

## Altruism

How can we explain the evolution of **altruism**, or behavior that promotes an individual to make sacrifices to help others? For example, if a bird sees a predator and gives an alarm call to alert other birds to the danger, that action makes the bird more visible to the predator and increases the chance the predator will target it.

Altruism will be favored if it increases the fitness of close relatives who share your genes by descent. However, the degree of altruism varies with the degree of relatedness: consider full siblings and first cousins.

A full sibling shares 50% of your genes (relatedness factor  $r = 0.5$ )

A first cousin shares 12.5% of your genes (relatedness factor  $r = 0.125$ )

Therefore: “I would not lay down my life for a brother, but would do so for 2 brothers or 8 cousins” (Haldane). Haldane says this as a way to show how relatedness affects how many genes would be passing. For example, 2 brothers \*  $\frac{1}{2}$  relatedness = 1. However, 8 first cousins \* 0.125 relatedness = 1.

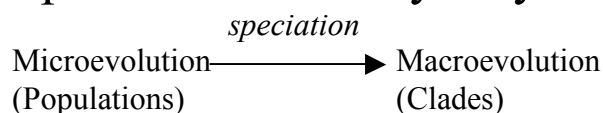
This concept was further formalized by Hamilton into **Kin-Selection Theory**, which explains when altruism will be beneficial in an inclusive fitness sense. Altruism will be favored if  $r*B > C$ , where  $r$  is relatedness,  $B$  is benefit to the recipient of altruism, and  $C$  is the cost to you.

For example, consider ground squirrels. They give alarm calls when predators are near: however, it turns out the female squirrels are the only gender to give an alarm call. Further, females reside in the same territory from infancy to adulthood, while males disperse. Therefore, all the females in one area will be related, and by giving alarm calls that female is providing a survival benefit to all the nearby females she is related to.

Another example is the **tuco-tuco**. These burrowing creatures have litters, so there are lots of babies. They also practice communal nursing of young: but again, it is a group of sisters who communally nurse their babies.

A final example is when turkeys form male coalitions to assist each other in mating competition. Why would a group of male turkeys ally themselves together? All the turkeys in a coalition are closely related ( $r \sim 0.5$  = brothers): thus, by helping one of their group to mate, they are indirectly propagating their own shared genes.

## Speciation: The Mystery of Mysteries



We have reviewed the major processes governing evolution within and among populations (**microevolution**). These processes are the same that govern the evolution of new species, or **macroevolution**.

That said, what is a **species**?

1. **Typological species concept:** Species were considered to be fixed entities, or a “thought of god.” Naturalists and philosophers from Aristotle through Linnaeus took this view, and

cataloguing the extent of nature was merely describing all of these fixed forms which were created along with the Earth.

2. **Evolutionary species concept:** Charles Darwin did not see species as qualitatively different from other varieties: instead, a species concept is an arbitrary category humans use to define the variation in form they see. In general, we think of species as independently evolving lineages – the general lineage concept. Different formations differ in emphasis, but are consistent with this idea:
  - a. **Discontinuous species concept:** *Proposed by Darwin.* Descent with modification, combined with extinction, allows us to consider species as organisms with discontinuous phenotypes. Thus species are defined by their morphological distinctiveness, and in practice most species can be defined by taxonomists.
  - b. **Phylogenetic species concept:** *Proposed by Systematists.* By looking at characters and their ancestry, you can describe a group's as shared-derived, monophyletic, etc. Thus you diagnose a species based on shared, derived traits relative to other sets of populations and species.
  - c. **Biological species concept:** *Proposed by NeoDarwinists.* Emphasizes **reproductive isolation**, examining groups of populations reproductively isolated from others.

### Forms of Reproductive Isolation

Even though these are presented as prezygotic and postzygotic, keep in mind they are not in any kind of set sequence, especially if referring to the textbook for Figure 24.4

**Prezygotic Isolation** occurs before mating and fertilization and prevents the formation of a zygote.

1. **Habitat:** Two sexually compatible species might dwell in different habitats and thus be reproductively isolated simply because they never meet. Consider a lake, and insects living right under the surface water, and another divergent species living just above the lake floor.
2. **Timing:** Two sexually compatible species might not have mating seasons that correspond with each other, or might not occupy the same range at the same time.
3. **Behavior:** A species behavior might prevent it from mating with another species – for example, many birds have specific mating rituals. If these are not performed correctly, then mating will not occur.
4. **Mechanical:** Two species reproductive organs just might not fit. Two species might also mate together successfully, but the female's ova will not recognize and accept the sperm (it will not have the correct surface proteins) – this is called **gamete recognition**.

**Postzygotic Isolation** refers to factors affecting reproductive success of hybrids.

1. **Viability:** The hybrid may have deleterious traits, or just be not well adapted to the environment.
2. **Fertility:** The hybrid may be viable, but may be sterile or unable to reproduce.

Reproductive isolation, trait differences etc. generally increase with the amount of time since the separation of two populations. Considering the **general lineage concept**, longer isolated lineages will be easier to diagnose by any method and different approaches will mostly agree. But recently separated lineages are often in a “grey zone”, where different criteria or emphases (e.g. phylogenetic vs biological species) give different results. This is because there is no necessary sequence of events or extent of change that defines a species. In many ways this demonstrates that species arise via microevolutionary change, the cornerstone of Darwin’s long argument.