Invasive Species

Introduction

Module 1

What are Invasives?

- Species extending beyond their natural range
- Tend to have a combination of negative impacts
  - economic
  - ecological
  - social impacts

Definitions

- Invasives
  - implies exotic and a threat to native species
- Exotics
  - from another part of the world
- Introduced Species
  - implies introduction but not a threat
- Alien Species
  - Implies introduction to a particular ecosystem

Definitions - **Noxious vs. Invasive**

- Primarily talking about plants
- Not all Invasive plants are noxious
- Noxious plants are weeds that are unwanted in a particular area at a particular time
- Noxious plants usually threaten agriculture

Definitions - **Noxious vs. Invasive**

Common Milkweed

Noxious but not invasive

Definitions - **Noxious vs. Invasive**

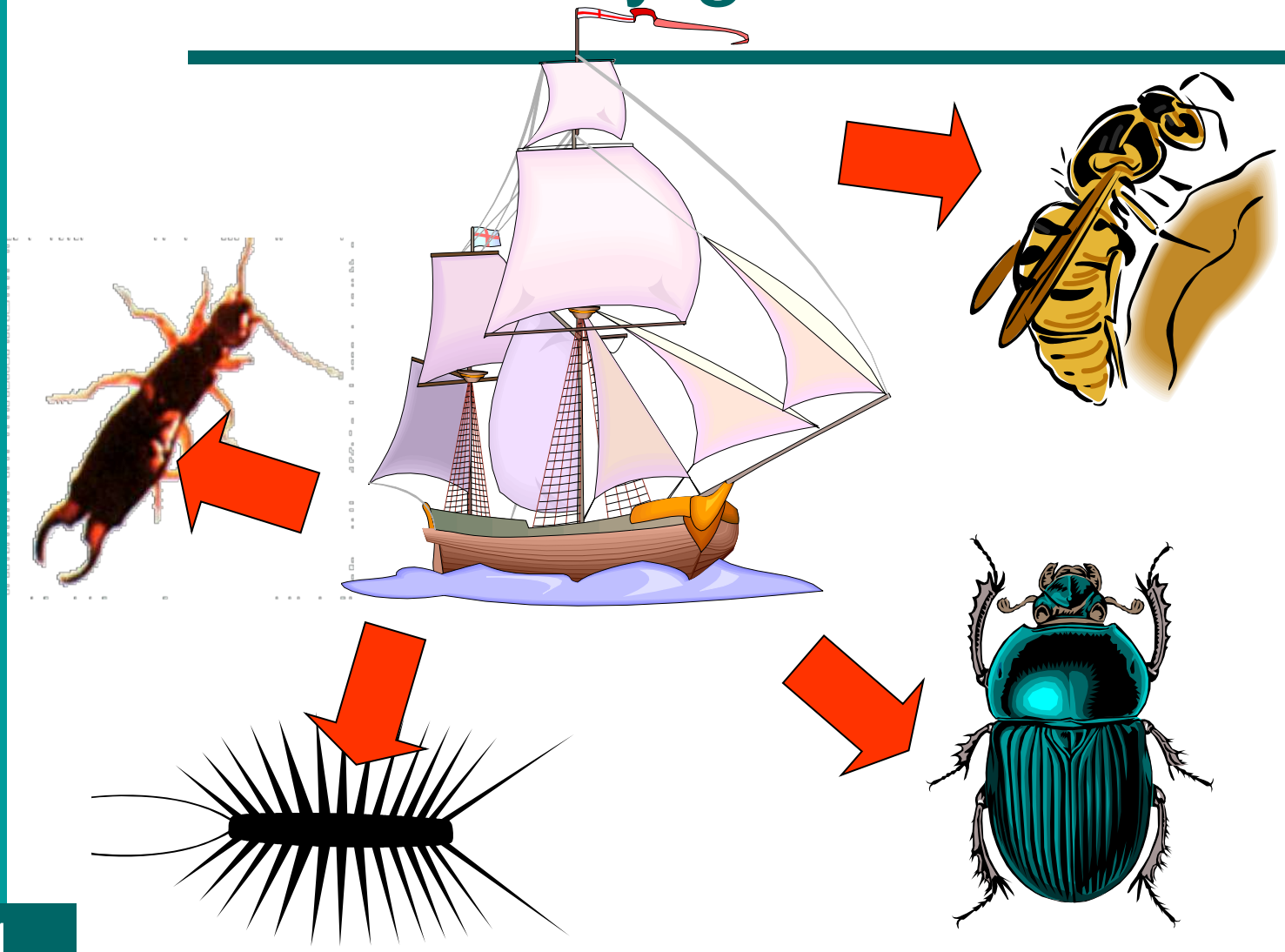
Common Buckthorn

Noxious and invasive

How do they get here?

- Accidentally Released
- Deliberately Released

How do they get here?



Impacts of invasive species

- Direct costs in lives (diseases), crop losses
- Costs of interdiction and control programs
- Costs in terms of reduced ecosystem function/services
- Costs in terms of biodiversity loss

Economic Impacts

Billions per year from

- Lost agricultural productivity
- Lost forest productivity
- Lost recreational opportunity
- Lost commercial and recreational fishing opportunity

Ecological Impacts

Significant threat to native species and ecosystems

- Can cause species to go extinct
- Reduce the biological diversity in an area
- Can change the timing and severity of fire cycles

Social Impacts

Invasive species change the way we live…

- West Nile Virus
- Imported Red Fire Ant
- Shell Fish Poisoning
- Asian Longhorned Beetle

Should We Worry?

- Not all invasive species are pests
- Not all invasive species have negative impacts

A beneficial invasive…

Earthworms

- the common earthworm (*Lumbricus terrestris*)
  - helps maintain soil fertility and structure and is an invaluable fishing partner
- introduced to North America in ballast soil from ships

Farm Crops

- over 90% of North America's food and feed production is derived from intentionally introduced exotic species

Many exotic species are relatively harmless

- The chance of an invasive species becoming a serious pest is quite low, and depends on:
  - size of introduction
  - adaptability of the organism
  - habitat suitability
  - level of competition
  - predation
  - disease
  - other organisms in similar niches

Examples deliberately introduced species

- Ring-necked Pheasant, Hungarian partridge

Some species become problems

- Once established, exotic species can have serious negative impacts
- In North America 300 tree feeding insects native to Europe are established
- 800 of the roughly 5000 plant species are not supposed to be here

Three steps …

for a invasive species to become a problem in Canada

1) Introduction

2) Establishment

3) Spread

1. Introduction

- Exotic species arrive through:
  - natural processes, or
  - human activity

1. Introduction

Natural Processes

- Species can be blown in
- animals native to the U.S. have moved north
- Species ranges change naturally - have been moving north for 10000 years

A great egret

Introduction

Human Activity

- either accidental
  - earthworms, Sea Lamprey, Alewife
- or intentional
  - Carp, Buckthorn, Purple Loosestrife, Garlic Mustard

Asian Carp

2. Establishment

- The majority of introduced exotics do not become established.
- Establishment occurs if the organism can successfully reproduce and maintain a population.
- There may be considerable lag time between introduction and establishment

2. Establishment

2. Establishment

European Gypsy Moth

- introduced into U.S. 1869
- first population explosion 1889
- moved into Ontario 1969
- first defoliation observed in Ontario 1984

2. Establishment

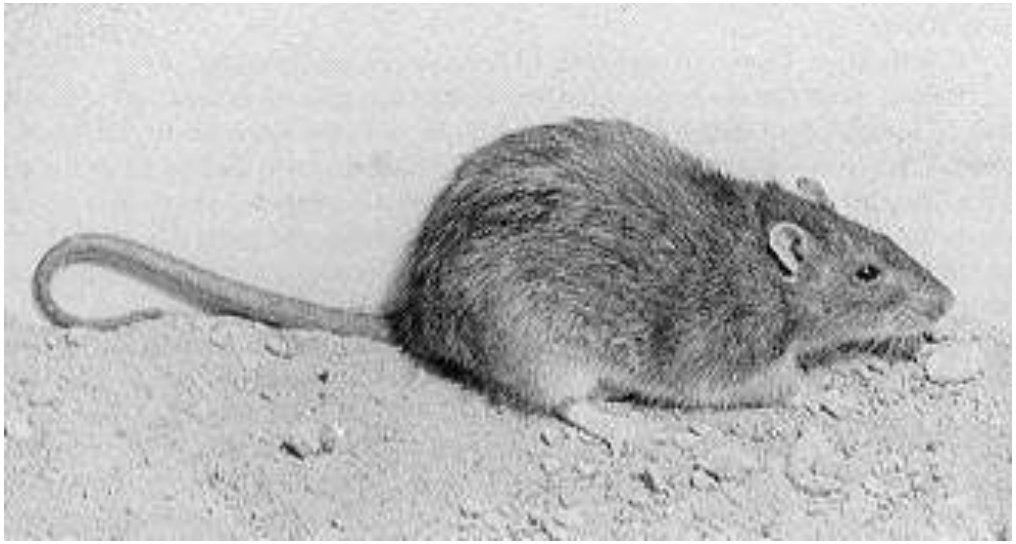
Chestnut blight

- An introduced fungus
- 50 years between introduction from China and establishment in U.S.

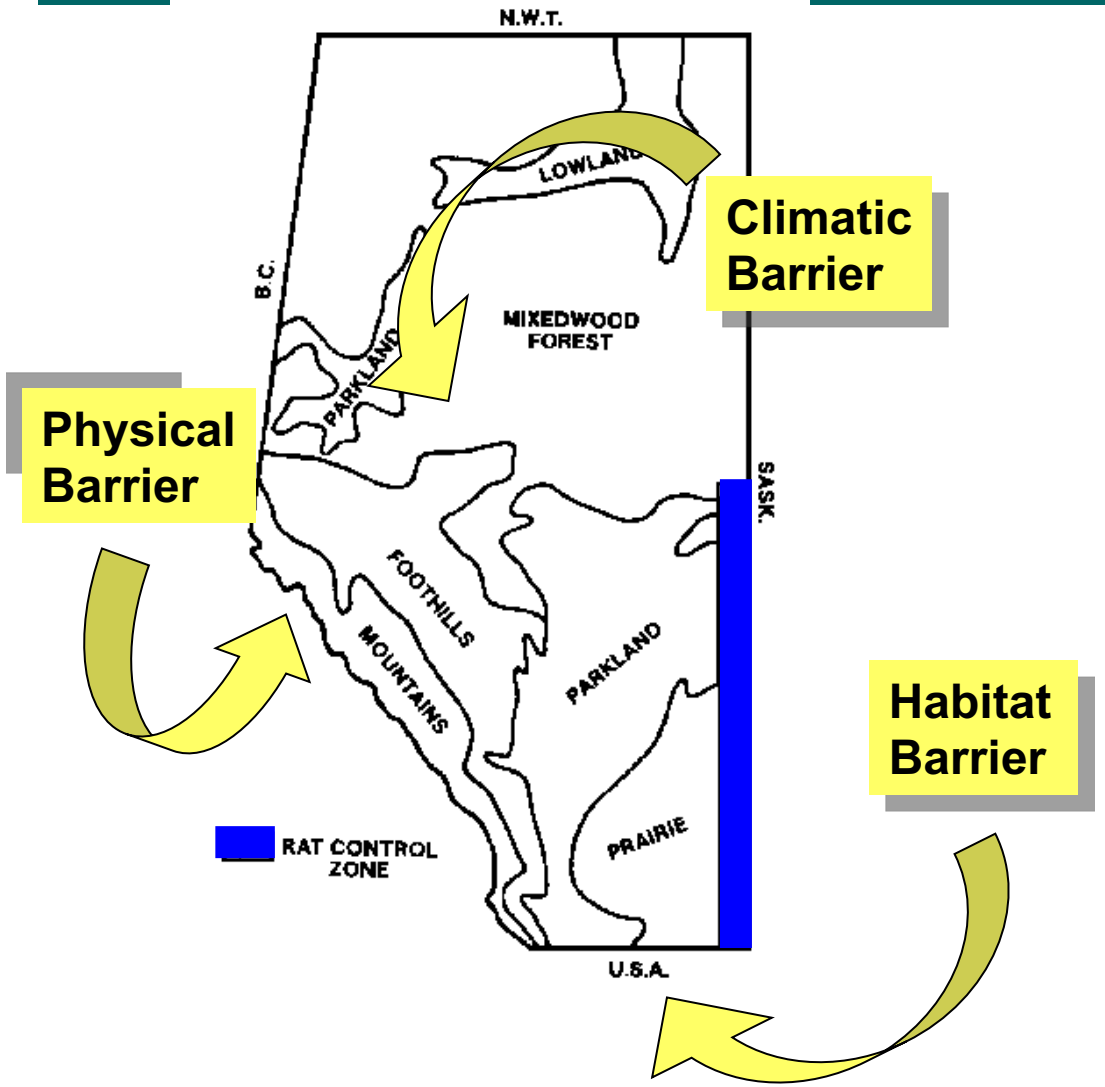
3. Spread

Once established, an exotic will spread into other suitable habitats depending on:

- tolerance to climate
- habitat needs
- physical barriers (e.g. Rocky Mountains)



3. Spread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MIXEDWOOD FOREST
PARKLAND
SASK.
FOOTHILLS
MOUNTAINS
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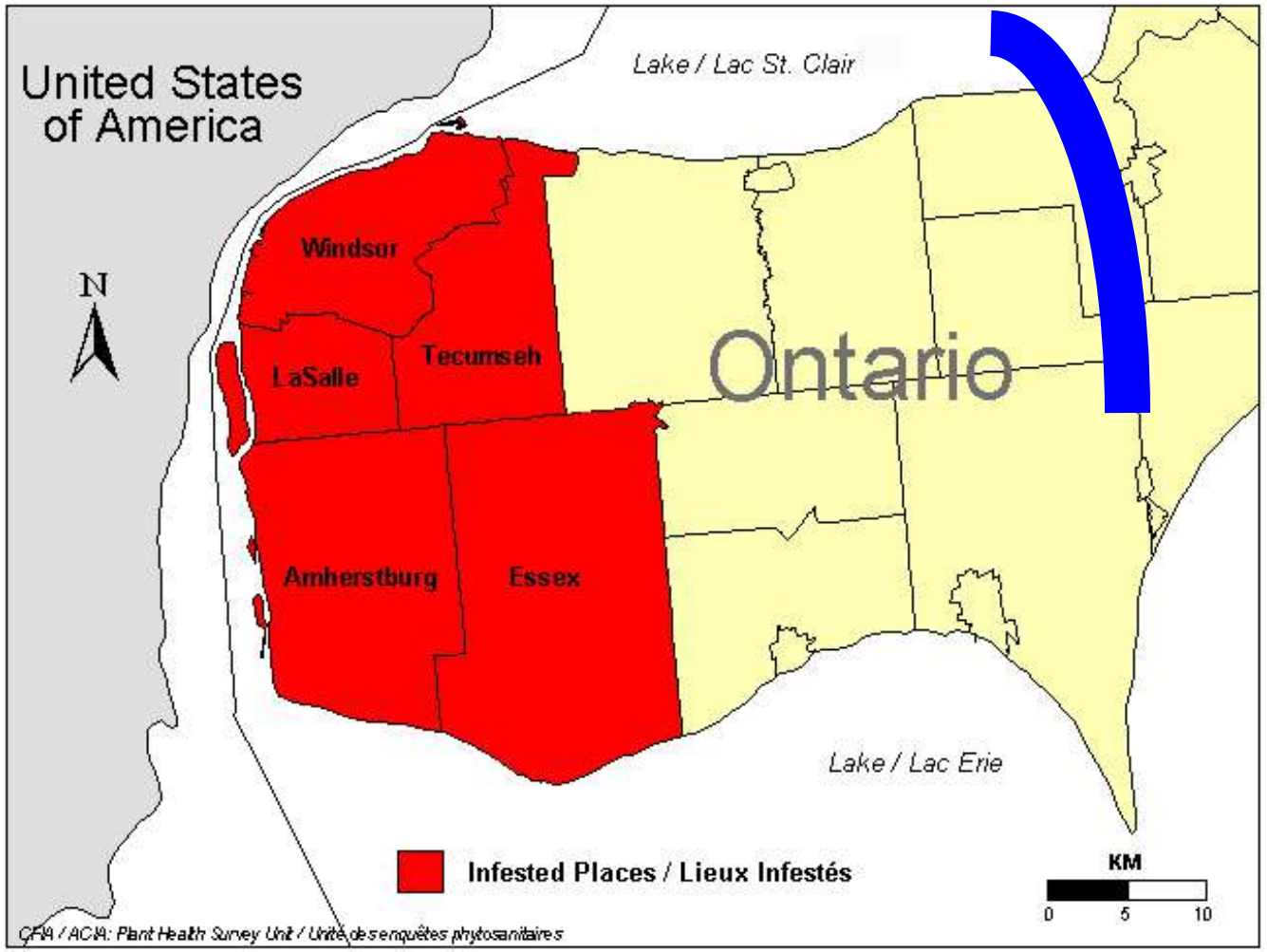
PRAIRIE
RAT CONTROL ZONE
U.S.A.
Climatic Barrier
Physical Barrier
Habitat Barrier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Module 1

What makes an invasive, invasive?

"Weedy" characteristics help exotic species become established and rapidly spread

- rapid growth under a wide range of soil and climate conditions
- rapid reproductive rates, or production of an overabundance of seeds
  - one mature Purple Loosestrife plant can produce over 2 million seeds/year

What makes an invasive, invasive?

- excellent dispersal mechanisms
  - Raccoon rabies travels in infected raccoons which may hitch rides on campers or trucks
  - Gypsy Moth egg masses are also moved on vehicles and camping equipment
  - West Nile virus can be carried hundreds of miles in infected birds

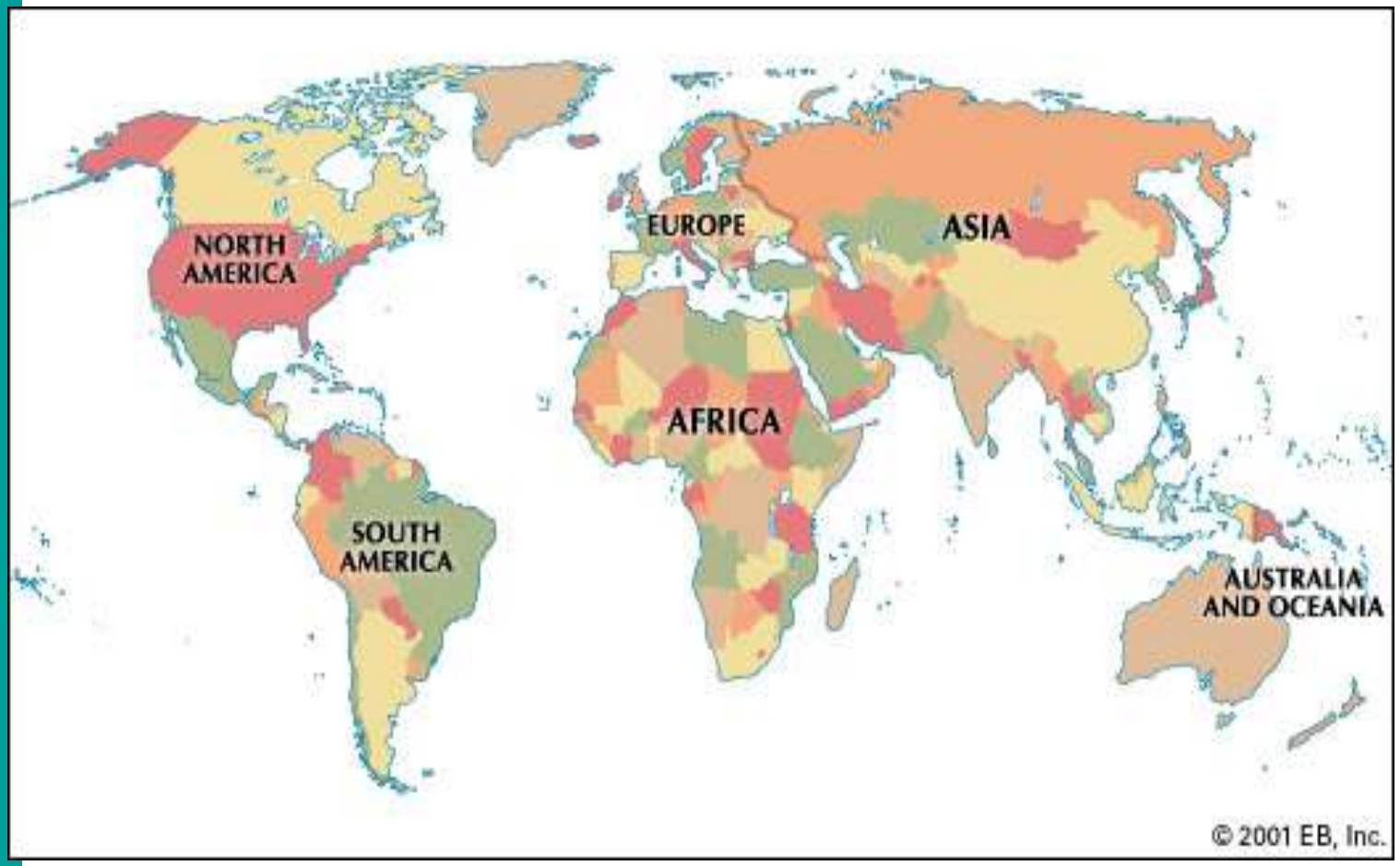
What makes an invasive, invasive?

- exotic plants may also spread vegetatively, through rhizomes or pieces of a mature plant

Invasives are Free to Grow

- exotic species also have no natural biological controls
- without these biological controls, establishment and spread is much easier

Some examples from other parts of the world



Some examples from other parts of the world

Brown Tree Snake

Some examples from other parts of the world

Some examples from other parts of the world

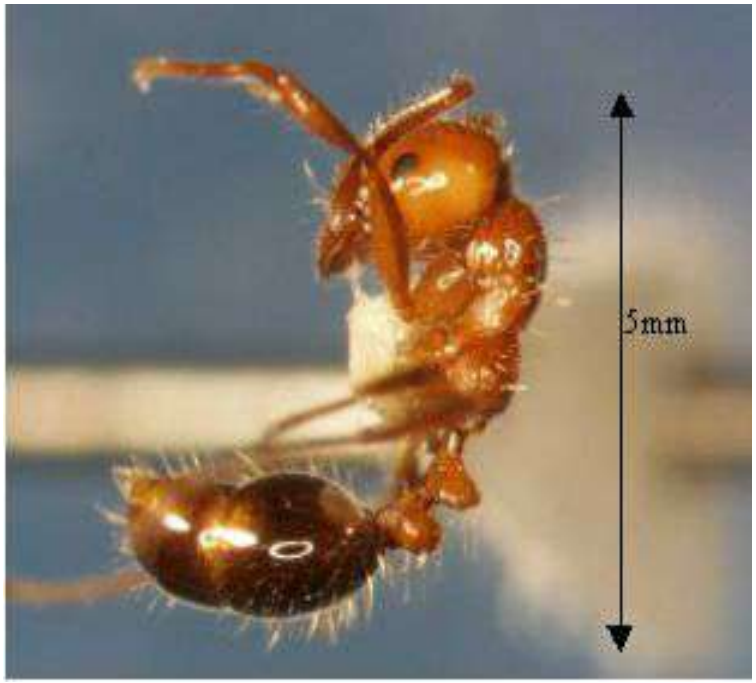
Kudzu

Some examples from other parts of the world

Cane Toad

Some examples from other parts of the world

Red Imported Fire Ant



Some examples from other parts of the world

Red Imported Fire Ant

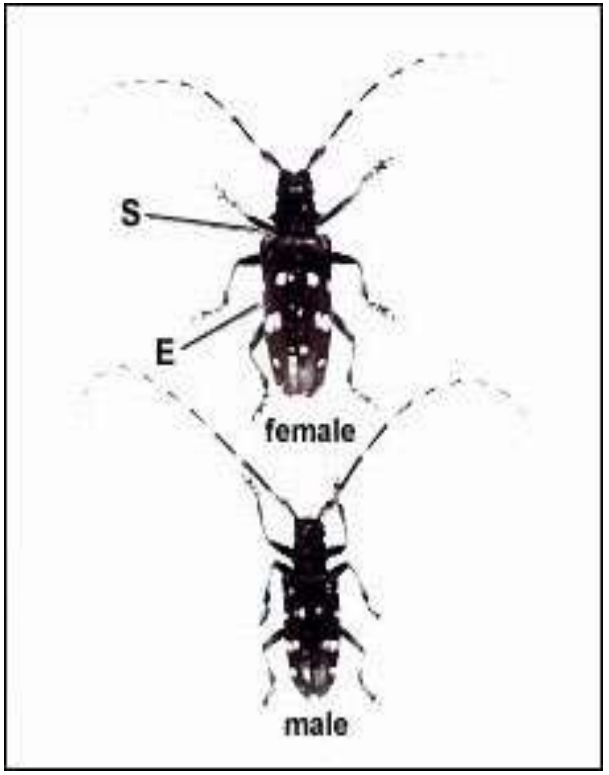
Some examples from other parts of the world

Velvet Tree

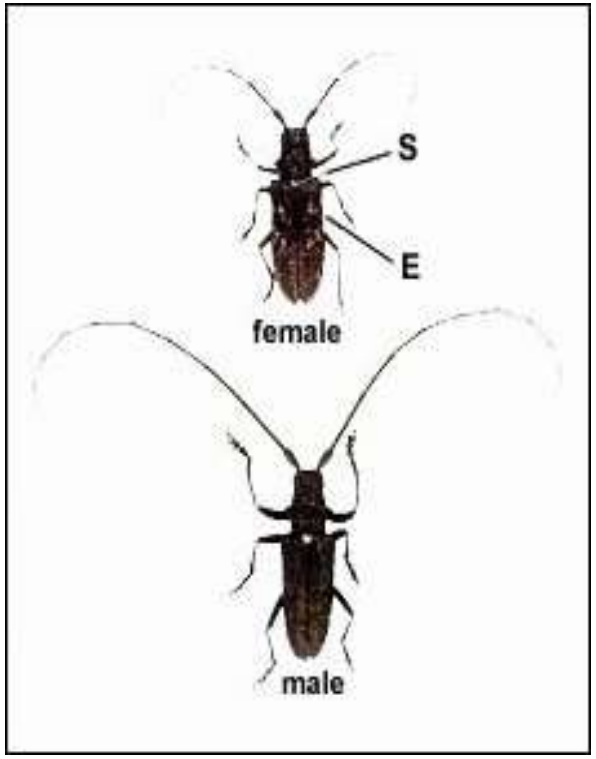
Some examples from other parts of the world

Asian Long Horned Beetle

Some examples from other parts of the world



Asian Long Horned Beetle



Whitespotted Sawyer

Some examples from other parts of the world

Feral Animals

Some examples from other parts of the world

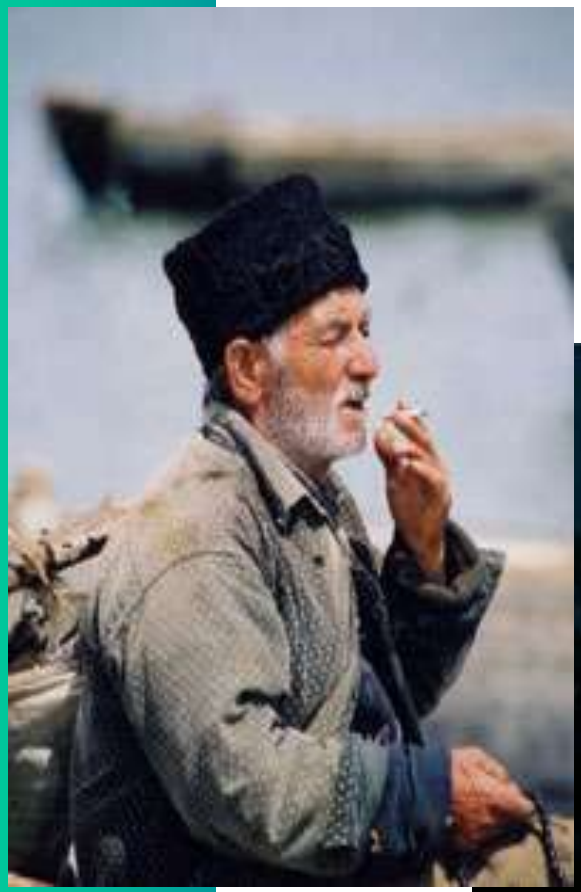
Northern Snakehead Fish

Some examples from other parts of the world

Fish Hook Water Flea

Cercopagis pengoi

Some examples from other parts of the world



Comb Jelly Fish

Some examples from other parts of the world

English Ivy

Some examples from other parts of the world

Giant Hogweed

Some examples from other parts of the world

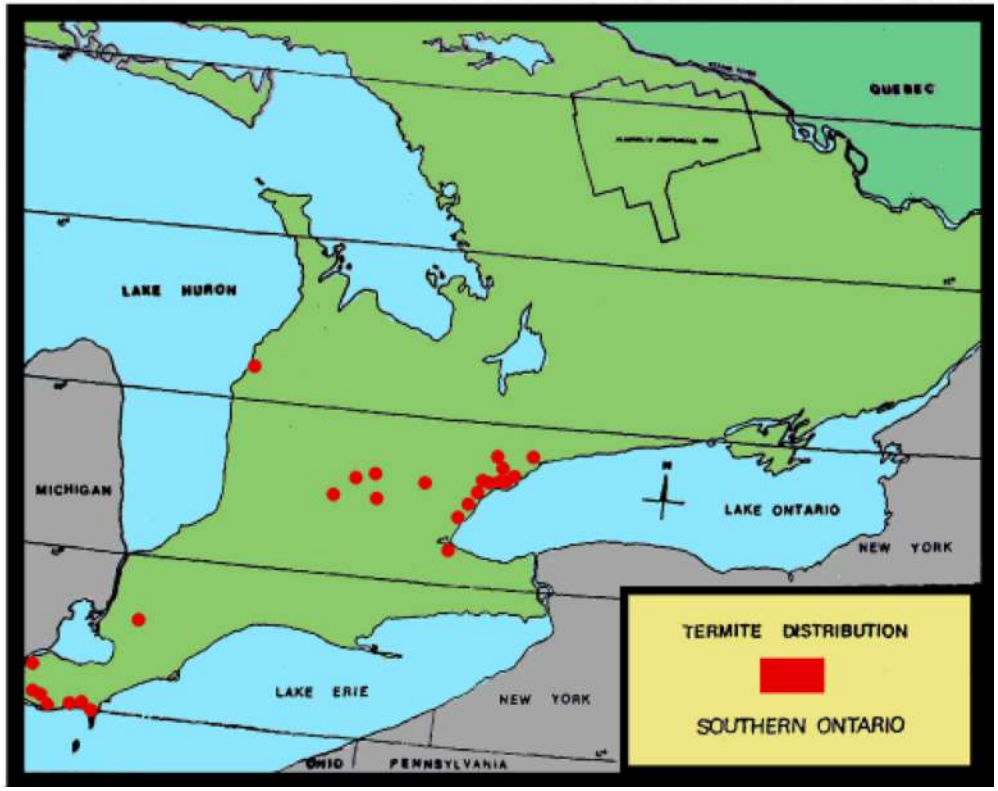
Sudden Oak Death

Some examples from other parts of the world

African Clawed Frog

Some examples from other parts of the world

Subterranean Termites



Some examples from other parts of the world

Presentation made possible by

- Ontario Forestry Association
- Eastern Ontario Model Forest
- Human Resources Development Canada
- Ontario Ministry of Natural Resources
  - Ontario Stewardship Program

- With contributions from:
  - City of Ottawa
  - Purdue University

Invasive Species

Terrestrial Plants

Module 2

Terrestrial plants - background

- Every plant has a native range
- Native to N. America means here before European settlement
- Non-native species have come from all over the world

Terrestrial plants - background

- Exotic plants are always exotic
- Most invasive plants were planted
- New introductions are still happening
- Many invasives have become naturalized

Terrestrial plants - Background

- Invasive plants can easily colonize their new environment
- Free of natural controls – herbivores, parasites and disease
- Exhibit such features as:
  - Strong vegetative growth
  - Abundant seed production
  - Rapid maturation

Terrestrial plants - Background

- Not all non-native plants are harmful
- Most of our agricultural crops are exotics which pose no threat to our environment

Impacts

Invasive alien plants:

- compete with/replace rare and endangered species
- encroach upon limited habitat of rare and endangered species
- reduce or eliminate localized or specialized native plant communities, such as spring ephemeral plant communities
- disrupt insect-plant associations necessary for seed dispersal of native plants

Impacts

Invasive alien plants:

- disrupt native plant-pollinator relationships
- reduce and eliminate host plants for native insects and other wildlife
- hybridize with native plant species, altering their genetic makeup
- serve as host reservoirs for plant pathogens and other organisms that can infect and damage desirable native and ornamental plants;

Impacts

Alien Invasive Impacts

- replace nutritious native plant foods with lower quality sources
- kill trees and shrubs through girdling
- increase the incidence of plant disease and stress in forested areas
- prevent seedling establishment of native trees and shrubs
- reduce vigor of mature trees through shading

Impacts

Invasive alien plants:

- reduce the amount of space, water, sunlight and nutrients that would be available to native species
- increase erosion along stream banks, shorelines and roadsides
- change characteristics of the soil structure and chemistry
- alter hydrological flows and conditions

Controlling Invasive Plants

- May be impossible to eradicate invasive plants that have become established
- Can prevent future establishment
- Control is the only real option:
  - Chemical
  - Mechanical
  - Biological

Controlling Invasive Plants

Mechanical Controls

Chemical Controls

Species List

- Amur Maple
- Black Locust
- Common Buckthorn
- Common Reed
- Dame's Rocket
- Dog Strangling Vine
- Flowering Rush
- Garlic Mustard
- Glossy Buckthorn
- Japanese Knotweed
- Manitoba Maple
- Norway Maple
- Purple Loosestrife
- Scots Pine
- Smooth Brome Grass
- Wild Parsnip

Amur Maple (*Acer ginnala*)

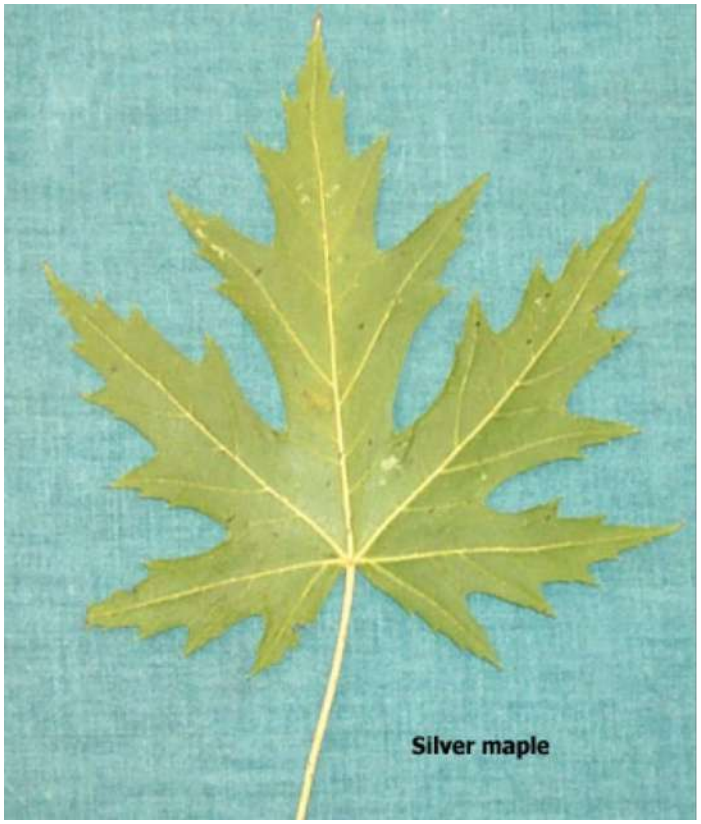
- **Origin:** eastern Asia
- **How it came to Ontario:**
  - commonly planted as an ornamental
  - plants seeded into nearby open areas

Amur Maple - Identification

- leaves narrow and triangular, brilliant red in autumn
- leaves have 2 short basal lobes

Amur Maple – Similar Species

- **Silver Maple**
  - more lobes
  - larger lobes
  - smooth bark when young
  - tree-like shape, not short and mushroom shaped

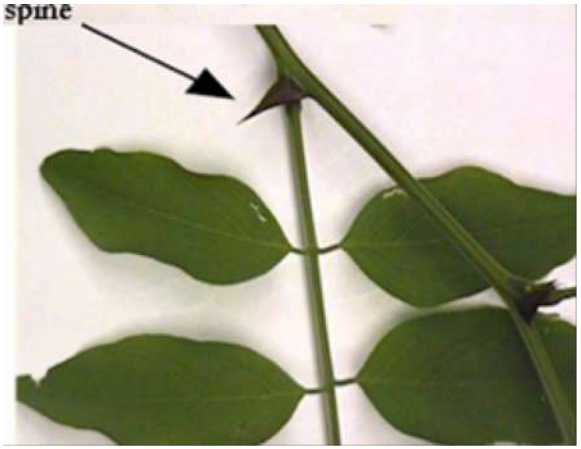


Black Locust
(*Robinia pseudoacacia*)

- **Origin:**
  - native to the Appalachian mnts.
- **How it came to Ontario:**
  - Brought up by United Empire Loyalists after the U.S. War of Independence
  - planted on many homesteads
  - now widely naturalized in many areas

Black Locust - Identification

- leaves compound with a terminal leaflet
- a pair of spines at the base



Black Locust - Identification

- fruit a flat pea pod with small dark seeds

- flowers showy, white drooping clusters in early summer

Black Locust – Similar Species

Honey Locust

- singly or doubly compound
- flowers greenish white
- no terminal bud or leaflet on its compound leaf
- thorns smooth, sharp, reddish, 3 branched or more
- Fruit is more twisted

Black Locust – Impacts

- Highly invasive
- Tend to dominate certain niches
- Does not spread rapidly from major concentrations
- Readily forms clones through root sprouts

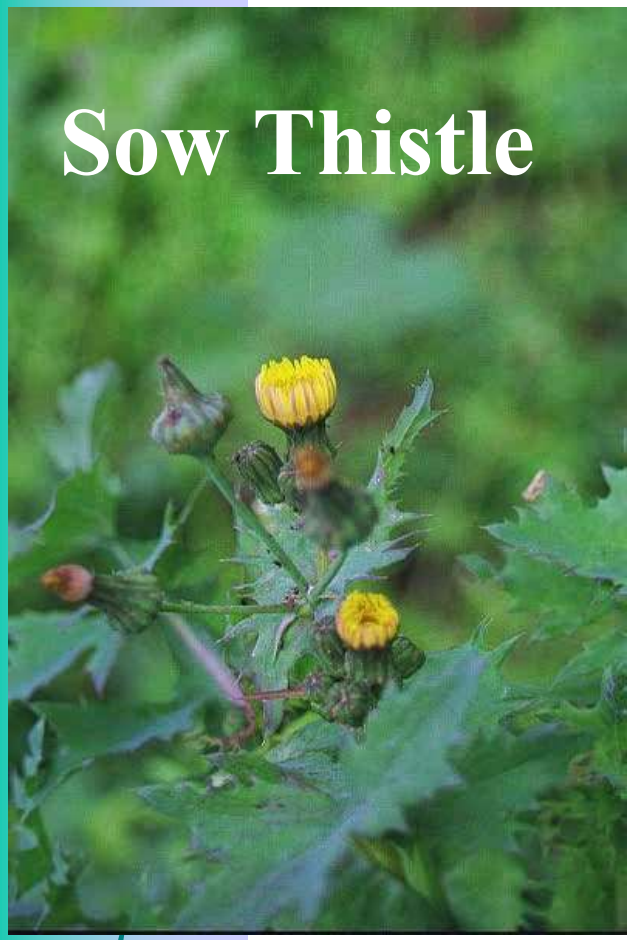
Canada thistle (*Cirsium arvense*)

- **Origin:**
  - introduced from Europe in the 17th century probably in crop seed
- **How it came to Ontario:**
  - once introduced it spreads quickly
  - seeds are light and easily windblown
  - seeds also float and disperse in water
  - seeds continued to contaminate crop seed

Canada Thistle - Identification

- Canada thistle differs from other thistles as it has:
  - small numerous purple flower heads
  - stems without spines
  - almost spineless flower heads
  - vigourous creeping roots

Canada Thistle – Similar species



Bull Thistle

Canada Thistle - Impact

Common (European) Buckthorn
(*Rhamnus cathartica*)

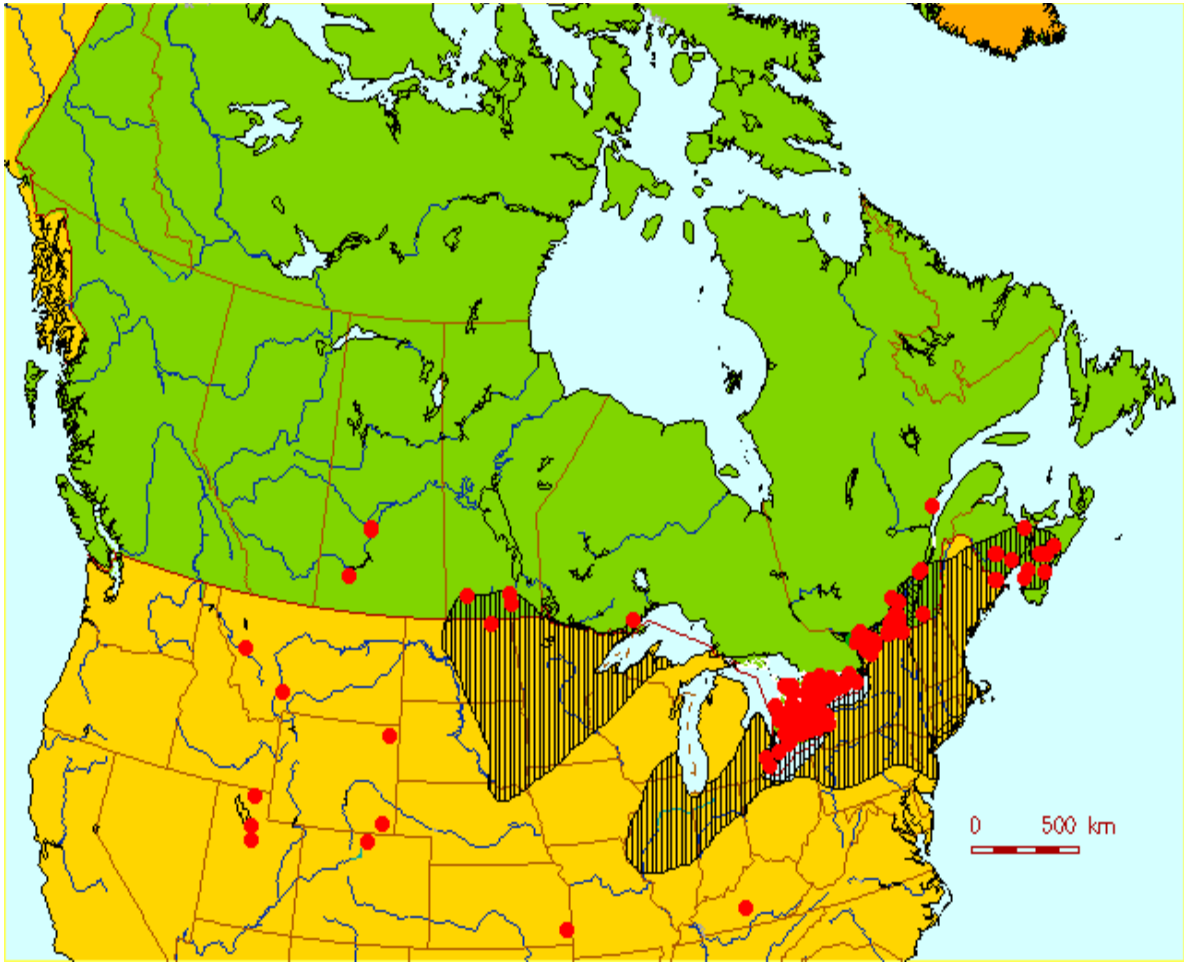
Common Buckthorn - Origin

- a native of Eurasia and North Africa
- not recorded in Canada until the late 1890s
- imported from Europe
- used for hedges and windbreaks

Common Buckthorn - Introduction

- easily spread by birds which eat the fruit and deposit seeds far and wide
- very hardy and has no diseases
- absent from the Canadian shield

Common Buckthorn - Range Map



Common Buckthorn - Identification

- coarse shrub or tree (up to 6m height)
- spine tipped short shoots (not thorns)
- leaves usually opposite
- strongly curved leaf veins
- black berrylike fruit in dense clusters

Common Buckthorn - Characteristics

- retains its leaves well into fall
- typically found in pastures, fencerows, clearings
- More common following ice storm

Common Buckthorn - Similar species

Glossy buckthorn

- alternate shiny leaves
- straight leaf veins
- Smooth leaf margins
- fruit in small clusters or individually

Common Buckthorn - Impacts

- Displaces native shrubs
- can form almost pure stands
- Interferes with natural succession
- Alternate host for crown rust fungi which affects oats

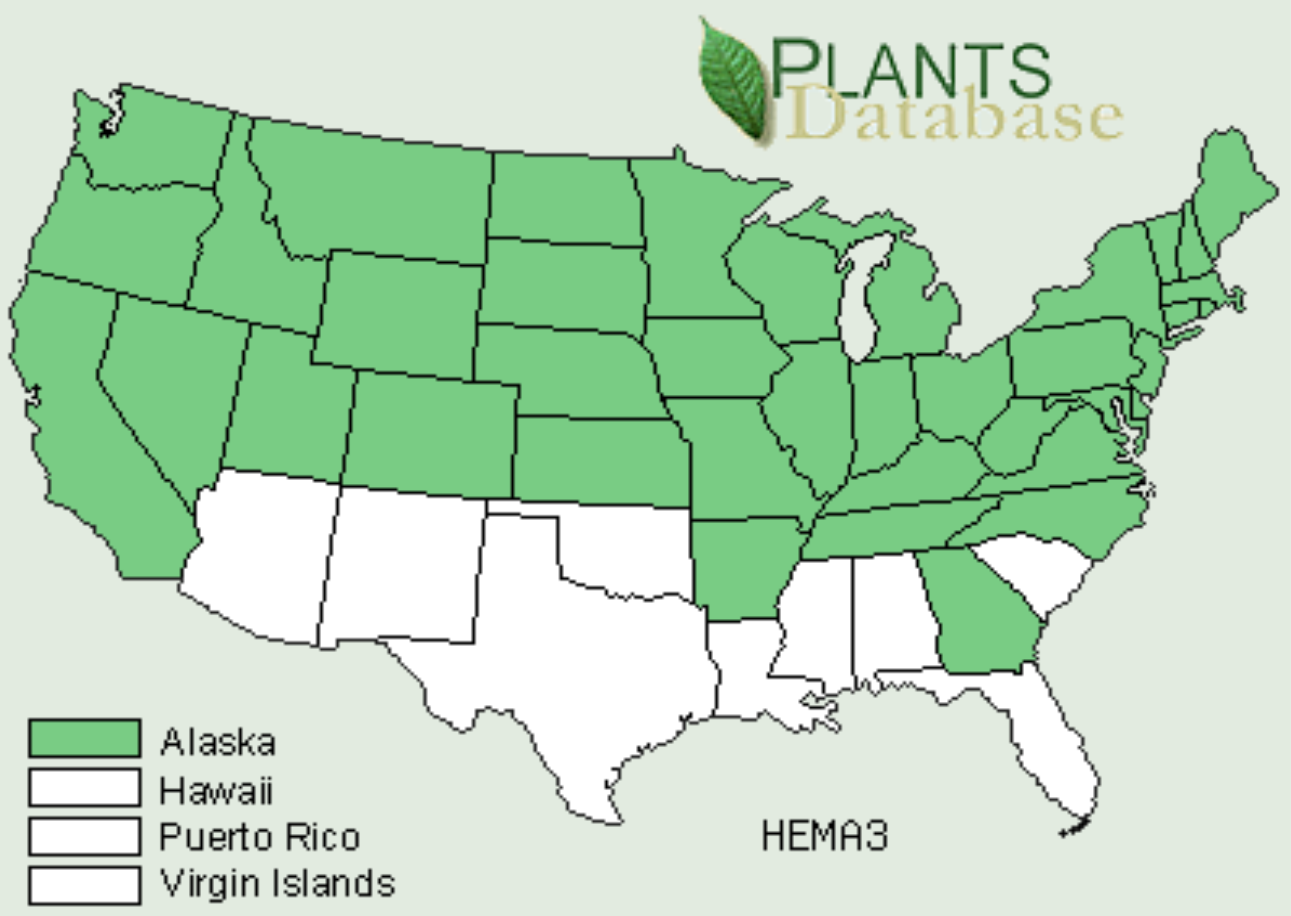
Common Buckthorn - Control Methods

- all control methods require follow up treatment
  - pulling
  - herbicides
  - fire will top kill Buckthorn

Dame's Rocket (*Hesperis matronalis*)

- **Origin:**
  - native to Eurasia
  - introduced to North America in the 1600's
- **How it came to Ontario**
  - a prolific seed producer
  - commonly included in wildflower mixes

Dame's Rocket - Range Map



Dame's Rocket - Identification

- large showy purple-pink flowers
- flowers with four petals
- 2-3' high
- leaves long, moderate in width, and toothed

Dog Strangling Vine
(*Cynanchum medium*)

Dog Strangling Vine - Origin & Introduction

Origin:

- native to Europe
- first grown in Massachusetts as an ornamental

How it came to Ontario:

- brought to Canada during the Second World War to be evaluated as a filler for lifejackets (seeds are bouyant)
- it subsequently escaped from research plots

Dog Strangling Vine - Identification

- Perennial
- 50-150 cm high
- 5 lobed purple flowers
- vine, stems intertwining
- leaves opposite, simple

Dog Strangling Vine - Identification

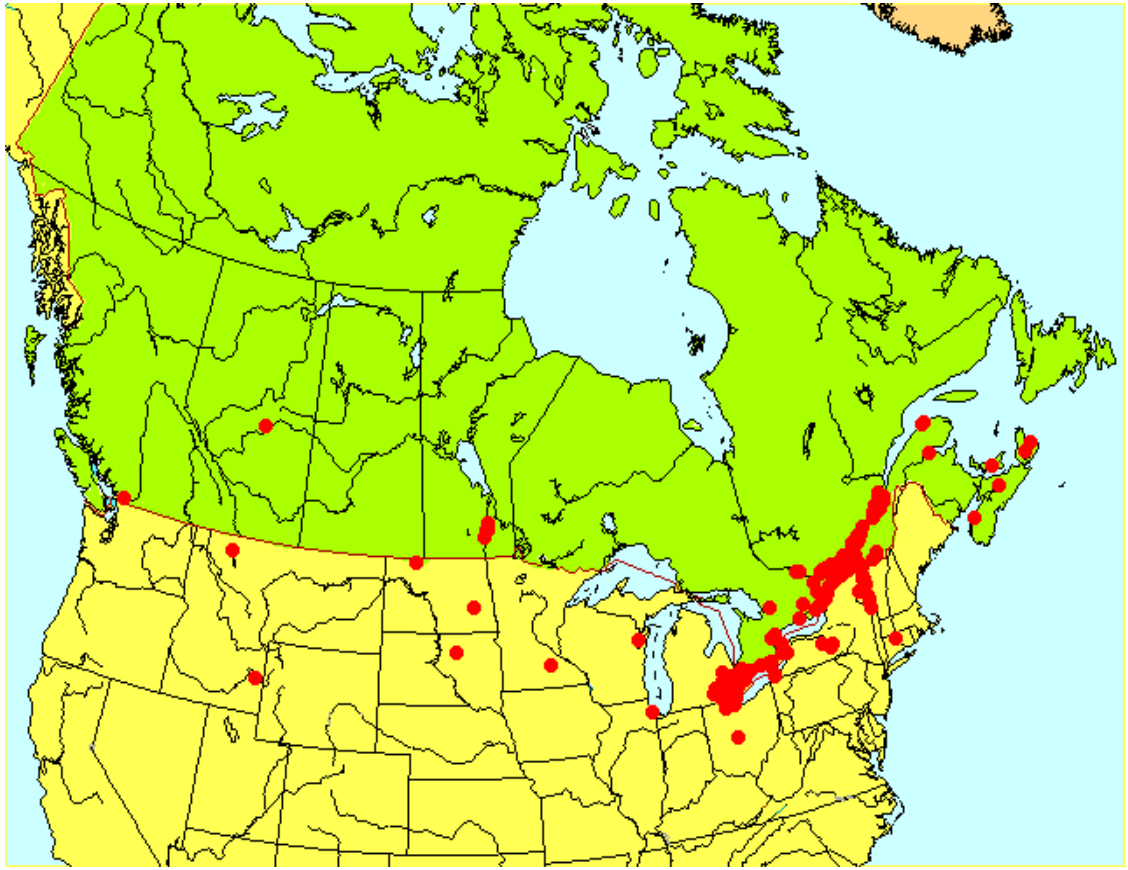
Dog Strangling Vine - Impacts

- forms dense patches
- limits recreational use (hence the common name)
- excludes all other species and dominate sites indefinitely

Flowering Rush (*Butomus umbellatus*)

- **Origin:**
  - native to Europe
- **How it came to Ontario:**
  - first seen in Canada in Montreal in 1897
  - spread rapidly up and down the St. Lawrence
  - Gananoque by 1940

Flowering Rush - Range Map



Flowering Rush - Identification

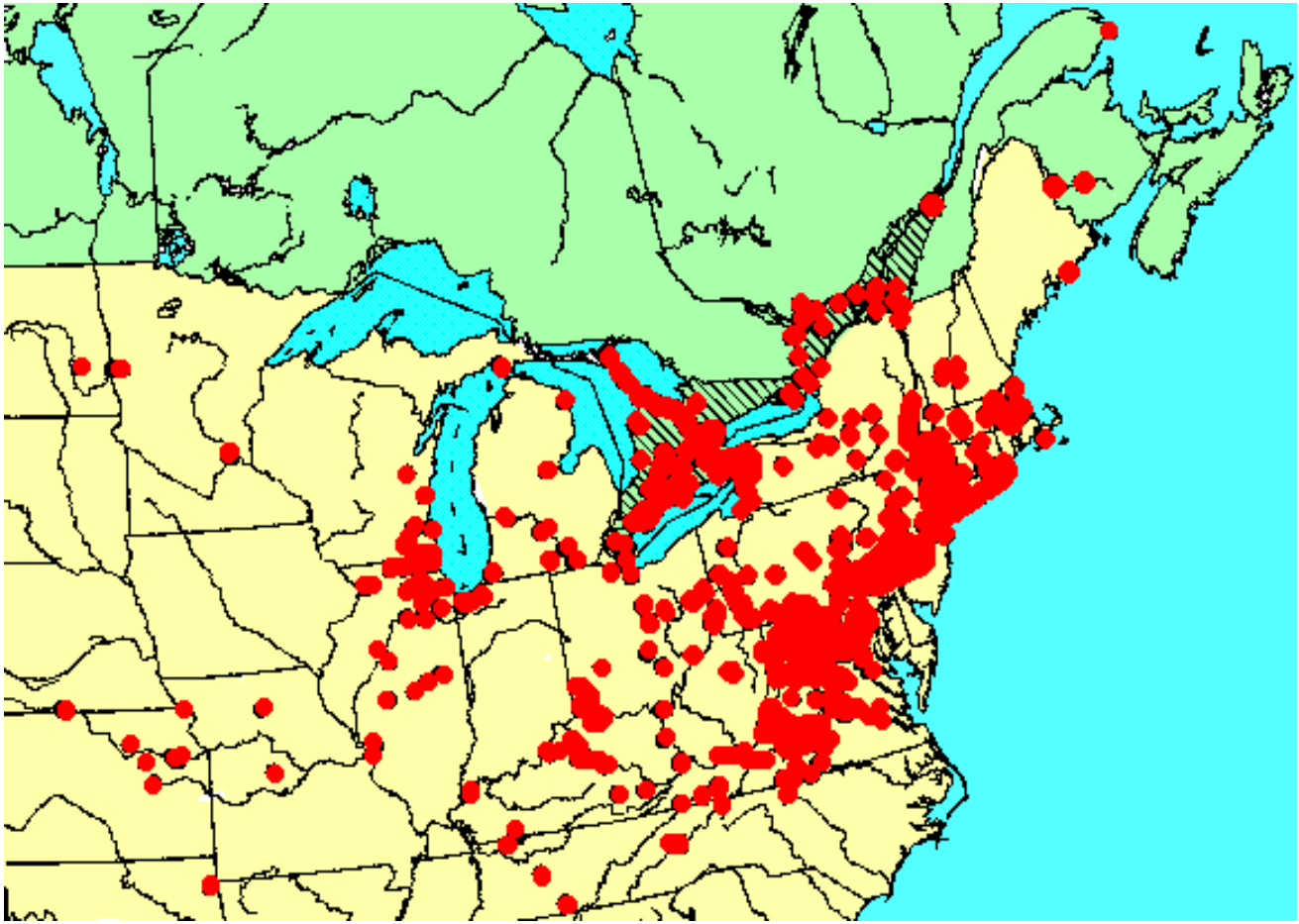
- perennial aquatic shoreline herb
  - long, linear 3-angled fleshy leaves
  - leaves erect or may float on the surface
  - single flowering stem overtops leaves
  - showy cluster of flowers

Garlic Mustard
(*Alliaria petiolata*)

Garlic Mustard - Origin and Introduction

- **Origin:**
  - native of Europe and Asia
- **How it came to Ontario:**
  - probably introduced deliberately in to North America
  - valued as a herb and for medicinal value

Garlic Mustard - Range Map



Garlic Mustard - Identification

- up to 1m tall
- alternate stalked leaves
  - heart shaped, rounded or triangular blades
- leaves smell like garlic
- small white flowers, with four petals
- seeds in long narrow capsules

Garlic Mustard - Characteristics

- grows in a variety of disturbed and natural sites
- prefers partial shade
- deciduous woodlands, floodplain forests, forest edges, hedgerows
- thrives in soils high in lime, not found on Canadian shield
- Bi-annual plant

Garlic Mustard - Impacts

- found in 37 national and provincial parks and ANSI's
- forms dense monocultures

Garlic Mustard - Control Methods

- fire
- mechanical removal
  - cutting at ground level before or after flowering but before seed set effective
  - repeated treatments required
- hand pulling effective for small infestations
- herbicides

Glossy Buckthorn (*Rhamnus frangula*)

Glossy Buckthorn
- Origin and Introduction

Origin:

- native to Eurasia and North Africa
- imported to North America as horticultural stock in the late 1800's

How it came to Ontario:

- naturalized throughout the northeastern U.S. and southeastern Canada
- seeds dispersed with feces of birds

Glossy Buckthorn - Identification

- Large shrub or small tree, up to 7m
- older stems are mottled with lenticels
- twigs are grey and hairy
- leaf bladed have 5-10 pairs of straight veins
- flowers greenish white
- fruit black, attached singly or in small clusters
- no thorns or spines

Glossy Buckthorn - Characteristics

- typically found in wetland habitats:
  - swamps, fens, and sometimes bogs
- also found on woodland edges, fencerows and old fields

Glossy Buckthorn - Impacts

- one of the most aggressive invasives of wetland habitats
- growth can be dense enough to exclude other native species

Glossy Buckthorn
- Impacts on other species

- berries food for a variety of wildlife
- birds spread the seeds far and wide
- competes for habitat with native saplings and shrubs
- alternate host of oat crown rust fungi

Glossy Buckthorn - Control Methods

- fire may be an effective control if annual burns are maintained for 5-6 years
- herbicides
- mechanical
- all treatments will need to be repeated to get re-sprouts and new seedlings germinating from the seed bank

Japanese Knotweed
(*Polygonum cuspidatum*)

Japanese Knotweed - Origin and Introduction

Origin:

- native to Asia

How it came to Ontario:

- brought to North America as an ornamental in the late 1800's
- rapidly spread through vegetative reproduction
- plant fragments are transported with soil

Japanese Knotweed - Identification

- perennial herb
- hollow bamboo-like stems
- heart shaped leaves
- deep root system
- with spreading rhizomes (out to 20 m)

Japanese Knotweed - Identification

Japanese Knotweed - Impacts

- deep roots make it hard to eradicate

- **On other species:**
  - dense, pure stands crowd out native vegetation
  - deep roots take water and nutrients from native vegetation

Control Methods

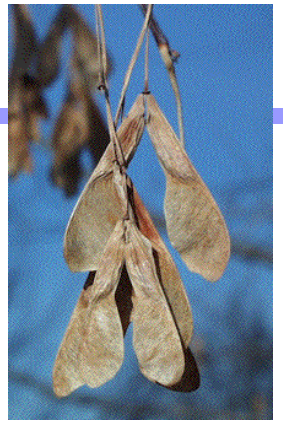
- pulling plants up is only partially effective
  - plants can regenerate from very small pieces of root left in soil
- cutting stalks, followed by an application of a herbicide is very effective
  - may need to be applied several times over 2-3 years to effectively kill all rhizomes

Manitoba Maple
(*Acer negundo*)

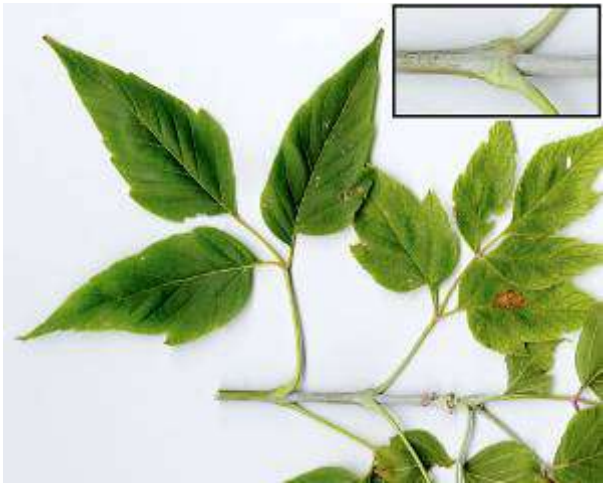
Manitoba Maple
- Origin and Introduction

- **Origin:**
  - native to North America
  - originally found in riparian woodlands in the eastern prairies and plains
- **How it came to Ontario:**
  - always found in extreme SW Ontario
  - now widely introduced and naturalized throughout eastern Canada

Manitoba Maple - Identification



- compound leaves, 3-9 leaflets
- leaflets with shallow irregular lobes or teeth, often asymetrical



Norway Maple (*Acer platanoides*)

Norway Maple - Origin and Introduction

- **Origin:**
  - native to Europe
- **How it came to Ontario:**
  - widely planted as an ornamental
  - has become naturalized in many areas

Norway Maple - Identification

- milky juice exudes from cut leaf stalks
- fruits with wings spread apart very wide
- seeds produced abundantly in most years

Similar Species

Norway

Sugar

Norway Maple - Impacts

- aggressively colonizes sites
  - abundant seed production
- has caused erosion problems in some Toronto ravines by shading out understory vegetation

Purple Loosestrife (*Lythrum salicaria*)

Purple Loosestrife - Origin and Introduction

- **Origin:**
  - native to Europe
  - plants were brought by settlers for their flower gardens
  - seeds were present in soil used for ballast in sea-going ships
- **How it came to Ontario:**
  - since introduction, Purple Loosestrife has steadily spread westward

Purple Loosestrife - Identification

- individual flowers
  - have 5 or 6 pink-purple petals
  - surrounding small, yellow centers
- each flower spike is made up of many individual flowers

Purple Loosestrife - Characteristics

- commonly found in wet areas
- wetlands
- poorly drained agricultural land (hayfields)

Purple Loosestrife - Impacts

- 190,000 ha of wetlands, marshes, pastures and riparian meadows impacted annually

- On habitat:
  - degrades wetland habitat
    - chokes out fish spawning habitat
    - competes with wild rice- a valuable food plant for wildlife

Control Methods

- hand pulling
  - easiest with:
  - small infestations
  - young plants
  - can be used to prevent spread from infested areas
  - need to remove as much of root system as possible

Control Methods

- Cutting
- Chemical
- Biological

Scot's Pine (*Pinus sylvestris*)

Scots Pine
- Origin and Introduction

- Origin
  - native from Scotland across Eurasia to the Pacific, and
- Introduction
  - widely planted throughout North America for several hundred years

Scots Pine - Identification

- needles in clusters of 2
- short needles less than 3 inches long
- blue-green in colour

Scots Pine - Impact

- Can be beneficial
- Can be detrimental

Smooth Brome Grass (*Bromus inermis*)

Smooth Brome Grass - Origin and Introduction

- **Origin:**
  - native of southern Europe
  - brought to North America as a valuable hay and pasture crop
- **How it came to Ontario:**
  - escaped from cultivation

Identification

- stems, sheaths and blades without hairs
  - may be some fine hairs at the blade nodes on the stem
- blades 8-15 mm wide
- reaches heights of 45-50 cm

Wild Parsnip (*Pastinaca sativa*)

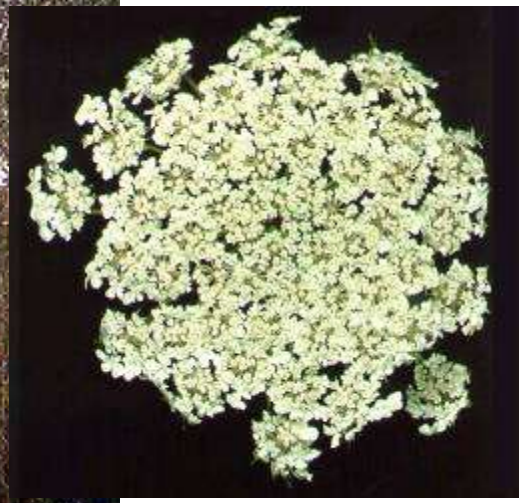
Origin and Introduction

- **Origin:**
  - native to Europe
- **How it came to Ontario:**
  - presumably seeds were brought in to North America in soil used for ballast in ships
  - once established it has spread, particularly down highway corridors

Wild Parsnip - Identification

- flower yellow umbel cluster
- compound leaves
- plants are yellow green
- thick juicy hollow stalk
- reaches height of 6-8’ (>2m)

Wild Parsnip - Similar Species



- **Queen Anne's Lace** (Wild carrot) is somewhat similar
  - has finer leaves and stem
  - has a white flower cluster

Wild Parsnip - Control Methods

- perennial plant,
- thick taproot (parsnip-like) very difficult to pull
- Herbicide can be effective,

Presentation made possible by

- Ontario Forestry Association
- Eastern Ontario Model Forest
- Human Resources Development Canada
- Ontario Ministry of Natural Resources
  - Ontario Stewardship Program

- With contributions from:
  - City of Ottawa
  - Purdue University

Invasive Species

Insects and Diseases

Module 3

Asian Longhorn Beetle

(*Anoplophora glabripennis*)

Statistics

- Over 100 introduced species of insects in North America

Identification

- Body 20-35 mm long, 7-12 mm wide
- Shiny black with up to 20 white dots arranged in parallel lines
- Antennae longer than body
- Legs black, tinged with a whitish-blue colour

Identification

- Adult exit holes
- ‘dime’ sized

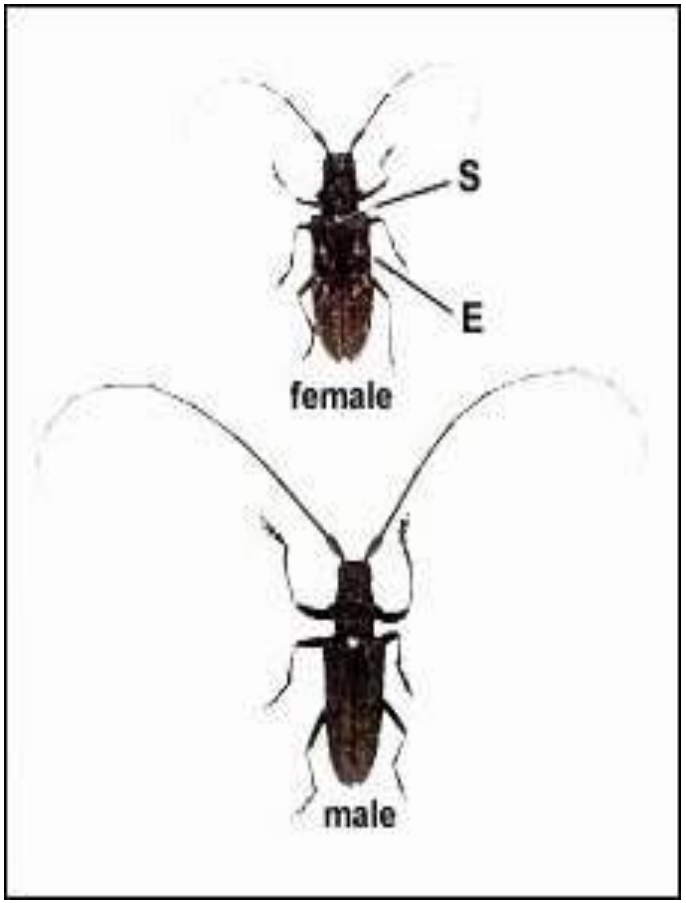
Identification

Large larvae

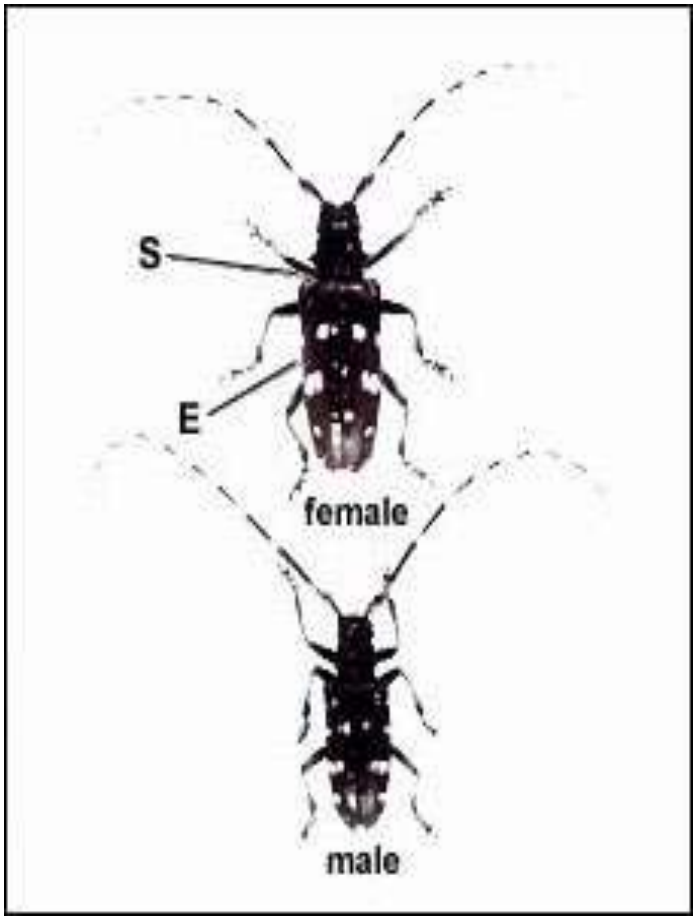
Characteristics

- Adults feed on leaves and bark of fine branches
- Female chews laying pit in bark which may leak frothy sap
- Young larvae feed on green inner bark for 8 to 10 months

Similar Species



White-spotted sawyer



Asian longhorn beetle

Impacts

Beech Bark Disease

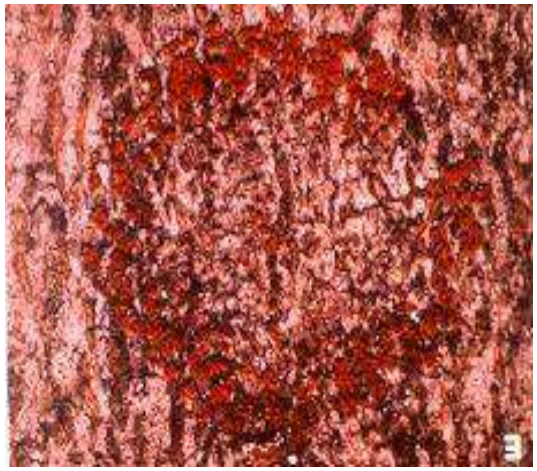
(Nectria coccinea var. faginata)

Identification

- Beech scale insects are:
  - Yellow soft-bodied insects
  - Adults 0.5-1mm long
  - The insects secrete a wooly white wax

Identification

- Fruiting bodies



Characteristics

- Infected and dying beech trees show signs of stress

Impacts

- beech scale insects weaken trees
  - mortality does not occur until Nectria invades tree
  - mortality 3-6 years after scale infestation
- in Pennsylvania the first wave of disease:
  - killed 50% of Be >25 cm dbh
  - 25 % lived but were infected by Nectria
  - 25% showed some resistance

Management Methods

- There are no controls for Beech Bark Disease
- Stands with a high % of Be are highly vulnerable
- Manage for beech bark disease only if there is disease
  - Beech trees can be infected by beech scale but not by the exotic Nectria canker

Management Methods

- prioritize trees for salvage
  - mark trees heavily infested with scale
  - Mark overmature trees, and trees with evidence of decay, broken tops or other wounds
- retain some trees for habitat
  - this will not effect the spread or impact of the disease
- don’t transport infected firewood or logs to unaffected areas

Brown Spruce Longhorn Beetle

(*Tetropium fuscum*)

Module 3

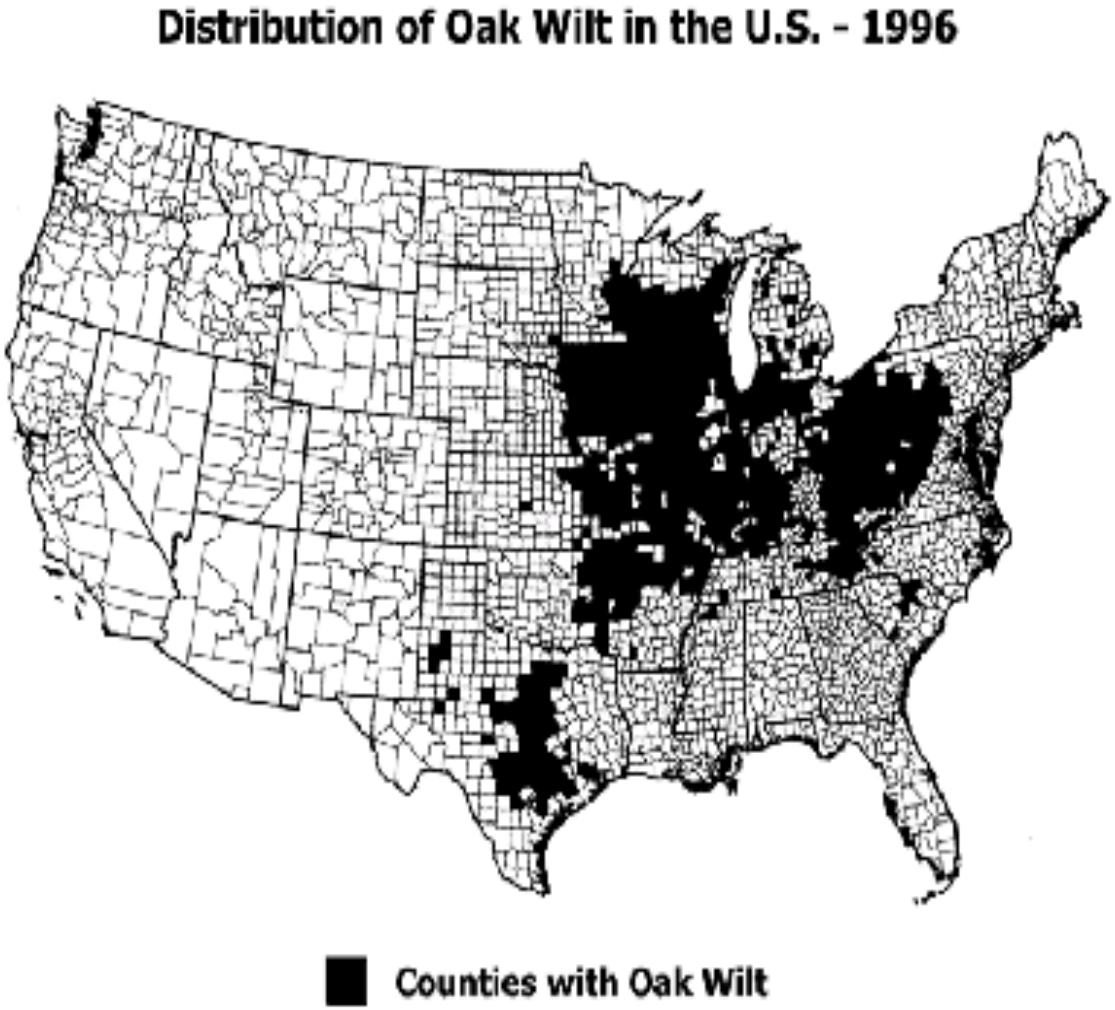
Location

Characteristics

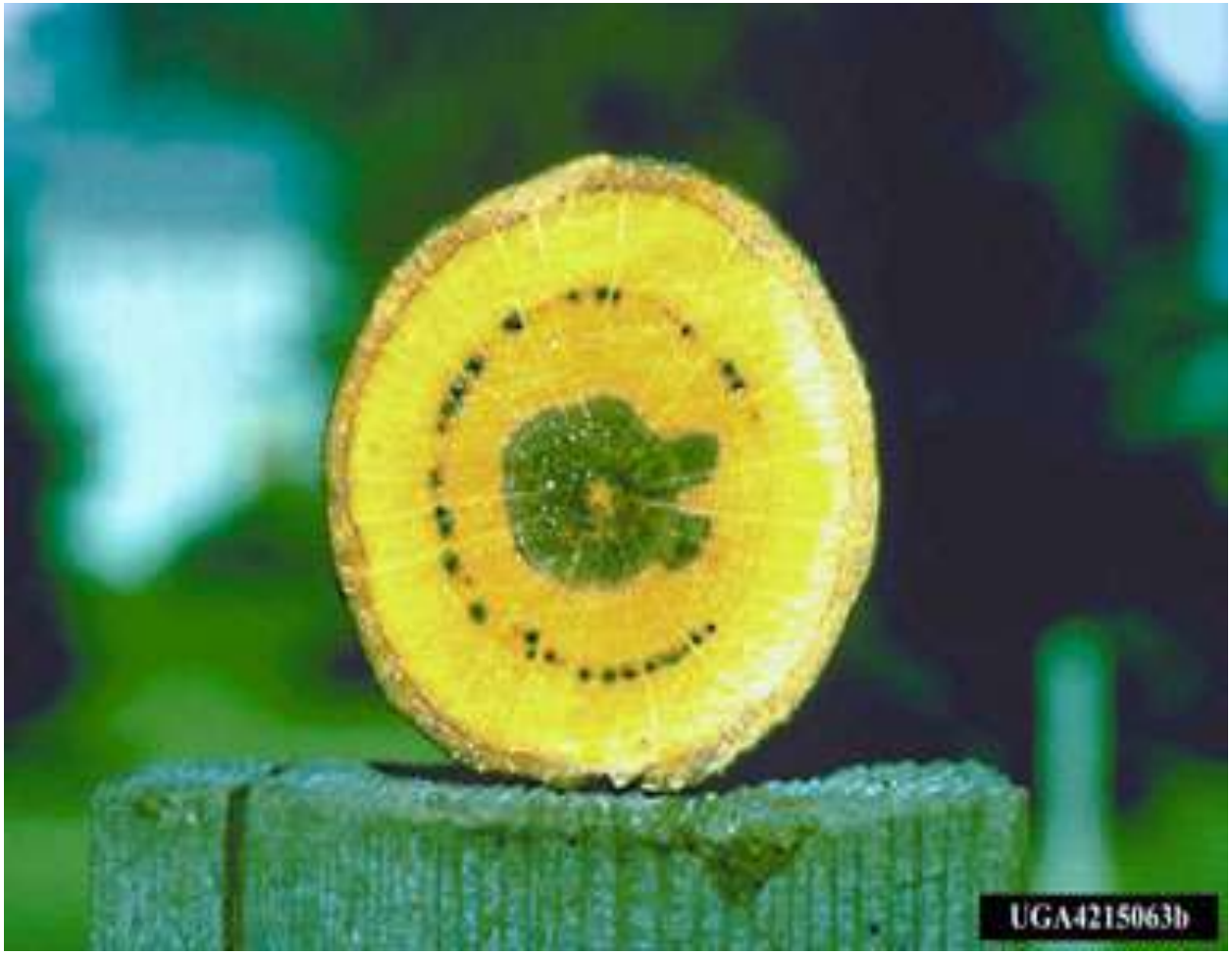
Oak Wilt

(Ceratocystis fagacearum)

Oak Wilt


Distribution of Oak Wilt in the U.S. - 1996
Counties with Oak Wilt

Oak Wilt



Oak Wilt


UGA3226035


UGA3227017

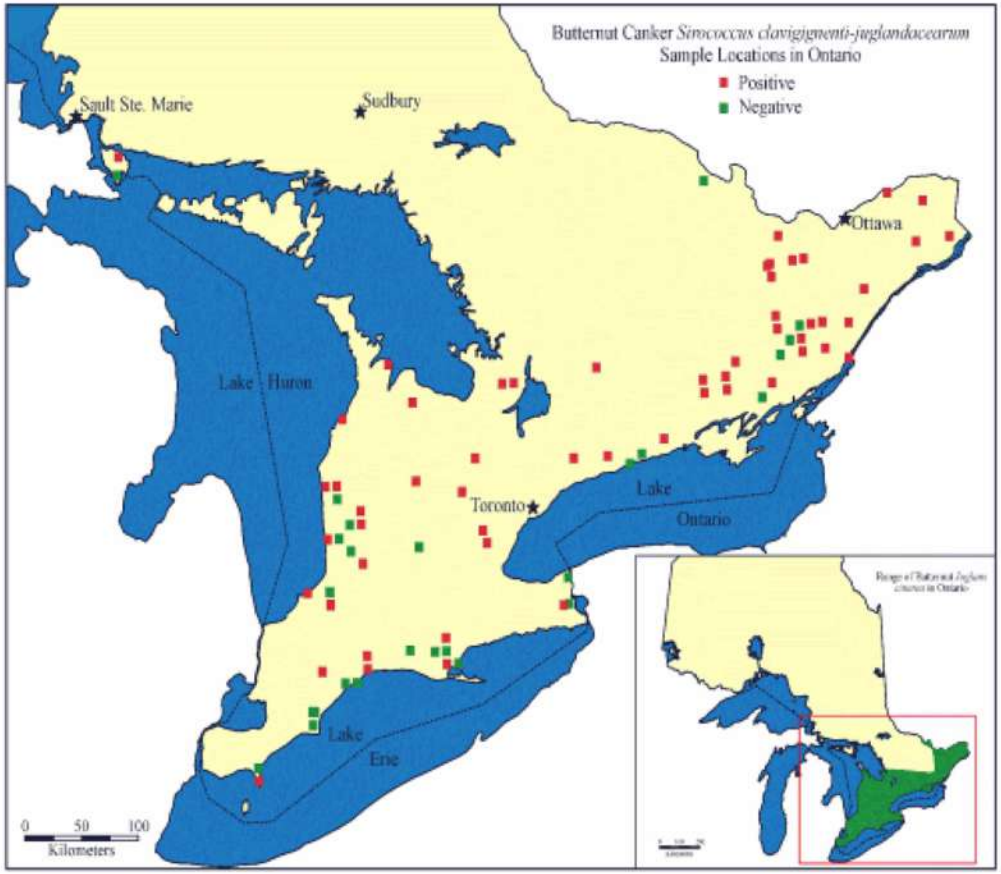

PREVENT OAK WILT
Don't Prune in May or June!
MINNESOTA DEPARTMENT OF AGRICULTURE
OAK WILT CONTROL PROGRAM
NAEGELE
UGA4215058


UGA4214003

Butternut Canker

(*Sirococcus clavigignenti juglandacearum*)

Range Map


Butternut Canker *Sirococcus clavigignenti-juglandacearum*
Sample Locations in Ontario
Positive
Negative
Sault Ste. Marie
Sudbury
Ottawa
Lake Huron
Toronto
Lake Ontario
Lake Erie
0 50 100
Kilometers

Identification

- Young, annual cankers are elongated, sunken areas commonly originating at leaf scars and buds

Identification

- Peeling the bark away reveals the brown to black elliptical areas of killed cambium

Identification

- Older, perennial branch and stem cankers are often found in bark fissures or covered by bark
- Can be bordered by successive callus layers

Characteristics

- Cankers develop anywhere on a tree, but are most common on the main stem, at the base of trees and on exposed roots.
- Butternut is the only known natural host killed by the fungus.
- The fungus can survive on dead trees for at least 2 years.

Impacts

- 80% decline of Bn in some states
- Harvesting has accelerated in Ontario
- Butternut is an important mast species
- there are no known controls

Management Methods

Preserve trees which show some signs of resistance

- mark and retain trees
  - with >70% live crown and
  - < 20% circumference of stem infected by canker

Chestnut Blight

(*Cryphonectria parasitica*)

Characteristics

- fungal spores enter through cracks or wounds in the bark
- the fungus forms sunken cankers which girdle the tree
- tree dies above the canker
- infected trees often resprout only to go through it all again

Impacts

- once extremely common
- chestnut is now all but eliminated
- In the first 40 years of the 20th century, blight destroyed 3.5 billion American chestnuts.

Dutch Elm Disease

(*Ophistoma ulmi*)

Identification

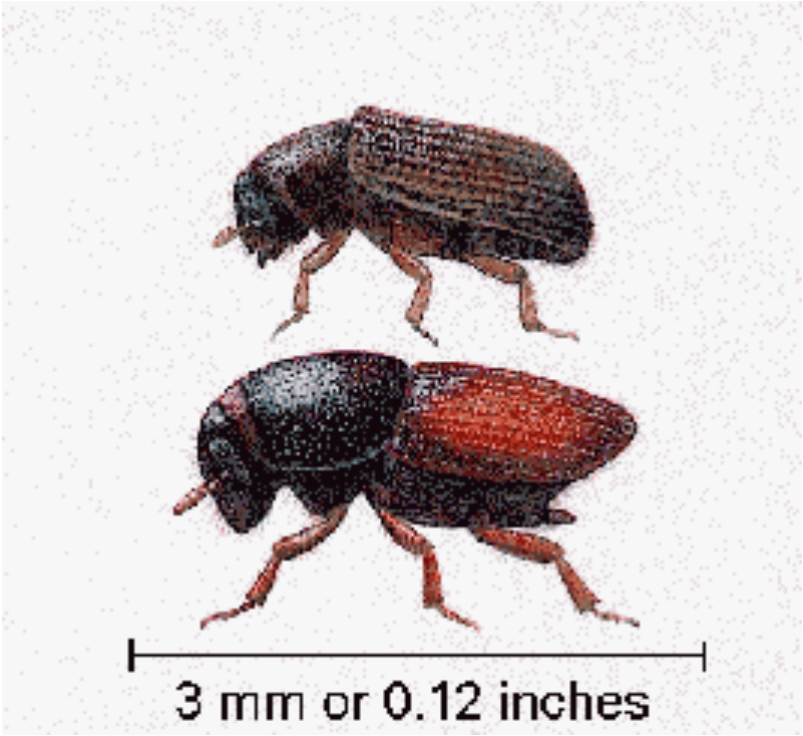
- branches and stems infected by DED fungus show dark streaks of discoloration
- cut through a dying branch to expose outer rings of wood

Identification

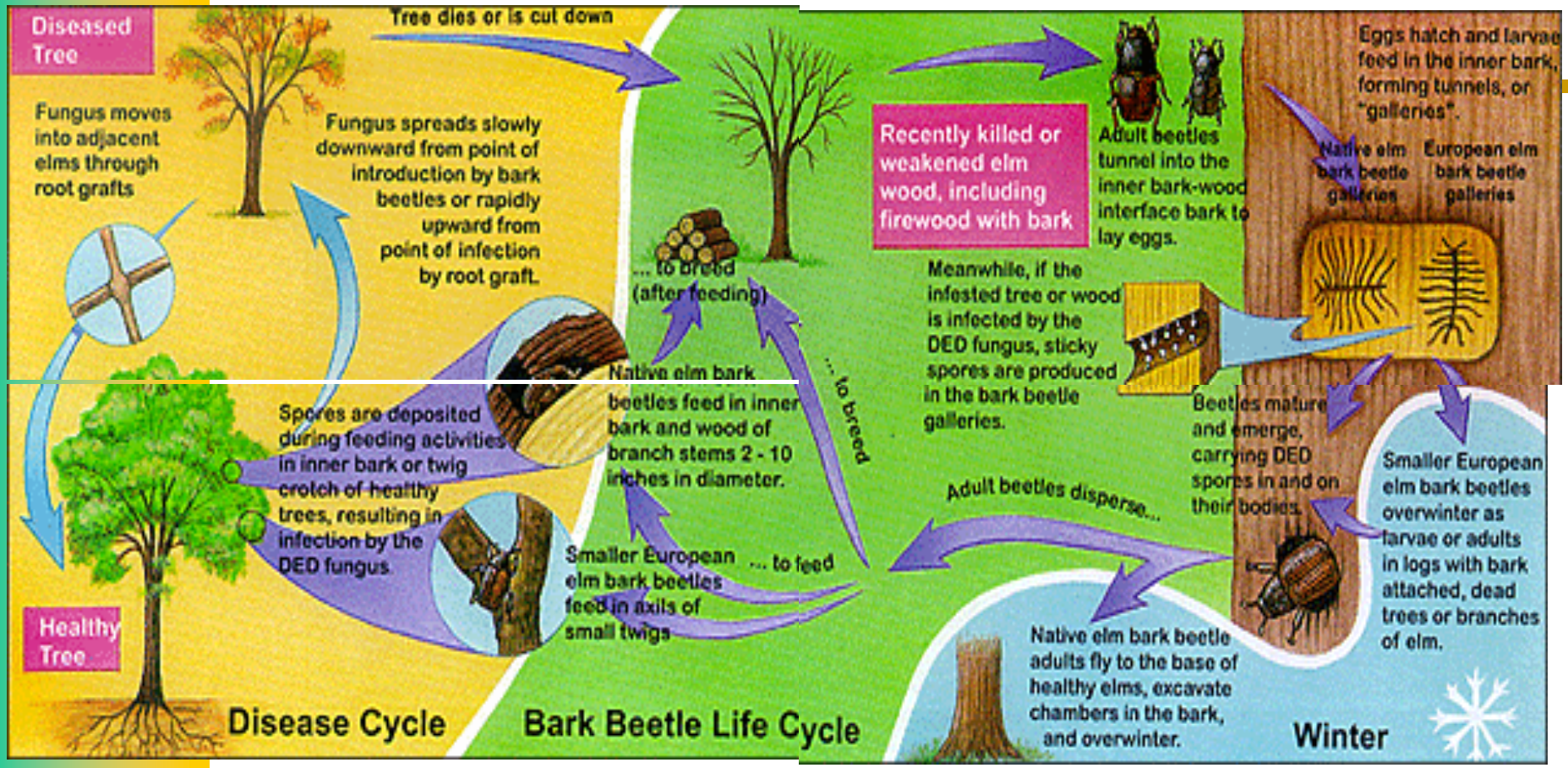
- wilting of leaves
- leaves yellow and brown

Identification

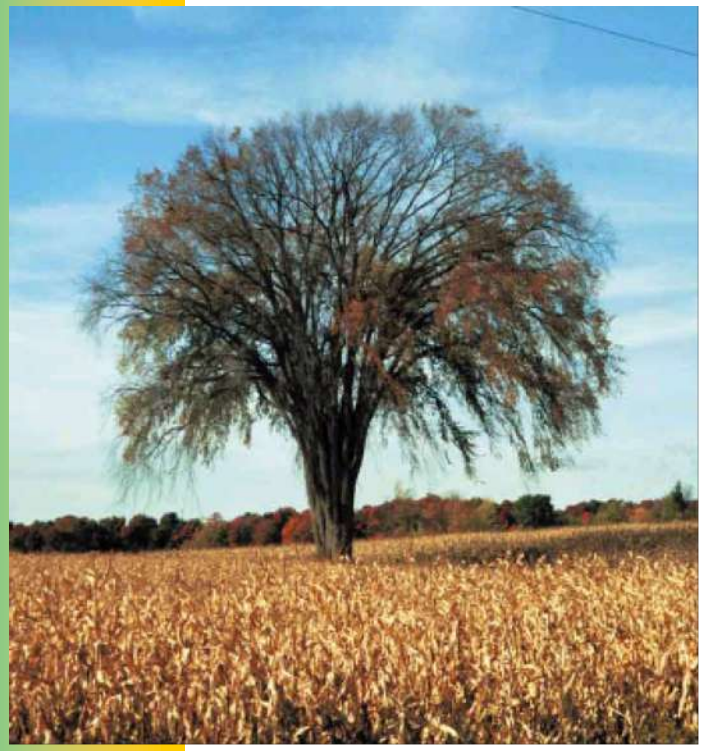
- Spread by bark beetles



Native (smaller) and European (larger) Elm bark beetles


Diseased Tree
Tree dies or is cut down
Fungus moves into adjacent elms through root grafts
Fungus spreads slowly downward from point of introduction by bark beetles or rapidly upward from point of infection by root graft.
... to breed (after feeding)
Recently killed or weakened elm wood, including firewood with bark
Adult beetles tunnel into the inner bark-wood interface bark to lay eggs.
Eggs hatch and larvae feed in the inner bark, forming tunnels, or "galleries".
Native elm bark beetle galleries
European elm bark beetle galleries
Meanwhile, if the infested tree or wood is infected by the DED fungus, sticky spores are produced in the bark beetle galleries.
Native elm bark beetles feed in inner bark and wood of branch stems 2 - 10 inches in diameter.
... to breed
Spores are deposited during feeding activities in inner bark or twig crotch of healthy trees, resulting in infection by the DED fungus
Beetles mature and emerge, carrying DED spores in and on their bodies.
Adult beetles disperse...
Smaller European elm bark beetles overwinter as larvae or adults in logs with bark attached, dead trees or branches of elm.
Smaller European elm bark beetles feed in axils of small twigs
... to feed
Healthy Tree
Native elm bark beetle adults fly to the base of healthy elms, excavate chambers in the bark, and overwinter.
Winter
Disease Cycle
Bark Beetle Life Cycle

Economic Impact



- Elm was widely planted as a street tree in towns and cities
- Millions have been spent removing dead Elm and treating infected Elm

Emerald Ash Borer
(*Agrilus planipennis*)

Emerald Ash Borer

- Still unsure of life cycle in NA
- Can kill an ash tree in 1 year

Emerald Ash Borer

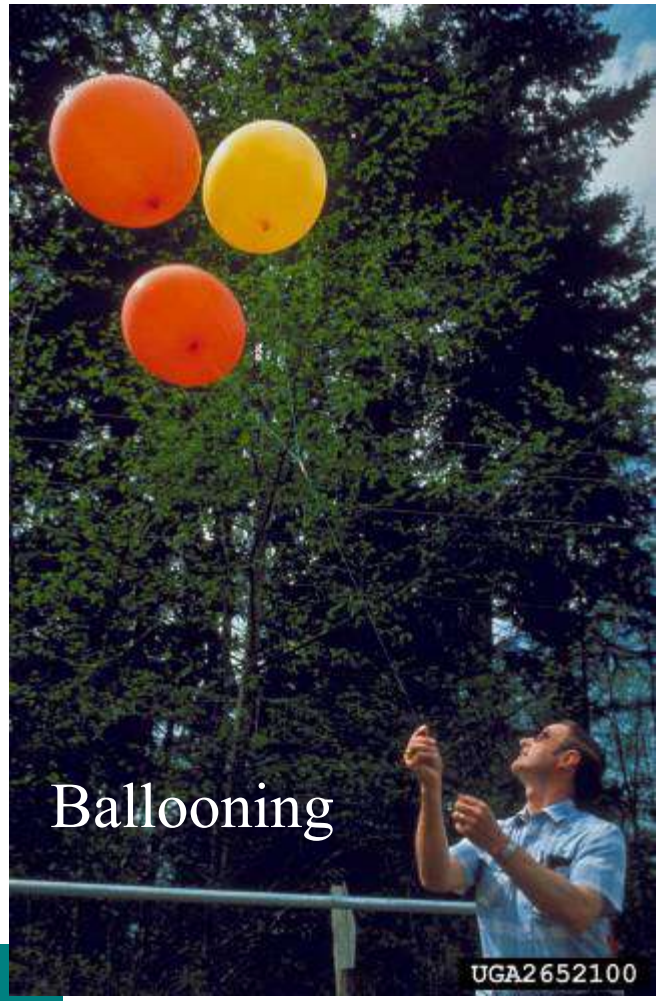
- Larvae girdle tree
- Trees often resprout below girdled area

Emerald Ash Borer

- Wood quarantines in place
- Aggressive control measures

Gypsy Moth
(*Lymantria dispar*)

Introduction



Ballooning

How it came to Ontario:

- the adult moths can travel 5-15 miles per year
- egg cases are often transported by cars and campers far greater distances
- larvae climb trees and are carried by wind considerable distances

Identification

Calendar of gypsy moth activity

Characteristics

Preferred food includes:

- Oak, Apple, Birch, Manitoba Maple, Hawthorn, Basswood, Poplar and Willow
- will eat just about any plant material including pines, grass and vegetables

Impacts

- defoliation is a stress to a tree
- defoliation drastically changes the forest habitat
  - less shade, drier conditions
- defoliation of weak trees or repeated defoliation may remove Oak from some stands
  - Oak may be weakened and not produce as much mast for wildlife

Economic Impact

- millions of dollars have been spent protecting trees from the gypsy moth infestation of the late 80's-early 90's

Control Methods

- destroy egg masses on site
- biological and chemical exist
- trap larvae on trunk
- clean campers and boats

Control Methods

Try to ride out the infestation

- Infestations last a few years
- Population grows until a virus knocks them down

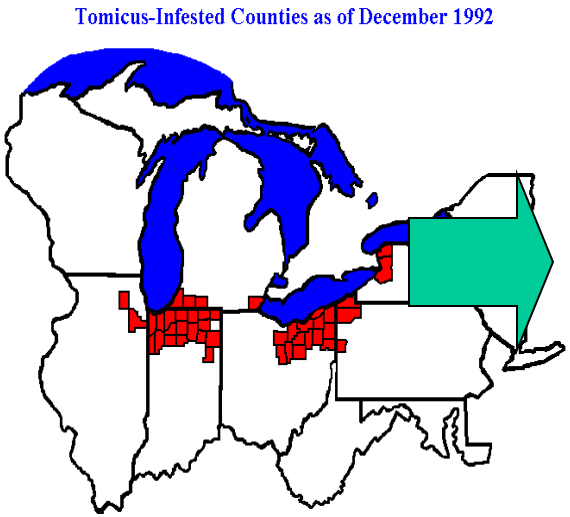
Pine Shoot Beetle

(*Tomicus piniperda*)

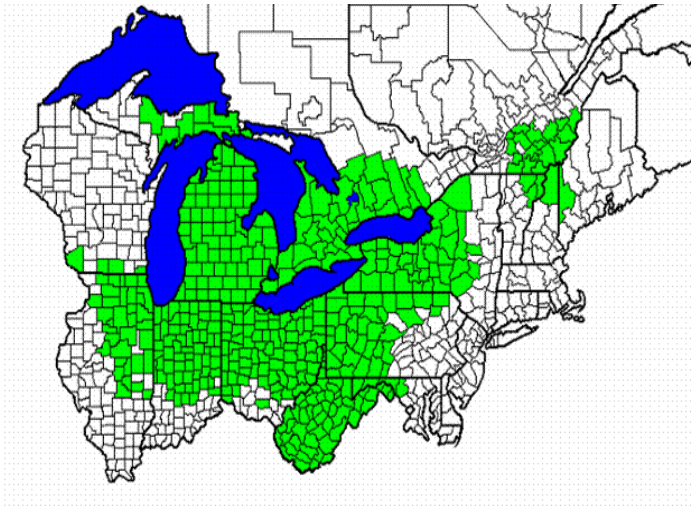
Origin and Introduction

- **Origin:**
  - major pest of pines in Europe and Asia.
  - first discovered in the U.S. on a Christmas tree farm in Ohio
  - probably introduced by foreign ships carrying beetle infested wood
- **How it came to Ontario:**
  - spread through the movement of Christmas trees or pine logs or nursery stock
  - beetles also naturally disperse in the wind

Origin and Introduction



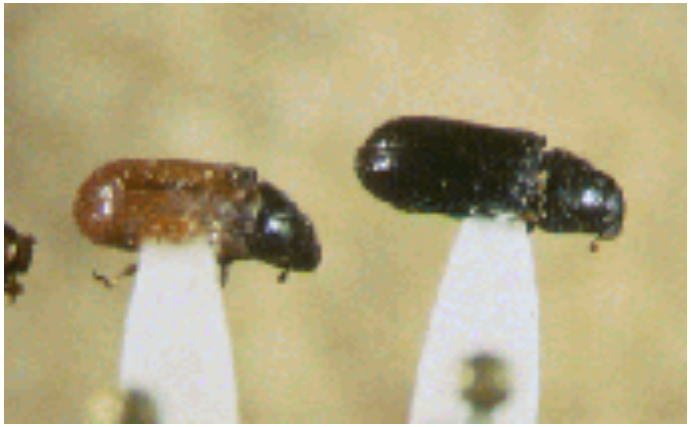
1992



2002

Identification

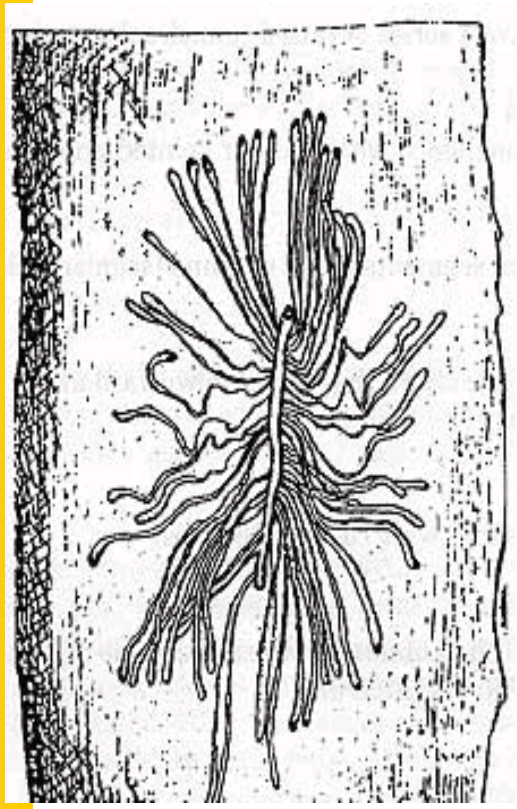
- adults:
- 3-5 mm long- size of a match head
- brown or black
- cylindrical shape



Identification

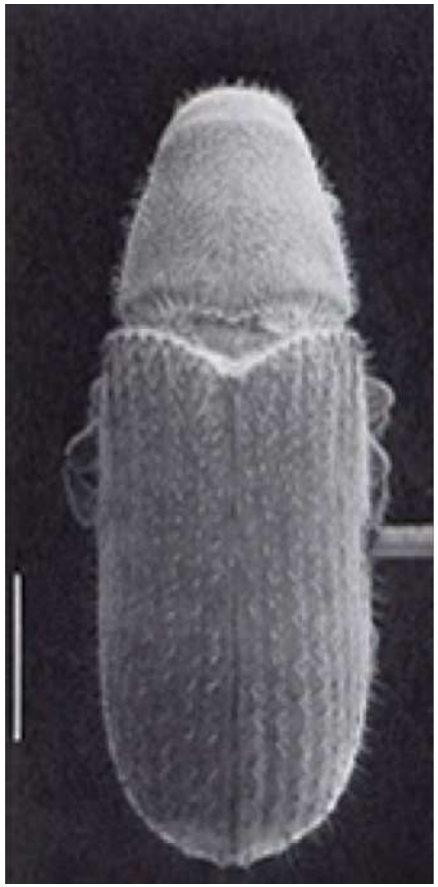
- Best to look for damage

Characteristics



- complete one life cycle per year
- overwinter inside the thick bark of living pine trees
- adults emerge in spring, mate and lay eggs in :
  - dead/dying/stressed pine trees
  - recently cut trees and stumps
  - logs
  - bark mulch

Characteristics



- larvae feed and mature under the pine bark
- emerge as adults in July
- adults feed on new and 1 year old pine shoots
- affected shoots drop, turn yellow
- preferred species is Scot's Pine, but the beetle will also feed on other pines, spruce, larch and fir

Impacts

- shoot feeding:
  - stunts height and diameter growth of trees
  - can cause poor form
- infested trees are weakened, and the beetle may even attack the trunk of the tree and lay eggs there

Economic Impact

- the beetle is the leading pest of pine trees in Europe
- infestations have lead to quarantines and restricted movements of Christmas trees
- all pine trees and wood products are inspected before they can leave the quarantine area
  - Christmas trees from quarantine areas:
  - cannot be moved into other areas
  - leftover trees must be chipped, burnt or fumigated (U.S.)

Control Methods

- integrated management programs are used on Christmas tree farms and nurseries
  - sanitation practices
  - Bait trees
  - chemical controls to reduce adult shoot feeding
  - visual and trap surveys to monitor population levels

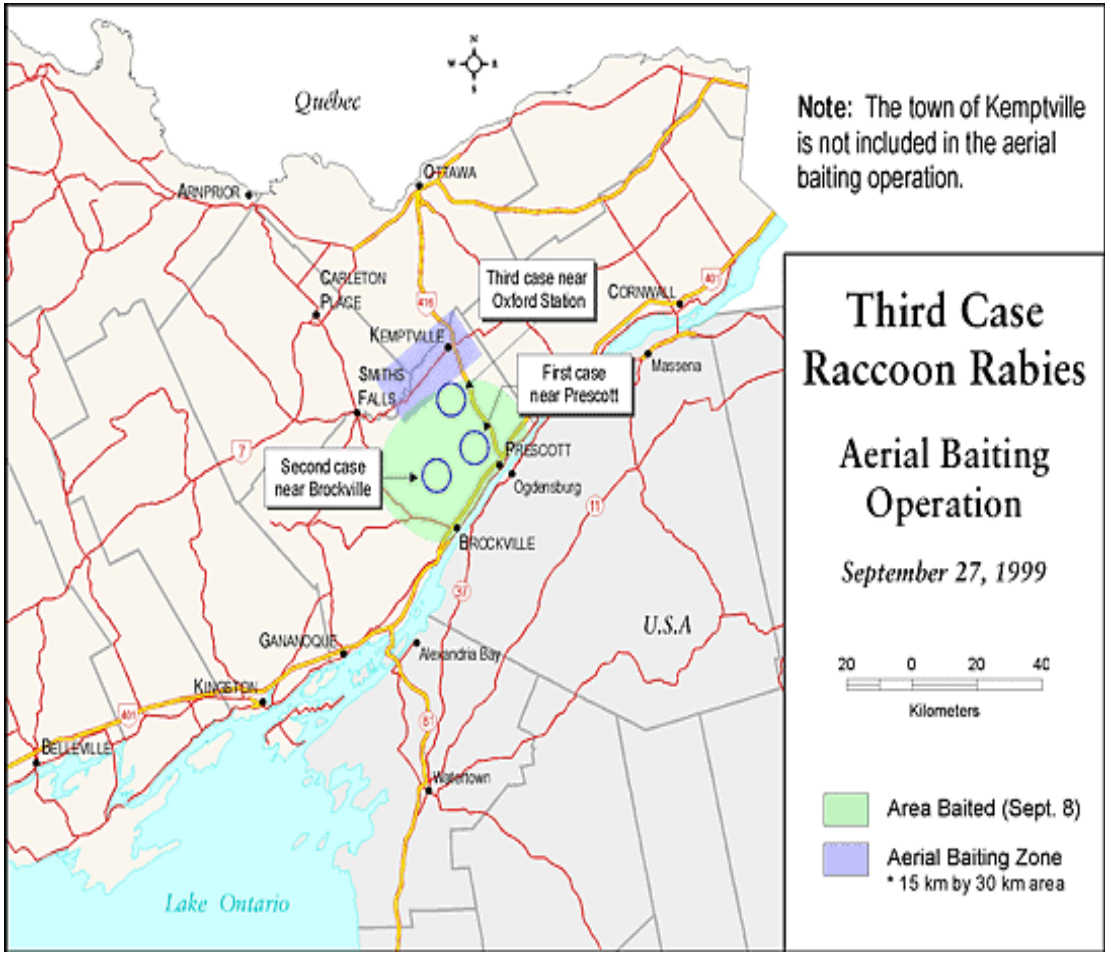
Raccoon Rabies

Module 3

Origin and Introduction

- **Origin:**
  - first reported in Florida in the 1940's
- **How it came to Ontario:**
  - rapidly moved to Virginia from the southern states in 1977, likely brought in with animals used for hunting
  - spread North and South steadily and reached Ontario in 1999

Range Map


Québec
ARNPRIOR
OTTAWA
CARLETON PLACE
KEMPTVILLE
SMITHS FALLS
Third case near Oxford Station
CORNWALL
Massena
First case near Prescott
PRESCOTT
Ogdensburg
Second case near Brockville
BROCKVILLE
U.S.A
GANANOQUE
Alexandria Bay
KINGSTON
BELLEVILLE
Watertown
Lake Ontario
Note: The town of Kemptville is not included in the aerial baiting operation.
Third Case Raccoon Rabies
Aerial Baiting Operation
September 27, 1999
20 0 20 40
Kilometers
Area Baited (Sept. 8)
Aerial Baiting Zone
* 15 km by 30 km area

Identification

- rabies is an infectious disease of the central nervous system
- caused by a Rhabdo virus
- persists in nature as a salivary gland infection of carnivorous animals
- all mammals are susceptible

Identification

- once signs of illness appear it is 100% fatal
- post exposure treatment is nearly 100% effective
- Raccoon rabies is a unique strain of rabies, commonly carried by raccoons, but also by skunks

Characteristics

- no sign is typical or characteristic
- only sure way to diagnose is with lab tests
- symptoms usually occur 30-50 days following exposure
  - dogs 14-60 days
- animal symptoms include:
  - restlessness
  - vicious, biting at everything
  - loss of coordination and tremors
  - convulsions and paralysis before death

Similar diseases

- Fox rabies is the common strain of rabies
  - present in Ontario since the 1950's
- Raccoons are also susceptible to distemper, and the symptoms between the two diseases are similar

Control Methods

- The Ontario Ministry of Natural Resources has implemented a control program in two areas; the St. Lawrence- 1000 Island area, and the Niagara Falls- Welland area.
  - prior to the first case
    - trappers were hired to live-trap and vaccinate raccoons in buffer areas
    - aerial baits were dropped in New York State and Vermont

Control Methods

- TVR, aerial baiting zones map from Canadian Geographic or MNR

Control Methods

- since the first confirmed case in Ontario in 1999
  - Depopulation around confirmed cases
  - an additional Trap-Vaccinate-Release zone
  - vaccine baits have been placed in cities and towns
  - aerial baits have been dropped outside the trapping areas

West Nile Virus

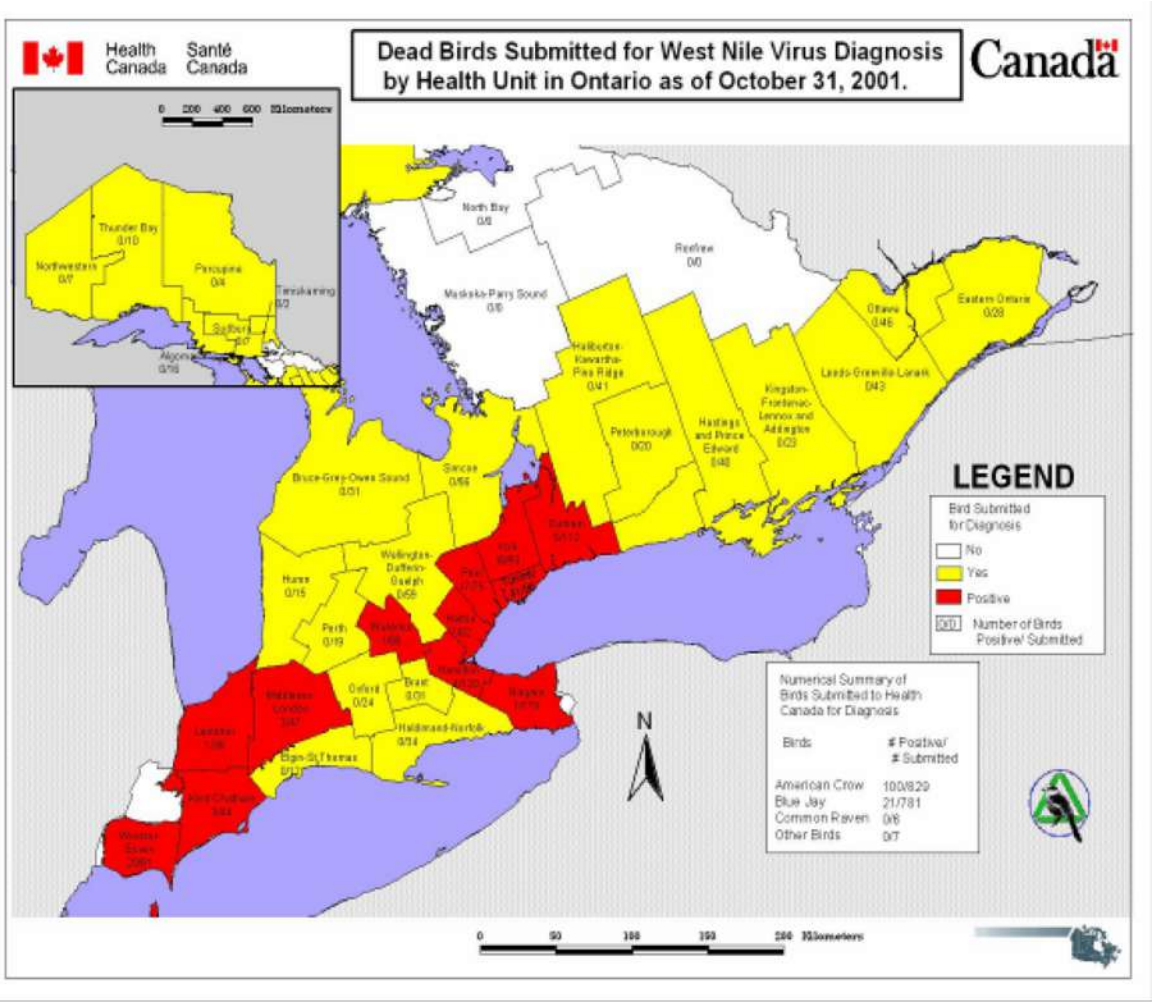
Origin

- native to Africa
- virus has been found in Africa, central Asia, the Middle East, and Mediterranean Europe
- most recently found in North America
- probably carried as an incubating virus in a person on an airplane to New York City(?)
- mosquitoes can transfer the virus from one animal to another

Introduction

- **How it came to Ontario:**
  - birds are carriers of the disease, particularly corvids (crows, blue jays)
  - disease is transmitted to another animals through mosquito bites

Ontario Status 2001



Identification and Characteristics

- the West Nile Virus causes encephalitis (brain swelling) in humans
- the first outbreak in New York City infected 62 people, killing 7

Identification and Characteristics

- potential to infect livestock and poultry
- 25 horses have been diagnosed with encephalitis on Long Island, 9 died

White Pine Blister Rust

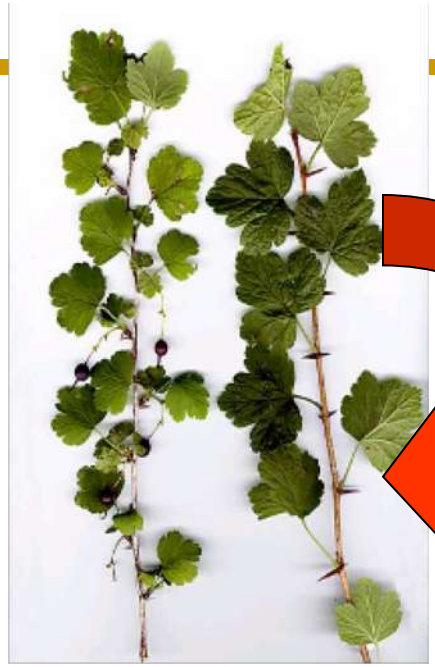
(*Cronartium ribicola)*

White Pine Blister Rust

White Pine Blister Rust

Life Cycle

3



4

1

2

Control

- Some white pine will be lost to blister rust
  - Thin out affected trees during harvesting
- Prune infected branches when you see them
- Prune lower 1/3 of the branches – decreases humidity and removes potential infection sites
- Remove all ribes (currents & goose berries) within 300 m

Questions & Comments

Presentation made possible by

- Ontario Forestry Association
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- Human Resources Development Canada
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  - Ontario Stewardship Program

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