Community – Structure and Models

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Community Structure

- Population don’t live apart from one another
- Group of Population : **Community**
- Within Community some sps. carryout same function or exploit same resource : **Guild** (e.g. Insect feeding birds)
- Zoologist : Bird Community, Mammal Community
- Ecologist : Autotrophic, Heterotrophic community

<u>Community vary in Biological Structure</u>

- Number of Species and Relative abundance of species (Biological Structure of Community)
- Dominants : Some measure of dominance
  - Most numerous
  - Highest biomass
  - Occupy most space
  - Contribute to energy flow & nutrient cycling
  - Influence rest of the community
- Ecologist = High No. = Dominant

  (But in forest, Large Trees are less in number)
- Scarce organism dominates by its activity,
  - e.g. Predatory Starfish *Pisaster*

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Decrease number of prey, they can <u>**coexist**</u>

- Key Stone Species; a relatively low biomass species that is a major factor in determining community structure

Number & Relative abundance define Species Diversity

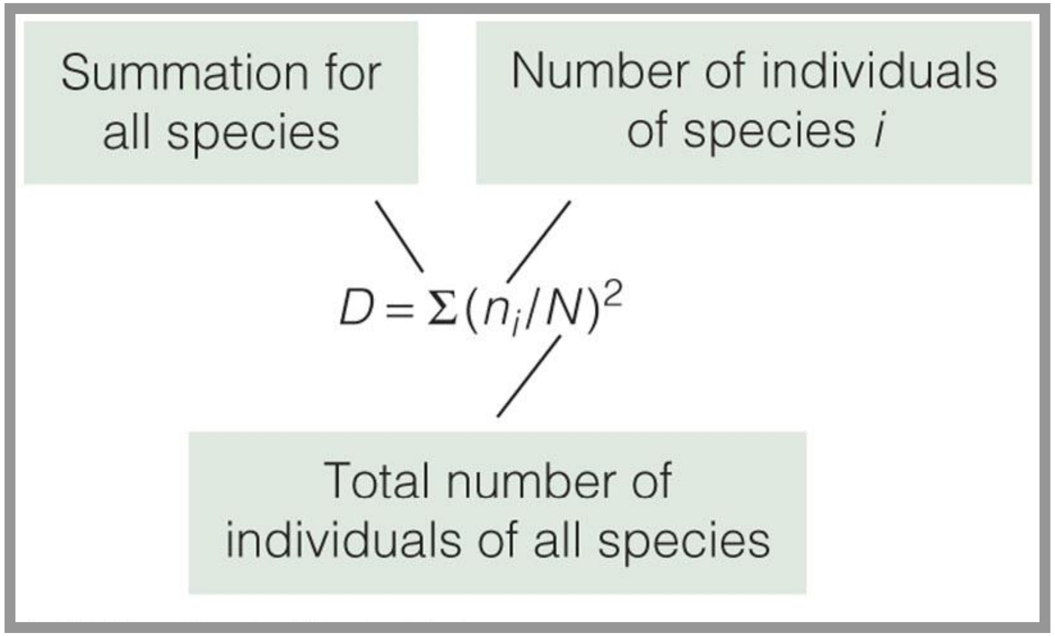
- Frequency, Density, Abundance, Dominance
- Relative Values
- IVI
- Species Richness and Species Evenness
- α, β and γ diversity
- Diversity Indices

The Number of Species and Their Relative Abundance Define Diversity.

Table 16.2 | Structure of a Second Deciduous Forest Stand in Northern West Virginia

Species	Number of Individuals	Relative Abundance (Percentage of Total Individuals)
Yellow-poplar (*Liriodendron tulipifera*)	122	44.5
Sassafras (*Sassafras albidum*)	107	39.0
Black cherry (*Prunus serotina*)	12	4.4
Cucumber magnolia (*Magnolia acuminata*)	11	4.0
Red maple (*Acer rubrum*)	10	3.6
Red oak (*Quercus rubra*)	8	2.9
Butternut (*Juglans cinerea*)	1	0.4
Shagback hickory (*Carya ovata*)	1	0.4
American beech (*Fagus grandifolia*)	1	0.4
Sugar maple (*Acer saccharum*)	1	0.4
	274	100.0

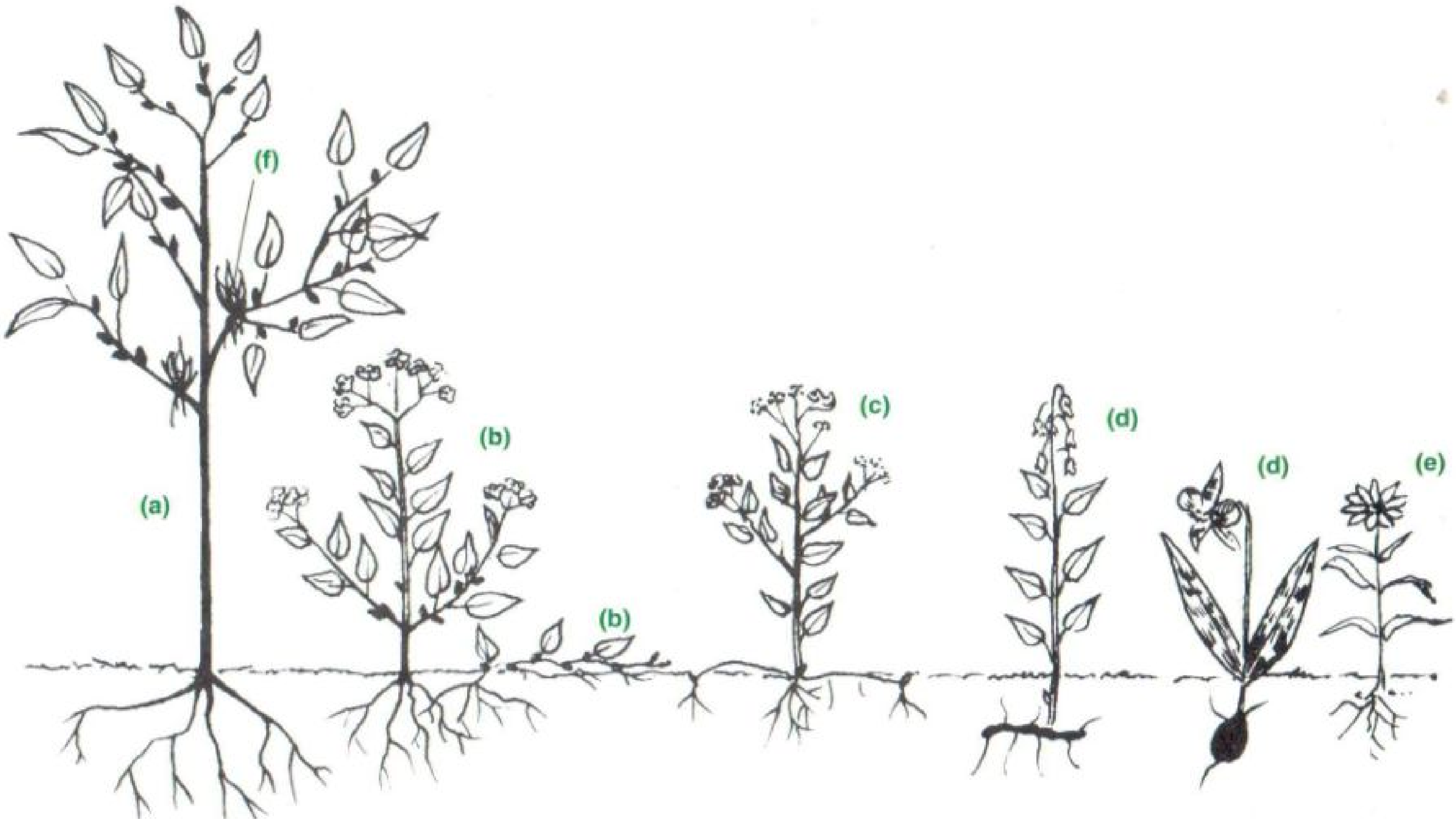
The Number of Species and Their Relative Abundance Define Diversity.



Simpson's Index (D) measures the diversity and dominance of species in a community.

Communities have defining Physical Structure

- Abiotic Factors
- Spatial Configuration of organism
- Christen Raunkiaer (1903), gave six life forms, based on height of perennating tissue above ground
  - Phanerophytes: >25 cm, moist, warm environment
  - Chamaephytes: ~25 cm, cool, dry climate
  - Hemicryptophytes: at surface, cold, moist
  - Cryptophytes; buried in ground, cold, moist
  - Therophytes, annuals, survive unfav. pd. as seed
  - Epiphytes; roots up in the air



(a) Phanerophytes (Greek *phaneros*, "visible"). Perennial buds carried well up in the air and exposed to varying climatic conditions. Trees and shrubs over 25cm; typical of moist, warm environments.

(b) Chamaephytes (Greek *chamia*, "on the ground"). Perennial shoots or buds on the surface of the ground to about 25cm above the surface. Buds receive protein from fallen leaves and snow cover. Typical of cool, dry climates.

(c) Hemicryptophytes (Greek, *hemi*, "half" and *kryptos*, "hidden"). Perennial buds at the surface of the ground, where they are protected by soil and leaves. Many plants have rosette leaves. Characteristic of cold, moist climates.

(d) Cryptophytes (Greek, *kryptos*, "hidden"). Perennial buds buried in the ground on a bulb or rhizome, where they are protected from freezing and drying. Typical of cold, moist climates.

(e) Therophytes (Gr. *theros*, "summer"). Annuals, with complete life cycle from seed to seed in one season. Plants survive unfavorable periods as seeds. Typical of deserts and grasslands.

(f) Epiphytes (Gr. *epi*, "upon"). Plants growing on other plants; roots up in the air.

- Life form spectrum: When the species within a community are classified into life form and each life form is expressed as a percentage, we get a life form spectrum

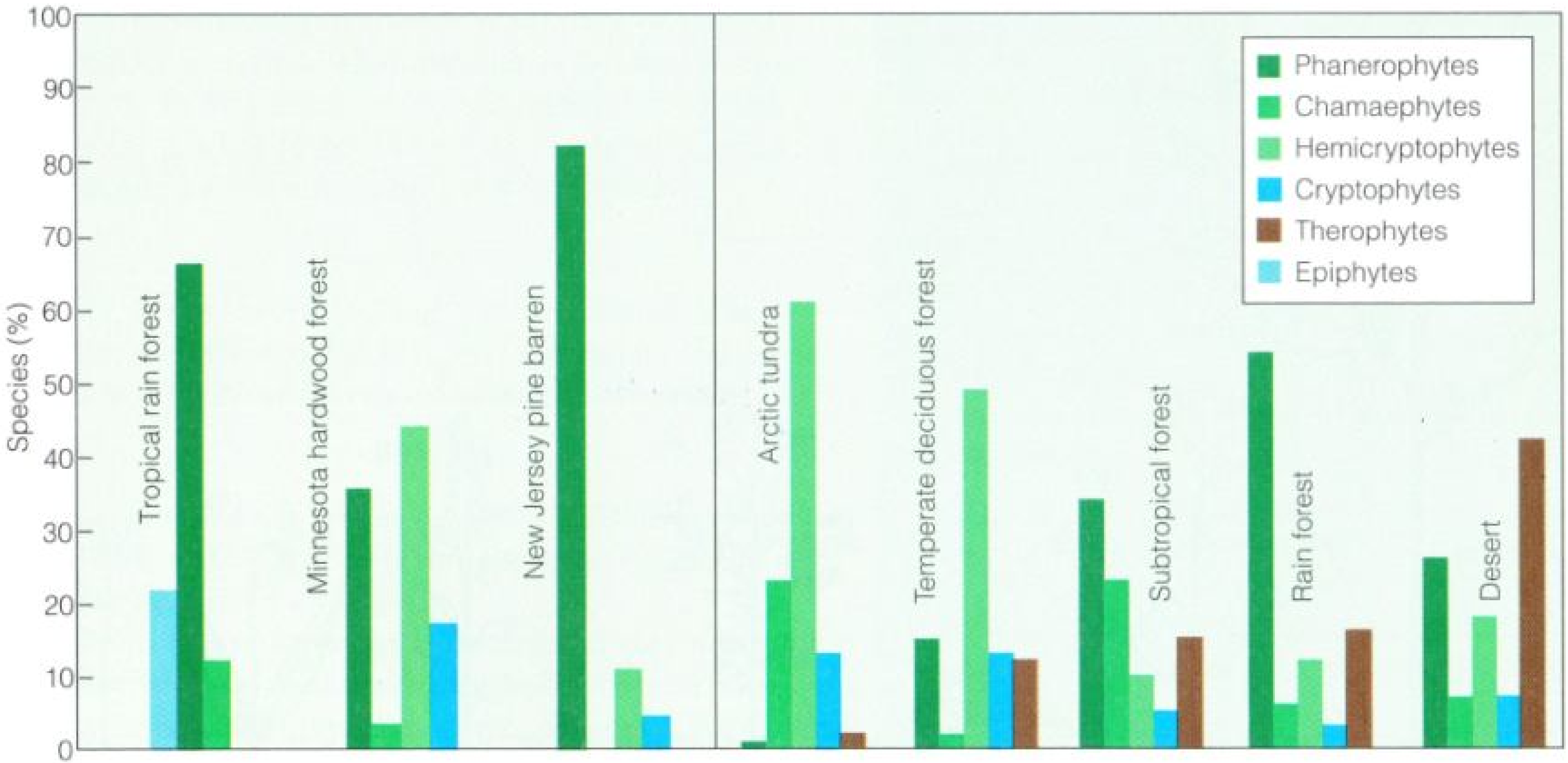


Figure 20.2 Left: Life form spectra of a tropical rain forest, a temperate forest in Minnesota, and a New Jersey pine barren. Note the absence of hemicryptophytes, chamaephytes, and therophytes in the tropical rain forest and the prominence of epiphytes. The pine barrens are dominated by phanerophytes. Right: Life form spectra of major ecosystems. Note the importance of hemicryptophytes in the arctic tundra and temperate deciduous forest, and the importance of phanerophytes and therophytes in the desert ecosystem.

Vertical Layering is characteristic of all community

- Terrestrial
  - Canopy : Open, dense
  - Understory: *Viburnum, Cornus, Carpinus*
  - Shrub Layer
  - Herb Layer (Slope)
  - Forest Floor : Decomposition
  - Organic Layer
  - Root Layer
  - Soil Strata

Aquatic

- Temperature and O2 level
  - Epilimnion: Free circulating water
  - Metalimnion: Thermocline
  - Hypolimnion: Cold water & low in O2
- Light penetration
  - Trophogenic Zone: Phytoplankton, Photosynthesis
  - Tropholytic Zone: Decomposition fast

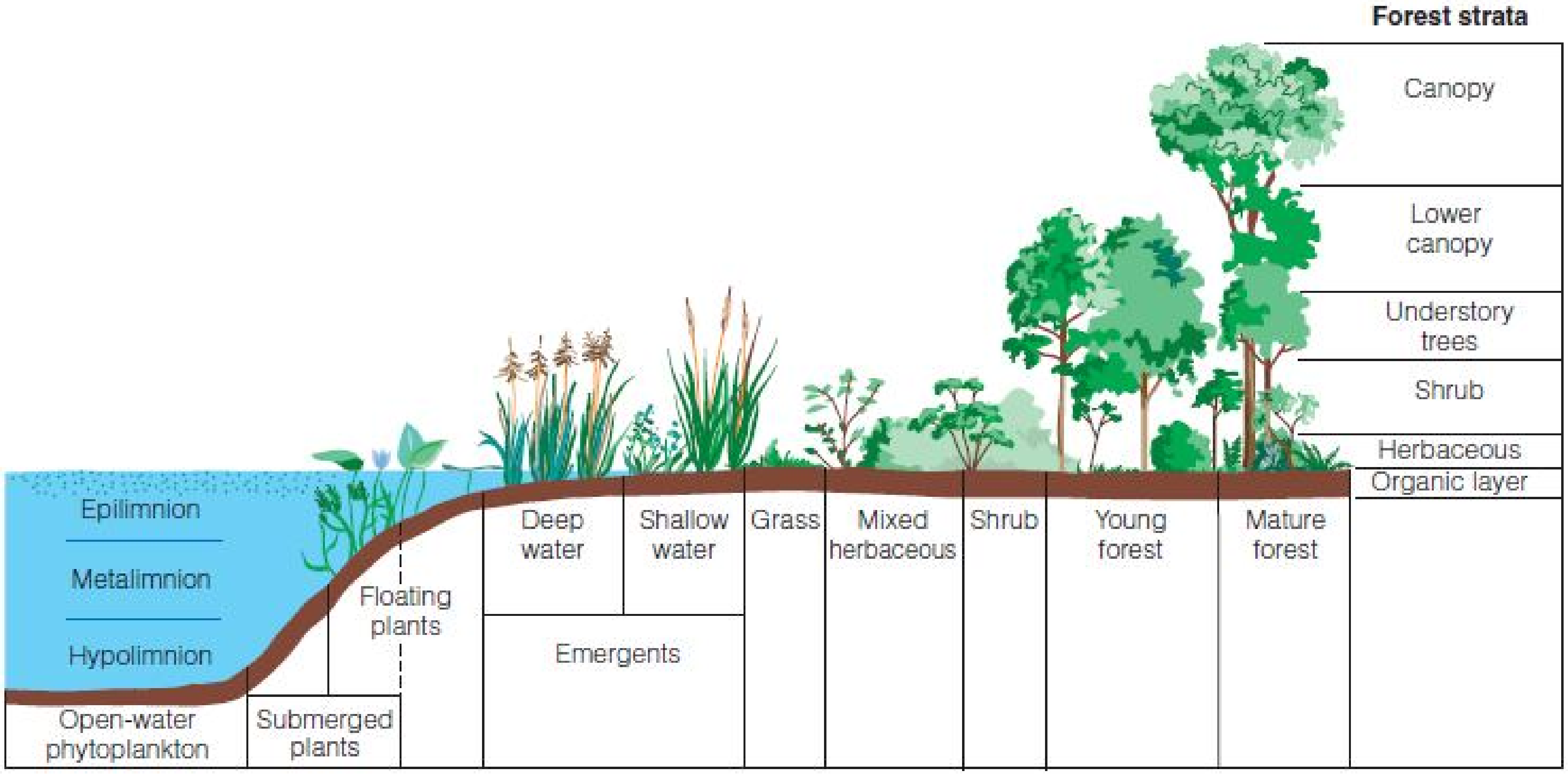
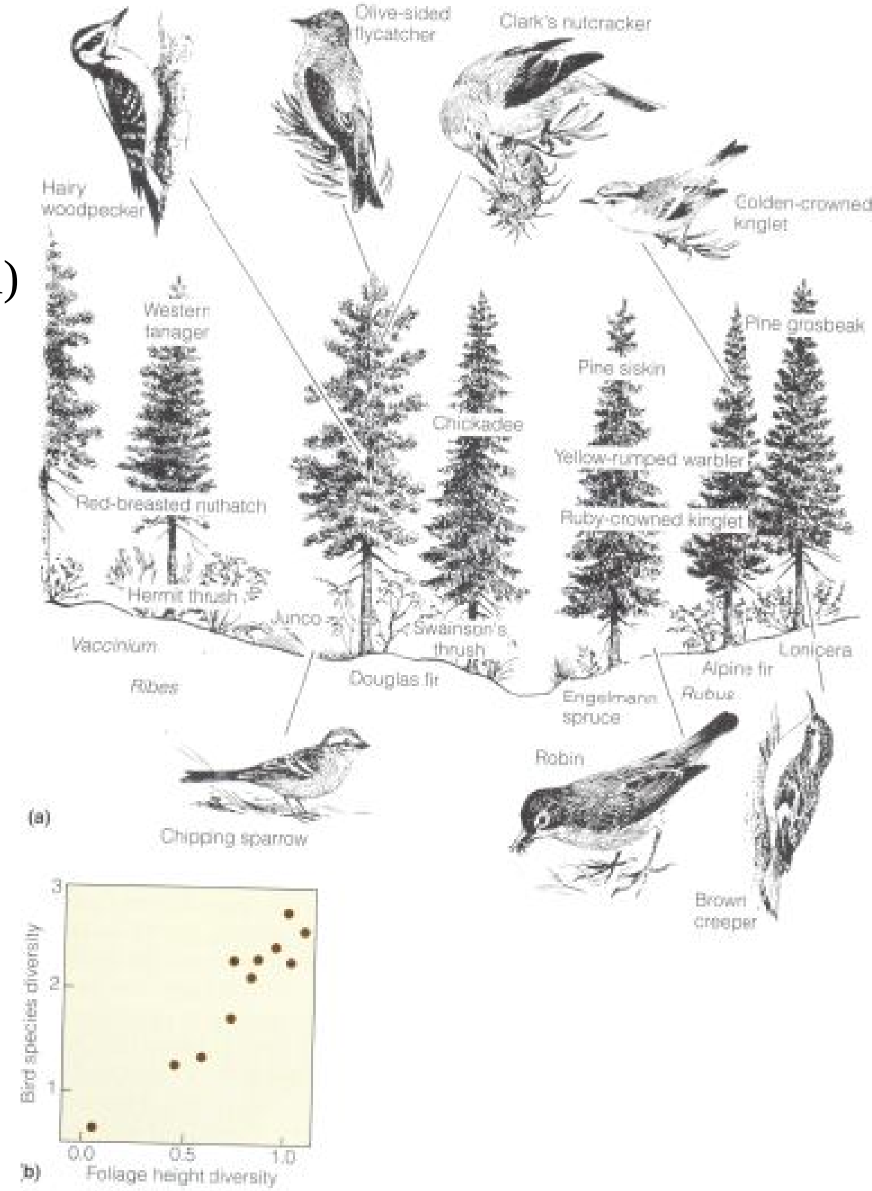


Figure 17.5 A vertical view of communities from aquatic to terrestrial. In aquatic and terrestrial environments, the primary zone of decomposition and regeneration is the bottom stratum, and the zone of energy fixation is the upper stratum. From left to right in the figure, community stratification and complexity increase. Stratification in aquatic communities is largely physical, influenced by gradients of oxygen, temperature, and light. Stratification in terrestrial communities is largely biological. Dominant vegetation affects the physical structure of the community and the microclimatic conditions of temperature, moisture, and light. Because the forest has four or five strata, it supports a greater diversity of life than can grassland with two strata. Floating and emergent aquatic plant communities typically support greater diversity of life than can open water.

- Vertical layering α animal diversity
  - Grass land: 6 to 7 bird sps (nest on ground)
  - Forest: >30 sps of bird
- Same is the case with insect diversity



Communities Exhibit Horizontal Patterns

- Horizontal patchiness increases physical complexity of community
  - Gap in canopy, soil structure, soil fertility, moisture condition, pattern of light & shade, small variation in topography, wind, slope, runoff, grazing animals etc

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microclimate

Horizontal patchiness of plants influence distribution & diversity of animal life

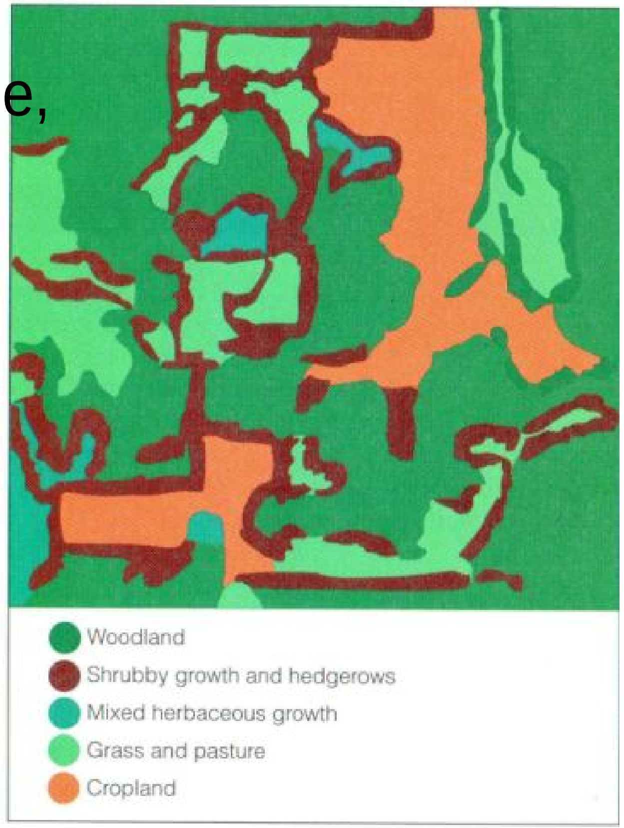
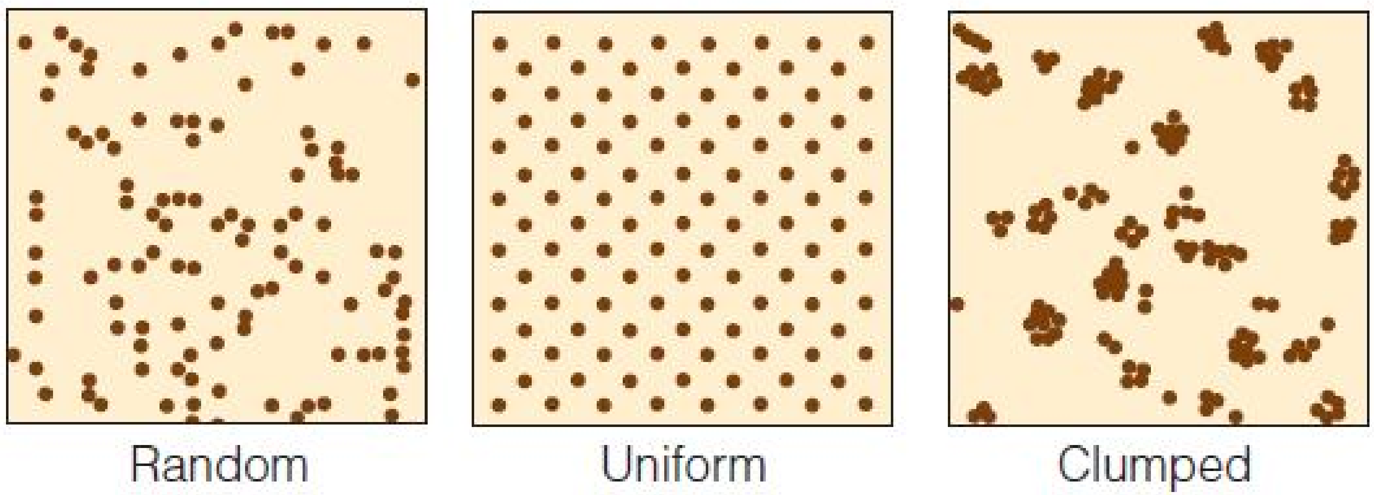
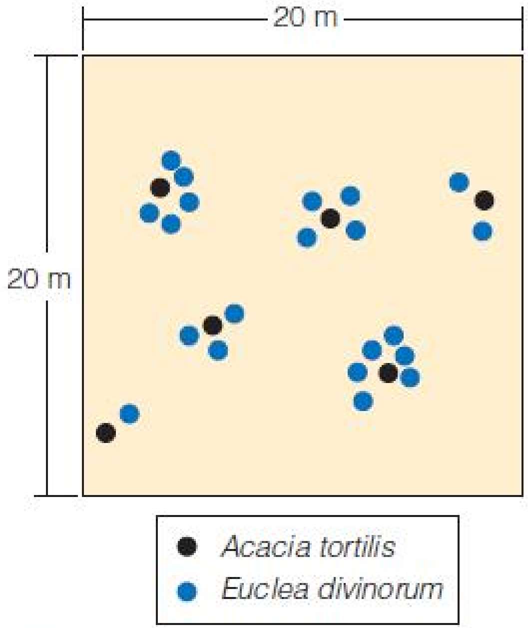


Figure 20.5 Horizontal patterns of vegetation patches in a Wisconsin countryside.

COMMUNITIES HAVE CHARACTERISTIC PATTERNS OF DISPERSION





(a)

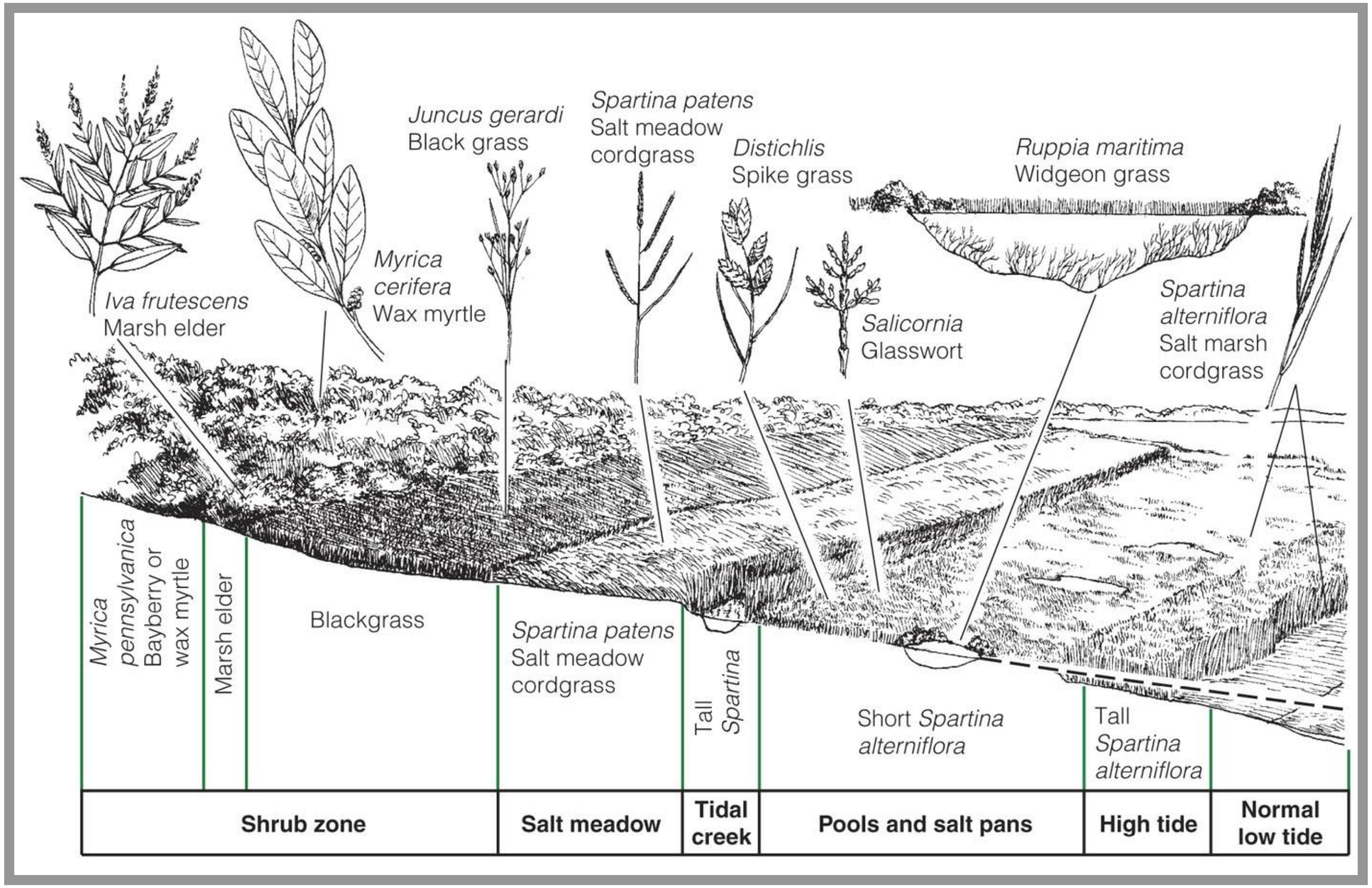

(b)

Acacia; intraspecific interaction for water, uniform distribution
Euclea; seeds eaten by bird that live on Acacia

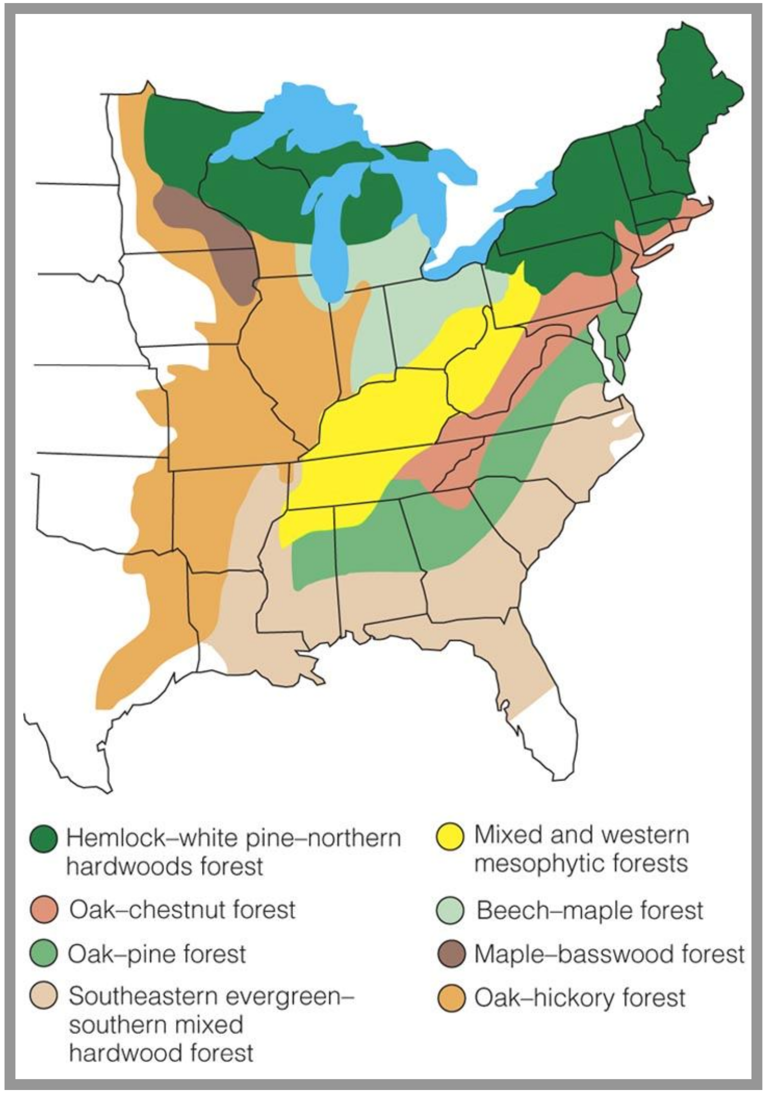
Spatial distribution of the shrub *Euclea divinorum, inhabiting the savannas of* southern Africa. Individuals are clumped under the canopies of *Acacia tortilis trees,* The clumps, however, are uniformly spaced due to the uniform spacing of *A. tortilis trees on the landscape*

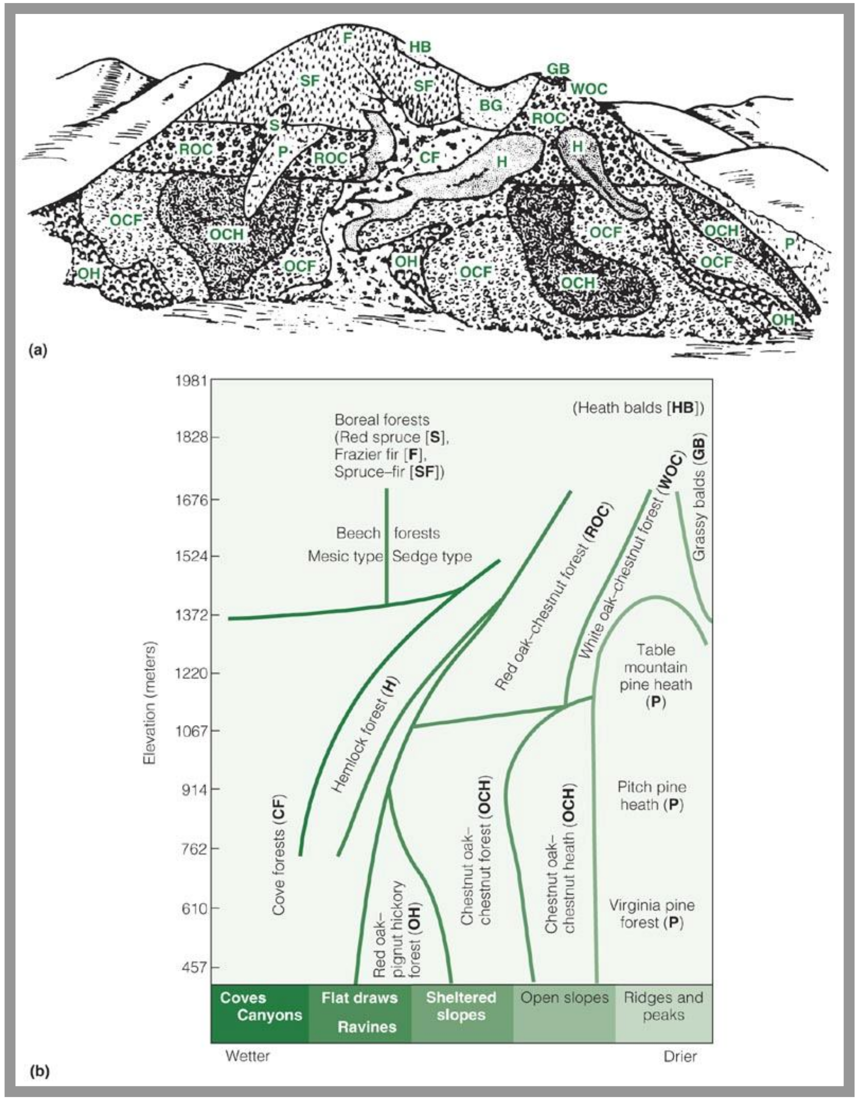
Shrubs in the Kara Kum Desert of central Asia conform to a uniform distribution. The root systems of these shrubs extend laterally up to eight times the diameter of their canopy, and competition for water in this arid environment is intense

- Zonation; changes in physical & biological structure of community across landscape
- Zonation Is Spatial Change in Community Structure.

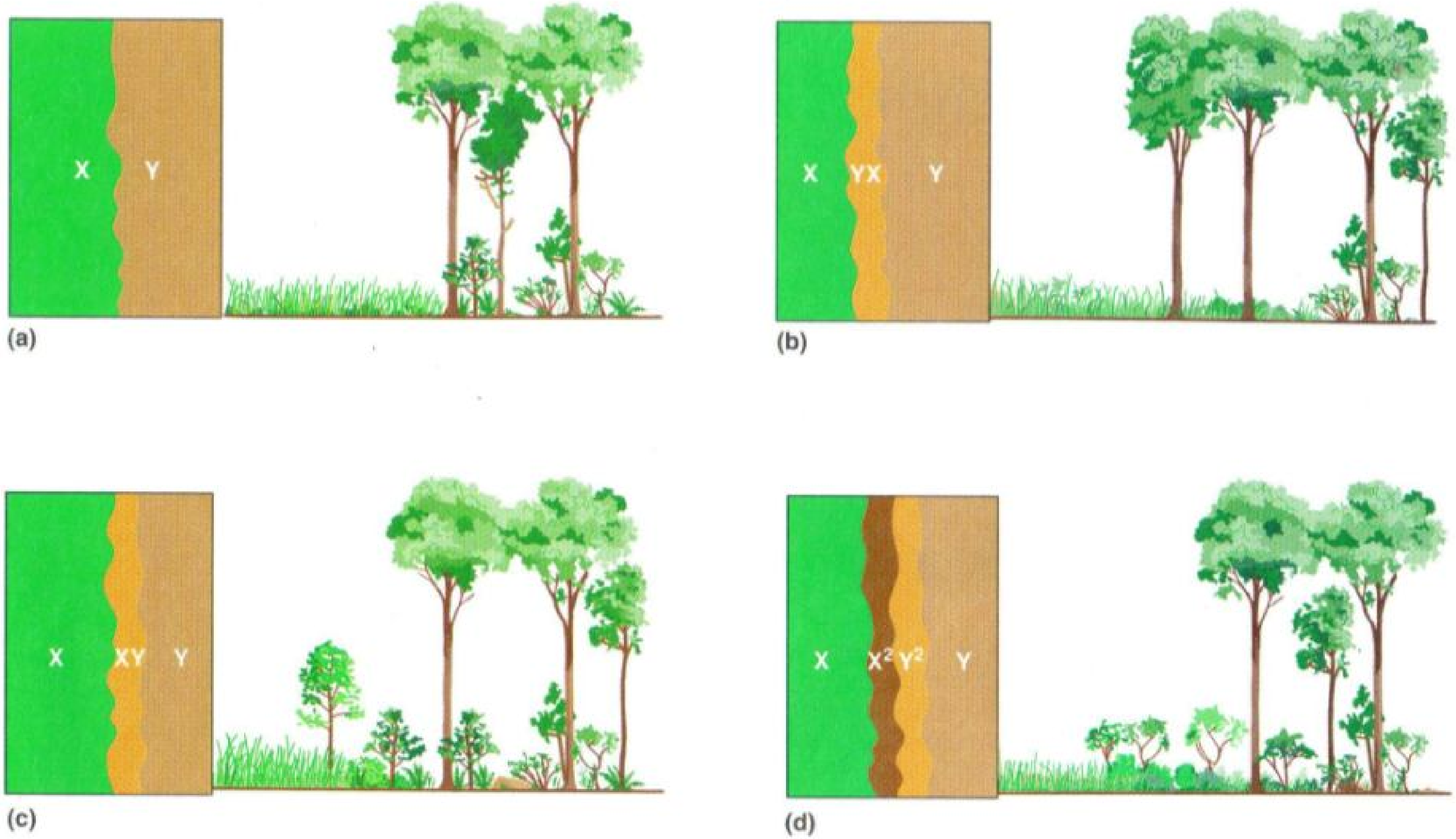


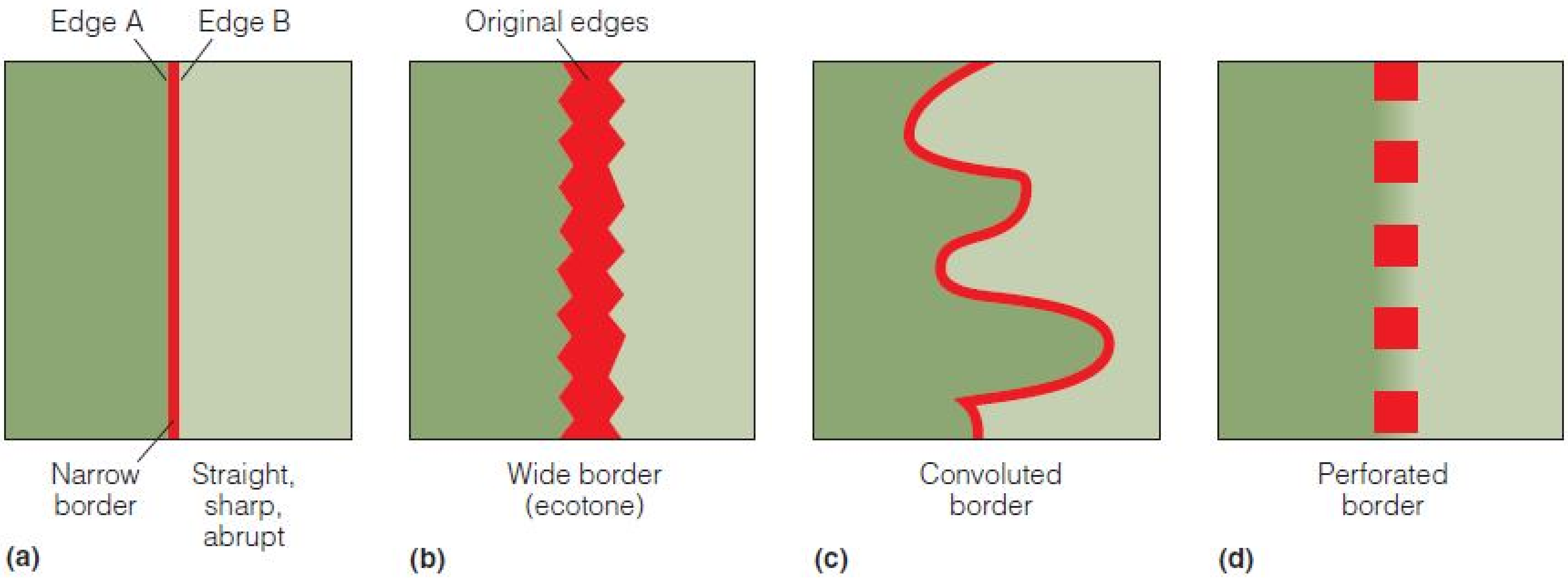
Defining Boundaries Between Communities Is Often Difficult





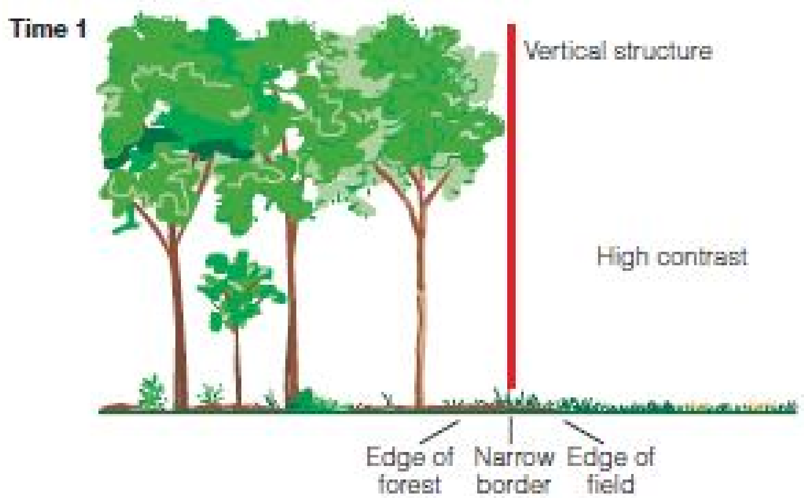
- Edge; where 2 or more different communities meet
- Ecotone; where 2 or more communities not only meet but intergrade
- Edge Effect; the variety and density of life are often greatest in and about edge & ecotones.

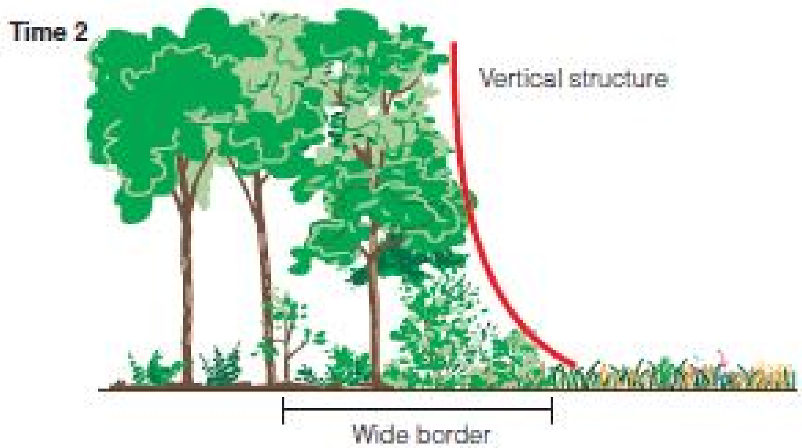

X
Y
(a)
X
YX
Y
(b)
X
XY
Y
(c)
X
X2
Y2
Y
(d)

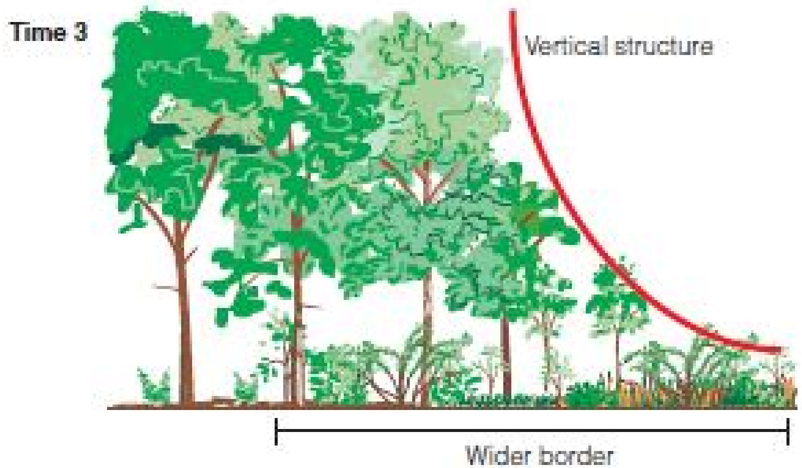


Types of borders. (a) Narrow, sharp, abrupt border created where the edges of two patches meet; (b) wide border creating an ecotone between two adjacent patches; (c) convoluted border; and (d) perforated border

Changes in vertical and horizontal structure of a border through time



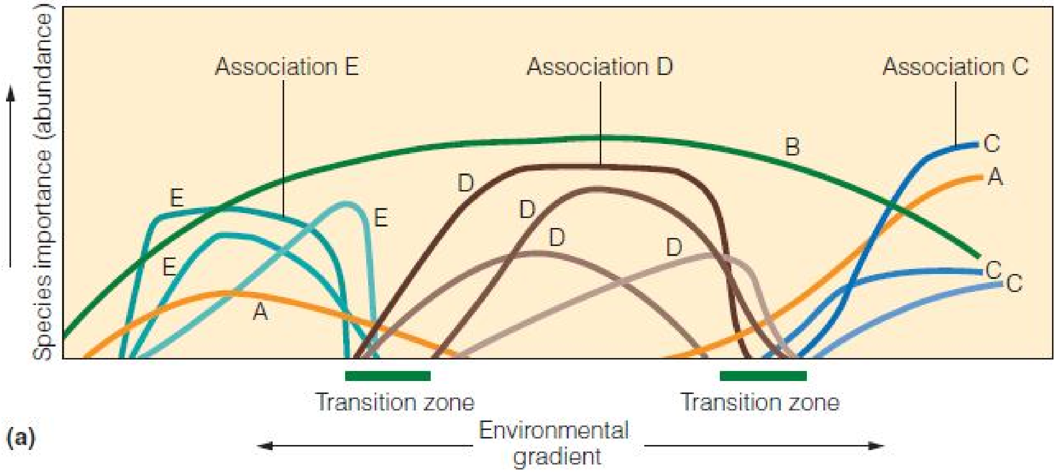




Long term natural; <u>Inherent Edge</u>

Disturbance; <u>Induced Edge</u>

- Consistent Floristic Composition
- International Botanical Congress (1910)
- Association is a type of community with
  - Relatively consistent species composition
  - Uniform general appearance (physiognomy)
  - Distribution that is characteristic of a particular habitat

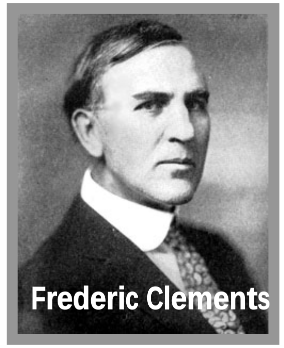


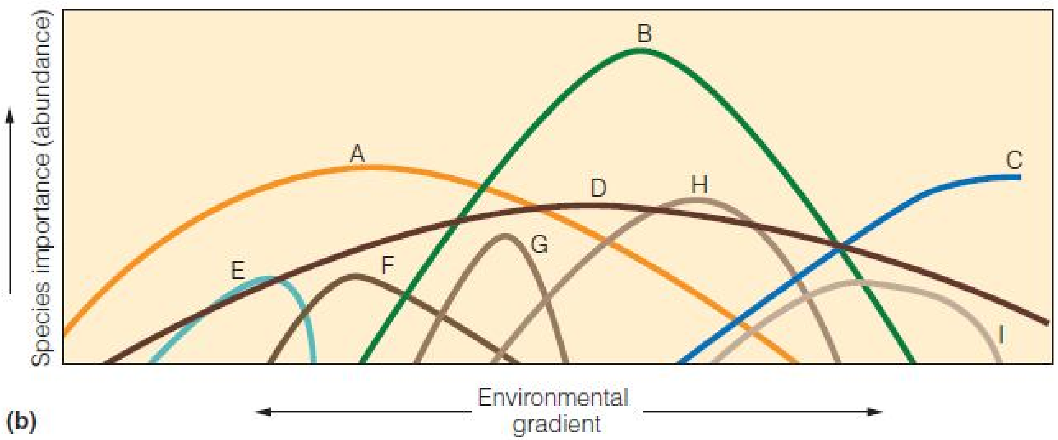
The organismal view by **Clements**.

Cluster exist

Association Present

Narrow Ecotone



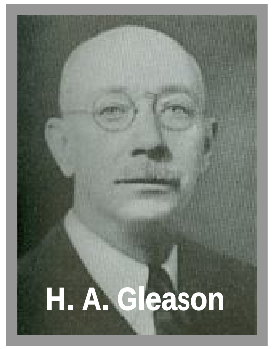


The individualistic view by **Gleason**.

Cluster doesnot exist

Association absent

Ecotone gradual



Two models of community. **(a) The organismal, or discrete**, view of communities proposed by **Clements**. Clusters of species (Cs, Ds, and Es) show similar distribution limits and peaks in abundance. Each cluster defines an association. A few species (e.g., A) have sufficiently broad ranges of tolerance that they occur in adjacent associations but in low numbers. A few other species (e.g., B) are ubiquitous. **(b) The individualistic, or continuum**, view of communities proposed by **Gleason**. Clusters of species do not exist. Peaks of abundance of dominant species, such as A, B, and C, are merely arbitrary segments along a continuum.