Slide 1

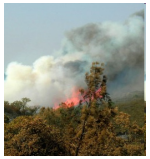
Ecological Succession

Lecture 20

Slide 2

Learning Outcomes

- Ecological Succession
- Pioneer Species
- Non-pioneer species
- Primary Succession
- Secondary Succession
- The role of fire in California's vegetation



Slide 3

Succession

- The King is Dead! …. Long Live the King!
- 1859 Henry David Thoreau "The Succession of Forest Trees"
- described succession in an Oak-Pine forest.

Slide 4

Ecological Succession

- Community structure is <u>always</u> changing in response to disturbances in the environment over time
- One group of species replace (Succeed) another as vegetation recovers from disturbance

Slide 5

Characteristics of Pioneer species

- Small stature
- Light demanding
- Rapid growth rates
- Early maturity
- High dispersal rates
- Symbiotic associations to fix-soil Nitrogen
- Shade intolerant

Slide 6

Non-Pioneer Species

- 'climax' species
- Large size and long-lived
- Low individual growth rates
- Low dispersal rates
- Low population growth rates
- Shade tolerant
- Hickory throughout Eastern USA

Slide 7

Primary Succession

- Colonization of a newly exposed surface
- No soil is present
- Examples
  - Glacier retreat
  - New lava flow
- May take thousands of years

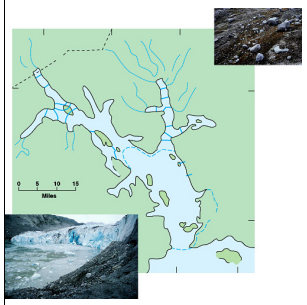
Slide 8

Glacier Retreat

- Glacier Bay fjord complex in southeastern Alaska
- Ice retreat since 1760

Slide 9

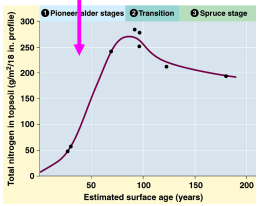
Pioneer Species Colonize



- Ice retreats - leaves moraines along the edge of the bay
- Lichen and moss pioneer species establish
- Autogenic changes in environment
  - **Organic matter accumulates**
  - **a shallow soil layer develops**
  - **pH drops**
  - **shade**

Slide 10

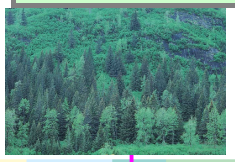
Pioneer Alder Stage

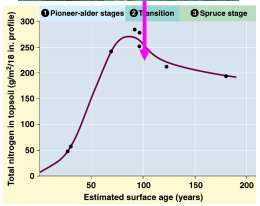


- Alders invade
- Autogenic changes in environment
  - Shade out the mosses
  - *Frankia* bacteria associated with Alder roots 'fix' nitrogen
  - Soil nitrogen increases

Slide 11

Transition

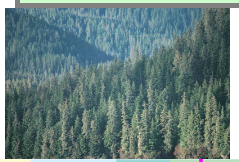


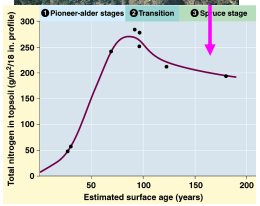


- Alders invaded by Sitka spruce
- Shade out the alder
- After a century form a dense forest

Slide 12

Hemlock Climax

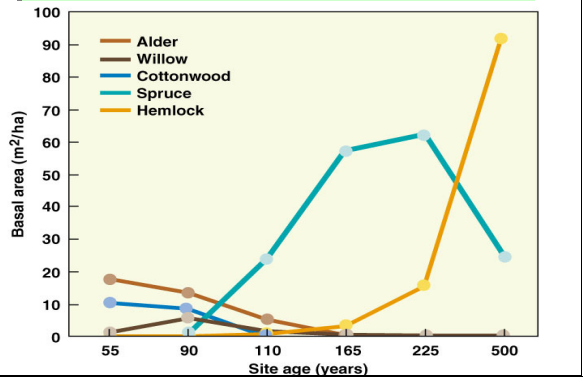




- Hemlock invades spruce stands
- Further acidifies soil
- Soils in low areas become waterlogged and oxygen deficient
- Trees die and mossy, acid bogs form

Slide 13

Primary Succession



Slide 14

Volcanoes

- Mudslides
- Ash deposits bury previous soil
- Mt St Helens Washington
- Erupted May 18 1980

Slide 15

Mt St. Helens

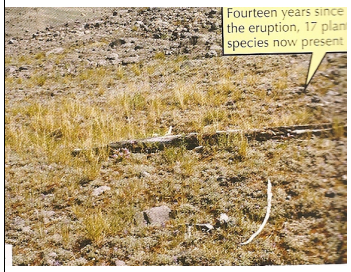
- Colonization of plots above the treeline
- Studebaker Ridge SW of Crater
- *Lupinus lepidus*

Slide 16

Colonizing Mt St. Helens

Slide 17

Mt St. Helens 1994



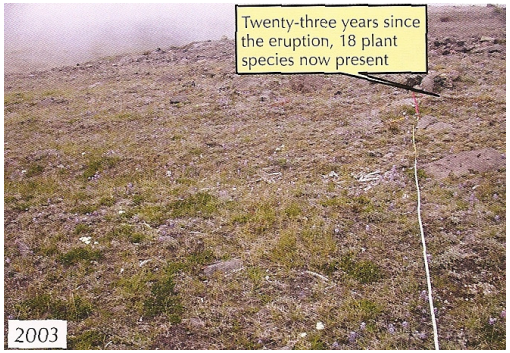
- Lupine facilitates colonization by other species
- Stabilizes ash
- Fixes nitrogen
- Traps wind-blown seeds of other species
- Nursery plant

Slide 18

Mt St. Helens 1997

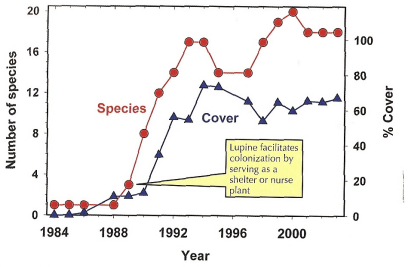
Slide 19

Mt St. Helens 2003



Slide 20

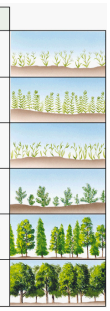
Mt St. Helens



Slide 21

Secondary Succession

Years after cultivation	Dominant vegetation
1	Crabgrass
2	Horseweed
3	Broomsedge
5–15	Pine seedlings
25–50	Pine forest (with developing understory of deciduous hard-woods—not shown)
150	Oak-hickory climax forest

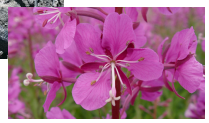


- Community suffers disturbance
- soil remain
  - Seed bank
- Pioneer community germinates from seeds or disperse from other sites
- Reaches climax faster

Slide 22

Secondary

Slide 23



Fire Dependent Species

- Some pioneer species depend upon periodic disturbance to create opportunities to colonize
- Fireweed
- Fire Poppy

- Golden Eardrops (***Dicentra chrysantha***)
- Whispering Bells
- (***Emmenanthe penduliflora***)
- Charcoal beetles

Slide 24

Fire Suppression

- Introduced 1910
- Results…
  - Prevented natural cycle of small local fires –
    - regeneration
  - Forest composition changed
  - Accumulation of 100 years of fuel
  - Large intense destructive fires
  - Exposes large area of unprotected soil to erosion

Role of Fire

- Periodic fires part of natural history throughout California
- Native Americans used fire to manage natural resources
- Human prevention of fire altered balance of conifer species in Sierra Nevada
- Favored Shade tolerant species
  - Incense Cedar, White Fir
- Detrimental to shade intolerant conifers
  - Ponderosa Pine, Jeffrey Pine, Sugar Pine, Giant Sequoia
- Require light and/or bare soil to germinate

Climax

- Theoretical end point of succession
- Dominated by long lived species
  - Adaptations to local abiotic conditions and strongest competitor
- Will generally return to this stage after disturbance