Chapter 47 Notes

The Nature of Ecosystems
An ecosystem is the sum of the organisms residing there and their interactions with the environment.
A primary producer is the plant that serves as an autotroph by harnessing the sun’s energy.
A consumer is the animal or heterotroph that derives energy from consuming the plant or other animals.
A detritivore is an animal that consumes debris and small bits of organic matter.
A decomposer eats wastes and remains of plants and animals.
The organisms of an ecosystem develop trophic levels.
A food web represents the passage of energy from one trophic level to the next.

A food web is a complex interaction among many species of the ecosystem.
In a grazing food chain, the energy goes from producers to consumers.
In a detrital food chain, the energy goes from producers to detritivores and decomposers.
An alteration in one species of a food web may affect many different organisms.

I gave two detailed examples of this: wolves in Banff National Park and sea otters and kelp forests in coastal waters. Know these examples well for the exam. Understand direct and indirect effects and the concept of the keystone species. All of the sea otter information is available in week 5.

Energy Flow Through Ecosystems
Primary production is the rate at which plants harness the sun’s energy.
This depends upon the availability of water and nutrients.
Primary production is higher on land than in water.
A biomass pyramid is used as a tool to represent the dry weight of the organisms at each trophic level.
1. The plants or producers make up the base of the pyramid.
2. Consumers make up the upper portion of the pyramid with the largest carnivores at the very top.

**Biological Magnification**
The effects of dangerous chemicals can become intensified as they move up the food chain. Mercury is a good example of this phenomenon. Mercury is present in small amounts in seawater, where it is absorbed by algae. Mercury is built up in the fat tissues of successive trophic levels: consumer plankton, small fish and then larger fish. Anything which eats these fish also consumes the higher level of mercury the fish have accumulated. Thus, predatory fish (swordfish, sharks, etc) or birds (osprey, eagles, etc.) have higher concentrations of mercury in their tissue than could be accounted for by direct exposure alone.

DDT is a synthetic pesticide banned in United States since the 1970s. Birds that are carnivores accumulate DDT in their tissues, produce brittle egg shells. This was a major factor in the decline of several birds of prey, including the bald eagle.

**Biogeochemical Cycles**
In biogeochemical cycles, nutrients move through environmental stores and living organisms. The elements enter the living portion of the cycle by becoming incorporated into plants. Examples of biogeochemical cycles are the water, carbon, nitrogen and phosphorus cycles.

**Carbon Cycle: This is all shown well in Figure 47.14 of the book.**
Most of the carbon is contained in the earth’s crust. The carbon in the ocean is originally formed from the shells of small organisms. The crust lifts up eventually and becomes part of the land mass. Diffusion takes place between the carbon in the atmosphere and that in the ocean. There is a loop-like current which delivers carbon dioxide to the ocean reservoir. Carbon changes form between carbon dioxide and bicarbonate. Man adversely affects the carbon cycle by releasing more carbon into the air than can be taken into the ocean reservoirs contributing to global warming.

**Greenhouse Gases and Climate Change**
The main gases that contribute to the greenhouse effect are: carbon dioxide, water, nitrous oxide, methane and chlorofluorocarbons. The sun’s heat is absorbed by the earth’s surface. Some of the heat is reflected back into the atmosphere, but atmospheric gases send some heat back to earth. The greenhouse effect is a natural necessary phenomenon to maintain reasonable temperatures on earth. The increase in greenhouse gases is creating abnormal global warming. Global warming is causing a warmer ocean temperature which result in melting glaciers and more severe storms.

**Nitrogen Cycle**
Nitrogen exists in the atmosphere as N2 which is not in a usable form for plants. Some natural processes such as lightening and volcanoes can convert the nitrogen to a usable form. The bacteria Rhizobium that exists in nodules on legumes also converts the nitrogen to a
usable form. Nitrogen changes from N2 to NH3 which then converts to NH4+ and NO3--, which are able to be used by plants. Manmade interference helps to denitrify the ecosystem. The leaching of water through the soil and the absence of crop rotation help to deplete the soil of nitrogen. When fertilizers run off into water sources, it causes algae blooms which are disadvantageous to animal species.

**Phosphorus Cycle**
Phosphorus cycles between the land and the ocean. Phosphates are necessary for major cellular components like nucleic acids, plasma membranes and ATP. Plants get phosphorus from the water and soil and animals get it from consuming plants or other animals. Phosphorus levels are quite often a limiting factor for plant growth. A lack of phosphorus in the soil can be due to the absence of crop rotation. An excess of phosphorus can result from water that runs off from fertilized fields. Excessive amounts of phosphorus in a watery environment can cause eutrophication. An algae bloom occurs that harms other plant and animal species. Eutrophication is difficult to reverse.

**The Water Cycle**
The water cycle begins when water evaporates from bodies of water and transpiration occurs in plants. Next water condenses in clouds and rains down. Water collects in watersheds, aquifers and in groundwater. Most individuals get water supply from groundwater. Ninety-five percent of the United States' fresh water is underground. Groundwater can be easily polluted and difficult to correct. Major aquifers are being depleted and contaminated with salt water intrusion because water is being removed faster than it is being replaced. As farmers in the Texan High Plains pump groundwater faster than rain replenishes it, the water tables are dropping. North America's largest aquifer, the Ogallala, is being depleted at a rate of 12 billion cubic metres (bcm) a year. Total depletion to date amounts to some 325 bcm, a volume equal to the annual flow of 18 Colorado Rivers. The Ogallala stretches from Texas to South Dakota, and waters one fifth of US irrigated land. A future water supply may be the ocean through utilization of a desalinization process to remove the salts.

**The Dead Zone off Oregon**
Located off the Oregon/ Washington coastline, this is a zone of coastal water where nearly all sea life has died due to hypoxia – or lack of oxygen. The area of the PNW dead zone is about the size of New Jersey.

There are currently ~400 documented dead zones around the world. Most are created by sewage and fertilizer run-off. The one of the coast of Oregon appears to be caused by a different mechanism, and may be related to climate change. Here is the link to the NSF film we saw in class: [http://www.nsf.gov/news/special_reports/deadzones/index.jsp](http://www.nsf.gov/news/special_reports/deadzones/index.jsp)