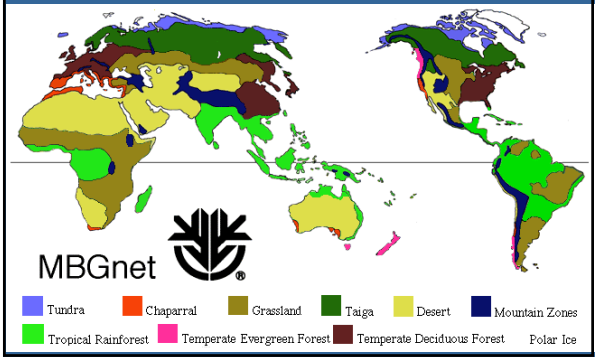
The biomes of the world

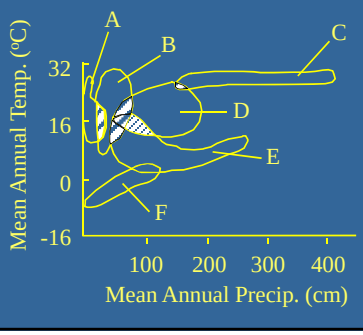


Biomes

Biome -

There are many terrestrial biomes on Earth

Climograph for North American Biomes



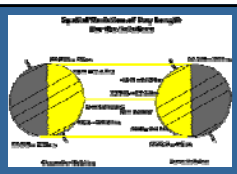
Tundra

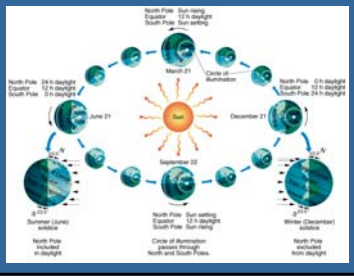
~ 7% of the terrestrial biosphere

Two types of tundra

- Arctic
  Climate & Location

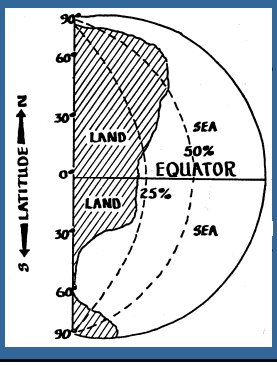
Soils





The **circle of illumination is the division between day and night over the earth. The circle of illumination bisects (cuts in half) all latitudes on the spring and autumnal equinoxes. At this time, all places have equal day length (12 hours). The circle of illumination always bisects the equator (0 degrees latitude).**

Not Found in S. Hemisphere



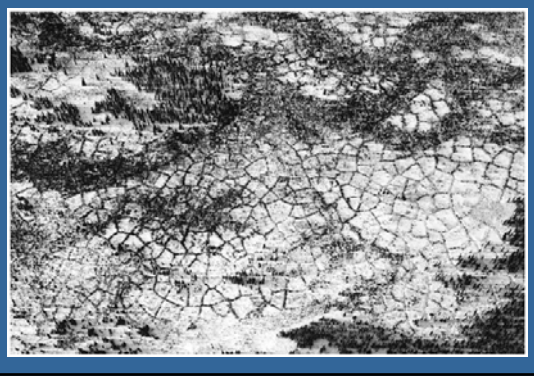
Dominant Soil Order is: Gelisol

Gelisol

Presence of permafrost or soil temperature of 0ºC or less within 2 meters of the surface; formed through the process of gleization.

Wet conditions slow decay allowing organic matter to accumulate and organic acids to be released. Organic acids react with iron to give a black/bluish-gray color.

Patterned Ground



Arctic tundra

Vegetation

Productivity is low (ca. 103 g C m^{-2} yr^{-1})

2% of total terrestrial productivity on Earth

Arctic tundra

Animals

Year round –

Winter –

Migrants –

Essentially no reptiles & amphibians

Why???

May have large oscillations in population size

Brown Lemmings

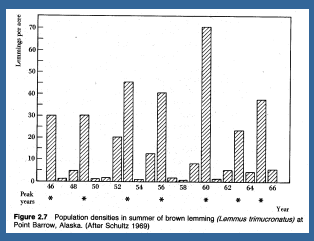


Figure 2.7 Population densities in summer of brown lemming (*Lemmus trimucronatus*) at Point Barrow, Alaska. (After Schultz 1969)

Changes in Latitude Changes in Altitude

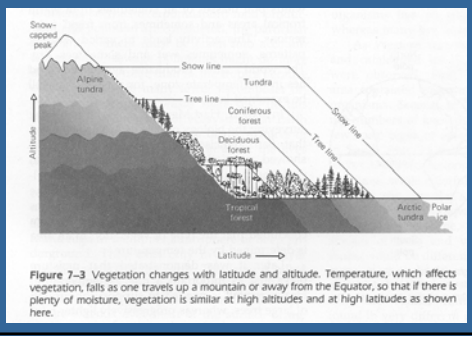


Figure 7–3 Vegetation changes with latitude and altitude. Temperature, which affects vegetation, falls as one travels up a mountain or away from the Equator, so that if there is plenty of moisture, vegetation is similar at high altitudes and at high latitudes as shown here.

Alpine tundra

Communities similar to arctic tundra

However:

Human Impacts

Boreal Forest

~15% of terrestrial biosphere

- Boreal Forest
  Climate & Location

  Soils

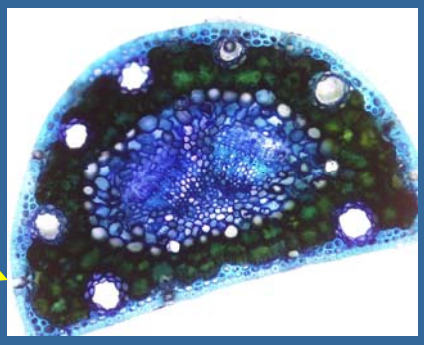
Spodosols are a common soil order

Spodosol

Light gray, whitish surface horizon on top of black or reddish B horizon; high in extractable iron and aluminum; formed through process of podzolization.

Soil solution of organic acids enhance leaching of iron and aluminum from the topsoil creating a sublayer composed of sand (white to gray in color). Leached materials deposited deeper in the soil forming the spodic horizon.

Sunken Stomate



Boreal Forest

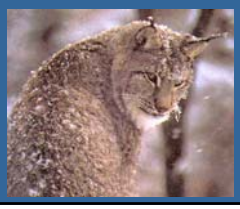
Animals

Boreal Forest

Animals

herbivores –

predators -



Boreal Forest

Animals

summer - abundant biting insects, migrant birds which nest (owls, redwings, thrushes, warblers)

few reptiles & amphibians

Human Impacts

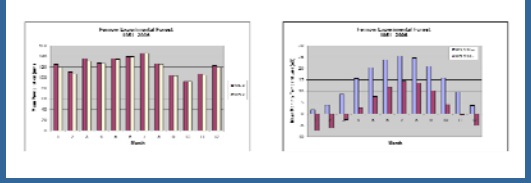
Temperate Deciduous Forest

~11% of terrestrial biosphere

Temperate Deciduous Forest

Climate & Location

Soils



Alfisols, Inceptisols, & Ultisols are a common soil orders

Alfisol

Shallow penetration of humus; translocation of clay; well-developed horizons.

Leaching of clays from the topsoil and into the subsoil.

Inceptisols are young soils that are weakly developed.

Ultisols are older soils that have been intensely leached creating cation poor, acidic, and clay & iron enriched subsoils.

Temperate Deciduous Forest

Vegetation

Productivity is high (ca. 638 g C m^{-2} yr^{-1})

17% of total terrestrial productivity on Earth

Temperate Deciduous Forest

Animals

Greater variety

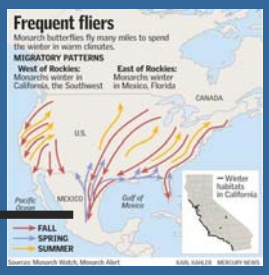
Characteristic mammals

Many birds & insects

Adapted to seasonality

Amphibians & reptiles are present

Monarch Butterflies



"Light sleeper"

True Hibernator

Gray Tree Frog

Unfrozen

Frozen

Temperate forests have been strongly influenced by human activities.

Nicholas County, WV
ca. 1920

Tropical Forests

~23% of terrestrial biosphere

Tropical Forests

Climate & Location

Three Types

- Tropical Thorn Forest

  Pronounced dry season; thorny shrubs & trees; found in S. America, S. Africa, & India; little rainfall

- Tropical Deciduous Forest

  Distinct wet & dry seasons; found in Central America, S. America, India, & Asia

Tropical Rain Forests

Climate & Location

Tropical Rain Forest Soils

Oxisols are a common soil order

Oxisol

Highly weathered soils with nearly featureless profile; red, yellow or gray; rich in kalolinate, iron oxides, and often humus; in tropics and subtropics.

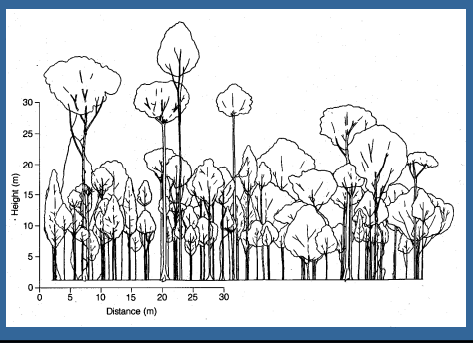
Tropical Rain Forests

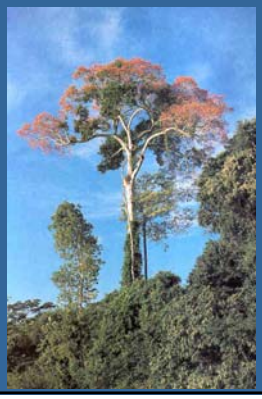
Vegetation

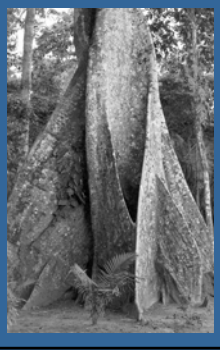
Highest productivity (ca. 911 g C m^{-2} yr^{-1})

36% of total terrestrial productivity on Earth

If you consider all types of tropical forests, then they account for 49% !!!


Height (m)
0
5
10
15
20
25
30
Distance (m)





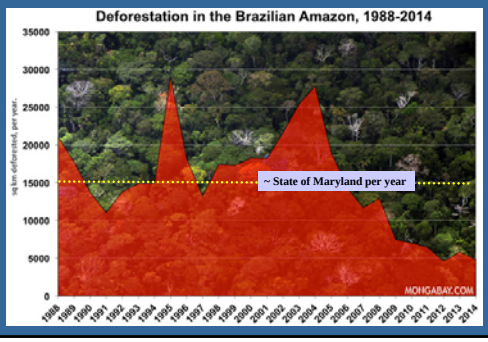
Tropical Rain Forests

Animals

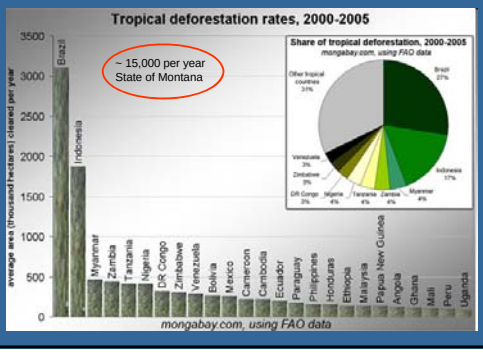
The Challenge of Research in the Canopy

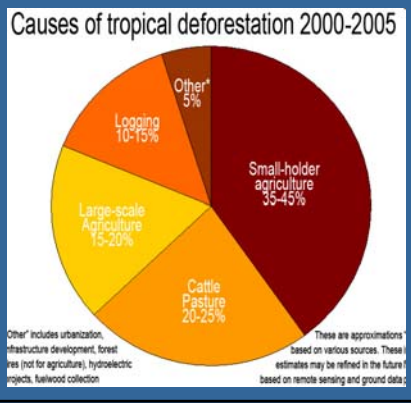
Since 2004 deforestation in the Brazilian Amazon has fallen ~ 80%.

This decline has occurred at the same time that Brazil's economy has grown roughly 40 percent.



Worldwide Tropical Deforestation





Deserts

~20% of terrestrial biosphere

Deserts & arid lands

Climate & Location

Desert Soils

Caliche

Aridisols are a common soil order

Aridisol

Develop in very dry environments; low in organic matter; high in base content; prone to the process of salinization.

Often accumulate calcium carbonate, gypsum, salt, & other easily leached minerals in the subsoil.

Deserts

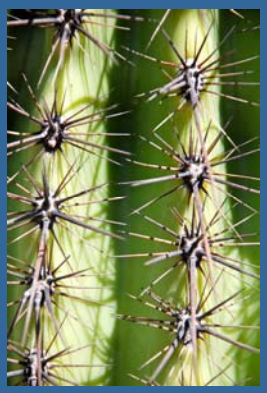
Vegetation

Adaptations to conserve water

lowest productivity ca. 95 g C m^{-2} yr^{-1}
5% of total terrestrial productivity on Earth

Saguaro Cactus

Desert in Bloom



Ocotillo

Creosote Bush

(growing for ca. 11,000 years ?)

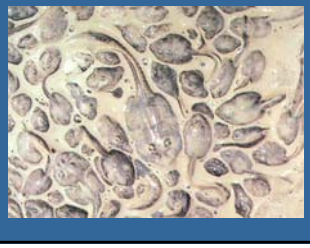
Prosopis juliflora **(honey mesquite)**

Deserts

Animals

Adaptations to conserve moisture & keep cool

Spadefoot Toad



The Camel's Hump

Is not filled with water! Rather ectopic fat storage.

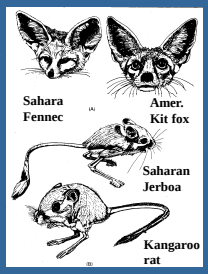
Convergent Evolution

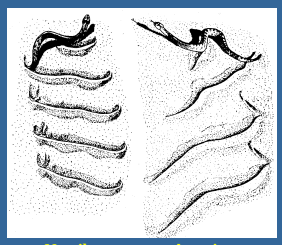
American Cacti **African Euphorbias**

Extreme environments, such as deserts, often contain examples of convergent evolution.

Convergent Evolution -

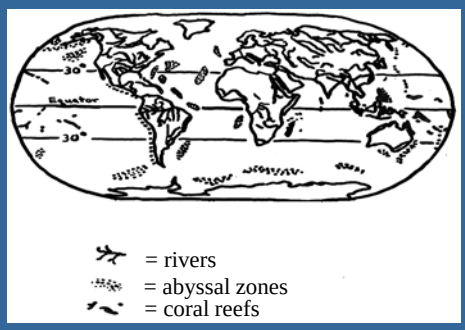
Convergent Evolution





Namib Sidewinder | American Sidewinder

Aquatic Biomes



= rivers
= abyssal zones
= coral reefs

~72% of the Earth's surface

Terrestrial vs Aquatic Biomes

	Terrestrial	Aquatic
Buoyancy		
Viscosity		
Temperature		
Autotrophs		
Oxygen		
Limits to NPP		

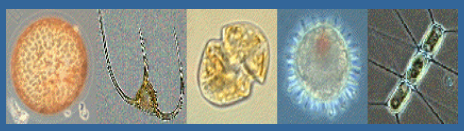
Consequences of living in water

- High buoyancy
- High viscosity
- Constancy of temperature
- Autotrophs are

Three categories of aquatic organisms

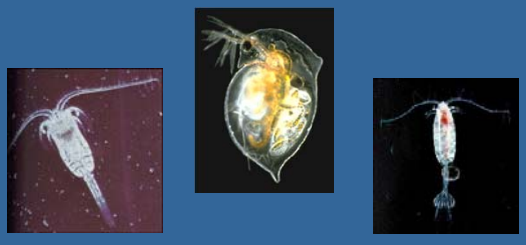
- Plankton –

  Phytoplankton -



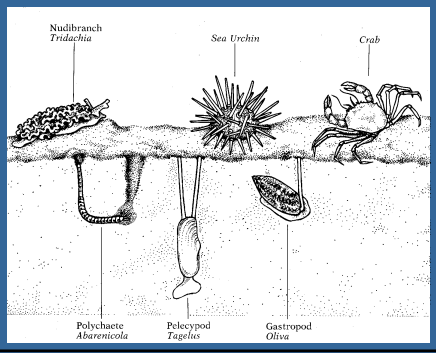
- Plankton –

  Zooplankton -



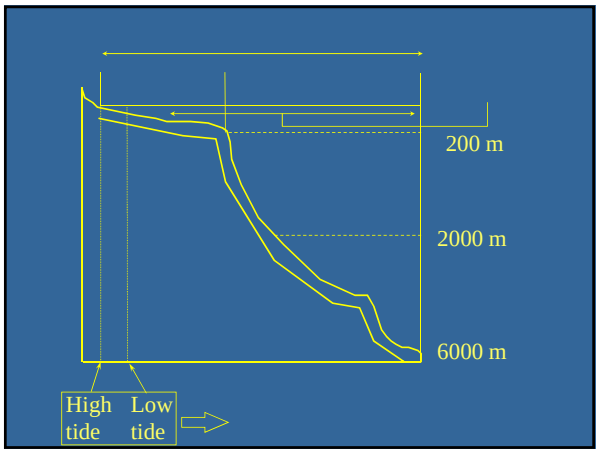
- Nekton -

- Benthos -



Marine habitats are classified on the basis of :

- Depth & the distance from the shore.
- Open water or bottom.
- The ability of light to penetrate.



Ocean Biome

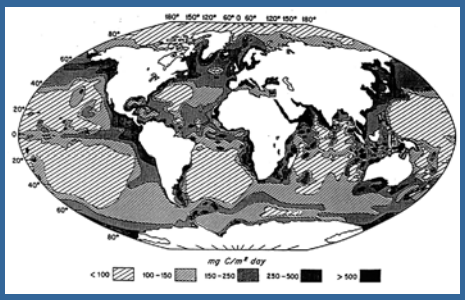
Intertidal - stressful

Neritic - highly productive WHY???

Oceanic - ~ 88% of ocean

Creatures from the Abyss

Productivity of the oceans



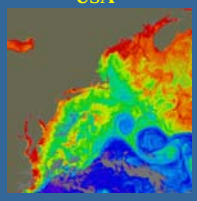
Highest productivity per unit area: coastal & upwelling areas.

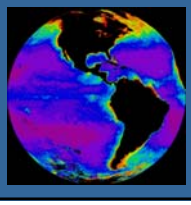
However, open ocean accounts for 76% of total.

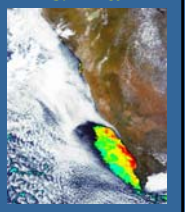
Ocean Productivity Viewed from Satellite Images

East Coast USA

West Coast S. Africa







Biomes Provide a Useful Classification For Global Estimates

Table 5.2 Primary Production and Biomass Estimates for the World[a]

Ecosystem	Area (10^{12} m²)	Mean plant biomass (kg C/m²)	Carbon in vegetation (10^{15} g)	Mean net primary production (g C/m²/yr)	Net primary productivity (10^{15} g/yr)
Tropical wet and moist forest	10.4	15	156.0	800	8.3
Tropical dry forest	7.7	6.5	49.7	620	4.8
Temperate forest	9.2	8	73.3	650	6.0
Boreal forest	15.0	9.5	143.0	430	6.4
Tropical woodland and savanna	24.6	2	48.8	450	11.1
Temperate steppe	15.1	3	43.8	320	4.9
Desert	18.2	0.3	5.9	80	1.4
Tundra	11.0	0.8	9.0	130	1.4
Wetland	2.9	2.7	7.8	1300	3.8
Cultivated land	15.9	1.4	21.5	760	12.1
Rock and ice	15.2	0	0.0	0	0.0
Global total	145.2		558.8		60.2

[a] From Houghton and Skole (1990).