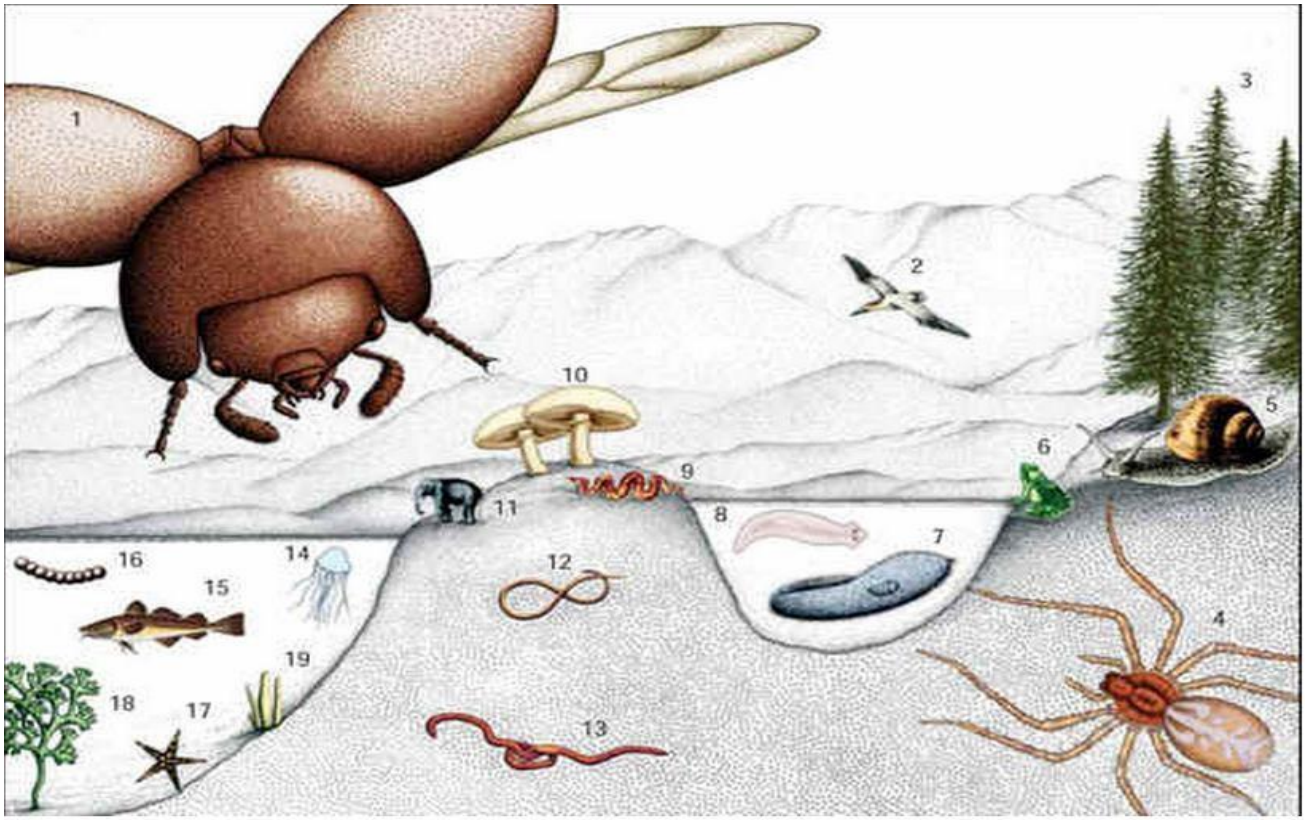
Insect Ecology

Lecture 1

Introduction to Insect Ecology



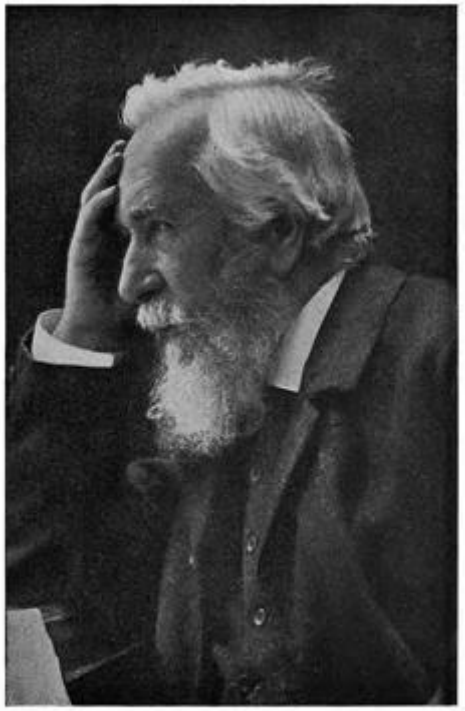
In this "species scape", the size of organisms is proportional to the number of species in the group they represent. 1. Insects: >1.000.000 species • 2. Birds: 9.800 • 3. Higherp lants: 250.000 • 4. Noninsectan arthropods: 190.000 • 5. Molluscs: 50.000 • 6. Amphibians: 4.200 • 7. Protozoa: 40.000 • 8. Flatworms: 12.200 • 9. Reptiles: 6.500 • 10. Fungi: 69.000 • 11. Mammals: 4.327 • 12. Roundworms: 12.000 • 13. Earthworms: 12.000 • 14. Cnidaria and Ctenophora: 9.000 • 15. Monera: 4.800 • 16. Fish: 18.800 • 17. Starfish: 6.100 • 18. Algae: 40.000 • 19. Sponges: 5.000.

http://www.natuurwetenschappen.be/cb/ants/projects/ibisca-why-arthropods.htm

0.1 What is Ecology ?

Ecology is a new science, emerged as a distinct discipline only at the turn of the 20th Century and became prominent in the second half of the 20th Century.

Ernst Heinrich Philipp August Haeckel, was an eminent German biologist, naturalist, philosopher, physician, professor and artist who described thousands of new species and coined many terms in biology, including *phylum*, *phylogeny*



February 16, 1834 – August 9, 1919

0.1 What is Ecology ?

Ecology: ~ Greek word oikos (house or surroundings) +logy (study of)

ecology– the investigation of the total relations of the animal both to its organic and to its inorganic environment. … …

… Ecology is scientific study of the interactions between organisms and their environments.

Ernst Haeckel, 1866

0.1 What is Ecology ?

- Late 1800s, ecology came into general use.

- Ecologists

- The study of the relationships, distribution, and abundance of organisms, or groups of organisms, in an environment.

S.I. Dodson, 1998

Ecology is NOT:

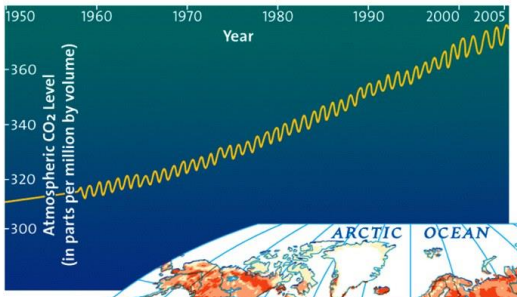
- Environmental Science (i.e., the study of man's effect on natural systems)
- Environmentalism (activism, aim to improving the environment).
- Resource management
  - Wildlife
  - Fisheries
  - Soil Resources
  - Forestry

Ecology as a science is a process, not just the knowledge it generates

- Much of our knowledge about the nature world is well established
  - e.g. Effects of climate change.
  - Confirmed by observation, experiments, modeling.
- Our understanding of many issues is incomplete and imperfect
  - e.g.: Which factors determine population density of species? How dose the temperature affect the life cycle of the pests?; role of predators in control prey populations.

Global Environmental Issues

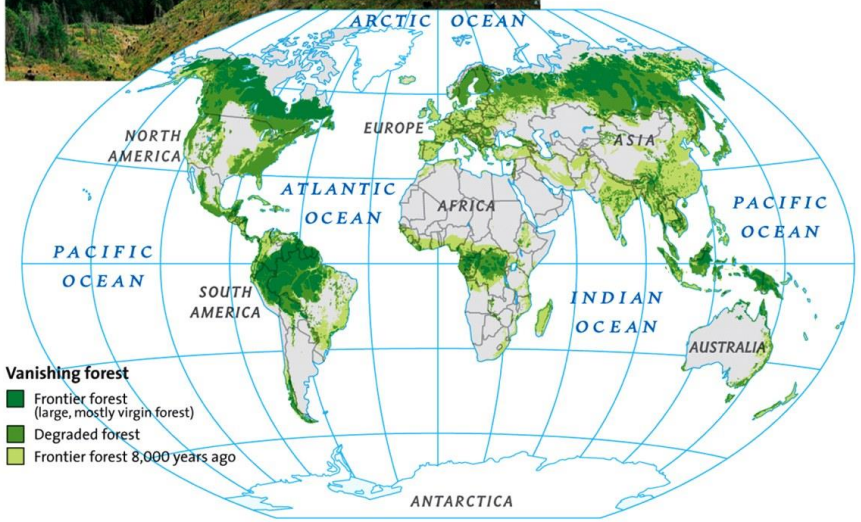
Global Warming



Scientists agree that rising levels of atmospheric carbon dioxide, a greenhouse gas, causes higher global temperatures.

Deforestation

Clear-cutting large tracts of timber, without sustainable replanting, contributes to deforestation, erosion, and loss of habitat.



❖ **Ecology** can be defined as the *scientific study of* ***interactions*** that determine the ***distribution & abundance*** *of organisms*.

Distribution refers to where organisms are found. We can study distribution on different scales:

where found *geographically*

where found in terms of *habitat*

how distributed *spatially within habitat*

Abundance refers to how many organisms occur. We can ask different questions about abundance:

- Does a species occur in *many habitats*? If so, it will appear abundant on a large scale -we will encounter it in many places.
- Are there *large numbers of individuals of a species in a habitat* where it occurs? If so, a species may be rare or abundant on a large scale, but in certain localities it will be abundant.

We can also look at abundance in terms of numbers of species, rather than in terms of individuals of a single species. We can ask whether an area has *many different species or only* a few species.

Interactions refer to the relationships between an organism or species and aspects of its environment.

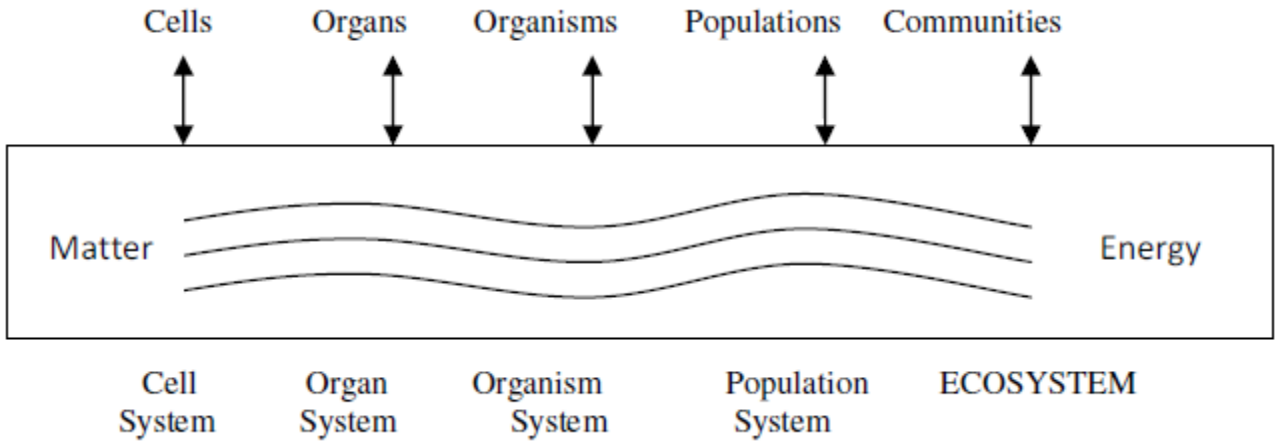
The above explanations of distribution, abundance, and interactions should indicate that we can study ecology on a various different levels. The main levels studied by ecologists are:

Individuals: We can consider how individuals are affected by the environment; this can determine whether they can survive (which will affect their distribution) and how well they reproduce (which will affect their abundance.)

Populations: *A population is a group of organisms of the same species within a defined area*. We can look at the **factors** that determine how large a population grows, that regulate it at a certain size, or that cause population size to fluctuate.

Communities: *A community usually refers to* ***all*** *the* ***organisms*** *within an* ***area***. We can also talk about a community of some type of organism, such as the community of herbivorous in a wheat field.

Ecosystems: *An ecosystem refers to all the organisms within an area and the* ***abiotic factors*** *that affect it*. Ecosystem or ecological system is the functioning together of community and the non-living environment where continuous exchange of matter and energy takes place. In other words, ecosystem is the assemblage of elements, communities and physical environment.

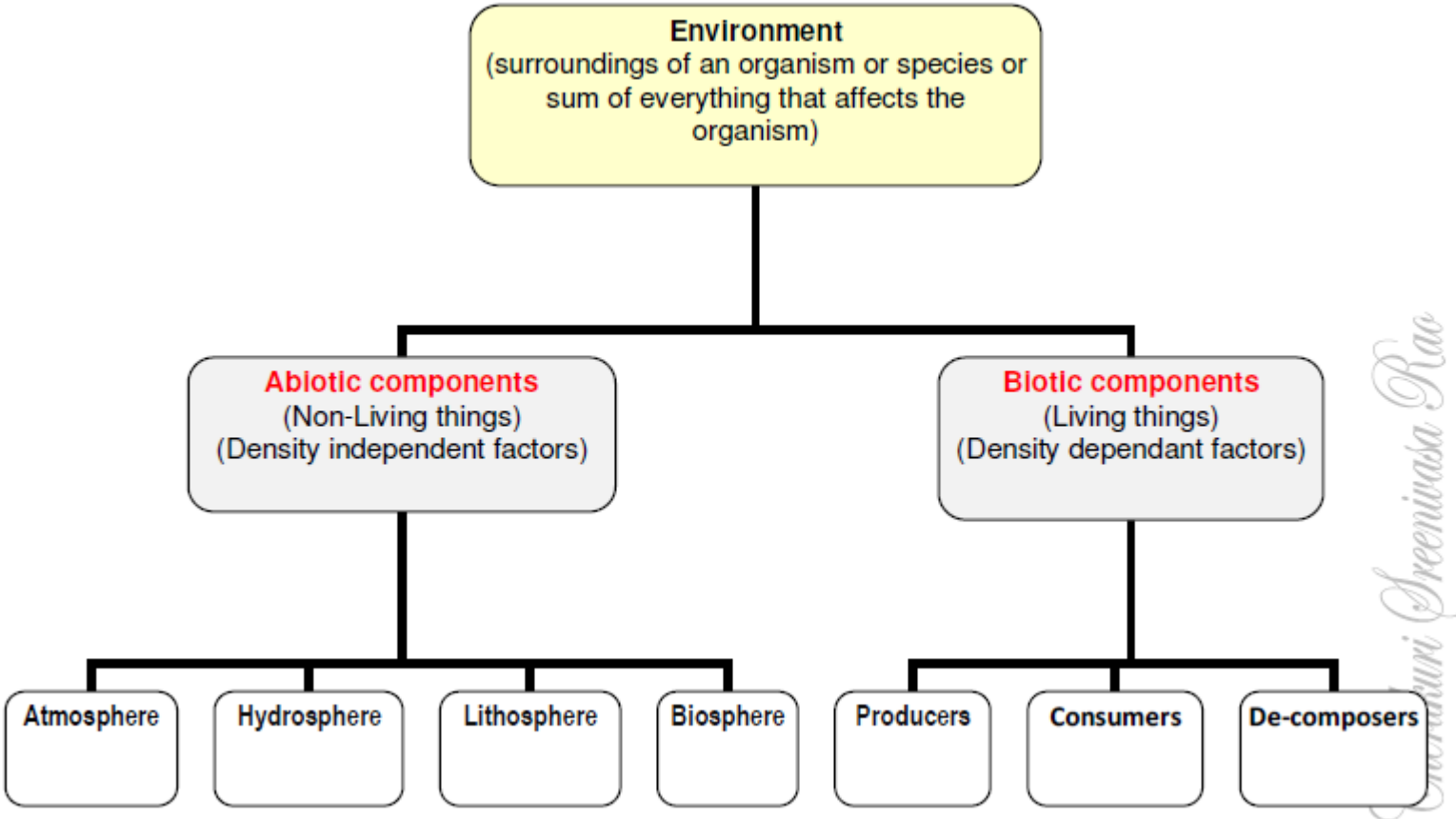


Habitat is the place where the organisms live.

Scientific study means using the scientific method, is an important part of the definition of ecology because it indicates that to study ecology we must be doing the things associated with science-testing hypothesis with objectively obtained, repeatable data.

For making a scientific approach to the study of ecology at all the levels *viz.*, individual, population, community and ecosystem, *it is essential to understand the various factors of the environment*. Climate constitutes the physical factors which exert their influence on all the organisms. Food and other organisms of the same and other species are the other important factors.

• The ***environment*** refers to the surroundings of an organism or species or sum of everything that affects the organism, and is generally considered to consist of two categories of factors: **Abiotic (*Density independent factors)* & Biotic factors (*Density dependant factors)***.



• ***Abiotic factors*** refer to nonliving aspects of the environment that affect an organism, such as temperature, moisture and humidity, rainfall, light, atmospheric pressure, air currents, water, oxygen, pH, salinity, place to live etc..

• ***Biotic factors*** refer to other organisms that interact with an organism or species, or the organic products of those organisms.

0.2 Why study Ecology?

- To explain some phenomena
- Ecology has important impacts on everyone's daily lives (news on environment)
- Huge impact of humans on global ecosystems--ecology holds key to predicting our future.
- To understand some of the natural laws (e.g., physical properties, energy transfer) that impose limitations on the interaction of organisms (including humans) with their living and nonliving environment.

- Why study insect ecology?

1.1 Levels of biological organisation

Organisms (Individual organism)

- living organisms, fundamental units of populations and communities

Populations

- group of individuals of a species

Communities

- an assemblages of species populations occurring together in space and time

Ecosystems

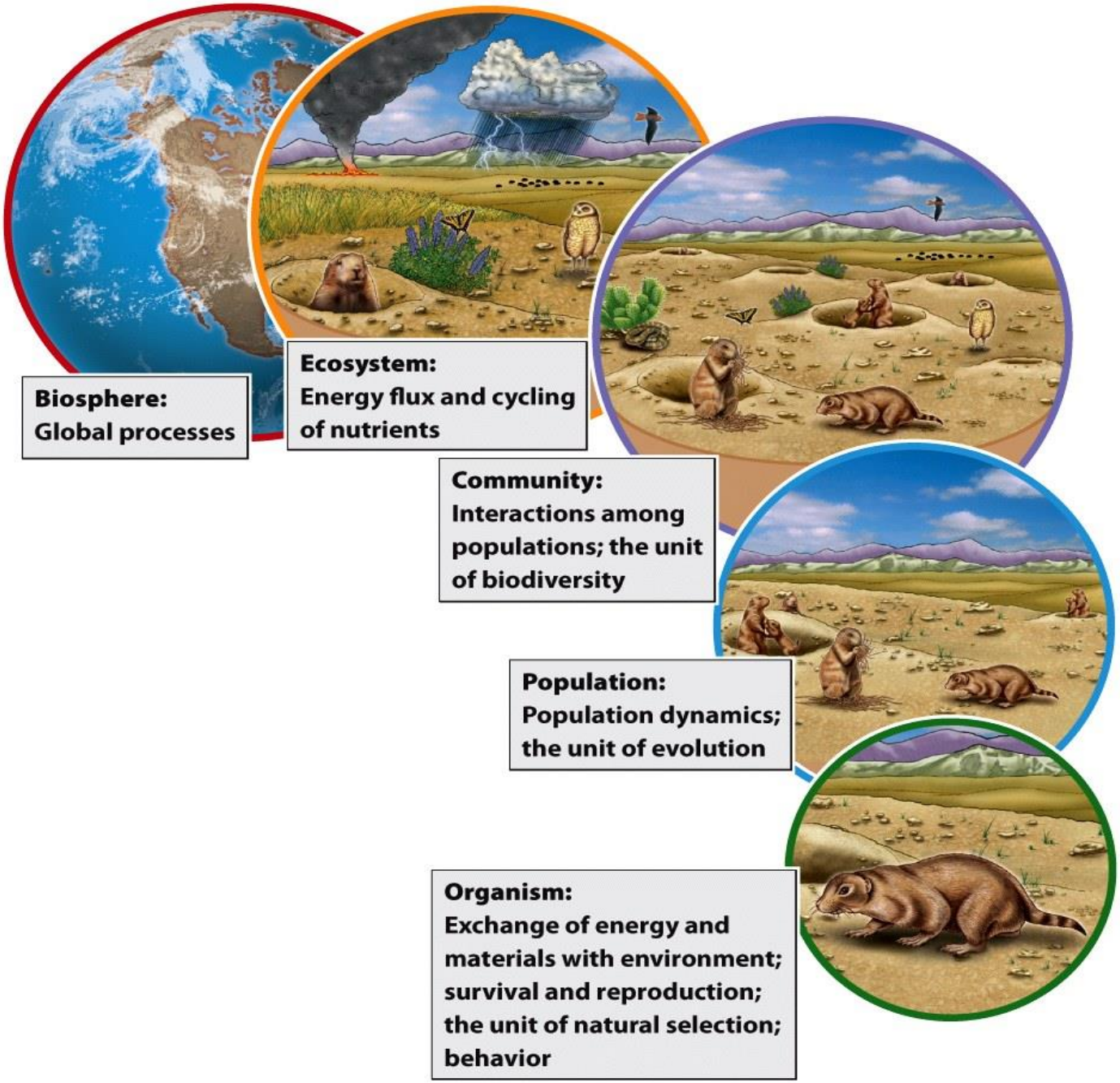
- a collection of two related components (biotic and abiotic) that function as a unit.

1.1 Levels of biological organisation

Ecosystem

- Consists of two basic interacting components:
  - The living organisms, or **biotic**
  - The Physical environment, or **abiotic**

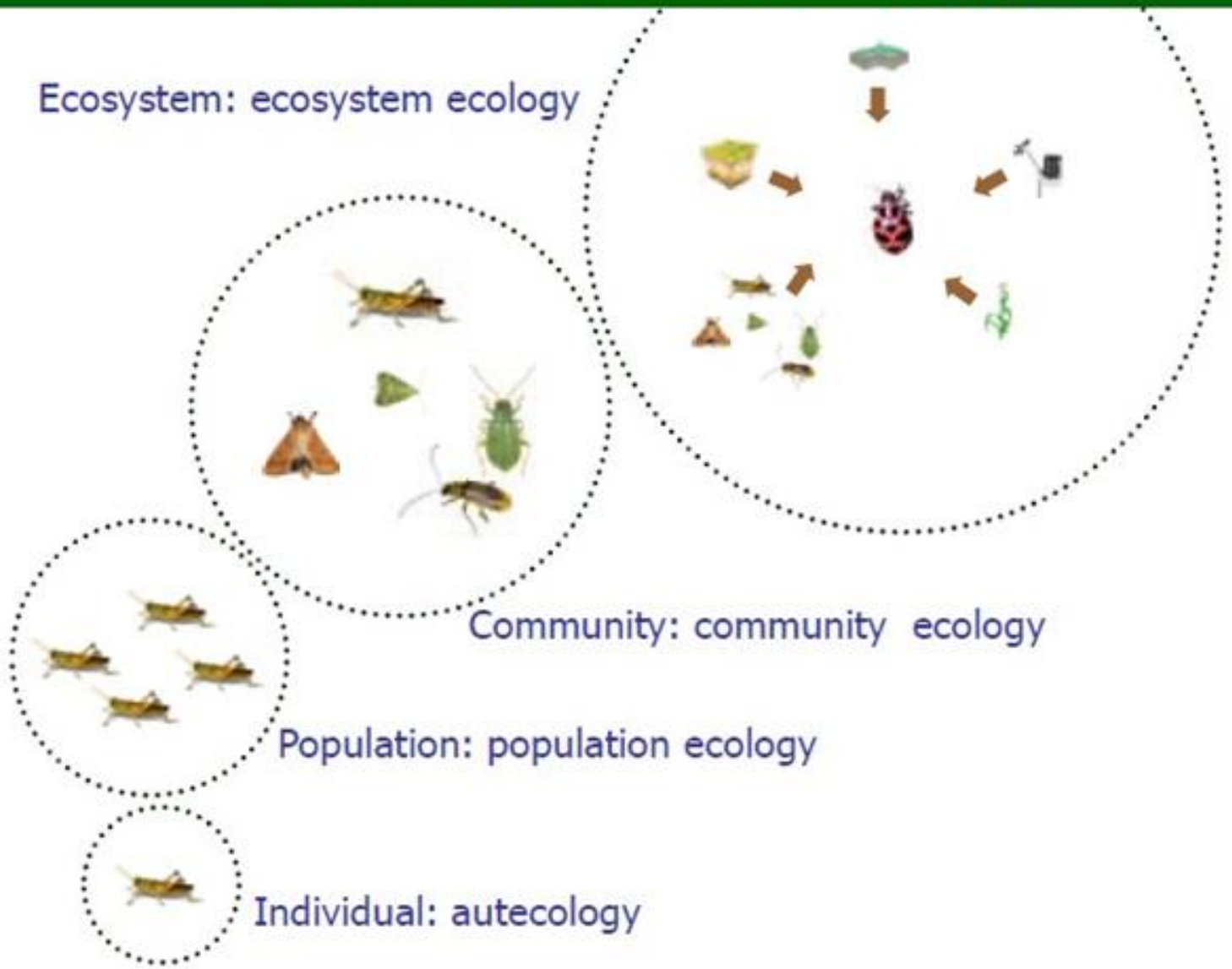
- Ecosystem varies in size from small to large
- An example
  - A forest ecosystem
    - Biotic: plants, animals, microbes that inhabit the forest
    - Abiotic: atmosphere, climate, soil, and water
    - Interaction: tree growths modify physical environment. Birds foraging on insects reduce insects and species abundance and composition.



Each ecological system embodies different processes

Figure 1.1
***The Economy of Nature,* Sixth Edition**

Levels of Insect Ecology



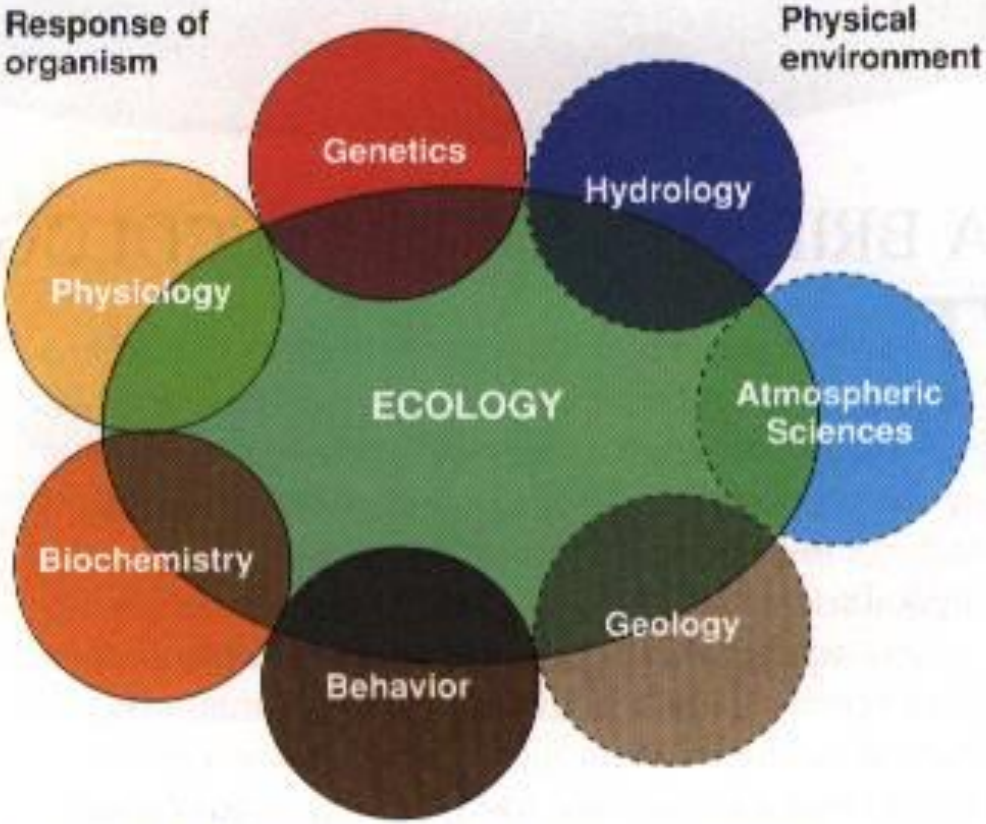


FIGURE 1.2 Ecology is an interdisciplinary science. It overlaps with many elements of physical and biological sciences.

1.2 Ecology of individual organisms

Individual organism forms the basic unit in ecology. It is the individual organism that responds to the environment.

Behavioral ecology is the study of how behavior of individuals affects their ability to survive and reproduce. How insect adapt to local environment.

Physiological Ecology (or Autecology) is the study of how physical factors, such at temperature, moisture, and light, affect the survival and reproduction and other biological processes of individual organisms.

Evolution Ecology is the study of environment influence on the evolution of organisms. Natural selection, **evolution of populations.**

Perspectives of Ecologists: Organism Approach

- How do form, physiology, and behavior lead to survival?

- Focus is on adaptations, modifications of structure and function, that suit the organism for life in its environment:

  - adaptations result from evolutionary change by natural selection, a natural link to population approach...

1.3 Ecology of group of individual organisms

Population ecology is the study of how groups of individuals (the same species) grow (or shrink) and reproduce. Depending on the nature of the species, many factors (food availability, competition, predation etc.) may affect population growth.

Community ecology is the study of how populations from different species interact to mutually affect each population's growth and survival**.** Community structure and dynamics.

Ecosystem ecology is the study of whole living systems, with focus on the flow of energy and biomass in large scale living systems.

Landscape ecology – study spatial patterns and underlying mechanisms (patches in landscape, fragmented landscape, corridors).

Conservation ecology, restoration ecology, and global change ecology.

Perspectives of Ecologists: Population Approach

- What determines the numbers of individuals and their variations in time and space?

- Focus is on processes of birth and death, immigration and emigration, influenced by:

  - the physical environment
  - evolutionary processes
  - interactions with other populations, a natural link to community approach...

Perspectives of Ecologists: Community Approach

- How are communities structured from their component populations?
- Diversity and relative abundance of different kinds of organisms living together, affected by:
  - population interactions, promoting and limiting coexistence
  - feeding relationships, responsible for fluxes of energy and materials, a natural link to ecosystem approach...

Food Chain