Evolution & Biogeography

16 February 2007
16th class meeting

Quammen
(26 Feb Creativity Topic)

READINGS, Friday 16 Feb:
Island Biogeography (*Song of the Dodo*)
Mon 19 February:
Pimm et al. Biodiversity (on website)

Lab 14/16 Feb: Meet in lab
Data analysis and graphing
See assignment on webpage
Lab 21/23 Feb: Meet in lab
Plants, Keys, Library
See assignment on webpage

Environmental Biology (ECOL 206)
University of Arizona, spring 2007

Kevin Bonine, Ph.D.
Anna Tyler, Graduate TA

http://eebweb.arizona.edu/courses/Ecol206/206_Page2007.html

1

Department of Planetary Sciences
Lunar and Planetary Laboratory
University of Arizona

LPL Evening Lecture Series
Presents

"Global Warming: Global Climate Change and the Human Condition"

Professor Emeritus Robert Strom
Lunar and Planetary Laboratory

Tuesday, February 27, 2007, 7:30 PM
Kuiper Space Sciences Lecture Hall (room 308)

Global warming is extremely complex because it deals with so many different characteristics of the Earth and their complex interactions. It is addressed by almost all sciences including many aspects of astronomy, geosciences, atmospheric, the biological and planetary sciences. It has recently become the concern of other diverse disciplines such as economics, agriculture, medicine and engineering. This talk will address these complex interactions, integrate them, and derive meaningful conclusions and possible solutions.

http://www.lpl.arizona.edu/COLPL

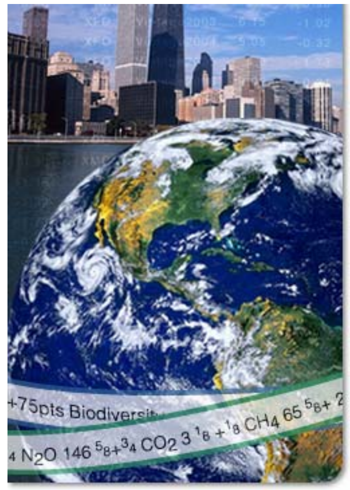
2

Reaping a profit from the air

As concern grows over global warming, farmers and corporations are responding by trading carbon credits through a Chicago exchange.

By Robert Lee Hotz, L.A. Times Staff Writer

February 10, 2007



3

http://www.chicagoclimatex.com/

Dessaur et al. 2000

Hybridization in Whiptail Lizards

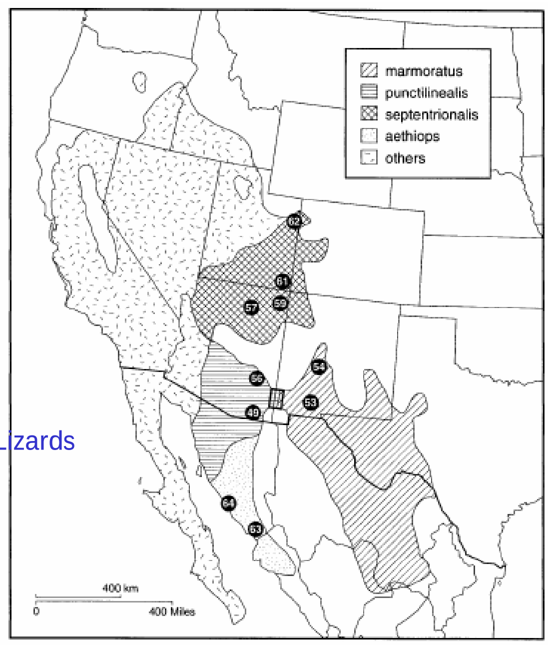


Fig. 1. Geographic range of the western whiptail lizard, *Cnemidophorus tigris* sensu lato, in the continental southwestern United States and northern Mexico. Rectangle (SE Arizona and SW New Mexico) outlines the contact region (detailed in figs. 3–5) where *C. t. punctilinealis* interbreeds with *C. t. marmoratus*. Numbers designate collecting sites (appendix 2) for specimens additional to those obtained within the contact region (fig. 3; appendix 1).

A. Cullum 1997, Am.Nat.

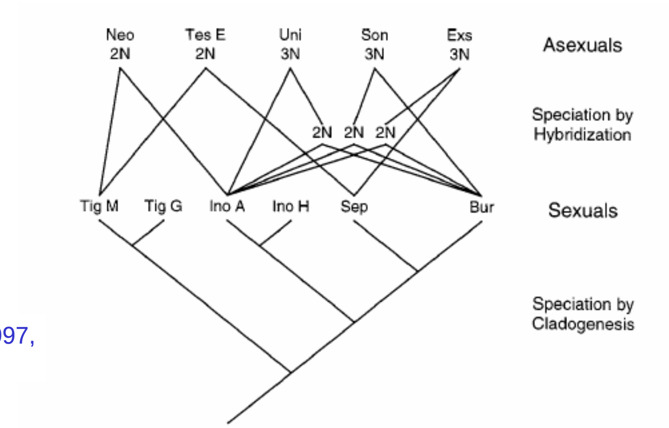
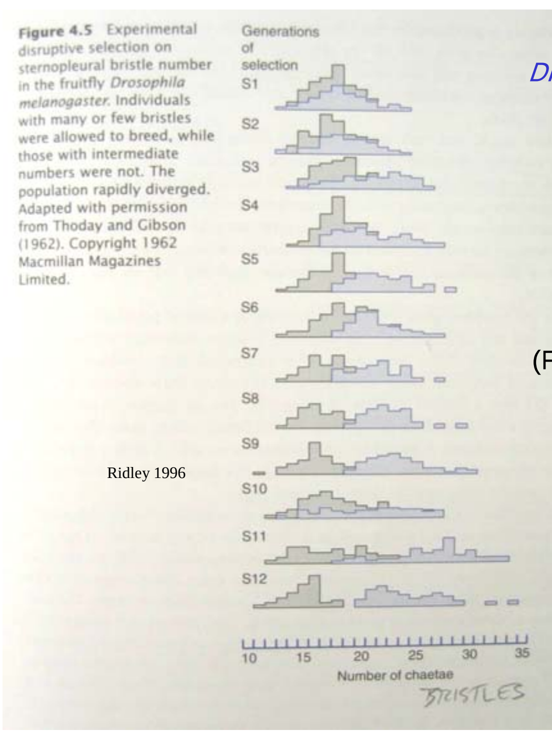


Fig. 1.—*Cnemidophorus* phylogeny. This hypothesized phylogeny of *Cnemidophorus* species examined in this study is intended only to show relationships among species, not the time of particular speciation events. The sexual group shows the typical bifurcating pattern of speciation via cladogenesis. The appearance of the asexual species exhibits the reticulate pattern of a hybridization event. Ploidy of asexual species is shown below their abbreviation. In triploid asexuals, intermediate diploid hybrids were believed to be involved in the two hybridization steps. Note that both sexual and asexual species have persisted independently since the hybridization events. Species abbreviations: *Neo, C. neomexicanus; Tes, C. tesselatus clone "E"; Uni, C. uniparens; Son, C. sonorae; Exs, C. exsanguis; Tig M, C. tigris marmoratus; Tig G, C. tigris gracilis; Ino A, C. inornatus arizonae; Ino H, C. inornatus heptagrammus; Sep, C. septemvittatus; Gul, C. gularis;* and *Bur, C. burti stictogrammus*. Sexual species phylogeny based on Densmore et al. (1989*a*), Dessauer and Cole (1989), and Moritz et al. (1989). Asexual species phylogeny based on Good and Wright (1984) and Dessauer and Cole (1989).

5



Drosophila Bristle Count

Disruptive Selection (Favors Both extremes)

6

Directional Stabilizing Disruptive

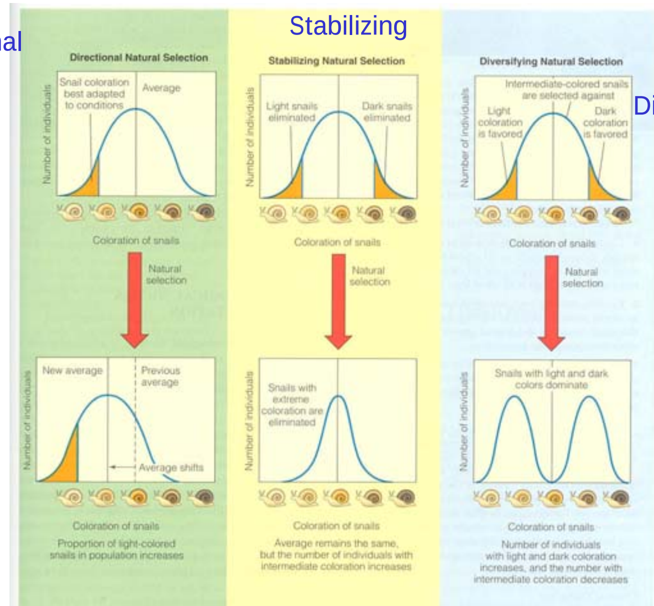
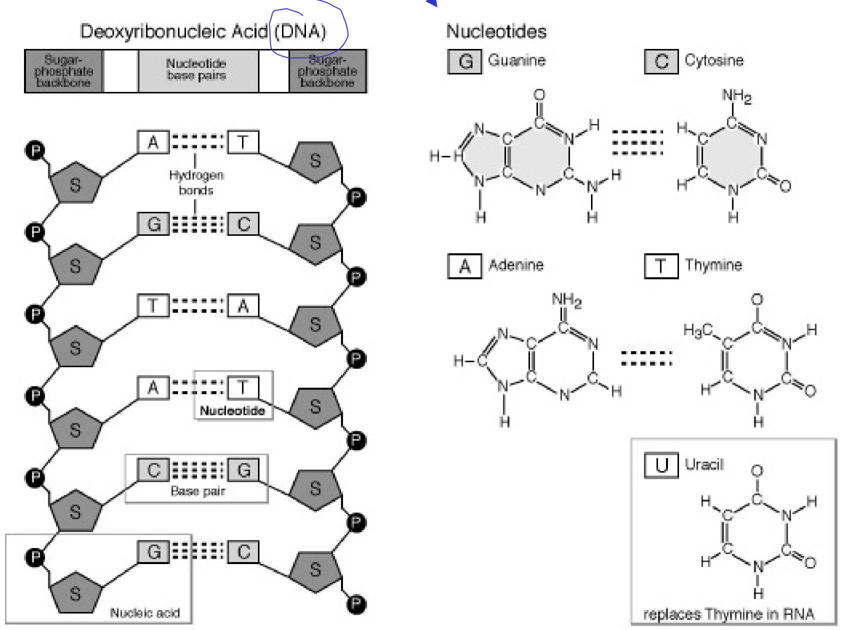


Figure 5-5 Three ways in which natural selection can occur, using the trait of coloration in a population of snails. In *directional natural selection*, changing environmental conditions select organisms with alleles that deviate from the norm so that their offspring (lighter-colored snails) make up a larger proportion of the population. In *stabilizing selection*, environmental factors eliminate fringe individuals (light- and dark-colored snails) and increase the number of individuals with average genetic makeup (intermediate-colored snails). In *diversifying natural selection*, environmental factors favor individuals with uncommon traits (light- and dark-colored snails) and greatly reduce those with average traits (intermediate-colored snails).

7

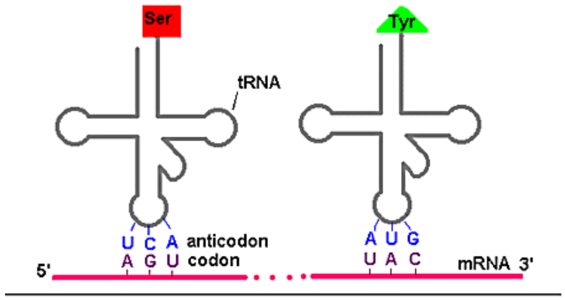


8

DNA sequence Codes for Proteins etc.

Genetic Code

A (adenine),
T (thymine), [**U**(uracil)]
C (cytosine),
G (guanine)



(Coding, sense strand)
(5' -> 3') **ATGGAATTCTCGCTC**
(3' <- 5') **TACCTTAAGAGCGAG**
(Template, antisense strand)

(5' -> 3') **AUGGAAUUCUCGCUC**
(mRNA made from Template strand)

2nd base in codon

1st base in codon	U	C	A	G	3rd base in codon
U	Phe Phe Leu Leu	Ser Ser Ser Ser	Tyr Tyr STOP STOP	Cys Cys STOP Trp	U C A G
C	Leu Leu Leu Leu	Pro Pro Pro Pro	His His Gln Gln	Arg Arg Arg Arg	U C A G
A	Ile Ile Ile Met	Thr Thr Thr Thr	Asn Asn Lys Lys	Ser Ser Arg Arg	U C A G
G	Val Val Val Val	Ala Ala Ala Ala	Asp Asp Glu Glu	Gly Gly Gly Gly	U C A G

The Genetic Code

1-Transcription
2-Translation

Proteins of amino acids

Galapagos Finches

(b)

(c)

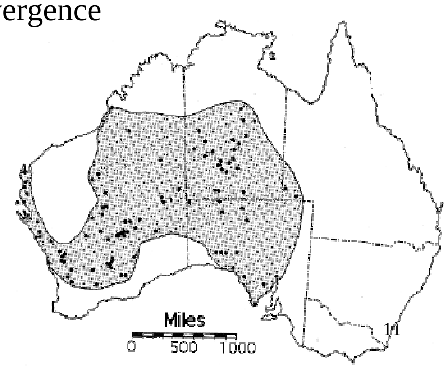
Brassica oleracea

Figure 17–8 A number of common vegetables are members of the same species, *Brassica oleracea*, including cauliflower, broccoli, cabbage, brussels sprouts, and kale. Artificial selection is responsible for the variation shown within this species. (Raymond Tschoepe)

Solomon et al. 1993

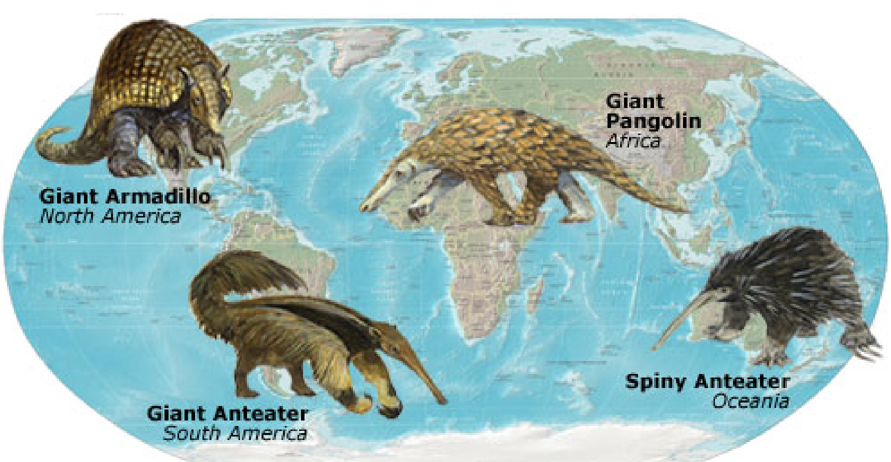
10

Convergence

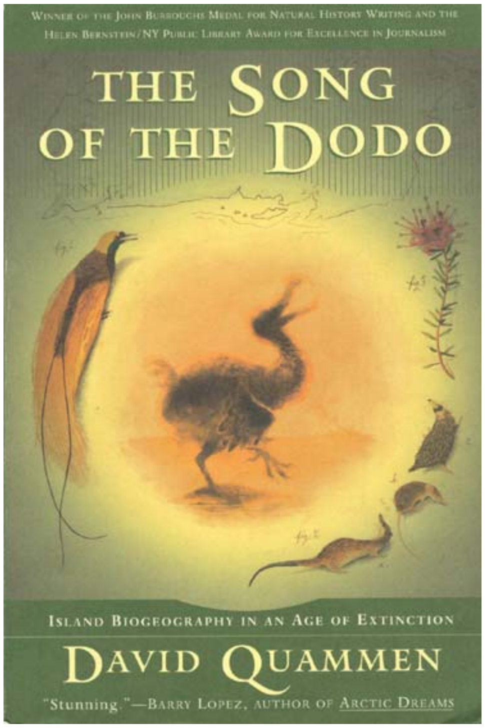


11

Convergent Evolution



12



Island Biogeography

13

Equilibrium Theory of Island Biogeography

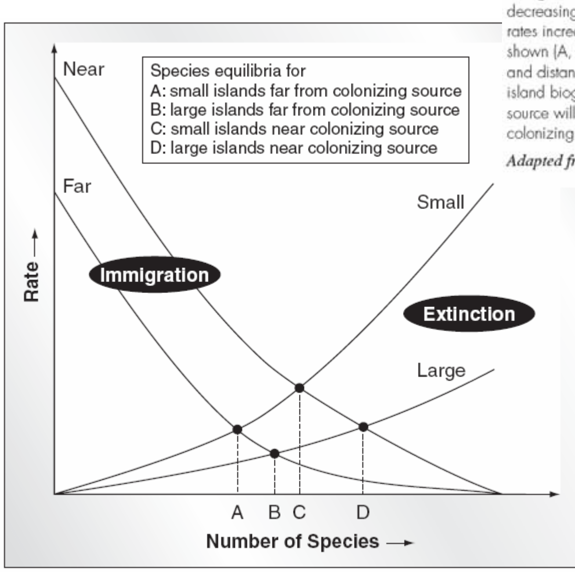


Figure 5.9
The equilibrium model of island biogeography predicts that numbers of species on an island represent an equilibrium between rates of immigration and extinction. Immigration rates increase with decreasing distance from an island's colonizing source. Extinction rates increase with decreasing area of the island. The four equilibria shown (A, B, C and D) depict different combinations of island size and distance from its colonizing source. The equilibrium theory of island biogeography predicts that large islands near a colonizing source will have more species than small islands far from a colonizing source.

Adapted from MacArthur and Wilson (1967).

VanDyke 2003

14

Equilibrium Theory of Island Biogeography

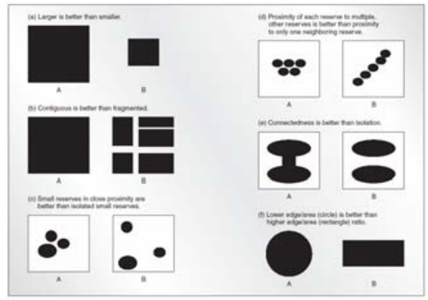


Figure 5.10
A graphical representation of the "rules" of island biogeography applied to nature reserves. In each case, design A is considered superior to design B.

- Habitat Fragmentation
- Reserve Design
- Predictions vs. Observations
- Missing Factors

Rescue Effect?

15

<u>Island Biogeography</u>

Quammen Excerpt from *Song of the Dodo* (p.52-55)

Lyell
Wallace
Darwin

Frogs vs. Birds

Oceanic vs. Continental

Size, Age, Distance

Endemism

16

Bali

Madagascar

17

Dispersal

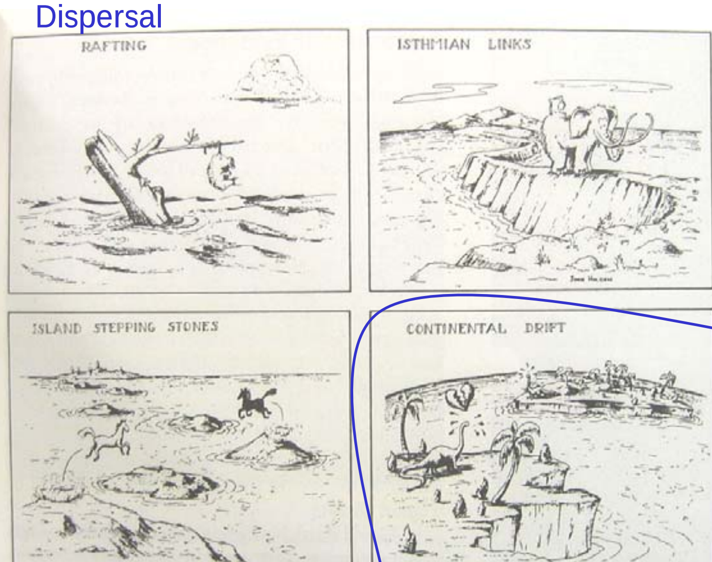


Figure 19.5 These sketches by John Holden illustrate various explanations for the occurrence of similar species on landmasses that are presently separated by vast oceans. (Reprinted with permission of John Holden)

Tarbuck and Lutgens 1999

Vicariance

18

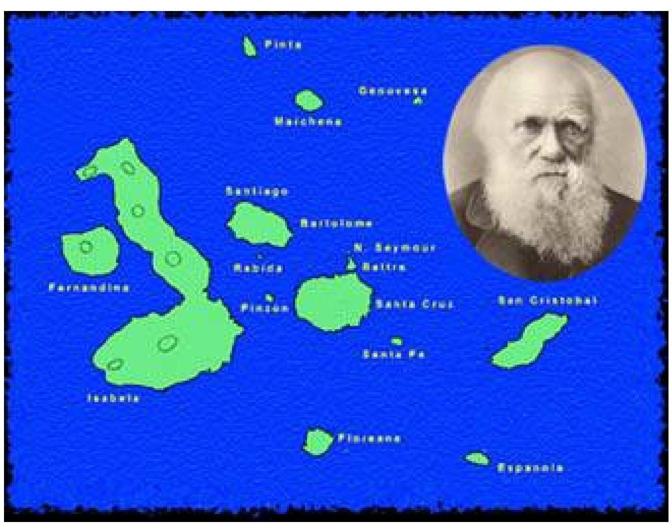
- Plate tectonics
- Climate (glaciation, drought)
- Sea level

Table 5–5 **The amount of time during two Pleistocene intervals that sea levels in southeast Asia were at or below present levels (BPL; given in meters). The approximate number of years in each time period, the approximate percentage of years in each time period, and the estimated number of times within each period that sea level fell below the level shown in column 1 are given.**

	Past 150,000 years			Past 250,000 years		
Sea Level BPL (m)	**Years**	**% of time**	**Events**	**Years**	**% of time**	**Events**
120	3,000	2	1	15,000	6	2
100	7,000	5	1	29,000	12	2
75	14,000	9	1	42,000	17	2
50	40,000	27	5	99,000	40	5
40	65,000	43	7	136,000	54	6
30	93,000	62	5	167,000	67	6
20	107,000	71	4	201,000	80	6
10	134,000	89	3	227,000	91	3

Source: after Voris 2000, Table 1.

Pough et al. 2004



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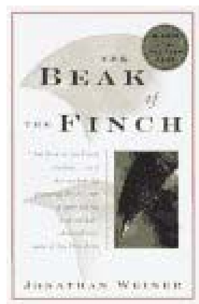


21

http://www.rit.edu/~rhrsbi/GalapagosPages/DarwinFinch.html

22

http://www.rit.edu/~rhrsbi/GalapagosPages/mockingbird.html

23

Galapagos

Humboldt Current

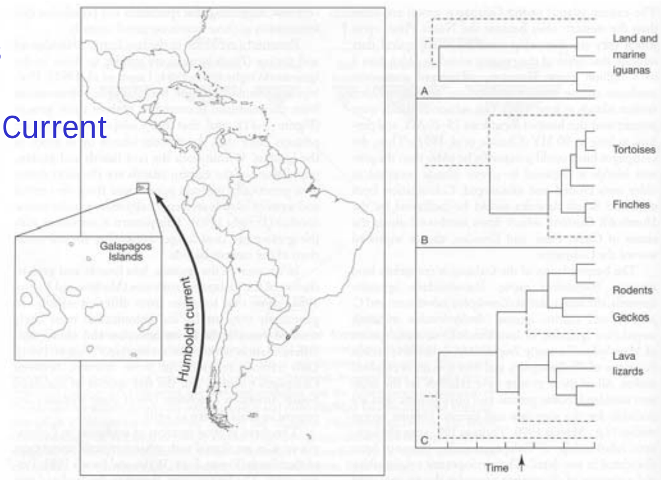


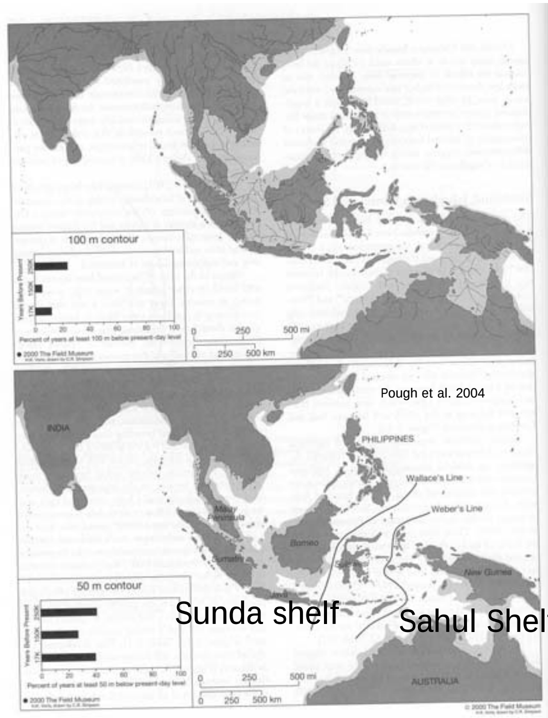
Figure 5–11 **Phylogenetic relationships and patterns of colonization of vertebrates in the Galapagos Islands.** *Left*, The location of the Galapagos Islands and the direction of the Humboldt Current, which presumably helped transport colonizers to the islands. *Right*, Three major patterns of relationships of Galapagos vertebrates. The time scale is arbitrary. The arrow on the horizontal axis indicates the time of origin of the present archipelago and/or the initial introduction of each group. Solid lines indicate the radiation of the endemic Galapagos taxa; dashed lines indicate the relationship of these taxa to their closest living mainland sister group. (A) Pattern of relationships for the land and marine iguanas (*Conolophus* and *Amblyrhynchus*), which show minimal differentiation within species, but share a remote common ancestor considerably earlier than the origin of the islands. (B) The giant tortoises (*Geochelone*) (and Darwin's finches) are endemic radiations within the archipelago stemming from a single colonization event. In the case of the tortoises, the mainland ancestral group appears to be extinct. (C) The gecko (*Phyllodactylus*), lava lizard (*Microlophus*), and rodent radiations appear to have resulted from multiple introductions from separate mainland stocks already differentiated to some degree. *(Source: Patton 1984.)*

Pough et al. 2004

25

Alfred Russel Wallace
(1823 - 1913)

Wallace's Line
→
Weber's Line

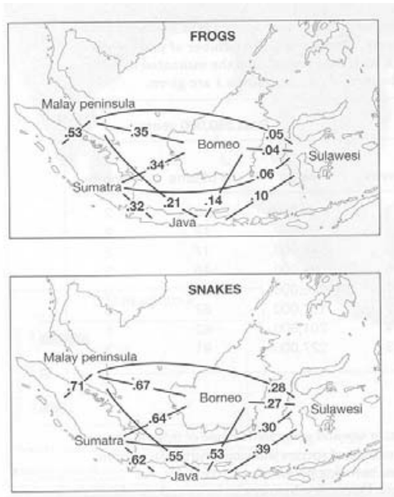


Pough et al. 2004

Sulawesi

26

Dispersal Ability



Pough et al. 2004

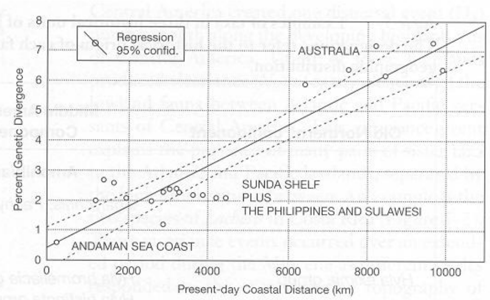
Figure 5–13 **Patterns of faunal resemblance among areas of the Sunda Shelf in their frog (top) and snake faunas (bottom).** The numbers reflect the number of shared species between areas, calculated as indexes of faunal similarity, where Similarity = (2 × number of species in common)/[(number of species in area A) + (number in area B)]. Note that snakes share a much greater proportion of species among these areas than do frogs. This very likely results from differing dispersal capabilities as well as differences in the potential for population isolation and speciation. *(Source: Inger and Voris 2001.)*

27

Dispersal Ability (Isolation by Distance)

Figure 5–15 **Correlation between genetic divergence and geographic coastline distance separating populations of *Cerberus rynchops* (linear regression with 95 percent confidence limits).** *(Source: Karns et al. 2000.)*

Pough et al. 2004



28