Lecture 8 Insect ecology and balance of life

Ecology:

The term ecology is derived from the Greek term "oikos" meaning "house" combined with "logy" meaning "the science of" or "the study of". Thus literally ecology is the study of earth's household comprising of the plants, animals, microorganisms and people that live together as interdependent components. The term ecology was coined by a German biologist Ernst Haekel (1869).

Definition of Ecology

Ecology can be defined as the science of plants and animals in relation to their environment.
Webster's dictionary defines ecology as "totality of pattern of relation between organisms and their environment."
Eugene P. Odum defined ecology as "the study of organisms at home"
Insect Ecology may be defined as the understanding of physiology and behaviour of insects as affected by their environment.

Ecology related terminology

i. **Habitat** is the place where the organism lives.

ii. **Population** denotes groups of individuals of any kind of organism. Insect populations are groups of individuals set in a frame that is limited in time and space.

iii. **Community** in the ecological sense includes all the populations of a given area. Community can also be defined as interacting 'web' of populations where individuals in a population feed upon and in turn are fed upon by individuals of other populations (Fig. 1)

iv. **Ecosystem**

Ecosystem or ecological system is the functioning together of community and the nonliving environment where continuous exchange of matter and energy takes place.
In other words ecosystem is the assemblage of elements, communities and physical environment.
Ecosystem is the ultimate unit for study in ecology as they are composed of living organisms and the nonliving environment.

Examples of natural ecosystem: Ponds, lakes and forests ecosystem (Fig.2)

v. **Biosphere** is the term used for all of the earth's ecosystems functioning together on the global scale.

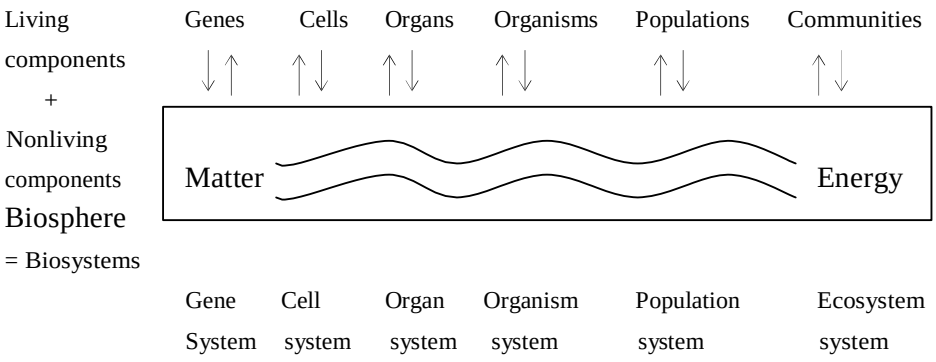

Figure 3. Flow of matter and energy in an ecosystem

Agroecosystem is largely created and maintained to satisfy human wants or needs. It is not a natural ecosystem but is man made. Agroecosystem is the basic unit of pest management - a branch of applied ecology.

A typical agroecosysyetm (Fig. 4) is composed of

i. more or less uniform crop-plant population
ii. weed communities
iii. animal communities (including insects)
iv. microbiotic communities
v. and the physical environment the react with.

Unique features of Agroecosystem

Dominated by plants selected by man
No species diversity and no intraspecific diversity. Genetically uniform
Phenological events like germination, flowering occur simultaneously
Lack of temporal continuity - due to various agricultural operations carried out by man like ploughing, weeding, pesticide application etc.
Plants contain imported genetic material
Nutrients are added
Outbreak of pests, weeds and diseases occur frequently

Balance of Nature

Balance of Nature is defined as the natural tendency of plant and animal population resulting from natural regulative processes in an undisturbed ecosystem (environment) to neither decline in numbers to extinction nor increase to indefinite density.

In unmanaged ecosystems, a state of balance exists or will be reached, that is species interact with each other and with their physical environment in such a way that on average, individuals are able only to replace themselves. Each species in the community achieves a certain status that becomes fixed for a period of time and is resistant to change which is termed as the balance of nature.

When man begins to manage creating new ecosystem (agroecosystem) where natural ecosystem existed previously, the balance is altered. The exceptionally strong forces react in opposition to our imposed change toward a return to the original system (e.g. outbreak of a pest is one of the forces). So insect pests are not ecological aberrations. Their activities counter wants and needs of human populations.

Factors that determine insect abundance

i) **Biotic potential**

It is the innate ability of the population to reproduce and survive. It depends on the inherited properties of the insect i.e., reproduction and survival. **Potential natality** is the reproductive rate of the individuals in an optimal environment. Survival rate depends on the feeding habits and protection to young ones (eg. Viviparity). Generally insects with high reproductive rate tend to have low survival rate and vice versa.

Insect pests with high reproductive rate and low survival rate are called **r strategists** named after the statistical parameter r, the symbol for growth rate coefficient. Such pests succeed because of sheer numbers. E.g. Aphids.

K strategists reproduce slowly but effectively compete for environmental resources and so their survival rate is high. (K letter denotes flattened portion of growth curve) eg. Codling moth of apple.

Birth rate or natality is measured as the total number of eggs laid per female per unit time. Factors determining birth rate are fecundity, fertility and sex ratio.

Death rate or mortality denotes the number of insects dying over a period.

Example of High reproductive rate

A single moth of *Earias vitella* (Bhendi fruit borer) lays about 200 eggs per female. Life cycle is completed in 1 month

After 1 month → 200 adults

↓

100 male+ 100 female

100 x 200 = 20,000 eggs

After 2nd month → 10,000 x 200 = 2,000,000 eggs

After 1 year → 2,000,000,000,000,000,000,000,000 adults

(i.e., 2 followed by 24 zeroes)

If a single moth can produce this much, they will cover 24.32 above earth surface in 1 year. But in reality only a fraction of progeny completes life cycle due to environmental resistance.

Environmental resistance is the physical and biological restraints that prevent a species from realizing its Biotic potential. Environmental resistance may be of 2 types.

1. Biotic factors - includes
    a) Competition (interspecific and intraspecific)
    b) Natural enemies (predators, parasites and pathogens)

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2. Abiotic factors -
    a) Temperature
    b) Light
    c) Moisture and water
    d) Substratum and medium

BIORESOURCES IN ECOSYSTEM

Ecosystem comprises of biological communities and non-living environment. e.g. Agro ecosystem, pond ecosystem, etc.). **Bioresources refers to the biodiversity of various organisms living in that ecosystem.**

e.g. The different pests of cotton, its natural enemies, hyperparasitoids, microbes, etc. are referred to the bioresources in cotton ecosystem.

The ecosystem should have more bioresources. Such ecosystem will be more stable. Insecticides will deplete the bioresources in ecosystem and make it less stable and prone to pest outbreak.

Natural control will be high when bioresources (e.g. Parasitoids and Predators) are more.