Introduction to Ecology

Definitions
- Species
- Populations
- Community
- Ecosystems
- Physiological ecology
- Population ecology
- Community ecology
- Landscape ecology (didn’t really do this one)

Factors
- Abiotic and biotic factors
- Cheetah case study
- Mazaella in the intertidal (abiotic and biotic factors limiting distribution)
- Tolerance ranges/law of tolerance
  - Range and distribution
  - Responses to tolerance limits: behavioral, physiological, morphological.
    - Short term and long term
  - Principle of allocation: allocate energy to various functions, cost/benefit to endothermy (regulator or conformer?) Did not cover this in F06
- Limiting factor

Adaptation/Natural selection (in brief) some examples

Biomes (aquatic and terrestrial)
- Climate and other factors determining biomes
  - Solar radiation and latitude
  - 23.5 degree tilt and seasons
  - Air circulation and precipitation (Hadley cells, 30 degrees N and S)
    - Warm air masses rise/rain, cold air masses sink/dry
  - Rainshadow effect
- Terrestrial biomes are described by plant communities and determined by Temp and Rainfall (moisture availability)
- Must ID them by Latitude and Altitude. Eg. not just a desert, but a temperate, tropical or polar desert (Temp!)
- Global ocean surface currents, Eastern and Western Boundary as climate determinants on E and W sides of continents
- Determinants of ocean ‘biomes’:
  - Temp
  - Currents
  - Nutrients
  - Salinity
  - Depth (photic zone)
  - Other
- Lakes: turnover (we didn’t cover this in F06)
Community Ecology

- **Niche**: definition. Specialists/generalists. Realized vrs. Fundamental niche (Balanus/Cthamalus)
- **Principle of Competitive exclusion**: 1934: GF Gause (Russia), exp w/ 2 paramecium species: competitive dominance
  - Competitive dominance (eg. local extinction, Balanus/Cthamalus)
  - Resource partitioning (Vultures): niche modification/divergence
  - Character displacement: finch beaks. Geographically separated pops of closely related species (allopatric) have similar traits. Geographically overlapping (sympatric) pops of closely related species have different characters

**Species with large impact**

- **Indicator species** (Pelican, Eagle, DDT). Often a specialist. Sensitive to change. Bioassays: exposing organisms to pollutants and determining their ability to survive. Presence of a species can give info about conditions (eg. Spanish moss and air quality). Certain inverts will give info about water quality, certain plants will indicate water etc.
- **Keystone species** (be careful of this one). Not necessarily abundant, can ‘hold’ a system together. Eg. Sea Otter, Wolf etc.
- **Dominant Species**: can control the distribution of other species
- **Ecosystem Engineers**: Foundation species. Not trophic but physical (eg. Juncus, beavers). Facilitators

**Diversity**

- **Species Diversity** = richness + RA/Dominance
  - Species richness: total #
  - Relative abundance (proportion of the total)
  - Species dominance
- **Functional Group diversity**
- **High Diversity** =
  - Habitat heterogeneity
  - High competition
  - Interspecific interactions
  - Abiotic factors
  - Disturbance
  - Functional group diversity
Community Interactions: Biotic

- Predation (+/-)
  - Cryptic coloration
  - Aposematic color (warning)
  - Batesian mimicry: harmless/harmful: monarch
  - Mullerian mimicry: 2 or more species, all toxic, mimic each other (eg. wasps, bees etc.
  - Angler fish/anglers
  - Herbivory (+/-): chemicals
- Parasitism (+/-), (Larger and debilitating) & Pathogens (small often lethal).
  - Sudden oak (Phytophthora ramorum), an oomycete (?) is a pathogen: 1994-2005 spread over 700 km. Led to decline in oaks, and a change in community structure (remember the story of Scrub jays and Steller jays and acorns!)
- Mutualism (+/+)
- Commensalism (+/o) ????
  ***When does a commensal or mutualistic relationship (eg. Mycorrhizae) turn parasitic?

Trophic dynamics

- Trophic levels (in brief)
- Energy Transfer (in brief) – very little to subsequent higher levels. High trophic level predators are few in # due to energy limitations in the system
- Toxin Buildups: biomagnification: trophic level transfer and build-up at high levels
- Complexity (#) of trophic levelsd = amount of energy avail at each level
- Energetic hypothesis:
  - 4-7 links long max in any given food web
  - More photosynthesizers (higher biomass at low level) = longer chains (more avail energy to sustain a longer chain)
- Dynamic Stability Hypothesis
  - Long chains are less stable
  - Variability in production at low levels (eg. caused by a disturbance etc.) is magnified at high levels. Can lead to extinction of top level organisms who can’t withstand the fluctuations
  - This would predict shorter chains in unpredictable environments

Bottom up/Top Down (Trophic) forcing in ecosystems

- V=Veg, H=Herb, P = Pred, N = nutrients
- Change in one leads to change in another
- V ➔ H, V ➔ H, V ➔ H (feedback)
- ▼ V ➔ ▼ H Herbivores are limited by plants
• This is **Bottom up** (lower to higher) higher are controlled by lower

  o  N 🜣 V 🜣 H 🜣 P, to change the top need to alter the bottom

• **Top Down** means the top will control the lower:

  o  V ← H  Herbivores will control the plants

  o  Predation controls community structure. Predators limit herbivores which limit Vegetation which limit Nitrogen through their uptake.

  o  **Trophic cascade model**: series of +/- effects

  o  4 Levels:

    ▪  ↓ Top Carnivore = ↑ Primary Carnivore =↓ Herb =↑ Phyto

    = ↓ Nutrients

  o  3 Levels:

    ▪  ↓ Primary Carnivore = ↑ Herb =↓ Phyto = ↑ Nutrients

The reality is probably intermediate, or shifting top-down, bottom up. Environmental conditions may change it.

Chile: wet years El Nino = top down
Dry years La Nina = bottom up

**Range and Distribution**

Spatial and Temporal (eg. phytoplankton and zooplankton)

Determined by:

  o  Habitat
  o  Abiotic factors (water and Temp.)
  o  Competition
  o  Geographic barriers

Boundaries and extensions
Disjunct pops: separated by a barrier (human or natural!) Allopatric speciation?

**Wolves in Yellowstone:**
Wolves drive Elk into mountains = more trees near the rivers and streams = (more songbirds too), more shade and stability of stream = more salmon and trout. System recovers!