Introduction to Ecology

Reading: Chapter 50 – Introduction, today
Chapter 52 – Population ecology, today and W
Chapter 54 – Ecosystem ecology, W&F

Outline of Lecture

1. Branches of ecology
2. Factors affecting species distribution
3. Biomes
   - Climate - temperature and water
   - Dominant species
   - Terrestrial and aquatic

Lab practical next week

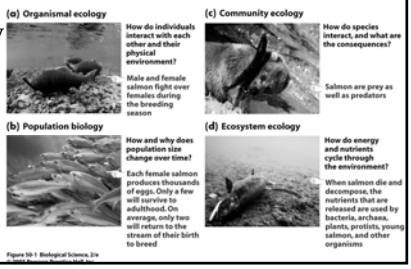
- Be on time!
- Look over Excel tutorial for Excel 2007/2010
- Review session Monday? Look for postings on Blackboard from TA's

What is ecology?

- Ecology is the study of how organisms interact with their environment;
- What factors control the distribution and abundance of organisms?
- "Eco" from "Oiko" = "home"

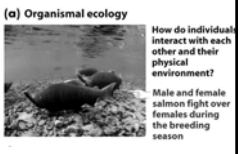
1. Types of Ecology

- Organismal (physiological and behavioral)
- Population
- Community
- Ecosystem
- Global



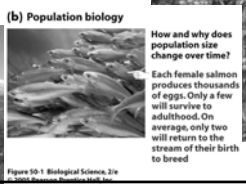
Organismal ecology

- Questions center on how organisms respond to biotic and abiotic factors in their environment
- Physiology, morphology, and behavior



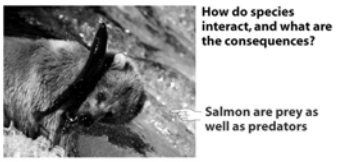
Population ecology

- a population is a group of organisms of the same species living in the same place at the same time.
- questions are related to factors that affect the number of individuals living in a habitat
  - – size, distribution of population?
  - - birth and death rates?
  - - population growth rate?



Community ecology

- a community consists of the organisms that live in an area and interact
- questions focus on
  - the interactions between organisms (who eats who, who helps who)
  - how those interactions affect community structure



Competition

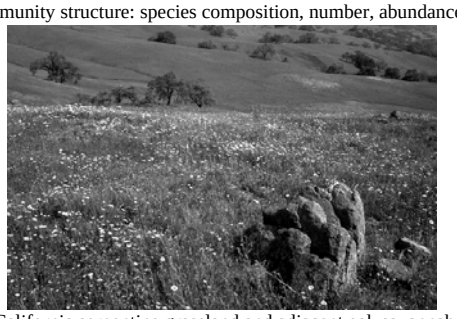
Mutualism

Species Interactions

Predators and parasites

Community structure

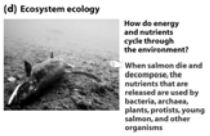
- What factors affect community structure?
- Factors: abiotic (e.g., climate, dist.)and biotic (species interactions)
- Community structure: species composition, number, abundance

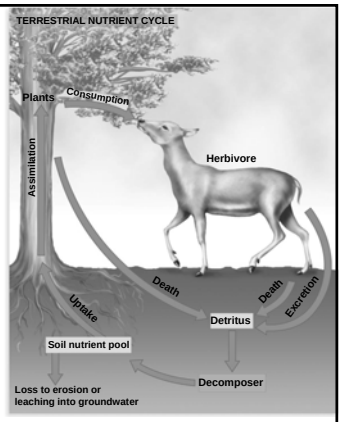


California serpentine grassland and adjacent oak savannah

Ecosystem ecology

- ecosystem = biotic (living) community + abiotic (nonliving) factors
- abiotic factors = soil, atmosphere, water, nutrients, energy, temperature
- Energy flow and cycling of nutrients





Global ecology

- Controls and patterns of worldwide circulation of energy and nutrients

Global Net Primary Productivity

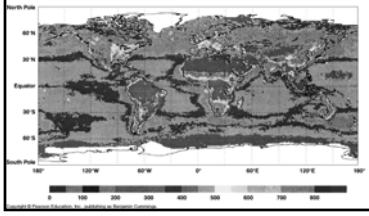


Fig. 54.4

Atmospheric CO_2 and Temp.

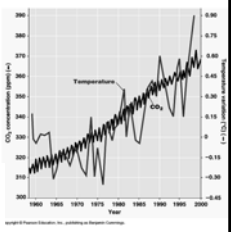
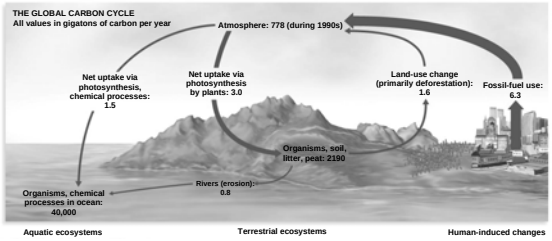


Fig. 54.26

The Global Carbon Cycle



2. What factors affect the distribution of organisms?

- species dispersal
- behavior and habitat selection
- other organisms such as predators, competitors, or facilitators
- abiotic factors such as nutrient availability, water, temperature

For Chapter 50

(see also the rest of this powerpoint)

Focus on:

- What are the differences between different levels of ecology?
- What factors determine climate? Average temp, average moisture, seasons, mountain and ocean effects (but don't need to know the specifics).
- For the six terrestrial biomes described:
  - how do temp and moisture determine the dominant species types?
  - how do temp and moisture determine levels of productivity?
  - don't need to know all the details of each biome.
- Aquatic habitats
  - What are the two main factors affecting types of aquatic habitats?
  - How do they influence light and oxygen availability?
  - What areas are the "tropical forests" and "deserts" of aquatic habitats? Why?
- How do history, species interactions, and the abiotic environment affect the biogeographic patterns of species?

Note

The following figures are mostly from Chapman and Reese 7th Ed., but your book has many similar figures. You should be able to understand the processes illustrated independent of the specific illustration.

What affects the distribution of organisms?

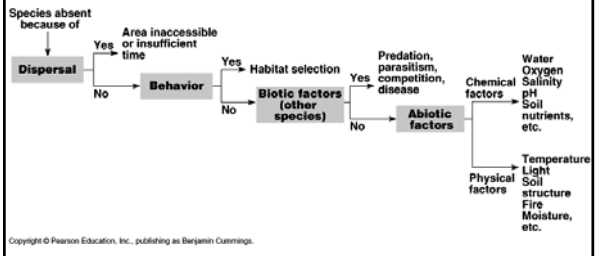


Fig. 50.5

Species dispersal

Species may not inhabit an area because of biogeographical boundaries.

Transplantation studies can give us information about potential ranges.

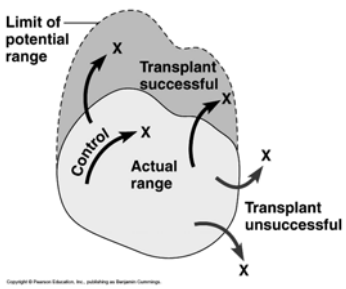


Fig. 50.6

Application: Introduced species

- breakdown in dispersal barriers
- most new species do not cause problems
- some do
- problems can be large, expensive, and difficult or impossible to reverse

Fig. 50.8 – Range expansion of Zebra mussel

Behavior and habitat selection

- organisms do not always occupy all available, suitable habitat
- may be specific in reproduction needs
- larval needs may be different from adult needs

Biotic factors

- interactions with other organisms
  - Negative: predation or competition
  - Positive: facilitation (e.g., pollinators

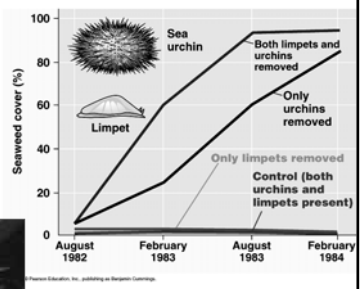
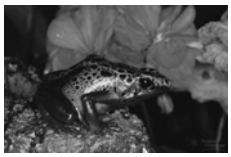


Fig. 50.9

urchin barrens

Biotic and abiotic factors: adaptations

Tolerate

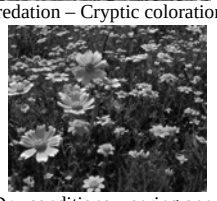


Predation - Aposematic coloration

Dry conditions - cacti

Avoid

Predation – Cryptic coloration

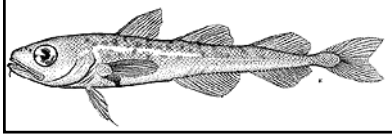


Dry conditions – spring annuals

Abiotic factors

- temperature
  - high temperature cause cell membranes to leak and enzymes to stop working
  - low temperature causes freezing
    - some animals have antifreezes that allow them to survive below freezing temperatures.

Fig. 27.1 – thermophilic bacteria, Nevada



Cool arctic fish (spp.?)

Abiotic factors

- water availability
  - too little water (desiccation)
    - Deserts, saltwater
  - too much water (anaerobic)

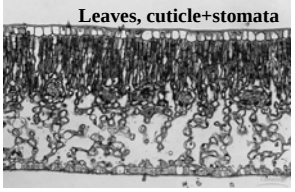
Organ pipe cacti, desert shrubs

Mangroves

Water availability - adaptations

All terrestrial organisms

Insects – tolerate, cuticle



Worms – avoid, behavior

Abiotic factors – Water availability

And aquatic organisms too!

Freshwater

Saltwater

Abiotic factors

- Sunlight
  - Competition, shade tolerance for plants
  - Photic zone, different wavelengths for aquatic organisms

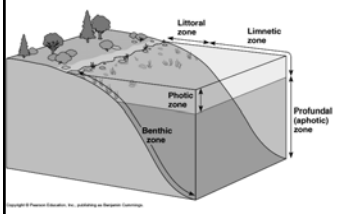


Fig. 50.18

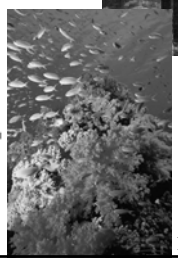


Fig. 50.23

Abiotic factors

- Wind
  - exacerbates the effects of temperature and water loss
  - also exerts forces on organisms (waves act in the same manner)

krummholz

Abiotic factors

- rocks and soil
  - substratum type
  - nutrient availability
  - pH

Combinations of factors

- barnacle distribution in the intertidal- predation from below, desiccation from above

Biomes

- Regions of the earth that are similar in organism type although the particular species differ
- Driven largely by climate – temp., water, seasonality
- Other factors – soil, topography

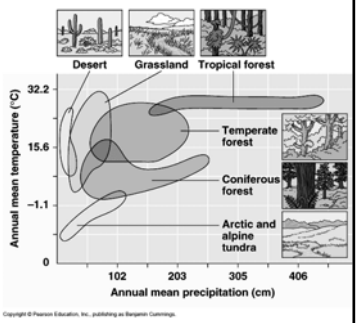


Fig. 50.10 – Biomes of North America

World biomes

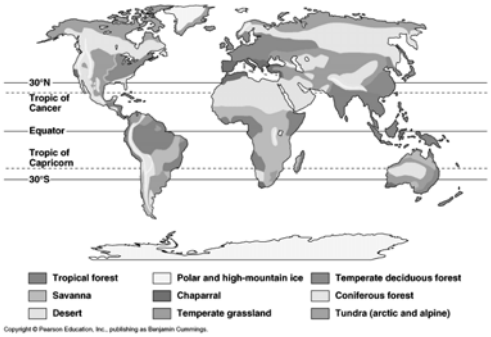


Fig. 50.24

Temperature

- Temperature is partly determined by the amount of solar radiation hitting an area
- Depends on latitude, angle of incidence

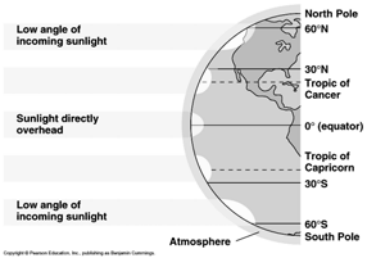


Fig. 50.11

What causes the seasons?

We know:
- Earth has elliptical orbit
- Earth is tilted on axis (23.5^{o})
- Seasons are opposite in northern and southern latitudes

What causes the seasons?

- It can NOT be the distance of the earth from the sun since the seasons are opposite in the northern and southern hemispheres.

Temperature

- seasons are caused by the tilt of the earth as it revolves about the sun

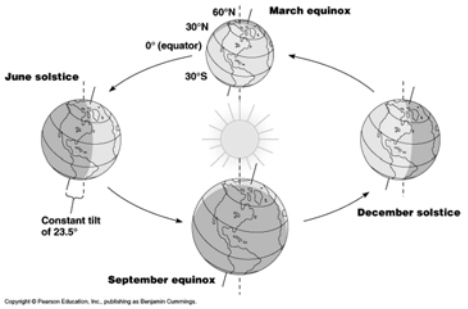


Fig. 50.12

Temperature

- Ocean circulation patterns driven by wind, continents, and rotation of Earth

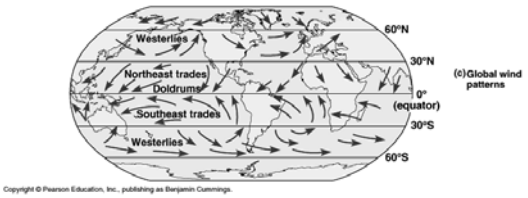


Fig. 50.13c

Water

- Warming air absorbs water and cooling releases water, causing more rain at some latitudes

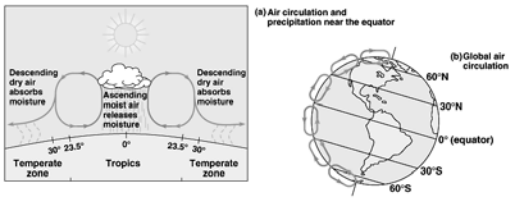


Fig. 50.13

Water

- Wind patterns interact with mountains to cause increased rain on windward sides, rain shadows on lee sides.

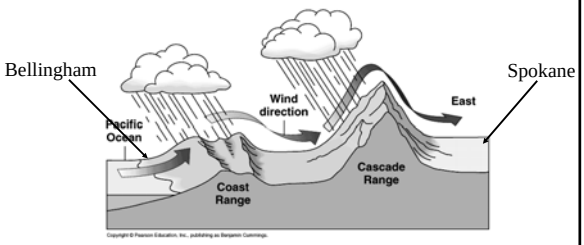


Fig. 50.14

World biomes – interactions among factors

- Latitude
- Seasons
- Atmosphere and ocean circulation patterns
- Mountains

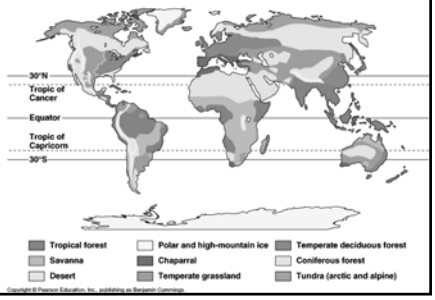


Fig. 50.24

Microclimates

- within a biome, region or habitat, temp., water, sunlight and other factors can vary dramatically
- these form small areas with microclimates or microhabitats
- Can have strong effects on species ranges

Fig. 50.26

We tend to think about averages but extremes are important too

- mangroves do not survive where it freezes, even for a short time. Salinity stress is compounded by freezing and the trees can't handle it.

The End