21 | Biogeography & Ecosystems

Part V – The Living Earth

Geography 101
Physical Geography: Earth’s Surface Landscapes
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Ecosystem Essentials

Today we’ll discuss biogeography and:
- Ecosystems
- Food chains/webs
- Community, habitat, niche concepts
- Succession

Some Definitions

Biogeography
- The study of the distribution patterns of organisms over space & time & of the processes that produced these patterns.

Biogeography
- How did continental drift play a role in species evolution?
- How do interconnected systems of the atmosphere, lithosphere, and hydrosphere affect the biosphere?

Some Definitions

Ecosystem
- Group of organisms & the environment with which they interact

Some Definitions

Ecology
- Study of the relationships between organisms and their environment and among the various ecosystems in the biosphere
- The economy of nature
Ecosystems

Ecosystems are complex open systems

The key is to understand the linkages & interconnections within & between systems

Overfishing

- Taking too many from one place
- Not just fishing’s fault though
  - Pollution
  - Dams and water diversion
  - Logging and development
  - Hatchery fish

Food Chains

- Energy enters ecosystem from the Sun
- Energy flows linearly — in a one-way direction — through ecosystems
- Energy exits ecosystem as heat loss to the environment

Food Webs

Ecosystems are typically structured in a food web

- Interconnected food chains
Food Web

A food web is made up of
- **Producers**
- **Consumers**
- **Decomposers**

Producers

Organisms capable of using CO₂ as their sole source of food
- Photosynthesis in plants
  - autotrophs

Photosynthesis

Unites CO₂ & Hydrogen
- Produces food for the plant

Chlorophyll
  - Green, light sensitive pigment that stimulates photosynthesis

Consumers

- Organisms that eat producers
- Also called heterotrophs

Herbivores

- Organisms that only eat plants (producers)
- Primary consumers

Carnivores

- Organisms that only eat meat

Secondary consumers

- eat primary consumers

Tertiary consumers

- eat primary & secondary consumers
- Top carnivore in the food chain
Consumers

**Omnivores**
- Eats both producers and consumers
  - Humans, other primates

**Detrivores**
- Feed on detritus
  - Dead organic debris – animal remains, fallen leaves, and wastes
  - Worms, mites, snails, crabs, vultures

Decomposers

- Primarily bacteria & fungi that break down detritus & both absorb & release nutrients in the process

Efficiency in a Food Web

- Thousands of years have helped nature work out food webs
- Humans change things

Livestock Fattening

**Midwest Corn Belt**
- Corn and soy grown to feed cattle and hogs
- Similar practices found in Europe & S. America

**The “feedlot”**
- Confined Animal Feeding Operation (CAFO)
- Must be regulated by EPA in US
- Ensure water and waste are handled properly
Livestock Fattening

Inefficient for protein
- A cow eats **21 pounds** of protein for every **1 pound** it produces
- ½ of US ag land is planted with feed crops for livestock & 70% of grain goes to livestock fattening
- Not to mention ethanol uses...

Biological Amplification

Biological amplification
- When certain chemicals remain stable in fatty tissues of consumers they become increasingly concentrated in top carnivores

Measuring Organic Matter

Biomass
- Dry weight of living organic matter in an ecosystem within a designated surface area.

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<th>Tropic level</th>
<th>Decomposers</th>
<th>Omnivores</th>
<th>Carnivores</th>
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Net Primary Production

- Rather than weight, looking at how productive an ecosystem is
- Wetlands & Forests most productive
Ecological Biogeography

How distribution patterns of organisms are affected by the environment

Communities

Community
- All of the plants & animals bound together by the food chains & other relationships
- Ecosystems typically comprised of multiple communities

Habitat
- Type of environment in which an organism lives or is biologically adapted to live

Niches
- The function, or occupation, of an organism within a community
  - survival
Abiotic Factors

The **Biosphere** is effected by the other spheres…

- **Hydrosphere**
  - Mediterranean Climate
  - Sclerophytes
    - Low water plants

- **Atmosphere**
  - Monarch butterflies (Danaus plexippus)
    - Migrate over 2,000 miles from the East Coast to Mexico
    - Navigate using an internal sun compass
      - Receptors in their eyes sensitive to UV light that aids in their navigation

- **Lithosphere**
  - Birds can utilize Earth’s magnetic field for migration
    - Magnetically charged particles in skull, maybe eye
    - Magnetic field can influence chemical reactions

**Hydrosphere**

- Climate determines water availability
- Water quality also important
  - Mineral content, salinity, pollution

- **Atmosphere**
  - Air & soil temps determine rates at which chemical reactions proceed
  - The colder the climate, the fewer the species
Lithosphere

**Bees** also have such particles in their abdomen
- This and sunlight alerts bees to location of new nectar

Lithosphere

**Sea turtles** detect changes in strength & inclination of magnetic field
- *Not only do they have internal compasses, but maps too*
- Probably how hatchlings are able to return to where they were born to lay their own eggs

Relationships

**Competition** – Negative interaction
- Predation
- Parasitism

**Symbiosis** – Positive
- Mutualism

Predation

- When one species feeds on another
- Can keep gene pool strong & populations healthy

Relationships

**Parasitic relationships**
- A relationship in which one of the organisms does not benefit & may eventually kill the host
Relationships

Symbiosis
- Where two or more species exist together in an overlapping relationship that does no harm.

Mutualism
- Each organism benefits and relies on the other for survival

Lichen
- An algae & a fungi living together
  - Algae is the producer (food source)
  - Fungi creates structure and physical support
  - Occupy a niche together that they could not if alone

Ecological Succession
- When newer communities replace older communities of plants & animals
  - Once assumed that plants and animals were trying to achieve a balance of birth, growth, & death rates
  - Now theorized that nature is in constant adaptation & non-equilibrium

Terrestrial Succession

Primary succession
- Soil has been destroyed in some way
- Early species form a **pioneer community**
Terrestrial Succession

**Secondary succession**
- Where the community has been destroyed, but underlying soil remains intact
As succession develops, species adapt to fill new niches

Wildfires
Fire can be an *essential* part of forest regrowth
- Seed dispersal in some pine species does not occur unless assisted by a forest fire
- Heat from the fire opens cones, releasing seeds
- Burned areas also recover relatively quickly
- Protein-rich plants which provide food for animals
Fire Ecology

Similar problems face urban areas though:
- Chaparral landscapes of Southern California
- Angora fire in Tahoe, 2007

Next Time… Evolution