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Environmental Science

Tenth Edition

Chapter 2 Ecosystems: What They Are

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Key Topics

- Ecosystems: A Description
- The Structure of Ecosystems
- From Ecosystems to Global Biomes
- The Human Factor

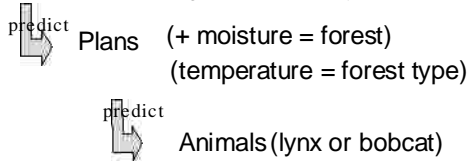
ECOSYSTEM: DEFINITION

- Ecosystems: A grouping of plants, animals, and microbes occupying an explicit unit of space and interacting with each other and their environment.
- Ecosystems: Units of Sustainable life on earth
Examples: a lake, a wetland, a coral reef, ...
- Can be investigated
- Ecology
 - study of ecosystems and all processes that determine the distribution of species and their interactions.

How Ecosystems Are Formed

Abiotics (moisture and temperature)

Abiotic factors: non-living, chemical and physical factors



2.1 Ecosystems: A Description

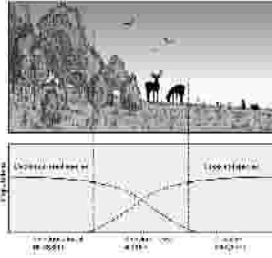
- Biotic community (Biota): grouping or assemblage of plants, animals, and microbes.
- Species: different kinds of plants, animals, and microbes in the community
- One species: individuals that are similar in appearance and distinct from other individuals.
- Biological definition of a species: the entirety of a population that can interbreed and produce fertile offspring in the community.

Ecosystems: A Description

- Population: number of individuals that make up the interbreeding, reproducing group in a given area.
- Association: a plant community with definite composition, uniform habitat characteristics and uniform plant growth.
 - Is determined by abiotic factors.
 - (explains the nature of the biotic community, how it fits in the landscape)
- Ecotone: Transitional region between different ecosystems.

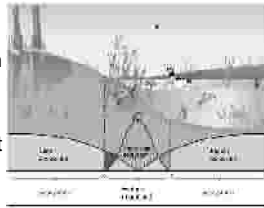
Ecotones on Land

- Shares many of the species and characteristics of both ecosystems
- May also include unique conditions that support distinctive plant and animal species



Terrestrial-to-Aquatic-System Ecotone

- Shares many of the species and characteristics of both ecosystems
- May also include unique conditions that support distinctive plant and animal species



Landscape, Biomes and the Biosphere

- Landscape: group of interacting ecosystems
 - Lake, marsh, dry land
- Biomes: similar or related ecosystems or landscapes (Terrestrial)
 - Examples: deserts, tropical rain forests, grasslands (Terrestrial)
 - Transitional zones exist between biomes – no sharp boundaries
- Aquatic Systems
 - Lakes, rivers, marshes, Ocean, estuaries, bays
 - Determined by salinity, depth, and permanence of water

Everything is connected

- Biosphere:
 - One Huge Ecosystem in which all animals, plants and microorganisms exist and the non-living matter in it.
 - All ecosystems are connected and interdependent

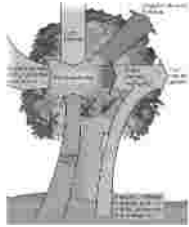
2.2 The Structure of Ecosystems

- Structure : Parts of the ecosystem and how they fit together
 1. Biotic community and abiotic environmental factors
 2. Biotic Structure: how different species fit in the together in the ecosystem
 3. Trophic structure: feeding relationships

Major Trophic categories

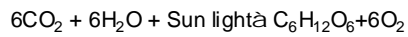
1. Producers
2. Consumers
3. Detritus Feeders and Decomposers

Autotrophs = Producers = Self feeders



-They make their own organic matter from inorganic molecules and energy from the sun (photosynthetic) or chemical reactions (chemosynthetic)

-Photosynthesis
Chlorophyll: green pigment, site of light capture



Organic versus Inorganic

- Organic: matter that make up the body of living organisms.
- Inorganic: exist apart from the activity of living organisms.



Figure 2.10 Environmental Science 100
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Proteins, carbohydrates, DNA

Consumers = Heterotrophs
Feed on organic matter for energy and growth

- Primary consumers = herbivores = rabbit: eat plant material
- Secondary consumers = carnivores = predators = coyotes: prey are herbivores and other animals.



Consumers = Heterotrophs

- Parasites = predator = either plant or animal: prey are plants or animals.



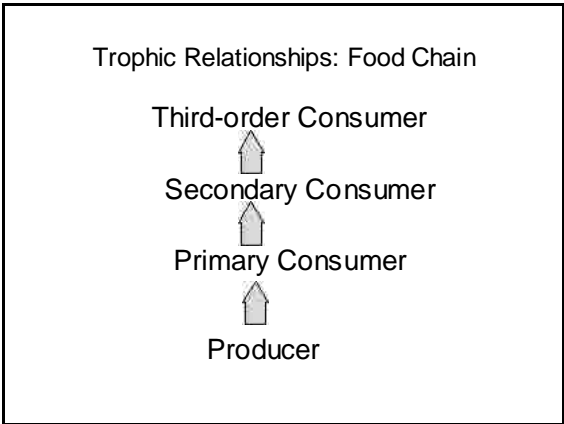
Figure 2.2.1: Dodder (Cuscuta sp.)
Dodders

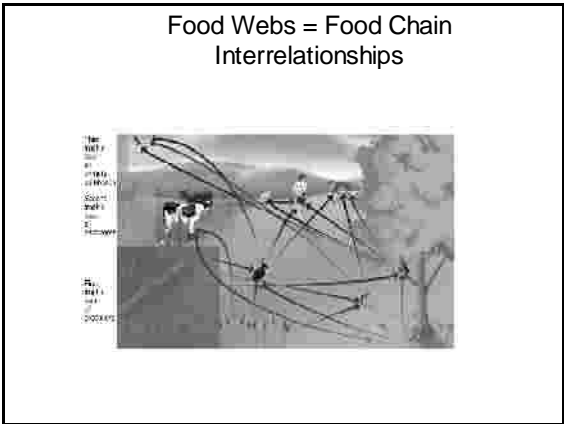
Ascaris
Lumbricoides

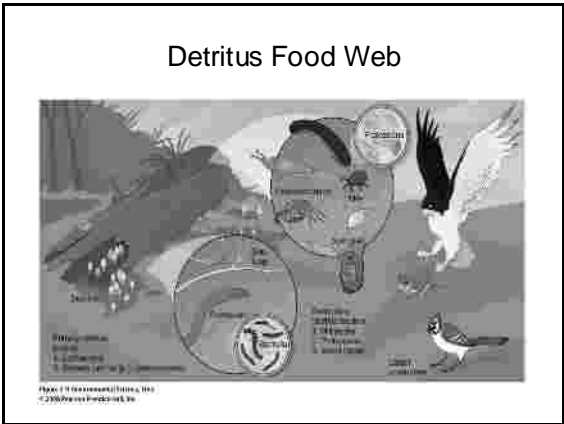
Lampreys

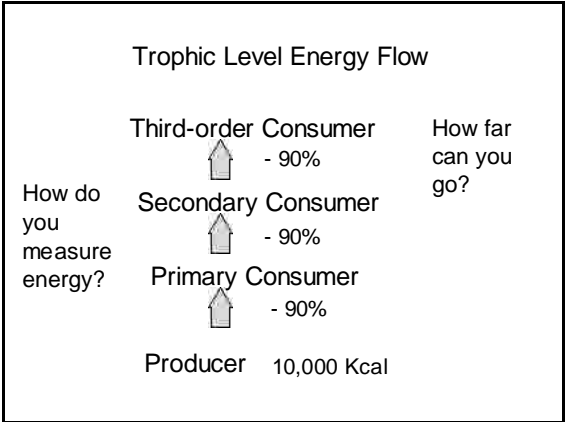
Detritus Feeders and Decomposers

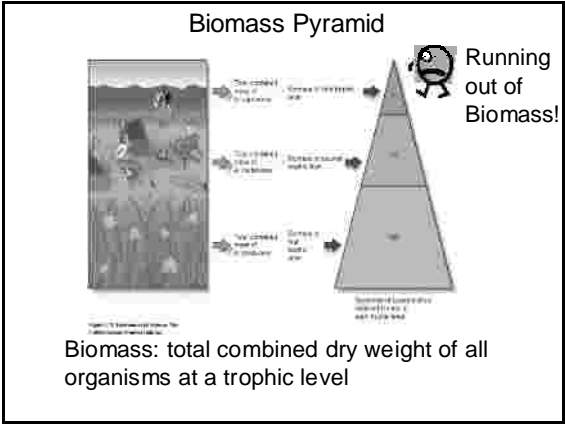
- Detritus: dead organic matter
- Detritus feeders: feed on dead matter
- Primary detritus feeders
 - Earthworms, termites,...
 - Decomposers: bacteria and fungi- cause rotting by secreting digestive enzymes that break down their food.
- Secondary d feeders: feed on primary detritus feeders
 - Millipedes, mites

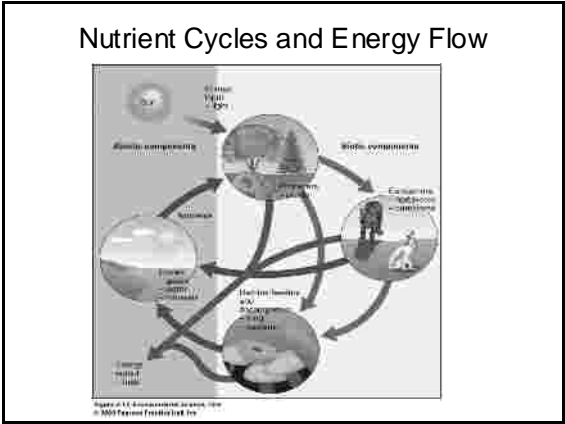












Nonfeeding (Symbiotic) Relationships

- **+ And + = Mutualism. Both species benefit by the interaction between the two species. Honey bee and flower, Lichens (alga and fungi)**

- **+ And 0 = Commensalism. One species benefits from the interaction and the other is unaffected.**

Barnacle riding
on a turtle shell



Cattle Egret

Nonfeeding (Symbiotic) Relationships

- **+ And - = One species benefits from the interaction and the other is adversely affected. Examples are parasitism**

Competitive Relationships

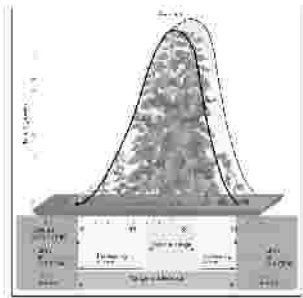
- Fierce competition is rare
- Resource Partitioning: refers to different usage of resource by different species. It reduces competition in a habitat by usage of different niches.
- Ecological Niche: refers to what the animal feeds on, where and when, how it responds to abiotic factors and where it nests.

Different utilization of resources → different niches

Abiotic Factors: Fundamental Principle

- Every species (both plant and animal) has an optimum range, zones of stress, and limits of tolerance with respect to every abiotic factor.
- The range of tolerance: range between the high and low limit.
- Both growth and population size are limited outside the optimum range
- Limiting factor: any factor that limits growth, reproduction or survival of a population

Survival Curves Illustrate Law of Limiting Factors



Oxygen Tolerance Curves for Two Different Fish Species

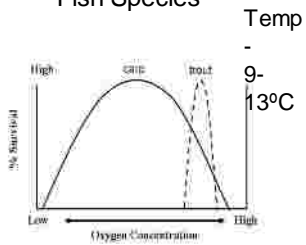


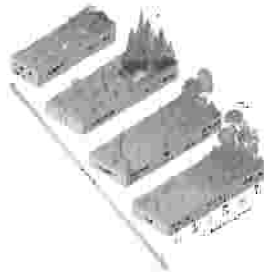
Diagram the temperature tolerance curves for each fish species

2.3 From Ecosystems to Global Biomes

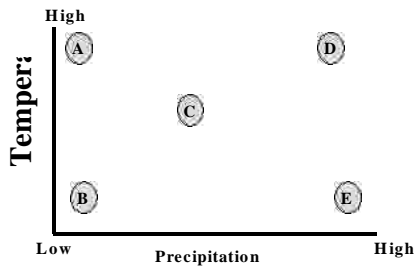
- Limiting factors determine the composition of biotic communities, thus explain the diversity of ecosystems on Earth. Important factors that shape the Biome are:
 - Climate
 - Microclimate and other abiotic factors
 - Biotic factors
 - Physical barriers

Climate and Major Biomes

- Climate is defined by the average temperature and amount of precipitation
- Moisture is what primarily determines the type of biome (e.g. forest)
- Temperature determines the kind of forest, grassland, etc...



Identify Biomes A to E Based on Temperature and Precipitation Levels:



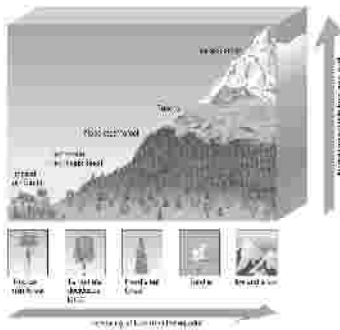
Answers

- A has high temperature and low moisture = hot desert
- B has low temperature and low moisture = cold desert (tundra with permafrost)
- C has medium temperatures and moisture = grassland
- D has high temperature and moisture = rain forest
- E has low temperature and high precipitation = arctic poles

Six Major Type of Biomes on Earth

Deserts	N. and S.W. Africa, S.W. USA
Grasslands and Prairies	Central N. America, Subequatorial Africa
Tropical Rain Forests	N. South America, Western Central Africa,
Temperate Forests	Western and central Europe, Eastern North America
Coniferous Forests	N. N. America, Europe
Tundra	

Effects of Latitude and Altitude



Microclimates



Exposed or sheltered site
Variation in ecosystems within a biome

- A microclimate refers to moisture and temperature conditions of a specific site that differ from the overall average climate of the region

Biotic factors

Factors involving other species may be limiting

- Competition
 - Grass versus tall trees
- Predation

Physical Barrier

- Physical barriers such as oceans generate differences between species on different continents or remote islands

2.4 The Human Presence

- Human are an integral part of ecosystems.
- Human impact on natural systems parallels significant changes in human life styles throughout history
- Three revolutions
 - Neolithic ~12000 year ago: development of agriculture and animal husbandry
 - Settlement and specialization of labor
 - Industrial ~1800 : science and technology
 - Use of fossil fuels à pollution, exploitation, colonization
 - Natural systems displaced by the human system
 - Environmental Revolution needed
 - *Red Sky in the Morning* by James Gustave

How Humans Modify Their Physical Environments to Meet Their Needs

- Produce abundant food
- Control water flow rate and direction
- Overcome predation and disease
- Construct our own ecosystems
- Overcome competition with other species

REMINDERS

- Read Revisiting Themes p. 51
- Review Questions
