



# BINGHAM UNIVERSITY

## BIOLOGICAL SCIENCES DEPARTMENT

### BIO 101 : General Biology I

#### Lecture I

#### Interrelationships of organisms



# Course outline

- **Interrelationships**
- **Ecological Concepts and Definitions**
- **Components of an Ecosystem**
- **Approaches to Ecology**
- **Food relationships**
- **Food Chain and Food web**
- **Pyramid of Number and Energy**
- **Energy flow and transformation**
- **Concept of Energy**
- **Laws governing Energy Transformation in an Ecosystem**

# LECTURE SUMMARY TODAY



- Environmental biology or Ecology is the study of the interaction among living & non-living things in their physical environment.
- Ecology can be divided into Autecology and Syncology.
- Environment, habitat, ecological niche, population, community (Biomes) and ecosystem are important concepts in ecology.
- Approaches used in ecology includes: Ecosystem, community, population and evolutionary or historical.

# INTERRELATIONSHIPS OF ORGANISMS

**Environmental biology or Ecology is the study of the interactions among living & non-living things in their physical environment (light, solar radiation, moisture, wind, oxygen, carbon dioxide, nutrients in soil, water, & atmosphere) & the biological environment (organisms of the same kind as well as other plants & animals).**



# ECOLOGY

**The study of living organisms in the natural environment**

**How they interact with one another**

**How they interact with their nonliving environment**



# What is Ecology

- Haeckel 1863. "the study of all the complex interrelationships referred to by Darwin as the conditions of the struggle for existence, or the economy of nature."
- Ecology is the scientific study of the interrelationships between organisms, and their environment
- Ecology is the sociology and economics of animals and plants



# What is Ecology

- The term ecology was coined from two Greek words: Oikos meaning "house" or "place to live" and Logos, meaning, "study of".
- The coining of the term was done by a German biologist Ernst Haeckel.



# Role of Ecology

- *Understanding nature*
  - "The ecological theater and the evolutionary play."
  - "Nothing in biology makes sense except in the light of evolution."
  - very little about evolution makes sense except in the light of ecology."
- *Managing nature*



# Ecology as a Science

- **Biology is a study of diversity, be it at the level of species or of molecules**
- **There are endless special cases**
- **Ecology and Evolution are more uncertain, and thus more challenging than many areas of science.**
- **you cannot deduce biology from first principles.**
- **What is noise to a physicist is music to a biologist.**



# Branches of Ecology

- **Ecology is subdivided into two:**
- **Autecology**
- **Syncology.**



**AUTECOLOGY** is the study of an individual organism or a single species of organism & its environment.

The study of interrelationships between groups of organisms or species of organisms living together in an area is termed **SYNCOLOGY**.



# CONCEPTS & DEFINITIONS



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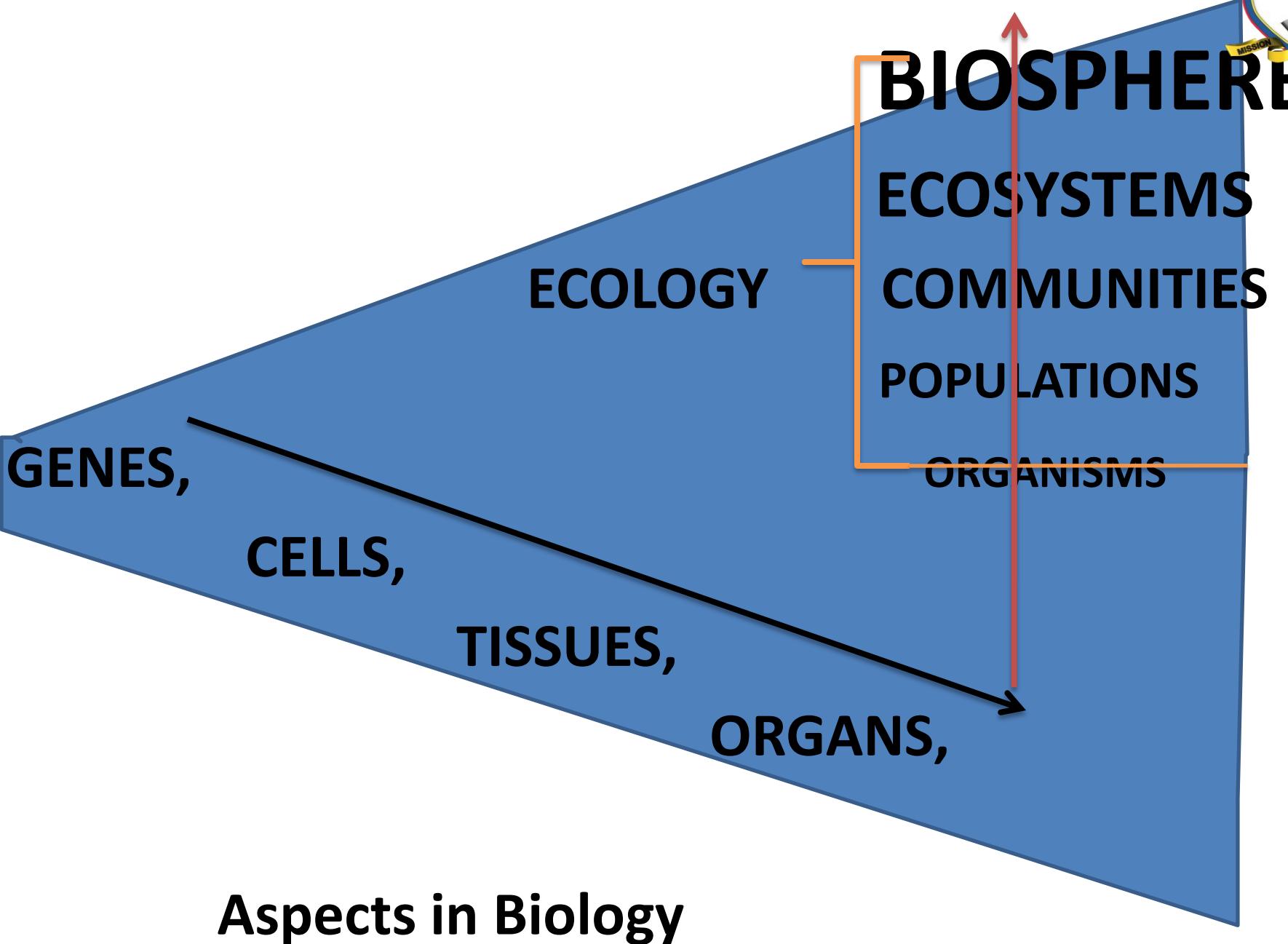


- NATURE = BIOTIC + ABIOTIC.

On earth, life exists in the:

- LITHOSPHERE (land masses)
- HYDROSPHERE (oceans & other water bodies)
- ATMOSPHERE (celestial object that has a gravitational field strong enough to prevent the gases from escaping from the earth)

Anywhere on earth that life exists is called the BIOSPHERE OR ECOSPHERE.

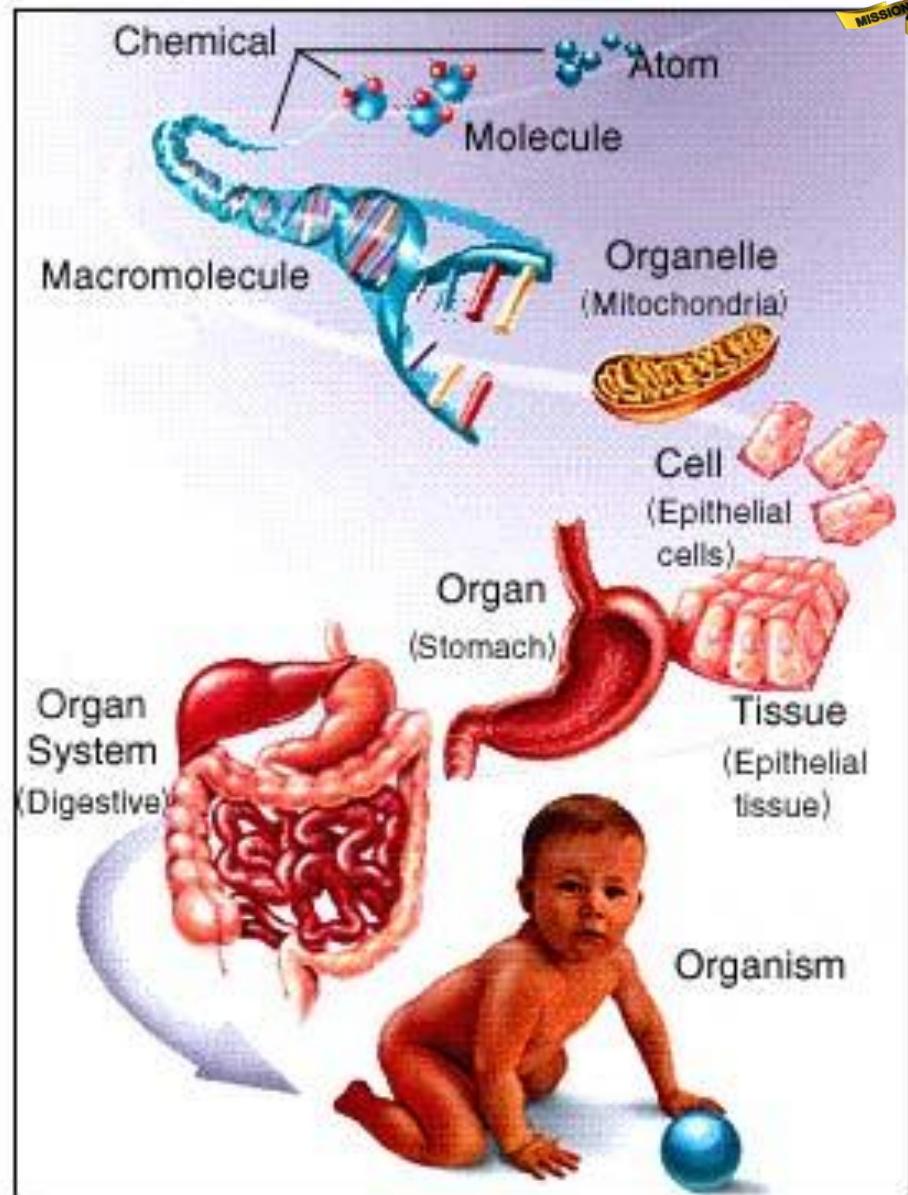




Biosphere	The part of Earth that contains all ecosystems	<p><b>Biosphere</b></p>
Ecosystem	Community and its nonliving surroundings	<p>Hawk, snake, bison, prairie dog, grass, stream, rocks, air</p>
Community	Populations that live together in a defined area	<p>Hawk, snake, bison, prairie dog, grass</p>
Population	Group of organisms of one type that live in the same area	<p><b>Bison herd</b></p>
Organism	Individual living thing	<p><b>Bison</b></p>
Groups of Cells	Tissues, organs, and organ systems	<p>Nervous tissue → Brain → Nervous system</p>
Cells	Smallest functional unit of life	<p><b>Nerve cell</b></p>
Molecules	Groups of atoms; smallest unit of most chemical compounds	<p><b>Water</b></p> <p><b>DNA</b></p>

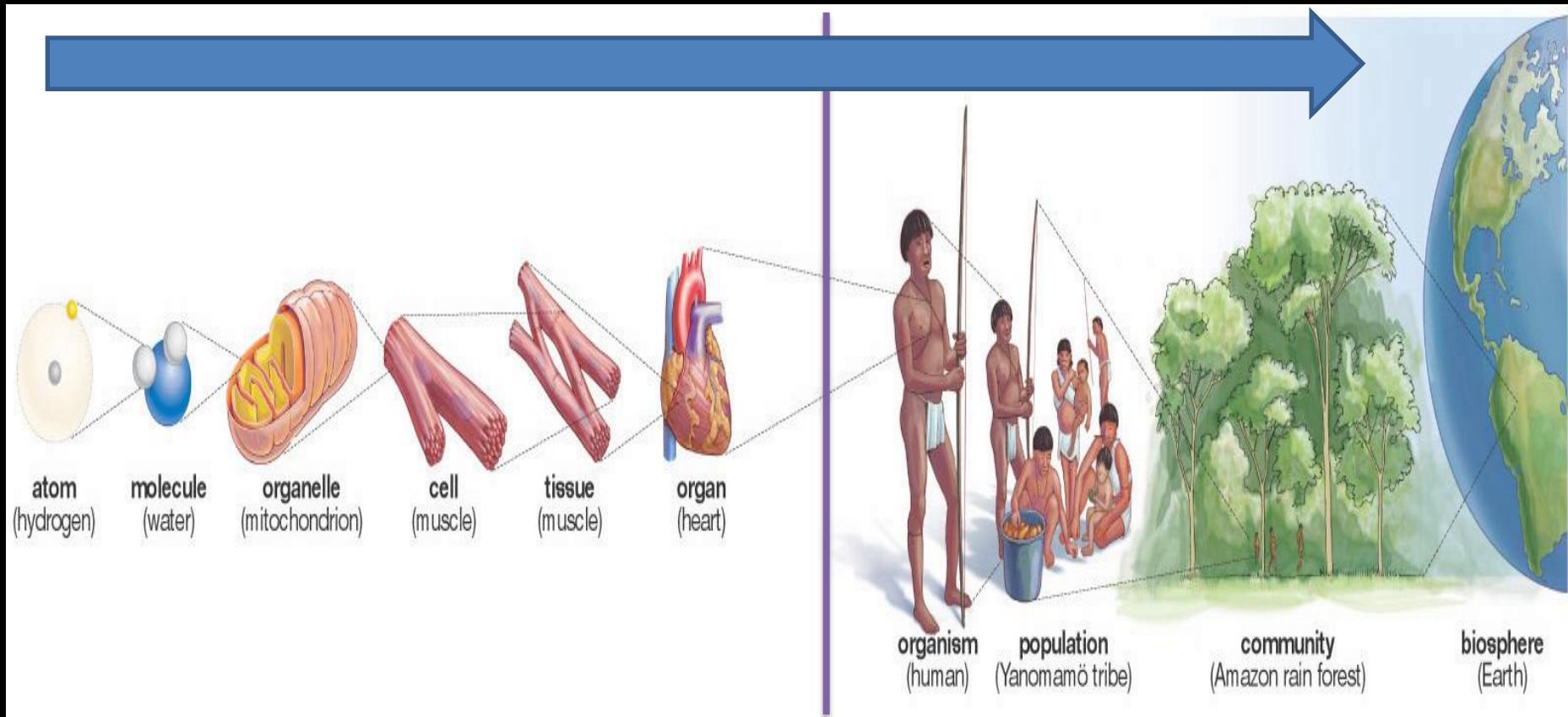
# What are the Simplest Levels?

- Atom
- Molecule
- Organelle
- Cell
- Tissue
- Organ
- System

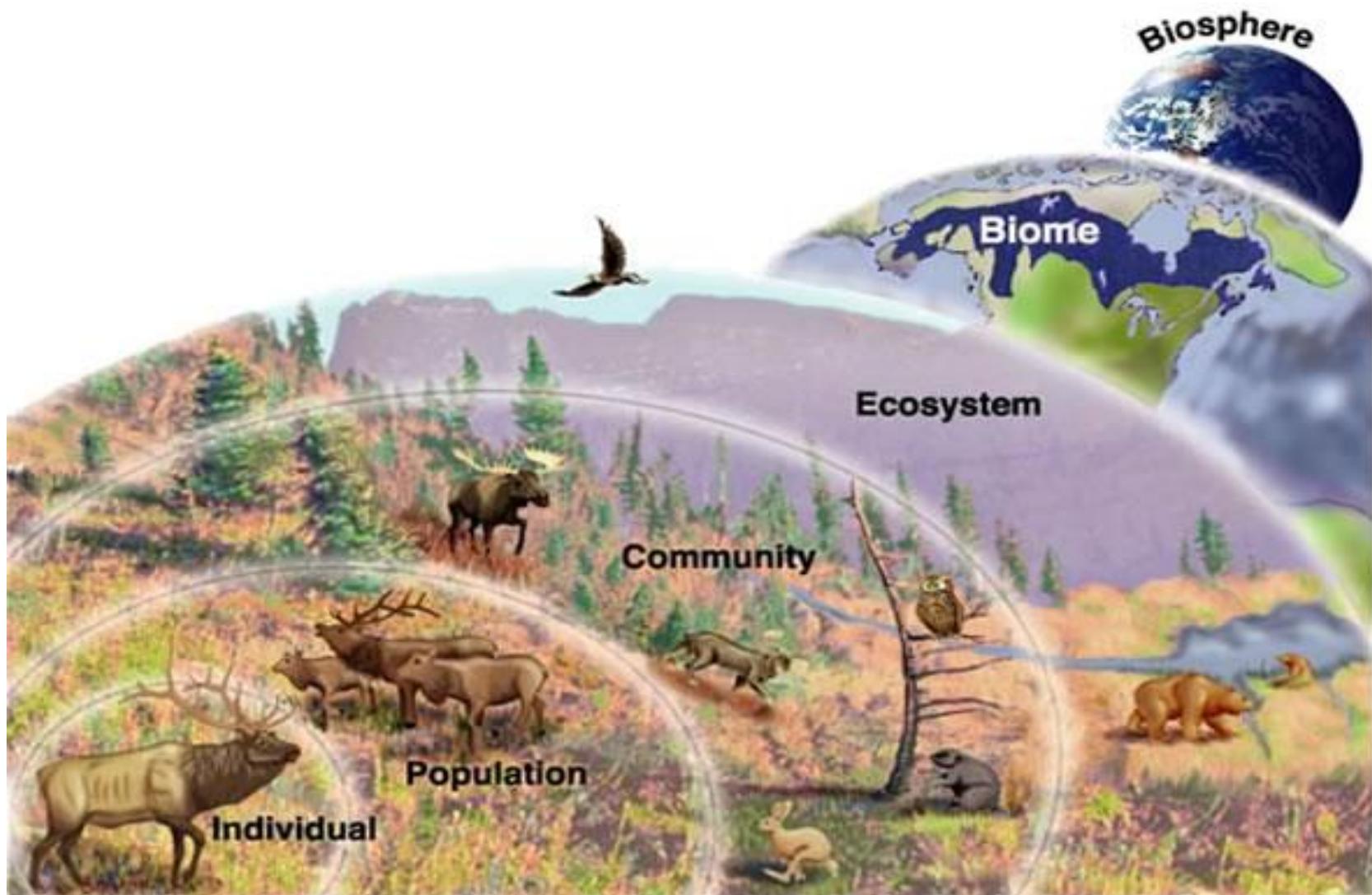




# Organizational levels of biology + Ecology



# Level of organization is used to show how organisms interact with each other & their environment



# Levels of organization



- **Organisms**
- **Populations**
- **Communities**
- **Landscapes**
- **The Biosphere**

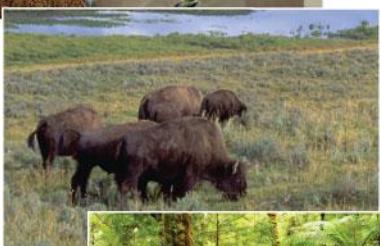
## Global ecology



## Landscape ecology



## Ecosystem ecology



## Community ecology



## Population ecology



## Organismal ecology



# Ecosystem

**Community + Abiotic environment, interacting**

An ecological system or ecosystem is a set of interacting, interdependent living (organic or biotic) and non-living (inorganic or abiotic) components or sub systems.





# Ecosystems: Fundamental Characteristics

- **Structure:**
  - Living (biotic)
  - Nonliving (abiotic)
- **Process:**
  - Energy flow
  - Cycling of matter (chemicals)
- **Change:**
  - Dynamic (not static)
  - Succession, etc.

# Community (Biomes)

All the populations of the different species living and inter-acting in the same ecosystem

A large group of natural population of plants & animals that live together in a given area & directly or indirectly depend on each other for survival.

7-spotted lady bird

(*Adephagia septempunctata*)

Bean aphids

(*Aphis fabae*)

Red ant (*Myrmica rubra*) and

Broom plant

(*Cytisus scoparius*)

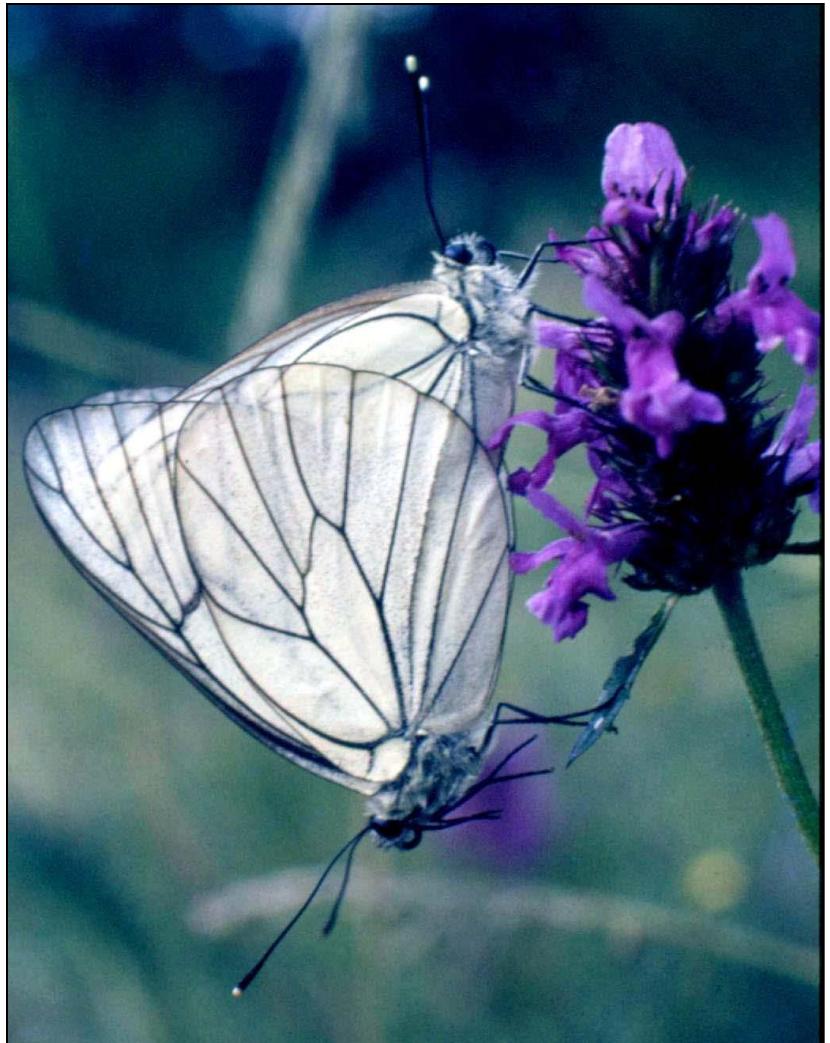


# Population

**A group of organism of the same species which live in the same habitat at the same time where they can freely interbreed**

**Group of same species of organisms occupying the same area at a particular time & interbreeds freely.**

The black-veined white butterfly (*Aporia crataegi*) mating



# Species

**A group of organisms that can breed to produce fully fertile offspring**

**Snow geese (*Chen caerulescens*)**



# Habitat

**The characteristics of the type of environment where an organism normally lives.**

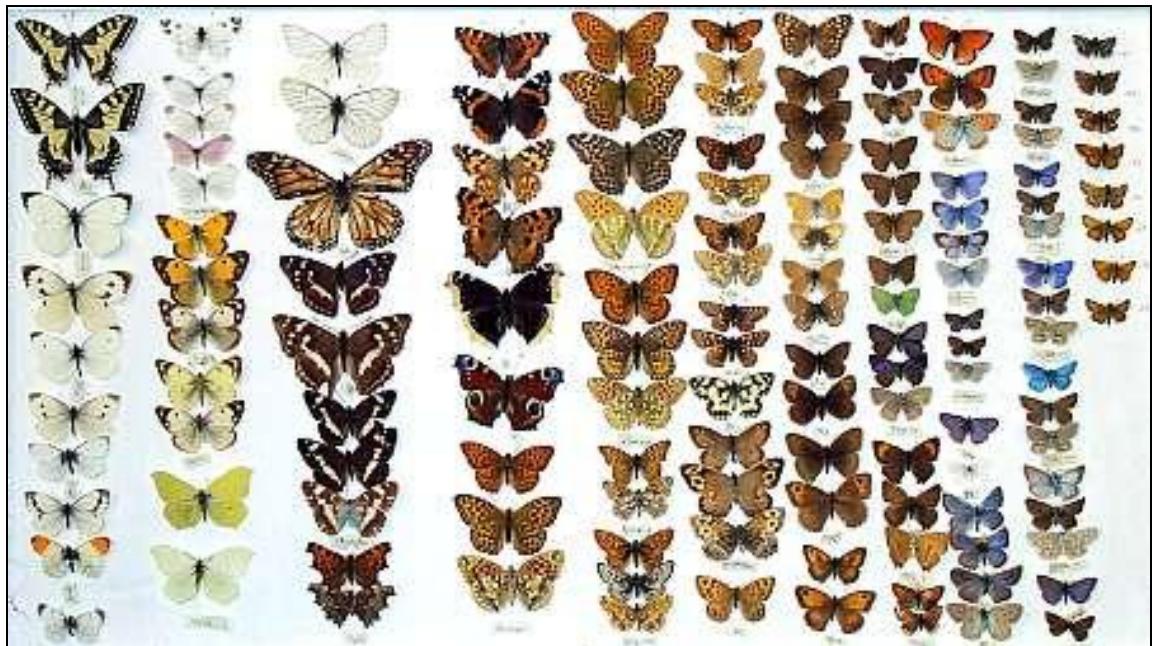
**(e.g. a stoney stream, a deciduous temperate woodland)**

**HABITAT: The natural dwelling place of an organism.**



# Biodiversity

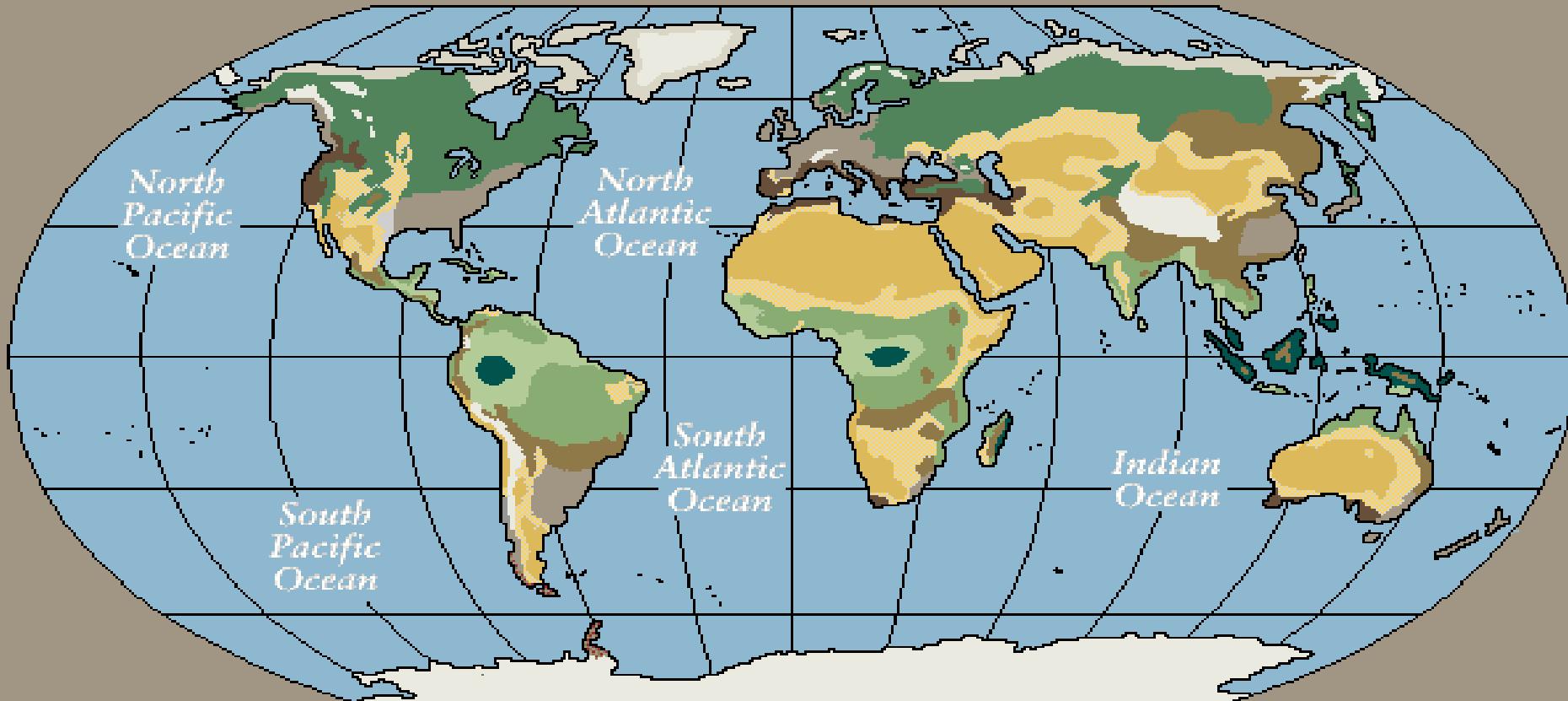
**The total number of different species in an ecosystem and their relative abundance**





- **ENVIRONMENT:**
- Everything associated with organisms, including living & non-living part of the world.
- **ECOLOGICAL NICHE:**
- The functional role an organism plays in the community.

# World Climate and Terrestrial Biomes.



## HOT & HUMID

(Rain Forest & Savanna)

No Dry Season

Short Dry Season

Drier Winter

## MILD & HUMID

(Mixed Forest & Grassland)

No Dry Season

Drier Winter

## COLD & HUMID

(Needle-Leaf & Mixed Forest)

No Dry Season

Drier Winter

## DRY

(Steppe & Desert)

Semi-Arid

Arid

## POLAR & ALPINE

(Tundra & Icecaps)

Peaks & Permafrost

Some Growth

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Regional climates may be described in terms of five different types of biomes. A biome is characterized by the particular combination of temperature, humidity, vegetation, and associated animal life in an area. This map shows the distribution of the world's major biomes: rain forest and savanna, mixed forest and grasslands, needle-leaf and mixed forests, steppe and desert, and tundra and icecaps.

# ECOLOGICAL APPROACHES



- **ECOSYSTEM:** (Exchange of matter and energy)
- **COMMUNITY:** (syncology) mainly concerned with the biotic components.
- **POPULATION:** ( autecology) concerned with the characteristic mathematical forms of the growth, maintenance and decline of species populations.
- **HABITAT:** (spatial concepts, it describes the typical environment of a particular organism, population, community or ecosystem( microhabitats)
- **EVOLUTIONARY OR HISTORICAL:** (changes of ecosystems over time



# Ecosystem approach

- The functional relationships between organisms (e.g. feeding) and their environment.
- Focuses on the exchange of energy and matter between living and non-living components of the system.



# Ecosystem Ecology

Groovy Categories

- Why is this field important?
- What is an ecosystem?
- Trophic Structure
- Nutrient cycles and food webs
- Ecosystem Processes
- Ecosystem engineers
- Biomes
- Global Changes



# **Community approach**

## **(Synecology)**



**This is concerned with the biotic components of ecosystems.**

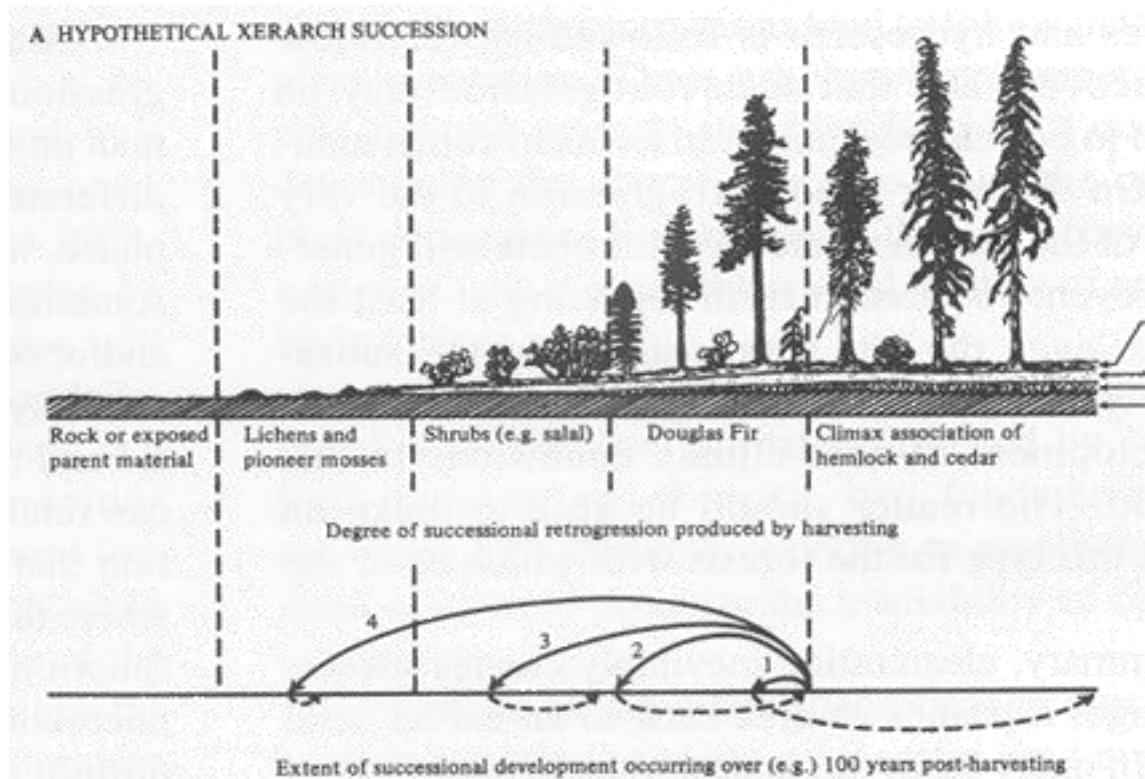
**Important aspect of community studies:**

**Concept of succession** :natural process by which a community of organisms replace another

**Climax communities** A point where further changes becomes very slow, and is dominated by long-lived, highly competitive species.

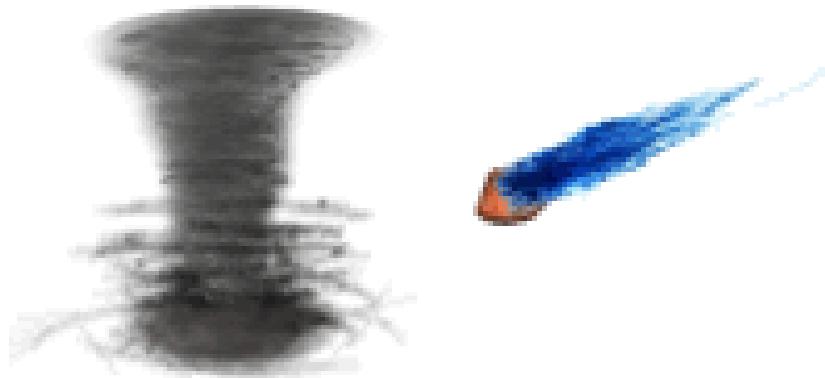
# Succession Definitions

- **Chronological distribution of organisms within an area**
- **The sequence of species within a habitat or community through time**
- **Shared:**
  - Time
  - Single area



# What Structures a Community?

- **Abiotic**
  - Climate
  - Latitude
  - Proximity to Ocean
  - Disturbances (abiotic)
- **Biotic**
  - Interspecific Interactions
    - Keystone Species
  - Disturbances (biotic)
  - (Intraspecific Interactions?)



# Types of Interspecific Interactions

	Species 1	Species 2
No interaction	○	○
Allelopathy	○	~
Commensalism	+	○
Mutualism	+	+
Competition	~	~
Predation	+	~
Parasitism	+	~

# **Population approach (autecology)**



- This study is concerned with the characteristics numerical forms of growth, maintenance and decline of species populations.
- It examines how characteristics such as an organism's morphology, behaviour, food preferences, etc are linked with its habitats, distribution and evolutionary history.

# Characteristics of a Population

- **What features can we measure of a population?**
- **Features:**
  - Size
  - Age structure
  - Sex ratios
  - Effective population size
  - Birth rate
  - Death rate
  - Immigration
  - Emigration





# Habitat approach

- Habitat is a spatial concept and it describes the typical environment of particular organism, population, community or ecosystem.
- Particular locations within the same overall habitat may have their own special conditions and are referred to as **MICROHABITATS** with **MICROCLIMATES**.
- It is convenient for studying characteristics of physical environment linked with plants and animals, e.g. soils, moisture and light.



# Habitat Ecology

- Studying habitat at temporal and spatial scales.....
- ✓ Habitat Loss and Fragmentation
- ✓ Invasive Species
- ✓ Disease Ecology
- ✓ Ecotoxicology
- ✓ Pollination
- ✓ Seed dispersal

# **Evolutionary or Historical Approach**



- Views the changes since life evolved.
- Examines how events influenced the form and distribution of species and how ecosystems, communities, populations and habitats have changed over time.

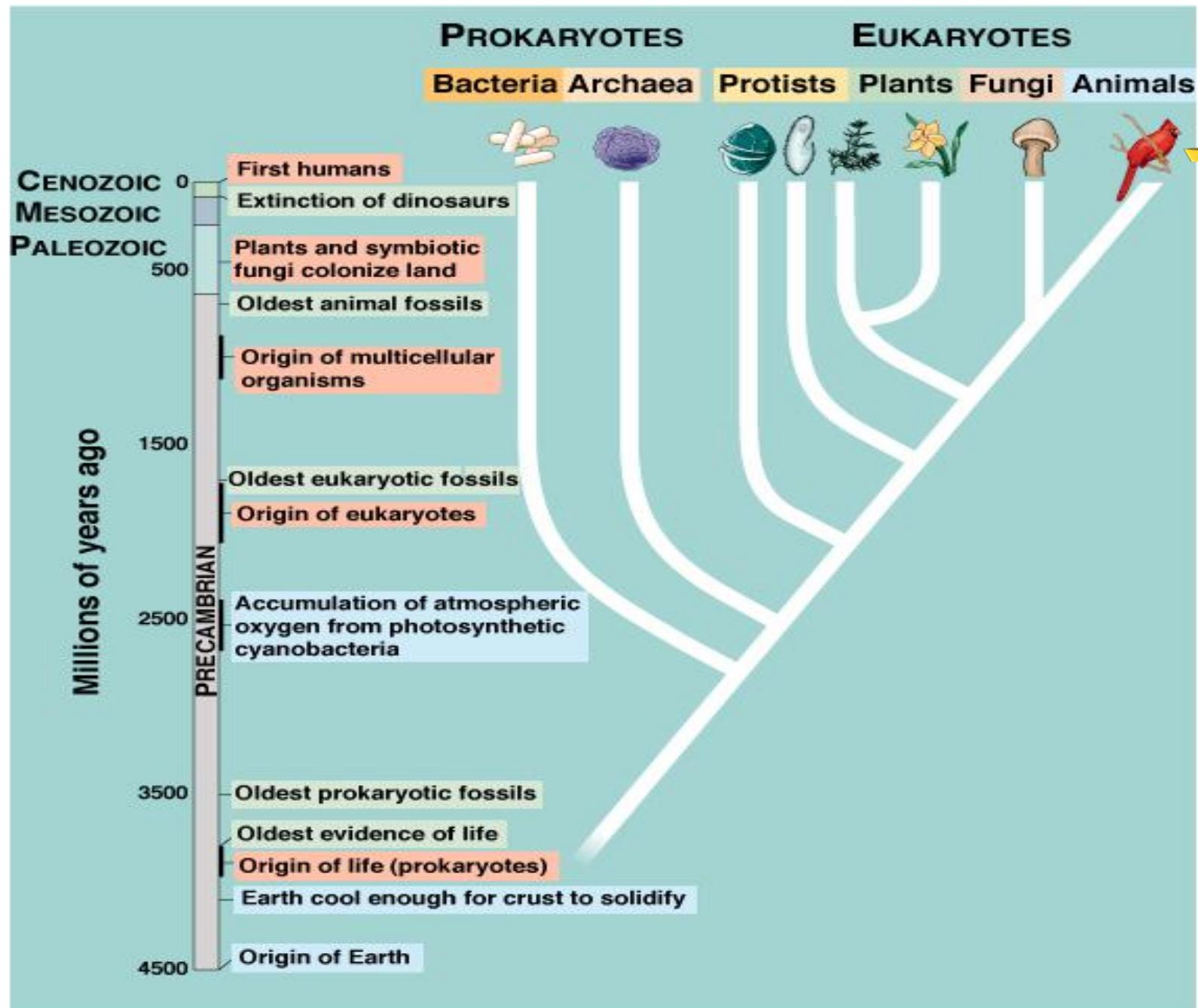
Thereby predicting the likely nature of future change.

The activities that are responsible for extinction and speciation and why species have a particular size or form, and reproductive strategy are studied

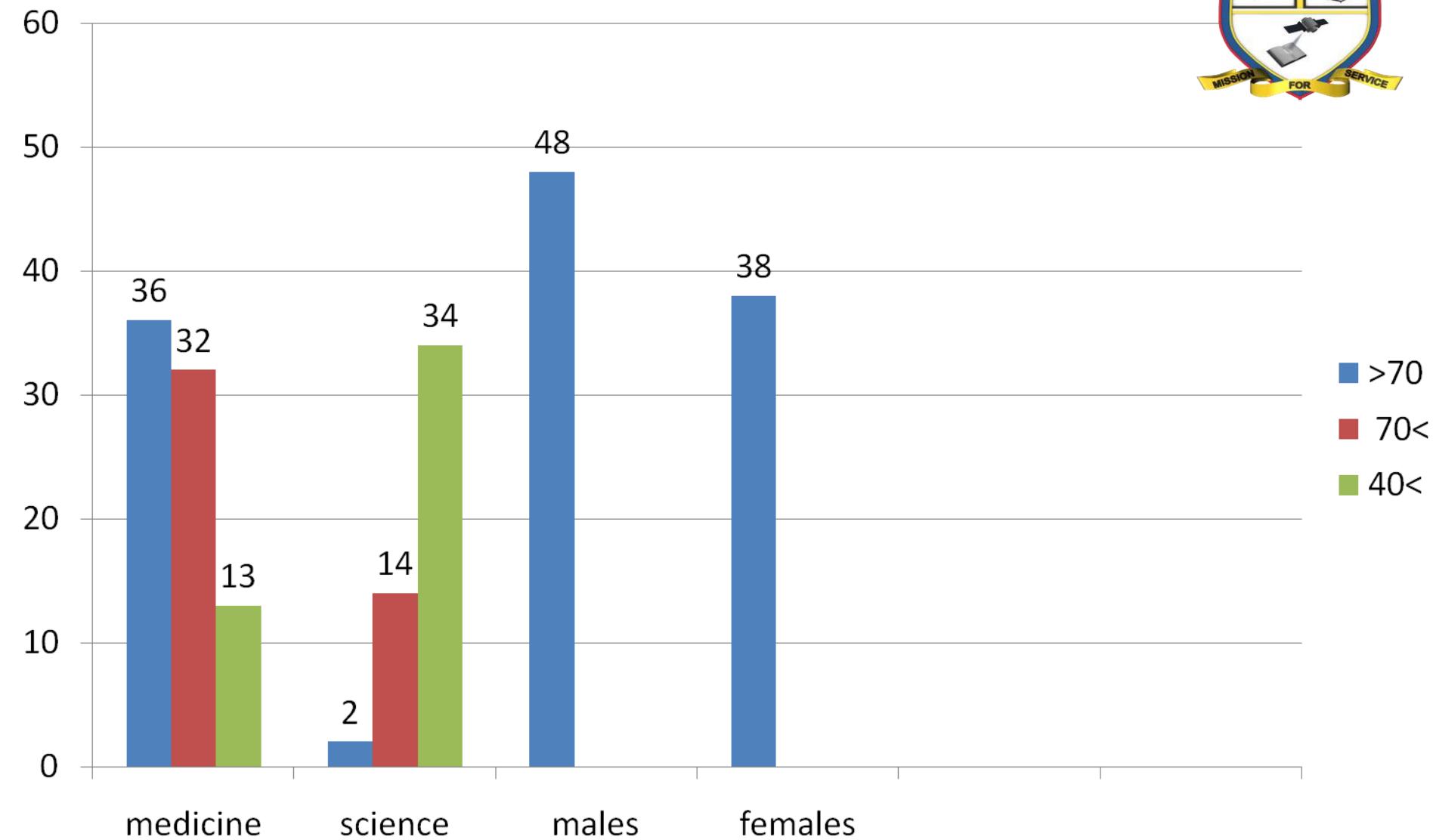
# Evolutionary or historical approach Cont.....



- **Palaeoecology** applies modern knowledge of ecosystems to the study of fossil organisms.
- It attempts to reconstruct past ecosystems and, in particular, to see how ecosystems and communities functioned before humans became a major influence.



# Bio 101 TEXT RESULT







# Questions

