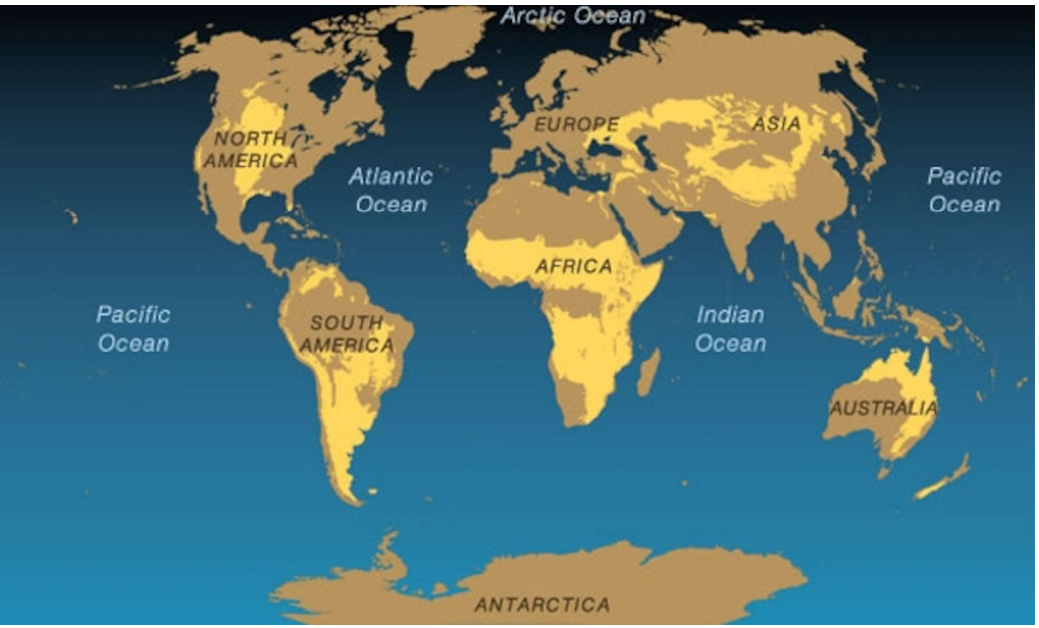
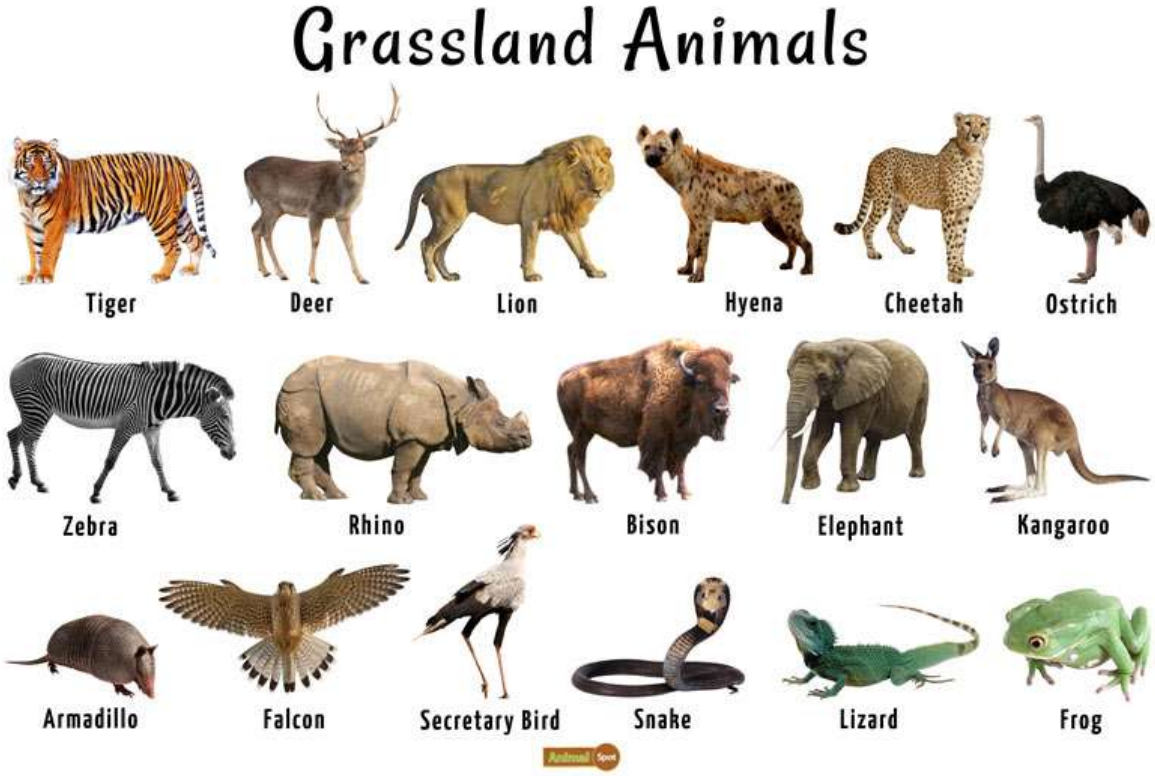
Zoogeography

Lesson 4

Grassland (between 20 and 40% of the world's land area)



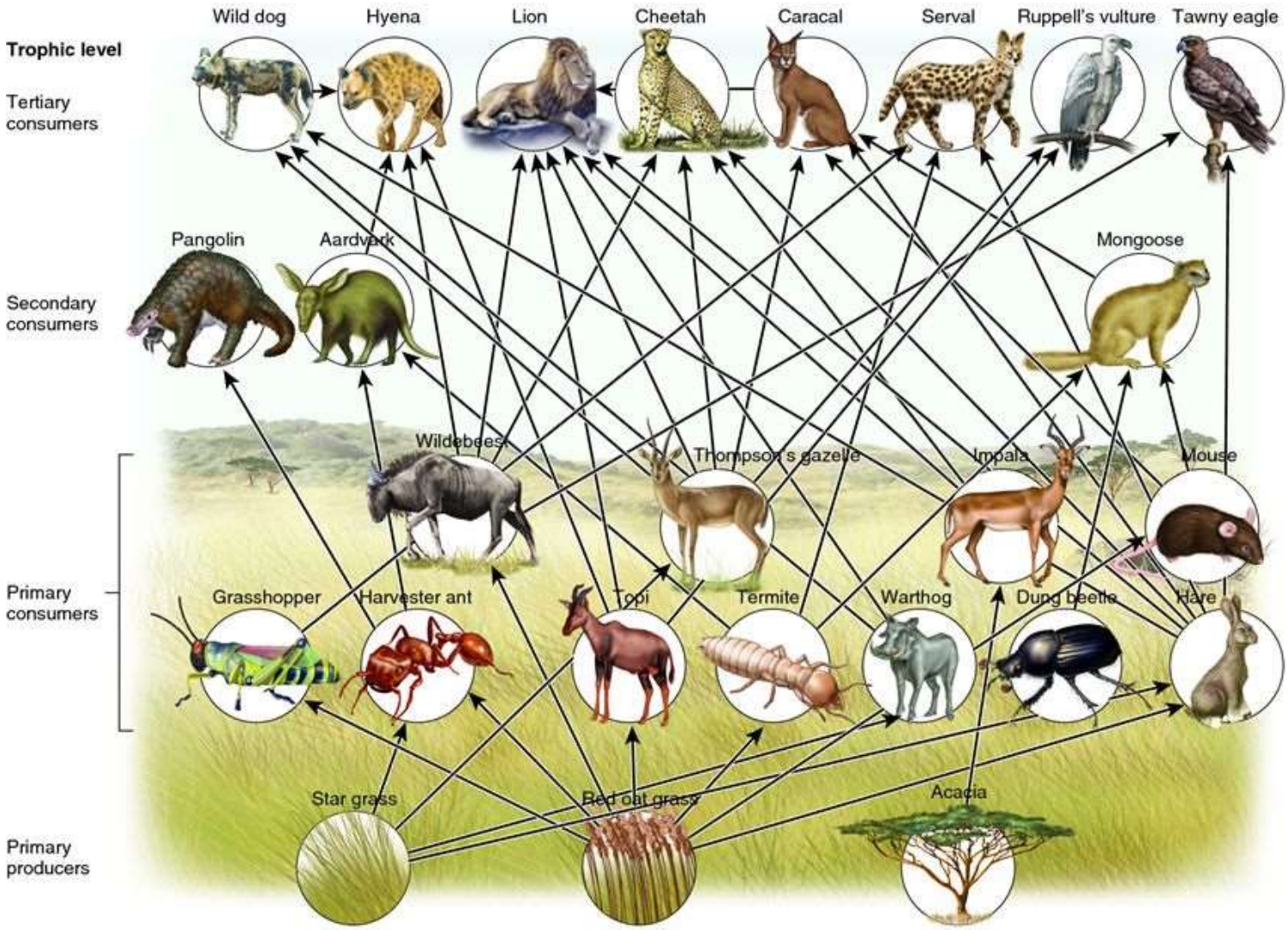


Grassland biomes consist of large open flat areas of grass. Trees can be present, but they are infrequent. The animals found in grasslands range from African elephants (*Loxodonta africana*) to various species of prairie dogs (*Cynomys* spp.).

Low rainfall, wildland fires, and grazing by animals are three factors that maintain grasslands. In grassland regions, the climate is ideal for the growth of grasses only.

Types of grasslands include savannas and temperate grasslands

Food chain


Trophic level
Tertiary consumers
Secondary consumers
Primary consumers
Primary producers
Wild dog
Hyena
Lion
Cheetah
Caracal
Serval
Ruppell's vulture
Tawny eagle
Pangolin
Aardvark
Mongoose
Wildebeest
Thompson's gazelle
Impala
Mouse
Grasshopper
Harvester ant
Topi
Termite
Warthog
Dung beetle
Hare
Star grass
Red oat grass
Acacia

Adaptations

- Many animals have feet, paws, and snouts such that they can burrow into the ground to avoid the daytime heat and stay safe from predators in their otherwise open habitat.
- Most of these species have digestive systems especially evolved for processing grass, which forms a major portion of their diet.
- Numerous animals have body colours to help them blend in seamlessly with their grassland habitat.
- Some animals are nocturnal, adapted with keen eyesight enabling them to hunt in the dark without any difficulty.

- Grasslands occupy nearly 25% of the earth's surface.

- This habitat type is home to the fastest animal (cheetah), the largest terrestrial mammal (African bush elephant), the largest bird (ostrich), as well as the heaviest snake (green anaconda) in the world.

- The prairie grasslands found in North America have been reduced to about 2% of their original area due to urbanization, endangering the existence of the wildlife it supports.

Humans have had a dramatic impact on the grassland biome. Because temperate grasslands have rich soil, most of the grasslands in the United States have been converted into fields for crops or grazing land for cattle. The loss of grasslands due to agriculture has affected several species, including monarch butterflies (*Danaus plexippus*).

In the African savannas, illegal hunting has resulted in the loss of many large animals, including elephants. The elephants protect the grasses of the savanna by crushing trees and shrubs. Without large animals around to stomp down the trees, they can more readily overtake the grasses, causing savannas to turn into forests. The resulting loss of the grasses would mean less food for grazing animals such as Grevy's zebras (*Equus grevy*).

Grasslands could help mitigate climate change: One study found California's grasslands and rangelands could store more carbon than forests because they are less susceptible to wildfires and drought. Still, only a small percentage—less than 10 percent—of the world's grassland is protected.

https://www.youtube.com/watch?v=XmtXC_n6X6Q

Taiga (or Boreal forest)

- Taiga covers 11.5% of the Earth's land area
- Coniferous forests (Eurasia and North America)
- the world's largest land biome
- it exists from the last 12,000 yrs, since the beginning of the Holocene
- After the permanent ice caps and tundra, taiga is the terrestrial biome with the lowest annual average temperatures.
- small variety of animals due to the harshness of the climate

• Cold winters and short summers: challenging for reptiles and amphibians, which depend on environmental conditions to regulate their body temperatures.

•only a few species in the boreal forest including red-sided garter snake, common European adder, blue-spotted salamander, northern two-lined salamander, Siberian salamander, wood frog, northern leopard frog, boreal chorus frog, American toad, and Canadian toad are adapted to Taiga's conditions.

Thamnophis sirtalis

Viper berus

Ambystoma laterale

Lithobates sylvaticus

•More than 300 species of birds have their nesting grounds in the taiga → only 30 stay for the winter.

Wildfires

- It plays a role in shaping the forest (e.g. dominant stand-renewing disturbance through much of the Canadian boreal forest), several species have evolved under conditions of periodic forest fires
- *Fire regime :*

(1) fire type and intensity (e.g., crown fires, severe surface fires, and light surface fires),

(2) size of typical fires of significance (The dominant fire regime in the boreal forest is high-intensity crown fires or severe surface fires of very large size, often more than 10,000 ha (100 km^2), and sometimes more than 400,000 ha (4000 km^2) (Heinselman, 1981).

(3) frequency or return intervals for specific land units (named fire rotation (Heinselman 1973) or fire cycle (Van Wagner 1978)

Human activities

Some of the larger cities situated in this biome are Murmansk, Yakutsk and Arkhangelsk (Russia), Anchorage (Alaska), Yellowknife (Canada), Tromsø (Norway), Luleå and Oulu (Finland).

Large areas of Siberia's taiga have been harvested for lumber since the collapse of the Soviet Union.

In Canada, only 8% of the taiga is protected from development, and the provincial governments allows clearcutting to occur on Crown land, which destroys the forest in large blocks.

Products from logged boreal forests include toilet paper, copy paper, newsprint, and lumber. More than 90% of boreal forest products from Canada are exported for consumption and processing in the United States.

Climate change

In Alaska, the length of the frost-free season has increased from 60 to 90 days in the early twentieth century to about 120 days a century later

to increase water stress and reduce tree growth in dry areas (central Alaska, western Canada and portions of far eastern Russia)

Precipitation is relatively abundant (Scandinavia, Finland, northwest Russia and eastern Canada) and where a longer growth season accelerates tree growth -> replacement with temperate forests

Increase of outbreaks of insect pests (forest-destroying plagues): - *Dendroctonus rufipennis* in Yukon and Alaska - *Choristoneura fumiferana* in North America

Tundra

sub-zero temperatures and short growing seasons

Adaptations: How do animals survive in the tundra biome

Surviving in the cold

•Animals living in the tundra regions have **thick fur and extra layers of fat** to keep them insulated.

•The **bodies** of most animals are **large with short limbs and tails** helping them to retain heat within their body, as much as possible.

•**Birds** of the tundra usually have **two layers of thick feathers** to stay warm.

•Animals like bears, arctic squirrels, and marmots **hibernate** through the winter season.

•Smaller animals like lemmings and stoats dig holes, known as **burrow**s and spend the cold season in there.

•Many animals, especially birds, **migrate** away from the Tundra during the winter season, and come back during the brief summers.

Locomoting on the snow

•Most ground-dwelling species have a characteristic **fur lining on their feet** to prevent them from getting too cold when walking long distances.

Camouflaging to the surroundings

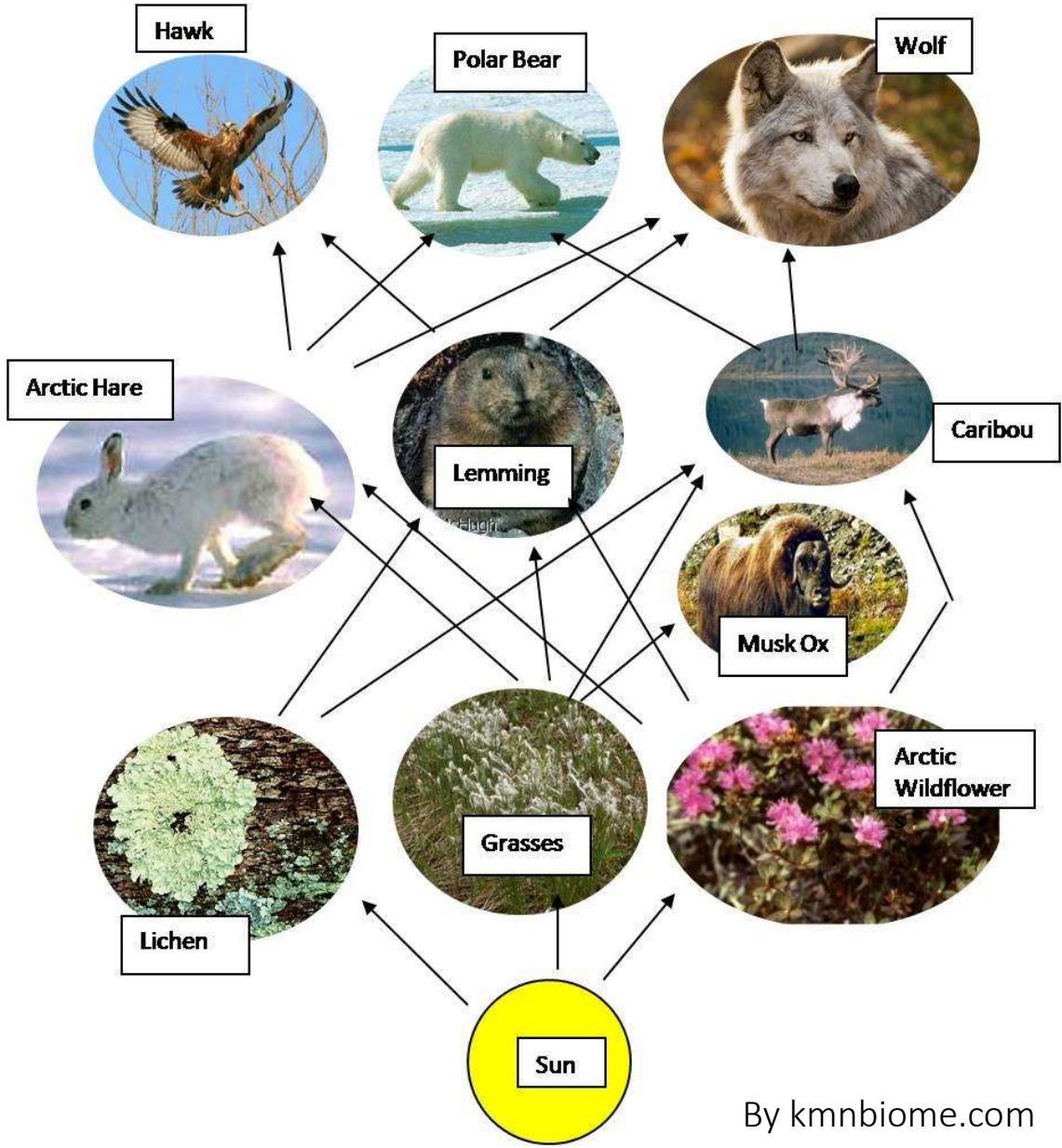
•Many animals of this region are **white in colour** so they can blend in with the white snow, and use it as an effective camouflage. This adaptation is useful for both predator and prey. Arctic foxes **lose their white fur in the summer to maintain the masquerade through that season**.

•Penguins have a **unique coloration** because of their regular forays in the water. For something that looks up towards the surface of the water, the penguin will blend in with the skies above, and for predatory birds looking into the water from above, it blends in with the black background of the sea floor.

Optimizing food resources

- The **competition** for food is naturally **extremely high**, especially during the winter months.

- So, many tundra animals have been seen to **grow at a slower rate** to optimize whatever little food they get during the summer.



By kmnbiome.com

Conservation status: Are there any endangered animals in the tundra?

Because of the **difficulty of access to humans**, and the sheer **inhospitable environment** that it poses to humankind, most of the animals of the tundra ecosystem are relatively safe.

Although the populations of some animals, like polar bears, Eskimo curlews, and the Arctic subspecies of the peregrine falcon, have been on a downward spiral for the past few decades because of the **improvements in technology** and man's ability to finally catch up and deal with the harsh conditions of the tundra.

Did You Know?

•The word **tundra** comes from the Finnish term *'tunturia'*, which means '**treeless plains**.'

•The snow-covering of the ground is thick enough to actually provide ample insulation for burrowing animals.

•Even during the summer season, **the temperatures do not exceed 10°C (50°F)**, and the daytime hours can last for up to 24 hours in the Polar Regions.

•The dominant animals in the tundra food chain, including the Arctic fox, polar bear, and Arctic wolf, **obtain water from the body of their prey**.

•One **example of a symbiotic relationship in the tundra** would be where a fox follows a caribou in search of food so the latter can dig holes in the ground to get lichens for itself, exposing some subnivean animals in the process that the fox can feed on.

•**Polar bears rarely drink water**; they chemically break down fat within their body to make water instead. The fat sources are replenished by feasting on the fatty parts of their prey, particularly the blubbers of seals. Most other parts of the seal's body are left for scavengers.

https://www.youtube.com/watch?v=cTQ3Ko9ZKg8
doi: 10.1146/annurev-marine-010213-135103

Ice

Sea ice covers some **3-7% of the total surface of our planet** depending on the season of the year.

Apart from being one of the most important climatic variables and **key indicator** of climate change, sea ice also provides an extreme and changeable habitat for diverse *sympagic* **organisms**, which play an important role in the ecosystems of the polar seas

The incorporation of micro-organisms from the water column into the sea ice occurs mainly during the ice formation. Ice crystals floating on water surface act as filter collecting particles such as micro-algae, heterotrophic protists and bacteria.

Metazoans can use sea ice either as temporary breeding, nursery and feeding ground or refuge area (allochthonous) or as a permanent habitat during the entire life cycle (autochthonous)

The liquid brine fraction of the ice matrix is home to a diverse array of organisms, ranging from tiny **archaea** to larger **fish and invertebrates**.

Thriving ice **algal communities**, generally dominated by **diatoms**, live at the ice/water interface and in recently flooded surface and interior layers, especially during spring, when temperatures begin to rise.

Although **protists** dominate the sea ice biomass, **heterotrophic bacteria** are also abundant.

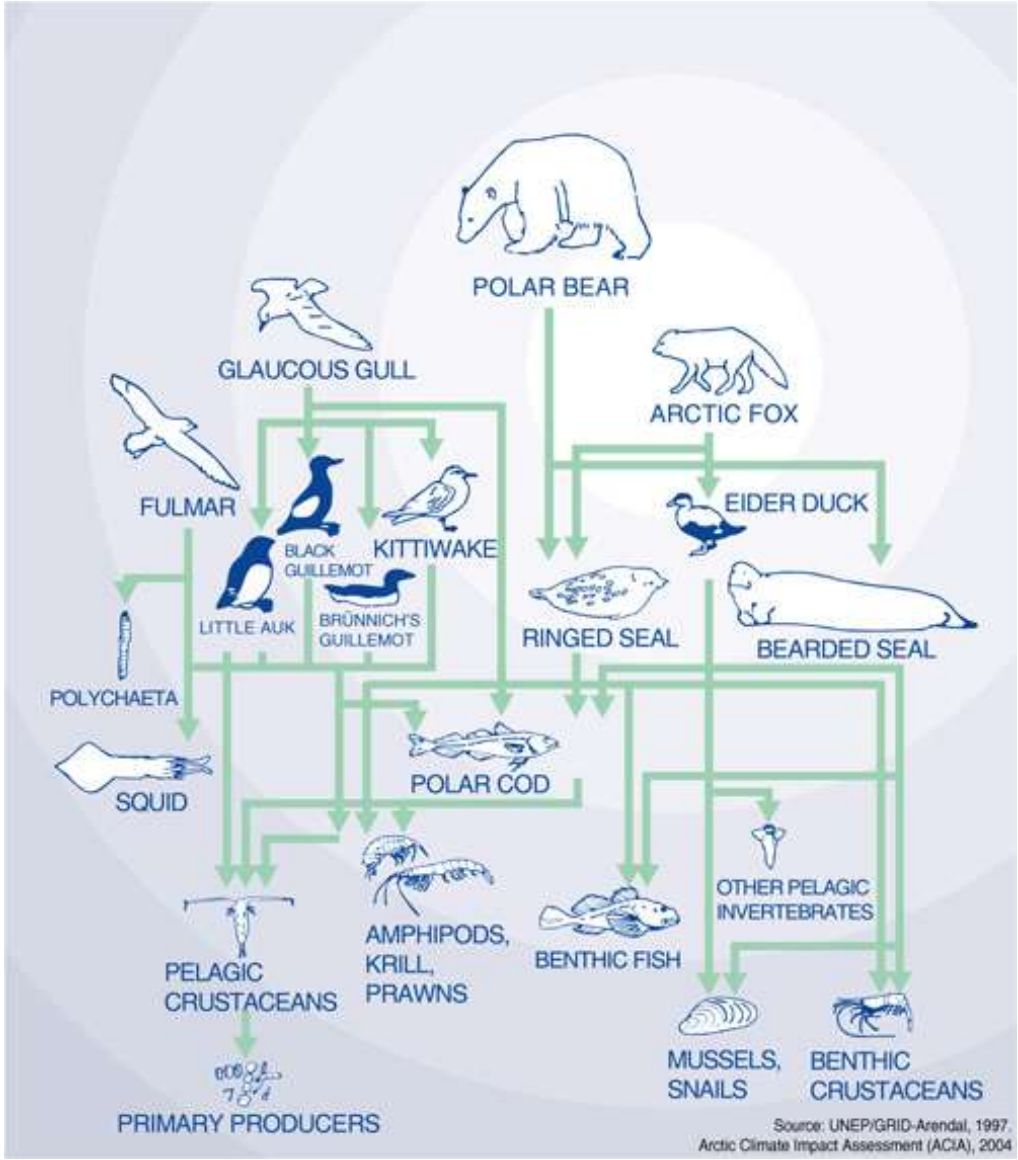
The sea ice ecosystem provides food for a host of animals, with **crustaceans** being the **most conspicuous**. Uneaten organic matter from the ice sinks through the water column and feeds benthic ecosystems. As sea ice extent declines, ice algae likely contribute a shrinking fraction of the total amount of organic matter produced in polar waters.

Arctic food chain

Many birds and mammals are strongly associated with ice which serves as a platform for resting, feeding and reproduction and provides a refuge from predators.

Ice algae contribute considerably to the total primary production in the Arctic (25%) and in the Antarctic (20%) and play an important role in sustaining the secondary production that supports marine mammals and birds.

Killer whales are the apex predators hunting for an diverse array of species including penguins, seals and other cetaceans



Threats

Polar regions have experienced **significant warming** in recent decades.

Climate-inducted changes have been most pronounced across the Arctic Basin and along the Antarctic Peninsula, with significant decreases in the extent, thickness and seasonal duration of sea ice.

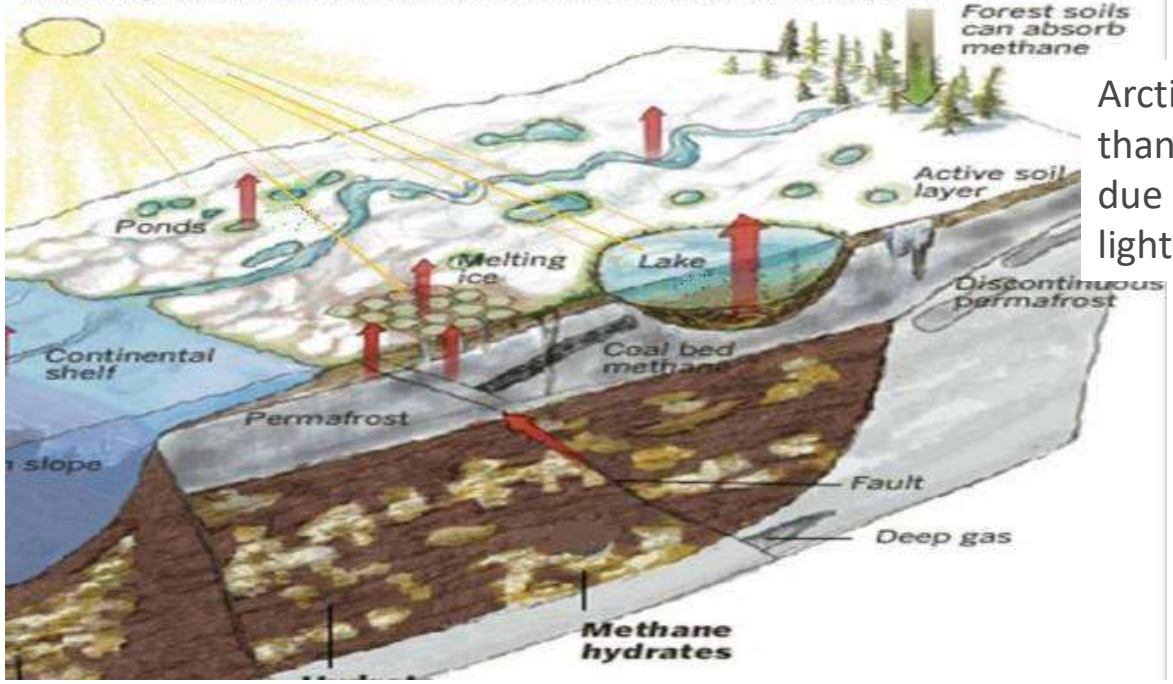
These changes have severe ecological consequences for the sea ice biota. The **habitat loss** and **changes in productivity**, species composition and **community structure** of the under-ice community have a negative impact on higher trophic levels. Warming can also affect the sea ice ecosystem through **changes in hydrography** which include **introduction of species from lower latitudes**. The decline of the sea-ice extent will improve the accessibility of the high latitude areas. That may led to increase of anthropogenic pressure on polar ecosystems (ship traffic, exploration, industrial activities and fisheries)

As the Arctic warms it emits methane

The rapid warming of the Arctic is thawing the solid frozen soil ,called permafrost.

As the permafrost thaws it emits methane. New ponds and thaw lakes keep emitting a lot of methane

The Arctic permafrost holds double the amount of carbon in the atmosphere



Arctic–boreal regions are warming nearly **four times faster** than the rest of Earth, and fire activity is projected to increase due to associated decreases in fuel moisture and increases in lightning ignitions

The release of methane gas is imminent, should the permafrost begin to thaw out in the summer, the dead plant material will begin to decompose, releasing the gases into the atmosphere. **Methane is able to trap heat 20 times more efficiently as compared to carbon dioxide**, and this is why the tundra, essentially prospering atop the permafrost, can lead to an *accelerated rate* of global warming

Freshwater

https://www.youtube.com/watch?v=R2DU85qLfJQ

- all continental aquatic environments. As the name indicates, freshwater is characterized by **low concentrations of salt** (containing less than 0.05% of dissolved salts) as opposed to seawater.

- **Freshwater only accounts for about 2.5–2.75% of all water on Earth.**

- However, 1.75–2% of freshwater is frozen in polar ice caps and glaciers as ice, and 0.5–0.75% exists as groundwater

↓

This leaves about 0.01% of freshwater on the surface where fish can live.

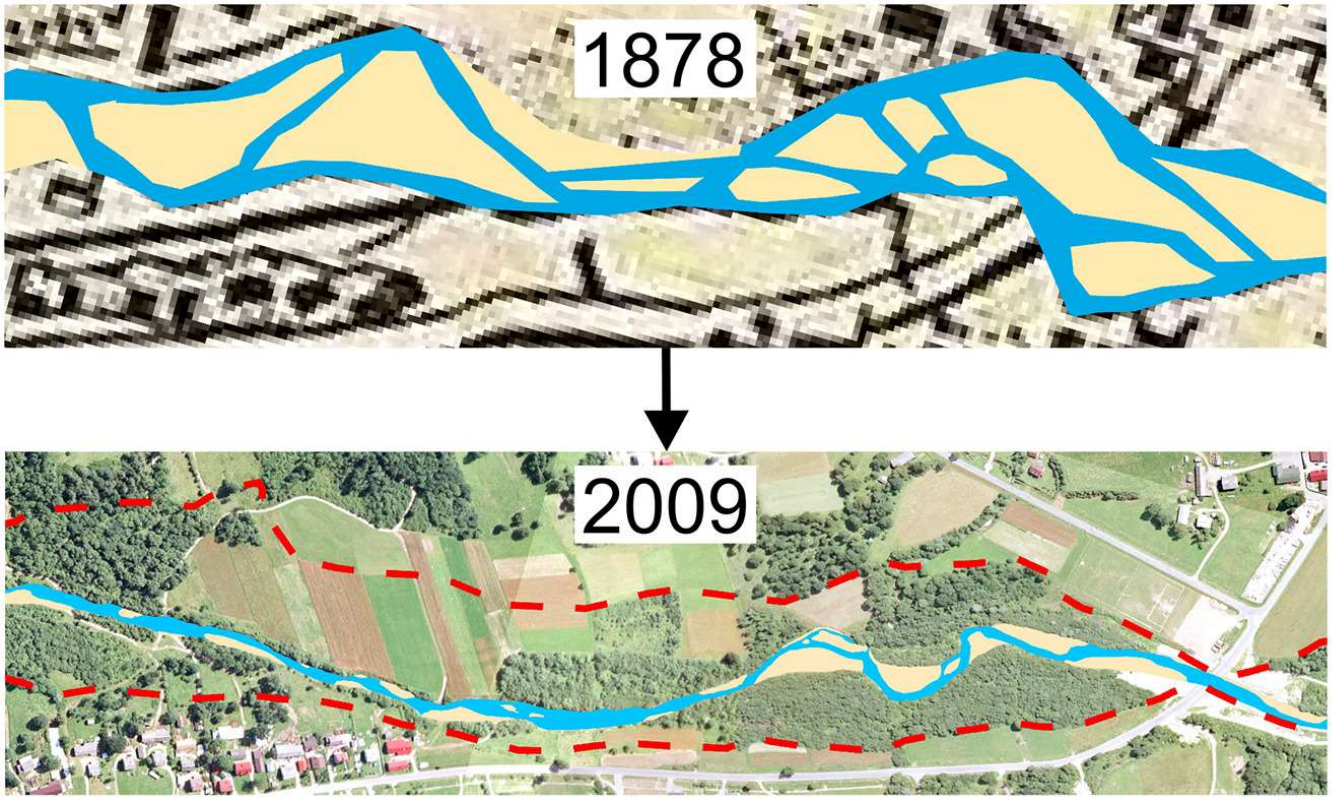
- nearly three-quarters of freshwater is concentrated in the Great Lakes region of Africa, the Great Lakes in North America and the Baikal Lake in Siberia

Threats

- The creation of dams and water-diversion systems blocks migration routes for fish and disrupts habitats.

- Water withdrawal for human use shrinks and degrades habitats.
- Runoff from agricultural and urban areas hurts water quality.
- Draining of wetlands for development depletes habitats.
- Overexploitation and pollution threaten groundwater supplies.

- Invasion of exotic species can harm native animals and plants.
- Global warming may lead to devastating floods and droughts.



Hadjdukiewicz and Wyzga, 2023

ANALYSIS OF HISTORICAL CHANGES IN PLANFORM RIVER GEOMETRY:

- diagnosis of hydromorphological river degradation justified establishing of an erodible river corridor
- identification of the belt of historical river migration helped delimit the erodible river corridor
- recognition of the degree of river narrowing indicated the potential for future river widening in the corridor

https://www.nationalgeographic.com/environment/article/freshwater-threats