Bio1B Evolution 10

Last lecture:

Species & speciation

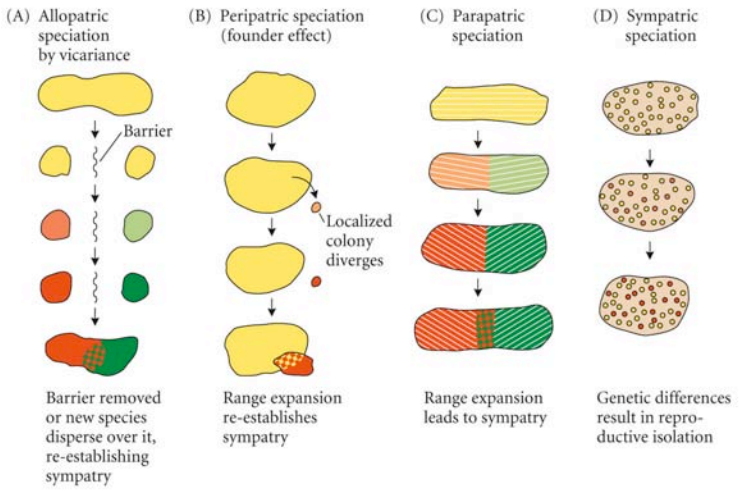
- What is a species anyway? (Pp. 487-492)
  - Interesting one - Ensatina salamanders
- Speciation processes (Pp 492-504; Losos & Rickleffs (2009) paper -
- Introduction & geographic modes
- Adaptive radiations

Today

Species & speciation

- Hybridization - hybrid zones, reinforcement & hybrid-speciation
- Macroevolution:
  - The fossil record and major transitions

Geographic modes of speciation



EVOLUTION 2e, Figure 18.1 Futuyma 2005

Hybrid zones - alternative outcomes after re-contact between lineages

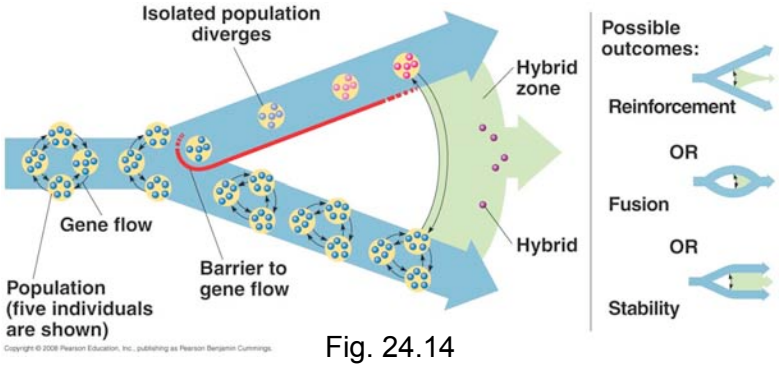
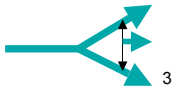


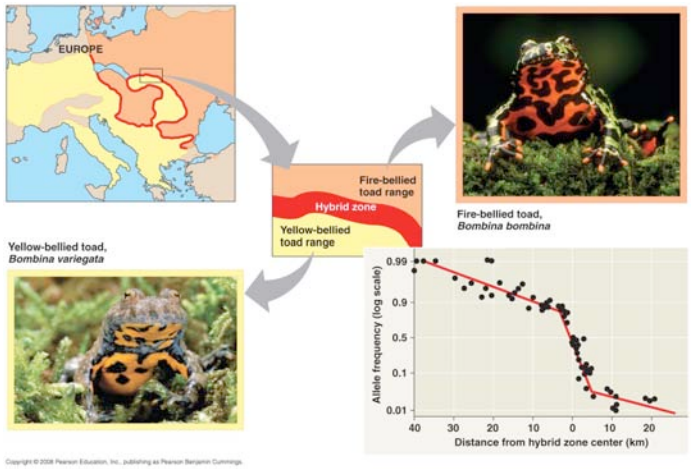
Fig. 24.14

Or - lineages don't hybridize and eventually overlap if ecologically distinct

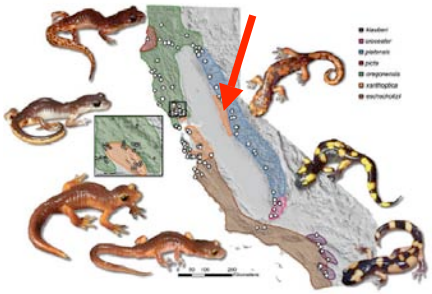
Or, new "hybrid species"

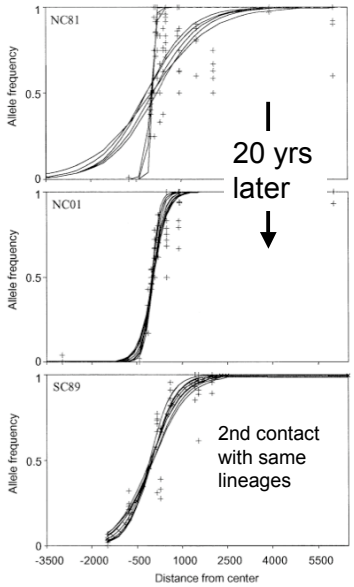


Hybrid zone - *Bombina variegata-bombina* (Fig. 24.13)



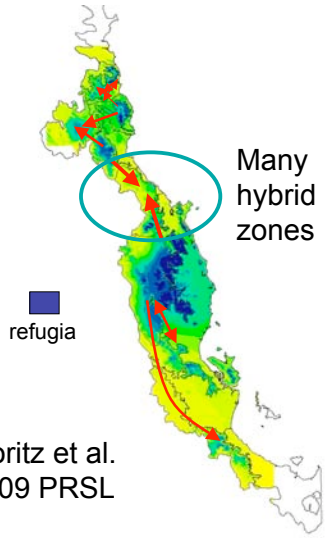
A stable hybrid zone in Ensatina





Alexandrino et al. 2005

Recent (<8kya) expansion from long-isolated (>2 Myr) refugia in the NE Australian rainforest



Moritz et al. 2009 PRSL

Is there evidence for reproductive isolation?

Is there evidence for reinforcement => prezygotic isolation?

Skinks = narrow (<1km) hybrid zones - selection against hybrids

Small marsupial - random mating, no evidence for RI

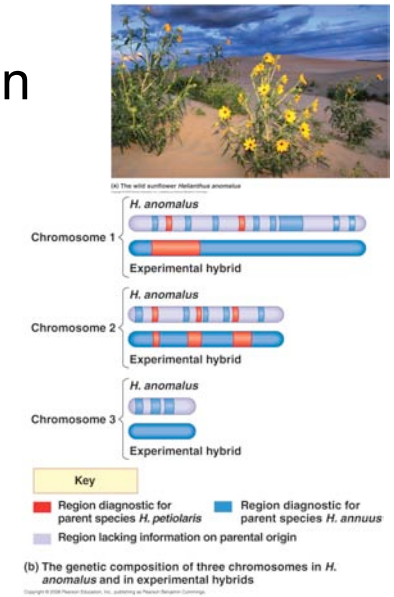
Frog - reinforcement => Reproductive isolation

Hybrid speciation

=> Formation of unique and isolated lineages from inter-lineage hybrids

- Allopolyploidy (see p. 496)
- If same ploidy, requires eco-geographic isolation from parent lineages
- E.g. arid-adapted *Helianthus anomalus* = *H.annuus* X *H. petiolaris*

Fig 24.18, p. 503



Speciation wrap-up

- Species are (largely) independent evolutionary lineages
- Divergent selection &/or genetic drift => increasing divergence and RI with time. Opposed by gene flow
- Speciation is inevitable if populations are isolated for long enough - RI evolves faster and most reliably with divergent selection in allopatry. Might also occur quickly in association with founder events and subsequent selection (peripatry)
- If diverging populations are in close proximity (para/sympatry), disruptive selection must be accompanied by non-random (like-like) mating to reduce gene flow

The fossil record: billions of years of sedimentation => recoverable history

- E.g. Grand Canyon & environs - layered sediments from recent to pre-Cambrian

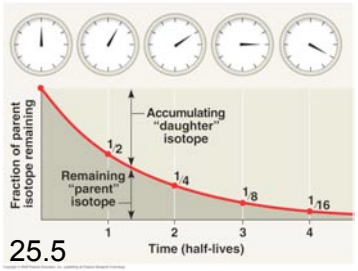


Fig. 25.5

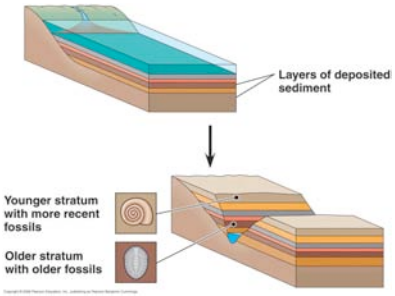
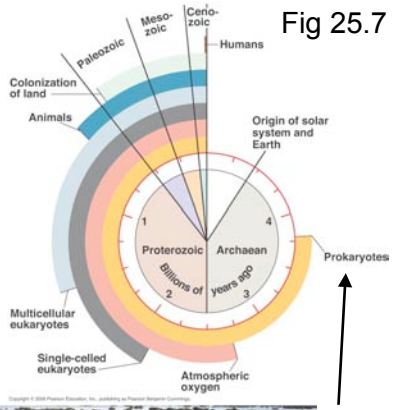


Fig. 22.3

Major transitions in earth history

- Earliest prokaryotes - fossil stomatolites 3.5 Bya
- Increase O_2 - 2.7 Mya
- Fossil eukaryotes 2.1Bya; multicell algae 1.2 Bya
- Complex metazoa 0.55 Bya
- Marine -> land 0.5 Bya
- [Hominids only 0.005 Bya]

Fig 25.7



The Cambrian "explosion" - Burgess shale & appearance of modern phyla

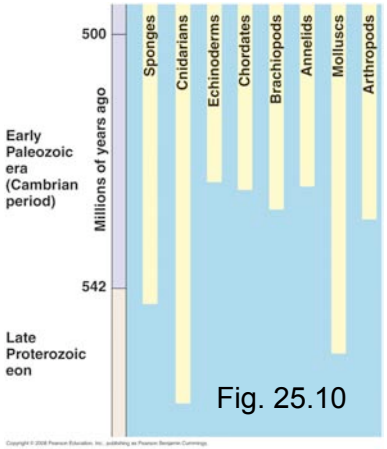


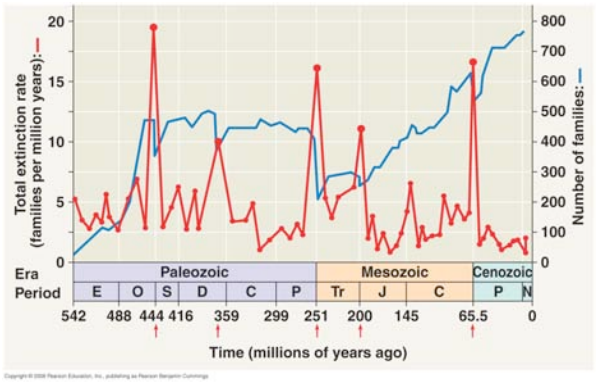
Fig. 25.10

Burgess shale

"Hallucigenia"

Weird stuff…

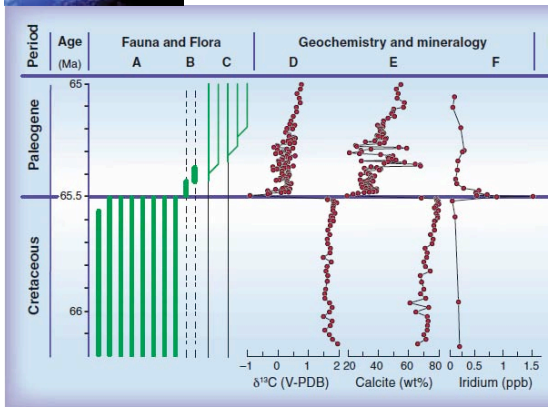
The big 5 mass extinctions

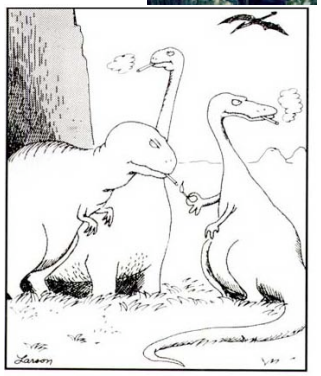


- Evidence from analyses of extinction (red) and blues (diversity) or families of marine invertebrates
- Permian-Triassic - 96% species extinction, 8/27 orders of insects; Volcanism in Siberia?
- Cretaceous-Paleogene ("K/T"), 65 Myr - demise of dinosaurs & large terrestrial animals => mammalian radiation

The asteroid impact hypothesis - Luiz & Walter Alvarez, UC Berkeley

(see Science, 5th March, p1214)





Faunal turnover

Carbon cycle change

Iridium spike

Understanding the transition of tetrapod vertebrates from water to land

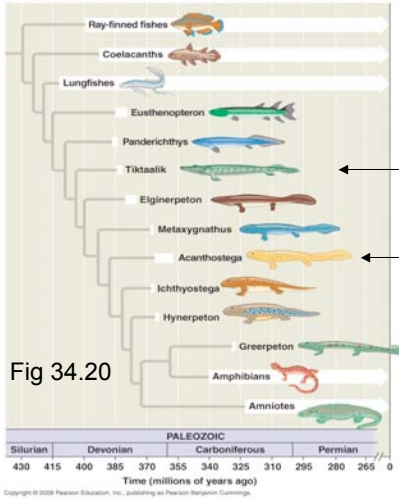


Fig 34.20