ANIMAL ECOLOGY and POLLUTION
ZOO 571

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Lecture 1 &2

- Practical = 20%
- Midterm Exam = 15%
- Presentation = 20%
- Assignments= 5%
- Final Exam = 40%

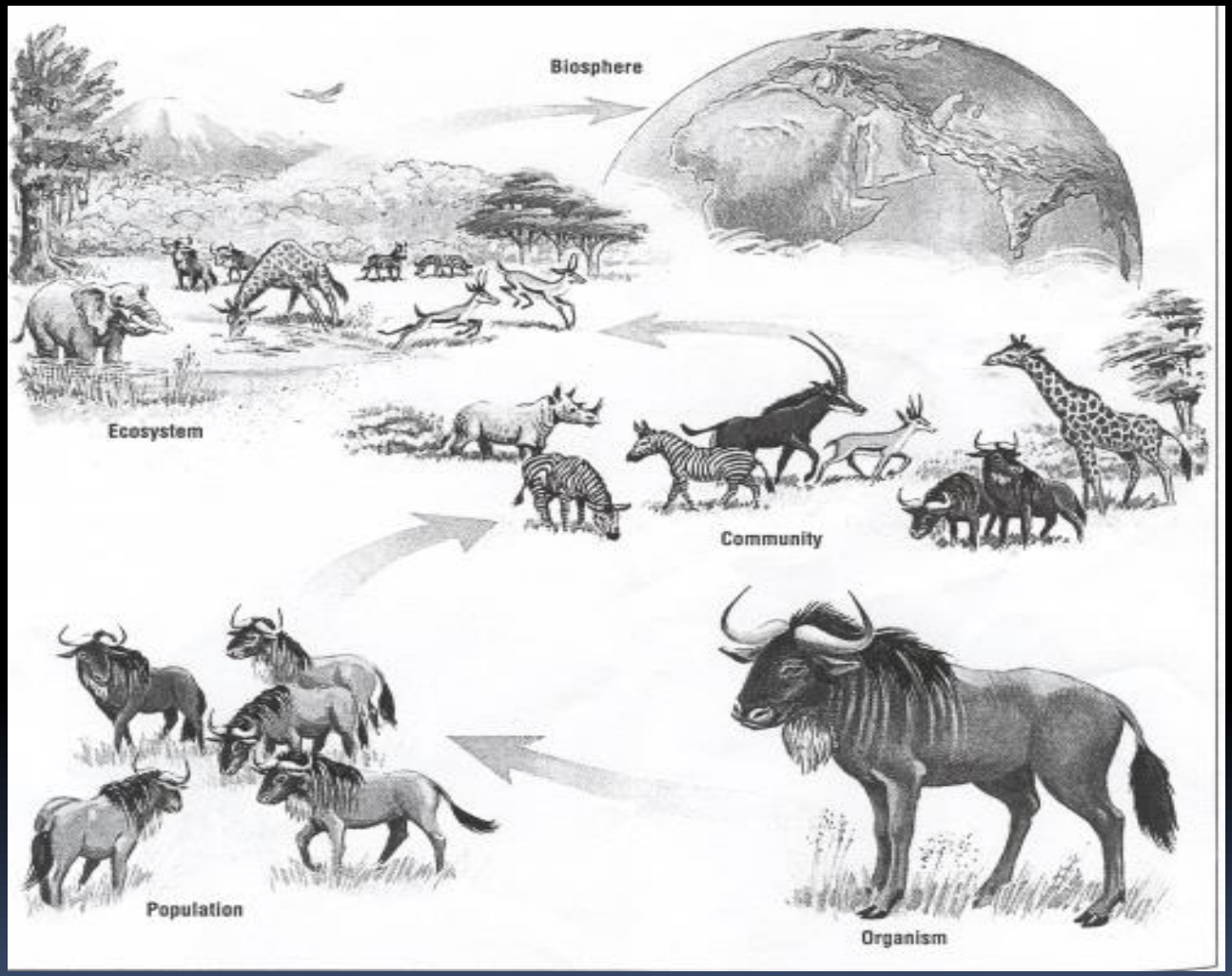
Course Outline

- Introduction to ecology
- Individuals' ecology
  - Organisms limiting factors
  - Important abiotic factors
- Population ecology
  - Structure and diversity
  - Biomass system
  - Population regulation
  - Interspecific competition
- Community and ecosystem ecology
  - Zoogeography
  - Aquatic ecological zones and ecosystems in Saudi Arabia
  - Ecological relationship between plankton and Nekton in marine, freshwater, and eustraine habitats.
  - Effects of ecological factors on aquatic animals and their media
- Aquatic community stratification
  - Primary productivity
    - Methods and measurements of primary productivity
- Pollution and pollutants
  - Ozone layer pollution
  - Heavy metals
  - Oxides
  - Sewage and hydrocarbons pollution
  - Pesticides and physical pollution

Introduction to Ecology

- Definition of ecology
  - Ecology is the scientific study of interactions between organisms and the environment
  - Ecology (from the Greek oikos=home, and logos=to study)
- Importance of studying ecology
  - The study of ecology reveals the richness of the biosphere, provides the basic understanding that helps conserve and sustain that richness

Levels of Biological Organization



Organism : An individual living thing.
Species:A group of the same organisms that are able to breed and produce fertile organisms.
Population: No individual organism lives completely on its own. It may live with other individuals of the same species to form a population.
An aggregation of individuals of the same species in a continuous area which contain no potential breeding barrier.
Several populations living together make up a community.
A group of interacting populations in a given habitat.
Community: Usually restricted to organisms of similar size and life habits e.g tree community, insect community, bird community, human community.

Biome: Several communities in a given area make up a biome.

A biome is a large geographical area with a similar climate. E.g. Tundra, Grassland, Desert etc.

The **biosphere** is the region on Earth where all life exists.

Ecosystem: An interacting system that consists of groups of organisms and their non-living environment with in a boundary.

Two parts of an Ecosystem
Biotic and Abiotic

- **Biotic** –
  - factors that are or were alive/living in an ecosystem.
- Examples: animals, plants, insects, bacteria, fungi, and dead organisms.
- **Abiotic-**
- Factors in an environment that are not or never were alive.
- Examples: rock island, gases, water, sun, minerals and temperature.

Ecological research scale ranges from individuals to the biosphere

a. Organismal ecology is concerned about the way in which an individual interacts with its environment.

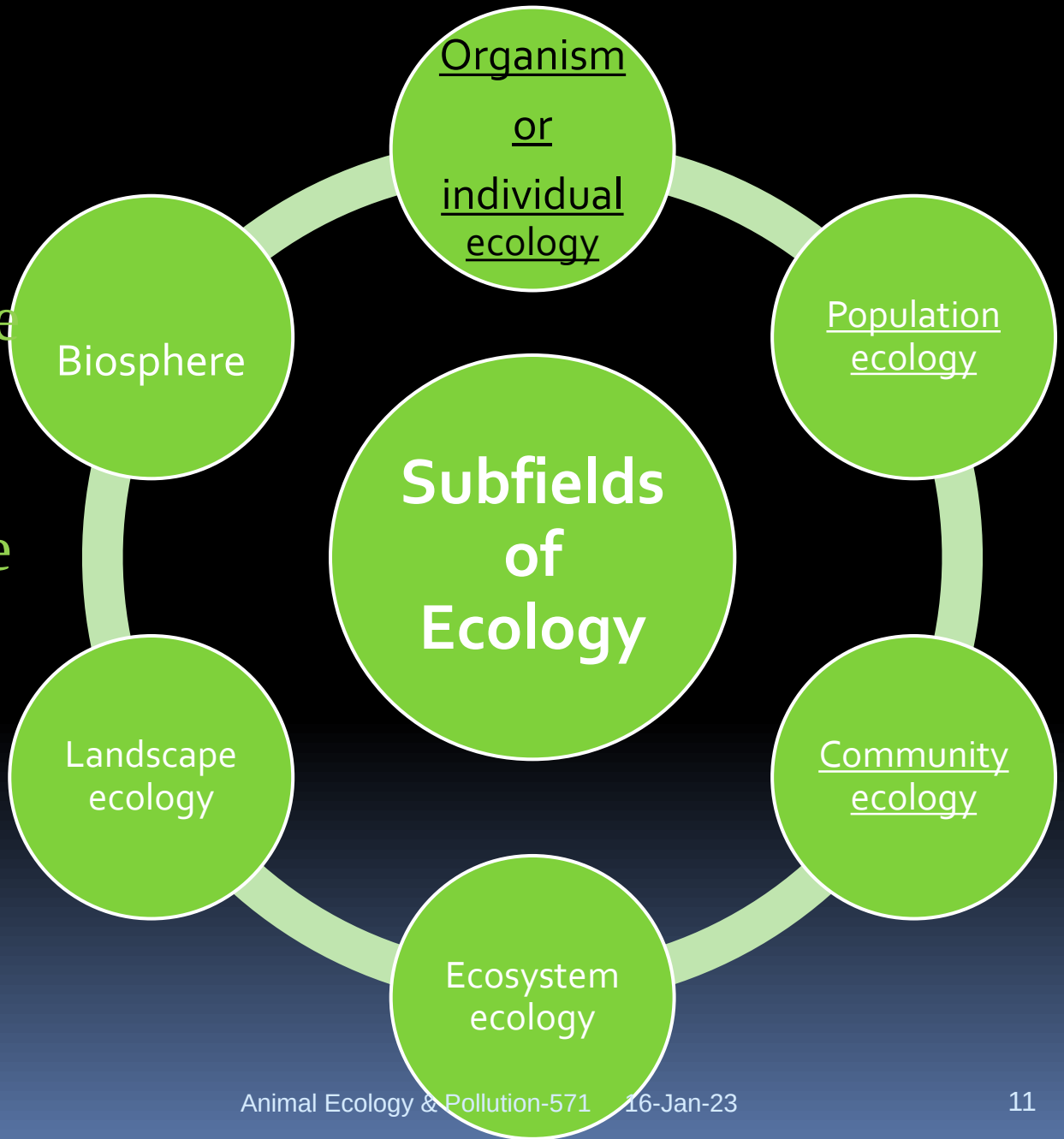
b. Population ecology is the study of a group of individuals of the same species.

c. Community ecology deals with all interacting species within a particular area.

An ecosystem consists of all abiotic factors plus all organisms that exist in a certain area à Ecosystem ecology.
Landscape ecology- interactions among ecosystems.

e. The biosphere is the global ecosystem.

- Ecology can be divided into areas of study ranging from the ecology of individual organisms to the dynamics of ecosystems and landscapes



Ecology of Individuals

Organismal ecology studies how an organism's structure, physiology, and (for animals) behavior meet environmental challenges.

- Relationship of individual with its environment
- Strong impact on distribution and abundance of organisms

- It is divided into:
  - Physiological ecology
  - Evolutionary ecology
  - Behavioral ecology

Habitat and Niche

- Each organism confronts the challenge of survival in a different way.
- The niche an organism occupies is the sum of all the ways it utilizes the resources of its environment.
- Part of this role may be played as the predator and part may be played as the prey.

Niche

- A niche may be described in terms of space utilization, food consumption, temperature range and mating requirements.
- An organism's niche would also take into account its behavior. You can think of an organism's niche as its job/role in the environment.

Niche

- A beaver is an ecosystem engineer. It cuts down trees and dams up a river which will flood the forest with a pond. Eventually the trees will die, new species of plants and wildlife will arrive to take advantage of the new conditions. Eventually, this forest will become a meadow. The beaver's NICHE is the role it plays in shaping the environment. But… it is also a main prey species for predators.

Habitat

- Niche is not synonymous with habitat. Habitat is a place, niche is a pattern of living. Habitat is the address and niche is the job or occupation.
- If two organisms have the same habitat and similar niches, they will compete with each other over the available resources. (food- water -shelter)

Habitat

- Competition is the struggle between two organisms within their habitat.
- If a species can avoid competing they may co-exist. But if they compete, one will eventually drive the other out of the habitat, unless they have slightly different niches.
- Example: times of activity

Different Niches to avoid competiton: Some animals in the same habitat could be;

- Nocturnal – active at night

- Diurnal - active during the day

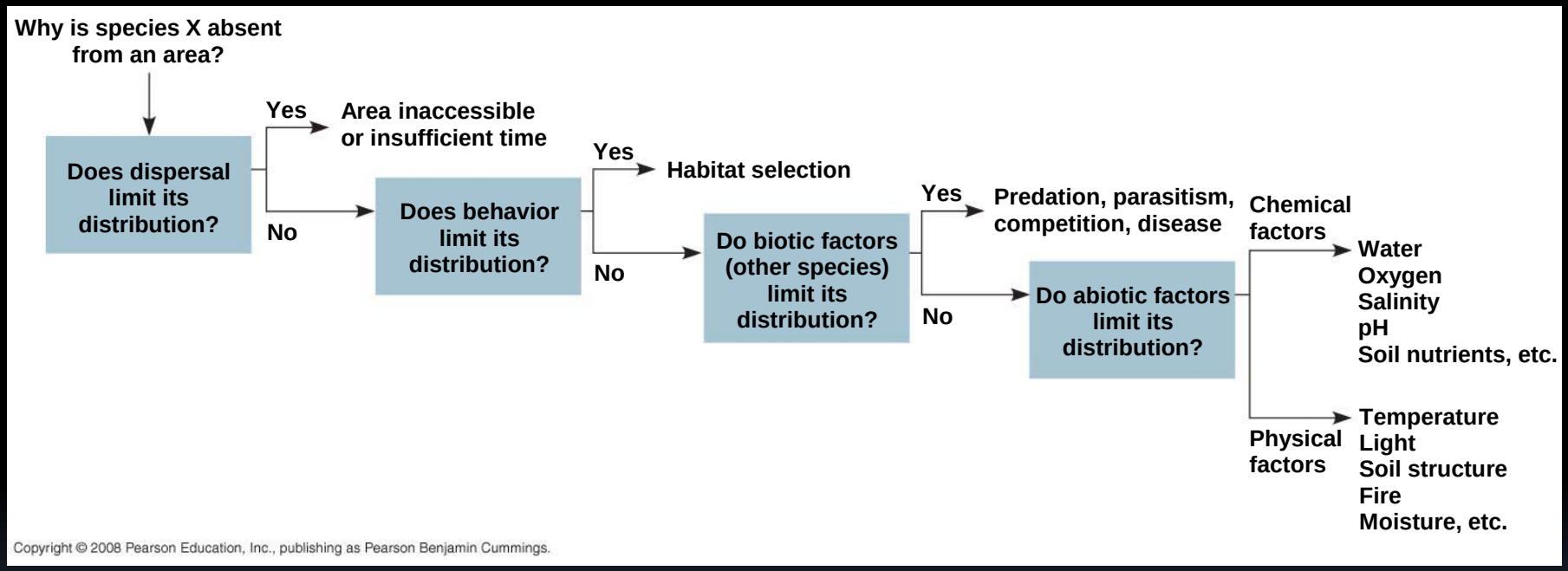
- Crepuscular – active at dawn and dusk

- Migration – moving from one area to another to use resources

- Hibernation – reducing activity severely for a period of time.

Interactions between organisms and the environment limit the distribution of species

- Ecologists have long recognized global and regional patterns of distribution of organisms within the biosphere
- Biogeography is a good starting point for understanding what limits geographic distribution of species
- Ecologists recognize two kinds of factors **biotic** **abiotic**



Flowchart of factors limiting geographic distribution

Dispersal and Distribution

- **Dispersal** is movement of individuals away from centers of high population density or from their area of origin
- Dispersal contributes to global distribution of organisms
- Natural range expansions show the influence of dispersal on distribution

Species Transplants

- Species transplants include organisms that are intentionally or accidentally relocated from their original distribution
- Species transplants can disrupt the communities or ecosystems to which they have been introduced
- example: rat and mongoose in Hawaii

Behavior and Habitat Selection

- Some organisms do not occupy all of their potential range
- Species distribution may be limited by habitat selection behavior

Biotic factors

- If behavior does not limit distribution of a species, then
- It is biotic factors (other species)
- Examples of biotic factors:
  - Inability to survive, grow, or reproduce can be due to
    - Predation (organisms that kill their prey)
    - Parasitism
    - Disease
    - Competition
    - Absence of a pollinator- in case of plants

Abiotic Factors

- 1: Temperature
- 2: Water
- 3: Sunlight
- 4: Wind
- 5: Rocks and soil

Temperature

- Environmental temperature is an important factor in distribution of organisms because of its effects on biological processes
- Cells may freeze and rupture below 0°C, while most proteins denature above 45°C
- Mammals and birds expend energy to regulate their internal temperature

Endothermy vs. Ectothermy

Endotherms = generate their own heat

Ectotherms = rely on environmental sources

Water

- Water availability in habitats is another important factor in species distribution
- Desert organisms exhibit adaptations for water conservation

Salinity

- Salt concentration affects water balance of organisms through osmosis
- Few terrestrial organisms are adapted to high-salinity habitats

- Wind (limiting factor)
  - Wind amplifies the effect of temperature on organisms
    - by increasing heat loss in organisms due to evaporation and convection
    - Contributes to water loss in organisms by increasing the rate of evaporative cooling in animals and transpiration in plants
    - Wind have a substantial effect on the morphology of plants by inhibiting the growth of limbs

Sunlight

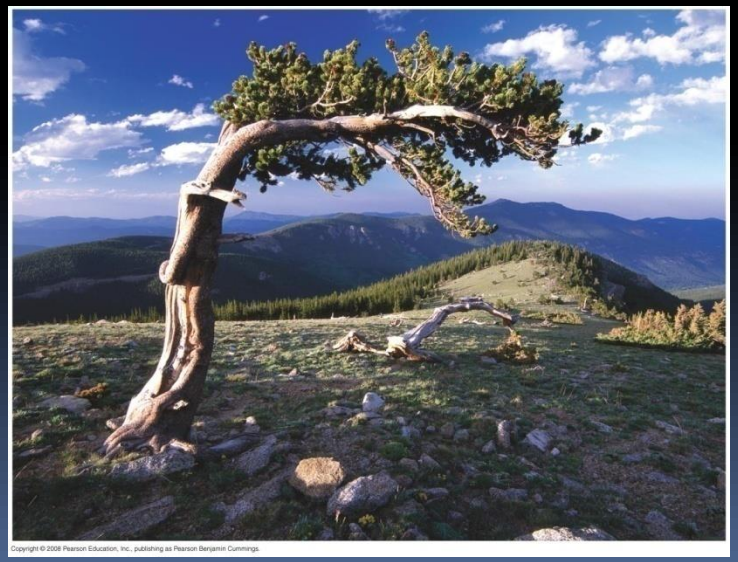
- Light intensity and quality affect photosynthesis in plants.

- Water absorbs light, thus in aquatic environments most photosynthesis occurs near the surface.
  - It provides energy that drives the ecosystem
  - Aquatic plants photosynthesis are limited to the top only
  - Light is important for the development and behavior of many organisms sensitive to photoperiod, example
    - Seasonal events such as flowering of plants
- In deserts, high light levels increase temperature and can stress plants and animals

Rocks and Soil

- Many characteristics of soil limit distribution of plants and thus the animals that feed upon them:
  - Physical structure
  - pH
  - Mineral composition

Aquatic compositions affect water chemistry and consequently organisms



Climate

- Four major abiotic components of **climate** are temperature, water, sunlight, and wind
- The long-term prevailing weather conditions in an area constitute its climate
- **Macroclimate** consists of patterns on the global, regional, and local level
- **Microclimate** consists of very fine patterns, such as those encountered by the community of organisms underneath a fallen log

Organisms Limiting Factors

- Every living organism has limits to the environmental conditions it can endure

- Limiting factors can be:
  - Biotic factors
  - Abiotic factors

- **Abiotic components** are non-living chemical and physical factors in the environment

These factors are primarily responsible for determining the growth and/or reproduction of an organism or population.

It may be a physical factor such as temperature or light, a chemical factor such as particular nutrient, or a biological factor such as a competing species. The limiting factor may differ at different times and places.

The **Law of Limiting factors** states that too much or too little of any abiotic factor can limit or prevent growth of a population of a species in an ecosystem

Organisms' Limiting Factors

- A **limiting factor** is a factor that controls a process, such as organism growth or species population, size, or distribution
  - The availability of food, predation pressure, or availability of shelter are examples of factors that could be limiting for an organism
  - An example of a limiting factor is sunlight in the rainforest, where growth is limited to all plants in the understory unless more light becomes available (such as in the event of a tree fall)

Law of the Minimum

Proposed by Justus von Liebig in 1840.
It says that the success of organism determined by crucial ingredient that is in short supply.
As abundance of one resource increases another resource may become limiting.
Also known as Liebig's Law of Minimum - a system maybe limited by the absence or minimum amount (in terms of that needed) of any required factor.

What this law states is that the rarest requirement of an organism will be the limiting factor to its performance

❖Law of Tolerance

Proposed by Victor Shelford in 1913.

It refers to the upper and lower bounds to physical environment an organism can tolerate.

❖

These boundaries affect the ability to function, grow, and reproduce. These changes can be broad and narrow.

❖

There are seasonal shifts in tolerance ranges, but within physiological limits.

❖

Implication - no organism can live everywhere

The principle of tolerance limits.