

# Biomes and Physiognomy

Reading: Chapter 18 GSF

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## Early plant ecology was biogeography

- Von Humboldt noticed relationships between large-scale vegetation patterns (e.g., physiognomy) and climate
  - Made observations on effects of altitude and air pressure on temperature and precipitation
- Clements viewed vegetation distribution as controlled mainly by climate patterns
- Modern remote sensing gives a global-scale view of climatic controls over vegetation distribution

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## Physiognomy and biomes across the globe

- **Biomes** are major biogeographic regions that differ from one another in structure (**physiognomy**) of dominant plant species
- Classification into a biome also suggests general characteristics of the ecosystem (climate, soils, animals, etc.)
- Biome classification, like vegetation classification at any scale, is somewhat arbitrary; sharp lines on a map are blurry on the ground; thus biome definitions tend to be broad descriptions
- Broad physiognomic types include forest, shrub, and grass/herbaceous; these each include different types
- Different biomes may share plants with similar physiognomy

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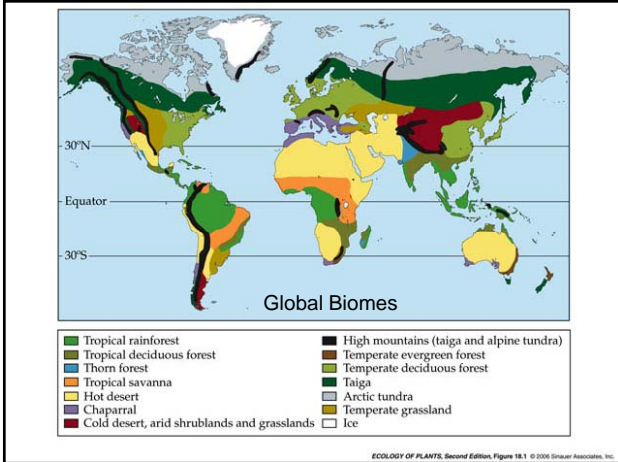
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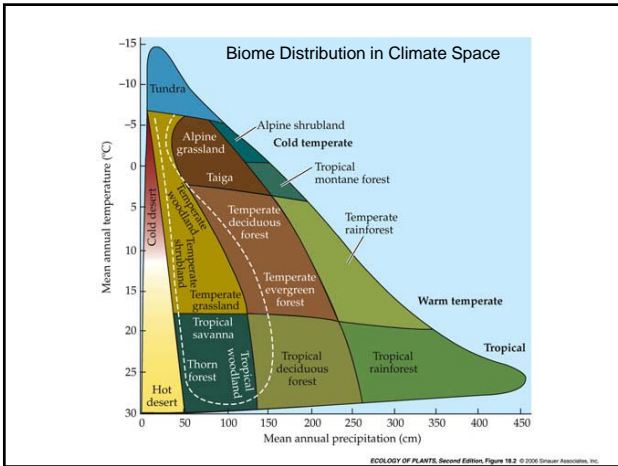
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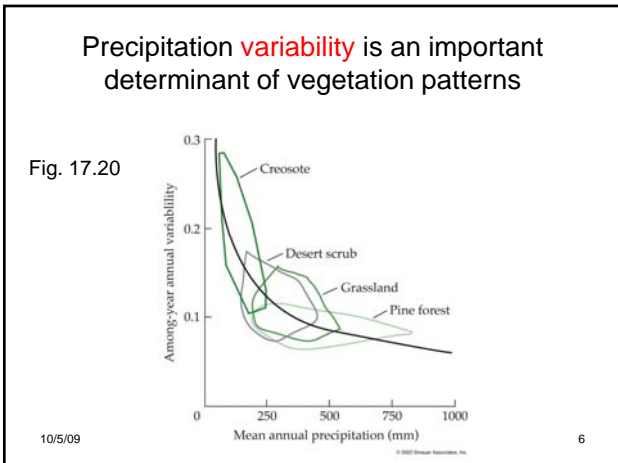
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## What processes govern patterns in physiognomy?

- Similarity of life forms (physiognomy) within a biome results from species sorting, biogeographical history, and convergent evolution
- Species sorting is an ecological process that favors certain related species in a given biome
  - Examples?
- Biogeographical history can result in related species being found in one area
  - Examples?

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## Convergent evolution

(A)



(B)



- leads to similar life forms in widely separated but similar biomes
- combines ecological and evolutionary processes

- Unrelated alpine tundra species in Ethiopia and South America
- Why are they so tall (~2m)?
- Other examples?

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## Similar physiognomic patterns can be shared by different biomes

- What environmental conditions favor a certain life form?
- Why is a particular life form advantageous in different biomes?

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### Perennial graminoids and shrubs

- **tundra** where growing season temperatures are  $<10^{\circ}\text{C}$ ; below this wood can't form
- **temperate shrublands** and **cold deserts** with moderate temps, low precip



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### Needle-leaved evergreens

- Grow in **taiga** or boreal forest, where summer temps are  $>10^{\circ}\text{C}$  but growing (frost-free) season is  $< 3$  months
- in **temperate rainforest** where it's seasonally cool, with strong wet season
- in **temperate woodlands** with mild temperatures and moderately dry growing seasons

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See <http://ngm.nationalgeographic.com/2009/10/redwoods/bourne-text>

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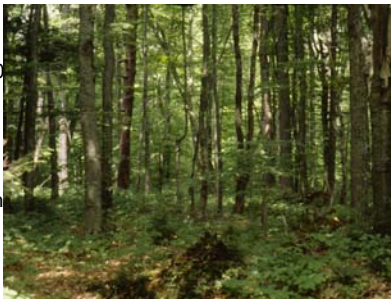
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### Broad-leaved deciduous trees (1)

- **Temperate deciduous forests**

- minimum winter temperature is  $-20$  to  $-40$  °C,
- relatively long and moist growing season
- moisture distributed throughout the year



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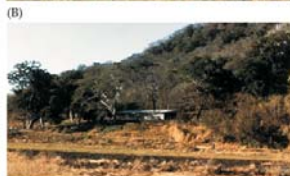
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### Broad-leaved deciduous trees (2)

- **Tropical drought deciduous forests**

- **Thorn forests**

- Hot and dry
- Disappearing faster than rainforests!



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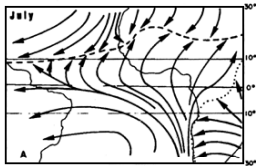
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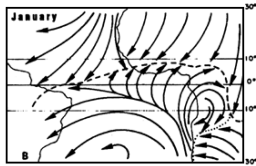
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**Seasonal migration of ITCZ leads to dry seasons in tropics**



Insolation in N. hemisphere in July "pulls" ITCZ northward, vice-versa in January

Positions of Discontinuity:  
 - - - Meteorological Equator  
 - - - Inter-tropical Convergence



Subtropical high pressure zones can reach into tropical latitudes when ITCZ migrates

More drought deciduous trees found where dry season is longer

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**Broad-leaved evergreen trees**

- Grow in **tropical rainforests** where frosts are rare and there is plenty of rainfall
- ITCZ remains over these areas
- What are the major limitations to growth in this environment?



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## Broad-leaved evergreen trees (2)



- **Temperate rainforests** in S. America and Oceania
- Dominated by *Nothofagus* spp.
- Mild temperatures and abundant rain lead to high productivity and long growing season, no dormant period



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<http://www.apstas.com/sgaptas-treas5.htm>

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## Perennial grasses

- **Temperate grasslands** and **tropical savannas**, where MAP is ~50-125 cm and precipitation seasonality is strong
- Fire, grazing



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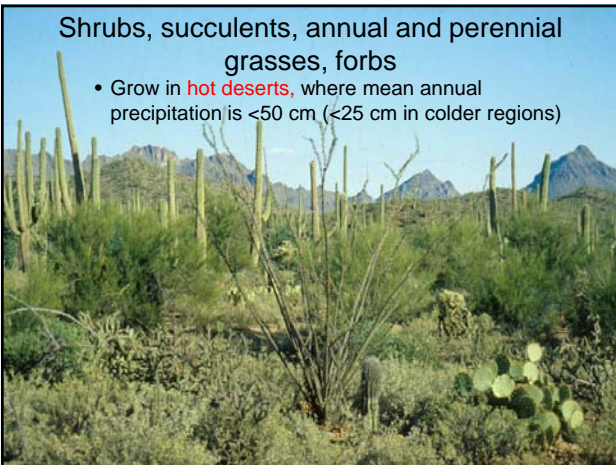
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## Shrubs, succulents, annual and perennial grasses, forbs

- Grow in **hot deserts**, where mean annual precipitation is <50 cm (<25 cm in colder regions)



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### This all sounds very Clementsian...

- Clements was focusing on broad patterns, at the biome scale ("climatic climax"). Gleason focused on more localized patterns. Both are valid views as long as we recognize the limitations of each view.
- Local variations in soils, topography, microclimate, disturbance create fine-scale variation in vegetation patterns, as recognized by Cowles, Gleason, Whittaker and others
- Vegetation classification schemes facilitate understanding for purposes of management, conservation, and communication among scientists

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