Introduction to Ecology

Definitions

- Species
- Populations
- Community
- Ecoystems
- Physiological ecology
- Population ecology
- Community ecology
- Landscape ecology (didn't really do this one)

Factors

- Abiotic and biotic factors
- Cheetah case study
- Mazaella in nthe 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
- Terrrestrial 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 (*Phtophthora 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
    - N → V → H → P, to change the top need to alter the bottom
- Top Down means the top will control the lower:
    - V ← H Herbivores will control the plants
    - Predation controls community structure. Predators limit herbivores which limit Vegetation which limit Nitrogen through their uptake.
    - **Trophic cascade model**: series of +/- effects
    - 4 Levels:
        - ↓ Top Carnivore = ↑ Primary Carnivore = ↓ Herb = ↑ Phyto = ↓ Nutrients
    - 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:
- Habitat
- Abiotic factors (water and Temp.)
- Competition
- 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!