

# Part - V MACROEVOLUTIONARY PATTERNS

BIO 111 Biological Diversity and Evolution  
Varsha 2017

Ullasa Kodandaramaiah

- Macroevolution: evolutionary patterns across species.

Macroevolutionary patterns are formed by microevolutionary processes

- Speciation links microevolution with macroevolution

# Some macroevolutionary patterns

Mass Extinctions

Convergent evolution

Divergent evolution

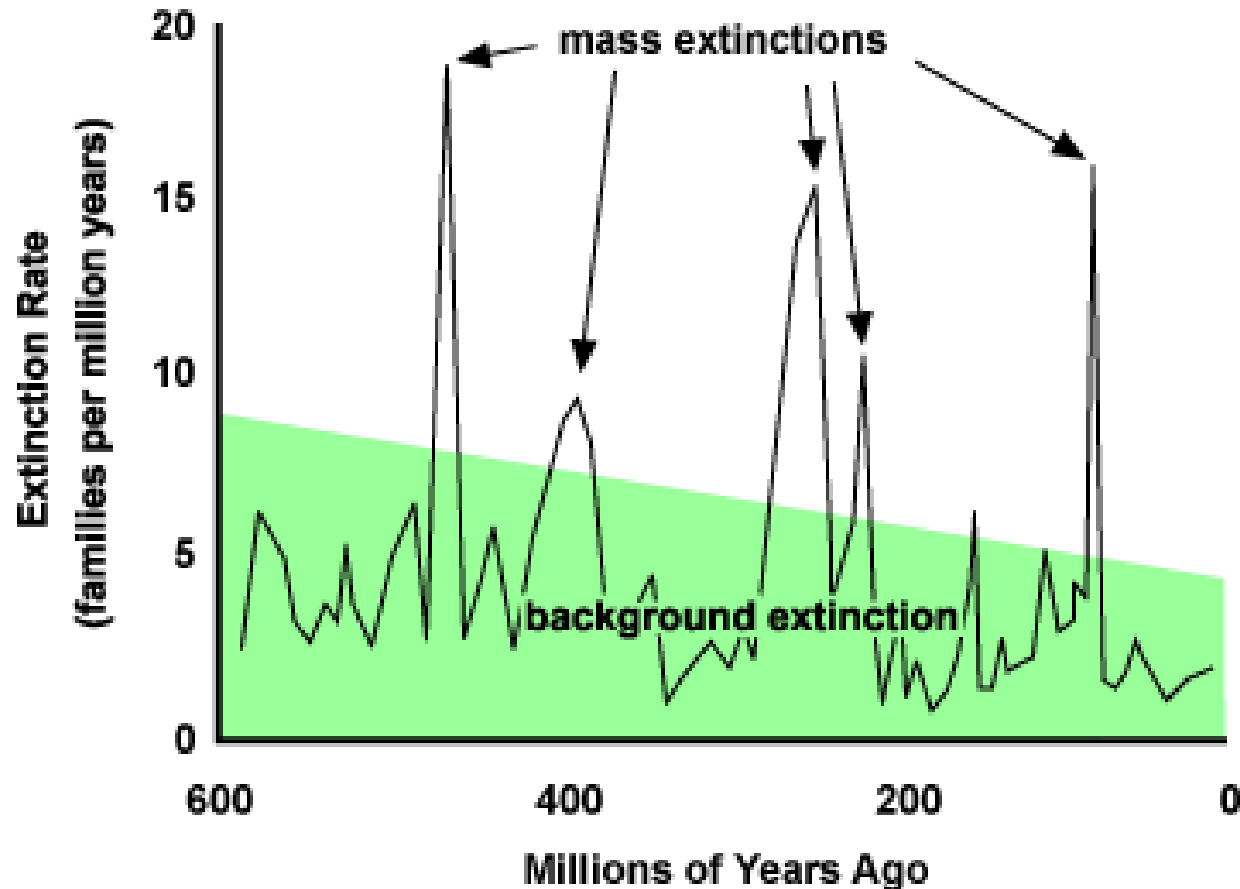
Adaptive radiations

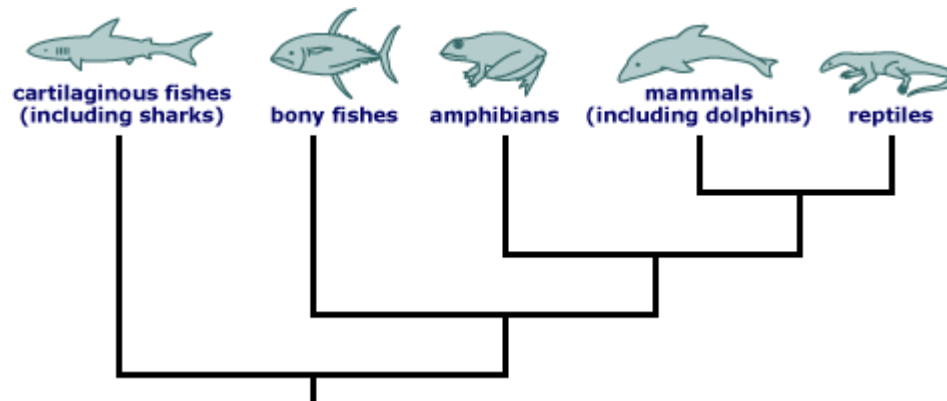
# Convergent evolution

- Convergent evolution (Convergence): organisms *independently* evolve similar traits due to similar selection pressures
- Organisms develop *analogous* structures (same function, but different origins)
  - E.g. Wings in birds, bats and insects
  - Warm-bloodedness

# Mass extinctions

- destroy many species at global level
- Fossil record indicates at least five mass extinctions in last 600 million years





Illustrations: [www.evolution.berkeley.edu](http://www.evolution.berkeley.edu)

## Old World Vultures

*Gyps bengalensis* (White-rumped Vulture)



Photo: Goran Ekstrom

## New World Vultures

*Gymnogyps californianus* (Californian condor)



Photo: Dick Daniels

# Rolling for defense

Pangolin. Source: carnivoraforum.net



Pill Bug. Photo: Mathew Willis



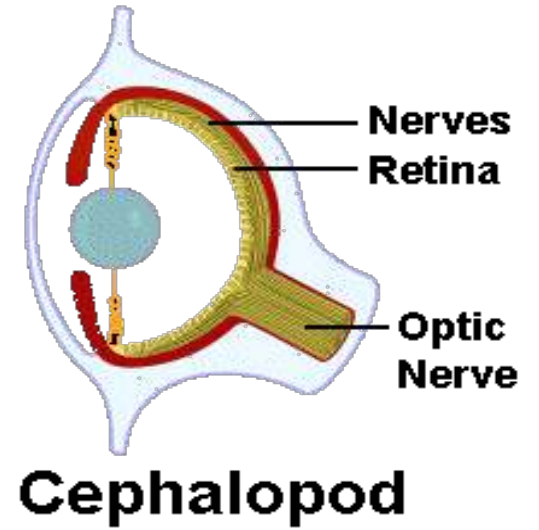
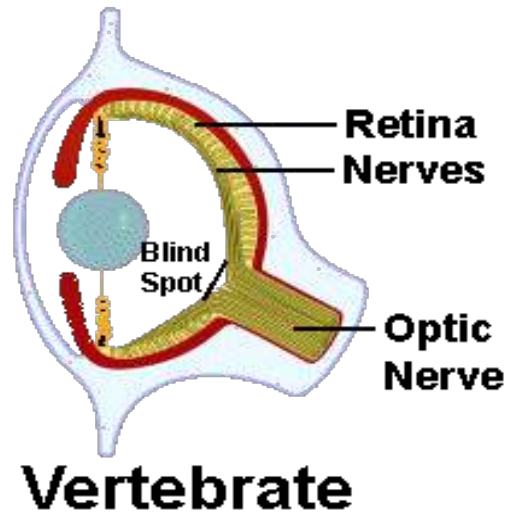
Pill millipede. Source: Wikimedia/ Marshal Hedin





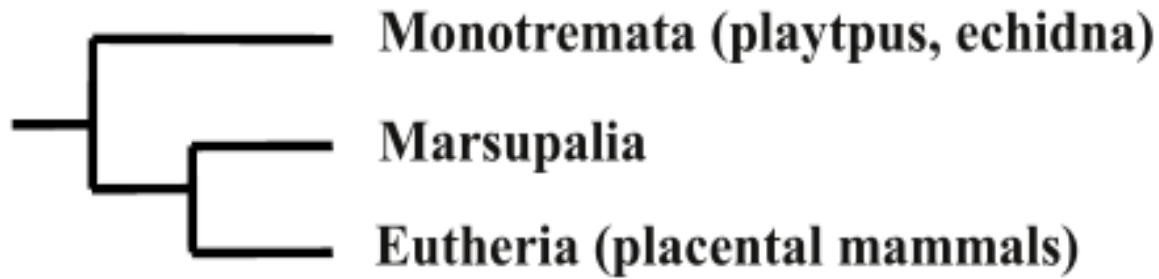
















Image: Parent Géry/Wikimedia



## Convergent evolution of eyes

Source: Eric Pianka / [www.zo.utexas.edu/courses/THOC/Convergence.html](http://www.zo.utexas.edu/courses/THOC/Convergence.html)



Niche	Burrower	Anteater	Nocturnal Insectivore	Climber	Glider	Stalking Predator	Chasing Predator
Placental Mammals	 Mole	 Lesser anteater	 Grasshopper mouse	 Ring-tailed lemur	 Flying squirrel	 Ocelot	 Wolf
Australian Marsupials	 Marsupial mole	 Numbat	 Marsupial mouse	 Spotted cuscus	 Flying phalanger	 Tasmanian quoll	 Thylacine

# Divergent evolution

Closely related species living in different environments and facing different environmental challenges evolve dissimilar characteristics.

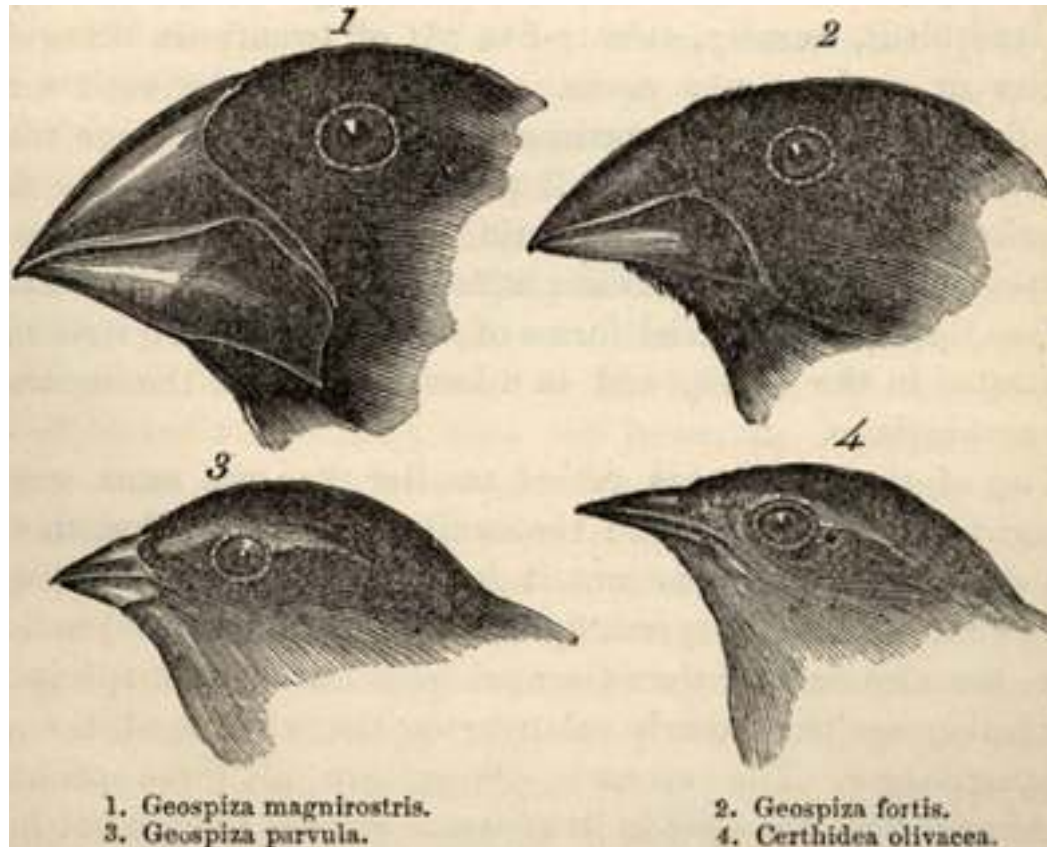
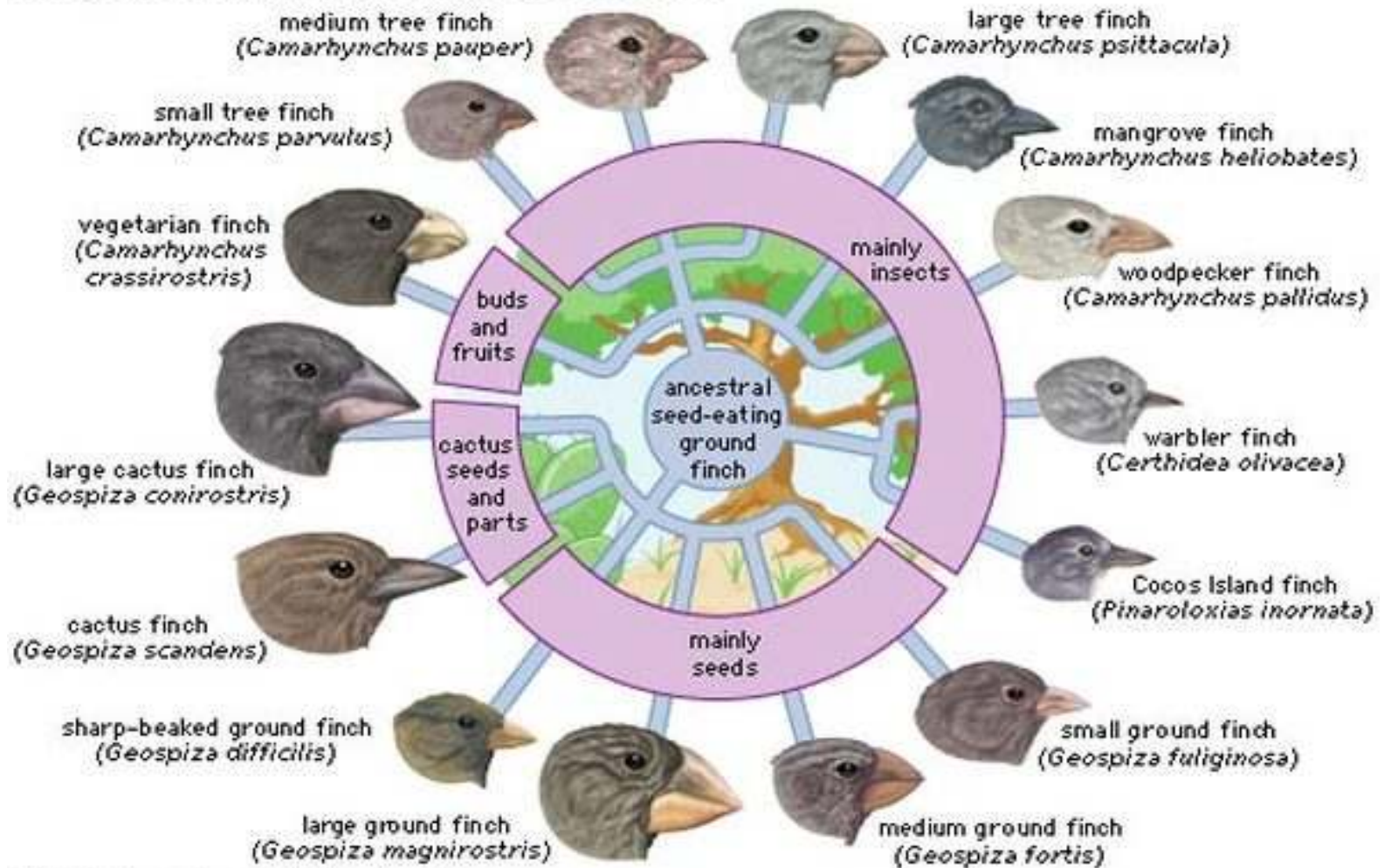


Image: darwinwasright.com

# Adaptive radiation

***An adaptive radiation* is a clade (group of related species) that has evolved into numerous, diverse forms**

## Adaptive radiation in Galapagos finches



# Hawaiian *Drosophila*

*D. suzukii*



*D. microthrix*



*D. nigribasis*

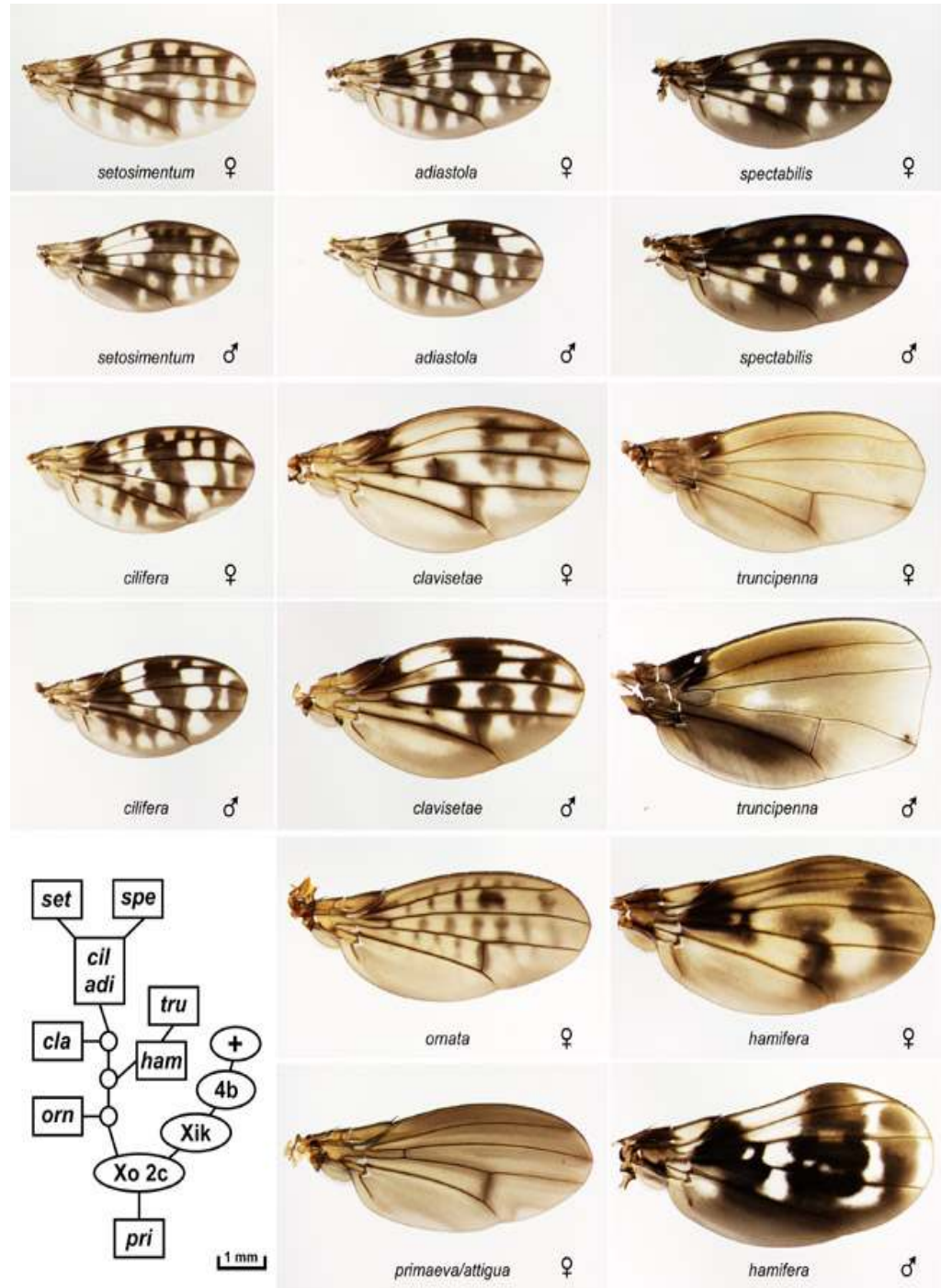
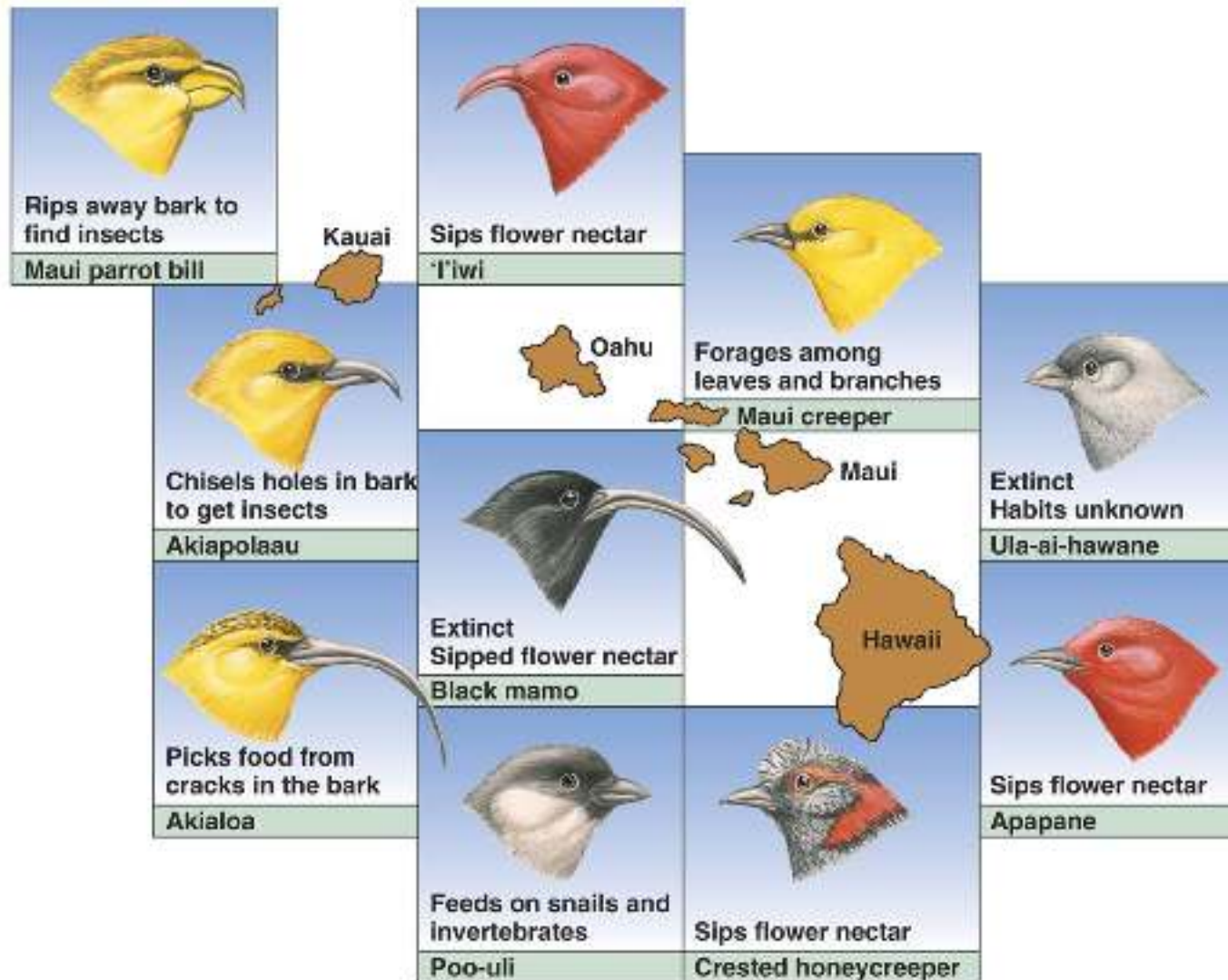


Figure 16-6 Evolutionary Analysis, 4/e  
© 2007 Pearson Prentice Hall, Inc.

Adapted from slides by Dhanashree Pranjpe

# Honeycreepers: Hawaii

Solomon/Berg/Martin, Biology, 6/e  
Figure 19.17



# Cichlids in the African Great Lakes



Adapted from slides by Tom Langen



# Ecomorphs

- Crown-Giant
- Trunk-Crown
- Trunk
- Twig
- Trunk-Ground
- Grass-Bush



*Anolis* adaptive radiation slides adapted from Rouse, Oklahoma State University. Images: Lab webpage of Jonathan Losos.



# Crown-Giant Anoles



*Anolis luteogularis*, **Soroa, Cuba**



*Anolis garmani*, **Jamaica**

# Trunk-Crown Anoles



*Anolis allisoni*, **Cuba**



*Anolis evermanni*, **Puerto Rico**



*Anolis chlorocyanus*, **Hispaniola**



*Anolis grahami*, **Jamaica**

# Trunk Anoles



*Anolis loysiana*, **Cuba**

*Anolis distichus*, **Hispaniola**



# Twig Anoles



*Anolis insolitus*, **Hispaniola**



*Anolis angusticeps*, **Bahamas and Cuba**



*Anolis valencienni*, **Jamaica**



*Anolis occultus*, **Puerto Rico**

# Trunk-Ground Anoles



*Anolis sagrei*, **Bahamas and Cuba**



*Anolis lineatopus*, **Jamaica**



*Anolis cristatellus*, **Puerto Rico**



*Anolis cybotes*, **Hispaniola**

# Grass-Bush Anoles



*Anolis bahorucoensis*, **Hispaniola**



*Anolis ophiolepis*, **Cuba**



*Anolis pulchellus*, **Puerto Rico**



# What causes adaptive radiations?

Pioneering a new habitat containing few competing organisms (*opportunity*)

- remote islands (eg Darwin's finches)
- isolated large lakes (African cichlids)

# Radiation after mass extinction (*opportunity*)

- e.g. Radiation of mammals after extinction of dinosaurs

## Evolution of a *key innovation*

- birds radiated after the evolution of flapping flight
- Angiosperms (flowering plants) radiated after the evolution of reproduction via flowers



Adapted from slides by Tom Langen

# Rates of morphological change in lineages

Stasis

Gradualism

Punctuated equilibrium

Saltation

# Stasis

- **Long periods (usually hundreds of millions of years) with little morphological change in a lineage**

Thought to be rare

Can theoretically happen due to very strong stabilizing selection in an environment that does not change much.

***Task: Find out examples of stasis***

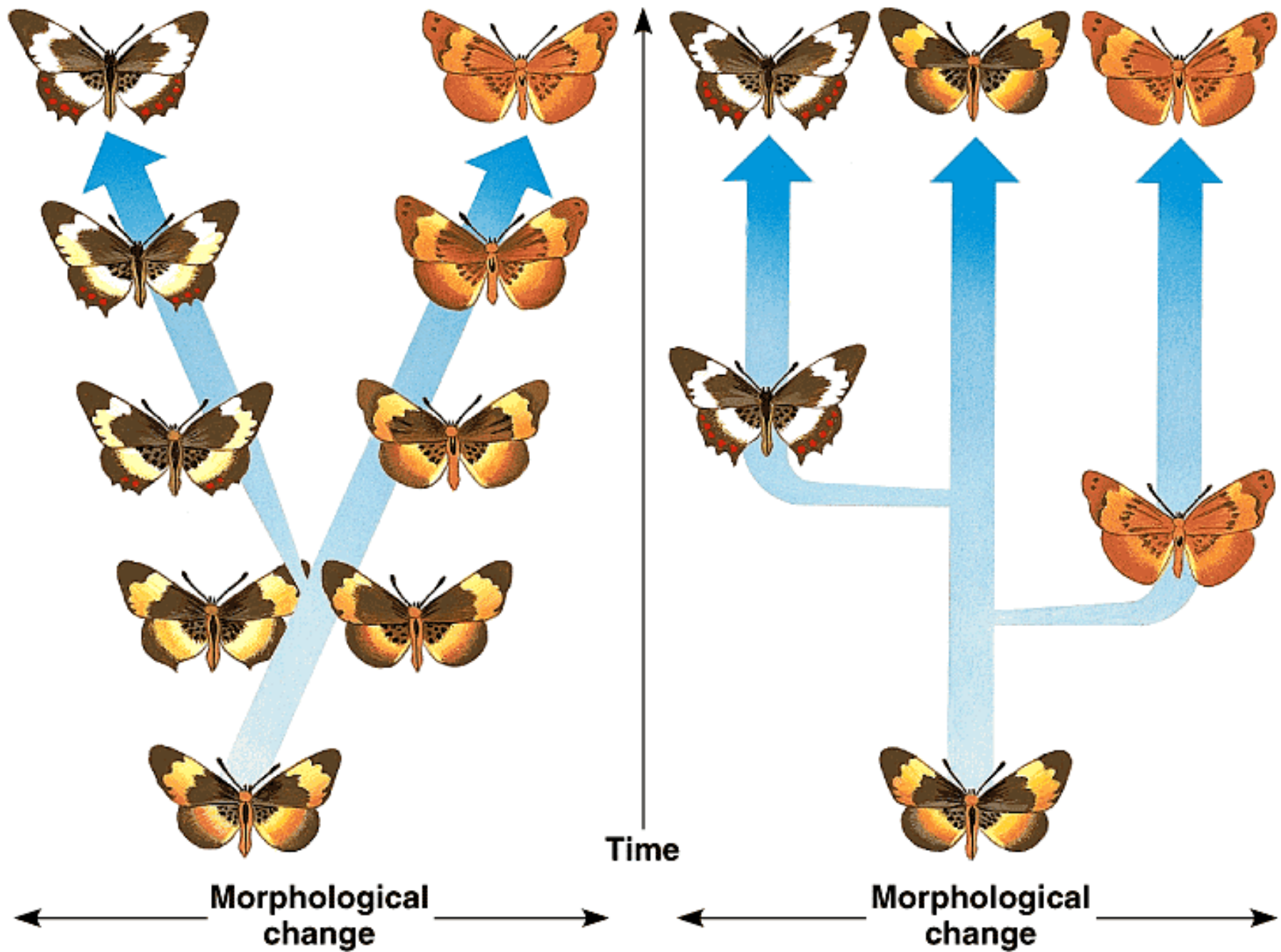
# Gradualism

**Evolutionary change in a lineage is gradual.**

Appears to be the most common among different models of evolutionary rates

# Punctuated equilibrium

**Rapid evolutionary change followed by long periods of little change**



**(a) Gradualism model**

**(b) Punctuated equilibrium model**



# Saltation

Large morphological change occurring abruptly

E.g. Formation of polyloids in plants