Ecology and ecosystems: the here and now

Feedback loops: ecological, physiological…

• Positive feedback: positive change in a state variable (eg. Nutrient input) leads to a positive response (higher growth etc.). These can ‘run away’ if not controlled. Eutrophication.

• Negative feedback: Increase leads to decrease – too many predators=few prey=lower population of predators. These can lead to stability (homeostasis)

What is an ecosystem in balance?

Dead zones in the oceans - eutrophication

• Eutrophication
• Too many nutrients lead to phytoplankton blooms
• Phytoplankton blooms lead to zooplankton blooms, fish etc…
• Organisms die, this leads to high bacterial populations (decomposers) which deplete oxygen
• This leads to more death
• Stratification and oxygen depletion on the bottom
• Can affect all trophic levels, but it takes time

The large region of low oxygen water often referred to as the ‘Gulf Dead Zone,’ shown here, crosses nearly 5,800 square miles of the Gulf of Mexico-seasonal
Stability?

Resilience – return?

Phase (state) shifts

Changed state

Ecology is the study of interactions between living things and the living and non-living components of their environment

- Organismal/physiological ecology
- Population ecology
- Community ecology
- Behavioral ecology
- Ecosystems

Global climate models predict that by 2055, corals will no longer be able to calcify
Interactions:

Interactions lead to organism and population range limits and dispersal limits. Both biotic and abiotic factors can 'limit' or define these.

Case: mussels in the intertidal
Case: Mazzaella parksii: a red intertidal alga.
Tolerance limits
Figure 3.2

Species tolerance

- Law of tolerance: the existence, abundance and distribution of a species in an ecosystem are (largely) determined by whether the levels of one or more factors (abiotic) falls within the range of tolerance
- Tolerance to abiotic and biotic factors in part determines the range/distribution

Abiotic factors are important in determining ecosystem structure

A limiting factor is one that limits distribution of a population due to an organism’s need for it, and its (generally) low availability

Species Interactions (Biotic): Interspecific and Intraspecific

- Competition
- Predation
- Symbiosis

Range explanations

- A species never dispersed beyond its present boundaries
- Pioneers failed to survive
- Range has been reduced over evolutionary time
- Pioneers became isolated/separated: phyleogeography
Adaptation by the process of Natural Selection

- Survival and differential reproductive success over a period of time
- Traits that increase ‘fitness’ are ‘selected for’, and are passed on through generations

Biomes

- What defines a biome?
- Where are the ‘lines’ drawn?
- What are the major controlling factors?
- What about aquatic ‘biomes’?
- Describe major biotic and abiotic characteristics of biomes
  - Terrestrial
  - Fresh water
  - Ocean

Biomes

- Animals and plants have ranges of tolerance to abiotic factors
- This in part determines the biotic components of biomes. These are broad geographic regions determined by temperature and rainfall, and described by their plant communities

Tolerance limits
Figure 3.2
Biomes and regional climate patterns

*Climate:* long term average of weather
*Weather:* short term patterns

- Insolation: amount of sun’s energy reaching the surface
- Albedo: reflectivity of surface
- Seasons: tilt of the Earth’s axis
- Hadley cells: large scale cells

**Other factors:**
- Rainshadow effect
- Ocean currents
Figure 50.5 The cause of the seasons

Figure 50.6a Global air circulation, precipitation, and winds

Figure 50.6b Global air circulation, precipitation, and winds

Figure 50.7 Rain shadows
Global winds

Sea surface temperature

Currents

South Africa

Eastern Boundary currents (Benguela):
Cool, dry air, arid climates

Western Boundary currents (Agulhas):
Warm, moist air, wet climates
Biomes and regional climate patterns

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Rainshadow effect
Ocean currents

Aquatic Biomes

- Temperature
- Currents
- Nutrients
- Salinity
- Oxygen
- Depth
- Sunlight
- Physical as well as chemical boundaries

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Some Key Points

- Animals interact with biotic and abiotic factors in ways which shape their survival and distributions.
- Biomes are delineated by abiotic factors, but biotic factors play a role too.
- Biomes are described by plant communities which are ‘controlled’ by temperature and precipitation.
- Oceans are different: currents and salinity/oxygen distribution have a major impact - productivity.
- Organisms have tolerance ranges to abiotic factors - both long term and short term effects.

Aquatic Biomes

- Temperature
- Currents
- Nutrients
- Salinity
- Oxygen
- Depth
- Sunlight

- Physical as well as chemical boundaries
- Oligotrophic
- Eutrophic
- Turnover rate

Ecosystem change: an example

Reduction of coral = increase in Algae. This shifts functional Groups of species, and affects Primary productivity.