Ecology

PowerPoint® Lecture Presentations for

Biology

Eighth Edition

Neil Campbell and Jane Reece

Lectures by Chris Romero, updated by Erin Barley with contributions from Joan Sharp

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What is Ecology?

- The branch of biology, study the relationships between organisms and their environments.

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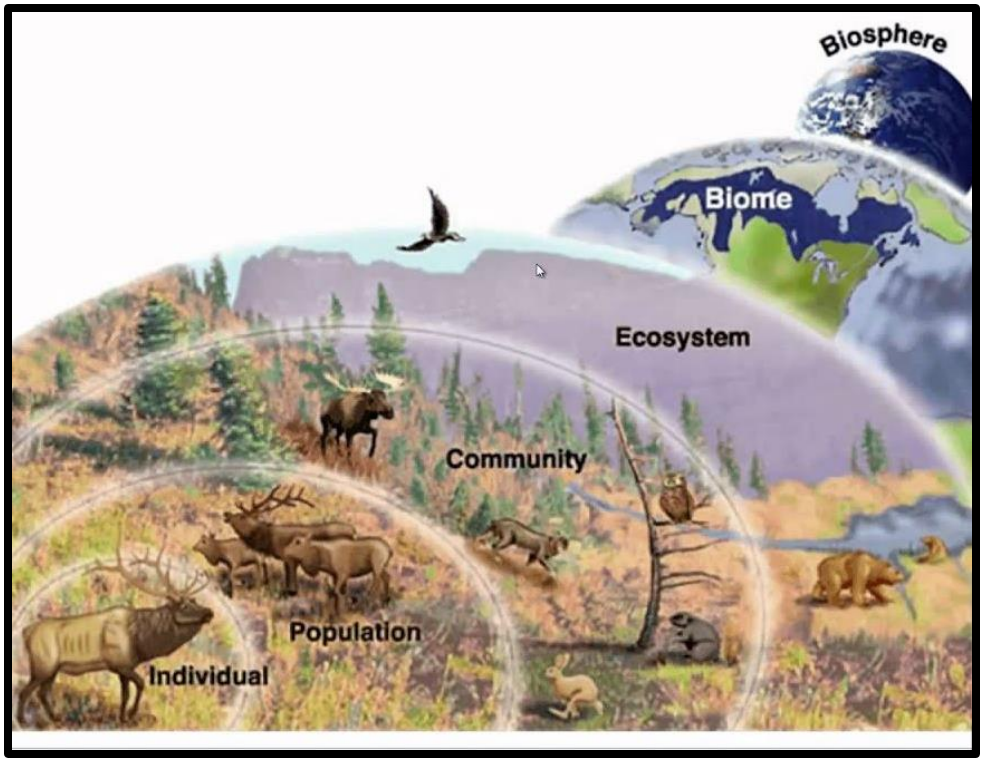
- The study of the relationships, distribution, and abundance of organisms, or groups of organisms, in an environment.

S.I. Dodson, 1998

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Levels of ecology:

Is the levels of organization are described from the smallest to the largest



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Levels of ecology:

Organism > individual organism in relation to other organism.

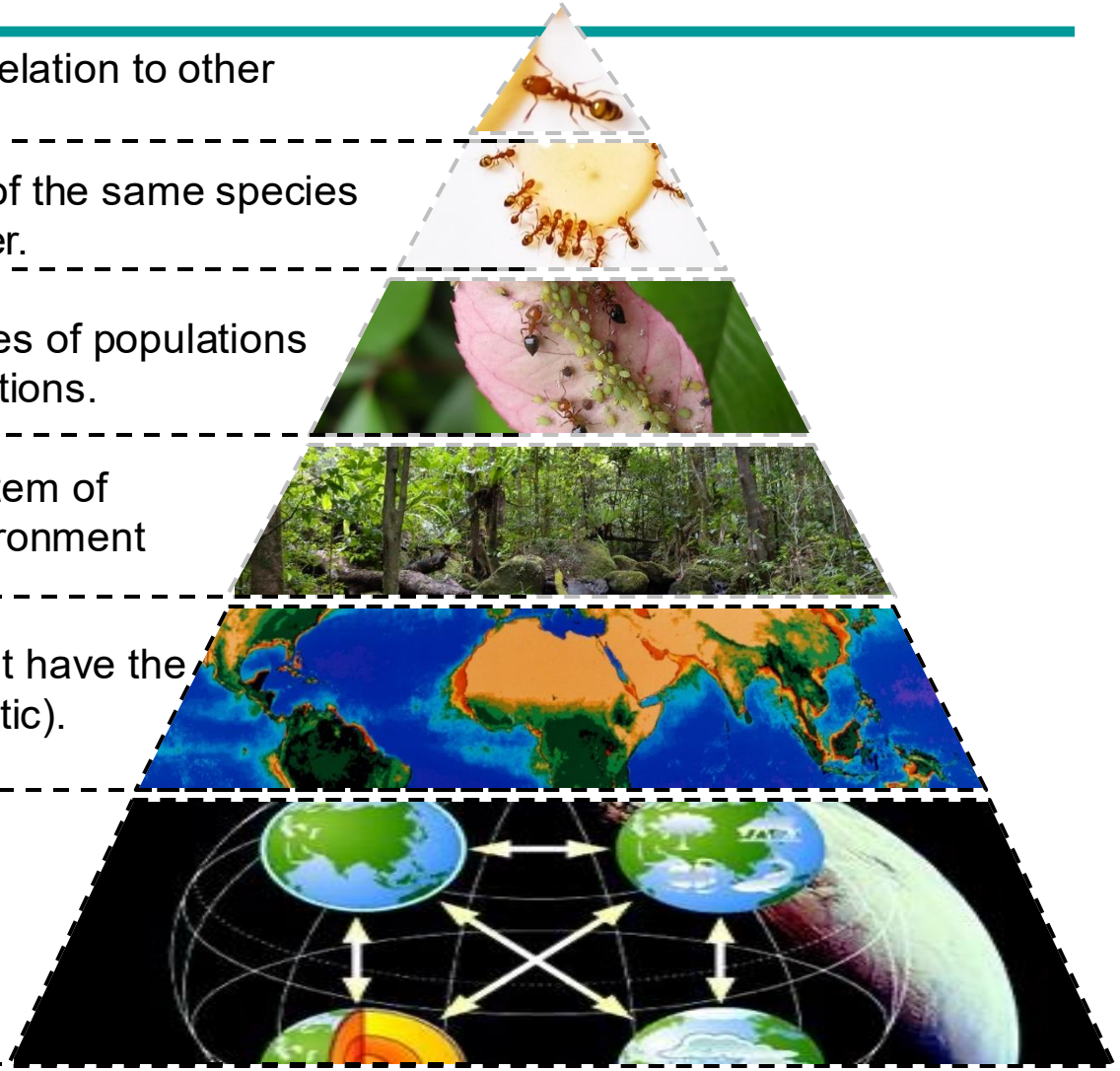
Populations > group of organisms of the same species and how they interact with each other.

Communities > natural assemblages of populations of different species and their interactions.

Ecosystem > the entire natural system of communities and their physical environment

Biomes > a group of ecosystem that have the same climate (i.e. terrestrial or aquatic).

Biosphere > all the biomes om earth.



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Population

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- **Populations :** group of organisms of the same species and how they interact with each other.
  - Studying the population involve how many organisms per unit area (density) and distribution (how clumped or spread).

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Measuring population

- Two important measures of a population are **population size** (the number of individuals in population) , and **population density** (It is the number of organisms per unit area or volume).

- To study the demographics of a population, it need to know **population size** and **population density**. Both important in describing the current status of the population, and making predictions about how it could change in the future.

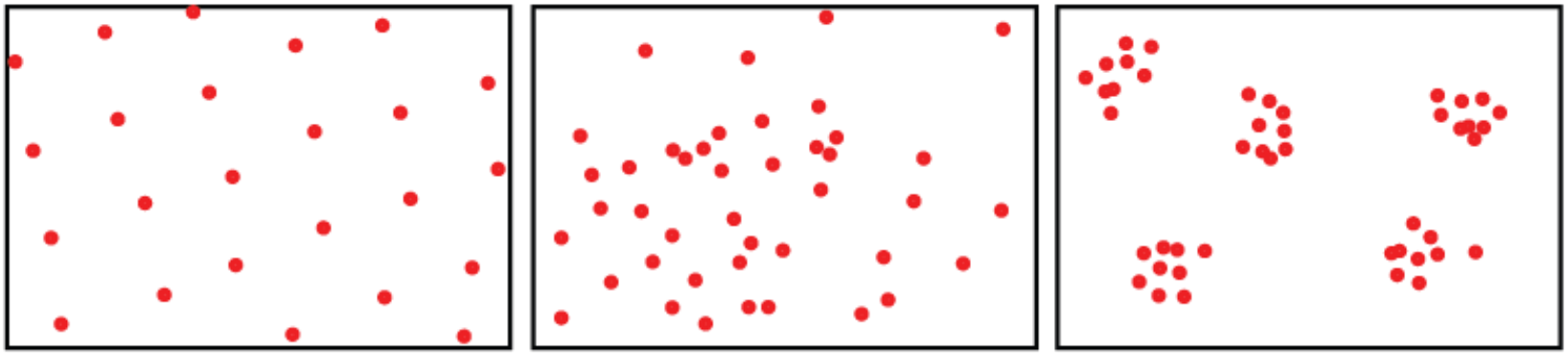
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Species distribution

Species distribution patterns (or **dispersion** patterns) refer to how the individuals in a population are distributed in space at a given time.

Species distribution patterns could be :

- uniform
- random
- clumped



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Uniform dispersion

- In uniform dispersion, individuals of a population are spaced more or less evenly.
- uniform dispersion pattern found in organisms that are solitary and/or territorial.
- An example of uniform dispersion in animal species where individuals stake out and defend territories (bear or wolves)

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Random dispersion

- In random dispersion, individuals are distributed randomly, without a predictable pattern.
- organisms that are not very territorial or do not live in big groups tend to have a more random dispersion due to the availability of good habitat. (snowshoe hare)

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Clumped dispersion

- In a clumped dispersion, individuals are clustered in groups.
- organisms that live in colonies, herds, flocks, or packs have a clumped dispersion pattern. (like a pack of wolves or dogs, schools of fish, or herds of elephants).

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Community Ecology

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The Community

- A biological **community** is an assemblage of populations of various species living close enough for potential interaction. All life / all populations in an area.
- Ecologists call relationships *between species* in a community ***interspecific interactions*****.**
- Interspecific interactions can affect the survival and reproduction of each species. *Effects can be positive (+), negative (–), or no effect (0).*
- Examples: competition, predation, herbivory, and symbiosis (parasitism, mutualism, commensalism).

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Competition

- **Interspecific competition** (–/– interaction) occurs when different species compete for a resource in short supply.
- Strong competition can lead to **competitive exclusion**, local elimination of a competing species.
- The ***competitive exclusion principle*** states that two species competing for the same limiting resources cannot coexist in the same place = 1 species per niche.

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Predation

- **Predation** (+/– interaction) refers to interaction where one species, the predator, kills and eats the other, the prey.
- Some feeding adaptations of predators are claws, teeth, fangs, stingers, and poison.
- Prey display various defensive adaptations: such as behavior and coloration.

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Herbivory: *Herbivores = Plant Predators*

- **Herbivory** (+/– interaction) refers to an interaction in which an herbivore eats parts of a plant or alga.
- It has led to evolution of ***plant defenses*** *against herbivores: secondary compounds* = are *chemical defenses*; and *mechanical defenses which are often osmoregulated.*

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Symbiosis: + + + 0 + -

- ***Symbiosis*** is a *dependency relationship* where two or more species live in direct and intimate contact with one another. The relationship is generally based one or some combination of the following ***benefits***:
- *Nutrition (food, water)*
- *Protection*
- *Reproduction*

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Parasitism + -

- In **parasitism** (+/– interaction), one organism, the **parasite**, derives nourishment from another organism, its **host**, which is harmed in the process.
- **Endoparasites** = parasites that live within the body of their host.
- **Ectoparasites** = parasites that live on the external surface of a host.
- Many parasites have a complex life cycle involving a number of hosts.
- Some parasites change the behavior of the host to increase their own fitness (reproduce more offspring).

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Mutualism + +

- Mutualistic symbiosis, or **mutualism** (+/+ interaction), is an interspecific interaction that benefits both species.
- A mutualism can be:
  - Obligate = *MUST* where one species cannot survive without the other.
  - Facultative = *OPTIONAL* where both species can survive alone.

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Commensalism + 0

- In **commensalism** (+/0 interaction), one species benefits and the other is apparently unaffected.
- Commensal interactions are hard to document in nature because any close association likely affects both species.

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A possible example of commensalism between cattle egrets (birds) and water buffalo: The Birds eat insects disturbed by the Buffalo as they move.



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Review

Interspecific Interaction	Description
Competition (−/−)	Two or more species compete for a resource that is in short supply. The competitive exclusion principle states that two species cannot coexist in the same community if their niches (ecological roles) are identical.
Predation (+/−)	One species, the predator, kills and eats the other, the prey. Predation has led to diverse adaptations, including mimicry.
Herbivory (+/−)	An herbivore eats part of a plant or alga. Plants have various chemical and mechanical defenses against herbivory, and herbivores have specialized adaptations for feeding.
Symbiosis	Individuals of two or more species live in close contact with one another. Symbiosis includes parasitism, mutualism, and commensalism.
Parasitism (+/−)	The parasite derives its nourishment from a second organism, its host, which is harmed.
Mutualism (+/+)	Both species benefit from the interaction.
Commensalism (+/0)	One species benefits from the interaction, while the other is unaffected by it.

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Ecosystems

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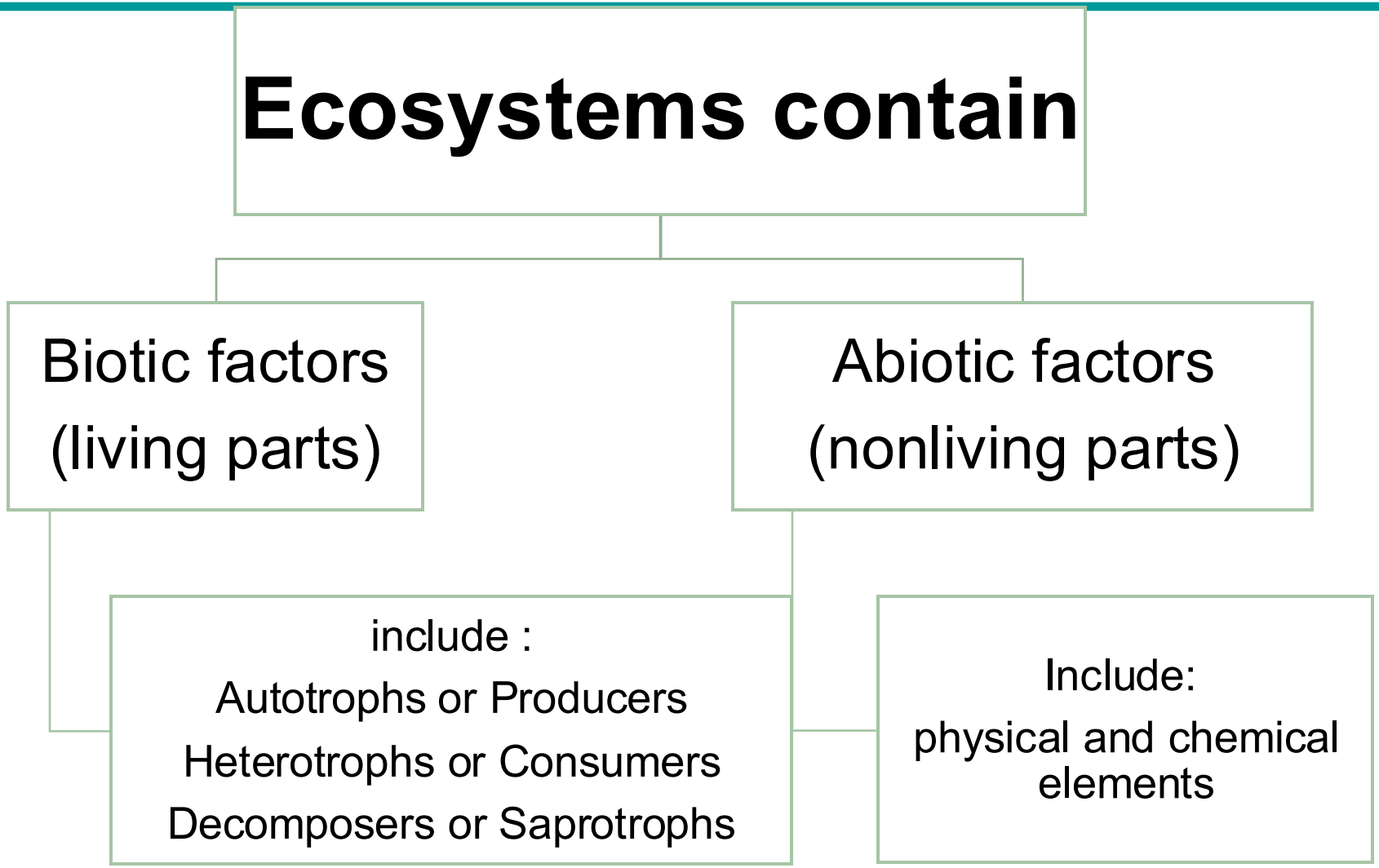
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Overview: Ecosystems

- An **ecosystem** consists of all the organisms living in a community, as well as the abiotic factors with which they interact.
- Ecosystems range from a microcosm, such as an aquarium, to a large area such as a lake or forest.

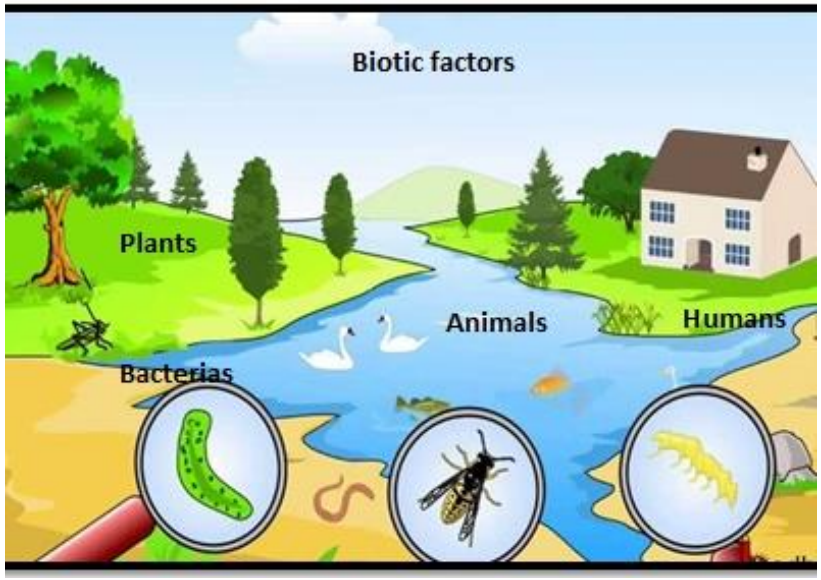
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Biotic factors

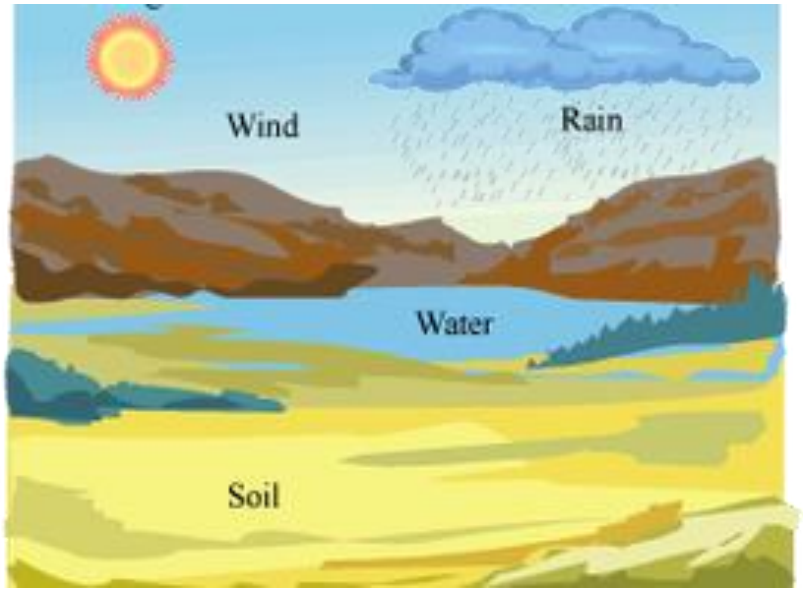
- **Biotic** factors are living or once-living organisms in the ecosystem.
- These are obtained from the biosphere
- They are capable of reproduction.
- Examples of biotic factors are animals, birds, plants, fungi, and other similar organisms.



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Abiotic factors

- **Abiotic** factors refer to non-living physical and chemical elements in the ecosystem.
- Abiotic resources are usually obtained from the lithosphere, atmosphere, and hydrosphere.
- Examples of abiotic factors are water, air, soil, sunlight, and minerals.



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Conservation Biology and Restoration Ecology

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Key points:

- Three Levels of Biodiversity
- Biodiversity and Human Welfare
- Ecosystem Services
- Three Threats to Biodiversity

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Human activities threaten Earth's biodiversity

- Rates of species extinction are difficult to determine under natural conditions.
- The high rate of species extinction is largely a result of ecosystem degradation by humans.
- Humans are threatening Earth's biodiversity.

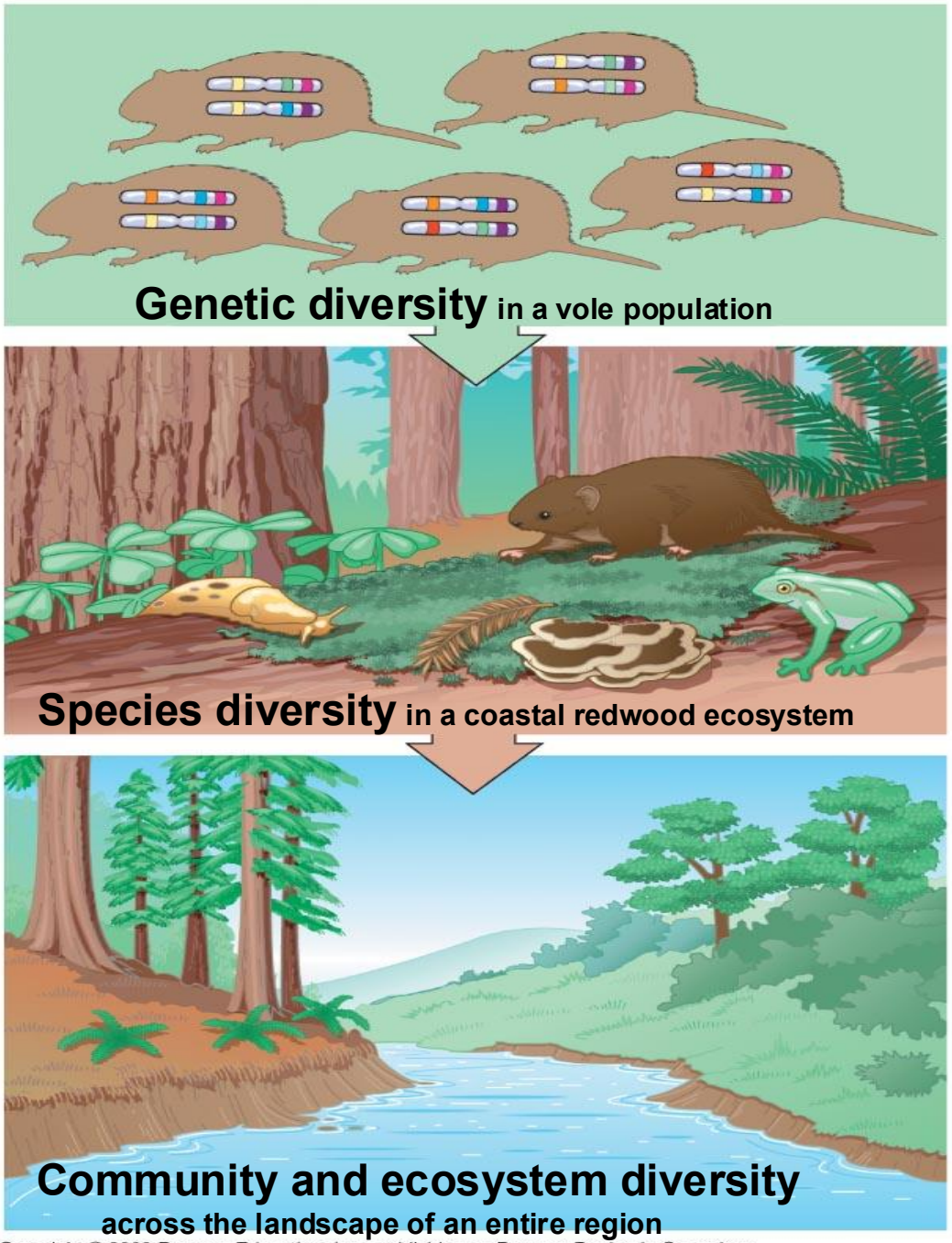
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Three Levels of *Biodiversity*

- Biodiversity has three main components:
  - ***Genetic diversity***
  - ***Species diversity***
  - ***Ecosystem diversity***

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Three Levels of Biodiversity



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Genetic Diversity & Species Diversity

- **Genetic diversity** comprises genetic variation within a population and between populations.
- **Species diversity** is the variety of species in an ecosystem or throughout the biosphere.
- According to the U.S. Endangered Species Act:
  - An **endangered species** is "in danger of becoming extinct throughout all or a significant portion of its range"
  - A **threatened species** is likely to become endangered in the foreseeable future.

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Ecosystem Diversity

- Human activity is reducing ecosystem diversity, the variety of ecosystems in the biosphere.
- More than 50% of wetlands in the contiguous United States have been drained and converted to other ecosystems.

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The endangered Marianas “flying fox” bat is an important pollinator



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Biodiversity and Human Welfare

- *Human **biophilia** allows us to recognize the value of biodiversity for its own sake*.
- Species diversity brings humans practical benefits. The enormous genetic diversity of organisms has potential for great human benefit.
- In the United States, 25% of prescriptions contain substances originally derived from plants.
- For example, the rosy periwinkle contains alkaloids that inhibit cancer growth.

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The rosy periwinkle, a plant that saves lives



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Ecosystem Services

- **Ecosystem services** encompass all the processes through which natural ecosystems and their species help sustain human life.
- Some examples of ecosystem services:
  - ***Purification of air and water***
  - ***Detoxification and decomposition of wastes***
  - ***Cycling of nutrients***
  - ***Moderation of weather extremes***.

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Three Threats to Biodiversity

- Most species loss can be traced to three major threats:
  - **Habitat destruction**
  - **Introduced species**
  - **Overexploitation**
- Human alteration of habitat is the greatest threat to biodiversity throughout the biosphere.
- In almost all cases, habitat fragmentation and destruction lead to loss of biodiversity.

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Introduced Species

- **Introduced species** are those that humans move from native locations to new geographic regions.
- Without their native predators, parasites, and pathogens, introduced species may spread rapidly.
- Introduced species that gain a foothold in a new habitat usually disrupt their adopted community.
- Sometimes humans introduce species by accident, as in case of the brown tree snake arriving in Guam as a cargo ship "stowaway."

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Overexploitation

- ***Overexploitation*** is *human harvesting* of wild plants or animals *at rates exceeding the ability of populations* of those species *to rebound*.
- Overexploitation by the fishing industry has greatly reduced populations of some game fish, such as bluefin tuna.
- DNA analysis can help conservation biologists to identify the source of illegally obtained animal products.

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Overexploitation



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