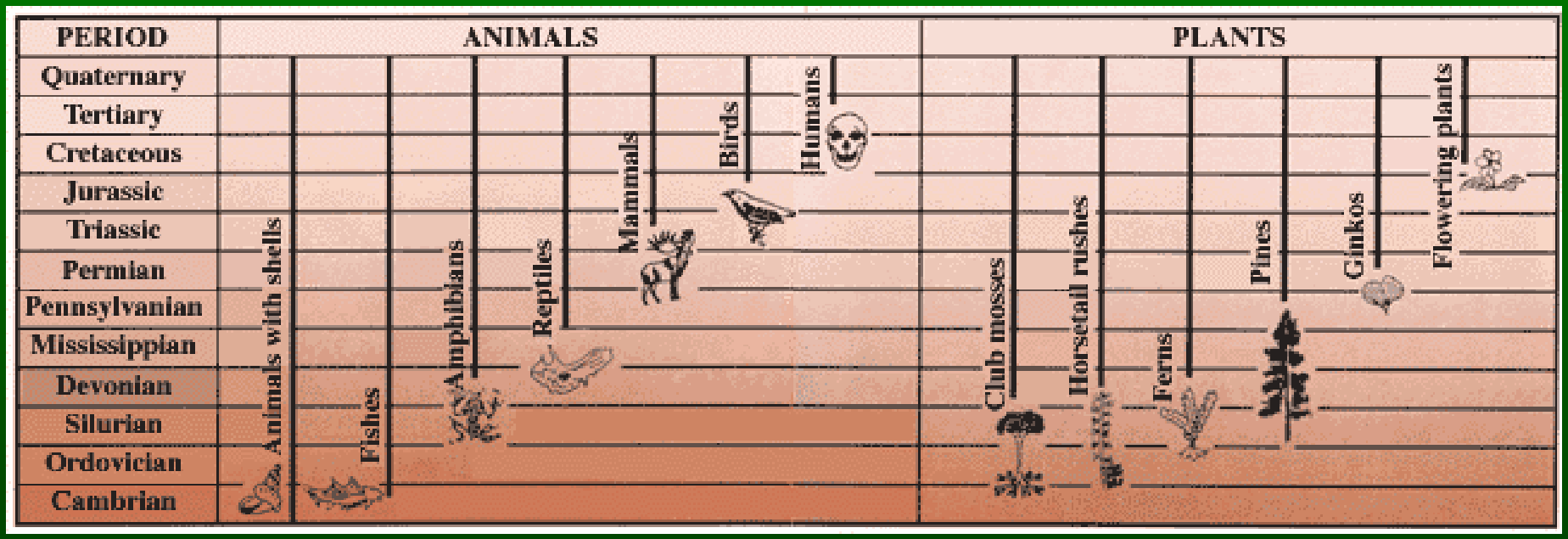
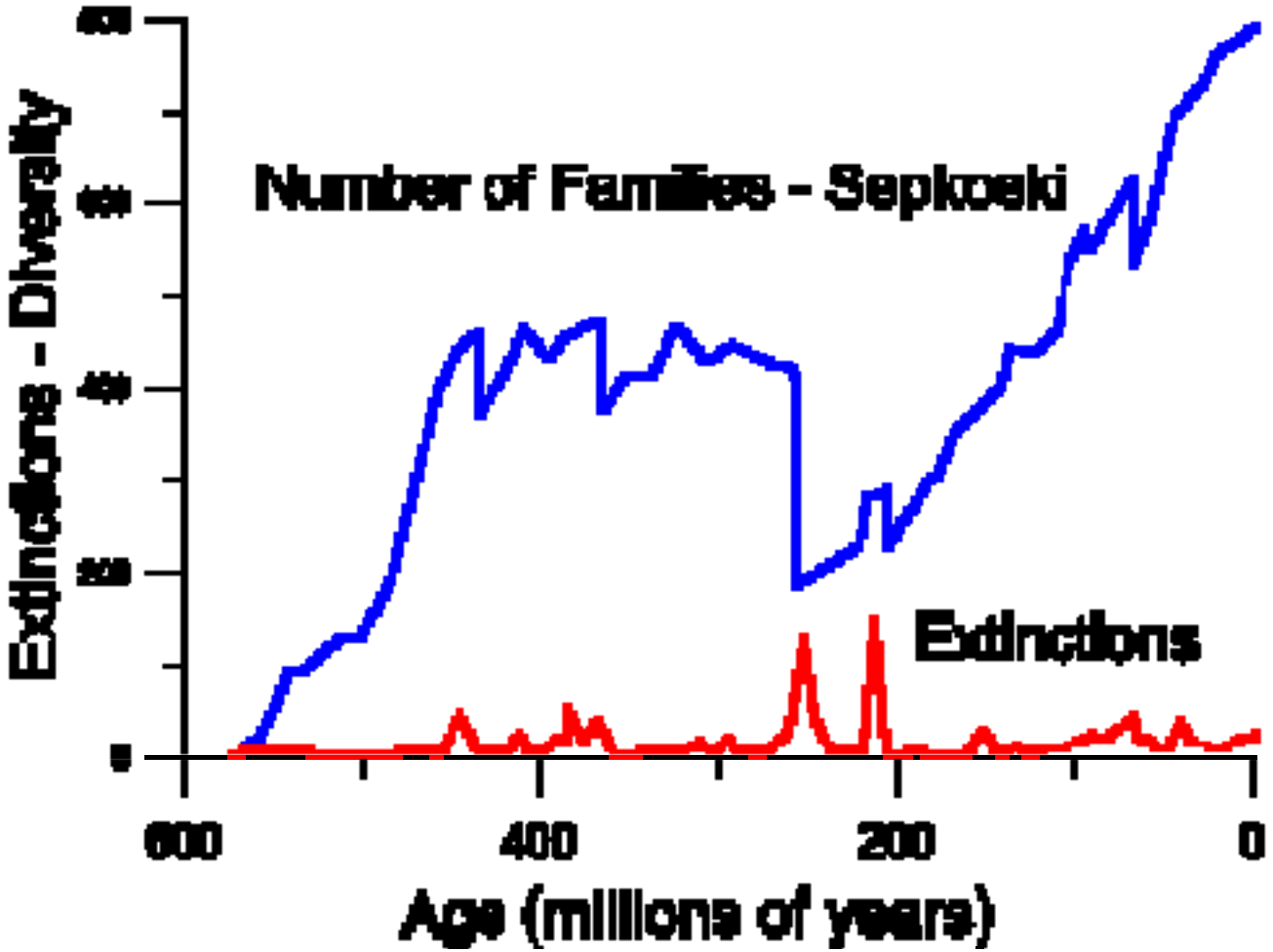
Macroevolution



Stratigraphic ranges and origins of some major groups of animals and plants.

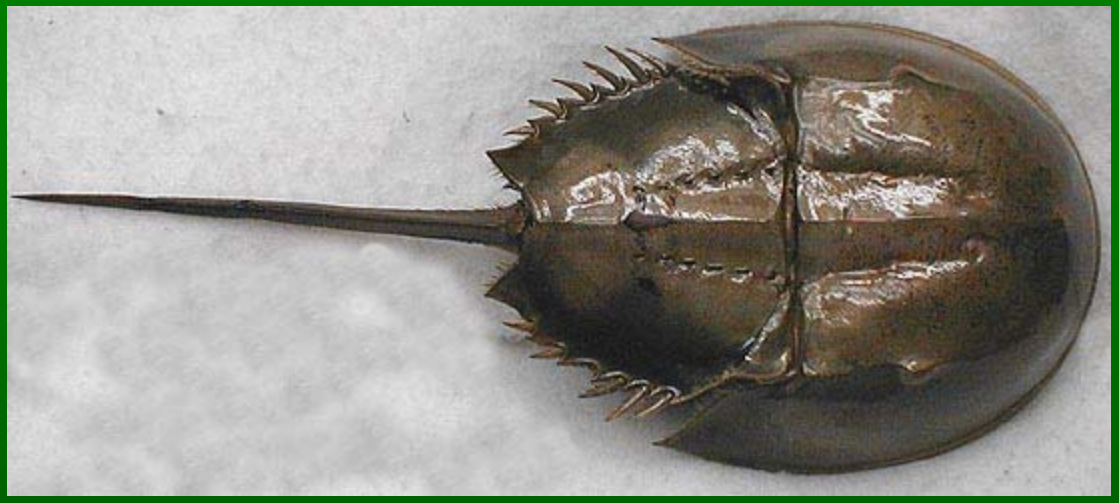
Evolution of Diversity



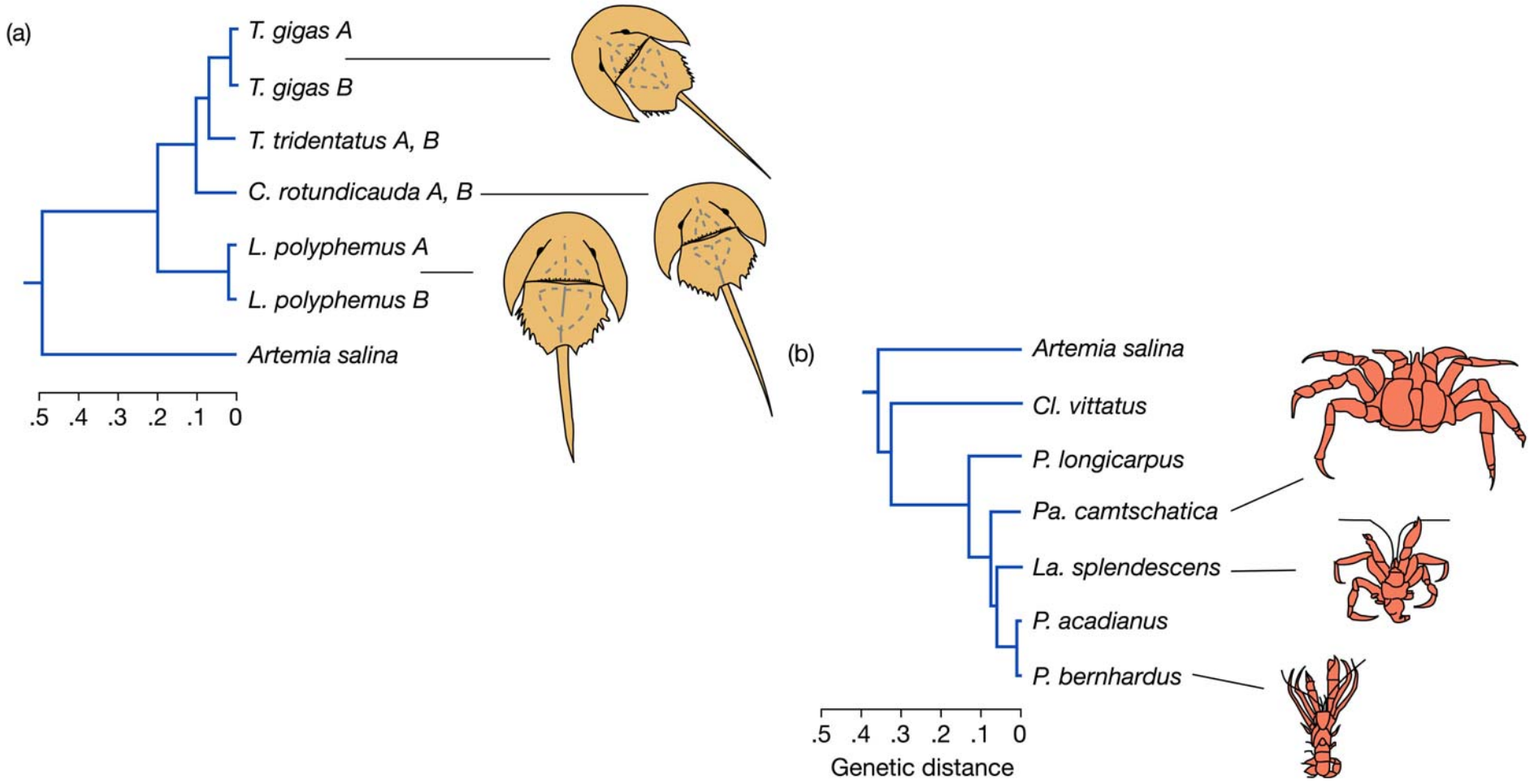
Macroevolution

- Macroevolutionary Rates (Revisited)
- Quantifying Rates of Change
- Inferences about Evolutionary Process
- Trends in Macroevolution

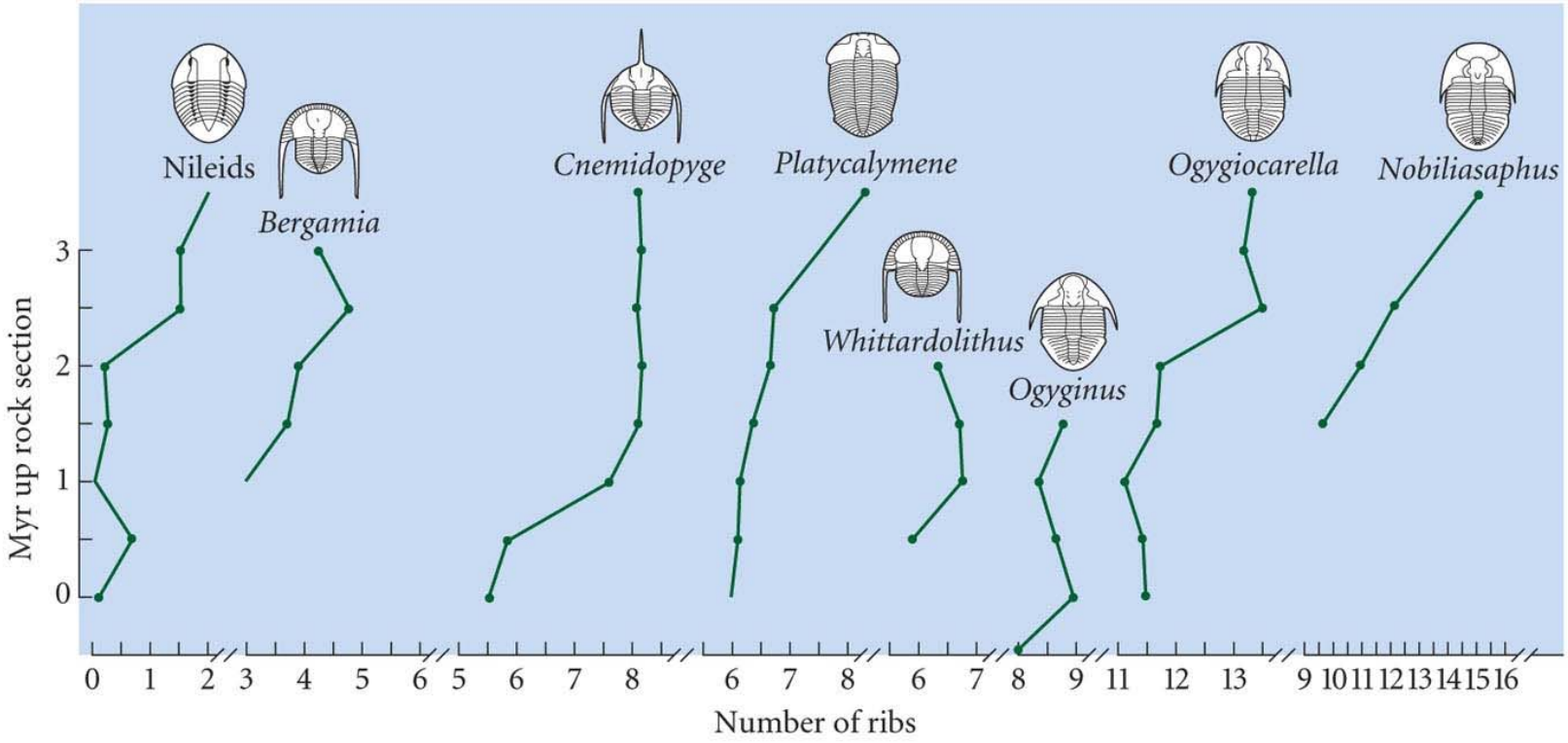
Rates of Evolution Vary Among Characters



Genetic and Morphological Rates may Differ



Rates Vary Among & Within Lineages



Trilobites

Two “living fossils”

(A)

Tadpole Shrimp
since Triassic

(B)

Coelacanth
since Devonian

Quantifying Rates, "the darwin" (Describes character changes)

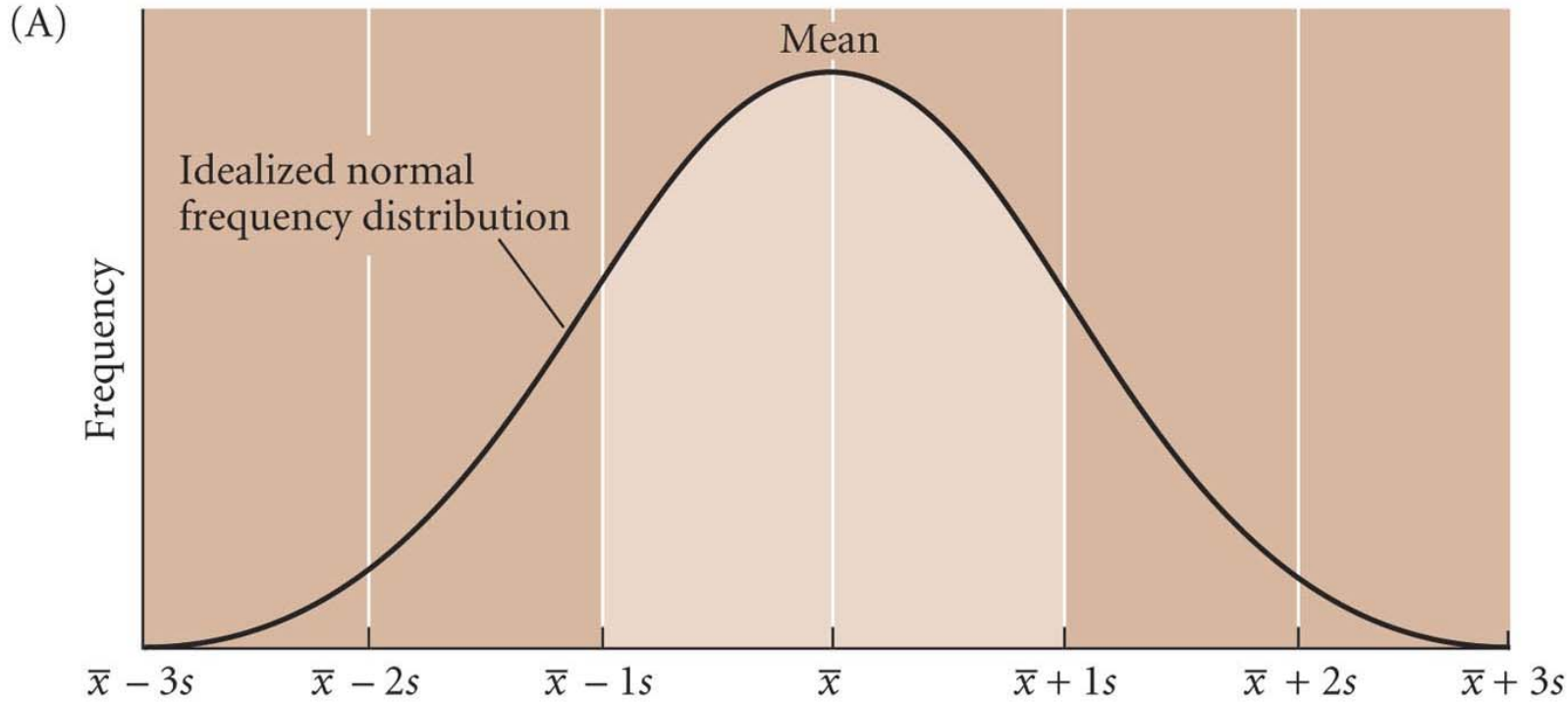
r (in darwins) $= (\ln(x_1) - \ln(x_2))/\Delta t$,
with t measured in millions of years

If $x_2 = 1$, and $x_1 = 2.718$, and t is 10 million yrs,

$r = (\ln(2.718) - \ln(1))/10 = 1/10 = 0.1$ darwins

(See Chap 4)

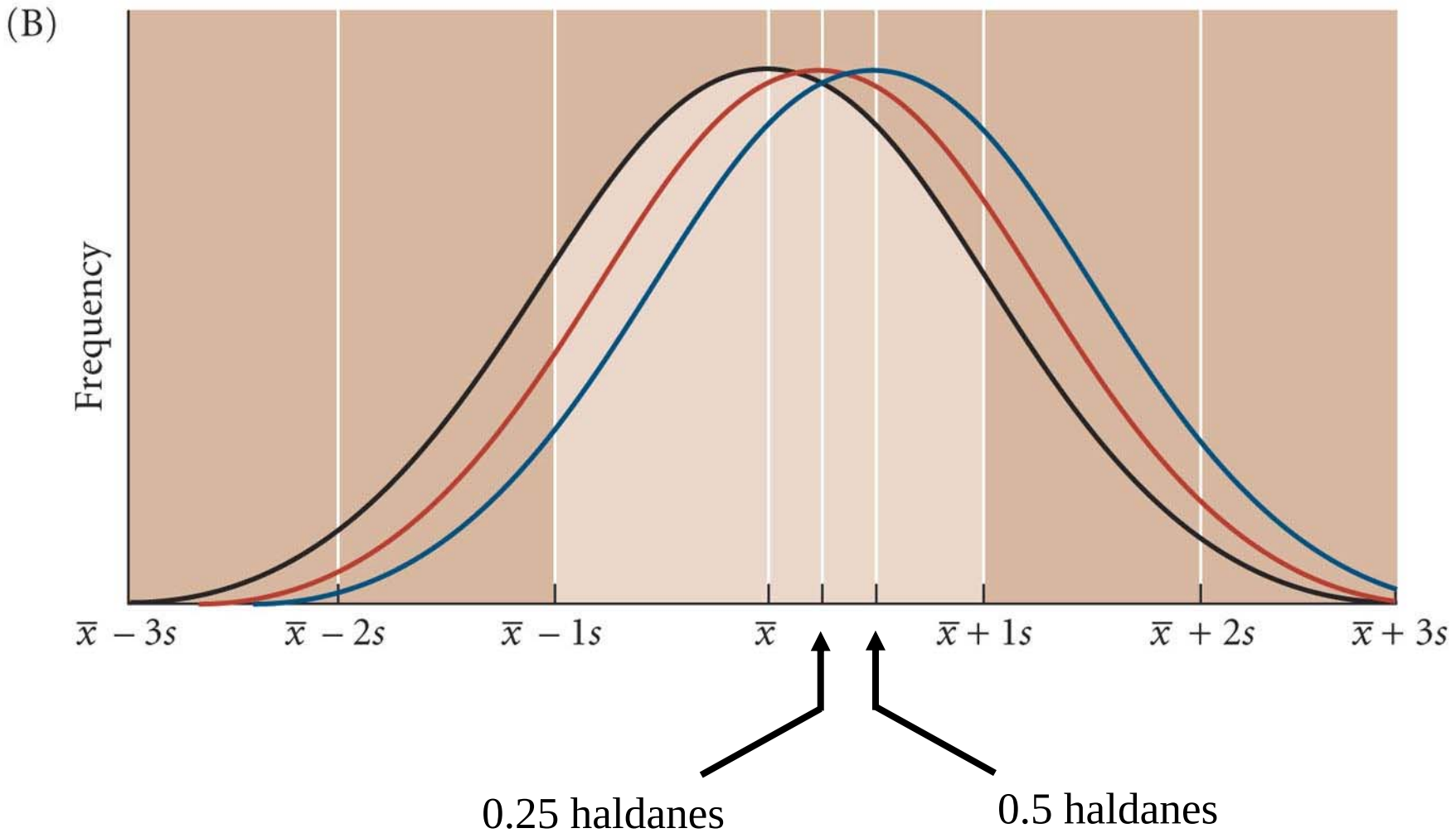
Quantifying rates, “the haldane”



Rate: number of SD by which character mean changes per generation.

(See Chap 4)

Quantifying rates, “the haldane”

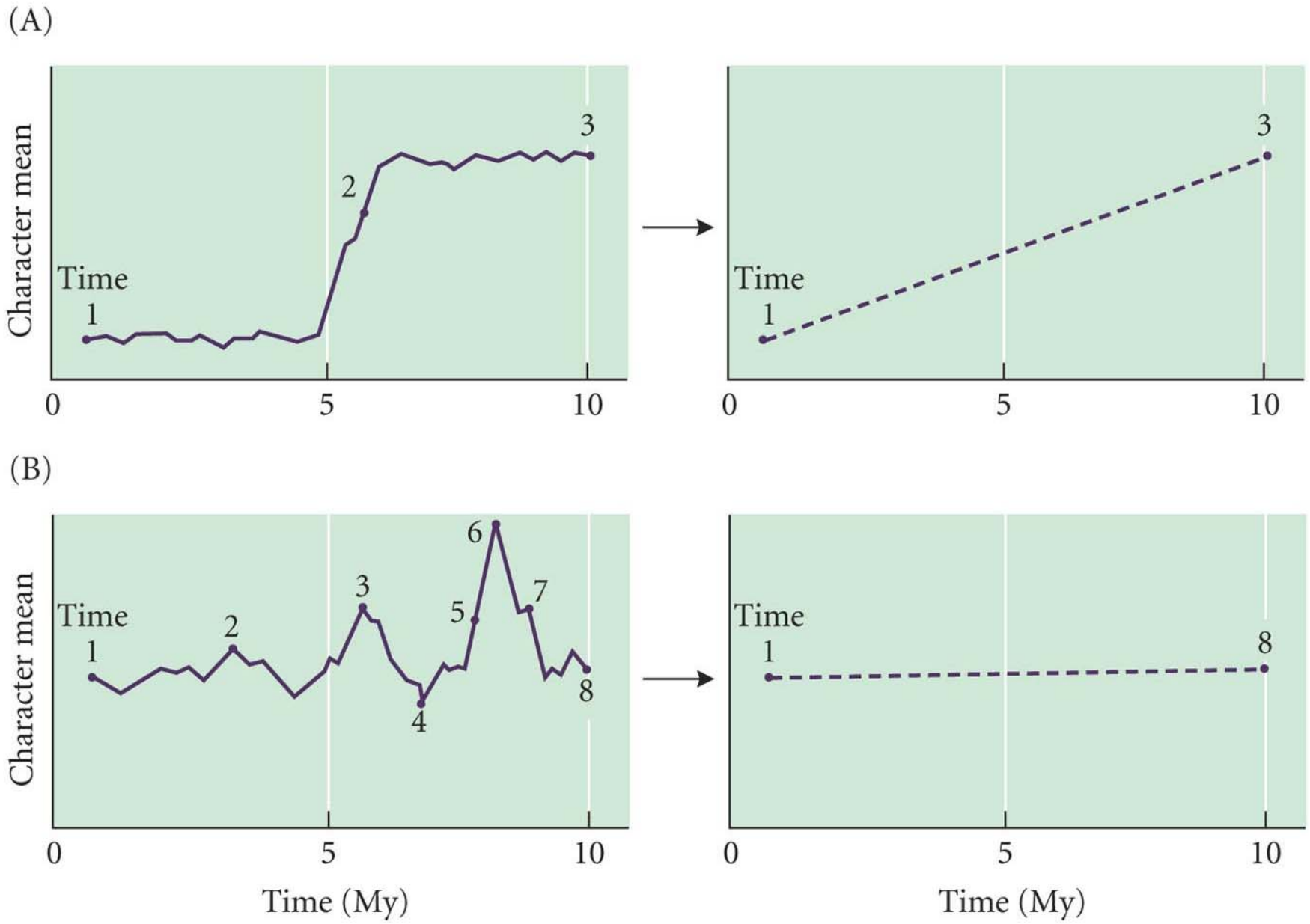


(See Chap 4)

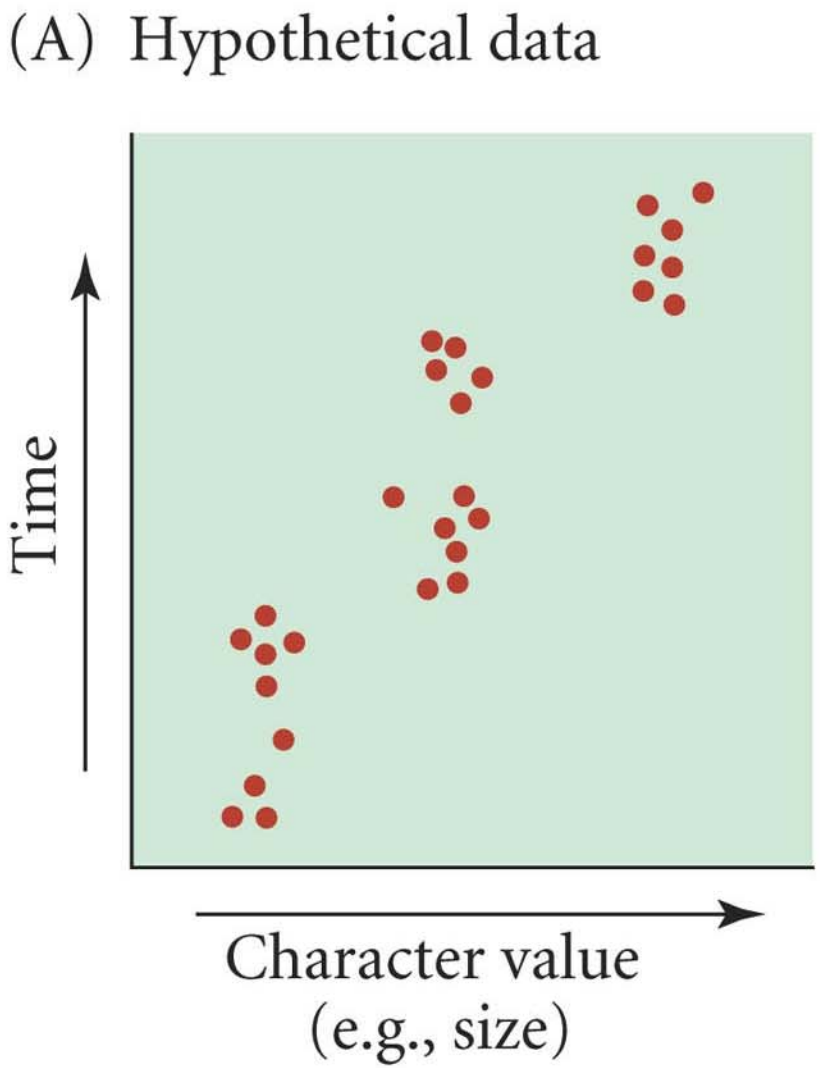
Rates Observed Depend on the Time Interval

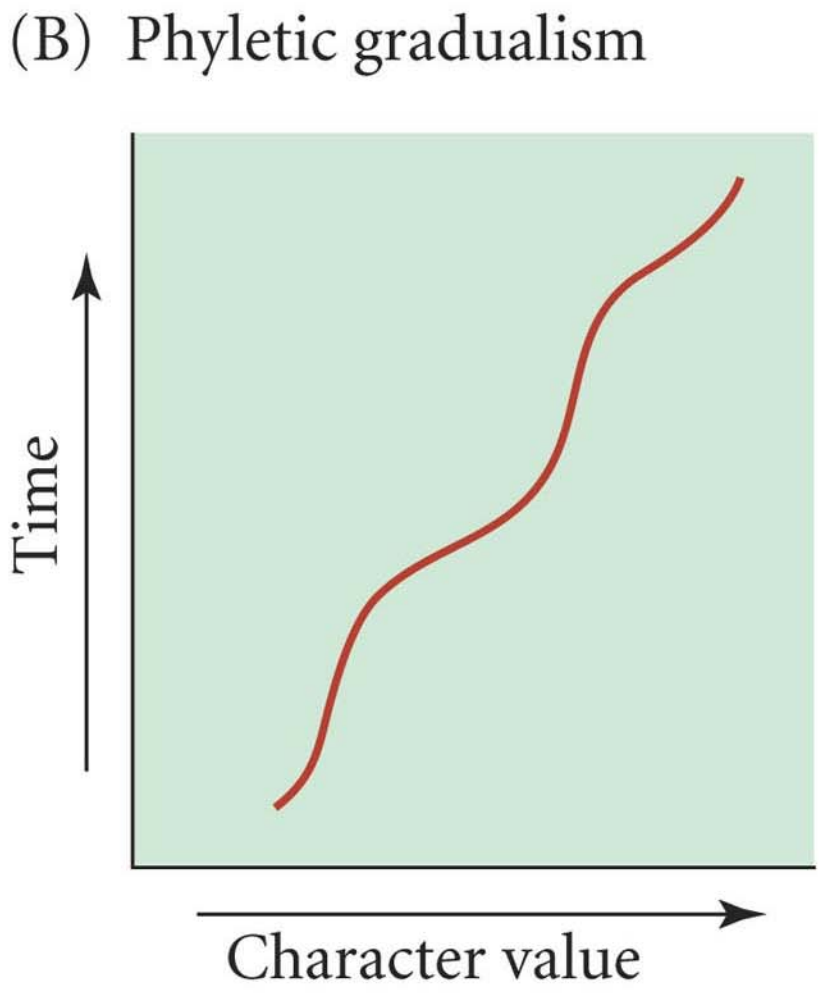
Scenario	Time Interval	Range of rates, d (mean in parentheses)
Selection expts	1.5-10 yr	12,000-200,000 (58,700)
Colonization	70-300 yr	0-79,700 (370)
Fossil invertebrates	0.3-350 Myr	0-3.7 (0.07)
Fossil vertebrates	8000 yr - 98 Myr	0-26.2 (0.08)

The rate of evolution may be low, even though there are episodes of rapid evolution



Macroevolutionary Inferences, Based on Rates

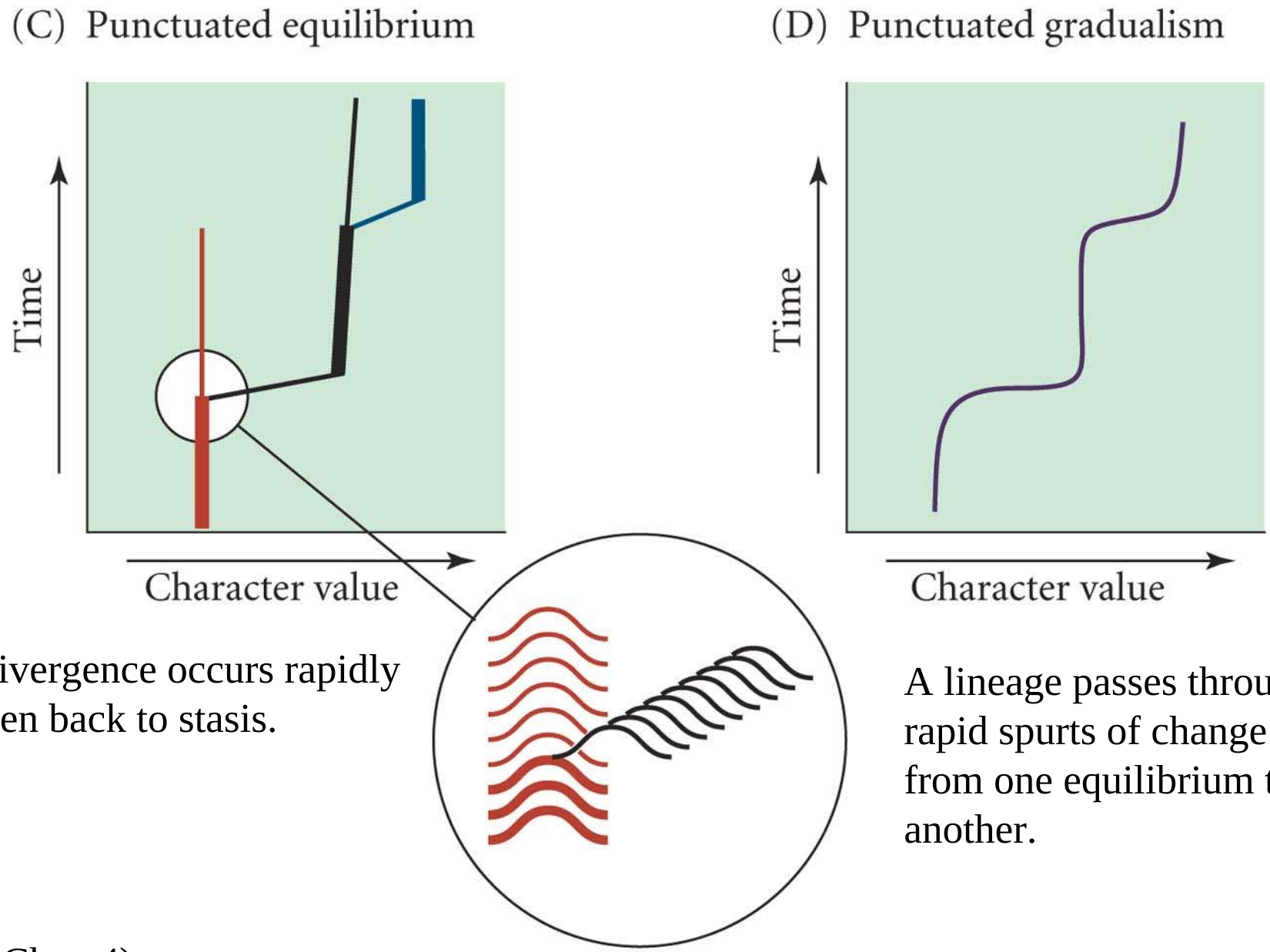




Traditional model of gradual change without any divergence.

(See Chap 4)

Macroevolutionary Inferences, Based on Rates

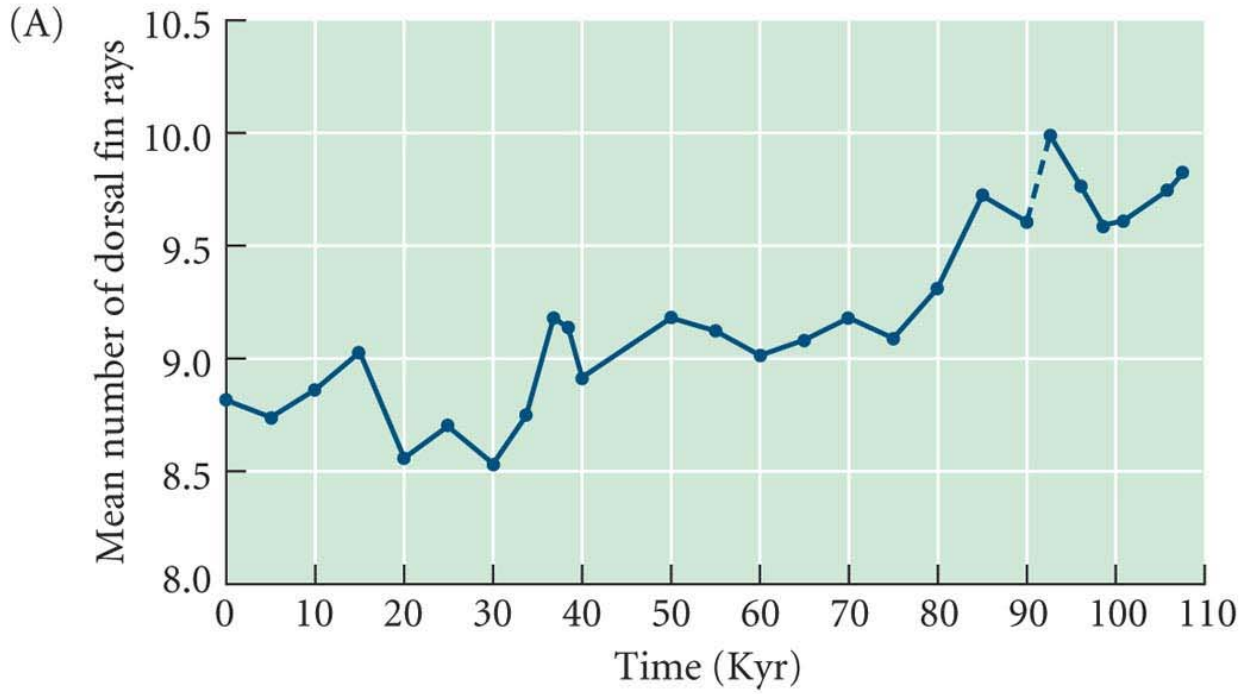


Divergence occurs rapidly then back to stasis.

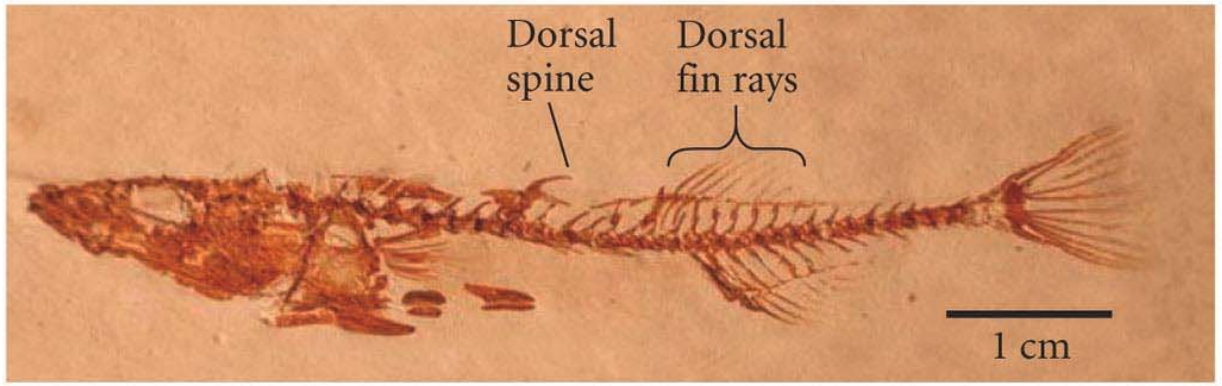
A lineage passes through rapid spurts of change from one equilibrium to another.

(See Chap 4)

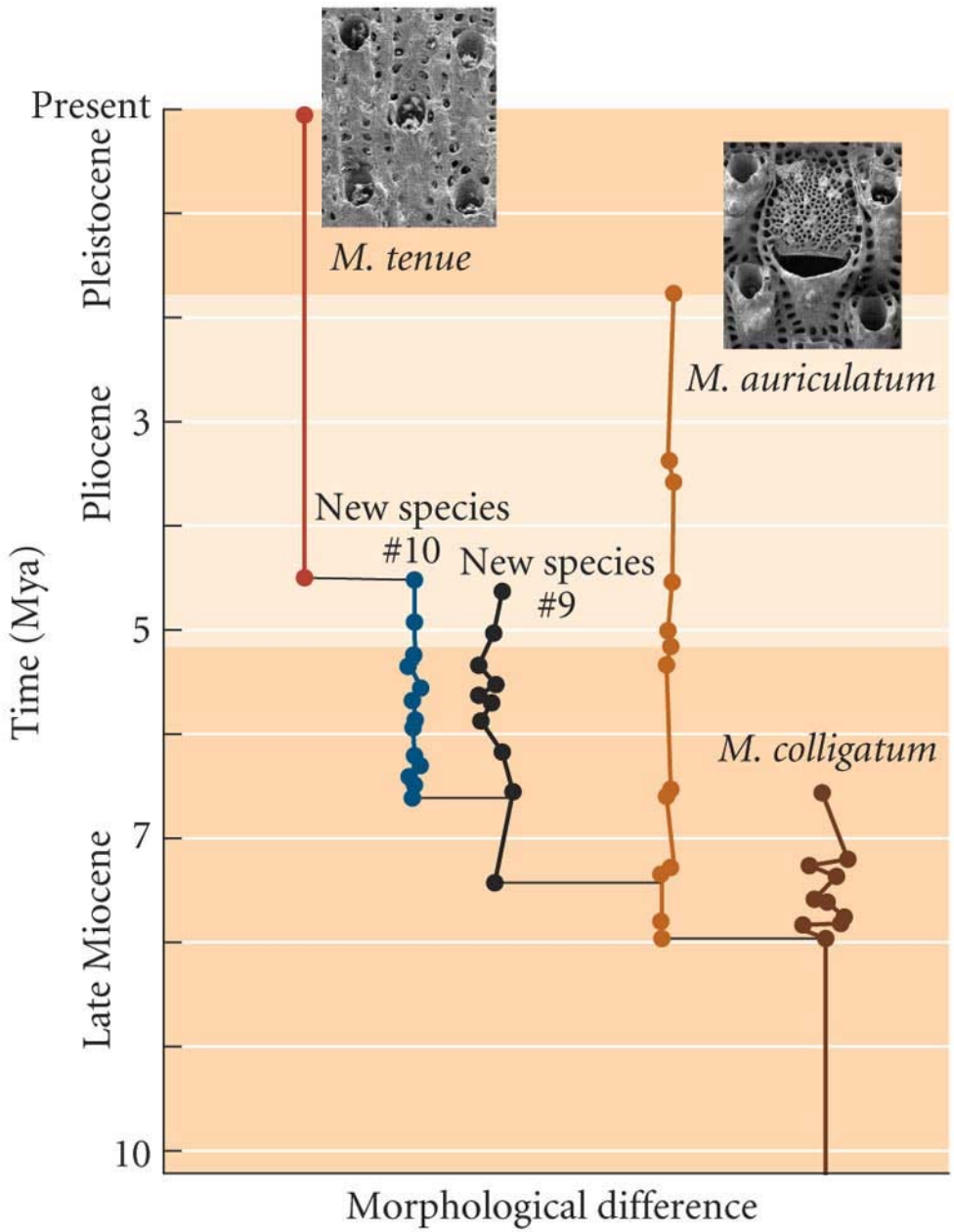
Gradual Evolution in Stickleback Fish



Gasterosteus doryssus



(See Chap 4)

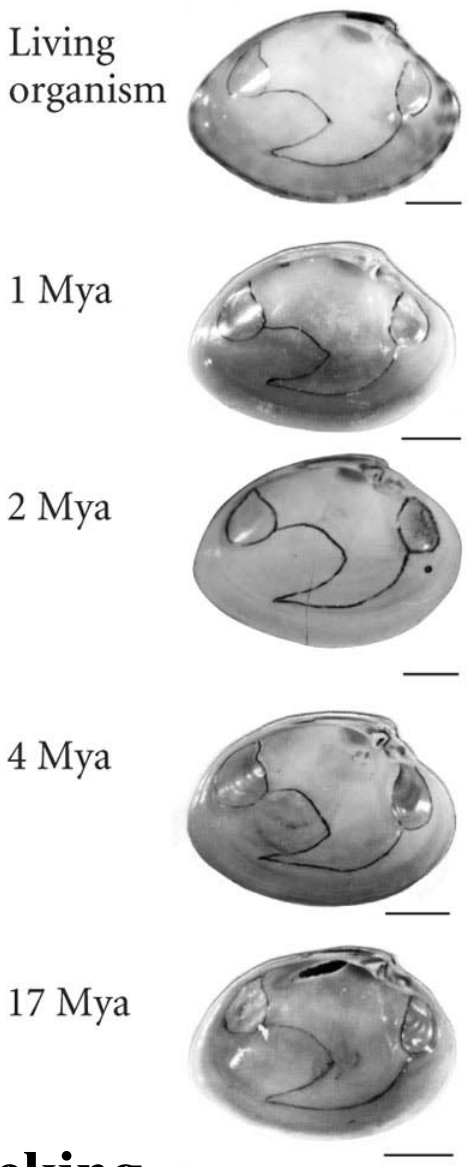


Punctuated equilibrium of *Metrarabdotos* bryozoans.

Predicts that speciation **is** necessary for character change to occur.

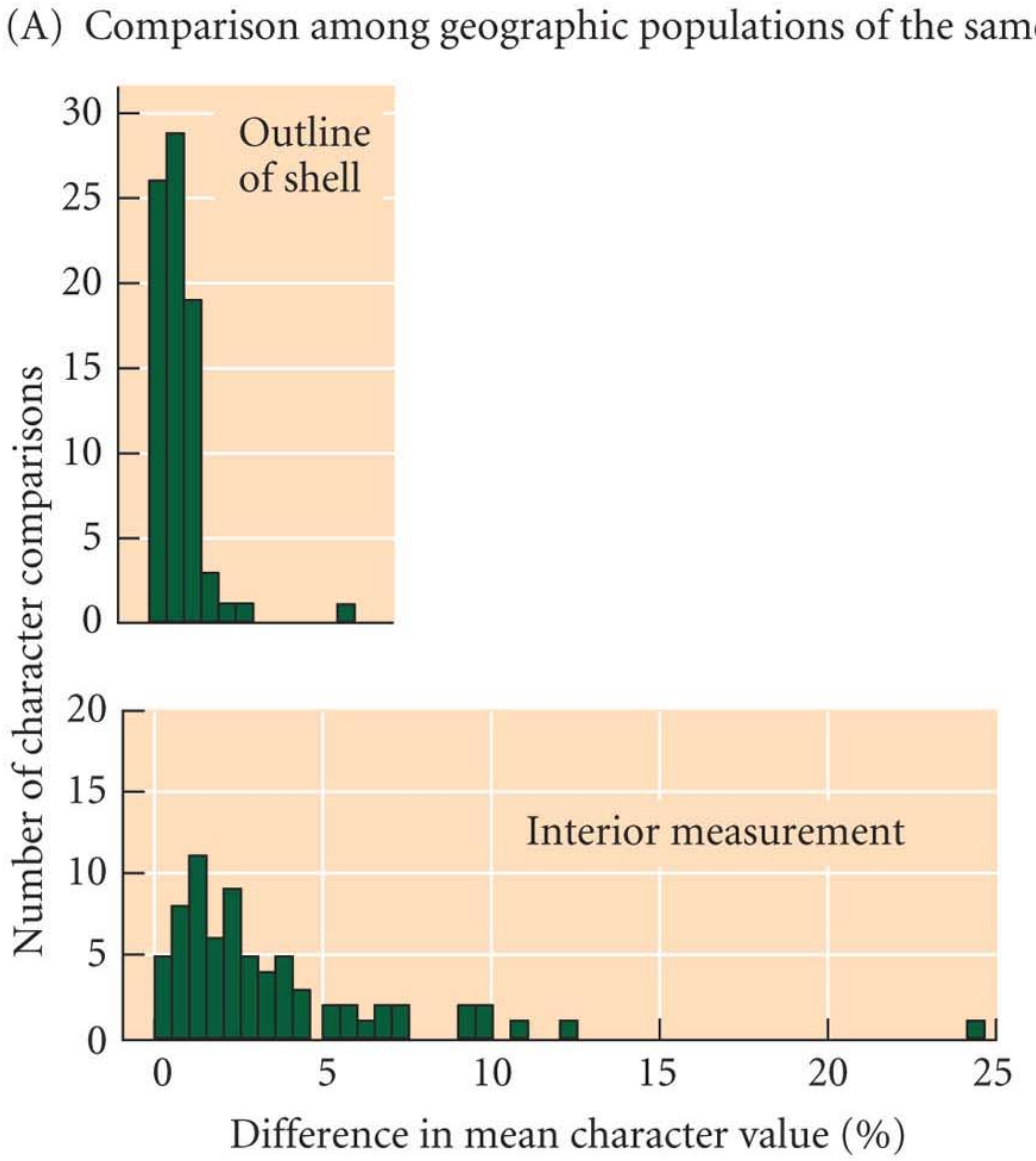
(See Chap 4)

Stasis in Fossil Bivalves

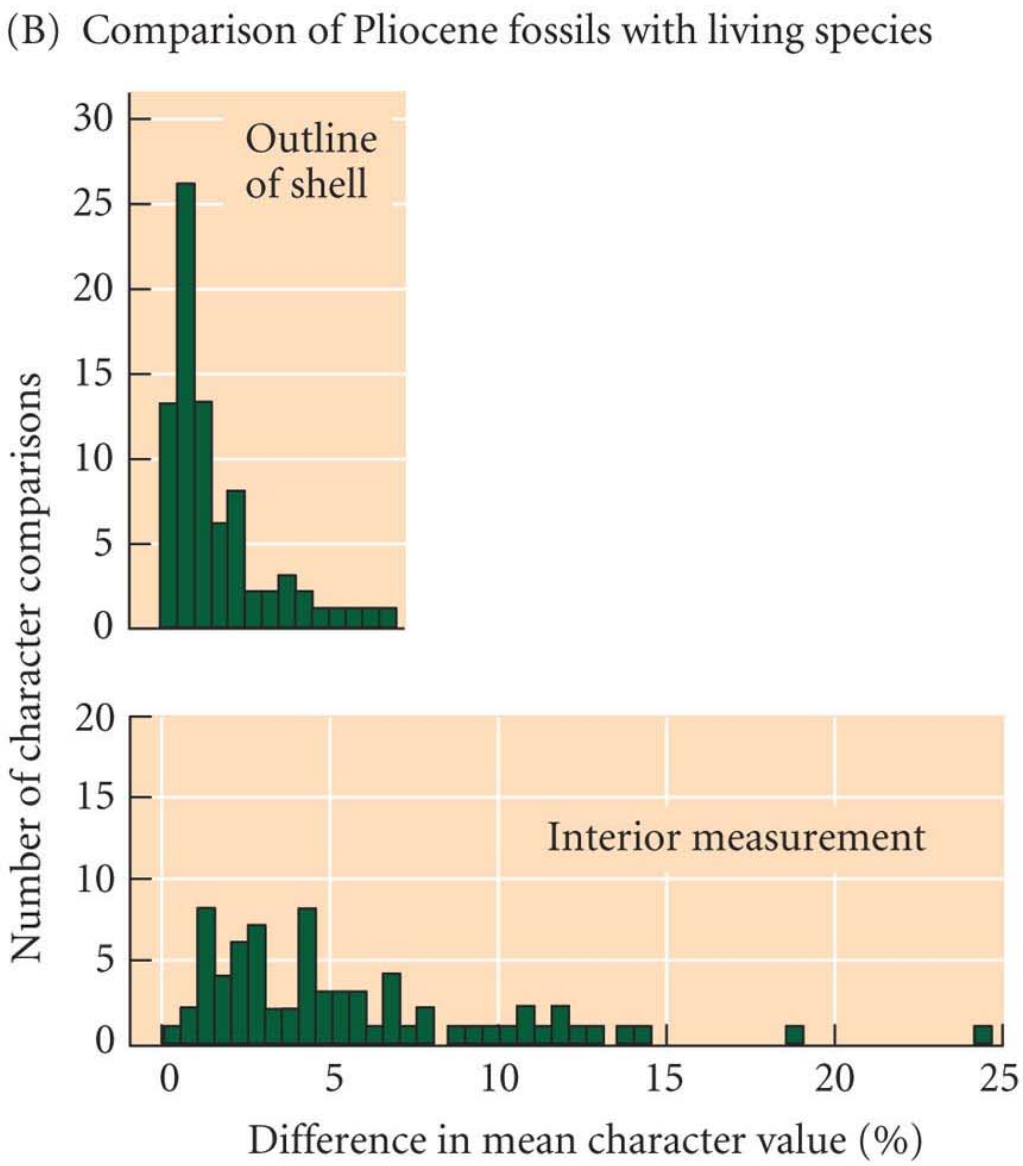


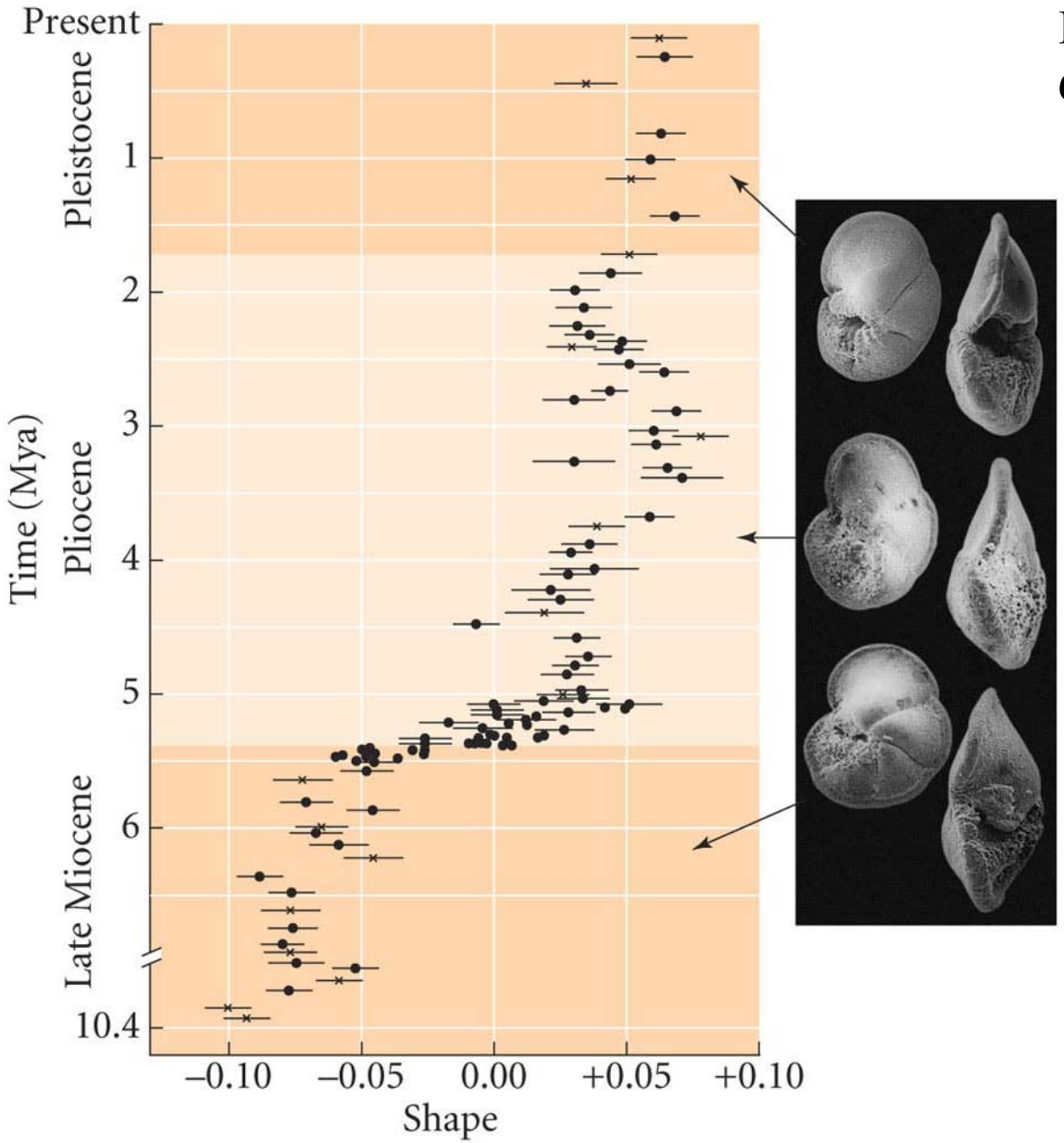
Concept of **Habitat Tracking**

A quantitative expression of stasis in shell characters of bivalves in the fossil record



A quantitative expression of stasis in shell characters of bivalves in the fossil record



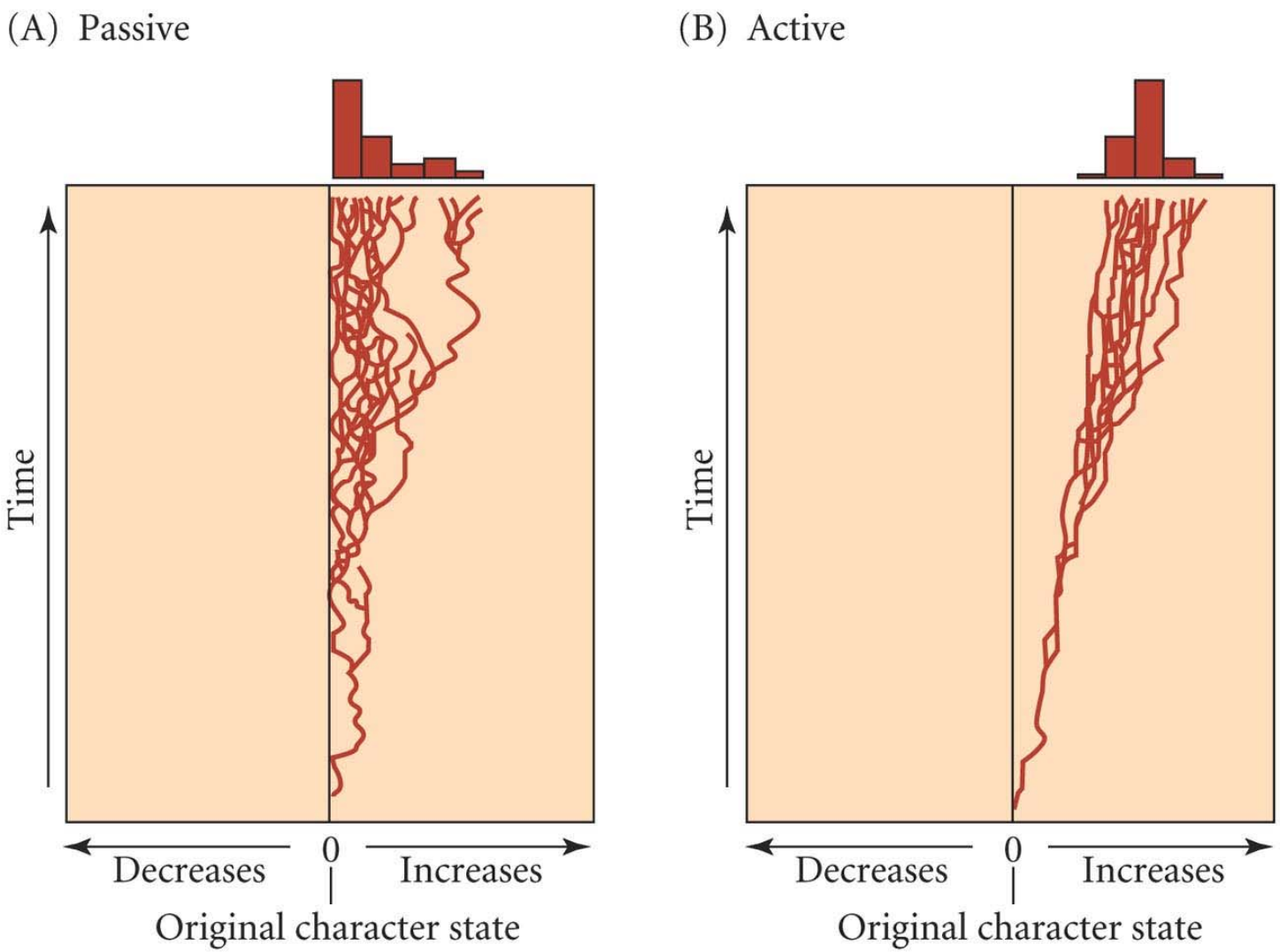


Punctuated gradualism in *Globorotalia* foraminifera.

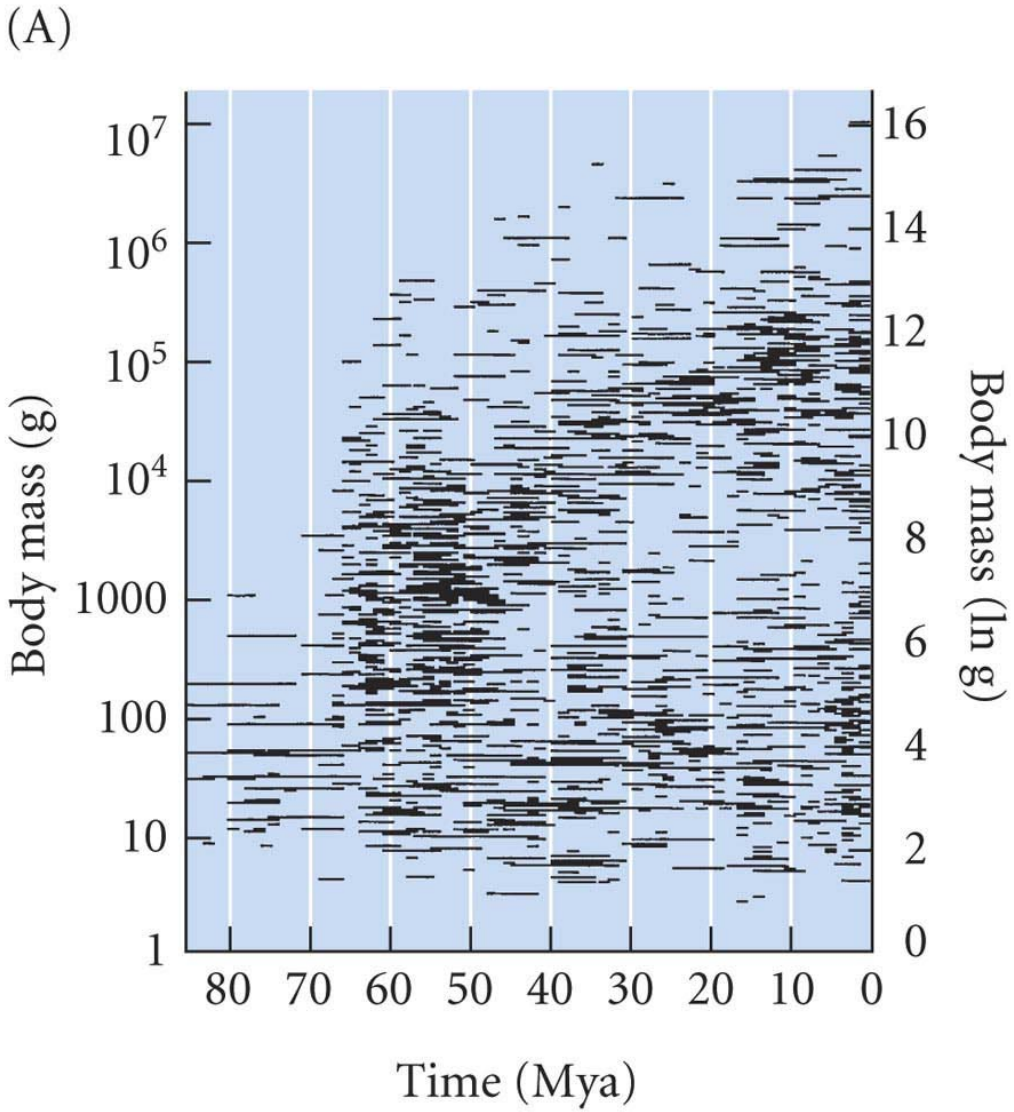
Predicts that speciation is **not** necessary for character change to occur.

(See Chap 4)

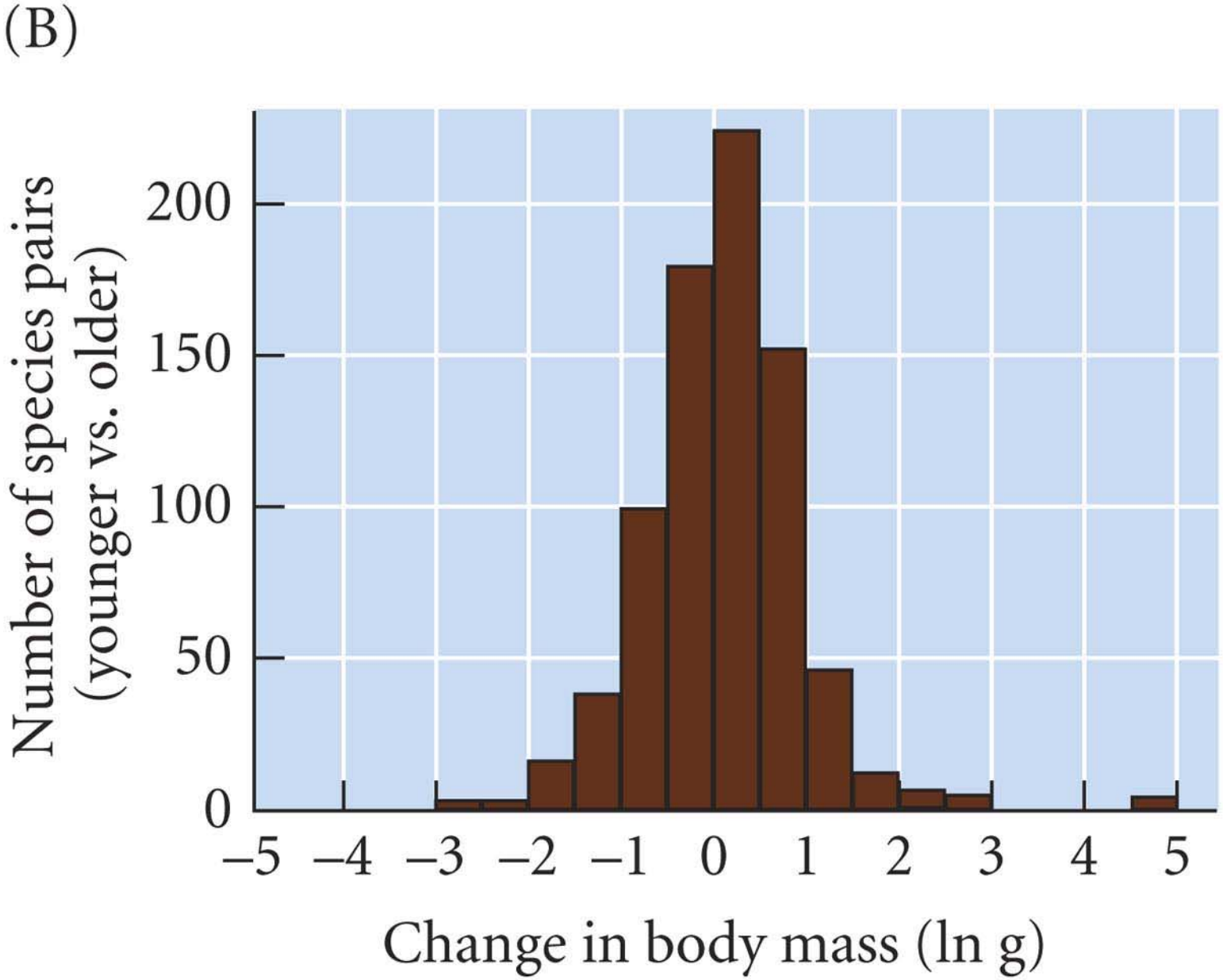
Trends in Macroevolution



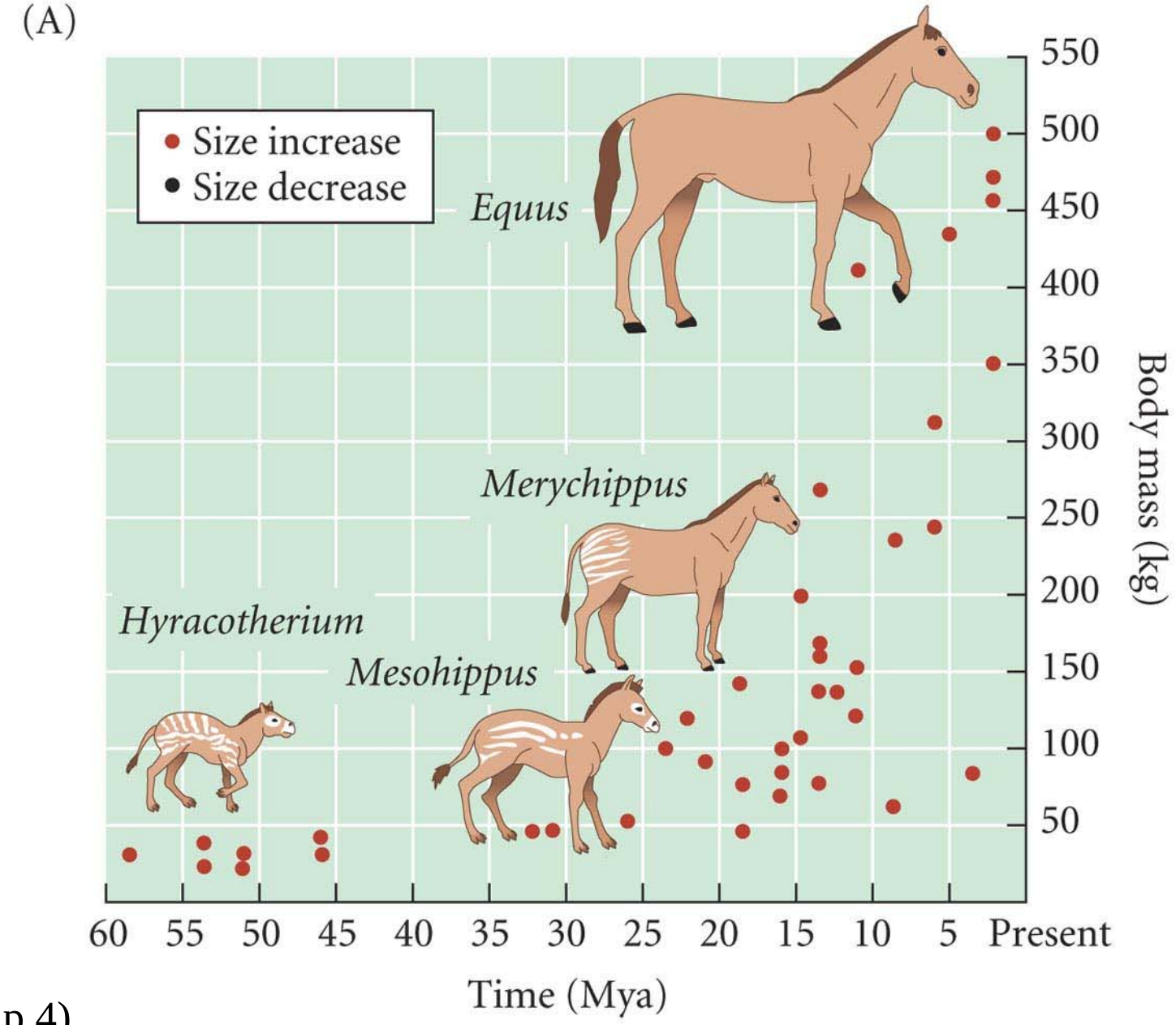
Cope's Rule in Mammals: A Passive Trend



Cope's Rule in Mammals: A Passive Trend

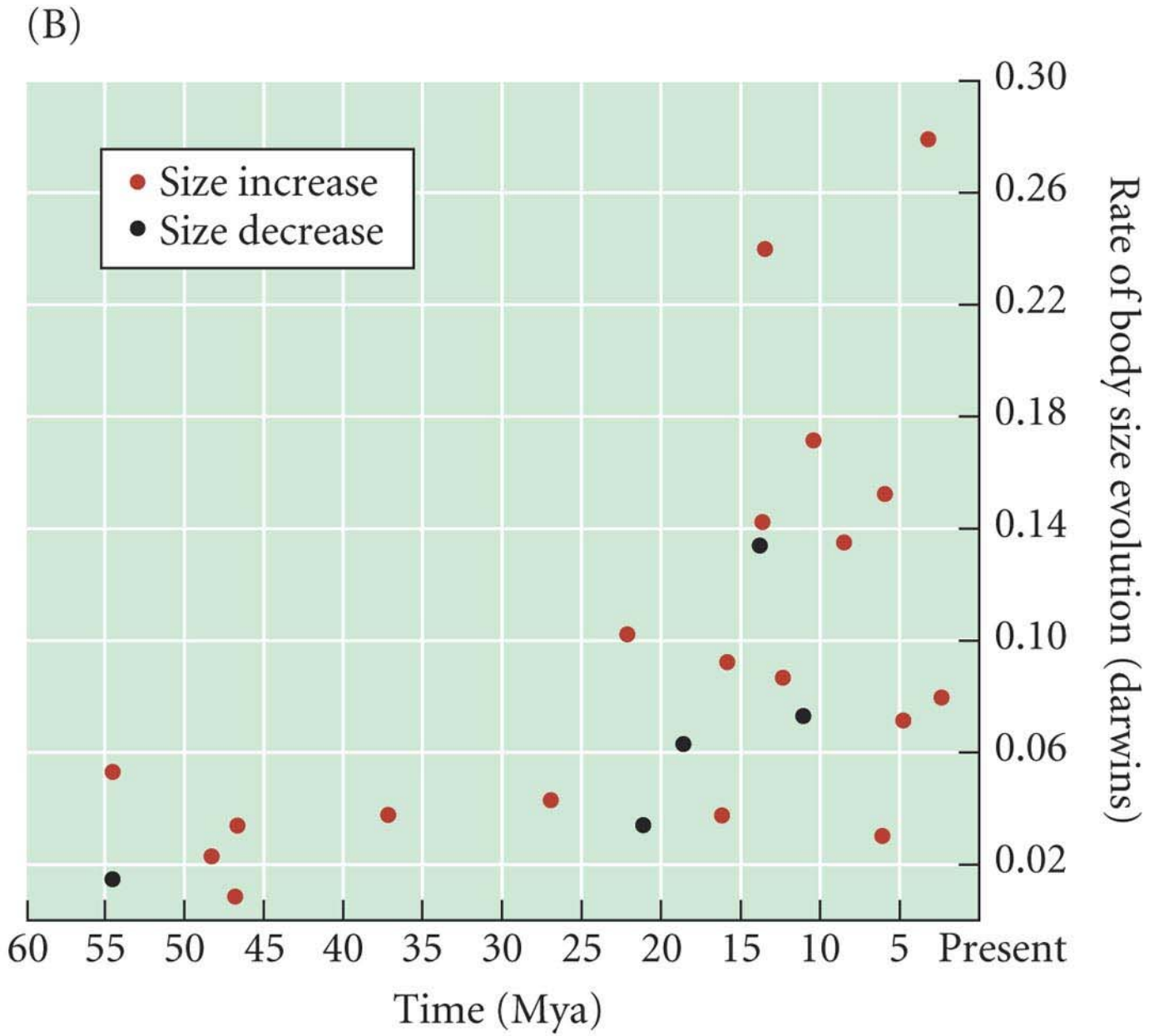


Evolution of body mass in the horse family, *Equidae*



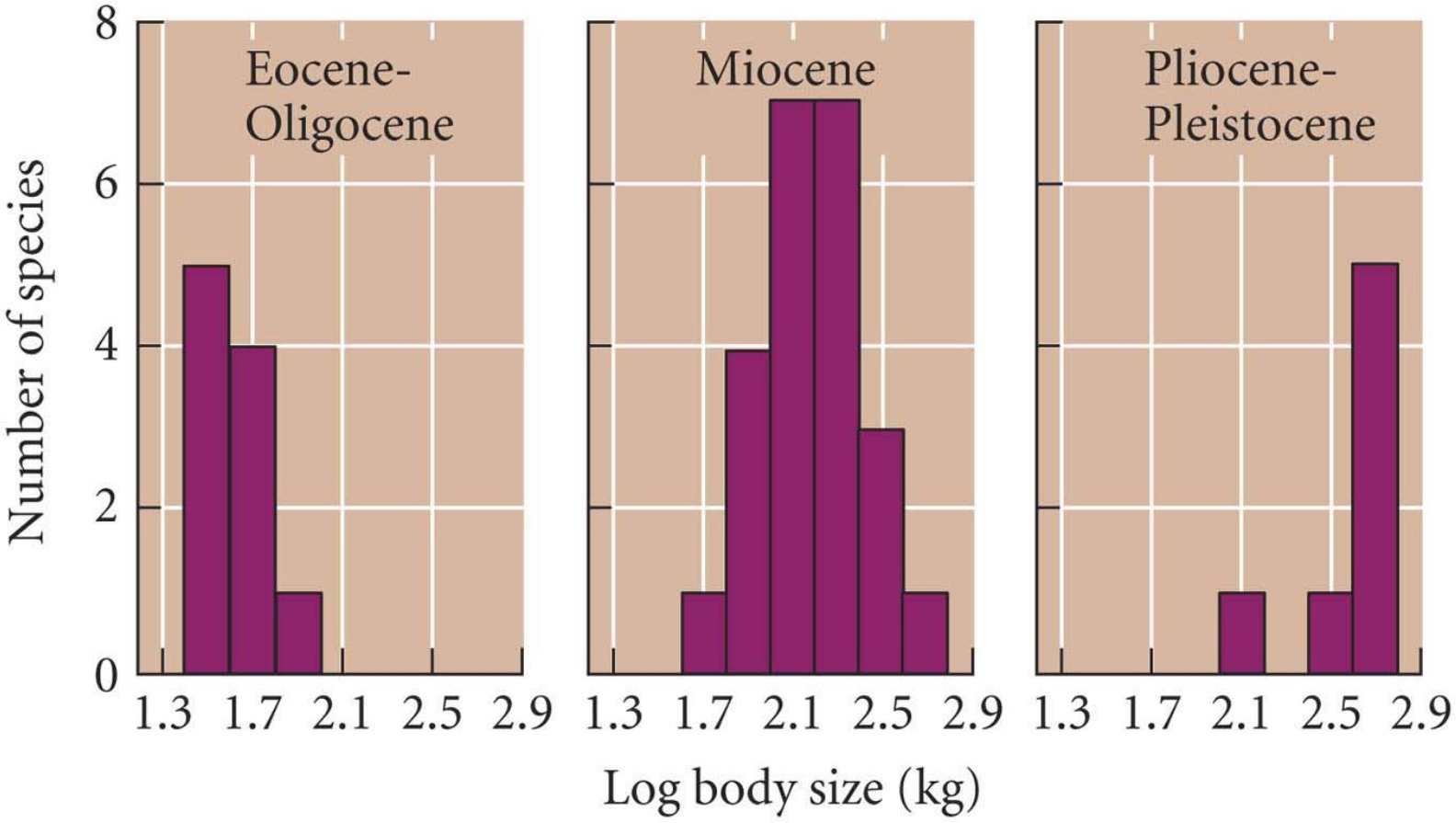
(See Chap 4)

Evolution of body mass in the horse family, *Equidae*



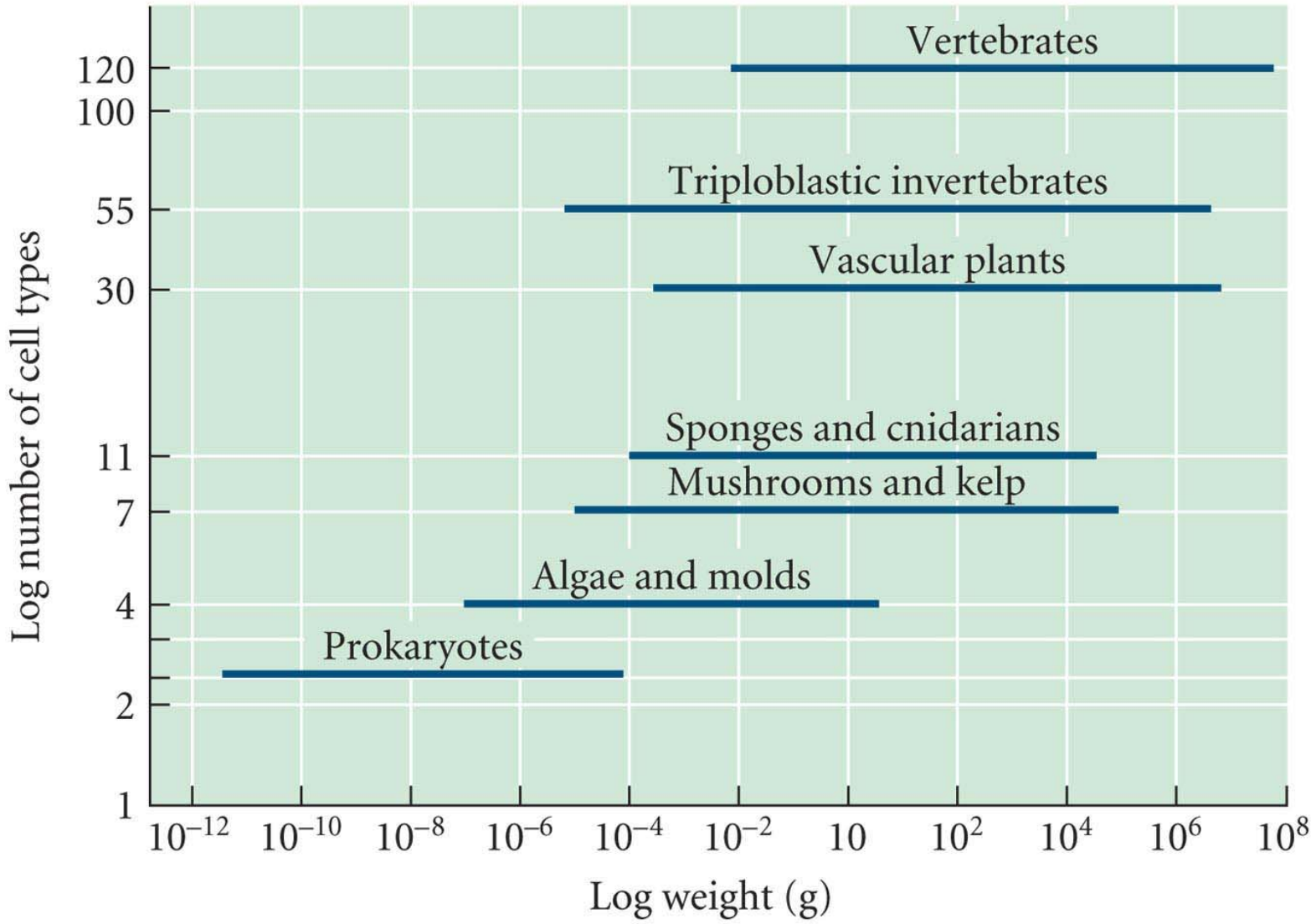
(See Chap 4)

Cope's Rule in Horses: An Active (driven) Trend



Change in max, mean and min sizes!

Evolution of Complexity: A Passive Trend



Complex structures often arise out of simple ones

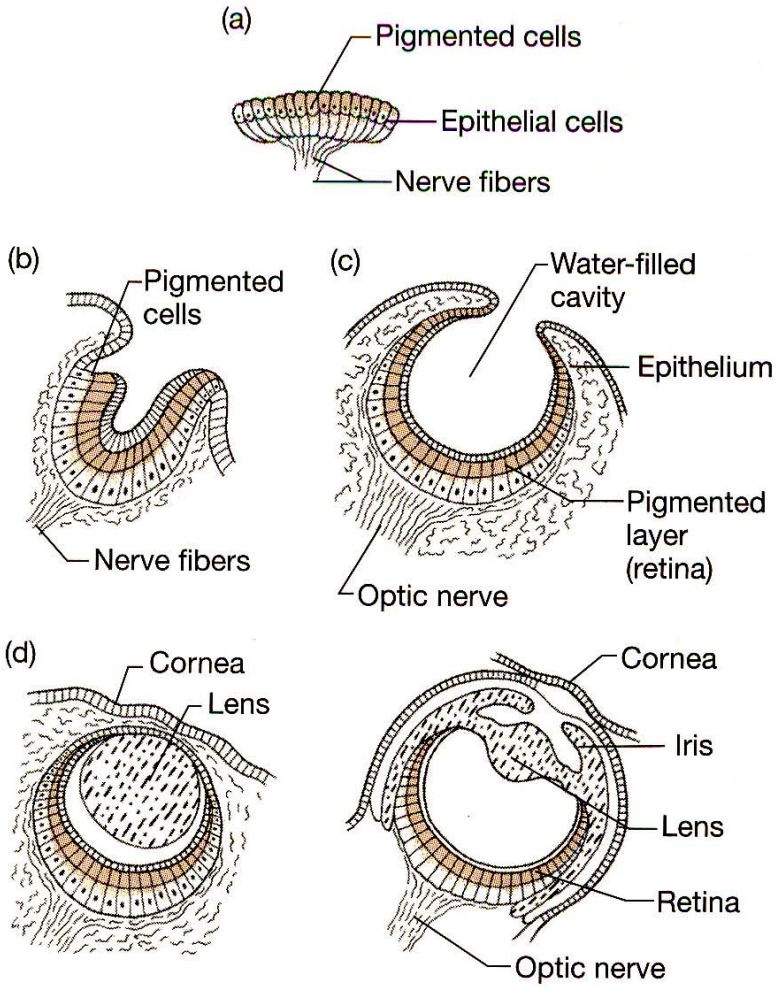
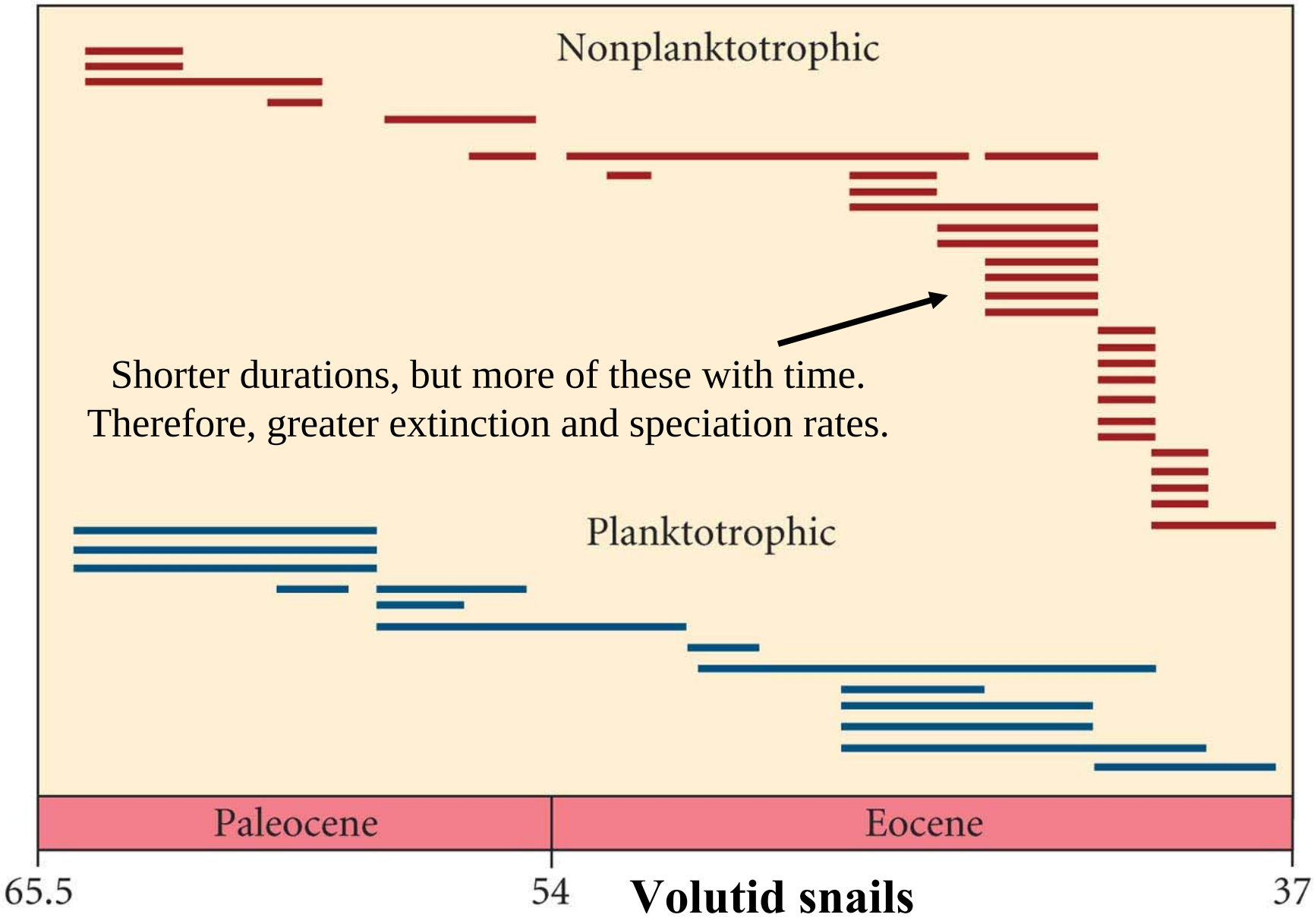


Figure 3.11 **Variation in mollusc eyes** (a) A pigment spot; (b) a simple pigment cup; (c) the simple optic cup found in abalone; (d) the complex lensed eyes of a marine snail called *Littorina* and the octopus. Pigmented cells are shown in color.

A trend caused by species selection



Evolution of Diversity: Active or Passive Trend?