

## NOTES ON BIO 201 – GENERAL ECOLOGY

### INTRODUCTION: WHAT IS ECOLOGY?

The word ECOLOGY has come to the forefront of human consciousness and has become a commonly used household word.

It has come to be recognized as a science which helps to integrate some of the fundamental concepts of civilization.

Ecology has emerged as a sciences of survival

Ecology was formed from two Greek words [Gk: *oikos*; home and *logos*; the study of ] – First coined by Earnst Haechel (1869). Ecology therefore means the study of an organism in its natural home.

Odum (1963) defined ecology as the study of structure and function of nature or the study of inter-relationships between organisms and their environment.

### ECOLOGY AS A COURSE:

Ecology is part of Biology because it deals with life – probing into the secrets of various levels living systems – organism, population.

It is a multidisciplinary science that uses the tools of other discipline to explain natural observed phenomena.

### WHO IS AN ECOLOGIST?

An Ecologists is a Physiologists - as such ecology may be interpreted as EXTERNAL PHYSIOLOGY of an organism and physiology as INTERNAL ECOLOGY of an organism

An Ecologists must be familiar with physics, chemistry, astronomy, geology, climatology, soil science, statistics, and closely allied areas as taxonomy, morphology, histology, genetics, physiology and ecology

### WHAT DOES HE DO?

He/She seeks with the aid of several instruments both simple and sophisticated to determine the processes and energy transfer and cycling of elements in nature.

He/she strives to provide a greater depth of understanding and an insight into how the world works.

## HIS TOOLS:

Here are some of his tools, though the list is not exhaustive: tracer methodology, spectrometry, colorimetry, chromatography, remote sensing, mathematical modelling, computer technology

## BASIC ECOLOGICAL CONCEPTS

There are 4 basic principles of ecology”

1. The system of ecology is huge (ecosystem) and it contains a network of interrelations of its parts.
2. These interrelated network is inclusive of a structure that contains both the abiotic and biotic composition (environment).
3. The networks present in the ecological system has a control of the energy flow and also in the flow of nutrients.
4. Energy from our solar system has a control over the flow of all the nutrient and energy.

## ECOLOGY SEEKS TO EXPLAIN

- Life processes and adaptations
- Distribution and abundance of organisms
- The movement of materials and energy through living communities
- The successional development of ecosystems
- The abundance and distribution of biodiversity in context of the environment

Emanating from these 4 basic principles are many basic ecological concepts developed in order to study this complexity: Habitat; Population; Territories; Community; Ecosystem

## SCOPE OF ECOLOGY: (coverage)

Ecology has a wide scope of coverage and is significant in many fields such as range, forest and game managements; agriculture – livestock raising; fish culture; conservation of land and its products (minerals, soil, vegetation, water); space ecology; problems of increasing population; pollution; urbanization; town planning; disaster mitigation.

SUBDIVISIONS OF ECOLOGY: There are two artificial divisions AUTECOLOGY and SYNECOLOGY

**AUTECOLOGY:** This is the study of interrelations of individual organisms with the environment or environmental physiology or ecophysiology or ecophysiological ecology. It is

the level of integration between the environment and the individual. It is experimental (field and laboratory).

**SYNECOLOGY:** The study of groups of organisms i.e. community. It is descriptive but also can be experimental with the aid of tools such as computer and radioactive tracers. It is subdivided into aquatic and terrestrial; Terrestrial includes Desert, Grassland, Forest and Aquatic includes Freshwater, Brackish and Marine water.

Through the concept of Tansley (1935) the divergence between autecology and synecology were brought together. The concept states that “all organisms are interacting with one another and also with the abiotic elements of their environment in an interrelated system. This means that organisms and environment form a reciprocating system. There is a give and take between these two systems with the action or inaction of one system having impact on the other system.

From this concept therefore emanates three main levels of integration in ecology:

- i. Individual
- ii. Population – Community
- iii. Ecosystem

These are referred to as the basic units of ecology especially the ecosystem.

**POPULATION:** An aggregation of individuals of the same species in a continuous area which contain no potential breeding barrier.

**COMMUNITY:** A group of interacting populations in a given habitat. Usually restricted to organisms of similar size and life habits e.g tree community, insect community, bird community, human community.

**BIOME:** Several interacting communities

**ECOSYSTEM:** abstraction of many separate ecosystems with similar characteristics.

### ***INDIVIDUAL LEVEL OF INTEGRATION IN ECOLOGY:***

#### **ECOLOGICAL NICHE and HABITAT:**

**NICHE:** The most widely accepted definition was one by Hutchinson (1957) – The NICHE is the set of BIOTIC and ABIOTIC conditions in which a species is able to persist and maintain stable population sizes. Two issues are recognizable from this definition (a) functional role of an organism (b) its position in time and space.

The ecological niche is a central concept in the ecology of organisms and is subdivided into **FUNDAMENTAL** and **REALISED NICHES**.

**FUNDAMENTAL NICHE:** the set of environmental conditions under which a species is able to persist.

**REALISED NICHE:** the set of environmental plus ecological conditions under which a species persists.

To determine an organisms status/niche in the community the following must be known:

- i. Nutrition and source of energy
- ii. Rate of metabolism and growth
- iii. Effect on other organism.

**THE HABITAT:** This is a related but distinct concept to **NICHE** that describes the environment over which a species is known to occur and the type of community formed as a result. More specifically, habitat can be defined as regions in environmental space that are composed of multiple dimensions, each representing a biotic or abiotic environmental variable, that is, any component or characteristic of the environment related directly (forage biomass) and quality or indirectly (elevation) to the use of a location by the animal eg. Aquatic or terrestrial environment.

Organisms are subject to environmental pressures but are also modifiers of their habitats by the regulatory feedback between them and their environment.

### ***POPULATION LEVEL OF INTEGRATION IN ECOLOGY:***

**POPULATION:** Population is the unit of analysis in Population ecology. A population consists of individuals of the same species that live, interact and migrate through the same niche and habitat. It is a group/aggregation of related individuals (same species) capable of interbreeding and living (occupying) a continuous area that contain no potential breeding barrier.

**N:B .** The organisms are of the same kind

They occupy a particular area

The population is the structural component of an ecosystem which develops and maintains itself by reproduction i.e. it is a self regulating system.

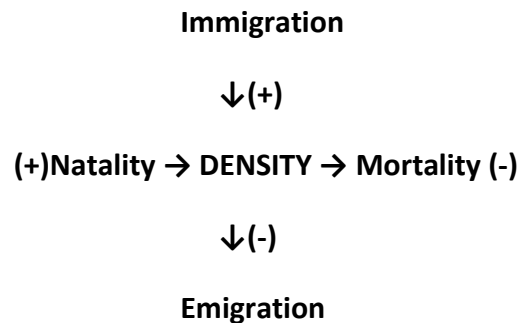
The basic characteristic of a population is its size or density (numbers per unit area or per unit volume)

Read on: Malthusian growth Model, Simplified population models, Age structure/pyramid,

These Introductory models serve as foundation upon which the discipline of population ecology is built in order to further understand demographic processes in real life study populations and conduct statistical tests.

The field of population ecology often uses data on life history and matrix algebra to develop projection matrices on fecundity and survivorship and this information is used in managing wildlife stocks and setting harvest quotas.

The population density is dependent on: Natality (birth), Mortality (deaths), Immigration and Emigration



Define the following: Natality (birth), Mortality (deaths), Immigration and Emigration

### ***POPULATION DYNAMICS***

The term population dynamics is applied to the study of changes in the numbers of organisms in populations and of the factors influencing these changes; It also includes the study of the rates of loss and replacement of individuals and if any regulatory processes tending to keep the numbers steady or at least to prevent excessive changes.

It is the aspect of population ecology dealing with forces affecting changes in population densities or affecting the form of population growth.

It is the study of marginal and long-term changes in the numbers, individual weights and age composition of individuals in one or several populations and biological and environmental processes influencing those changes

Population dynamics deals with

- a. Environmental influences upon populations of organisms ( e.g. temperature influences upon populations, effect of quantity of food supply, effect of moisture, effect of other species –Interspecific interactions, effect of natural enemies, effect of diseases/disease causing organisms or various combinations of these factors)
- b. The influence of members of the population upon each other (Intraspecific Interactions) both favourable and adverse

Read on: population range, population growth rate, population limiting factors, dispersion(spatial distribution), Survivorship curve

Define: Carrying Capacity, biotic potential, environmental resistance.

### ***COMMUNITY LEVEL OF INTEGRATION IN ECOLOGY:***

This is a sub discipline of ecology which studies the distribution, abundance, demography and interactions between co-existing populations.

The community is a group of interacting populations in a particular habitat. It consists of an assemblage of plants (Producers) and animals (Consumers) living in the same environment and are mutually interdependent.

There is great diversity of species in a community and a diversity of physical environment.

N:B. In a Community:

- i. Diversity is greatest among small organisms
- ii. Greatest in the tropics
- iii. Number decreases on a latitudinal gradient as we move from North to South.

### ***PRODUCTIVITY/PRODUCTION IN ECOSYSTEMS:***

Productivity or Production refers to the rate of generation of biomass in an ecosystem. It is usually expressed in units of mass per unit surface (or volume) per unit time, for instance grams per square metre per day. The mass unit may relate to dry matter or to the mass of carbon generated. It is a measurement of the rates of conversion of energy and nutrients into growth.

There two major types:

**PRIMARY PRODUCTIVITY (Productivity of Autotrophs) and SECONDARY PRODUCTIVITY (Productivity of Heterotrophs)**

**FOOD WEBS AND TROPHIC LEVELS:** These are two widely employed conceptual models/maps used to explain the linkages among species in relation to production in the ecosystem and transfer of energy. They are used to illustrate pathways of energy flow in an ecological community, usually starting with solar energy being used by plants during photosynthesis. Food webs can be more complicated depending on which ecological dimension is being mapped such as SPECIES COMPOSITION (types), SPECIES RICHNESS (number), BIOMASS (dry weight of plants and animals), PRODUCTIVITY (rates of conversion of energy and nutrients into growth) and STABILITY (food webs over time).

**TROPHIC DYNAMICS:**

When the relative abundance or biomass of each functional feeding group is stacked into their respective trophic (feeding) levels they naturally sort into a PYRAMID OF NUMBERS .

One of the several patterns that is repeated amongst the planet's ecosystems is the emergent pyramidal arrangement or trophic levels with amounts of energy transfer decreasing as species become further removed from the source of production.

The size of each level in the pyramid generally represents biomass which can be measured as the dry weight of an organism. Autotrophs may have the highest global proportion of biomass, closely rivalled or surpassed by microbes.

Functional trophic groups sort out hierarchically into pyramid trophic levels because it requires adaptations to become a photosynthesizer or a predator, few organisms have the adaptations needed to combine both abilities. Each trophic level contains unrelated species that grouped together because they share common ecological functions.

The net effect of direct or indirect relations is called TROPHIC CASCADES.

***SOME ELEMENTARY METHODS OF STUDY:***

Students are expected to undertake some field practical on the following:

**PRACTICAL 1: COLLECTING DATA AND DATA HANDLING**

**PRACTICAL 2: ESTIMATION OF POLLUTION SIZE USING QUADRAT METHOD**

**PRACTICAL 3: MEASURING ENVIRONMENTAL FACTORS ON LAND**

**PRACTICAL 4: MEASURING ENVIRONMENTAL FACTORS IN WATER**

**PRACTICAL 5: MEASUREMENT OF EDAPHIC FACTORS**

***TYPE-WRITTEN ESSAYS:***

The students shall be given written essay assignments periodically. These shall be submitted spiral bound observing all standard type-setting rules.

**Example of Topics:**

- 1. Relationships among plants and animals in the biotic community.**
- 2. Waste dumps and the environment.**
- 3. Climatic changes and its influence on Biodiversity.**
- 4. Natural disaster; cause and effects.**
- 5. Stratification and ecological niche in the biotic community.**
- 6. Edaphic factors; impact on biomass, richness and distribution of soil organisms.**