Energy Flow through Ecosystem-I

Energy Flow through Ecosystems

All living beings require energy for the most metabolic pathways (mostly as ATP). Life itself is an energy-driven process. Living organisms would not be able to form macromolecules (proteins, lipids, nucleic acids, and complex carbohydrates) from their monomeric subunits without a constant supply of energy.

Living things acquire energy in three different ways:

1. Photosynthesis
2. Chemosynthesis, and
3. Consumption and digestion of other living or previously living organisms

Photosynthetic and chemosynthetic organisms are autotrophs, i.e. they capable of synthesizing their own food. Photoautotrophs use sunlight as an energy source, whereas chemoautotrophs use inorganic molecules as an energy source. Autotrophs are significant for all ecosystems.

Photoautotrophs, like plants, algae, and photosynthetic bacteria, serve as the energy source for several ecosystem of the world. These ecosystems are often called grazing food webs. Photoautotrophs harness the energy of the sun by converting it to chemical energy (ATP and NADP). This energy is used to synthesize complex organic molecules.

Chemoautotrophs are primarily bacteria that are found in sunlight deficient places, such as in those associated with dark caves or hydrothermal vents at the bottom of the ocean. several chemoautotrophs in hydrothermal vents use hydrogen sulphide released from the vents as a source of energy. They supplies energy to the rest of the ecosystem.

Productivity within Trophic Levels

Productivity within an ecosystem is the percentage of energy that enters the ecosystem through biomass in a specific trophic level. Biomass is the total mass of living or previously living organisms within a trophic level in per unit area at the time of measurement. Ecosystems have characteristic amounts of biomass at each trophic level.

Productivity of primary producers is important in an ecosystem as these organisms bring energy to other living organisms. The rate at which photosynthetic primary producers incorporate solar energy called gross primary productivity.

As all organisms need to use some of this energy for their own functions (like respiration and resulting metabolic heat loss) scientists often refer to the net primary productivity of an ecosystem. Net primary productivity is the energy that remains in the primary producers after accounting for the organisms' respiration and heat loss. The net productivity is then available to the primary consumers at the next trophic level. For example, if 13,187 of the 20,810 kcal/m^2/yr were used for respiration or were lost as heat, the available energy 7,632 kcal/m^2/yr is left for use by the primary consumers.

Ecological Efficiency: The Transfer of Energy between Trophic Levels

Large amounts of energy are lost from the ecosystems from one trophic level to the next trophic level as energy flows from the primary producers to top consumers and decomposers through the various trophic levels. The principal cause for the loss of energy is the 2nd law of thermodynamics. The 2nd law states that whenever energy is converted from one form to another, there is an increase in the entropy of the system. In biologic systems, it means that a large amount of energy is lost as metabolic heat when the organisms of one trophic level consume the energy from the organisms of the other trophic level. In the Silver Springs ecosystem example, suppose that the primary producers produced 7618 kcal/m^2/yr from this 1103 kcal/m^2/yr is availale for the primary consumers. The measurement of energy transfer efficiency between two successive trophic levels is termed the trophic level transfer efficiency (TLTE).

Trophic level transfer efficiency (TLTE) may be defined as:

TLTE=production at present trophic level production at previous trophic level X 100(46.2.1)

In Silver Springs, the TLTE between the first two trophic levels was approximately 14.8 percent. The low efficiency of energy transfer between trophic levels is usually the major factor that limits the length of food chains in a food web. Following 4 to 6 energy transfers, there is not enough energy left to support another trophic level.