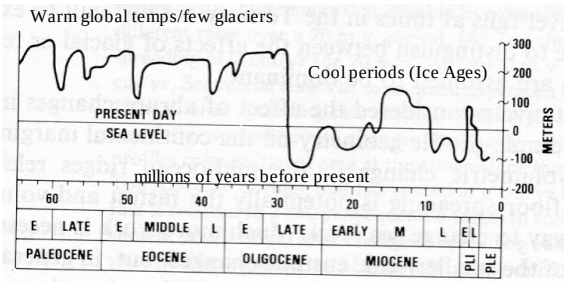
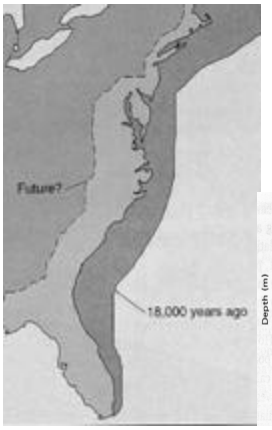
Sea level (the height of coastal waters) has changed throughout the history of earth

Why can you find fossils of marine organisms in Colorado?
Why do you see vertical strata when you drive up the mountains?

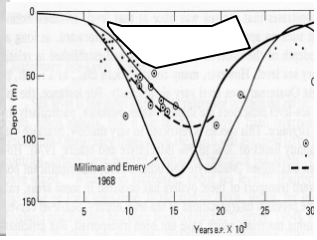


Ice Ages and Oxygen isotopes

- evaporated water is high in O_{16} and low in O_{18}
- under warm conditions, most freshwater is in oceans, so oceans have a low $[O_{18}] / [O_{16}]$
- under cold conditions, a lot of O_{16} is tied up in glaciers, leaving high $[O_{18}]$ in the ocean

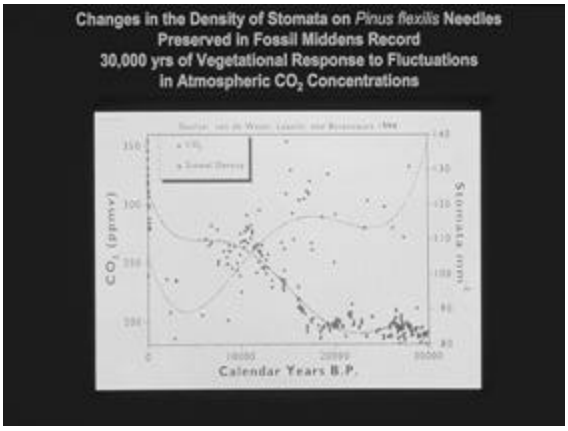


more recent sea level change

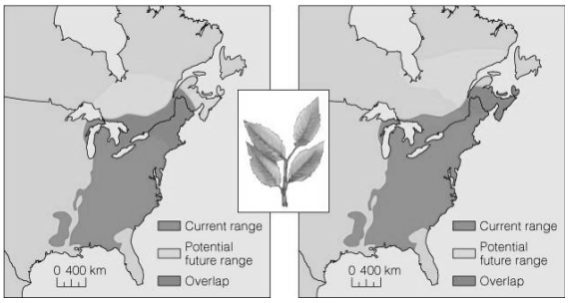


How do communities change with ice ages?

- there are no written records of community structure from back then
- the work of paleoecologists
- look at pollen records (buried in lakes) to get ideas of plant communities
- look at packrat middens
- look at fossils on land and in ocean sediments



Current geographic range and predicted future range for American Beech under 2 climate change scenarios. A. 4.5ºC warming. B. 6.5ºC warming.

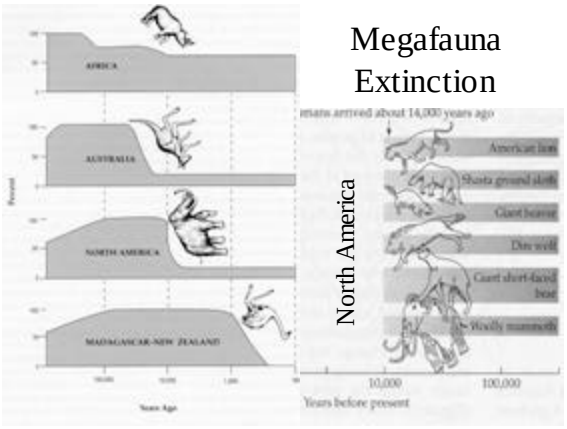


Based on Paleoecological Data...

- trees "migrate" with climate change
  - migrate north-south
  - migrate with elevation
- forest communities are not constant through time, because plant species migrate at different rates and in different patterns
- how will forests migrate during next climate change?
  - dispersers such as passenger pigeon are extinct
  - habitats are fragmented

Last Ice Age Allowed Humans to Colonize North America

- Bering land bridge allowed NE Asians to colonize NA 14,000 years ago
- large animals in NA were not used to human hunters
- some were probably driven to extinction by these early colonists
- What caused the megafauna extinction
  - The BIG KILL?
  - The BIG CHILL?
  - THE BIG ILL?



Megafauna Extinction

Succession

•community: a group of populations of plants and animals in a given place and time

•succession: the developmental process that a community goes through; disturbances tend to "reset" succession

•primary succession: succession from an area that has not been previously occupied. (no seed bank, no soil, lichens, N-fixers)

•secondary succession: the re-establishment of a community following a disturbance that does not remove everything to bare rock (seed bank, trunk regeneration, mature soils)

Succession

•facilitation: when a species makes it more likely that another species will colonize the community

•inhibition: when a species makes it less likely that another species will colonize the community

•pioneer community: an early sere (stage) of succession with a high degree of r-selected species

•climax/mature community: the final sere of succession with a high degree of K-selected species. this stage changes little once it is reached, until a disturbance resets the succession

•mixed community: intermediate seres characterized by r- and K- selected species, or species with intermediate traits along the r-K continuum

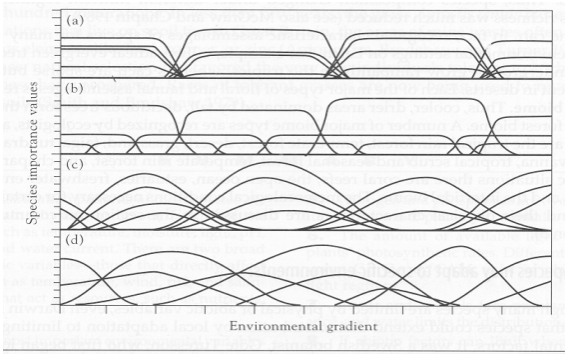
F.E. Clements: Balance of nature view of communities

- All the species living together in an organized, systematic manner to form a super organism.
- Communities even "evolved" in a way analogous to species over millions of years.
- Succession was like organismic development (oak forests became oak forests just as a puppy becomes a dog)
  - In equilibrium
  - Saturated with species
  - Strong biotic interactions
  - Resource limited
  - Optimal performance
  - Deterministic

H. A. Gleason view of communities

- history, chance, and randomness are important in community structure.
  - A community is a fortuitous association of organisms whose adaptations allowed them to live together under the particular physical and biological conditions that characterize a particular place.
    - Non-equilibrium
    - Many open niches
    - Abiotic stresses important
    - Opportunism
    - Stochastic effects

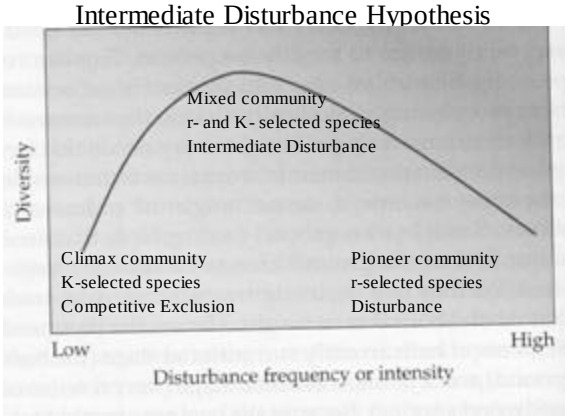
Clements vs. Gleason



Intermediate Disturbance Hypothesis

- proposed to explain high biodiversity in rainforests and coral reefs
  - stability was old, niche-diversification, competition Clementian explanation
  - intermediate disturbance is newer, Gleasonian interpretation
- Disturbance: anything the kills or damages members of a community, such as storms, landslides, lightning strikes, plagues, waves…
- **At low levels** (frequency, intensity, and size) of disturbance, you find low diversity because only species that (1) are competitively dominant (2) those most resistant to damage or death due to physical extremes or natural enemies. " Climax" communities are low diversity.
- **At high levels** of disturbance, everything gets wiped out and you only find pioneering species that are able to colonize new space. "Pioneer" or " colonizing" communities are low diveristy.
- **At intermediate levels**, you find mixed communities

Intermediate Disturbance Hypothesis



Does natural flux justify transforming nature?

- Gleason's view (which most ecologists hold to be more accurate than Clements) states that nature is in constant flux
- If change is "natural", why worry about deforestation, floods, global warming?