

LECTURE #7: MACROEVOLUTION AND SYSTEMATICS

Evolution occurs at two levels

Microevolution: at the population level; a change in allelic makeup of the population

- Hardy Weinberg (sexual recombination does not affect this)

Macroevolution: a change in species: from one species to another or from one species into two species

The Goal of Systematics

-to create a system of classification of every species that reflects their true evolutionary relationships

*Who is related to whom, not just who looks like whom

Why????

Birds are reptiles- birds evolved from reptiles-feathers are reptile scales

Archaeopteryx: 1800s, teeth like reptiles, feathers, wing claw, long tail vertebrate

Monophyletic group: includes the most recent common ancestor and ALL of its descendants

WHAT WE WANT

Paraphyletic group: includes the most recent common ancestor, but not all of its descendants

Ex. Birds and reptiles

Polyphyletic group: includes species that do NOT share a common ancestor

Ex. Protists

TREES ARE HYPOTHETICAL - they are a hypothesis of relationships-NEVER SET IN STONE

Taxonomy (taxonomists describe and assign names to newly discovered organisms)

-Most important category is the **SPECIES**

- it has biological reality (all individuals of a potentially interbreeding group)
- it's the "unit" of evolution (its members in populations)

-Other categories represent our current understanding of relationships

Hierarchical Classification of the domestic cat (1.8million species)

- Domain • Eukarya
- Kingdom • Animalia (animals)
- Phylum • Chordata (chordates)
 - (Subphylum)- Vertebrata
- Class • Mammalia (mammals)
- Order • Carnivora (carnivores)
- Family • Felidae (cats)
- Genus • *Felis*
- species • *catus*

Organisms diversify by the process of speciation (definition of species)

2 useful (but not completely satisfactory) definitions of speciation

- Morphological species concept (MSC) (based on morphology)
- Biological Species concept (BSC) (based on reproduction)

Morphological Species Concept

- based on morphological features (characters) that can be observed or measured (shape, color)
- Most commonly used method for determining species
- BUT has some problems....

CHARACTERS=features of organisms (structural, physiological, behavior, etc) used by systematic to
Construct phylogenies

Problems with the MSC

- Subjective quality-which features are best for determining a species?
- Some members of the same species look identical (cryptic species)

Evolutionary Convergent

-Natural selection may produce similar features in species with similar ways of life and in similar environments (=convergence)

CONVERGENT EVOLUTION

-WATER: 1000 TIMES DENSER THAN AIR=SELECTIVE PRESSURE

ALL RESPOND TO WATER DENSITY IN SAME WAY

BODILY SHAPE-FUSIFORM

Ex. Penguin, shark, dolphin- all have same form, they're all built to cut through water

Convergent evolution:

Sugar glider vs. flying squirrel

Allauida=Madagascar plant looks like ocotillo

n.american mole v. Australian mole

HOMOLOGY VS ANALOGY

Homology: a similar trait that results from common ancestry

Analogy: a similar trait that results from evolutionary convergence (i.e. independent evolutionary origins)

Biological Species Concept

- a population or group of populations whose members have the potential to mate, reproduce, and produce viable, fertile offspring* * still a problem
- the most widely accepted definition of species and the one used in the Modern Synthesis (post Darwin and Mendel)
- the critical question about whether two populations represent different species **-IS THERE A GENE FLOW BETWEEN THEM???**
- Gene flow may involve migration of individuals or just genes (e.g. as happens in plants when pollen is transported from one population to another)

Problems with the BSC

- May be hard to verify lack of gene flow (cannot prove a negative)
- cannot be applied to asexual organisms
- cannot be applied to fossil organisms
- squidginess: possible vs. potential vs. likelihood

POSSIBILITY/POTENTIAL/LIKELIHOOD

- mating of lions and tiger (=ligers)
- tigers and lions (=tigons, also tiglons or tions)*
- *father defined (infertile offspring)
- dogs (*Canis Familiaris*) and wolves (*C.lupus*) (fertile offspring)
- Mimulus lewisi* (bees) *M.cardinalis* (birds)

Can be mated and easily reproduced in greenhouse; little likelihood, therefore different species

WOLVES AND COYOTES (SURPRISE)

- identifying a subspecies-----*canis lupus familiaris-c.familiaris*
-----*canis lupus latrans + c.latrans*

Cladogenetic Speciation

- applying the BCS and cladogenesis:
- how does one interbreeding population become two non-interbreeding populations?**
- And then, how do two populations become reproductively isolated to become two species?

Models of Cladogenetic Speciation

Allopatric speciation: two populations differentiate in two separate geographic areas (common in animals, less common in plants)

Sympatric speciation-two populations differentiate in the same geographic areas(common in plants, less common in animals)

Speciation Steps

1. Separation by geographical barrier
2. Reproductive isolation
3. Genetic divergence by accumulation