- **Biodiversity:** During the process of ecological succession, ecosystems develop from a simple community to a more complex one. This increased complexity also brings about greater stability, i.e. it is less likely to be affected by outside influences such as the activities of people, invasive plants, or disease. The most robust ecosystems are usually also those with the greatest variety of plants and animals.
- **Biological evolution:** All organisms change their form and function over long periods of time, some to the extent that they no longer resemble their original form. This process is called biological evolution.

The principles and processes described here can be applied to virtually every sphere of human activity: agriculture, population growth, energy use and conservation, pollution, health and technology. How well we understand them and the implications of disrupting them will determine the kinds of decisions we make and ultimately, how well we look after our only home, the Earth.

Further reading

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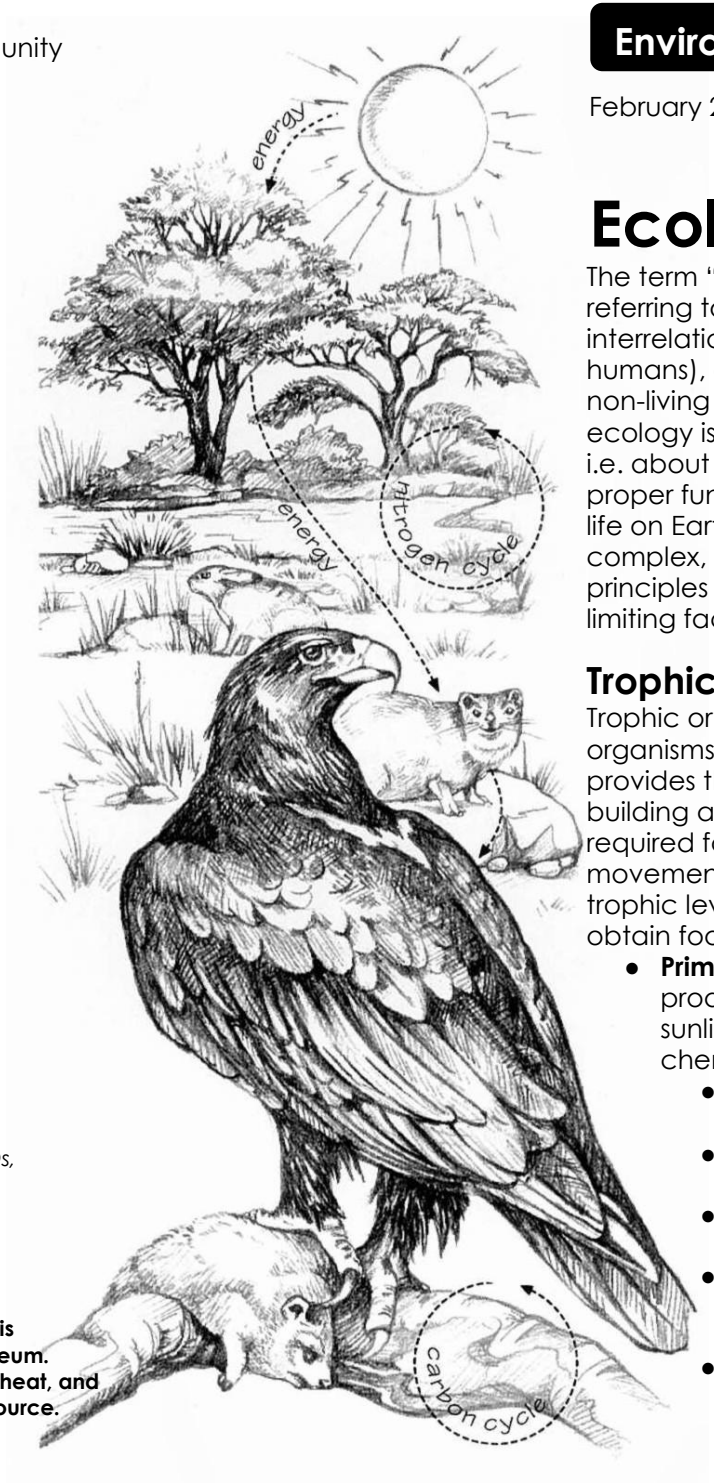

Enviro Facts 2

February 2009

Ecology

The term "Ecology" comes from a Greek word "oikos" referring to a "house" or "home". Ecology is about the interrelationships between organisms (including humans), and their environment, both living (biotic) and non-living (abiotic). Another way to view it is that ecology is about how the natural environment works, i.e. about ecological processes. The integrity and proper functioning of these processes are essential for life on Earth. Some of the processes are simple, others complex, but all are grouped into five interdependent principles - trophic levels, energy flow, material cycling, limiting factors and constant change.

Trophic levels

Trophic or feeding levels are about who eats what. All organisms (plants and animals) require food which provides them with chemical materials, or nutrients, for building and maintaining living cells, and energy required for all metabolic processes, growth and movement. Organisms can be divided into different trophic levels according to the way in which they obtain food. These levels are:

- **Primary producers** - all green plants which produce their own food from air, water and sunlight (during photosynthesis) as well as from chemicals absorbed in solution from the soil.
    - **Primary consumers** - all herbivorous animals which feed on green plants.
    - **Secondary consumers** - carnivorous animals that feed on herbivores.
    - **Tertiary consumers** - carnivorous animals that feed on other carnivores.
    - **Reducers** - animals, such as worms, crabs, vultures or carrion eaters, that feed on any dead organic matter.
    - **Decomposers** - fungi and bacteria which break down organic matter into its inorganic components for re-use by plants.

Food chains and food webs

- **Food chain:** A chain of feeding habits from primary producers through primary, secondary and tertiary consumers, ending with reducers and decomposers.
- **Food web:** All food chains are linked to each other to form complex food webs. For example, one plant species may be eaten by more than one animal species, which may in turn be eaten by other animal species.
- **Trophic levels:** Each level (link) in the food chain is a trophic level. The first link is always a primary producer, and the last link is always either a reducer or a decomposer.
- **Food pyramids:** When organisms consume food, energy and chemical materials are transferred from one trophic level to the next. Each transfer between trophic levels uses up energy, so that for the ecological process to work, a large biomass (total weight) of primary producers is required to support a smaller biomass of primary consumers and an even smaller biomass of secondary consumers. This is explained as a food pyramid.

Energy flow

All life depends upon the flow of energy and materials through ecosystems. Energy is neither created nor destroyed but is transferred through the trophic levels within an ecosystem. At each transfer, less energy is available to the next level. Some of the energy is necessary for metabolism, movement and growth within each level.

Nearly all energy available on Earth (except geothermal and nuclear energy) derives from the sun. Some of it may have 'arrived' millions of years ago and been stored in coal or oil; some may have 'arrived' more recently and been stored in vegetation. A small percentage of the total amount of solar energy reaching the Earth is 'fixed' by the photosynthetic process in green plants, the foundation of the food pyramid. When herbivorous animals digest plant tissue, some of the energy is released. This energy is used to power the animal's movement, metabolism and growth, and some is stored in its body, e.g. in fatty tissue. Some energy is given off as heat. Indigestible plant tissue passes out of the animal as waste, which is decomposed and reused in the ecosystem. Similarly, when a carnivore eats a herbivore, some of the energy in its prey's flesh is transferred to it, and once again energy is utilised during the carnivore's movement, metabolism and growth. This is why there is always a greater biomass of plants than of the herbivores eating them, and of herbivores than of carnivores. Those creatures at the 'top of the food pyramid' are thus, both fewest in number and the lowest in biomass. Humans have made themselves an exception to this with a resultant impact on all other creatures. Think what this would mean if all humans were vegetarian.

Material cycling

Biologically useful elements such as hydrogen, carbon, phosphorus, calcium and nitrogen are constantly being recycled between the biotic and abiotic components of ecosystems. This system of recycling is known as the biogeochemical cycle. Unlike energy, there is no continual input of matter or chemical materials from outer space. Some biogeochemical cycles may be rapid, in others the materials are temporarily stored in short-term nutrient pools such as in the bodies of plants and animals, in the soil and in the sediments of lakes and oceans. Materials may also be fixed in rocks lying beneath the surface and these may only be released to Earth ecosystems by geological activity, erosion, mining or agriculture.

Limiting factors

Limiting factors are of two kinds, chemical and physical:

- **Chemical:** Every living organism requires certain kinds and quantities of chemical nutrients. If one of these nutrients is absent, or present in insufficient amounts, even if all the others are available in abundance, the organism will function poorly or die. In some cases, the limiting factor may not be the lack of a particular nutrient, but an excess of it, i.e. it occurs in amounts which are poisonous. Consequently all organisms must live within a range between too much and too little of their essential requirements. This is called their range of tolerance.
- **Physical:** Examples of physical limiting factors for plants are water, sunlight, fire, temperature, disease, grazing pressure, competition with other species and the activities of people, e.g. destroying certain plant species. Examples of physical limiting factors for animals are water, temperature, the availability of shelter and nesting or breeding sites (including our homes), diseases and parasites, predation, and the activities of people, e.g. hunting and habitat destruction.

Thus all plants and animals can only live within a range between too much and too little of their essential requirements – their range of tolerance.

Constant change - succession and evolution

- **Constant change:** Nothing in nature is static. Erosion and weathering constantly wear away the Earth's crust and, in response, isostatic (equilibrium) forces move the crust up or down. Mountains are gradually eroded and after millions of years become flat plains. Sediments brought down by rivers are continually being deposited in the world's seas and lakes, over millions of years become compressed to form rocks and, in time, may revert to dry land. Through isostacy, this land may even be pushed upwards to form mountain chains, hence the presence of sea-life fossils in high mountains such as the Himalayas.
- **Ecological succession:** Within any ecosystem, plants and animals are continually developing to maturity, growing old and dying, and being replaced by others. The new organisms may be the same species or they might be the new species colonising the area, thus changing the composition of the biotic community. Unless influenced by people or catastrophic events (such as volcanic eruptions), the biotic community of an ecosystem will change in an orderly and broadly predictable fashion. This process is called ecological succession.