

Lecture 9: Speciation



ON
THE ORIGIN OF SPECIES

BY MEANS OF NATURAL SELECTION,

OR THE

PRESERVATION OF FAVOURED RACES IN THE STRUGGLE
FOR LIFE.

By CHARLES DARWIN, M.A.,

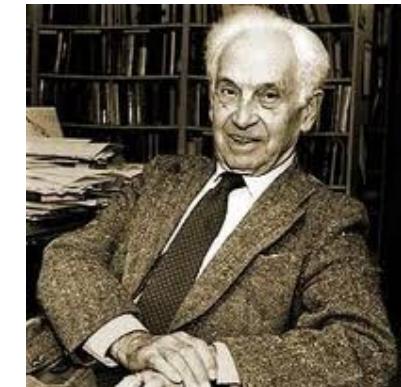
FELLOW OF THE ROYAL GEOLOGICAL, LINNEAN, ETC., SOCIETIES;
AUTHOR OF "JOURNAL OF RESEARCHES DURING H. M. S. BEAGLE'S VOYAGE
ROUND THE WORLD."

LONDON:

JOHN MURRAY, ALBEMARLE STREET.
1859.

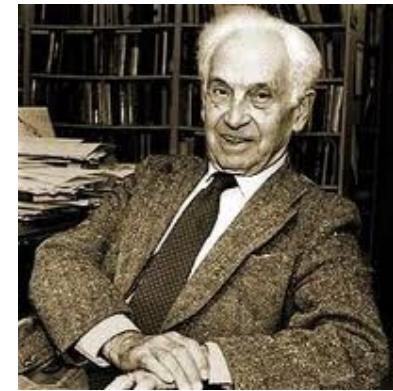
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For most of The Origin of Species Darwin concentrates on how and why organisms change over time, but really fails to explain how the continuous process of evolution produces discrete groups of species.



Dutch New Guinea

--locals recognise 136 species
of local birds, while
ornithologist recognise 137



This finding convinced Mayr that species were not arbitrary groupings but objective facts

How have biologists traditionally told
species apart?

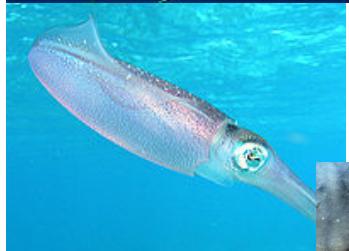




Classifying the Diverse Adaptations of Life

Taxonomic Hierarchy:

- Kingdom (*animals, plants, fungi, protista, bacteria, archaea*)
- Phylum (*chordata, arthropoda, annelida, mollusca*)
- Class (*mammalia, reptilia, aves, insecta, arachnid, crustacean*)
- Order (*carnivora, primates, artiodactyla, lepidoptera, hymenoptera*)
- Family (*felidae, hominidae, rodentia, apidae*)
- Genus (*Felis, Homo, Ratus, Apis*)
- Species (*catus, sapiens, ratus, mellifera*)



But...

Species are sometimes difficult to tell apart.

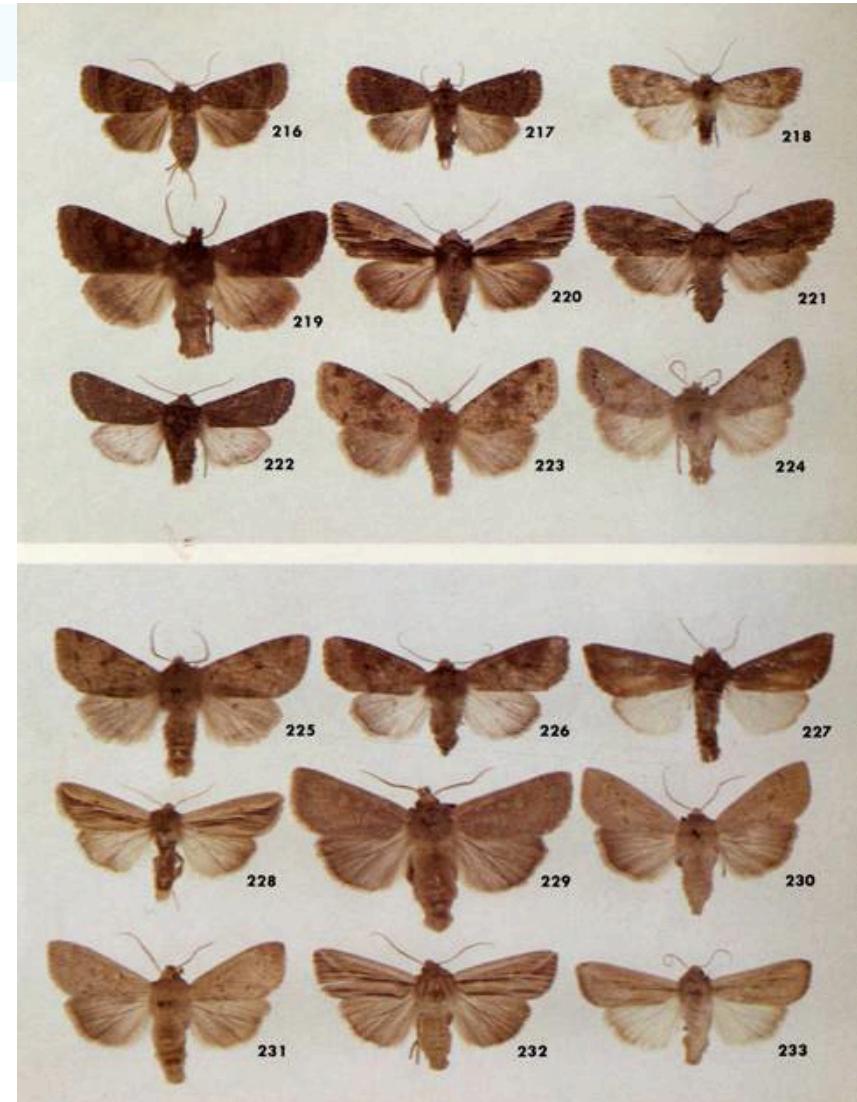
**18 different
species of
noctuid cutworm
moths**

(Phylum: Arthropoda

Class: Insecta

Order: Lepidoptera

Family: Noctuidae)



Others look different but are all one species.















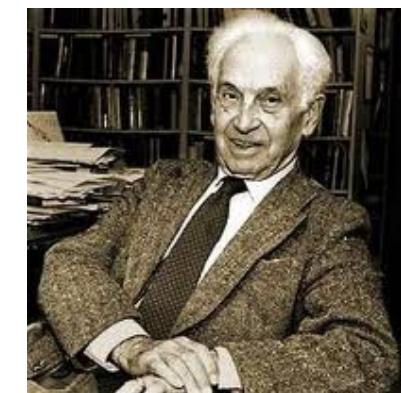
At what point are differences between populations large enough to make us call them different species?



When you ponder variation, you arrive at the notion that species are not distinct because they look different but because there are barriers between them the prevent interbreeding.



Theodosius Dobzhansky



The Species Concept

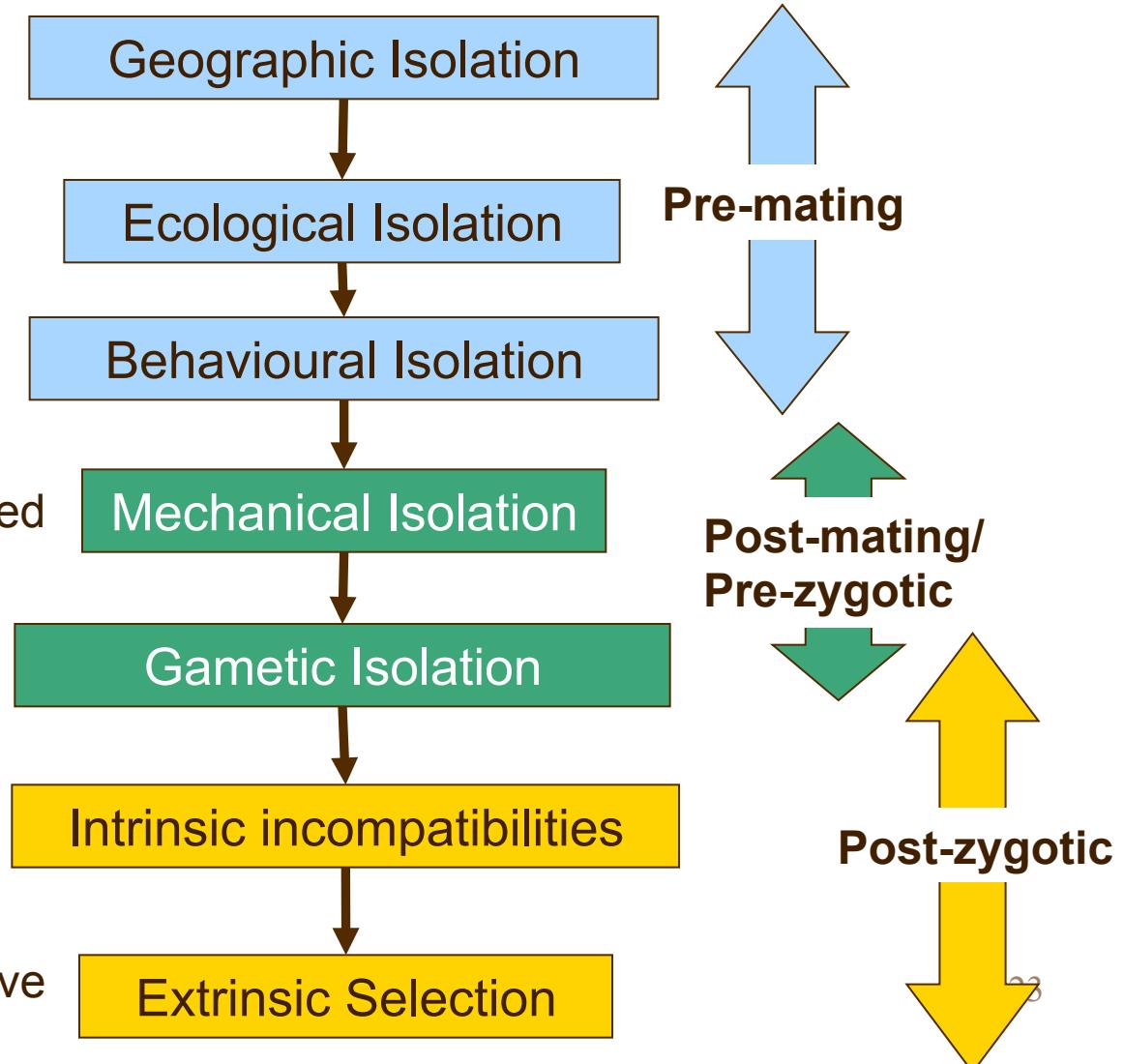
“Species are groups of actually or potentially interbreeding populations, which are reproductively isolated from other such groups”

– Ernst Mayr’s 1942 Biological Species Concept

Reproductively isolated simple means that different species have differences in appearance, breeding or physiology that prevent them from successfully interbreeding.

Barriers to Gene Flow

- Different places
- Different habitats
- Specialised pollinators
- Mating seasons differ
 - Mating rituals
 - No gametes transferred
 - Pollen competition
 - Gametes don't fuse
 - Developmental Problems
 - Hybrid Sterility
 - Hybrids not competitive
 - Low fitness

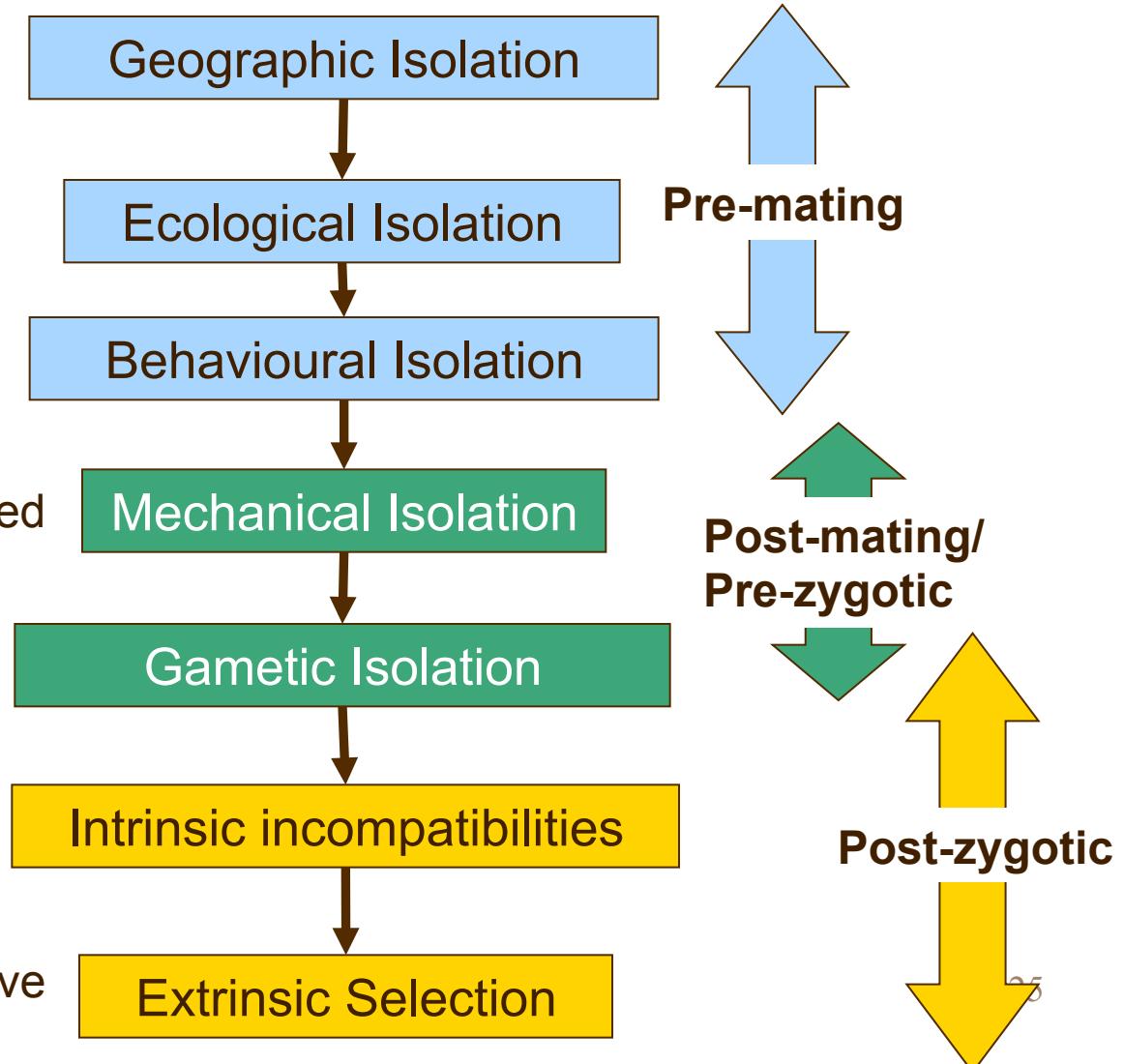


Geeps, mules and ligers

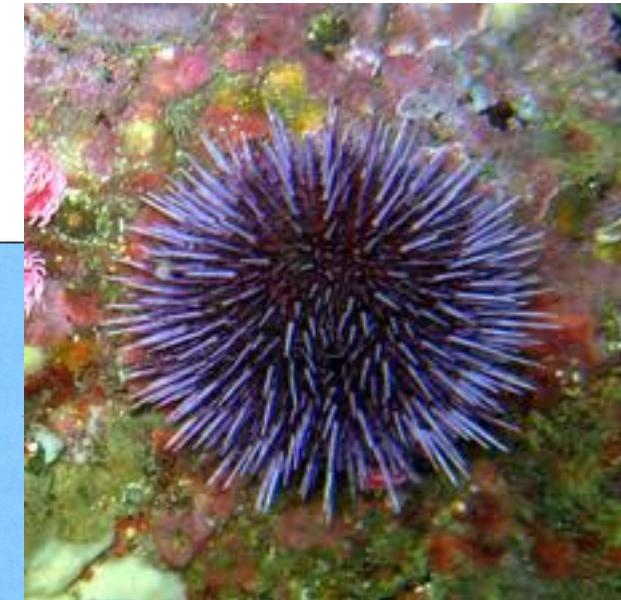


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But how do species arise?

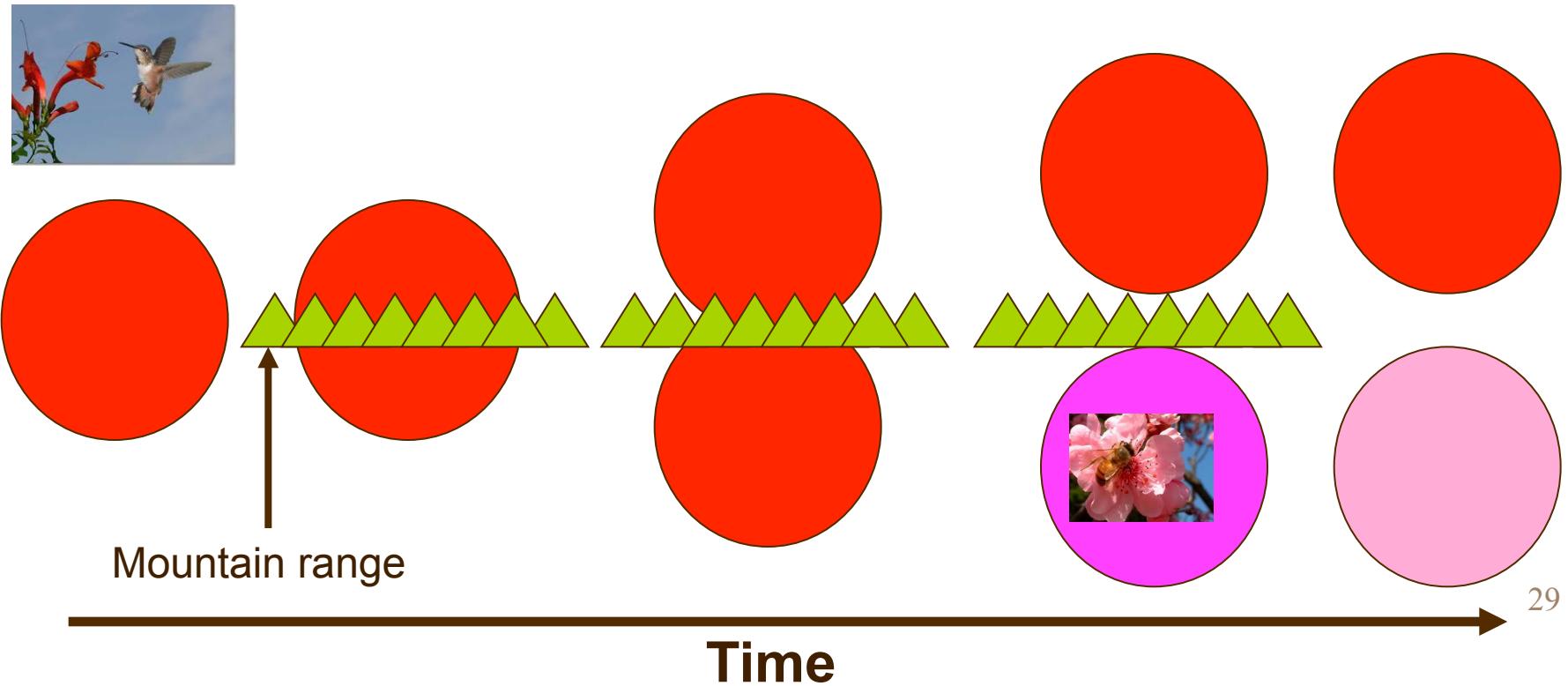




Models of Speciation –

1) Allopatric Speciation

- Evolution of isolation barriers due to geographic or habitat separation
- Populations Isolated - gene flow greatly reduced or absent
- Populations diverge by drift and selection to different environments



An example of allopatric speciation



Allopatric Speciation in Salamanders

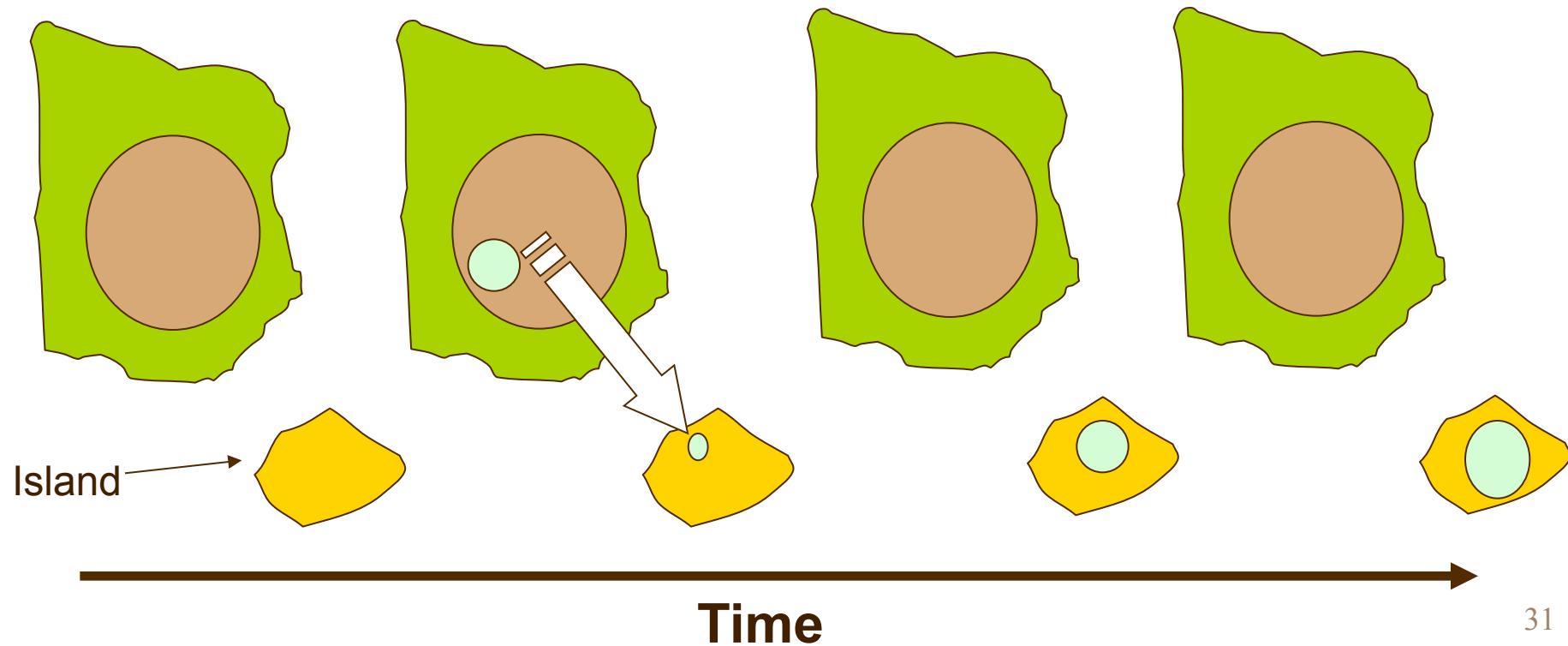


- *Ensatina escholtzii*
- Southward migration
- Population went to either side of the valley
- Adjacent populations hybridize
- Populations cannot interbreed at other end

Models of Speciation –

2) Peripatric / Founder effects

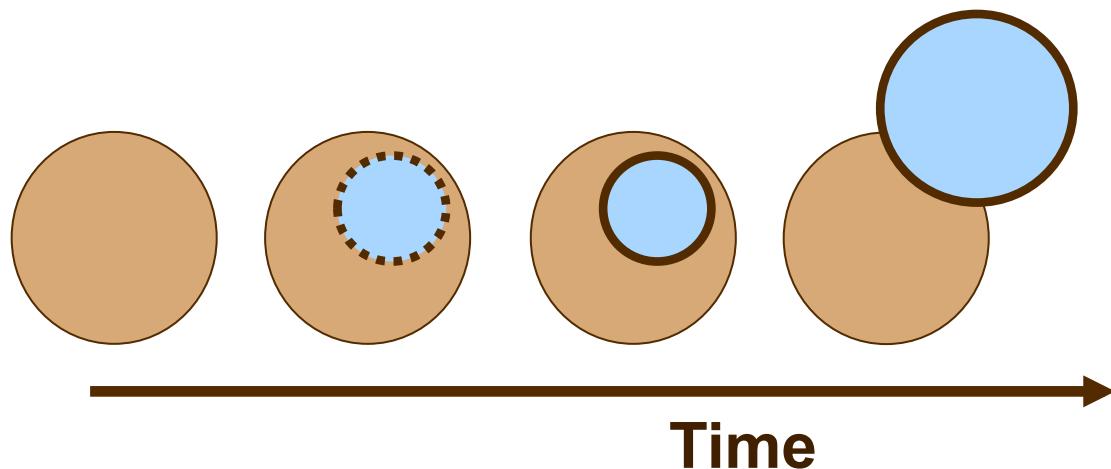
- Migration of a few individuals
- Isolated smaller populations – gene flow reduced
- Strong effects of founder effects



Models of Speciation –

3) Sympatric Speciation

- Isolating barriers to gene flow arise **WITHIN** a randomly mating population
- Divergent selection for different resources or microhabitats
- Selection then favours alleles that cause non-random mating

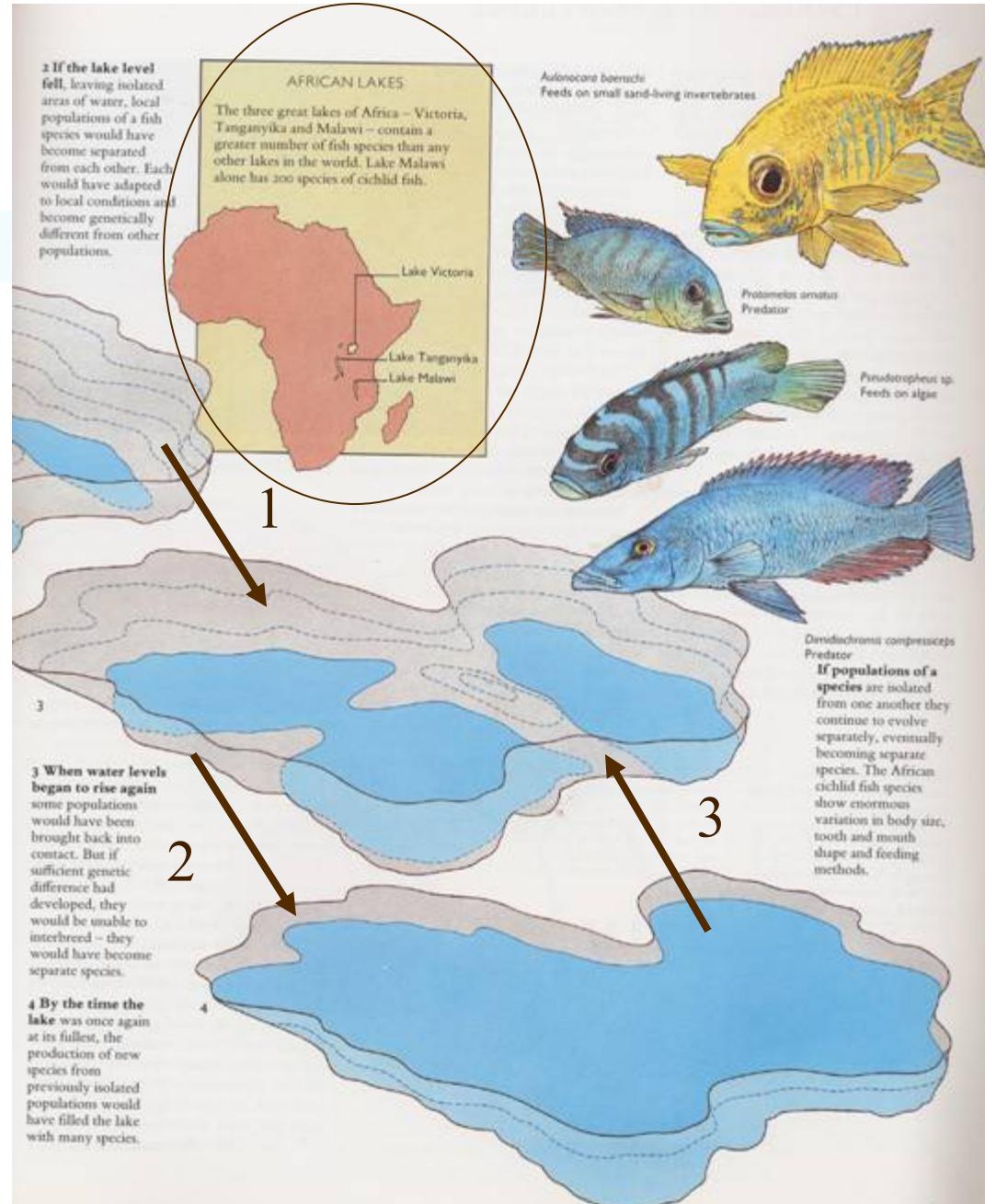


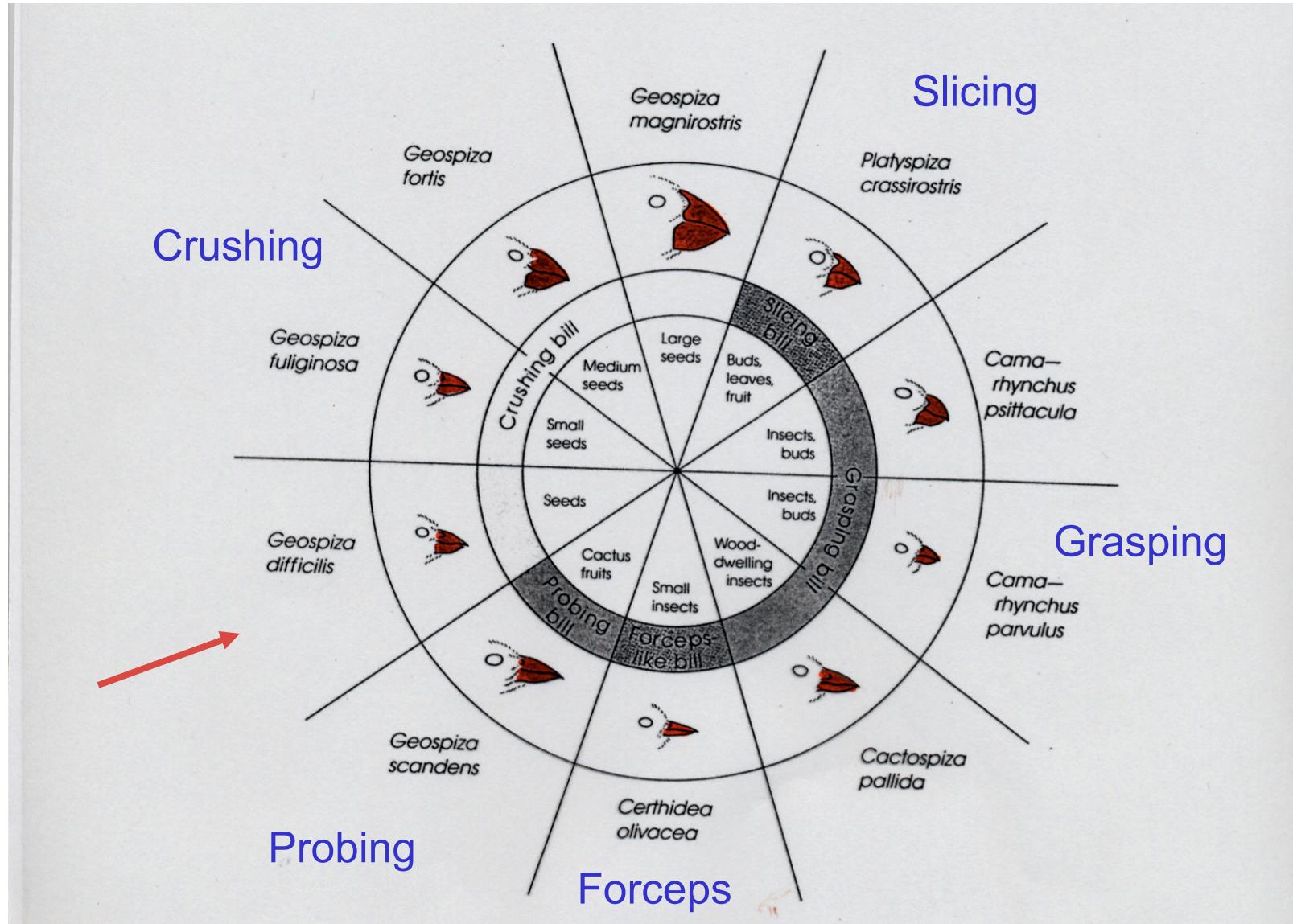
Adaptive Radiation

e.g. African cichlids

(300 species in ~200,000 years)

- Adaptive ecological divergence in microhabitat
- Selection for feeding morphologies

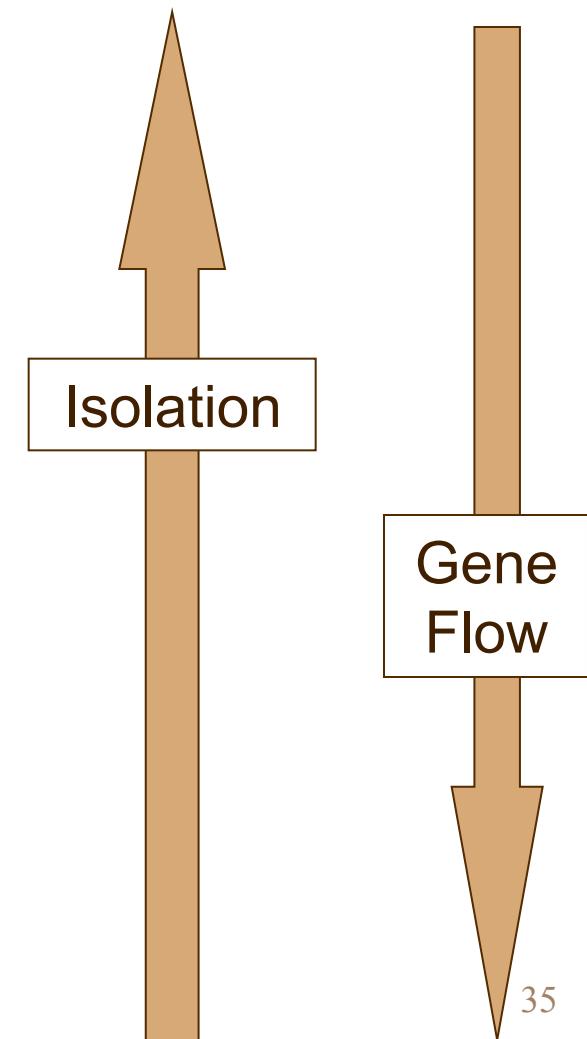
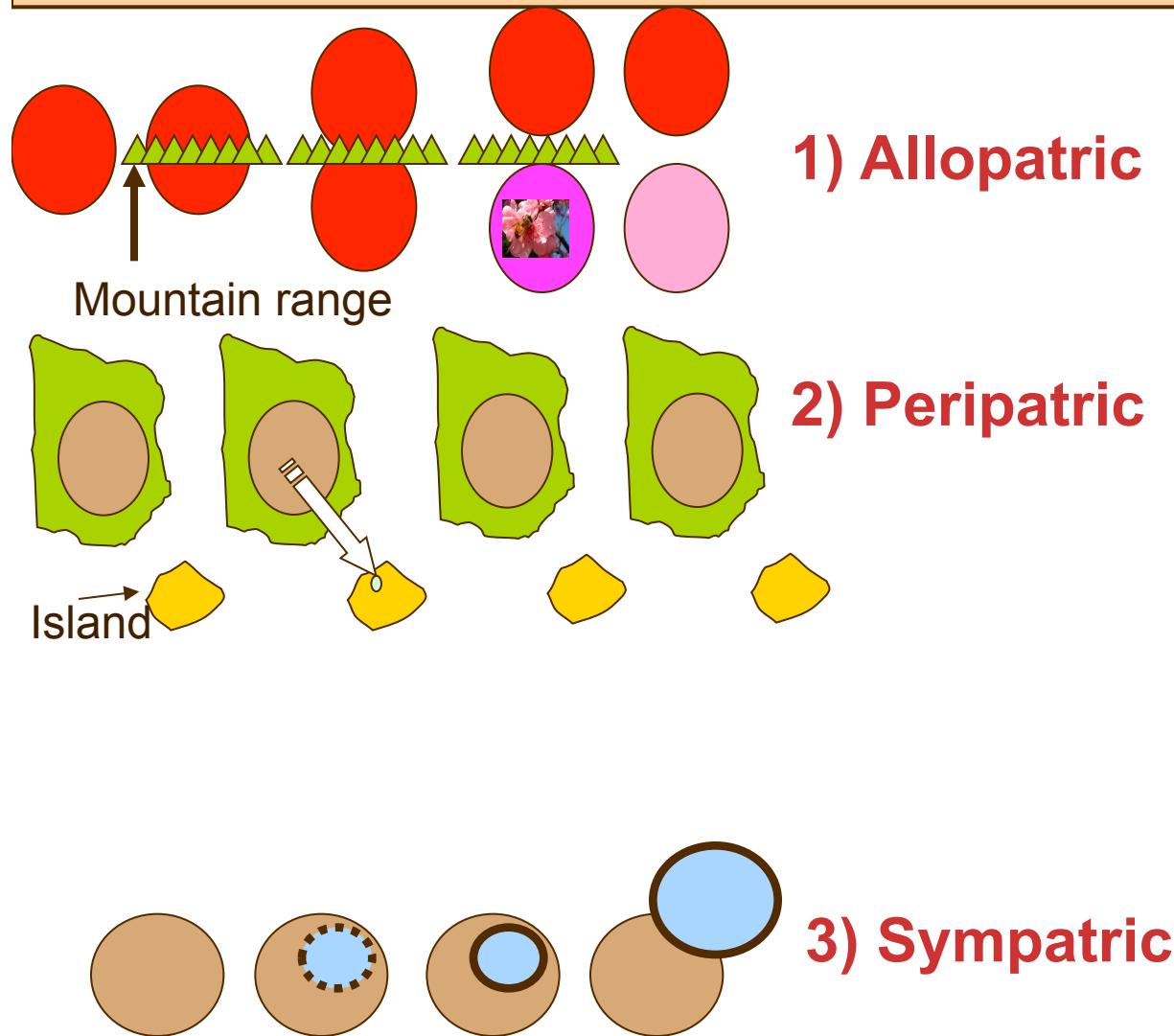




- Directional Selection (Competitive Release) *e.g. Darwin's finches*

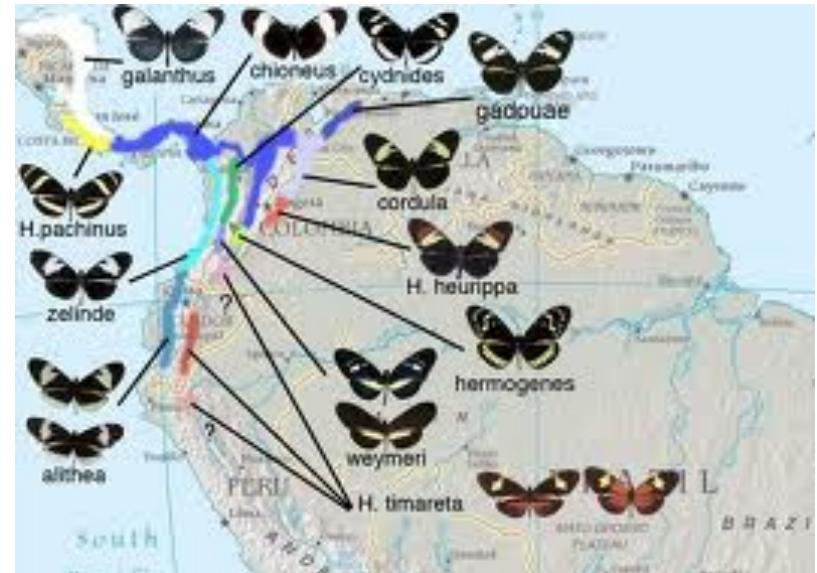
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Summary of Models of Speciation



Speciation by hybridisation

- Could the many species have been produced by hybridization?
- Lonely *H.cydno* flit across the mountains and mates with *H.melpomene* to produce a hybrid.
- The hybrid facies other hybrids more than the parental types, and perhaps a new species is born.



H. melpomene



H. heurippa



H. cydno



H. melpomene

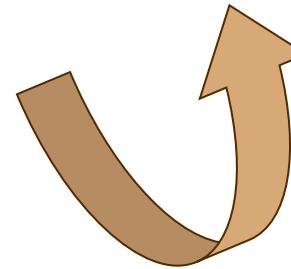
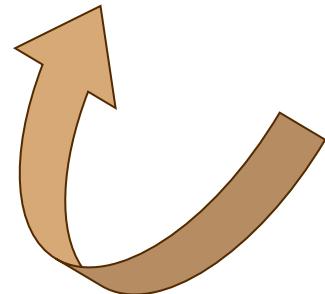


H. cydno

X



Sterile



These butterflies could
interbred and looked like
the wild type *H. heurippa*



Reading

[http://
scienceblogs.com/
loom/2006/06/14/
darwin_meet_frankens
tein.php#more](http://scienceblogs.com/loom/2006/06/14/darwin_meet_frankenstein.php#more)

