

## Physical Geography Chapter 11: Biogeography

Ecosystem - broad and flexible

- they are open systems -sharp boundary - Fig 11.1 - small ecosystem
- can be artificial - Fig 11.2

Ecosystems typically have four basic components:

1. Abiotic - non living part of the system  
In a Pond Ecosystem: Ca, H<sub>2</sub>O, NaCl, O<sub>2</sub>, CO<sub>2</sub>
2. Autotrophs (Self nourished) - basic producers
  - plants -utilize sunlight to make food through photosynthesis (release O<sub>2</sub>)
  - some bacteria, and sulfur-dependent ocean bottom critters
3. Heterotrophs – (other nourished) – animals that survive by eating plants or other animals
  - a. Herbivores –eat only living plant material
  - b. Carnivores- eat other animals
  - c. Omnivores- eat everything
  - important for they respire - release O<sub>2</sub> back to environment
4. Decomposers or Detritivores - feed on dead plants and animal material and waste products.

### Trophic Structure

- the pattern of feeding in an ecosystem

Food Chain- sequence of levels in the feeding pattern

- simplest chains only plants and decomposers
- most here 4 → grass → mouse → owl → fungi

Trophic level

number of steps they are removed from the autotrophs - TABLE 11.1

Reality - Food chains do not operate in isolation, they develop food webs (Figure 11.3)

### Energy Flow

The laws of Thermodynamics apply to ecosystems

*First Law:* Energy cannot be created nor destroyed, it can only be changed from one form to another

Sun energy → Photosynthesis → works through ecosystem until oxidation (fire, respiration)

Bio mass - total amount of living material in an ecosystem

- decreases with each trophic level

*Second Law:* whenever energy is transformed from one state to another there will be a loss of energy through heat.

- Heat Loss: Respiration, movement

Principle applies to agriculture: There is a great deal more bio mass (and food energy) available in a field of corn than there is in the cattle that eat the corn.

## **Productivity**

➤ the rate at which new organic material is created at a particular trophic level

Primary Productivity - refers to the formation of new organic matter through photosynthesis by autotrophs

Secondary Productivity - refers to the rate of formation of new organic matter at the heterotroph level

### **Primary Productivity**

Table 11.2 - at the Autotroph level

- Efficiency is surprisingly low- less than 5% is utilized of the sun
- Earth as a whole - less than 1%

However, the PP of the ecosphere is huge

- 170 Billion metric tonnes
- 2/3 terrestrial, 1/3 marine

Humans consume less than 1% of Earth's PP is plant food

Table 11.2 - PP reflects insolation angle (affect on photosynthesis)

Ocean PP is best in Photic zone (top 100m where sun penetrates) - Fig 11.6 ocean upwelling helps too

- Tied to Photosynthesis

Some artificial ecosystems increase productivity in areas where the original (productivity was low)

Secondary Productivity

- Rate of energy transfer from one trophic level to another is very low (Fig 11.7)
- 10% reasonable estimate of productivity
- requires a huge biomass of the autotroph level to support one animal that eats only meat

## **Ecological Niche**

Habitat - Each organism performs a specific role in the system and lives in a certain location

The combination of role and habitat for a particular species is referred to as its ecological niche

A number of factors influence ecological niches:

1. Generalists - can survive on a wide variety of food

Grizzly - wild berries, honey, fish

2. Specialist - eats a specific food supply Koala - eucalyptus

The generalist are in the majority- Why?

Sometimes a species can change in its ecological niche:

Humans are generalist, but can be carnivores, herbivores, or omnivores

### Succession and Climax Communities

Autotrophs usually dictate the characteristics of terrestrial ecosystems

➤ These species are greatly influenced by climate

If the plants that comprise the bio mass of the first trophic level are allowed to develop naturally without obvious interference from or modification by humans, the resulting association of plants is called natural vegetation

➤ Plant communities - compatible - can not compete (one will eliminate the other)

Succession - the developmental process by which natural vegetation of a particular location develops in a sequence of stages involving different plant communities

1. Primary Succession- bare substrate is the beginning point

➤ A pioneer community invades the bare substrate

BS- lava, bare beach, glacial seds

➤ Alterations by this pioneer community allow development of new plant communities, which in turn further alter the community

Can hundreds or a few thousand years

2. Secondary Succession- begins when some natural process, such as a forest fire, tornado, or landslide that has damaged or destroyed a great deal of the existing vegetation

Gap Creation - Occurs more quickly

Common form of second any succession is associated with agriculture in the SE U.S. - Figure 11.9

First- Crab- grass (weeds) >> Pioneers >>Pave for hardwood brush - sassafras, persimmon and sweet gum

(soil gets better hold, more moisture)

Pine forests - too much shade

(seeds do not germinate in shade)

Give way to hardwoods - Oak, Hickory

Fig 11.9: 100-200 years process

Climax Community - final step in the process of succession

- Oak History Forest at Fig 11.9
- More than one climax community can be developed in an environment
- One of several possible could develop depending upon conditions (drainage, nutrients, soil or topography)

No one CC can exist in EQ with the environment for an indefinite period of time

Many biogeographers and ecologists today view plant communities and the ecosystems upon which they are based as a landscape

Landscape - an expression of all the various environmental factors functioning together

Landscape - is a mosaic of inter locking parts

- >Matrix - dominant area of the mosaic
- >Patches - gaps created by natural processes
- >Corridors- relatively linear features such as roads, fences, powerlines, hedges

**Dominant environmental influence- climate AND the *climate can change***

### **Environmental Controls**

Tolerance- an organism's range of survival conditions

Ecological optimum -refers to the environmental conditions under which a species will flourish

Ecotone- the overlap, or zone of transition, between two plant or animal communities

Biomes- terrestrial ecosystems

- influenced by climate (influences shape of leaves)
- Local scale- acidity of soil
- drainage
- salinity of water

#### **A. Climate Factors**

1. Sunlight - vital source for energy in Photosynthesis
  - a. Quality of light
  - b. Light Intensity
  - c. Light Duration
2. Availability of water
3. Wind

Plants are really subject to these factors, animals too, but since they are mobile, it's easier

Bergmann's Rule- within a warm blooded species the body size of the subspecies usually increases with the decreasing mean T of its habitat

Allen's Rule - in a warm blooded species, the relative size of exposed portions of the body decrease with the decrease in mean T.

These rules indicate:

members of the same species living in colder climates eventually evolve shorter and smaller appendages (ears, nose, arms, legs, etc.) than their relatives in (Allen's) warm climates, and that in cold climates, body size will be larger, with more mass to provide the body heat needed for survival and for protection of the main trunk of the body where vital organs are located (Bergmann's).

Human Analogy

#### B. Soil and Topography

Soil variations are very important and often produce sharp boundaries in vegetation type

Pines-sandy soils

cranberries- acid soils

Grasses in clays

wheat, chili-Alkaline

Topography- sunny south facing slopes

shaded north facing slopes

steepness of slope too

#### C. Natural Catastrophes

Produces patches in ecosystems

#### D. Biotic Factors

Other plants or animals can affect whether - something will be a part of an ecosystem

Competition Plants is for light, and for water (roots)

Some animals help plants pollinate

Rare for predation to cause extinction

#### E. Human Impact on Ecosystems

➤Eliminated much of Earth's natural vegetation

➤Farming, fire, grazing of domestic critters, afforestation/ deforestation, roads, urban development, dam building, irrigation, water tables, mining, filling and draining of wetlands

Malibu fires

Desertification - famine

Often affects us hazardly

## **Classification of Terrestrial Ecosystems**

### **1. Forest Biomes**

- easily recognized as associations of large, woody perennial tree species, generally several times the height of a human, with a more or less closed canopy of leaves over head
- occur in tropics and middle latitudes

### **A. Tropical forests**

#### **1. Tropical rainforest (fig 11.23)**

- competition is for light
- trees look similar
- little or no sunlight reaches surface
- llanas –vines
- surface soils rich, at depth poor
- arboreal critters
- galeria forest- follows rivers out

#### **2. Monsoon Rain forest**

- less species than true rain forest
- species proliferate despite dry season
- many evergreen and deciduous

#### **3. Other Tropical forests, thornbush and scrub**

- margins of the sub tropical hi- rainforests
- lower bio mass
- more thorny, resistant to draught

### **B. Middle- Latitude forests**

- develop mechanisms to withstand periods of water deprivation due to low T and annual variations in precipitation

#### **1. Mediterranean Scherophyllous Woodland**

- Cs climates
  - freezes rare
  - low growing
  - chaparral or marquis
  - oaks in shaded areas
- (fig 11.21)

#### **2. Broad- leaf Deciduous forest**

- warm summer, cold winter
  - trees become dormant
  - Certain oaks, hickory, chestnut, beach, maples
  - trees of deciduous forest are tall
- (Fig 11.25)

#### **3. Broad- leaf Evergreen Forest**

- active through out the year
- southern hemisphere locations
- SE Australia, N.Z., S. Africa, S. Chile
- limited belt in Florida along gulf coast

4. Mixed forest
  - Deciduous mix with conifers (pines)
  - Conifers can't compete, but are found in less favorable sites
  - eventually conifers become dominant with latitude
5. Coniferous Forest
  - climate severity and impoverished soils
  - North of 50°latitude
  - Boreal forest of Taiga

#### Grassland Biomes

1. Tropical Savanna Grasslands: Fig 11.27
2. Middle- Latitude Grasslands
  - Tall Grass Prairie
  - Short Grass Prairie: Fig 11.28

#### Desert