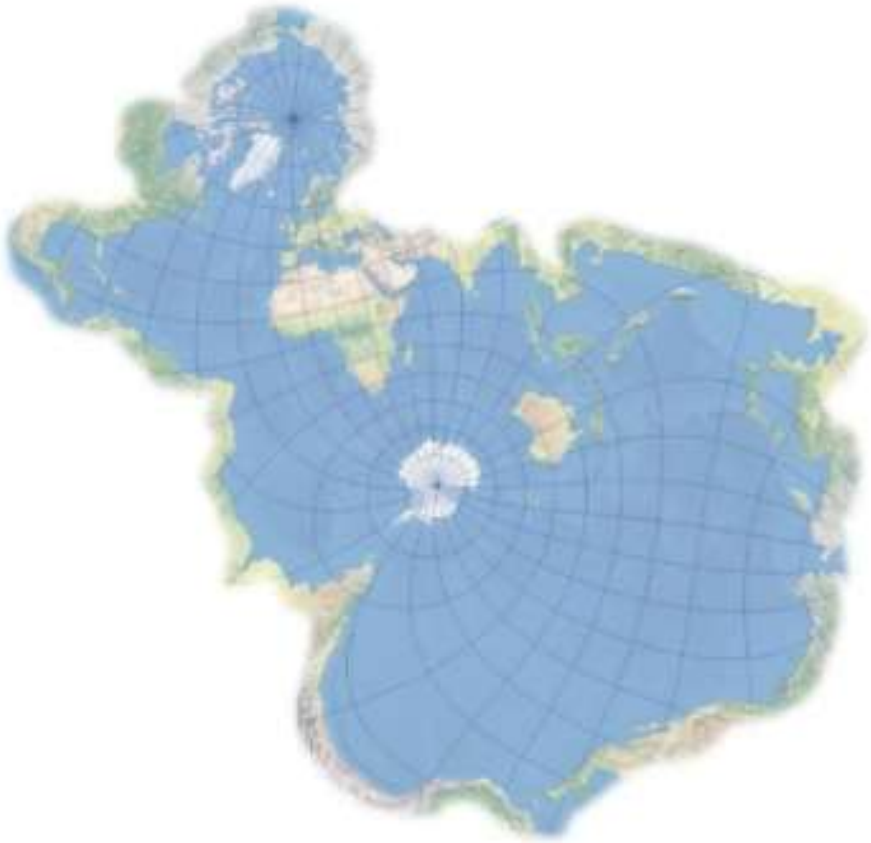
Zoogeography

Lesson 11

World map according to fish



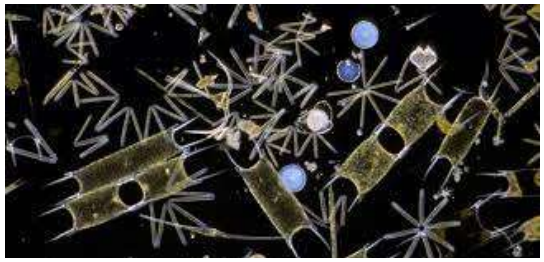
Although pelagic areas may seem like a boundary-less continuum, water chemistry, salinity, depth/pressure, currents and variations in primary productivity create different regions within these systems with distinct biotas and geographies.

- 210 000 species of marine organisms have been described so far

- 1,8 million species from the land

- 250 000 land plant species

- Only 3500-4500 phytoplankton species



Larval dispersal

- The potential efficacy of larval dispersal is shown by the fact that species of benthic invertebrate along the western coasts of the Atlantic are more widely distributed if they have planktonic larvae than if they do not

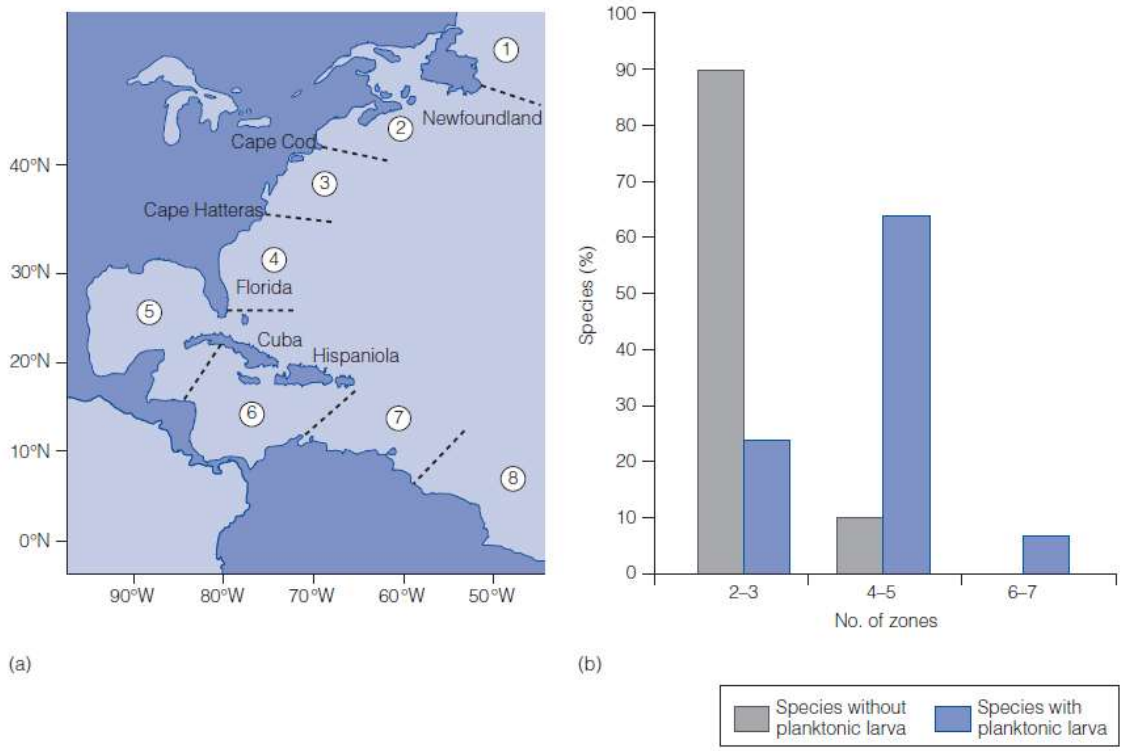


Figure 9.8 (a) Biogeographical zones down the western coasts of the Atlantic. (b) The number of invertebrate benthic species that occupy these zones, with or without planktonic larvae. Adapted from Scheltema [63].

- long-lived larvae will need to feed during the days of dispersal, so it is not surprising to find that such larvae are more common in low latitudes, where the phytoplankton season is long, than in high latitudes, in which it is shorter

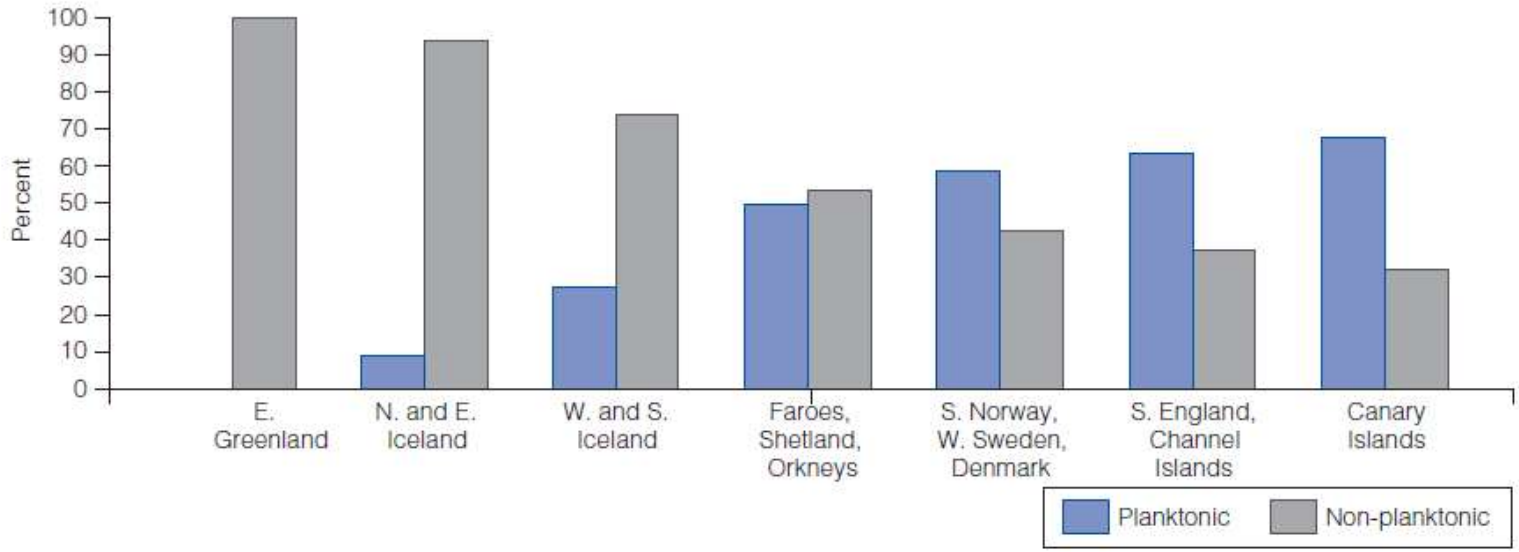


Figure 9.9 The percentage of gastropod species that either have, or do not have, planktonic larvae, at different latitudes. Adapted from Thorson [64].

Coral reefs

- Coral reefs provide a complex, three-dimensional environment that is home for an immense diversity of marine organisms, including 25% of the diversity of life in the oceans, and comprise the greatest diversity of species of vertebrate per square metre known on Earth.
- To date, 35 000–60 000 different species of reef-dwelling organisms have been described, and this is probably only a fraction of the total number.

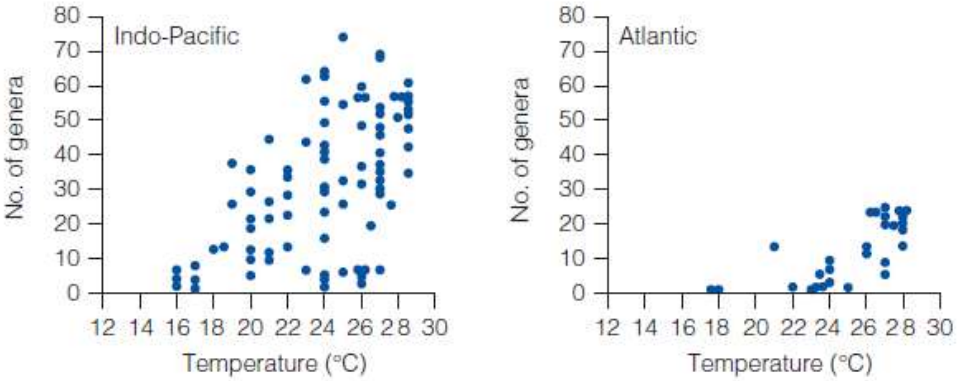


Figure 9.10 The number of genera of coral at different mean annual sea-surface temperatures in the Indo-Pacific and Atlantic oceans. From Rosen [65].

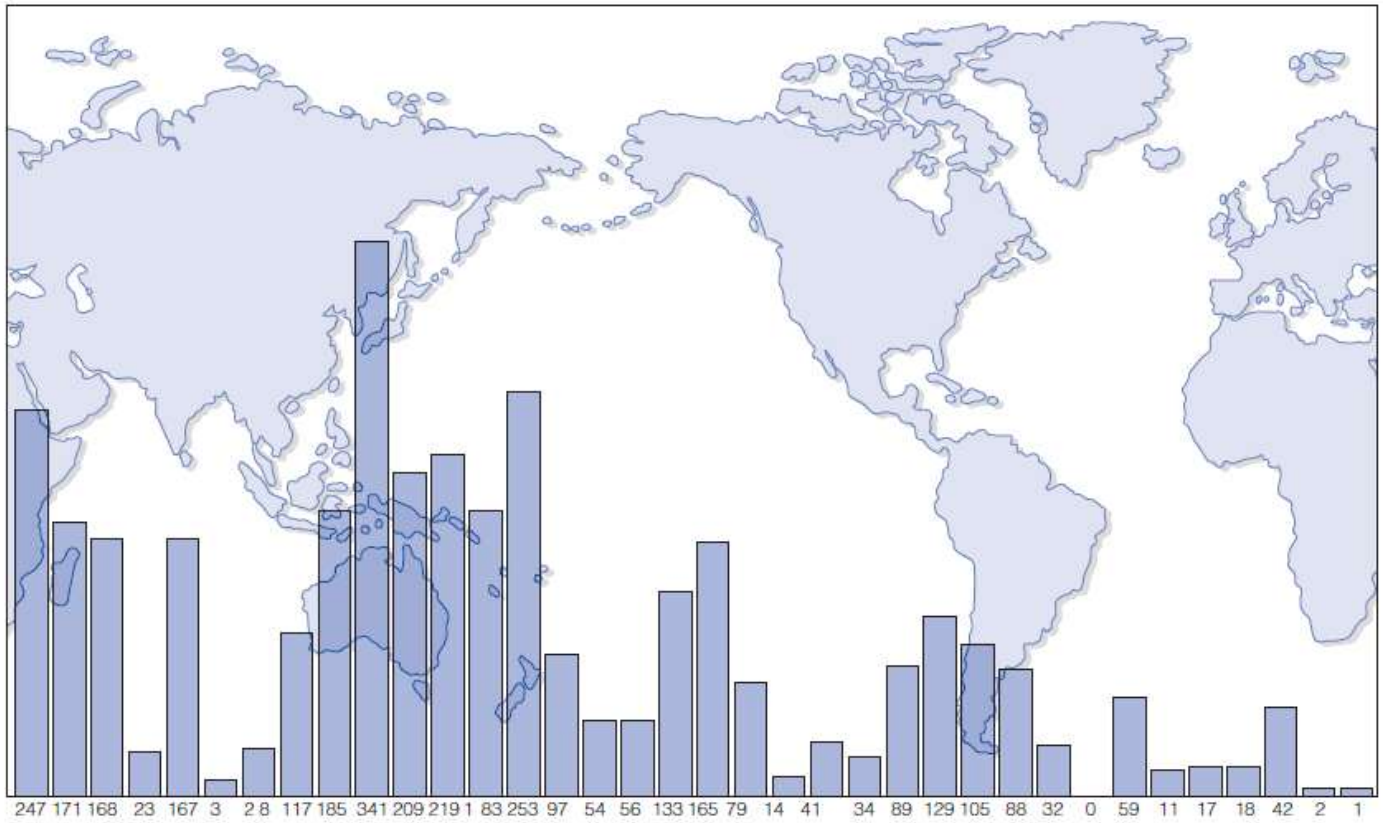


Figure 9.13 Longitudinal gradients in fish species richness. The columns represent the total number of fish species (from a sample of 799 species) that occur in each 10°-wide band of longitude. Note how the diversity increases in the latitudes that include the West Indies and Caribbean, where there are many coral reefs. Adapted from McAllister *et al.*

Migration: Behaviour or Instinct?

- Migration is instinctive (often guided by the Earth's magnetic field for orientation)
- Fly without guidance or previous experience
- Use little or no directional clue
- Learning migration behaviours for most animals is critical to their survival

Migration Behaviours

- Most animals must learn their migratory routes

Older members of the group pass down essential knowledge to younger animals, teaching them the migration route along with valuable strategies and behaviours.

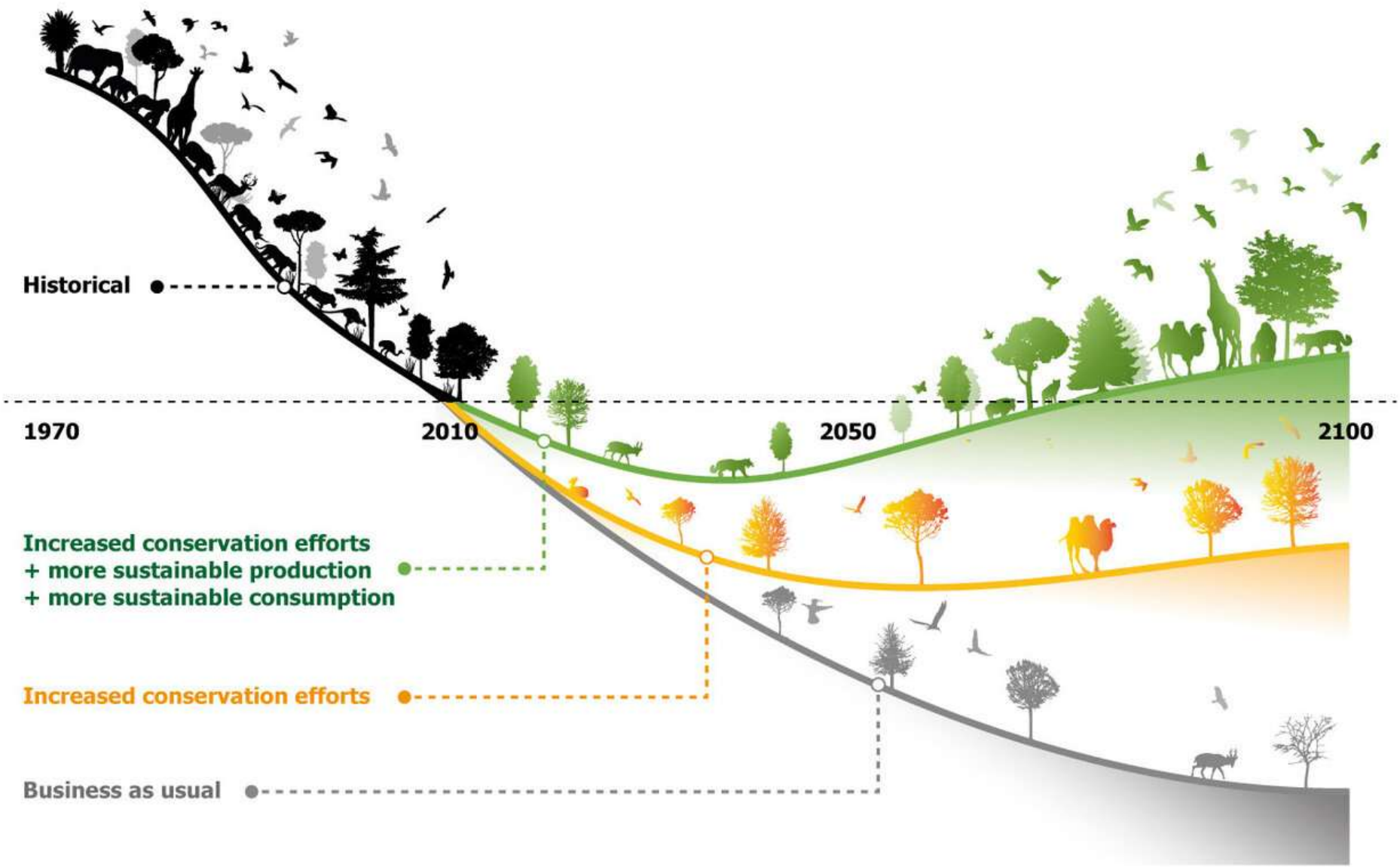
Animals who are not taught these behaviours will not likely survive

Advantages of migration

1. Migration allows birds to secure more favorable living conditions by avoiding extreme climates—such as intense cold, heat, or storms—and by moving to areas with abundant food.
2. By alternating between two different habitats, migratory birds can access varied food sources, enabling larger populations to thrive.
3. Change in habitat provides greater variety in bird diet.
4. long summer days offer extended daylight hours for foraging, which is crucial for feeding their young.
5. Predation pressure is less because it arrives in large numbers in breeding ground, so it help in their survival

Hazards of Migration

- Natural hazards:
  - Climate changes
  - Drought
  - Food supply
  - Predators
  - Physical demands of migration
  - Journey is tiresome, some specimens die during the journey
- Man-made hazards:
  - Barriers (fences, dams and skyscrapers)
  - Water, aircraft, and fishing practices
  - Telegraphic wires, towers, light houses



This artwork illustrates the main findings of the article, but does not intend to accurately represent its results (https://doi.org/10.1038/s41586-020-2705-y)

Key indicators

- **8 million**: estimated total number of **animal and plant species** on Earth

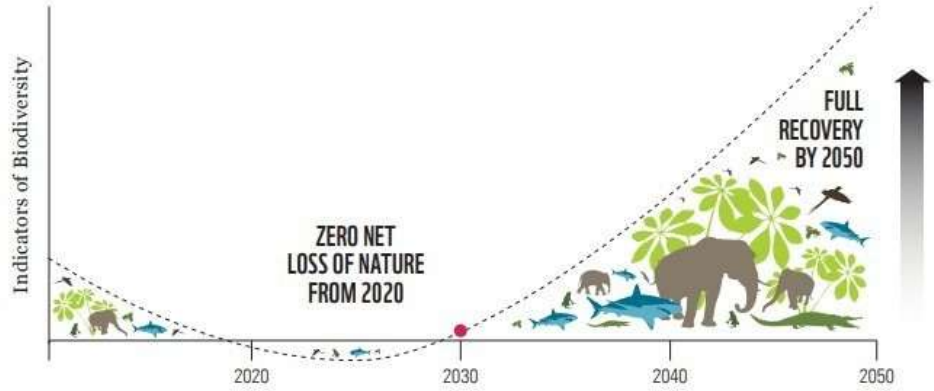
- **1 million**: estimated total number of **species threatened** with extinction

- **75%: Earth's environment 'severely altered'** by human actions

- **66%: marine environment 'severely altered'** by human actions

- **1000 x:** current rate of **biodiversity loss** compared to natural rate

Figure 23: Nature Positive by 2030
A measurable global goal for nature. Source: Locke et al. (2021)[193].



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.

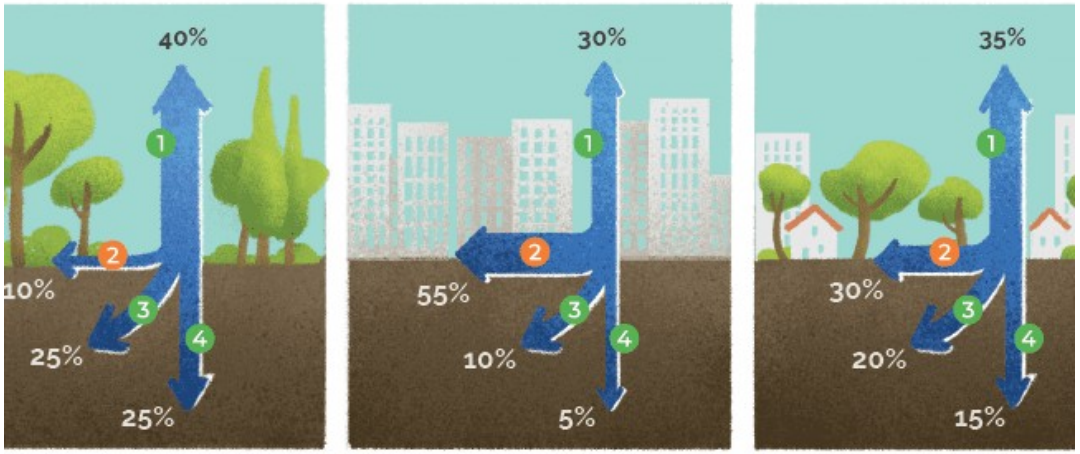
Impacts of invasive species

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