What is a species?

- Hypothesis, categories; not a real thing

Two major categories of evolutionary changes…

- Cladogenesis- splitting of lineages over time
- Anagenesis- evolutionary change within lineages over time

Major Issues with Speciation Theory…

- No true meaning of a species
- Geographic isolation provides the opportunity for divergence
- Bottle neck can cause radical changes
- Role of natural selection in speciation
- Prezygotic vs. Postzygotic reproductive isolation
- Genetic mechanisms responsible for reproductive isolation

Speciation

- Formation of a new species

What are species concepts?

- Characteristics that define what a species is
- Criteria for deciding objectively whether two entities are one or more that one species

Biological Species Concept

- Groups of organisms that can interbreed, and are reproductively isolated from other species
- E. Mayr- worked with birds
- Used to be tested
- Problems is it can't be applied to fossils, asexual organisms, can't get specific time of formation

Difficulty of recognizing species

- Sympatric species- if they do not interbreed, then they are good species
- Allopatric species- may be difficult to asses whether they are "potentially interbreeding"
- Difficult to decide what constitutes reproductive isolation
- If they produce sterile hybrids, then they are certainly reproductively isolated
- Partially sterile hybrids

Phylogenetic Species Concept

- An irreducible cluster of organisms that is diagnosable distinct from other such clusters, and within which there is a parental pattern of ancestry and descent
- Strengths- Describes what we mean when we talk abut species, can be used for almost any organismal group
- Weakness- Impossible to apply

Evolutionary Species Concept

- A species is a single lineage of populations or organisms that maintains its identity from other such lineages and which has its own evolutionary tendencies and historical fate
- Strengths- contains historical component, specific criteria that can be diagnosed in natural populations
- Weakness- Vague

Bottom line of species concepts

- Biological species concept is the major species concept used by modern biologists in practice
- Large group is applying the phylogenetic species concept, particularly conservation genetics

Key features of operational species concept

- Reproductive cohesion within species
- Reproductive isolation from other such groups
- Recognition that species are dynamic evolutionary lineages, not static "types"
- Protect- Individual populations, threatened portions of species ranges, ecologically distinct populations

Hybrids

- Cross between genetically different forms

Hybrid Zones

- Populations come in contact after isolation

Hybridization

- Crosses between genetically differential forms

Introgression

- Movement of genes between species mediated by backcrossing
- Hybrid breeds successfully with parental type

Sympatric Speciation

- Speciation without restriction to gene flow
- Reproductive isolation without geographic barriers
- Assortative mating and stable polymorphism

Allopatric Speciation

- Speciation with geographic isolation

Secondary Contact

- Populations often come into contact after periods of isolation
- Sympatric following allopatric

- Population divergence is inevitable during allopatric due to mutation, drift, and local natural selection
- Divergence will lead to reproductive isolating mechanisms

Pre-zygotic isolating mechanisms
- Potential mates do not meet
- Temporal isolation- mate at different times
- Mechanical isolation
- Behavioral isolation
- Habitat isolation- Populations in different areas
- Copulation occurs but gametes do not meet
- Gametes are transferred, eggs not fertilized

Bottleneck effect
- Disaster occurs and only a few from a population survive

Post-zygotic reproductive isolation
- Reduced hybrid availability
- Hybrid infertility
- Hybrid dies prematurely

Vicariance
- Formerly widespread population becomes fragmented

Genetic Revolution
- Mayr proposed that small populations in novel habitats would undergo a lot of genetic diversity due to drift and that subsequently would gain novel alleles and allelic combinations by mutation

Peripatric Speciation
- When a group of species is separated from main populations (founder effect)

Reinforcement
- Pre-zygotic barrier strengthened, hybrid offspring are less fit than parents

Model of Allopatric, Peripatric, and Sympatric speciation…