# JIB 116/4
# Animal Diversity

## Chapter 28: Phylum Chordata
## Class Mammalia

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# Class: Mammalia

If it has hair…

# Characteristics: Mammalia

- Body mostly covered with hair
- Integument with glands: sweat, scent, sebaceous, mammary
- Skull with 2 occipital condyles and secondary palate
- Middle ear with 3 ossicles – malleus, incus, stapes
- Movable eyelids
- Fleshy external ears (pinnae)
- 4 chambered heart
- Lungs with alveoli, larynx
- Excretory system of metanephric kidneys, bladder
- Highly developed brain, with cerebral cortex (layer of cerebrum)
- Endothermic and homeothermic
- Separate sexes
- Internal fertilization
- Milk for young from mammary glands

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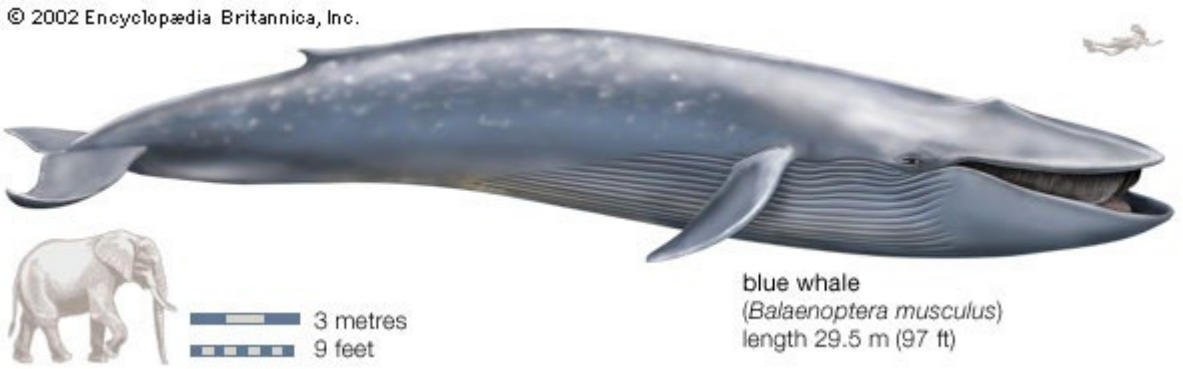
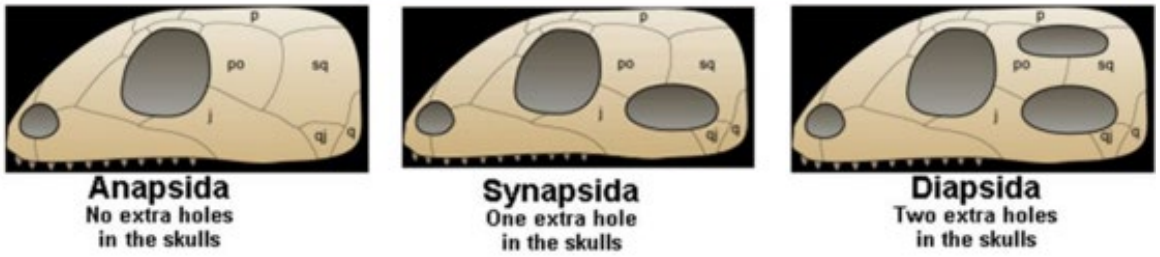
# Class: Mammalia

Kitti's Hog-nosed bat



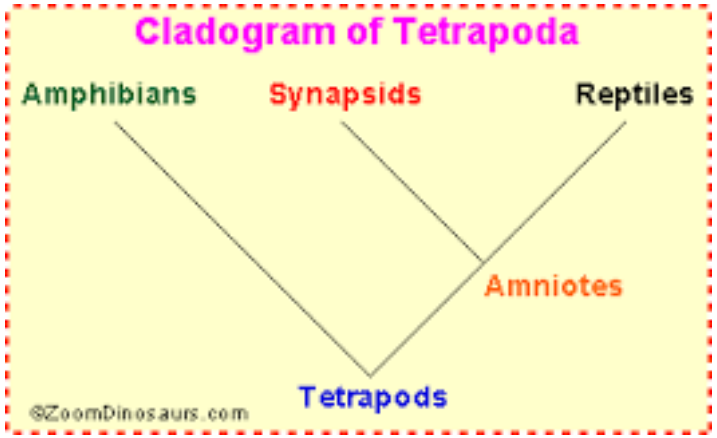

- 5400 species
- Some have been domesticated
- Many species have been listed as critically endangered

# Origin & evolution of mammals




**The holes in the skull are thought to provide better attachment for jaw muscles which allowed the animals to capture and digest a greater variety of prey.**

- Earliest synapsids diversified to herbivorous and carnivorous collectively: pelycosaurs
- primitive Late Paleozoic synapsids, also known as mammal like reptiles (not accurate)



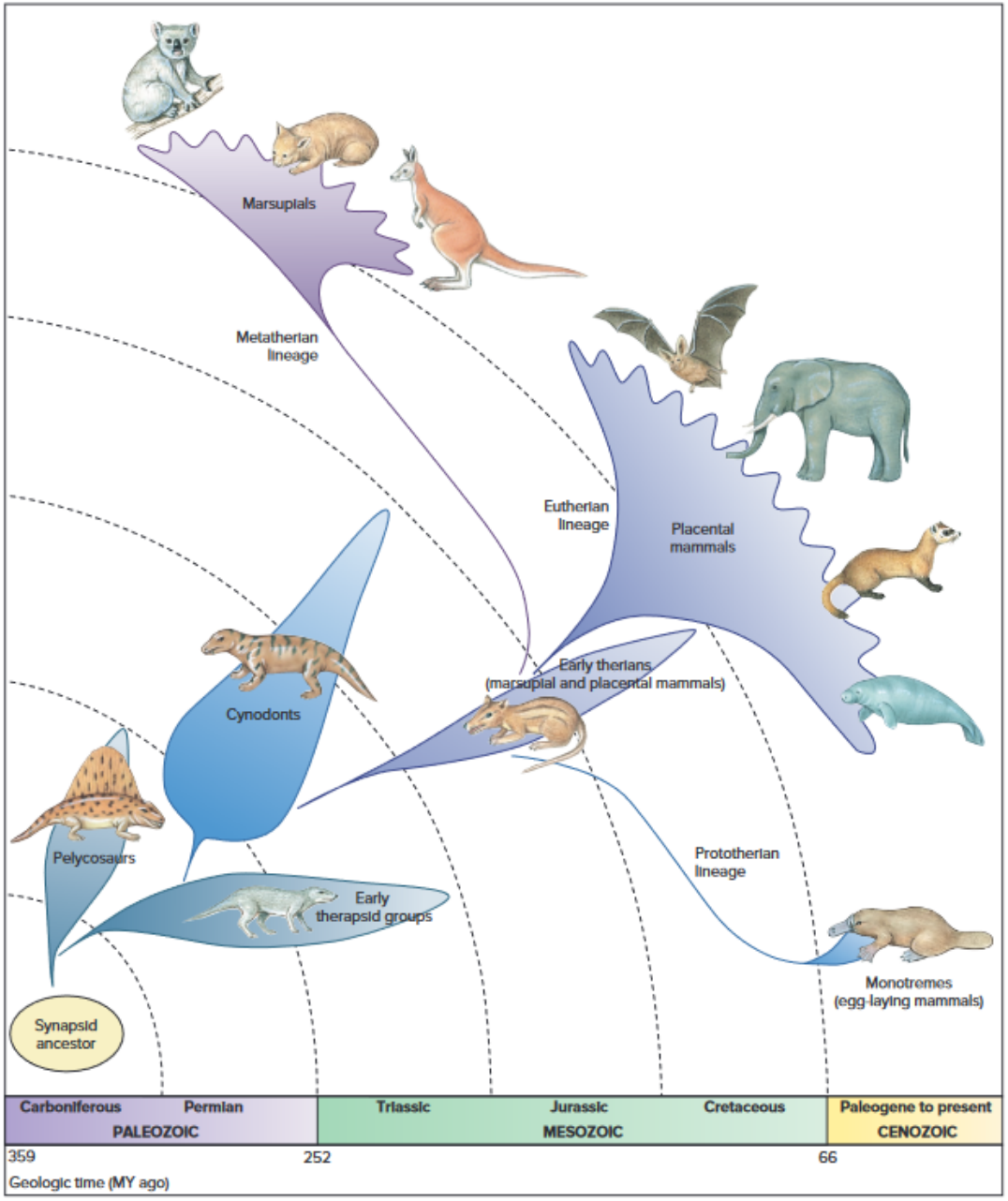
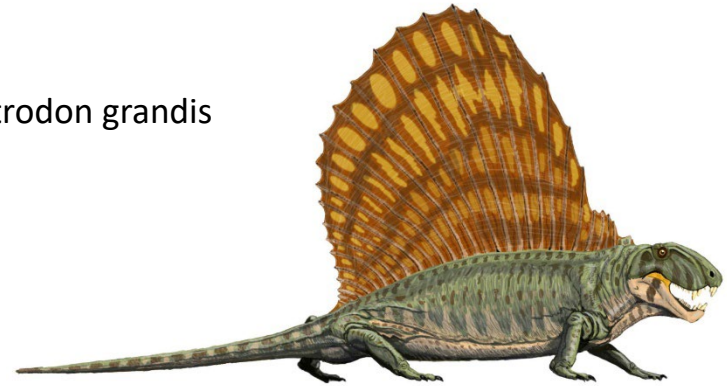



Figure 28.1 Evolution of major groups of synapsids. The synapsid lineage, characterized by lateral temporal openings in the skull, began with pelycosaurs, early amniotes of the Permian period. Pelycosaurs diversified extensively and evolved changes in jaws, teeth, and body form that presaged several mammalian characteristics. These trends continued in their successors, the therapsids, especially in cynodonts. One lineage of cynodonts gave rise in the Triassic period to early mammals. Fossil evidence indicates that all three groups of living mammals—monotremes, marsupials, and placentals—are derived from the same cynodont lineage. The great diversification of modern placental orders occurred during the Cretaceous and Paleogene periods.

# Origin & evolution of mammals

Dimetrodon grandis



**Pelycosaurs:**
- Largest amniotes
- Early Permian period (320mya)
- Resemblance to lizards (diapsids)
- But not closely related to lizards
- Gave rise to therapsids

Broomicephalus

**Therapsids:**
- Only synapsid group to survive past the paleozoic era
- Evolved erect gait – upright limbs beneath body (not sprawled on side)
- Muscular coordination centre of brain cerebellum expanded role
- One group survived into Mesozoic era: cynodonts

Thrinaxodon


**Cynodonts:**
- 260 mya
- Specialized jaw muscle, stronger bite
- Heterodont teeth
- Secondary bony palate – breathe while eating
- Diaphragm

# Origin & evolution of mammals

- Earliest mammals of late Triassic period were small mouse-like animals:
- Large crania, redesigned jaws, new type of teeth - diphyodont

**Diphyodont**: two successive sets of teeth
Polyphyodonts: teeth are constantly replaced
Monophyodonts: animals who have only one set of teeth that do not change over a long period of growth.

- Endothermic
- Hair for insulation
- Sebaceous and sweat glands evolved
- Probably hatched from eggs, dependent on maternal milk, protection
  [Monotremes: echidna and platypus]
- 58 mya Eocene epoch modern mammals diversified rapidly
- Living mammals (29 orders): 2 clades – Theria & Monotremata (1 order)
- Theria: metatherians (marsupials, 7 orders) & eutherians (placentals, 21 orders)

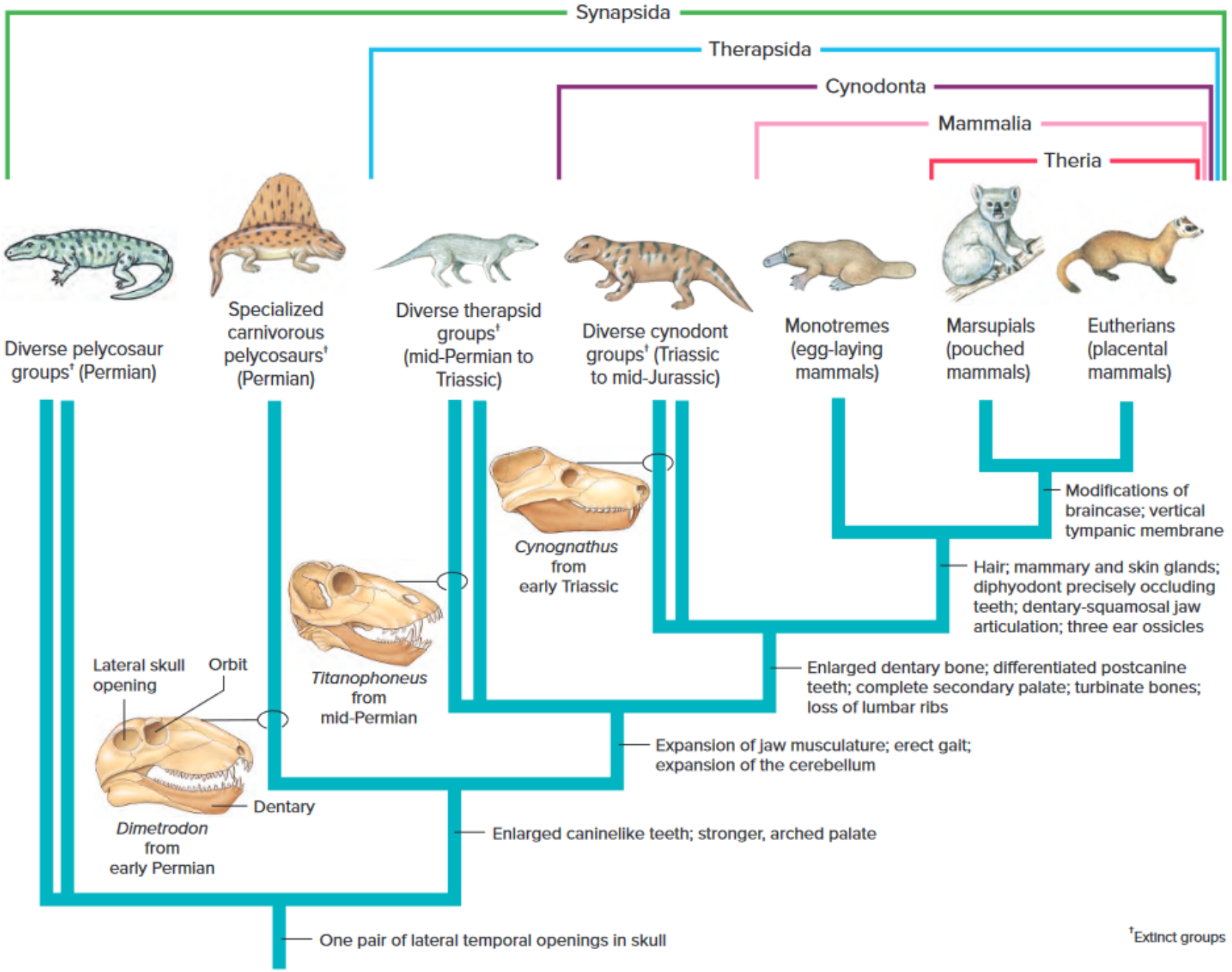



Figure 28.2 Abbreviated cladogram of synapsids emphasizing origins of important characteristics of mammals. The skulls show progressive increase in size of the dentary relative to other bones in the lower jaw and increasing heterodonty.

# Structural & Functional Adaptations of Mammals

**Integument**

-The mammalian skin + associated skin structures are unique to Mammalia than other group of animals
-Thicker than other vertebrates
-Epidermis is thinner layer and protected by hairs, and in areas where intense contact and use (e.g. palms, soles), are thicken with keratin fibrous protein layer.

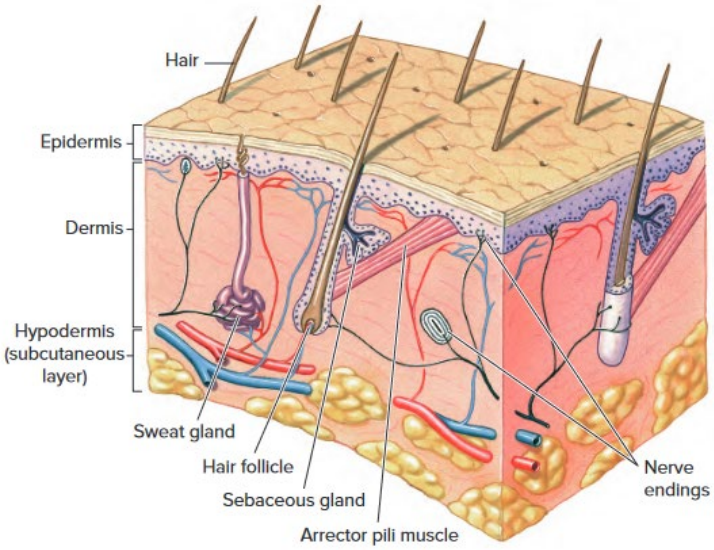



Figure 28.6 Structure of human skin (epidermis and dermis) and hypodermis, showing hair and glands.

Try on 3D interactive model of integument

https://human.biodigital.com/gar/anatomy/male/integumentary-system/

https://g.co/kgs/JWc7ug

# Structural & Functional Adaptations of Mammals

**Integument**

**Hair:**

- All mammals have hair
- Whales? Sensory bristles on snout
- Keratin: fibrous protein
- Insulation, water proof

Arctic fox

# Structural & Functional Adaptations of Mammals

**Integument**

**Horns & antlers:**

- True horns (Bovidae family): hollow keratinized epidermis , not shed, not branched, continue growth, embraces a core of bone arising from the skull, occur in both sexes
- Antlers (Cervidae family): branched, solid bone when mature, develop beneath velvet during their annual spring growth and complete before the autumn breeding season, shed after breeding season, occur only in male deers (Except Caribou)

# Structural & Functional Adaptations of Mammals

**Integument**

**Glands:**

- Sweat: not present in other vertebrates, only mammals
- Scent: communication, territory boundary, warning, defense, attracting mate
- Sebaceous: produces sebum, keep skin and hair pliable and glossy
- Mammary: milk, monotremes lack nipples – secrete milk onto fur on mother's belly

# Structural & Functional Adaptations of Mammals

**Food & Feeding**

- Teeth – reveals eating habits
- Heterodont
- Incisors, canines, molars, premolars
- Diphyodont:
- Deciduous, permanent teeth

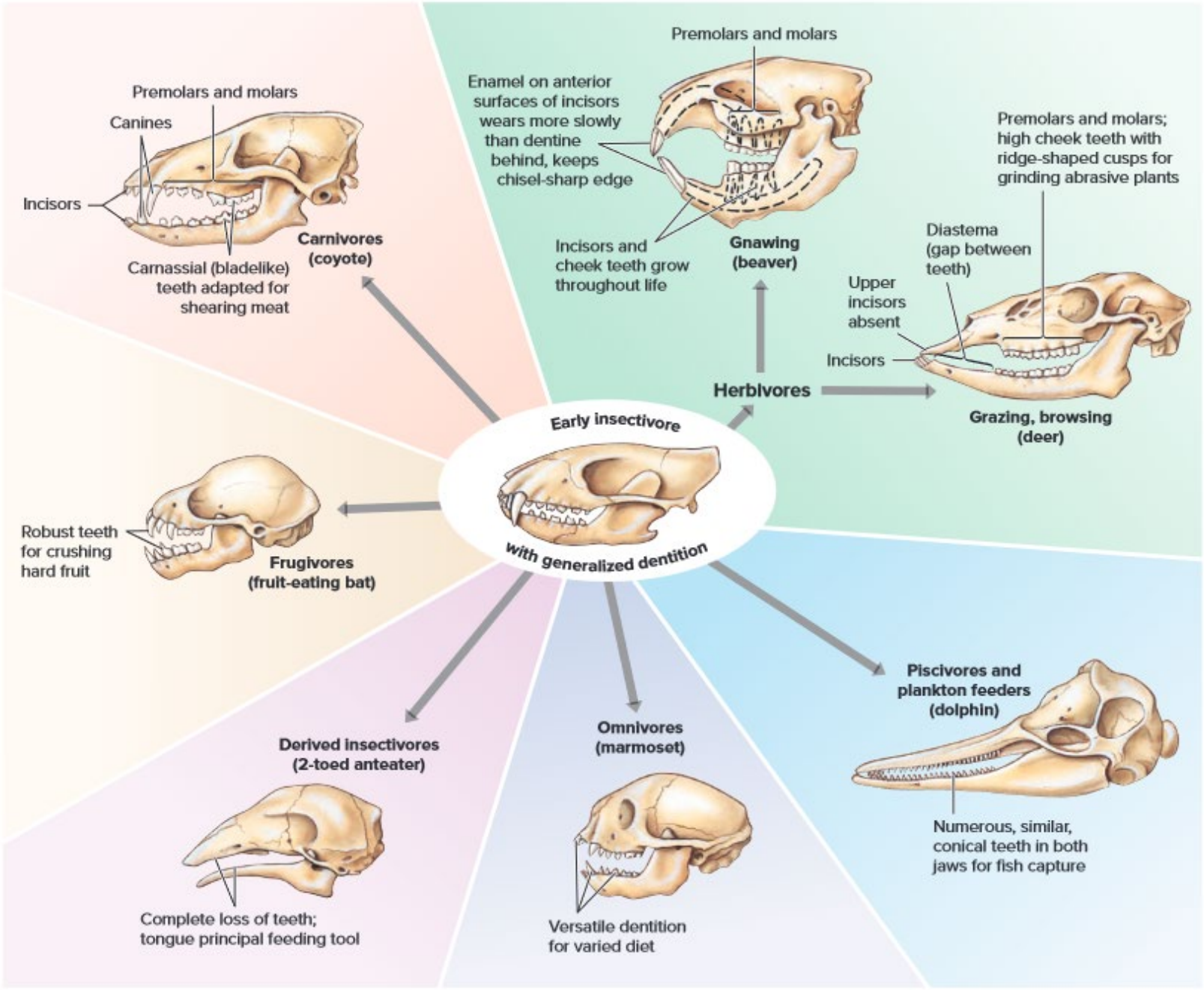
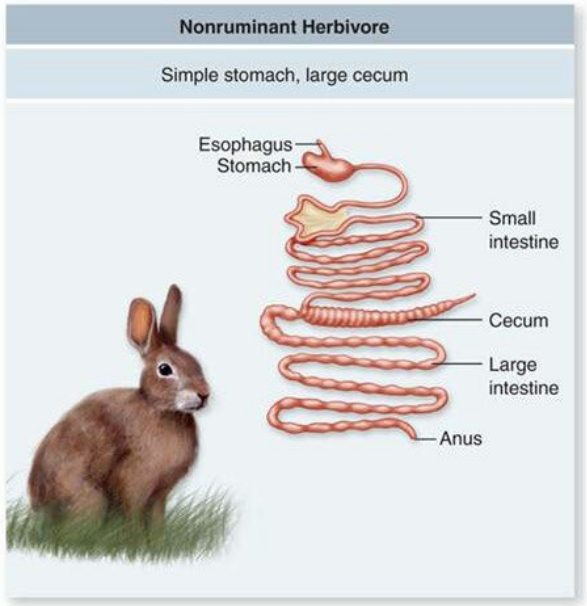


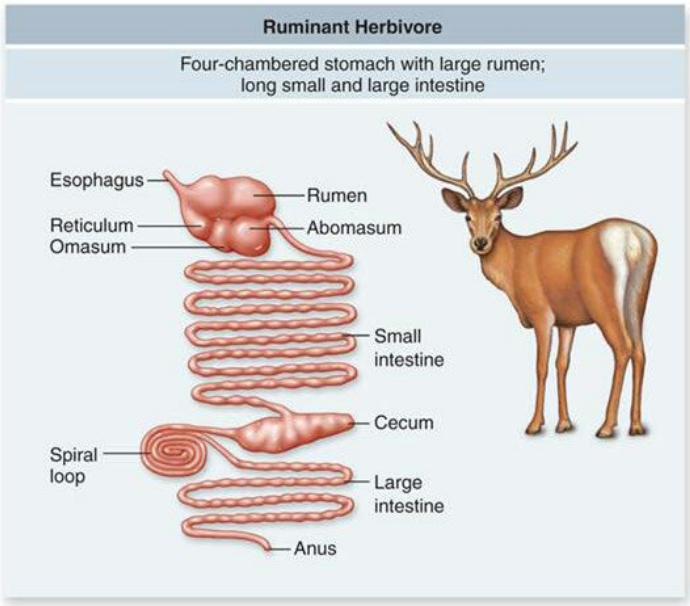

Figure 28.11 Feeding specializations of major trophic groups of placental (eutherian) mammals. Early placentals were insectivores; all other types are descended from them.

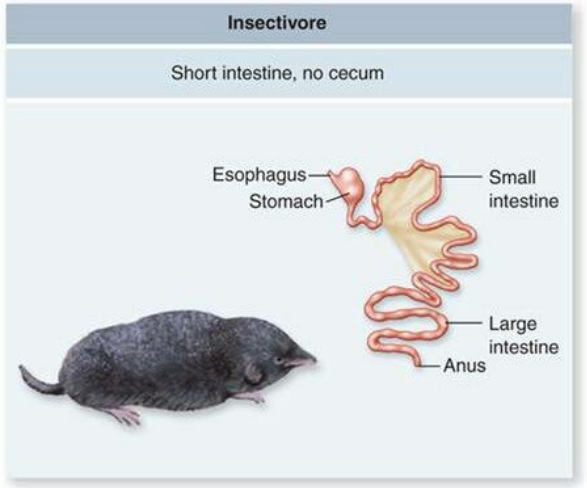
# Structural & Functional Adaptations of Mammals

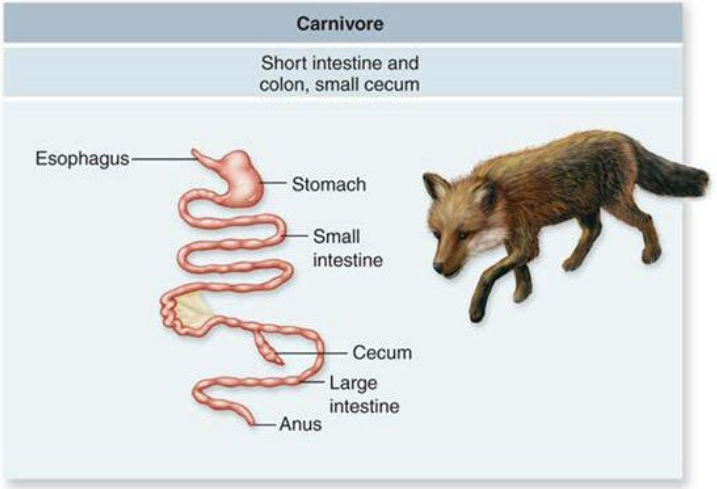
**Food & Feeding**

- Herbivore: cellulose breakdown, bacteria
- Coprophagy: eat fecal matter (nonruminant)
- Ruminant chew cud
- Insectivorous mammals are small
- feeding on insects and invertebrates -do not need prolonged fermentation
- So their intestinal tract is short
- Their teeth with pointed cusps to puncture the exoskeleton of prey
- Some are toothless



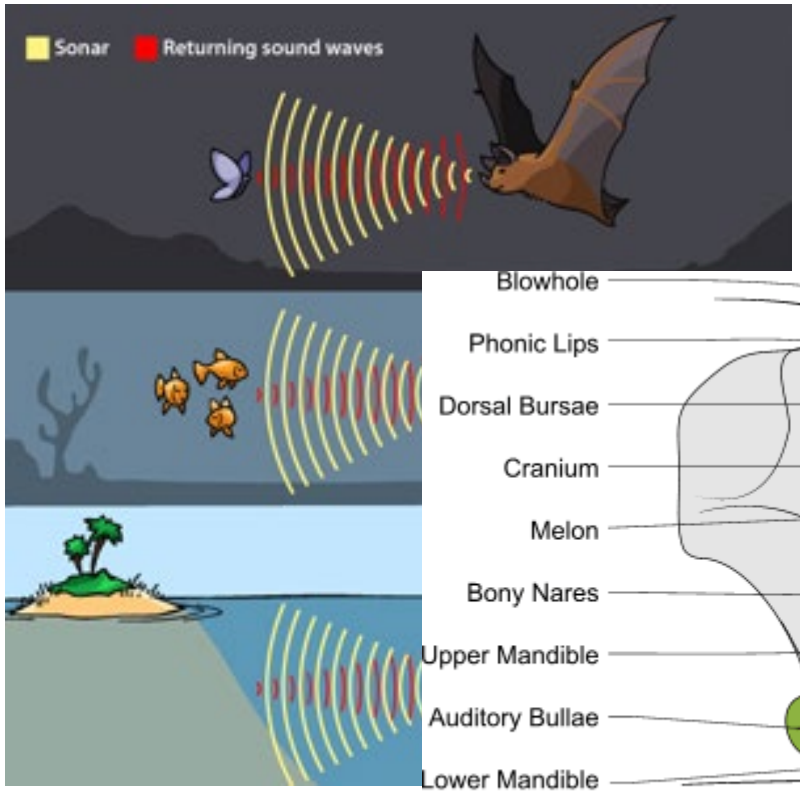



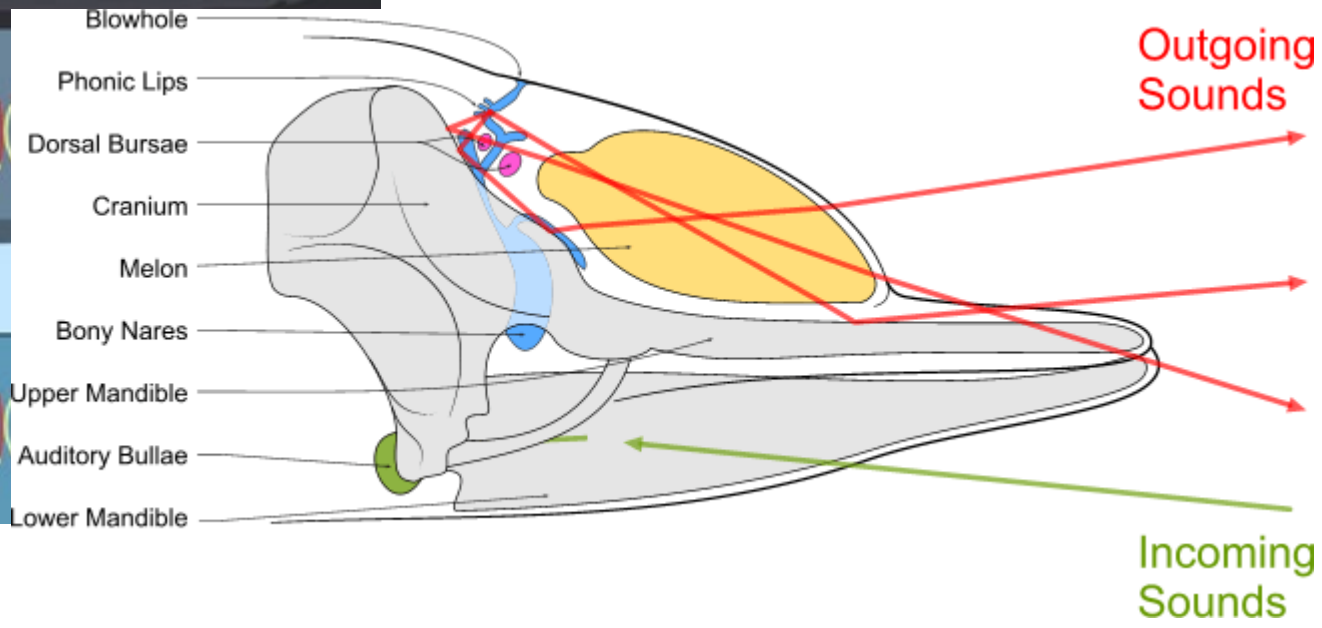
# Migration

Barren ground carribou
160 to 1100km
From Canada & Alaska

Seals & whales makes the longest mammalian migration.
Over 18 000km

# Echolocation



# Echolocation

- a physiological process for locating distant or invisible objects (such as prey) by sound waves reflected to the emitter (such as a bat) from the objects (https://www.merriam-webster.com/dictionary/echolocation)

# Reproductive cycles

Monestrous:

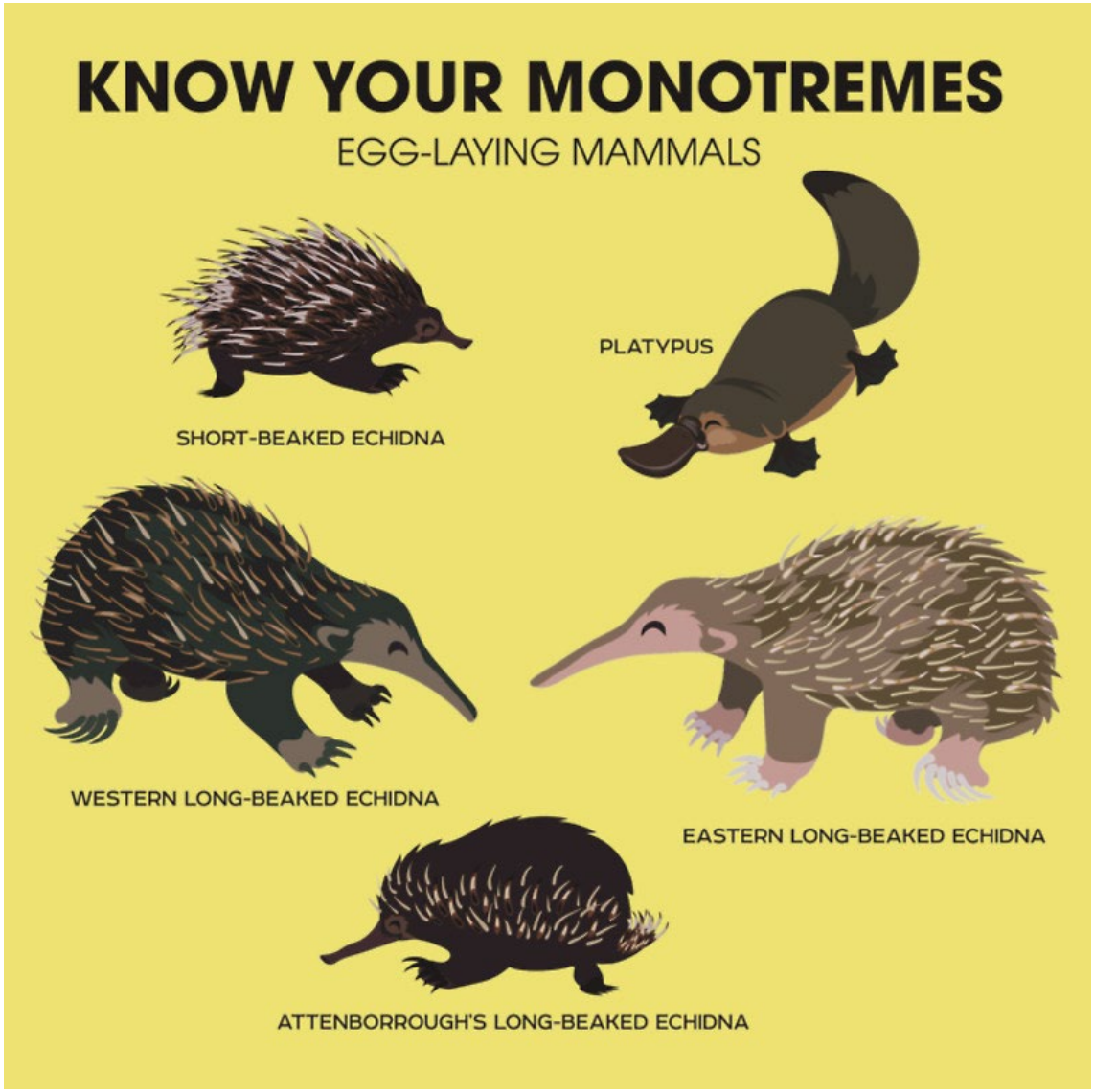
- Single oestrus event during breeding season
  [Dog, fox, bat]

Polyestrous

- Recurrence of oestrus events during breeding season
  [field mice, squirrels]

Menstruation cycle: Some monkeys and humans

# Reproductive patterns




**Monotremes:**

- Egg layer
- One breeding season per year
- Eggs hatch and incubated in abdominal pouch (Echidna)

- Milk from mother

# Reproductive patterns

There are about 300 species of **marsupials** in the world: of which 200 are native to Australia, Tasmania and New Zealand; 100 in Americas – most of them found in South America, and only one species 'Virginia opossum' is found in North America.

Top: Musky Rat-kangaroo , Brown Dorcopsis, Bilby. Bottom: Tammar Wallaby, Kangaroo, Tree Kangaroo, Koala.

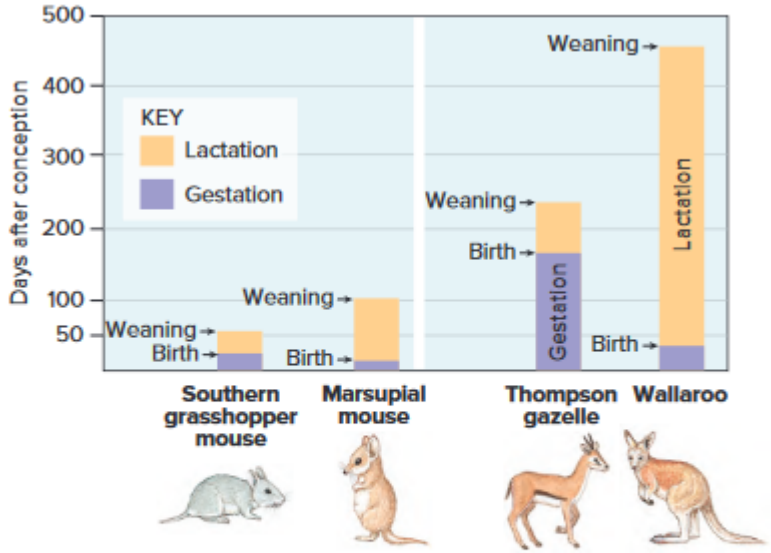
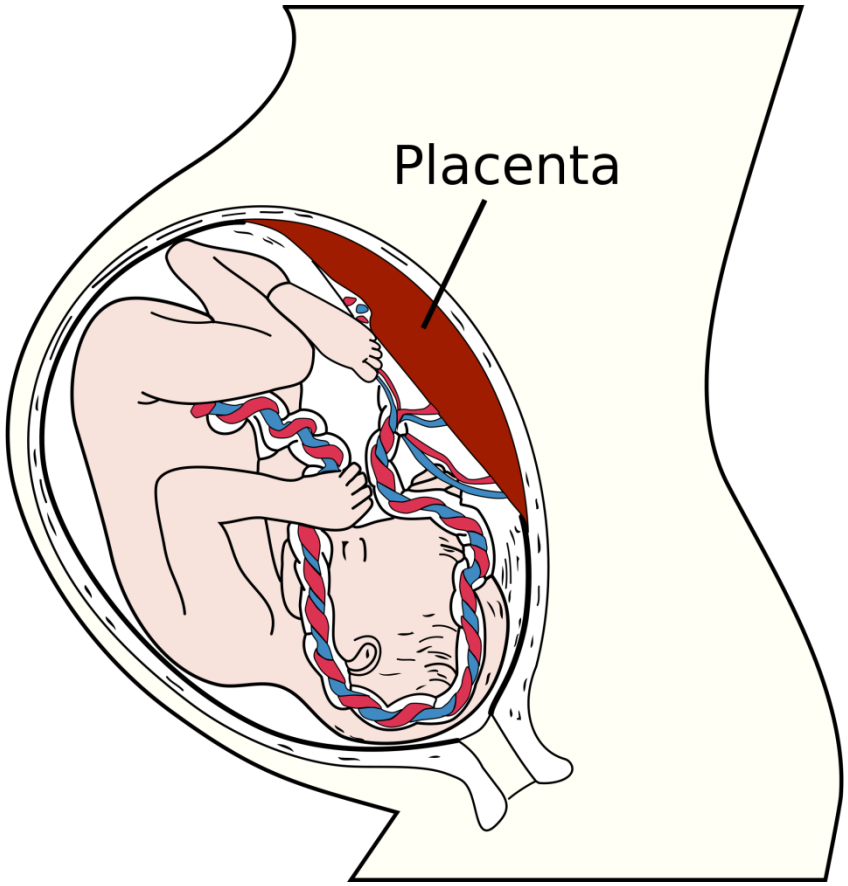



Figure 28.22 Comparison of gestation and lactation periods between matched pairs of ecologically similar species of marsupial and placental mammals. The graph shows that marsupials have shorter intervals of gestation and longer intervals of lactation than do similar species of placentals.

# Reproductive patterns

**Eutherians:**

- Placental mammals
- Prolong gestation period
- Embryos remain in uterus
- Nourished by food supplied by choriovitelline placenta
- Condition of young at birth differs
- Walking period



# Waiting for Baby


SOURCES: Restoring the Pacific Northwest; Exploring Mammals, Int'l Wildlife Encyclopedia; A Companion to Biological Anthropology; Mammalogy; Biology, Medicine, and Surgery of Elephants

S. Hess/ ©Oregon Zoo

# So since Intensive Course, we explored

- Carcinology: crustacea
- Entomology: insects
- Ichthyology: fishes
- Herpetology: amphibians and reptiles
- Ornithology: birds
- Mammalogy: mammals

# Bat diversity from Penang Hill

# Bat diversity from Penang Hill


Figure 1: Bat species captured during the Penang Hill BioBlitz 2017 at Moniot Road
Species: A= *Balionycteris maculata;* B= *Rhinolophus stheno;*
C= *Rhinolophus affinis;* D= *Rhinolophus pusillus;* E= *Hipposideros armiger*
F= *Hipposideros galeritus;* G= *Kerivoula hardwicki;* H= *Myotis muricola*

Table 1: List of bats recorded at Moniot Road, Penang Hill based on trapping and acoustic surveys conducted from 23 to 26 October 2017

| Family | Species | Common Name | No of captured individuals |
|---|---|---|---|
| Pteropodidae | *Balionycteris maculata** | Spotted-Wing Fruit Bat | 1 |
| Rhinolophidae | *Rhinolophus stheno* | Lesser Brown Horseshoe Bat | 19 |
| | *Rhinolophus affinis* | Intermediate Horseshoe Bat | 18 |
| | *Rhinolophus pusillus* | Least Horseshoe Bat | 6 |
| Hipposideridae | *Hipposideros galeritus* | Cantor's Roundleaf Bat | 12 |
| | *Hipposideros armiger* | Great Roundleaf Horseshoe Bat | 3 |
| Vespertilionidae | *Kerivoula hardwickii* | Hardwicke's Woolly Bat | 7 |
| | *Myotis muricola* | Whiskered Bat | 7 |
| | | **Total** | **73** |

Note: *new record for Penang island.

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# BAT SPECIES IN THE FORESTS RESERVES OF PENANG ISLAND AFTER 2010: WITH TWO MORE NEW RECORDS FILED

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**Abstract:** Bat communities in Old World tropical rainforests serve various ecological roles to sustain their habitats, yet may be vulnerable to the loss of their natural habitats. Moreover, the exact biological and ecological roles of the majority of the bats in Penang Island are still understudied. Therefore, we conducted surveys at four selected primary forest reserves (Bukit Genting, Penang National Park, Relau and Teluk Bahang) on Penang Island to determine the forest bat species currently living on the island. This study was conducted using harp traps and mist nets from February 2015 to August 2016. A total of 135 individuals, four families and 11 species of bats were caught with an average capture rate of 2.7 bats per harp-trap night and $4.05\times10^{-3}$ bats per mist-net metre square hour. *Cynopterus brachyotis* was the only Pteropodids species recorded and *Rhinolophus affinis* has the highest capture number in our surveys. Along with *Coelops frithii* reported earlier, two new species, namely *Myotis muricola* and *Phoniscus jagorii*, were documented for the first time in Penang Island, indicating that the forest bat community here is still undersurveyed. Our survey results suggested that the primary forests on Penang Island are valuable for bat conservation in terms of hosting uncommon forest species.

Keywords: Chiroptera, primary forests, tropical rainforests, insular bats, bat conservation.

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ORIGINAL ARTICLE

# Bats from the understorey of lowland tropical rainforests across Peninsular Malaysia

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Keywords: conservation, *Kelawar*, lowland evergreen, Peninsular Malaysia, tropical rainforest

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## ABSTRACT

To date, 110 bat species are recorded in Peninsular Malaysia. Many of these species depend upon tropical forests, which have rapidly decreased in extent over recent decades. Yet, updated information on species distributions in the region is still lacking. Here, we report bat species records and their distribution based from surveys undertaken at 30 lowland tropical rainforest sites across Peninsular Malaysia. We recorded 56 species from seven families. The three most abundant species across the peninsula were *Rhinolophus affinis*, *Hipposideros bicolor* complex and *Hipposideros cervinus*. Four out of nine singleton species (*Chironax melanocephalus*, *Coelops robinsoni*, *Myotis hermani* and *Hesperoptenus doriae*) are forest specialists that are patchily distributed across the peninsula, while another five are open space/edge species that utilise the forest occasionally. The understorey assemblage comprises frugivorous, insectivorous and nectar-drinking species. Thirteen percent of all captured species are represented by at least one record outside of their previous known distributional range. Furthermore, our study suggests that updated and informative species distribution is essential to further study these bat species since information on their ecology and basic natural history remains poorly known. An improved understanding of species ecology and population status will contribute to more effective conservation efforts. Our survey data provide comprehensive records of understorey forest bats in a biodiversity hotspot.

STAM Methods: Science and Technology of Advanced Materials: Methods
ACCELERATING DEVELOPMENT OF MATERIALS SCIENCE

# Peninsular Malaysia - Home to 110 bats species

**Researchers from University of Malaya and China Agricultural University painstakingly searched for all bats' records in Peninsular Malaysia and found records for 110 species. This first comprehensive list of bat species found in Peninsular Malaysia has been published in the scientific journal PLOS ONE recently.**

This Long-winged Tomb Bat (Taphazous longimanus) is a first record for Krau Wildlife Reserve, Peninsular Malaysia.

© VC Lim

Bats made up about 50% of mammal species in the tropical forests and 20% of mammal species worldwide. There are at least 1300 species of bats around the world, but the number of bat species in Peninsular Malaysia was previously unknown.

Though several lists of bat species have covered Peninsular Malaysia as part of a broader region (for example, the Indo-Pacific) or been assembled for particular locations in Peninsular Malaysia such as Krau Wildlife Reserve and Ulu Gombak Forest Reserve, no comprehensive list had been produced specifically for the entire Peninsular Malaysia. It is indeed important for the development of suitable conversation plans to know which species are present in Peninsular Malaysia and where they have been reported.

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Lim, V. C., Ramli, R., Bhassu, S., & Wilson, J. J. (2017). A checklist of the bats of Peninsular Malaysia and progress towards a DNA barcode reference library. PLOS ONE, 12(7),

# Human & the nature

**Nature can do without humans, but humans cannot exist without nature**


https://www.worldatlas.com/articles/countries-with-the-most-threatened-mammal-species.html

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