

Most introduced species don't become permanently established and although they may survive in our climate, they are not able to reproduce in increasing numbers. The majority of new species disappear before they are even noticed. Some species do become established however; these species have populations that are able to sustain themselves over time. Again, the majority of these newcomers do not cause significant harm; they blend into the background along with the multitude of native species that make up our local flora and fauna. Unfortunately, some introduced species do become a problem – they are able to increase in numbers to a point where they are having a significant impact on our society, economy and/or environment.

This manual is meant to be used as a guide for landowners who are interested in how non-native species may be impacting their property. It is intended to help landowners with their management decision making process – to provide options that are based on practical opportunities for successfully achieving long-term property goals.

INVASIVE SPECIES

MANAGEMENT OPTIONS FOR THE ONTARIO LANDOWNER



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Written by
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and **Peter Neave**

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INVASIVE SPECIES: MANAGEMENT OPTIONS
FOR THE ONTARIO LANDOWNER.

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For additional information on the Caring for Your Land workshop series, see www.eomf.on.ca/projects (follow the Information for Landowners link).

The authors of this manual have worked hard to synthesize much of the relevant information available on invasive species and their management. And while there is much known about different species, about how they move around, and about potential impacts, it is obvious from the literature that there are some considerable gaps in practical information for landowners who are currently dealing with the arrival, and associated impacts, of invasive species in their woodlots.

Although it may seem that invasive species are an overwhelming environmental problem disrupting natural ecosystems and wreaking havoc on your capabilities to manage your property, perhaps it will be of some comfort to know that Canada is much better off than many other areas of the world – our cold Canadian winters will keep many of the world’s worst invaders at bay. There will always be forests and fields. There will always be lakes, rivers and wetlands. Mother Nature will survive and we will adapt to her new reality.

This manual was written by Mark Richardson and Peter Neave who have collaborated with others on a number of previous EOMF projects; these include *A Guide to Improving and Maintaining Sugar Bush Health and Productivity* as well as *Agroforestry Best Management Practices Volume 1: Woodlot Management* and *Volume 2: Tree Cover*. Both authors have brought their unique set of capabilities to the numerous post-work meetings needed to see this project through to completion. Elizabeth Holmes, Program Planner for the EOMF, was responsible for editing the final draft before it was sent to

production at Mary Moore’s Cedar Lane Studio (cedarlane@ripnet.com). For both Elizabeth and Mary, it has been a considerable task working with the authors to blend their writing styles, interpret the diagram descriptions and devise a reader-friendly manual.

This publication would not have occurred if it were not for the partnership and support of the Ontario Woodlot Association (OWA). OWA’s vision of healthy and productive forests for Ontario’s woodlot owners engages the organization in addressing issues such as invasive species. We encourage you to visit the OWA website (www.ont-woodlot-assoc.org) for more information on forest management, property stewardship, and invasive species.

If you have any comments on this manual please do not hesitate to contact the authors through the EOMF.

Funding for this publication was made possible by the Invasive Alien Species Partnership Program, an initiative of the Government of Canada. For more information on what the government is doing to combat invasive species see Appendix C.

The logo for Canada, featuring the word "Canada" in a serif font with a small Canadian flag above the letter 'a'.The logo for the Ontario Woodlot Association, with "Ontario" in a script font above "WOODLOT" in a bold, blocky font, and "ASSOCIATION" in a smaller font below.The logo for the Eastern Ontario Model Forest, featuring a stylized landscape with trees and a sun/moon above the text "EASTERN ONTARIO MODEL FOREST".

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1 INTRODUCTION

Ontario's settled landscape supports a wide diversity of life, however, not all the species belong there. Many of the aquatic and terrestrial species around us come from other parts of the world, after having been relocated from their native habitat and range into a new and different ecosystem. This phenomenon is not unique to Ontario and it is probably safe to say that there would not be one ecosystem across the globe that has not been altered in some way by the introduction of new species.



Fortunately for us, most introduced species don't become permanently established and although they may survive in our climate, they are not able to reproduce in increasing numbers. The majority of new species disappear before they are even noticed. However, some species do become

established; these species have populations that are able to sustain themselves over time. Again, fortunately for us, the majority of these newcomers do not cause significant harm; they blend into the background along with the multitude of native species that make up our local flora and fauna. Regrettably, some introduced species do become a problem – they are able to increase in numbers to a point where they have a significant impact on our society, economy and/or environment.

This manual is meant to be used as a guide for landowners who are interested in how non-native species may be impacting their property. It is intended to help landowners with their management decision making process – to provide options that are based on practical opportunities for successfully achieving long-term property goals. To do this, the authors are making the assumption that you have one or more specific goals in mind for your property in the first place. Having a goal is important because it is the basis for all decision making. Non-native species can impact the capability of your property to reach your goals in a timely and cost-effective manner. This manual has three main goals:

- 1) to help you make management decisions;
- 2) to help you save time and money, and;
- 3) to provide you with information about invasive species, your property, and how it functions.



Although the focus of this manual is on terrestrial habitats, wherever appropriate information on aquatic habitats and species is provided.

NAMES AND DEFINITIONS

If you are like most landowners, you probably know the difference between native and non-native species. Native species are found within their natural range – they exist in a particular ecosystem or habitat naturally, regardless of human activity. Native species are part of the biodiversity of an area – part of the natural mix of species which is influenced by such factors as local site conditions and climate.

A variety of terms are used to describe species that are not normally from a particular environment, region or country – invasive, alien, invading, non-native, exotic, introduced, naturalized and foreign are the most common. At times, there is some confusion amongst the public, policy makers, ecologists and the news media about the specific meaning of each term and how or when to use them. They are often used in conjunction with each other (*invasive alien species*) or even synonymously to mean the same thing. Although this publication focuses on the first two, invasive and alien, the following table should help you understand the key differences in definition.

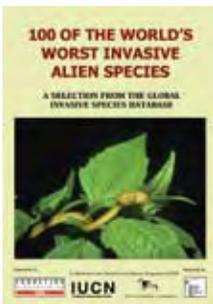
Term	Definition	Associated Species
Alien	A species not naturally found in a particular environment, region or country	Carp, black locust, Norway spruce, European hornet, Kentucky bluegrass, yellow clematis, starling, Japanese knotweed, Scots pine
Invasive	An alien species that could cause or is causing some type of harm	Emerald ash borer, giant hogweed, purple loosestrife, zebra mussel, dog-strangling vine, gypsy moth, Canada thistle
Invading	A new species that is rapidly establishing itself in an area	Subterranean termites, giant hogweed, dog-strangling vine, Norway maple
Non-native	Originally from another part of the world	All alien species
Exotic	An organism that is established in an area but is not native to that area	Ring-necked pheasant, Hungarian partridge
Introduced	A newly released non-native species	All alien species
Naturalized	A non-native species that has become commonplace with native species	European starling, crown vetch, Canada thistle
Foreign	A species from another land or country	All alien species
Pest	Invasive species but also native species causing adverse impacts	

Note how similar the definitions can be. This makes it very difficult to fit any particular species under one single definition; it is often a matter of personal preference, the current number of individuals (few vs. many), and what is regionally common in the area where the term is being used.

What is in a name anyway? From your perspective as a landowner, whether a species is alien, introduced, or non-native may not be that important. In all probability you are really interested in how these species impact you, your property and your ability to use it.

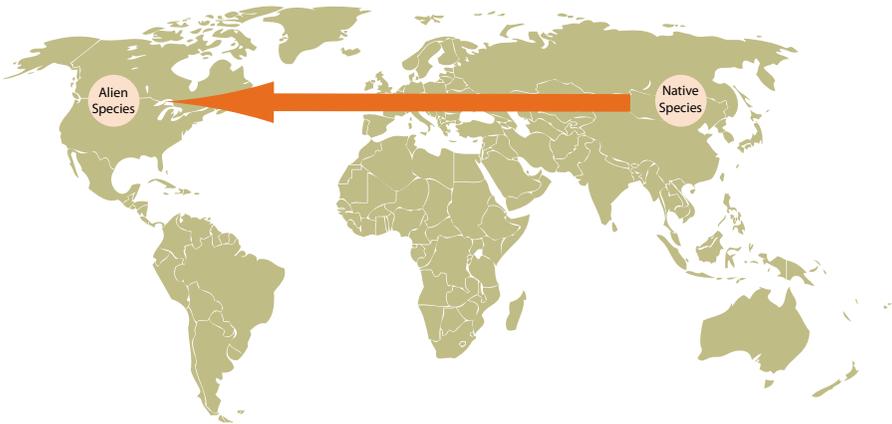


Most alien species tend to be ecologically benign. The impact on the ecosystem to which they are introduced is relatively small, where they simply exist as an unnatural part of the local biodiversity. However, some alien species can be pretty malevolent; they grow in number to the point where they cause very significant economic, social, or environmental harm. These species are referred to as invasive species, and they are the ones you should be most concerned about.



There is considerable information available on species that have established themselves in ecosystems in which they were not intended to be.

As an example, the Global Invasive Species Project (<http://www.gisp.org/>) has published a very interesting report on the 100 worst invaders – it lists a number of species that can be found in Ontario.



Currently, there are a number of wood boring insects damaging North American trees. Although these insects are classified as invasive here, they come from an area where they would be considered part of the native insect population.



Photo: Ohio State Weed Lab Archive,
Ohio State University, Bugwood.org

Not all alien species come from other countries – Manitoba maple, for example, is native to the prairie region of Canada but, thanks to human activity, has expanded its range to other parts of the country including Ontario.

THEIR ORIGIN

All species have a native range where they can be normally found. Within this range the total number of species present will increase and decrease over time naturally – populations cycle and environmental changes may promote or suppress certain species. There are also natural changes to a species' native range caused by changing climatic conditions and species adaptations; however, natural changes to a species' native range take place slowly over time that is often measured in centuries. Alien species are moved over much larger distances, in much shorter periods of time than would ever take place through natural means. We humans are responsible for this.



Many centuries ago, Ontario would have looked a lot different than it does now. At that time, giant sheets of ice had forced most of today's species to move far to the south. As these massive glaciers melted, the landscape was dramatically changed. Plants and animals followed the glaciers' retreat in a process of natural range expansion that is probably still occurring today.

Invasive species problems do not occur exclusively in Canada. We have exported our fair share of species to other countries only to have them become invasive in their newly found homes. Examples include: beavers to South America; large mouth bass to central America, Europe and Japan; bullfrogs to western North America and the Caribbean; and, grey squirrels to Great Britain.



THEIR IMPACTS

All non-native species have some sort of impact on the ecosystem in which they are introduced. It is the degree or amount of impact that is important. Even the most innocuous alien plant takes up space that could otherwise be used by a native plant. Other species tend to be much more offensive; they can take over a lot of space and exclude other plants completely.



Net covered in zebra mussels



Zebra mussel shells on a beach

Single zebra mussel



Ontario's industrial sector has been dealing with aquatic invasive species for decades. Impacts caused by non-native species are subjective and vary from area to area. As a result, some species can be labelled as invasive in some areas, while in other areas they may be considered alien. In addition, alien species may persist without significant impact for years, slowly increasing in numbers and distribution. At some point, when their numbers reach a certain level or when environmental conditions change, alien species begin to demonstrate invasive tendencies.



Ontario has about 19 species of earthworms; all but two have been imported from other regions of the world. While there are significant benefits to having a healthy earthworm population in gardens and agricultural fields (especially no-till fields), recent research has shown that earthworms are having a negative impact on woodlot health and function. One person's invasive species may be another's alien species!

Most definitions used to describe non-native species are essentially based on impact. Alien species tend to have less harmful impacts, or to not currently be causing a significant impact; invasive species are alien species with ‘attitude.’ They can cause serious impacts.

When sailing vessels from other parts of the world first started coming to Canada, they brought with them many new species of plants, insects and disease. While many of these species were not able to survive in the New World environment, some of them were. They have since become naturalized and are now often commonly found mixed in with Canada’s native species. Over the years, some of these species have changed our natural areas considerably while others have simply blended into the background.

In many ways we are unaware of the impact from non-native species that were introduced a long time ago – they have altered or changed the old ecosystems into what we now consider to be our natural environment. We live in a settled landscape that has forever been altered by human activity. Hence, our current environment is one that we often think of as being ‘natural.’ For this reason, we are really only concerned with recently or newly introduced species that are capable of altering our existing (already altered) environment.

Human migration around the globe has provided many species with an opportunity to escape their normal range, moving past mountain chains and across oceans. European ships sailing to the New World brought with them many species that are now commonplace in Canada’s ecosystems.



ALIEN SPECIES IMPACTS

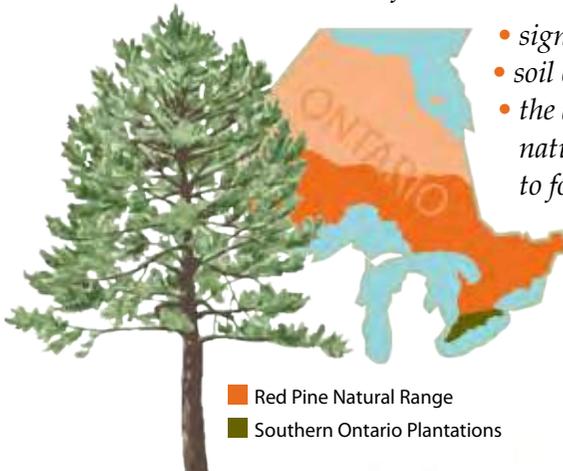
While it is generally agreed that invasive species cause problems in so far as Canada's economy and environment are concerned, there is often disagreement on the overall impact of alien species. Some alien species are even beneficial.



Most of our agricultural crops are alien species – no one would argue about the huge benefit they provide to our economy and society.

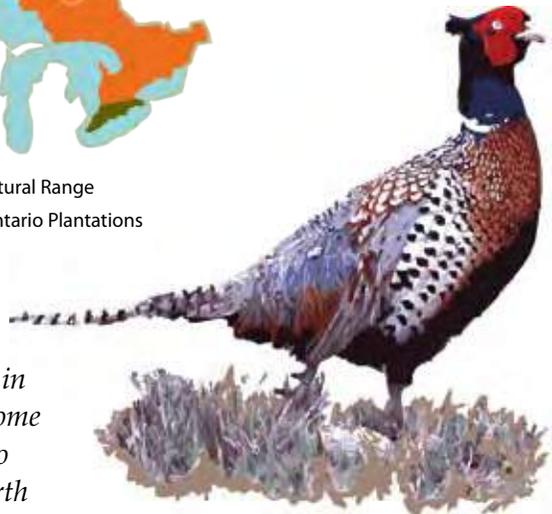
In many parts of southern Ontario, red pine is an alien species that was purposely planted outside its natural range. Red pine plantations dot southern Ontario's landscape and provide huge benefits and opportunities for landowners including:

- significant economic returns
- soil conservation benefits
- the ability to speed up the natural return of open land to forested land



- Red Pine Natural Range
- Southern Ontario Plantations

The ring-necked pheasant is an important game bird that was first introduced from Asia in the mid 1800s. It has since become established in southern Ontario and in many other parts of North America, where it provides recreational and economic benefits to many communities.





Alien species are common inhabitants of urban areas. Here, one native Eastern white cedar survives amongst a long list of alien species that include: Norway maple, Norway spruce, Japanese knotweed, Kentucky bluegrass, many weedy lawn species, and a number of purchased ornamental

shrubs and plants. In many highly-disturbed urban environments, alien species will survive better than native species.



Common plantain is an introduced species. Although it may cause some fastidious lawn owners grief, is it really a problem? Most of our commonly found urban weed species are alien.



The yellow-jacket originally came from Europe. It is a common insect species in urban areas where it has an impact on native insect populations, and on anyone who happens to get stung by one!



Pet store turtles like this red-eared slider become an alien species if released into the wild where they compete with native species for food, shelter, and nesting sites.

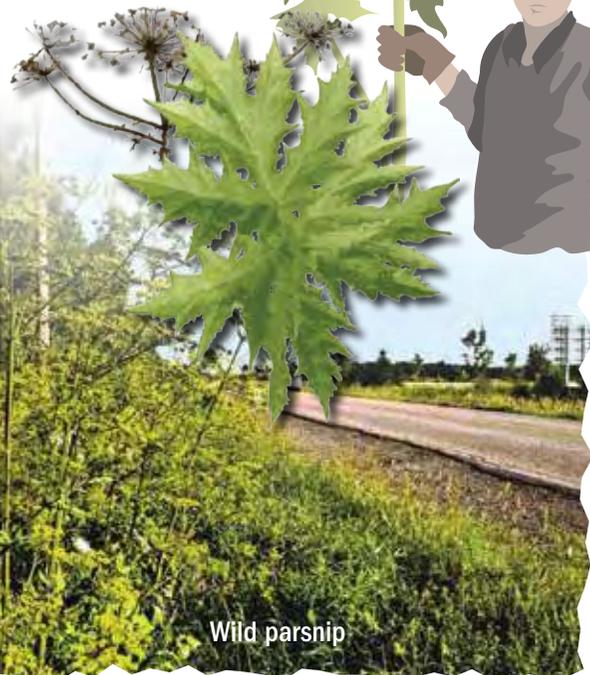
INVASIVE SPECIES IMPACTS

From your perspective as a landowner, invasive species are those that cause you harm. They affect your ability to enjoy or use your property. They affect your ability to benefit from it. Invasive species may also affect your quality of life; several human and animal disease organisms can be considered invasive. Invasive species may affect agricultural commodities, driving up the cost of your weekly grocery bill.

Identifying giant hogweed is pretty easy when it is fully grown – it is truly giant! It also produces a sap that can react with sunlight to cause severe skin reactions. Other plants like leafy spurge and wild parsnip can also do this. It is always a good idea to wear protective gloves and clothing and to wash thoroughly after handling suspect plant parts.



Giant hogweed

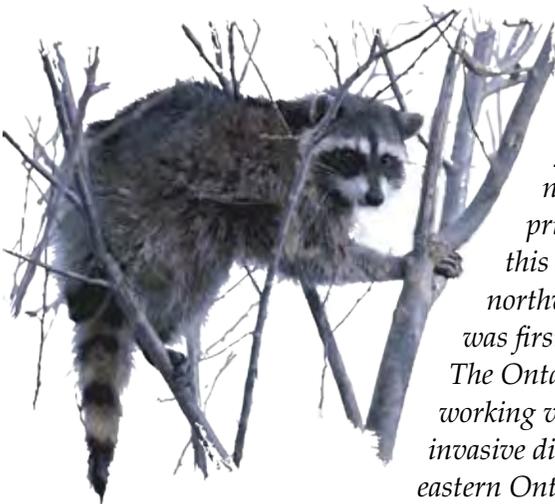


Wild parsnip



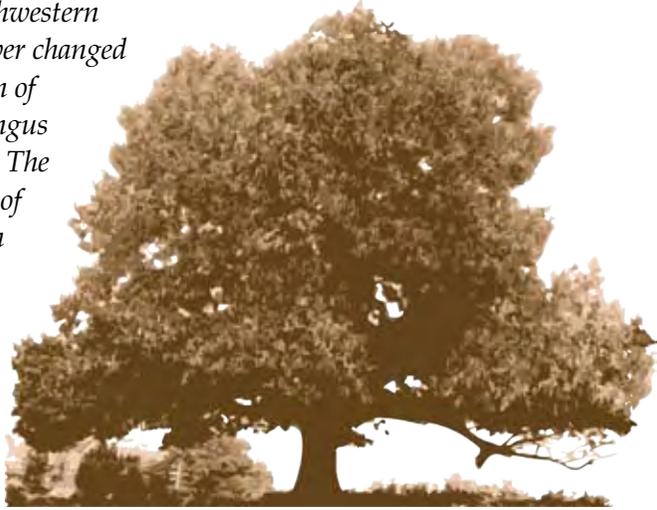
Some invasive species can cause tree mortality. Dutch elm disease is an invasive fungus that kills American elm trees. The disease is spread by two species of elm bark beetle, one of which is invasive. There are several other species of invasive disease organisms that can contribute to tree mortality, including butternut canker, chestnut blight and sudden oak death.

Many invasive plants, insects and disease organisms are serious pests of farm operations and can significantly reduce crop yields if not controlled. Farmers know only too well how costly it is to manage invasive species problems.



Raccoon rabies is a terrible and usually fatal disease of the central nervous system. Transmitted primarily through raccoons, this disease has been spreading northward from Florida where it was first reported in the late 1940s. The Ontario government has been working very hard to control this invasive disease since its arrival in eastern Ontario in 1999.

The forests of southwestern Ontario were forever changed by the introduction of chestnut blight fungus in the early 1900s. The blight kills the top of the tree, leaving an intact root system that can re-grow new sprouts until they too are killed by the fungus. The American chestnut, once the most majestic tree in the forest, now clings to a meagre existence in the understory of other species.



Some invasive plants can push native plants out of their natural habitats – over time, the number and diversity of spring flowers will change when an invasive species spreads rapidly through a woodlot.

Invasive insects can reduce the timber harvest value of forested land by directly degrading log quality and harvest volumes, and by affecting your ability to sell wood products. Sirex wood wasp, emerald ash borer, gypsy moth caterpillar, pine shoot beetle and others pose a significant threat to woodlot management plans of landowners.



KEY POINTS FOR LANDOWNERS:

-  **Invasive species are non-native species that cause some type of harm**
 - From your perspective as a landowner, they can cost you money, and/or affect your ability to get what you want from your property
 - These impacts may require a change in your management activities
-  **Alien species are non-native species that aren't causing you harm**
 - They come from other areas, ecosystems, countries
 - Many have been around for a long time
 - Some of them are even beneficial
-  **Today's alien species may be tomorrow's invasive species**
 - Some introduced species slowly expand their range over decades but not really causing any significant problems
 - At some point in time, and often for reasons that aren't understood, these 'sleeper species' begin to show invasive tendencies and start to cause harm



2 CHARACTERISTICS OF INVASIVE SPECIES

All species have certain characteristics that determine their ability to live in a particular area and to co-exist with all the other species that are around them. One or more of these characteristics can determine how successful a particular species is relative to another.

Did you ever wonder why your forest isn't made up of only one species like maple, or why grasses dominate some areas but not others, or why you don't have trout in your cottage lake? The answer to these questions is dependent on any of five key factors – regional climate, microclimate, site, past disturbance patterns, and individual species characteristics. These are interrelated, so it is the mix of factors that influences what lives where, as well as the general abundance of any particular species in an ecosystem.



Climate: All species are adapted to a particular climatic range where temperature and precipitation patterns play the most important role. Some species prefer dry, hot environments, others can't tolerate freezing, and others need plenty of rainfall to survive. It is possible to find similar regions of climate in different parts of the globe.

In this way, species can become established outside of their normal range.



Microclimate: Within any forest, wetland, or field there can be a number of features which influence the conditions of sun, shade, exposure, wind, drainage and other factors.

Variations in any of these factors can influence what species grows or lives there – some species will have

very specific requirements, while others, like most invasive species, will be unaffected by differences in microclimate.

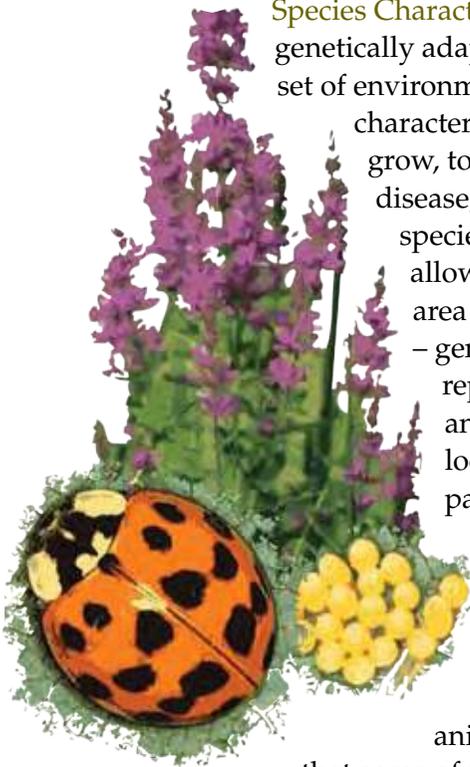
Site: Especially for plants, site-specific variables like soil properties play a key role in determining what species can be found in any particular area. Some invasive species are able to thrive in a variety of site conditions.



Land Use Patterns: Some species require relatively undisturbed habitats, while others thrive in disturbed areas – it is well documented that most terrestrial invasive species do better in disturbed habitats. The current land use of any particular area has a significant influence on what species will survive where. Many invasive species are capable of surviving over a range of land use patterns – wetland, forest, field environments.

Our landscape has been settled for well over two hundred years – most invasive species thrive in disturbed environments.





Species Characteristics: Every species is genetically adapted to thrive on a given set of environmental conditions. These characteristics define its capacity to grow, to avoid predators, to resist disease, and to reproduce. Invasive species exhibit characteristics that allow them to be successful in the area to which they are introduced – generally, they have a high rate of reproduction, are fast growing, and are well adapted to the local climate, site, and land use patterns.

Some estimates put the total number of species on the planet in the range of 1.5 million to 1.75 million. With this many species of plants and animals, it only stands to reason that some of them would have the capability of surviving, if not thriving, when introduced to different parts of the world.

When introduced to the South Pacific island of Guam, the brown tree snake found itself in an environment to which it was ideally suited – the climate was perfect, there was an abundance of prey (not previously exposed to this type of predator), and there was nothing on the island that liked to eat it. As a result, the number of snakes exploded to the point where several species of native birds and lizards disappeared from the island forever.





There have been several well-documented examples of unusual species sightings in Ontario ecosystems. Examples include piranha that have been caught by anglers, venomous spiders that crawled out of a bunch of grapes from Mexico, and exotic tropical birds that have escaped captivity. Just because a new species has been found does not indicate that it is established in Ontario. Many new species are introduced but only a few will ever become permanently established – to survive here a species needs two things:

- 1) It has to be able to survive in the area in which it was introduced, and;
- 2) It has to be released in sufficient number in the first place to develop a population that is reproducing.

Take either of these factors away from a species and it is simply an alien species that does not have the ability to grow in numbers.

WHAT MAKES THEM SUCCESSFUL?

Invasive species have characteristics that allow them to thrive in the area where they are introduced. They are generalists, capable of surviving in a variety of different locations, habitats and conditions. In their new environment, invasive species are not subject to natural predators and diseases that would help keep their population under control. And more often than not, invasive species have a high rate of reproduction, producing many offspring that essentially take over a particular area.

As a result, invasive species flourish in the settled landscape of eastern Ontario. They can out-compete native species for space and food. This may appear to be opposite to many of Ontario's endangered species which have very specific site requirements making them vulnerable to habitat loss, disturbance and predation. In many ways, endangered species are their own worst enemy by having characteristics that don't allow them to thrive in the settled landscape.



European buckthorn, first introduced to North America as a garden shrub, has several characteristics that make it successful in our area:

- Broad habitat requirements
- No natural predators
- Well adapted to local climate
- Fast growing
- Hard to kill
- Strong reproducer - produces a lot of seed

Rusty crayfish is an aquatic species native to other regions of North America and spread primarily through bait bucket release. It exhibits the following characteristics:

- Broad habitat requirements
- Relatively few natural predators
- Spreads rapidly – released from bait buckets
- Well adapted to local climate
- High reproductive rate
- Aggressive - monopolizes bottom habitats



Garlic mustard vs. wood poppy

It is the nature of invasive species that poses such a risk to many of Ontario's endangered species. Invasives grow and reproduce quickly, they have the capacity to survive on a wide number of sites, and they often do exceptionally well in disturbed areas. The wood poppy (*Stylophorum diphyllum*), a native species on the endangered species list, has very specific site requirements and is found in only two small locations in Ontario, one of which is now being impacted by garlic mustard, a very invasive plant from Europe.



What do you think the wood poppy's future is in Ontario?

Is it worth trying to save a species that may have once been plentiful but now, thanks to habitat loss and new threats posed by an invasive species, may be doomed to extirpation from the province? What if one of the populations of wood poppy was on your property? Would you work to save it?



HOW DO THEY GET INTO CANADA?

Although some do, most new species don't come here naturally; many are picked up and moved out of their native habitat by human activity. They get here through a variety of means.



Ships may carry aquatic species in their ballast water or on their hulls – many species currently causing trouble in Ontario's lakes came here originally as stowaways from other freshwater ecosystems.



Round goby



Spiny water flea



Zebra mussel

Many invasive plants are first introduced as garden plants or shrubs, but soon jump the fence into areas where they are not wanted.

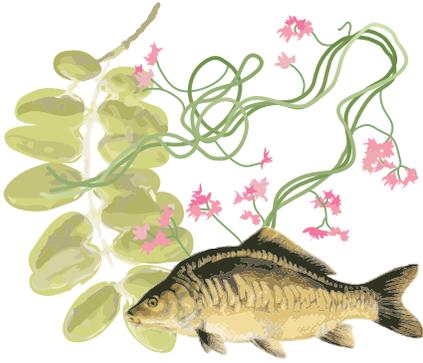


Many species of insects have emerged from untreated wood packaging material imported with consumer goods and raw materials.



Most of our invasive bark beetle species have arrived by means of this pathway.





Some species have been intentionally released for one reason or another. The common carp, now a familiar fish in many waterways throughout North America, was once stocked as a game fish and for aquatic vegetation control. Some plant species were also planted to stabilize soil and stream banks.

Although there are few species currently causing problems in Ontario, unwanted aquarium and pond fish and plants released into the wild pose a significant threat to aquatic ecosystems. In other parts of the world, released pets have become a huge problem.



In the case of some species, we are unsure how they got here or even where they originally came from. Butternut is a native tree species that is under attack from an invasive disease which appeared to come out of the blue. Unless something is done to stop the butternut canker it may eventually push the tree right out of the province, and possibly even out of existence.

Preventing the introduction of new species by cutting off the pathways of invasion represents one of the best ways to avoid future problems – it is always easier to stop them from coming in than it is to get rid of them when they are here.

HOW DO THEY GET ONTO YOUR PROPERTY?

While stopping the introduction of new species is very important in helping to reduce future impacts, it is equally important to take steps to slow the rate of spread of those species that are already here. Invasive species get to your property in a number of ways.



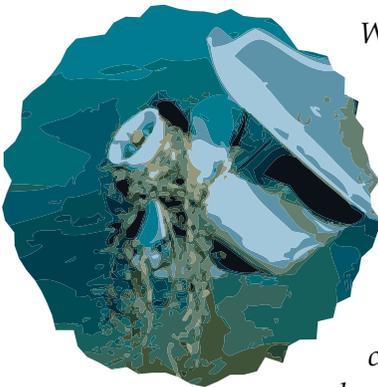
Emptying live bait into a water body from which it did not originate can introduce new species to lakes, rivers and streams. Species like rusty crayfish and the fish hook water flea have been spread in this manner.

Many plants reproduce by seeds that are spread by the wind. Depending on the size of the seed, a species may spread by only a few meters, or by several kilometres. Seeds may also attach themselves to articles of clothing, or vehicles and then be transported well outside the currently infested area.



Some species of plants are able to reproduce from small fragments of roots or stems left in the soil. Moving infected soil from one location to another is one sure way of introducing plants like Japanese knotweed into new areas. Moving soil around has also been responsible for dispersing the seeds of many invasive plant species from one location to another; this is especially true for plants in urban areas where soil movement is often very common.

The movement of firewood infested with invasive insect species has, in part, contributed to the spread of a number of non-native bark beetles. At the time of printing this manual, new populations of the highly destructive emerald ash borer have been discovered in Toronto, the Montérégie region of Quebec, and even in the nation's capital, Ottawa. These satellite populations, which are well outside the main area of infestation in southwestern Ontario, were most certainly spread through the movement of infested firewood.



Water weeds like Eurasian water milfoil have been spread from lake to lake through recreational boating. Plants and plant fragments can easily become entangled on boat trailers and motors which are then moved to non-infested water bodies.

Invasive shrubs like common and glossy buckthorn, and Japanese barberry are spread by birds and other animals. Today's dinner can be tomorrow's invasive.



Campers and other vehicles may pick up unwanted invasive hitchhikers and move them into new areas. The European gypsy moth caterpillar has been known to crawl onto and into vehicles. Egg masses can also be moved in this way.



Once established, an invasive species will begin to spread on its own. Often the genetic characteristics that make them successful in the first place include those characteristics that help promote their spread – small wind-blown seeds, sticky seeds, mobility.

KEY POINTS FOR LANDOWNERS:

-  **The environment in which a new species is introduced needs to be appropriate for the species to proliferate**
-  **Invasive species have characteristics that allow them to out-compete native species**
-  **Species are moved around the world and onto your property in a number of ways**



Even though invasive species will forever have an effect on your property, it is not all doom and gloom. Through efforts to control, manage, or eradicate problem species you may be able to meet your objectives. In addition, you may be able to change your management practices and goals to adapt to those species which cannot be controlled.

3 INVASIVE SPECIES ON YOUR PROPERTY

Your forests, wetlands and agricultural areas are capable of producing a wide variety of benefits. Some of these are marketable commodities – food and fibre that can be produced and sold for a profit. Other benefits like clean air, clean water, wildlife and personal enjoyment are usually not marketable but may be equally or more important to you as the landowner. Whether you own one acre or a thousand, invasive species can interrupt your land’s unique capabilities to provide:

- agricultural crops
- forest products
- wildlife habitat
- aesthetic and recreational enjoyment



The ability of your land to provide benefits is dependent on the same physical, cultural and biological variables that support the growth and proliferation of invasive species, namely: climate patterns, weather events, soil properties, topography and human influences. These five factors determine the type

of native species you have on your property, and how they interact. The characteristics of the species, and their relative condition and abundance determine the type of benefits you can enjoy from your property.

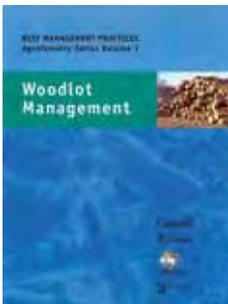


Weather events like the 1998 ice storm contributed to an increase and spread of invasive species like common buckthorn. Natural disturbance opens up the canopy, allowing more light to reach the forest floor. Invasive species are often faster growing than native species, allowing them to better capitalize on newly created opportunities.

Human activity such as road building and logging disturbs the existing forest structure, creating new opportunities for invasive species. Many invasive species, like this mullein, are quick to colonize areas disturbed by human activity.



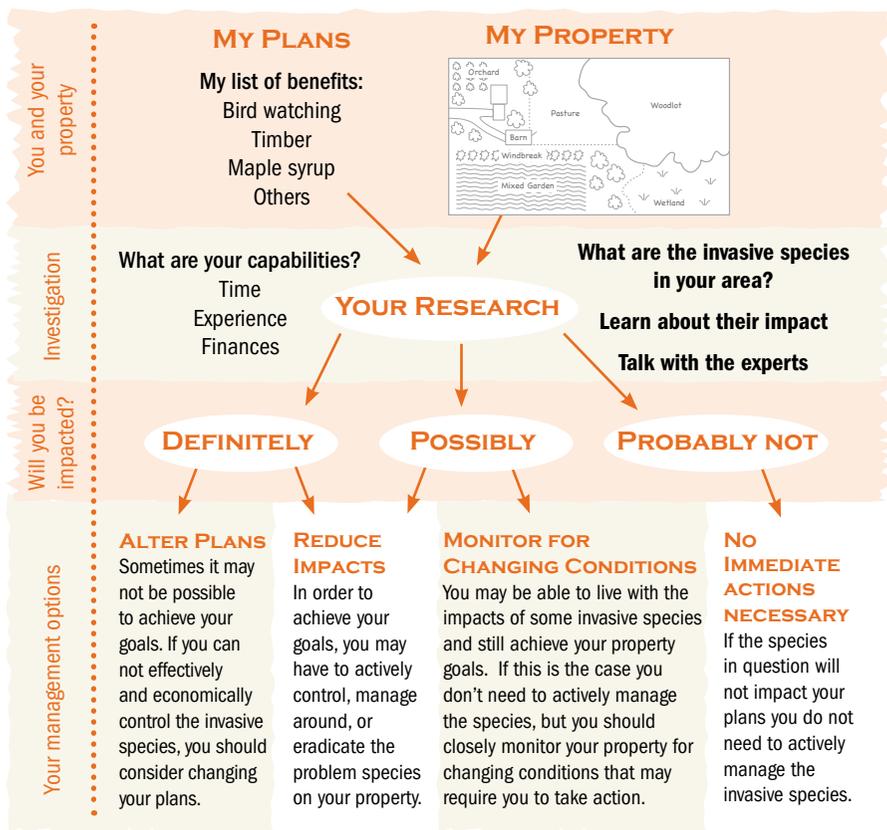
Plants and animals grow, reproduce and die. Even though it may appear that there is little change from year to year, your property is changing. Invasive species disrupt the normal cycles and processes that influence how your property changes over time. The introduction of one or more new species alters the way an ecosystem functions. It changes the process of normal species interactions that have evolved over the millennia. This interruption of normal property functioning inevitably affects your ability to extract the benefits you want from it. Invasive species lessen your ability to use and enjoy your property.



The authors of this publication also contributed significantly to Agroforestry Best Management Practices Volume 1: Woodlot Management and Volume 2: Tree Cover which both contain more information on the natural processes that affect your property.

For the most part, you as the landowner make decisions on how your property will be used – you choose to cut trees, to plant crops, to hunt, or to pasture cattle. You make choices because you want to get something out of your property. Financial returns, wildlife enjoyment, peace of mind, recreation, what ever it is, it is your choice to manage in this way and for the benefits you want. If invasive species can have an impact on your ability to manage your property in the way you want, you need to determine what your options are.

CAN AN INVASIVE SPECIES UPSET YOUR PLANS?



Decision tree for landowner options

Use the figure above as a guide for determining possible courses of action for your property. You will need to have a clear understanding of what you want to do with your land – what are the benefits you want to extract from it?

Unfortunately, there is no easy way to determine the likelihood of a particular species impacting your plans – it depends on the species. What you want to do is compare your plans against any potential invasive species problems that might occur. For example, if you are growing red pine for timber, what invasive species affect red pine? If wildlife is important to you, how could it be impacted? Researching how invasive species could impact your plans will give you an idea of what needs to be done to reach your goals.

Many landowners feel a sense of responsibility to their land and to those who will own it after they are gone – this strong stewardship ethic drives their management actions. Goals like improving wetland health and wildlife habitat are not money makers for most landowners; they do it for their property and their sense of well-being. Unfortunately, broad goals like environmental protection are often the most difficult to achieve – so many factors, like invasive species, are capable of affecting management plans.

LANDOWNER AWARENESS



Garlic mustard is a biennial plant, meaning that it takes two years to complete its life cycle. In the first year it exists as a small innocuous-looking ground plant. In the second year it grows erect and seeds. If not discovered soon enough, garlic mustard can dominate a forest understory, pushing out many of the native plants.

It is important to be aware of what is happening on your property. Some landowners claim that invasive plant species like garlic mustard and dog-strangling vine take over large areas of their property in a very short amount of time – “one year there is nothing, the next year it is everywhere.” While seed can blow in from neighbouring areas to cause a significant new infestation, it is more likely that the number of plants has grown steadily over a period of time. Many invasive species can stay below a landowner’s radar for a number of years, slowly expanding their numbers and range. When the species is discovered, it may have spread to a point where it is very difficult to control.

Use this manual as a guide, but seek out additional references and expertise from other sources. The key to success is being properly (and property!) informed – use the Web, your local library and talk to government departments, local stewardship groups and not-for-profit organizations. In addition, the news media has been covering more and more invasive species stories. Try to find out what is in your area.



Regular monitoring for invasive species and their impacts is also a recommended practice. Walk your property and look for:

- changing conditions
- declining or dying trees
- species that you are not familiar with
- plants that appear to be increasing in abundance



One of the best ways to find invasive plants is to walk your property in late fall after all the leaves have fallen off the trees – if you see a shrub or a plant with green leaves, it is probably an alien plant and it should be identified. European and glossy buckthorn are easy to identify from late October through early November.

PICK YOUR BATTLES

Eliminating or avoiding invasive species impacts is often a difficult, time consuming and expensive battle so, before you even start, wouldn't it be better to know if you can win the fight?

If an invasive species threatens to upset your plans to benefit from your property:

- What options do you have to reduce impacts?
- How much will it cost?
- How much time is needed?

Careful consideration of these three questions before you act will give you an idea of whether your efforts will work – if the task is too big, too difficult or too expensive, it may be advisable to adjust your plans.



When purple loosestrife first made headlines, many landowners and environmental groups embarked on a campaign to manually remove it from infested wetlands. While their effort was commendable, in reality there was little chance of success. Loosestrife is a prolific seed producer and it returned to most cleared areas within a few years.

Butternut canker is devastating butternut across its range. Many landowners are collecting nuts and planting seedlings in an attempt to save this endangered species. This is a low-cost effort that may someday help find a disease-resistant tree and save the species.

The insecticide Bt works very well on European gypsy moth larvae but is it worth the cost to have your property sprayed? Gypsy moth is an invasive defoliating insect that was the subject of a huge aerial spraying campaign in the early 1990s. At that time,





the infested area was huge and there was no real end to the outbreak in sight. By the mid 1990s, however, the population had essentially collapsed on its own as a result of a naturally occurring virus and fungus species. Deciding if spraying is right for you should in part be made on the basis of how healthy your forest is in the first place. Healthy trees can usually handle one or two seasons of significant defoliation. They suffer, they get stressed and they may even lose some branches, but they usually live. Previously stressed trees on the other hand, can't cope as well with more stress – if your forest is stressed to begin with the impact of a serious defoliation may cause increased mortality. Can you live with gypsy moth-incurred mortality in your woodlot? If the answer is no, you are a candidate for aerial spraying.

White pine blister rust is a serious disease of white pine which can dramatically reduce timber quality and volume. Landowners do have options when it comes to reducing the impact of this invasive disease. For more information on this pathogen see Case Study 3.



Eurasian water milfoil is an invasive aquatic plant that spreads through fragmentation. Mechanical removal of this pest does not work and may in fact contribute to its spread throughout the water body.

Invasive plants will most often affect understory plants and tree seedlings – if you are planning on managing your forest for timber production, do you need to worry about invasive plants? If timber products are your only objective the answer is: probably not. Invasive plants will not interfere with your ability to grow the trees you already have to maturity. However, if you are managing for the next forest, and want to encourage regeneration then perhaps you should be concerned about those plant species that can interfere with the normal forest regeneration cycle.





Even though invasive species will forever have an effect on your property, it is not all doom and gloom. Through efforts to control, manage, or eradicate problem species you may be able to meet your objectives. In addition, you may be able to change your management practices and goals to adapt to those species which cannot be controlled.

OPTIONS FOR PROPERTY OWNERS

The ‘decision tree’ (page 27) introduces the idea that it is important to evaluate potential impacts against property goals – how will a particular species affect you? Your decision to act should in part be based on your chances of success. It is important to carefully explore the issue and your particular situation. Don’t jump to conclusions too early – evaluate, discuss, and seek help from knowledgeable people and organizations.

Hopefully your research into the issue will provide you with a sense of confidence that your efforts to control impacts will be worthwhile; but if not, you should consider adapting your long-term plans. Don’t waste a lot of time, money and effort on management activities that will not provide the benefit(s) you want. Adapt your plans – find something else to work for.

Prevention

It may be possible to stop some invasive species from finding your property in the first place. Here are some general tips that are pretty easy to follow.

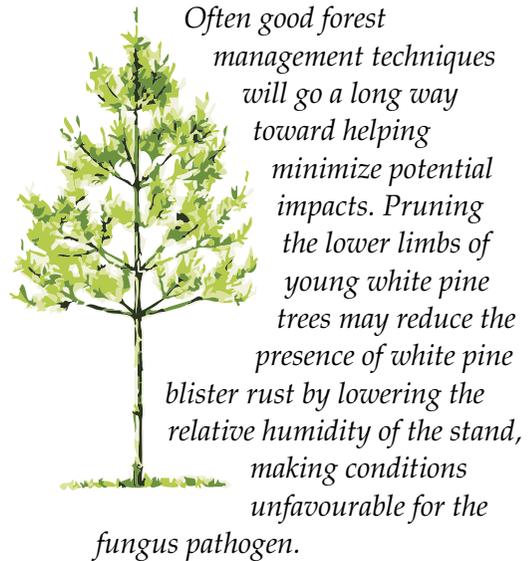
Terrestrial Species

- Don’t add to the problem – plant native species wherever possible or avoid planting species that are known to be invasive
- Avoid seed mixtures that may contain invasive species
- Avoid buying wood material (logs, firewood) that may contain invasive species – buy local if you can and check the Canadian Food Inspection Agency website (www.inspection.gc.ca) for up-to-date information on problem areas

- Don't take firewood from city trees out to the country
- Follow recommended forest management practices – avoid or minimize disturbance
- When traveling, don't bring live plants or seeds into the country
- Clean soil and debris from all equipment coming onto your property, especially if it has come from other areas of the province



Avoiding unnecessary disturbance is one of the best ways of reducing opportunities for new species invasion.



Aquatic Species

- Clean your boat and trailer before you move it from one water body to another
- Don't release live bait or bilge water into an aquatic habitat unless it came from that water body in the first place

**Wanted dead, not alive
INVADING SPECIES**

*Northern Snakehead, *Channa argus**



Albion Fisheries

- Don't release unwanted pets or water plants into the wild
- If you catch an invasive fish species, don't release it back into the water

EARLY DETECTION

The early detection of new species is one of the best options for landowners because, in most cases, it is impossible to eradicate or even control some species once they are firmly established.

- Learn about invasive species – you don't need to be an expert, but a basic understanding of the issue is the first step toward the early identification of a problem
- Learn to identify problem signs on your property
 - New species that you have never seen before
 - Single species taking over large areas
 - Sudden changes in forest health that can't easily be explained
- Pay attention to news stories on invasive species in your area – they can give you a heads-up on what's coming
- Talk with your neighbours – find out if they are concerned about anything new or different on their property
- Monitor your property regularly – become familiar with what you have now and watch for changes

RAPID RESPONSE

If you do find anything new, or identify an existing problem that can be fixed with corrective action, then it is by far in your best interest to do something right away. Find out what is recommended for the species and act. It is at this point in time that the cost and effort of controlling invasive species is the lowest.



Finding dog-strangling vine and other invasive plants early is critical – once well established, invasive species can be very difficult to remove from your property.

MANAGEMENT

Managing existing invasive species problems is the most difficult and costly option for landowners. Once they are established eradication is seldom possible, and all you can do is work toward a reduction in impacts. There are usually no easy solutions to an invasive species problem – any form of control requires hard work, careful planning and a dedication to the cause. Many landowners may start management activities only to give up or stop well before they have effectively reduced the threat.



Managing to promote good forest health is always recommended. A healthy forest may be more resilient to the stress caused by invasive species.

Many herald biological control, fighting one species with another, as the hope of the future of invasive species management. While bio-control does hold some promise and will no doubt be the subject of much effort and research in the future, biological control methods will probably not eliminate invasive species from your property. However, they may help reduce populations and, consequently, impacts.



There have been many spectacular failures around the world where new introductions have ended up causing more problems than solving.

In addition, successful biological control usually does not mean eradicating a particular problem species - the species is still present, just in fewer numbers.

The decision tree figure (page 27) presents a decision support key for determining when action against invasive species should be taken. Basically, if a species can influence your long-term plans, you may want to consider management actions that can reduce overall impacts. Your management approach will be influenced by:

- The invading species
 - You will need to research control and management options
 - What is involved and what are the chances you will be successful?
 - Can the species be controlled or managed in the first place?
 - How much time is needed before good results can be expected?
- The level of infestation
 - Is the infestation confined to a small area, or is it distributed throughout the property?
 - Do you have one acre to protect or one hundred?
 - Is the species common in the surrounding area?
- Your management objective
 - Do the costs outweigh the benefits?
 - What will happen if you do nothing?
 - Do you have the time, the technical know-how, and the financial resources?

CONTROLLING INVASIVE SPECIES ON YOUR PROPERTY

Pre Coated Sticky Tree Bands



There are a variety of commercially-available as well as homemade barriers that trap or prevent caterpillar movement up and down a tree. While these barriers may help reduce the total amount of defoliation, they require regular cleaning and are obviously better suited to individual trees rather than forested situations. It is also important to install them properly – petroleum based products spread directly on the bark can kill a tree.

Hand pulling of invasive plants can work if the infestation is small enough, and the plant is one that is receptive to control through mechanical means. If the plant is well established on the property, however, or if there is already a significant bank of available seeds in the soil, hand pulling will seldom work.



Mechanical levers can be used to pry invasive shrubs like buckthorn from the soil.

Although many landowners are concerned about potential negative implications of using pesticides, they represent one of the best and, sometimes the only, effective control option for many invasive species problems.



MANAGING YOUR FOREST IN THE PRESENCE OF INVASIVE SPECIES

Controlling invasive species on your property is one option you have as a landowner. By directly reducing their numbers you may be able to still achieve your long-term plans. A second option you have is to adjust your existing management practices in an attempt to reduce the overall impact – what can you do to your property to protect it from invasive species impacts? Here are some general concepts that may be of help to you:

1) Seek the advice of knowledgeable and impartial experts

- If you agree with their recommendations and they are a good fit with your current situation, adjust your management activities.
- Maintain an up-to-date forest inventory – knowing what you have and how much of it you have (including its quality) will help you make decisions on what types of management actions are warranted.

2) Always work to maintain a healthy and diverse forest – it is unlikely that one invasive species will come along and wipe out all your trees if you have a variety of species, and age classes, and if your forest is healthy to begin with

- If you are not already doing so, include managing to improve forest health as one of your main objectives.
- Conduct harvests carefully – a damaged forest or site is more susceptible to other stresses.



Regardless of the invasive threat, over-harvesting is seldom recommended. Removing too many trees at any one time can cause significant problems for the remaining trees – increased logging damage and wind throw can be even more problematic than the damage caused by the invasive pest.

3) Consider the impact of invasive forest pests that are not presently in your area – species that aren't in your area now may impact you in the future.

- Is it possible, or even recommended, to accelerate the harvest of one particular species over another (again, foresters and other experts can help you here – use them)?

- What do you need to do now to reduce impact on your forest, and your pocketbook in the future?
 - Carefully evaluate all options and make informed decisions – get the facts, avoid the hype, and take your time.
- 4) **Can you process and use your own forest products – lumber, firewood, maple syrup?**
- Increasing the amount of material you use from your property may lessen your dependence on buying and selling forest products.
 - Seek out local markets for your products.

Emerald Ash Borer – Do you need to act?



The emerald ash borer (EAB) is an invasive tree-boring pest native to parts of Asia. Unfortunately for us, it is well suited to Ontario's climate, and to the ash-laden cities

and forests of southern Ontario. The EAB is a very serious pest of ash trees and many parts of southern Ontario have already experienced significant tree mortality.

The emerald ash borer was found in Ottawa in July 2008.

Here are some general facts you should be aware of:

- The EAB will kill an ash tree in a very short amount of time – sometimes in as little as two summers for larger trees, one summer for smaller ones
- Trees tend to decline rapidly – if you have declining ash trees, check them out
- The bug itself is difficult to detect – the adults are small and the larvae are found below the bark
- The EAB spreads slowly on its own – probably all of the 'hot spots' found outside the main area of infestation are from firewood movement
- It is highly unlikely that this insect will be stopped – eradication is impossible and the EAB will eventually spread throughout the region
- We really don't know what the long-term impact of this pest will be on the forests of North America – it has only been here for a relatively short amount of time



- There is a lot of EAB information on the web – look it up

If you are a landowner, you may be wondering what impact this pest will have on you. That depends on a number of things including:

- Your long-term goals for your property – what benefits do you want to extract from it?
- The amount of ash growing in your forests, yards and fencerows – each property will be different
- When the EAB first becomes established on your property, or when regulations restricting the use of movement of ash material are implemented for your area – is it already there or is it several years away?

Woodlot Management Recommendations

Probably the best advice for Ontario's woodlot owners is to seek professional advice – this will be money well spent even if you are not planning on harvesting trees. At a minimum you want to determine the following before you change your management activities:

- 1) How much ash do you have on your property, what is the average diameter, what is the estimated value?
- 2) How will an EAB infestation alter your existing plans? Can you sell your timber, will you be able to move it off your property, will ash mortality change the future recommended management actions for your woodlot?
- 3) What will the impact of losing the ash component of your forest be on the rest of the woodlot? There will be a huge difference for stands that have only a 10% ash component compared to a forest that is made up of 50% ash.
- 4) What options do you have? What happens if you take no actions or should you accelerate or favour the harvest of ash trees?

Losing ash trees in your woodlot to the EAB is like harvesting trees except you don't get to pick the trees. Foresters make harvesting recommendations based on stand stocking levels – only overstocked stands should be harvested. The EAB will kill trees, lowering the overall stocking of the stand. This will alter when, and how much, harvesting is recommended for your woodlot even if your main target species is something other than ash.

Planting Recommendations

Whether it is in an urban or rural setting, planting ash should probably be avoided. Pick another species that is suited for the site and your long-term plans. It is unlikely that EAB will eliminate ash entirely – nature will eventually adjust, just give her a few hundred years.

Urban Tree Care Recommendations

Unfortunately, ash trees are one of the few native tree species that can thrive in an urban environment. If you own a property in a city or town near an area where EAB has been found it is unlikely that your trees will be missed by this bug and you will probably eventually be forced to remove them. Not all is lost, however; there is a new injectable product on the market that can offer some protection from the pest.

Burning Ash

Ash makes for great firewood – it dries quickly and is easy to split. If you can burn your own EAB-killed ash trees then it is not a total loss because, after all, you may have a lot of it. Check with the CFIA (www.inspection.gc.ca) to see if there are any restrictions on moving ash material off your property – if so, don't move it because you may be contributing to the spread of EAB and you could be subject to a hefty fine.



KEY POINTS FOR LANDOWNERS:

- Invasive species are here to stay – this issue will always have the potential of impacting your property
- Have clearly defined property management goals – what do you want to do now, what benefits do you want to realize in the future?
- Do your research – investigate if your plans could be affected, how extensive the impacts could be, and what options you have to reduce them

It is important to pick your battles:

- Invasive species are much harder to control once they are well established – detecting them before they become a problem is critical
- Plants are generally easier to control than insects
- It is much easier to manage them before they spread throughout your property
- Not all species can be controlled – find out how much work it will be and how much money you will need to invest to achieve your long-term plans
- If you choose to act, carefully evaluate your management options

Will it be effective?

- How much work is involved?
- Do you need any special certification or training?
- Evaluate your results
 - If effective, continue to monitor and reapply efforts as needed
 - If ineffective, revise your approach or your plans
- Manage your property well to begin with
 - Minimize disturbance
 - Maintain a healthy and diverse forest
 - Have a management plan
 - Be aware of what is happening on your property
 - Don't overreact to a potential invasive species problem – over-harvesting may do more harm than good

CASE STUDY 1: Bovine Spongiform Encephalopathy (BSE) or Mad Cow Disease



Origins

Found in Europe throughout the 1980s and 1990s, the disease was believed to have originated by feeding animals slaughter by-products such as sheep brains and spinal cord tissue as a cheap source of protein for cattle. The first case in Canada was in Alberta in 2003. Since then 11 additional cases have been found.

The Organism

BSE is caused by a prion-type protein which overtakes an animal's nervous system leading to death. Animals are primarily infected through eating contaminated feed. A related disease, Creutzfeldt-Jakobs disease, can be contracted by humans who consume infected beef.

Status in Canada

Non-native. Currently found sporadically in British Columbia and the Prairie Provinces.

Impact

The discovery of the disease in Canada resulted in drastically reduced cattle prices and export restrictions were imposed by the United States and other countries. Cattle prices have still not recovered (as of the spring of 2008).

CONTROL MECHANISMS

Enhanced Feed Ban

Ruminant brain tissues are no longer permitted for use as a feed supplement in Canada.

Specified Risk Material

Specified risk materials are those beef products which, in infected animals, would contain prion material. These include skull and brain tissues in animals over 30 months of age. These tissues are removed and destroyed as a precautionary measure.

Cattle Screening

Ongoing since 1992, cattle screening first identified the BSE disease in 2003. Since then 30,000 cattle have been tested annually with almost all testing negative. Animals which do test positive never reach the food chain for human consumption. High risk animals including older animals and those that appear sick are targeted in testing.

LANDOWNER CONTROL OPPORTUNITIES

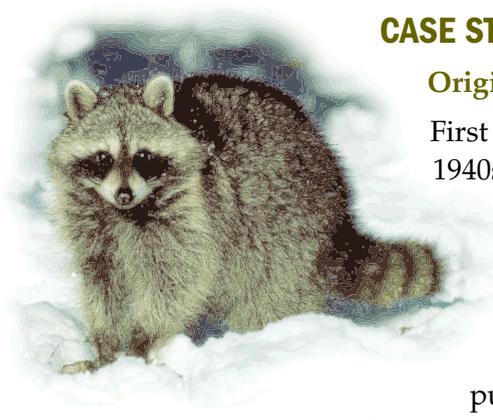
Landowner control options include participating with veterinarians, slaughterhouses and government officials to remove potentially infected animals from the food chain. Age verification of cattle also enhances sales opportunities.

Battles Won

The screening process in Canada has proven effective. Canada is finding and removing BSE-infected animals from the food chain.

Battles Lost

Losing the BSE-free status was devastating to the Canadian cattle industry.



CASE STUDY 2: Raccoon Rabies

Origins

First discovered in Florida in the 1940s, raccoon rabies slowly spread northward. The spread of the disease accelerated rapidly when infected raccoons were brought into Virginia in the 1960s for sporting purposes. The disease has

spread progressively northward, crossing the New York State-Ontario border in 1999. Since then there have been 126 confirmed raccoon rabies cases in eastern Ontario.

The Organism

Rabies is a virus which infects the nervous system of mammals, almost invariably leading to death. The virus is spread through contact with infected saliva or blood, typically through animal bites.

Status in Canada

Non-native invasive

Impact

Large impact on native wildlife with hundreds/thousands of raccoons, skunks, foxes and coyotes dying in the northeastern United States. Also a large public health cost from post-exposure treatment and vaccinations. Also a threat to livestock.

CONTROL MECHANISMS

The Ontario government implemented three control strategies to stop the spread of the disease throughout the province:

1) Aerial Baiting

Baits which contained a rabies vaccine pack were distributed throughout the control area. This is the most cost effective method of control but results in a relatively low proportion of animals being effectively vaccinated (10-25%).



2) Point Infection Control

When a case of raccoon rabies was confirmed in an area, all non-vaccinated raccoons, skunks, coyotes and foxes were euthanized within a five-kilometre radius to eliminate potentially infected animals which had come into contact with the rabid animal. An additional five-kilometre radius was treated with TVR (see 3).



3) Trap-Vaccinate-Release (TVR)

Most raccoons, skunks, coyotes, and foxes in these areas were live-trapped, vaccinated against rabies, and released. Although a costly and time consuming technique, it results in a very high proportion of animals being effectively vaccinated (60-100%).

LANDOWNER CONTROL OPPORTUNITIES



Participating with government agencies in their control operations, and eliminating potential contact with suspect animals on your property.

Battles Won

Raccoon rabies has not spread outside of the United Counties of Leeds and Grenville, or Wolfe Island. Limited treatment of the public for post-exposure. No new cases since the summer of 2006.

Battles Lost

Together, 126 cases in Leeds and Grenville and on Wolfe Island.



CASE STUDY 3: White Pine Blister Rust

Origins

Native to central Siberia. Infected transplants were taken to Europe and later to North America in the late 1800s. By 1914 infected stock had been transplanted throughout most of the natural range for white pine.

The Organism

A fungal disease which infects both white pine and Ribes plants.

The disease cycle works as follows: During moist weather in early fall, spores are produced on Ribes plants which subsequently infect pine needles. The rust fungus slowly grows in the pine needles and blisters eventually burst on pine branches two to three years after infection and re-infect Ribes plants. The fungus travels throughout the pine tree, eventually killing it.



Impact

Hundreds/thousands of white pine are killed annually by the disease.

CONTROL MECHANISMS

Several control options have proven successful in the past:

1. Infected branches can be pruned from the tree before the disease can spread.
2. Ribes can be removed or destroyed, breaking the infection cycle.
3. Plantations can be base-pruned to eliminate damp, moist conditions under which the fungus can thrive.
4. Timely thinnings also reduce the moist conditions in which the fungus thrives.

Battles Won

With proper control mechanisms in place white pine plantations can be managed successfully with minimal mortality.

Battles Lost

Thousands of white pine still die annually.

CASE STUDY 4: Agricultural Weeds

Origins

Many agricultural weeds were native to Europe and were brought to North America on soil ballast used on ships. Weed seeds spread rapidly throughout North America through natural dispersal mechanisms and in crop seed planted elsewhere. Other weeds were intentionally brought to North America as ornamentals or for other purposes.

The Organism

Non-native weeds come from all over the world.



Canada thistle

Examples of non-native agricultural weeds include:

Broad-leaved plantain	Flixweed
Wild carrot	Quackgrass
Knapweed	White cockle
Stinkweed	Wild oats
Teasel	Mullein
Canada thistle	White sweet clover
Sulfur cinquefoil	

Impact

In agricultural operations they can reduce crop yield and increase costs.

CONTROL MECHANISMS

Almost all agricultural weeds can be controlled through traditional herbicide or cultivation techniques.

The Ontario Ministry of Agriculture, Food and Rural Affairs offers good information on agricultural weeds and associated control options. See www.omafra.gov.on.ca.

Battles Won

Agricultural crops are grown successfully throughout Canada despite these weed pressures.

Battles Lost

Control is a costly business and some yield losses can still be expected annually.

CASE STUDY 5: Zebra Mussel



Origins

Originally native to the Caspian Sea it was brought to the Great Lakes in ballast water.

The Organism

A small, highly prolific mussel; each female produces over a million eggs per year. When young it is a planktonic stage the size of a human hair and it is easily dispersed by water currents.

Impact

Massive numbers of mussels have clogged municipal and industrial water intake pipes. They are filter feeders and have greatly increased water clarity by removing plankton and algae. This plankton and algae was a valuable part of the food chain: with its removal, populations of some larval fish and other invertebrates have begun to decline. Zebra mussels are fed on by a number of native fish and waterfowl and their numbers have reached a plateau in recent years.

CONTROL MECHANISMS

Impossible to control once established; most control efforts have been limited to reducing the spread to new water bodies by means of boat washing, draining live wells, eliminating the dumping of bait, etc.

Battles Won

Very few.

Battles Lost

Zebra mussels have spread to over 100 lakes in eastern North America.

CASE STUDY 6: Urban Invasives – Norway Maple

Origins

Widely planted as a shade tree in urban areas, it is native to Europe and western Asia.

The Organism

A large ornate tree, it is well suited to the urban environment.

Impact

Very shade tolerant and a prolific seed producer, Norway maple can form a monoculture understory in native forest stands. This reduces biodiversity and eliminates some food sources for wildlife. In extreme cases, as in steep ravines, soil erosion can also become a problem as native plant cover is reduced, limiting its ability to retain soil.

CONTROL MECHANISMS

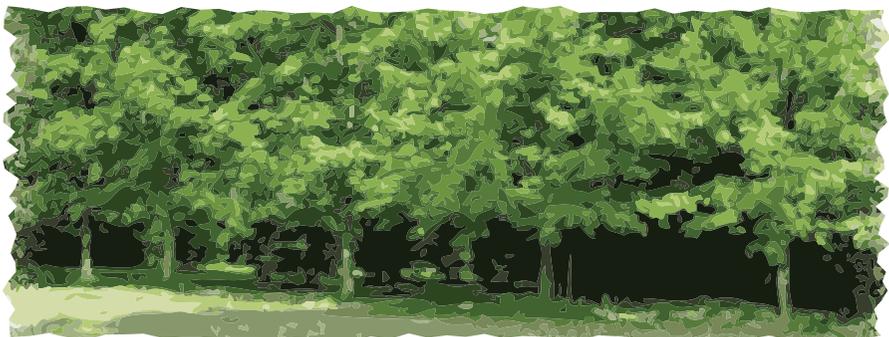
Don't plant Norway maple. Existing stands can be controlled by pulling, cutting or through the use of herbicide.

Battles Won

Many municipalities are switching to native shade tree species such as red maple or beech.

Battles Lost

Many urban areas are overrun with Norway maple regeneration. As it is a beautiful shade tree, it is likely to continue producing seed in these areas for many years to come.



Appendix A: Additional Sources of Invasive Species Information

Eastern Ontario Model Forest (EOMF)

- www.eomf.on.ca
- Hosts workshops on invasive species
- Produced this manual

Ontario Woodlot Association (OWA)

- www.ont-woodlot-assoc.org
- Publishes a newsletter on a variety of woodlot topics including invasive species

Environment Canada (EC)

- www.ec.gc.ca/eee-ias
- Tasked with leadership and coordination of the national strategy on invasive species
- Manages the Invasive Alien Species Partnership Program, a funding program for projects that reduce invasive species impacts

Canadian Food Inspection Agency (CFIA)

- www.inspection.gc.ca
- General information on some species
- Specific information on regulated pest species

Natural Resources Canada (NRCan) (Canadian Forest Service - CFS)

- www.nrcan.gc.ca
- www.cfs.nrcan.gc.ca
- Information on forest related insects and diseases
- NRCan maintains a forest invasive species webpage www.exoticpests.gc.ca

Ontario Ministry of the Environment (MOE)

- www.ene.gov.on.ca
- Information on pesticides and pesticide legislation

Ontario Ministry of Natural Resources (MNR)

- www.mnr.gov.on.ca (search on invasive species)
- Tasked with the management of Ontario's natural resources – forests, water, wildlife

Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA)

- www.omafra.gov.on.ca (search on invasive species)
- Good information on plant species

Ontario Federation of Anglers and Hunters (OFAH)

- www.invadingspecies.com
- Good information on aquatic species

Hinterland Who's Who

- www.hww.ca
- General information on invasive species

Ontario Invasive Plants Council

- www.stewardshipcentre.on.ca (search on invasive species council)
- Newly formed, look to this group for additional information in the future

Appendix B: Invasive Species in Southern and Eastern Ontario

The following is a list of invasive species that are relatively common, or of special concern, in southern and/or eastern Ontario. It is by no means complete, and may contain many species not currently present on your property or even in your area. Species are listed by type: insects, plants, and diseases. Some common aquatic species are also provided for your information.

Insect Species

Forest Pests

- Asian long-horned beetle
- European gypsy moth
- European wood wasp
- Emerald ash borer
- Hemlock woolly adelgid
- Larch casebearer
- Pale tussock moth
- European oak leafroller
- Two spotted oak borer
- European spruce bark beetle
- Common pine shoot beetle

Urban and Social Pests

- European hornet
- European yellow-jacket
- Common yellow-jacket
- European earwig
- European chaffer beetle
- Black-footed spider (arachnid)

Plant Species

- Purple loosestrife
- Dog-strangling vine
- Garlic mustard
- Giant hogweed
- Yellow sweet clover
- Japanese knotweed
- Leafy spurge
- Canada thistle
- Smooth brome grass
- Reed canary grass
- Spotted knapweed

Tree and Shrub Species

- Norway maple
- Scots pine
- Common buckthorn
- Glossy buckthorn
- Tartarian honeysuckle
- Lilac
- Russian olive

Plant Disease Species

- White pine blister rust
- Butternut canker
- Chestnut blight
- Dutch elm disease
- Sudden oak death
- Oak wilt
- Plum pox virus

Aquatic Species

Rusty crayfish

Eurasian water milfoil

Fish hook water flea

European frog-bit

Rudd

Ruffe

Sea lamprey

Round goby

Viral Hemorrhagic Septicemia (VHS)

Zebra mussel

Quagga mussel

Fanwort

Yellow perch parasite

Animal and Human Disease Pathogens

West Nile Virus (human)

Raccoon rabies (human/animal)

Foot and Mouth Disease (animal)

Bovine Spongiform Encephalopathy (BSE) (animal/human)

Appendix C: Responsibility for Invasive Species in Canada

Invasive species are considered by the three levels of government (federal, provincial, and municipal) to be a ‘horizontal issue,’ meaning that the responsibility for reducing impacts, and preventing new introductions stretches across a wide number of governmental departments, agencies and sectors. Generally, the various governments are tasked with developing policies, programs and legislation that address the four priorities laid out in *An Invasive Alien Species Strategy for Canada* (www.ec.gc.ca/eee-ias/).

Prevention – stopping new species from coming to Canada or existing invasive species from being spread within the country

- Trade and movement of goods can be restricted
- Primarily a federal government responsibility
- Best and least expensive way of reducing impacts

Early Detection – finding newly introduced species early, before they are well established and out of control

- Provincial and federal responsibility
- Finding new species early is usually the only time when eradication is possible

Rapid Response – controlling or eradicating newly found species

- Level of response dependent on potential impacts and chance of success
- Very expensive
- Under legislation governments and municipalities have considerable power to control invasive species on your property

Management – reducing impacts of species that are well established and cannot be eradicated

- Primarily a landowner’s responsibility – very few programs exist to help landowners offset impacts and reduce management costs

For the most part, how governments deal with invasive species is a function of:

1. How long a particular species has been here – newly introduced species tend to be the focus of more activity than well established species
2. The threat they pose to our economy, environment and society – species like forest pests have historically been the focus of control programs

Landowner Implications

It is possible that you may be affected by legislation designed to control or manage invasive species – the *Plant Protection Act*, municipal weed control bylaws, as well as other legislative pieces provide the government with broad and sweeping powers to deal with some species types.

- Check with your municipality to see what you need to do.
- Check the Canadian Food Inspection Agency website (www.inspection.gc.ca) to find out more about regulated species in and near your area.
- Check with local environmental interest groups to see if management programs are available.
- Be proactive in your management – determine what species can impact you and develop contingency plans for them.

