Lecture 5:

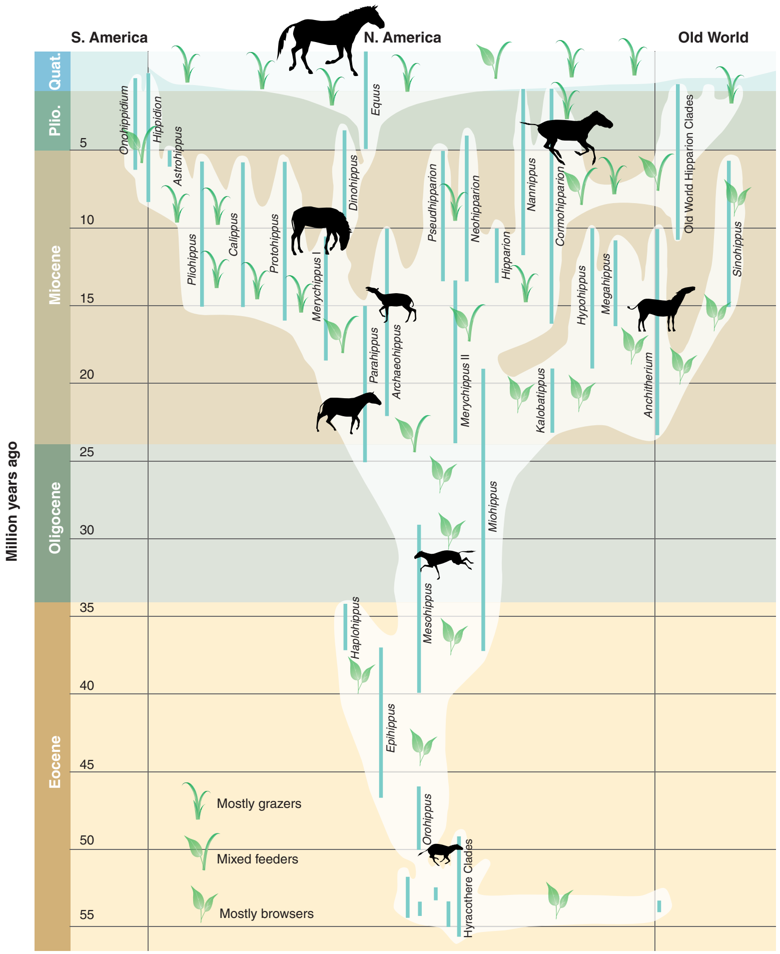
Evidence of evolution:
The fossils in and within

Course 410

Molecular Evolution

Evidence of evolution

2. Changes of species over time

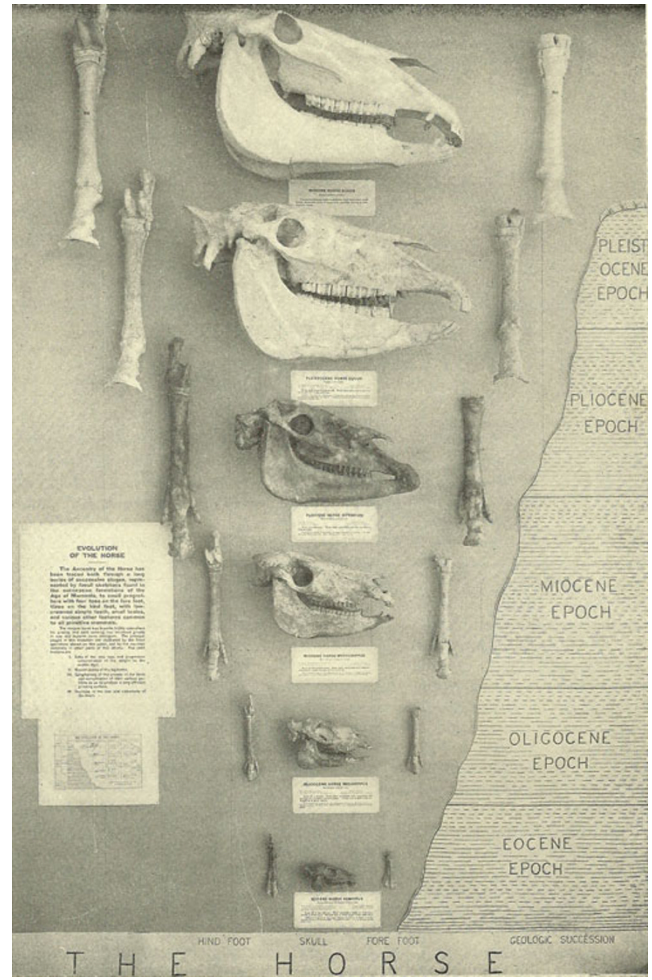


Fossil Horses—Evidence for Evolution

Bruce J. MacFadden

Fossil Horses, Orthogenesis, and Communicating Evolution in Museums

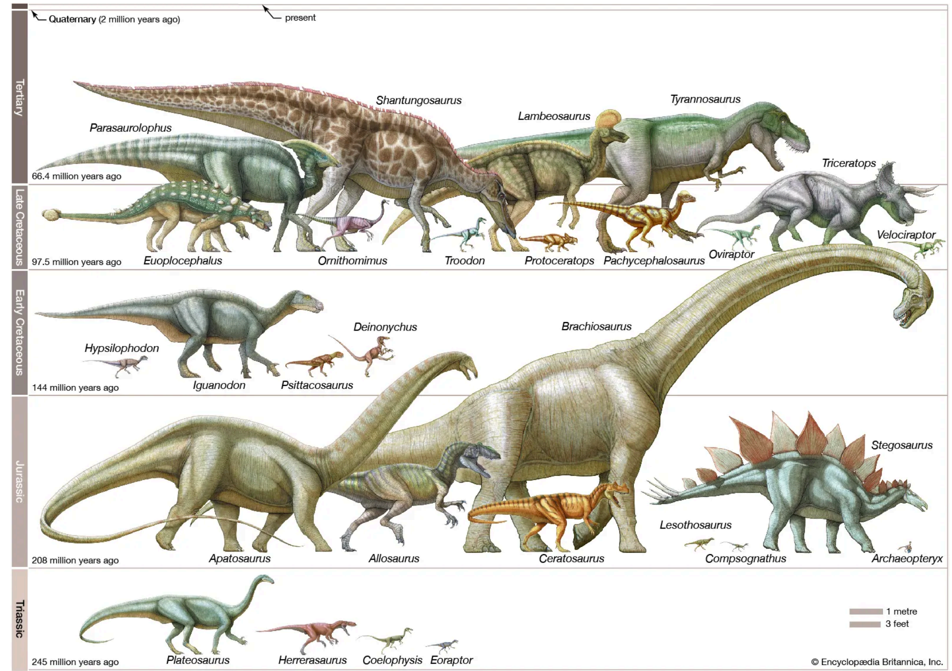
Bruce J. MacFadden · Luz Helena Oviedo · Grace M. Seymour · Shari Ellis



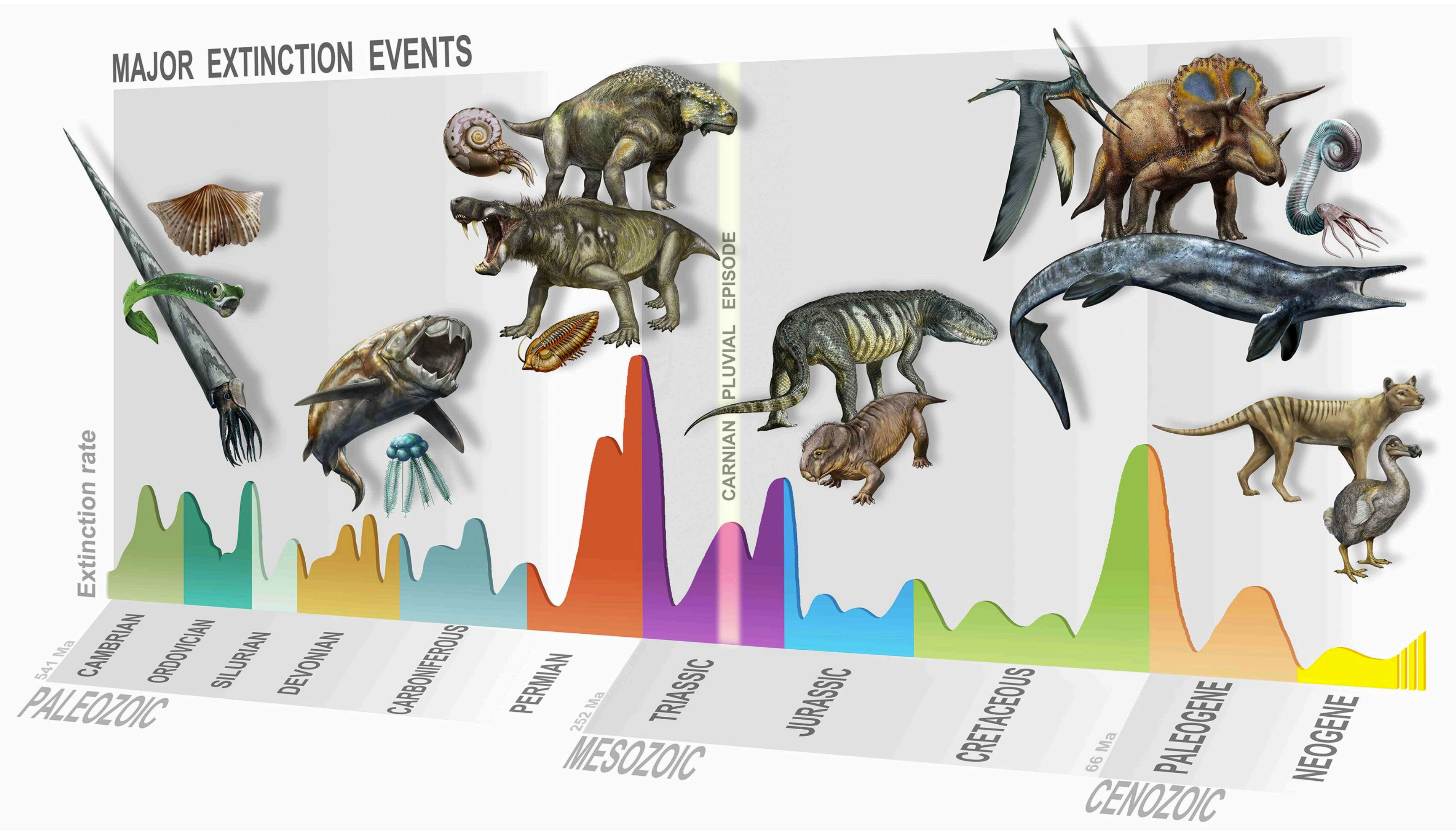
Evidence of evolution

3. Fossil record

Organisms of the past

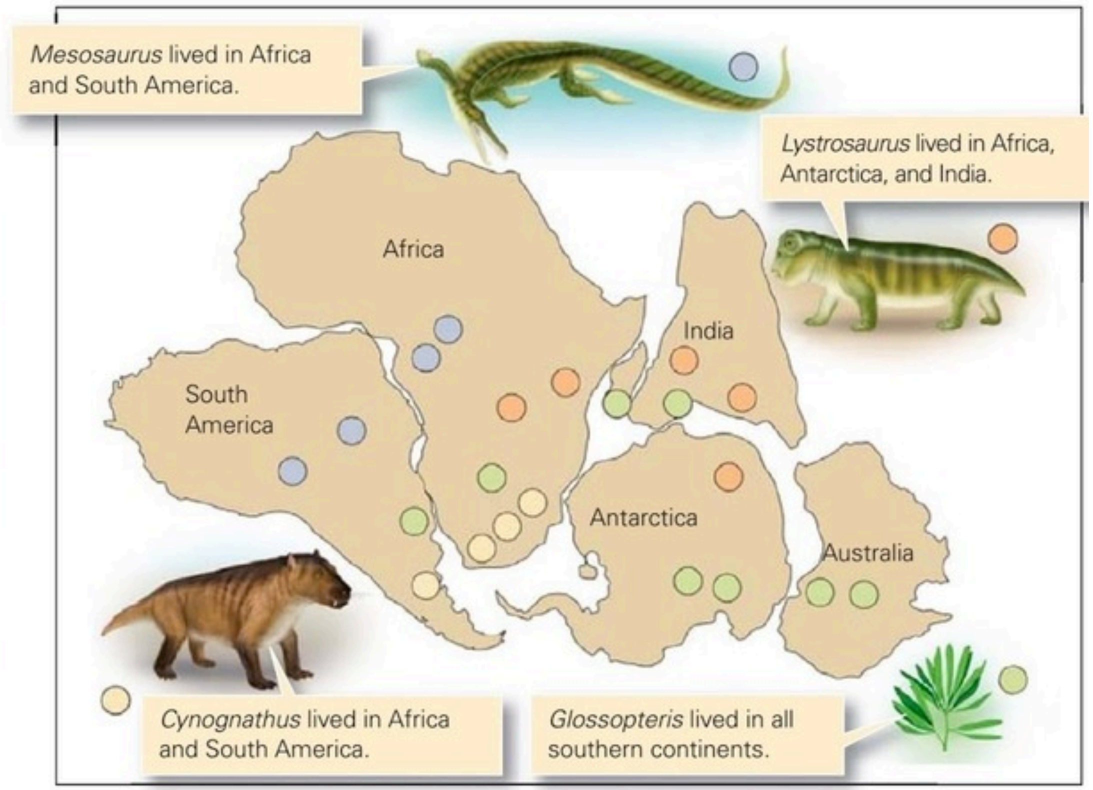


Extinction



MAJOR EXTINCTION EVENTS
Extinction rate
CARNIAN PLUVIAL EPISODE
541 Ma
CAMBRIAN
ORDOVICIAN
SILURIAN
DEVONIAN
CARBONIFEROUS
PERMIAN
PALEOZOIC
252 Ma
TRIASSIC
JURASSIC
CRETACEOUS
MESOZOIC
66 Ma
PALEOGENE
NEOGENE
CENOZOIC

Continental drift & species



Law of succession

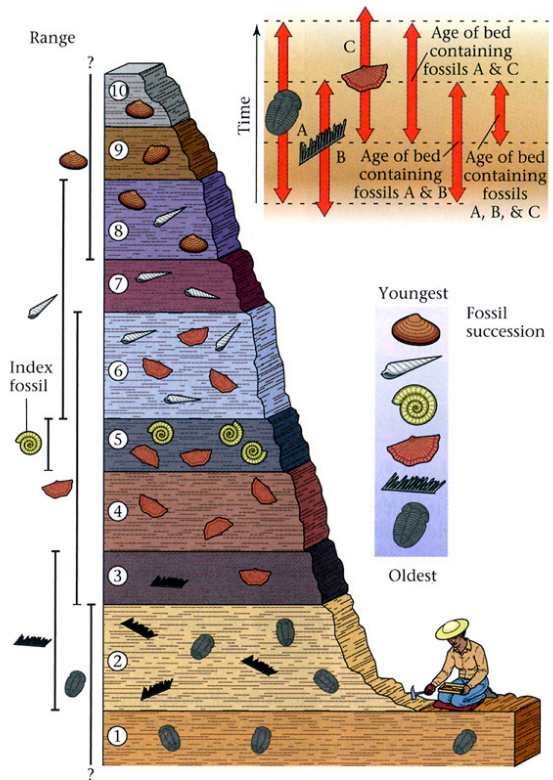
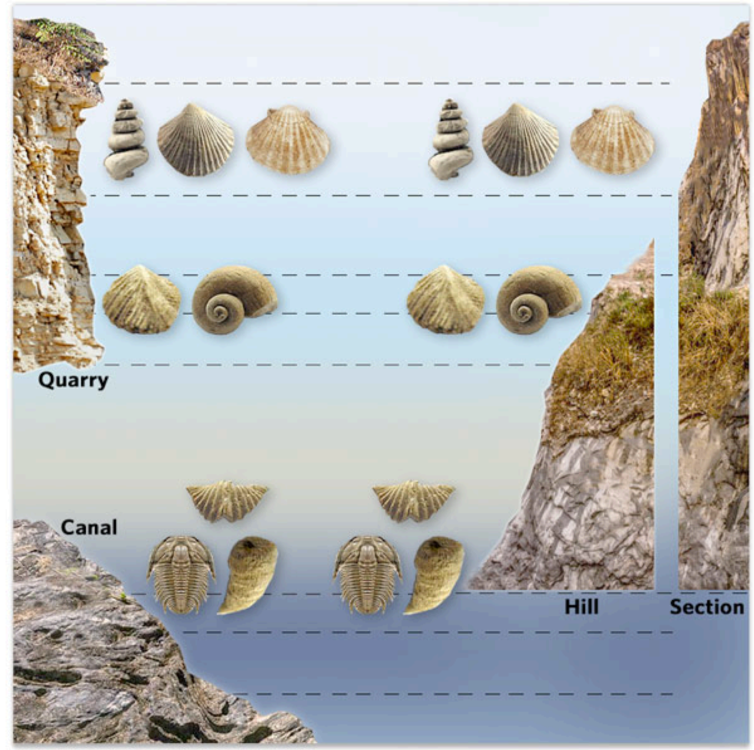
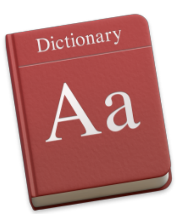


FIGURE 12.7 The principle of fossil succession. Note that each species has only a limited range in a succession of strata, and ranges of different fossils may overlap. Widespread fossils with a short range are index fossils. The inset illustrates how overlapping fossil ranges can be used to limit the age range of a given bed.





suc·ces·sion | sək'seSH(ə)n |

noun

1 a number of people or things sharing a specified characteristic and following one after the other: *she had been secretary to a succession of board directors*.
- *Geology* a group of strata representing a single chronological sequence: *the Cretaceous succession*.

2 the action or process of inheriting a title, office, property, etc.: *the new king was already elderly at the time of his succession*.
- the right or sequence of inheriting a position, title, etc.: *the **succession to** the Crown was disputed*.
- *Ecology* the process by which a plant or animal community successively gives way to another until a stable climax is reached. Compare with sere[2].

OPEN ACCESS Freely available online PLoS BIOLOGY

Tracking Marsupial Evolution Using Archaic Genomic Retroposon Insertions

Maria A. Nilsson*, Gennady Churakov, Mirjam Sommer, Ngoc Van Tran, Anja Zemann, Jürgen Brosius, Jürgen Schmitz*

Institute of Experimental Pathology (ZMBE), University of Münster, Münster, Germany

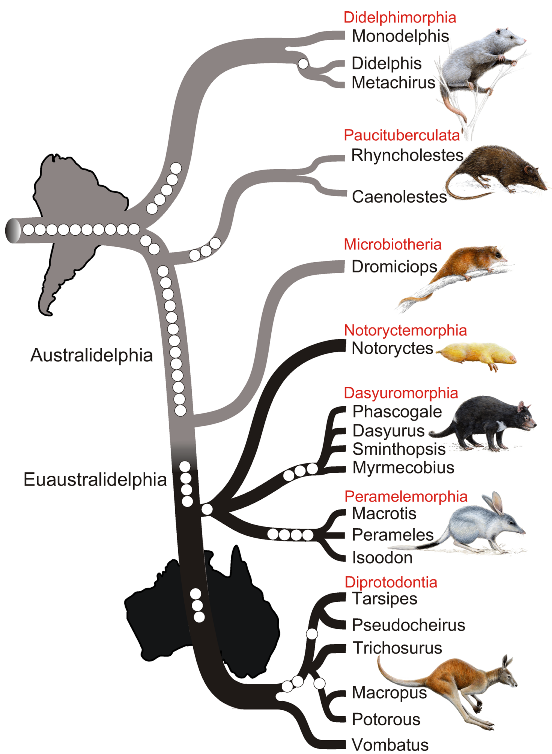
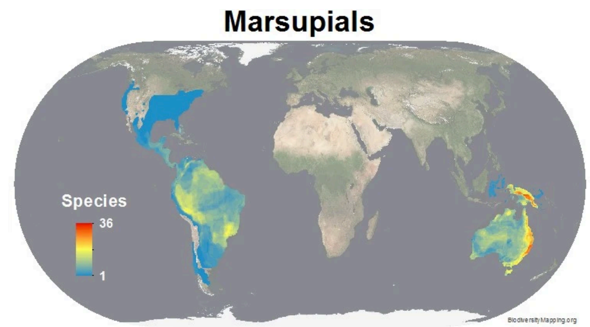


Figure 2. Phylogenetic tree of marsupials derived from retroposon data. The tree topology is based on a presence/absence retroposon matrix (Table 1) implemented in a heuristic parsimony analysis (Figure S3). The names of the seven marsupial orders are shown in red, and the icons are representative of each of the orders: Didelphimorphia, Virginia opossum; Paucituberculata, shrew opossum; Microbiotheria, monito del monte; Notoryctemorphia, marsupial mole; Dasyuromorphia, Tasmanian devil; Peramelemorphia, bilby; Diprotodontia, kangaroo. Phylogenetically informative retroposon insertions are shown as circles. Gray lines denote South American species distribution, and black lines Australasian marsupials. The cohort Australidelphia is indicated as well as the new name proposed for the four "true" Australasian orders (Euaustralidelphia).
doi:10.1371/journal.pbio.1000436.g002



Marsupials: origin and current diversity

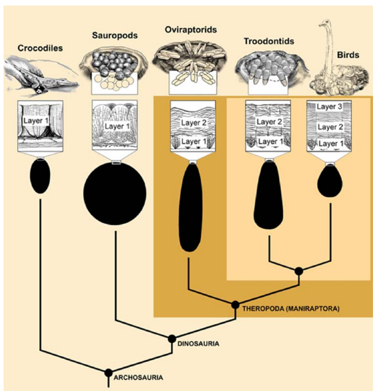
Transitional forms

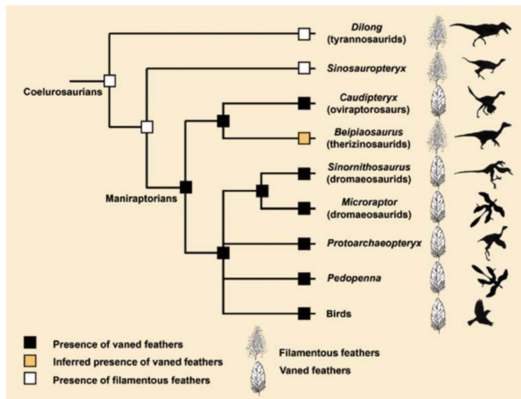
Evo Edu Outreach (2009) 2:248–256
DOI 10.1007/s12052-009-0133-4

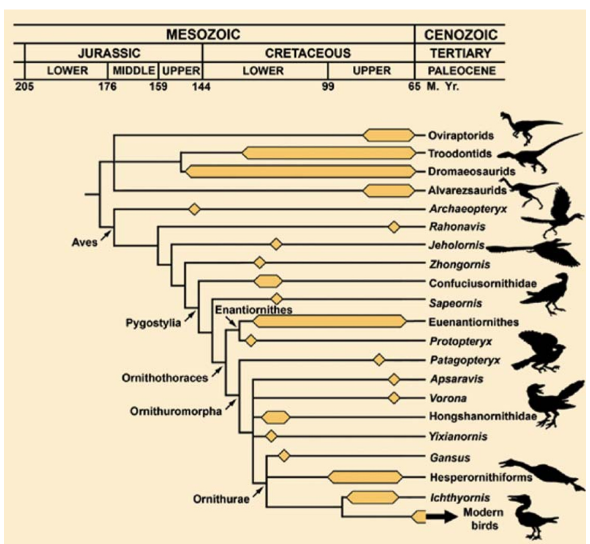
ORIGINAL SCIENTIFIC ARTICLE

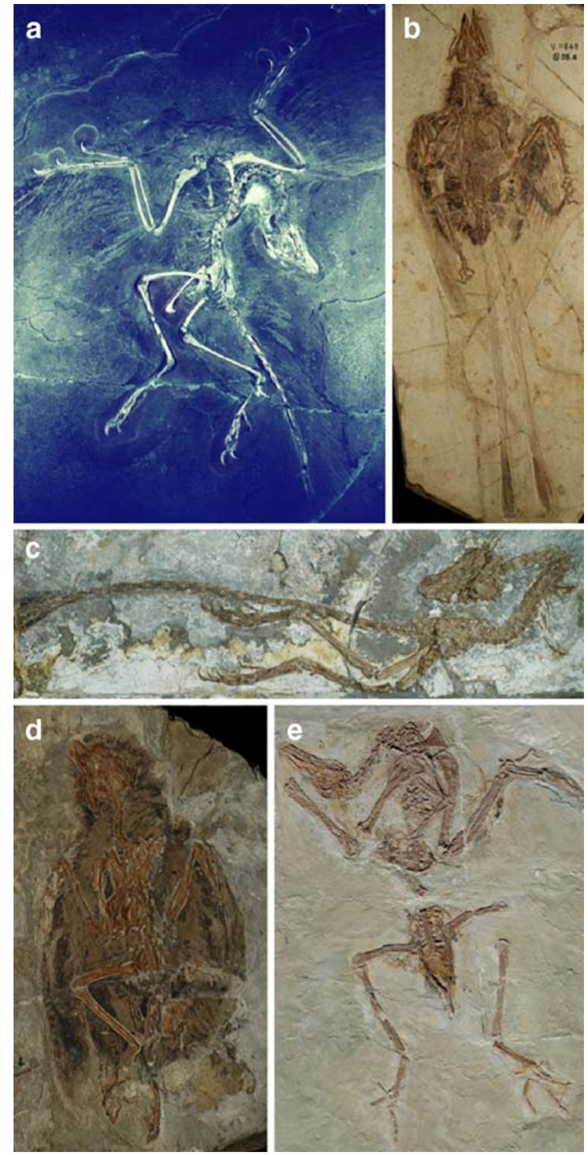
Downsized Dinosaurs: The Evolutionary Transition to Modern Birds

Luis M. Chiappe

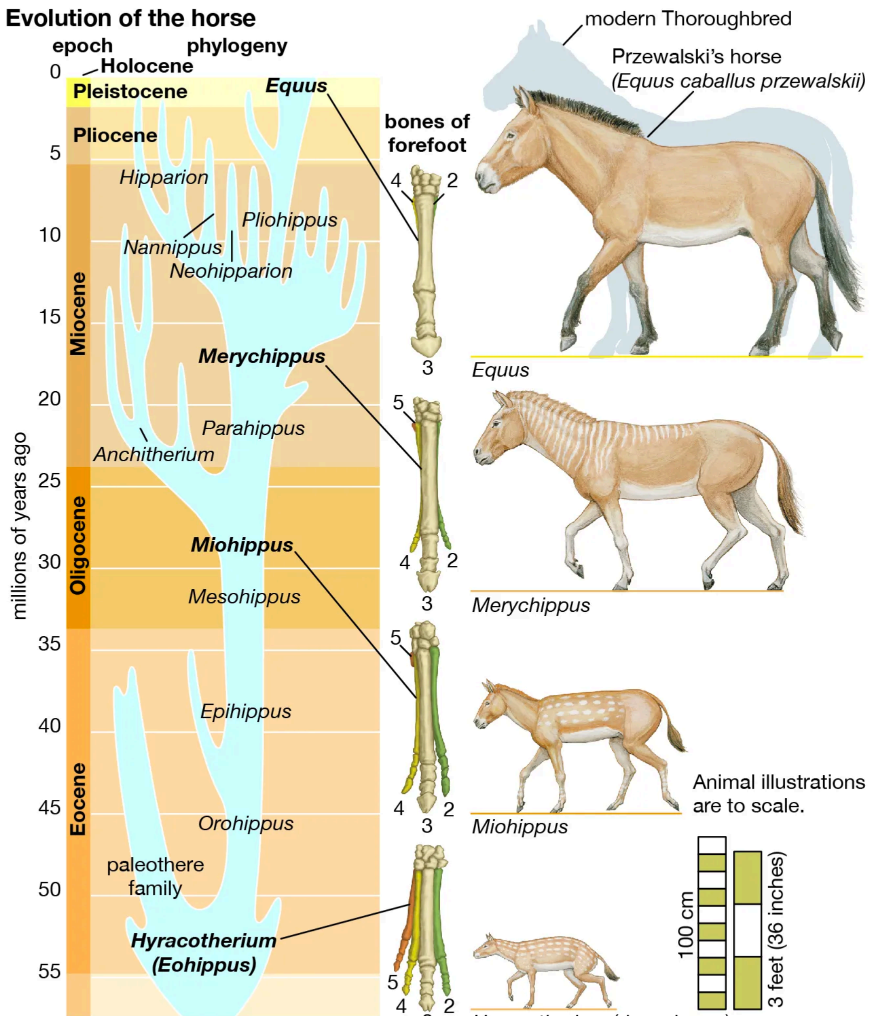


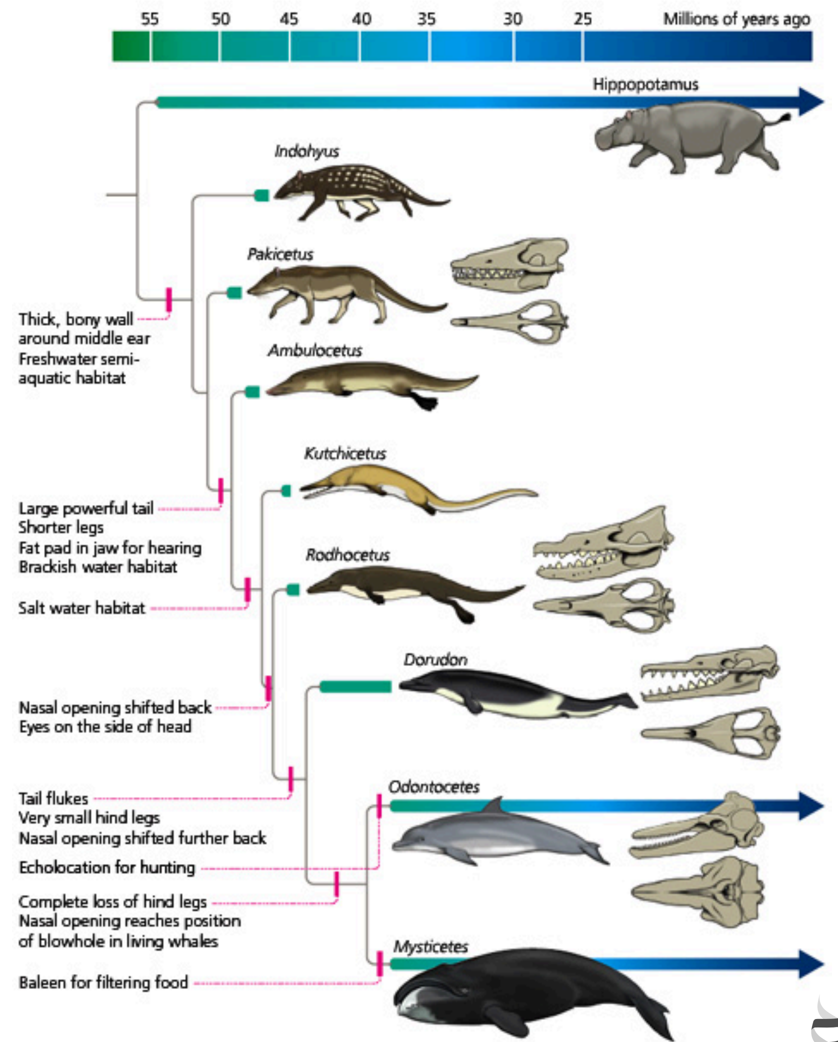






Transitional forms





Evidence of evolution

4. Vestigial structures

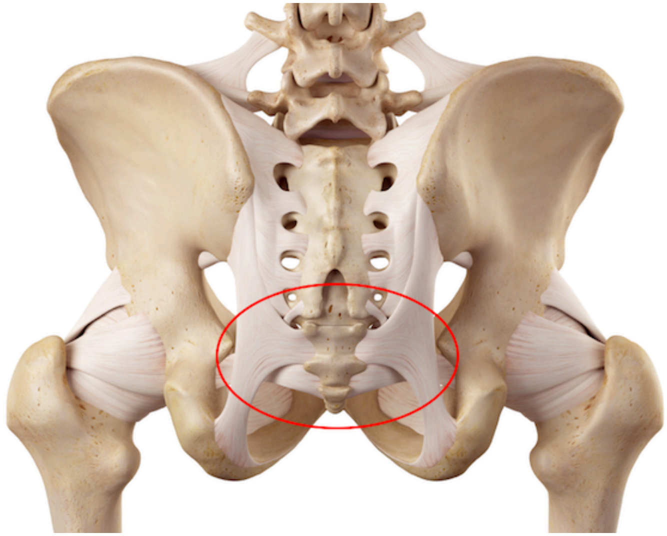
Definition

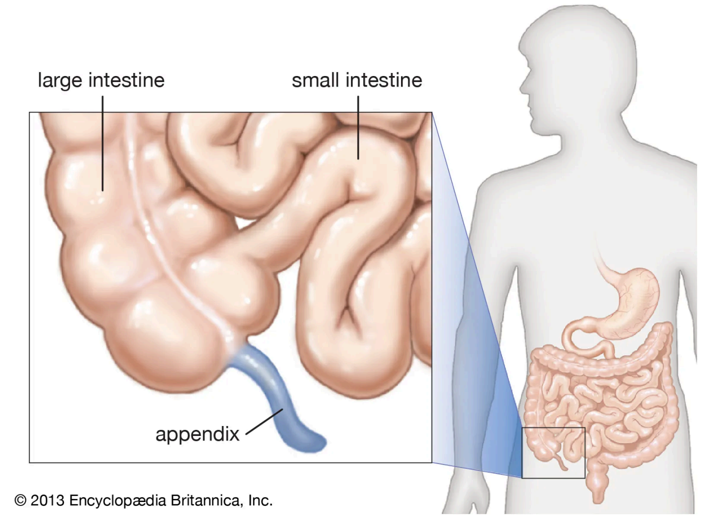
ves·tig·i·al | ve'stij(ē)əl |

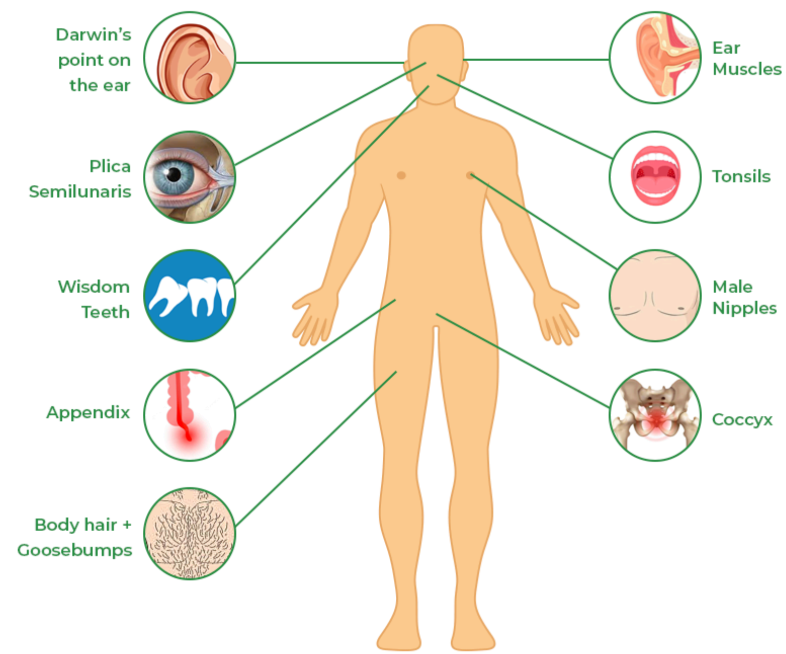
adjective

forming a very small remnant of something that was once much larger or more noticeable: *he felt a vestigial flicker of anger from last night*.

• *Biology* (of an organ or part of the body) degenerate, rudimentary, or atrophied, having become functionless in the course of evolution: *the vestigial wings of kiwis are entirely hidden*.







Tailbone, Appendix, …

Humans

Cavefish and the basis for eye loss

Jaya Krishnan[1] and Nicolas Rohner[1,2]

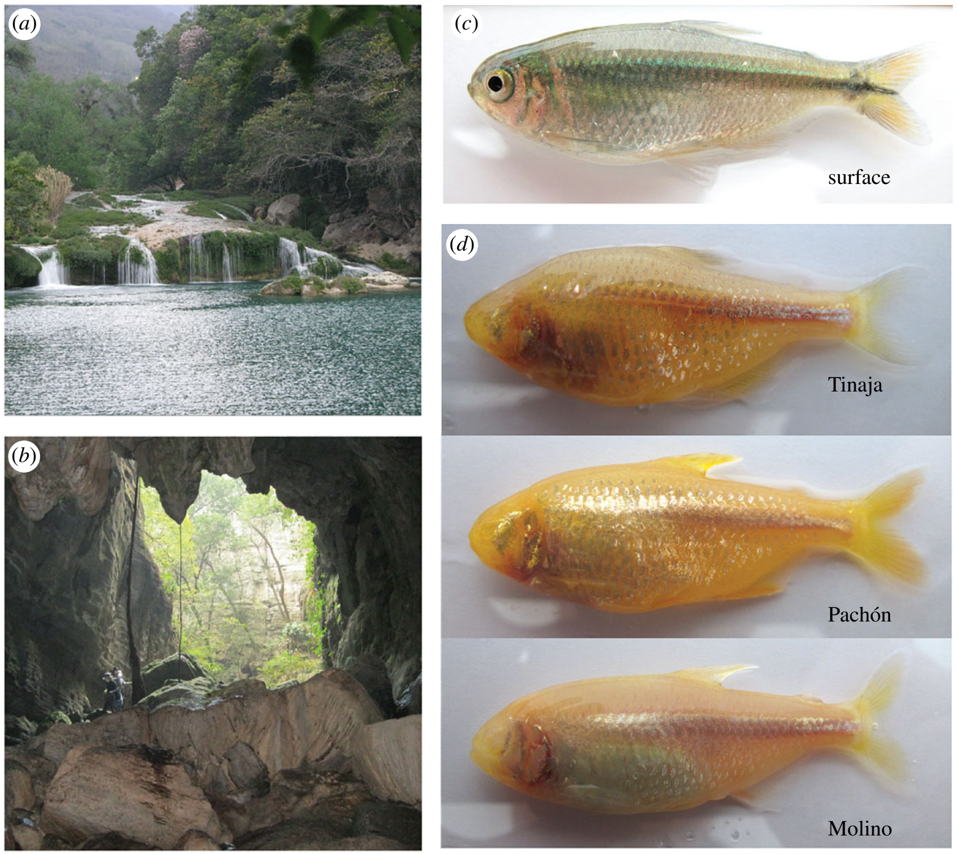


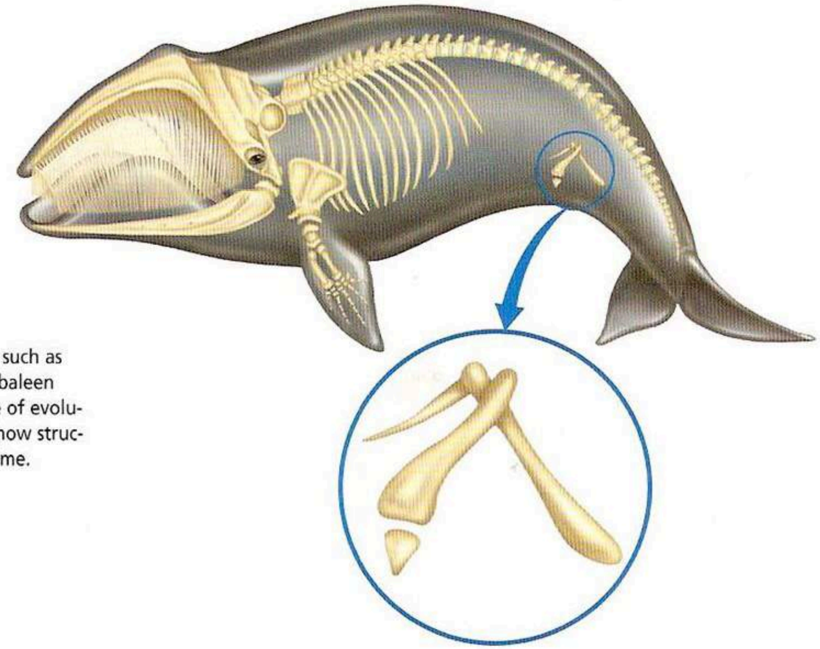
Figure 1. Surface and cave populations of *Astyanax mexicanus*. Panel (*a*) depicts an example of the river habitat of the surface populations of *Astyanax mexicanus*. Panel (*b*) shows the entrance to the Tinaja cave. Panels (*c,d*) depict the obvious morphological differences between surface fish and three independently derived cave populations (Tinaja, Pachón and Molino). While the surface fish are pigmented and have eyes (*c*), the cave forms have converged on the loss of eyes and strongly reduced their pigmentation (*d*).

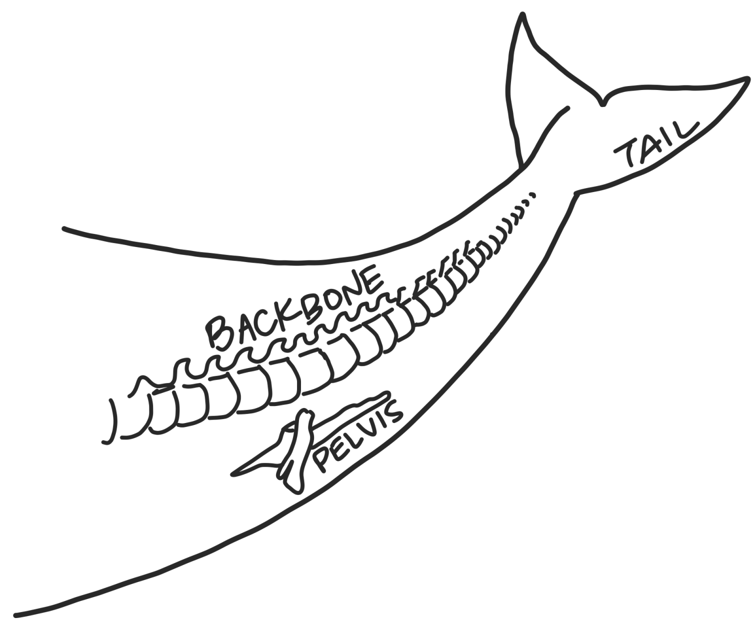
Vacant eye sockets

cave fish

Pelvis
whale

Figure 15.8
Vestigial structures, such as pelvic bones in the baleen whale, are evidence of evolution because they show structural change over time.





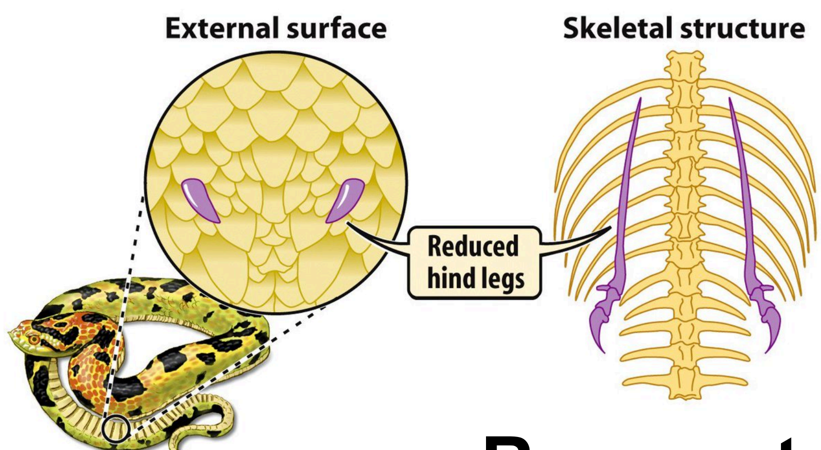


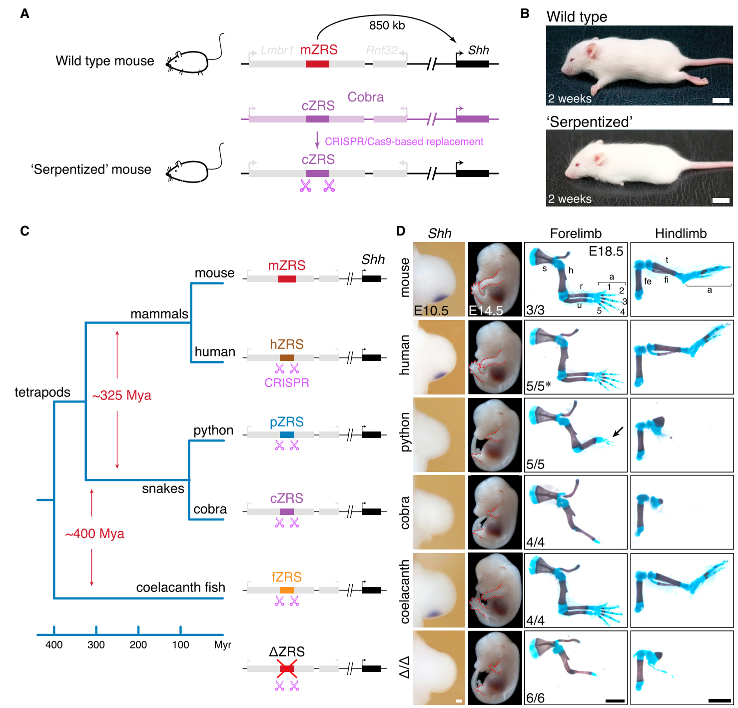
Figure 16-4b Discover Biology 3/e

Article

Cell

Progressive Loss of Function in a Limb Enhancer during Snake Evolution

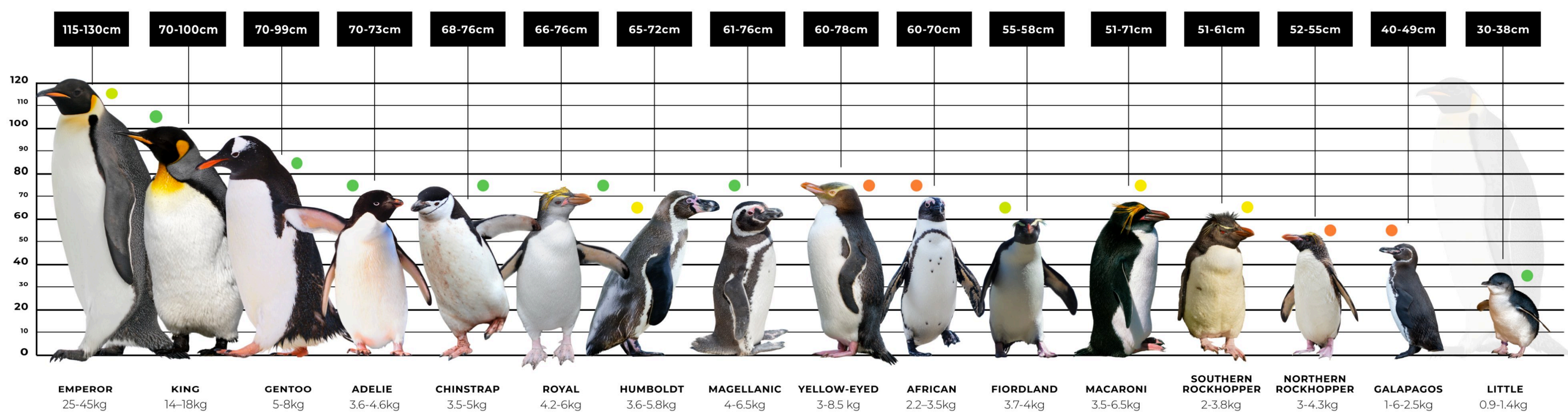
Evgeny Z. Kvon,[1] Olga K. Kamneva,[2] Uirá S. Melo,[1] Iros Barozzi,[1] Marco Osterwalder,[1] Brandon J. Mannion,[1] Virginie Tissières,[3] Catherine S. Pickle,[1] Ingrid Plajzer-Frick,[1] Elizabeth A. Lee,[1] Momoe Kato,[1] Tyler H. Garvin,[1] Jennifer A. Akiyama,[1] Veena Afzal,[1] Javier Lopez-Rios,[3] Edward M. Rubin,[1,4] Diane E. Dickel,[1] Len A. Pennacchio,[1,4,*] and Axel Visel[1,4,5,6,*]
[1]MS 84-171, Lawrence Berkeley National Laboratory, Berkeley, CA 94720, USA
[2]Department of Biology, Stanford University, Stanford, CA 94305, USA
[3]Department of Biomedicine, University of Basel, 4058 Basel, Switzerland
[4]U.S. Department of Energy Joint Genome Institute, Walnut Creek, CA 94598, USA
[5]School of Natural Sciences, University of California, Merced, CA 95343, USA
[6]Lead Contact
*Correspondence: lapennacchio@lbl.gov (L.A.P.), avisel@lbl.gov (A.V.)
http://dx.doi.org/10.1016/j.cell.2016.09.028



Remnant hind legs

Snakes

Reduced wings
flightless birds



Disclaimer

Figures, photos, and graphs in my lectures are collected using google searches. I do not claim to have personally produced the material (except for some). I do cite only articles or books used. I thank all owners of the visual aid that I use and apologize for not citing each individual item. If anybody finds the inclusion of their material in my lectures a violation of their copy rights, please contact me via email.

hhalhaddad@gmail.com