Study Questions: Evolution, Species Interactions, and Biological Communities

1. Explain evolution, including terms such as adaptation, natural selection and mutation.
1. How and why might new species arise? Explain the terms sympatric and allopatric speciation.
1. Compare and contrast competition, mutualism, commensalism, predation, and parasitism.
1. Compare and contrast r- and k-reproductive strategies.
1. Explain the difference between S and J growth curves.
1. Explain the difference between abundance and diversity.
3. Describe the process of succession.

Species: genetically similar organisms that can successfully reproduce with each other

The ecological niche is a species’ role and environment

• Habitat: the place or set of environmental conditions in which a particular organism lives.
• Ecological niche: the role played by a species in a biological community and the total set of environmental factors that determine a species distribution.

What Determines Where Species Live?

Factors such as temperature, nutrient supply, etc

Tolerance limits: minimum and maximum levels of factors beyond which organisms cannot survive

Competitive exclusion principle: no two species can occupy the same ecological niche for long.
Selective pressures and random mutations lead to

Natural selection: the process in which better competitors reproduce more successfully

Adaptation: changes that allow an organism or population to survive in its environment

Some of these changes are passed on genetically

Evolution: gradual changes in species that result from competition for scarce resources

Speciation: the development of a new, distinct species

Speciation can occur as a result of:
- New food or other resource
- New stress (climate or predator)
- Geographic isolation
- Behavioral isolation

• Geographic isolation results in allopatric speciation—species arise in non-overlapping geographic locations.

• Behavioral isolation results in sympatric speciation—species arise in the same location as the ancestor species.

Geographic isolation is a mechanism in allopatric speciation.

4 of the 13 Galapagos Finch Varieties

(a) Large ground finch (seeds)
(b) Cactus ground finch (cactus fruits and flowers)
(c) Vegetarian finch (seeds)
(d) Woodpecker finch (insects)
Taxonomy describes relationships among species

Taxonomy: the study of types of organisms and their relationships.

<table>
<thead>
<tr>
<th>Taxonomic Level</th>
<th>Humans</th>
<th>Corn</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kingdom</td>
<td>Animalia</td>
<td>Plantae</td>
</tr>
<tr>
<td>Phylum</td>
<td>Chordata</td>
<td>Anthophyta</td>
</tr>
<tr>
<td>Class</td>
<td>Mammalia</td>
<td>Monocotyledons</td>
</tr>
<tr>
<td>Order</td>
<td>Primates</td>
<td>Commenales</td>
</tr>
<tr>
<td>Family</td>
<td>Hominidae</td>
<td>Poaceae</td>
</tr>
<tr>
<td>Genus</td>
<td>Homo</td>
<td>Zea</td>
</tr>
<tr>
<td>Species</td>
<td>Homo sapiens</td>
<td>Zea mays</td>
</tr>
<tr>
<td>Subspecies</td>
<td>H. sapiens sapiens</td>
<td>Zea mays mays</td>
</tr>
</tbody>
</table>

Species Interactions

• Competition
Organisms compete for:
Nutrients, space, mates, etc.
Intra- and inter-specific competition exist

Co-evolution: predator and prey evolve in response to each other (camouflage, mimicry)

American bittern
Scorpion Fish

• Predation
Predator: organism that feeds directly upon another living organism (prey)

Camouflage
**Symbiosis**: 2 or more species living together

**Commensalism**: 1 species benefits, 1 is neutral

**Mutualism**: both members benefit

**Parasitism**: 1 species benefits, 1 is harmed

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**Table 3.2  Types of Species Interactions**

<table>
<thead>
<tr>
<th>Interaction between Two Species</th>
<th>Effect on First Species</th>
<th>Effect on Second Species</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mutualism</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Commensalism</td>
<td>+</td>
<td>0</td>
</tr>
<tr>
<td>Parasitism</td>
<td>+</td>
<td>−</td>
</tr>
<tr>
<td>Predation</td>
<td>+</td>
<td>−</td>
</tr>
<tr>
<td>Competition</td>
<td>±</td>
<td>±</td>
</tr>
</tbody>
</table>

* (beneficial; − harmful; 0 neutral; ± varies)

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**The Growth of Species Populations**

- **Exponential growth**: population growth with no limits; it results in a “J” growth curve when graphed.
- **Logistic growth**: limited population growth; it results in a “S” shaped growth curve when graphed.
Ideal, unlimited population growth is exponential. Actual growth slows down as resources become limited.

Limits to population size

- **Density-dependent**, meaning as population size increases, the effect intensifies. With a larger population, there is an increased risk that disease or parasites will spread, or that predators will be attracted to the area.
- **Density-independent** limits to population are often nonbiological, capricious acts of nature. A population is affected no matter what its size.

Reproductive Strategies

- **r-adapted species**: use rapid, copious reproduction
- **K-adapted species**: slower reproduction, fewer offspring

Species respond to limits differently: r- and K-selected species

<table>
<thead>
<tr>
<th>Reproductive Strategies</th>
<th>r-Selected Species</th>
<th>K-Selected Species</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Short life</td>
<td>1. Long life</td>
<td></td>
</tr>
<tr>
<td>2. Rapid growth</td>
<td>2. Slower growth</td>
<td></td>
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<tr>
<td>3. Early maturity</td>
<td>3. Late maturity</td>
<td></td>
</tr>
<tr>
<td>4. Many, small offspring</td>
<td>4. Few, large offspring</td>
<td></td>
</tr>
<tr>
<td>5. Little parental care and protection</td>
<td>5. High parental care and protection</td>
<td></td>
</tr>
<tr>
<td>6. Little investment in individual offspring</td>
<td>6. High investment in individual offspring</td>
<td></td>
</tr>
<tr>
<td>7. Adapted to unstable environment</td>
<td>7. Adapted to stable environment</td>
<td></td>
</tr>
<tr>
<td>8. Pioneers, colonizers</td>
<td>8. Late stages of succession</td>
<td></td>
</tr>
<tr>
<td>11. Ranged highly by mortality factors</td>
<td>11. Ranged highly by extrinsic factors</td>
<td></td>
</tr>
<tr>
<td>12. Low trophic level</td>
<td>12. High trophic level</td>
<td></td>
</tr>
</tbody>
</table>
Diversity: number of different species within an area

Abundance: number of individuals of a species within an area

The greater diversity in a community, the greater resiliency and stability of that community

Communities

Community: all the populations that live and interact in an area

Ecotones: boundaries between adjacent communities

Communities Are Dynamic and Change Over Time

- **Climax community** - The community that developed last and lasted the longest.

- **Primary succession** - land that is bare of soil—a sandbar, mudslide, rock face, volcanic flow—is colonized by living organisms where none lived before.

Primary Succession

• **Secondary succession** - after a disturbance, if left undisturbed, a community will mature to a characteristic set of organisms.

• **Pioneer species** - the first species to colonize a community in primary succession on land.

Invasive species: organisms not normally found in a particular location that disrupt the local community

Hawaiian mongoose

Polynesian rat