.

2Nodes are government agencies, networks, and other organizational entities that are thematically focused and play a recognized role in invasive species research, management, public outreach, or policy.

3Affiliates are individuals with invasive species interests and qualifications that align with the NAISN mission.
Mexico published its “National Invasive Species Strategy” in 2010 identifying the strategic objectives and the priority actions needed to address the problem. The National Commission for the Knowledge and use of Biodiversity (CONABIO), which is responsible for the National Invasive Species Information System, is currently coordinating a Global Environmental Project to implement the strategy in coordination with different government agencies, as well as developing a rapid screening tool to identify new invaders to be regulated in the country.

While an improved legislative framework and invasive species management efforts are very important within the countries of North America, the overall improvements will be of limited value if there remains a reluctance to fully implement measures to prevent biological invasions when those measures interfere strongly with commerce and trade. Governments must demonstrate the will to invest in monitoring and control policies and programs; industry must incorporate effective invasive species monitoring and control measures in their practices; and the public must respond to societal responsibilities to prevent introduction or movement of invasive species, eliminate them before they become established, and manage those that have established. Transition toward this model will create a much more effective approach to invasive species management that will—among other things—create opportunities to generate new knowledge, develop new products and services, and improve and validate existing processes and technologies.

Establishment in North America

Over the years, a number of invasive species centers, institutes, laboratories, and networks have been established in North America to help meet the needs of public conservation land and waterway resource managers about invasive species issues. Two workshops were held in 2010 (March and November) to determine how to integrate these various groups into a North American Invasive Species Network. Scientists, policy makers, resource managers, NGOs, educators, and information specialists from Canada, Mexico, and the US attended the workshops, along with the directors from these entities or their representatives.

As a result of the November 2010 workshop, seven invasive species centers, institutes, and one federally funded Canadian research network have agreed to become part of the North American Invasive Species Network (NAISN). Since then, NAISN has added another Canadian member. In 2011, NAISN was established as a non-profit organization in the United States (501(C)3) that unifies and connects these existing invasive species efforts into a single network resulting in better communication, coordination, collaboration, and cooperation in dealing with the multi-jurisdictional aspects of biological invasions in North America. Participating member organizations, groups, or individuals have the ability to participate as Hubs, Nodes, or Affiliates.

In April 2012, the third NAISN workshop was held to develop a five-year business strategic plan. A number of issues were discussed, including strategic objectives, potential demonstration projects, how to market and advertise NAISN services, engaging Native Americans/First Nations/Aboriginal peoples, and setting priorities and timelines. This five-year business strategy was developed to guide NAISN during its formative years. The creation and execution of the Network will require rapid learning from initial efforts and the flexibility to adapt to changing conditions. Therefore, we envision the need to refine this strategy biannually. It is envisioned, as NAISN grows and expands, that the Network will work to enhance information exchange among scientists, government agencies, and private landowners through the use of a comprehensive website modeled after the Centers for Disease Control and Prevention (CDC) website and the aggregation of databases from over 250 databases that contain information of invasive species currently in use worldwide. NAISN will also begin to track invasive species expenditures through annual surveys of federal, provincial, state, municipal and tribal governments and oversee a comprehensive analysis of economic impacts of invasive species; such information could readily be used by policy-makers and elected officials. Finally, NAISN will provide “one stop shopping” for the news media and develop and implement national public awareness campaigns about invasive species in the North America.

Strengths, Weaknesses, Opportunities, and Threats Analysis or SWOT

A SWOT analysis was conducted at the April 2012 NAISN workshop that questioned the Board of Directors about the organization’s current strengths, weaknesses, opportunities, and threats. There was broad consensus that NAISN currently possesses and has access to unique capacity in scientific expertise, training and outreach tools and skills, and communication technology in the field of invasive species management and outreach. The organization’s weaknesses were also evaluated. Some of the deficiencies identified were in wildlife taxonomic expertise; economics; tracking research; marine expertise; intra- and inter-country statistical knowledge on invasive species issues; out-
reach standards and standing operating principles (SOPs); and funding. Some of the opportunities identified were: enhanced public and media awareness through the use of tools similar to the “Smokey Bear” icon used by the US Forrest Service; endowments and other permanent funding sources; greater focus on pathways to prevention efforts; sponsored internships and scholarships; greater leveraging of the organization’s international status; introduction of certifications to enhance invasive species management and control (e.g., “green leather”); and coordination or pooling resources to mitigate the impacts of government austerity. Threats to the organization were also identified and ranged from government cutbacks to a lack of operating funds.

Mission, Goals, and Priorities

No individual NAISN hub or node has the capability to address all aspects of providing services that will enhance invasive species management in North America. NAISN constituency groups are comprised of the general public, government agencies (personnel and granting entities), policy makers, the news media, and future NAISN hubs, nodes, and affiliates. Given this wide target audience, NAISN hubs and nodes must partner to maximize effectiveness and avoid duplication of efforts. Within this collaborative framework, each hub and node will have particular areas of expertise and will offer services consistent with its individual mission and provide added capabilities and benefits to the overall network.

As NAISN is part of the overall invasive species management community in North America, its mission is to provide natural resource managers in government and private sectors with tools and information needed to develop and execute strategies for successfully preventing new introductions; effectively responding to eradicable new invasive species populations; conducting research on invasive species biology, ecology and associated environmental and economic impacts; managing invasive species to minimize their environmental and economic impacts; and—based on scientific evidence—informing the public, news media, and policy makers about invasive species issues in North America.

From the information obtained during the course of the three NAISN workshops, NAISN will fulfill this mission if it accomplishes three goals: (1) to work in close partnership with natural resource managers throughout North America to understand their highest priority invasive species science and information needs; (2) work with university and government scientists to develop and refine invasive species science information and tools that can be readily used to produce effective management strategies; and (3) to deliver these tools and information in a timely and useful way directly to resource managers on the ground.

In pursuit of its missions and goals, NAISN will focus on three priority science and information activities:

1. Develop a NAISN Web Presence

The University of Georgia Hub will continue to create, support, and populate the NAISN website and develop and implement tools and resources to support the working objectives of NAISN (e.g., implementation of a North American wide invasive species database aggregator through collaboration with Colorado State University). As a result of this effort, the NAISN hubs—University of Florida; Colorado State University; Montana State University; Mississippi State University; Algoma University; CONABIO; and, Canada-Ontario Invasive Species Centre—will be able to link to the web tools and resources to increase dissemination of information trilaterally and regionally. The web presence is expected to have an indirect benefit of expanding the number of NAISN hubs (through an application process) and will increase geographical coverage of the initiative throughout the United States, Mexico, and Canada.

2. Develop Regional Watch Lists and the Most Invasive Species List

In order to improve our ability to anticipate which non-native species may become invasive to prevent their introduction and spread, non-native species in the commercial pet and plant industries, along with those species that may be accidently introduced via trade, need to be identified and evaluated for potential invasiveness (risk assessment). With increased availability of information about invasive species throughout the world available in the scientific literature and on the web, our ability to undertake risk assessment has improved. A numerical threat index will be developed to rate potential invaders based on distribution and abundance with respect to climate, biological characteristics, and preferred habitats of the species. From this information, regional “Watch Lists” will be developed.

NASIN will also identify 100 invasive species in North America that really are "worse than any others.” Listing protocols will be developed to evaluate species and their interactions with ecosystems along with their economic impacts.
Species will be selected for the 100 worst invasive species list according to two overall criteria: their serious impacts on biological diversity and/or human activities, and their economic impact. Of course, any absence from the NAISN lists will not imply that a species poses a lesser threat.

3. NAISN Demonstration Projects

NAISN will develop and implement a series of demonstration projects to showcase the organization's capacity to produce results, grow the organization, and secure funding. Initially, projects should be developed that require only a minimal amount of funding to execute and involve collaboration among hubs and nodes. Possible projects include informational material (both printed and on the web), white papers targeting in-depth analysis of a specific invasive species issue, risk assessment examples (along with a NAISN-approved guide on how to develop them), regional or national surveys, host specialized invasive species seminars, and conduct economic impact studies.

Data Management

A survey conducted in 2006 by Crall et. al. found over 200 databases that contain information on invasive species within the US. Within NAISN, a survey conducted prior to the April workshop revealed NAISN hubs were using several invasive species databases. These examples illustrate the need to standardize existing invasive species data into an easily accessible format.

The Global Invasive Species Information Network (GISIN) was formed to provide a platform for sharing invasive species information at a global level via the Internet and other digital means. A group of collaborators led by the United States Geological Survey and Colorado State University are developing the GISIN as a web-based network of databases that are connected by a common set of data types. The resulting network, or GISIN, provides increased access to data and information that will in turn help detect, rapidly respond to, and control invasive species. The Board of Directors of NAISN decided to adopt the GISIN database as a framework to be featured on the NAISN website that will facilitate data and information sharing across its member hubs and nodes. Using the GISIN data exchange protocol, NAISN’s members can map the data available on their websites to a common data server. These data can then be hosted on the NAISN website, providing an outlet to disseminate all available information on invasive species across North America at one site. Although the GISIN data exchange protocols support species occurrence data, species resource URLs, and species status records, NAISN believes the most important data that GISIN can provide are invasive species occurrence data.

Recruitment of New Hubs and Nodes

As a result of the November 2010 workshop, eight invasive species centers and/or institutes, and one regional network have become part of the North American Invasive Species Network (NAISN) either as a hub or a node. They are:

- Canada-Ontario Invasive Species Centre, Canada (hub)
- Canadian Aquatic Invasive Species Network, Canada (node)
- Center for Aquatic and Invasive Plants, USA (hub)
- Center for Invasive Species and Ecosystem Health, USA (hub)
- Center for Invasive Species Management, USA (hub)
- Comisión Nacional para el Conocimiento y Uso de la Biodiversidad, Mexico (hub)
- Geosystems Research Institute, USA (hub)
- Invasive Species Research Institute, Canada (hub)
- National Institute of Invasive Species Science, USA (hub)

The present network lacks comprehensive geographic and/or taxonomic coverage, especially in the southwestern region of the United States and on the west coast of Mexico, the United States, and Canada. The network also lacks coverage on marine organisms found in the Pacific Ocean, Gulf of Mexico, and the Atlantic Ocean (the Arctic is covered by the node CAISN). NAISN will actively seek and recruit new, existing centers, institutes, labs, and networks to expand geographic and taxonomic coverage and services throughout North America. To do this, NAISN will design and implement a recruitment strategy to add six additional hubs by 2014. Although the number of hubs will be limited, the number of nodes and affiliates will be unlimited.
Marketing

NAISN will actively seek new ways to market its services to the public as well as to federal, First Nations, state/provincial, and local government agencies, the news media, and policy makers. Basic marketing action items may consist of a NAISN informational brochure that details the services offered by its hubs and nodes, developing a communication strategy to “brand” NAISN and hubs and nodes similarly to the US Centers for Disease Control and Prevention or the US National Interagency Fire Center (the addition of logos, etc.), and hosting and providing regional and national webinars, short courses (a possible means of generating income), and especially focusing on tri-national events such as invasive species pathway abatement activities between the countries and at the ports. Some specific marketing avenues to explore include: conducting an outreach needs assessment (along with identifying those groups who are using hub/node services); developing and providing horticultural certification of non-invasive species products (although that may be difficult because of the lag times that are common between first introduction and when a species becomes invasive); and providing regional lists of recommended native species that can be used to replace invasive plant species used in the ornamental plant trade.

10 Essential Core Invasive Species Resource Services

NAISN’s 10 Essential Core Invasive Species Resource Services provide the fundamental framework for cost-effective invasive species management in North America and are used to varying degrees by successful invasive species management programs by government agencies, First Nation’s governing bodies, and private landowners. These core services provide a working definition of modern invasive species management and a guiding framework for the responsibilities of resource management agencies and private landowners. These services are:

1. Prevent the introduction of new or potential invasive species;
2. Conduct periodic surveillance activities for early detection of potential invasive species and to determine the size of existing biological invasions;
3. Rapidly respond to new invasions in terms of quarantine, containment, and eradication activities;
4. Prioritize management of existing biological invasions targeting invasive species that are highly disruptive of native ecosystems and/or causing economic damage. Implement a management program with the goal of achieving “maintenance control” where possible;
5. Mobilize and participate in local community partnerships through Cooperative Invasive Species Management Areas (CISMAs) and Cooperative Weed Management Areas (CWMAs);
6. Inform, educate, and conduct outreach efforts to help prevent the introduction of invasive species, help early detection of new invaders, provide greater awareness and understanding of damage caused to North America’s ecology and economy, and educate the public about why there is a need to manage invasive species;
7. Support and conduct research to develop more cost-effective invasive species management methods and better exclusion technology;
8. Identify, develop, and disseminate information about best management practices in invasive species surveillance and control efforts;
9. Provide information technology (IT) services that support the efforts of resource managers and policy-makers related to invasive species prevention, eradication, control, research, education, and outreach; and
10. Evaluate and report the effectiveness of current invasive species management efforts.

Future Activities to Enhance the Ten Essential Core Invasive Species Services

To enhance existing governmental, First Nations, and private landowners’ management of invasive species in North America, NAISN will work (as funding becomes available) to establish and/or expand the following efforts:

- Develop innovative approaches for invasive species monitoring and surveillance, such as new information sources, new survey methods, and improved methods for data analysis and visualization;
- Develop innovative IT tools, including use of the Internet and other approaches to foster information sharing and use, the development of mobile apps for invasive species identification, and new decision-support utilities;
- Establish, coordinate, and help support Cooperative Invasive Species Management Areas (CISMAs) throughout North America;
• Identify and disseminate information about best practices in invasive species management and informatics;
• Integrate existing database frameworks to build a synergistic data framework for NAISN. Objectives of this effort are to integrate existing databases, such as EDDMapS and other existing databases used in the US, Canada, and Mexico via the GISING protocol. This task involves mirroring the GISIN database at Colorado State University and the University of Georgia to provide backup security and expand the number of occurrence records contributed by trilateral partners;
• Establish a media presence by developing a strategic marketing plan, implement the plan, and create a media icon similar to the USDA’s Smokey the Bear;
• Showcase existing success stories (e.g., data integration, multi-agency Melaleuca removal project in Florida, focus on good news, new findings in invasive species biology and ecology);
• Build scientific, technical, human and institutional capacities in Mexico to develop a comprehensive invasive species management program in government agencies and research universities;
• Engage First Nations (planning, culturally appropriate consultation); NRCS; Extension services; etc. Conduct an extensive invasive species outreach campaign to the First Nations by establishing invasive species programs for individual First Nations; develop management plans for their reservations that would be tied to existing established tribal programs: wetlands, range management, road maintenance, etc.; and provide communications services by hosting First Nations-focused websites and listservs;
• Establish and offer NAISN-sponsored internships and scholarships for invasive species research and management;
• Organize and coordinate rapid assessment teams in areas of high introductions of invasive species and help establish early warning surveillance systems throughout North America’s shipping ports;
• Enhance coordination and communication among the many disparate invasive species groups throughout the western region of North America to foster more effective regional actions;
• Conduct an economic impacts study for natural resource-based invasive species taxa in North America;
• Expand the EDDMapS to include multiple invasive species taxa (biocontrol releases, forest insects and pests, animals, etc.) throughout the entire western North America through program collaboration and on-line and formal training;
• Help compile national statistics in Canada, Mexico, and the United States on natural area invaders through surveys and comprehensive data requests on invasive species management expenditures and track on-going invasive species research within each country;
• Develop watch lists for each geographical region in North America; and,
• Establish and administer an insurance fund through state and provincial contributions to remedy emergency funding restraints on public conservation lands and waterways that more adequately address the realities of new biological invasions.

Conclusion
Invasive species have impacted and will continue to greatly impact North America’s natural environment and its economy. Because invasive species do not respect jurisdictional boundary lines, they must be managed with a multi-jurisdictional approach. Government agencies are faced with the daunting task of developing and implementing effective invasive species preventive and management strategies in a complex environment that does not currently work effectively across all jurisdictional lines.

The newly formed NAISN brings new science and information capacity to invasive species management and will work to unite, expand, and draw upon existing core services found in NAISN’s hubs and nodes in North America. As fundamental operating principles, NAISN will work to restore sustainability of North America’s fish and wildlife populations, protect ecosystem health, and build social responsibility through environmental stewardship. The organization will also work with a broad array of invasive species organizations, the public, the news media, and policy makers and engage natural resource managers to help them articulate and prioritize their science and information needs. NAISN will work to provide relevant science and informational services to enhance existing invasive species efforts, along with increasing public awareness.
References