Zoogeography

Lesson 9

What is a native species?

Native species are those that normally live and thrive in a particular community. They occupy specific habitats and have specific niches in their native environment. They have natural predators that help to keep their population in check

What is a non-native species?

A species living outside its native distributional range, which has arrived there by human activity, either deliberate or accidental. Non-native species are non necessarily invasive.

Zebra mussels (*Dreissena polymorpha*), were accidentally introduced to North America, and are now found in some Pennsylvanian waterways

What is a non-native invasive species?

A non-native species that adversely affects habitats and biodiversity

The **red palm weevil** (***Rhynchophorus ferrugineus*** Olivier, 1790) is a weevil beetle, native to Asia and a deadly pest of many palm species.

Common characteristics of invasive species

Invasive species in general:

- Have few natural predators, competitors, parasites or diseases
- Have high reproductive rate
- Are long-linved
- Are generalists
- Are pioneer species

Characteristics that make Zebra mussels a good invader include its ability to tolerate a widerange of environments, and high reproduction rate; female mussels release up to 100,000 eggs per year.

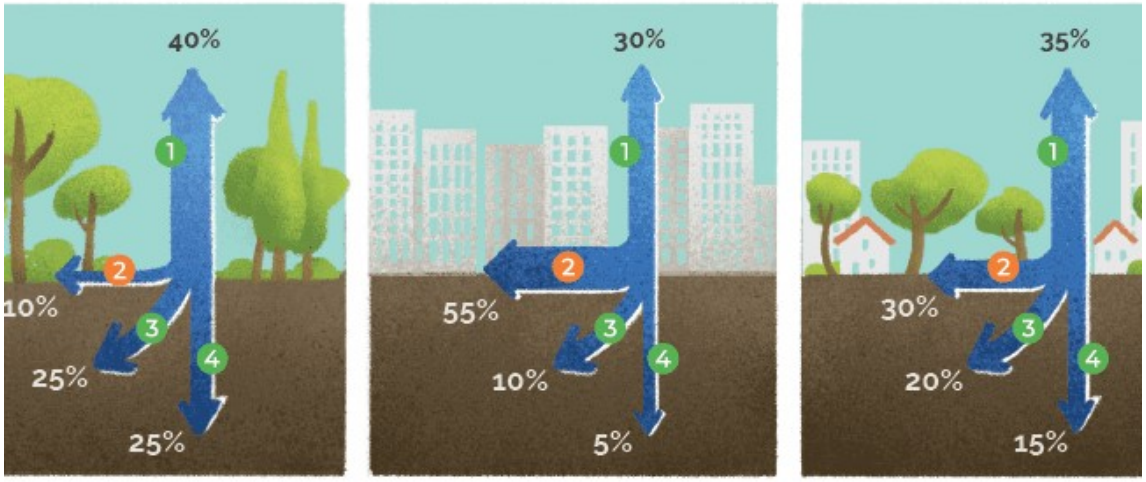
Impacts of invasive species

Displace native species

The feral pig is widely considered one of the worst invasive species throughout its introduced range, particularly in the tropical north (Australia). Feral pigs have a direct physical impact in natural landscapes as ecosystem engineers, as well as in the cultural landscape as pests.

Impacts of invasive species

Reduce forest health and productivity



Rooting by feral pigs directly damages the ground and vegetation and impacts plant species richness; increases **run-off**, erosion and water quality; influences soil chemistry and fungal and microbial life; and slows regeneration.

Impacts of invasive species

Some invasive species kill native species

Pigs can also predate on food sources such as yams, roots, tubers and turtles. In northern New South Wales, feral pigs predate on eggs and chicks of the culturally important coastal emu (*Dromaius novaehollandiae)*, which is at risk of local extinctions (less than 50 animals) because of the small size of the population, habitat fragmentation, and inappropriate fire regimes (Heenan 2020).

Impacts of invasive species

Indirect impacts

Hemlock woolly adelgid is killing Eastern hemlock trees (*Tsuga canadensis*) throughout Pennsylvania and the northeast. Eastern hemlock forests play an important role in maintaining stream temperatures and oxygen levels favourable for brook trout. Hemlock mortality leads to increased water temperatures and oxygen levels, and therefore reduced brook trout populations.

Hemlock woolly adelgid

Hemlock woolly adelgid infestation

Hemlock mortality along stream bank

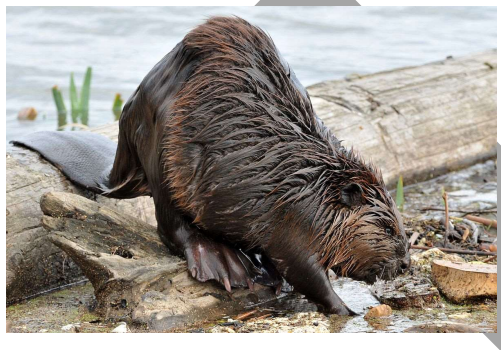
Impacts of invasive species

Economic impacts

Invasive species are responsible for tremendous economic losses through loss in forest and agricultural productivity, spread of diseases that impact humans, among other impacts.

European starlings (*Sturnus vulgaris*), spread diseases to wildlife, livestock, and humans, damage agricultural crops, and displace native birds. Their damage to agricultural crops is estimated at $800 million annually.

The American beaver (*Castor canadensis*), introduced to South America is responsible for the disappearance of 17 million hectares of forest that have become, meadows, peat bogs and shrublands



Mnemiopsis leidyi,
In Adriatic sea since 2016

The Heaven tree,
Ailanthus altissima

New emerging invasive species

The Asian hornet (*Vespa velutina*), introduced to western Europe in 2004, preys on other species of insect, particularly honey bees. This has led to major losses in honey bee colonies, decreasing beekeeping production and therefore impacting local economies. The species is also a threat to public health and incidences of anaphylactic shock due to people being stung have been reported. The full impact of the species invasion as as yet unknown.

Invasion

- The success of a species can, in part, be measured by its geographical distribution, and the ability to move into new areas.
- Introduced into Central Park, New York, in 1891. Since then, it has spread widely and is now present throughout the United States
- It has partially displaced the bluebird (*Sialia sialis*) and the yellow-shafted subspecies of the northern flicker (*Colaptes auratus*).

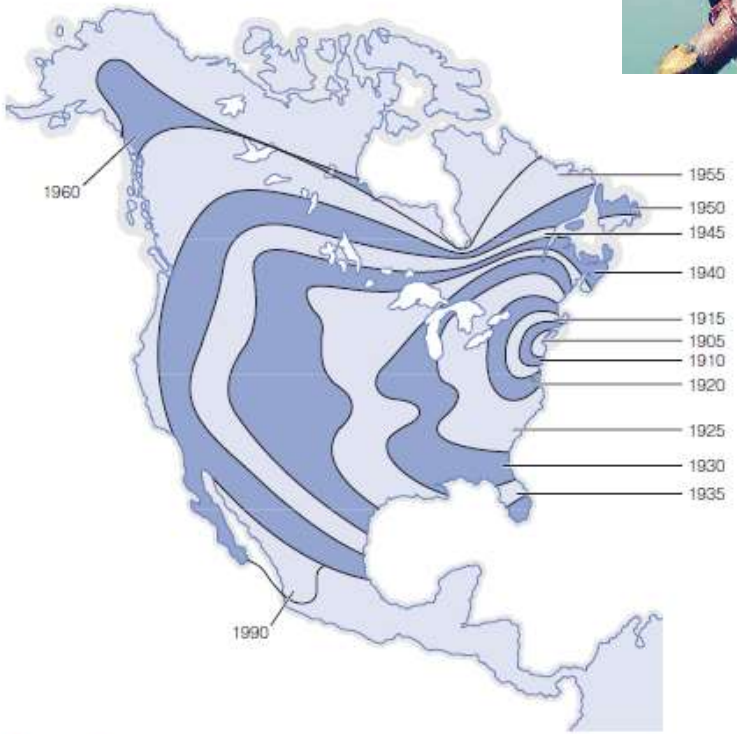


Figure 2.43 Map of North America showing the range extension of the European starling (*Sturnus vulgaris*) following its introduction to the continent late in the nineteenth century. Adapted from Baughman [12].

Invasion

Figure 2.44 Map of North America showing the range extension of the Eurasian collared dove (*Streptopelia decaocto*) since its introduction to the Bahamas in the 1970s. Its spread in North America follows a similarly rapid extension of range in Europe over the last century.

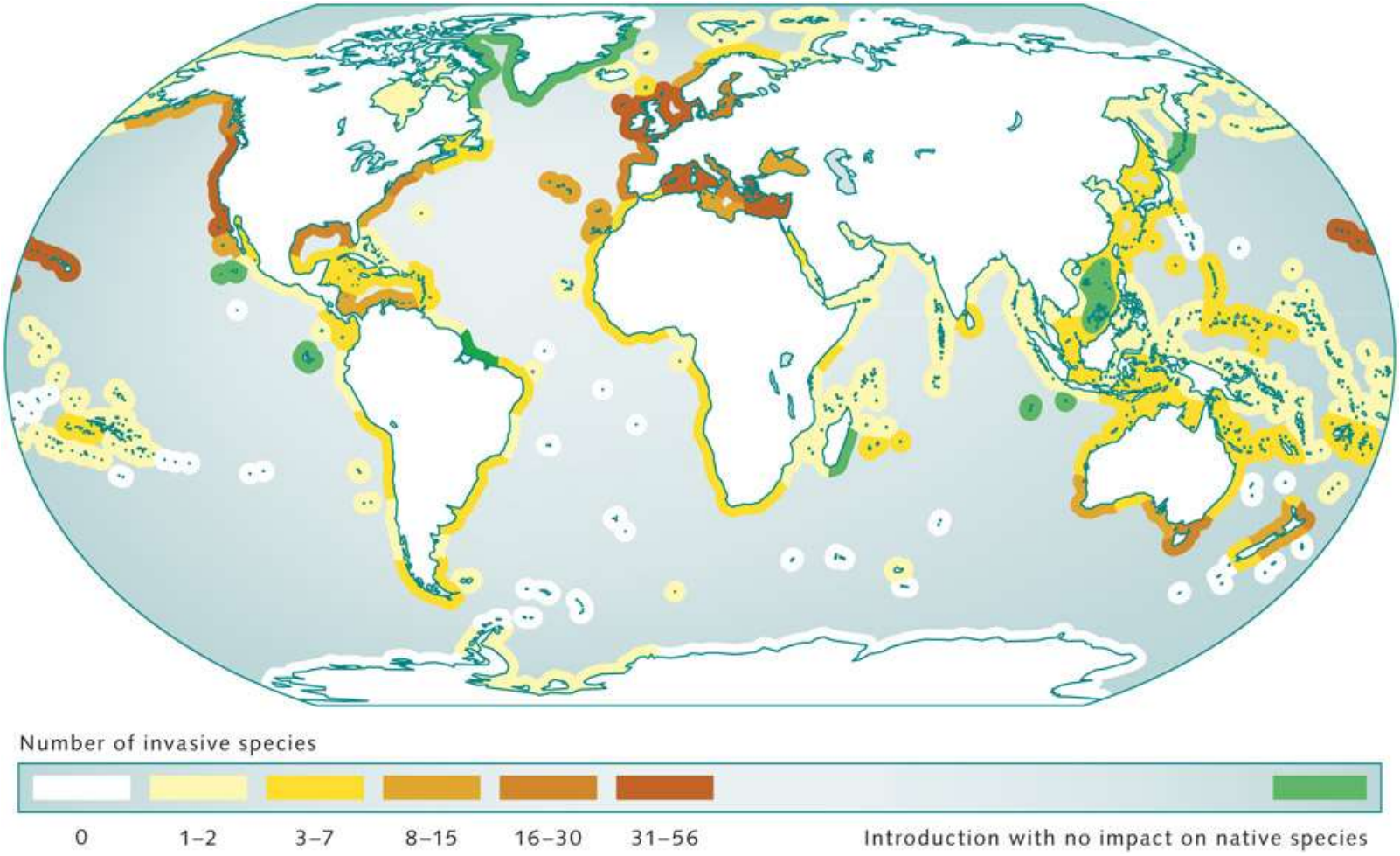
Invasion

- An example is the American grey squirrel (*Sciurus carolinensis*), which was introduced into the British Isles in the nineteenth century.
- Between 1920 and 1925 the native red squirrel (*Sciurus vulgaris*) suffered a dramatic decline in numbers in Britain, largely due to disease.

! The invader must be able to survive the **pressures of predation** and **parasitism** in its new environment and to face biotic resistance of **local populations.**

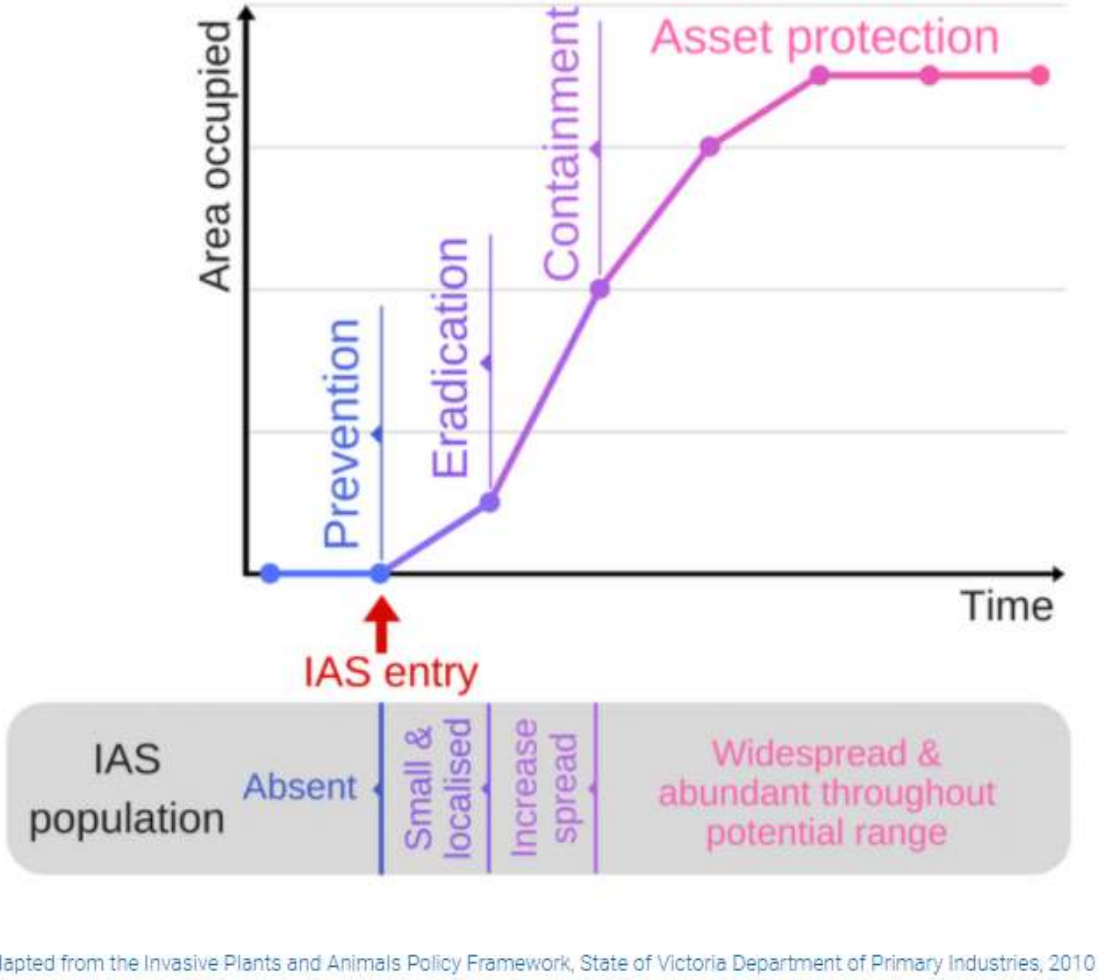
Do not underevaluate the effects of an invader in a new ecosystem!!!

Alien and Invasive species



Invasion

- **Eradication**
- **Biological control**
- **GMOs**



Adapted from the Invasive Plants and Animals Policy Framework, State of Victoria Department of Primary Industries, 2010

What you can do

- When boating, clean your boat thoroughly before transporting it to a different body of water.
- Clean your boots before you hike in a new area to get rid of hitchhiking weed seeds and pathogens.
- Don’t move firewood (it can harbour forest pests like emerald ash borer).
- Don't release aquarium fish and plants, live bait or other exotic animals into the wild. If you plan to own an exotic pet, do your research and plan ahead to make sure you can commit to looking after it.
- Volunteer at your local park, refuge or other wildlife area to help remove invasive species. Help educate others about the threat.
- Stay educated about emerging threats to native flora and fauna so that you can be as aware as possible about how to help combat these pests.
- Report sightings of emergent species to the proper authorities to help monitor their spread and/or control efforts.

a quarter of a billion people around the world suffer from malaria each year.

Anopheles gambiae

dsx-female (*AgdsxF*) exon 5 highly conserved

dsx-male (*AgdsxM*

CRISPR–Cas9-targeted disruption of the intron 4–exon 5

Sterile females

Genetics and Genomics

Simple genetic modification aims to stop mosquitoes spreading malaria

Genetically modifying mosquitoes to express antimalarial genes and pass them on to their offspring is being tested as a new strategy to eliminate malaria.

Research Article

Genetics and Genomics

https://www.nature.com/articles/nbt.4245

Converting endogenous genes of the malaria mosquito into simple non-autonomous gene drives for population replacement

Astrid Hoermann, Sofia Tapanelli, Paolo Capriotti, Giuseppe Del Corsano, Ellen KG Masters, Tibebu Habtewold, George K Christophides, Nikolai Windbichler

Department of Life Sciences, Imperial College London, United Kingdom

Together, with better education and increased awareness