Review of Evolution and Ecological Relationships

A love story of mutation. (And no. This animal does not actually exist.)
Four Criteria for Sustainability

Sustainable Ecosystems

Need:

Reliance on Solar Energy
High Biodiversity
Population Control
Nutrient Cycling

This note set aligns with this concept.
What the heck is evolution acting on?

- Evolution – how life and its genes change over time.
  - Basic tenet – all species descended from earlier, ancestral species

- The organization of life:
  - Individual
  - Population – group of individuals of the same species
  - Community – a group of many populations
  - Ecosystem – communities and surrounding abiotic parts
  - Biosphere – all ecosystems combined

- Evolution acts on the individual
Main Theory of Evolution – Theory of Natural Selection

- Proposed by Charles Darwin in *Origin of Species*
- It states:
  - Individuals have variation.
  - Variation is due to mutations.
  - Some mutations are helpful for survival (adaptation). Some mutations are harmful.
    - Helpful mutations will increase survival. Increased survival = increased chances of having babies. Those babies are likely to have the helpful mutation.
    - Harmful mutations die before reproduction occurs.
  - After many generations of reproduction, helpful mutations show up more in a population.
Natural Selection Example: Owls

• Owls have silent flight while other birds make some noise in flight. Why?
  – Millions of years ago, an owl-like creature is born with a mutation. The mutation is feather tips that cause no sound when flying...or less sound.
  – These “owls” can eat more and survive longer.
    • They have more babies!
    • Mutation is passed on.
    • Owl-like creatures that do not have this mutation ultimately are outcompeted and slowly die out.
Other Types of Selection – Artificial

• Artificial Selection
  – When man applies evolutionary influence.

• Examples:
  – Dog Breeds
    • Bulldogs cannot give natural birth.
  – Genetically Modified Organisms (GMOs)
    • Enviropigs – pigs injected with bacteria DNA to reduce phosphorus loads in wastes
    • Glofish – Fish injected with jellyfish DNA

I ♥ YOU BULLDOG, even if you weren’t meant for this Earth.
Other Types of Selection

- Sexual Selection
  - When traits are selected for that increase the likelihood of matings.
- This can result in very elaborate traits
- Often these traits do not help survival – may actually reduce lifespan. However, the additional matings that are earned compensate for this hindrance.
Coevolution

- Process when two species evolve in response to each other.

- Example:
  - Newts and Garter Snakes
    - Newts are poisonous to counteract snake immunity
  - Bats and Moths
    - Bats find moths by sonar. Moths fall out of sky when sonar is heard.
  - Pollinators and Plants

- As a result of coevolution, organisms have developed many different types of interactions with each other seen in the natural world.
Ecology

• Ecology – the study of the relations of organisms to each other and the environment

• Five different ecological relationships to know
  – Symbiotic Relationships - Intimate living together of members of two or more species
    • Parasitism
    • Commensalism
    • Mutualism
  – Non-symbiotic Relationships
    • Predation
    • Competition
Symbiotic Interactions

- **Parasitism** - One organism benefits while the other is harmed.
  - May result in death, but not immediate death
  - Example: Sea Lamprey and Lake Trout

- **Commensalism** - One organism benefits while the other is neither benefited nor harmed.
  - Example: Cattle and Cattle Egrets

- **Mutualism** - Both members benefit.
  - Example: Mychorrhizae – a relationship of fungus and plants
    - Fungi grow on root systems of plants to make the root system much bigger allowing plant to absorb more water and nutrients. The plant makes food and gives it to the fungus in return.
  - Example: Gut Mutualism
    - When bacteria live in the guts of species. Bacteria break down materials that are difficult to digest and extract more nutrients for host animal. Bacteria get a place to live. (This is how termites digest wood)
Non-symbiotic Species Interactions

- **Predation** – One organism (predator) eats another one (prey)
  - Death is pretty immediate to the prey item

- **Competition** – Organisms are both trying to use the same environmental resources
  - Interspecific Competition - between members of different species.
  - Intraspecific Competition - between members of the same species.

- This helps to create territoriality where organisms defend specific area against others.
Species Role In a Community

• Every species has an ecological niche in a community and ecosystem
  – A niche is the description of the role a species plays in a biological community
    • Generalists - Broad niche (live many places, eat many things, tolerant)
    • Specialists - Narrow niche (live in specific habitat, limited diet, not tolerant to change)

• The species “habitat” is where it lives; It’s niche is **HOW** it lives (its patterns of living)
Specialist Niche vs Generalist Niche
What Happens When Organisms Share Similar Niches?

• The Law of Competitive Exclusion tries to explain what happens in this situation:
  – The Law says: No two species can occupy the same niche and compete for the same resources for an extended period of time.
What Happens When Organisms Share Similar Niches?

• So, there are only a few options if this situation happens:
  – One will either migrate to avoid conflict
  – One will become extinct or get outcompeted by the other
  – OR, species partition (or split) the resource to avoid conflict with others.
    • Resource partitioning – splitting the resource up by specializing.
      – Given resource can only be partitioned a certain number of times.
      – Example: Warbler Feeding in Trees
Each warbler eats insects and uses pine trees to eat from. To avoid competition, species use different parts of the tree to forage in. The entire insect population is “partitioned” out amongst the five similar species.
• Resource Partitioning – Examples
  – Insect eating birds feeding on the trunk
  – Shorebird beak size specializes in food sources found at different depths in sand