# Venomous mammal

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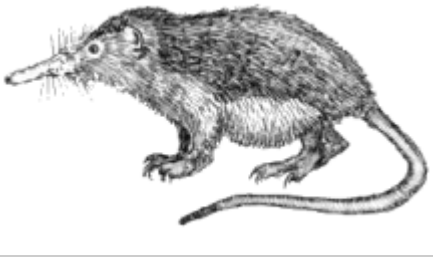
**Venomous mammals** are animals of the class Mammalia that produce venom, which they use to kill or disable prey, or to defend themselves from predators or conspecifics. In modern nature, venomous mammals are rare. Mammalian venoms form a heterogeneous group having different compositions and modes of action and are present in three orders of mammals, Insectivora, Monotremata, and Chiroptera. A fourth order, Primates, is proposed to have venomous representatives.[1] To explain the rarity of venom delivery in Mammalia, Mark Dufton of the University of Strathclyde has suggested that modern mammalian predators do not need venom because they are able to kill quickly with their teeth or claws, whereas venom, no matter how sophisticated, requires time to disable prey.[2]



The Cuban solenodon has a venomous bite.

In spite of the rarity of venom among extant mammals, venom may be an ancestral feature among mammals, as venomous spurs akin to those of the modern platypus are found in most non-therian Mammaliaformes groups.[3]

Venom is much more common among other vertebrates; there are many more species of venomous reptiles (e.g. venomous snakes), and fish (e.g. stonefish). There is no known species of venomous bird. However, some birds are poisonous to eat or touch, and *Sinornithosaurus*, a dinosaur related to birds, may have had a venomous bite.[4] There are only a few species of venomous amphibians; certain salamandrid salamanders can extrude sharp venom-tipped ribs.[5][6]

## Contents

# Definitions

Several definitions of venomous animals have been proposed.[1]

Bücherl states that venomous animals must possess at least one venom gland, a mechanism for excretion or extrusion of the venom, and apparatus with which to inflict wounds.

Mebs states that venomous animals produce venom in a group of cells or gland, and have a tool, the venom apparatus, which delivers the venom by injection during a bite or sting. The venom apparatus in this definition encompasses both the gland and the injection device, which must be directly connected.

Fry et al. stated that a venom is a secretion produced in a specialized gland in one animal and delivered to a target animal through the infliction of a wound. This secretion must contain molecules that disrupt normal physiological processes so as to facilitate feeding or defense by the producing animal. Additionally, the feeding secretion of hematophagous specialists (e.g. vampire bats) may be regarded as a specialized subtype of venom.

# Evolutionary history and paleontology

Venomous mammals may have been more common in the past. Most non-therian mammals possess tarsal spurs akin to those of the modern platypus, suggesting that this feature was very widespread, with gobiconodontids and *Zhangheotherium* being among the clearer examples. The absence of venom spurs in non-Mammaliaformes cynodonts suggests that venom was an ancient mammalian synapomorphy and ancestral characteristic.[7]

Canine teeth dated at 60 million years old from two extinct species, the shrew-like *Bisonalveus browni* and another unidentified mammal, show grooves that some palaeontologists have argued are indicative of a venomous bite. However, other scientists have questioned this conclusion given that many living non-venomous mammals also have deep grooves down the length of their canines (e.g., many primates, coatis and fruit bats), suggesting that this feature does not always reflect an adaptation to venom delivery.[8]

# Examples

## Insectivores

With the exception of vampire bats, insectivores are the only mammals so far observed to produce toxic saliva. These species have significantly enlarged and granular submaxillary salivary glands from which the toxic saliva is produced.[9]

The Cuban solenodon (*Solenodon cubanus*) and Hispaniolan solenodon (*Solenodon paradoxus*) look similar to large shrews. They both have venomous bites; the venom is delivered from modified salivary glands via grooves in their second lower incisors. It was reported that death was frequent among Hispaniolan solenodons kept together in the same enclosure, with bite marks on their feet being the only observable cause. Such use in competition may be a secondary aspect of the insectivore venom.[1]

The northern short-tailed shrew (*Blarina brevicauda*), Mediterranean water shrew (*Neomys anomalus*), and Eurasian water shrew (*Neomys fodiens*) are capable of delivering a venomous bite. Other American short-tailed shrews: the Southern short-tailed shrew (*Blarina carolinensis*), Elliot's short-tailed shrew (*Blarina hylophaga*), and Everglades short-tailed shrew (*Blarina peninsulae*) and the Transcaucasian water shrew (*Neomys teres*)

possibly also have a venomous bite. Shrews cache various prey in a comatose state, including earthworms, insects, snails, and to a lesser extent, small mammals such as voles and mice. This behaviour is an adaption to winter. In this context, the shrew venom acts as a tool to sustain a living hoard, thus ensuring food supply when capturing prey is difficult. This is especially important considering the high metabolic rate of shrews. Arguments against this suggest that the venom is used as a tool to hunt larger prey. Insectivores have an enhanced dependence on vertebrate food material, which is larger and more dangerous than their power to weight ratio would allow, thus requiring an extra asset to overcome these difficulties.[9] Extant shrews do not have specialized venom delivery apparatus. Their teeth do not have channels, but a concavity on the first incisors may collect and transmit saliva from the submaxillary ducts, which open near the base of these teeth.[10]

The Northern short-tailed shrew is one of several venomous shrews.

The European mole (*Talpa europaea*), and possibly other species of mole,[11] have toxins in their saliva that can paralyze earthworms, allowing the moles to store them alive for later consumption.[12]

## Male platypus

Both male and female platypodes (*Ornithorhyncus anatinus*) hatch with keratinised spurs on the hind limbs, although the females lose these during development. The spurs are connected to the venom-producing crural glands, forming the crural system. During the mating season these glands become highly active, producing venom to be delivered by the channeled spur. Echidnas, the other monotremes, have spurs but no functional venom glands. Although not potent enough to be lethal to humans, platypus venom is nevertheless so excruciating that victims may sometimes be temporarily incapacitated. Platypus envenomation was fairly common when the animal was still hunted for its fur. Nowadays any close contact with the animal is rare and restricted to biologists, zookeepers and fishermen (who occasionally catch them in lines or nets).[1]

The calcaneous spur found on the male platypus's hind limb is used to deliver venom.

When platypodes attack, they drive their hind legs together with considerable force so that the spurs are embedded in the flesh caught between and if venom is being produced, a few milliliters are injected by repeated jabbing.[13] The spurs have enough strength to support the weight of the platypus, which often hangs from the victim, requiring assistance for removal.

Most of the evidence now supports the proposition that the venom system is used by males on one another as a weapon when competing for females, taking part in sexual selection. During this season, males become more aggressive and are found with punctures in their bodies, especially in the tail region. Adult male platypodes also largely avoid each other.[1]

Platypus venom is likely retained from its distant non-monotreme ancestors, being the last living example of what was once a common characteristic among mammals.[14]

### Vampire bats

The definition of venom by Fry et al. (see Definitions) regards the feeding secretions of hematophagous (blood eating) specialists as a particular subtype of venom. In this context, the subfamily Desmodontinae represents the venomous mammals from the order Chiroptera. This group comprises the most well known venomous bat, the common vampire bat (*Desmodus rotundus*) and two other rare species, the hairy-legged vampire bat (*Diphylla ecaudata*) and the white-winged vampire bat (*Diaemus youngi*). These bats produce toxic saliva with anticoagulant properties and have a series of anatomical and physiological adaptations to allow nourishment based solely on blood. The majority of their prey do not perish from the attack or contact with the venom. Because it causes only minor discomfort for the prey, it can be argued that the vampire bat saliva is not a true venom.[1]

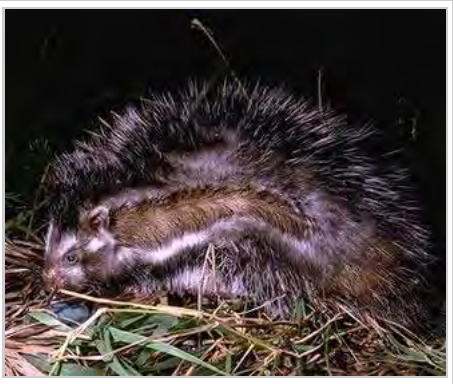
## Arguably venomous mammals

### Primates

Slow lorises (*Nycticebus coucang*, *Nycticebus bengalensis*) and pygmy slow lorises (*Nycticebus pygmaeus*), are arboreal prosimians. They are considered indirectly or secondarily venomous, because their venom is produced in the brachial gland on the inside of the elbows, licked, and injected into the victim by a specialized tooth comb.[15] A protein in the secretion, which is similar to the allergen protein isolated from the domestic cat, may be introduced by the bites of these lorises, resulting in anaphylaxis. The brachial gland is a specialized apocrine sweat gland and the tooth comb is a set of spaced incisors on the lower jaw, primarily used for grooming. The lack of physical connection between the brachial gland and the tooth comb makes it hard for lorises to fit in most of the definitions of a venomous animal. Additionally, this “venom” is toxic only for some incidentally susceptible species.[1]

### Insectivores

Hedgehogs (*Erinaceinae*) anoint their spines with a range of toxic and irritating substances. They will sometimes kill toads (*Bufo*), bite into the toads' poison glands and smear the toxic mixture on their spines.[16][17][18]


The African crested rat smears toxins on its flank hairs.

The African crested rat (*Lophiomys imhausi*) has a mane of long, coarse black-and-white banded hairs which extends from the top of the animal's head to just beyond the base of the tail. This mane is bordered by a broad, white-bordered strip of hairs covering an area of glandular skin on the flank. When the animal is threatened or excited, the mane erects and this flank strip parts, exposing the glandular area. The hairs in this flank area are highly specialised; at the tips they are like ordinary hair, but are otherwise spongy, fibrous, and absorbent. The rat is known to deliberately chew the roots and bark of the Poison-arrow tree (*Acokanthera schimperi*), so-called because human hunters extract the toxin, ouabain, from them to coat arrows that can kill an elephant. After the rat has chewed the tree, it deliberately slathers the resulting mixture onto its specialised flank hairs which are adapted to rapidly absorb the poisonous mixture, acting like a lamp wick. It thereby creates a defense mechanism that can sicken or even kill predators which attempt to bite it.[18][19][20][21]

Tenrecs, which are similar in appearance to hedgehogs but from a different line of evolutionary descent, may also have separately evolved self-anointing behaviour.[16]

# Chemical defense

Skunks can eject a noxious fluid from glands near their anus. It is not only foul smelling, but can cause skin irritation and, if it gets in the eyes, temporary blindness. Some members of the mustelid family, such as the striped polecat (*Ictonyx striatus*), also have this capacity to an extent. Pangolins can also emit a noxious smelling fluid from glands near the anus. The greater long-nosed armadillo can release a disagreeable musky odor when threatened.

# See also

- Venomous fish
- Toxicofera - The clade that contains all venomous species of reptile.
- Toxic birds
- List of venomous animals
- Venomous snakes
- Poisonous amphibians

# References

## Notes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# External links

- Shrew handbook (http://wildlifedamage.unl.edu/handbook/handbook/allPDF/mam_d87.pdf)
- Shrew venom (http://members.vienna.at/shrew/cult-poison.html)
- Northern short-tailed shrew venom (http://pubs.acs.org/cen/critter/8242shrews.html)
- Platypus venom (http://www.kingsnake.com/toxinology/old/mammals/platypus.html)
- Slow Loris Research (http://www.kingsnake.com/toxinology/loris/slow_loris.html) by a toxicologist - includes photos.
- Slow loris venom (http://www.bbc.co.uk/iplayer/episode/b01bcp7z/Natural_World_20112012_Jungle_Gremlins_of_Java/)