

Community Structure

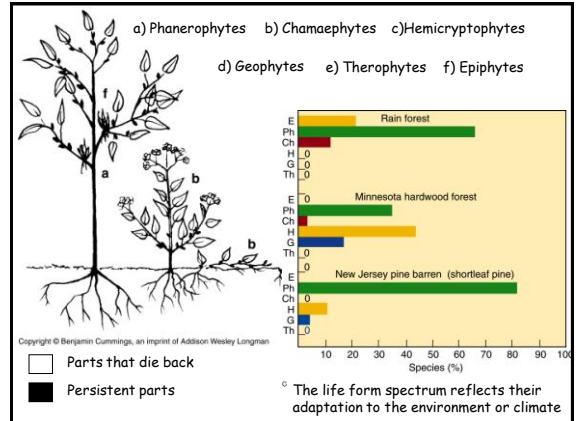


Community Structure

- Animal and plant species interacting directly or indirectly in the same environment or habitat is referred to as a **community**
- **Guilds** → species that utilize the same habitat or food resource in a similar matter (**functional group**)
- Communities also classified in terms of their means of energy acquisition
 - Heterotrophic vs. Autotrophic
- Can be classified based on characteristics
 - Physical & biological

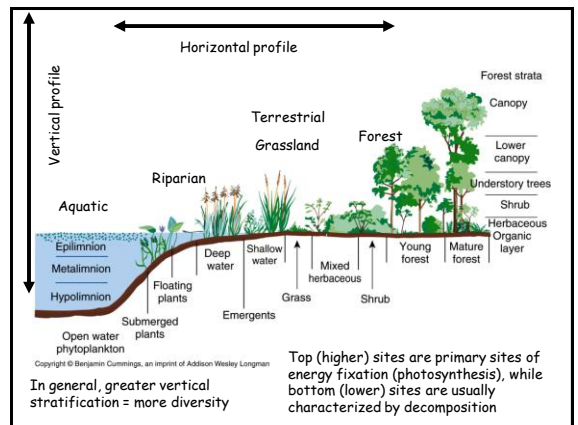
Community Structure

- Physical structure
 - Both biotic & abiotic
 - Largely defined by vegetation
- Raunkiaer Life Forms
 - Classified plant life by the relation of the embryonic or meristemic tissues that remain inactive over the winter or prolonged dry periods (handout)
 - Six classes: **Therophytes, Geophytes, Hemicryptophytes, Chamaephytes, Phanerophytes, Epiphytes**

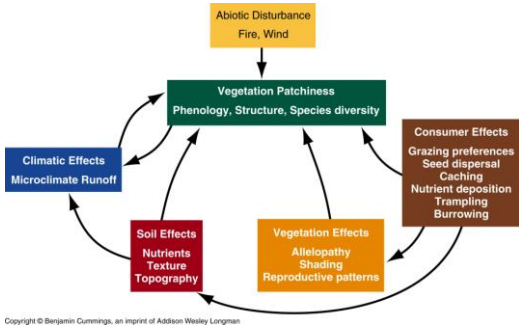


Community Structure

- Vertical Stratification
 - Vertical structure largely determined by plant life form (influenced by vertical light gradient)
 - Provides physical structure which will ultimately influence animal life forms
 - Example: Forest ecosystem from top to bottom
 - Canopy, understory, shrub layer, herb or ground layer, forest floor, soil (horizons), etc.



Overall, the patterns we see at all scales in the landscape are the product of an array of physical and biological influences (interacting)



Community Structure

- **Biological Structure**
 - The mix of species defines the structure of communities
- **Species Dominance**
 - Most numerous or account for greatest biomass (may not represent its influence in the community)
 - **Keystone species** → those whose presence is critical to the integrity of the community
 - Measures of dominance
 - Relative abundance & relative frequency

Community Structure

- **Biological Structure**
- **Species Diversity**
 - **Species Richness and Evenness**
 - Richness (S) → number of sp in community
 - $S = p_i$
 - Shannon Index (H):
 - $H = \sum (p_i) (\log_2 p_i)$
 - Simpson Index (C) → index of dominance
 - $C = 1 - \sum (p_i)^2$

Community Structure

- **Biological Structure**
- **Species Diversity**
 - Diversity Indices can be used to compare species diversity:
 - Within a community (**alpha diversity = α**)
 - Between communities or habitats (**beta diversity = β**)
 - Among communities over a geographical area (**gamma diversity = γ**)

Community Structure

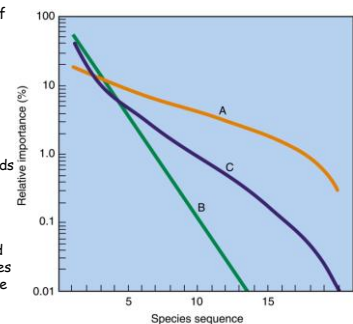
- **Biological Structure**
- **Species Abundance (3 models)**
 - **Random-niche (or broken stick model)**
 - Abundance as a random partitioning of resources distributed along a continuum
 - **Niche preemption (or geometric distribution)**
 - Most successful or dominant species preempts the most space
 - **Log-normal hypothesis**
 - Relative abundance of each species determined by variety of conditions (resources, environment, interactions)

Graphical representation of species abundance models

Curve A: Random niche
→ boundaries located at random positions

Curve B: Niche preemption
→ relative importance plotted on log scale yields a straight line

Curve C: Log-normal hypothesis
→ distribution determined by large number of variables that affect the competitive abilities of the species involved



Community Structure

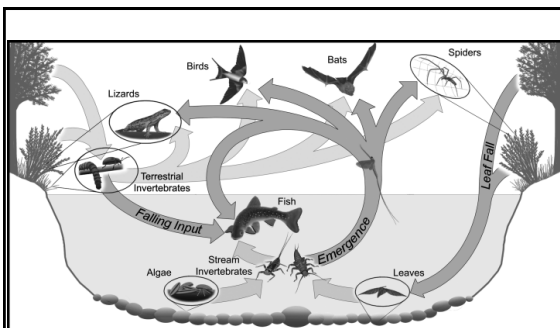
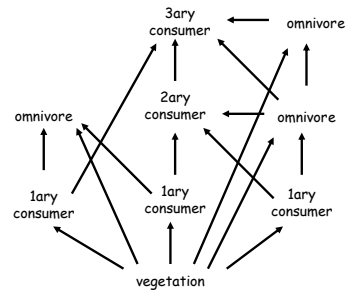
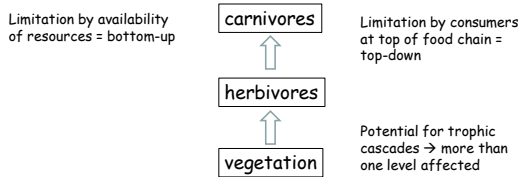
- Influences of population interactions
- How do species interactions affect community structure?
 - Competition (interspecific vs. intraspecific)
 - Predation (predator-prey oscillations)
 - Parasitism & Disease (parasite-host relationships)
 - Mutualism (direct vs. indirect, coevolutionary adaptations)

Community Structure

- Food Webs
 - Acquisition of food (the energy and nutrients required for assimilation)
- Grass → Cow → Man
- Feeding relationships in nature are not simple

Community Structure

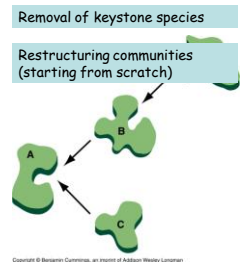
- Food Webs
 - Bottom-up vs. Top-down regulation



Baxter et al. 2005 (Copyright 2005 Blackwell Publishing Ltd) Illustration by Jeremy Monroe

Community Structure

- Assembly Rules
 - How do communities form?
 - How do species become assembled?
 - What factors may be involved?
- Intriguing problem in ecology



Community Structure

- **Classification of Communities**
 - Physiognomy (the general appearance, vertical structure, and growth form of vegetation)
 - Useful method for delineating communities
 - Animal distribution usually correlates with plant community structure
 - Communities named after the dominant life form (i.e., coniferous or deciduous forest; sagebrush, or short-grass prairie)
 - If habitat boundaries well defined, communities classified by physical features (i.e., tidal flats, sand dunes, cliffs, ponds, streams, etc.)

