Unit 13 Notes: Ecology

I. The Structure of Ecosystems

A. Abiotic factors such as temperature, water availability, fires, and soil composition affect the distribution of organisms in the biosphere.

1. The diversity of abiotic environments is largely responsible for the diversity of organisms.

2. Organisms inhabiting a region affect the abiotic factors through processes as soil formation, erosion prevention, and transpiration.

B. Trophic relationships between organisms determine the flow of energy and biomass in an ecosystem.

1. Organisms transform most of energy they consume into heat and motion, causing the 10% rule.

2. Productivity and the resulting biomass also decline in higher trophic levels.

3. Ecosystems can sustain far fewer top predators than low-level consumers and producers.

C. Each species has a particular niche, or role it plays in an ecosystem.

1. Each species is adapted to exploit certain ecosystem resources including habitat, energy, and water.

2. Competition for resources keeps two species from occupying the same niche (prin. of competitive exclusion).

3. Adaptive radiation through natural selection helps to divide resources between similar species.

D. Many species have symbiotic (close-contact) relationships.

1. Mutualistic symbiosis benefits both species.

2. Parasitism benefits one species at a cost to the other.

3. In commensalism, one species benefits while the other is not appreciably affected.

II. Ecosystem Dynamics

A. Biogeochemical cycles exchange important nutrients between living things and their environment.

1. The carbon cycle "begins" with the CO_2 reservoir in the atmosphere and water.

a. Producers fix CO_2, turning it into sugars and cellulose.

b. Respiration returns CO_2 to the environment.

c. Carbon deposited in the ground is still part of the cycle, but is stuck for an extended period of time.

2. The nitrogen cycle also occurs between the atmosphere and organisms.

a. N_2 gas is fixed into the soil by lightning and bacteria.

b. Plants uptake NH_3 and NO_3^- from the soil to make proteins.

c. Animals make their proteins from their nitrogen containing food.

d. Decomposition of dead organisms and wastes returns nitrogen to the soil.

e. Other bacteria convert soil nitrogen into N_2.

3. Major events that circulate water include: evaporation, precipitation, respiration, and transpiration.

B. The productivity of ecosystems and their organisms is affected by limiting factors.

1. A resource in short supply normally keeps growth in check (rain in deserts).

2. Even if a resource is abundant in one biome as compared to another, competition for that resource keeps individual populations in check.

C. Population exhibit certain patterns with regard to limiting factors.

1. If there is little competition for a resource, the population may experience a period of exponential growth.

2. As population density (and competition) increases, growth becomes logistic and then levels at the carrying capacity.

3. If growth is exponential until the carrying capacity is reached (and overshot), a massive death rate will follow (boom-and-bust cycle).

4. If the limiting factor is inconsistent, population size emulates the fluctuations with a bit of lag (as seen in predator-prey cycles).

III. Ecosystems in Time

A. Natural selection favors organisms that can disperse and then colonize (successfully settle) new territory.

1. Plants use wind and animals for dispersal while animals can move great distances across land or sea.

2. Continent borders, mountains, and inhospitable conditions provide barriers (geographic isolation, independent evolution).

3. Lately, humans have provided a breach to these barriers for many exotic species.

a. Exotics can invade/damage host ecosystems because they evolved with similar abiotic factors in a separate location.

b. The host ecosystem has evolved no "checks" on the exotic species – balance is upset, sometimes with devastating consequences.

B. Ecosystems naturally change over time as species are introduced by natural means or abiotic factors change.

1. Primary succession begins with bare rock (etc.) and lichens, mosses, and/or small annuals (enrich soil).

2. If decent soil is present, secondary succession will continue to change the site as species more competitive for current conditions replace the established species.

3. A stable, climax community can result…?