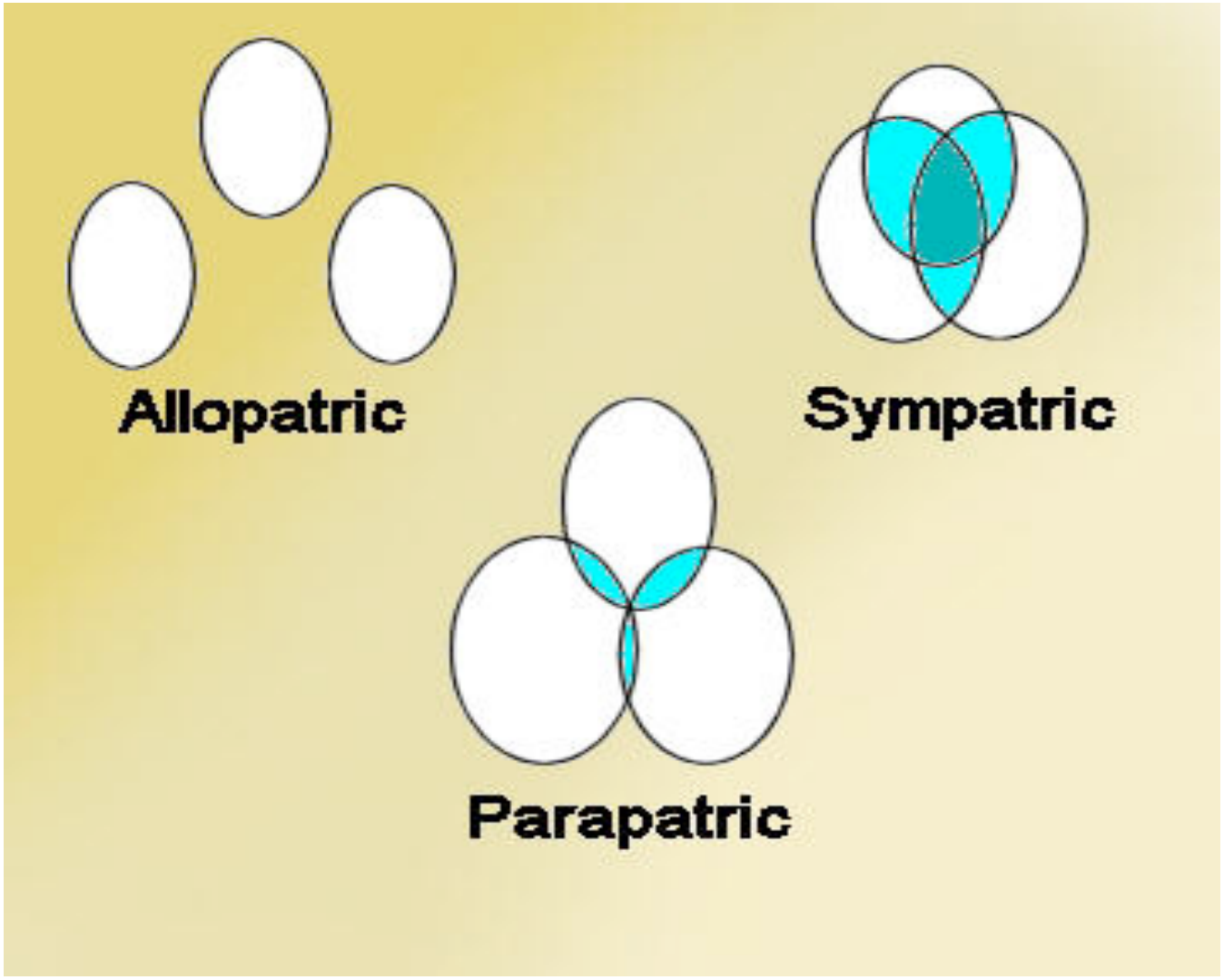
Hot off the press….

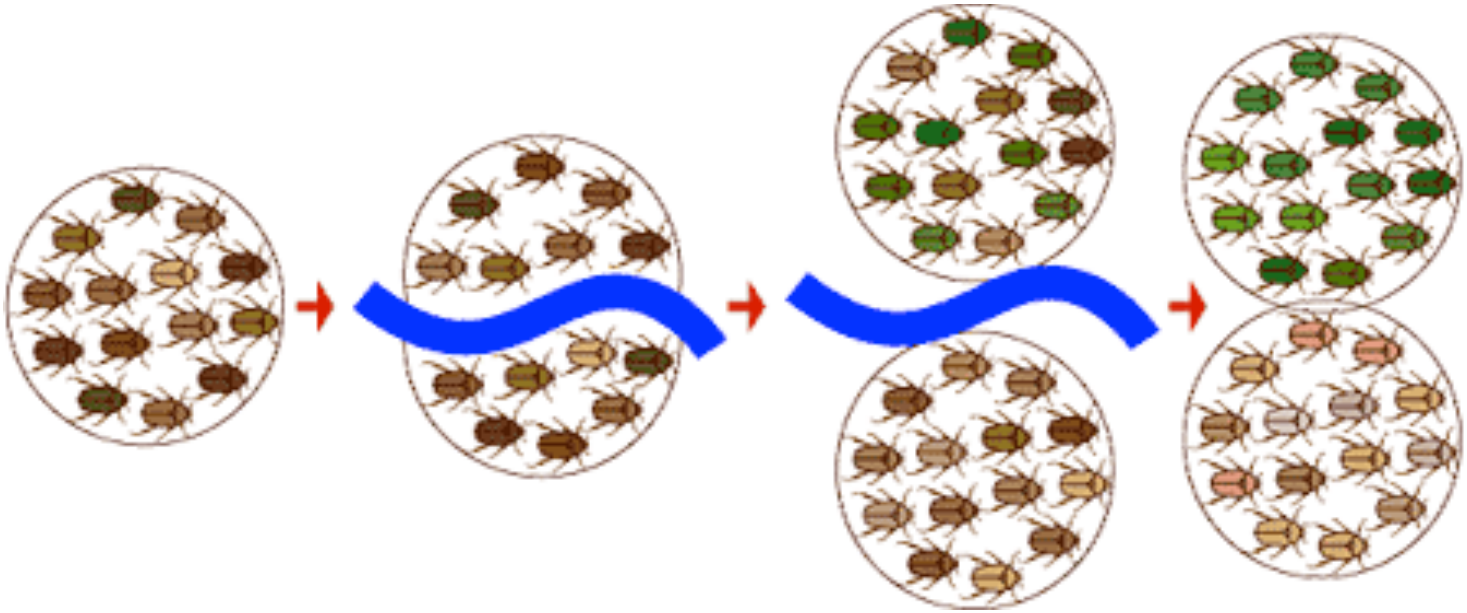

A consequence of El Nino?

Modes of Speciation

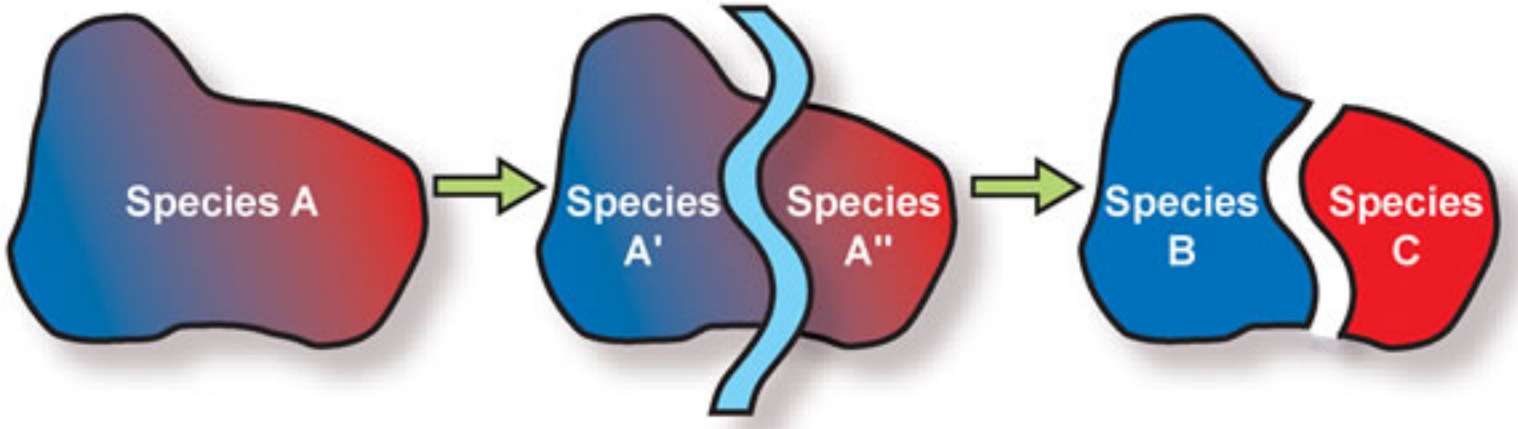


Allopatric Speciation

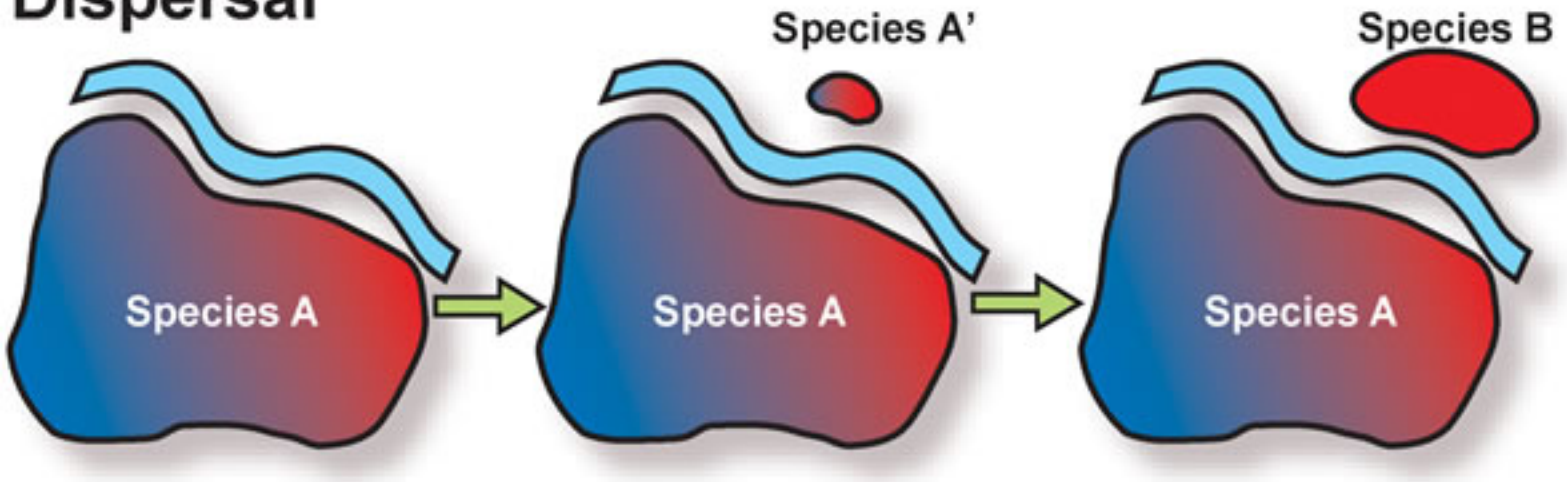
Geographic isolation cuts off gene flow between populations and leads to the formation of reproductive barriers



Vicariance



Dispersal



Ancestral population

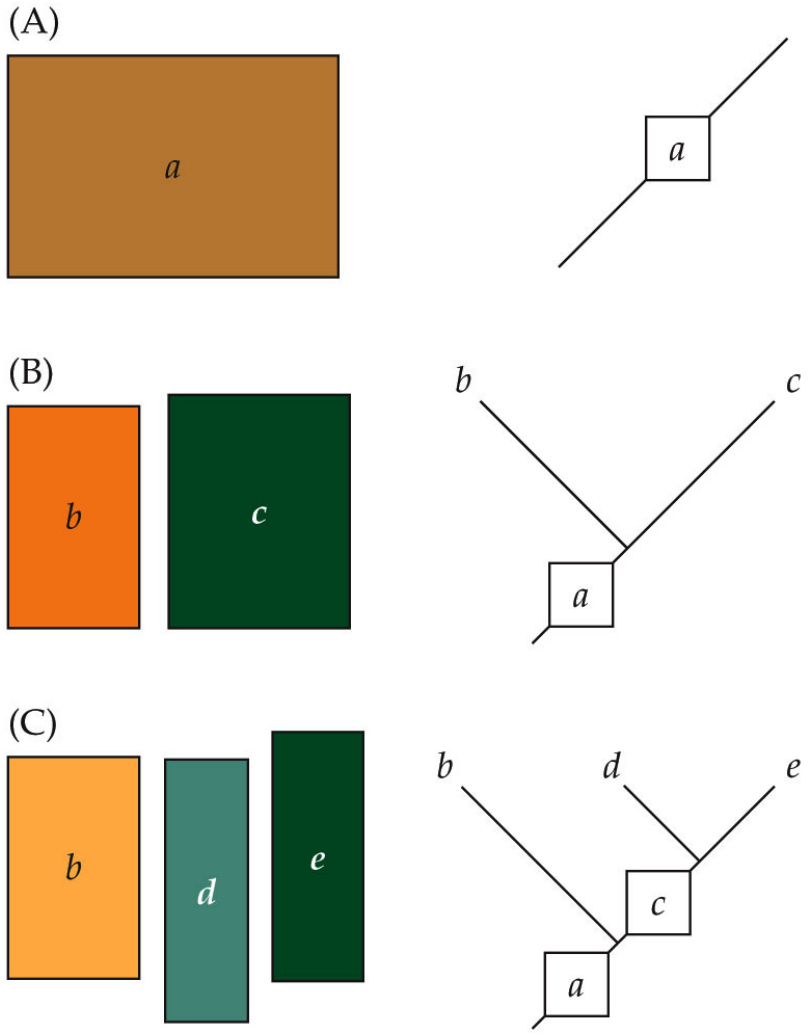
Geographic Isolation

Speciation

An illustration of allopatric speciation through vicariance.

Species *a* lives in a continuous geographic range (think about a continental mass). Then, that range is separated into two ranges. The populations diverge, forming new Species *b* and *c*.

At a later time, the range inhabited by Species *c* is subdivided. This results in the divergence of Species *c* into new Species *d* and *e*.

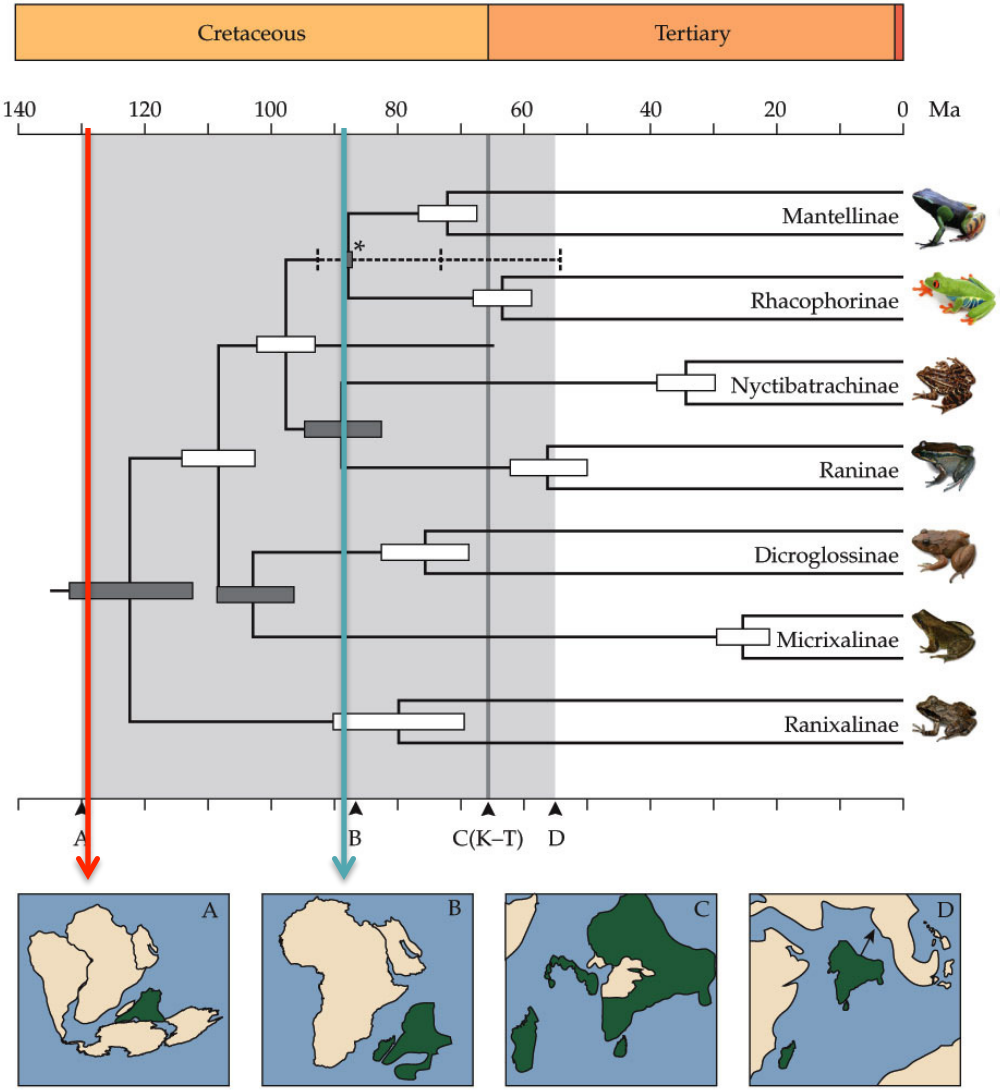


Allopatric speciation: **Vicariance**

Grand Canyon (AZ) as barrier

Allopatric speciation: **Vicariance**

Gondwanaland breakup and the family Ranidae …

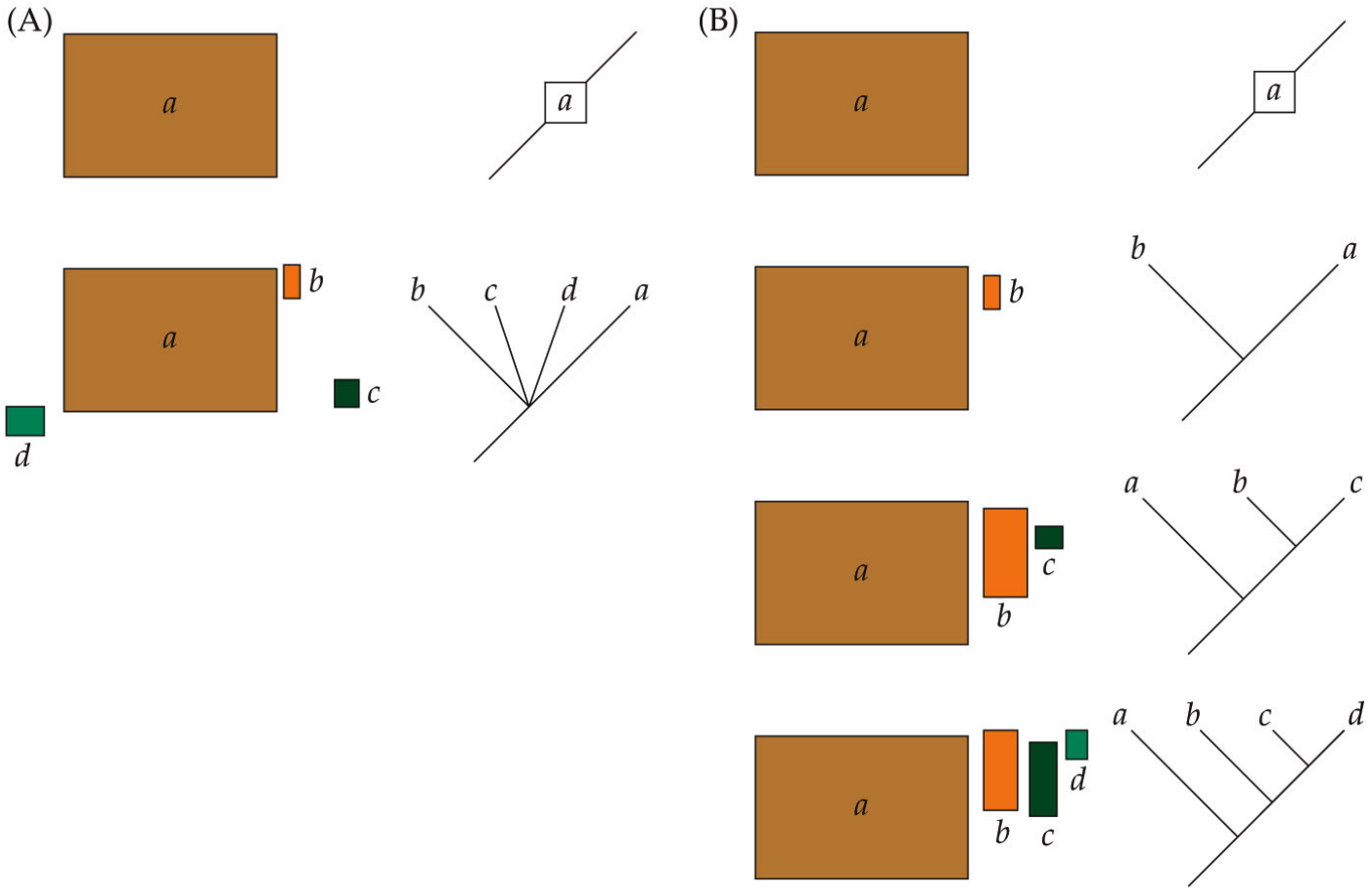


Madagascar

India/Seychelles

BIOGEOGRAPHY, 4e, Figure 7.13

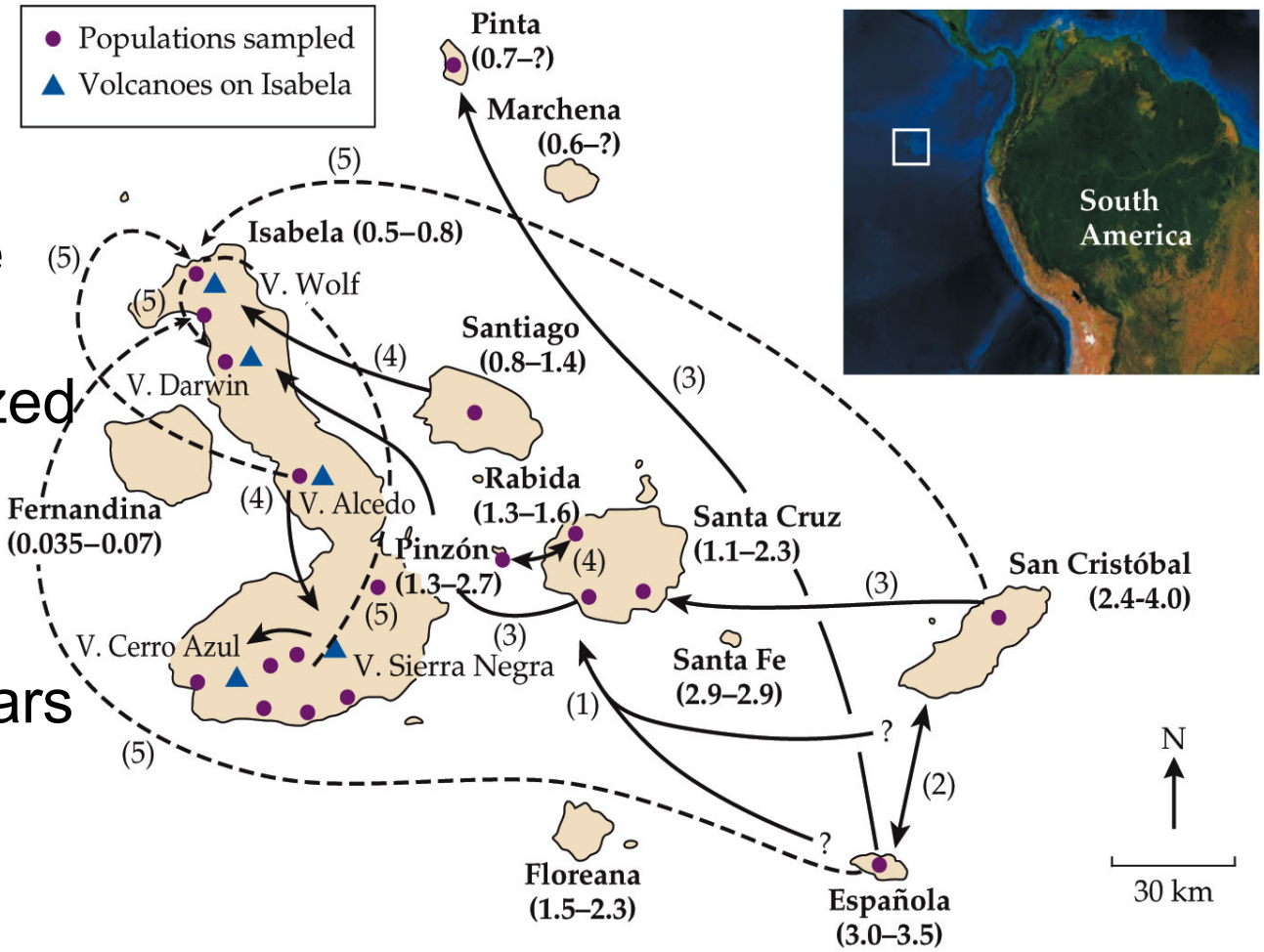
Allopatric speciation: **Dispersal** (= “peripheral isolates”)



Allopatric speciation: **Dispersal**

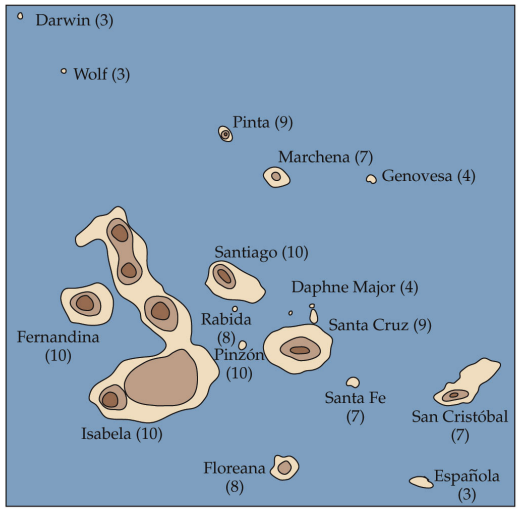
The proposed phylogeographic history of Galapagos tortoises

Immigrants from the mainland of South America first colonized the large islands of San Cristobal and Espanola, probably some 2-3 million years ago.



BIOGEOGRAPHY, 4e, Figure 7.15

On the other hand, Darwin's finches in the Galapagos have reached the final stages of speciation. All are probably derived from a single ancestral population, also probably arriving at the Galapagos some 2-3 million years ago.

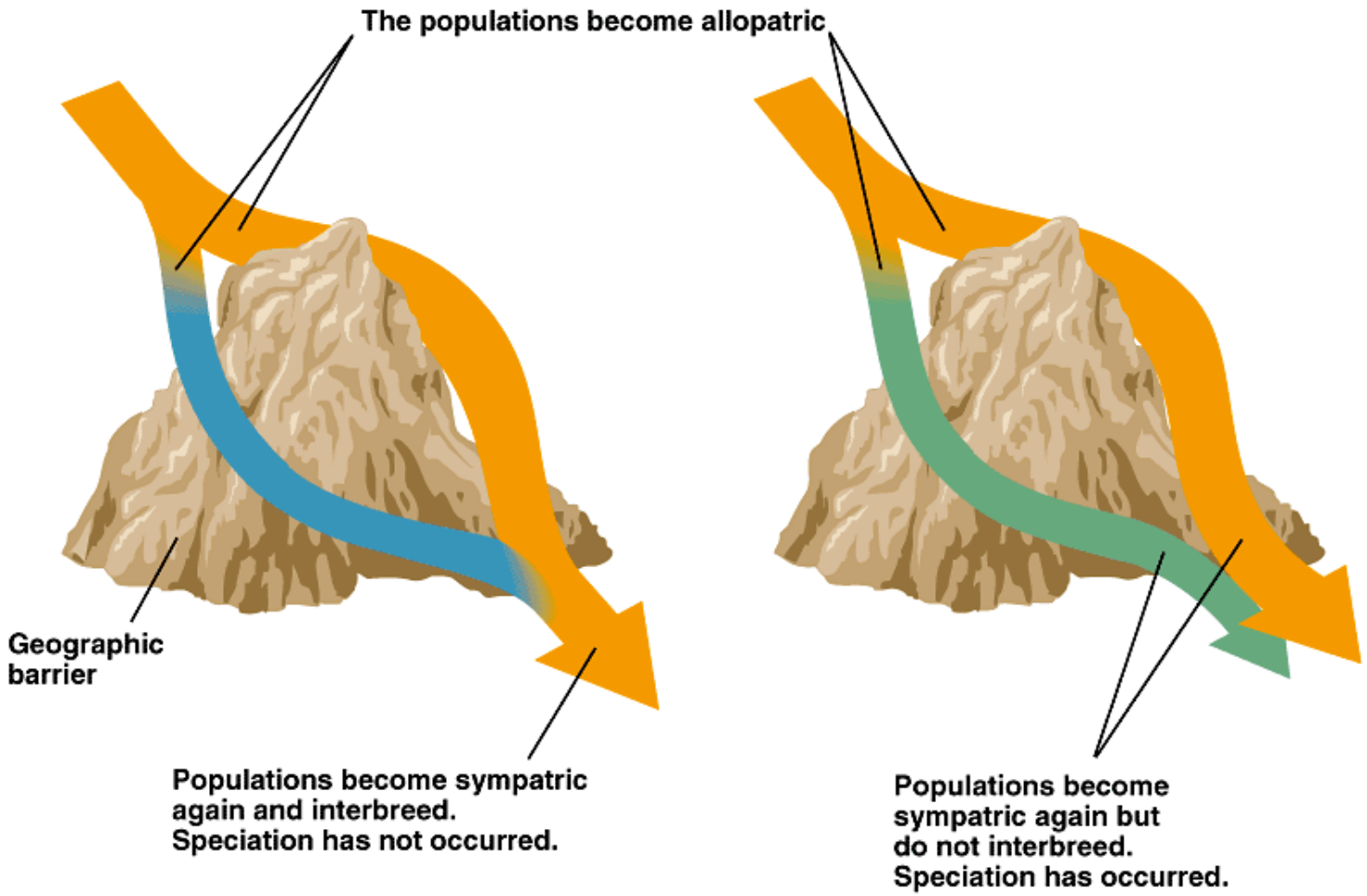


BIOGEOGRAPHY, 4e, Figure 7.16 (Part 1)

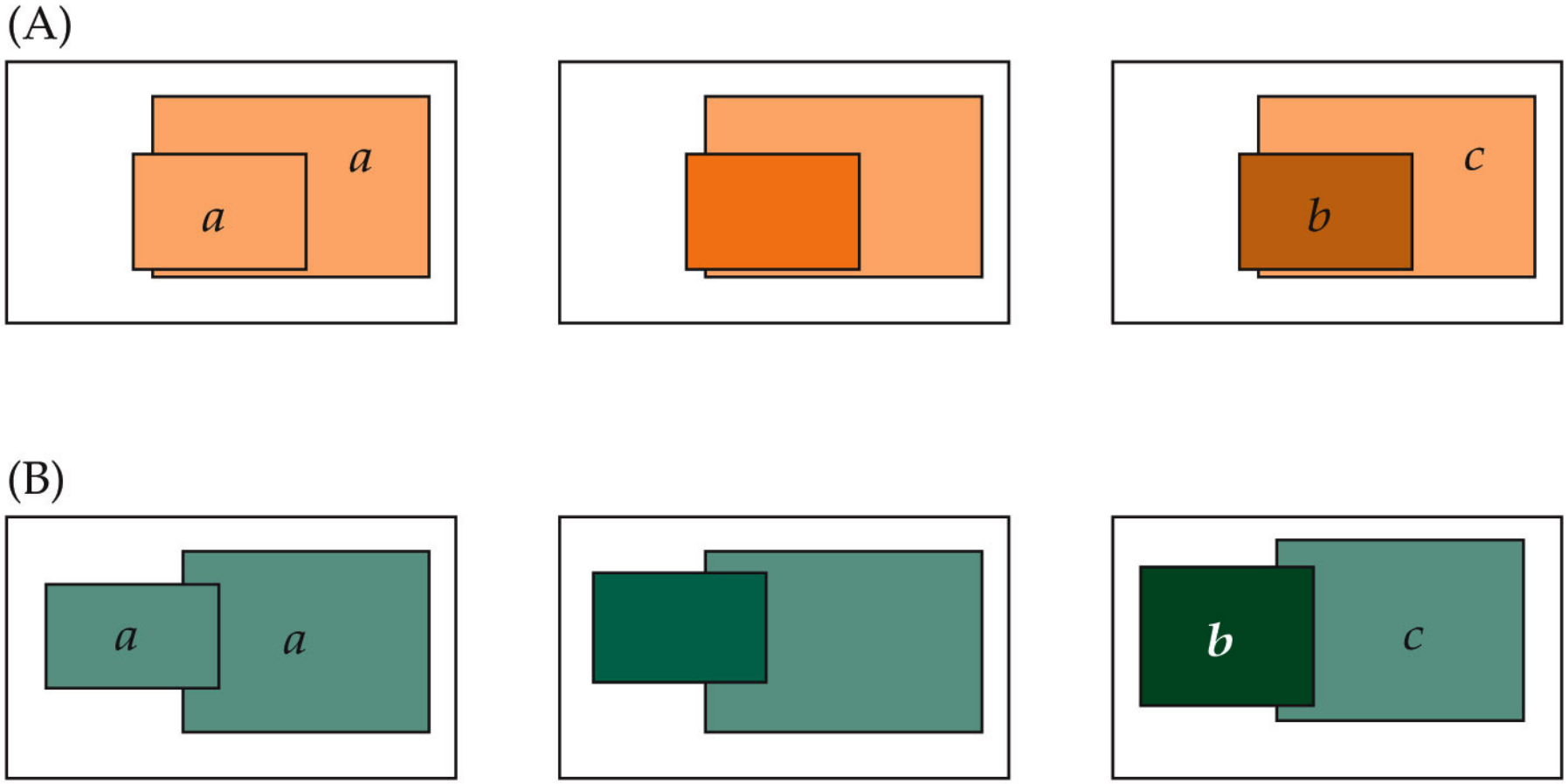
BIOGEOGRAPHY, 4e, Figure 7.16 (Part 2)

What if previously isolated populations get together again?

i.e. “secondary contact”



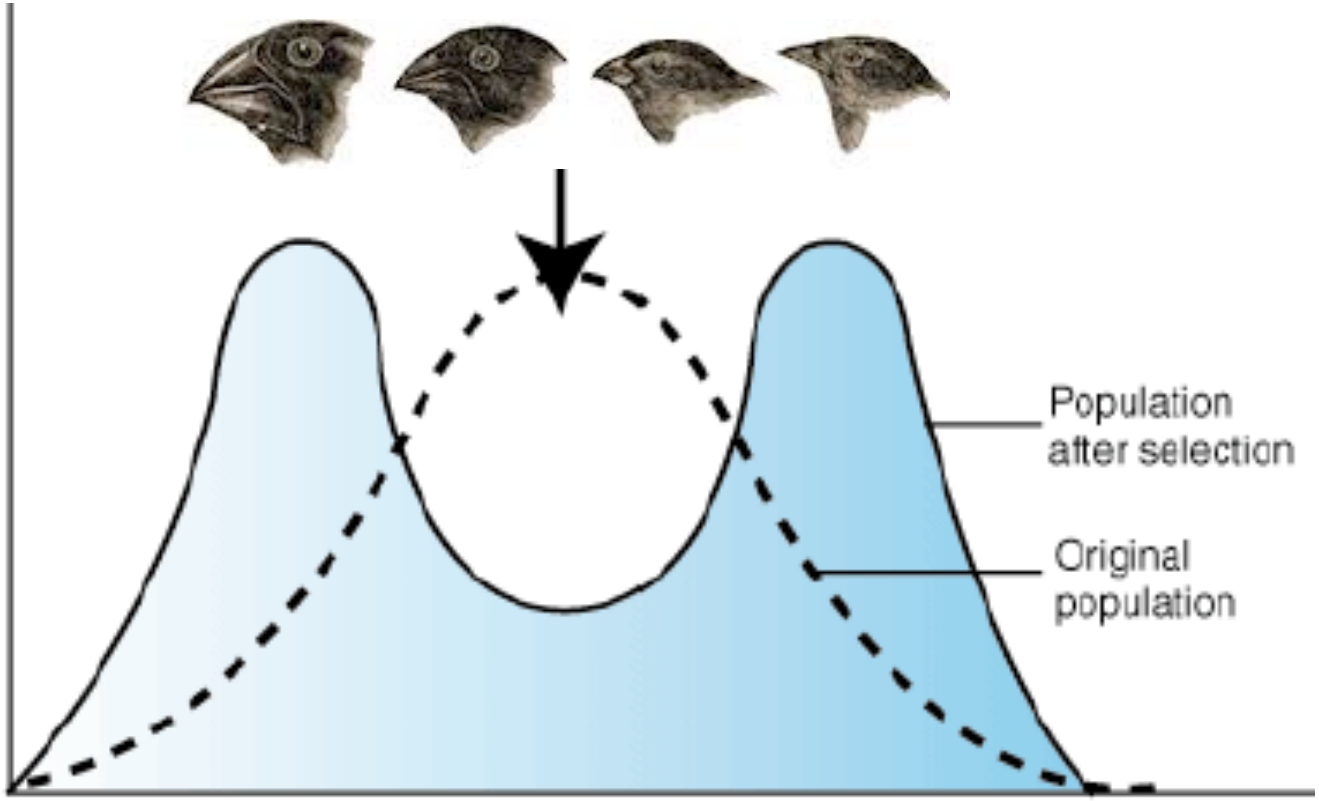
Sympatric speciation (A) and Parapatric speciation (B).



Sympatric and parapatric speciation

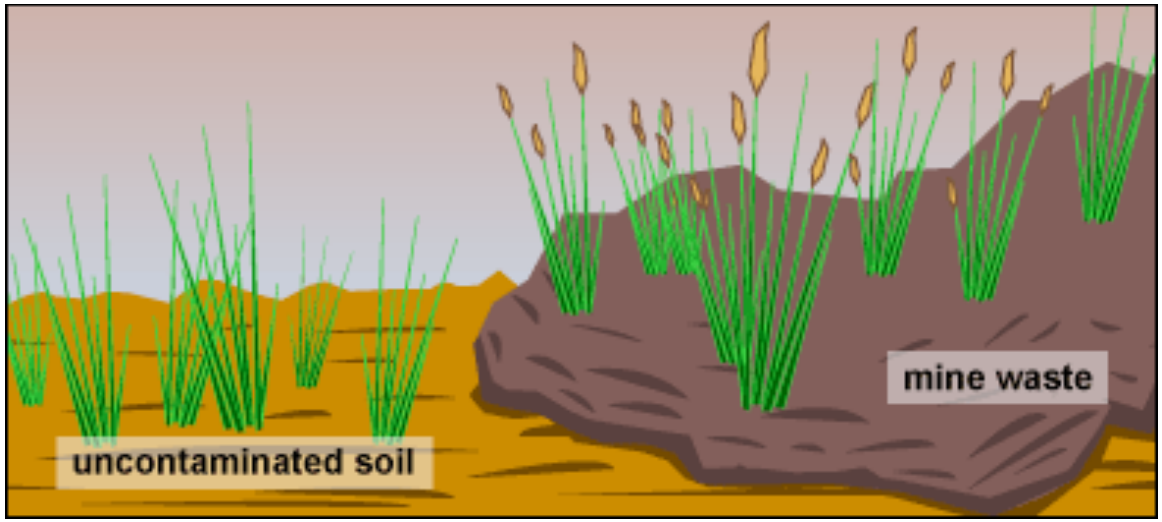
How to overcome gene flow in a population?

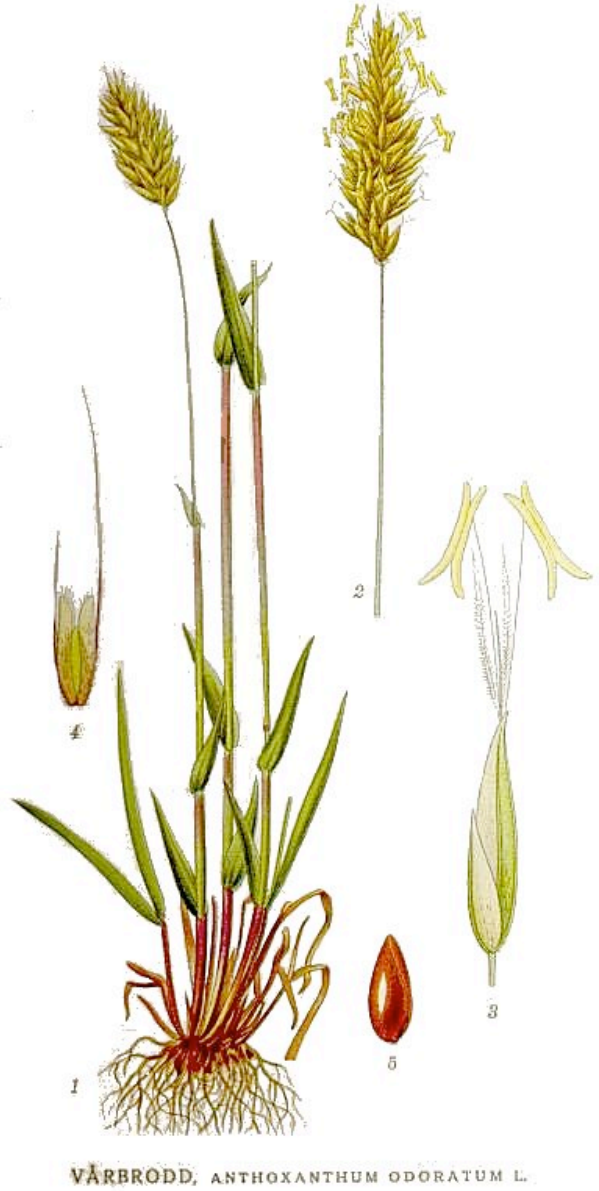
1. Disruptive selection: selection that favors the extreme traits in a population

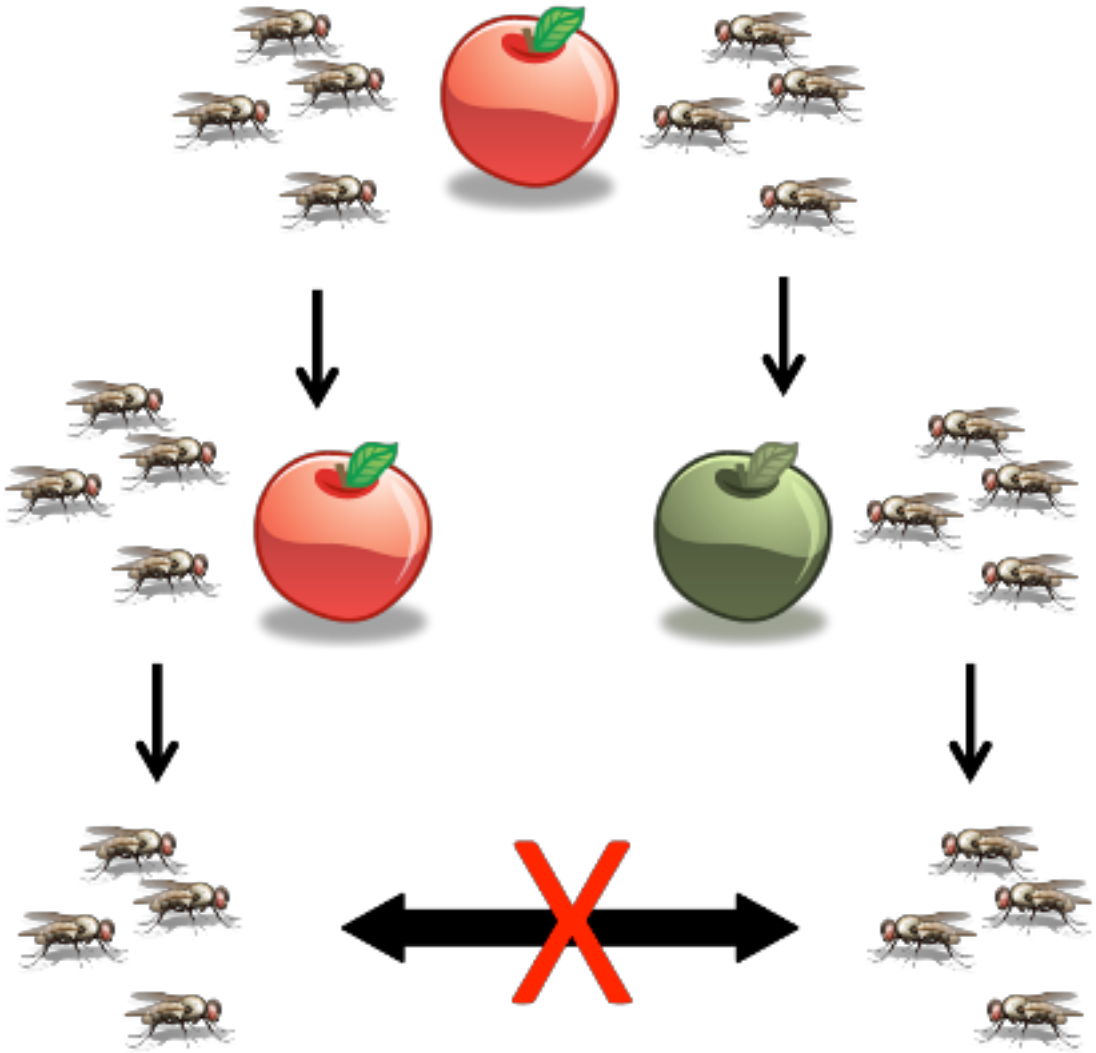


Parapatric speciation ???

Sweet Vernal Grass
(*Anthoxanum odoratum*)



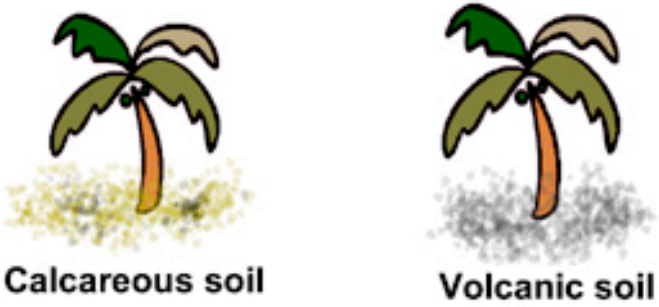




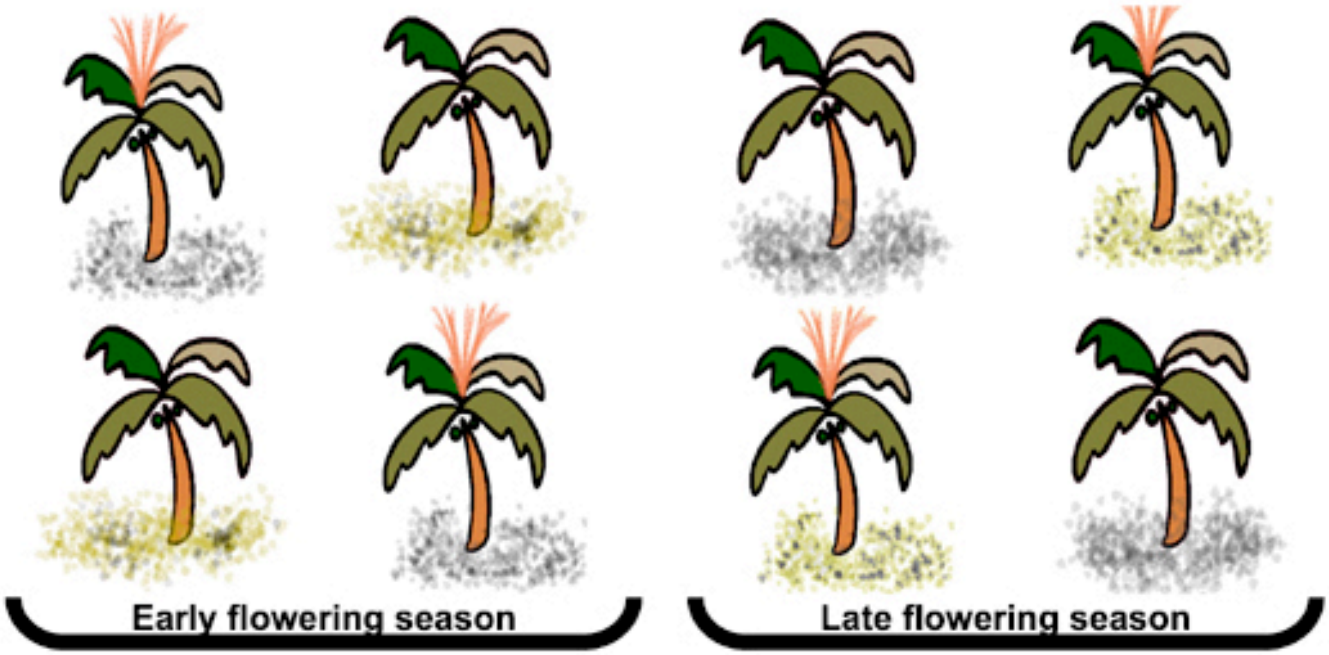
Disruptive selection

Savolainen et al.
Nature, 2006, 441, 210-213

Some palms survive better in volcanic acidic soils whereas others perform better in basic calcareous soils



Assortative mating



Palms growing in calcareous soil tend to flower later than palms growing in volcanic soils

TABLE 7.2 *Distribution of More than 1400 Cichlid Species in 12 African Lakes, Representing about 60 Percent of the Global Cichlid Species Richness*

Location	Number of known species	Estimated age of basin (Myrs)	Major radiating lineages
Malawi	600	8.6	Haplochromine
Victoria	>500	0.4	Haplochromine
Tanganyika	180	~20	Several
Edward	60	2.0	Haplochromine
Kivu	16	5.0	Haplochromine
Barombi Mbo	11	~1	Tilapiine
Kyoga	>10	0.4	Haplochromine
Albert	10	2.0	Haplochromine
Bermin	9	0.8	Tilapiine
Ejagham	7	0.01	Tilapiine
Mweru	6	0.35	Haplochromine
Natron	5	1.0	Tilapiine

Source: After Turner 2007.

Haplochromis fenestratus
Generalized algae eater

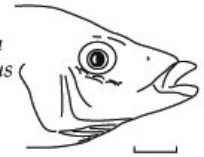
Petrotilapia tridentiger
Rock scraper

Haplochromis guentheri
Algal filament picker

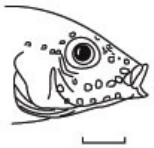
Cyathochromis obliquidens
Rock and leaf scraper

Labeotropheus fuelleborni
Rock scraper

Hemitilapia oxyrhynchus
Plant scraper

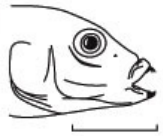


Aulonocara nyassae
Arthropod picker

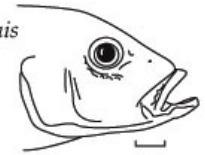


Docimodus johnstoni
Fin biter

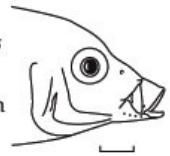
Labidochromis vellicans
Arthropod picker



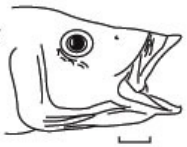
Haplochromis pardalis
Fish eater



Haplochromis cyaneus
Zooplankton feeder



Haplochromis polyodon
Fish eater



Pseudotropheus tropheops
Rock scraper

Haplochromis similis
Leaf chopper

Pseudotropheus zebra
Rock scraper

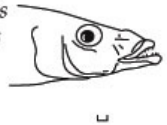
Haplochromis euchilus
Rock-probing insect eater

Pseudotropheus fuscus
Rock scraper

Lethrinops brevis
Sand-digging insect eater

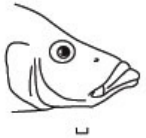
Cynotilapia afra
Zooplankton feeder

Rhamphochromis macrophthalmus
Fish eater

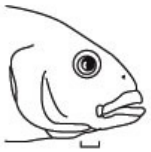


Genyochromis mento
Scale eater

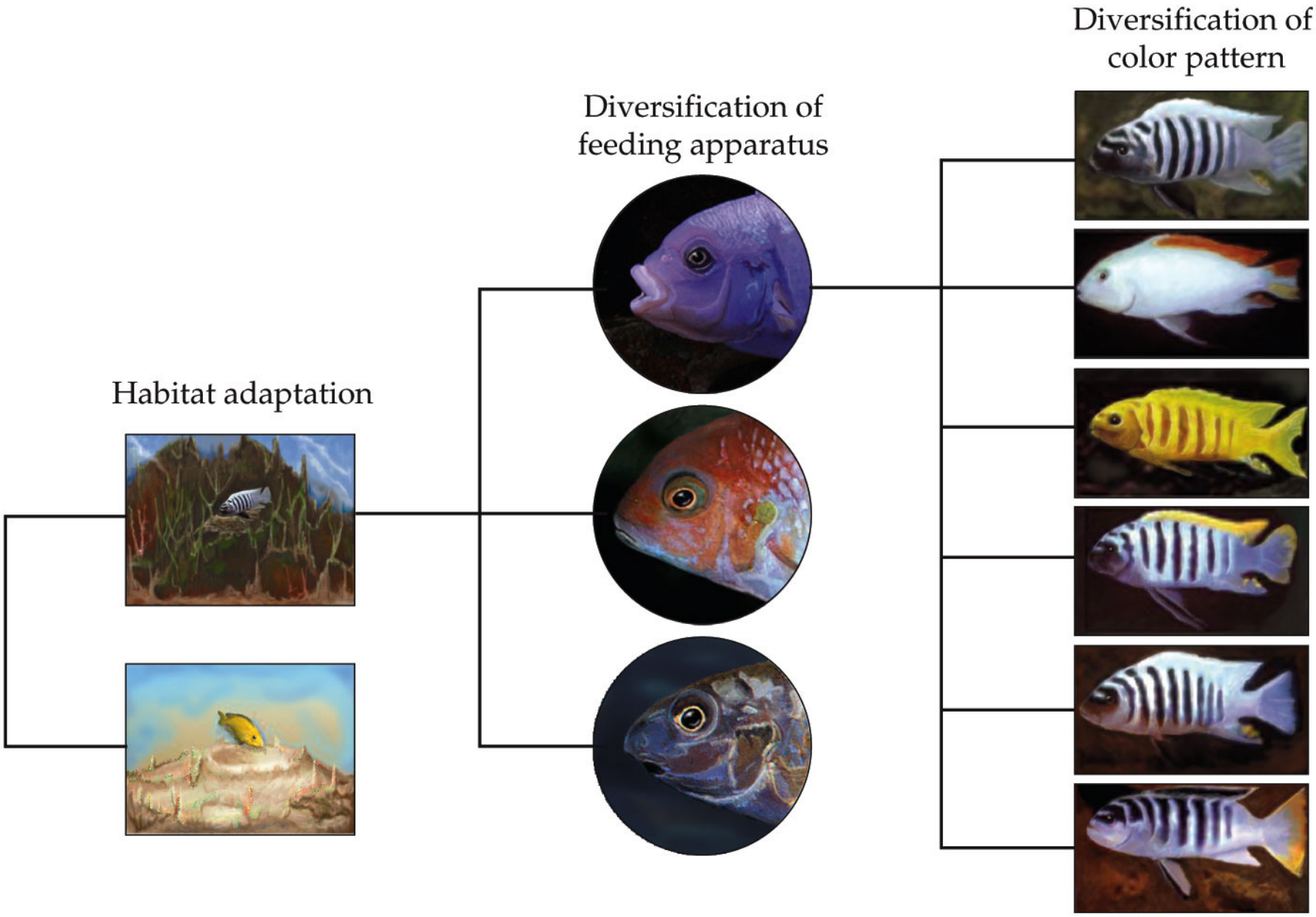
Haplochromis compressiceps
Fish eater and eye biter



Corematodus shiranus
Scale eater



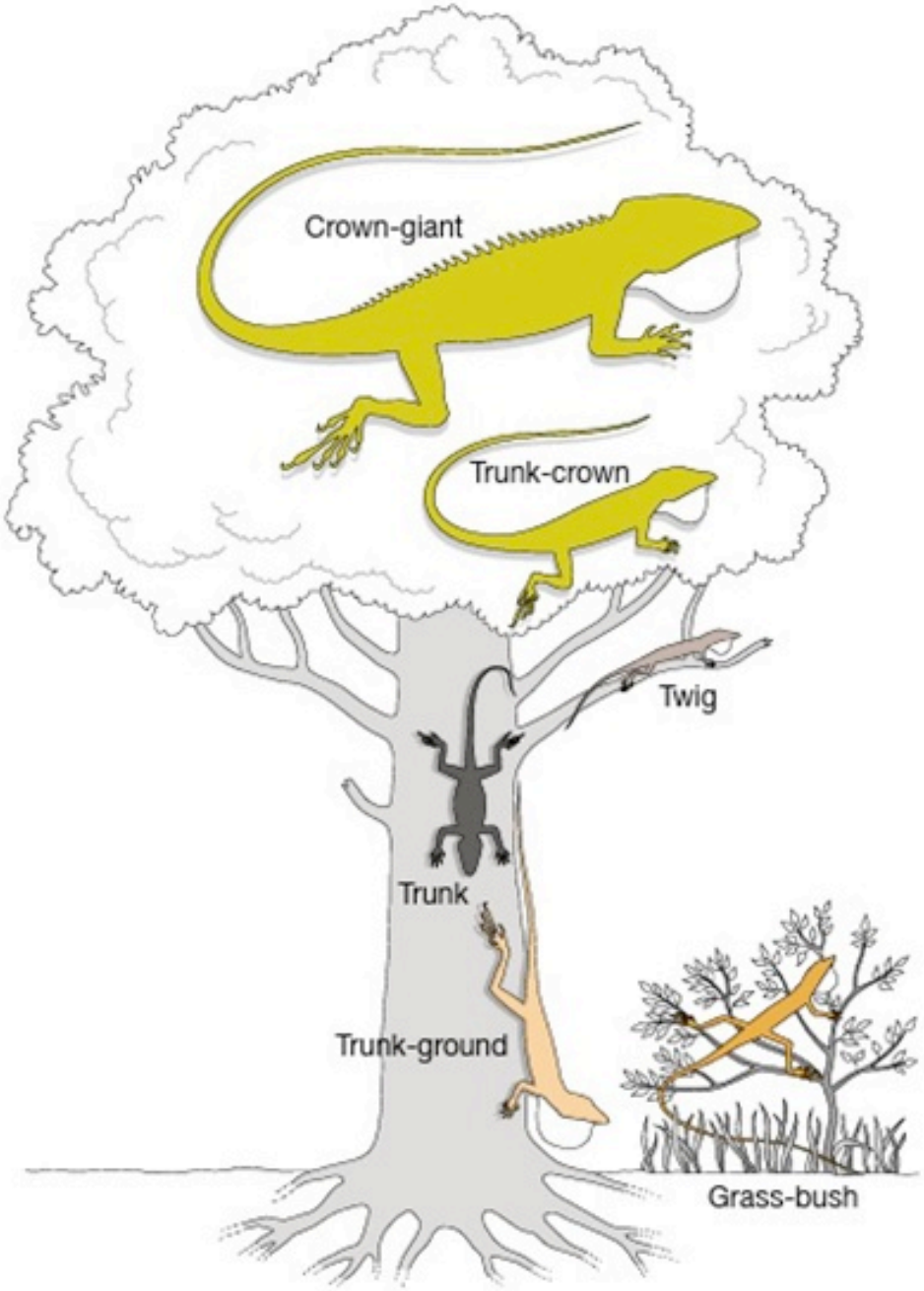
All scale lines (⌴) = 1 cm



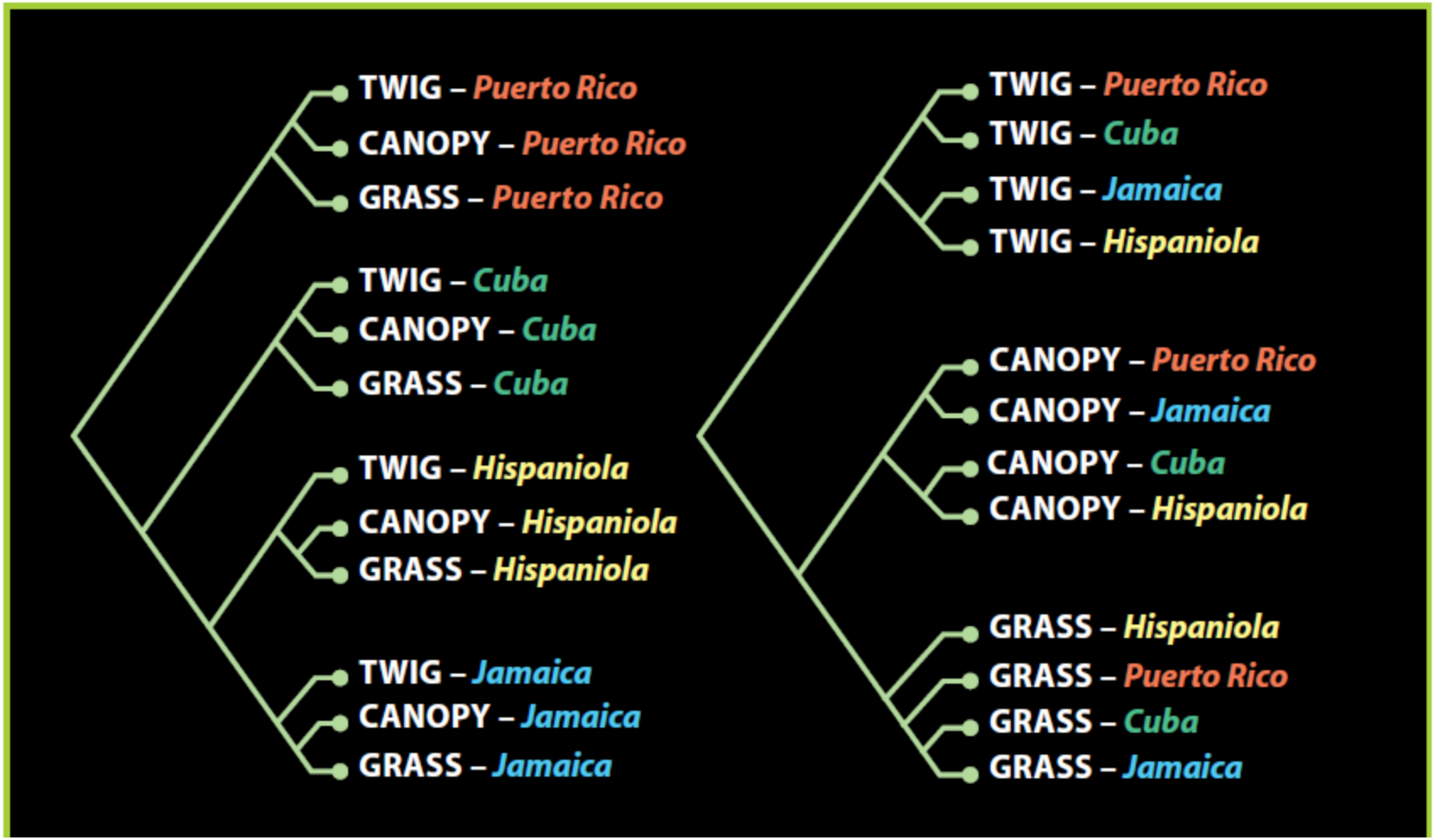
***BIOGEOGRAPHY, 4e*, Figure 7.22**

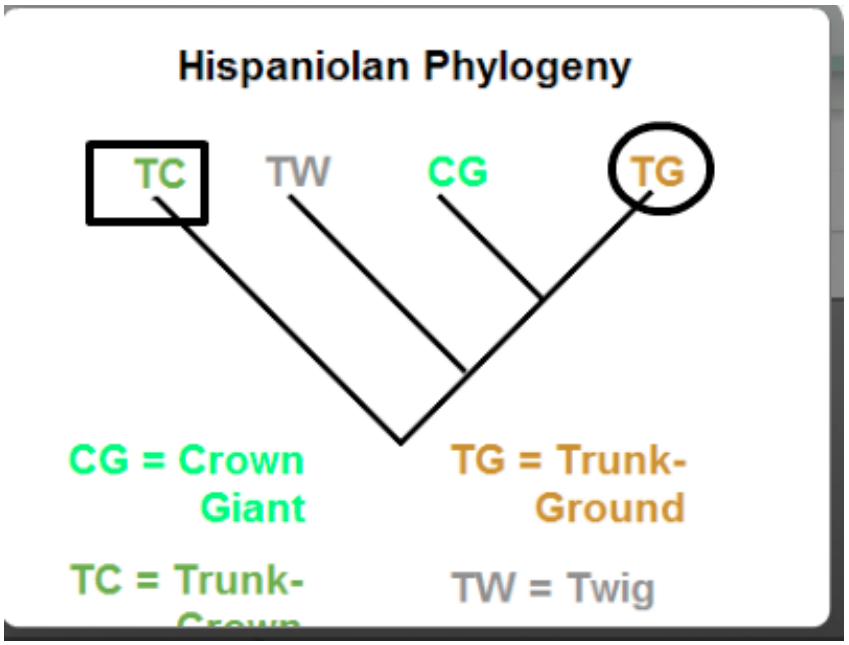
Ecological speciation

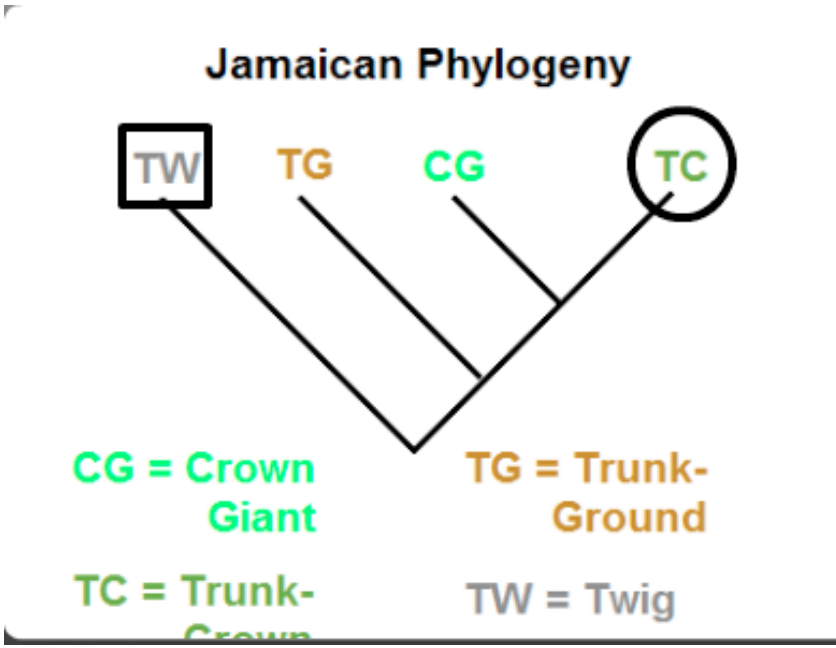
- The evolution of reproductive isolation between populations as a result of ecologically-based divergent natural selection.
  - An alternative to the allopatric-sympatric dichotomy
  - More species of anole on a given Caribbean island like Cuba than can be accounted for via isolation events

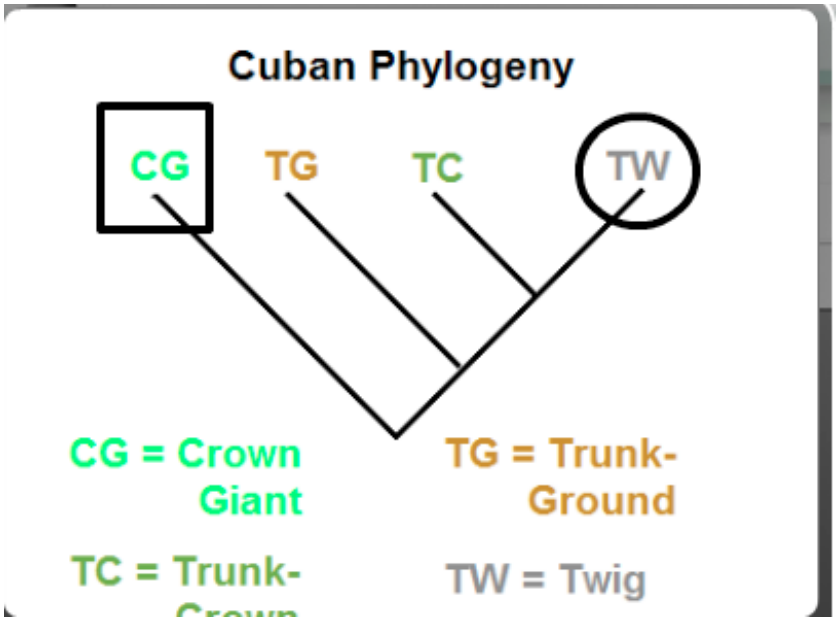


From Losos (2009). *Lizards in an Evolutionary Tree*


TWIG – Puerto Rico
CANOPY – Puerto Rico
GRASS – Puerto Rico
TWIG – Cuba
CANOPY – Cuba
GRASS – Cuba
TWIG – Hispaniola
CANOPY – Hispaniola
GRASS – Hispaniola
TWIG – Jamaica
CANOPY – Jamaica
GRASS – Jamaica
TWIG – Puerto Rico
TWIG – Cuba
TWIG – Jamaica
TWIG – Hispaniola
CANOPY – Puerto Rico
CANOPY – Jamaica
CANOPY – Cuba
CANOPY – Hispaniola
GRASS – Hispaniola
GRASS – Puerto Rico
GRASS – Cuba
GRASS – Jamaica





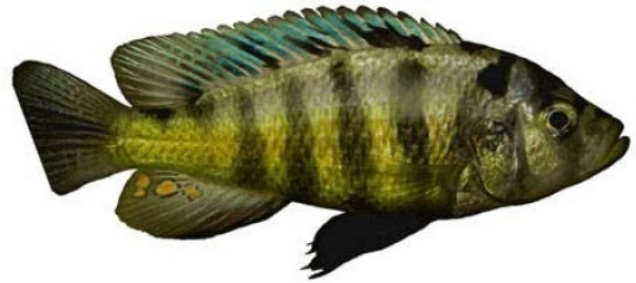


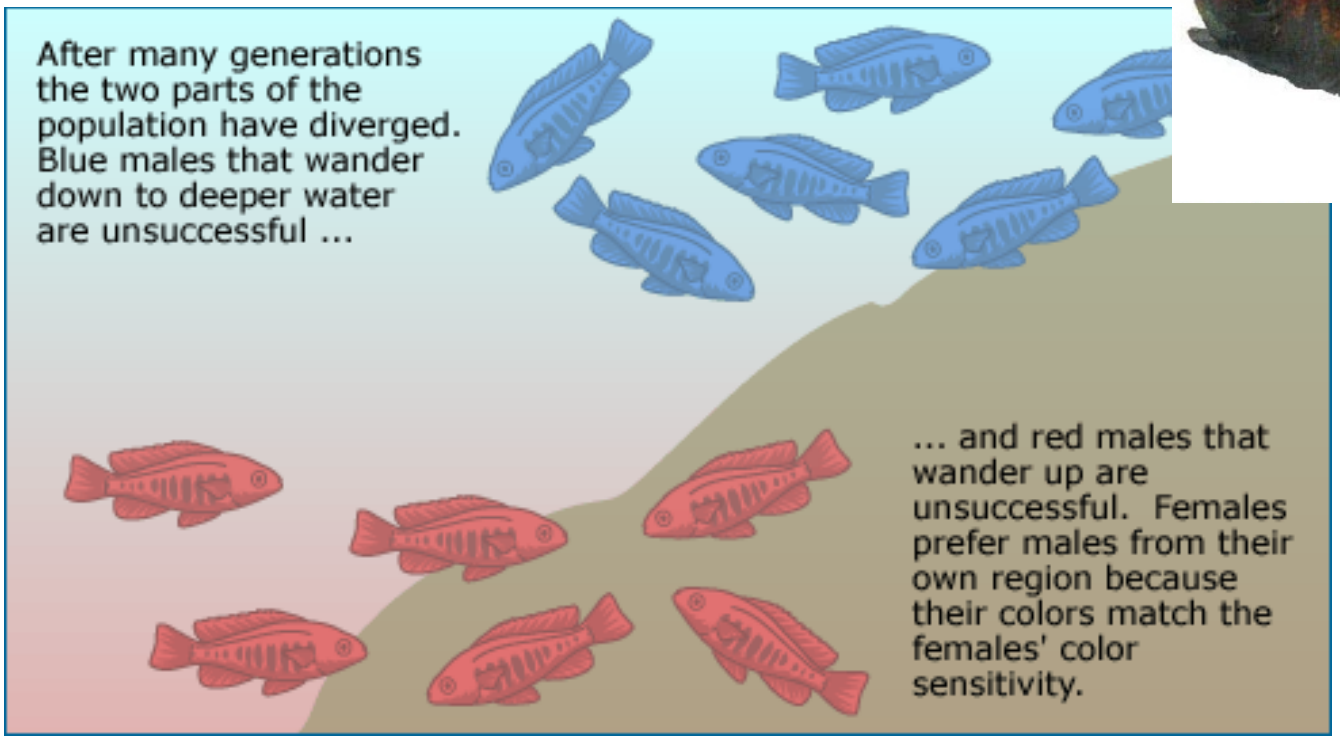
Exceptional Convergence on the Macroevolutionary Landscape in Island Lizard Radiations

D. Luke Mahler, Travis Ingram, Liam J. Revell, Jonathan B. Losos

Science 19 July 2013,
341: 292-295

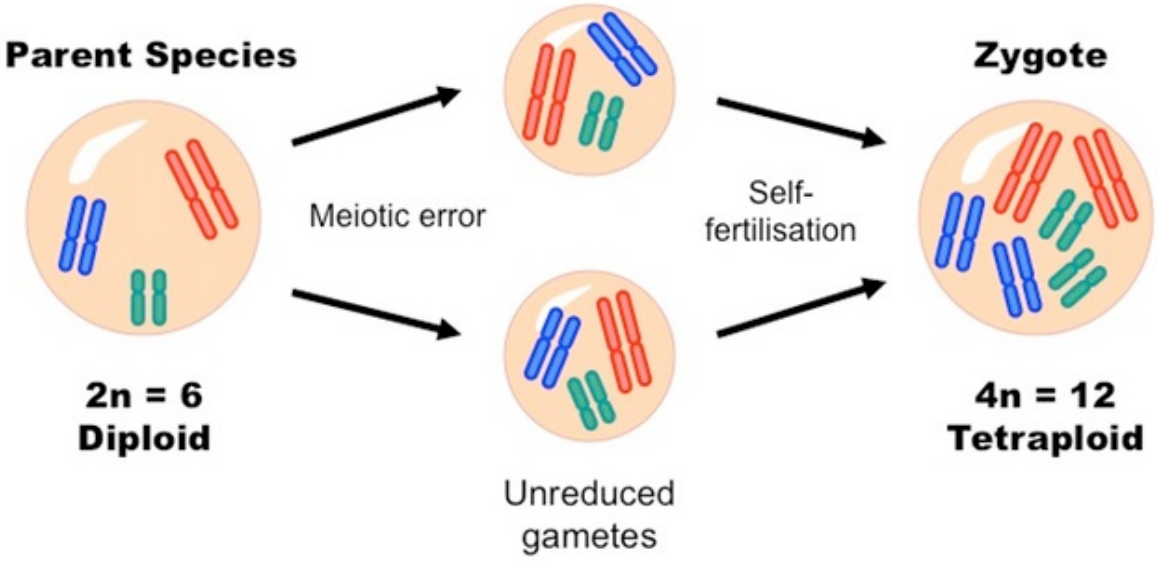
Red Fish, Blue Fish, One Fish Becomes Two Fish

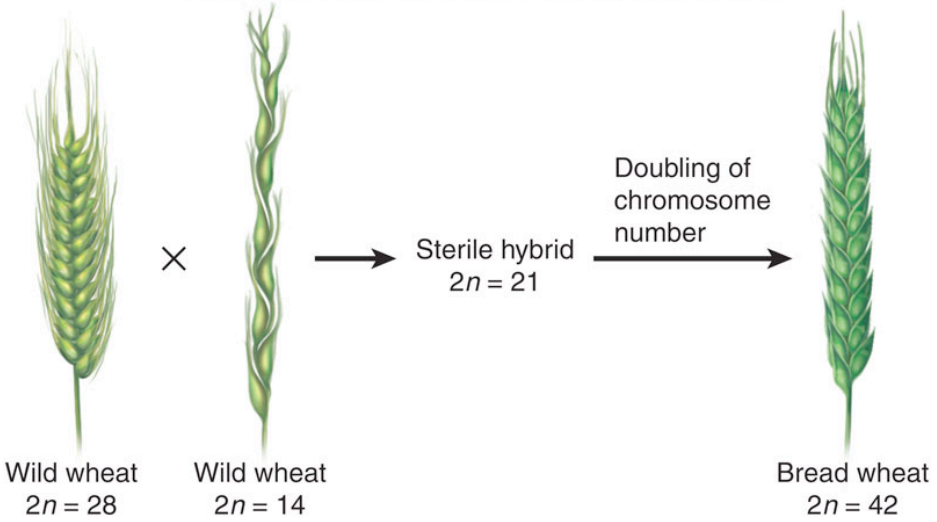


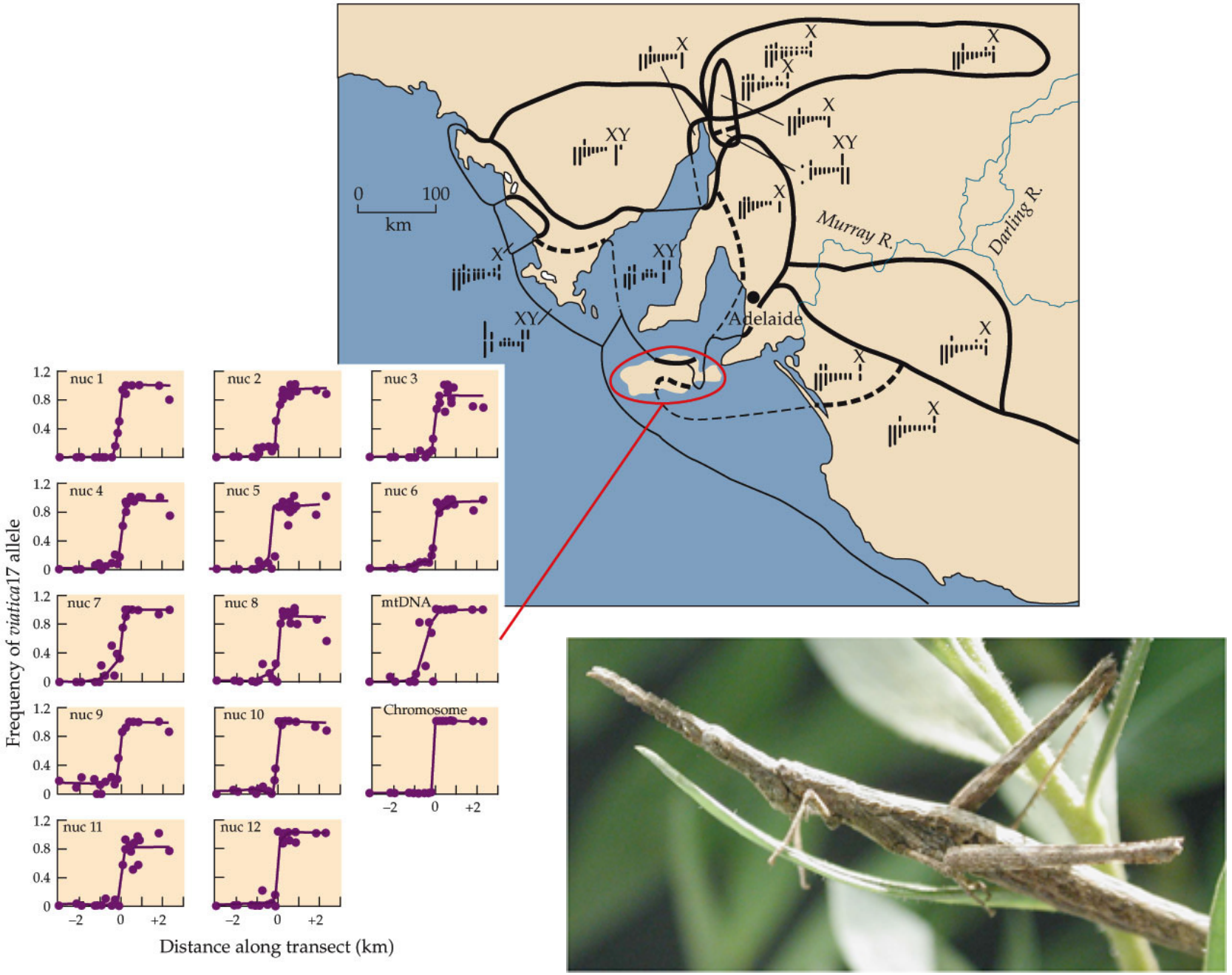


Seehausen et al. Nature, 2008 455, 620-626

2. Chromosomal changes: meiotic error can lead to speciation via polyploidy; may be fairly common in plants



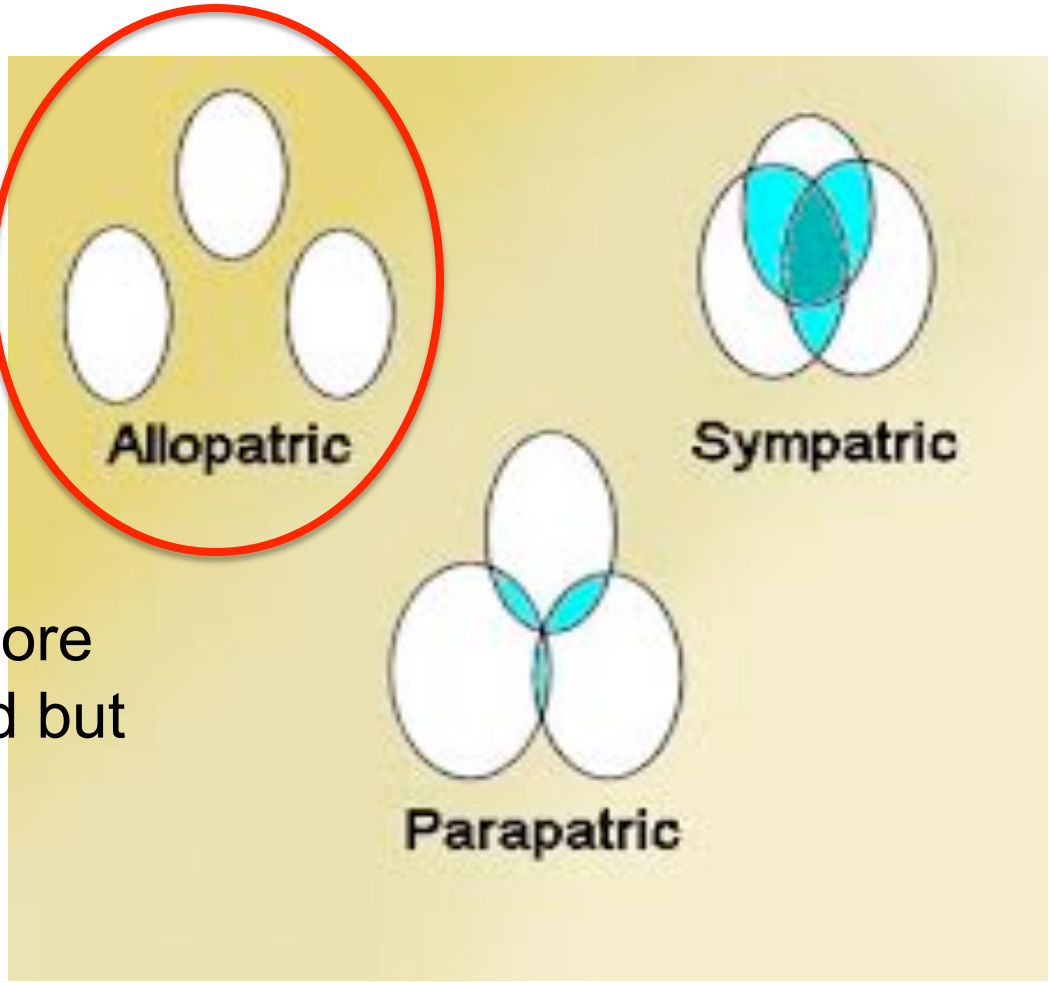




BIOGEOGRAPHY, 4e, Figure 7.20

Allopatric vs. Sympatric (& Parapatric) Speciation

--Allopatric speciation likely most predominant



-- Sympatric/parapatric speciation likely occurs more commonly than suspected but hard to detect

Adaptive Radiation

Causality attributed to ecological opportunity

--Appearance of new resources

--Extinction of species previously using resources

--Colonization of area where resources not used

--Evolution of a new trait that permits use of new resource (key innovation)