

Sexual Selection, Geographic Speciation



Paleobiology

February 03, 2016

Sexual selection

- Charles Darwin (again)
 - The descent of man, and selection in relation to sex (1871)
 - Intra-Gender competition – Members of the same gender fight each other for the right to mate with the opposite sex. Traits advantageous to winning fights are selected for.
 - Inter-Gender preference – Members of one sex only prefer members of the opposite gender with certain traits.
 - Tiered Sexual selection – intra-gender competition is followed by inter-gender preference.
 - (The above is not formally recognized jargon)

Inter-gender preference

- Generally what is meant by sexual selection is inter-gender preference
- However, the line between inter-gender preference and intra-gender competition is somewhat blurry.
- Generally it is the females that does the choosing, but this is not a rule.

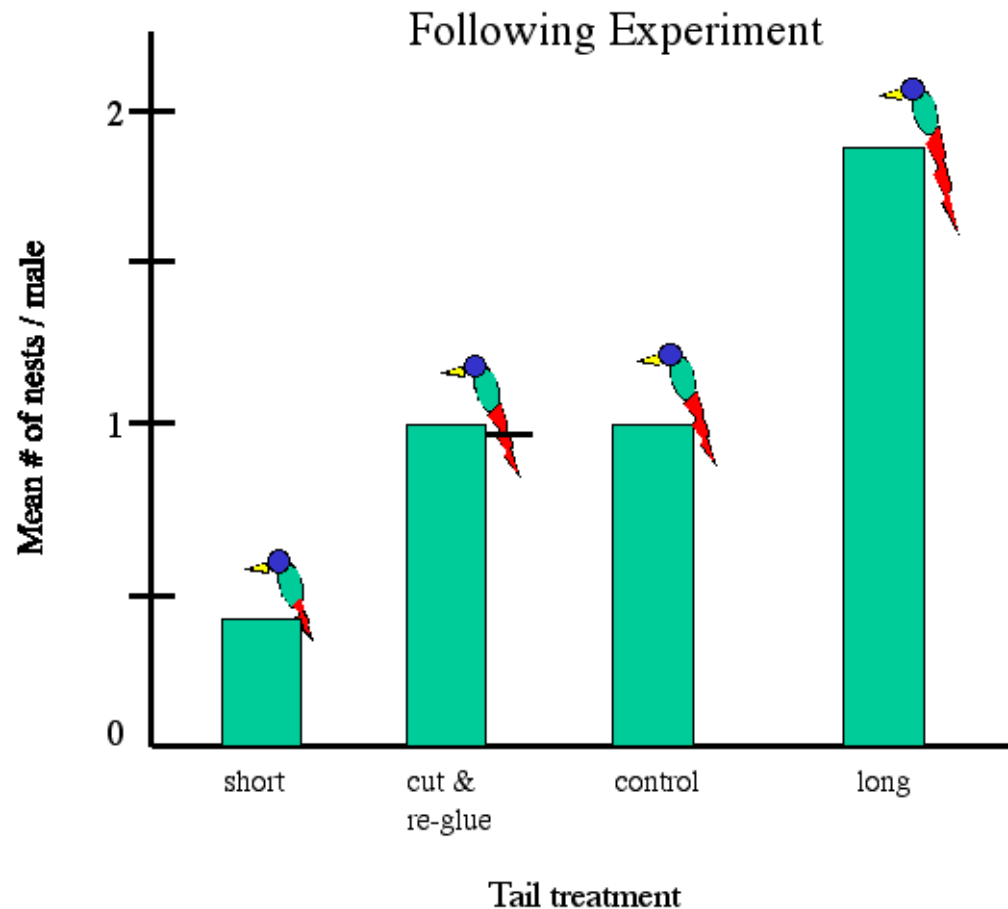
The *classic* example of sexual selection



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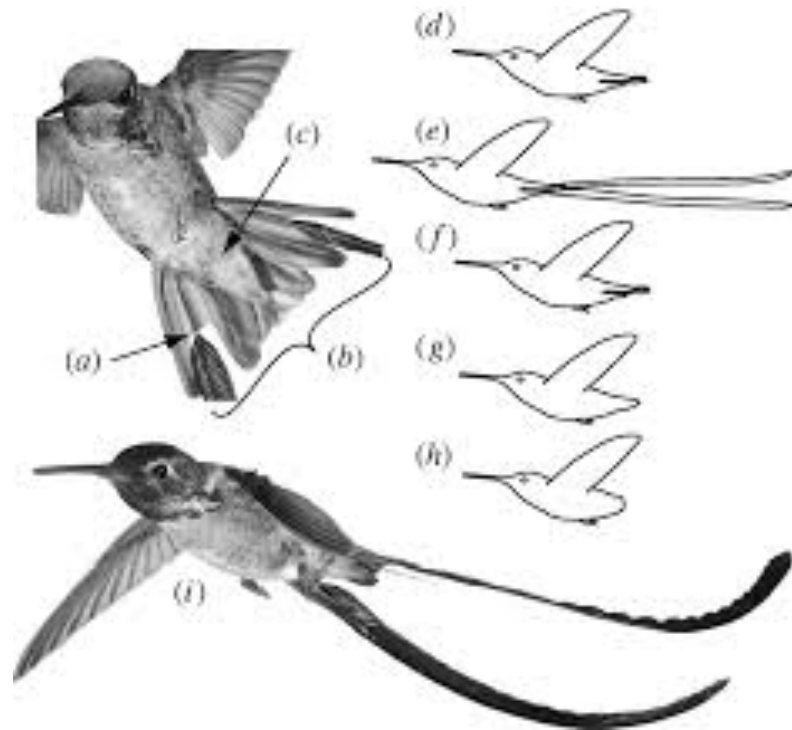


The *classic* example of sexual selection



Explanations for sexual selection

- Handicap Hypothesis – Female widowbirds prefer males with long tails that make life more difficult, because it shows how “tough” they are that they can succeed despite this disability.



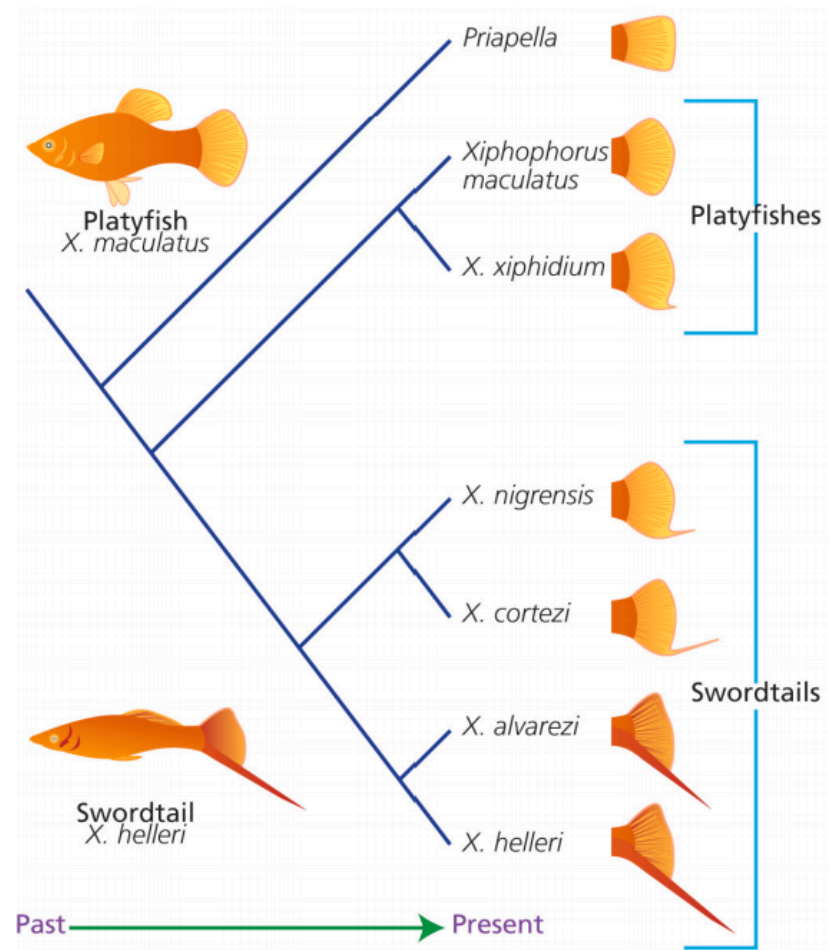
Explanations for sexual selection

- Pre-Existing Bias Hypothesis – Females have a genetic preference for the extreme trait that exists before the extreme trait is phenotypically manifest.



Pre-existing bias in swordtail fish

- Pre-Existing Bias Hypothesis – Females have a genetic preference for the extreme trait that exists before the extreme trait is phenotypically manifest.



Why is sexual selection noteworthy?

- The pre-existing bias hypothesis/effect shows that the potential for morphologic change can be present in populations well before we see the change. This dovetails with the ideas of the “sloshing bucket” or “neo-mutationism” models of evolution, where we are waiting for state changes.
- Sexual selection is invoked fairly frequently in the Dinosaur community to explain morphological features that we do not understand.

Sexual Selection, Display, or Combat

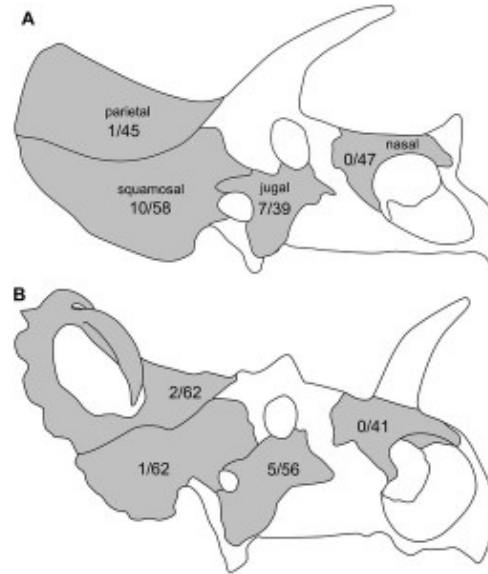


Sexual Selection, Display, or Combat

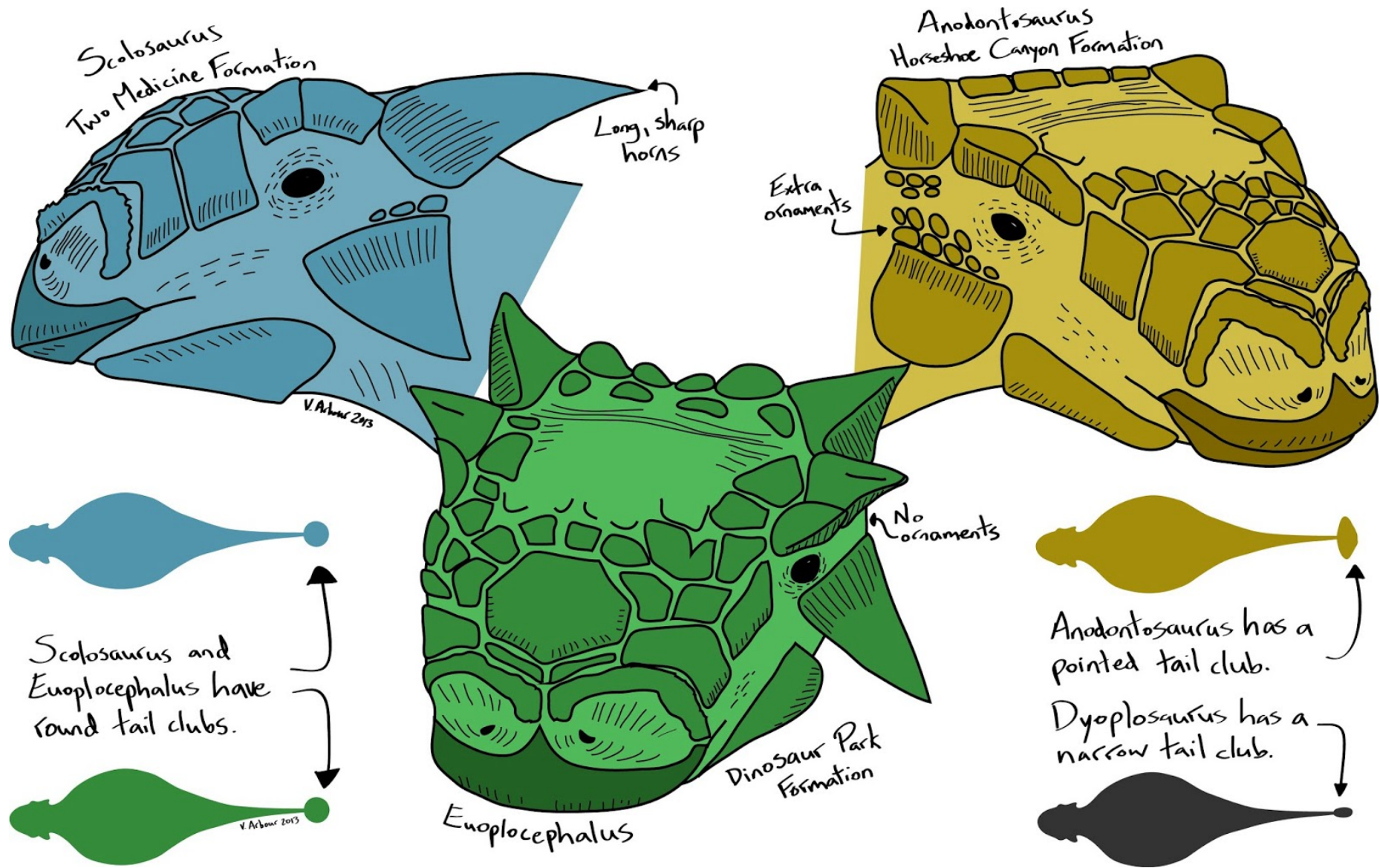
- Intra-gender competition
(sexual selection)
- Inter-gender preference
(sexual selection)
- Intraspecific competition
(dominance)
- Intraspecific cooperation
(recognition)
- Interspecific competition
(defense)
- Physiological need
(thermoregulation)



Sexual Selection, Display, or Combat



Sexual Selection, Display, or Combat

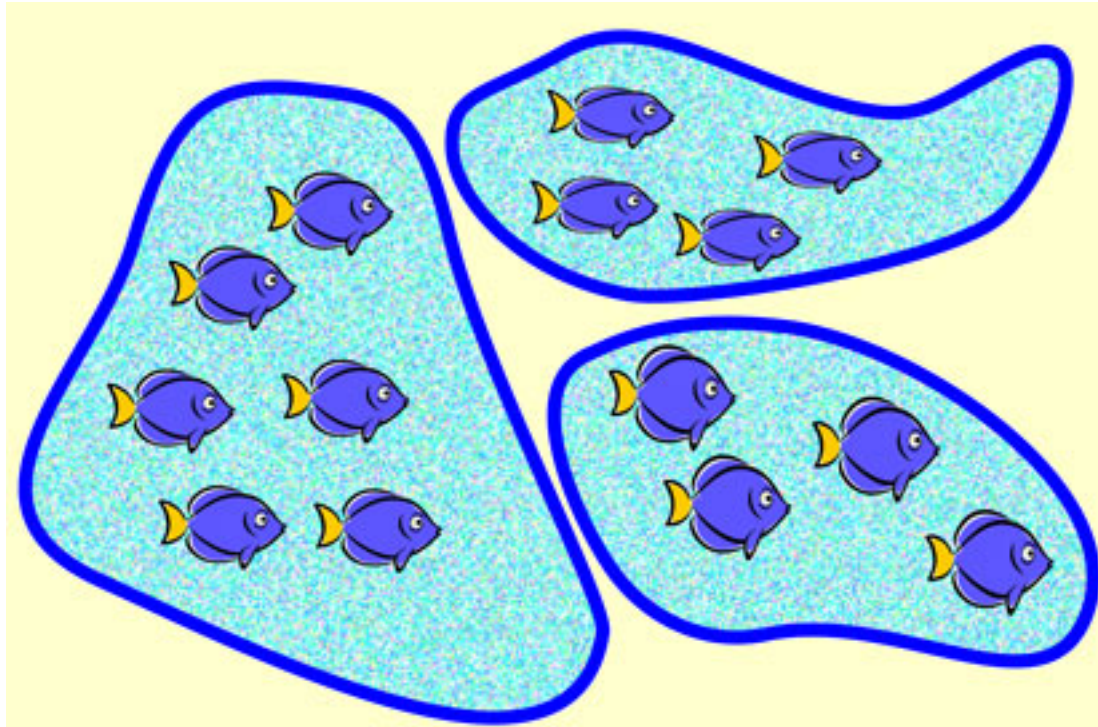


Sexual selection in fossils

- In order to demonstrate sexual selection, do we need to disprove other uses for those traits?
 - Many structures may serve more than one role.
 - Even if a feature is primarily used for a certain purpose, does not mean that it originally evolved (was selected) for that purpose.
- One proposed criterion for proving sexual selection in dinosaurs is the requirement to show strong sexual dimorphism.
 - Demonstrating sexual dimorphism is just as difficult.
- What we really need is experimentation like in the cases of the widowbirds and swordtail fishes.

Models of geographic speciation

- Allopatric speciation – A species is geographically divided into separate populations.
- Those populations adapt to their new environments (or experience genetic drift) and become new species
- *Allo* – Other, Different



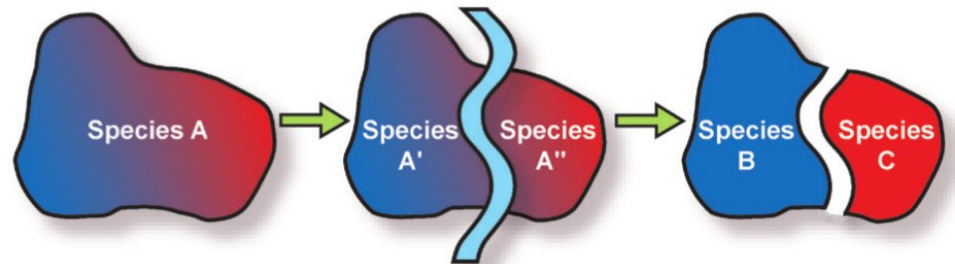
Allopatry:

Each variety in its own range
Become species due to drift and
local adaptation

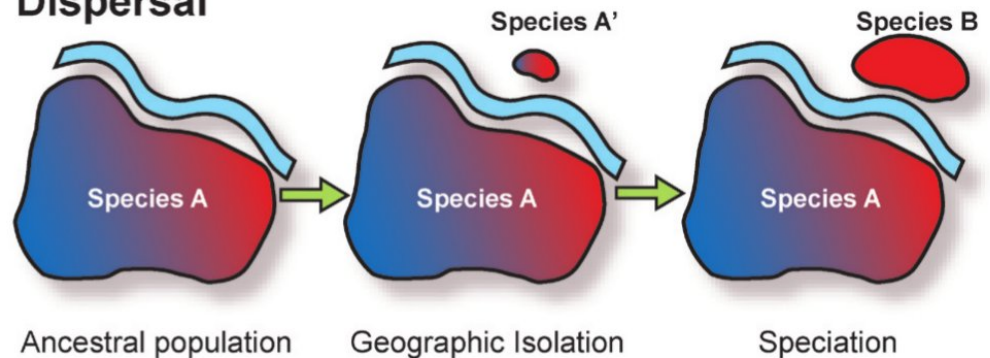
Models of geographic speciation

- Allopatry can come about in two different ways.
- Vicariance – the ancestral population is divided by a geographic barrier
- Dispersal – a new population migrates across a geographic barrier that now separates it from its ancestral home.

Vicariance

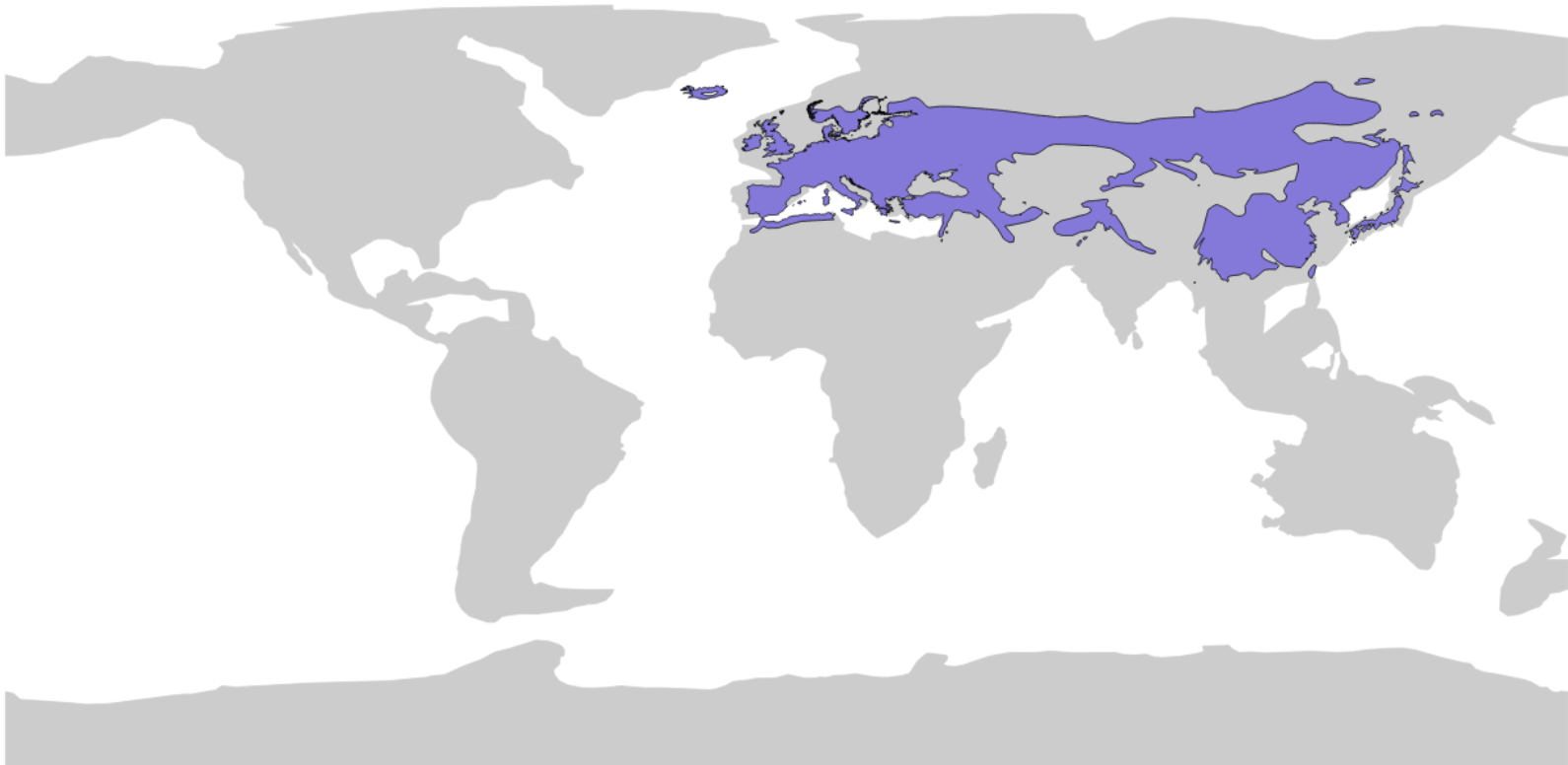


Dispersal



A disjunct distribution

A genus or other higher taxon (e.g., genus, family) that is split into different species populations – presumably by vicariance or dispersal



What is and is not dispersal

- Dispersal != Radiation

- Radiation is when a clade (taxonomic group) creates many new species – i.e., undergoes a period of high speciation rates.

- Dispersal != Peripatry

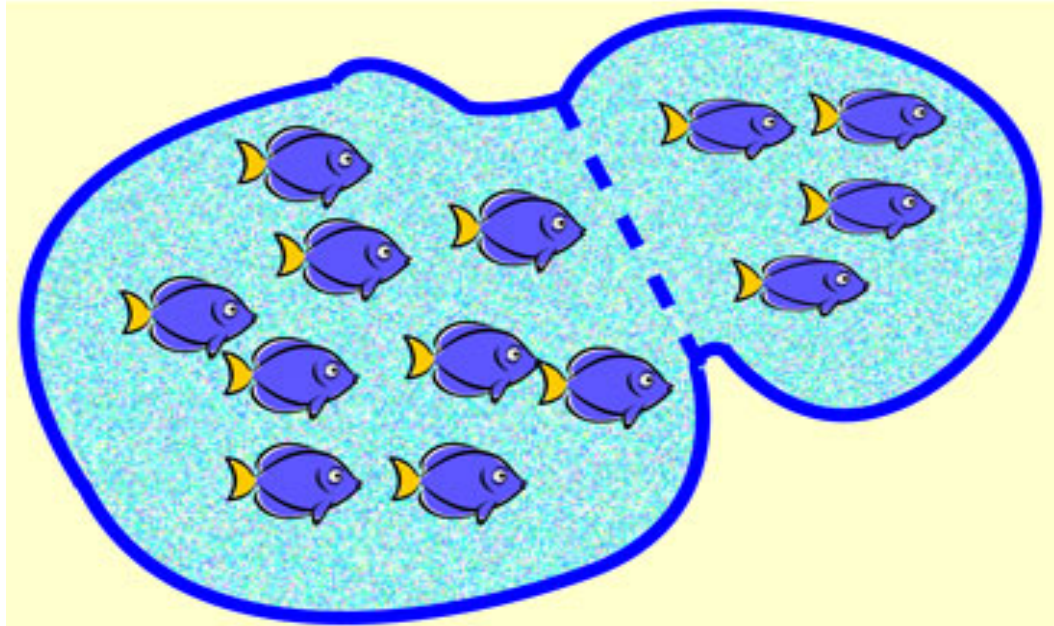
- Peripatry does involve a sub-population at the edge or just beyond the range of the ancestral population that is sort of geographically distinct, but is not separated by a barrier.

- Dispersal != Propagule Dispersal

- Dispersal can also refer to biological dispersal, how an organism disperses its sperm or young.

Peripatric speciation

- Peripatric speciation is often defined in two different ways.
 - Population Size – In this definition peripatry is the same as allopatry, but the younger species population is smaller than the older.
 - Geographic Barrier – In this definition, peripatry is the same as allopatry, but the two populations are close together and may or may not be separated by a barrier.



Peripatry:

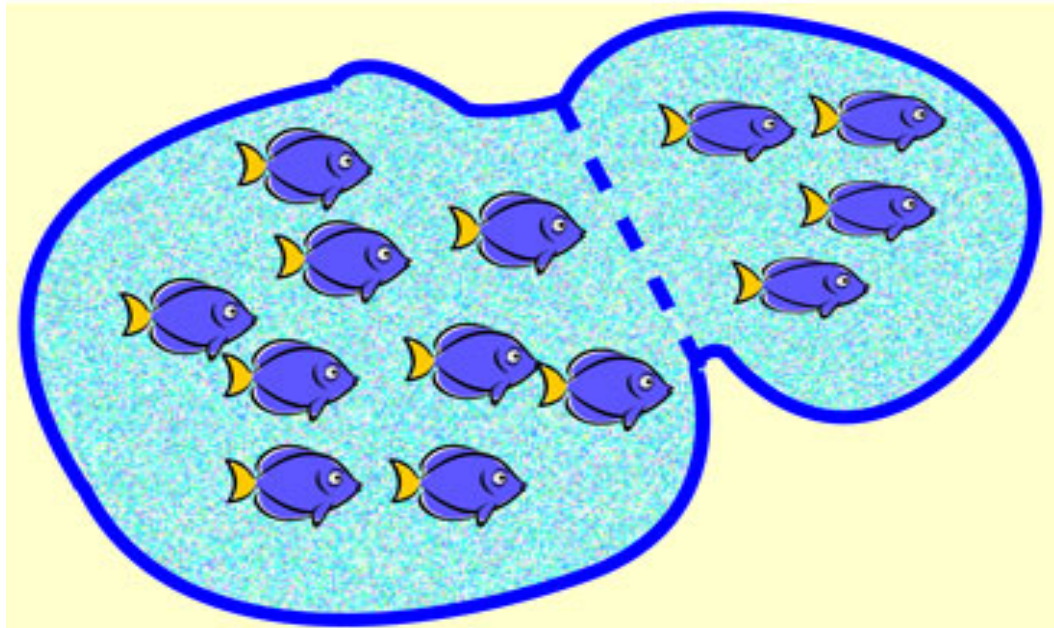
Varieties differ at the edge of the range
Become species similarly to allopatry

Parapatry:

Variation evolves at the edge of the range
Become species similarly to sympatry

Parapatric speciation

- Parapatric Speciation happens when a population covers a large, continuous geographic area.
- Although the sub-populations at both ends of the geographic range are technically connected, they are more likely to mate with each other.
- They may also experience different environmental conditions leading to different selective pressures.



Peripatry:

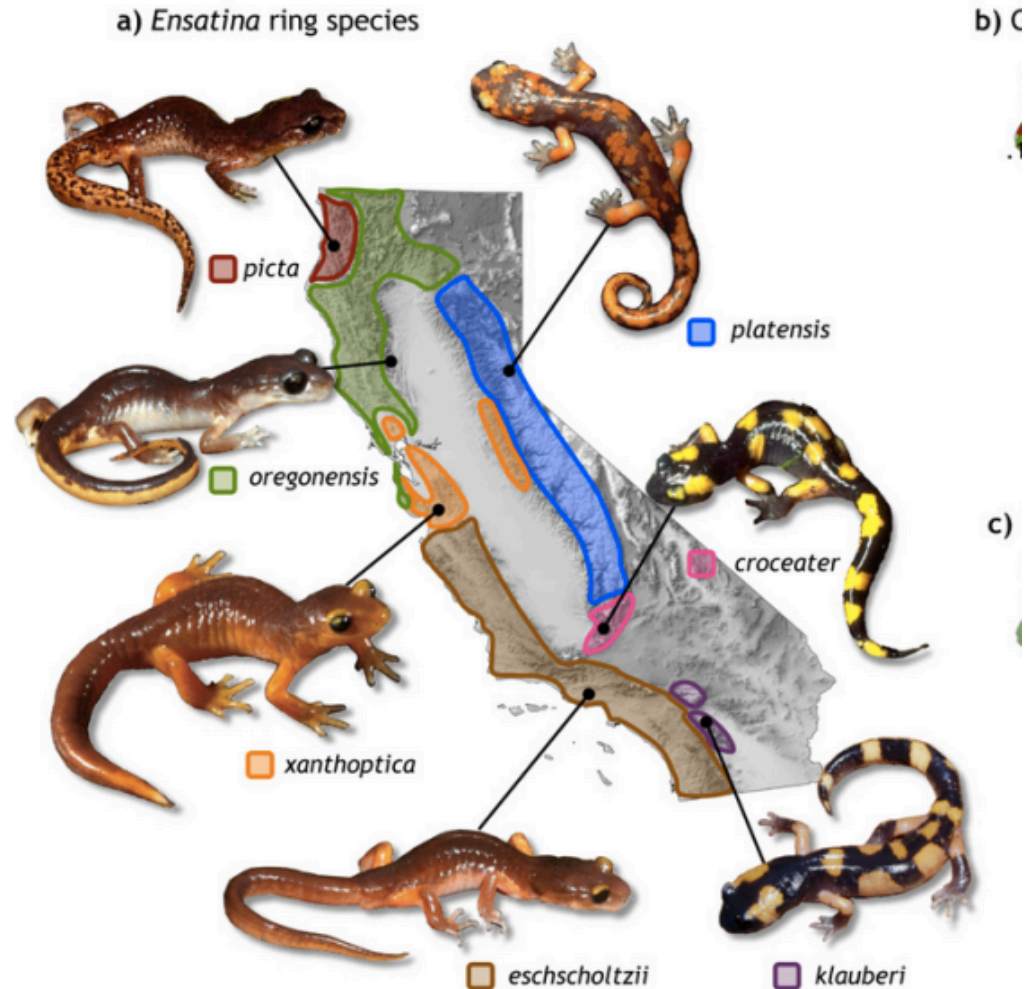
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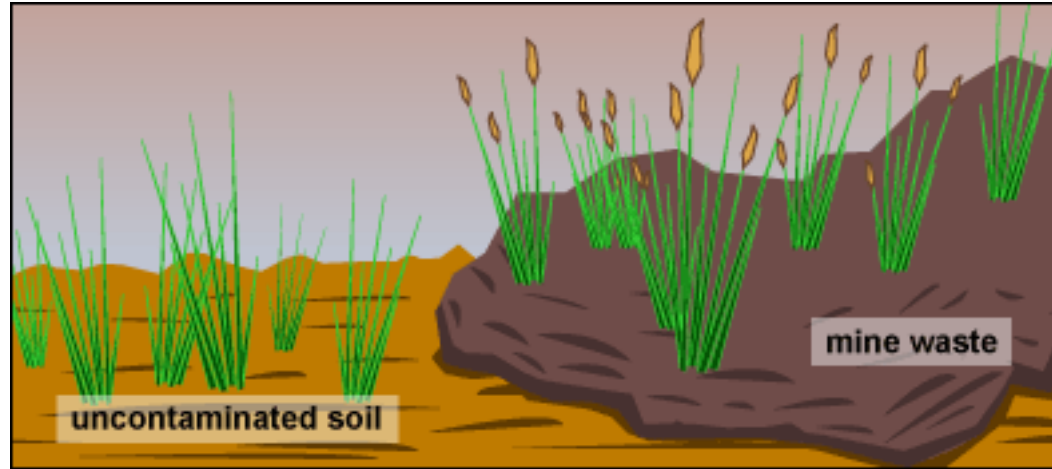
Parapatric speciation

- The classic example of parapatric speciation comes from the existence of ring species.
- There is now some doubt as to whether ring species are a real phenomenon.



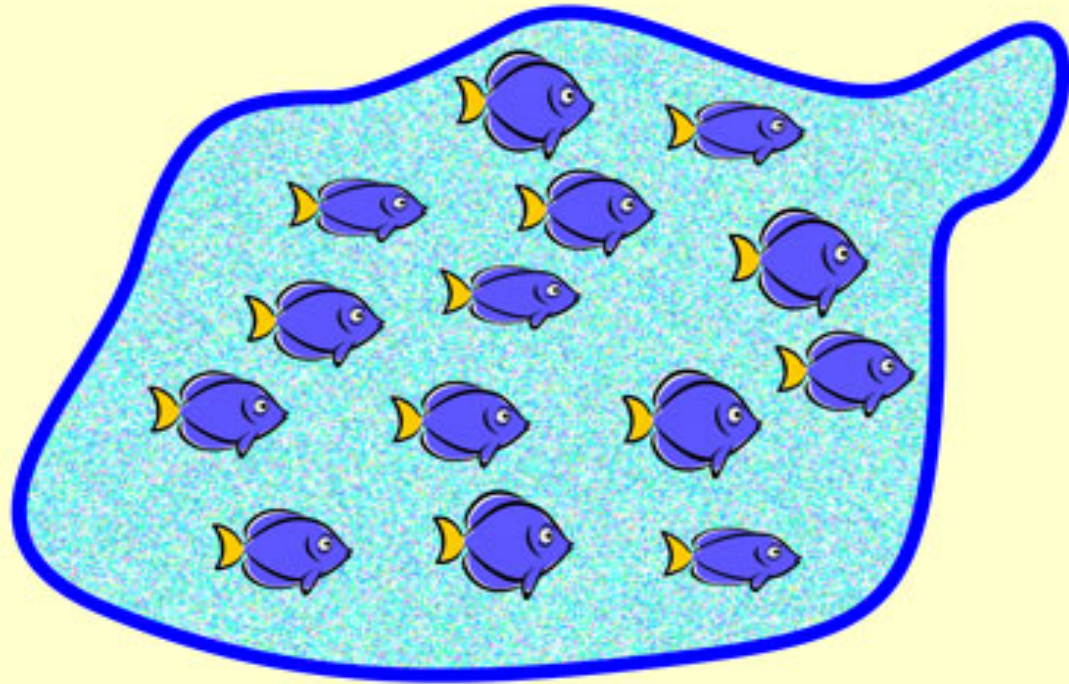
Parapatric speciation

- Nevertheless, parapatric speciation is real, and is predicted by basic ecological gradient/niche theory.
- We will discuss this more later on in the course.



Sympatric speciation

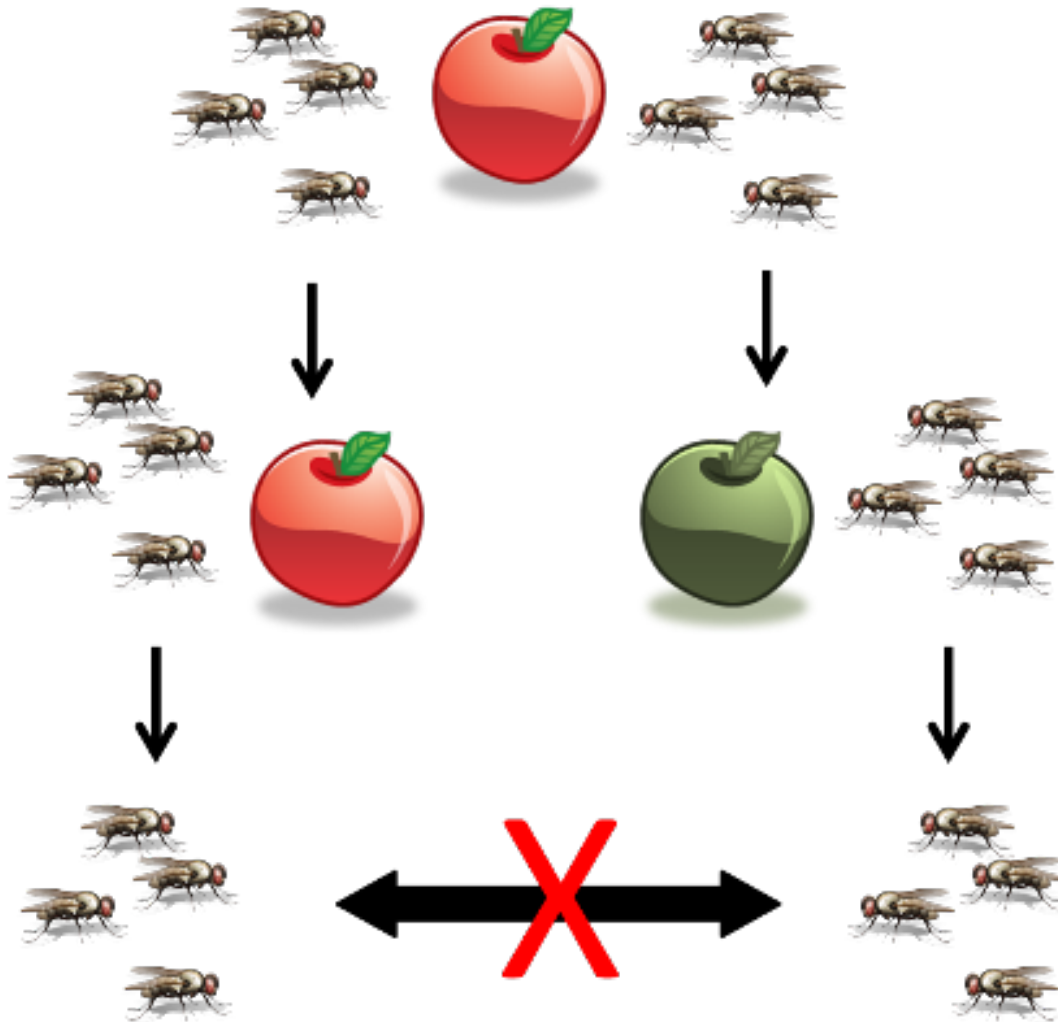
- Sympatric speciation is very similar to parapatric speciation.
- It represents speciation within a single population that is not geographically widespread



Sympatry:

Many varieties in one range
Become species through adaptation
to different aspects of the range

Classic sympatric speciation example



We probably should not distinguish

- Both sympatry and parapatry are both characterized by three criteria
 - A single geographically continuous population.
 - Non-random mating habits.
 - Different environmental conditions within the population's range.
- You may also hear about stasipatric speciation, which is a rarely used term because it is effectively equivalent to parapatry and sympatry.