

Class Mammalia

Subclass Theria

Infraclass Metatheria: The Marsupials

A. Introduction.

1. Marsupials (or metatherians) are often characterized by the female's abdominal pouch, or marsupium, which gives rise to the common name of this group. This is a poor diagnostic feature, however, because not all marsupials have a marsupium (about 50% have a permanent pouch), and a pouch occurs in echidnas (a monotreme).
2. Marsupials are best distinguished from eutherians by their relatively small maternal energy investment in young prior to birth compared to eutherians.
 - a. No marsupials have litters that weigh >1% of the mother's body mass. In contrast, small eutherians, such as rodents and insectivores, may have litters that weigh 50% of the mother's body mass.
 - b. Maternal investment in lactation is much greater in marsupials, however, so by the time young are weaned, total investment in a litter may be similar between marsupials and eutherians of similar body mass. Renfree (1933) noted that "Marsupials have, in effect, exchanged the umbilical cord for the teat."
 - c. In addition to reproductive characteristics, marsupials differ from eutherians in many skeletal and anatomical features (see Table 10.1, page 172, in text).

B. Reproduction.

1. The marsupial reproductive tract.
 - a. Females have a bifurcated (paired) reproductive tract; 2 lateral vaginae are on either side of a medial vaginal canal, or sinus.
 - b. The 2 prongs of a male's penis probably are compatible with the corresponding lateral vaginae during copulation.
 - c. Following a short gestation period, parturition occurs through extension of the medial vaginal canal, not through the lateral vaginae.
2. The choriovitelline placenta.
 - a. The membranes of the choriovitelline placenta are less developed and provide less effective nutrient exchange from mother to fetus.
 - b. Villi absent.
 - c. Among marsupials, only the bandicoots and koala have chorioallantoic placentae.
 - d. Gestation is necessarily short because of relatively inefficient nutrient exchange and a weak structural connection between the fetus and the endometrium.
3. Paired sperm occur in the didelphids and caenolestids, a condition not found in any other mammal.
4. The marsupium.
 - a. Not all marsupials have a marsupium. Numbat, some New World possums, rat-possums, and many small marsupial mice do not have a pouch.

b. Pouches may open anteriorly or posteriorly.

C. Zoogeography.

1. Living marsupials occur in North America, Central and South America, and Australasia, which includes Australia, Tasmania, New Guinea, and surrounding islands.
2. The oldest fossil evidence of marsupials dates from the early Cretaceous of North America.
3. A diversity of marsupial fossil forms is known from South America by the late Cretaceous.
4. The current hypothesis of metatherian biogeography holds that marsupials originated in North America, dispersed to South America (where they underwent a spectacular radiation), moved across Antarctica and into Australia where they enjoyed a second radiation.

D. Taxonomy.

1. Wilson and Reeder (1993) recognized 7 orders and 18 extant families of marsupials. The first 3 orders listed below (Didelphimorphia, Paucituberculata, and Microbiotheria) all have a single family and occur in the New World. The remaining orders are Australasian in distribution.
2. New World marsupials.
 - a. Order Didelphimorphia.
 - 1) This order contains a single family Didelphidae, which includes 2 subfamilies: the Caluromyinae with 3 genera and 5 species, and the Didelphinae with 12 genera and 58 species.
 - 2) This order has been referred to as Ameridelphia reflecting its New World distribution.
 - 3) The only extant marsupial north of Mexico and the only marsupial in Arkansas, the Virginia opossum, is a didelphid.
 - 4) Didelphids are often referred to as "generalized;" they probably differ little in most respects from their Cretaceous ancestors.
 - 5) Skull characteristics.
 - a) Opossums have relatively long rostrums, a small braincase, and often, a prominent sagittal crest.
 - b) They have 5 upper and 4 lower incisors (that is, they are polyprotodont).
 - c) Their canines are large.
 - d) The dental formula is $5/4, 1/1, 3/3, 4/4 = 50$.
 - 6) Postcranial skeleton.
 - a) Their feet are not syndactylous, and the first toe of their hind feet (hallux) is partially opposable. All toes except the hallux have claws; the hallux has a nail.
 - b) The tail is prehensile and usually long and scaly.
 - 7) Most members of this group are omnivorous or carnivorous.

- 8) They can be found in most neotropical habitats from sea level to over 3000m, from dry thornscrub and grassland to tropical forest.
 - 9) Most are at least partially arboreal.
 - 10) Opossums are generally solitary, not interacting with conspecifics except to reproduce.
- b. Order Paucituberculata—the caenolestids (the “shrew” and “rat” opossums).
- 1) Today, this order of marsupials is represented by 1 small family of shrew-like animals, the Family Caenolestidae, which contains 3 genera and 5 species.
 - 2) Caenolestids are small, shrew-like animals with small eyes, and thick, gray or gray-brown pelage. The margin of each upper lip is interrupted by a distinctive flap of skin.
 - 3) They have a long rostrum, small eyes, and hind limbs longer than the forelimbs.
 - 4) The marsupium is absent.
 - 5) All caenolestids live in western South America.
 - 6) Their tails are long but not prehensile, and their feet are not syndactylous.
 - 7) Females lack a pouch.
 - 8) Skull characteristics.
 - a) Caenolestids have a rounded cranium, weak zygomatic arches, and a long and conical rostrum.
 - b) Each lower jaw has a large incisor that extends forward from the lower jaw (diprotodont), followed by 6 or 7 small and simple incisors, canines, and premolars, each separated by a space.
 - c) The upper canines are large stabbing teeth.
 - d) The first 3 upper molars have a hypocone (small on the third).
 - e) The dental formula is $4/3-4, 1/1, 3/3, 4/4 = 46$ or 48 .
 - 9) Caenolestids are believed to feed mostly on insects, but they have been seen to use their projecting lower incisors to repeatedly stab baby rodents (which they then ate).
 - 10) They forage in dense vegetation on the ground in dense, cold, and wet forests either at high elevations in the Andes or along the southern coast of Chile.
 - 11) The earliest members of this group are found in Oligocene faunas of South America. They were diverse in the Oligocene and Miocene.
- c. Order Microbiotheria.
- 1) Family Microbiotheriidae contains only 1 extant species, the monito del monte (*Dromiciops gliroides*).
 - 2) The order is known only from South America; currently, *Dromiciops* is found in the Andes of Chile and Argentina.
 - 3) While not diverse, microbiotheres are especially interesting because they may be more closely related to Australian marsupials than to any South American family.

- 4) *Dromiciops* is a small animal with a long, moderately prehensile tail and silky, dense pelage.
 - 5) Its ears are short and rounded.
 - 6) The tail is long and may serve as a site for storing fat to maintain the animal during hibernation.
 - 7) The pouch or marsupium is well developed.
 - 8) *Dromiciops* has a peculiar skull, especially compared to that of the didelphids (with which it was once classified).
 - a) The premaxillae is elongated; the nasals are expanded posteriorly; and paroccipital processes are absent.
 - b) The auditory bullae are unique: large, inflated, ossified, with the anterior third of the bullar wall formed by a large process of the alisphenoid.
 - c) The teeth are also unusual.
 - The upper and lower incisors are broad and spatulate.
 - The uppers form a semicircle or U-shaped dental arcade, while the lowers are splayed outward.
 - The cusps of the cheekteeth are low and rounded compared to those of didelphids.
 - The dental formula, however, is identical to that of the Didelphidae (5/4, 1/1, 3/3, 4/4 = 50), and like didelphids, *Dromiciops* is polyprotodont and not syndactylous.
 - 9) Monito del montes live in dense, humid vegetation in the mountains of southern Chile and Argentina. They have a special liking for thickets of bamboo.
 - 10) Monito del montes are primarily insectivorous, feeding in the trees as well as on the ground, but they may occasionally consume vegetation.
 - 11) The fossil genus *Microbiotherium* is known from the late Oligocene.
3. The Australasian marsupials.
- a. Order *Dasyuromorphia*—the Tasmanian wolf, Tasmanian devil, and numbats.
 - 1) Dasyuromorphs are said to be modern representatives of a sort of basal stock of australodelphian marsupials, from which other Australian families arose.
 - 2) They are not syndactylous, and they have 4/3 incisors (polyprotodont).
 - 3) This order contains 3 families.
 - a) Family *Thylacinidae*—the thylacine, or Tasmanian wolf.
 - b) Family *Myrmecobiidae*—numbats.
 - c) Family *Dasyuridae*—the Tasmanian devil.
 - b. Order *Peramelemorphia*—the bandicoots and bilbies.
 - 1) Peramelemorphs are terrestrial animals of small to medium size.
 - 2) They have long pointed heads and compact bodies.
 - 3) Their forearms are short and their hindlimbs relatively long.

- 4) The forefeet of most species are adapted for digging, with long forefeet and strong claws on second, third, and fourth toes.
- 5) The first and fifth toes are absent, or if present, small and lacking claws.
- 6) On the hindfeet, the fourth toe is largest.
- 7) Digits 2 and 3 are syndactylous, that is, they are joined except that they have separate claws.
- 8) Peramelemorphs usually move by hopping.
- 9) They are considered to be among the polyprotodont marsupials, and the combination of syndactylous feet and polyprotodont incisors defines them.
- 10) Dentition.
 - a) Their incisors are flattened at the tips, not pointed as they are in the other main group of polyprotodonts, the dasyuromorphs.
 - b) The crown of the last lower incisor is bilobed. Peramelemorphs have well-developed canines, 3 upper and 3 lower premolars, and 4 upper and 4 lower molars.
 - c) The third upper premolar is larger than the second.
 - d) The premolars have a generally blade-like, slicing shape (plagialacoid), while the molars are tritubercular or quadrate.
- 11) The diet of bandicoots and bilbies is made up mostly of insects, but they also eat lots of plant material, and sometimes also rodents and lizards. Most species forage by rooting or digging about in the ground.
- 12) An unusual feature of peramelemorphs is that they have chorioallantoic placentae.
- 13) A marsupium is present and opens to the rear.
- 14) Peramelemorphs are found in a wide range of habitats in Australia and New Guinea.
- 15) Two families are represented.
 - a) Family Peramelidae—bandicoots and bilbies.
 - b) Family Peroryctidae—spiny bandicoots, mouse bandicoot.
- c. Order Diprotodontia—the kangaroos, koala, wombats, pigmy possums, and numerous other primarily herbivorous marsupials.
 - 1) They can be distinguished from other metatheres because they are both syndactylous (digits 2 and 3 of the hind feet are fully fused except for the claws) and diprotodont (a single pair of incisors dominates the lower jaw, although sometimes an additional pair is present).
 - 2) Most diprotodonts have 3 pairs of incisors in their upper jaws, but this number is reduced to 1 pair in 1 family, the wombats.
 - 3) Diprotodonts lack lower canines. Upper canines are present, but they vary in shape from low and smooth to having many sharp, curved ridges (selenodont or lophodont).

- 4) Most diprotodonts are herbivores, but some have secondarily returned to being insectivorous, and others have become specialized for feeding on sap and nectar.
- 5) A number of species of diprotodonts are important economically, as a source of meat and leather, or as competitors with domestic livestock.
- 6) The diprotodonts, with 10 families including 117 species, make up the largest order of marsupials.
 - a) Family Phascolarctidae—koala.
 - b) Family Vombatidae—wombats.
 - c) Family Phalangeridae—brush-tail possums.
 - d) Family Potoroidae—potoroos, bettongs, and the musky rat-kangaroo.
 - e) Family Macropodidae—kangaroos.
 - f) Family Burramyidae—pygmy-possums.
 - g) Family Acrobatidae—feather-tailed glider.
 - h) Family Pseudocheiridae—rock ringtail possum.
 - i) Family Petauridae—striped possums.
 - j) Family Tarsipedidae—honey possum.
- d. Order Notoryctemorphia—the marsupial mole.
 - 1) This order of metatherians contains 2 species, the marsupial moles (*Notoryctes caurinus* and *N. typhlops*; the status of *N. caurinus* has been questioned).
 - 2) Marsupial moles are astonishingly like eutherian golden moles (Insectivora, Chrysochloridae) in size and shape, and in the silky, iridescent texture and appearance of their fur.
 - 3) They have vestigial, functionally blind eyes that lack lens and pupil.
 - 4) They also have no external ears.
 - 5) Their snouts are covered by a horny shield, and their short and stout tails are also encased in leathery skin.
 - 6) The foreclaws are modified to be like miniature spades, with the third and fourth digits of the forefeet greatly enlarged and bearing enormous triangular claws.
 - 7) They do not appear to be syndactylous.
 - 8) The last 5 cervical vertebrae are fused, apparently to brace the neck when the animal pushes against the soil with its head. These animals “swim” through the soil, leaving no permanent burrow.
 - 9) The teeth of the marsupial moles appear degenerate. They are neither fully polyprotodont nor diprotodont.
 - 10) The dental formula varies somewhat, but it is usually around $4-3/3, 1/1, 2/3, 4/4 = 40-44$.
 - 11) The upper molars are zalambdodont, and the lower molars have lost their talonid basins.
 - 12) Marsupial moles feed on invertebrate larvae.

- 13) They are active day and night, and they often forage on the surface as well as beneath the ground.
- 14) The marsupium is small but well developed.
- 15) The phylogenetic relationships of marsupial moles remain uncertain. Biochemically, they do not appear to be close to any other marsupial.