ANTH 42: Primates in Nature

Lecture 2:
Primate evolution

http://weber.ucsd.edu/~jmoore/courses/anth42web/

Rules to a story
... but today, not in that order:

- **What?**
- **When?**
- **Where?**
- **Why?**

- **What?** Dating methods and deep time
- **When?** How do fossils form - taphonomy
- **Where?** The primate fossil record
- **Why?** Evolution and its mechanisms (including natural selection) [later lecture!]

WHEN: Dating methods

* Bishop James Ussher: 1650 calculated from Bible that Creation occurred 4004 BC
* Mary Ann Mantell: 1820 discovered “Iguanodon” tooth (Sussex, UK)*
* Richard Owen: 1842 coined word “Dinosaur”

1854: Dinner in the Iguanodon

Was hard to reconcile 6,000 years with creatures SO different and so clearly extinct.

Uniformitarianism violated.

* Other giant bones known, but this specimen first to kick off ‘modern’ interest

WHEN: Dating methods

Strata laid down in layers, oldest are deepest.

Uniformitarianism & the earth

Younger or older?

Sometimes, geological processes can muddle that up.

But with more data, can usually figure it out.
WHEN: Dating methods
≈ 100 years trying to date fossils. Recognized fossil ‘stages’ - rocks with no crinoids or coral overlaid by rocks with crinoids and coral, but no dinosaurs, so could talk about “age of crinoids” and “age of dinosaurs”. Knew the order taxa showed up (relative dating), but argue about when in years (absolute dating).

WHEN: Dating methods
Absolute.
Dendrochronology (tree rings)
Growth depends on rainfall; annual rings.
Count inward from outermost ring, get age of tree.
Bristlecone pine 5,000 yrs

WHEN: Dating methods
River oaks, S. Germany: > 10,000 yrs
Bristlecone Pines, SW USA: 8,500

WHEN: Dating methods
Radiometric
Isotopic decay - measurable rates
WHEN: Dating methods

**Absolute. Dendrochronology**

**Radiometric**

**Isotopic decay - measurable rates**

- total amount of carbon
- amount of $^{14}$C
- $^{14}$C/$^{12}$C at death (atmospheric)

Radioactive decay of unstable isotopes - half-life

**Uranium - Lead ($U/Pb$)**

- $^{235}U \to ^{207}Pb$: 700 my
- $^{238}U \to ^{206}Pb$: 4,500 my

**Potassium - Argon ($K/Ar$)**

- $^{40}K \to ^{40}Ar$: 1,300 my

NOW: “DEEP TIME”

- 4.4 billion years ago
- 500 million years ago (mya)

Radioactive decay of unstable isotopes - half-life

4.4 billion years ago

500 million years ago (mya)
And now to shift scales...
And now to shift scales... [fish, after all...]

500 million years ago (mya)

65mya
WHERE: Taphonomy - one consequence

Living species Same color = closely related.

- Because VAST MAJORITY of individual organisms that have ever lived do NOT become fossils (let alone recognizable ones),
- And of the ones that do, only a TINY MINORITY then become exposed and available for study,
- We expect gaps in the fossil record….

Morphological similarity

WHERE: Taphonomy - one consequence

Living species Same color = closely related.

- Count species in modern habitat, compare with fossil species in similar “fossil habitat”, estimate # missing species. Guess?
- Morphological similarity

Fossils

≈ 90% (Uniformitarianism)
WHERE: Taphonomy - one consequence

- Cheating to connect branches with species we haven’t found, even if we know they must have existed.
- So connect up available species.
- Make mistakes.

WHERE: Taphonomy - another consequence

What PARTS get left?
Faces aren’t easy to chew and don’t have much meat (medium-size animals).

WHERE: Taphonomy - one consequence

- Cheating to connect branches with species we haven’t found, even if we know they must have existed.
- So connect up available species.
- Make mistakes.

WHERE: Taphonomy - another consequence

- Find new fossil, revise understanding (and get closer to reality)

WHERE: Taphonomy - another consequence

Aegyptopithecus (jaw and skull found separately)

Dinosaur National Monument (UT)

“How do we put them together??

“Lucy”
WHAT: The record.

- What does a mammal look like when it’s a bone?
- What’s the difference between a primate and a possum?

Origin & recognition of mammals

500 million years - 1st fish to present!

Dinosaurs! Reptiles!

Reptile --> mammal

Jurassic ~1m

Synapsids

Mammmal (mammals, primates)

Mammmal (mammals, primates)

Primates v. other mammals

Postorbital bar --> bony orbit

But it’s not real obvious, hence disagree over Tupaia!

Maybe primate (tree shrew)!
Not primate (elephant shrew)!

“Postorbital bar is usually complete”!

Primates v. other mammals

Primates v. other mammals

Opossum
Tree shrew
Otolemur
Macaca
Varecia

Bony definition of mammal

Mammmal (mammals, primates)

500 million years - 1st fish to present
Prosimian vs. anthropoid skulls

Primate phylogeny (Falk)

- Plesiadapiforms (‘proto-primates’)
- Adapiforms (prosimians)
- Omomyiforms (tarsiers [?])
- Late Oligocene (early simians)
- Early Miocene (apes)
- Madagascar (lemur megafauna)

130 mya, South America, Africa, India all connected

115 mya, drifting apart.

No “primates”

80 - 90 mya
Conceivable ancestors of primates around, but continents separate.
Dinosaurs still dominant.
Madagascar off on own.

End Cretaceous - K/T boundary
65 mya - ‘primates’!
Plesiadapiforms

Eyes lateral

Plesiadapis: ~2´ (beaver-sized); North Dakota

Purgatorius

~ rat size; ~65mya

Purgatory, Montana.

“primatomorph”

Prosimians - or “flying lemurs”?

Nail, not claw

Weird jaw + grasping paws…

Adapiforms

Notharctus

Wyoming ~ 40-50mya

Adapis (France)

Definitely primate…

Eocene

Adapids

Oomyids

Eocene 40 Ma

Late Eocene 40 Ma

http://dmoz.org:80/ symlinked history/html
Lots of specimens and # species

Note forward facing eyes, postorbital bar