



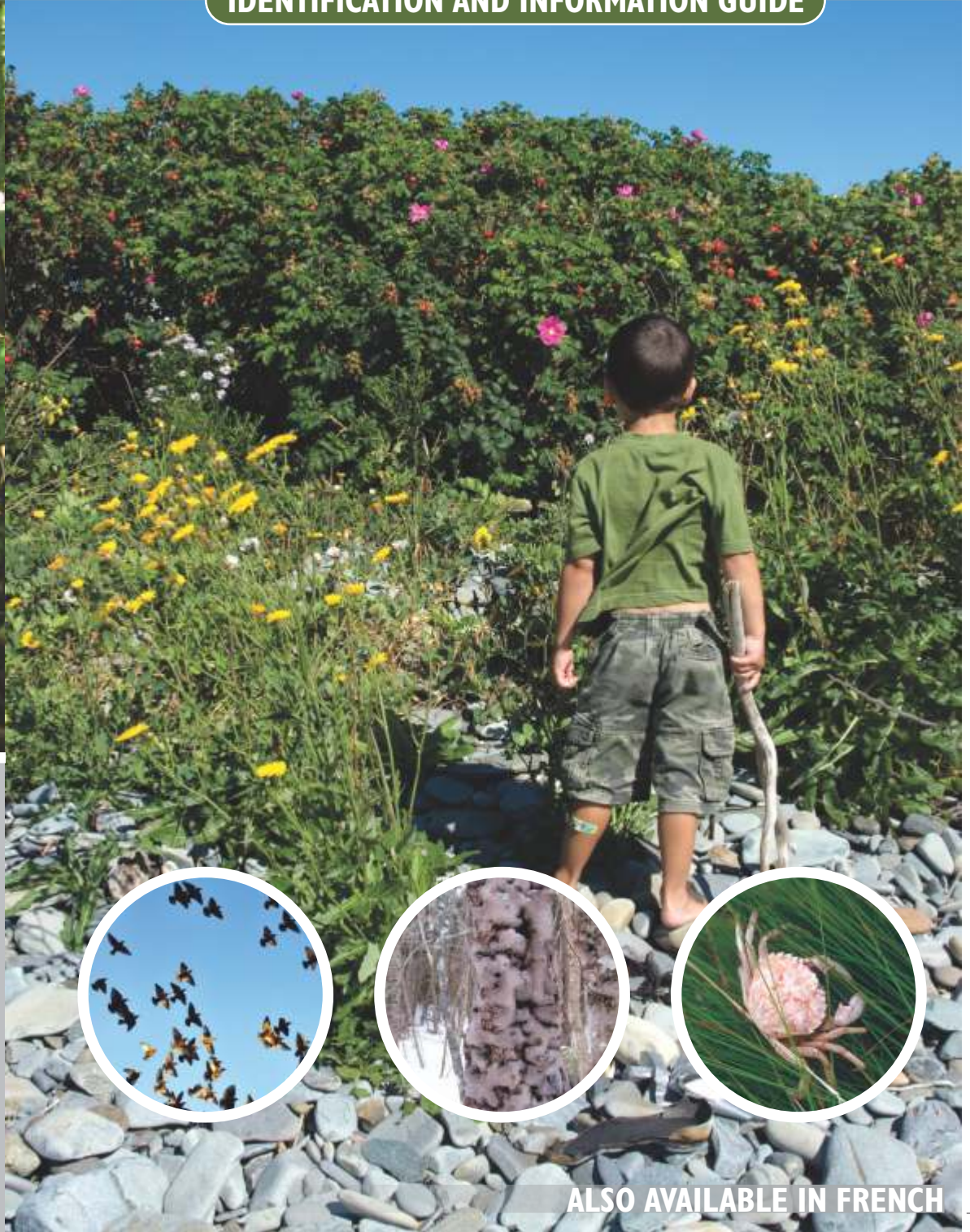
INVASIVE ALIEN SPECIES In Nova Scotia

Invasive Alien Species are a group of species that have been introduced to Nova Scotia by humans and threaten us and the environment. In the last several hundred years, many human-assisted pathways have permitted these introductions, which threaten our province's incredible biodiversity and jeopardize the health and integrity of natural ecosystems. This has, in turn, placed added pressure on our oceans, forests, and watersheds. We all depend on these vital natural resources for our own well-being and prosperity; it's in our best interest to take note and to take action. This guidebook outlines some of the impacts and threats presented by these species, and stewardship actions that we can all take to help provide healthy and vibrant ecosystems for future generations.



INVASIVE ALIEN SPECIES In Nova Scotia

IDENTIFICATION AND INFORMATION GUIDE



Canada This project was undertaken with the financial support of the Government of Canada provided through the Department of the Environment.

ALSO AVAILABLE IN FRENCH



Identification & Information Guide

© 2012, Mersey Tobeatic Research Institute, www.merseytobeatic.ca
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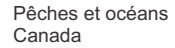
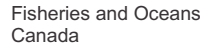
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Visit www.invasivespecies.ca to view and download English and French electronic versions of this guide.

The front and back covers display a mosaic of Invasive Alien Species with photos by Alain Belliveau, Sean Blaney and Gilbert van Ryckevorsel.



This project was undertaken with the financial support of the Government of Canada provided through the Department of the Environment. The views presented herein are solely those of the Mersey Tobeatic Research Institute. They are reflective and supportive of the 2004 federally- and provincially-approved invasive alien species strategy of Canada.

This guide is a companion to...

Species at Risk of Nova Scotia: Identification and Information Guide

Healthy Lakes and Wetlands for Tomorrow: A Landowner Stewardship Guide for Species at Risk in Nova Scotia

Atlantic Coastal Plain Flora in Nova Scotia: Identification and Information Guide

Healthy Beaches and Dunes for Tomorrow: A Landowner Stewardship Guide for Nova Scotia Landowners

Guide to FSC Certification for Woodlot Owners in Nova Scotia





If an observant naturalist takes a walk in a town, village or farm anywhere in Nova Scotia, they will notice a landscape dominated by species deliberately or incidentally introduced to our province by humans. Our lawns, our gardens - from tiny herbs to tall trees, our crops, and even our weeds are largely composed of immigrants from elsewhere that replace the species that occupied these same areas 300 years ago. These introduced species are, for the most part, not the underlying cause of the local losses of native species but rather a symptom of intensive changes to the landscape wrought by humans. As such most introduced species are not rightly called “invasive species”, a term reserved for the small portion of introduced species that are capable of spreading into less-disturbed areas to the point where they significantly alter the structure and function of pre-existing plant and animal communities. Those invasives are the species with which this book concerns itself.



Worldwide, invasive species are one of the top causes of species loss, and they frequently have major economic impacts because of direct displacement of species and ecosystem functions that we value and because of the very resource-intensive efforts required to limit their impacts. Clearly then, it is to our benefit to comprehend the issues posed by invasive species, to learn to recognize the particular species that are most likely to be problematic invasives, and to understand the

most effective steps that we can take to prevent them from further impacting Nova Scotia's natural heritage and economic well-being.

Those are the aims of this guide. Whether at a provincial scale or within one's own property, it is most efficient to prevent the establishment of invasive species entirely or to deal with them as quickly as possible after their arrival, and this publication brings together information to make prevention, early detection and management of invasive species easier for Nova Scotians. I hope that you find the guide interesting and informative and that it inspires you to participate in efforts to limit invasive species establishment and to reduce the impacts of already established invasives.

Yours naturally,

Sean Blaney
Botanist and Assistant Director
Atlantic Canada Conservation
Data Centre

February, 2012



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How To Use This Guide: Layout Description

The counties in NS where the species have been observed are highlighted. Species may not have always been documented in all counties in which they occur. New county records are of interest and can be submitted to MTRI or ISANS with supporting details.

Each species' native region is shown.

For plant and fish species, suggestions of native alternatives are included. For more ideas on non-invasive gardening species, visit www.invasivespecies.ca.

This guide is divided into three sections:
 Aquatic Marine Terrestrial

Key identification features are indicated for each species. Because some species are difficult to identify, always check with local experts for positive identification.

Simple stewardship actions are offered for preventing, reporting, and removing Invasive Alien Species.



WHAT IS AN INVASIVE ALIEN SPECIES?

Invasive Alien Species are a group of species that are both **alien** (exotic) and **invasive**. The terms “alien” and “invasive” are often defined differently by different people and organizations. In this guidebook, alien or exotic species are those that have been introduced to Nova Scotia by humans since Europeans first colonized this area in the 1600s and brought many new species that drastically changed our landscape. A species is considered invasive when it threatens us or the environment. In general, there are four common types of threats associated with Invasive Alien Species:

Examples of Threats



© HEATHER STEWART

ENVIRONMENTAL

Example: Oriental Bittersweet overtakes native shrubs and trees and reduces local biodiversity.



© ALAIN BELLIVEAU

ECONOMIC

Example: Beech Bark Disease infects and kills Beech trees, reducing a woodlot's value.



© DONNA R. ELLIS, UNIVERSITY OF CONNECTICUT, BUGWOOD.ORG

HUMAN HEALTH

Example: Giant Hogweed causes a severe rash.



© KEN HAMMOND, U.S. DEPARTMENT OF AGRICULTURE

SOCIAL

Example: Chain Pickerel dominates a local fishing spot and destroys an important place of community.

This guidebook's focus is mainly on exotic species that threaten the environment by outcompeting, displacing, or destroying native species. With guidance from many experts, the species highlighted in this guidebook were selected as the most significant environmental threats. Other species, like those in the Species to Watch section (page 16) and those found at www.invasivespeciesns.ca could also prove to be just as detrimental. All of these species warrant our attention because they threaten our province's incredible biodiversity and jeopardize the health and integrity of natural ecosystems.

HOW DID INVASIVE ALIEN SPECIES GET HERE?

Many human-assisted **pathways** have permitted the introduction of Invasive Alien Species in Nova Scotia for centuries, perhaps even thousands of years. The limited or sparse distribution of a few of Nova Scotia's native plant species, such as Wild Leek and Groundnut, suggests that these may be relics of ancient cultivation practices by North American peoples and were spread around for their value as food items. Europeans colonists in Nova Scotia introduced many species of plants and animals in the New World, most intentionally but some by accident. So began a significant change to our province's flora and fauna. This change became even more substantial in the 1900s when global trade and travel increased dramatically, providing more opportunities for the spread of species - either by human intention or by accident.

KEY DEFINITIONS

EXOTIC SPECIES: Those that have been introduced to Nova Scotia by humans since Europeans first colonized this area in the 1600s and brought many new species that drastically changed our landscape.

INVASIVE SPECIES: Those that threaten us or the environment. This guidebook's focus is mainly on exotic species that threaten the environment.

PATHWAYS: Ways in which invasive alien species are introduced or spread. Introductions can be both intentional (purposeful) or unintentional (accidental) and they can be "authorized" or "unauthorized" (illegal).

Examples of Pathways



© ALAIN BELLIVEAU

HORTICULTURAL TRADE



© NOAA NATIONAL OCEAN SERVICE

BALLAST WATER



© ALAIN BELLIVEAU

RECREATIONAL BOATING



© ALAIN BELLIVEAU

TRANSPORTATION STOWAWAYS

WHY SHOULD WE BE CONCERNED WITH INVASIVE ALIEN SPECIES?

In Nova Scotia, nearly all types of native habitat are, or will soon be, affected by alien species. After reaching our province, some alien species demonstrate ecological advantages that help them outcompete, displace, or destroy native species. For example, Smallmouth Bass are good at competing for space and nutrients. Others, like Beech Bark Disease, simply attack and destroy native species. Some Invasive Alien Species can degrade natural areas by altering nutrient cycles, changing the soil, or transforming a site's vulnerability to disturbances such as fire and erosion. Others can even hybridize with native species, thereby threatening the way those native species have been evolving for thousands of years. Recently, these negative impacts have resulted in the World Conservation Union ranking Invasive Alien Species second only after habitat loss as the biggest threat to native biodiversity.

Examples of Ecological Impacts



© DEPARTMENT OF FISHERIES AND OCEANS
COMPETITIVE PRESSURE
Example: Exotic tunicates outcompetes native marine species for food and space.



© ALAIN BELLIVEAU
DISPLACEMENT
Example: Rugosa Rose grows dominantly on a sand dune and excludes native species.



© CHRIS MCCARTHY, PARKS CANADA
DESTRUCTION
Example: Green Crab destroys beds of Eel Grass and reduce habitat for invertebrates.



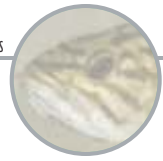
© ALAIN BELLIVEAU
GENETIC POLLUTION
Example: Common Reed (ssp. *australis*) hybridizes with our rare native subspecies (ssp. *americanus*).

WHAT CAN I DO ABOUT INVASIVE ALIEN SPECIES?

In 2004, after a plea from federal, provincial, and territorial Ministers for Wildlife, Forests, Fisheries and Aquaculture, the Government of Canada developed a national Invasive Alien Species strategy that outlined four priorities:

1. prevention of new invasions;
2. early detection of new invaders;
3. rapid response to new invaders;
4. management of established and spreading invaders (containment, control and eradication).

This guidebook provides basic information for identification and stewardship actions that can help you prevent, detect, respond, and even manage Invasive Alien Species, whether you're a woodlot owner, a city dweller, a garden store owner, an angler, or just a citizen trying to provide a better and brighter future for people and for wildlife. Consider this – all of the impacts described above can, and often do, negatively affect the health and integrity of native ecosystems in Nova Scotia, which in turn places added pressure on our oceans, forests, and watersheds. We all depend on these vital natural resources for our own well-being and prosperity; it's in our best interest to take note and to take action. **Read on, learn more about this issue, and become an agent for positive change!**



Stewardship means taking personal ownership of, and responsibility for, the environment. It means caring for the land in a responsible way to ensure that healthy ecosystems are passed on to future generations.

There are many simple actions that can prevent the introduction of new Invasive Alien Species and limit the spread of those already introduced. The eradication of Invasive Alien Species is usually extremely costly or impossible. The most effective way of keeping invasive species out of our province is to prevent their arrival in the first place.

Spread the Word and be a Role Model



Never underestimate the power of communication and the value of mentoring youth. By spreading the word about stewardship, you can create social change that will make a profound difference in your community. If Invasive Alien Species are recognized as a threat by an entire community, action from government, industry, and other communities will follow. Your voice and leadership will make a difference.

© BRAD TOMS



Keen college students visit a site full of Invasive Alien Species

© ALAIN BELLIVEAU



An insightful teacher learns to identify Japanese Knotweed

Learn to Identify Invasive Alien Species



Knowledge is power. The ability to recognize Invasive Alien Species gives you the power to detect, report, and respond to invasions before it is too late. Some of the most threatening Invasive Alien Species can be completely eradicated if detected and reported early; but this is only possible if keen, knowledgeable stewards are monitoring the province's vast landscape and oceans. Use this guidebook, the extensive resources on the internet, and the experience of local experts (see page 18) who are anxious to share their knowledge, to spread the word about Invasive Alien Species in your community.



Invasive Alien Species often "look" exotic, making them easy to identify, as is the case with the bamboo-like Japanese Knotweed

© ALAIN BELLIVEAU



Ask Questions and Demand Change

From stewardship, to science, to politics, questions can be drivers of positive change. Consider the invasion of Purple Loosestrife in Nova Scotia in the 1900s. Once it was recognized as a potential threat, people started spreading the word, identifying it in many new areas, and asking how we could stop or slow down this invasion. As a result, most garden centres stopped selling this species and researchers even developed biocontrol methods that slowed down the spread significantly. To provoke similar positive change, consider asking these questions:

AT THE GARDEN CENTRE: Will this garden plant be invasive?

AT A LOCAL FISHING HOLE: Could fish eggs or plant parts be present on my boat or fishing gear?

MOVING FIREWOOD LONG DISTANCES: Could I be transporting a deadly insect or fungi?



Will this plant invade?

© JEANETTE O'NEIL



Am I spreading invasive fish?

© SANDRA PHINNEY



Should I move this firewood?

© ALAIN BELLIVEAU

Invasive Alien Species are still being traded and moved all around the world. Instead of burdening future generations with the task of destroying or controlling invasives, let's ask those tough questions, and let's demand change from ourselves, from our communities, and from industry and government.



Manage Invasive Alien Species and Restore Degraded Areas

Even if you're an excellent steward, you may still have Invasive Alien Species on your property or in your area. Although most invasions are impossible to completely eradicate on a provincial scale, you can still ensure that your property or community are not contributing to the problem by manually removing and properly disposing of Invasive Alien Species and by promoting native and non-invasive species. The ecology of each species is different; therefore control methods will vary considerably. This guidebook is a starting point and offers basic information for some of our most invasive species; you are encouraged to keep reading, keep learning, and keep asking questions about the management of Invasive Alien Species. Remember that one of the best defences against Invasive Alien Species is an intact, natural ecosystem.



AVOIDING INVASIVE ALIEN TERRESTRIAL SPECIES



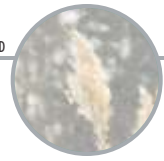
- Avoid purchasing potentially invasive terrestrial species.
- Do not move organisms from one area to another.
- Convert degraded areas into healthy, resilient ecosystems.
- Support efforts to strengthen laws on the transportation of terrestrial species.
- Support legislation to provide funding for more research, monitoring, management, education and prevention of Invasive Alien Species.



AVOIDING INVASIVE ALIEN MARINE AND AQUATIC SPECIES



- Avoid purchasing potentially invasive marine and aquatic species.
- Do not move organisms from one area to another.
- Never release live bait, aquarium fish or plants into water or sewer.
- Support efforts to strengthen laws on the transportation of marine and aquatic species.
- Support legislation to provide funding for more research, monitoring, management, education and prevention of Invasive Alien Species.



DID YOU KNOW? Some ornamental plants sold at garden centres are poorly labelled or mislabelled. If you'd like to avoid planting invasive species, be aware that a species' scientific name (like *Phragmites australis*) is the best way to identify it. Also, be aware that varieties (var.), cultivars and subspecies (ssp.) that are related to our native species (sharing the same scientific name) are often exotic and can be invasive. These, when properly labelled, are written after the principal scientific name: *Phragmites australis* ssp. *americanus*. By sticking to tried and true non-invasive plants, and by reading labels, you'll be on your way to a worry-free, non-invasive garden! Visit www.invasivespecies.ca for more information on non-invasive garden plants.

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© LEVI CLICHE, CLEAN ANnapolis RIVER PROJECT



Cutting Glossy Buckthorn © MARLA BOJARSKI, PARKS CANADA



Removing tunicates from aquaculture gear



Uprooting Glossy Buckthorn with an ExtractiGator



Live More Sustainably

Activities in our everyday lives often contribute to the spread of Invasive Alien Species. For example, using products from overseas requires container ships that may unknowingly transport Invasive Alien Species to Nova Scotia. Buying local products and reducing your overall ecological footprint not only helps to reduce habitat destruction, climate change, pollution, and overexploitation of natural resources, it is also fundamental for the prevention of species introductions across the globe.



© FARMERS' MARKET NOVA SCOTIA

Buy local: Buy from local farmers who work hard to grow local fruit, produce, and other goods, and reduce your "food miles".



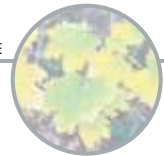
Travel within NS: Vacation right here in beautiful Nova Scotia, and reduce your ecological footprint.



© ALAIN BELLEAU

Gain energy independence: Produce your own green energy by using the wind, the sun and local firewood.

Stewardship Results



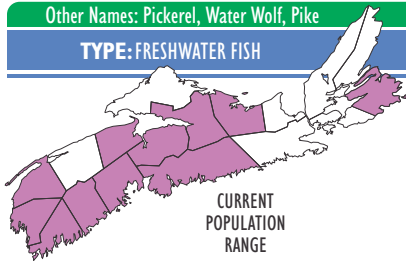
The presence of many established exotic species in Nova Scotia is often due to just one or two specimens entering our boundaries, and then spreading successfully. Imagine the results of stopping the spread of an exotic species:

- Save a million trees from the deadly attack of an exotic insect or fungus.
- Keep your local fishing pool teeming with native trout.
- Make vegetable gardening a little easier by preventing the spread of new weed species.
- Protect our wild spaces so they can abound with wildlife.
- Save an endangered species from extinction.
- Save our industries and governments billions of dollars in Invasive Alien Species management costs.

We hold the power to prevent the spread of Invasive Alien Species and to encourage native biodiversity. Let's ensure that future generations inherit healthy ecosystems by taking every action we can to prevent, detect, and properly respond to Invasive Alien Species. **We can all make a difference!**

Other Names: Pickerel, Water Wolf, Pike

TYPE: FRESHWATER FISH



Chain Pickerel

Esox niger

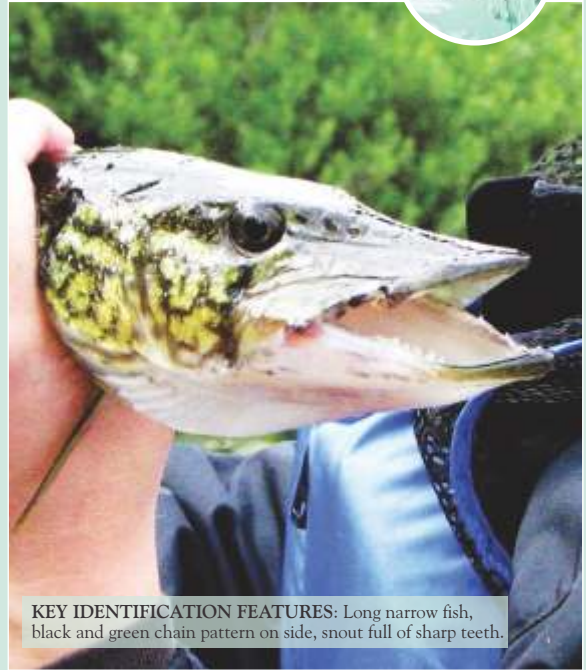


DESCRIPTION: Long, narrow, torpedo-shaped, green body with a darker back and white belly. Adults have chain-like pattern on sides; juveniles lack pattern. Long snout filled with many large, sharp teeth. Tail fin is deeply forked. Average length is 15 to 20 inches (38 to 51 cm). Often very slimy to the touch.

HABITAT & IMPACT: Inhabits shallow, vegetated ponds, lakes and sluggish streams. Chain Pickerel are voracious predators and are known to consume fish, insects, mice and snakes. Within just a few years, native speckled trout population can be decimated. Not only transforms aquatic ecosystems, but also negatively impacts traditional sport fishing opportunities.

PATHWAY: In Nova Scotia since 1940s due to accidental and illegal introductions.

INTERESTING FACT: Chain Pickerel is known to wander into brackish waters where it can survive for some time.



KEY IDENTIFICATION FEATURES: Long narrow fish, black and green chain pattern on side, snout full of sharp teeth.

A snout full of sharp teeth

© PERRY MUNROE



Prefers shallow, vegetated waters

© ALAIN BELLIVEAU



Torpedo-shaped body

© KEN HAMMOND, US DEPARTMENT OF AGRICULTURE



NATIVE DISTRIBUTION

Native Alternative

Native fish species, like Speckled Trout and White Perch, are exciting and tasty sport fish. The presence of Chain Pickerel often eliminates populations of these preferred native sport fish.



Trout fishing in Nova Scotia

© PETER POOLE



Pattern of light and dark green chains on side

© PERRY MUNROE

Stewardship Actions

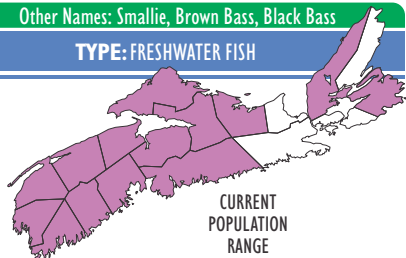
If you're in a lake or river that is known to have Chain Pickerel, keep your fishing gear, boating gear, livewell and buckets clean so that you're not accidentally transporting fish or fish eggs into another watershed. It is illegal to use or possess Chain Pickerel for bait in Nova Scotia. Report any new Chain Pickerel sites to the Department of Fisheries and Aquaculture at inland@gov.ns.ca or 902.485.5056.

Smallmouth Bass

Micropterus dolomieu

Other Names: Smallie, Brown Bass, Black Bass

TYPE: FRESHWATER FISH



Distinct horizontal bars on head

© BRIAN GRATWICKE



© ERIC ENGBRETSON, US FISH AND WILDLIFE SERVICE, BUGWOOD.ORG



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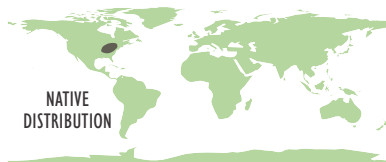
© JASON LEBLANC

DESCRIPTION: Robust, brown to green body with a white belly. Back fin is spiny. Sides have dark, blotchy, vertical bars, and head has several dark horizontal bars. Average length is 9 to 15 inches (23 to 38 cm).

HABITAT & IMPACT: Inhabits lakes and streams with rocky bottoms and plenty of shade. An efficient predator of many smaller fish, mammals and amphibians. Not only eats native species, but also consumes much of the food which some native fish require for survival. Spread of both the Smallmouth Bass and Chain Pickerel threatens native fish communities in more than half of the primary watersheds in Nova Scotia.

PATHWAY: Authorized release in 1942 in Bunkers Lake, Yarmouth County, as sanctioned by government. The last authorized introduction occurred in 1984.

INTERESTING FACT: Smallmouth Bass are inactive and do not eat during the winter.



Native Alternative

The native White Perch is similar in appearance, and is known for its thrilling fight and delicious flavour.

Stewardship Actions

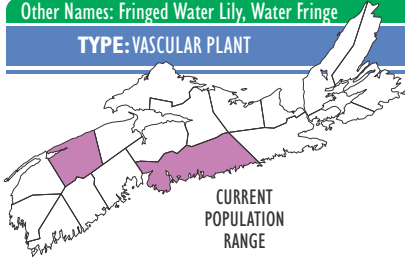
If you're in a lake or river that is known to have Smallmouth Bass, keep your fishing gear, boating gear, livewell and buckets clean so that you're not accidentally transporting fish or fish eggs into another watershed. It is illegal to use or possess Smallmouth Bass as bait in Nova Scotia. Report any new Smallmouth Bass sites to the Department of Fisheries and Aquaculture at inland@gov.ns.ca or 902.485.5056.

Other Names: Fringed Water Lily, Water Fringe

TYPE: VASCULAR PLANT

Yellow Floating Heart *Nymphoides peltata*

3



CURRENT
POPULATION
RANGE

DESCRIPTION: Bottom-rooted floating-leaved aquatic plant. Leaves round and heart or kidney-shaped, 3-15 cm in diameter, with slightly wavy edges and often tinged purple-brown beneath. Flowers several, on individual stalks from common point on the stem, yellow, 3-4 cm in diameter, star-shaped with 5 fringed petals, in bloom from June to August. Long and thick creeping stems typically bear several 2-3 mm thick erect leaf-bearing stems.

HABITAT & IMPACT: Slow-moving waters of pond, lakes, rivers, streams and wetlands, from water's edge to a depth of 4 m. Yellow Floating Heart can form dense mats of floating vegetation that excludes native species. Can also create stagnant areas which results in a lower level of oxygen and negatively affects native fish habitat. The quality of native freshwater habitat suffers, and even recreational activities (like swimming and canoeing) can become difficult or impossible.

PATHWAY: First marketed as an ornamental plant in 1891 in the United States, subsequently spread as a horticultural species and still commonly used in some regions. Only recently introduced to Nova Scotia, where it was first reported escaped from a water garden at Little Albro Lake (Halifax County) in 2006.

INTERESTING FACT: This species, which reproduces abundantly by seed and through its root system, may also spread over considerable distances via broken root and stem fragments. Even moving just a small piece of a Yellow Floating Heart stem can be enough to spread this invasive species to a new water body or river system.



KEY IDENTIFICATION FEATURES:
Aquatic plant, five fringed petals.

Yellow, fringed, star-shaped flower

© MARTIN THOMAS



Invasion in Dartmouth

© CATHY CONRAD



Round and heart-shaped

© MARTIN THOMAS



NATIVE
DISTRIBUTION

Native Alternative

Floating Heart (*Nymphoides cordata*), Yellow Pond Lily (*Nuphar variegata*), and Fragrant Water Lily (*Nymphaea odorata*) are all attractive, native aquatic plants.

Stewardship Actions

Promote the use of beautiful, native ornamental aquatic plants. Always clean your recreational gear properly after visiting a waterway. If you find this invasive species, report it to the Community-Based Environmental Monitoring Network at environmental.network@smu.ca or 902.491.6243, or to the Invasive Species Alliance of Nova Scotia at www.plantpatrolnls.ca/report-an-invasive-alien-species.html.



Fragrant Water Lily

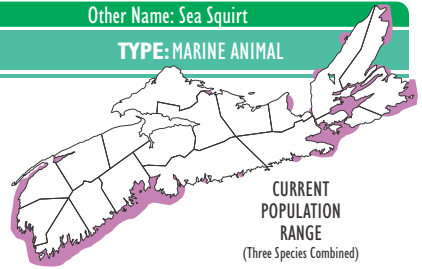
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Tunicates

Ciona, *Botryllus*, & *Botrylloides* spp.

Other Name: Sea Squirt

TYPE: MARINE ANIMAL

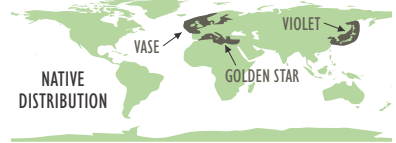


CURRENT
POPULATION
RANGE
(Three Species Combined)

GENERAL DESCRIPTION: Small marine, filter-feeding animals, sometimes referred to as sea squirts, live attached to underwater objects. Some, like the Vase Tunicate, grow as large solitary individuals. Others, like the Golden Star and Violet tunicates, grow colonially in large, spreading mats.

HABITAT & IMPACT: Usually grow in sheltered, low-current areas, attached to rocks, seaweeds, Eelgrass and other native species, or on man-made structures such as ropes, docks, boat hulls and shellfish culture gear. Alters natural marine ecosystems by outcompeting native species for food and space. Threaten coastal and offshore fishing and aquaculture activities by fouling aquaculture species and gear.

INTERESTING FACT: Tunicates are said to eat their own brains during metamorphosis. Tunicate fossils date back as far as 540 million years ago, a time when plants were not yet found on land.



NATIVE
DISTRIBUTION



KEY IDENTIFICATION FEATURES:
See individual species descriptions below.

Violet Tunicate growing on Blue Mussels

© DEPARTMENT OF FISHERIES AND OCEANS

Stewardship Actions

If boating or fishing in tunicate-infested waters, keep your boat hull and gear clean to avoid accidentally transporting tunicates to new locations. Avoid transporting infested shellfish or water that may contain tiny bits of tunicate to avoid accidental introductions into unaffected or less-affected areas. If you spot any of these invasive tunicate species, report the location to Fisheries and Oceans Canada at 888.435.4040.

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Vase Tunicate

Vase Tunicate

Ciona intestinalis

Description: Cylindrical, without a stalk, translucent, smooth, and varying from light greenish-yellow to orange or pink. Up to 15 cm long. Can form dense groups of individuals.

Pathway: Present in the Bay of Fundy since the 1850s, abundant since the mid-1990s, pathway not definitively known.

© DEPARTMENT OF FISHERIES AND OCEANS



Golden Star Tunicate

Golden Star Tunicate

Botryllus schlosseri

Description: Forms dense mats of star or flower-shaped colonies, made up of many small, daisy petal-shaped individuals. Colour varies from orange, yellow, red, greenish grey, violet, dark grey, to black.

Pathway: Present in Nova Scotia since the 1980s, pathway not definitively known.

© DEPARTMENT OF FISHERIES AND OCEANS



Violet Tunicate covering a rock

Violet Tunicate

Botrylloides violaceus

Description: Forms dense mats made up of many small individuals that are arranged in curving tracks. Colour varies from whitish, yellow, orange, reddish-brown, to violet.

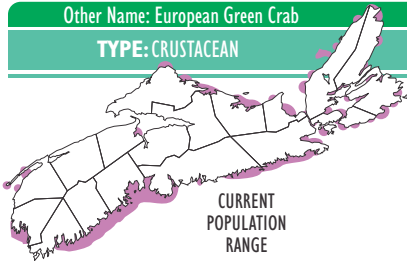
Pathway: Present in Nova Scotia since 1990s, pathway not definitively known.

Other Name: European Green Crab

TYPE: CRUSTACEAN

Green Crab

Carcinus maenas



CURRENT POPULATION RANGE

DESCRIPTION: Carapace up to 10 cm wide (usually less than 8 cm) and varies in colour from mottled, green, red, yellow, to brown. Five obvious spines on either side of eyes, with three bumps between eyes. Back legs are pointed, slightly flattened and hairy.

HABITAT & IMPACT: Common in shallow water of salt marshes, beaches and rocky coasts or in vegetation. Can tolerate a wide range of salinities. A voracious consumer of plants and animals, especially soft-shell clams, oysters, quahogs and mussels. Uproots and destroys beds of Eel Grass, an important habitat-forming species for native fish, invertebrates and waterfowl. Predation and habitat destruction by Green Crab negatively impact biodiversity and harm local shellfish fisheries.

PATHWAY: Appeared in the 1950s in the Bay of Fundy, probably moving up along the infested coast of the northeastern United States. Pathway not definitively known.

INTERESTING FACT: Green Crab is often referred to as the cockroach of the sea.



KEY IDENTIFICATION FEATURES: Five spines either side of eyes, three bumps between eyes, back legs pointed, slightly flat and hairy.

Green Crab in Lunenburg County

© SARAH HOLDEN



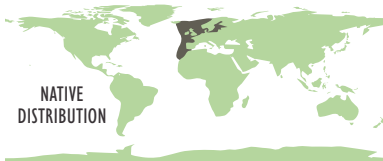
Intact Eel Grass bed

© ALAIN BELLIVEAU



© CHRIS MCCARTHY, PARIS CANADA

Damaged Eel Grass



NATIVE DISTRIBUTION



Distinctive 5 spines on either side of eyes

© ALAIN BELLIVEAU



The colour of Green Crab varies

© MARTIN THOMAS

Stewardship Actions

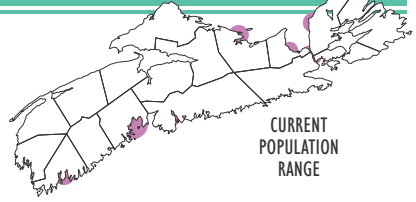
If boating or fishing in Green Crab-infested waters, keep your gear clean to avoid accidentally transporting crabs or crab larvae. Avoid transporting water or vegetation that may contain tiny crab larvae to prevent the accidental introduction into unaffected or less-affected areas. If Green Crabs are caught as by-catch, do not release them. If you spot this invasive species, report the location to Fisheries and Oceans Canada at 888.435.4040.

Oyster Thief

Codium fragile ssp. *fragile*

Other Names: Dead Man's Fingers, Green Sponge

TYPE: ALGAE



DESCRIPTION: Green alga shaped like a small bush, velvety and spongy to the touch. Light to dark green. Branches are thick (3 to 10 mm), spongy, Y-shaped, cylindrical, and without golden yellow blisters seen in native rockweed. Up to 90 cm long. On the beach, branches may dry up white and look like fat spaghetti.

HABITAT & IMPACT: Subtidal areas down to 18 m (60 ft) and tide pools. Often seen drifting in bays. Typically attaches to rocks, reefs, wharves, and even native species of algae, molluscs and crustaceans. Gradually uproots, overtakes and replaces Eelgrass and kelps. Important habitat-forming species for native fish, lobster and shellfish. Attaches to mollusc shells thereby preventing feeding and making them weaker and more prone to predation. Negatively affects and reduces economically important populations of shellfish.

PATHWAY: Present in eastern Canada since 1989, pathway not definitively known.

INTERESTING FACT: Can float away after attaching to oysters and other shellfish, hence its common name.

KEY IDENTIFICATION FEATURES: Much branched, velvety, spongy, without golden yellow blisters, looks like white fat spaghetti when dry on the beach.

Invasion off Nova Scotia coast

© ROBERT SCHEIBLING, DALHOUSIE UNIVERSITY



Oyster Thief in shallow water

© FLYINGDREAM, EN.WIKIPEDIA



© ROBERT SCHEIBLING, DALHOUSIE UNIVERSITY

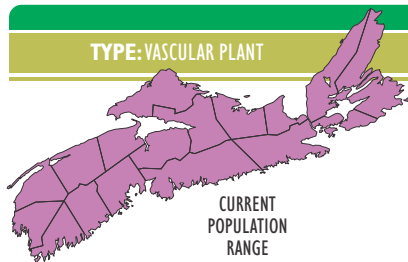


Oyster Thief uprooting native algae

Stewardship Actions

If boating or fishing in Oyster Thief-infested waters, keep your gear clean to avoid accidentally transporting it elsewhere. Avoid transporting water that may contain fragments of Oyster Thief, to prevent the accidental introduction into unaffected or less-affected areas. If you spot this invasive species, report the location to Fisheries and Oceans Canada at 888.435.4040.

TYPE: VASCULAR PLANT



CURRENT
POPULATION
RANGE

DESCRIPTION: Large deciduous tree, up to 18 m tall, with a large crown. Large, maple-shaped leaves. Leaf stem has milky sap. Flowers greenish, and blooming in early spring. Seeds look like a pair of green wings. Buds are round.

HABITAT & IMPACT: Upland forests, so far mostly limited to urban areas. Creates dense shade, grows competitive networks of shallow roots, and releases toxic chemicals, all of which are detrimental to other native species. Once established, can reduce native biodiversity and even provoke soil erosion due to a lack of ground vegetation.

PATHWAY: Said to have first been brought to the United States in 1756, Norway Maples became much more widespread around the 1940s when they were used to replace White Elms dying of Dutch Elm Disease (see page 11).

INTERESTING FACT: This species has been banned in two states in the United States due to its invasive nature.



NATIVE
DISTRIBUTION

Native Alternative

Sugar Maple (*Acer saccharum*) and Red Maple (*Acer rubrum*) are excellent, native maple trees. Both are excellent for fall colours and producing maple syrup. For a smaller, shrubby maple, try Striped Maple (*Acer pensylvanicum*) or Mountain Maple (*Acer spicatum*).

© ALAIN BELLIVEAU



Sugar Maple fall colours

© ALAIN BELLIVEAU



Striped Maple bark

Norway Maple

Acer platanoides



KEY IDENTIFICATION FEATURES:
Maple leaves, milky white sap in leaf stem.

Invasion of woodlands in Lunenburg County

© BRETT JOHNSON



Round buds

© BILL COOK, MICHIGAN STATE UNIVERSITY, BUGWOOD.ORG



Yellow leaves in fall

© ALAIN BELLIVEAU



Typical tree shape

© BRETT JOHNSON

Stewardship Actions

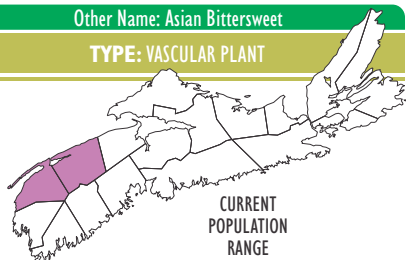
Promote the use of beautiful, native or non-invasive trees. Encourage government, industry and your fellow citizens to do everything in their powers to prevent the trade and movement of Norway Maple. Pull or dig out small seedlings by hand. Saplings and larger trees can be cut down or girdled. Remember, the common name (Norway Maple) of this species may vary, but the scientific name (*Acer platanoides*) is always the same. If you spot an invasion of Norway Maple, report it to the Invasive Species Alliance of Nova Scotia at www.plantpatrolns.ca/report-an-invasive-alien-species.html.

Oriental Bittersweet

Celastrus orbiculatus

Other Name: Asian Bittersweet

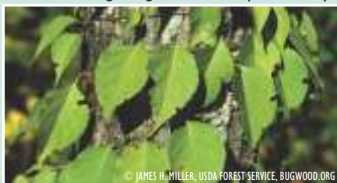
TYPE: VASCULAR PLANT



KEY IDENTIFICATION FEATURES: Vine or trailing shrub, simple, alternate, roundish leaves, berries yellow with three red pods.

An invasion engulfing trees in Annapolis County

© ALAIN BELLIVEAU



© JAMES H. MILLER, USDA FOREST SERVICE, BUGWOOD.ORG

Leaves roundish, simple and alternate



© JAMES A. ALLISON, GOVERNMENT OF NEW BRUNSWICK, BUGWOOD.ORG

Yellow fruit with red seed pods



© LESLIE J. MEHRHOFF, UNIVERSITY OF CONNECTICUT, BUGWOOD.ORG

Flower cluster, each flower with 5 petals



Native Alternative

Virginia Clematis (*Clematis virginiana*) is a native, non-invasive, and charming vine with clusters of white flowers.

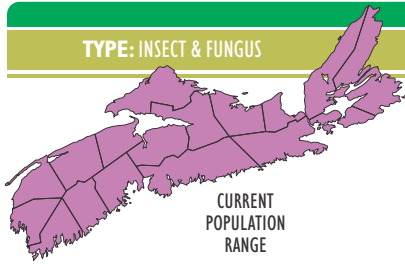
Stewardship Actions

Promote the use of beautiful, non-invasive ornamental plants. Encourage government, industry and your fellow citizens to do everything in their powers to prevent the trade and movement of Oriental Bittersweet. Pull up all roots for seedlings. Cut repeatedly (bi-weekly, especially in the spring) for larger plants. Do not compost pulled and cut plant parts; instead, dry and burn on site (with permit). If you spot Oriental Bittersweet, report it to the Invasive Species Alliance of Nova Scotia at www.plantpatrolns.ca/report-an-invasive-alien-species.html.



Virginia Clematis, a native vine

© ALAIN BELLIVEAU

CURRENT
POPULATION
RANGE

DESCRIPTION: Disfigured beech trees. Results from combination of the exotic Beech Scale insect and two fungus species, one of which (*Neonectria faginata*) may also be exotic. Beech Scale insect is only 1 mm long, usually covered by whitish, cottony wax secretion. It damages the tree's bark. Fungi, which are not seen by the naked eye, infect damaged trees and often leave severe crater- or target-shaped scars.

HABITAT & IMPACT: Affects the vast majority of beech trees in Nova Scotia, which are found scattered in mixedwood and hardwood forests and predominantly on drier ridges and hilltops. Trees are usually weakened and often die. If trees persist, it is often by root suckering, which can result in a dense shrubby forest that is both ecologically and economically unproductive. An important tree species of the Acadian forest which once dominated many hardwood stands has been greatly affected by this disease.

PATHWAY: Likely hosted on a European Beech tree planted in the Halifax Public Gardens in 1890, when the disease was also first recorded in North America.

INTERESTING FACT: Towering Beech once grew all over Nova Scotia, sometimes getting as old as 300 years.

NATIVE
DISTRIBUTION

Rare, healthy Beech

© ALAIN BELLIVEAU



KEY IDENTIFICATION FEATURES: Spots of white, cottony secretion on bark, or crater- or target-shaped scars on bark.

© ALAIN BELLIVEAU

Typical disfigurement



© LOUIS-MICHEL LANGELOISE, DÉPARTEMENT DE LA SANTÉ DES FORÊTS, BURNWOOD.ORG

White, waxy wool from Beech Scale



© JOSEPH D'ARLEN, USDA FOREST SERVICE, BURNWOOD.ORG

Fruiting bodies from fungus



Severe scarring

© ALAIN BELLIVEAU

Stewardship Actions

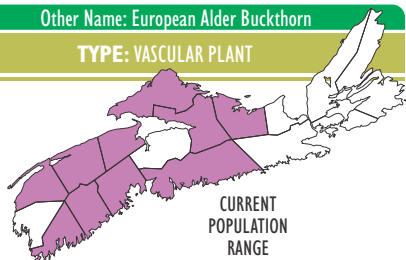
About one in 100 Beech trees remains disease-free, this is likely due to genetics. If you have healthy Beech trees in your woodlands, let them disperse their seeds and root suckers so that these good genetics spread and help the species recover. Use local wood products to avoid the long-distance transportation of insects and pests from faraway timber and firewood. Encourage government and industry to do everything in their powers to prevent other insects and diseases from entering our province and harming our forests.

Glossy Buckthorn

Frangula alnus

Other Name: European Alder Buckthorn

TYPE: VASCULAR PLANT



CURRENT
POPULATION
RANGE



KEY IDENTIFICATION FEATURES: Glossy oval leaves with smooth edges, blackish-brown bark and spotted gray, inner bark yellow.

Invasion of wetlands in Queens County

© DAVID MAZEROLLE



Glossy leaves, black ripe berries © SEAN BLANEY



Flower clusters

© ALAIN BELLIVEAU



Dense infestation

© SEAN BLANEY

Native Alternative

Chokecherry (*Prunus virginiana*) and Serviceberries (*Amelanchier* spp.) are native shrubs similar in appearance to Glossy Buckthorn. However, their berries make a wonderful jelly.



Chokecherry flowers

© ALAIN BELLIVEAU

Stewardship Actions

Promote the use of attractive, native and non-invasive shrubs. Encourage government, industry and your fellow citizens to do everything in their powers to prevent the trade and movement of Glossy Buckthorn. Uproot smaller plants, and repeatedly cut larger plants to slow down spread. Feed branches and foliage to livestock. Do not compost pulled and cut plant parts; instead, dry and burn on site (with permit). If you spot Glossy Buckthorn, report it to the Invasive Species Alliance of Nova Scotia at www.plantpatrolns.ca/report-an-invasive-alien-species.html.

DESCRIPTION: Single or many-stemmed shrub or small tree, reaching heights of 6 m. Leaves alternate along the stem, oval-shaped, 3 to 7 cm long and 2.5 to 4 cm wide, with smooth edges and a glossy upper surface. Flowers star-shaped, five-petaled, greenish-white, 3 to 5 mm wide, clustered in leaf axils and blooming from May to June. Produces 6 to 10 mm red berry-like fruits which turn black when ripe and are non-edible.

Bark blackish-brown and spotted with grey. Inner bark is bright yellow.

HABITAT & IMPACT: Wet to moist old fields, thickets, forest, shores and open wetlands. Forms dense stands which can replace wetland and shoreline plant communities and take over forest understories, even eliminating tree seedlings. Tolerant of acidic conditions, this species is well adapted to invade a wide variety of natural habitats in Nova Scotia and may represent the greatest threat to plant communities in the province.

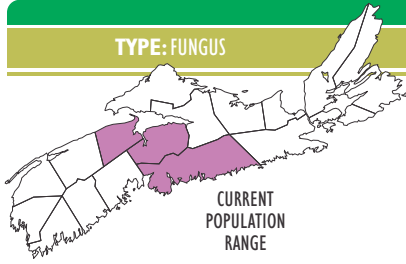
PATHWAY: Introduced to North America in the late 1700s or early 1800s as a hedge or ornamental species and first noted as a serious invader of native habitats in the early 1900s. Sale of this species has mostly been phased out in North America, though a few cultivars remain on the market. The species has been present in Nova Scotia for at least half a century.



NATIVE
DISTRIBUTION

INTERESTING FACT: Although this plant's berries are poisonous to many animals (including humans), they are commonly eaten by a variety of birds and some small mammals. Once they are consumed, the seeds can be spread over several kilometers, starting new infestations.

TYPE: FUNGUS



White Nose Syndrome

Geomyces destructans



DESCRIPTION: A white fungus that grows on a bat's snout, wings and ears. Grows well in the cold of winter when bats are overwintering in caves and other hibernacula. Weakened, infected bats are awoken by the fungal attack and starve to death due to excessive activity. Symptoms include considerable body fat loss, winter or daytime flying, wing damage and scarring, and death.

HABITAT & IMPACT: This fungus attacks many bat species, including the Little Brown (*Myotis lucifugus*), the Northern Long-eared (*Myotis septentrionalis*), and the Tricolored (*Perimyotis subflavus*) here in Nova Scotia. Because the fungus grows well in cold temperatures, overwintering bats in caves and other hibernacula are affected. So far, over 5.5 million bats in North America have been killed, with a mortality rate of over 90% in many areas.

PATHWAY: This syndrome was first detected in New York State in 2006, possibly having been transported from Europe. It then spread rapidly between bats and from colony to colony.

INTERESTING FACT: Generally, a female bat has only one offspring at a time. Bats are amazing insect-eaters and a vital part of North American ecosystems.



KEY IDENTIFICATION FEATURES: White fungus on bat's snout, wings, or ears; bats flying in winter or during day.

White fungus on nose, wings and ears

© MARVIN MORIARTY, US FISH AND WILDLIFE SERVICE



Outer bats not yet affected



Infected wing, with spots of white fungus



Nose full of white fungus

© RYAN VON LINDEN, NY DEPARTMENT OF ENVIRONMENTAL CONSERVATION



A cave near Windsor

© JONATHAN GUY

Stewardship Actions

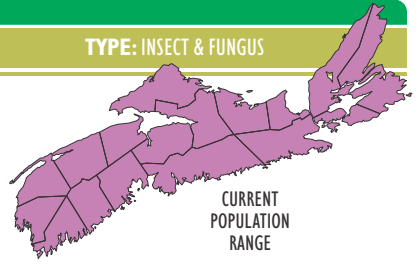
If you must travel to faraway places, try to keep your belongings clean and free of spores and seeds by cleaning well immediately upon arrival. Avoid entering hibernacula (caves, abandoned mines) since your clothes, shoes, or person could spread the fungus. Avoid handling bats. Immediately report any odd bat behaviour (winter or day flying), or dead or dying bats that you see, to your local DNR office (see www.gov.ns.ca/natr/staffdir/offices.asp for office locations).



Dutch Elm Disease

Hylurgopinus, Scolytus, & Ophiostoma spp.

TYPE: INSECT & FUNGUS



CURRENT
POPULATION
RANGE



KEY IDENTIFICATION FEATURES: Leaf wilt, brown leaves, and brown stains under bark.

Stand of dead White Elm trees in Cape Breton

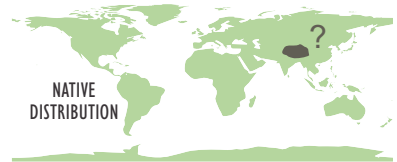
© J-F BERGERON, ENVIROFOTO

DESCRIPTION: Dead and dying White Elm trees. Results from several different microscopic sac fungi (all of which are probably exotic) that infect the tree when one of two elm bark beetles (one of which is exotic) feed on its bark. The beetles reproduce and continue spreading the fungi to other elm trees. Early signs include significant leaf wilting in early summer, with brown leaves clinging to the tree for some time, followed by the tree dying from the fungal infection within a year or two. Other signs include very small boring holes, reddish-brown or black beetles about 2 to 3 mm long, networks of beetle feeding galleries just inside the bark, and brown staining under bark.

HABITAT & IMPACT: Most common in floodplains, and today along cultivated fields. This insect-fungi combination makes for a very contagious disease that has destroyed most White Elm trees in Nova Scotia.

PATHWAY: First found in Liverpool in 1969, probably brought to North America in wooden crates made of elm wood.

INTERESTING FACT: The fungi was identified by a Dutch phytopathologist in 1921, hence its common name.



NATIVE
DISTRIBUTION



Serrated leaf on healthy White Elm

© ALAIN BELLIVEAU



Young, healthy White Elm trees

© ALAIN BELLIVEAU

Stewardship Actions

Only about one in 100,000 White Elm trees displays some level of resistance to Dutch Elm Disease. If you have healthy White Elm trees in your woodlands, let them disperse their seeds so that the species persists. Use local wood products to avoid the long-distance transportation of insects and pests from faraway timber and firewood. Encourage government and industry to do everything in their powers to prevent other insects and diseases from entering our province and harming our forests.



© JOSEPH O'BRIEN, USDA FOREST SERVICE, BUGWOOD.ORG

Fruiting bodies of fungus



© USDA FOREST SERVICE ARCHIVE, USDA FOREST SERVICE, BUGWOOD.ORG

European Elm Bark Beetle



© JOSEPH O'BRIEN, USDA FOREST SERVICE, BUGWOOD.ORG

Brown staining under bark

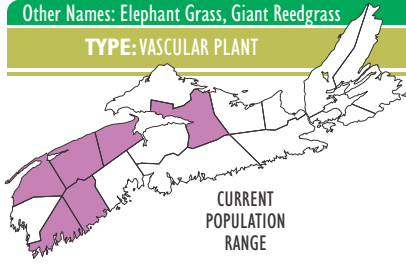


© BEAT FORSTER, SWISS FEDERAL INSTITUTE FOR FOREST, SNOW AND LANDSCAPE RESEARCH, FORESTIMAGES.ORG

Beetle feeding gallery

Other Names: Elephant Grass, Giant Reedgrass

TYPE: VASCULAR PLANT



Common Reed

Phragmites australis ssp. *australis*



DESCRIPTION: Very tall, stout grass, often reaching heights of 3 m or more (exceptionally to 4 m). Stem hollow, up to 1.5 cm thick. Leaves usually bluish-green, 15-50 cm long, 2 to 4 cm wide. Flower head large and feathery, 15 to 40 cm long, blooming in late July to September, purplish when young and straw-coloured at maturity. Each tiny flower is surrounded by silky hairs, giving the inflorescence its feathery appearance. Looks very similar to our native subspecies (ssp. *americanus*).

HABITAT & IMPACT: Wet ditches and various freshwater or brackish shores and wetlands. Spreading quickly through its roots (to several meters a year!), it can quickly form large dense stands that exclude native species and can alter the structure and function of native marsh ecosystems.

PATHWAY: Probably first introduced accidentally in North America in ships' ballasts or as a seed contaminant in the late 1700s or early 1800s. Also spread to a limited extent as an ornamental grass. Introduced subspecies has likely been present in Nova Scotia for quite some time, as the earliest specimen collections date back to 1910.

INTERESTING FACT: This reed and others like it have been used as a premium thatching material for thousands of years.



KEY IDENTIFICATION FEATURES: Very tall, feathery flower head. Visit www.invasiveplants.net/phragmites/phrag/morph.htm to properly distinguish from our very similar native subspecies.

© ALAIN BELLIVEAU



Feathery flower head

© ALAIN BELLIVEAU



As tall as 4 m!

© ALICIA PRAY-LESLIE



Similar native subspecies

© DAVID MAZEROLLE

Native Alternative

Our native Old Switch Panic Grass (*Panicum virgatum* var. *spissum*), Blue-joint Reedgrass (*Calamagrostis canadensis*) and Blunt Manna-grass (*Glyceria obtusa*) are delightful, non-invasive grasses.



Blunt Manna-grass

© HELEN GROWLER

Stewardship Actions

Promote the use of attractive, native or non-invasive grasses. Encourage government, industry and your fellow citizens to do everything in their powers to prevent the trade and movement of Common Reed. Mow plants often, or have a goat graze them several times (careful that it does not graze on rare native plants!). Do not compost pulled and cut plant parts; instead, dry and burn on site (with permit). If you spot Common Reed, report it to the Invasive Species Alliance of Nova Scotia at www.plantpatrolns.ca/report-an-invasive-alien-species.html.

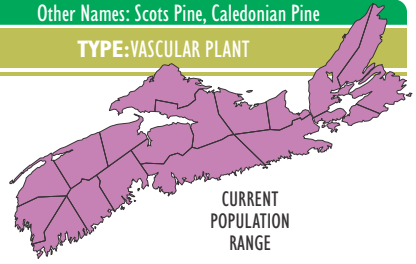


Scotch Pine

Pinus sylvestris

Other Names: Scots Pine, Caledonian Pine

TYPE: VASCULAR PLANT



DESCRIPTION: Large evergreen, coniferous tree up to 25 m tall. Twisty needles in bundles of two, 4 to 6 cm long, blue-green, sharp-pointed. Bark of upper branches and trunk yellowish. Cones 3-6 cm long.

HABITAT & IMPACT: Grows in many soil conditions and different moisture levels, requires sunlight. Can escape into open woodlands, wetlands and barrens and threatens native biodiversity by outcompeting species and modifying ecosystems.

PATHWAY: First used in Canada in 1920s for reforestation of abandoned agricultural lands. Became more widespread later when used as Christmas tree, landscaping, and shelterbelts.

INTERESTING FACT: This species is the national tree for Scotland, hence its common name.



KEY IDENTIFICATION FEATURES: Pine needles about 4 to 6 cm long, bark of upper tree often orange.

Invasion of open woodlands in Digby County

© ALAIN BELLIVEAU



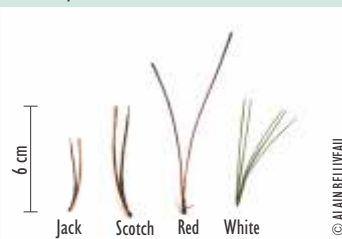
Needles

© DAVID PATRIQUIN



Bell-shaped flower

© DAVID PATRIQUIN



Needles in bundles of two, 4 to 6 cm long

© ALAIN BELLIVEAU

Native Alternative

Three versatile, native pine trees grow in Nova Scotia: White Pine (*P. strobus*), Red Pine (*P. resinosa*) and Jack Pine (*P. banksiana*).



White Pine

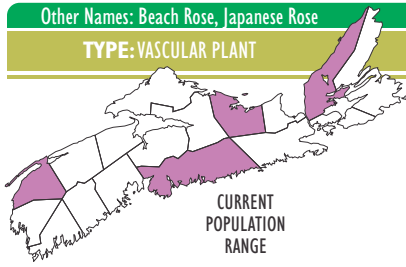
© ALAIN BELLIVEAU

Stewardship Actions

Use beautiful, native or non-invasive pine trees. Encourage government, industry and your fellow citizens to do everything in their powers to prevent the trade and movement of Scots Pine. Pull out seedlings. Cut down bigger trees, and burn cones on site. If you find Scots Pine, report it to the Invasive Species Alliance of Nova Scotia at www.plantpatrolns.ca/report-an-invasive-alien-species.html.

Other Names: Beach Rose, Japanese Rose

TYPE: VASCULAR PLANT



Rugosa Rose

Rosa rugosa



DESCRIPTION: Dense shrub up to 2.5 m tall. Stem robust with abundant thorns of all sizes. Twigs covered with fine hairs. Twig with 5 to 7 oval-shaped, toothed leaflets. Flowers dark pink to white, 6-9 cm wide, strong-scented, blooming in summer. Hip large, 2-2.5 cm in diameter, dark red and smooth.

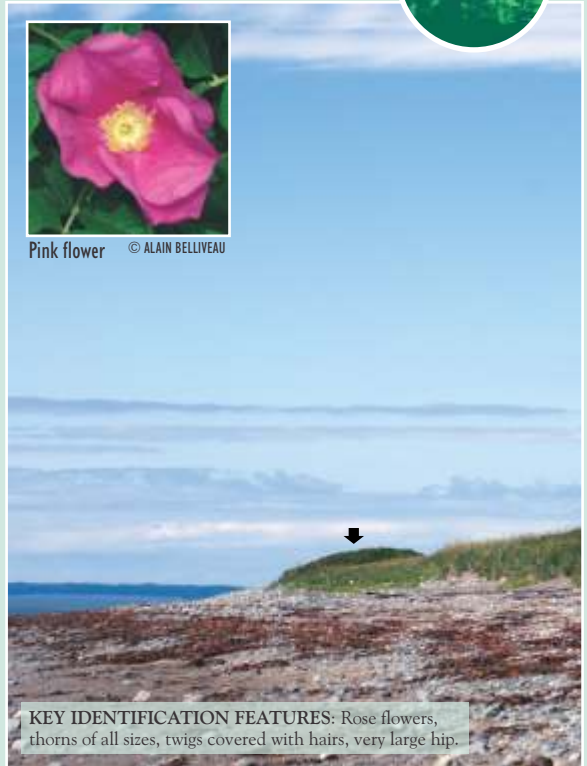
HABITAT & IMPACT: Coast, sandy areas, and ditches. Spreading mainly by its roots, but can also be spread long distances by mammals and birds. Can also spread long distances by flotation of old hips in seawater. Once established, very few if any species can compete with Rugosa Rose. This species threatens biodiversity and ecosystem function in beach, dune and headland habitats in many areas of the province.

PATHWAY: Brought to northeastern North America as an ornamental plant probably in the late 1800s.

INTERESTING FACT: Rugosa Rose hips are high in vitamin C. Locals now gather hips to make jelly as was done in the Second World War when citrus fruits were difficult to import.



Pink flower © ALAIN BELLEVEAU



KEY IDENTIFICATION FEATURES: Rose flowers, thorns of all sizes, twigs covered with hairs, very large hip.

Invasion above beach in Digby County

© ALAIN BELLEVEAU



White flower

© MARTIN THOMAS



Thorns of all sizes

© ALAIN BELLEVEAU



Large, red, smooth hip

© ALAIN BELLEVEAU



Compound leaves

© ALAIN BELLEVEAU

Native Alternative

Virginia Rose (*Rosa virginiana*) is a native rose species, and sometimes considered the best all-around wild rose, with pretty rose flowers and excellent fall colours.



Virginia Rose

© MARINA MYRA

Stewardship Actions

Promote the use of attractive, native roses. Encourage government, industry and your fellow citizens to do everything in their powers to prevent the trade and movement of Rugosa Rose. Dig out, mow or uproot plants, or have a goat graze them several times (careful that it does not graze on rare native plants!). If you find Rugosa Rose, report it to the Invasive Species Alliance of Nova Scotia at www.plantpatrolns.ca/report-an-invasive-alien-species.html.



The species highlighted in this guidebook represent only a few examples of exotic organisms that have proved detrimental for native species and ecosystems. Still, many other exotic species impact or threaten to impact our province's native biodiversity. A few of these are included here. For a more up-to-date and complete list, please visit www.invasivespecies.ca.



© ALAIN BELLIVEAU

Woodland Angelica (*Angelica sylvestris*): Native to most of Europe and Western Asia, this 1.5m tall, purple-stemmed herbaceous plant was intentionally introduced as a garden herb. It threatens floodplain forests in the Maritimes and is already established in the Saint John River in New Brunswick, where it can be found in dense stands.



© ALAIN BELLIVEAU

European Starling (*Sturnus vulgaris*): Native to parts of Europe, Asia and Africa, this blackish, usually white-spotted bird was brought to North America by the American Acclimatization Society, a late 1800s group dedicated to the deliberate introduction of European flora and fauna to the New World for economic and cultural reasons. Huge flocks of this exotic bird species compete with some of Nova Scotia's native birds.



© ALAIN BELLIVEAU

Common Hawkweed (*Hieracium lachenalii*): Native to most of Europe, this yellow-flowered, milky-sapped herbaceous plant was probably introduced accidentally. It threatens native plant diversity of some forest habitats and is already established in some areas.



© ANDREAS THOMSEN

Spiny-cheeked Crayfish (*Orconectes limosus*): Native to northern parts of the United States, this small crayfish may have been introduced into Nova Scotia as live fishing bait or as an aquarium species. This crayfish can outcompete native aquatic species. It is the only crayfish found in Nova Scotia.



© MARTIN THOMAS

Common Valerian (*Valeriana officinalis*): From Eurasia, this herbaceous plant was intentionally introduced as a garden herb. This plant can be recognized by its very hairy nodes, its compound leaves with many lance-shaped segments and its fragrant flowers. It currently threatens open forests and marshy forests in the Amherst and Wolfville areas and appears to be spreading.



© MARTIN THOMAS

Purple Loosestrife (*Lythrum salicaria*): This infamous wetlands-invader is from Europe, northern Africa and Asia, and was introduced to North America on several occasions: intentionally as a garden herb and accidentally in ship ballast. Although still considered a big threat in some parts of the continent, it seems to compete primarily in human-disturbed wet areas like ditches. The use of a biocontrol species — including weevils and beetles — seems to have slowed the spread of Purple Loosestrife.



© ALAIN BELLIVEAU

Knotweed Species (*Polygonum cuspidatum* & *sachalinense*): These hollow-stemmed, bamboo-like herbaceous plants are native to eastern Asia and were deliberately introduced to North America as ornamental plants. Its ability to establish a strong root system and grow dense colonies that crowd out other plants has received much attention throughout North America. In Nova Scotia, it is usually limited to human-disturbed sites in the province, although it may still threaten riparian habitats.



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European Fire Ant (*Myrmica rubra*): This stinging ant native to Europe and Asia was probably brought to Nova Scotia with potted plants, mulch or fill. Although it is usually restricted to a few urban and agricultural areas of the province, it threatens to alter natural ecosystems that depend on specific, native species of ants.



© MARTIN THOMAS

Multiflora Rose (*Rosa multiflora*): This large, thorny shrub is native to Asia and was introduced to North America as an ornamental plant. It can usually be distinguished from other roses in Nova Scotia by its clusters of white flowers. Although mostly prevalent in human-disturbed, open habitats in this province, it can grow in open forest habitat and forest edges.



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Giant Hogweed (*Heracleum mantegazzianum*): This giant herbaceous plant is native to central Asia and was introduced to North America as an ornamental plant. Its sap can cause rashes and even blindness. In Nova Scotia, it may threaten stream banks and other riparian areas in a few locations.



© ROBERT L. ANDERSON, WDA FOREST SERVICE, BUGWOOD.ORG

Balsam Woolly Adelgid (*Adelges piceae*): This tiny insect is native to central Europe and was likely introduced deliberately through the nursery trade. It attacks both stems and shoots of our native Balsam Fir, which weakens and even kills trees.



© DAVID MAZEROLLE

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Reed Canary Grass (*Phalaris arundinacea*): This tall grass has a native and exotic form. It is believed that the introduction of the exotic form, combined with human-caused nutrient enrichment of many wet habitats, is resulting in pure stands along waterways and in seepages. It threatens native vegetation and can reduce species diversity.



Garlic Mustard (*Alliaria petiolata*): Native to Europe, central and western Asia, and northwestern Africa, this biennial herbaceous plant was purposefully introduced as a garden herb. It threatens woodlands and floodplains, and is even capable of suppressing soil fungi essential to the growth of native species.



© UNITED STATES GEOLOGICAL SURVEY

Coffin Box (*Membranipora membranacea*): Native to Europe, this marine invertebrate was first observed in Nova Scotia seas in the 1990s. This species can form large colonies or mats, which can kill kelp. Each individual in a colony is coffin-shaped.

Species Plaguering Other Parts of North America

RUGOSA ROSE



The value of good stewardship is priceless when you consider the irreversible ecological impacts of an Invasive Alien Species and the time and effort required to manage just one. The following species are found in North America, but not yet in Nova Scotia. Good stewardship, starting here in our own backyards, can help prevent the introduction of more detrimental exotic species like these. Let these species, and a longer list of them at www.invasivespecies.ca, be motivation for you. Each one of us can make a positive difference!



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Dog Strangling Vine (*Cynanchum rossicum* & *louiseae*): Native to southern Europe, this herbaceous vine was introduced as an ornamental plant. This species forms dense patches that displace native species in many upland habitats in Ontario and northeastern United States.



© ALISON FOX, UNIVERSITY OF FLORIDA, BUGWOOD.ORG

Eurasian Water-milfoil (*Myriophyllum spicatum*): This aquatic plant is native to Europe, Asia and northern Africa, and is believed to have been introduced intentionally, or possibly as an aquarium escape in the United States. It can form dense infestations that crowd out native species. It is present in both New Brunswick and Prince Edward Island.



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Chinese Mitten Crab (*Eriocheir sinensis*): Native to the northwestern end of the Pacific Ocean, this versatile crustacean was first reported in the Great Lakes in the 1960s. It has been known to drive native invertebrates to extinction, and can even cause river bank erosion where it burrows. It has recently been recorded in the St. Lawrence River.



© DAVID CAPPAREL, MICHIGAN STATE UNIVERSITY, BUGWOOD.ORG

Emerald Ash Borer (*Agrilus planipennis*): This metallic green beetle is native Asia and was probably introduced to North America in shipping containers. It is currently found as close as Québec, and appears to be spreading rapidly. It threatens to kill most of the ash trees in North America, including those of Nova Scotia.



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Rock Snot (*Didymosphenia geminata*): This warm-water alga is native to Europe, Asia and parts of North America. It can form large mats on submerged surfaces and can negatively affect aquatic habitats. This alga species is now found in several northeastern states.



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Zebra Mussels (*Dreissena polymorpha*): Native to southern Russia, this small freshwater mussel was first detected in the Great Lakes, probably introduced via ballast water. It is currently found as close as Ontario and Massachusetts, and threatens to invade and disrupt freshwater lake ecosystems throughout North America.



Many individuals and community members have been involved in activities related to the prevention, monitoring and management of these species. The following organizations, along with these individuals, form an ever-growing group that is involved in Invasive Alien Species work in Nova Scotia. If you would like to volunteer your time, or learn more about a specific species or region, contact these organizations: They abound with expertise and are keen to share their know-how and to spread the word about Invasive Alien Species in your area.



The Invasive Species Alliance of Nova Scotia (ISANS) is a non-profit group of individuals and organizations focused on improved communication and information sharing to better address the threat of invasive alien species at the provincial level in Nova Scotia. Membership includes representatives from federal and provincial government agencies, academia, aboriginal peoples organizations, and environmental non-profit organizations. ISANS is a founding member of the National Invasive Species Council (NISC), and the Invasive Alien Species Atlantic Network. For more information about ISANS, please visit their website (www.invasivespeciesns.ca) or send them an email (info@invasivespeciesns.ca).



The Mersey Tobeatic Research Institute (MTRI) is a charitable research co-operative whose mission is to promote sustainable use of natural resources and biodiversity conservation in the Southwest Nova Biosphere Reserve and beyond through research, education, and the operation of a field station. MTRI researchers and volunteers have undertaken several projects that have promoted awareness and stewardship of species and habitats affected by Invasive Alien Species. For more information or to learn how to get involved, visit our website www.merseytobeatic.ca, email info@merseytobeatic.ca or call 902.682.2371.



Environment
Canada

Environment Canada is a federal government department that manages the Invasive Alien Species Partnership Program (IASPP), a program that engages Canadians in actions to prevent, detect and respond rapidly to invasive alien species in order to minimize the risk posed by the species to the environment, economy and society. Environment Canada manages the program cooperatively with the Canadian Food Inspection Agency and Fisheries and Oceans Canada. Under this initiative, funding is provided to provinces, municipalities, non-government organizations and other groups who are working on invasive alien species preventative activities. IASPP funded projects reduce the introduction and spread of invasive alien species, improve the understanding and awareness of the issue in Canada, and enable Canadians to be actively involved in projects that address the threats posed by invasive alien species. For more information about Environment Canada's activities related to invasive alien species, please visit their website (www.ec.gc.ca/eee-ias/) or send them an e-mail (iaspp-ppeec@ec.gc.ca).



Fisheries and Oceans
Canada

The Department of Fisheries and Oceans (Government of Canada) Aquatic Invasive Species (DFO-AIS) Program conducts monitoring surveys for marine invasive organisms, in the coastal, Bay of Fundy and Gulf of St. Lawrence waters of Nova Scotia. The Program is a collaborative effort between DFO, and the Nova Scotia Department of Fisheries and Aquaculture, academia, the aquaculture industry and community groups. The goal of the Program is to conduct monitoring and research and provide scientific advice to help reduce the introduction and spread of AIS through prevention, early detection and rapid response mechanisms. To report an AIS, call 1-800-435-4040 or e-mail: XMARinvasive@dfo-mpo.gc.ca. To learn more about AIS, visit: www.dfo-mpo.gc.ca/science/enviro/ais-eae/index-eng.htm.



Fisheries and Aquaculture

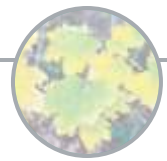
The Nova Scotia Fisheries and Aquaculture is responsible for protecting, conserving, and enhancing the quality and diversity of the fishery resources of Nova Scotia and providing continued and varied angling opportunities through resource assessment and classification, enhancement, and management of that resource. Aquatic invasive species can have severe impacts to native ecosystems and fish populations. The Department focuses efforts on prevention, outreach and education, research, monitoring and developing effective rapid response plans and legislation to address aquatic invasive species issues in Nova Scotia. Through participation on the National Aquatic Invasive Species Committee (NAISC) and the Northeast Aquatic Nuisance Species Panel (NEANS), the Department continues collaborate on coordinated initiatives and action planning to protect the freshwater fisheries resources from impacts of aquatic invasive species. To learn more about the Department and its initiatives visit www.gov.ns.ca/fish/sportfishing/ or email leblanje@gov.ns.ca or call 902.485.7029.



Project UFO (Unidentified Foreign Organisms) is a collaborative initiative in Cape Breton, Nova Scotia, Canada, between scientists, research assistants, and students at Cape Breton University and Atlantic Coastal Action Program (ACAP) Cape Breton to increase public awareness about the invasive alien species that threaten our regional ecosystems. Project UFO's primary objectives are to better understand the status of invasive species on Cape Breton Island and to inform environmental stakeholders about the best way to prevent the introduction or spread of these alien invaders. For more information about Project UFO, please visit their website (www.projectufo.ca).



The Clean Annapolis River Project (CARP) is a charitable, community-based, non-governmental organization incorporated in 1990 with a mission to restore and protect the ecological health of the Annapolis River watershed through science, leadership and community engagement. CARP has undertaken and supported several initiatives to promote awareness and control the spread of invasive species, including: identifying populations of invasive plants, producing and disseminating outreach material on invasive plants and fish, working toward the eradication/control of invasive plant communities, collaborating with DFO on the collection of data on invasive tunicates, and the development of Municipal bylaws. For more information, visit their website (www.annapolisriver.ca), email them at carp@annapolisriver.ca, or call 902.532.7533.



Canada Food Inspection Agency

The Canadian Food Inspection Agency (CFIA) is the federal agency dedicated to safeguarding food, animals and plants, which enhances the health and well-being of Canada's people, environment and economy. The CFIA develops and delivers quarantine and inspection programs and services designed to protect Canada's plant resource base. A primary goal of the CFIA's plant protection program is to prevent the introduction of new plant pests, including weeds and invasive plants. Since the release of An Invasive Alien Species Strategy for Canada in September 2004, the CFIA has also been working with a variety of partners to develop a coordinated invasive plant program for Canada. This has included the development of an Invasive Plants Policy and increased capacity in weed risk assessment, as well as the regulation of numerous new plant species as pests for Canada. For more information please contact us at IAS.EEE@inspection.gc.ca or visit our website at www.inspection.gc.ca/invasive.



Atlantic Canada CDC Canada Atlantique

The Atlantic Canada Conservation Data Centre (ACDC), based in Sackville, NB, is a non-profit organization founded in 1998 by federal, provincial and non-governmental partners to provide data and expertise about species and ecological communities of conservation concern in support of decision-making, research, and education in Atlantic Canada. ACDC follows methods used by similar organizations (which are generally within provincial or state governments) across North America and southward. ACDC conducts an extensive program of biological inventories to further the understanding of species and community distribution and status. For more information, visit www.accdc.com.



Nova Scotia Natural Resources

The Nova Scotia Department of Natural Resources' (NSDNR) mission is to build a better future for Nova Scotians through responsible natural resources management. This includes biodiversity, forest, geological and park resources. Specific roles include the research and monitoring of impacts and control of forest pests, and of invasive alien species on species at risk and natural ecosystems. NSDNR also plays a role in coordinating inter-governmental collaboration efforts, especially for terrestrial species. Visit their biodiversity website (www.gov.ns.ca/natr/wildlife/biodiversity) or forest health website (www.gov.ns.ca/natr/forestprotection/foresthealth) for more details.



The Tusket River Environmental Protection Association was organized in April, 1986, in response to a flood of potentially toxic, turbid water from a tin mine into the East Tusket River, and rapidly became involved in numerous local concerns. In practice it aims to address all environmental concerns in the Tri-County region, particularly in Yarmouth County and the Tusket Catchment. Public education in and advocacy of environmental concerns occupy a large part of our efforts. In regards to invasive alien species, it promotes stewardship and awareness by hosting an annual Chain Pickerel fishing tournament (catch-and-kill encouraged), and it has also employed summer students to remove purple loosestrife from a local marsh ecosystem which it continues to monitor. More details are available on its website (www.trepa.ca).



Ecology Action Centre

The Ecology Action Centre (EAC) is a non-governmental organization based in Halifax, Nova Scotia dedicated to building a healthier and more sustainable Nova Scotia. Environmental issues in the areas of the built environment, marine and coastal environment, energy, food, transportation, wilderness, and climate change are tackled through social and scientific research, education, engagement, mobilization, and collaboration. Central to the goals of the EAC is the protection of the natural environment and resources, which involves raising awareness and promoting stewardship activities for IAS. For more information on the EAC, please visit www.ecologyaction.ca.



Parks Canada and Kejimikujik National Park and National Historic Site recognise the threat that invasive exotic species represent for the native biodiversity and ecological integrity of ecosystems, throughout Nova Scotia. Kejimikujik works in collaboration with academia, other government departments, NGOs, volunteers and visitors to prevent the introduction of invasive exotic species and reduce or eliminate those already present. Control programs are already in place for the European Green Crab (*Carcinus maenas*). Plants species such as Scotch Broom (*Cytisus scoparius*) Glossy Buckthorn (*Rhamnus frangula*) and Purple Loosestrife (*Lythrum salicaria*) are also being managed at the park. The park has produced an education booklet about invasive plants available in both official languages. To learn more about volunteer opportunity in Kejimikujik, please contact the park at 902-682-2770. Cape Breton Highlands National Park is committed to the protection and presentation of a representative portion of the Maritime Acadian Highlands natural region of Canada. Native biodiversity, a cornerstone of the ecological integrity the park is mandated to preserve, is threatened by a number of invasive non-native species. The park actively monitors the occurrence of a number of invasive plants and animals within and on its borders and conducts an invasive species control program. For more information visit the park website (www.pc.gc.ca) or call 902.285.3007.



The Nature Conservancy of Canada (NCC) is the nation's leading not-for-profit, private land conservation organization, working to protect our most important natural areas and the species they sustain. Since 1962 NCC and its partners have helped to protect more than 2.6 million acres (1 million hectares), coast to coast. On a global scale, invasive alien species threaten biodiversity at a level second only to habitat loss. As such, NCC is dedicated to locating, documenting and managing invasive species on its protected lands across Canada. Working in partnership with local communities, government and other NGOs, NCC has conducted several removal activities and educational events around the identification, spread, removal and management of invasive species which impact habitats for native flora and fauna. To learn more, visit www.natureconservancy.ca.



Nova Scotia Transportation and Infrastructure Renewal

The Nova Scotia Department of Transportation and Infrastructure Renewal (NSTIR) builds and maintains provincial infrastructure for Nova Scotians, including highways, schools, hospitals and other public buildings. Given that invasive alien species often move along transportation corridors, NSTIR has a role in preventing their spread. The Environmental Services Section of NSTIR has been engaged with assessments of Garlic Mustard near Grand Pre (www.gov.ns.ca/tran/works/enviroservices/) and is sponsoring research by the NS Agricultural College on Japanese Knotweed at a wetland restoration site in Antigonish (www.104antigonish.ca/wordpress).

Universities have played an important role of researching Invasive Alien Species to learn about impact and distribution. Professors and their students at universities in Nova Scotia have studied many aspects of these species including the impact of Rugosa Rose (Nick Hill, Leah Beveridge, Andrea Flynn, and David Garbary- St. Francis Xavier University), and the genetic resistance to Beech Bark Disease (Beata Chledowski-University of New Brunswick and Judy Loo), just to name a few.

Thank You!

This guide is full of information provided by many people about Invasive Alien Species as well as dozens of photos, many of which were specifically taken for this guide. Many thanks to the following who donated their photos and/or time:

Megan Crowley, David Mazerolle, Nick Hill, Jim Todd, Dawn Sephton, Martin Thomas, Sean Blaney, Brad Toms, Sherman Boates, Mark Elderkin, David Patriquin, Jeffie McNeil, Alicia Pray-Leslie, Amanda Lavers, Ruth Newell, Jason LeBlanc, Kira Krumhansl, Leif Helmer, Marika Godwin, Heather Stewart, Chris McCarthy, Sandra Phinney, Levi Cliche, Marla Bojarski, Ashley Shelton, Sarah Holden, Brett Johnson, Jonathan Guy, Peter Neily, Bruce Stewart, Marina Myra, Diane LaRue and Bob Pett.

This guide was completed with the assistance, advice and edits from the following experts:



Nick Hill is a plant ecologist, consultant and director at the Fern Hill Institute for Plant Conservation. A graduate of Acadia and Dalhousie universities, he has authored several scientific articles on Invasive Alien Species ecology in NS.



Dawn Sephton is an aquatic science biologist with Fisheries and Oceans Canada. A graduate of Mount Allison and McMaster Universities, she has co-ordinated DFO's marine aquatic invasive species monitoring program in NS since 2006.



David Mazerolle is a botanist at the Atlantic Canada Conservation Data Centre in Sackville, NB. He studied the geography and control of exotic invasive plants in protected areas for his Masters at Université de Moncton.



Jason LeBlanc is a fisheries biologist at the NS Department of Fisheries and Aquaculture. He studied fish ecology and biogeography at St. FX and works on resource management and invasive species issues both provincially and nationally.



Ruth Newell is the curator of the E.C. Smith Herbarium at Acadia University where she is responsible for the care of approximately 200,000 dried botanical specimens. She received a Masters of Science degree in Guelph.



Kira Krumhansl recently finished a PhD in biology at Dalhousie University. Her thesis research focused on the effects of Invasive Alien Species on kelp ecosystems in coastal waters around NS.



The Natural Resources Environmental Technology class of 2012 helped gather information and photos for this guidebook.

Ten students, under the guidance of instructors Leif Helmer and Alain Belliveau, from the NS Community College program in Bridgewater, Lunenburg County, contributed to this guidebook by gathering information and photos for a course project on Invasive Alien Species. Kicked-off by a field trip to an Annapolis County site laden with invasive plants, each student's mission was to research an Invasive Alien Species and to provide pertinent information on its identification and impacts. Thanks for your hard work, and good luck in your endeavours!



Alain Belliveau, with the help of everyone mentioned above, assembled this guidebook during the winter of 2012.

Alain is an Ecosystems Researcher at the Mersey Tobeatic Research Institute where he carries out research on forest ecosystems, rare plant communities and Invasive Alien Species. His interest in ecosystems and how we manage them developed during his time at Dalhousie University where he received a Masters in Resource and Environmental Management. The exciting experience of assembling this guidebook has left him with a profound respect for the impacts from introduced species in Nova Scotia.