**Week 4 Notes – Geology and Ecology**

* Ecology – controls over distribution and abundance of living things
* Study of living things and their interaction with the environment
* Example - Mt. St. Helens – ecosystem destroyed and rebuilt after geologic eruption
* Species – population successfully produces offspring (ligers and mules not species)
* Population – Group of individuals of same species in an area
* Community – Groups of populations of different species living in same area
* Habitat – Where a species lives
* Niche – How a species makes a living (what it eats and does)
* Indigenous species – species lives where it evolved.
* Exotic species – species migrates or brought in…
* Burbot in Green River… not a Utah native
* Invasive Species - <http://wildlife.utah.gov/learn-invasive-mussels.html>
* Biosphere – part of earth where life exists
* Biota – all organisms in an area
* Ecosystem – Ecological community and it’s non-living environment in which energy flows and chemicals cycle
* Natural Service - Environment provides resources to sustain life… Ecosystems can produce clean air, water and soil and provide nutrients.. Estuary in CA … Tijuana River

Ecosystem Dynamics

* All biotic and abiotic interactions in an area
* The area can be very large or very small
* Controlled by two important processes:
* The flow of energy through the ecosystem
* The cycling of matter (nutrients) within the ecosystem
* Energy Flow – Sunlight is the Energy Source
  + The Laws of Thermodynamics
    - Energy can be neither created nor destroyed, it can only change forms (e.g., light energy 🡪 heat energy).Matter (atoms) is a form of energy.
    - The transfer of energy is never 100%, some energy is always lost in the transfer (mostly as heat).

Measuring Energy

* + - Energy measured in calories
    - the heat raise 1gram of water 1°C
    - calories measure heat energy
    - food energy in kilocalories or Calories
    - 1 Calorie (Cal) = 1000 cal
    - Energy can be measured in joules (J)
    - 1 joule = 0.24 cal
    - De-watered Biomass is often used as an indirect measure
    - weight (mass) of organic matter per unit area per unit time

Productivity

* + Limitations on Primary Production.
    - Light limitations
      * Equator vs. poles
      * Surface vs. deep water
    - Moisture limitations
      * Wet vs. dry climates/seasons
    - Temperature limitations
      * Hot vs. cold climates/seasons
    - Nutrient limitations
      * Low vs. high nutrient availability

Nutrient Cycling

* + All life requires essential nutrients (chemicals).
    - Like carbon, nitrogen, phosphorus, potassium, etc.
  + Unlike energy, these nutrients are recycled within ecosystems.
    - This recycling of nutrients involves both biotic (biological) and abiotic (geological & chemical) pathways, and are called biogeochemical cycles.
    - Biogeochemical cycles involve reservoirs (sources), sinks (depositories), and fluxes (movements) for each nutrient.

Food webs and Trophic Structure

* + Producers
    - Photosynthetic organisms (autotrophs)
  + Consumers
    - Organisms that feed on others (heterotrophs)
      * herbivores feed on plants (producers)
      * carnivores feed on animals (predators & parasites)
      * omnivores feed on both plants & animals
      * detritivores feed on dead organisms and waste material
        + also called scavengers or decomposers
        + play a key role in the recycling of nutrients
  + Food chains depict these feeding relationships.
    - The chain ends with the top predator/carnivore
  + Available energy controls food chain structure
    - Bottom-up control
      * Increasing the productivity of plants will lead to more consumers (herbivores & carnivores) up the chain.
    - Top-down control
      * Increasing top predators will decrease herbivores, which will increase producers, which will decrease nutrients.
  + Available energy decreases at each level
    - An average of only 10% of the energy at one level is passed to the next level.
      * 10% is used to build tissue & stored energy (biomass).
      * 90% is lost as heat energy and organic wastes (feces).

Biodiversity – number and abundance of species in a community or ecosystem – Major Concern

* Species “richness”
* Species “evenness” relative numbers of each
* Dominant species
* Keystone species – disproportionate effects (humans)

Factors Increasing Biodiversity

* Constant Environmental Factors
  + Elevation
  + Climate
  + Sea Level (earthquakes)
  + Lots of species near equator (mild climate, lots of sun etc.)
  + Diverse habitat – lots of niches
  + Periodic moderate disturbances (fires, storms etc.) provide new habitat
  + Harsh environments and special species (hot springs)
  + Evolution – long term changes in the system as organisms adapt

Factors that Decrease Biodiversity

* Extreme environments (Great Salt Lake dries up) matter of scale
* Extreme disturbance
* Environmental Stress
* (pollution)
* Invasive Species
* **Transformation of land**
* Simplification of habitat
* Reduces Biodiversity

Human Domination

* Extinction… appear to be in a major extinction event (birds, mammals, fish etc..) Ferret, grizzly, wolf, praire dog, eagle, falcon, owl <http://wildlife.utah.gov/habitat/pdf/endgspec.pdf>
* Land Transformation is the main cause
* How much is a duck worth? It’s worth what it costs to replace habitat lost by land transformation or simplification

Environmental Ethic (Stephen J. Gould – fantastic author!)

* Geologic time is very long and geologic processes operate slowly in terms of a human life span.
* Humans are one of millions of species and each has it’s own value and is unique.
* Humans are irrelevant in terms of geologic time and history (Earth here long after we are gone)
* If we sustain our resources by preservation of habitat and biodiversity we will last longer.
* We don’t need to save Mother Earth, we need to save ourselves from ourselves.

Footprint

* Resource Accounting
* Understand how ecosystem works
* “Don’t crap in your own nest”
* Active Management
* Carbon or Energy
* Water
* Food
* <http://www.footprintnetwork.org/en/index.php/GFN/>
* <http://environment.nationalgeographic.com/environment/freshwater/change-the-course/water-footprint-calculator/>
* <http://www.nature.org/greenliving/carboncalculator/>
* <http://myfootprint.org/en/> (total inc food)

Ecological Restoration

* Restore lost habitat and biodiversity… not 100% - Everglades largest project in USA
* Hydrology
* Soil and rock
* Vegetation
* Wetlands
* Floodplains
* Dams
* Mines

**Conservation and Preservation** are closely linked and involve a degree of protection, but how protection is carried out is the key difference.

* Conservation means protection of natural resources, while preservation is associated with the protection of buildings, objects, and landscapes. Conservation also generally follows an economic motive.
* Put simply, conservation seeks the **proper use of nature**, while preservation seeks **protection of nature from use**. Environmental movement of the early 1900s with two opposing views:
  + Conservationists seek to regulate human use

Preservationists want to eliminate human impact

Aldo Leopold, often called the father of ecology, called for wilderness protection and an enduring land ethic. Wilderness preservation is fundamental to the idea of deep ecology – the philosophy that recognizes an inherent worth of all living beings, regardless of their instrumental utility to human needs. One of the largest conservation organizations in the world, the World Wildlife Fund, was created in 1961. In 1962, Rachel Carson’s Silent Spring launched the modern environmental movement. Preservation groups such as the Sierra Club shifted from protesting to working with politicians to influence policy.

Extra Notes – 11 Basic Concepts

* Interrelationship between organisms and environment – need accurate understanding of interrelationship and use the data to preserve earths ability to sustain life..
* In Nature a variety of physical and biological factors influence and organisms ability to grow and repro in one place
* There is variability in the way each species respond to env.., that caused them to have different ranges – however a species presence on a site depends on its ability to disperse onto the site and survive
* Organisms of a certain species comprise populations.. Pop can grow or decline depending on env factors
* Species with similar responses to env are typically found together and form communities… each community is unique but they can overlap
* On any site organisms interact and can help or harm one another
* All ecosystem functions depend on energy.. Producers obtain energy from the sun and convert to biologically useful form – photosynthesis – consumers eat producers and other consumers.. Decomposers convert nutrients back to non-bio forms
* Decomposers convert nutrients back to non-bio forms
* Ecosystems constantly change – slow or fast, changes can be due to physical factors, arrival or extinction of species, alternated relationships between species (eagles and foxes) and evolution
* Humans have changed earth’s ecosystems more than other animals. **Ecologists #1 concern right now is loss of biodiversity and preservation of biodiversity, climate change and sustainability of all forms of life.**