

Biology 1B—Evolution Lecture 9 - Speciation Processes

Species identification - the grey zone...

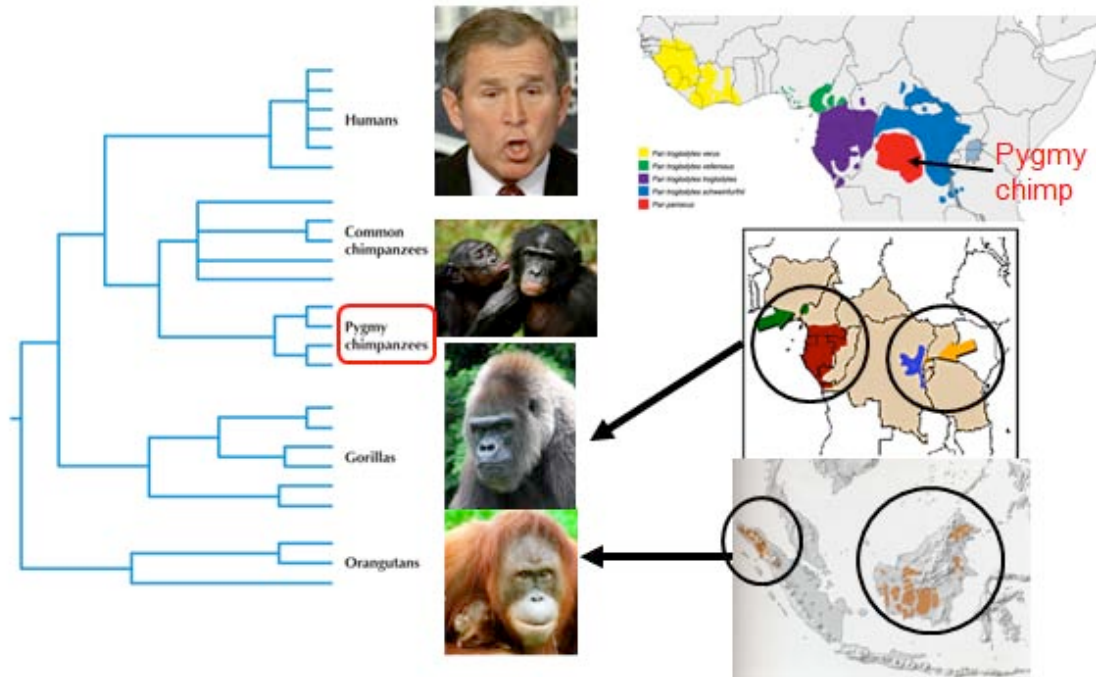


Figure 1

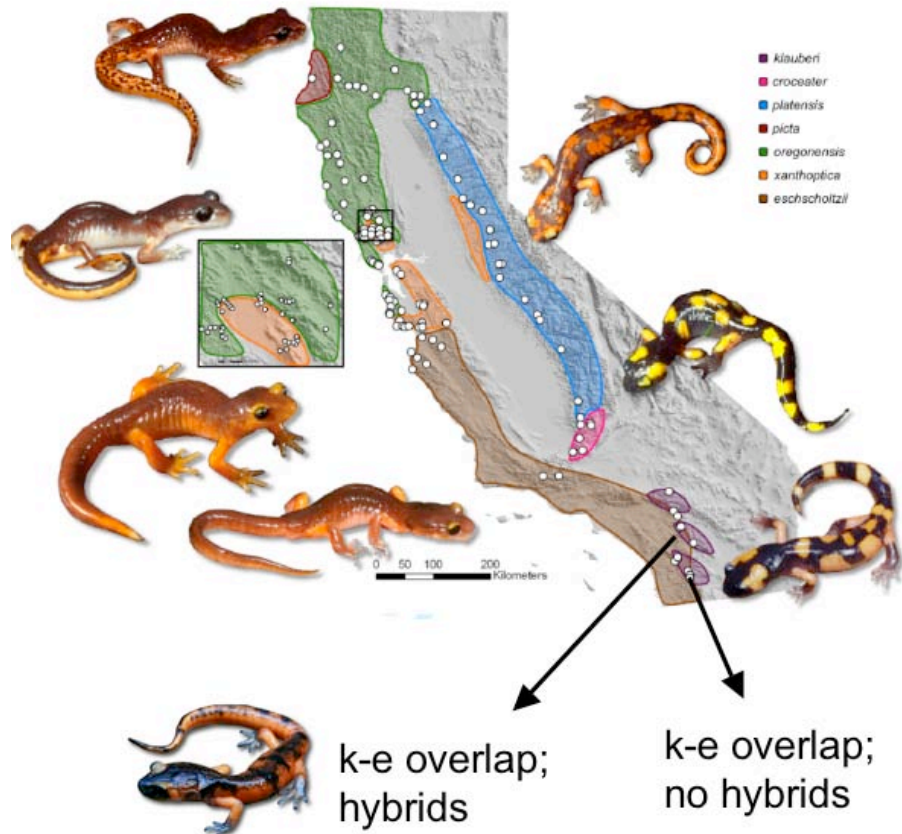
Consider this cladogram. Let's examine it with all three species concepts:

For each species, we can identify them and their sub-species phylogenetically using molecular analysis of their genomes. Examining them using a discontinuities species model also returns much the same result.

However, in terms of the biological species concept, we don't know for some of these species or subspecies. There are common and pygmy chimpanzees separated by a river: should we still call them a single species? Or since they are experiencing habitat reproductive isolation, are they two species? What about Bornean v Sumatran orangutans, or east vs west African gorillas?

Ensatina eschscholtzii – a ring species

- Salamanders that mimic newts with an orange stripe (in the Bay Area)
- Their geographic range covers much of California, excluding the Central Valley:



- The ancestral range was in the redwood forests of the north, but they have migrated independently along the west coast and the Sierra Nevada
- There are gradual transitions along the coasts: on the west, the salamanders are plain and cryptic; on the east, they are disrupted (disruptive against leaf litter background), blotched, and highly colored
- In the foothills of the Sierra Nevada, there is a hybrid zone where the coastal form and Sierra form have come back together
- In the mountains behind San Diego, the plain and blotched overlap with no interbreeding. Yet, just to the north at Palomar, they overlap and form hybrids.
- Could be considered a “ring species” because they make a loop of gradual transitions
- Current taxonomy is that there is one species with 7 sub-species, but they could be classified as having two species or 11+ species if a phylogenetic concept is used
- Since these species are in the process of evolving, there is much gray area between populations, causing classification problems

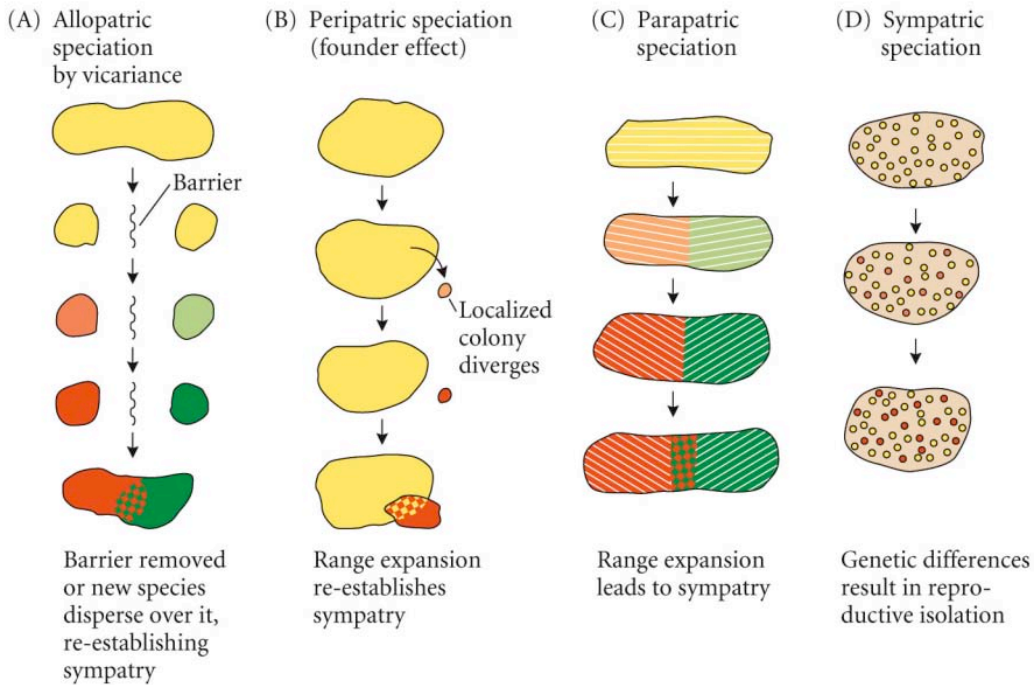
Speciation processes

Recall that:

Disruptive Selection increases population divergence

Genetic Drift increases population divergence

Migration decreases random mating and divergence

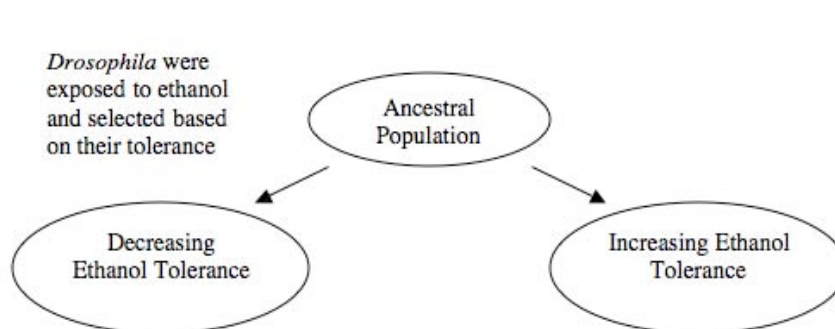


EVOLUTION 2e, Figure 18.1 Futuyma 2005

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Allopatric:

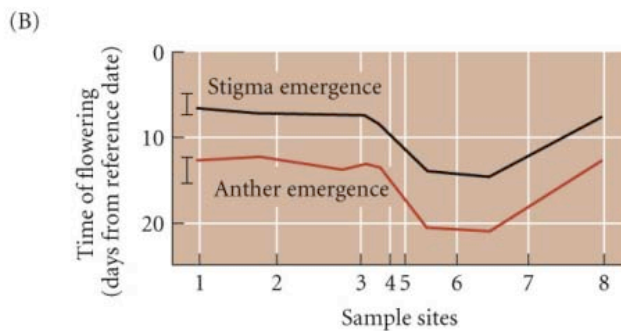
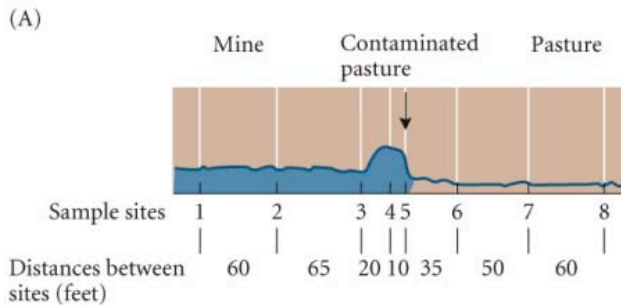
- A geographical barrier arises so that a population is split, and over time, the two sets of populations diverge (though drift +/- selection) such that they are reproductively isolated and perhaps ecologically distinct when they come back together
- This is the dominant form of speciation
- Enhanced with divergent selection
- Example: tiny tropical frogs on adjacent mountains diverge into sister species (they are each others' closest relatives). In rapidly breeding systems, this process can be tested experimentally in the lab:



- When the two groups of flies were brought back together, there was some reproductive isolation (in as short a time as 5 years—something Darwin would have found unbelievable)

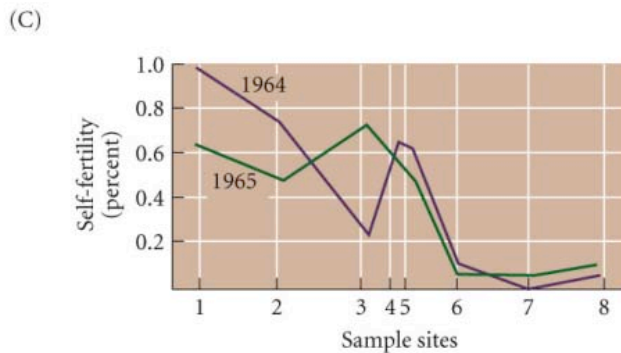
Parapatric:

- Lacks a concrete boundary like allopatric speciation...instead it occurs in adjacent diverging populations with some potential for gene flow across the boundary
- Needs divergent (disruptive selection) and non-random mating to function as a mechanism of speciation
- Recall the grasses living on adjacent mine sites in which phenotype frequency changed based on the grasses' respective habitats:



Here, the grasses shift in mating (creating non-random mating because each habitat's grass mates at a different time)

The mine site grasses flower earlier and have an increased rate of self-fertilization (temporal isolation). There is also the post-zygotic isolation of the fitness of the mine grass versus the non-mine grass.



EVOLUTION 2e, Figure 18.20

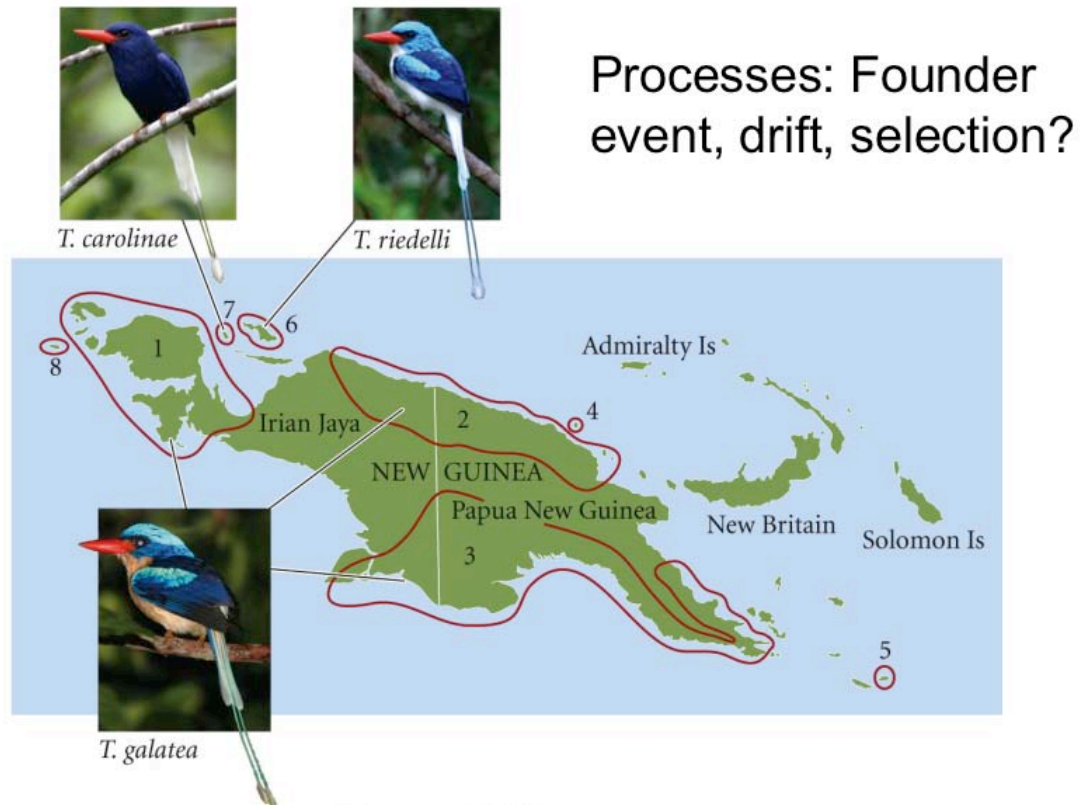
Sympatric:

- Though these populations are overlapping spatially, divergent selection is at work with pre-zygotic isolation as a necessary side effect
- Non-random mating must arise, and it does in the form of the groups isolated by disruptive selection mating only with members of their own groups
- Example: Lord Howe palms on Islands near Australia with sister species of palms that differ in important ecological characteristics (i.e. soil types)

- Different sister species on different soil types flower at different times, reproductively isolating themselves
- Difficult to say because it takes more time and more active avoidance of gene flow

Peripatric:

- May particularly apply to islands because it refers to a Founder-like speciation in which a small group of individuals (colonial group) breaks off from a large population (continental group)
- The novel environment of the island gives rise to divergent selection
- Example: the Paradise-Kingfishers of New Guinea



EVOLUTION 2e, Figure 18.17

Futuyma 2005