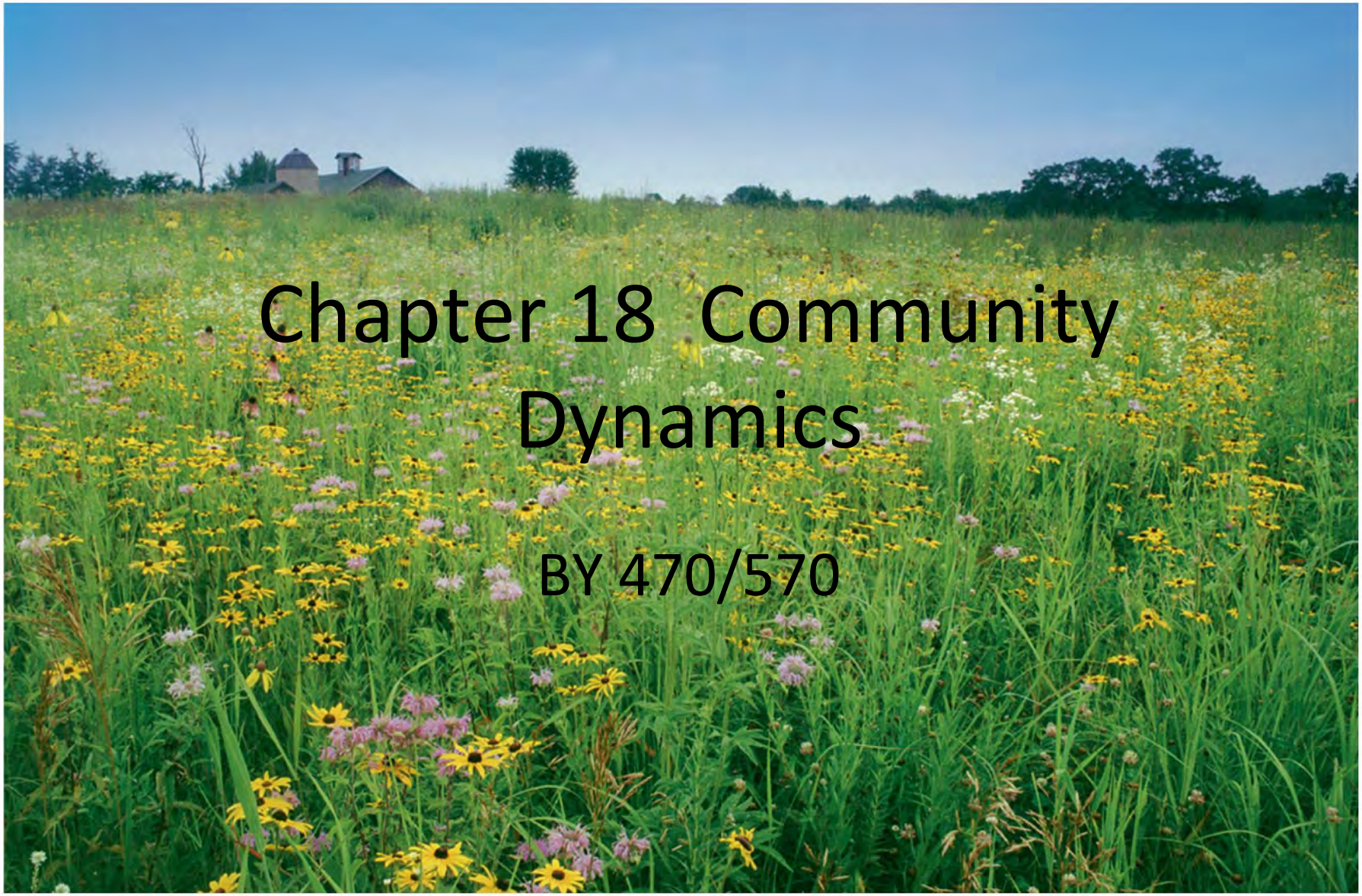


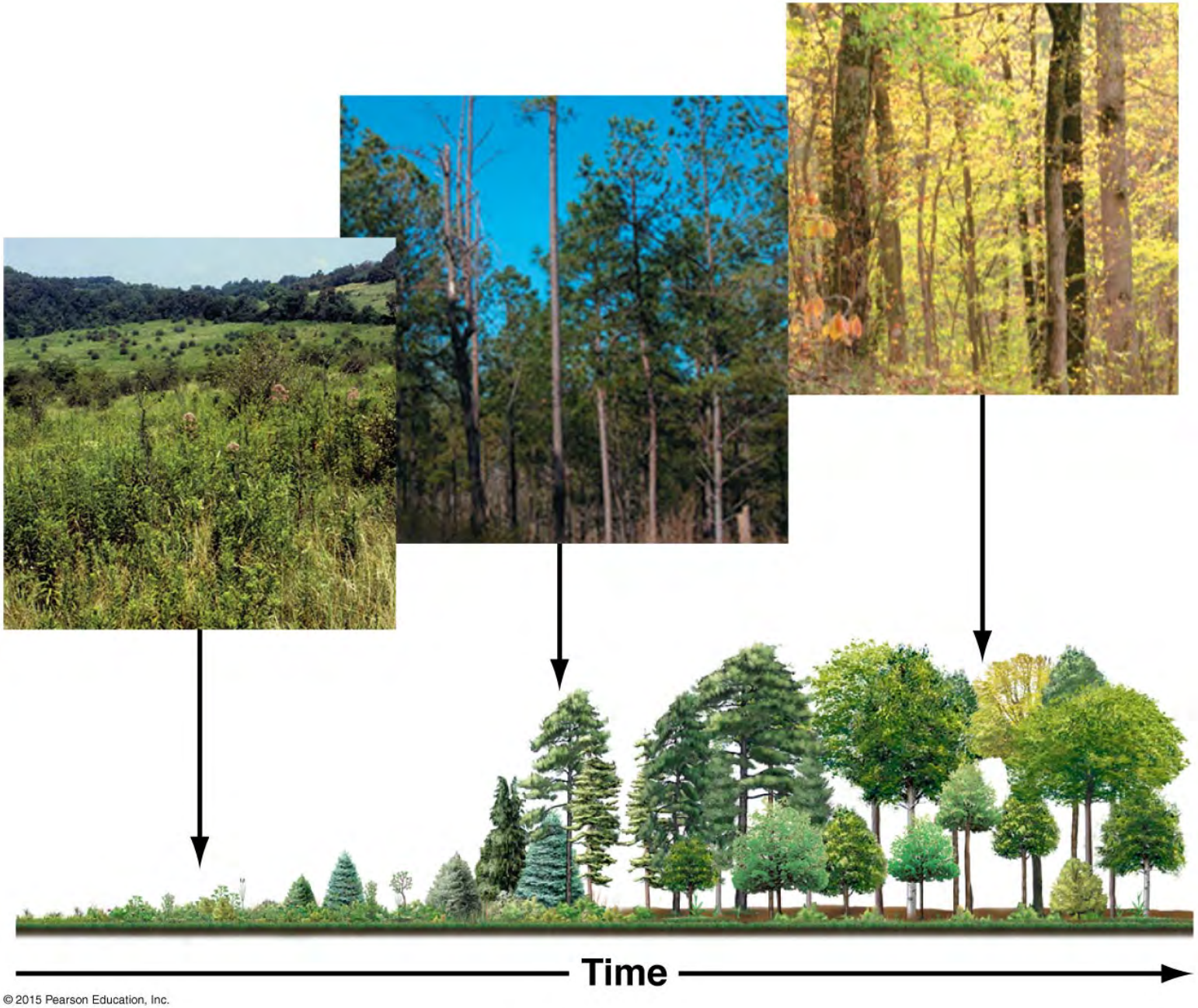
Chapter 18 Community Dynamics

BY 470/570

Succession

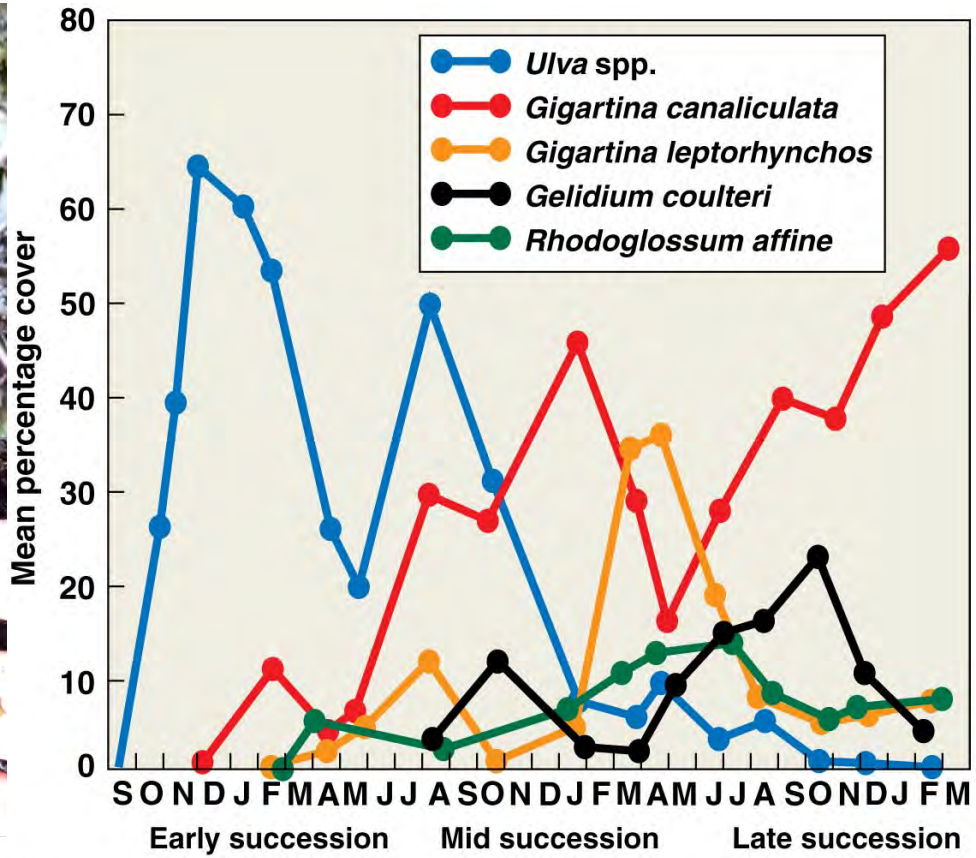
- Temporal change in community structure at a given location
- What changes take place in a community as it changes through time?
- What do we call this process of temporal change?

Community Structure Changes through Time



Marine/Aquatic succession

(a)



(b)

Succession over time

- A **sere** is the sequence of communities seen in succession, from grass to shrub to forest
- Each of the changes is a **seral stage**, a point on the continuum of vegetation through time

Two major types of succession

1) Primary/early Succession—no previous community
   - no real organic matter at start; slow

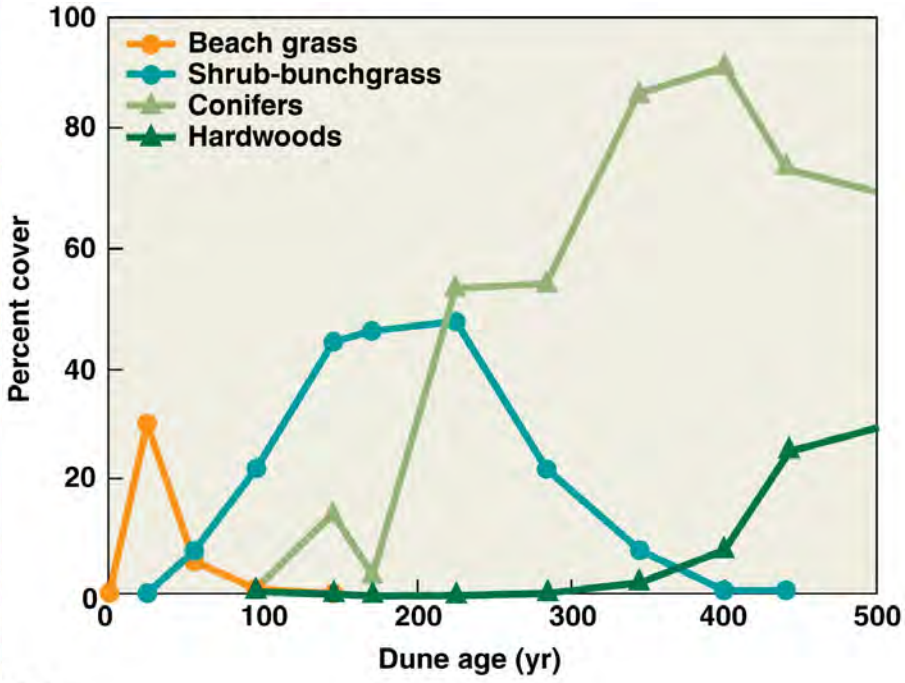
2) Secondary/late Succession—previous community there and removed or disturbed
   - organic matter; fast

https://ferrebeekeeper.files.wordpress.com/2011/03/lichen27.jpg

Primary Succession

- A sand dune is an inhospitable site that can undergo primary succession
- Plant cover stabilizes the dunes

(a)



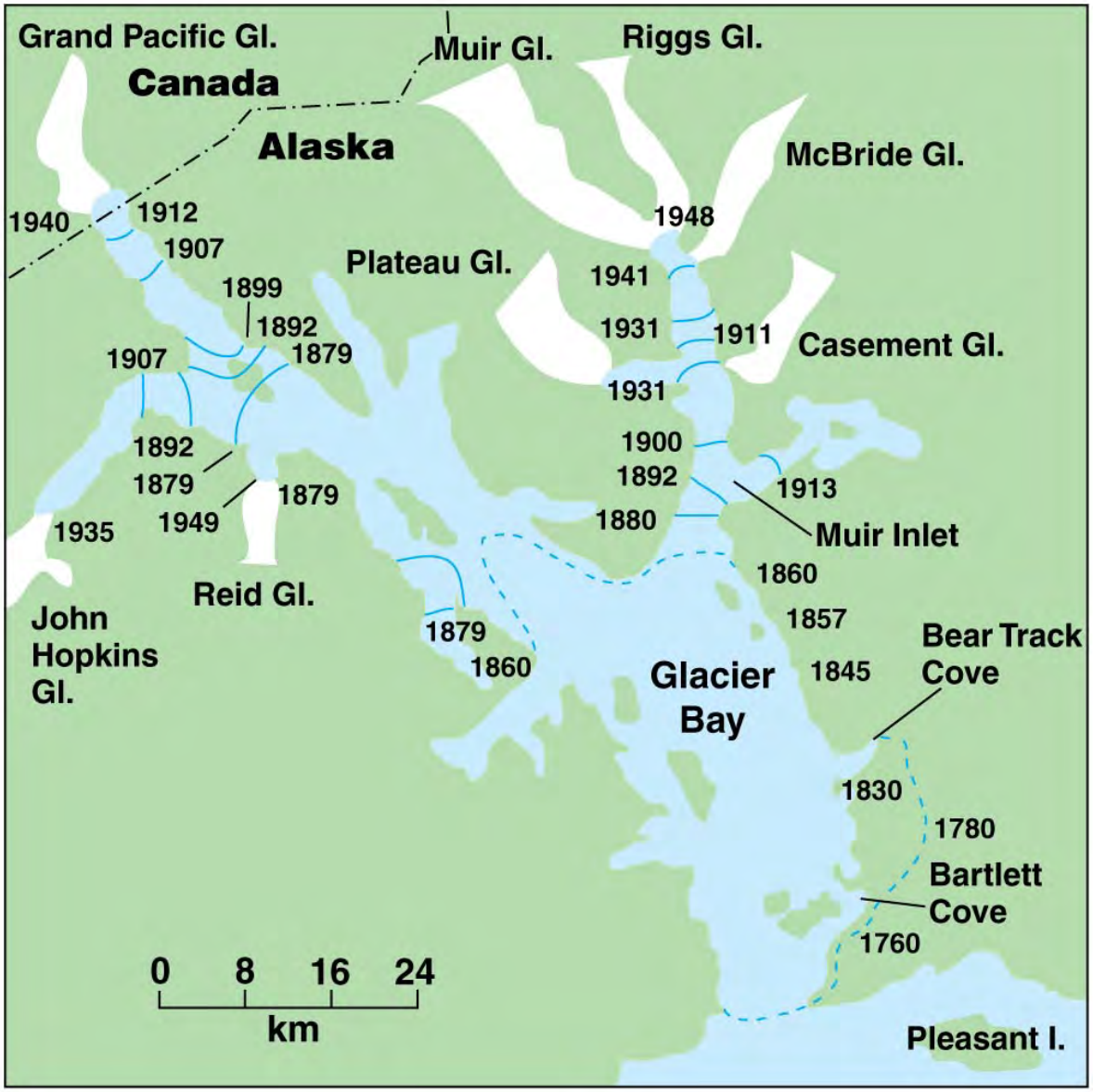
(b)

Primary Succession Occurs on Newly Exposed Substrates

(a)

Primary Succession Occurs on Newly Exposed Substrates

(a)



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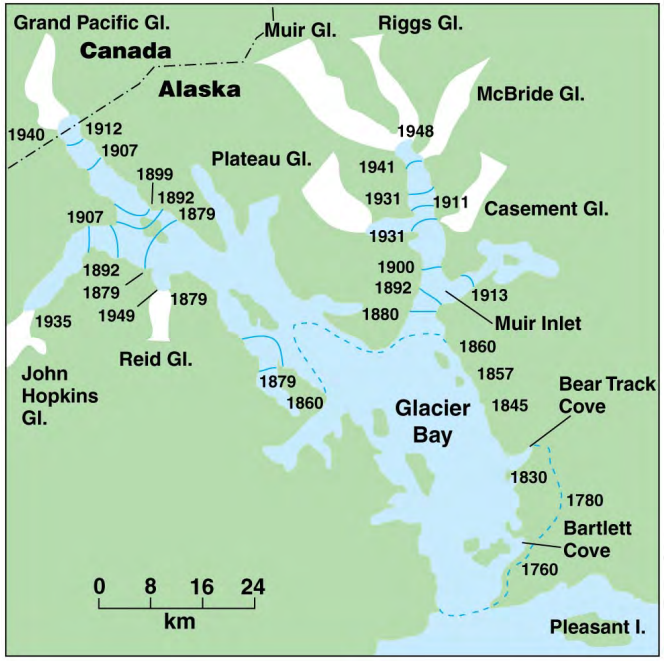
Primary Succession Occurs on Newly Exposed Substrates



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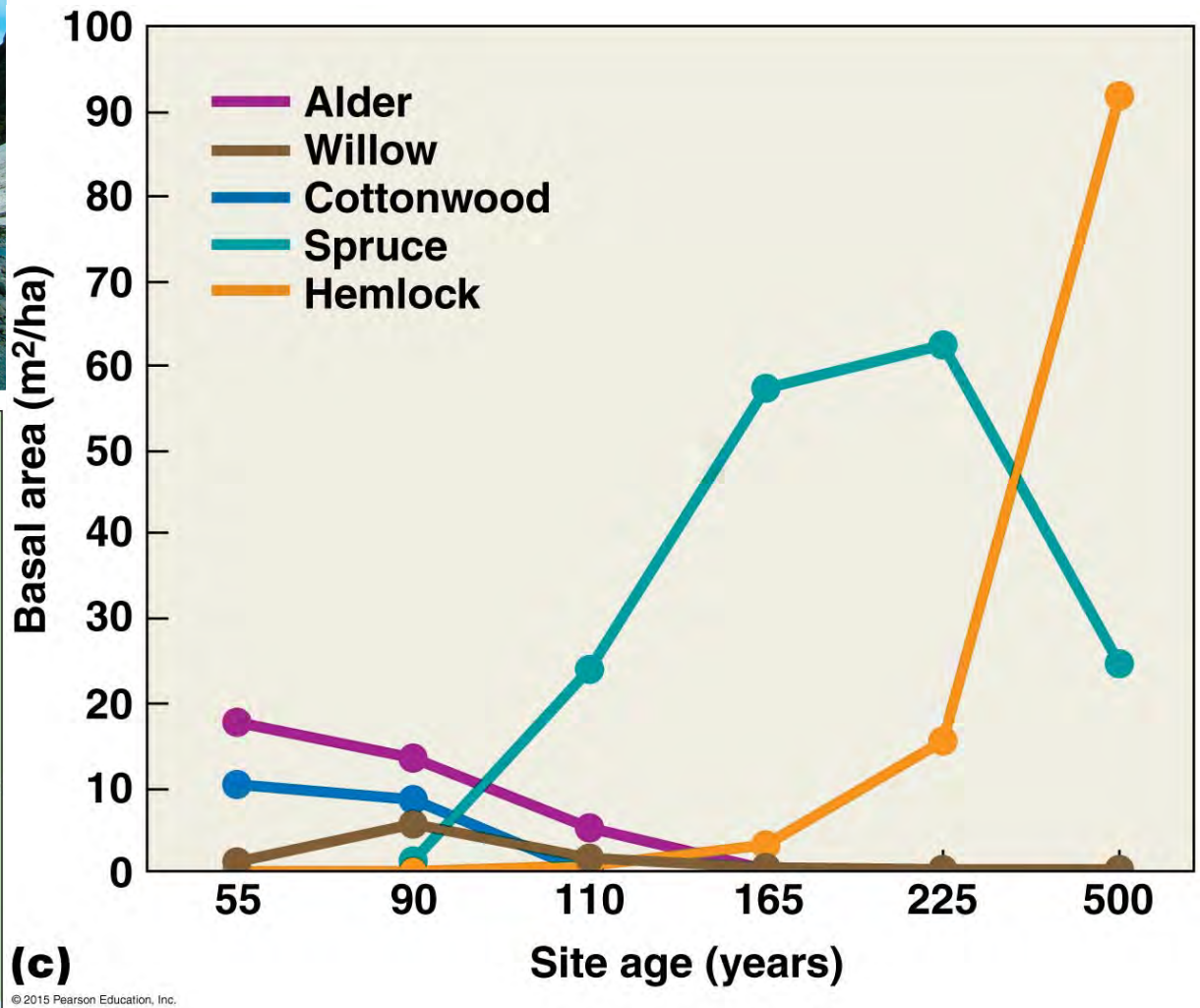
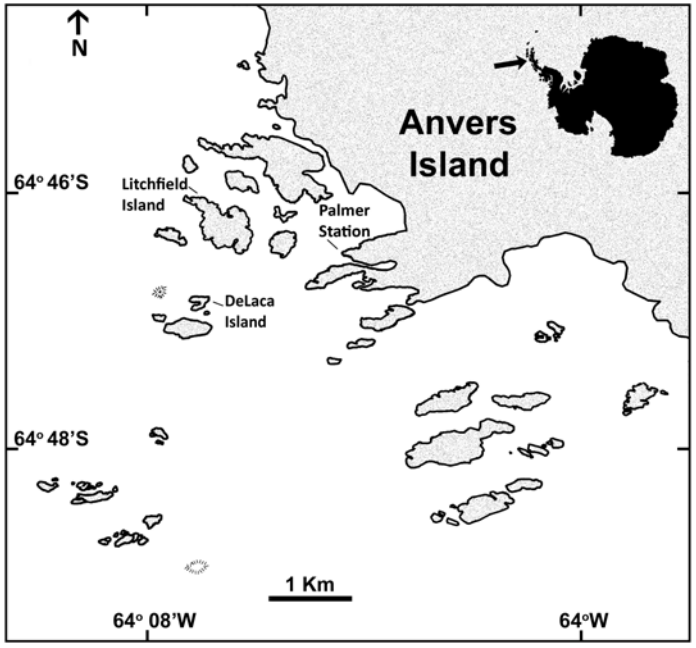
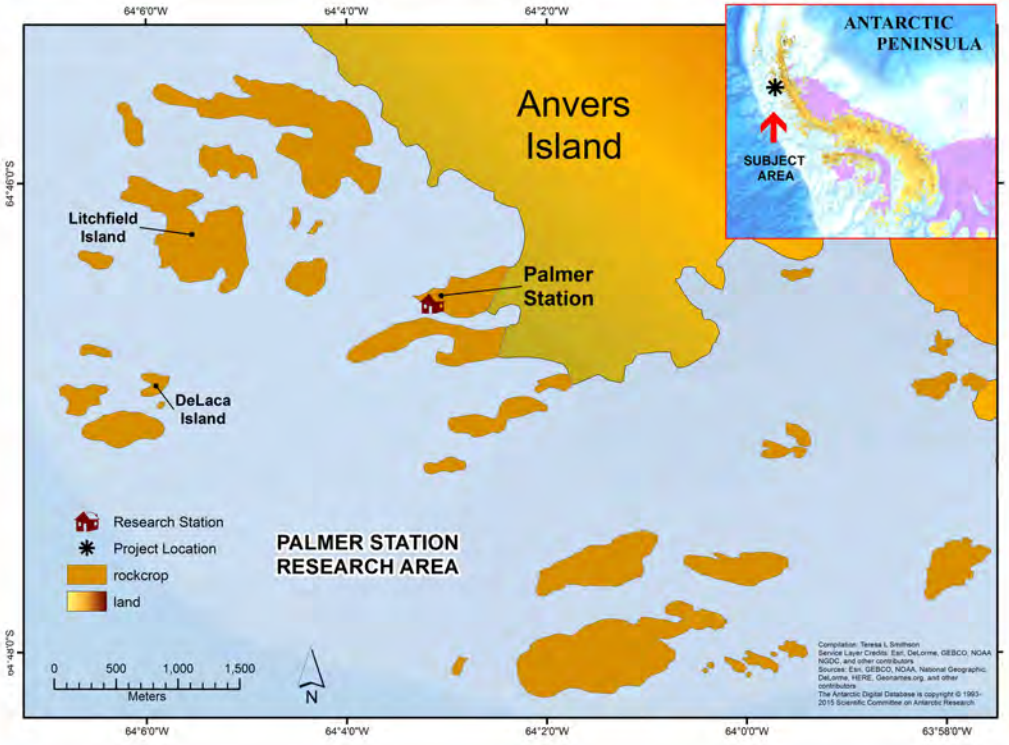


(c)

Primary Succession Occurs on Newly Exposed Substrates

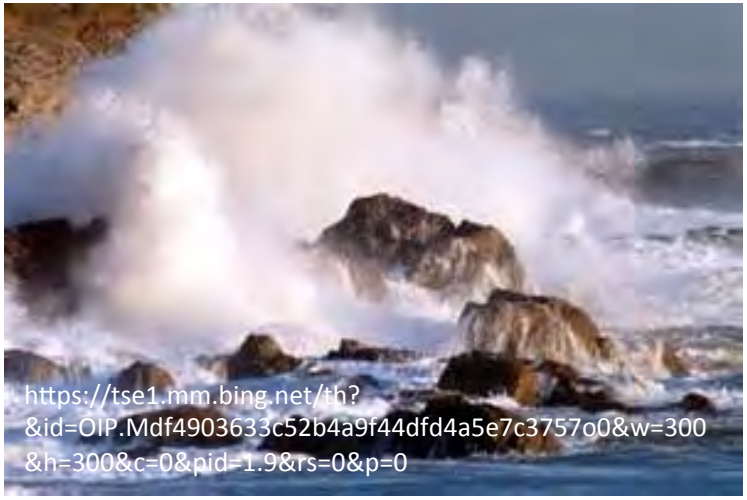




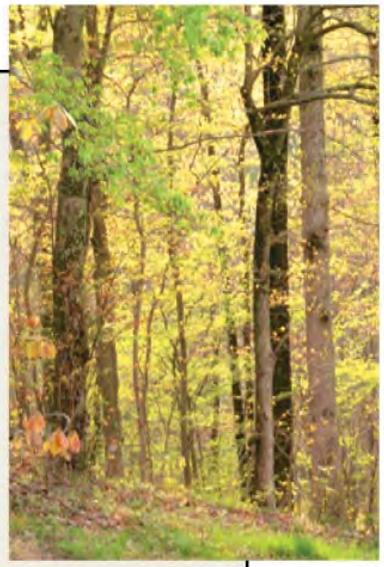
Secondary succession

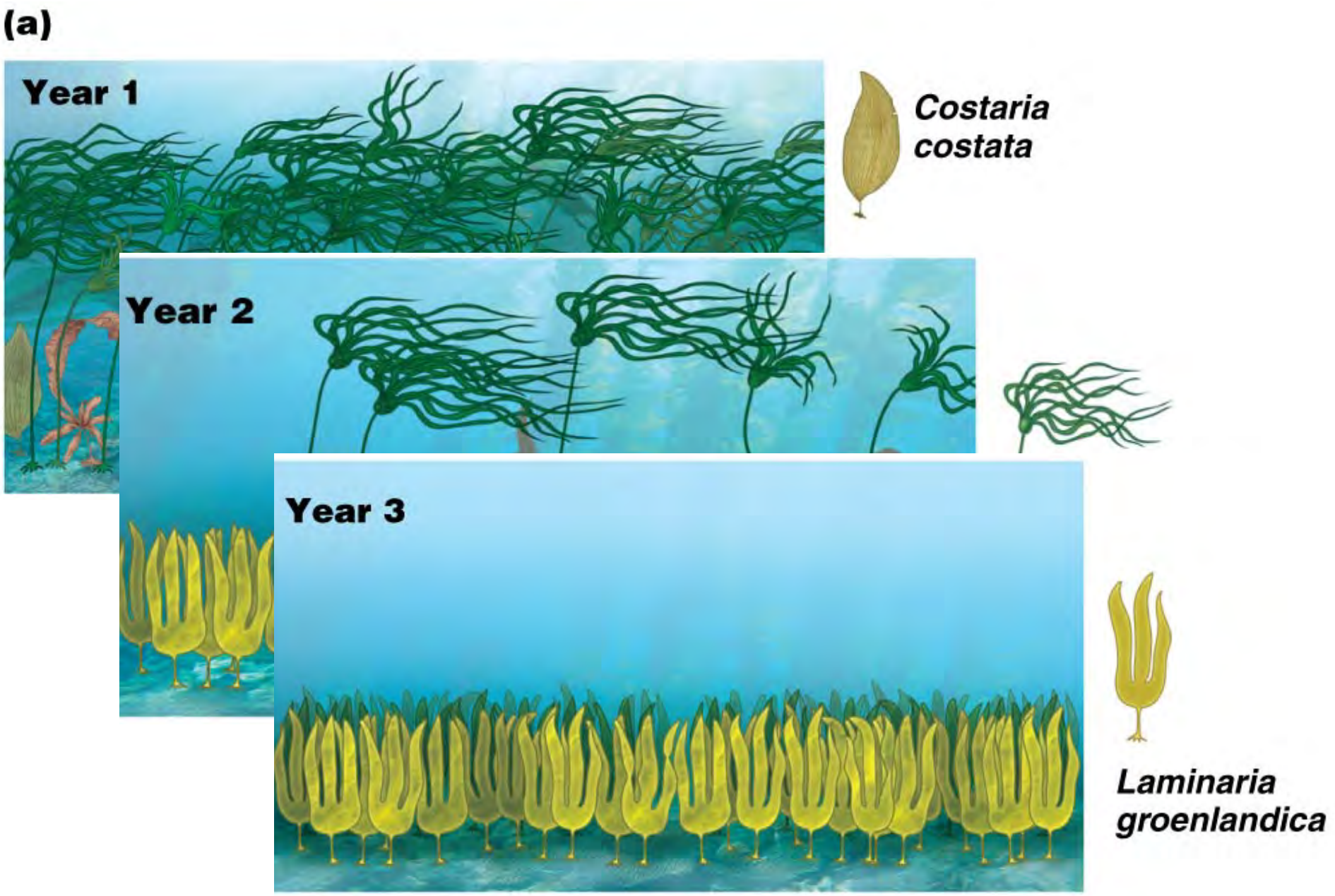
- Takes place at a site that was previously occupied by a community
- Physical & biological disturbances:

e.g. agriculture, waves, predation, competition, etc



Secondary Succession Occurs after Disturbances





History of Succession

- Ecologists have been studying succession for more than a century
- Clements (1916, 1936) - **Monoclimax hypothesis** views the community as a highly integrated superorganism


https://ferrebeekeeper.files.wordpress.com/2011/03/lichen27.jpg

Initial floristic composition

- Egler (1954) hypothesis proposed that the process of succession at any site depends on which species arrive first
- Succession not orderly, some facilitation & some inhibition - individualistic


https://ferrebeekeeper.files.wordpress.com/2011/03/lichen27.jpg

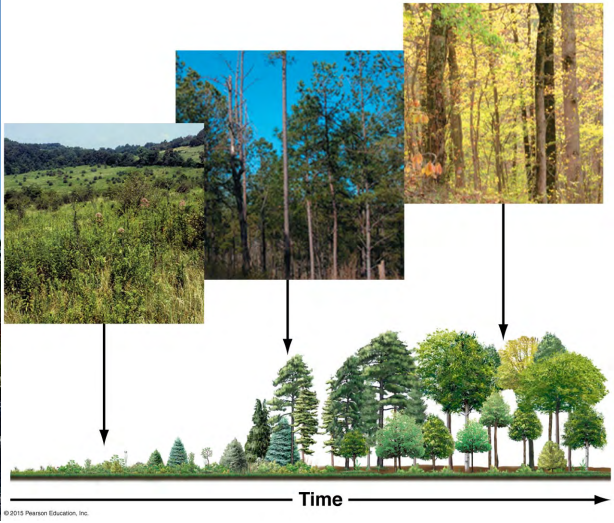
Connell & Slatyer (1977) – 3 models

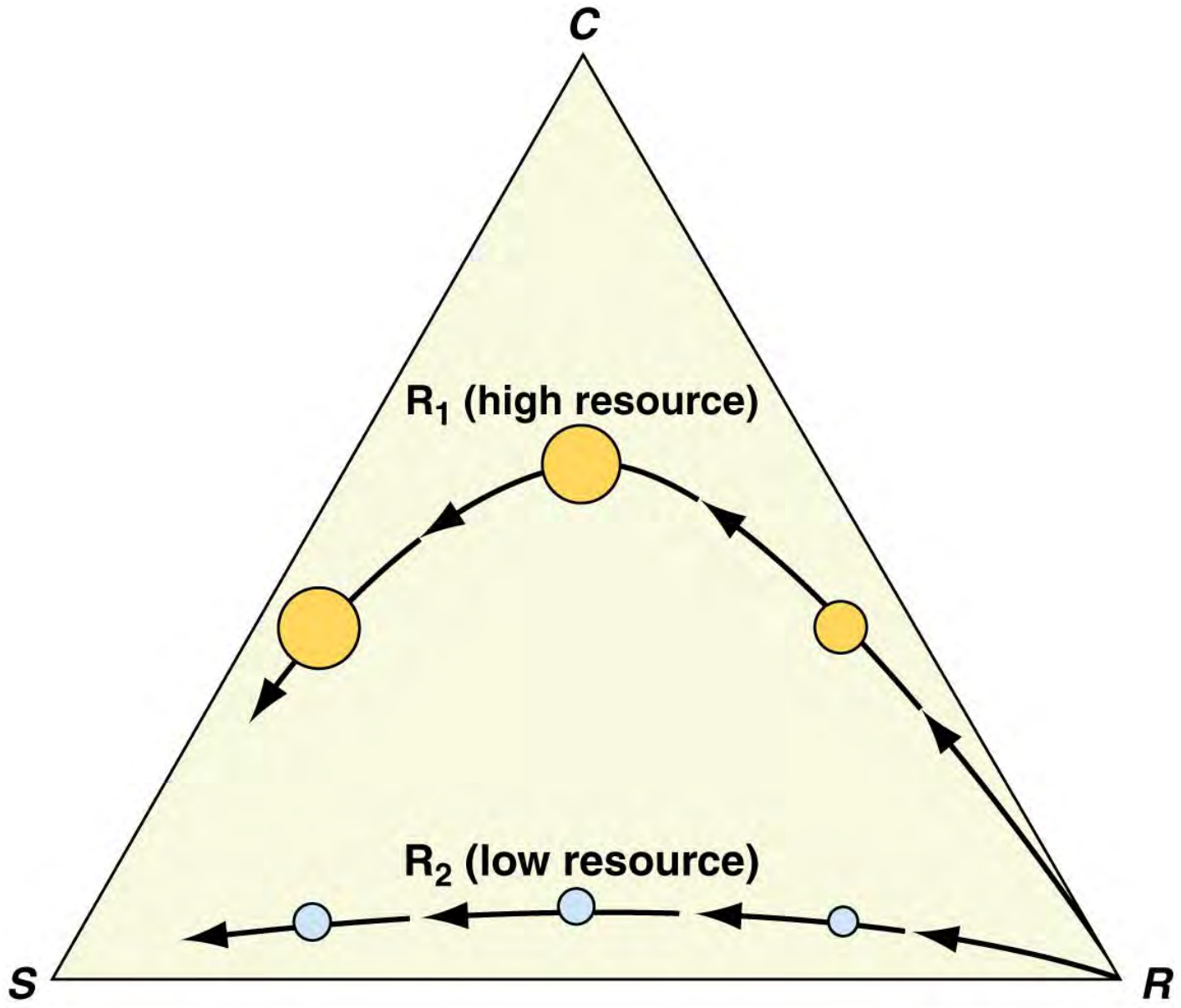
- **Facilitation model** – early successional species change the environment, making it more suitable for later successional species to invade and grow
- **Inhibition model** – involves strong competitive interactions
- **Tolerance model** – species in earlier successional stages neither aid nor inhibit later successional species

https://ferrebeekeeper.files.wordpress.com/2011/03/lichen27.jpg

Grimes triangle (UAST)

- *R* (ruderal) – species that can rapidly colonize disturbed sites
- *C* (competitive) – species that live in predictable habitats with abundant resources
- *S* (stress) – species that are stress-tolerant





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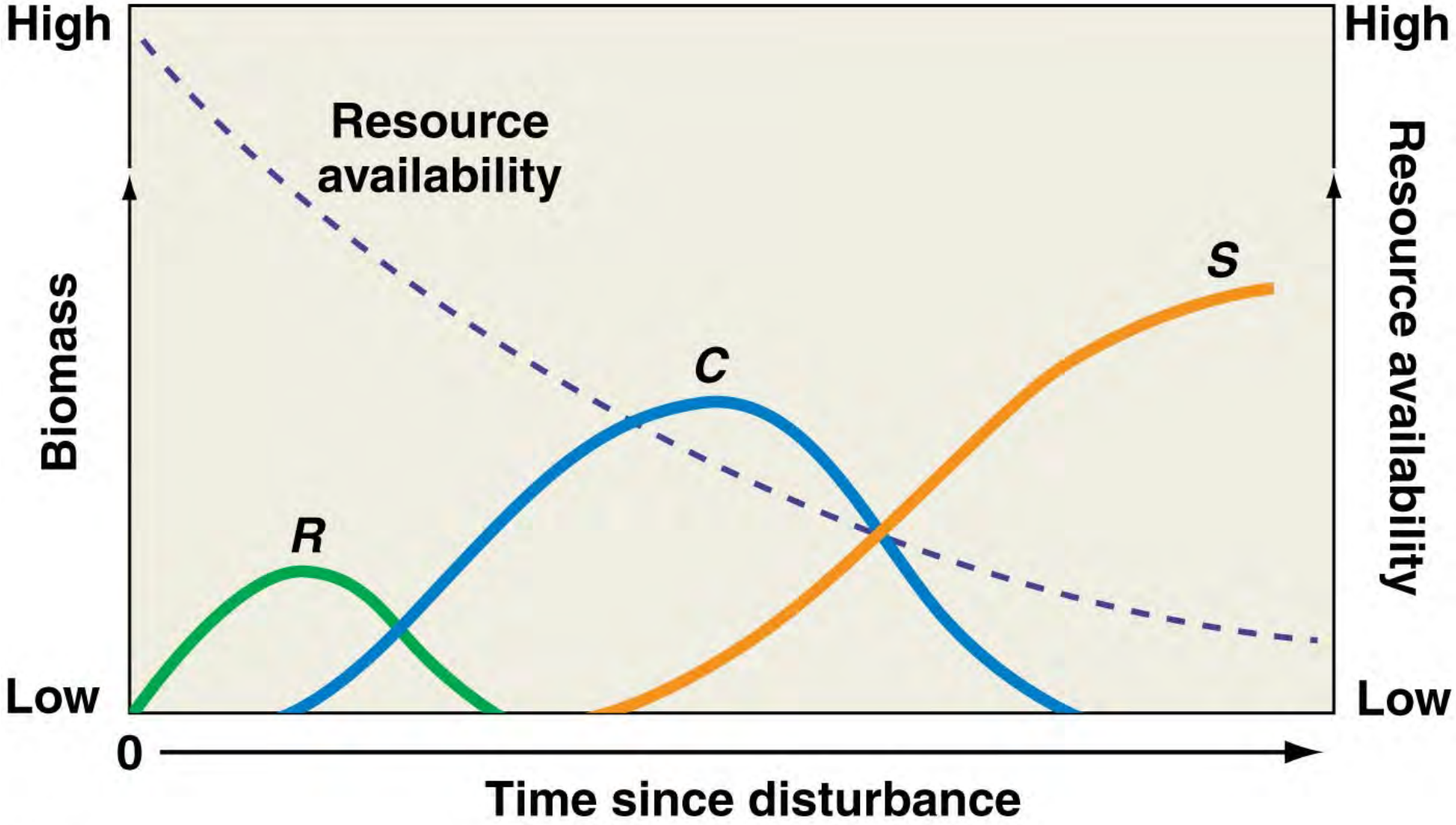
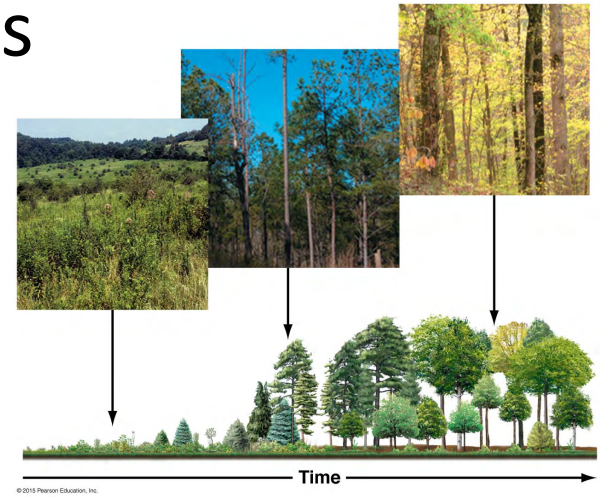

High
High
Resource availability
Biomass
Resource availability
S
C
R
Low
Low
0
Time since disturbance

Succession dominance

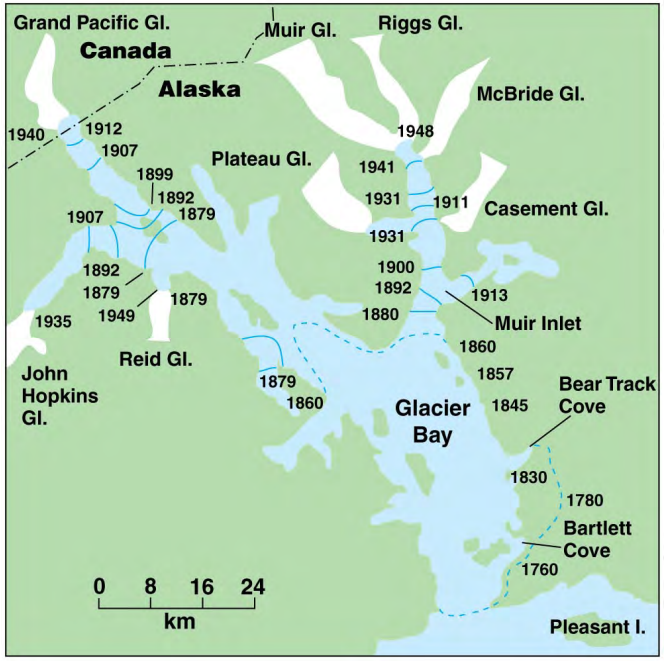
- Pattern of dominance shifts during succession
  - early – fast-growing, shade-intolerant species
  - later – slower-growing, shade-tolerant species
- Resource ratio hypothesis – succession is based on a trade-off in characteristics that enable plants to complete for light and nitrogen (essential resources)

Autogenic vs. Allogenic changes

- **Autogenic** environmental change is the result of the presence and activities of organisms within the community
- **Allogenic** environmental change is a result of a feature of the physical environment, so is governed by physical rather than biological processes



Primary Succession Occurs on Newly Exposed Substrates



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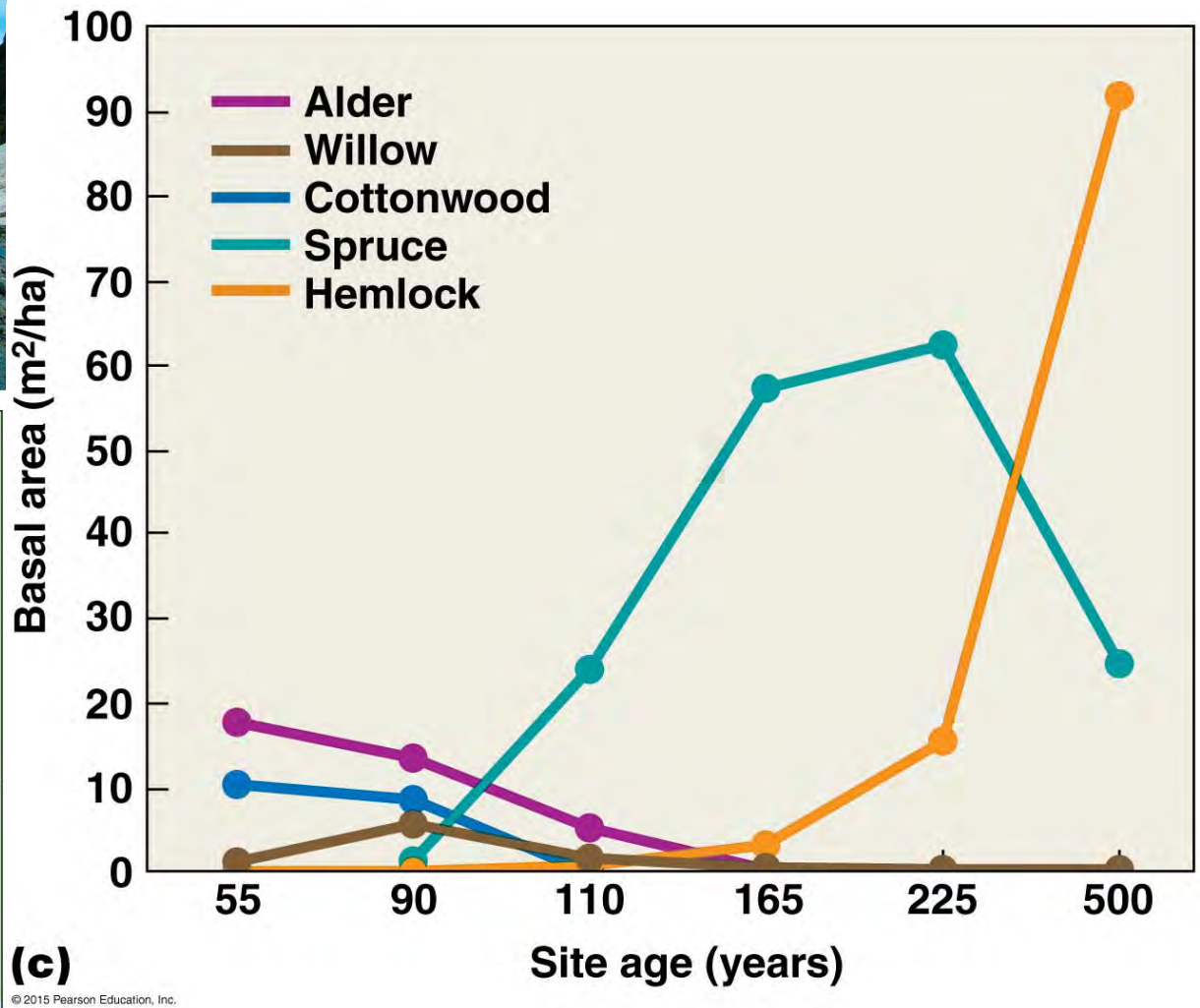
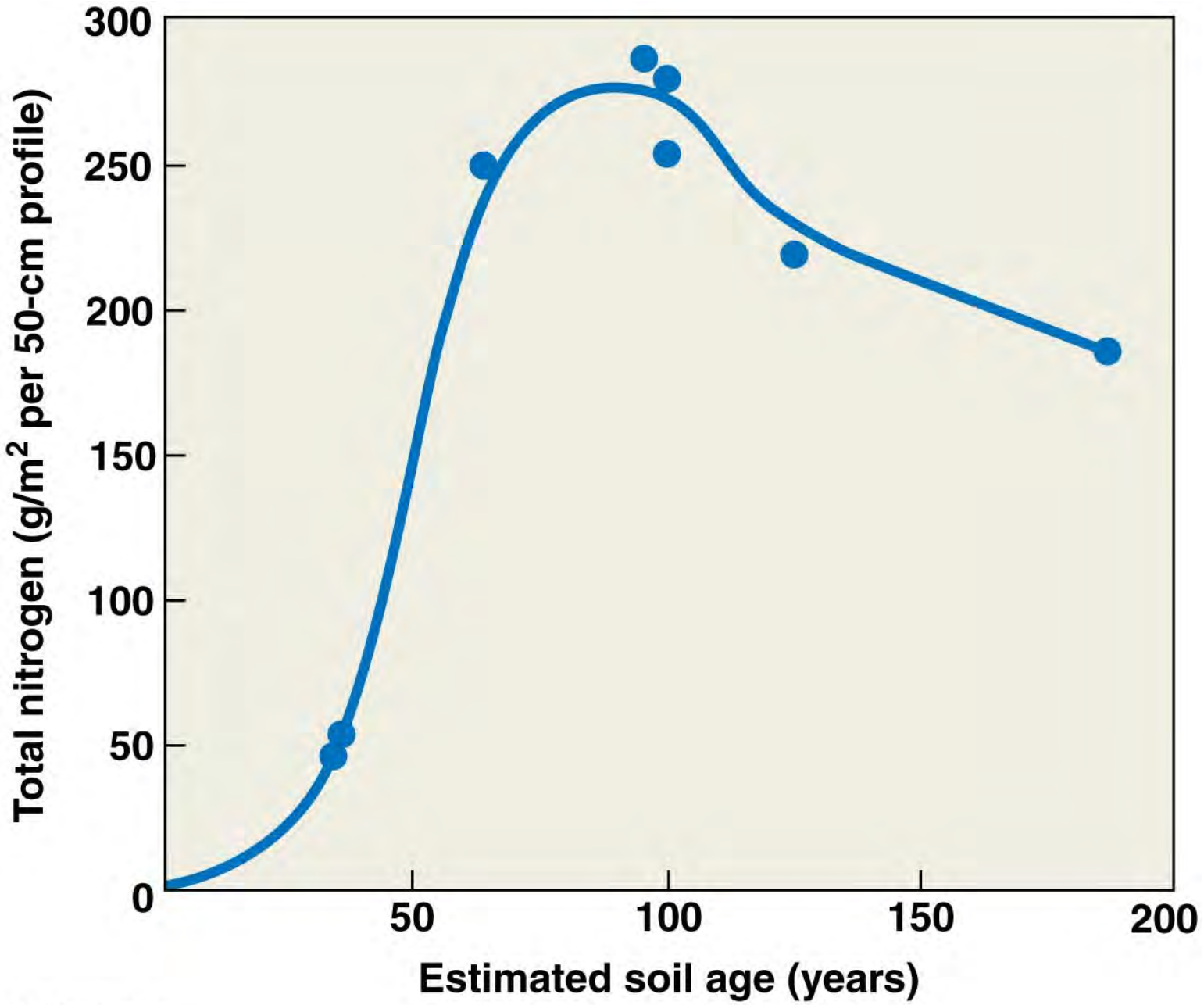


(c)

Succession Is Associated with Autogenic Changes in Environmental Conditions



Japanese knotweed

- Herbaceous, perennial plant native to East Asia, Japan, China, & Korea
- Looks like bamboo
- Stems max height 3-4 m (~10-13 ft)
- Can be found in temperate riparian ecosystems, roadsides, dumps
- Invasive species

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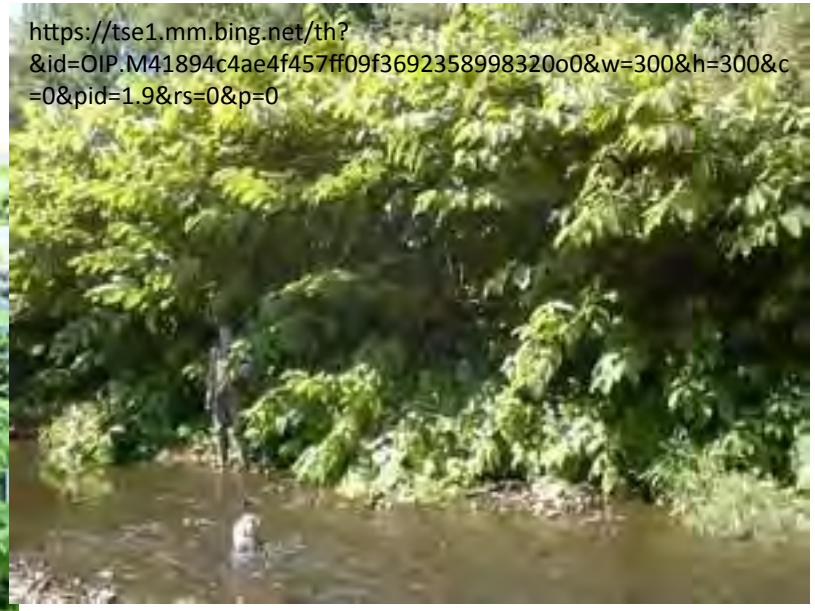
Succession Is Associated with Autogenic Changes in Environmental Conditions



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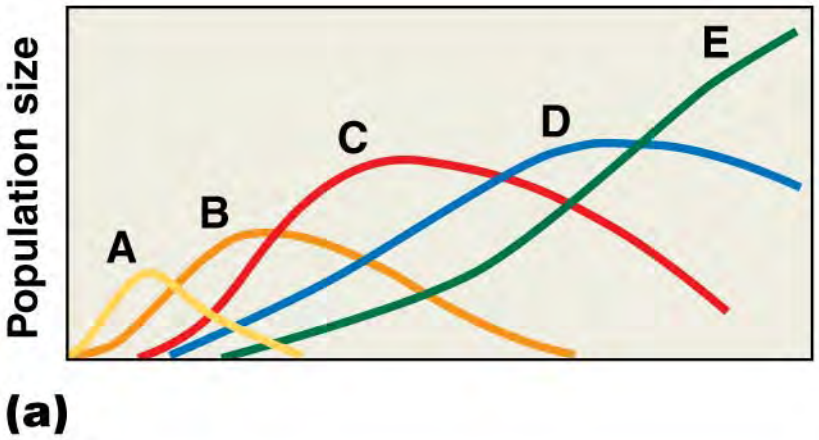
Species diversity changes



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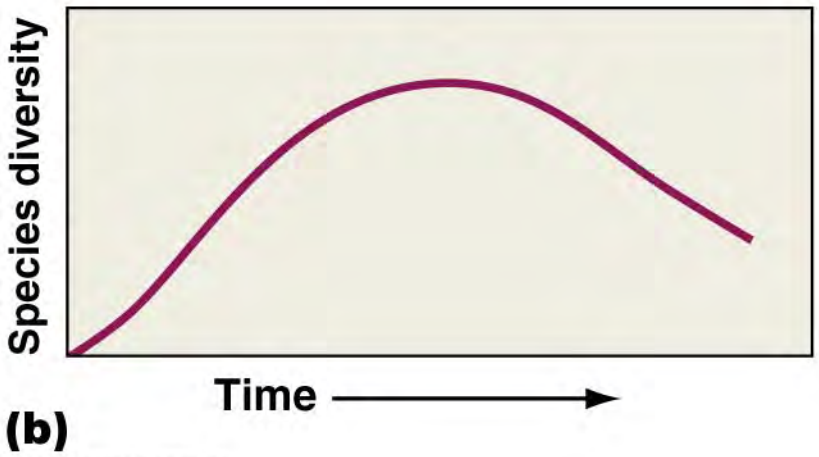

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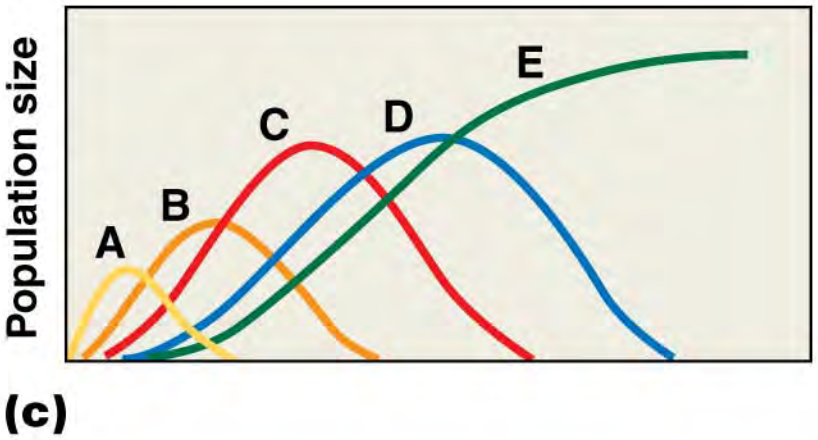

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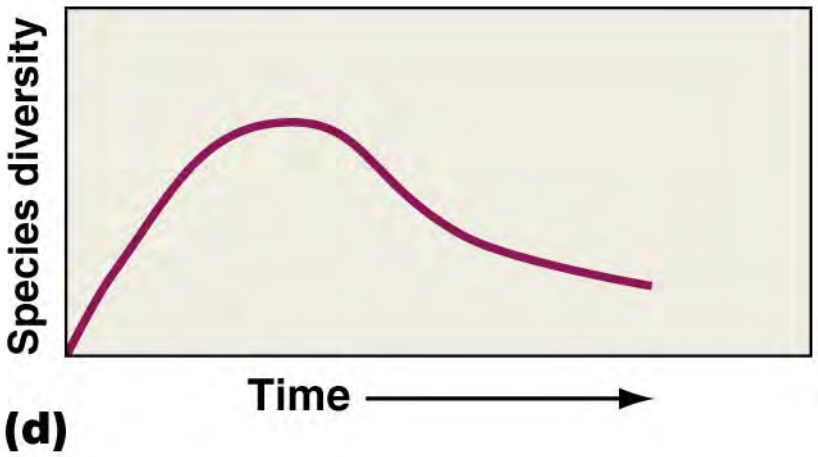
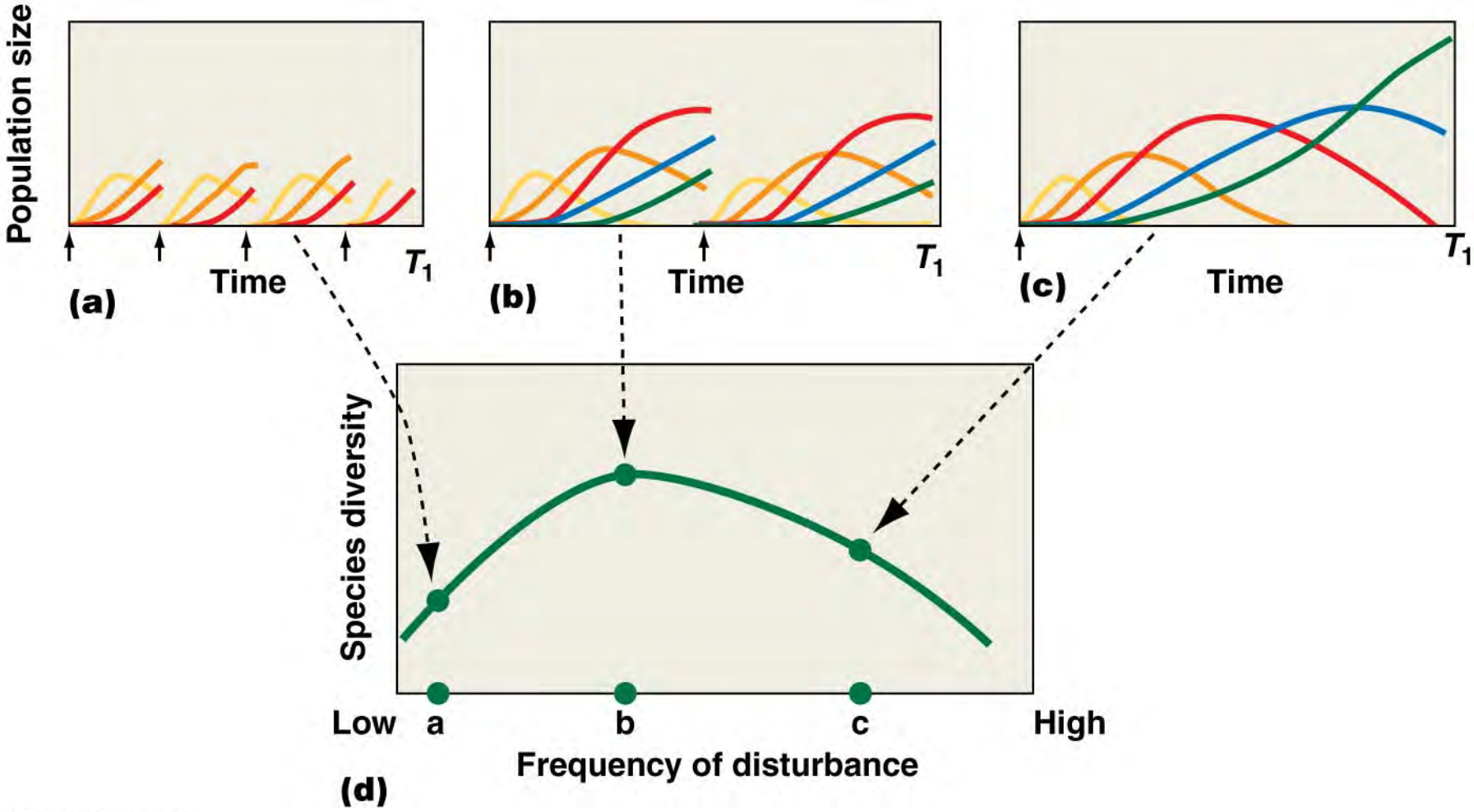


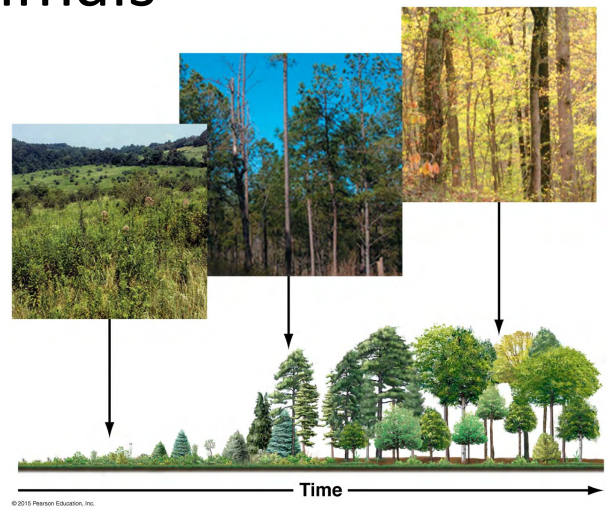
(d)

Intermediate disturbance hypothesis

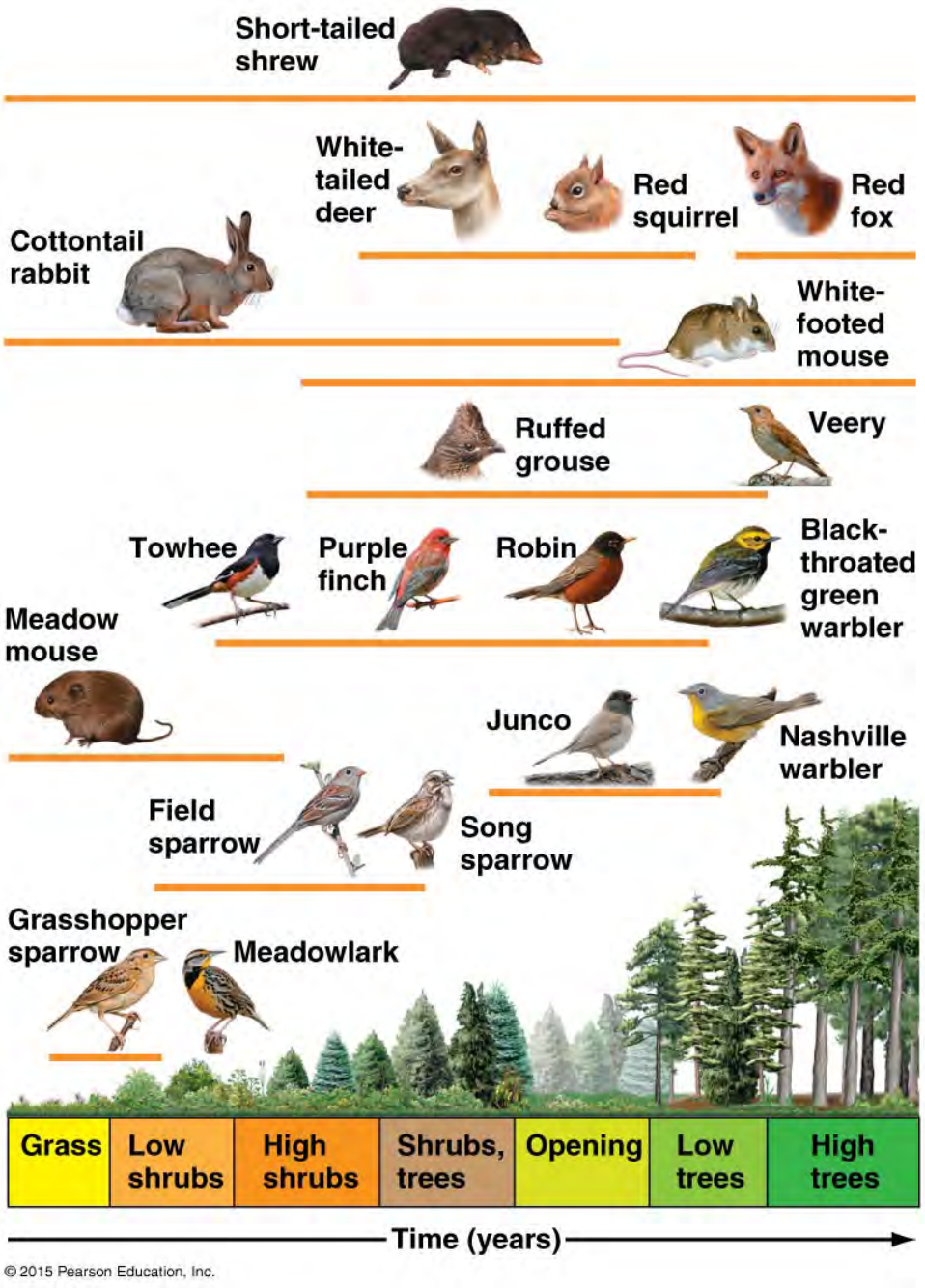


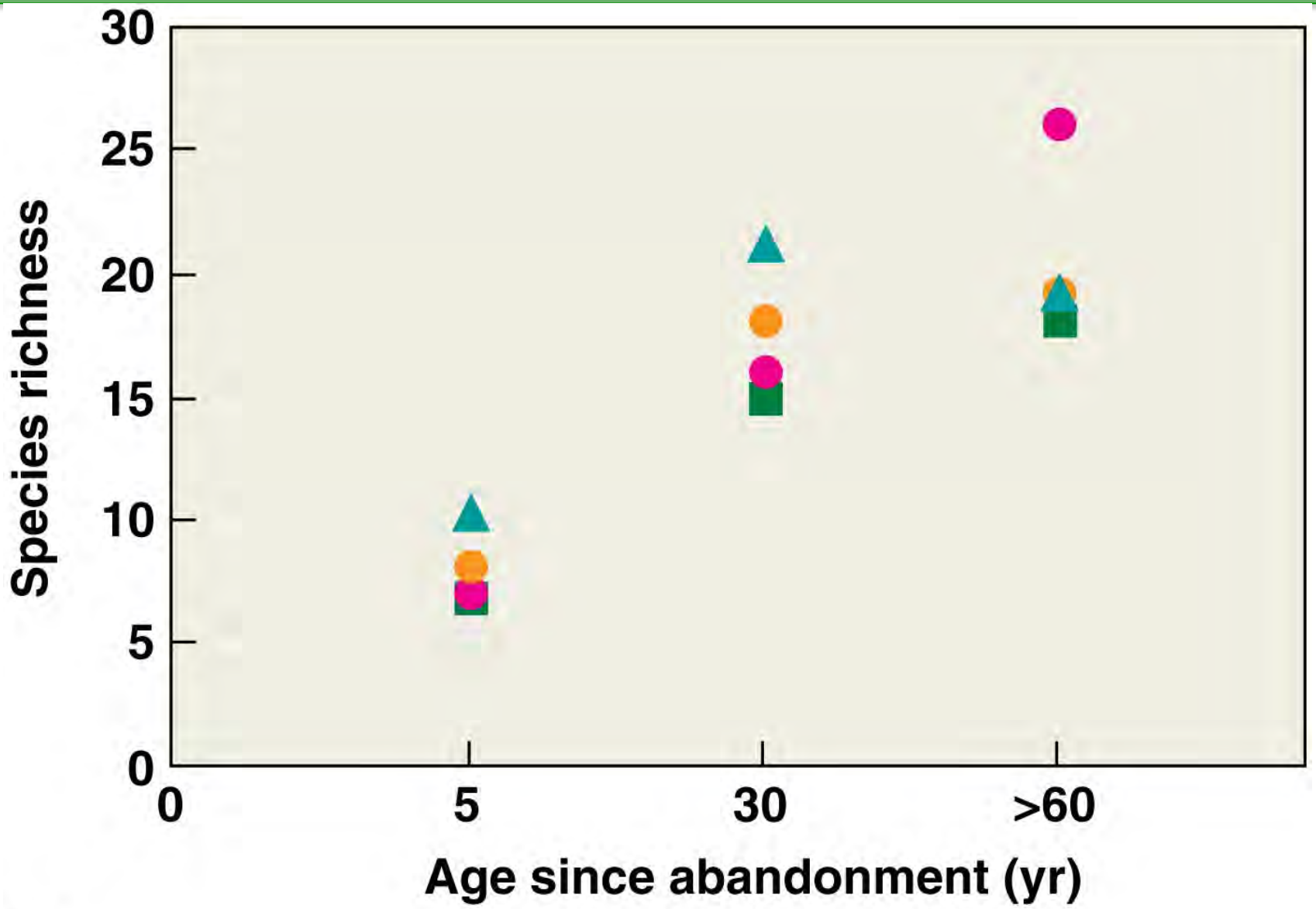
Heterotrophic species succession

- Different species are seen in early stages of succession than in the later stages
  - Grassland species disappear
  - Shrubland species colonize
  - Eventually the shrubland species disappear and are replaced by forest animals



Succession Involves Heterotrophic Species





(a)

Allogenic environmental changes

- Strictly abiotic environmental changes can affect succession over timescales ranging from days to thousands of years, or longer
- Environmental fluctuations that occur many times during an organism's life span are unlikely to influence successional patterns among species with a similar life span
- These fluctuations are unlikely to influence patterns of secondary succession in those communities

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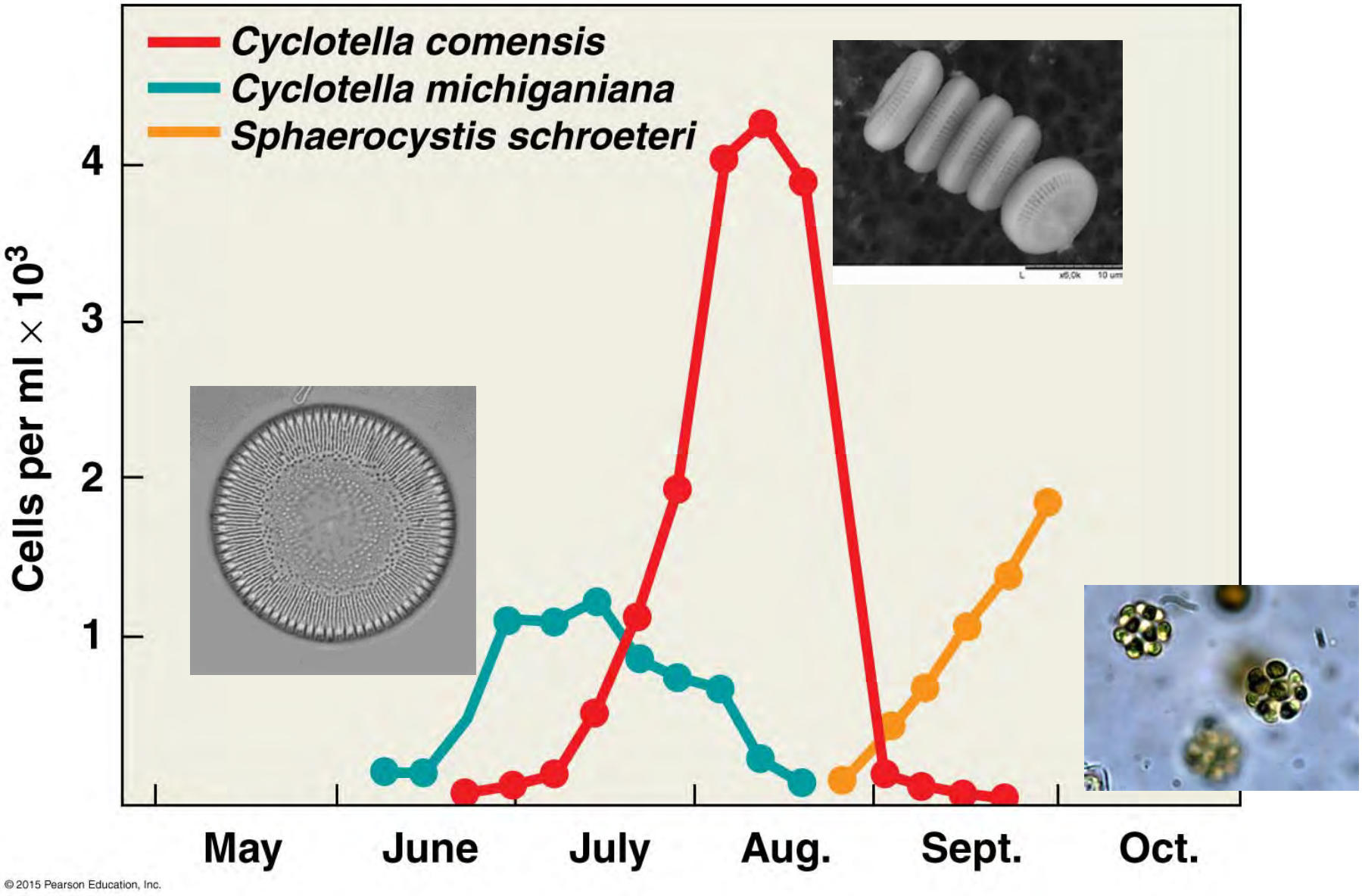
Systematic Changes in Community Structure Are a Result of Allogenic Environmental Change at a Variety of Timescales



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Succession

- Temporal change in community structure at a given location
  - Facilitation, inhibition, tolerance
  - RCS species
  - Autogenic & allogenic
  - Disturbance frequency

https://ferrebeekeeper.files.wordpress.com/2011/03/lichen27.jpg