

Concepts of Biology: BIOL 111

Study guide for Exam 5

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Lectures 35–39

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Outline

1 Questions and answers

1.1 Exam 4

Results of Exam 4: statistic summary

Summary:

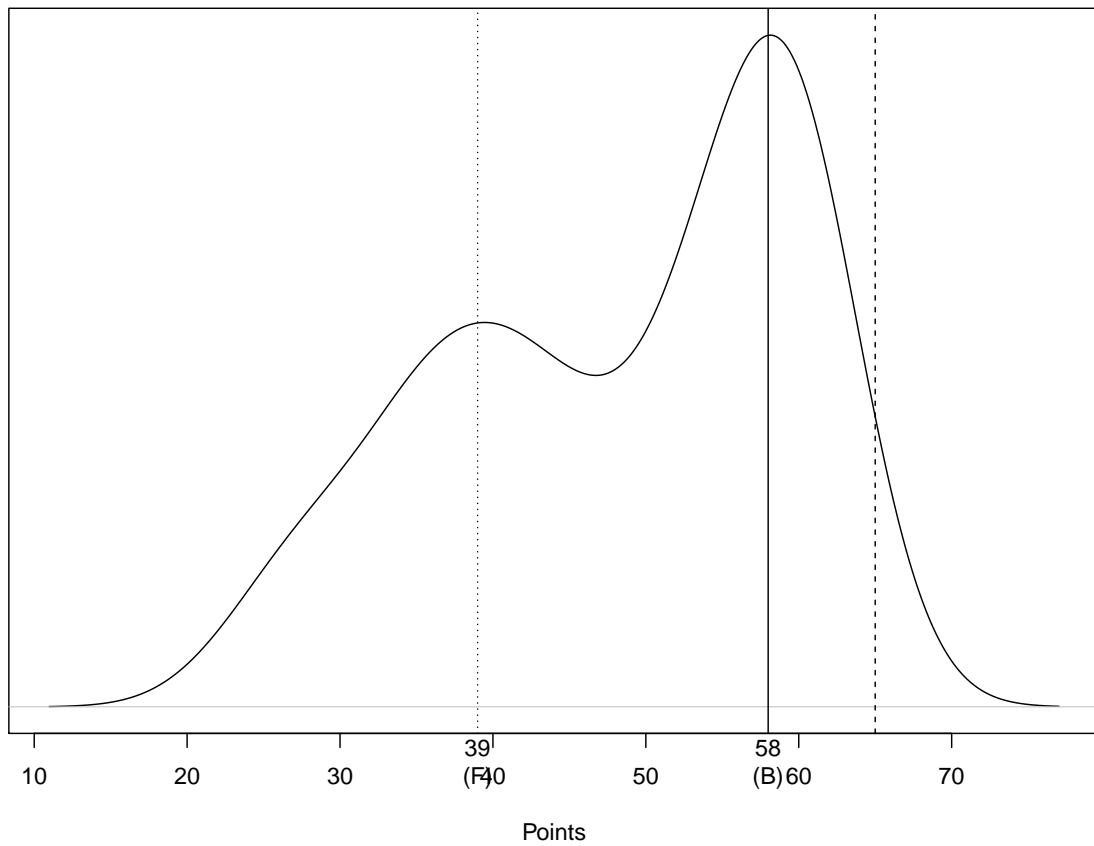
Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	NA's
23.00	39.25	52.00	48.37	59.00	65.00	25

Grades:

F	D	C	B	max
39	46	52	58	65

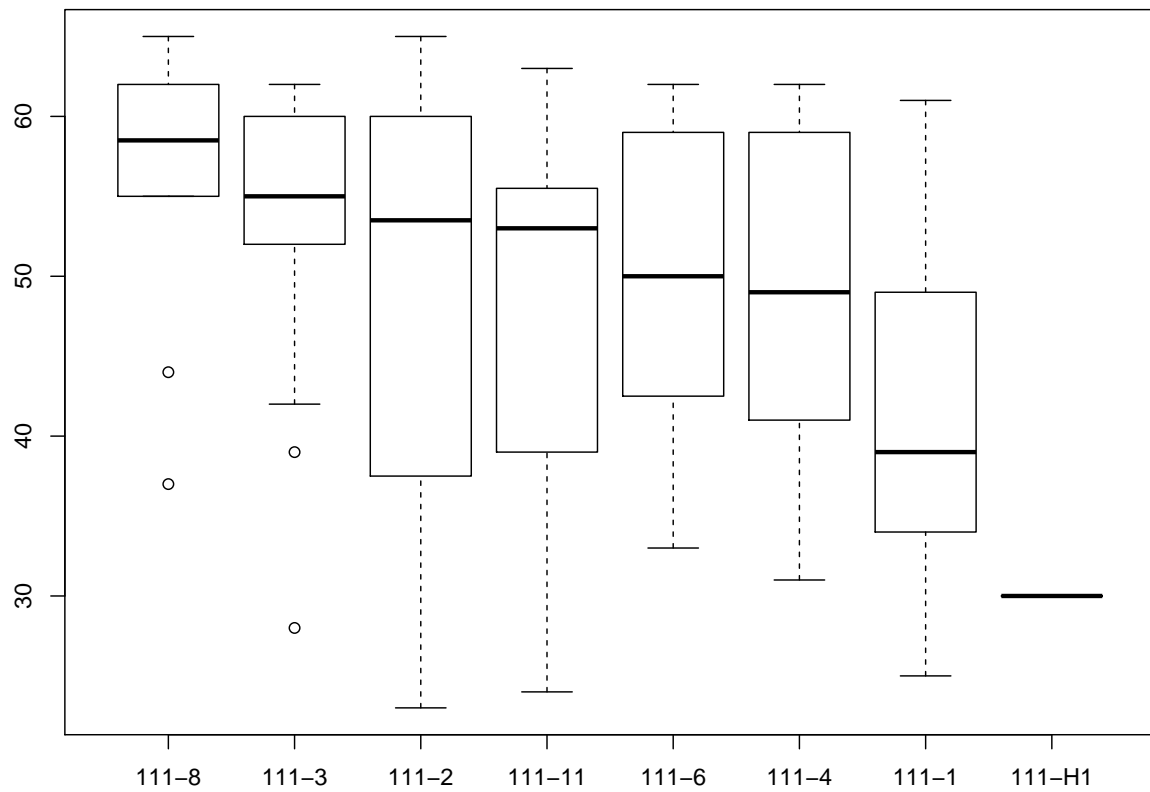
Results of Exam 4: the curve

Density estimation for Exam 4 (Biol 111)



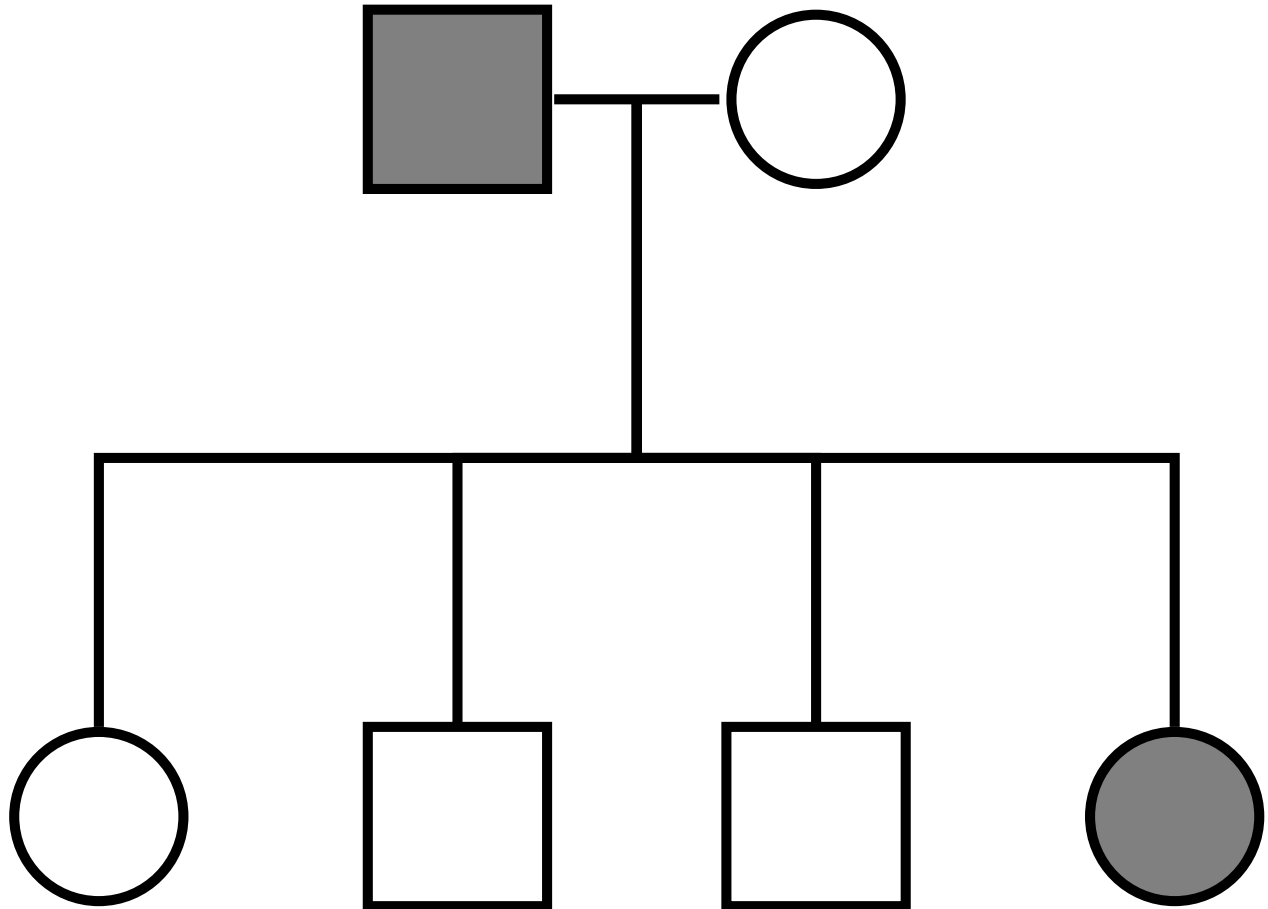
Results of Exam 4: sections

Competition between Biol 111 sections (Exam 4)



Results of Exam 4: two questions

- Epidermis contains:
 - A. Several types of tissues
 - B. **Several types of cells**
 - C. One type of cells
- Is the disease from the pedigree chart below:



- A. Dominant
- B. Recessive
- C. I need more information

2 Where we are?

2.1 Jurassic park

From Triassic to Cretaceous

Mesozoic era:

- Triassic: starts 252 Mya
- Jurassic: starts 201 Mya
- Cretaceous: starts 145 Mya, ends 66 Mya

Subdivisions of Cretaceous

System	Series	Stage
Paleogene	Paleocene	Danian
Cretaceous	Upper	Maastrichtian
		Campanian
		Santonian
		Coniacian
		Turonian
		Cenomanian
	Lower	Albian
		Aptian
		Barremian
		Hauterivian
		Valanginian
		Berriasian
Jurassic	Upper	Tithonian

- Hauterivian: first flowering plants (pollen)
- Barremian/Aptian: Famous Yixian formation (China)
- Maastrichtian: end of dinosaur age

Archosauromorph reptiles

- Proterosuchia, Aetosauria: basal archosauromorphs
- Crocodylomorpha: advanced behavior, four-chambered heart
- Pterosauria: archosaur “bats”, some with fur-like cover. Note that skin membrane is not very effective wing.
- Dinosauria: bipedal archosaurs:

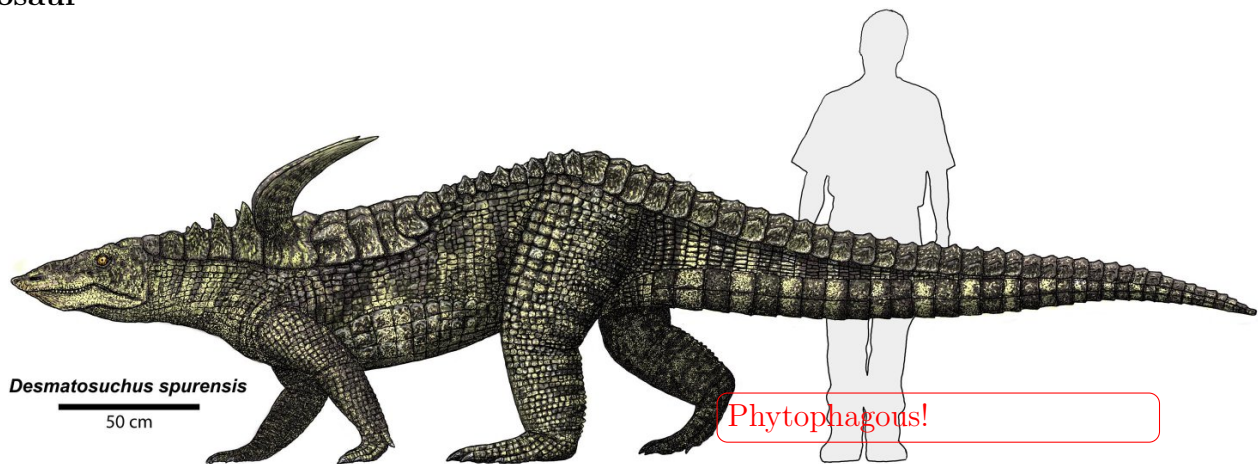
- Ornithischia: “bird-hipped”, include ankylosaurs and stegosaurs, ornithomids (like *Iguanodon*), pachycephalosaurs and ceratopsids (but not birds!)
- Saurischia: “lizard-hipped”:
 - A. Theropoda: true bipedal, carnivorous or insectivorous, mostly feathered: Ceratosauria (“southern carnivores”), Allosauroidea and relatives, including *T. rex*, Maniraptora and descendants
 - B. Sauropodomorpha: secondary quadrupedal, small heads, long necks, long tails; largest dinosaurs

Proterosuchid



Chasmatosaurus from movie

Aetosaur



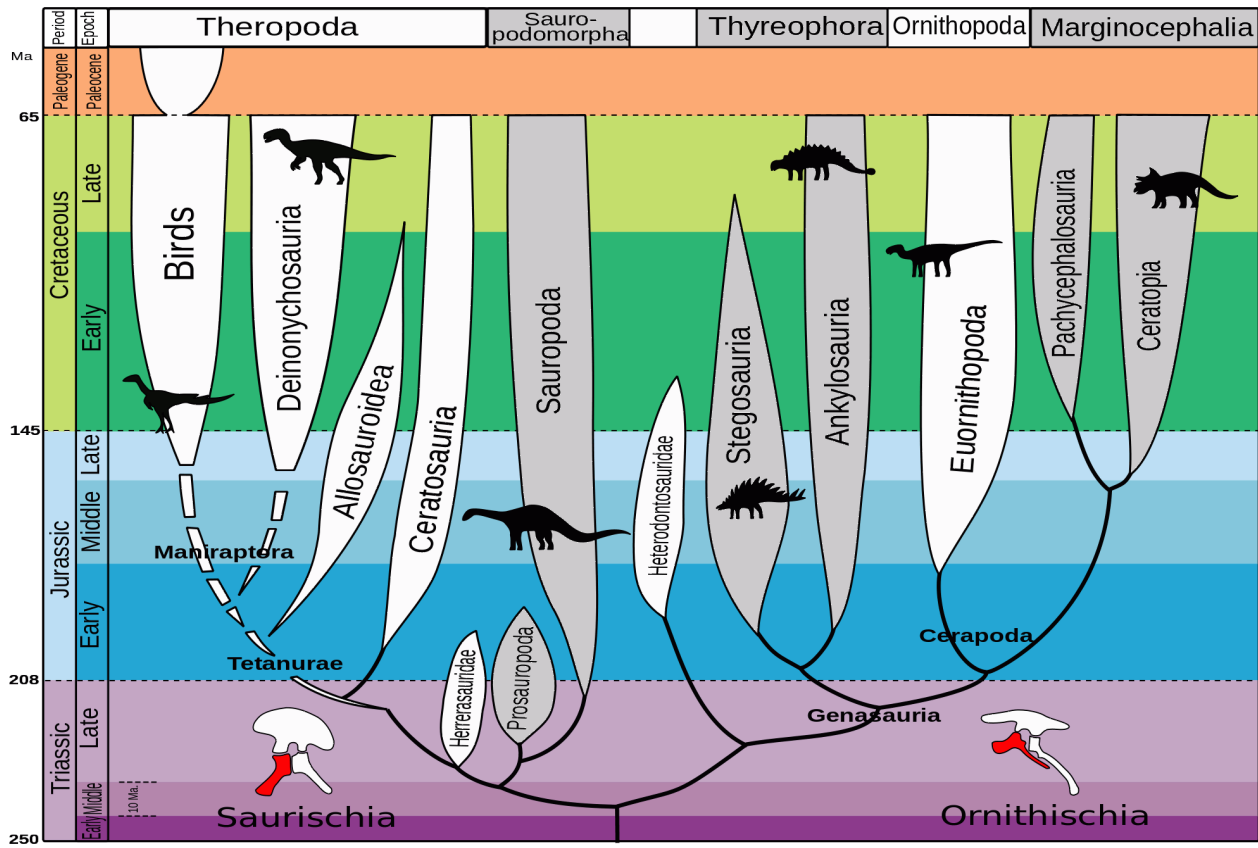
Desmatosuchus spurensis
50 cm

Phytophagous!

Dsungaripterus pterosaur



Dinosaurs in time



Early ornithischian *Tianyulong*



Allosaurioid *Yutyrannus* from China



Feathered, warm-blooded, social

Theropoda: *Tarbosaurus* and *Gallimimus*



Early maniraptor *Gigantoraptor*



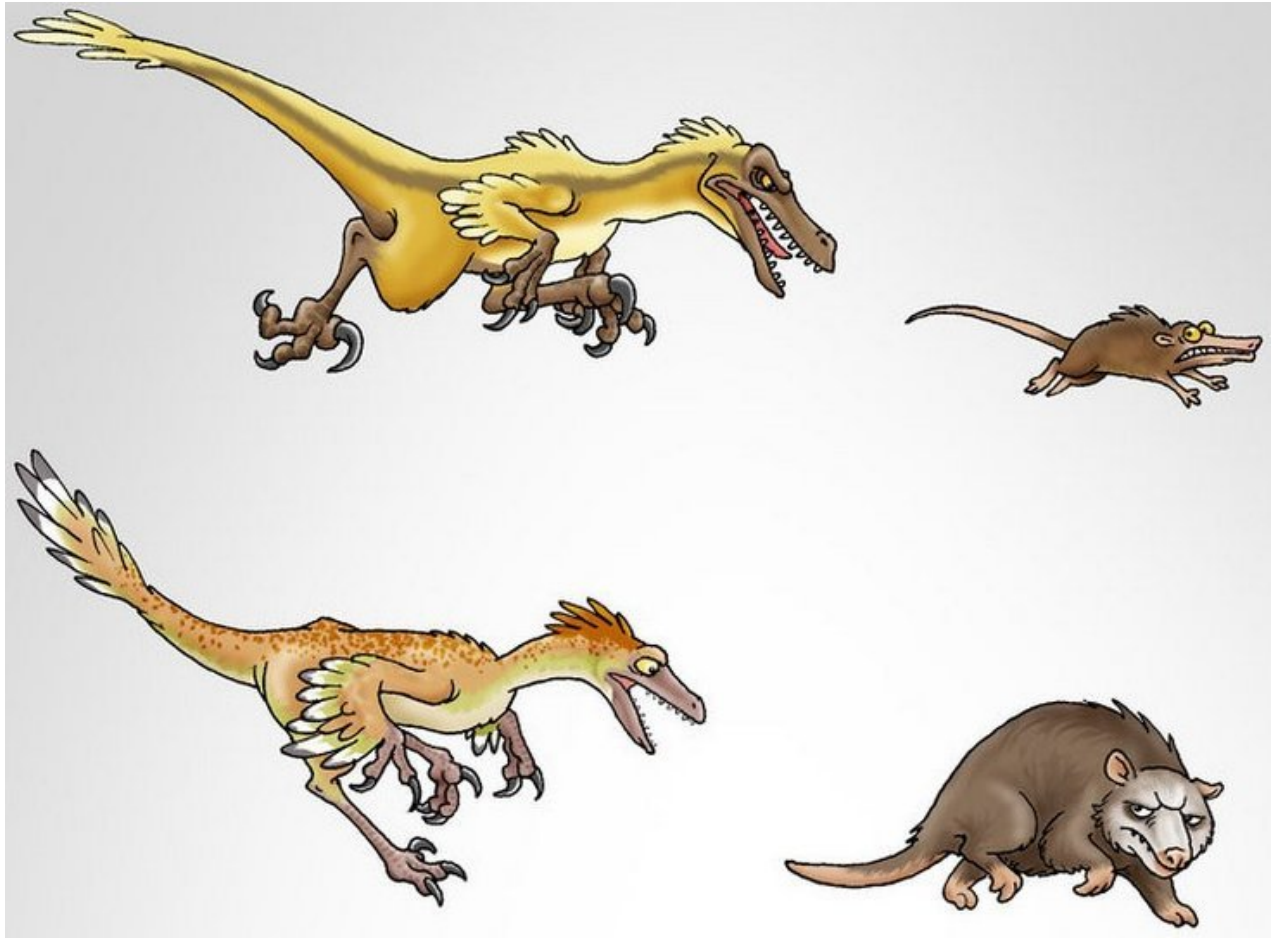
Late maniraptor *Microraptor*



3 Mesozoic-Cenozoic extinction

3.1 The raise and fall of giant reptiles

Reptiles and mammals cartoon, part I



Reptiles and mammals cartoon, part II



Mesozoic-Cenozoic extinction

Two extinctions:

- Most of large archosauromorphs, plus plesiosaurs and ichthyosaurs. Crocodiles, birds, mammals, amphibians survived.
- Shelled cephalopods (belemnites, ammonites) and many other marine groups

Plants and insects were not affected at all.

Why they were so big

- To digest plants (cellulose), higher temperature will help. Dinosaurs developed size-related **endothermy**.
- To escape from predators, the prey should grow big.
- As a result, in Jurassic park all herbivores were giants.
- Turtles are an exception, but they live on a very little fuel and are over-armored to escape predators.

Mammals in Jurassic

- They fed mostly on insects
- Their chewing system is not yet developed to the level when they can live on plants
- By the law of ecological pyramid (i.e., 10000 grasses – 100 rabbits – 1 fox), terrestrial ecosystems do not support more than three floors of feeding chain.
- As a result, **small predator (“fox”) ecological niche was empty: there was no constant supply of food**

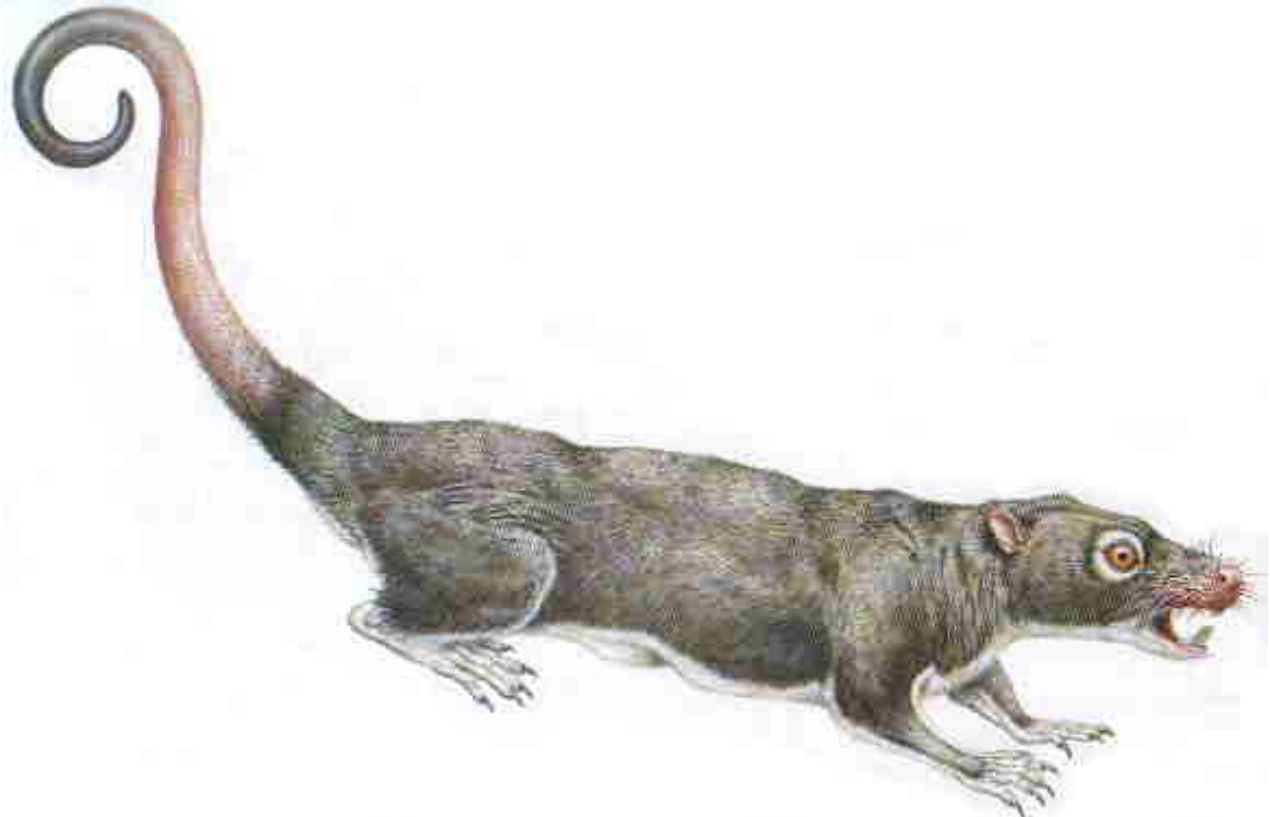
“Every worm has his weak spot”: egg problem

- Eggs need warming. Physical laws allow egg to be warmed to the center only if it is not exceed ≈ 0.5 m in diameter.
- Forces of evolution pushed dinosaurs to grow as big as possible, but egg size was limited.
- As a result, dinosaur young were vulnerable to everybody who would want to feed on them. Fortunately, the small predator did not exist.

How small predator niche was finally filled

- First herbivorous mammals (multituberculates) appeared in the Middle Cretaceous
- From that point, small predators will have the constant food source
- As a result, they appeared shortly after. They were not only mammals but also snakes and small archosauromorphs.

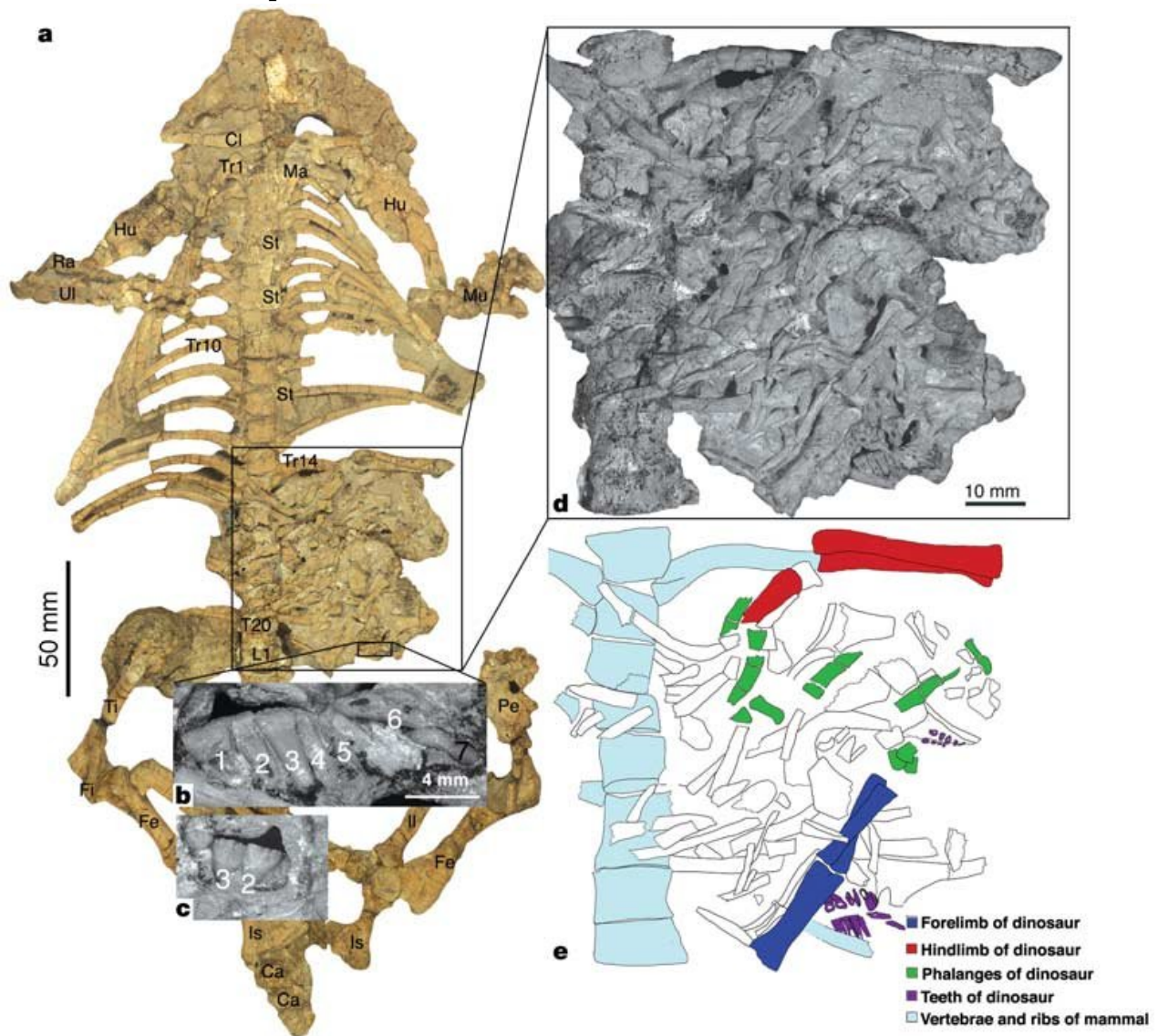
Multituberculate mammal: first small herbivore



Dinosaurs decline: the theory

- Small predator will occasionally feed on dinosaur young which turn many species to the route of extinction. Moreover, new species do not appear.
- Dinosaur lineages slowly declined towards the late Cretaceous.

Dinosaurs decline: the proof

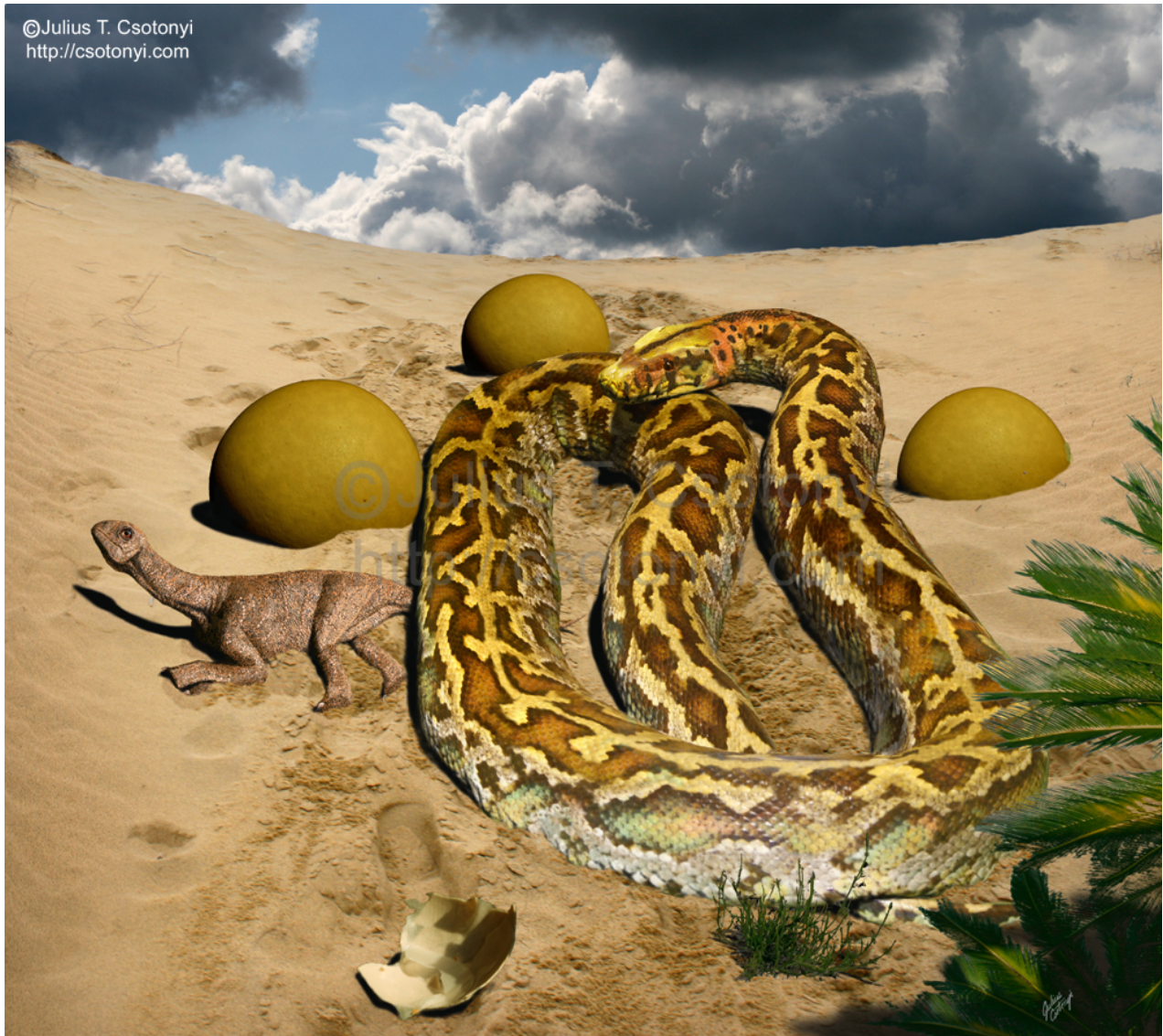


In 2005, Chinese paleontologists find the tricodont mammal skeleton with young dinosaur in the stomach

The hero: *Repenomamus robustus* (reconstruction)



Snakes also help in dinosaur extinction



Pterosaurs?

- To escape the competition with better organized birds, they also pushed to be larger and larger.
- At some point, they faced the same “dinosaur problem”: they cannot defend their young...

Asteroid?



Asteroid?

- Impact theories are mentally attractive but do not explain slow and “blurred” extinction as well as existence of “untouchable” groups like plants and insects.
- Ecological palaeontology states that most mass extinctions were results of **biological crises**. The nature of these crises was internal.
- But yes, asteroid could be the “straw that breaks the camel’s back”

What about the ocean?

- Marine fauna typically “sits below the salt” on the “ecological dining table”: they feed on nutrients which are left from terrestrial biota
- Every significant change in land flora resulted in mass extinction in the sea.
- In the end of Cretaceous, **grasses** changed the flow of minerals from land to sea completely.
- Dinosaur decline and marine extinction simply coincided.

“Sitting below the salt”



Why dinosaurs did not decrease a size?

- They did. They are birds now.
- However, terrestrial lineages did not withstand competition with mammals.

Summary

Well, this is me who killed di-
nosaurs...



For Further Reading

References

- [1] Dinosaurs. <http://en.wikipedia.org/wiki/Dinosaur>
- [2] Ecological crisis. http://en.wikipedia.org/wiki/Ecological_crisis

Outline

4 Where we are?

Herbivore mammals triggered the process of dinosaur decline

Well, this is me who killed dinosaurs...



5 Our time

5.1 Cenozoic era

From Paleogene to Quaternary

Cenozoic era:

- Paleogene: starts 66 Mya

Includes:

- Paleocene
- Eocene
- Oligocene

- Neogene: starts 23 Mya

Includes:

- Miocene
- Pliocene

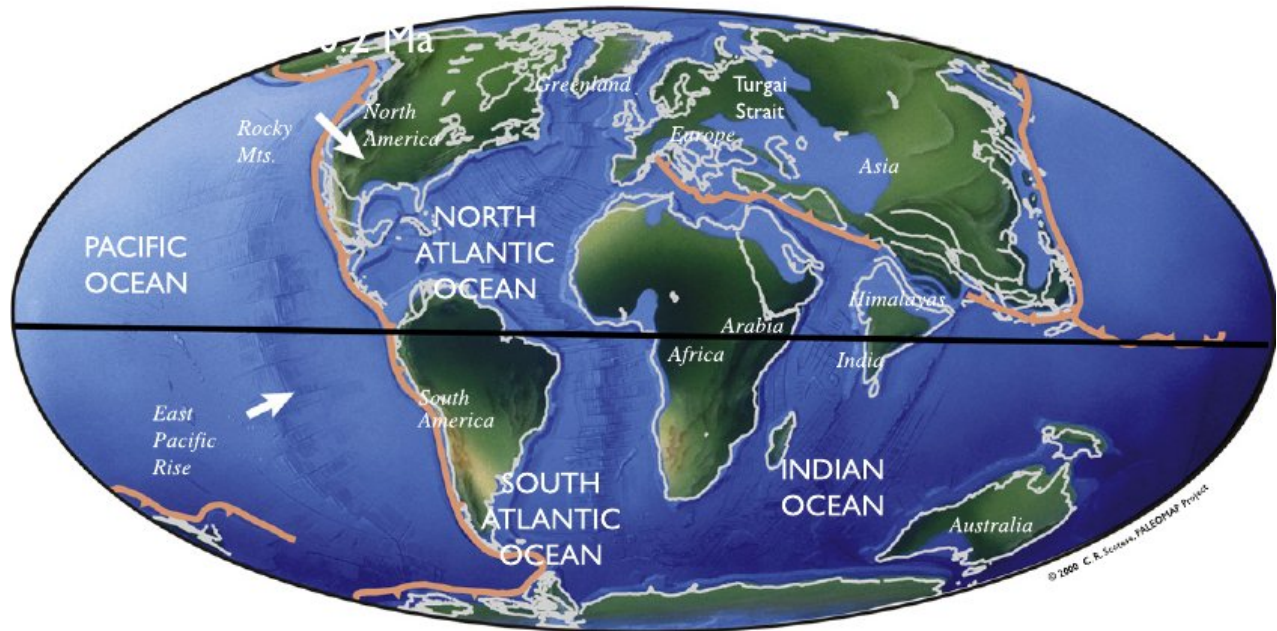
- Quaternary: starts 2.5 Mya

Includes:

- Pleistocene
- Holocene

Paleogene

50.2 Ma Paleogene



- Warm, even climate
- South America isolated, Tethys sea is slowly closing, India moves to Asia
- Mammals fill the big size class

Paleogene: when most of mammal order appeared

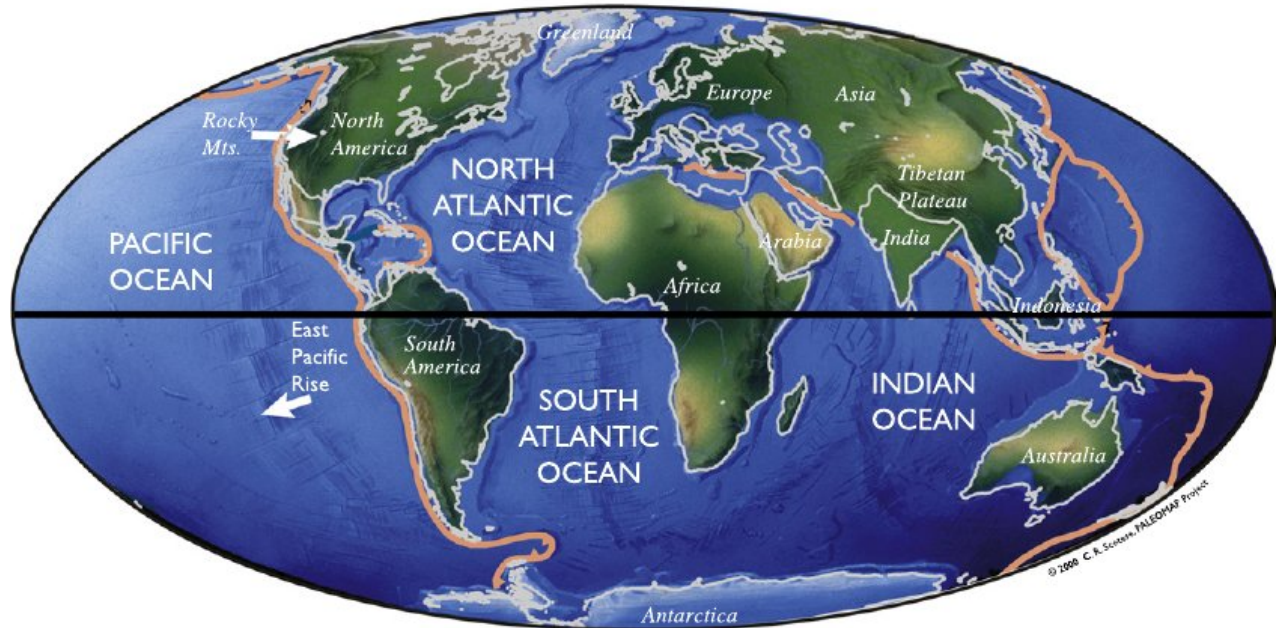


Paleogene: when aliens temporarily took empty niches



Neogene

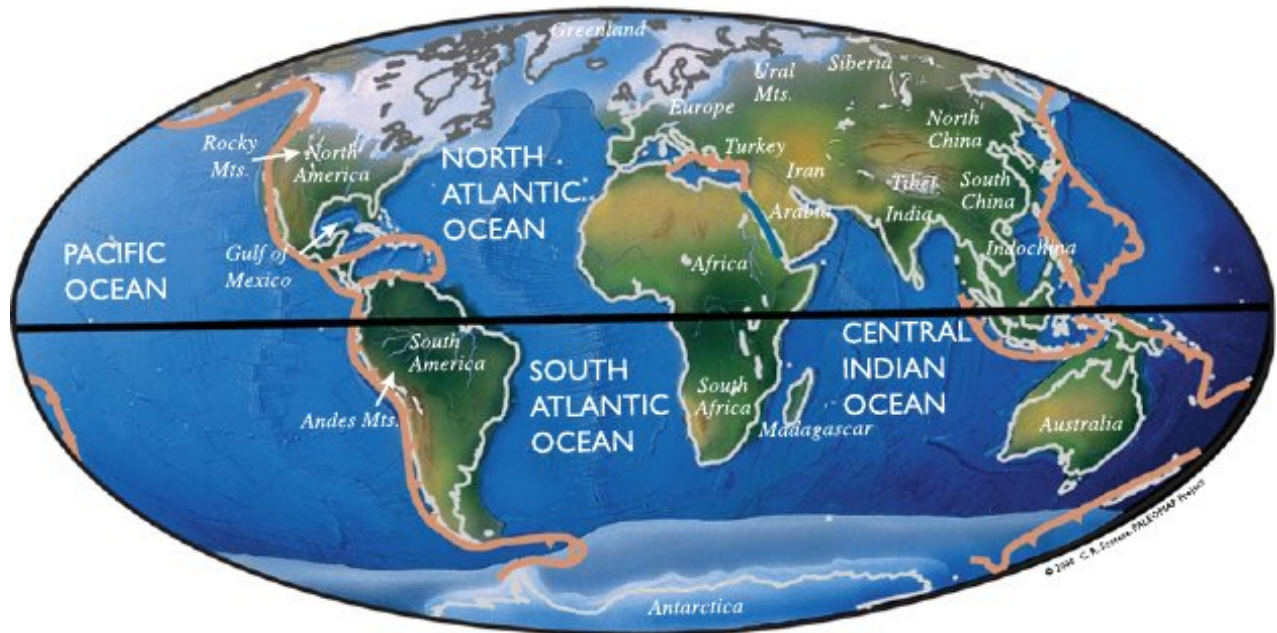
14 Ma Neogene



- Colder and drier
- Ice covers Antarctic, Americas united
- Grasses and hoofed mammals form grasslands

Quaternary

21000 Years Quaternary



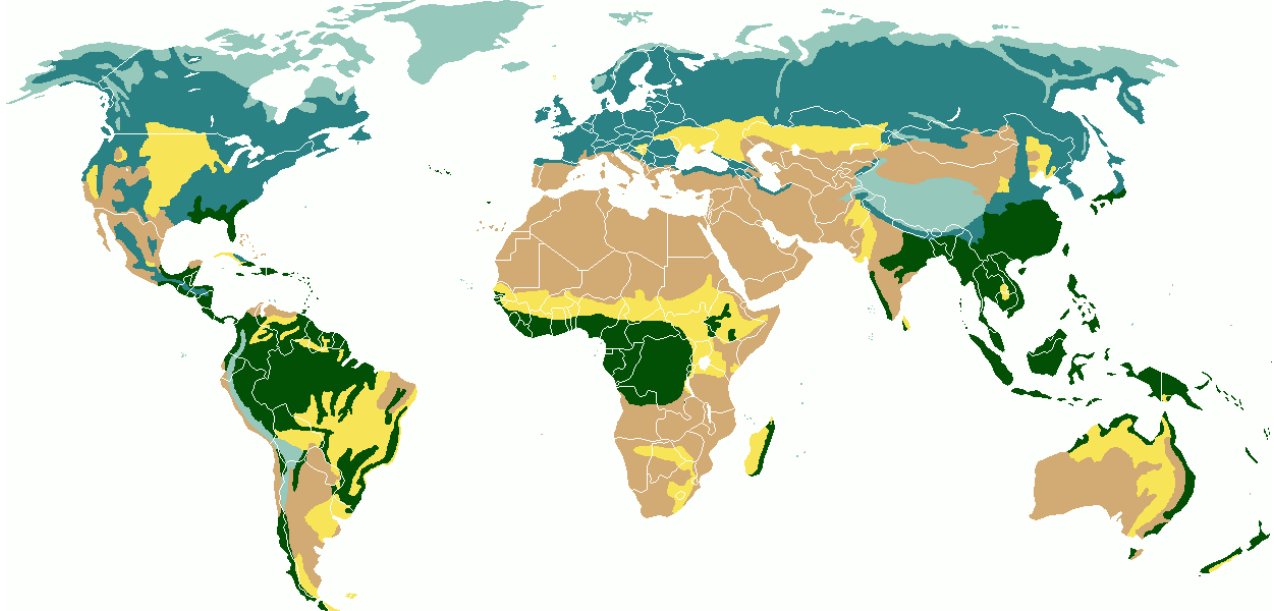
- Great glaciation again (the last was in Carboniferous)
- Rocky Mountains and Himalayas
- Humans

5.2 Ecogeography: origin of biomes

Ecogeography

- The science which study the distribution of main ecosystems (biomes)
- Biomes are mostly based on vegetation

Map of Earth biomes (simplified from Wikipedia)



Tundra, boreal forests, grasslands, deserts, tropical forests

Origin of biomes

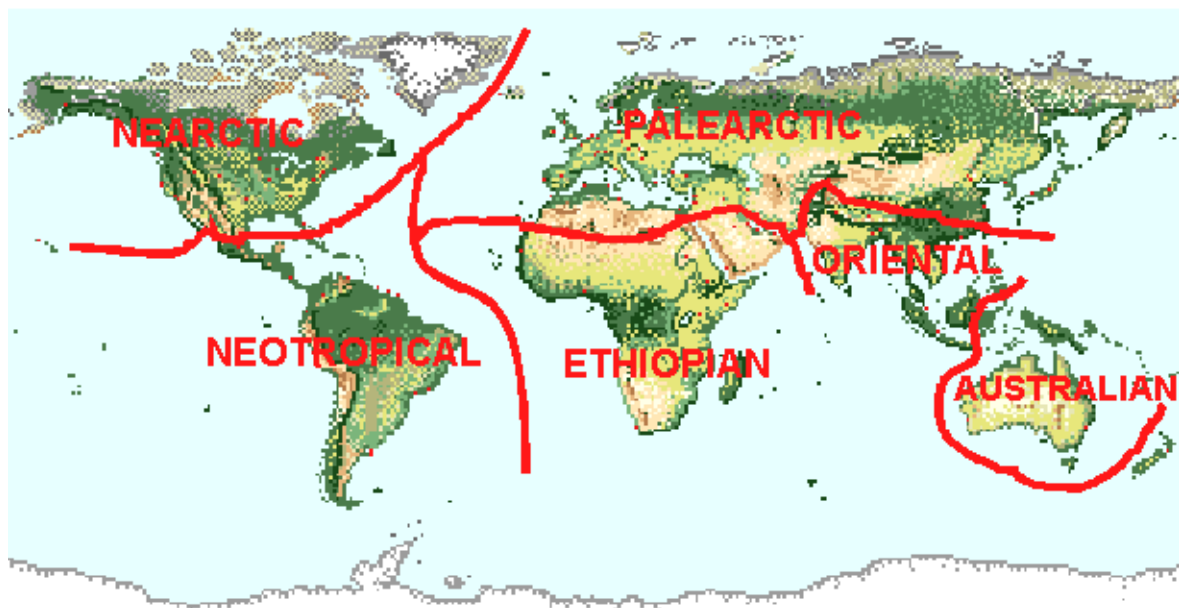
- Tundra: Quaternary, the newest biome
- Boreal forests: Paleogene, note the dominance of conifers
- Grasslands: Neogene, supports by both animals and plants
- Deserts: Permian (very old!)
- Tropical forests: Paleogene, “made” by plants and insects

5.3 Biogeography: origin of provinces

Biogeography

- Studies the distribution of plant and animal groups (not ecosystems!)
- It is more tightly related with phylogeny and evolution

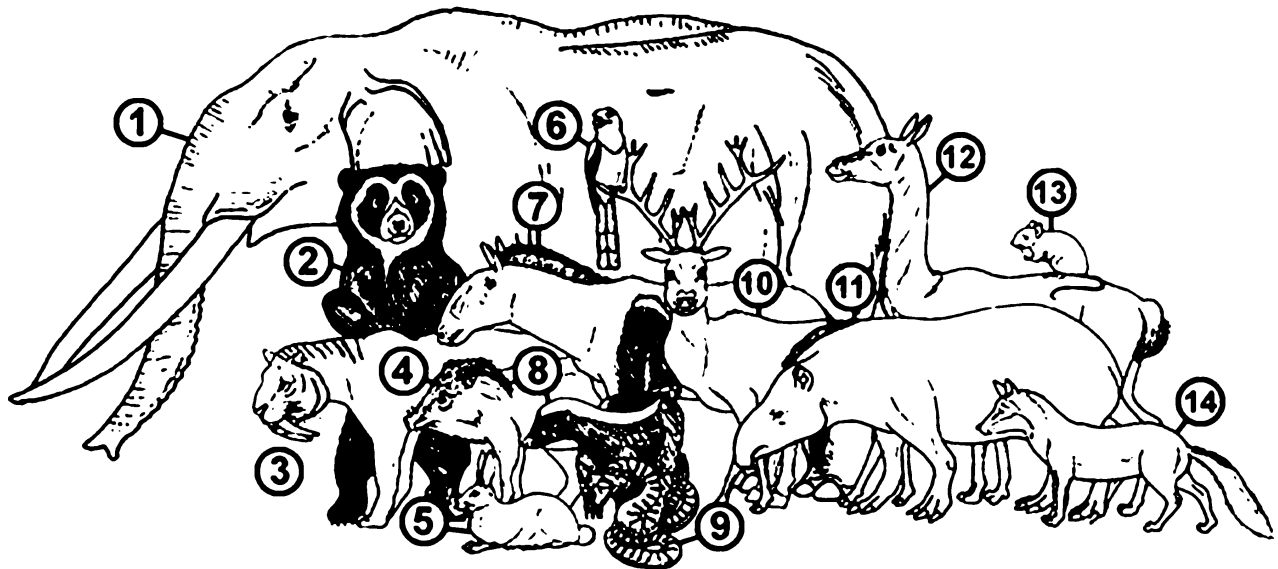
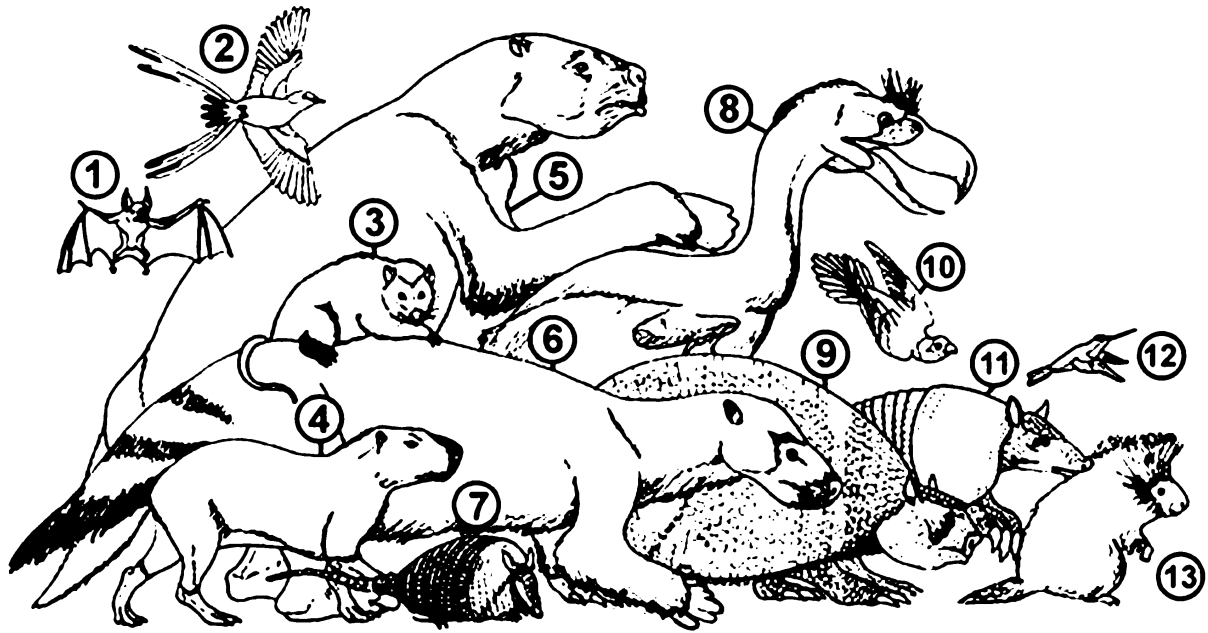
Botanical and zoological maps of the world



Great American Interchange

- Before Neogene, South America was an isolated continent like Australia now and keeps very unusual fauna
- Formation of the Isthmus of Panama led to the dramatic exchange in fauna between South and North Americas
- More advanced northern animals invaded South America but some of southern species (like armadillo, porcupines, opossums, giant sloth) became very successful on the North.

Great American Interchange: north and south



Some of this fauna lives now or was exterminated by early humans



For Further Reading

References

- [1] Ecogeography. <http://en.wikipedia.org/wiki/Biome>
- [2] Phytogeography. <http://en.wikipedia.org/wiki/Phytogeography>
- [3] Great American Interchange. http://en.wikipedia.org/wiki/Great_American_Interchange

Outline

6 Where we are?

From Paleogene to Quaternary

Cenozoic era:

- Paleogene: starts 66 Mya
- Neogene: starts 23 Mya
- Quaternary: starts 2.5 Mya

Includes:

- Pleistocene
- Holocene

7 Origin of us

7.1 Just another ape

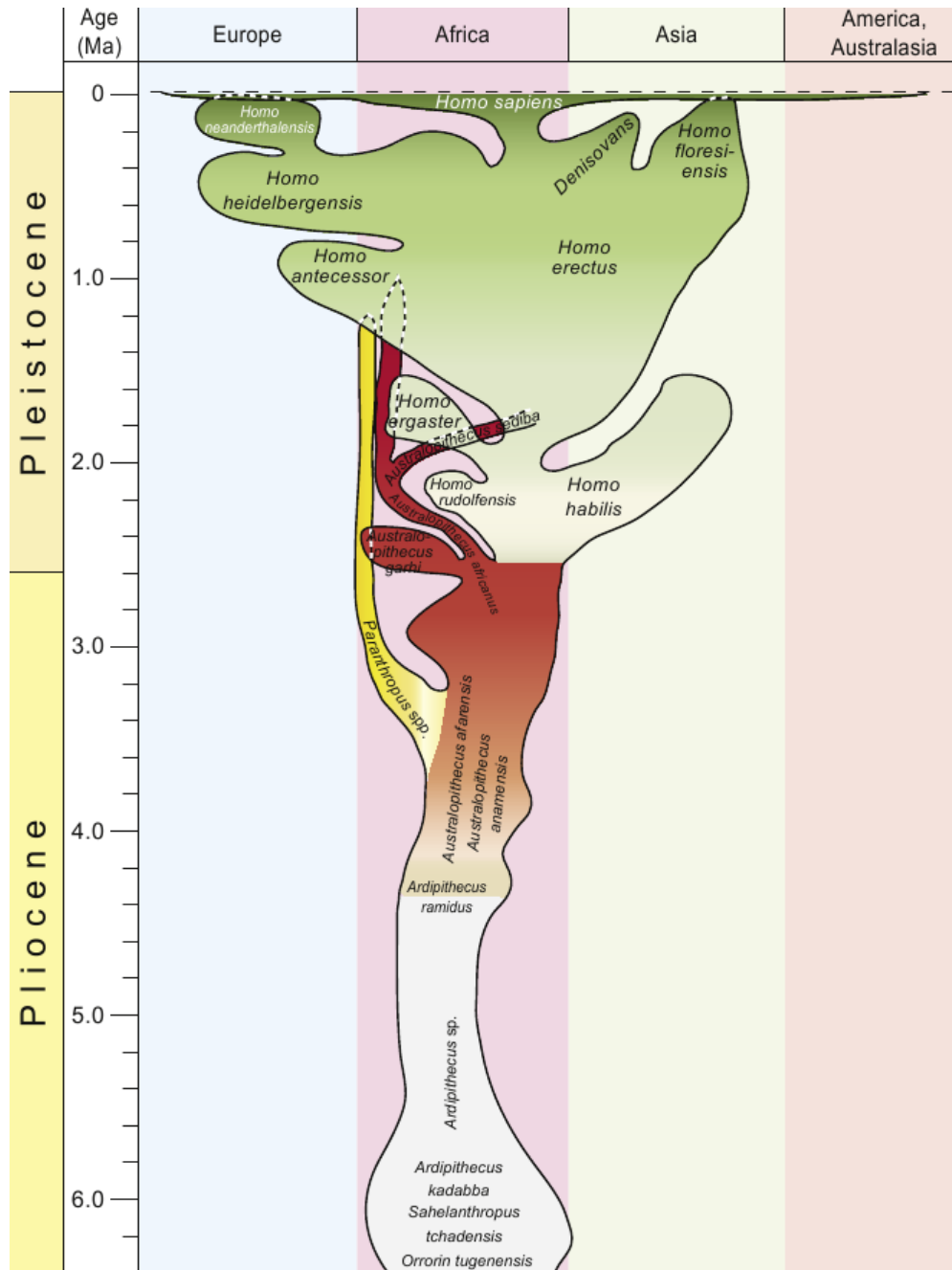
We and monkeys

- It is scientifically correct to call us “monkeys” since we belong to the same order, Primates
- More strictly, humans and their relatives belong to the family Hominidae (hominids)

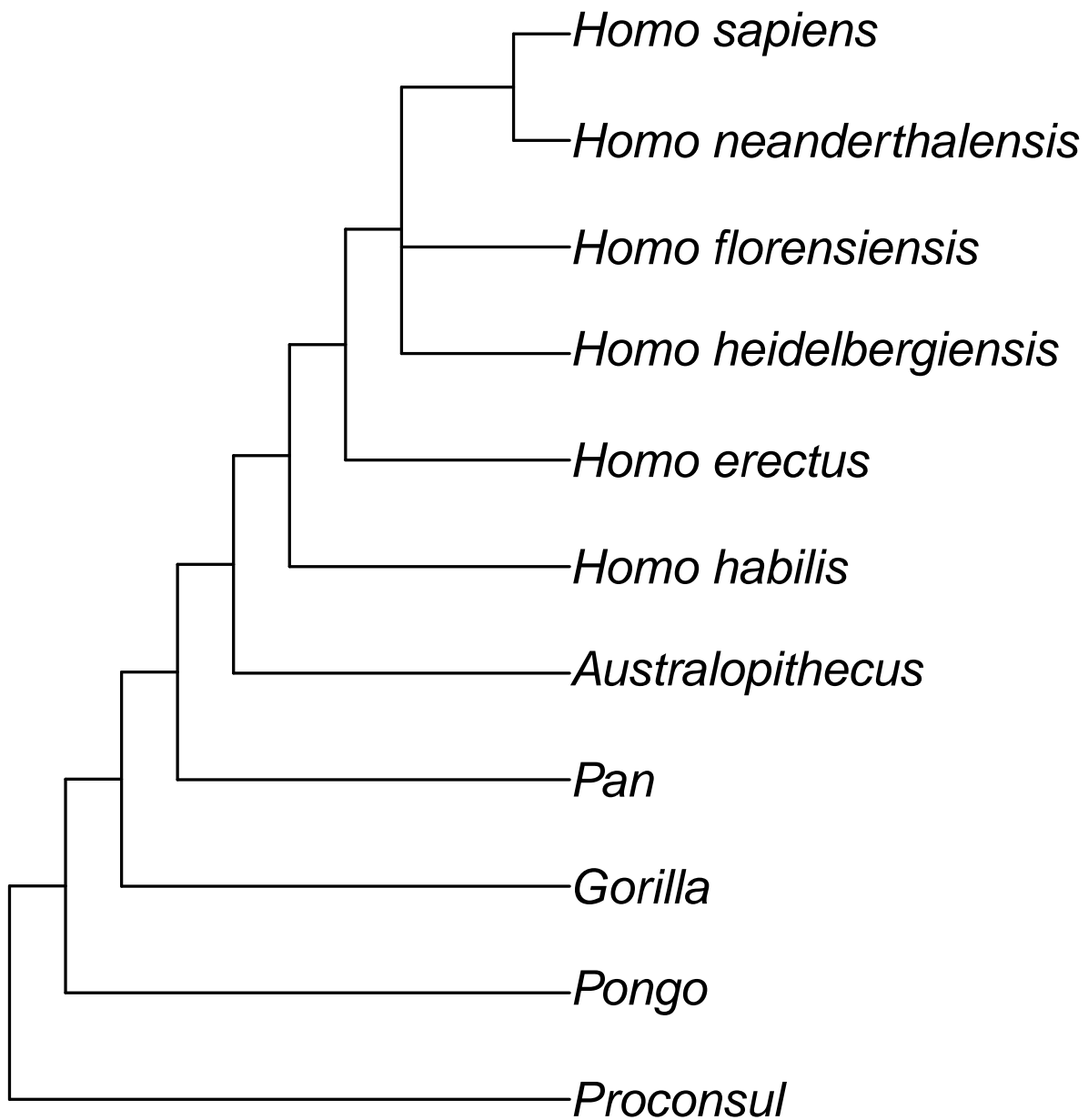
We and monkeys



Time and space of Hominidae evolution



Phylogenetic tree of hominids (simplified)

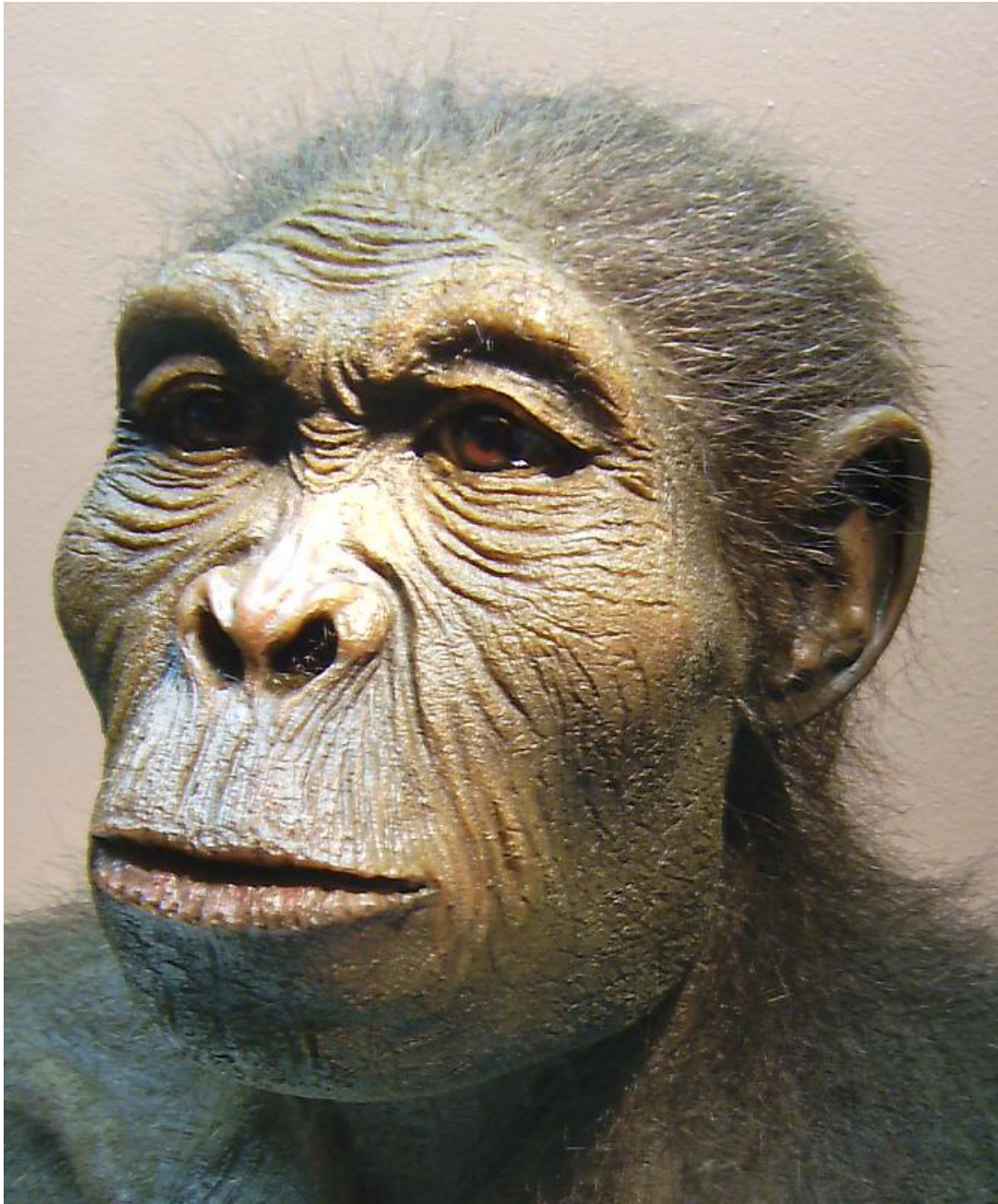


Please note that some terminal groups exchange their genes (e.g., Neanderthals with modern humans)

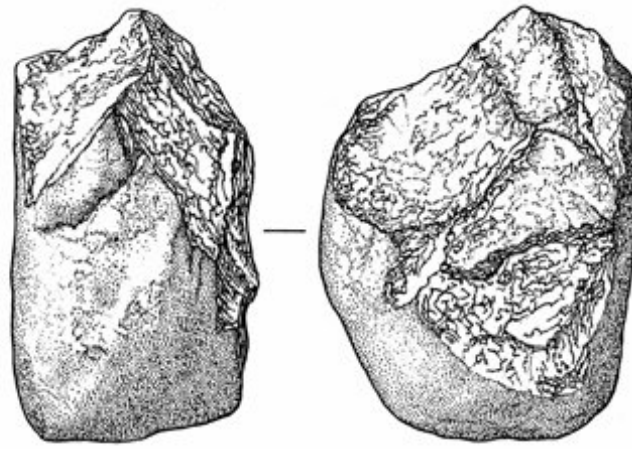
Step I: still a monkey—*Australopithecus* spp.



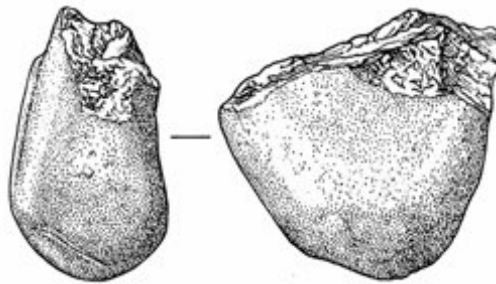
Step II: tool-maker—*Homo habilis*



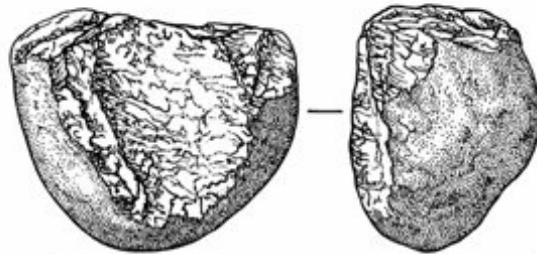
... and his tools



a



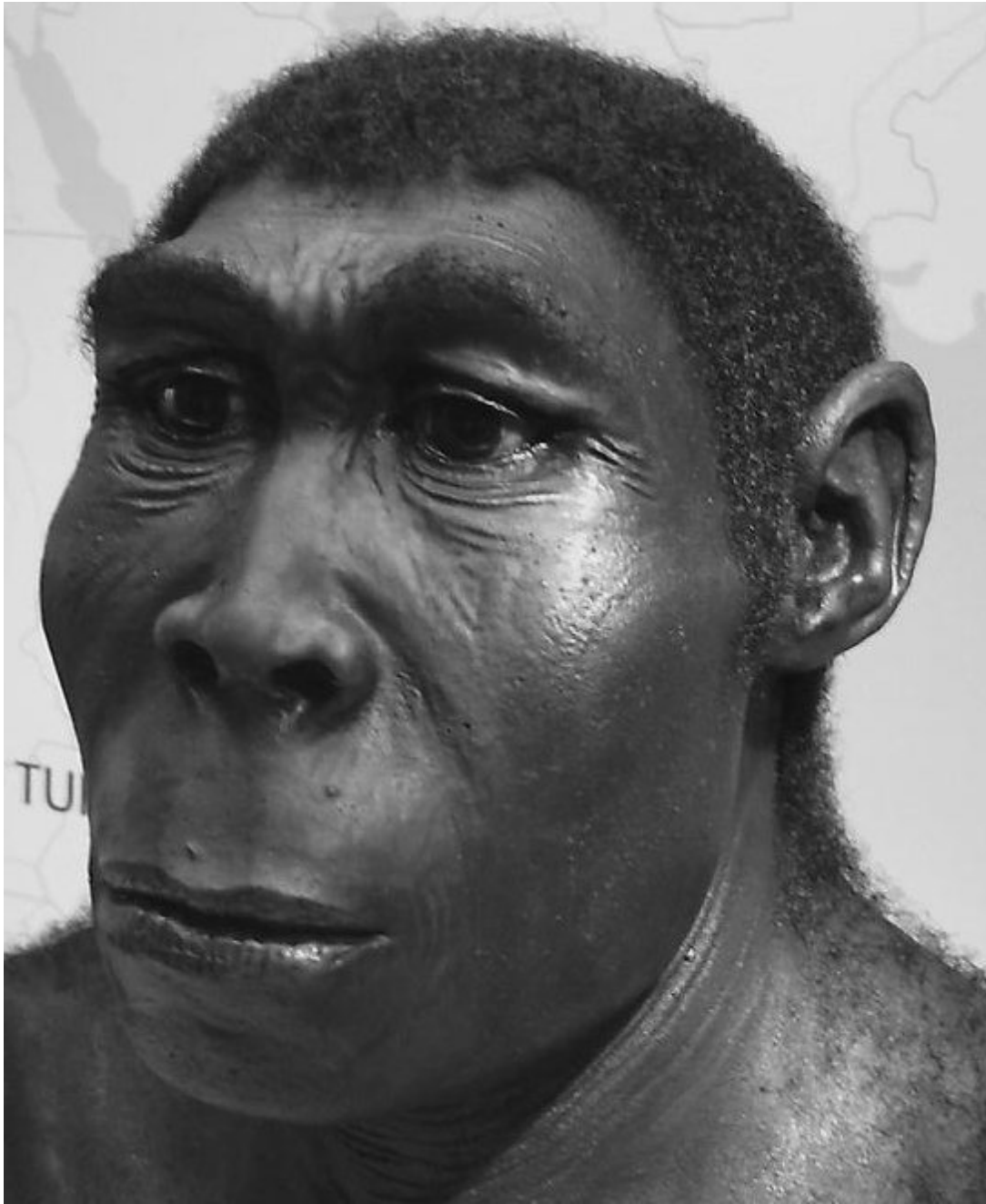
b



c



Step III: fire-maker—*Homo erectus*



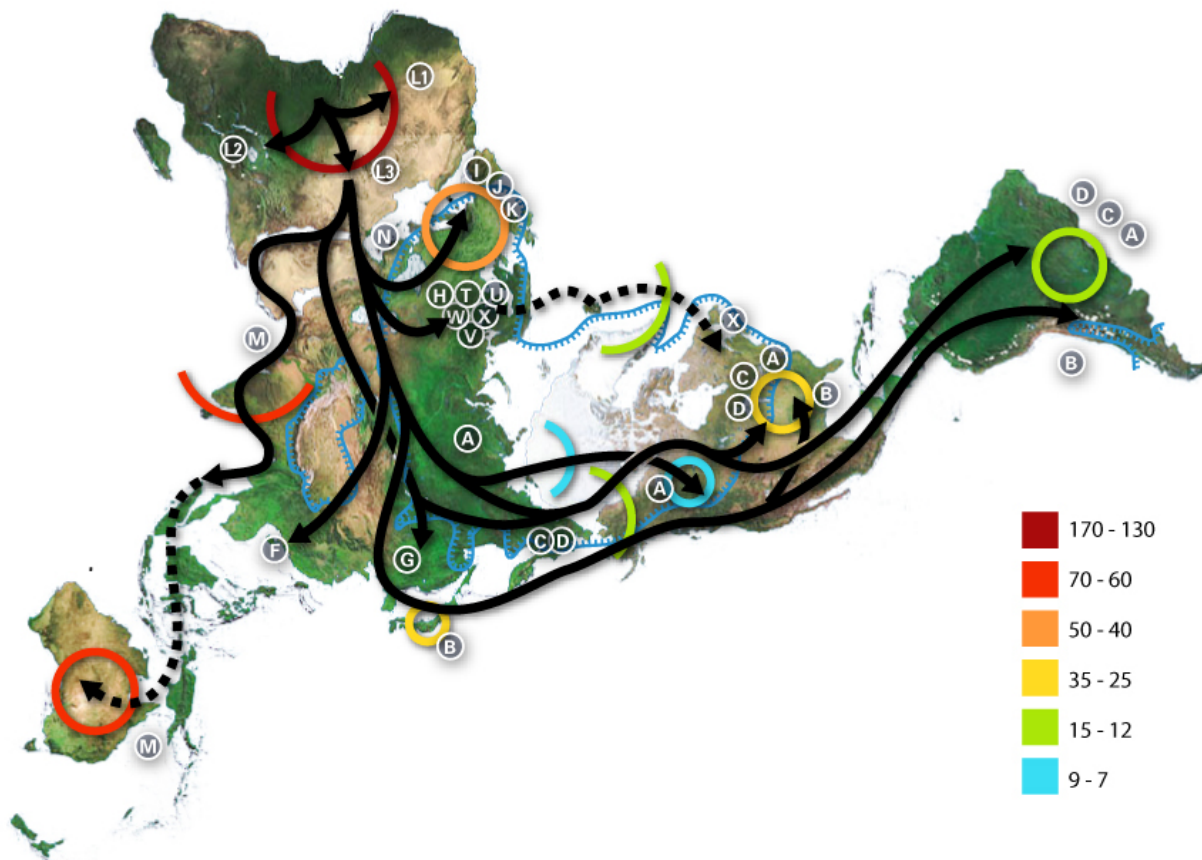
Step IV: grave-maker—*Homo neanderthalensis*



Step V: *Homo sapiens* play the “Evolution” game



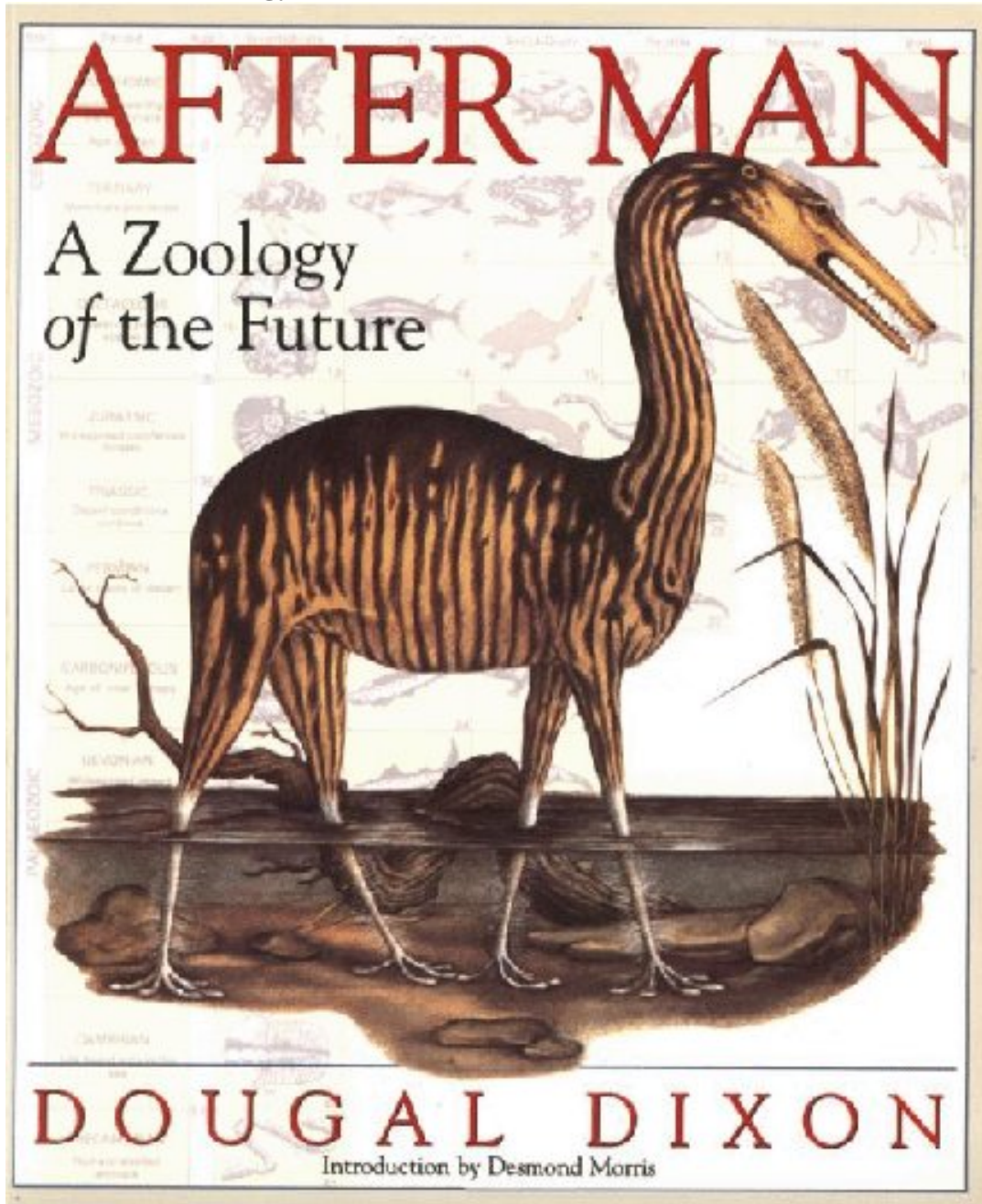
Out of Africa



8 Future evolution

8.1 Dougal Dixon and his “After Man” book

D. Dixon. After man. Zoology of the Future. 1981



Two main assumptions

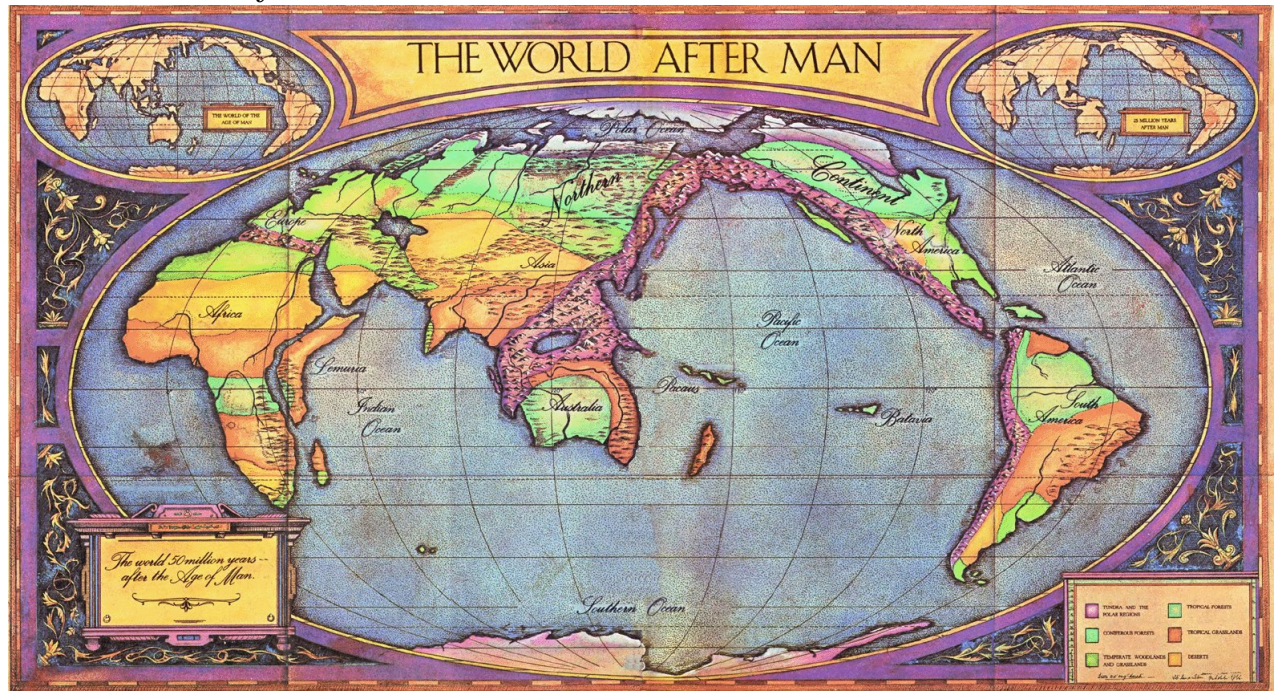
- Big mammals will disappear from Earth (exterminated by humans)
- Humans will disappear without traces (leaved to colonize other planets?)

Some results

- Rodents and hares will radiate and fill niches of big hoofed mammals and their predators

- In many places, previously “neglected” groups will fill new ecological niches

World in 50 million years



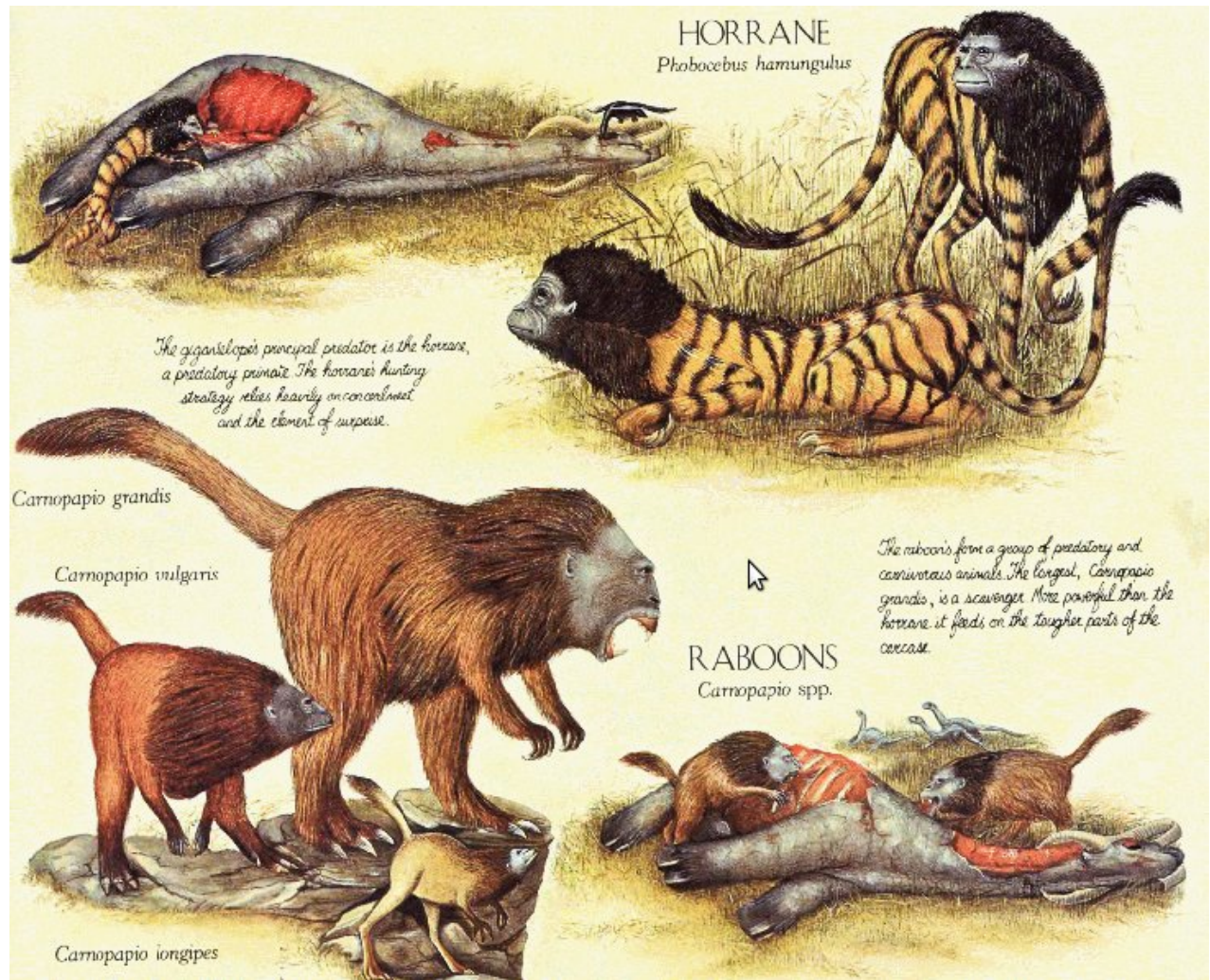
“Hoofed hares” and “wolf rats”



Tropical “monkey cat”



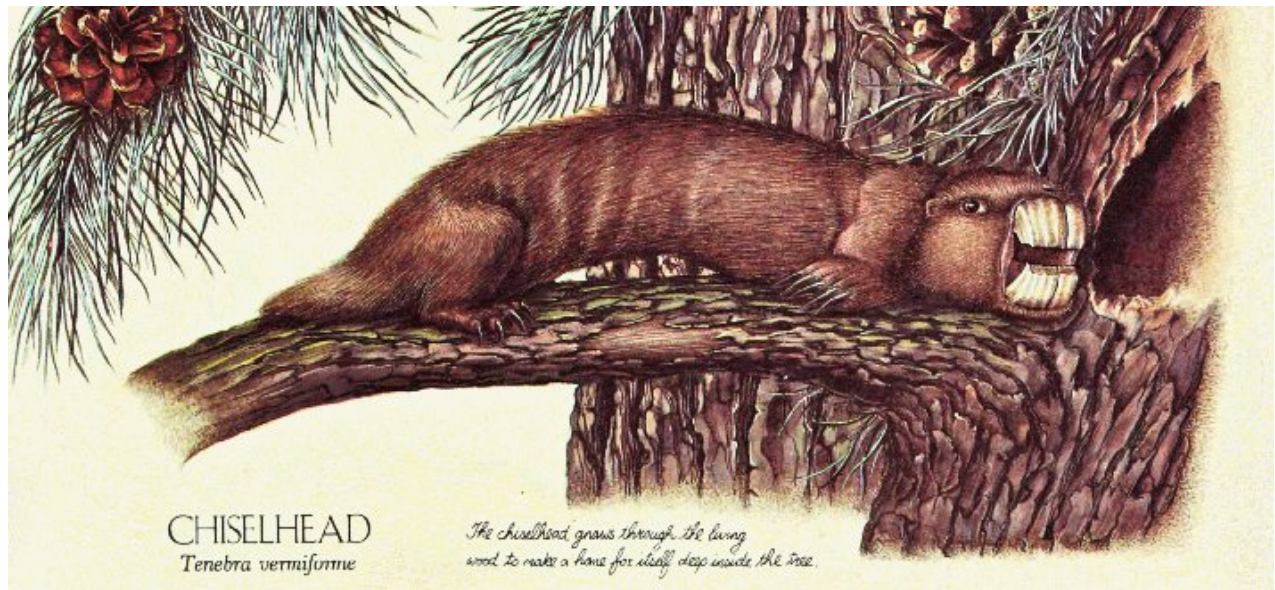
Carnivorous monkeys



Mammal ectoparasite



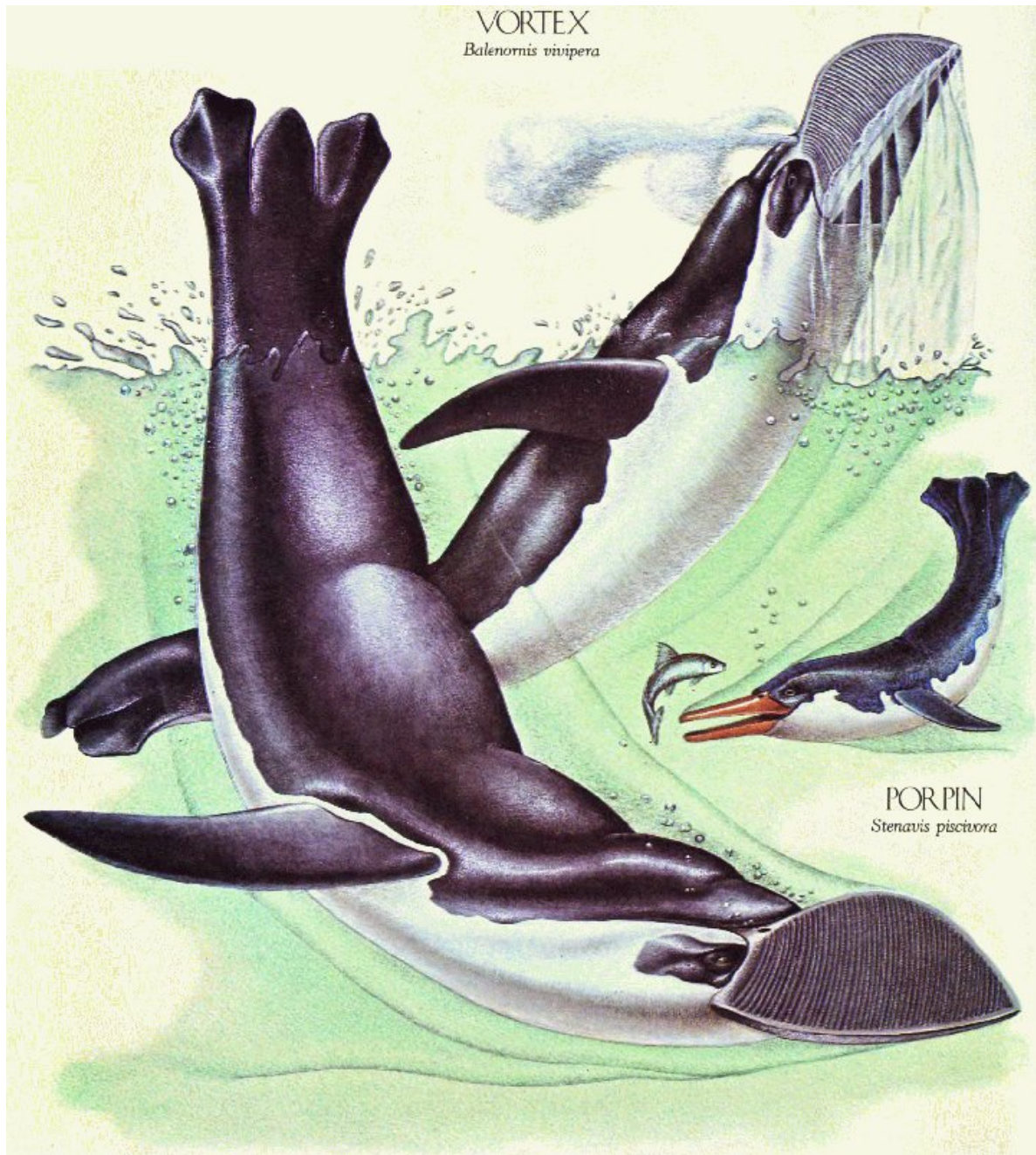
Chiselhead, wood-inhabiting mammal



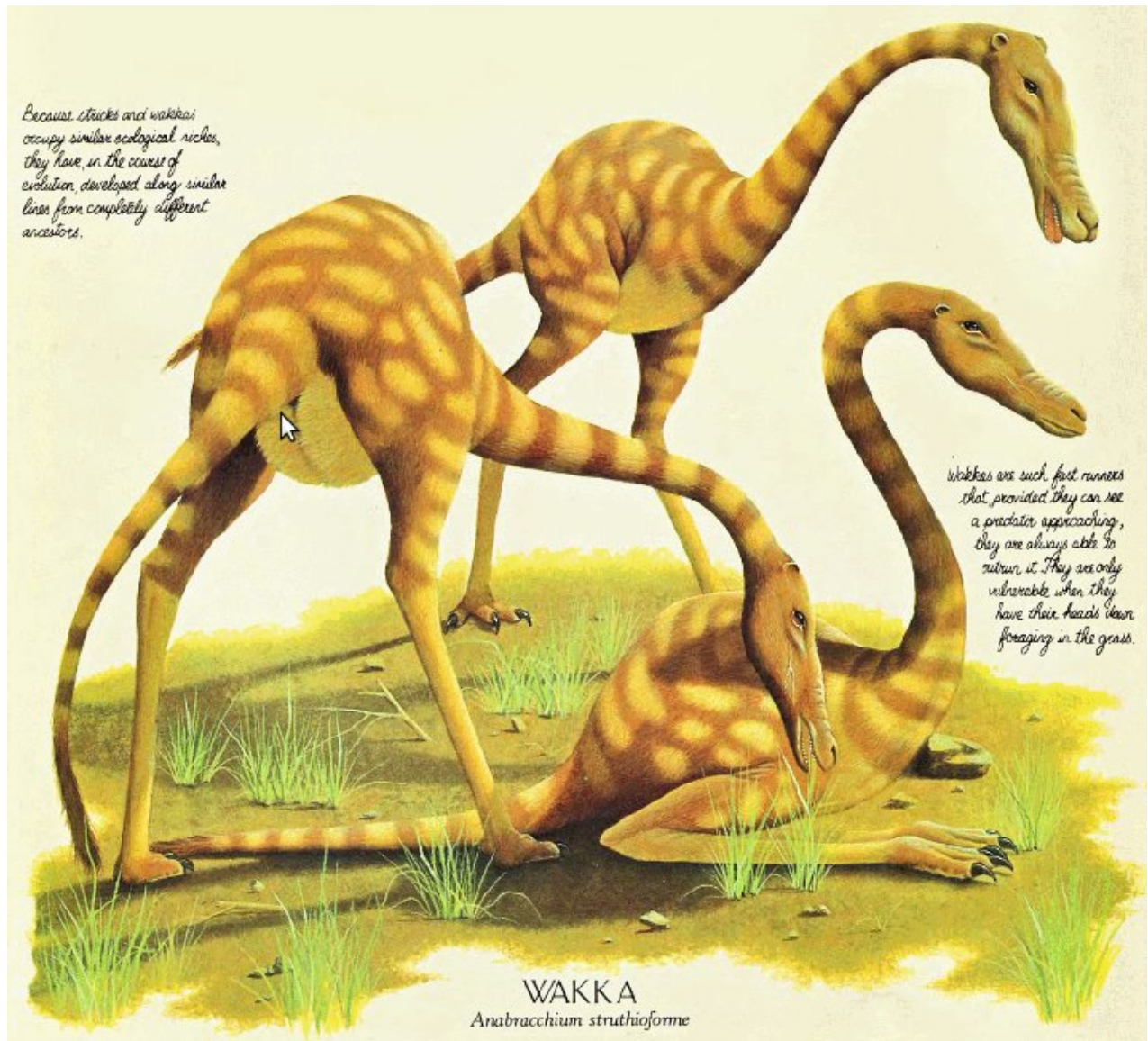
Australian terrestrial bats



Penguin whale



Bipedal mammal herbivore



Short anonymous absolutely voluntary survey

- A. What do you **like** most in Biology 111?
- B. What do you **dislike** most in Biology 111?
- C. **Which lab** do you remember most of all?
- D. Please grade (1—bad, 5—excellent):
 - (a) Lectures
 - (b) Labs
 - (c) Exams

For Further Reading

References

- [1] Walking with beasts (movie). http://en.wikipedia.org/wiki/Walking_with_Beasts
- [2] Human evolution. http://en.wikipedia.org/wiki/Human_evolution
- [3] Homo. <http://en.wikipedia.org/wiki/Homo>
- [4] D. Dixon. After man. Zoology of the Future. http://www.sivatherium.narod.ru/library/Dixon/main_en.htm

9 Movies

- BBC: Walking with beasts
 - New dawn
 - Whale killer (first half)
 - Next of kin