

Scorpiones

An order of the Arachnida characterized by chelate pedipalps and chelicerae (pincerlike appendages), pectines (feathery chemo- and mechanoreceptors used to survey the texture of the ground surface and detect pheromones), and a narrow, flexible postabdomen bearing a venomous segment (telson) with a terminal sting (aculeus).

Morphology

The scorpion body is divided into a cephalothorax (prosoma), covered by an unsegmented carapace, and a segmented abdomen (opisthosoma) (Figs. 1 and 2). The opisthosoma is differentiated into an anterior preabdomen (mesosoma) and a postabdomen (metasoma), which, together with the telson, constitutes the "tail" or cauda. The cephalothorax bears the chelicerae, pedipalps, and four pairs of walking legs. The preabdomen contains seven segments, the postabdomen five. One pair of small, simple median eyes (ocelli) and, depending on the species, 2–5 (usually 3) pairs of anterolateral eyes are situated on the carapace. Troglotic (cave-dwelling) scorpions lack all or some eyes (usually the median pair). Each of the seven preabdominal segments is covered by a tergite, the ventral segments by a sternite. The genital aperture, covered by the genital operculum, opens ventrally on the first segment. A small, quadrate basal piece articulates laterally with the pectines on the second segment. The lateral areas of sternites III–VI possess four pairs of oblique, oval slits, the openings (spiracles) of the internal respiratory organs (book lungs).

Fig. 1 Scorpion, *Smeringurus mesaensis* (Stahnke, 1957), adult male. (a) Dorsal view. (b) Ventral view. (Photos by Randy Mercurio and Steve Thurston; copyright © American Museum of Natural History)

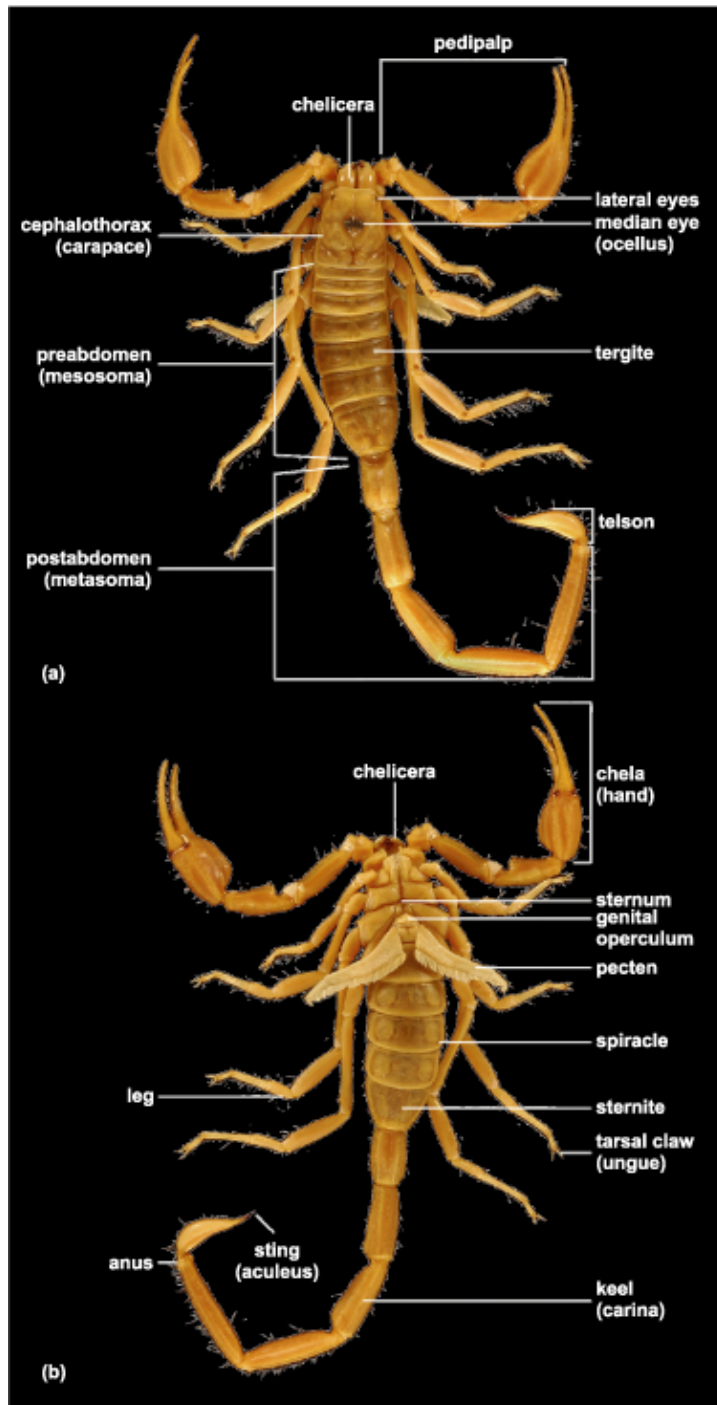


Fig. 2 Scorpion, *Hadrurus arizonensis* (Ewing, 1928), adult male. (Photo by Randy Mercurio; copyright © American Museum of Natural History)



Classification

Scorpions are derived from amphibious ancestors that lived in the Silurian, more than 400 million years ago. Paleozoic scorpions closely resemble modern descendants in anatomical details, except that some were considerably larger. *Brontoscorpio anglicus* measured approximately 1 m (3.3 ft) in length. Scorpions were formerly considered the sister group of other arachnids because they closely resemble extinct marine eurypterids (the sister group of arachnids) but recent data suggest that scorpions are embedded in the arachnid lineage, and merely retain primitive features.

Approximately 1490 extant species of scorpions, placed in 170 genera, and between 13 and 20 families (depending on the authority), have been described worldwide. They vary in color from translucent through tan or brown to black, or combinations thereof, and in size from 10 mm to 21 cm (0.4–8.3 in.).

Distribution

Scorpions occur on all continents except Antarctica, but are most abundant and diverse in tropical and subtropical regions, especially in desert and semidesert habitats. They also occur in savannas and grasslands, in deciduous, coniferous, and tropical rainforests, on high mountain slopes (above 5500 m, 18,000 ft, elevation) in the Alps, Himalayas, and Andes; in some of the deepest caves (nearly 1000 m, 3300 ft, below the surface), and in the intertidal zone. Although most scorpions are terrestrial, some are arboreal. Favored habitats include burrows (up to 1 m, or 3.3 ft, deep, to escape hot diurnal temperatures), spaces under tree bark, logs, stones, and in rock crevices. Some species adapt well to human environments. Scorpions are often abundant in suitable habitats. Densities of 1 per square meter were reported for the Middle Eastern *Leiurus quinquestriatus* and of 8–12 per square meter for the intertidal *Serradigitus littoralis* from Baja California.

Ecology

Scorpions are primarily nocturnal. All fluoresce under long–wave ultraviolet light, facilitating their collection and observation at night. Their simple eyes detect luminosity, but little else. Prey are detected with slit sense organs in the tarsi, sensory setae (trichobothria) on the pedipalps, and the pectines, and are attacked with the chelate pedipalps or venomous sting. Scorpions with slender pedipalps are prone to sting their prey, those with robust pedipalps to crush prey mechanically, reserving the sting for large or strong prey. All use the pedipalps to manipulate prey, tearing pieces off with the chelicerae to be digested in a preoral cavity before being sucked into the gut.

Scorpions are important consumers in some communities. *Scorpio maurus* was reported to eat an annual average of 11% of the Israeli isopod population; *Urodacus yaschenko*i consumes 7.9 kg/ha (7.8 lb/acre) of invertebrate prey in Australia. Cannibalism and predation by other scorpion species may be the most important sources of scorpion mortality, but other invertebrate predators (such as centipedes) and vertebrates are also important predators. Mortality is highest immediately after birth, lower for individuals of intermediate age, and high for adults (65%, 30%, and 60% per year, respectively, for the Australian *Urodacus manicatus*). Mortality is particularly high among males due to increased mobility during the breeding season and cannibalism by females. Skewed adult sex ratios of 1.2–1.4:1 are typical. Social behavior occurs rarely in species of *Heterometrus*, *Opisthacanthus*, and *Pandinus*, in which family groups with overlapping generations cooperate to construct and occupy communal burrows, inhabited by individuals of various ages.

Reproduction and development

Reproduction in scorpions is indirect. Intromission occurs via a spermatophore. The male attaches the spermatophore to the substrate while grasping the female by the pedipalps or chelicerae during a mating dance or "promenade–aux–deux." The species–specific spermatophore catapults the sperm mass into the female gonopore when a lever is touched (a lock–and–key mechanism). All scorpions are viviparous (live–bearing). Embryos develop in the reproductive tract and

receive nourishment from maternal tissues. Some are parthenogenetic. Scorpions have low reproductive rates in comparison to other terrestrial arthropods and are among the most long-lived. Gestation times are long (several months to more than a year) and litter sizes small (1–105). Young are fairly large at birth and helpless (altricial), clinging to the mother for the first few molts before dispersing. Time to sexual maturity varies from 2 to 8 years, depending on the species. Average longevity is 4–5 years, but larger species may live 25–30 years. Scorpions do not molt as adults.

Small litter sizes, long generation times, and low survivorship among sexually immature females contribute to a low rate of population increase for most scorpions. Many are habitat specific, range-restricted, and sensitive to environmental degradation, exacerbating their risk of extinction due to human activities, including habitat destruction and harvesting for the souvenir and exotic pet trades.

Toxicity

Scorpion venoms contain multiple low-molecular-weight proteinaceous neurotoxins that block sodium and potassium channels, preventing the transmission of nerve impulses across synapses. Scorpion envenomation represents a significant cause of morbidity and mortality in some regions (such as Mexico, North Africa, and the Middle East). Some 100,000 scorpion stings occur annually in Mexico, killing as many as 800 people (mostly young children and the elderly). The figures may be even higher in North Africa and the Middle East. However, most scorpions are harmless. The sting may be painful, but not dangerous. About 25 species, all in the family Buthidae, are considered medically important worldwide. Most of these occur in the New World genera *Centruroides* and *Tityus*, and the Old World genera *Androctonus*, *Buthus*, *Leiurus*, *Mesobuthus* and *Parabuthus*. *Centruroides exilicauda*, from Arizona, California, and New Mexico, is the only species known to be lethal in the United States. The venom of these scorpions has proved fatal to healthy children up to 16 years of age and to adults suffering from hypertension and general debility.

Morphology

Scorpions are prominent in mythology and folklore. A classical zodiacal constellation is named after scorpions. The toxicity and fearsome appearance of scorpions contribute to a fascination that has always and continues to surround them. See also: Arachnida

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For Further Study

Topic Page: >> Biological & Biomedical Science: >> Zoology: Arthropoda

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