



Omnivorous Animals

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Introduction



Ravens are omnivores.

Omnivores (from Latin: *omni* all, everything; *vorare* to devour) are species that eat both plants and animals as their primary food source. They are opportunistic, general feeders not specifically adapted to eat and digest either meat or plant material primarily.

Omnivory has evolved several times among different groups of animals. The first vertebrates were piscivores, then insectivores, carnivores and finally herbivores. A complex set of adaptations was necessary for feeding on highly fibrous plant materials, requiring structural modifications to the teeth, jaws, and digestive tract. Only a small proportion of extant tetrapods are obligate herbivores; many carnivores also consume

low-fiber plant material as well as insects and fish, so it could be that early tetrapods made the transition to fully fledged herbivory by way of omnivory.

Definition

Although the term *omnivore* literally means *eater of everything*, omnivores cannot really eat "everything" that other animals eat; they can only eat things that are at least moderately easy to get and still at least moderately nutritious. For example, most of them cannot live by grazing (easy to get, but not nutritious enough), nor can they eat some hard-shelled animals or successfully hunt large or fast prey (nutritious, but too hard to get).

Omnivorous species

Although there are cases of herbivores eating meat matter, as well as examples of carnivores eating plants, the classification refers to the adaptations and main food source of the species in general, so these exceptions do not make either individual animals nor the species as a whole omnivores.

Pigs furnish a well-known example of an omnivore. Crows are another example of an omnivore that many people see every day. Humans are regarded as omnivores.

Most bear species are considered omnivores, but individual diets can range from almost exclusively herbivorous to almost exclusively carnivorous, depending on what food sources are available locally and seasonally. Polar bears are classified as carnivores while pandas are classified as herbivores, although giant pandas will eat some meat (e.g., insects) from time to time, and polar bears will sometimes eat plants (such as kelp) but of neither is the exception a significant part of their diet.

Various mammals are omnivorous by nature, such as pigs, badgers, bears, coatis, hedgehogs, opossums, skunks, sloths, squirrels, raccoons, chipmunks, mice and rats. Also some primates are omnivorous including humans and chimpanzees. Various birds are omnivorous, whose diet varies from berries and nectar to insects, worms, fish, and small rodents; examples include cassowarys, chickens, crows and related corvids, keas, rallidae, and rheas. In addition, some lizards, turtles, fish, such as piranhas, and invertebrates are also omnivorous.

While virtually all mammals may display "omnivorous" behavior patterns - depending on conditions of supply, culture, etc - mammals will generally prefer one class of food or another, with optimized digestive processes. Like most arboreal species, most squirrels are primarily granivores, preferring nuts and seeds. but as with virtually all mammals, squirrels can resort to consuming some meat as fallback food if starving or facultatively, e.g., when nests are in danger of being raided by predators, etc.

Depending on the species of bear, there is generally a preference for one class of food or another as plants and animals are digested differently.

While scientific classification aims to promote communication and analysis of various differences and similarities between species, the concept of an "omnivore" is broad and could be applied to virtually any mammal since disease risks and the quality of digestion are often not considered. There are social, psychological and non-nutritive factors that influence diet behavior. "[T]he behavioral basis of omnivory has not been thoroughly explored... and food selection behavior is central to understanding the causes and consequences of omnivory. However, few studies have actually addressed this issue through rigorous tests of multiple hypotheses."

In order for the concept of "omnivore" to be regarded as a scientific classification, some clear set of measurable and relevant criteria would need to be considered to differentiate between an "omnivore" and the other vague but less ambiguous diet categories e.g., faunivore, folivore, scavenger, etc.

Chapter 1

Pig



A domestic sow and her piglet.

Scientific classification

Kingdom:	Animalia
Phylum:	Chordata
Class:	Mammalia
Subclass:	Theria
Infraclass:	Eutheria
Order:	Artiodactyla
Family:	Suidae
Subfamily:	Suinae
Genus:	<i>Sus</i> Linnaeus, 1758

A **pig** is any of the animals in the genus ***Sus***, within the Suidae family of even-toed ungulates. Pigs include the domestic pig, its ancestor the wild boar, and several other wild relatives. Pigs are omnivores and are highly social and intelligent animals.

Description and behavior

A typical pig has a large head with a long snout which is strengthened by a special prenasal bone and by a disk of cartilage at the tip. The snout is used to dig into the soil to find food and is a very acute sense organ. There are four hoofed toes on each foot, with the two larger central toes bearing most of the weight, but the outer two also being used in soft ground.

The dental formula of adult pigs is 3.1.4.3 in each jaw, giving a total of 44 teeth. The rear teeth are adapted for crushing. In the male the canine teeth form tusks, which grow continuously and are sharpened by constantly being ground against each other.

Distribution

With around 2 billion individuals alive at any time, the domesticated pig is one of the most numerous large mammals on the planet.

The ancestor of the domesticated pig is the wild boar, which is one of the most numerous and widespread large mammals. Its many subspecies are native to all but the harshest climates of continental Eurasia and its islands, from Ireland and India to Japan and north to Siberia. Although it has been exterminated in some areas, its numbers are stable or even increasing rapidly, in most of its native range.

Long isolated from other pigs on the many islands of Indonesia, Malaysia, and the Philippines, pigs have evolved into many different species, including wild boar, bearded pigs, and warty pigs. Humans have introduced pigs into Australia, North and South America, and numerous islands, either accidentally as escaped domestic pigs which have gone feral, or as wild boar. These have typically adapted well, and are increasing in number and broadening their range outside human control.

Diet and foraging

Pigs are omnivores, which means that they consume both plants and animals. In the wild, they are foraging animals, primarily eating leaves, grasses, roots, fruits and flowers. In confinement pigs are fed mostly corn and soybean meal with a mixture of vitamins and minerals added to the diet.

Relationship with humans

Domesticated pigs are commonly raised as livestock by farmers for meat (called pork), as well as for leather. Their bristly hairs are also used for brushes. Some breeds of pig, such as the Asian pot-bellied pig, are kept as pets.

Pigs that are allowed to forage may be watched by swineherds. Because of their foraging abilities and excellent sense of smell, they are used to find truffles in many European countries.

Both wild and feral pigs are commonly hunted.

Species



Sus barbatus (Bearded Pigs)

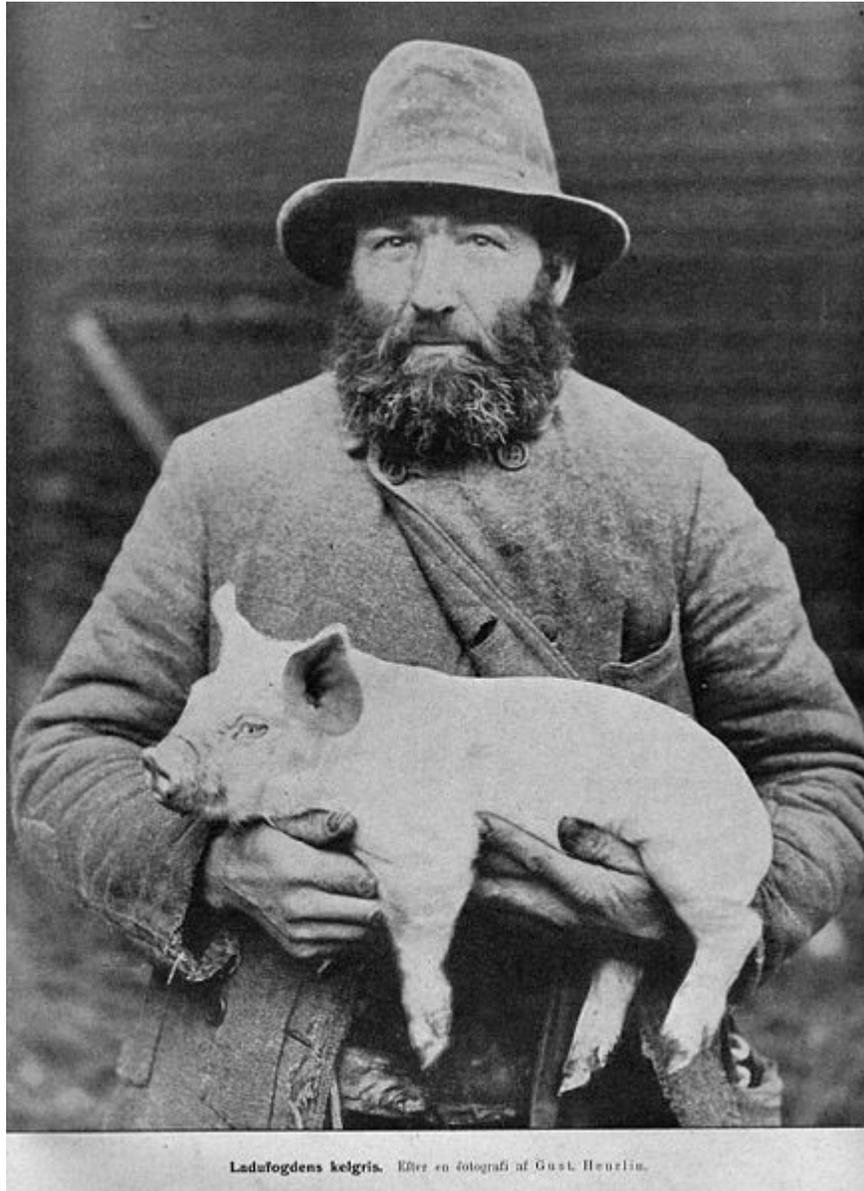
The genus *Sus* is currently considered to have 10 living species and a number of extinct species known as fossila:

- *Sus ahoenobarbus* - Palawan Bearded Pig Huet, 1888
- †*Sus australis* - Early Pleistocene of China Han, 1987
- *Sus barbatus* - Bearded Pig Müller, 1838
- †*Sus bijiashanensis* - Early Pleistocene of China Han *et al*, 1975
- *Sus bucculentus* - Heude's Pig or Indo-Chinese (or Vietnam) Warty Pig Heude, 1892
- *Sus cebifrons* - Visayan Warty Pig Heude, 1888
- *Sus celebensis* - Celebes Warty Pig or Sulawesi Warty Pig Müller & Schlegel, 1843
- *Sus domestica* or *Sus scrofa domestica* - Domestic pig Linnaeus, 1758
- †*Sus falconeri* - Pleistocene of the Siwalik region, India
- †*Sus houi* - Pleistocene of China Qi *et al*, 1999
- †*Sus hysudricus*

- †*Sus jiaoshanensis* - Early Pleistocene of China Zhao, 1980
- †*Sus liuchengensis* - Early Pleistocene of China Han, 1987
- †*Sus lydekkeri* - Pleistocene of China Zdansky, 1928
- †*Sus offecinalis* - China Koenigswald, 1933
- *Sus oliveri* - Oliver's Warty Pig or Mindoro Warty Pig Groves, 1997
- †*Sus peii* - Early Pleistocene of China Han, 1987
- *Sus philippensis* - Philippine Warty Pig Nehring, 1886
- *Sus scrofa* - Wild Boar Linnaeus, 1758
- †*Sus subtriquetra* - Xue, 1981
- †*Sus strozzi*
- *Sus verrucosus* - Java Warty Pig Müller, 1840
- †*Sus xiaozhu* - Early Pleistocene of China Han *et al*, 1975

The Pygmy Hog, formerly *Sus salvanius* is now placed in the monotypic genus *Porcula*.

Domestic pigs



Swedish pigfarmer with piglet. Early 20th century

Pigs have been domesticated since ancient times in the Old World. Archeological evidence suggests that pigs were being managed in the wild in a way similar to the way they are managed by some modern New Guineans from wild boar as early as 13,000–12,700 BP in the Near East in the Tigris Basin. Remains of pigs have been dated to earlier than 11,400 BP in Cyprus that must have been introduced from the mainland which suggests domestication in the adjacent mainland by then. A separate domestication also occurred in China.

In India pigs have been domesticated since a long time mostly in Goa and some rural areas for pig toilets. Though ecologically logical as well as economical pig toilets are waning in popularity as use of septic tanks and/or sewerage system is increasing in rural areas.

Pigs were brought to southeastern North America from Europe by Hernando de Soto and other early Spanish explorers. Pigs are particularly valued in China and on certain oceanic islands, where their self-sufficiency allows them to be turned loose, although the practice is not without its drawbacks. With managed rotational grazing techniques pigs can be raised in an environmentally sound manner on pasture much like grazing sheep, goats and cows without high grain inputs.

The domestic pig (*Sus scrofa domesticus*) is usually given the scientific name *Sus scrofa*, although some authors call it *S. domesticus*, reserving *S. scrofa* for the wild boar. It was domesticated approximately 5,000 to 7,000 years ago. Their coats are coarse and bristly. They are born brownish colored and tend to turn more grayish colored with age. The upper canines form sharp distinctive tusks that curve outward and upward. Compared to other artiodactyles, their head is relatively long, pointed, and free of warts. Their head and body length ranges from 0.9 to 1.8 m and they can weigh between 50 and 350 kg.

Pigs are intelligent and can be trained to perform numerous tasks and tricks. Recently, they have enjoyed a measure of popularity as house pets, particularly the dwarf breeds.

Cultural and religious reference to pigs

Pigs are frequently referenced in culture and religion and are a popular topic for idioms and famous quotes.

Environmental impacts

Domestic pigs that have escaped from farms or were allowed to forage in the wild, and in some cases wild boars which were introduced as prey for hunting, have given rise to large populations of feral pigs in North and South America, Australia, New Zealand, Hawaii, and other areas where pigs are not native. Accidental or deliberate releases of pigs into countries or environments where they are an alien species have caused extensive environmental change. Their omnivorous diet, aggressive behaviour, and their feeding method of rooting in the ground all combine to severely alter ecosystems unused to pigs. Pigs will even eat small animals and destroy nests of ground nesting birds. The Invasive Species Specialist Group lists feral pigs on the list of the world's 100 worst invasive species and says:



Feral pigs (razorbacks) in Florida

“ Feral pigs like other introduced mammals are major drivers of extinction and ecosystem change. They have been introduced into many parts of the world, and will damage crops and home gardens as well as potentially spreading disease. They uproot large areas of land, eliminating native vegetation and spreading weeds. This results in habitat alteration, a change in plant succession and composition and a decrease in native fauna dependent on the original habitat. ”

Health issues

Pigs can harbour a range of parasites and diseases that can be transmitted to humans. These include trichinosis, *Taenia solium*, cysticercosis, and brucellosis. Pigs are also known to host large concentrations of parasitic ascarid worms in their digestive tract. The presence of these diseases and parasites is one reason pork meat should always be well cooked or cured before eating. Today, trichinellosis infections from eating pork are relatively uncommon, at least in the United States, due to more stringent health laws, better refrigeration and public awareness of the dangers of eating undercooked meat. Some religious groups that consider pork unclean refer to these issues as support for their views.

Pigs are susceptible to bronchitis and pneumonia. They have small lungs in relation to body size; for this reason, bronchitis or pneumonia can kill a pig quickly. There is concern that pigs may allow animal viruses such as influenza or Ebola Reston to infect

humans more easily. Some strains of influenza are endemic in pigs, and pigs also can acquire human influenza.

Pigs can be aggressive and pig-induced injuries are relatively common in areas where pigs are reared or where they form part of the wild or feral fauna.

Chapter 2

Badger

Badger



European badger

Scientific classification

Kingdom:	Animalia
Phylum:	Chordata
Class:	Mammalia
Order:	Carnivora
Suborder:	Caniformia
Superfamily:	Musteloidea
Family:	Mustelidae
	Melinae
Subfamily:	Mellivorinae
	Taxidiinae

Genera

Arctonyx
Melogale
Meles
Mellivora
Taxidea

Badgers are short-legged, heavy-set omnivores in the weasel family, Mustelidae. There are eight species of badger, in three subfamilies: Melinae (badgers of Europe and Asia), Mellivorinae (the Ratel or honey badger), and Taxideinae (the American badger). The Asiatic stink badgers of the genus *Mydaus* were formerly included in the Melinae and Mustelidae, but recent genetic evidence indicates that these are actually members of the skunk family, placing them in the taxonomic family Mephitidae.

Badgers include the species in the genera *Meles*, *Arctonyx*, *Taxidea* and *Mellivora* species. Their lower jaw is articulated to the upper by means of a transverse condyle firmly locked into a long cavity of the cranium, so that dislocation of the jaw is all but impossible. This enables the badger to maintain its hold with the utmost tenacity, but limits its jaw movement to hinging open and shut, or sliding from side to side without the twisting movement possible for the jaws of most mammals.

Etymology



An American badger adult female, or sow

The word *badger* originally applied to the European badger (*Meles meles*). Its derivation is uncertain. It possibly comes from the French word *bêcheur* (digger) The Oxford English Dictionary states it probably derives from *badge* + *-ard*, referring to the white mark borne like a badge on its forehead. It is possibly related to the Romanian *viezure* ("badger"), a word of uncertain etymology, believed to be inherited from

Dacian/Thracian and related to the Albanian *vjedhullë* ("badger", "thief") and *vjeth* ("to steal"), and the Slavic *jazvrŭ* ("hedgehog"; cf. Serbian *javazac* "badger"). The less common name *brock* (Old English: *brocc*), (Scots: *brock*) is a Celtic loanword (cf. Gaelic *broc* and Welsh *broch*, from Proto-Celtic **brokko*) meaning *grey*. The Proto-Germanic term was **pahsu-* (cf. German *Dachs*, Dutch *das*, Norwegian *svin-toks*; Early Modern English: *dasse*), probably from the PIE root **tek'-* "to construct," so that the badger would have been named after its digging of setts (tunnels).

A male badger is a boar, a female is a sow and a young badger is a cub. A collective name suggested for a group of badgers is a cete, but badger colonies are more often called clans. Badger dens are called setts.

Classification

The following list shows where the various badger species are placed in the Mustelidae classification.

- **Family Mustelidae**
 - **Subfamily Melinae**
 - **Genus *Arctonyx***
 - Hog Badger, *Arctonyx collaris*
 - *Arctonyx albogularis*
 - *Arctonyx hoevenii*
 - **Genus †*Enhydritherium***
 - Giant Florida Sea Otter, *Enhydritherium terraenovae*
 - **Genus †*Satherium***
 - *Satherium piscinarium* (Hagerman's Otter)
 - **Genus *Melogale***
 - Burmese Ferret-badger, *Melogale personata*
 - Javan Ferret-badger, *Melogale orientalis*
 - Chinese Ferret-badger, *Melogale moschata*
 - Bornean Ferret-badger, *Melogale everetti*
 - **Genus *Meles***
 - Japanese Badger, *Meles anakuma*
 - Asian Badger, *Meles leucurus*
 - European Badger, *Meles meles*
 - **Subfamily Mellivorinae**
 - Honey Badger or Ratel, *Mellivora capensis*
 - **Subfamily Taxideinae:**
 - †*Chamitataxus avitus*
 - †*Pliotaxidea nevadensis*
 - †*Pliotaxidea garberi*
 - American Badger, *Taxidea taxus*
 - **Subfamily Mustelinae**
 - *Includes: weasels, martens, polecats and allies*

- **Family Mephitidae**
 - **Genus *Mydaus***
 - Indonesian or Sunda Stink Badger (Teledu), *Mydaus javanensis*
 - Palawan Stink Badger, *Mydaus marchei*

Distribution

Badgers are found in much of North America, Ireland, Great Britain and most of Europe as far as southern Scandinavia. They live as far east as Japan and China. The Javan Ferret badger lives in Indonesia.

Behavior

The behavior of badgers differs by family, but all shelter underground, living in burrows called setts which may be very extensive. Some are solitary, moving from home to home, while others are known to form clans. Clan size is variable from 2 to 15. Badgers can be fierce animals and will protect themselves and their young at all costs. Badgers are capable of fighting off much larger animals such as wolves and bears. Honey badgers in Africa have been known to fend off multiple lions, hyenas and other dangerous top tier carnivores. The many venomous snakes in Africa are also consumed with ease by the ferocious African Honey Badger. Badgers can run or gallop at up to 25–30 kilometres per hour (16–19 mph) for short periods of time.

In North America, coyotes sometimes eat badgers and vice versa, but the majority of their interactions seem to be mutual or neutral. American badgers and coyotes have been seen hunting together, in a cooperative fashion.

Diet

The diet of the Eurasian badger consists largely of earthworms, insects, and grubs. They also eat small mammals, amphibians, reptiles and birds as well as roots and fruit. Indeed, in southern Spain, badgers mostly feed on rabbits. The honey badger of Africa consumes honey, porcupines and even venomous snakes (such as the puff adder). They will climb trees to gain access to honey from bees' nests. American Badgers are fossorial carnivores. Unlike many carnivores that stalk their prey in open country, badgers catch most of their food by digging. They can tunnel after ground-dwelling rodents with amazing speed.

Badgers have been known to become intoxicated with alcohol after eating rotting fruit.

Chapter 3

Sloth



Brown-throated Three-toed Sloth
(*Bradypus variegatus*)
Gatun Lake, Republic of Panama.

Conservation status



Data Deficient (IUCN 3.1)

Scientific classification

Kingdom: Animalia

Phylum: Chordata

Class: Mammalia

Subclass: Theria

Infraclass: Eutheria

Superorder: Xenarthra

Order: Pilosa

Folivora

Suborder: Delsuc, Catzeflis, Stanhope, and
Douzery, 2001

Families

Bradypodidae

Megalonychidae

†Megatheriidae

†Mylodontidae

†Nothrotheriidae

†Orophodontidae

†Scelidotheriidae

Sloths are the six species of medium-sized mammals belonging to the families Megalonychidae and Bradypodidae, part of the order Pilosa. They are arboreal residents of the rainforests of Central and South America. The sloth's taxonomic suborder is **Folivora**, while some call it **Phyllophaga**. Both names mean "leaf-eaters"; derived from Latin and Greek respectively. Names for the animals used by tribes in Ecuador include **Ritto**, **Rit** and **Ridette**, mostly forms of the word "sleep", "eat" and "dirty" from Tagaeri tribe of Huaorani.

Ecology



Feeding Brown-throated Three-toed Sloth (*Bradypus variegatus*), Cahuita National Park, Costa Rica

Sloths are classified as folivores as the bulk of their diet consists mostly of buds, tender shoots, and leaves, mainly of *Cecropia* trees. Some two-toed sloths have been documented as eating insects, small reptiles and birds as a small supplement to their diet. Linnaeus's Two-toed Sloth has recently been documented eating human feces from open latrines. They have made extraordinary adaptations to an arboreal browsing lifestyle. Leaves, their main food source, provide very little energy or nutrition and do not digest easily. Sloths therefore have very large, specialized, slow-acting stomachs with multiple compartments in which symbiotic bacteria break down the tough leaves. As much as two-thirds of a well-fed sloth's body-weight consists of the contents of its stomach, and the digestive process can take a month or more to complete.

Even so, leaves provide little energy, and sloths deal with this by a range of economy measures: they have very low metabolic rates (less than half of that expected for a mammal of their size), and maintain low body temperatures when active (30–34 °C or 86–93 °F), and still lower temperatures when resting.

Although unable to survive outside the tropical rainforests of South and Central America, within that environment sloths are outstandingly successful creatures: they can account for as much as half the total energy consumption and two-thirds of the total terrestrial mammalian biomass in some areas. Four of the six living species are presently rated

"least concern"; the Maned Three-toed Sloth (*Bradypus torquatus*), which inhabits Brazil's dwindling Atlantic Forest, is classified as "endangered", while the island-dwelling Pygmy Three-toed Sloth (*B. pygmaeus*) is critically endangered. The ongoing destruction of South America's forests, however, may soon prove a threat to other sloth species.

Physiology

Sloth furs exhibit specialized functions: the outer hairs grow in a direction opposite from that of other mammals. In most mammals hairs grow toward the extremities, but because sloths spend so much time with their legs above their bodies, their hairs grow away from the extremities in order to provide protection from the elements while the sloth hangs upside down. In most conditions, the fur hosts two species of symbiotic cyanobacteria, which provide camouflage. Because of the cyanobacteria, sloth fur is a small ecosystem of its own, hosting many species of non-parasitic insects. Sloths have short, flat heads; big eyes; a short snout; long legs; and tiny ears. They also have stubby tails, usually 6–7 cm long. Altogether, sloths' bodies usually are anywhere between 50 and 60 cm long.

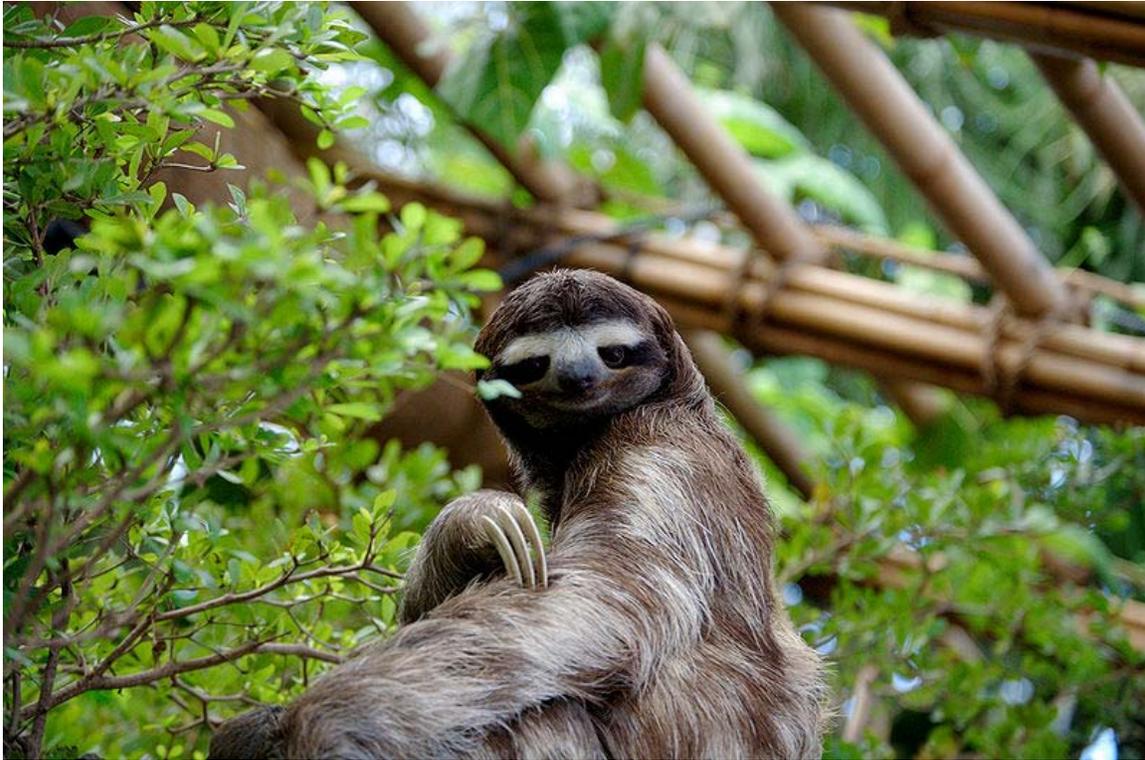
Sloths' claws serve as their only natural defense. A cornered sloth may swipe at its attackers in an effort to scare them away or wound them. Despite sloths' apparent defenselessness, predators do not pose special problems: sloths blend in with the trees and, moving only slowly, do not attract attention. Only during their infrequent visits to ground level do they become vulnerable. The main predators of sloths are the jaguar, the harpy eagle, and humans. The majority of recorded sloth deaths in Costa Rica are due to contact with electrical lines and poachers. Despite their adaptation to living in trees, sloths make competent swimmers. Their claws also provide a further unexpected deterrent to human hunters: when hanging upside-down in a tree they are held in place by the claws themselves and often do not fall down even if shot from below.



Pale-throated Three-toed Sloth (*Bradypus tridactylus*) in a Costa Rican rehabilitation center

Sloths move only when necessary and even then very slowly: they have about a quarter as much muscle tissue as other animals of similar weight. They can move at a marginally higher speed if they are in immediate danger from a predator (4 m or 13 feet per minute for the three-toed sloth), but they burn large amounts of energy doing so. Their specialized hands and feet have long, curved claws to allow them to hang upside-down from branches without effort. While they sometimes sit on top of branches, they usually eat, sleep, and even give birth hanging from limbs. They sometimes remain hanging from branches after death. On the ground the maximum speed of the three-toed sloth is 2 m or 6.5 feet per minute.

It had been thought that sloths were among the most somnolent animals, sleeping from 15 to 18 hours each day. Recently, however, Dr. Neil Rattenborg and his colleagues from the Max Planck Institute for Ornithology in Starnberg, Germany, published a study testing sloth sleep-patterns in the wild; this is the first study of its kind. The study indicated that sloths sleep just under 10 hours a day.



Three-toed Sloth in the Dallas World Aquarium

They go to the ground to urinate and defecate about once a week, digging a hole and covering it afterwards. They go to the same spot each time and are vulnerable to predation while doing so. The reason for this risky behavior is unknown, although some believe that this is to avoid making noise while defecating from up high that would attract predators. Consistent with this, they reportedly relieve themselves from their branches during storms in rainy season. Another possible explanation is that the middens provide the sloths with one of their few methods of finding one another for breeding purposes, since their sense of smell is far more acute than their eyesight or hearing. It has also been pointed out that individual sloths tend to spend the bulk of their time feeding on a single "modal" tree; by burying their excreta near the trunk of that tree, they may help nourish it.

Infant sloths normally cling to their mothers' fur, but occasionally fall off. Sloths are very sturdily built and rarely die from a fall. In some cases they die from a fall indirectly because the mothers prove unwilling to leave the safety of the trees to retrieve the young. Females normally bear one baby every year, but sometimes sloths' low level of movement actually keeps females from finding males for longer than one year.

Almost all mammals have seven cervical vertebrae or "neck bones" (including those with very short necks, such as elephants or whales, and those with very long necks, such as giraffes). The few exceptions include manatees and two-toed sloths, which each have only six cervical vertebrae, and three-toed sloths with nine cervical vertebrae.

Classification

Sloths are members of the superorder Xenarthra, a group of mammals that appeared approximately 60 million years ago, although at least one source puts the date at which sloths and related animals broke off from other placental mammals at about 100 million years ago. Also included among the Xenarthra are anteaters and armadillos. The earliest xenarthrans were arboreal herbivores with sturdy spines, fused pelvises, stubby teeth and small brains.

The living sloths belong to one of two families, known as the **Megalonychidae** ("two-toed" sloths) and the **Bradypodidae** (three-toed sloths). All living sloths have in fact three toes; the "two-toed" sloths, however, have only two fingers. Two-toed sloths are generally faster moving than three-toed sloths. Both types tend to occupy the same forests: in most areas, one species of three-toed sloth and one species of the larger two-toed type will jointly predominate.

However, their adaptations belie the actual relationships of the living sloth genera, which are more distant from each other than their outward similarity suggests. The common ancestor of the two genera apparently lived 35–40 million years ago, making the living forms stunning examples of convergent or parallel evolution. The two-toed sloths of today are far more closely related to one particular group of ground sloths than to the living three-toed sloths. Whether these ground-dwelling Megalonychidae were descended from tree-climbing ancestors or whether the two-toed sloths are really miniature ground sloths converted (or reverted) to arboreal life cannot presently be determined to satisfaction. The latter possibility seems slightly more likely, given the fact that the small ground sloths *Acratocnus* and *Neocnus* which were also able to climb are among the closer relatives of the two-toed sloths, and that these together were related to the huge ground sloths *Megalonyx* and *Megalocnus*.

The evolutionary history of the three-toed sloths is not well known. No particularly close relatives, ground-dwelling or not, have yet been identified.

The ground sloths do not constitute a monophyletic group. Rather, they make up a number of lineages, and as far as is known until the Holocene most sloths were in fact ground-dwellers. The famous *Megatherium*, for example, belonged to a lineage of ground sloths that was not very close to the living sloths and their ground-living relatives, like the small *Neocnus* or the massive *Megalonyx*. Meanwhile, *Mylodon*, among the last ground sloths to disappear, was only very distantly related to either of these.

Suborder Folivora (sloths)

- **Family Bradypodidae (Three-toed sloths)**
 - *Bradypus*
 - Pale-throated Sloth (*Bradypus tridactylus*)
 - Brown-throated Sloth (*Bradypus variegatus*)
 - Maned Sloth (*Bradypus torquatus*)

- Pygmy Three-toed Sloth (*Bradypus pygmaeus*)
- **Family Megalonychidae (two-toed sloths and extinct ground sloths)**
 - *Choloepus* (Two-toed sloths)
 - Hoffmann's Two-toed Sloth (*Choloepus hoffmanni*)
 - Linnaeus's Two-toed Sloth (*Choloepus didactylus*)
 - *Acratocnus*
 - *Habanocnus*
 - *Neocnus*
 - *Imagocnus*
 - *Megalocnus*
 - *Megalonyx*
- **Family Megatheriidae (megatheriid ground sloths)**
 - *Eremotherium*
 - *Hapalops*
 - *Megatherium*
 - *Nothropus*
- **Family Mylodontidae (mylodontid ground sloths)**
 - *Glossotherium*
 - *Lestodon*
 - *Mylodon*
 - *Paramylodon*
 - *Scelidotherium*
 - *Chubutherium*
- **Family Nothrotheriidae (nothrotheriid ground sloths)**
 - *Nothrotheriops*
 - *Nothrotherium*
 - *Thalassocnus*
- **Family Orophodontidae (orophodontid ground sloths)**

Extinction

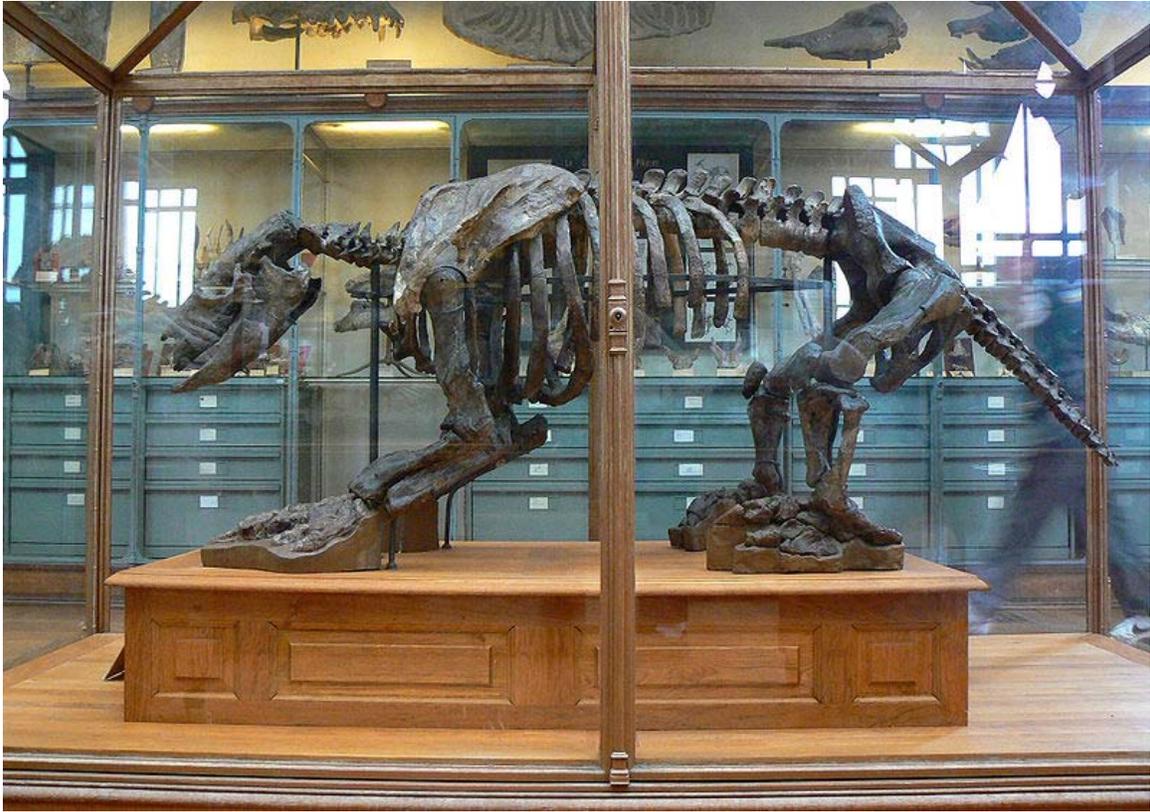
Until geologically recent times, ground sloths such as *Megatherium* lived in South America and parts of North America, but along with many other animals they disappeared immediately after the arrival of humans on the continent. Much evidence suggests that human hunting contributed to the extinction of the American megafauna, like that of far northern Asia, Australia, New Zealand, and Madagascar. Simultaneous climate change that came with the end of the last Ice age may have also played a role in some cases. However, the fact that ground sloths survived on the Antilles long after they had died out on the mainland points toward human activities as the agency of extinction.



Choloepus sp., Dortmund Zoo



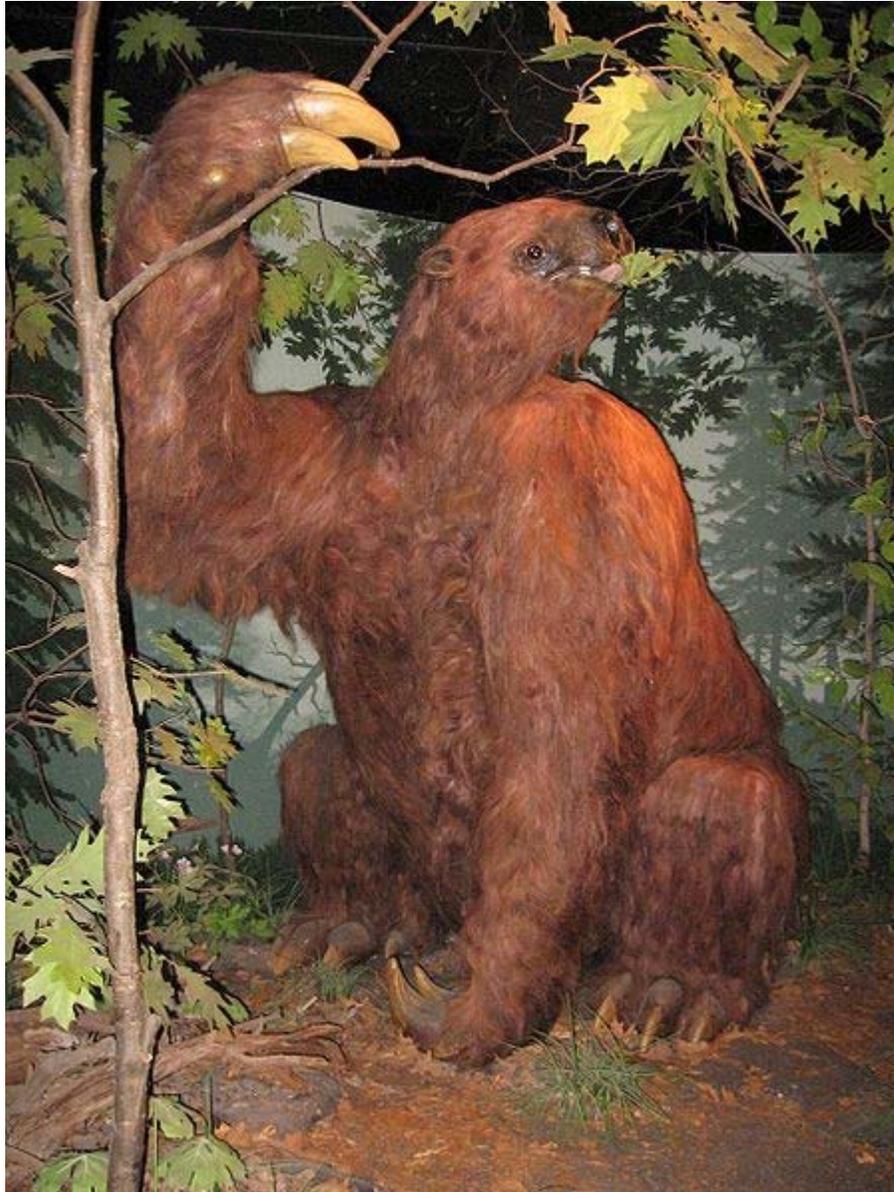
Megatherium fossil, Natural History Museum, London



Scelidotherrium leptoccephalum fossil. Muséum national d'histoire naturelle, Paris



Brown-throated Three-toed Sloth at Dallas World Aquarium



Reconstruction of giant ground sloth based on *Megalonyx jeffersonii*, Iowa Museum of Natural History

Chapter 4

Squirrel



Various members of the Sciuridae family

Scientific classification

Kingdom: Animalia
Phylum: Chordata
Class: Mammalia
Order: Rodentia
Suborder: Sciuromorpha
Sciuridae
Family: Fischer de Waldheim,
1817

Subfamilies and tribes

- Subfamily Ratufinae
- Subfamily Sciurillinae
- Subfamily Sciurinae
 - Tribe Sciurini
 - Tribe Pteromyini
- Subfamily Callosciurinae
 - Tribe Callosciurini

- Tribe Funambulini
- Subfamily Xerinae
 - Tribe Xerini
 - Tribe Protoxerini
 - Tribe Marmotini

Squirrels belong to a large family of small or medium-sized rodents called the **Sciuridae**. The family includes tree squirrels, ground squirrels, chipmunks, marmots (including woodchucks), flying squirrels, and prairie dogs. Squirrels are indigenous to the Americas, Eurasia, and Africa and have been introduced to Australia. Squirrels are first attested in the Eocene, about forty million years ago, and are most closely related to the mountain beaver and to dormice among living species.

Etymology

The word *squirrel*, first attested in 1327, comes via Anglo-Norman *esquirel* from the Old French *escurel*, the reflex of a Latin word *sciurus*. This Latin word was itself borrowed from Ancient Greek word σκίουρος, *skiouros*, which means shadow-tailed, referring to the bushy appendage possessed by many of its members.

The native Old English word, *ācweorna*, survived only into Middle English (as *aquerna*) before being replaced. The Old English word is of Common Germanic origin, with cognates such as German *Eichhorn* and Norwegian *ekorn*.

Characteristics



Skull of an Oriental giant squirrel (genus *Ratufa*). Note the classic sciuriform shape of the anterior zygomatic region.

Squirrels are generally small animals, ranging in size from the African pygmy squirrel, at 7–10 cm (2.8–3.9 in) in length, and just 10 g (0.35 oz) in weight, to the Alpine marmot, which is 53–73 cm (21–29 in) long, and weighs from 5 to 8 kg (11 to 18 lb). Squirrels typically have slender bodies with bushy tails and large eyes. Their fur is generally soft and silky, although much thicker in some species than others. The color of squirrels is highly variable between – and often even within – species.

The hindlimbs are generally longer than the forelimbs, and they have four or five toes on each foot. Their paws on their forefeet include a thumb, although this is often poorly developed. The feet also have a soft pad on the underside.

Squirrels live in almost every habitat from tropical rainforest to semiarid desert, avoiding only the high polar regions and the driest of deserts. They are predominantly herbivorous, subsisting on seeds and nuts, but many will eat insects, and even small vertebrates.

As their large eyes indicate, squirrels generally have an excellent sense of vision, which is especially important for tree-dwelling species. They also have very versatile and sturdy claws for grasping and climbing. Many also have a good sense of touch, with vibrissae on their heads and limbs.

The teeth of sciurids follow the typical rodent pattern, with large gnawing incisors that grow throughout life, and grinding cheek teeth set back behind a wide gap, or diastema. The typical dental formula for sciurids is:

Dentition

1.0.1.3

1.0.1.3

Behavior



Several species of squirrels have melanistic phases. In large parts of United States and Canada, the most common variety seen in urban areas is the melanistic form of the Eastern Gray Squirrel.

Squirrels breed once or twice a year, and give birth to a varying number of young after three to six weeks, depending on species. The young are born naked, toothless, helpless, and blind. In most species of squirrel, only the female looks after the young, which are weaned at around six to ten weeks of age and become sexually mature at the end of their first year. Ground dwelling species are generally social animals, often living in well-developed colonies, but the tree-dwelling species are more solitary.

Ground and tree squirrels are typically diurnal, while flying squirrels tend to be nocturnal—except for lactating flying squirrels and their offspring which have a period of diurnality during the summer.

Feeding



A squirrel at Sambalpur. This is the most common type of squirrel found in India.

Unlike rabbits or deer, squirrels cannot digest cellulose and must rely on foods rich in protein, carbohydrates, and fat. In temperate regions, early spring is the hardest time of year for squirrels, because buried nuts begin to sprout and are no longer available for the squirrel to eat, and new food sources have not become available yet. During these times squirrels rely heavily on the buds of trees. Squirrels' diet consists primarily of a wide variety of plant food, including nuts, seeds, conifer cones, fruits, fungi and green vegetation. However some squirrels also consume meat, especially when faced with hunger. Squirrels have been known to eat insects, eggs, small birds, young snakes and smaller rodents. Indeed, some tropical species have shifted almost entirely to a diet of insects.

Predatory behavior by various species of ground squirrels, particularly the thirteen-lined ground squirrel, has been noted. For example, Bailey, a scientist in the 1920s, observed a thirteen-lined ground squirrel preying upon a young chicken. Wistrand reported seeing this same species eating a freshly killed snake. Whitaker examined the stomachs of 139 thirteen-lined ground squirrels, and found bird flesh in four of the specimens and the remains of a short-tailed shrew in one; Bradley, examining white-tailed antelope squirrels' stomachs, found at least 10% of his 609 specimens' stomachs contained some type of vertebrate, mostly lizards and rodents. Morgart (1985) observed a white-tailed antelope squirrel capturing and eating a silky pocket mouse.

Taxonomy



Grizzled Giant Squirrel (*Ratufa macroura*) of the Ratufinae



Southern Flying Squirrel (*Glaucomys volans*) of the Pteromyini



Prevost's Squirrel (*Callosciurus prevosti*) of the Callosciurini



Unstriped Ground Squirrel (*Xerus rutilus*) of the Xerini



Alpine Marmot (*Marmota marmota*) of the Marmotini



A baby squirrel sleeping.

The living squirrels are divided into five subfamilies, with about 50 genera and nearly 280 species. The oldest squirrel fossil, *Hesperopetes*, dates back to the Chadronian (Late Eocene, about 40–35 million years ago), and is similar to modern flying squirrels.

During the latest Eocene to the Miocene, there were a variety of squirrels which cannot be assigned with certainty to any living lineage. At least some of these probably were variants of the oldest, basal "proto-squirrels" (in the sense that they lacked the full range of living squirrels' autapomorphies). The distribution and diversity of such ancient and ancestral forms suggests that the squirrels as a group might have originated in North America.

Apart from these sometimes little-known fossil forms, the phylogeny of the living squirrels is fairly straightforward. There are three main lineages, one comprising the Ratuinae (Oriental giant squirrels). These contain a mere handful of living species in tropical Asia. The Neotropical Pygmy Squirrel of tropical South America is the sole living member of the Sciurillinae. The third lineage is by far the largest and contains all other subfamilies; it has a near-cosmopolitan distribution. This further supports the hypothesis that the common ancestor of all squirrels living and fossil lived in North America, as these three most ancient lineages seem to have radiated from there – if

squirrels had originated in Eurasia for example, one would expect quite ancient lineages in Africa, but African squirrels seem to be of more recent origin.

The main group of squirrels also can be split up in three, which yields the remaining subfamilies. The Sciurinae contains the flying squirrels (Pteromyini) and the Sciurini, which among others contains the American tree squirrels; the former have often been considered a separate subfamily but are now seen as a tribe of the Sciurinae. The pine squirrels (*Tamiasciurus*) on the other hand are usually included with the main tree squirrel lineage, but appear to be about as distinct as the flying squirrels; hence they are sometimes considered a distinct tribe, Tamiasciurini.

Be that as it may, the three-way split of the main squirrel lineage is rather neat from a biogeographical and ecological perspective. Two of the three subfamilies are of about equal size, containing between nearly 70 to some 80 species each; the third is about twice as large. The Sciurinae contains arboreal (tree-living) squirrels, mainly of the Americas and to a lesser extent Eurasia. The Callosciurinae on the other hand is most diverse in tropical Asia and contains squirrels which are also arboreal, but have a markedly different habitus and appear more "elegant", an effect enhanced by their often very colorful fur. The Xerinae – the largest subfamily – are made up from the mainly terrestrial (ground-living) forms and include the large marmots and the popular prairie dogs among others, as well as the tree squirrels of Africa; they tend to be more gregarious than other squirrels which do not usually live together in close-knit groups.

- Basal and *incertae sedis* Sciuridae (all fossil)
 - *Hesperopetes*
 - *Kherem*
 - *Lagrivea*
 - *Oligosciurus*
 - *Plesiosciurus*
 - *Prospermophilus*
 - *Sciurion*
 - *Similisciurus*
 - *Sinotamias*
 - *Vulcanisciurus*
- Subfamily Cedromurinae (fossil)
- Subfamily Ratufinae – Oriental giant squirrels (1 genus, 4 species)
- Subfamily Sciurillinae – Neotropical Pygmy Squirrel (monotypic)
- Subfamily Sciurinae
 - Tribe Sciurini – tree squirrels (5 genera, c.38 species)
 - Tribe Pteromyini – true flying squirrels (15 genera, c.45 species)
- Subfamily Callosciurinae – Asian ornate squirrels
 - Tribe Callosciurini (13 genera, nearly 60 species)
 - Tribe Funambulini palm squirrels (1 genus, 5 species)
- Subfamily Xerinae – terrestrial squirrels
 - Tribe Xerini – spiny squirrels (3 genera, 6 species)
 - Tribe Protoxerini (6 genera, c.50 species)

- Tribe Marmotini – ground squirrels, marmots, chipmunks, prairie dogs, etc. (6 genera, c.90 species)

Chapter 5

Raccoon

Raccoon



Conservation status



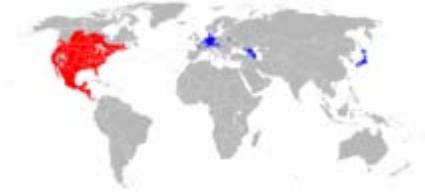
Least Concern (IUCN 3.1)

Scientific classification

Kingdom: Animalia
Phylum: Chordata
Class: Mammalia
Order: Carnivora
Family: Procyonidae
Genus: *Procyon*
Species: *P. lotor*

Binomial name

Procyon lotor
(Linnaeus, 1758)



Native range in red, introduced range
in blue

Synonyms

Ursus lotor Linnaeus, 1758

The **raccoon** also known as the **common raccoon**, **North American raccoon**, **northern raccoon** and colloquially as **coon**, is a medium-sized mammal native to North America. It is the largest of the procyonid family, having a body length of 40 to 70 cm (16 to 28 in) and a body weight of 3.5 to 9 kg (8 to 20 lb). The raccoon is usually nocturnal and is omnivorous, with a diet consisting of about 40% invertebrates, 33% plant foods, and 27% vertebrates. It has a grayish coat, of which almost 90% is dense underfur, which insulates against cold weather. Two of its most distinctive features are its extremely dexterous front paws and its facial mask, which are themes in the mythology of several Native American tribes. Raccoons are noted for their intelligence, with studies showing that they are able to remember the solution to tasks up to three years later.

The original habitats of the raccoon are deciduous and mixed forests of North America, but due to their adaptability they have extended their range to mountainous areas, coastal marshes, and urban areas, where many homeowners consider them to be pests. As a result of escapes and deliberate introductions in the mid-20th century, raccoons are now also distributed across the European mainland, the Caucasus region and Japan.

Though previously thought to be solitary, there is now evidence that raccoons engage in gender-specific social behavior. Related females often share a common area, while unrelated males live together in groups of up to four animals to maintain their positions against foreign males during the mating season, and other potential invaders. Home range sizes vary anywhere from 3 hectares for females in cities to 50 km² for males in prairies (7 acres to 20 sq mi). After a gestation period of about 65 days, two to five young (known as a "kit", plural "kits") are born in spring. The kits are subsequently raised by their mother until dispersion in late fall. Although captive raccoons have been known to live over 20 years, their average life expectancy in the wild is only 1.8 to 3.1 years. In many areas hunting and traffic accidents are the two most common causes of death.

Etymology



The mask of a raccoon is often interrupted by a brown-black streak that extends from forehead to nose.

The word "raccoon" was adopted into English from the native Powhatan term, as used in the Virginia Colony. It was recorded on Captain John Smith's list of Powhatan words as *aroughcun*, and on that of William Strachey as *arathkone*. It has also been identified as a Proto-Algonquian root **ahrah-koon-em*, meaning "[the] one who rubs, scrubs and scratches with its hands".

Similarly, Spanish colonists adopted the Spanish word *mapache* from the Nahuatl *mapachitli* of the Aztecs, meaning "[the] one who takes everything in its hands". In many languages, the raccoon is named for its characteristic dousing behavior in conjunction with that language's term for *bear*, for example *Waschbär* in German, *orsetto lavatore* in Italian and *araiguma* (アライグマ) in Japanese. In French and Portuguese (in Portugal), the washing behavior is combined with these languages' term for *rat*, yielding, respectively, *raton laveur* and *ratão-lavadeiro*.

The colloquial abbreviation *coon* is used in words like *coonskin* for fur clothing and in phrases like *old coon* as a self-designation of trappers. However, the clipped form is also in use as an ethnic slur. The raccoon's scientific name, *Procyon lotor*, is neo-Latin, meaning "before-dog washer", with *lotor* Latin for "washer" and *Procyon* Latinized Greek from *προ-*, "before" and *κύων*, "dog".

Taxonomy

In the first decades after its discovery by the members of the expedition of Christopher Columbus – the first person to leave a written record about the species – taxonomists thought the raccoon was related to many different species, including dogs, cats, badgers and particularly bears. Carl Linnaeus, the father of modern taxonomy, placed the raccoon in the genus *Ursus*, first as *Ursus cauda elongata* ("long-tailed bear") in the second edition of his *Systema Naturae*, then as *Ursus Lotor* ("washer bear") in the tenth edition. In 1780, Gottlieb Conrad Christian Storr placed the raccoon in its own genus *Procyon*, which can be translated either to "before the dog" or "doglike". It is also possible that Storr had its nocturnal lifestyle in mind and chose the star *Procyon* as eponym for the species.

Evolution

Based on fossil evidence from France and Germany, the first known members of the family *Procyonidae* lived in Europe in the late Oligocene about 25 million years ago. Similar tooth and skull structures suggest procyonids and weasels share a common ancestor, but molecular analysis indicates a closer relationship between raccoons and bears. After the then-existing species crossed the Bering Strait at least six million years later, the center of its distribution was probably in Central America. Coatis (*Nasua* and *Nasuella*) and raccoons (*Procyon*) have been considered to possibly share common descent from a species in the genus *Paranasua* present between 5.2 and 6.0 million years ago. This assumption, based on morphological comparisons, conflicts with a 2006 genetic analysis which indicates raccoons are more closely related to ringtails. Unlike other procyonids, such as the crab-eating raccoon (*Procyon cancrivorus*), the ancestors of the common raccoon left tropical and subtropical areas and migrated farther north about 4 million years ago, in a migration that has been confirmed by the discovery in the Great Plains of fossils dating back to the middle of the Pliocene.

Subspecies

Four subspecies of raccoon endemic to small Central American and Caribbean islands were often regarded as distinct species after their discovery. These are the Bahaman raccoon and Guadeloupe raccoon, which are very similar to each other; the Tres Marias raccoon, which is larger than average and has an angular skull; and the extinct Barbados raccoon. Studies of their morphological and genetic traits in 1999, 2003 and 2005 led all these island raccoons to be listed as subspecies of the common raccoon in the third edition of *Mammal Species of the World* (2005). A fifth island raccoon population, the

Cozumel raccoon, which weighs only 3 to 4 kg (6.6 to 8.8 lb) and has notably small teeth, is still regarded as a separate species.

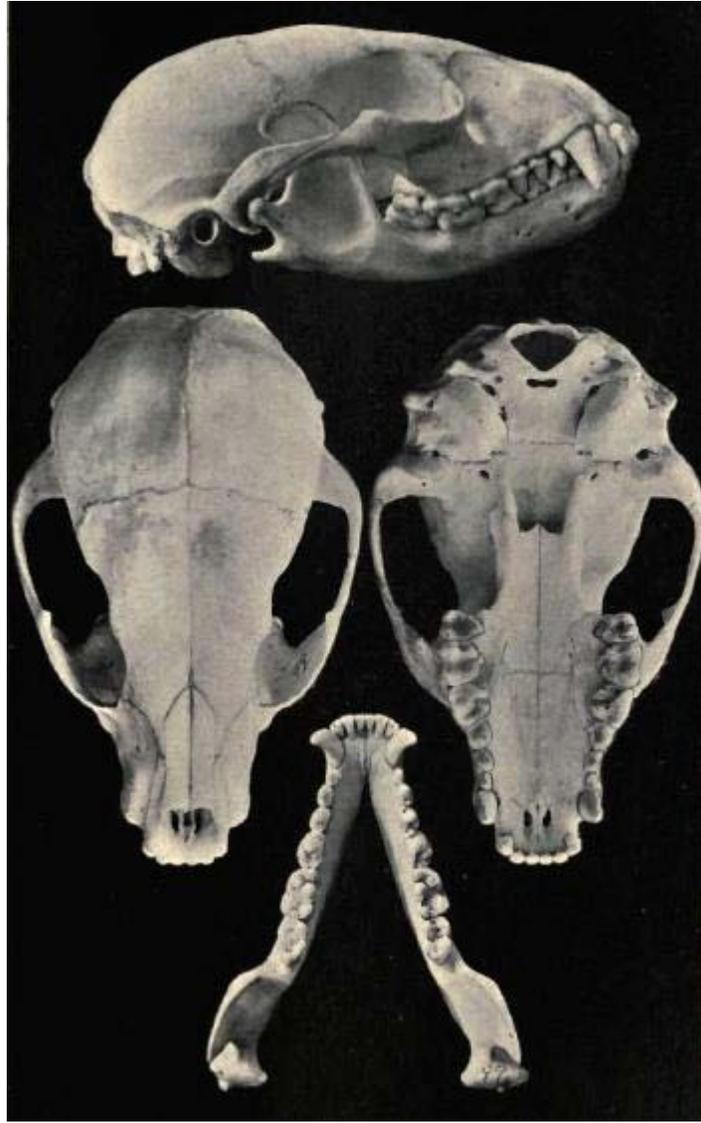
The four smallest raccoon subspecies, with an average weight of 2 to 3 kilograms (4.4 to 6.6 lb), are found along the southern coast of Florida and on the adjacent islands; an example is the Ten Thousand Island raccoon (*Procyon lotor marinus*). Most of the other 15 subspecies differ only slightly from each other in coat color, size and other physical characteristics. The two most widespread subspecies are the eastern raccoon (*Procyon lotor lotor*) and the upper Mississippi Valley raccoon (*Procyon lotor hirtus*). Both share a comparatively dark coat with long hairs, but the upper Mississippi Valley raccoon is larger than the eastern raccoon. The eastern raccoon occurs in all US states and Canadian provinces to the north of South Carolina and Tennessee. The adjacent range of the upper Mississippi Valley raccoon covers all US states and Canadian provinces to the north of Louisiana, Texas and New Mexico.

Description

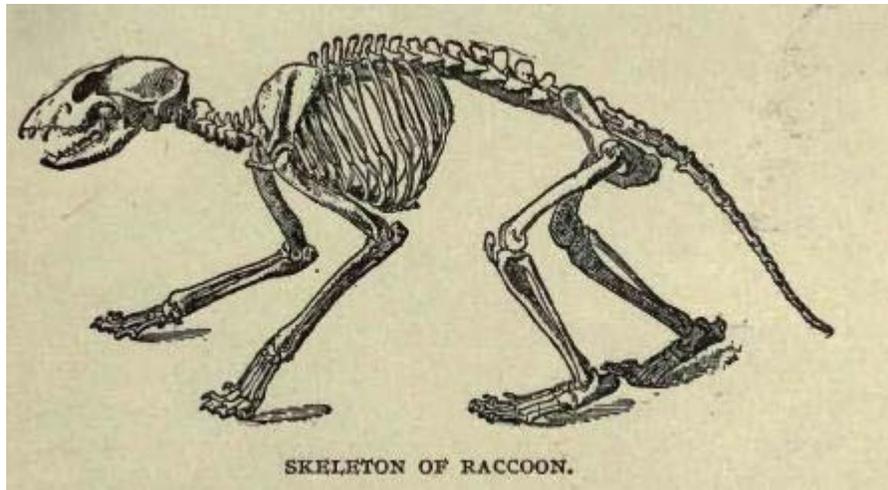
Physical characteristics



Track



Skull with dentition: 2/2 molars, 4/4 premolars, 1/1 canines, 3/3 incisors



Raccoon skeleton

Head to hindquarters, raccoons measure between 40 and 70 cm (16 and 28 in), not including the bushy tail which can measure between 20 and 40 cm (8 and 16 in), but is usually not much longer than 25 cm (10 in). The shoulder height is between 23 and 30 cm (9 and 12 in). The skull of the adult male measures 94.3–125.8 mm long and 60.2–89.1 mm wide, while that of the female measures 89.4–115.9 mm long and 58.3–81.2 mm wide. The body weight of an adult raccoon varies considerably with habitat; it can range from 2 to 14 kilograms (4 to 30 lb), but is usually between 3.5 and 9 kilograms (8 and 20 lb). The smallest specimens are found in Southern Florida, while those near the northern limits of the raccoon's range tend to be the largest. Males are usually 15 to 20% heavier than females. At the beginning of winter, a raccoon can weigh twice as much as in spring because of fat storage. It is one of the most variably sized of all mammals. The heaviest recorded wild raccoon weighed 28.4 kg (62.6 lb), by far the largest weight recorded for a procyonid.

The most characteristic physical feature of the raccoon is the area of black fur around the eyes, which contrasts sharply with the surrounding white face coloring. This is reminiscent of a "bandit's mask" and has thus enhanced the animal's reputation for mischief. The slightly rounded ears are also bordered by white fur. Raccoons are assumed to recognize the facial expression and posture of other members of their species more quickly because of the conspicuous facial coloration and the alternating light and dark rings on the tail. The rings resemble those of a ringtail lemur. The dark mask may also reduce glare and thus enhance night vision. On other parts of the body, the long and stiff guard hairs, which shed moisture, are usually colored in shades of gray and, to a lesser extent, brown. Raccoons with a very dark coat are more common in the German population because individuals with such coloring were among those initially released to the wild. The dense underfur, which accounts for almost 90% of the coat, insulates against cold weather and is composed of 2 to 3 cm (0.8 to 1.2 in) long hairs.



Raccoon baculum or "penis bone"

The raccoon, whose method of locomotion is usually considered to be plantigrade, can stand on its hind legs to examine objects with its front paws. As raccoons have short legs compared to their compact torso, they are usually not able either to run quickly or jump great distances. Their top speed over short distances is 16 to 24 km/h (10 to 15 mph). Raccoons can swim with an average speed of about 5 km/h (3 mph) and can stay in the water for several hours. For climbing down a tree headfirst—an unusual ability for a mammal of its size—a raccoon rotates its hind feet so they are pointing backwards. Raccoons have a dual cooling system to regulate their temperature; that is, they are able to both sweat and pant for heat dissipation.

Raccoon skulls have a short and wide facial region and a voluminous braincase. The facial length of the skull is less than the cranial, and their nasal bones are short and quite broad. The auditory bullae are inflated in form, and the sagittal crest is weakly developed.

The dentition—40 teeth with the dental formula: $\frac{3.1.4.2}{3.1.4.2}$ —is adapted to their omnivorous

diet: the carnassials are not as sharp and pointed as those of a full-time carnivore, but the molars are not as wide as those of a herbivore. The penis bone of males is about 10 cm (4 in) long and strongly bent at the front end and is often used by biologists to classify reproductive status of specimens. Seven of the thirteen identified vocal calls are used in communication between the mother and her kits, one of these being the birdlike twittering of newborns.

Senses



Bottom side of the front paw with visible vibrissae on the tips of the digits

The most important sense for the raccoon is its sense of touch. The "hyper sensitive" front paws are protected by a thin horny layer which becomes pliable when wet. The five digits of the paws have no webbing between them, which is unusual for a carnivoran. Almost two-thirds of the area responsible for sensory perception in the raccoon's cerebral cortex is specialized for the interpretation of tactile impulses, more than in any other studied animal. They are able to identify objects before touching them with vibrissae located above their sharp, nonretractable claws. The raccoon's paws lack an opposable thumb and thus it does not have the agility of the hands of primates. There is no observed negative effect on tactile perception when a raccoon stands in water below 10 °C (50 °F) for hours.

Raccoons are thought to be color blind or at least poorly able to distinguish color, though their eyes are well-adapted for sensing green light. Although their accommodation of 11 dioptre is comparable to that of humans and they see well in twilight because of the tapetum lucidum behind the retina, visual perception is of subordinate importance to raccoons because of their poor long-distance vision. In addition to being useful for orientation in the dark, their sense of smell is important for intraspecific communication. Glandular secretions (usually from their anal glands), urine and feces are used for marking. With their broad auditory range, they can perceive tones up to 50–85 kHz as well as quiet noises like those produced by earthworms underground.

Intelligence

Only a few studies have been undertaken to determine the mental abilities of raccoons, most of them based on the animal's sense of touch. In a study by the ethologist H. B. Davis in 1908, raccoons were able to open 11 of 13 complex locks in less than 10 tries and had no problems repeating the action when the locks were rearranged or turned upside down. Davis concluded they understood the abstract principles of the locking mechanisms and their learning speed was equivalent to that of rhesus macaques. Studies in 1963, 1973, 1975 and 1992 concentrated on raccoon memory showed they can remember the solutions to tasks for up to three years. In a study by B. Pohl in 1992, raccoons were able to instantly differentiate between identical and different symbols three years after the short initial learning phase. Stanislas Dehaene reports in his book *The Number Sense* raccoons can distinguish boxes containing two or four grapes from those containing three.

Behavior

Social behavior



Raccoons in a tree. The Raccoon's social structure is grouped into what Ulf Hohmann calls a "three class society".

Studies in the 1990s by the ethologists Stanley D. Gehrt and Ulf Hohmann indicated that raccoons engage in gender-specific social behaviors and are not typically solitary, as was previously thought. Related females often live in a so-called "fission-fusion society", that is, they share a common area and occasionally meet at feeding or resting grounds. Unrelated males often form loose *male social groups* to maintain their position against foreign males during the mating season – or against other potential invaders. Such a group does not usually consist of more than four individuals. Since some males show aggressive behavior towards unrelated kits, mothers will isolate themselves from other raccoons until their kits are big enough to defend themselves. With respect to these three different modes of life prevalent among raccoons, Hohmann called their social structure a "three class society". Samuel I. Zeveloff, professor of zoology at Weber State University and author of the book *Raccoons: A Natural History*, is more cautious in his interpretation and concludes at least the females are solitary most of the time and, according to Erik K. Fritzell's study in North Dakota in 1978, males in areas with low population densities are as well.

The shape and size of a raccoon's home range varies depending on age, gender, and habitat, with adults claiming areas more than twice as large as juveniles. While the size of home ranges in the inhospitable habitat of North Dakota's prairies lay between 7 and 50 km² (3 and 20 sq mi) for males and between 2 and 16 km² (1 and 6 sq mi) for females, the average size in a marsh at Lake Erie was 0.49 km² (0.19 sq mi). Irrespective of whether the home ranges of adjacent groups overlap, they are most likely not actively defended outside the mating season if food supplies are sufficient. Odor marks on prominent spots are assumed to establish home ranges and identify individuals. Urine and feces left at shared latrines may provide additional information about feeding grounds, since raccoons were observed to meet there later for collective eating, sleeping and playing.

Concerning the general behavior patterns of raccoons, Gehrt points out "typically you'll find 10 to 15 percent that will do the opposite" of what is expected.

Diet

Though usually nocturnal, the raccoon is sometimes active in daylight to take advantage of available food sources. Its diet consists of about 40% invertebrates, 33% plant material and 27% vertebrates. Since its diet consists of such a variety of different foods, Zeveloff argues the raccoon "may well be one of the world's most omnivorous animals". While its diet in spring and early summer consists mostly of insects, worms, and other animals already available early in the year, it prefers fruits and nuts, such as acorns and walnuts, which emerge in late summer and autumn, and represent a rich calorie source for building up fat needed for winter. They eat active or large prey, such as birds and mammals, only occasionally, since they prefer prey that is easier to catch, specifically fish and amphibians. Bird nests (eggs and after hatchlings) are frequently preyed on, and small birds are often helpless to prevent the attacking raccoon. When food is plentiful, raccoons can develop strong individual preferences for specific foods. In the northern parts of their range, raccoons go into a winter rest, reducing their activity drastically as long as a permanent snow cover makes searching for food impossible.

Dousing



Captive raccoons often douse their food before eating.

Raccoons sample food and other objects with their front paws to examine them and to remove unwanted parts. The tactile sensitivity of their paws is increased if this action is performed underwater, since the water softens the horny layer covering the paws. However, the behavior observed in captive raccoons in which they carry their food to a watering hole to "wash" or douse it before eating has not been observed in the wild. Naturalist Georges-Louis Leclerc, Comte de Buffon (1707–1788) believed that raccoons do not have adequate saliva production to moisten food, necessitating dousing, but this is certainly incorrect. Captive raccoons douse their food more frequently when a watering hole with a layout similar to a stream is not farther away than 3 m (10 ft). The widely

accepted theory is that dousing is a vacuum activity imitating foraging at shores for aquatic foods. This is supported by the observation that such foods are doused more frequently. Cleaning dirty food does not seem to be a reason for "washing". Experts have cast doubt on the veracity of observations of wild raccoons dousing food.

Reproduction

Raccoons usually mate in a period triggered by increasing daylight between late January and mid-March. However, there are large regional differences which are not completely explicable by solar conditions. For example, while raccoons in southern states typically mate later than average, the mating season in Manitoba also peaks later than usual in March and extends until June. During the mating season, males roam their home ranges in search of females in an attempt to court them during the three to four day period when conception is possible. These encounters will often occur at central meeting places. Copulation, including foreplay, can last over an hour and is repeated over several nights. The weaker members of a *male social group* also are assumed to get the opportunity to mate, since the stronger ones cannot mate with all available females. In a study in southern Texas during the mating seasons from 1990 to 1992, about one third of all females mated with more than one male. If a female does not become pregnant or if she loses her kits early, she will sometimes become fertile again 80 to 140 days later.



A kit

After usually 63 to 65 days of gestation (although anywhere from 54 to 70 days is possible), a litter of typically two to five young is born. The average litter size varies widely with habitat, ranging from 2.5 in Alabama to 4.8 in North Dakota. Larger litters are more common in areas with a high mortality rate, due, for example, to hunting or severe winters. While male yearlings usually reach their sexual maturity only after the main mating season, female yearlings can compensate for high mortality rates and may be responsible for about 50% of all young born in a year. Males have no part in raising young. The kits (also called "cubs") are blind and deaf at birth, but their mask is already visible against their light fur. The birth weight of the about 10 cm (4 in)-long kits is between 60 and 75 g (2.1 and 2.6 oz). Their ear canals open after around 18 to 23 days, a few days before their eyes open for the first time. Once the kits weigh about 1 kg (2 lb), they begin to explore outside the den, consuming solid food for the first time after six to nine weeks. After this point, their mother suckles them with decreasing frequency; they are usually weaned by 16 weeks. In the fall, after their mother has shown them dens and feeding grounds, the juvenile group splits up. While many females will stay close to the home range of their mother, males can sometimes move more than 20 km (12 mi) away. This is considered an instinctive behavior, preventing inbreeding. However, mother and offspring may share a den during the first winter in cold areas.

Life expectancy



Captive raccoons like this one in Bear Country USA are known to live for more than 20 years.

Captive raccoons have been known to live for more than 20 years. However, the species' life expectancy in the wild is only 1.8 to 3.1 years, depending on the local conditions in terms of traffic volume, hunting, and weather severity. It is not unusual for only half of the young born in one year to survive a full year. After this point, the annual mortality rate drops to between 10% and 30%. Young raccoons are vulnerable to losing their mother and to starvation, particularly in long and cold winters. The most frequent natural cause of death in the North American raccoon population is distemper, which can reach epidemic proportions and kill most of a local raccoon population. In areas with heavy vehicular traffic and extensive hunting, these factors can account for up to 90% of all deaths of adult raccoons.

The most important natural predators of the raccoon are bobcats, coyotes, and great horned owls, the latter mainly prey on young raccoons. In the Chesapeake Bay, raccoons are the most important mammalian prey for bald eagles. In their introduced range in the former Soviet Union, their main predators are wolves, lynxes and eagle owls. However, predation is not a significant cause of death, especially because larger predators have been exterminated in many areas inhabited by raccoons.

Range

Habitat



Taking refuge in a tree, Ottawa, Ontario

Although they have thrived in sparsely wooded areas in the last decades, raccoons depend on vertical structures to climb when they feel threatened. Therefore, they avoid open terrain and areas with high concentrations of beech trees, as beech bark is too smooth to climb. Tree hollows in old oaks or other trees and rock crevices are preferred by raccoons as sleeping, winter and litter dens. If such dens are unavailable or accessing them is inconvenient, raccoons use burrows dug by other mammals, dense undergrowth, roadside culverts in urban areas, or tree crotches. In a study in the Solling range of hills in Germany, more than 60% of all sleeping places were used only once, but those used at least ten times accounted for about 70% of all uses. Since amphibians, crustaceans, and other animals found around the shore of lakes and rivers are an important part of the raccoon's diet, lowland deciduous or mixed forests abundant with water and marshes sustain the highest population densities. While population densities range from 0.5 to 3.2 animals per square kilometre (0.2 – 1.2 animals per square mile) in prairies and do not usually exceed 6 animals per square kilometer (2.3 animals per square mile) in upland hardwood forests, more than 20 raccoons per square kilometer (50 animals per square mile) can live in lowland forests and marshes.

Distribution in North America

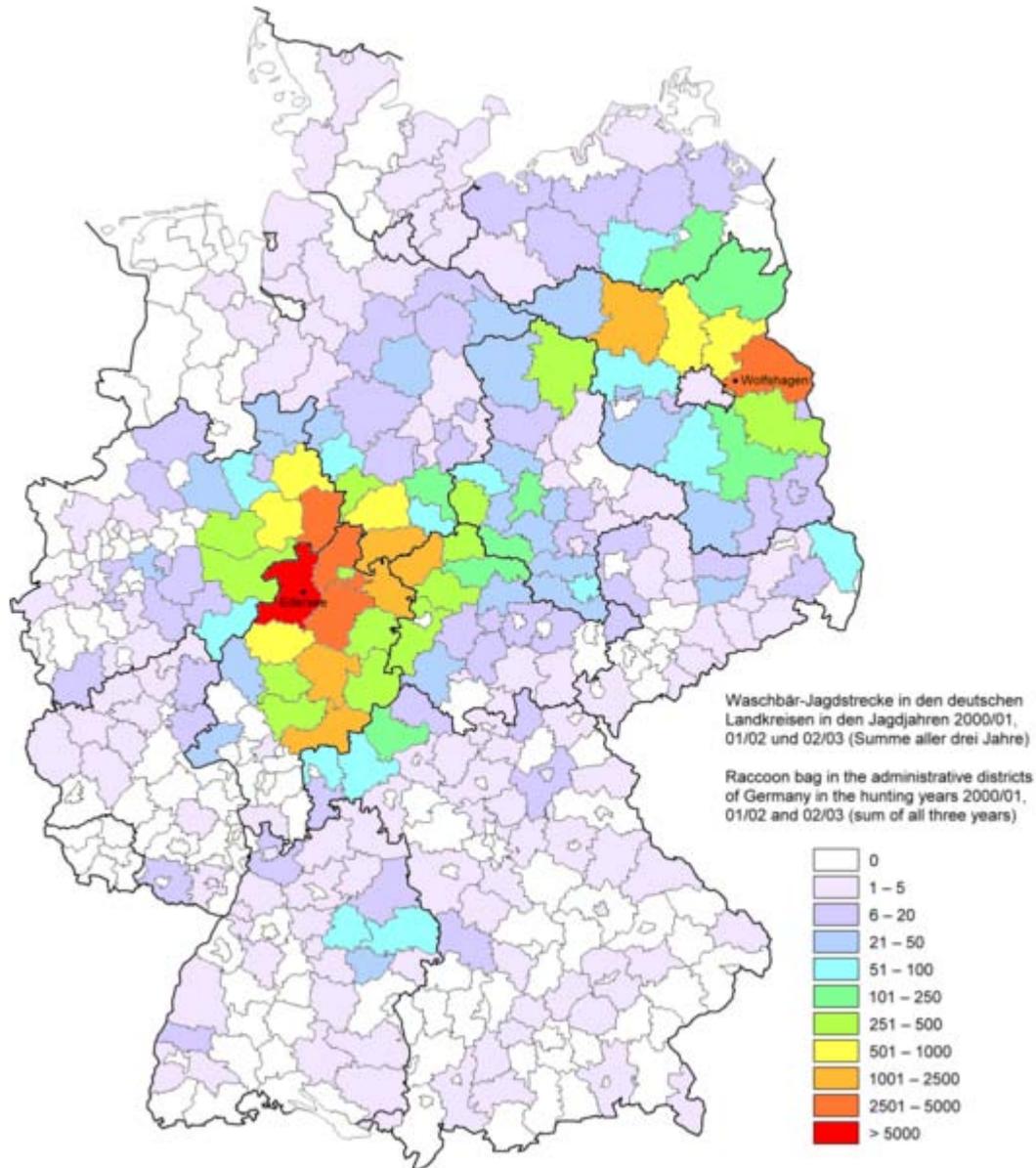
Raccoons are common throughout North America from Canada to Panama, where the subspecies *P. l. pumilus* coexists with the crab-eating Raccoon (*P. cancrivorus*). The population on Hispaniola was exterminated as early as 1513 by Spanish colonists who hunted them for their meat. Raccoons were also exterminated in Cuba and Jamaica, where the last sightings were reported in 1687. The Bahaman raccoon (*P. l. maynardi*) was classified as endangered by the IUCN in 1996.



Racoon in the middle of the night looking for food (Sierra-Nevada Mountains, California)

There is evidence that in pre-Columbian times raccoons were numerous only along rivers and in the woodlands of the Southeastern United States. As raccoons were not mentioned in earlier reports of pioneers exploring the central and north-central parts of the United States, their initial spread may have begun a few decades before the 20th century. Since the 1950s, raccoons have expanded their range from Vancouver Island—formerly the northernmost limit of their range—far into the northern portions of the four south-central Canadian provinces. New habitats which have recently been occupied by raccoons (aside from urban areas) include mountain ranges, such as the Western Rocky Mountains, prairies and coastal marshes. After a population explosion starting in the 1940s, the estimated number of raccoons in North America in the late 1980s was 15 to 20 times higher than in the 1930s, when raccoons were comparatively rare. Urbanization, the expansion of agriculture, deliberate introductions, and the extermination of natural predators of the raccoon have probably caused this increase in abundance and distribution.

Distribution outside North America



Distribution in Germany: Raccoons killed or found dead by hunters in the hunting years 2000/01, 01/02 and 02/03 in the administrative districts of Germany

As a result of escapes and deliberate introductions in the mid-20th century, the raccoon is now distributed in several European and Asian countries. Sightings have occurred in all the countries bordering Germany, which hosts the largest population outside of North America. Another stable population exists in northern France, where several pet raccoons were released by members of the U.S. Air Force near the Laon-Couvron Air Base in 1966. About 1,240 animals were released in nine regions of the former Soviet Union between 1936 and 1958 for the purpose of establishing a population to be hunted for their fur. Two of these introductions were successful: one in the south of Belarus between

1954 and 1958, and another in Azerbaijan between 1941 and 1957. With a seasonal harvest of between 1,000 and 1,500 animals, in 1974 the estimated size of the population distributed in the Caucasus region was around 20,000 animals and the density was four animals per square kilometer (10 animals per square mile). In Japan, up to 1,500 raccoons were imported as pets each year after the success of the anime series *Rascal the Raccoon* (1977). In 2004, the descendants of discarded or escaped animals lived in 42 of 47 prefectures.

Distribution in Germany

On April 12, 1934, two pairs of pet raccoons were released into the German countryside at the Edersee reservoir in the north of Hesse by forest superintendent Wilhelm Freiherr Sittich von Berlepsch, upon request of their owner, the poultry farmer Rolf Haag. He released them two weeks before receiving permission from the Prussian hunting office to "enrich the fauna", as Haag's request stated. Several prior attempts to introduce raccoons in Germany were not successful. A second population was established in East Germany in 1945 when 25 raccoons escaped from a fur farm at Wolfshagen east of Berlin after an air strike. The two populations are parasitologically distinguishable: 70% of the raccoons of the Hessian population are infected with the roundworm *Baylisascaris procyonis*, but none of the Brandenburgian population has the parasite. The estimated number of raccoons was 285 animals in the Hessian region in 1956, over 20,000 animals in the Hessian region in 1970 and between 200,000 and 400,000 animals in the whole of Germany in 2008.

The raccoon was a protected species in Germany, but has been declared a game animal in 14 states since 1954. Hunters and environmentalists argue the raccoon spreads uncontrollably, threatens protected bird species and supersedes domestic carnivorans. This view is opposed by the zoologist Frank-Uwe Michler, who finds no evidence a high population density of raccoons has negative effects on the biodiversity of an area. Hohmann holds extensive hunting cannot be justified by the absence of natural predators, because predation is not a significant cause of death in the North American raccoon population.

Distribution in the former USSR

Experiments in acclimatising raccoons into the USSR began in 1936, and were repeated a further 25 times until 1962. Overall, 1,222 individuals were released, 64 of which came from zoos and fur farms (38 of them having been imports from western Europe). The remainder originated from a population previously established in Transcaucasia. The range of Soviet raccoons was never single or continuous, as they were often introduced to different locations far from each other. All introductions into the Russian Far East failed; melanistic raccoons were released on Petrov Island near Vladivostok and some areas of southern Primorye, but died. In Middle Asia, raccoons were released in Kyrgyzstan's Jalal-Abad Province, though they were later recorded as "practically absent" there in January 1963. A large and stable raccoon population (yielding 1000–1500 catches a year) was established in Azerbaijan after an introduction to the area in 1937. Raccoons apparently

survived an introduction near Terek, along the Sulak River into the Dagestani lowlands. Attempts to settle racoons on the Kuban River's left tributary and Kabardino-Balkaria were unsuccessful. A successful acclimatization occurred in Belarus, where three introductions (consisting of 52, 37 and 38 individuals in 1954 and 1958) took place. By January 1, 1963, 700 individuals were recorded in the country.

Urban raccoons

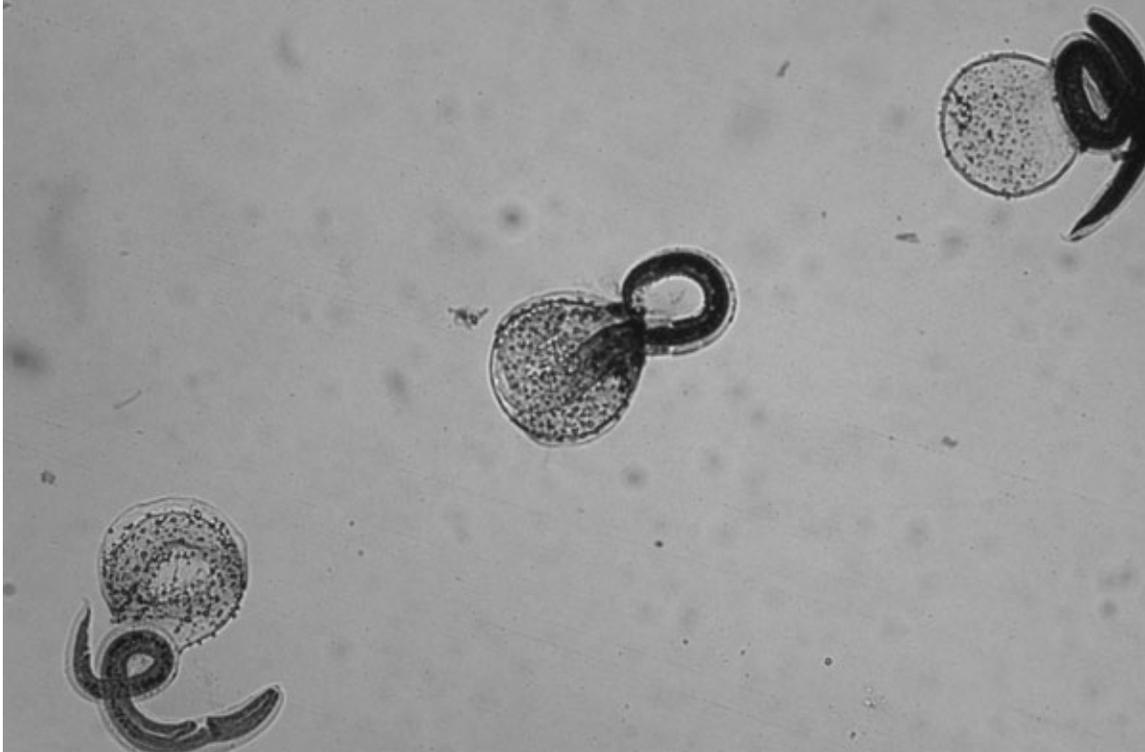


On the roof of a house in Albertshausen, Germany

Due to its adaptability, the raccoon has been able to use urban areas as a habitat. The first sightings were recorded in a suburb of Cincinnati in the 1920s. Since the 1950s, raccoons have been present in Washington, D.C., Chicago, and Toronto. Since the 1960s, Kassel has hosted Europe's first and densest population in a large urban area, with about 50 to 150 animals per square kilometer (130–400 animals per square mile), a figure comparable to those of urban habitats in North America. Home range sizes of urban raccoons are only three to 40 hectares (7.5–100 acres) for females and eight to 80 hectares (20–200 acres) for males. In small towns and suburbs, many raccoons sleep in a nearby forest after foraging in the settlement area. Fruit and insects in gardens and leftovers in municipal waste are easily available food sources. Furthermore, a large number of additional sleeping areas exist in these areas, such as hollows in old garden trees, cottages, garages, abandoned houses, and attics. The percentage of urban raccoons

sleeping in abandoned or occupied houses varies from 15% in Washington, D.C. (1991) to 43% in Kassel (2003).

Health



Baylisascaris procyonis larvae

Raccoons can carry rabies, a lethal disease caused by the neurotropic rabies virus carried in the saliva and transmitted by bites. Its spread began in Florida and Georgia in the 1950s and was facilitated by the introduction of infected individuals to Virginia and North Dakota in the late 1970s. Of the 6,940 documented rabies cases reported in the United States in 2006, 2,615 (37.7%) were in raccoons. The U.S. Department of Agriculture, as well as local authorities in several U.S. states and Canadian provinces, has developed oral vaccination programs to fight the spread of the disease in endangered populations. Only one human fatality has been reported after transmission of the rabies virus from a raccoon. Among the main symptoms for rabies in raccoons are a generally sickly appearance, impaired mobility, abnormal vocalization, and aggressiveness. There may be no visible signs at all, however, and most individuals do not show the aggressive behavior seen in infected canids; rabid raccoons will often retire to their dens instead. Organizations like the U.S. Forest Service encourage people to stay away from animals with unusual behavior or appearance, and to notify the proper authorities, such as an animal control officer from the local health department. Since healthy animals, especially nursing mothers, will occasionally forage during the day, daylight activity is not a reliable indicator of illness in raccoons.

Unlike rabies and at least a dozen other pathogens carried by raccoons, distemper, an epizootic virus, does not affect humans. This disease is the most frequent natural cause of death in the North American raccoon population and affects individuals of all age groups. For example, 94 of 145 raccoons died during an outbreak in Clifton, Ohio, in 1968. It may occur along with a following inflammation of the brain (encephalitis), causing the animal to display rabies-like symptoms. In Germany, the first eight cases of distemper were reported in 2007.

Some of the most important bacterial diseases which affect raccoons are leptospirosis, listeriosis, tetanus, and tularemia. Although internal parasites weaken their immune systems, well-fed individuals can carry a great many roundworms in their digestive tracts without showing symptoms. The larvae of the *Baylisascaris procyonis* roundworm, which can be contained in the feces and seldom causes a severe illness in humans, can be ingested when cleaning raccoon latrines without wearing breathing protection.

Chapter 6

Mouse

Mouse

Temporal range: Late Miocene–Recent



House Mouse, *Mus musculus*

Scientific classification

Kingdom:	Animalia
Phylum:	Chordata
Class:	Mammalia
Order:	Rodentia
Superfamily:	Muroidea
Family:	Muridae
Subfamily:	Murinae
Genus:	<i>Mus</i> Linnaeus, 1758

Species

30 known species

A **mouse** (plural: **mice**) is a small mammal belonging to the order of rodents. The best known mouse species is the common house mouse (*Mus musculus*). It is also a popular pet. In some places, certain kinds of field mice are also common. This rodent is eaten by large birds such as hawks and eagles. They are known to invade homes for food and occasionally shelter.

The American White-footed Mouse (*Peromyscus leucopus*) and the *deer mouse* (*Peromyscus maniculatus*), as well as other common species of mouse-like rodents around the world, also sometimes live in houses. These, however, are in other genera.

Cats, wild dogs, foxes, birds of prey, snakes and even certain kinds of arthropods have been known to prey heavily upon mice. Nevertheless, because of its remarkable adaptability to almost any environment, the mouse is one of the most successful mammalian genera living on Earth today.

Mice can at times be harmful rodents, damaging and eating crops, causing structural damages and spreading diseases through their parasites and feces. In North America, breathing dust that has come in contact with mouse excrements has been linked to hantavirus, which may lead to Hantavirus Pulmonary Syndrome (HPS).

Primarily nocturnal animals, mice compensate for their poor eyesight with a keen sense of hearing, and rely especially on their sense of smell to locate food and avoid predators.

Reproduction



Pups that are just a day old

Breeding onset is at about 50 days of age in both females and males, although females may have their first estrus at 25–40 days. Mice are polyestrous and breed year round; ovulation is spontaneous. The duration of the estrous cycle is 4–5 days and estrus itself lasts about 12 hours, occurring in the evening. Vaginal smears are useful in timed matings to determine the stage of the estrous cycle. Mating is usually nocturnal and may be confirmed by the presence of a copulatory plug in the vagina up to 24 hours post-copulation. The presence of sperm on a vaginal smear is also a reliable indicator of mating.

Female mice housed together tend to go into anestrus and do not cycle. If exposed to a male mouse or the pheromones of a male mouse, most of the females will go into estrus in about 72 hours. This synchronization of the estrous cycle is known as the Whitten

effect. The exposure of a recently bred mouse to the pheromones of a strange male mouse may prevent implantation (or pseudopregnancy), a phenomenon known as the Bruce effect.

The average gestation period is 20 days. A fertile postpartum estrus occurs 14–24 hours following parturition, and simultaneous lactation and gestation prolongs gestation 3–10 days owing to delayed implantation. The average litter size is 10–12 during optimum production, but is highly strain-dependent. As a general rule, inbred mice tend to have longer gestation periods and smaller litters than outbred and hybrid mice. The young are called pups and weigh 0.5–1.5 g (0.018–0.053 oz) at birth, are hairless, and have closed eyelids and ears. Cannibalism is uncommon, but females should not be disturbed during parturition and for at least 2 days postpartum. Pups are weaned at 3 weeks of age; weaning weight is 10–12 g (0.35–0.42 oz). If the postpartum estrus is not utilized, the female resumes cycling 2–5 days post-weaning.

Newborn male mice are distinguished from newborn females by noting the greater anogenital distance and larger genital papilla in the male. This is best accomplished by lifting the tails of littermates and comparing perineums.

Laboratory mice



Knockout mice

Mice are common experimental animals in biology and psychology primarily because they are mammals, and also because they share a high degree of homology with humans. They are the most commonly used mammalian model organism, more common than rats. The mouse genome has been sequenced, and virtually all mouse genes have human homologs. They can also be manipulated in ways that would be considered unethical to do with humans (note Animal Rights). A **knockout mouse** is a genetically engineered mouse that has had one or more of its genes made inoperable through a gene knockout.

There are other reasons why mice are used in laboratory research. Mice are small, inexpensive, easily maintained, and can reproduce quickly. Several generations of mice can be observed in a relatively short period of time. Mice are generally very docile if raised from birth and given sufficient human contact. However, certain strains have been known to be quite temperamental. Mice and rats have the same organs in the same places, just different proportions.

Subgenera



Field mouse of the subgenus *Mus*.

All members of the *Mus* genus are referred to as mice. However, the term *mouse* can also be applied to species outside of this genus. *Mouse* often refers to any small muroid rodent, while *rat* refers to larger muroid rodents. Therefore these terms are not taxonomically specific. For simplicity, only the rodent subgenera belonging to the *Mus* genus are listed here.

Genus *Mus* - Typical mice

- Subgenus *Coelomys* (East Asia)
- Subgenus *Mus* (Eurasia to North Africa, except for the House mouse which is worldwide.)
- Subgenus *Nannomys* (Sub-Saharan Africa)
- Subgenus *Pyromys* (East Asia)
- Subgenus and species *Mus lepidoides*

As pets



Pet mice

Many people buy mice as companion pets. They can be playful, loving and can grow used to being handled. Like pet rats, pet mice should not be left unsupervised outside as they have many natural predators, including (but not limited to) birds, lizards, cats, and dogs. Male mice tend to have a stronger odor than the females. However, mice are careful groomers and as pets they never need bathing. Well looked after mice can make ideal pets. Some common mouse care products are:

- Cage – Usually a hamster or gerbil cage, but special mouse cages are now available.
- Food – Special pelleted and seed-based food is available. Mice can generally eat most rodent food (for rats, mice, hamsters, gerbils, etc.)
- Bedding – Usually made of hardwood pulp, such as aspen, sometimes from shredded, uninked paper or recycled virgin wood pulp. Using corn husk bedding is avoided because it promotes *Aspergillus* fungus, and can grow mold once it gets wet, which is rough on their feet.

Nutrition

In nature, mice are herbivores, consuming any kind of fruit or grain from plants. Due to this, mice adapt well to urban areas and are known for eating most all types of food scraps. In captivity, mice are commonly fed commercial pelleted mouse diet. These diets are nutritionally complete, but they still need a large variety of vegetables. Food intake is approximately 15 g (0.53 oz) per 100 g (3.5 oz) of body weight per day; water intake is approximately 15 ml (0.53 imp fl oz; 0.51 US fl oz) per 100 g of body weight per day.

As food



"Pinkie" mice for sale as reptile food

Mice are a staple in the diet of many small carnivores. Humans have eaten mice since prehistoric times and still eat them as a delicacy throughout eastern Zambia and northern Malawi, where they are a seasonal source of protein. Mice are no longer routinely consumed by humans elsewhere.

In various countries mice are used as food for pets such as snakes, lizards, frogs, tarantulas and birds of prey, and many pet stores carry mice for this purpose. Some countries, such as Germany and the United Kingdom, have banned the practice of feeding live mice, citing ethical concerns regarding both predator and prey.

Common terms used to refer to different ages/sizes of mice when sold for pet food are "pinkies", "fuzzies", "crawlers", "hoppers", and "adults". Pinkies are newborn mice that have not yet grown fur; fuzzies have some fur but are not very mobile; hoppers have a full coat of hair and are fully mobile but are smaller than adult mice. Mice without fur are easier for the animal to consume, however mice with fur may be more convincing as animal feed. These terms are also used to refer to the various growth stages of rats.

Sniff better than dogs

Israeli scientists have tested mice as a new airport security detectors. It consists of three concealed cartridges each containing eight specially trained mice. If they senses traces of explosives or drugs, they will trigger the alarm. According to the New Scientist the mice work four-hour shifts and are more accurate than using dogs or x-ray machines.

Chapter 7

Bear

Bears

Temporal range: 38–0 Ma
Late Eocene - Recent



American Black Bear, *Ursus americanus*

Scientific classification

Kingdom: Animalia
Phylum: Chordata
Class: Mammalia
Order: Carnivora
Suborder: Caniformia

Ursidae
Family: G. Fischer de
Waldheim, 1817

Genera

- *Ailuropoda*
- *Helarctos*

- *Melursus*
- *Ursus*
- *Tremarctos*
- *Agriarctos* †
- *Agriotherium* †
- *Amphicticeps* †
- *Amphicynodon* †
- *Arctotherium* †
- *Arctodus* †
- *Indarctos* †
- *Kolponomos* †
- *Parictis* †
- *Plionarctos* †
- *Ursavus* †

Bears are mammals of the family **Ursidae**. Bears are classified as caniforms, or doglike carnivorans, with the pinnipeds being their closest living relatives. Although there are only eight living species of bear, they are widespread, appearing in a wide variety of habitats throughout the Northern Hemisphere and partially in the Southern Hemisphere. Bears are found in the continents of North America, South America, Europe, and Asia.

Common characteristics of modern bears include a large body with stocky legs, a long snout, shaggy hair, plantigrade paws with five nonretractile claws, and a short tail. While the polar bear is mostly carnivorous and the giant panda feeds almost entirely on bamboo, the remaining six species are omnivorous, with largely varied diets including both plants and animals.

With the exceptions of courting individuals and mothers with their young, bears are typically solitary animals. They are generally diurnal, but may be active during the night (nocturnal) or twilight (crepuscular), particularly around humans. Bears are aided by an excellent sense of smell, and despite their heavy build and awkward gait, they can run quickly and are adept climbers and swimmers. In autumn some bear species forage large amounts of fermented fruits which affects their behaviour. Bears use shelters such as caves and burrows as their dens, which are occupied by most species during the winter for a long period of sleep similar to hibernation.

Bears have been hunted since prehistoric times for their meat and fur. To this day, they play a prominent role in the arts, mythology, and other cultural aspects of various human societies. In modern times, the bear's existence has been pressured through the encroachment on its habitats and the illegal trade of bears and bear parts, including the Asian bile bear market. The IUCN lists six bear species as vulnerable or endangered, and even least concern species such as the brown bear are at risk of extirpation in certain countries. The poaching and international trade of these most threatened populations is prohibited, but still ongoing.

Etymology

The English word "bear" comes from Old English *bera* and belongs to a family of names for the bear in Germanic languages, in origin from an adjective meaning "brown". In Scandinavia the word for bear is *björn* (or *bjørn*), and is a relatively common given name for males. The use of this name is ancient and has been found mentioned in several runestone inscriptions. In Germanic culture, the bear was a symbol of the warrior, as evident from the Old English term *beorn* which can take the meaning of both "bear" and "warrior".

The reconstructed Proto-Indo-European name of the bear is **h₂rt̥k̑os*, whence Sanskrit *r̥k̑ṣa*, Avestan *arša*, Greek *ἄρκτος* (*arktos*), Latin *ursus*, Welsh *arth* (whence perhaps "Arthur"), Albanian *ari*, Armenian *arj*. Also compared is Hittite *ḫartagga-*, the name of a monster or predator. In the binomial name of the brown bear, *Ursus arctos*, Linné simply combined the Latin and Greek names.

The Proto-Indo-European word for bear, **h₂rt̥k̑os* seems to have been subject to taboo deformation or replacement in some languages (as was the word for wolf, *wlk̑os*), resulting in the use of numerous unrelated words with meanings like "brown one" (English *bruin*) and "honey-eater" (Slavic *medved*). Thus some Indo-European language groups do not share the same PIE root. The theory of the bear taboo is taught to almost all beginning students of Indo-European and historical linguistics; the putative original PIE word for bear is itself descriptive, because a cognate word in Sanskrit is *rak̑ṣas*, meaning "harm, injury".

Evolutionary history

The family Ursidae is one of nine families in the suborder **Caniformia**, or "doglike" carnivores, within the order **Carnivora**. Bears' closest living relatives are the pinnipeds and musteloids.

The following synapomorphic (derived) traits set bears apart from related families:

- presence of an alisphenoid canal
- paroccipital processes that are large and not fused to the auditory bullae
- auditory bullae are not enlarged
- lacrimal bone is vestigial
- cheek teeth are bunodont and hence indicative of a broad, hypocarnivorous (non-strictly meat-eating) diet (although hypercarnivorous (strictly meat-eating) taxa are known from the fossil record)
- carnassials are flattened

Additionally, members of this family possess posteriorly oriented M2 postprotocrista molars, elongated m2 molars, and a reduction of the premolars.

Modern bears comprise eight species in three subfamilies: Ailuropodinae (monotypic with the giant panda), Tremarctinae (monotypic with the Spectacled Bear), and Ursinae (containing six species divided into one to three genera, depending upon authority).

Fossil bears

The earliest members of Ursidae belong to the extinct subfamily *Amphicyodontinae*, including *Parictis* (late Eocene to early middle Miocene, 38-18 million years (Ma) ago) and the slightly younger *Allocyon* (early Oligocene, 34-30 Ma), both from North America. These animals looked very different from today's bears, being small and raccoon-like in overall appearance, and a diet perhaps more similar to that of a badger. *Parictis* does not appear in Eurasia and Africa until the Miocene. It is unclear whether late Eocene ursids were also present in Eurasia, although faunal exchange across the Bering land bridge may have been possible during a major sea level low stand as early as the late Eocene (~37 Ma) and continuing into the early Oligocene. European genera morphologically very similar to *Allocyon*, and also the much younger American *Kolponomos* (~18 Ma), are known from the Oligocene, including *Amphicticeps* and *Amphicynodon*.



Plithocyon armagnacensis skull

The raccoon-sized, dog-like *Cephalogale* is the oldest-known member of the subfamily **Hemicyoninae** which first appeared during the middle Oligocene in Eurasia ~30 Ma ago.

The subfamily also includes the younger genera *Phoberocyon* (~20-15 Ma), and *Plithocyon* (~15-7 Ma).

A *Cephalogale*-like species gave rise to the genus *Ursavus* during the early Oligocene (30-28 Ma); this genus proliferated into many species in Asia and is ancestral to all living bears. Species of *Ursavus* subsequently entered North America together with *Amphicyonodon* and *Cephalogale* during the early Miocene (21-18 Ma).

Members of living lineages of bears diverged from *Ursavus* ~20 Ma ago, likely via the species *Ursavus elmensis*. Based on genetic and morphological data, the subfamily **Ailuropodinae** (pandas) was the first to diverge from other living bears ~19 Ma ago, although no fossils of this group have been found pre-dating about 5 Ma.

The New World short-faced bears (**Tremarctinae**) differentiated from Ursinae following a dispersal event into North America during the mid Miocene (~13 Ma). They invaded South America (~1 Ma) following formation of the Isthmus of Panama. Their earliest fossil representative is *Plionarctos* in North America (~10-2 Ma). This genus is probably the direct ancestor to the North American short-faced bears (genus *Arctodus*), the South American short-faced bears (*Pararctotherium* and *Arctotherium*), and the spectacled bears, *Tremarctos*, represented by both an extinct North American species (*T. floridanus*), and the lone surviving representative of the **Tremarctinae**, the South American spectacled bear (*T. ornatus*).



Fossil of Cave bear (*Ursus spelaeus*)

The subfamily Ursinae experienced a dramatic proliferation of taxa ~5.3-4.5 Ma ago coincident with major environmental changes, with the first members of the genus *Ursus* also appearing around this time. The sloth bear is a modern survivor of one of the earliest lineages to diverge during this radiation event (~5.3 Ma); it took on its peculiar morphology related to its diet on termites and ants no later than by the early Pleistocene. By 3-4 Ma ago, the species *Ursus minimus* appears in the fossil record of Europe, which apart from size is nearly identical to today's Asiatic black bear. It is likely ancestral to all bears within Ursinae, perhaps aside from the sloth bear. Two lineages evolved from *U. minimus*, the black bears (including the sun bear, the Asiatic black bear, and the American black bear), and the brown bears. Modern brown bears evolved from *U. minimus* via *Ursus etruscus*, which itself is ancestral to both the extinct Pleistocene cave bear and the ancestor of today's brown and polar bears. Species of Ursinae have migrated repeatedly into N. America from Eurasia as early as 4 Ma ago during the early Pliocene.

The fossil record of bears is exceptionally good. Direct ancestor-descendent relationships between individual species are often fairly well-established, with sufficient intermediate forms known to make the precise cut-off between an ancestral and its daughter species subjective.

Other extinct bear genera include *Agriarctos*, *Indarctos*, and *Agriotherium* (sometimes placed within hemicyonids).

Taxonomic revisions of living bear species

The giant panda's taxonomy (subfamily Ailuropodinae) has long been debated. Its original classification by Armand David in 1869 was within the bear genus *Ursus*, but in 1870 it was reclassified by Alphonse Milne-Edwards to the raccoon family. In recent studies, the majority of DNA analyses suggest that the giant panda has a much closer relationship to other bears and should be considered a member of the family Ursidae. Estimates of divergence dates place the giant panda as the most ancient offshoot among living taxa within Ursidae, having split from other bears 17.9 to 22.1 Ma ago. The red panda was included within Ursidae in the past. However, more recent research does not support such a conclusion and instead places it in its own family Ailuridae, in superfamily Musteloidea along with Mustelidae, Procyonidae, and Mephitidae. Multiple similarities between the two pandas, including the presence of false thumbs, are thus thought to represent an example of convergent evolution for feeding primarily on bamboo.

There is also evidence that, unlike their neighbors elsewhere, the brown bears of Alaska's ABC islands are more closely related to polar bears than they are to other brown bears in the world. Researchers Gerald Shields and Sandra Talbot of the University of Alaska Fairbanks Institute of Arctic Biology studied the DNA of several samples of the species and found that their DNA is different from that of other brown bears. The researchers discovered that their DNA was unique compared to brown bears anywhere else in the world. The discovery has shown that while all other brown bears share a brown bear as their closest relative, those of Alaska's ABC Islands differ and share their closest relation

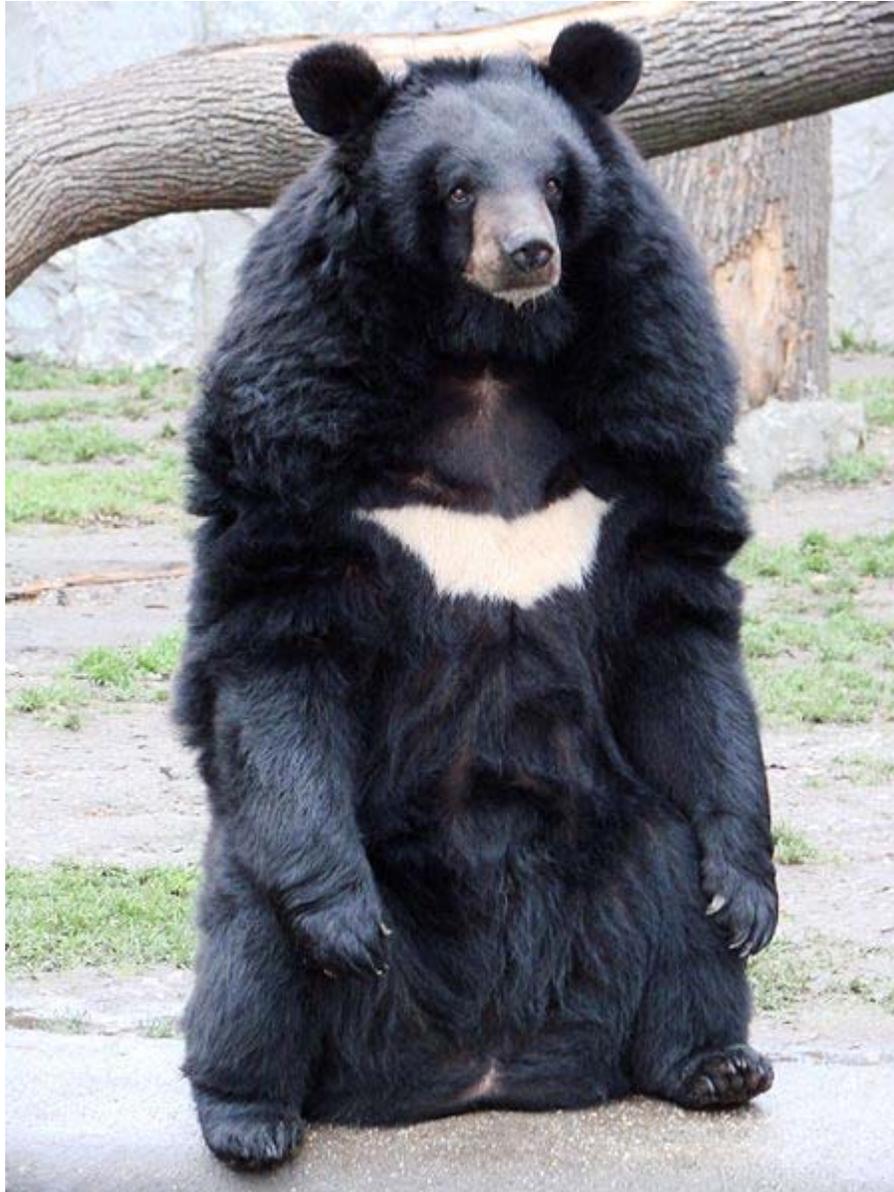
with the polar bear. There is also the very rare Tibetan blue bear, which is a type of brown bear. This animal has never been photographed.

Koalas are often referred to as bears due to their appearance; they are not bears, however, but marsupials.

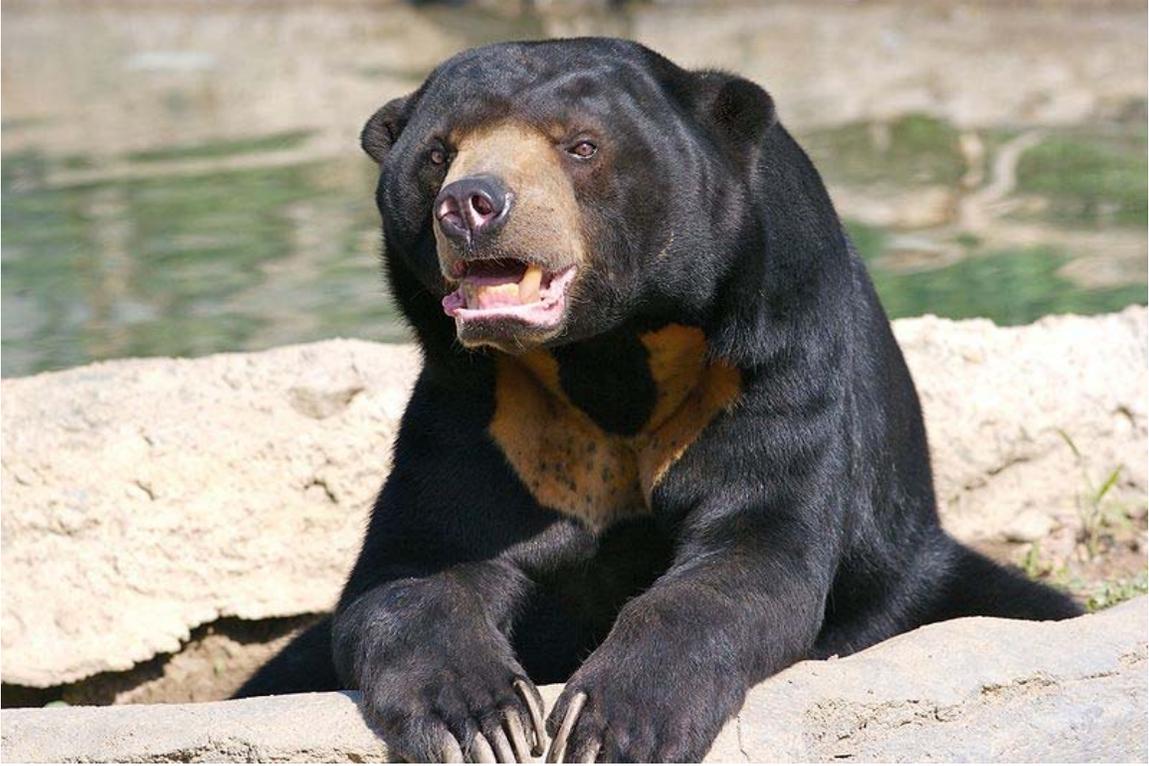
Classification



Brown bear *Ursus arctos*, at the Moscow Zoo



Asian black bear *Ursus thibetanus*, at the Wrocław Zoo, Poland



Sun bear *Helarctos malayanus*, at the Columbus Zoo



Giant panda *Ailuropoda melanoleuca*, "Tian Tian"

Family Ursidae

- Subfamily Ailuropodinae
 - †*Ailurarctos*
 - †*Ailurarctos lufengensis*
 - †*Ailurarctos yuanmouensis*
 - *Ailuropoda* (pandas)
 - †*Ailuropoda baconi*
 - †*Ailuropoda fovealis*
 - *Ailuropoda melanoleuca*, giant panda
 - *Ailuropoda melanoleuca melanoleuca*, giant panda
 - *Ailuropoda melanoleuca qinlingensis*, Qinling panda
 - †*Ailuropoda microra*
 - †*Ailuropoda wulingshanensis*
- Subfamily Tremarctinae
 - *Tremarctos* (Spectacled bears)
 - *Tremarctos ornatus*, spectacled bear
 - †*Tremarctos floridanus*
- †*Arctodus*
 - †*Arctodus simus*
 - †*Arctodus pristinus*
- †*Arctotherium*
 - †*Arctotherium angustidens*
 - †*Arctotherium bonariense*
 - †*Arctotherium brasilense*
 - †*Arctotherium latidens*
 - †*Arctotherium tarijense*
 - †*Arctotherium vetustum*
 - †*Arctotherium wingei*
- †*Plionarctos*
 - †*Plionarctos edensis*
 - †*Plionarctos harroldorum*
- Subfamily Ursinae
- †*Agriotherium*
 - †*Agriotherium inexpectans*
 - †*Agriotherium schneideri*
 - †*Agriotherium sivalensis*
- *Helarctos*
 - *Helarctos malayanus*, Sun bear
 - *Helarctos malayanus malayanus*
 - *Helarctos malayanus euryspilus*, Borneo sun bear

- †*Indarctos*

- †*Indarctos anthraciti*
- †*Indarctos arctoides*
- †*Indarctos atticus*
- †*Indarctos nevadensis*
- †*Indarctos oregonensis*
- †*Indarctos salmontanus*
- †*Indarctos vireti*
- †*Indarctos zdanskyi*

- *Melursus*

- *Melursus ursinus*, sloth bear
 - *Melursus ursinus inornatus*, Sri Lankan sloth bear
 - *Melursus ursinus ursinus*, Indian sloth bear

- †*Ursavus*

- †*Ursavus brevirohinus*
- †*Ursavus depereti*
- †*Ursavus elmensis*
- †*Ursavus pawniensis*
- †*Ursavus primaevus*

Ursus

- †*Ursus abstrusus*
- *Ursus americanus*, American black bear
 - *Ursus americanus altifrontalis*, Olympic black bear
 - *Ursus americanus amblyceps*, New Mexico black bear
 - *Ursus americanus americanus*, Eastern black bear
 - *Ursus americanus californiensis*, California black bear
 - *Ursus americanus carlottae*, Haida Gwaii black bear or Queen Charlotte black bear
 - *Ursus americanus cinnamomum*, cinnamon bear
 - *Ursus americanus emmonsii*, Glacier bear
 - *Ursus americanus eremicus*, Mexican black bear
 - *Ursus americanus floridanus*, Florida black bear
 - *Ursus americanus hamiltoni*, Newfoundland black bear
 - *Ursus americanus kermodei*, Kermode bear or spirit bear
 - *Ursus americanus luteolus*, Louisiana black bear
 - *Ursus americanus machetes*, West Mexico black bear
 - *Ursus americanus perniger*, Kenai black bear
 - *Ursus americanus pugnax*, Dall black bear

- • *Ursus americanus vancouveri*, Vancouver Island black bear
- *Ursus arctos*, brown bear
 - *Ursus arctos arctos*, Eurasian brown bear
 - *Ursus arctos alascensis*
 - *Ursus arctos beringianus*, Kamchatka brown bear or Far Eastern brown bear
 - †*Ursus arctos californicus*, California golden bear
 - †*Ursus arctos crowtheri*, Atlas bear
 - †*Ursus arctos dalli*
 - *Ursus arctos gobiensis*, Gobi bear (very rare)
 - *Ursus arctos horribilis*, grizzly bear
 - *Ursus arctos isabellinus*, Himalayan brown bear or Himalayan red bear
 - *Ursus arctos lasiotus*, Ussuri brown bear or black grizzly
 - *Ursus arctos middendorffi*, Kodiak bear
 - †*Ursus arctos nelsoni*, Mexican grizzly bear
 - *Ursus arctos piscator*, Bergman's bear (extinct?)
 - *Ursus arctos pruinosus*, Tibetan blue bear or Tibetan bear or Himalayan blue bear
 - *Ursus arctos sitkensis*
 - *Ursus arctos syriacus* Syrian (brown) bea
- • *Ursus americanus vancouveri*, Vancouver Island black bear
- *Ursus arctos*, brown bear
 - *Ursus arctos arctos*, Eurasian brown bear
 - *Ursus arctos alascensis*
 - *Ursus arctos beringianus*, Kamchatka brown bear or Far Eastern brown bear
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 - *Ursus arctos sitkensis*
 - *Ursus arctos syriacus* Syrian (brown) bea

The genera *Melursus* and *Helarctos* are sometimes also included in *Ursus*. The Asiatic black bear and the polar bear used to be placed in their own genera, *Selenarctos* and *Thalarctos* which are now placed at subgenus rank.

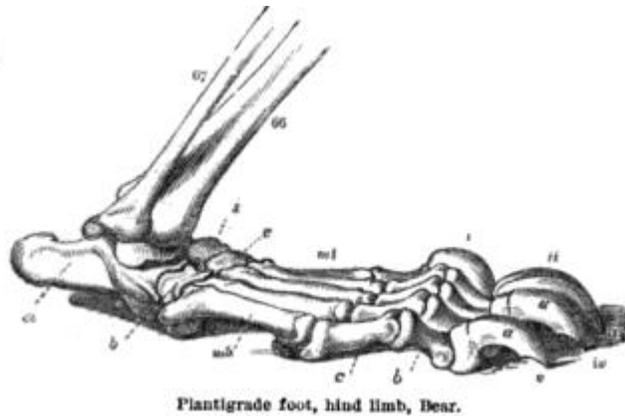
A number of hybrids have been bred between American black, brown, and polar bears.

Biology

Morphology



Despite being quadrupeds, bears can stand and sit similarly to humans.



Plantigrade foot, hind limb, Bear.

Unlike other carnivora, bears have plantigrade hind feet

Bears are generally bulky and robust animals with relatively short legs. Bears are sexually dimorphic with regard to size, with the males being larger. Larger species tend to show increased levels of sexual dimorphism in comparison to smaller species, and where a species varies in size across its distribution individuals from larger sized areas tend also to vary more. Bears are the most massive terrestrial members of the order Carnivora, with some Polar Bears and Brown Bears weighing over 750 kilograms (1,700 lb). As to which species is the largest may depend on whether the assessment is based on which species has the largest individuals (brown bears) or on the largest average size (polar bears). The smallest bears are the Sun Bears of Asia, which weigh an average of 65 kilograms (140 lb) for the males and 45 kilograms (99 lb) for the females.

Unlike other land carnivorans, bears are plantigrade. They distribute their weight toward the hind feet which makes them look lumbering when they walk. They are still quite fast with the brown bear reaching 30 miles per hour (48 km/h) although they are still slower than felines and canines. Bears can stand on their hind feet and sit up straight with remarkable balance. Bears have non-retractable claws which are used for digging, climbing, tearing and catching prey. Their ears are rounded.

Bears have an excellent sense of smell, a better sense of smell in fact than the dogs (Canidae), or possibly any other mammal. This sense of smell is used for signalling between bears (either to warn off rivals or detect mates) and for finding food. Smell is the principal sense used by bears to find most of their diet.

Dentition

Unlike most other members of the Carnivora, bears have relatively undeveloped carnassial teeth, and their teeth are adapted for a diet that includes a significant amount of vegetable matter. The canine teeth are large, and the molar teeth flat and crushing. There is considerable variation in dental formula even within a given species. It has been suggested that this indicates bears are still in the process of evolving from a carnivorous to a predominantly herbivorous diet. Polar bears appear to have secondarily re-evolved

fully functional carnassials, as their diet has switched back towards carnivory. The dental formula for living bears is: $\frac{3.1.2-4.2}{3.1.2-4.3}$

Distribution and habitat

The bears are mostly found in the northern hemisphere, with a single species, the spectacled bear, occurring in South America. The Atlas Bear, a subspecies of the Brown Bear, was the only bear native to Africa. It was distributed in North Africa from Morocco to Libya, but has been extinct since around the 1870s. All the other species are found in North America, Asia and Europe. The most widespread species is the Brown Bear, which occurs from Western Europe eastwards through Asia to the western areas of North America. The American Black Bear is restricted to North America, and the Polar bear is restricted to the Arctic Sea. All the remaining species are Asian.

With the exception of the Polar Bear the bears are mostly forest species. Some species, particularly the Brown Bear, may inhabit or seasonally use other areas such as alpine scrub or tundra.

Behaviour

While many people think that bears are nocturnal, they are in fact generally diurnal, active for the most part during the day. The belief that they are nocturnal apparently comes from the habits of bears that live near humans which engage in some nocturnal activities, such as raiding trash cans or crops while avoiding humans. The sloth bear of Asia is the most nocturnal of the bears, but this varies by individual and females with cubs are often diurnal in order to avoid competition with males and nocturnal predators. Bears are overwhelmingly solitary and are considered to be the most asocial of all the Carnivora. Liaisons between breeding bears are brief, and the only times bears are encountered in small groups are mothers with young or occasional seasonal bounties of rich food (such as salmon runs).

Vocalizations

Bears produce a variety of vocalizations such as:

- **Moaning:** produced mostly as mild warnings to potential threats or in fear.
- **Barking:** produced during times of alarm, excitement or to give away the animal's position.
- **Huffing:** made during courtship or between mother and cubs to warn of danger.
- **Growling:** produced as strong warnings to potential threats or in anger.
- **Roaring:** used much for the same reasons as growls and also to proclaim territory and for intimidation.

Diet and interspecific interactions



Asian black bear feeding on berries



Brown bears make use of infrequent but predictable salmon runs in order to feed

Their carnivorous reputation notwithstanding, most bears have adopted a diet of more plant than animal matter and are completely opportunistic omnivores. Some bears will climb trees in order to obtain mast (edible vegetative or reproductive parts such as acorns); smaller species which are more able to climb include a greater amount of this in their diet. Such masts can be very important to the diet of these species, and mast failures may result in long range movements by bears looking for alternate sources of food. One exception is the polar bear, which has adopted a diet mainly of marine mammals to survive in the Arctic. The other exception is the giant panda which has adopted a diet mainly of bamboo. Stable isotope analysis of the extinct giant short-faced bear (*Arctodus simus*) shows that it was also an exclusive meat eater, probably a scavenger. The sloth bear, though not as specialized as the previous two species, has lost several front teeth usually seen in bears and developed a long, suctioning tongue in order to feed on the ants, termites and other burrowing insects that they favour. At certain times of the year these insects can make up 90% of their diet. All bears will feed on any food source that becomes available, and the nature of that varies seasonally. A study of Asiatic black bears in Taiwan found that they would consume large numbers of acorns when they were most common, and switch to ungulates in other times of the year.

When taking warm-blooded animals, bears will typically take small or young animals, as they are easier to catch. Although (besides polar bears) both species of black bear and the brown bear can sometimes take large prey, such as ungulates. Often, bears will feed on other large animals when they encounter a carcass, whether or not the carcass is claimed by or is the kill of another predator. This competition is the main source of interspecies conflict. Bears are typically the apex predators in their range due to their size and power, and can defend a carcass against nearly all comers. Mother bears also can usually defend their cubs against other predators. The tiger is the only known predator known to regularly prey on adult bears, including sloth bears, Asiatic black bears, giant pandas, sun bears and small brown bears.

Breeding



Bear cubs, like this American Black Bear, are sometimes killed by males

The age at which bears reach sexual maturity is highly variable, both between and within species. Sexual maturity is dependent on body condition, which is in turn dependent upon the food supply available to the growing individual. In the females of smaller species may have young in as little as two years, whereas the larger species may not rear young until they are four or even nine years old. First breeding may be even later in males, where competition for mates may leave younger males without access to females.



American Black Bears mating

The bear's courtship period is very brief. Bears in northern climates reproduce seasonally, usually after a period of inactivity similar to hibernation, although tropical species breed all year round. Cubs are born toothless, blind, and bald. The cubs of brown bears, usually born in litters of 1–3, will typically stay with the mother for two full seasons. They feed on their mother's milk through the duration of their relationship with their mother, although as the cubs continue to grow, nursing becomes less frequent and cubs learn to begin hunting with the mother. They will remain with the mother for approximately three years, until she enters the next cycle of estrus and drives the cubs off. Bears will reach sexual maturity in five to seven years. Male bears, especially Polar and Brown Bears, will kill and sometimes devour cubs born to another father in order to induce a female to breed again. Female bears are often successful in driving off males in protection of their cubs, despite being rather smaller.

Winter dormancy



Polar bear mother is nursing her cub

Many bears of northern regions are assumed to hibernate in the winter. While many bear species do go into a physiological state often colloquially called "hibernation" or "winter sleep", it is not true hibernation. In true hibernators, body temperatures drop to near ambient and heart rate slows drastically, but the animals periodically rouse themselves to urinate or defecate and to eat from stored food. The body temperature of bears, on the other hand, drops only a few degrees from normal and heart rate slows only slightly. They normally do not wake during this "hibernation", and therefore do not eat, drink, urinate or defecate the entire period. Higher body heat and being easily roused may be adaptations, because females give birth to their cubs during this winter sleep.

Relationship with humans



Polar bear at Wapusk National Park, Canada

Some species, such as the polar bear, American black bear, sloth bear and the brown bear, are dangerous to humans, especially in areas where they have become used to people. All bears are physically powerful and are likely capable of fatally attacking a person, but they, for the most part, are shy, are easily frightened and will avoid humans. Injuries caused by bears are rare, but are often widely reported. The danger that bears pose is often vastly exaggerated, in part by the human imagination. However, when a mother feels her cubs are threatened, she will behave ferociously. It is recommended to give all bears a wide berth because they are behaviorally unpredictable.

Bears may also come into conflict with humans where they raid crops or attack livestock. These problems may be the work of only a few bears but create a climate of conflict as farmers and ranchers may perceive all losses as due to bears and advocate the preventive removal of all bears. Mitigation methods may be used to reduce bear damage to crops, and reduce local antipathy towards bears.



Bear danger area closure sign of a type used in Denali National Park in Alaska

Laws have been passed in many areas of the world to protect bears from hunters' habitat destruction. Public perception of bears is often very positive, as people identify with bears due to their omnivorous diet, ability to stand on two legs, and symbolic importance, and there is widespread support for bear protection, at least in more affluent societies. In more rural and poorer regions attitudes may be more shaped by the dangers posed by bears and the economic costs that they incur to farmers and ranchers. Some populated areas with bear populations have also outlawed the feeding of bears, including allowing them access to garbage or other food waste. Bears in captivity have been trained to dance, box, or ride bicycles; however, this use of the animals became controversial in the late 20th century. Bears were kept for baiting in Europe at least since the 16th century.

Bears as food and medicine

Many people enjoy hunting bears and eating them. Their meat is dark and stringy, like a tough cut of beef. In Cantonese cuisine, bear paws are considered a delicacy. The peoples of China, Japan, and Korea use bears' body parts and secretions (notably their gallbladders and bile) as part of traditional Chinese medicine. It is believed more than 12,000 bile bears are kept on farms, farmed for their bile, in China, Vietnam and South Korea. Bear meat must be cooked thoroughly as it can often be infected with *Trichinella spiralis*, which can cause trichinosis.

Chapter 8

Chipmunk

Chipmunks

Temporal range: Early Miocene to Recent



Least chipmunk

Scientific classification

Kingdom:	Animalia
Phylum:	Chordata
Class:	Mammalia
Order:	Rodentia
Suborder:	Sciuromorpha
Family:	Sciuridae
Tribe:	Marmotini

Subtribe: Tamiina
Genus: *Tamias*
Illiger, 1811

Chipmunks are small striped squirrels native to North America and Asia. They are usually classed either as a single genus with three subgenera, or as three genera.

Etymology and taxonomy

Chipmunks are usually classified either as a single genus, *Tamias*, or as three genera: *Tamias*, containing the eastern chipmunk; *Eutamias*, containing the Siberian chipmunk; and *Neotamias*, containing the 23 remaining, mostly western, species. These classifications are arbitrary, and most taxonomies over the twentieth century have placed the chipmunks in a single genus. However, studies of mitochondrial DNA show that each of the three chipmunk groups is about as distinct genetically as genera such as *Marmota* and *Spermophilus*.

Tamias is Greek for "storer," a reference to the animals' habit of collecting and storing food for winter use.

The common name originally may have been spelled "chitmunk" (from the Odawa word *jidmoonh*, meaning "red squirrel"; *c.f.* Ojibwe, *ajidamoo*). However, the earliest form cited in the Oxford English Dictionary (from 1842) is "chipmonk". Other early forms include "chipmuck" and "chipminck", and in the 1830s they were also referred to as "chip squirrels," possibly in reference to the sound they make. They are also called "striped squirrels", "chippers", "munks", "timber tigers", or "ground squirrels", though the name "ground squirrel" usually refers to other squirrels, such as those of the genus *Spermophilus*.

Diet

Chipmunks have an omnivorous diet consisting of grain, nuts, fruit, berries, birds' eggs, small frogs, fungi, worms, insects and on occasions small mammals like young mice. At the beginning of autumn, many species of chipmunk begin to stockpile these goods in their burrows, for winter. Other species make multiple small caches of food. These two kinds of behavior are called larder hoarding and scatter hoarding. Larder hoarders usually live in their nests until spring. Cheek pouches allow chipmunks to carry multiple food items to their burrows for either storage or consumption.

Ecology and life history

Eastern chipmunks mate in early spring and again in early summer, producing litters of four or five young twice each year. Western chipmunks only breed once a year. The young emerge from the burrow after about six weeks and strike out on their own within the next two weeks.

These small mammals fulfill several important functions in forest ecosystems. Their activities harvesting and hoarding tree seeds play a crucial role in seedling establishment. They consume many different kinds of fungi, including those involved in symbiotic mycorrhizal associations with trees, and are an important vector for dispersal of the spores of subterranean sporocarps (truffles) which have co-evolved with these and other mycophagous mammals and thus lost the ability to disperse their spores through the air.

Chipmunks play an important role as prey for various predatory mammals and birds, but are also opportunistic predators themselves, particularly with regard to bird eggs and nestlings. In Oregon, Mountain Bluebirds (*Siala curruoides*) have been observed energetically mobbing chipmunks that they see near their nest trees.

Chipmunks construct expansive burrows which can be more than 3.5 m in length with several well-concealed entrances. The sleeping quarters are kept extremely clean as shells and feces are stored in refuse tunnels.



Western Chipmunk inside Zion National Park, Utah, USA



Western Chipmunk in the Capitol Reef National Park, Utah, USA (39 s)



Eastern Chipmunk (*Tamias striatus*), Quebec, Canada

Classification

Subgenus *Tamias*

- Eastern chipmunk, *Tamias striatus*

Subgenus *Eutamias*

- Siberian chipmunk, *Eutamias sibiricus*

Subgenus *Neotamias*

- Alpine chipmunk, *Neotamias alpinus*
- Yellow-pine chipmunk, *Neotamias amoenus*
- Buller's chipmunk, *Neotamias bulleri*
- Gray-footed chipmunk, *Neotamias canipes*
- Gray-collared chipmunk, *Neotamias cinereicollis*
- Cliff chipmunk, *Neotamias dorsalis*
- Durango chipmunk, *Neotamias durangae*

- Merriam's chipmunk, *Neotamias merriami*
- Least chipmunk, *Neotamias minimus*
- California chipmunk, *Neotamias obscurus*
- Yellow-cheeked chipmunk, *Neotamias ochrogenys*
- Palmer's chipmunk, *Neotamias palmeri*
- Panamint chipmunk, *Neotamias panamintinus*
- Long-eared chipmunk, *Neotamias quadrimaculatus*
- Colorado chipmunk, *Neotamias quadrivittatus*
- Red-tailed chipmunk, *Neotamias ruficaudus*
- Hopi chipmunk, *Neotamias rufus*
- Allen's chipmunk, *Neotamias senex*
- Siskiyou chipmunk, *Neotamias siskiyou*
- Sonoma chipmunk, *Neotamias sonomae*
- Lodgepole chipmunk, *Neotamias speciosus*
- Townsend's chipmunk, *Neotamias townsendii*
- Uinta chipmunk, *Neotamias umbrinus*

Extinct:

- †*Tamias aristus*

Chapter 9

Hedgehog

Hedgehogs



European Hedgehog

Scientific classification

Kingdom:	Animalia
Phylum:	Chordata
Class:	Mammalia
Order:	Erinaceomorpha
Family:	Erinaceidae
Subfamily:	Erinaceinae G. Fischer, 1814

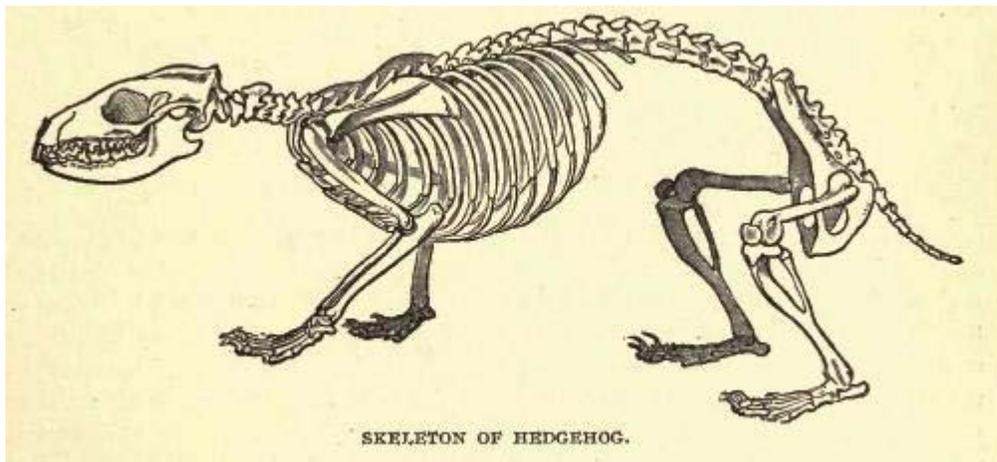
Genera

- *Atelerix*
- *Erinaceus*
- *Hemiechinus*
- *Mesechinus*
- *Paraechinus*

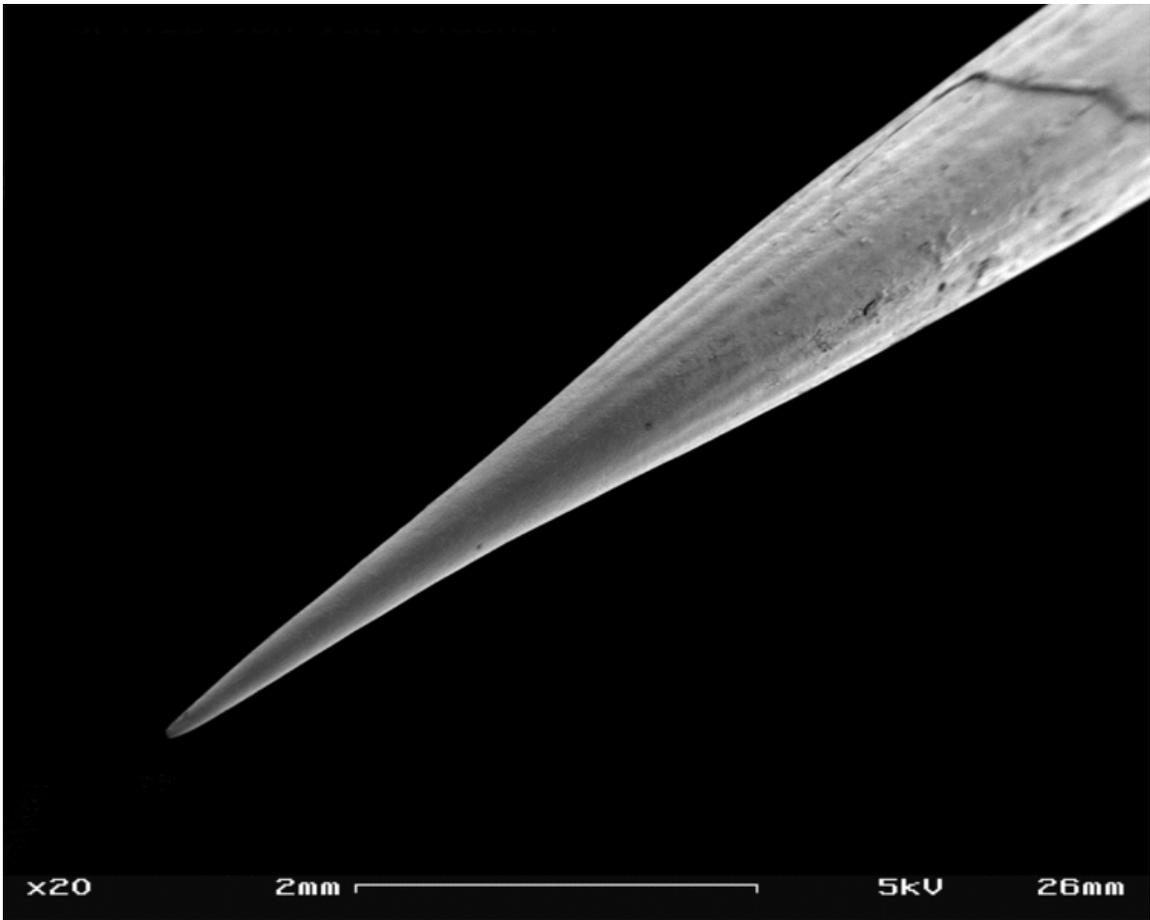
A **hedgehog** is any of the spiny mammals of the subfamily **Erinaceinae** and the order Erinaceomorpha. There are 17 species of hedgehog in five genera, found through parts of Europe, Asia, Africa, and New Zealand. There are no hedgehogs native to Australia, and no living species native to North America; those in New Zealand are introduced. Hedgehogs have changed little over the last 15 million years. Like many of the first mammals they have adapted to a nocturnal, insectivorous way of life. The name 'hedgehog' came into use around the year 1450, derived from the Middle English 'heyghoge', from 'heyg', 'hegge' = hedge, because it frequents hedgerows, and 'hoge', 'hogge' = hog, from its piglike snout. Other names include 'urchin', 'hedgepig' and 'furze-pig' .

Physical description

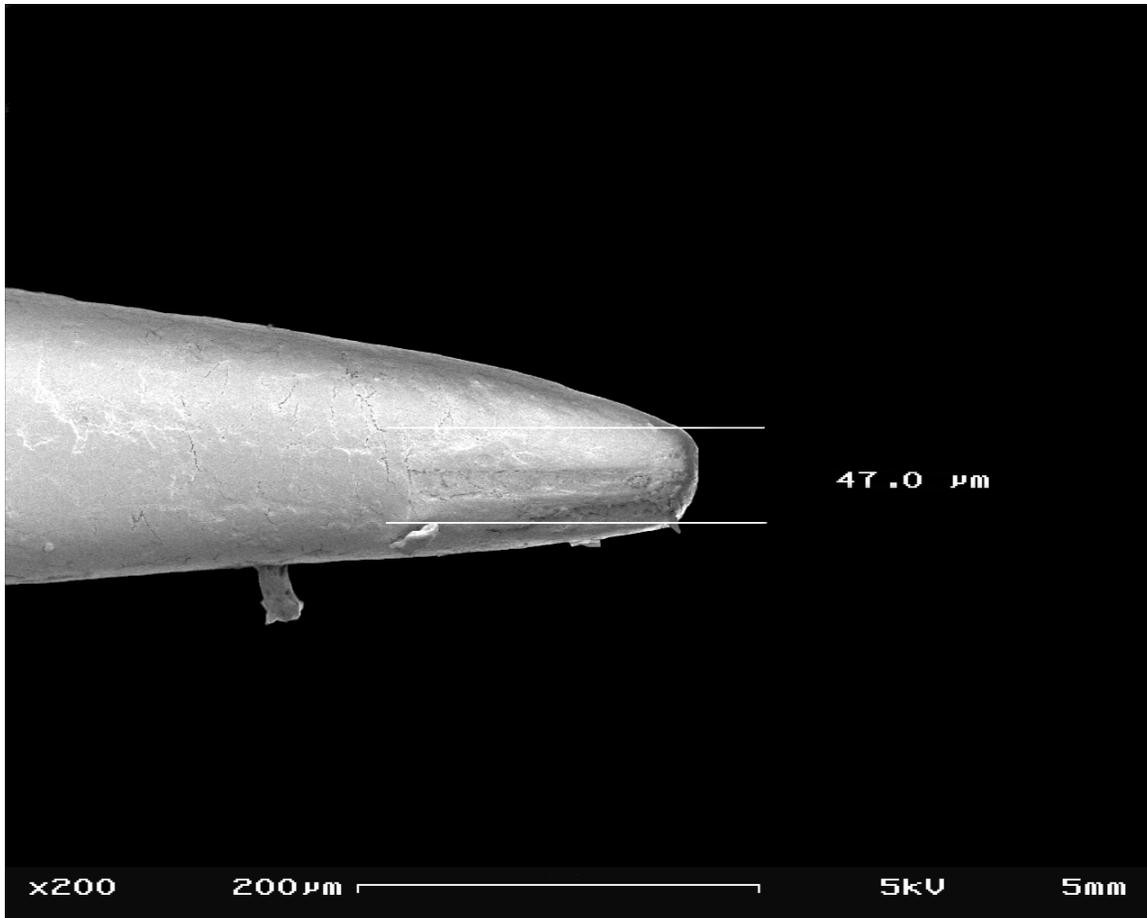
Hedgehogs are easily recognized by their spines, which are hollow hairs made stiff with keratin. Their spines are not poisonous or barbed and, unlike the quills of a porcupine, cannot easily be removed from the hedgehog. However, spines normally come out when a hedgehog sheds baby spines and replaces them with adult spines. This is called "quilling." When under extreme stress or during sickness, a hedgehog can also lose spines.



Hedgehog skeleton



Close-up of the last 5 mm of a hedgehog spine (SEM microscope)



Close-up of the last 0.4 mm of a hedgehog spine in SEM

A defense that all species of hedgehogs possess is the ability to roll into a tight ball, causing all of the spines to point outwards. However, its effectiveness depends on the number of spines, and since some of the desert hedgehogs evolved to carry less weight, they are much more likely to try to run away and sometimes even attack the intruder, trying to ram into the intruder with its spines, and rolling as a last resort. This results in a different number of predators for different species: while forest hedgehogs have relatively few, primarily birds (especially owls) and ferrets, smaller species like the Long-eared Hedgehog are preyed on by foxes, wolves and mongooses.

Hedgehogs are primarily nocturnal, although, depending on the species, they may be more or less active during the day. The hedgehog sleeps for a large portion of the daytime either under cover of bush, grass, rock or in a hole in the ground. Again, different species can have slightly different habits, but in general hedgehogs dig dens for shelter. All wild hedgehogs can hibernate, although not all do; hibernation depends on temperature, species, and abundance of food.

The hedgehog's back is made up of two large muscles, which control the positioning of its quills. There are about 5,000 to 6,500 quills on the average hedgehog, and these are

durable on the outside, while being filled with air pockets on the inside. The hedgehog uses its quills to protect itself from predators, using muscles which draw their quilled skin to cover their full body, and pulling in the parts of their bodies not covered, such as their head, feet, and belly. This form of defense is the hedgehog's most successful, but is usually their last resort.

Hedgehogs have many alternate defense mechanisms. In most situations a hedgehog will flee rather than confront a threat, rolled up in a ball or not. All hedgehogs possess the stamina to run, many can make 4.5 miles per hour or better, and are particularly adept at climbing steep walls, trees, and fences and even swimming.

Hedgehogs are fairly vocal and communicate through a combination of grunts, snuffles and/or squeals, depending on species.



Self-anointing

Hedgehogs occasionally perform a ritual called anointing. When the animal encounters a new scent, it will lick and bite the source, then form a scented froth in its mouth and paste

it on its spines with its tongue. It is unknown what the specific purpose of this ritual is, but some experts believe anointing camouflages the hedgehog with the new scent of the area and provides a possible poison or source of infection to predators poked by their spines. Anointing is sometimes also called anting because of a similar behavior in birds.

Similar to opossums, mice, and moles, hedgehogs have some natural immunity against snake venom due to the protein erinacin in the animal's muscular system.

In captivity, hedgehogs tend to get along with dogs, cats and other pets. On the rare occasions when they do feel threatened by these animals, the hedgehog will roll into a ball until the threatening animal disappears. Still, care should be taken to protect hedgehogs from particularly large, aggressive, or mischievous pets.

Diet



A young European Hedgehog

Although traditionally classified in the now abandoned order Insectivora, hedgehogs are not exclusively insectivores but are almost omnivorous. Hedgehogs feed on insects, snails, frogs and toads, snakes, bird eggs, carrion, mushrooms, grass roots, berries, melons, and watermelons. In fact, berries constitute a major part of an Afghan Hedgehog's diet in early spring after hibernation. The hedgehog is occasionally spotted after a rainstorm foraging for earthworms. Although forest hedgehogs, most well-known to Europeans, are indeed mainly insectivores, this is not necessarily true for other species.

In areas that have hedgehogs in the wild, they are often welcomed as a natural form of garden pest control. Many people leave food out to attract hedgehogs and they will consume tinned cat or dog food (with a preference for chicken flavours, and a dislike of fish), chopped peanuts, and raisins. Pet food is preferable to dairy, but both are often too high in fat and too low in protein. It is best to leave out only a small treat, leaving them plenty of appetite for the pests in one's garden. Hedgehogs will welcome water as they will become quite thirsty. If you are letting a hedgehog drink from a pool, make sure that there is a way out: even though hedgehogs can swim they will get tired and drown. Leaving out milk will cause a hedgehog to have stomach pains.

Reproduction and lifespan



A foraging European Hedgehog

Depending on the species, the gestation period is 35–58 days. The average litter is 3–4 newborns for larger species and 5–6 for smaller ones. As with many animals, it is not unusual for an adult male hedgehog to kill newborn males.

The hedgehog's dilemma is based on the apparent danger of a male hedgehog being injured by a spine while mating with a female hedgehog. However, this is not a problem for hedgehogs, as the male's penis is very near the center of its abdomen (often mistaken for a belly button) and the female can curl her tail upward until her vulva protrudes behind the rest of her body. Thus, the male does not have to get completely on top of the female when mating.

Hedgehogs have a relatively long lifespan for their size. Larger species of hedgehogs live 4–7 years in the wild (some have been recorded up to 16 years), and smaller species live 2–4 years (4–7 in captivity), compared to a mouse at 2 years and a large rat at 3–5 years. Lack of predators and controlled diet contribute to a longer lifespan in captivity (8–10 years depending on size).

Hedgehogs are born blind. The hedgehogs are birthed with a protective membrane covering their quills, which dries and shrinks over the next several hours. The infants are born with quills beneath the skin, like pimples, and pass the skin after they have been cleaned.

Predators

Hedgehog bones have been found in the pellets of the European Eagle Owl.

Domesticated hedgehogs



European Hedgehog being held

The most common pet species of hedgehog are hybrids of the White-bellied Hedgehog or Four-toed Hedgehog (*Atelerix albiventris*) and the North African Hedgehog (*A. algirus*). It is smaller than the European Hedgehog, and thus is sometimes called the African Pygmy Hedgehog. Other species kept as pets are the Long-eared Hedgehog (*Hemiechinus auritus*) and the Indian Long-eared Hedgehog (*H. collaris*).

Domesticated species prefer a warm climate (above 72 °F/22 °C but below 85 °F/29.5 °C) and do not naturally hibernate. They have an insectivorous diet. Commonly, this is replaced with cat food and ferret food and is supplemented by insects and other small animals. Today, many pet stores sell hedgehog mixes that are specifically formulated for hedgehogs. Crickets, mealworms, and pinkies (baby mice) are also favored treats. It is illegal to own a hedgehog as a pet in some U.S. states and some Canadian municipalities, and breeding licenses are required. No such restrictions exist in most European countries with the exception of Scandinavia. However, in the UK wild hedgehogs are considered endangered and it is illegal to keep one as a pet.

The purchase of Domesticated Hedgehogs has seen a considerable increase in the last few years, owing to their apparently innocent and playful looks. Hedgehogs are considered a low-maintenance pet. Their curiosity and need for stimuli make for quick adjustment to their owners, and their eating and waste habits make for a relatively clean housing environment for the pet. Overall they exhibit very few vulnerabilities to species-specific disease (although several do exist) and are easy to care for.

Pest control



European Hedgehog

Hedgehogs are a powerful form of pest control. A single hedgehog can keep an average garden free of pests by eating up to 200 grams of insects each night. It is common throughout the United Kingdom to see people attempting to lure hedgehogs into their gardens with treats and hedgehog-sized holes in their fences.

One problem with using hedgehogs for garden pest control is the use of chemical insecticide. While the hedgehog is large enough to resist most insecticides, it cannot withstand them if it eats many insects which have become full of the poison. This causes many hedgehog deaths where pet hedgehogs eat contaminated bugs within the house.

In areas where hedgehogs have been introduced, such as New Zealand and the islands of Scotland, the hedgehog itself has become a pest. In New Zealand it causes immense

damage to native species including insects, snails, lizards and ground-nesting birds, particularly shore birds. As with many introduced animals, it lacks natural predators. With overpopulation, it kills off more insects than initially intended and expands its diet to include things such as snails, worms, and the eggs of wading birds.

Correcting overpopulation is troublesome itself. Attempts to eliminate hedgehogs from bird colonies on the Scottish islands of North Uist and Benbecula in the Outer Hebrides were met with international outrage. Eradication began in 2003 with 690 hedgehogs being killed. Animal welfare groups attempted rescues to save the hedgehogs. By 2007, legal injunctions against the killing of hedgehogs were put in place. In 2008, the elimination process was changed from killing the hedgehogs to trapping them and releasing on the mainland.

Hedgehog diseases

Hedgehogs suffer many diseases common to humans. These include cancer, fatty liver disease, and cardiovascular disease.

Cancer is very common in hedgehogs. The most common is squamous cell carcinoma. Squamous cell spreads quickly from the bone to the organs in hedgehogs, unlike in humans. Surgery to remove the tumors is rare because it would result in removing too much bone structure.

Fatty liver disease is believed by many to be caused by bad diet. Hedgehogs will eagerly eat foods that are high in fat and sugar. Having a metabolism adapted for low-fat, protein-rich insects, this leads to common problems of obesity. Fatty liver disease is one sign, heart disease is another.

Hedgehogs uncommonly transmit a characteristic fungal skin infection to human handlers as well as other hedgehogs. This ringworm or dermatophytosis infection is caused by *Trichophyton erinacei*, which forms a distinct mating group within the *Arthroderma benhamiae* species complex.

Human influence



A European hedgehog found in Ireland.

As with most small mammals living around humans, cars pose a great threat to hedgehogs. Many are run over as they attempt to cross roadways. Another common human-related fatality is pesticides. Hedgehogs that eat insects filled with pesticides will often develop digestive problems and eventually die.

In 2006, McDonald's changed the design of their McFlurry containers to be more hedgehog-friendly. Previously, hedgehogs would get their heads stuck in the container as they tried to lick the remaining food from inside the cup. Then, being unable to get out, they would starve to death. Domesticated hedgehogs display this behavior by getting their head stuck in tubes (commonly, lavatory paper tubes) and walking around with the tube on their head. Hedgehog owners often refer to this as "tubing" and promote the behavior by supplying clean tubes. Most owners are considerate enough, however, to cut the tubes lengthwise so as to prevent the hedgehog from remaining trapped against their will. Curiously though, some will still knowingly get themselves stuck for a few hours.

Culinary and medicinal use

Hedgehogs are a food source in many cultures. Hedgehogs were eaten in Ancient Egypt, and some recipes of the Late Middle Ages call for hedgehog meat. In the Middle East and

especially among Bedouins, hedgehog meat is considered medicinal, and thought to cure rheumatism and arthritis. Romani people supposedly still eat it, and also use the blood and the fat for its supposed medicinal value. One method for killing the animal suggests holding it up by one of its hind legs and cutting off the tip of its nose when it unrolls, which kills it and drains the blood at the same time. The animal is then cleaned and boiled or roasted.

During the 1980s, "hedgehog-flavour" crisps were introduced in Britain, although the product did not in fact contain any hedgehog.

Genera and species



Long-eared Hedgehog



An urban European hedgehog out foraging at night.



European Hedgehog

Subfamily **Erinaceinae (Hedgehogs)**

- Genus *Atelerix*
 - Four-toed Hedgehog, *Atelerix albiventris*
 - North African Hedgehog, *Atelerix algirus*
 - Southern African Hedgehog, *Atelerix frontalis*
 - Somali Hedgehog, *Atelerix sclateri*
- Genus *Erinaceus*
 - Amur Hedgehog, *Erinaceus amurensis*
 - Southern White-breasted Hedgehog, *Erinaceus concolor*
 - European Hedgehog, *Erinaceus europaeus*

- Northern White-breasted Hedgehog, *Erinaceus roumanicus*
- Genus *Hemiechinus*
 - Long-eared Hedgehog, *Hemiechinus auritus*
 - Indian Long-eared Hedgehog, *Hemiechinus collaris*
- Genus *Mesechinus*
 - Daurian Hedgehog, *Mesechinus dauuricus*
 - Hugh's Hedgehog, *Mesechinus hughii*
- Genus *Paraechinus*
 - Desert Hedgehog, *Paraechinus aethiopicus*
 - Brandt's Hedgehog, *Paraechinus hypomelas*
 - Indian Hedgehog, *Paraechinus micropus*
 - Bare-bellied Hedgehog, *Paraechinus nudiventris*

Chapter 10

Coati

Coati



White-nosed coati *Nasua narica*

Scientific classification

Kingdom:	Animalia
Phylum:	Chordata
Class:	Mammalia
Order:	Carnivora
Family:	Procyonidae
Genus:	<i>Nasua</i> and <i>Nasuella</i>



Range map

Coatis, genera *Nasua* and *Nasuella*, also known as the Brazilian aardvark, Mexican *tejón*, hog-nosed coon, pizotes, crackoons and snookum bears, are members of the raccoon

family (Procyonidae). They are diurnal mammals native to South America, Central America, and south-western North America. The word "coatimundi" is a commonly used misnomer applied to solitary adult males of *N. nasua*. The term is reported to be derived from the Tupi language (Paraguay).

Physical characteristics

Adult coatis measure 33 to 69 cm (13 to 27 in) from head to the base of the tail, which can be as long as their bodies. Coatis are about 30 cm (12 in) tall at the shoulder, and weigh between 2 and 8 kg (4.4 and 18 lb), about the size of a large house cat. Males can become almost twice as large as females and have large, sharp canine teeth. The above measurements are for the white-nosed and South America coatis. The Cozumel Island coati is in the lower range of these measurements, and the two mountain coatis are smaller.

All coatis share a slender head with an elongated, flexible, slightly upward-turned nose, small ears, dark feet, and a long, nonprehensile tail used for balance and signaling.

Ring-tailed coatis have either a light brown or black coat, with a lighter under-part and a white-ringed tail in most cases. Coatis have a long brown tail with rings on it which are anywhere from starkly defined like a raccoon's to very faint. Like raccoons and unlike ring-tailed cats and cacomistles, the rings go completely around the tail. Coatis often hold the tail erect, and it used as such to keep troops of coatis together in tall vegetation. The tip of the tail can be moved a bit on its own, as is the case with cats, but it is not prehensile as is that of the kinkajou, another procyonid.

Coatis have bear- and raccoon-like paws, and coatis, raccoons, and bears walk plantigrade (on the soles of the feet, as do people). Coatis have nonretractable claws. Coatis also are, in common with raccoons and other procyonids (and others in the order Carnivora and rare cases amongst other mammals), double-jointed and their ankles rotatable beyond 180°, and therefore are able to descend trees head first. Other animals living in forests have acquired some or all of these properties through convergent evolution, including members of the mongoose, civet, ferret-skunk, cat, and bear families. Some of these animals walk on the toes of the front paws and soles of the back paws.

The coati snout is long and somewhat pig-like and extremely flexible and can be rotated up to 60° in any direction, the former being part of the reason for its nickname the hog-nosed raccoon. The nose is used to push objects and rub parts of their body. The facial markings include white markings around the eyes and on the ears and snout.

Coatis have strong limbs to climb and dig, and have a reputation for intelligence, like their fellow procyonid, the raccoon. They prefer to sleep or rest in elevated places and niches, like the rainforest canopy, in crudely-built sleeping nests. Coatis are active day and night.

Habitat and range

Overall, coatis are widespread, occupying habitats ranging from hot and arid areas to humid Amazonian rainforests or even cold Andean mountain slopes, including grasslands and bushy areas. Their geographical range extends from the southwestern U.S. (southern Arizona, New Mexico, and Texas) through northern Argentina. Around 10 coatis are thought to have formed a breeding population in Cumbria, UK.

Taxonomy

The following species have been scientifically described:

- **Genus *Nasua***
 - *Nasua narica* (Linnaeus, 1766) – Brown- or white-nosed coati, *pizote*, or *antoon* (Southwestern United States, Mexico, Central America, and Colombia)
 - *Nasua nasua* (Linnaeus, 1766) – South American coati (South America)
 - *Nasua nelsoni* Merriam, 1901 – Cozumel Island coati (Cozumel, Mexico)
- **Genus *Nasuella***
 - *Nasuella meridensis* (Thomas, 1901) – Eastern mountain coati (Venezuela)
 - *Nasuella olivacea* (Gray, 1865) – Western mountain coati (Colombia and Ecuador)

The coati species cited above can be told apart by their size, build, and hide color, in addition to having differing geographical ranges.

Genetic evidence has suggested the genus *Nasuella* should be merged into *Nasua*, as the latter otherwise is paraphyletic. Other genetic studies have shown the closest relatives of the coatis are the olingos.

Lifespan

In the wild, coatis live for about seven to eight years, while in captivity they can live for up to 15 years.

Feeding habits

Coatis are omnivores; their diet consists mainly of ground litter invertebrates and fruit (Alves-Costa *et al.*, 2004, 2007, Hirsch 2007). They also eat small vertebrate prey, such as lizards, rodents, small birds, birds' eggs, and crocodile eggs. The snout, with a formidable sense of smell, assists the skilled paws in a hog-like manner to unearth invertebrates.

Behavior

Little is known about the behavior of the mountain coatis, and the following is almost entirely about the coatis of the genus *Nasua*. Unlike most members of the raccoon family (Procyonidae), coatis are primarily diurnal. Coati females and young males up to two years of age are gregarious and travel through their territories in noisy, loosely-organized bands made up of four to 25 individuals, foraging with their offspring on the ground or in the forest canopy. Males over two years become solitary due to behavioural disposition and collective aggression from the females, and will join the female groups only during the breeding season.

When provoked, or for defense, coatis can be fierce fighters; their strong jaws, sharp canine teeth, and fast scratching paws, along with a tough hide sturdily attached to the underlying muscles, make it very difficult for potential predators (e.g., dogs or jaguars) to seize the smaller mammal.

Coatis communicate their intentions or moods with chirping, snorting, or grunting sounds. Different chirping sounds are used to express joy during social grooming, appeasement after fights, or to convey irritation or anger. Snorting while digging, along with an erect tail, states territorial or food claims during foraging. Coatis additionally use special postures or moves to convey simple messages; for example, hiding the nose between the front paws as a sign for submission; lowering the head, baring teeth, and jumping at an enemy signal an aggressive disposition. Individuals recognize other coatis by their looks, voices, and smells, the individual smell is intensified by special musk-glands on their necks and bellies.

Coatis from Panama are known to rub their own fur and that of other troop members with resin from *Trattinnickia aspera* trees, but its purpose is unclear. Some proposed possibilities are it serves as an insect repellent, a fungicide, or as a form of scent-marking.

Reproduction

Little is known about the behavior of the mountain coatis, and the following is almost entirely about the coatis of the genus *Nasua*. Coati breeding season mainly corresponds with the start of the rainy season to coincide with maximum availability of food, especially fruits: between January and March in some areas, and between October and February in others. During the breeding season, an adult male is accepted into the band of females and juveniles near the beginning of the breeding season, leading to a polygynous mating system.

The pregnant females separate from the group, build a nest on a tree or in a rocky niche and, after a gestation period of about 11 weeks, give birth to litters of three to seven kits. About six weeks after birth, the females and their young will rejoin the band. Females become sexually mature at two years of age, while males will acquire sexual maturity at three years of age.

Natural enemies

Besides humans, the principal predators of coatis are other carnivores. Enemies include jaguarundis, foxes, dogs, tayras, ocelots and jaguars. However, large raptors, such as Ornate Hawk-Eagles, Black-and-chestnut Eagles and Harpy Eagles, also are known to hunt them. White-faced capuchin monkeys also hunt their pups.

Status

Coatis face unregulated hunting and the serious threat of environmental destruction in Central and South America. The absence of scientifically sound population studies of *Nasua* or *Nasuella* in the wild is probably leading to a severe underestimation of the ecological problems and decline in numbers affecting the species.

Successful adaptation to life in human proximity (e.g., similar to raccoons living in metropolitan areas in the U.S.) is very unlikely; the species is thus threatened by habitat destruction.

Coatis in captivity

Coatis are one of five groups of procyonids commonly kept as pets in various parts of North, Central and South America, the others being the raccoons (common and crab-eating), the kinkajou, the ring-tailed cat and cacomistle. However, while both the white-nosed and South America coatis are common in captivity, mountain coatis and the Cozumel Island coati are very rare or absent in captivity.

Coatis are small creatures that can be wild, somewhat difficult to control or train in some cases, and generally behave in a manner radically different from that of a pet dog. Optimally, they should have a spacious outdoor enclosure and a coati-proofed room in the house and/or other climate-controlled place, as well. They can be given the run of the house but need careful watching, more careful in some cases than others.

It is possible to litter or toilet train coatis; if one cannot be trained as such, it is still possible to lessen problems in that they tend to designate a latrine area which can have a litter pan placed in it as is done with many ferrets, pet skunks, rabbits, and rodents. Coatis generally need both dog and cat vaccines for distemper and many other diseases and a killed rabies vaccine. They can be spayed or neutered for the same reason as cats and dogs and other pets.



White-nosed coati at Corcovado National Park, Costa Rica



White-nosed coati at Tikal, Guatemala



South American coati, *Nasua nasua*, in an English zoo



White-nosed coati in Rincón de la Vieja National Park, Costa Rica



South American coati near Iguazu Falls, Brazil



White-nosed coati on Mt. Hopkins near Madera Canyon, Arizona



Coati from zoo in Czech republic



Coati foraging in Playa del Carmen, Mexico

Chapter 11

Opossum

Didelphimorphia

Temporal range: Late Cretaceous–
Recent



Virginia Opossum *Didelphis
virginiana*

Scientific classification

Kingdom: Animalia
Phylum: Chordata
Class: Mammalia
Infraclass: Marsupialia
Order: **Didelphimorphia**
Gill, 1872
Family: **Didelphidae**
Gray, 1821

Opossums are the largest order of marsupials in the Western Hemisphere. They are also commonly called *possums*, though that term is also applied to Australian fauna of the

suborder Phalangeriformes. The Virginia Opossum was the first animal to be named an *opossum*; usage of the name was published in 1610. The word *opossum* comes from the Algonquian *aposooum*, meaning "white beast". Opossums probably diverged from the basic South American marsupials in the late Cretaceous or early Paleocene.

Their unspecialized biology, flexible diet and reproductive strategy make them successful colonizers and survivors in diverse locations and conditions.

Characteristics

Didelphimorphs are small to medium-sized marsupials, with the largest just exceeding the size of a large house cat, and the smallest the size of a small mouse. They tend to be semi-arboreal omnivores, although there are many exceptions. Most members of this taxon have long snouts, a narrow braincase, and a prominent sagittal crest. The dental formula is: $\frac{5.1.3.4}{4.1.3.4}$. By mammalian standards, this is a very full jaw. The incisors are very small, the canines large, and the molars are tricuspid.

Didelphimorphs have a plantigrade stance (feet flat on the ground) and the hind feet have an opposable digit with no claw. Like some New World monkeys, opossums have prehensile tails. Like all marsupials, the fur consists of awn hair only, and the females have a pouch. The tail and parts of the feet bear scutes. The stomach is simple, with a small cecum.

Opossums have a remarkably robust immune system, and show partial or total immunity to the venom of rattlesnakes, cottonmouths, and other pit vipers. Opossums are about eight times less likely to carry rabies than wild dogs, and about one in eight hundred opossums are infected with this virus.

Reproduction and life cycle



Sleeping Virginia opossum with babies in her relaxed pouch

As a marsupial, the opossum has a reproductive system including a divided uterus and marsupium, which is the pouch. Opossums do possess a placenta, but it is short-lived, simple in structure, and, unlike that of placental mammals, is not fully functional. The young are therefore born at a very early stage, although the gestation period is similar to many other small marsupials, at only 12 to 14 days. Once born, the offspring must find their way into the marsupium to hold onto and nurse from a teat. The species are moderately sexually dimorphic with males usually being slightly larger, much heavier, and having larger canines than females. The largest difference between the opossum and other mammals is the bifurcated penis of the male and bifurcated vagina of the female (the source of the Latin "didelphis," meaning double-wombed). Male opossum spermatozoa exhibit cooperative methods of ensuring the survival of genotypically similar sperm by forming conjugate pairs before fertilization. Such measures come into place particularly when females copulate with multiple males. These conjugate pairs increase motility and enhance the likelihood of fertilization. Conjugate pairs dissociate into separate spermatozoa before fertilization. The opossum is one of many species that employ sperm cooperation in its reproductive life cycle.

Female opossums often give birth to very large numbers of young, most of which fail to attach to a teat, although as many as thirteen young can attach, and therefore survive, depending on species. The young are weaned between 70 and 125 days, when they detach

from the teat and leave the pouch. The opossum lifespan is unusually short for a mammal of its size, usually only two to four years. Senescence is rapid.

Diet

Didelphimorphs are opportunistic omnivores with a very broad diet. Their diet mainly consists of carrion and many individual opossums are killed on the highway when scavenging for roadkill. They are also known to eat insects, frogs, birds, snakes, small mammals, and earthworms. Some of their favorite foods are fruits, and they are known to eat avocados, apples, clementines, and persimmons. Their broad diet allows them to take advantage of many sources of food provided by human habitation such as unsecured food waste (garbage) and pet food.



Opossum fur is quite soft.

Behavior

Opossums are usually solitary and nomadic, staying in one area as long as food and water are easily available. Some families will group together in ready-made burrows or even under houses. Though they will temporarily occupy abandoned burrows, they do not dig or put much effort into building their own. As nocturnal animals, they favor dark, secure areas. These areas may be below ground or above.



Didelphis marsupialis: intrusion in human dwelling (French Guiana)



"Playing possum"

When threatened or harmed, they will "play possum", mimicking the appearance and smell of a sick or dead animal. This physiological response is involuntary, rather than a conscious act: sometimes baby opossums' brains do not react, therefore they do not "play dead". When playing possum, the lips are drawn back, teeth are bared, saliva foams around the mouth, and a foul-smelling fluid is secreted from the anal glands. Their stiff, curled form can be prodded, turned over, and even carried away. The animal will regain consciousness after a period of minutes or hours and escape.

Adult opossums do not hang from trees by their tails, as sometimes depicted, though babies may dangle temporarily. Their semi-prehensile tails are not strong enough to support a mature adult's weight. Instead, the opossum uses its tail as a brace and a fifth limb when climbing. The tail is occasionally used as a grip to carry bunches of leaves or bedding materials to the nest. A mother will sometimes carry her young upon her back, where they will cling tightly even when she is climbing or running.

Threatened opossums (especially males) will growl deeply, raising their pitch as the threat becomes more urgent. Males make a clicking "smack" noise out of the side of their mouths as they wander in search of a mate, and females will sometimes repeat the sound in return. When separated or distressed, baby opossums will make a sneezing noise to

signal their mother. If threatened, the baby will open its mouth and quietly hiss until the threat is gone.

Hissing or squawking is a defensive process that helps the opossum keep unwanted guests from bothering them.

In hunting and foodways

The Virginia Opossum was once widely hunted and consumed in the United States where available.

In Dominica and Trinidad the Common Opossum or manicou is popular and can only be hunted during certain times of the year owing to over-hunting. The meat is traditionally prepared by smoking, then stewing. It is light and fine-grained, but the musk glands must be removed as part of preparation. The meat can be used in place of rabbit and chicken in recipes. Historically, hunters in the Caribbean would place a barrel with fresh or rotten fruit to attract opossums that would feed on the fruit or insects.

In Mexico, opossums are known as "tlacuache" or "tlaquatzin". Their tails are eaten as a folk remedy to improve fertility.

Opossum oil (possum grease) is high in essential fatty acids and has been used as a chest rub and a carrier for arthritis remedies given as topical salves.

Opossum pelts have long been part of the fur trade.

Classification

Family Didelphidae

- Subfamily Caluromyinae
 - Genus *Caluromys*
 - Subgenus *Mallodelphys*
 - Derby's Woolly Opossum (*Caluromys derbianus*)
 - Brown-eared Woolly Opossum (*Caluromys lanatus*)
 - Subgenus *Caluromys*
 - Bare-tailed Woolly Opossum (*Caluromys philander*)
 - Genus *Caluromysiops*
 - Black-shouldered Opossum (*Caluromysiops irrupta*)
 - Genus *Glironia*
 - Bushy-tailed Opossum (*Glironia venusta*)
- Subfamily Didelphinae
 - Genus *Chacodelphys*
 - Chacoan Pygmy Opossum (*Chacodelphys formosa*)
 - Genus *Chironectes*
 - Yapok or Water Opossum (*Chironectes minimus*)
 - Genus *Cryptonanus* (translation of Spanish article)

- Agricola's Gracile Opossum (*Cryptonanus agricolai*)
- Chacoan Gracile Opossum (*Cryptonanus chacoensis*)
- Guahiba Gracile Opossum (*Cryptonanus guahybae*)
- Red-bellied Gracile Opossum (*Cryptonanus ignitus*) † 1962
- Unduavi Gracile Opossum (*Cryptonanus unduaviensis*)

○

- Genus *Didelphis*



Skull of a Virginia Opossum, *D. virginiana*

- White-eared Opossum (*Didelphis albiventris*)
- Big-eared Opossum (*Didelphis aurita*)
- Guianan White-eared Opossum (*Didelphis imperfecta*)
- Common Opossum (*Didelphis marsupialis*)
- Andean White-eared Opossum (*Didelphis pernigra*)
- Virginia Opossum (*Didelphis virginiana*)

- Genus *Gracilinanus*

- Aceramarca Gracile Opossum (*Gracilinanus aceramarcae*)
- Agile Gracile Opossum (*Gracilinanus agilis*)
- Wood Sprite Gracile Opossum (*Gracilinanus dryas*)
- Emilia's Gracile Opossum (*Gracilinanus emilae*)
- Northern Gracile Opossum (*Gracilinanus marica*)
- Brazilian Gracile Opossum (*Gracilinanus microtarsus*)

- Genus *Hyladelphys*
 - Kalinowski's Mouse Opossum (*Hyladelphys kalinowskii*)
- Genus *Lestodelphys*
 - Patagonian Opossum (*Lestodelphys halli*)
- Genus *Lutreolina*
 - • Lutrine or Thick-tailed Opossum (*Lutreolina crassicaudata*)
- Genus *Marmosa*
 - Heavy-browed Mouse Opossum (*Marmosa andersoni*)
 - Isthmian Mouse Opossum (*Marmosa isthmica*)
 - Rufous Mouse Opossum (*Marmosa lepida*)
 - Mexican Mouse Opossum (*Marmosa mexicana*)
 - Linnaeus's Mouse Opossum (*Marmosa murina*)
 - Quechuan Mouse Opossum (*Marmosa quichua*)
 - Robinson's Mouse Opossum (*Marmosa robinsoni*)
 - Red Mouse Opossum (*Marmosa rubra*)
 - *Marmosa simonsi*
 - Tyleria Mouse Opossum (*Marmosa tyleriana*)
 - Guajira Mouse Opossum (*Marmosa xerophila*)
 - *Marmosa zeledoni*
- Genus *Marmosops*
 - Bishop's Slender Opossum (*Marmosops bishopi*)
 - Narrow-headed Slender Opossum (*Marmosops cracens*)
 - Creighton's slender opossum *Marmosops creightoni*
 - Dorothea's Slender Opossum (*Marmosops dorothea*)
 - Dusky Slender Opossum (*Marmosops fuscatus*)
 - Handley's Slender Opossum (*Marmosops handleyi*)
 - Tschudi's Slender Opossum (*Marmosops impavidus*)
 - Gray Slender Opossum (*Marmosops incanus*)
 - Panama Slender Opossum (*Marmosops invictus*)
 - Junin Slender Opossum (*Marmosops juninensis*)
 - Neblina Slender Opossum (*Marmosops neblina*)
 - White-bellied Slender Opossum (*Marmosops noctivagus*)
 - Delicate Slender Opossum (*Marmosops parvidens*)
 - Brazilian Slender Opossum (*Marmosops paulensis*)
 - Pinheiro's Slender Opossum (*Marmosops pinheiroi*)
- Genus *Metachirus*

- Brown Four-eyed Opossum (*Metachirus myosuros*)
- Genus *Micoureus* (translation of Spanish article)
 - Alston's Mouse Opossum (*Micoureus alstoni*)
 - White-bellied Woolly Mouse Opossum (*Micoureus constantiae*)
 - Woolly Mouse Opossum (*Micoureus demerarae*)
 - Tate's Woolly Mouse Opossum (*Micoureus paraguayanus*)
 - Little Woolly Mouse Opossum (*Micoureus phaeus*)
 - Bare-tailed Woolly Mouse Opossum (*Micoureus regina*)



Monodelphis domestica

- Sepia Short-tailed Opossum (*Monodelphis adusta*)
- Northern Three-striped Opossum (*Monodelphis americana*)
- Northern Red-sided Opossum (*Monodelphis brevicaudata*)
- Yellow-sided Opossum (*Monodelphis dimidiata*)
- Gray Short-tailed Opossum (*Monodelphis domestica*)
- Emilia's Short-tailed Opossum (*Monodelphis emiliae*)
- Amazonian Red-sided Opossum (*Monodelphis glirina*)
- Ihering's Three-striped Opossum (*Monodelphis iheringi*)

- Pygmy Short-tailed Opossum (*Monodelphis kungsi*)
- Marajó Short-tailed Opossum (*Monodelphis maraxina*)
- Osgood's Short-tailed Opossum (*Monodelphis osgoodi*)
- Hooded Red-sided Opossum (*Monodelphis palliolata*)
- Reig's Opossum (*Monodelphis reigi*)

- • Ronald's Opossum (*Monodelphis ronaldi*)
- Chestnut-striped Opossum (*Monodelphis rubida*)
- Long-nosed Short-tailed Opossum (*Monodelphis scalops*)
- Southern Red-sided Opossum (*Monodelphis sorex*)
- Southern Three-striped Opossum (*Monodelphis theresa*)
- Red Three-striped Opossum (*Monodelphis umbristriata*)
- One-striped Opossum (*Monodelphis unistriata*)

- Genus *Philander*
 - Anderson's Four-eyed Opossum (*Philander andersoni*)
 - Deltaic Four-eyed Opossum (*Philander deltae*)
 - Southeastern Four-eyed Opossum (*Philander frenatus*)
 - McIlhenny's Four-eyed Opossum (*Philander mcilhennyi*)
 - Mondolfi's Four-eyed Opossum (*Philander mondolfii*)
 - Olrog's Four-eyed Opossum (*Philander olrogi*)
 - Gray Four-eyed Opossum (*Philander opossum*)

- Genus *Thylamys* (translation of Spanish article)
 - Cinderella Fat-tailed Mouse Opossum (*Thylamys cinderella*)
 - Elegant Fat-tailed Mouse Opossum (*Thylamys elegans*)
 - Karimi's Fat-tailed Mouse Opossum (*Thylamys karimii*)
 - Paraguayan Fat-tailed Mouse Opossum (*Thylamys macrurus*)
 - White-bellied Fat-tailed Mouse Opossum (*Thylamys pallidior*)
 - Common Fat-tailed Mouse Opossum (*Thylamys pusillus*)
 - Argentine Fat-tailed Mouse Opossum (*Thylamys sponsorius*)
 - Tate's Fat-tailed Mouse Opossum (*Thylamys tatei*)
 - Dwarf Fat-tailed Mouse Opossum (*Thylamys velutinus*)
 - Buff-bellied Fat-tailed Mouse Opossum (*Thylamys venustus*)

- Genus *Tlacuatzin* (translation of Spanish article)
 - Grayish Mouse Opossum (*Tlacuatzin canescens*)

Chapter 12

Skunk

Skunks



Striped skunk

Scientific classification

Kingdom:	Animalia
Phylum:	Chordata
Class:	Mammalia
Order:	Carnivora
Suborder:	Caniformia
Superfamily:	Musteloidea
Family:	Mephitidae Bonaparte, 1845

Genera

Conepatus
Mydaus
Mephitis (type)
Spilogale

Skunks are mammals best known for their ability to secrete a liquid with a strong, foul odor. General appearance varies from species to species, from black-and-white to brown or cream colored. Skunks belong to the family Mephitidae and to the order Carnivora. There are 10 species of skunks, which are divided into four genera: *Mephitis* (hooded and striped skunks, two species), *Spilogale* (spotted skunks, two species), *Mydaus* (stink

badgers, two species), and *Conepatus* (hog-nosed skunks, four species). The two skunk species in the *Mydaus* genus inhabit Indonesia and the Philippines; all other skunks inhabit the Americas from Canada to central South America.

Skunks had been classified as a subfamily within the family Mustelidae, which includes ferrets, weasels, otters and badgers. However, recent genetic evidence suggests that skunks are not as closely related to the mustelids as previously thought; they are now classified in their own family.

Physical description

Skunk species vary in size from about 15.6 to 37 inches (40 to 94 cm) and in weight from about 1.1 pounds (0.50 kg) (spotted skunks) to 18 pounds (8.2 kg) (hog-nosed skunks). They have a moderately elongated body with relatively short, well-muscled legs, and long front claws for digging.

Although the most common fur color is black and white, some skunks are brown or grey, and a few are cream-colored. All skunks are striped, even from birth. They may have a single thick stripe across back and tail, two thinner stripes, or a series of white spots and broken stripes (in the case of the spotted skunk). Some also have stripes on their legs.



A Hooded Skunk Skeleton on Display at The Museum of Osteology

Diet

Skunks are omnivorous, eating both plant and animal material and changing their diet as the seasons change. They eat insects and larvae, earthworms, small rodents, lizards, salamanders, frogs, snakes, birds, moles, and eggs. They also commonly eat berries, roots, leaves, grasses, fungi, and nuts.

In settled areas, skunks also seek human garbage. Less often, skunks may be found acting as scavengers, eating bird and rodent carcasses left by cats or other animals. Pet owners, particularly those of cats, may experience a skunk finding its way into a garage or

basement where pet food is kept. Skunks commonly dig holes in lawns in search of grubs and worms.

Skunks are one of the primary predators of the honeybee, relying on their thick fur to protect them from stings. The skunk scratches at the front of the beehive and eats the guard bees that come out to investigate. Mother skunks are known to teach this to their young.

Behavior

Skunks are crepuscular and are solitary animals when not breeding, though in the colder parts of their range they may gather in communal dens for warmth. During the day, they shelter in burrows that they dig with their powerful front claws, or in other man-made or natural hollows as the opportunity arises. Both genders occupy overlapping home ranges through the greater part of the year; typically 2 to 4 square kilometres (0.77 to 1.5 sq mi) for females, up to 20 square kilometres (7.7 sq mi) for males.

Skunks are not true hibernators in the winter, but do den up for extended periods of time. However, they remain generally inactive and feed rarely, going through a dormant stage. They often overwinter in a huddle of multiple (as many as twelve) females. Males often den alone. The same winter den is often repeatedly used.

Although they have excellent senses of smell and hearing – vital attributes in a crepuscular omnivore – they have poor vision. They cannot see, with any clarity, objects more than about 3 metres (10 ft) away, making them vulnerable to death by road traffic. They are short-lived animals: Fewer than 10% survive for longer than three years.

Reproduction



A striped skunk kit

Skunks typically mate in early spring and are a polygynous species, meaning that (successful) males usually mate with more than one female. Before giving birth (usually in May), the female will excavate a den to house her litter of four to seven kits. They are placental, with a gestation period of about 66 days.

When born, skunk kits are blind, deaf, and covered in a soft layer of fur. About three weeks after birth, their eyes open. The kits are weaned about two months after birth, but generally stay with their mother until they are ready to mate, at about one year of age.

The mother is very protective of her kits and will often spray at any sign of danger. The male plays no part in raising the young and may even kill them.

Anal scent glands

The most notorious feature of skunks is their anal scent glands, which they can use as a defensive weapon. They are similar to, though much more developed than, the glands found in species of the Mustelidae family. Skunks have two glands, one on each side of the anus. These glands produce a mixture of sulfur-containing chemicals such as methyl and butyl thiols traditionally called *mercaptans*, which have a highly offensive smell that can be described as a combination of the odors of rotten eggs, garlic and burnt rubber. The odor of the fluid is strong enough to ward off bears and other potential attackers and

can be difficult to remove from clothing. Muscles located next to the scent glands allow them to spray with a high degree of accuracy, as far as 2 to 5 metres (6.6 to 16 ft). The smell aside, the spray can cause irritation and even temporary blindness and is sufficiently powerful to be detected by a human nose anywhere up to a mile downwind. Their chemical defense, though unusual, is effective, as illustrated by this extract from Charles Darwin's *Voyage of the Beagle*:

We saw also a couple of *Zorrillos*, or skunks—odious animals, which are far from uncommon. In general appearance the *Zorrillo* resembles a polecat, but it is rather larger, and much thicker in proportion. Conscious of its power, it roams by day about the open plain, and fears neither dog nor man. If a dog is urged to the attack, its courage is instantly checked by a few drops of the fetid oil, which brings on violent sickness and running at the nose. Whatever is once polluted by it, is for ever useless. Azara says the smell can be perceived at a league distant; more than once, when entering the harbour of Monte Video, the wind being off shore, we have perceived the odour on board the *Beagle*. Certain it is, that every animal most willingly makes room for the *Zorrillo*.



Western Spotted Skunk also called a zorrillo in Spanish

Skunks are reluctant to use this weapon, as they carry just enough of the chemical for five or six uses – about 15 cc – and require some ten days to produce another supply. Their bold black and white coloring however serves to make the skunk's appearance

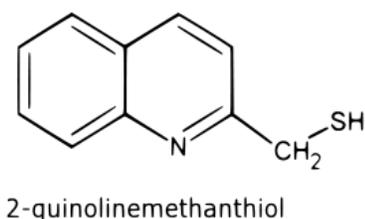
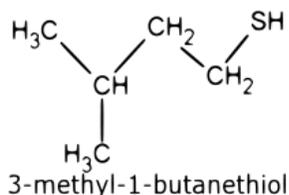
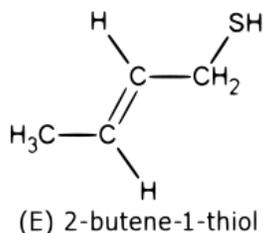
memorable. Where practical, it is to a skunk's advantage simply to warn a threatening creature off without expending scent: black and white warning color aside, threatened skunks will go through an elaborate routine of hisses, foot stamping, and tail-high threat postures before resorting to the spray. Interestingly, skunks usually do not spray other skunks, with the exception of males in the mating season. Though they fight over den space in autumn, they do so with teeth and claws.

The singular musk-spraying ability of the skunk has not escaped the attention of biologists. The names of the family and the most common genus (*Mephitidae*, *Mephitis*) mean "stench," and *Spilogale putorius* means "stinking spotted weasel." The word *skunk* is a corruption of an Abenaki name for them, *segongw* or *segonku*, which means "one who squirts" in the Algonquian language.

Most predatory animals of the Americas, such as wolves, foxes and badgers, seldom attack skunks – presumably out of fear of being sprayed. The exception is the great horned owl – the animal's only serious predator – which, like most birds, has a poor-to-nonexistent sense of smell.

Skunks are common in suburban areas. Frequent encounters with dogs and other domestic animals, and the release of the odor when a skunk is run over, have led to many myths about the removal of the skunk odor. Due to the chemical composition of the skunk spray, most of these household remedies are ineffective, with the exception of a peroxide formula or other remedies that break down the thiols.

Skunk spray is composed mainly of low molecular weight thiol compounds, namely (*E*)-2-butene-1-thiol, 3-methyl-1-butanethiol, and 2-quinolinemethanethiol, as well as acetate thioesters of each of these. These compounds are detectable by the human nose at concentrations of only 10 parts per billion.



Bites

The Centers for Disease Control (CDC) recorded 1,494 cases of rabies in skunks in the United States for the year 2006 — about 21.5% of reported cases in all species. Skunks trail raccoons as vectors of rabies, although this varies regionally (raccoons dominate along the Atlantic coast and eastern Gulf of Mexico, skunks throughout the Midwest and down to the western Gulf, and in California). Despite this prevalence, all recorded cases of human rabies from 1990–2002 are attributed by the CDC to dogs or bats.

Domestication



A domesticated skunk

The keeping of skunks as pets is legal in only certain U.S. states. *Mephitis mephitis*, the striped skunk species, is the most social skunk and the one most commonly domesticated. When a skunk is kept as a pet, its scent gland is surgically removed. Typical life spans for domesticated skunks are longer than wild skunks.

Domesticated skunks can legally be kept as pets in the UK. However, the Animal Welfare Act 2006 has made it illegal to remove their scent glands (it is considered to be a cosmetic operation), thus making them impractical as pets. Many owners abandon skunks in the wild when they discover that vets will no longer perform the operation to remove their scent glands. Without its scent glands, a skunk will have difficulty defending itself from predators.

Classification

Arranged alphabetically.

- **Family Mephitidae**
 - Genus: *Conepatus*

- *Conepatus chinga* – Molina's Hog-nosed Skunk
- *Conepatus humboldtii* – Humboldt's Hog-nosed Skunk
- *Conepatus leuconotus* – American Hog-nosed Skunk
- *Conepatus semistriatus* – Striped Hog-nosed Skunk
- Genus: *Mephitis*
 - *Mephitis macroura* – Hooded Skunk
 - *Mephitis mephitis* – Striped Skunk
- Genus: *Mydaus*
 - *Mydaus javanensis* – Indonesian or Javan Stink Badger (Teledu)
 - *Mydaus marchei* – Palawan Stink Badger
- Genus: *Spilogale*
 - *Spilogale angustifrons* – Southern Spotted Skunk
 - *Spilogale gracilis* – Western Spotted Skunk
 - *Spilogale putorius* – Eastern Spotted Skunk
 - *Spilogale pygmaea* – Pygmy Spotted Skunk

Chapter 13

Rat

Rats

Temporal range: Early Pleistocene
– Recent



The common Brown Rat (*Rattus norvegicus*)

Scientific classification

Kingdom: Animalia
Phylum: Chordata
Class: Mammalia
Order: Rodentia
Superfamily: Muroidea
Family: Muridae
Subfamily: Murinae
Genus: ***Rattus***
Fischer de

Waldheim, 1803

Species

64 species

Synonyms

Stenomys Thomas, 1910

Rats are various medium-sized, long-tailed rodents of the superfamily Muroidea. "True rats" are members of the genus *Rattus*, the most important of which to humans are the black rat, *Rattus rattus*, and the brown rat, *Rattus norvegicus*. Many members of other rodent genera and families are also referred to as rats, and share many characteristics with true rats.

Rats are typically distinguished from mice by their size; rats are generally large muroid rodents, while mice are generally small muroid rodents. The muroid family is very large and complex, and the common terms *rat* and *mouse* are not taxonomically specific. Generally, when someone discovers a large muroid, its common name includes the term *rat*, while if it is small, the name includes the term *mouse*. Scientifically, the terms are not confined to members of the *Rattus* and *Mus* genera, for example, the pack rat and cotton mouse.

Species and description

The best-known rat species are the Black Rat (*Rattus rattus*) and the Brown Rat (*Rattus norvegicus*). The group is generally known as the Old World rats or true rats, and originated in Asia. Rats are bigger than most Old World mice, which are their relatives, but seldom weigh over 500 grams (1.1 lb) in the wild.

The term "rat" is also used in the names of other small mammals which are not true rats. Examples include the North American pack rats, a number of species loosely called kangaroo rats, and others. Rats such as the Bandicoot rat (*Bandicota bengalensis*) are murine rodents related to true rats, but are not members of the genus *Rattus*. Male rats are called *bucks*, unmated females are called *does*, pregnant or parent females are called *dams*, and infants are called *kittens* or *pups*. A group of rats is either referred to as a *pack* or a *mischief*.

The common species are opportunistic survivors and often live with and near humans, therefore they are known as commensals. They may cause substantial food losses, especially in developing countries. However, the widely distributed and problematic commensal species of rats are a minority in this diverse genus. Many species of rats are island endemics and some have become endangered due to habitat loss or competition with the Brown, Black or Polynesian rat.

Wild rodents, including rats, can carry many different zoonotic pathogens, such as *Leptospira*, *Toxoplasma gondii*, and *Campylobacter*. The Black Death is traditionally believed to have been caused by the micro-organism *Yersinia pestis*, carried by the

Tropical Rat Flea (*Xenopsylla cheopis*) which preyed on Black Rats living in European cities during the epidemic outbreaks of the Middle Ages; these rats were used as transport hosts. Other zoonotic diseases linked to pest rodents include Classical swine fever and Foot-and-mouth disease.

The average lifespan of any given rat depends on which species is being discussed, but many only live about a year due to predation.

As pets



A domesticated rat

Specially bred rats have been kept as pets at least since the late 19th century. Pet rats are typically variants of the species Brown rat, but Black rats and Giant pouched rats are also known to be kept. Pet rats behave differently than their wild counterparts depending on how many generations they have been kept as pets. Pet rats do not pose any more of a health risk than pets such as cats or dogs. Tamed rats are generally friendly and can be taught to perform selected behaviors.

As subjects of scientific research



A laboratory rat strain known as a Zucker rat. These rats are bred to be genetically prone to diabetes, the same metabolic disorder found among humans.

In 1895, Clark University in Worcester, Massachusetts (United States) established a population of domestic white brown rats to study the effects of diet and for other physiological studies. Over the years, rats have been used in many experimental studies, which have added to our understanding of genetics, diseases, the effects of drugs, and other topics that have provided a great benefit for the health and wellbeing of humankind. Laboratory rats have also proved valuable in psychological studies of learning and other mental processes (Barnett, 2002), as well as to understand group behavior and overcrowding (with the work of John B. Calhoun on behavioral sink). A 2007 study found rats to possess metacognition, a mental ability previously only documented in humans and some primates.

Domestic rats differ from wild rats in many ways. They are calmer and less likely to bite; they can tolerate greater crowding; they breed earlier and produce more offspring; and their brains, livers, kidneys, adrenal glands, and hearts are smaller (Barnett 2002).

Brown rats are often used as model organisms for scientific research. Since the publication of the Rat Genome Sequence, and other advances such as the creation of a rat SNP chip, and the production of knockout rats, the laboratory rat has become a useful genetic tool, although not as popular as mice. When it comes to conducting tests related to intelligence, learning, and drug abuse, rats are a popular choice due to their high

intelligence, ingenuity, aggressiveness, and adaptability. Their psychology, in many ways, seems to be similar to humans. Entirely new breeds or "lines" of brown rats like the Wistar rat have been bred for use in laboratories. Much of the genome of *Rattus norvegicus* has been sequenced.

In medicine

Rats can serve as zoonotic vectors for certain pathogens and thus cause disease, such as Lassa fever and Hantavirus. *Rattus rattus*, and the rat flea *Xenopsylla cheopis*, are notorious for their role in epidemics of bubonic plague.

In odor detection

Rats have a very good sense of smell and are easy to train, this has led to their use in Landmine and Tuberculosis detection

Taxonomy of Rattus

The genus *Rattus* is a member of the giant subfamily Murinae. There are several other murine genera that are sometimes considered part of *Rattus*: *Lenothrix*, *Anonymomys*, *Sundamys*, *Kadarsanomys*, *Diplothrix*, *Margaretamys*, *Lenomys*, *Komodomys*, *Palawanomys*, *Bunomys*, *Nesoromys*, *Stenomys*, *Taeromys*, *Paruromys*, *Abditomys*, *Tryphomys*, *Limnomys*, *Tarsomys*, *Bullimus*, *Apomys*, *Millardia*, *Srilankamys*, *Niviventer*, *Maxomys*, *Leopoldamys*, *Berylmys*, *Mastomys*, *Myomys*, *Praomys*, *Hylomyscus*, *Heimyscus*, *Stochomys*, *Dephomys*, and *Aethomys*.

The genus *Rattus* proper contains 64 extant species. A subgeneric breakdown of the species has been proposed, but does not include all species.

Species of rats

Genus ***Rattus*** - Typical rats

- *incertae sedis*
 - Annandale's Rat (*Rattus annandalei*) – Indonesia, Malaysia, and Singapore
 - Enggano Rat (*Rattus enganus*) – Indonesia
 - Philippine Forest Rat (*Rattus everetti*) – Philippines
 - Polynesian Rat (*Rattus exulans*) – Fiji and most Polynesian islands, New Zealand, Easter Island, and Hawaii
 - Hainald's Rat (*Rattus hainaldi*) – Indonesia
 - Hoogerwerf's Rat (*Rattus hoogerwerfi*) – Indonesia
 - Korinch's Rat (*Rattus korinchi*) – Indonesia
 - † Maclear's Rat (*Rattus macleari*) – Christmas Island
 - Nillu Rat (*Rattus montanus*) – Sri Lanka

- Molaccan Prehensile-tailed Rat (*Rattus morotaiensis*) – Indonesia
- † Bulldog Rat (*Rattus nativitatis*) – Christmas Island
- Kerala Rat (*Rattus ranjinae*) – India
- New Ireland Rat, *Rattus sanila*
- Andaman Rat (*Rattus stoicus*) – Andaman Islands
- Timor rat (*Rattus timorensis*) – Timor
- *R. norvegicus* group
 - Himalayan Field Rat (*Rattus nitidus*) – Bangladesh, Bhutan, China, India, Indonesia, Laos, Myanmar, Nepal, Palau, the Philippines, Thailand, and Vietnam
 - Brown Rat or Norway Rat (*Rattus norvegicus*) – worldwide except Antarctica
 - Turkestan Rat (*Rattus pyctoris*; obs. *Rattus turkestanicus*) – Afghanistan, China, India, Iran, Kyrgyzstan, Nepal, and Pakistan
- *R. rattus* group
 - Sunburned Rat (*Rattus adustus*) – Enggano Island, Indonesia
 - Sikkim Rat (*Rattus andamanensis*) – Bhutan, Cambodia, China, India, Laos, Myanmar, Nepal, Thailand, and Vietnam
 - Rice-field Rat (*Rattus argentiventer*) – Southeast Asia
 - Summit Rat (*Rattus baluensis*) – Malaysia
 - Aceh Rat, *Rattus blangorum*
 - Nonsense Rat (*Rattus burrus*) – India
 - Hoffmann's Rat (*Rattus hoffmanni*) – Indonesia
 - Koopman's Rat (*Rattus koopmani*) – Indonesia
 - Lesser Rice-field Rat (*Rattus losea*) – China, Laos, Taiwan, Thailand, and Vietnam
 - Mentawai Rat (*Rattus lugens*) – Indonesia
 - Mindoro Black Rat (*Rattus mindorensis*) – Philippines
 - Little Soft-furred Rat (*Rattus mollicomulus*) – Indonesia
 - Osgood's Rat (*Rattus osgoodi*) – Vietnam
 - Palm Rat (*Rattus palmarum*) – India
 - Black Rat (*Rattus rattus*) – worldwide except Antarctica
 - Sahyadris Forest Rat, *Rattus satarae*
 - Simalur Rat (*Rattus simalurensis*) – Indonesia
 - Tanezumi Rat (*Rattus tanezumi*) – Afghanistan, Bangladesh, Cambodia, China, Cocos (Keeling) Islands, Fiji, India, Indonesia, Japan, North Korea, South Korea, Laos, Malaysia, Myanmar, Nepal, Pakistan, the Philippines, Taiwan, Thailand, and Vietnam
 - Tawi-Tawi Forest Rat (*Rattus tawitawiensis*) – Philippines
 - Malayan Field Rat (*Rattus tiomanicus*) – Indonesia, Malaysia, the Philippines, and Thailand
- *R. xanthurus* group
 - Bonthain Rat (*Rattus bontanus*; obs. *Rattus foramineus*) – Indonesia
 - Opossum Rat (*Rattus marmosurus*) – Indonesia
 - Peleng Rat (*Rattus pelurus*) – Indonesia
 - *Rattus salocco*

- Yellow-tailed Rat (*Rattus xanthurus*) – Indonesia
- *R. leucopus* group (New Guinean group)
 - Arfak Rat (Vogelkop Mountain Rat), *Rattus arfakiensis*
 - Western New Guinea Mountain Rat, *Rattus arrogans*
 - Sula Rat (*Rattus elaphinus*) – Indonesia
 - Spiny Ceram Rat (*Rattus feliceus*) – Indonesia
 - Giluwe Rat (*Rattus giluwensis*) – Papua New Guinea
 - Japen Rat (*Rattus jobiensis*) – Indonesia
 - Cape York Rat (*Rattus leucopus*) – Australia, Indonesia, and Papua New Guinea
 - Eastern Rat (*Rattus mordax*) – Papua New Guinea
 - Moss-forest Rat (*Rattus niobe*) – Papua New Guinea, Indonesia
 - New Guinean Rat (*Rattus novaeguineae*) – Papua New Guinea
 - Arianus's Rat, *Rattus omichlodes*
 - Pocock's Highland Rat, *Rattus pococki*
 - Spiny Rat (*Rattus praetor*) – Indonesia, Papua New Guinea, and Solomon Islands
 - Glacier Rat (*Rattus richardsoni*) – Indonesia
 - Stein's Rat (*Rattus steini*) – Indonesia and Papua New Guinea
 - Van Deusen's Rat (*Rattus vandeuseni*) – Papua New Guinea
 - Slender Rat (*Rattus verecundus*) – Indonesia and Papua New Guinea
- *R. fuscipes* group (Australian group)
 - Dusky Rat (*Rattus colletti*) – Australia
 - Bush Rat (*Rattus fuscipes*) – Australia
 - Australian Swamp Rat (*Rattus lutreolus*) – Australia
 - Dusky Field Rat (*Rattus sordidus*) – Australia, Indonesia, and Papua New Guinea
 - Pale Field Rat (*Rattus tunneyi*) – Australia
 - Long-haired Rat (*Rattus villosissimus*) – Australia