



Invasive Species

Imagine, for a moment...

- ◉ Imagine, for a moment, that every hardwood deciduous tree in the community has died.
 - There are no trees lining the streets
 - The environmental center has had to be completely clear cut
 - The sides of streets are rural roads are lined with stacks of rotting, infested logs.
- ◉ Seem unlikely?



March 15, 1999

DEPARTMENT OF AGRICULTURE Office of the Secretary

Declaration of Emergency

A serious outbreak of the Asian longhorned beetle is occurring in Illinois and New York. This insect, native to China and Japan, is a destructive pest hardwood trees.

If this pest moves into the hardwood forests of the United States, the nursery and forest products industry could experience severe economic losses.

Resources are insufficient to meet the estimated \$5.5 million needed for the Federal Share.

Therefore...I declare that there is an emergency which threatens the forest and maple syrup industries of this country.

*Dan Glickman, Secretary of Agriculture,
United States of America*

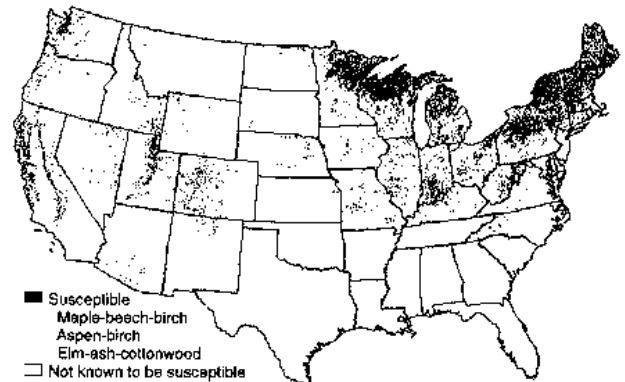


Figure 3. U.S. forest types potentially at risk to Asian longhorned beetle infestations. (Source: USDA Forest Service)

Gain one, lose many

- ◉ According to the USDA, this one species had the potential to wipe out dozens, if not hundreds of *species* of hardwood trees across the nation.
- ◉ How could the addition of one species cause so many others to die out?
- ◉ Why don't native species do this kind of damage?



One among many

- ◉ Another major threat includes the Gypsy Moth.
 - When GM densities reach very high levels, trees may become completely defoliated (lose their leaves).
 - Entire stands of trees can be lost with repeated years of leaf loss.

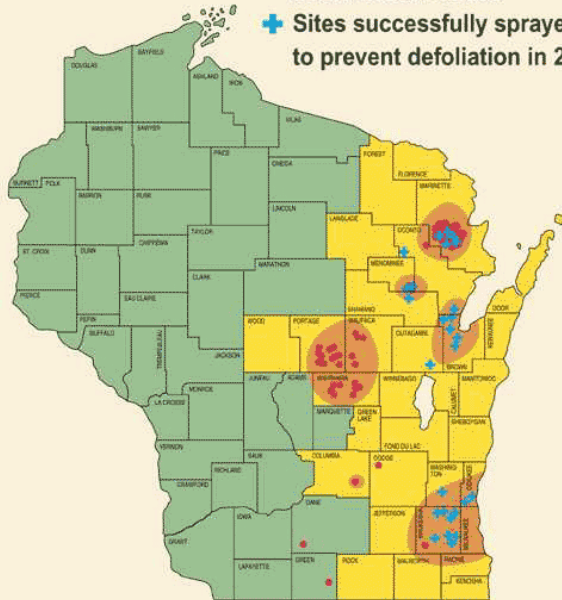


Gypsy Moth damage



Gypsy Moth Distribution

- Uninfested
- Infested
- Defoliated in 2002
- Areas within which defoliation could occur in 2003
- + Sites successfully sprayed to prevent defoliation in 2002



The newest threat

- ◉ The latest invasive insect to threaten Wisconsin forests is the Emerald Ash Borer (EAB).
- ◉ The Emerald ash borer is an exotic beetle that was discovered in southeastern Michigan near Detroit in the summer of 2002.
- ◉ The larvae (the immature stage) feed on the inner bark of ash trees, disrupting the tree's ability to transport water and nutrients.
- ◉ It became established in Wisconsin in summer 2008



The emerald ash borer,

Agrilus planipennis Fairmaire, a beetle native to Asia, was first detected in Michigan in 2002. Evidence suggests that the beetle was established in Michigan for a number of years prior to its discovery. Emerald ash borer has since been detected in Ohio, Indiana, Virginia, Maryland, and Ontario, Canada. In addition to spreading by natural means, emerald ash borer can be transported to new areas in infested firewood, timber, and nursery stock. The beetle is responsible for the loss of more than 7 million ash trees in Michigan alone.



Host:

In North America, emerald ash borer is known to infest all species of ash (*Fraxinus* spp.). Ash can be recognized by the presence of compound leaves which are arranged opposite of one another on the branches.



Larva



S-Shaped Galleries

D Shaped
Emergence
Hole



Biology:

Eggs are laid between layers of bark and in bark crevices. Larvae hatch in about one week and bore into the tree where they feed on the inner bark and phloem, creating "S"-shaped galleries. The larvae go through three feeding stages, and then excavate a pupal chamber in the fall, where they will overwinter as prepupae. Pupation occurs in late spring, and adults begin to emerge through "D"-shaped exit holes in May and early June. Adults will remain active until the end of summer.

Not EAB:

This commonly encountered beetle (The Six-spotted green tiger beetle *Cicindela sexguttata*) is often mistaken for EAB due to its similar appearance. It is a predator of small insects and is usually found on woodland trails.



Photographs: James W. Smith, David Cappaert, www.invasive.org and PA DCDNR

Signs and Symptoms:

New infestations are difficult to detect, as damage to the tree may not be apparent for up to three years. Signs of older infestation can include branch dieback in the upper crown, excessive epicormic branching on the tree trunk, vertical bark slits and woodpecker damage.



Dieback



Epicormic branching



Bark Slits



Woodpecker Damage

Other Stressors:

Ash may also be stressed by drought, diseases such as ash yellows, and by native insects like the redheaded ash borer, *Neodolytus acuminatus*, (Fabricius) which creates a round emergence hole.



Redheaded Ash Borer

The Cost

- ◉ Invasive insects cost municipalities, property owners, nursery operators, and forest products industries tens of millions of dollars each year.
- ◉ Every year, Wisconsin forests are bombarded with more and more invasive species
- ◉ Each is individually capable of destroying major portions of our state's timber.
- ◉ Without effort to fight these insects, Wisconsin could lose one of its most valuable natural resources.



Why?

- ◉ Take a moment and hypothesize why and how this could happen.
- ◉ How could a handful of different species of insects create this kind of devastating risk?
- ◉ Why is it that we rarely hear about native insects causing this much damage?
- ◉ What is different about these introduced insects?
- ◉ How do we fight this kind of problem?
- ◉ Is this a human-caused problem?



Definitions

- ◉ Invasive species are living species (plants, animals, fungi, or microorganisms) that spread rapidly and cause harm to other species by preventing them from being able to obtain nutrition, reproduce, and/or perform natural functions at a normal rate.
 - *Invasives – living species that disrupt & harm native species*
- ◉ Most invasive species come from another continent.
- ◉ Native species are species that naturally inhabit an ecosystem.



Different Names, Same Problem

- ◉ Invasives can go by many other names, including
 - Introduced species
 - Nonindigenous Species
 - Alien species
 - Exotic species
 - Weeds
 - Pests



Invasives: usually, but not always introduced

- ◉ Most are brought in from other continents willingly or unwillingly.
 - However, some invasive species can be native to an area.
 - E.g. even though it is a native species, some biologists consider Whitetail deer to be invasive when their population surpasses a sustainable level
 - When there are too many deer, understory plants in forests begin to disappear.



Clarification #1

- ◉ Often “*invasive*” and “*introduced*” are used interchangeably
 - While this is often true, it is not *always* true
- ◉ Some introduced species can be very helpful or valuable.
- ◉ 98% of the US food supply comes from introduced plants and animals including...
 - Wheat Rice Cattle Poultry
- ◉ Introduced species are not always bad. Introduced species only become invasive when they displace native species.
 - Wheat rarely displaces a native population w/o humans



Clarification #2

- ◉ There is also a misconception that *all* introduced species become invasive.
 - In fact, most do not.
- ◉ Of every 100 exotic species introduced to North America, only about 10 are able to survive without the planting or assistance of humans
 - E.g. rice does not spread from its field on its own
- ◉ Of the 10 in 100 that can survive without humans, only about 1 of these will cause serious ecological problems.
 - So odds are that only 1% of introduced species become invasive



However...

- ◉ However, this 1% causes more than its share of damage
- ◉ US environmental damage from invasive species is estimated at **\$138 billion per year.**
 - To give some perspective, this cost is more than twice the total value of Wisconsin's entire agricultural industry
- ◉ Zebra mussels alone have caused \$3 billion in damage to the Great Lakes.
 - This equates to ~\$100/yr lost for every man, woman, and child that live in a Great Lakes State because of one species!
 - NOAA: 35 million population; Cornell: \$3 billion cost.



Successful Invaders

- ◎ Invasive species usually have several of the following characteristics:
 1. They grow rapidly and compete with other plants or animals
 2. They produce large numbers of seeds/offspring at a young age
 3. Their seeds/eggs can survive a long time before sprouting
 4. They can travel long distances
 5. They have few if any predators
 6. Their native region has a climate similar to the affected area of the US
 7. They have multiple reproductive strategies.
 8. They have few, if any, specific needs



Invasives: Habitat Generalists

- ◉ Invasive species are often “habitat generalists”
 - They can occupy a broad range of habitats
 - Because they can adapt to many kinds of habitats, they can spread to many parts of the country.
 - They can use or create food in many ways.
- ◉ **Invasives spread well because they don't have specific needs...and many kinds of habitat can fill those needs.**

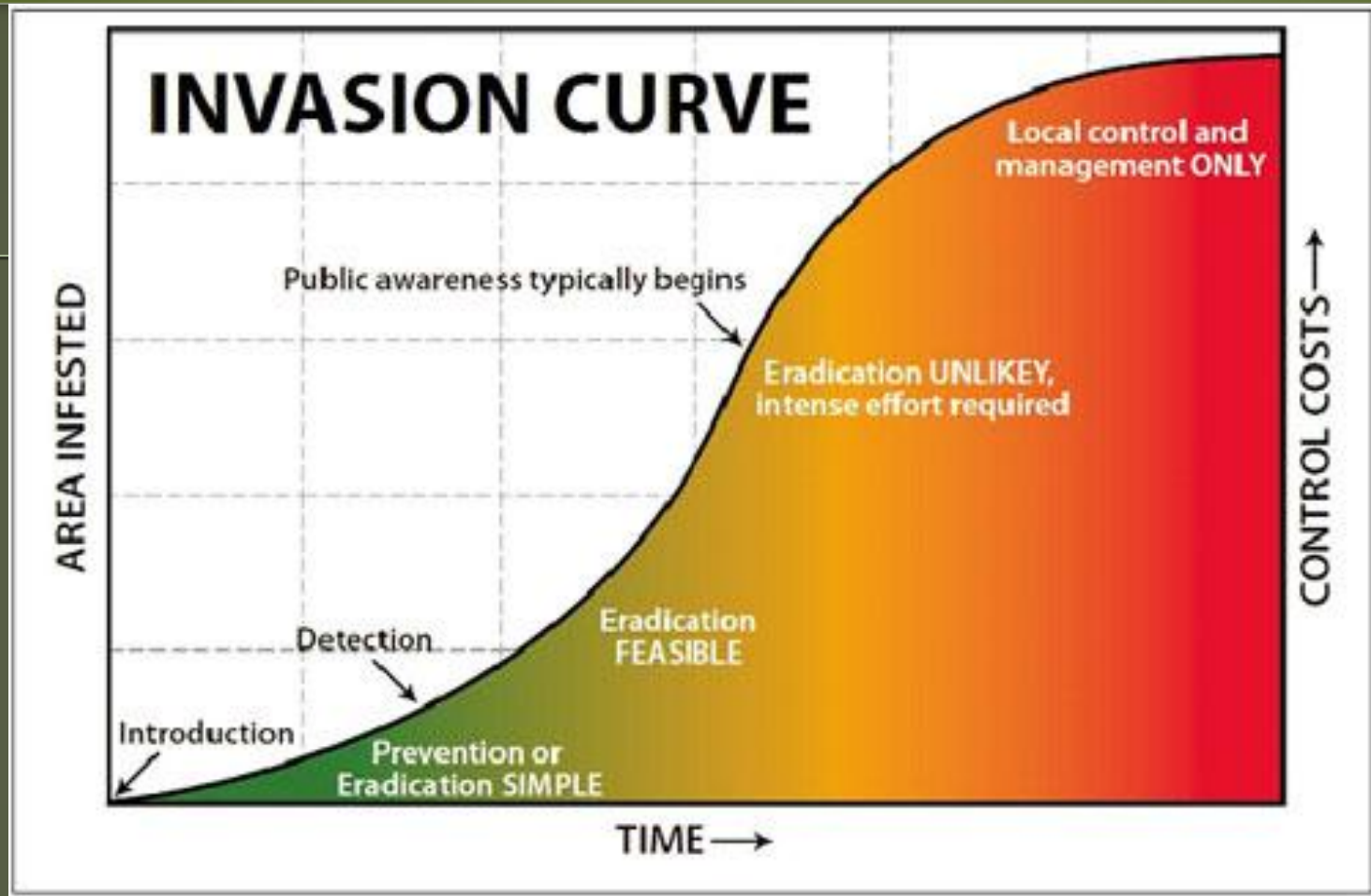


Invasives Compete Well

- ◉ Invasive species can obtain resources more quickly or efficiently than the native species in a habitat due to...
 1. A lack of natural predators in their new habitat.
 2. An ability to tolerate human disturbance
 3. Rapid reproductive strategies
 4. Rapid growth and development
 5. Multiple feeding strategies
 6. Few if any specific physical needs or requirements

- ◉ If unchecked, invasive species have the potential to eradicate some or all native species and interrupt natural ecological processes.





- The biological invasion curve shows that prevention is the cheapest and most effective strategy.
- It also shows that most awareness of an invasive species comes only after eradication is basically impossible.



Sometimes Invasives Have Help (from us!)

- ◎ **Humans aid the spread of invasives in many ways. Two key ways humans help invasives are...**
 - Transportation
 - Habitat Disturbances
- ◎ In every example in this presentation, the invasive species was brought to the US by human activity (shipping, rail, etc.)
 - Invasives very rarely occur unless they have help.



Habitat Succession and Disturbance

- ◉ Transporting invasives allows them to gain access to ecosystems they were a never a part of.
 - Without transportation, invasives would never leave their native regions.
- ◉ Besides transporting invasive species, humans can also aid them through habitat *disturbance*.
- ◉ Habitat *disturbances* are when habitats experience a rapid event that changes the availability of resources such as light or nutrients.
 - Unlike succession which is the slow, sustainable change of habitats



Habitat Disturbances

- ◉ Habitat Disturbances can be natural
 - For example, a fire, flood, or volcano is a natural occurrence that can completely change a habitat
- ◉ Habitat Disturbances can also be manmade
 - E.g. building roads, agriculture, pollution, invasives, urban sprawl, etc.



Examples of Human Habitat Disturbances

- ◉ When humans build roads, roadsides are first disturbed by the construction equipment that makes the road.
 - Later, disturbances occur from the repeated mowing and spraying of herbicides
 - This kind of activity makes native species less competitive.
 - Equipment, people, and introduced animals will help spread the seeds of invasive plants.
- ◉ Because of mowing and herbicides, only grasses are able to survive. Any shrubs or trees and most flowers will be lost.
 - Invasive grasses become even more successful because they can more quickly recover from regular human disturbance.
- ◉ More invasives will be continue to be introduced with continued human activity.
 - As invasive species become more prevalent, they “choke out” native plants and the native animals that need those plants.



Summary

- ◎ Invasive species spread rapidly and cause harm to native species
- ◎ Usually invasive species are introduced
 - However, very few introduced species become invasive because only 1% become established
- ◎ US environmental damage from invasive species is estimated at \$138 billion per year.



Summary (cont.)

- ◉ Invasives spread well because they don't have specific needs...and many kinds of habitat can fill those needs.
- ◉ Invasive species can obtain resources more quickly or efficiently than the native species in a habitat
- ◉ If unchecked, invasive species have the potential to eradicate some or all native species and interrupt natural ecological processes.



Summary (cont.)

- The biological invasion curve shows that prevention is the cheapest and most effective strategy.
- It also shows that most awareness of an invasive species comes only after eradication is basically impossible.



Summary (cont.)

- ◎ **Two key ways in which humans help invasive species are...**
 - Transportation
 - Habitat Disturbances
- ◎ Human activity moves species to locations where they never previously existed.
- ◎ Habitat disturbance can give invasive species an increased ability to compete with native species or reduce native species' competitiveness.

