

Mammalogy Lecture 4B - Therian Mammal Diversity: Eutherians

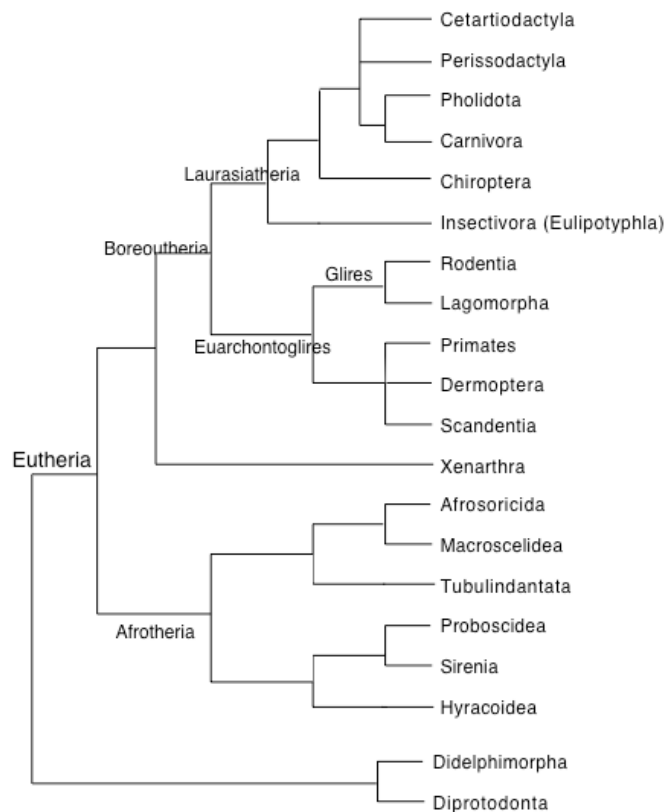
VI. Eutherian Groups. We won't go through the diversity here in as great detail as we did for Marsupials. We'll leave a lot of details for the lab.

We'll recognize 18 orders of placental mammals. For 150 years, the relationships among these were a classic problem in mammalogy. The reason for this is that in the Cretaceous, there was a rapid radiation. That is, the modern Eutherian orders evolved in a burst, which results in a phylogeny that looks more like a bush than a tree, with very short internal branches. Resolving these relationships has been a very active area of research, and a large number of papers have been published in the last 20 or so years that have made enormous strides.

We'll use the phylogeny shown here to structure our treatment of eutherian diversity (it's one of the first large-scale eutherian molecular phylogenies). There have been some surprises.

Eutherian Phylogenetic Relationships

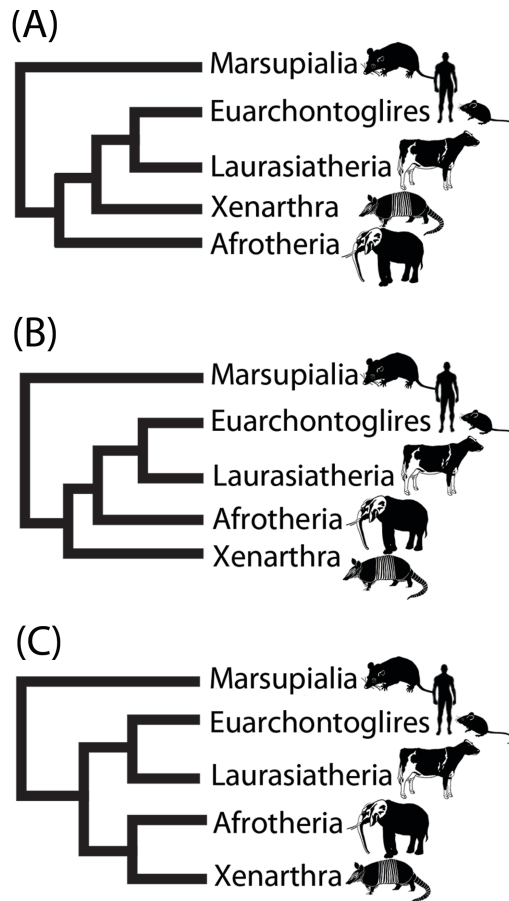
(Madsen, 2001; Murphy et al., 2001a, b)



Madsen et al., 2001. *Nature*, 409:610
Murphy et al., 2001a. *Nature*, 409:614
Murphy et al. 2001b. *Science*, 294:2348

We'll focus on 4 groups of orders: Afrotheria (6 orders), Xenarthra (1 or 2 orders), Euarchontoglires (5 orders), & Laurasiatheria (6 orders).

There is support for other resolutions of the deepest nodes (shown below) and controversy around the timing of radiation. Still, we can use this phylogeny as a working hypothesis.



Some datasets support tree C (e.g., Esselstyn et al. 2017 - pdf on website), but Murphy et al. (2021. *Ann. Rev. Anim. Sci.*, 9:29) demonstrate that ambiguity still persists, >20 years after the initial phylogenomic studies.

Afrotheria is the name given to the first group we'll discuss. This group is one of the big surprises to emerge consistently from these molecular phylogenies. It contains 6 orders, all but one of which has its first occurrence in Africa.

O: Proboscidea - elephants, now known only from Africa and Asia.

Formerly much more diverse and widespread.

F. Elephantidae 2 Genera, 3 species.

- Asiatic Elephant – *Elephas* (Small ears)
- African Elephants – *Loxodonta* (Large ears)

*Back-to-front tooth replacement rather than from underneath.

O: Sirenia - sea cows, Caribbean and Indian Oceans, also Amazonia. 2 G and 4 S in 2 families

Hind limbs are reduced to vestigial organs.

These are the sister group to elephants and also have back-to-front tooth replacement (more teeth than elephants; 30 vs 6), although this is probably independently evolved.

F: Trichechidae: *Trichechus* - manatee

O: Hyracoidea - hyraxes - single family with 5 species in 3 genera.

F: Procaviidae: *Procavia* - Feet have unique friction pads. Live in clans (family groups).

Herbivorous, rock hyraxes and tree hyraxes.

O: Macroscelidea - elephant shrews - Central and southern Africa.

F: Macroscelididae - 5 Genera and 20 species.

They're cursorial & get their name from large limbs. This has implications for reproductive biology that we'll discuss later.

Macroscelides

A new species of *Rhynchocyon* was discovered a few years ago and media attention illustrates the problem of non-standardized common names.

O: Tubulidentata - armadillo (monotypic)

F: Orycteropidae - *Orycteropus*

Myrmecophagous & has the adaptations: long tongue, slender dentary, etc.

Unique tooth pattern: hexagonal prisms.

O: Afrosoricida (a.k.a., Tenrecoidea) – tenrecs and golden moles

These two (or 3) families were traditionally lumped into the order Insectivora. However, lots of molecular data support their sister group relationship with each other and their inclusion in Afrotheria.

F. Tenrecidae – tenrecs - 8 genera, 31 species

Madagascar and adjacent east-central Africa

The genus *Echinops*, which we saw in lab (hair modified as spines).

The next group is South American; we'll recognize a single order, which we saw in lab.

O: Xenarthra (Pilosa plus Cingulata) - sloths, anteaters, and armadillos. 4 families 29 species.

South American - formerly very diverse. One group has invaded N. Am.

Are characterized by an additional articulation between successive vertebrae, formed by the **xenarthrous process**, a structure unique to this order.

F: Myrmecophagidae - anteaters 3 Genera and 4 Species all S. & C. American

Myrmecophaga and we saw *Tamandua* in lab.

All are myrmecophagous

- extremely long snout
- thin delicate dentary
- long protrusible tongue (supported by large hyoid)
- sticky copious saliva
- teeth are absent
- forelimbs are modified for digging

F: Bradypodidae - 3-toed sloths. Single genus, 4 species.

Bradypus – three-toed sloth.

These are arboreal foliivores, so they have adaptations for eating low quality food (like *Phascolarctos*).

They also have 8-9 cervical vertebrae, and the evolutionary genetic mechanism of this is mutations in homeobox (Hox) genes.

The next major clade is called **Boreoeutheria**, and it contains groups with apparent origins in the northern hemisphere. Boreoeutheria has two groups of orders:

Euarchontoglires (a truly horrible name)

O: Rodentia. Rodents are worldwide, ~30 families split into 5 suborders, > 2550 species. This represents ~44% of all mammals.

All have ever-growing, chisel-like incisors, a large diastema, and grinding cheek teeth.

The suborders are (mostly) diagnosable by a combination of jaw morphologies and zygomaseteric conditions.

Sciurognathous vs. Hystricognathus.

Protrogomorphous vs. Sciuiromorphous vs. Hystricomorphous vs. Myomorphous

SO: Hystricomorpha - Primarily South American and African

F: Erethizontidae - New World porcupines (3 G, 17 S)

Erethizon is the only hystricomorph that's native to North America.

- primarily eat bark, very arboreal

SO: Sciuiromorpha - world-wide.

F: Sciuridae – squirrels, chipmunks, and marmots 60 Genera, 298 Species
Worldwide, except Australia

Urocitellus beldingi – We'll talk about the social system in this species.

SO: Castorimorpha – North/Central America and Eurasia.

F: Heteromyidae - pocket mice and kangaroo rats and mice - 5 Genera, 66 Species (external, fur-lined cheek pouches).

Primarily North American, just get into South America

The family exhibits two trends:

Progressively desert-adapted forms.

Progressively saltatorial forms.

Microdipodops - kangaroo mouse

Enlarged auditory bullae

Extreme renal physiology

May never actually have to consume water

F: Geomyidae - pocket gophers 7 Genera, 41 Species

North & Central America

Thomomys talpoides - northern pocket gopher

Extremely fossorial

Fusiform body
Small eyes and pinnae
Velvety fur
Short tactorial tail
Claws modified for digging (front limb - we'll address later).
Procumbent incisors - protrude from mouth when it's closed.

SO: Myomorpha – Worldwide (>1300 species)

F: Muridae - rats and mice, including *Mus* and *Rattus* (>700 species)

F: Cricetidae – hamsters, voles, New World rats and mice (>600 species)

SF: Neotominae - New World rats and mice

Reithrodontomys megalotis - western harvest mouse

Onychomys – grasshopper mice are carnivorous.

<https://www.youtube.com/watch?v=IWshPHGxBY>

SF: Arvicolinae - voles and lemmings (semi-fossorial, dramatic population fluctuations – we'll examine later)

Microtus longicaudus - long-tailed vole

O: Lagomorpha – rabbits, hares & pikas - 2 families 98 species

The sister-group to rodents – Glires (Rodentia + Lagomorpha)

All have chisel-like upper and lower first incisors, and small peg-like second upper incisors, have a diastema (are herbivorous).

F: Leporidae - rabbits and hares - 11 Genera, 67 Species North America and Eurasia

- Highly Cursorial, including fenestrated rostrum

Lepus townsendii - white-tailed jackrabbit.

O: Primates - 14 families 518 species. The order is world-wide, & probably evolved from arboreal ancestors.

Two Suborders:

SO: Strepsirhini - Often referred to as Prosimians. Diagnosed by dental comb.

F: Lemuridae - lemurs - 5 Genera, 21 Species Restricted to Madagascar

Representative form is the genus *Lemur*

SO: Haplorhini - Often referred to as Anthropoids.

F: Callithricidae - tamarins and marmosets - 4 Genera, 26 Species

Entirely neotropical and omnivorous *Leontopithecus*

F: Hominidae - great apes, 4 Genera, 7 Species

Worldwide and omnivorous

Pongo, Pan, Gorilla, and Homo

O: Dermoptera - gliding lemur or colugo 2 species

F: Cynocephalidae - Phillipines and S.E. Asia

Have a gliding membrane that extends between wrist and ankles.

Have comb-like lower incisors use for grooming.

Cynocephalus

O: Scandentia - tree shrews. Are not shrews, but there's been a lot of uncertainty regarding relationships.

F: Tupaidae – Asian squirrel-like organisms 4 genera and 24 species.

Tupaia – There is evidence of a mutualism between these and pitcher plants.

Laurasiatheria - 6 Orders

O: Insectivora (a.k.a., **Eulipotyphla** or **Soricomorpha**) - Worldwide except Australia. Lots of groups used to be lumped in here. Some authors use the name Eulipotyphla to differentiate the new concept of this order.

527 species – 9 % of all mammals

F: Soricidae - shrews 26 G., 440 Sp., Worldwide except S. America.

Shrews use echolocation to gain information about surroundings.

Includes a common form *Blarina brevicauda* that has venomous saliva that it uses to kill larger animals; *Microtus* may comprise 90% of its winter diet.

Sorex palustris - water shrew.

O: Chiroptera. Bats are worldwide, 21 families, also split in to two suborders. 1386 species.
20% of mammals

All have powered flight. And the flight membrane is supported by the hand (hence name). This character evolved only a single time.

Bats have a keeled sternum like birds, but it's not nearly as extensive as birds.

Yinpterochiroptera includes large bats (sometimes called megabats) and some small bats (called microbats), including *Craseonycteris*.

F: Pteropodidae - Flying foxes - primarily frugivorous. 45 G, 197 S

They rely on vision; only one genus echolocates. We saw a skeleton in lab.

Rousettus (the echo-locating form).

Yangochiroptera includes ~15 families of echo-locating bats. We'll mention two.

F: Phyllostomidae – New World leaf-nosed bats 62 Genera, 214 Species
Neotropics

Spectacular diversity in feeding habits

- sanguinivorous forms *Desmodus rotundus*
- Nectarivorous forms *Choeronycteris*
- frugivorous forms *Artebius jamaicensis* & *Centurio*
- Piscivorous, and frog-eating (*Trachops*;
(<http://www.youtube.com/watch?v=4SW-2TYX8Sg>)

F: Vespertilionidae - Vespertilionids - 54 Genera, 493 Species worldwide

All are primarily insectivorous. All our local bats are vespertilionids.

Euderma maculatum - spotted bat. Solitary, cliff-roosting bat, Idaho species, not represented in our collection.

O: Carnivora - Majority are meat eaters, although there are also herbivorous forms

There are 11-14 families, including the familiar canids and felids, but the order also includes the old order Pinnipedia, 3 aquatic families: the seals, walrus, and sea lions.

F: Phocidae - seals - 14 Genera, 19 species - Aquatic

Here represented by elephant seal *Mirounga*. We'll talk about at the end of the semester.

Terrestrial forms (~11 families) are characterized by carnassial teeth that are adapted for shearing meat. 4th upper premolar - 1st lower molar.

F: Procyonidae - racoons and their kin. 6 G & 14 S All in the New World.

ringtail – *Bassariscus*

racoon - *Procyon*

O: Pholidota – pangolins - 3 genera, 8 species. Asian and African.

These are likely the sister group to Carnivora.

F: Manidae - *Manis*

They have scales, which are composed of keratin. If you look at them, you can see the individual fibers that comprise the scales.

Young cling to base of mother's tail.

They're myrmecophagous and have the adaptations that typically associate with that.

O: Cetartiodactyla - even-toed ungulates & whales. 20 (or so) families 551 species.

Characteristics of 11 terrestrial families:

- 3rd & 4th digits are modified. Metapodials are elongate and fused into a cannon bone
- The ungula (nail homologue) is modified into hoof.
- Primarily herbivorous, but there are omnivorous forms.
- In many families, the stomach is multi-chambered

F: Giraffidae - 2 Genera and 5 species *Giraffa*
Ruminants, with 4-chambered stomachs.
unique horns - parietal bones

Characteristics of fully marine forms (9 families, ~90 species)

- Fusiform bodies

- Forelimb modified into fins
- Hind limbs lost (pelvic girdle vestige remains).

Whales actually appear to be sister group to Hippopotamidae.

There are phenomenal fossil intermediates from the terrestrial ancestors of whales; we'll address these during locomotion lectures.

There are two reciprocally monophyletic groups (McGowan et al. 2021. Syst. Biol. 69:478.).

Mysticete (baleen) whales (3 families) - Named for baleen, keratinized plates used in filter feeding

F: Balaenopteridae – rorquals. 2 Genera and 8 Species *Megaptera*

Odontocete (toothed) whales – several (6) families

F: Delphinidae - dolphins. 17 Genera and 40 species. *Orcinus*

O: Perissodactyla - odd-toed ungulates: 3 families 21 species

Formerly more diverse and widespread.

3rd digit is expanded and may have a single hoof - Lateral digits reduced

Herbivorous - have diastema.

F: Rhinocerotidae - 4 Genera, 5 Species - Keratinized horn

Ceratotherium - white rhino

F: Equidae - 1 Genus, 8-12 Species - Natural distribution includes only East Africa and Asia, although much equid evolution occurred in North America.

Equus grevyi - Grevy's zebra - Narrow stripes that extend to hooves.