Why are cold environments considered fragile?

What are the characteristics of cold environments?

Lesson Objectives:

By the end of the lesson you will be able to:

1. Appreciate why cold environments are considered fragile.

2. Understand how plants and animals have adapted to these conditions.

Fragile Ecosystems

- Climates (precipitation, temperature and wind) in cold environments vary considerably- mountainous to glacial.

- Vegetation must adapt to these conditions –

Case Study- The Arctic – highly seasonal climate – cold winter and short summer.

Vegetation has adapted to characteristics of the climate through being small in size and predominance of perennials (plants living for several years).

Case Study - Arctic (Tundra) Ecosystems

Arctic tundra is a harsh environment for plant growth – WHY?

- Low temperatures
- Prolonged snow cover
- Strong winds
- Short growing season
- Thin nutrient deficient soils.

Vegetation in Cold Environments

- Plant cover is reduced towards the poles due to drier and cooler climate and shorter summers.
- Plant cover and height is decreased.
- Polar deserts – less than 10% vegetated. Although, locally, in favoured locations moss and lichen may cover a large proportion of the area.
- In Antarctica there is a very limited cover of lichen and some mosses in crevices.
- Soils lack organic material.

Vegetation found in cold environments

	Adaptation	How the adaptations help for life in the Arctic
1	Prostrate (low-lying) shrub	Insulation beneath snow, warmer microclimate.
2	Cushion plants	Low-lying plant close to the ground surface so that it reduces the impact of windspeed on water loss. Warm microclimate (cushion up to 25°C warmer than air).
3	Annuals rare	Growing season too short for full cycle.
4	Herbaceous perennials common	Large underground root structure, store food over winter.
5	Reproduction often by rhizomes, bulbs or layering	Avoids reliance on completing flower–seed production cycle.
6	Pre-formed flower buds	Maximises time for seed production.
7	Growth at low temperatures	Maximises length of growing season.
8	Optimum photosynthesis rate at lower temperature than most plants	Maximises length of growing season.
9	Frost resistance	Can survive at low temperatures – true of flowers, fruit and seed.
10	Longevity	Suitable for 'opportunist' life style; lichens may live for several thousand years.
11	Drought resistance	Suitable for rock surfaces or arid climates.

Figure 3.33 Adaptations of Arctic vegetation

Highlight the main ways plants have adapted to cold environments

How do geomorphological processes and landforms influence vegetation?

Slope angle and aspect (way it faces) influences the local climate (temp etc) and moisture availability.

Eg In East Greenland dwarf birch are located on the tops of hummocks while sedges are located in the wetter depressions.

Frost heave (mass movement) makes it difficult for roots to establish, so areas of active soil movement often are devoid of vegetation.

How have animals adapted to cold environments?

1. Very few species (of 8600 bird species only 70 breed in Arctic.
2. Large numbers of a single species eh lemmings, caribou.
3. Population numbers are cyclical.

Many species only exist in the Arctic – know as **endemic species**. Many are genetically unique, some are migratory.

See fig 3.37 – and highlight how animals have adapted to their conditions.

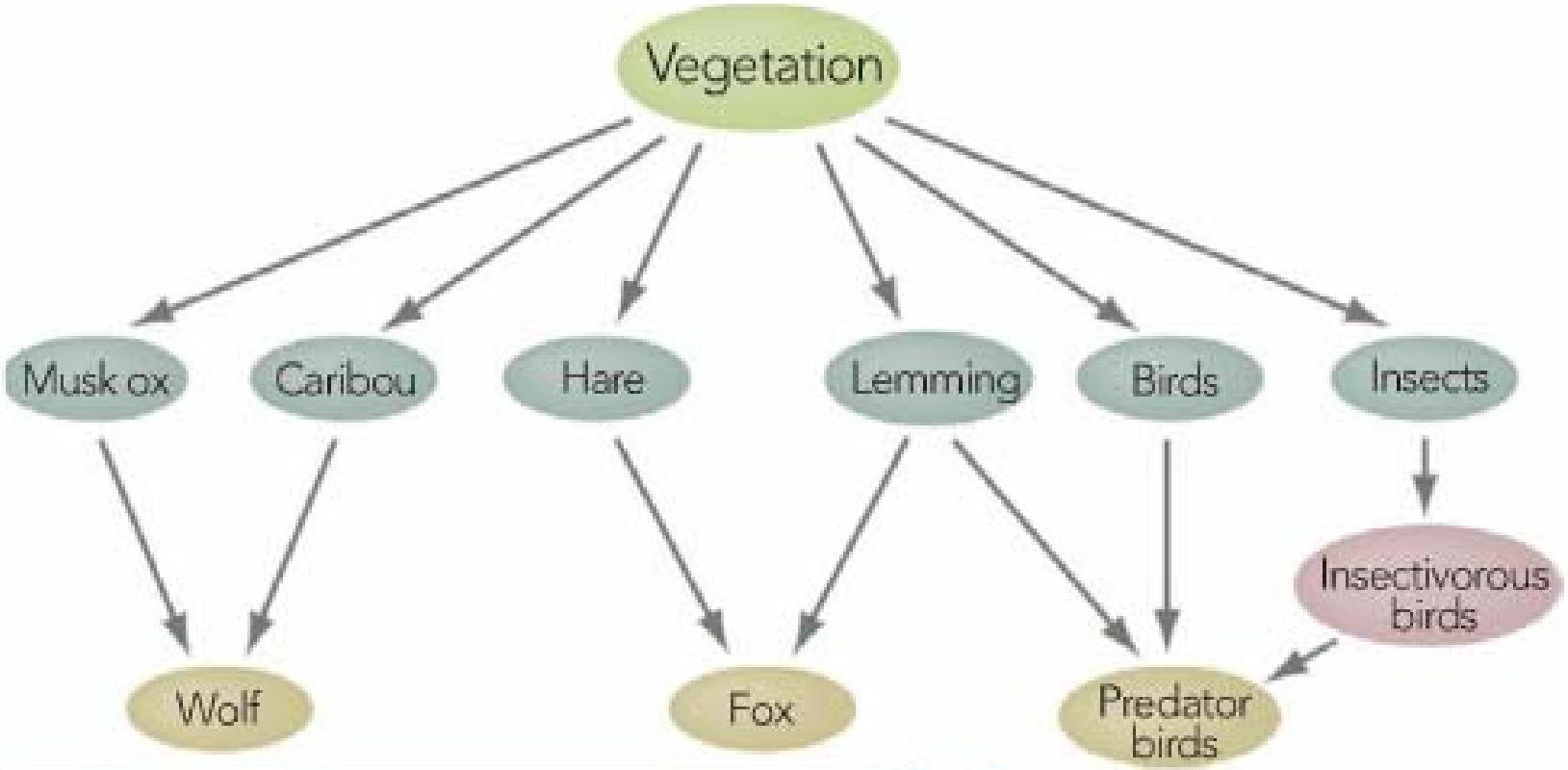


Figure 3.38 A simplified tundra foodchain

What are the problems of the food web in cold environments?

Soils – why are soils a problem in cold environments?

- Bacterial activity is low – low temperatures and waterlogged conditions stop the recycling of nutrients and decomposition.
- Soils often waterlogged as drainage is poor- especially in permafrost zone. Although active layer thaws in summer, sub soil remains frozen – waterlogged.
- Soils contain angular fragments as a result of freeze-thaw and frost heave.
- Common soils found in tundra areas are tundra gleys.
- Where soils are better drained podzols develop – show distinct soil horizons.

Nutrient Cycle

Nutrients are essential for plant growth – but the cycling of nutrients can be difficult in cold environments because:

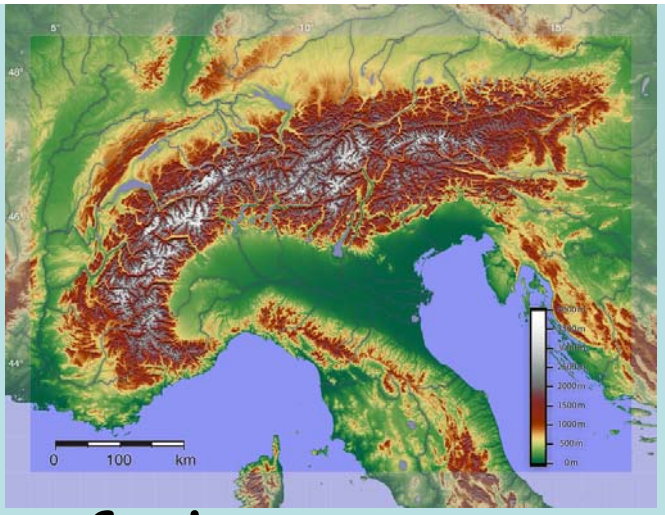
1. Amount of nutrients in soil are limited because the rate of mineral weathering is slow= low nutrient level in soils.

2. Precipitation levels are low – why?

Therefore few nutrients are dissolved in rainfall.

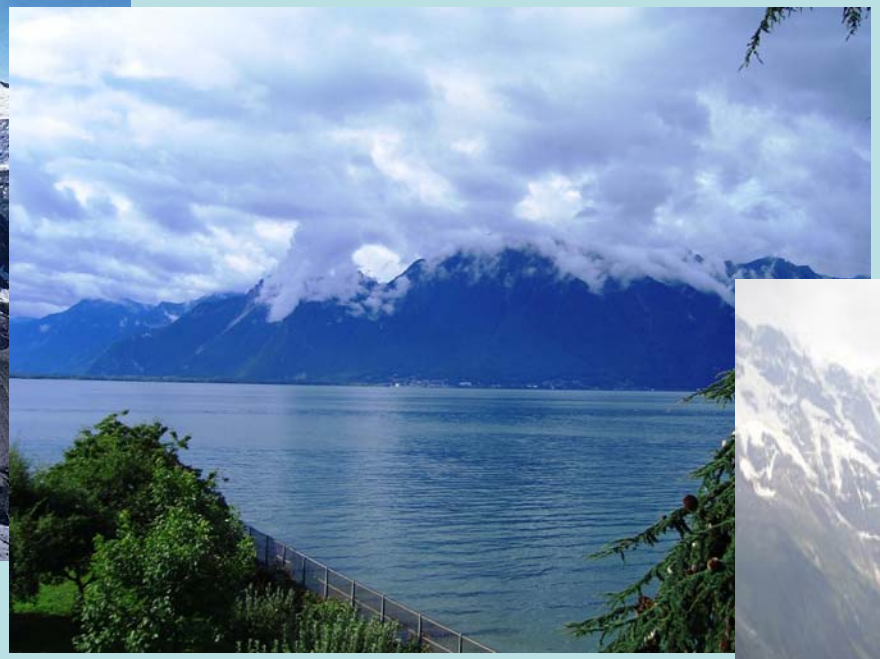
3. Frozen ground/ snow cover make it difficult for plant roots to reach/ absorb limited supply of nutrients.

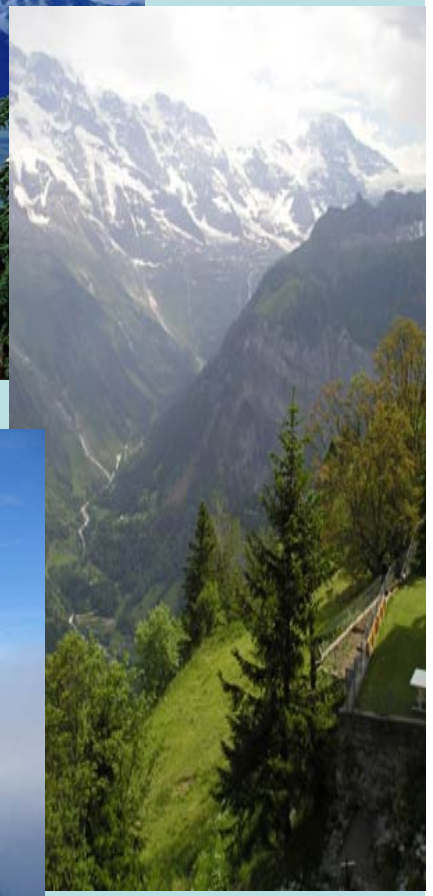
Case Study – Climate and Ecosystems in the Alps



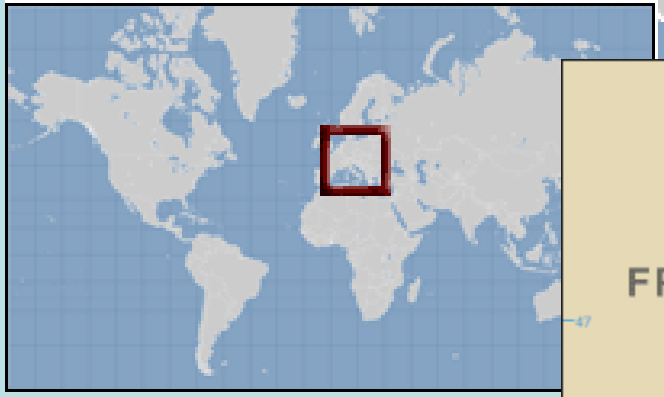
The Alps is the name for one of the great mountain range systems of Europe, stretching from Austria and Slovenia in the east, through Italy, Switzerland, Liechtenstein and Germany to France in the west.

We will be concentrating on the Swiss Alps.





Switzerland



Swiss Alps

Use the Text book to complete a case study about the Swiss Alps.

1. What is the climate like? Give examples and figures.

2. What are the characteristics of vegetation and how has it adapted to the environment?

3. Describe animals life in the Swiss Alps.

4. Describe and suggest reasons for the change in vegetation in the Swiss Alps with altitude.

Extension: How might the ecosystem be threatened?

Why are cold environments not fragile?

- Small number of species and slow growth rate- Population numbers vary greatly. Large oscillations provide polar and artic ecosystems with resilience and can survive change – eg Climate change.

- Disturbance of permafrost – changes are restricted to areas where there is a high proportion of ground ice – stability may be achieved.

- Few number of species – decline of one species has an impact on others – food chain – often only small numbers that can easily become extinct by indigenous communities.

- The tundra ecosystem has great spatial range allowing small areas to recover – problems occur when the ecosystem becomes fragmented and the opportunity for recovery becomes limited.

Human impact on the environment…

- Ice-rich permafrost can be destroyed by heat from buildings, pipelines, changes in vegetation cover and the impact of vehicles and machinery.
- Thermokarst refers to the subsidence that occurs as permafrost melts. It results in the formation of pits and hollows which are often filled with water.
- Common cause for man-induced thermokarst is the removal of vegetation for agriculture or construction.
- Movement of vehicles can also cause this.
- This melting of the permafrost can lead to further damage of vegetation and erosion of the landscape.

Homework…

Issues associated with the development of cold environments.

Make notes under the above heading from 118-120.

Due: Fri Lesson