Scorpiones (Scorpions)

QUICK FACTS

Kingdom: Animalia

Major Group*: Protostomia

Phylum: Arthropoda

Subphylum: Chelicerata

Class: Arachnida

Order: Scorpiones

* Term not part of ITIS taxonomy

Common Name: Scorpion

Description:

Arachnid with chelate pedipalps and chelicerae, pectines, and a narrow, flexible postabdomen bearing a telson with a terminal sting.

NEWS
JOURNALS

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- Scorpions glow to sense.
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Evolution and Systematics

Scorpions are among the most ancient terrestrial arthropods, derived from amphibious ancestors that lived in the Middle Silurian, around 425 million years ago. Paleontologists maintain that early fossil scorpion species inhabited shallow tropical seas, implying that terrestrial scorpions invaded land independently of other arachnids; when this invasion occurred, however, is unclear.

Based on an extensive fossil record, which includes marine Silurian deposits, coal deposits from the Carboniferous, and Cretaceous amber, the scorpion “ground plan” has changed little over time. The external morphology of fossil scorpions closely resembles that of modern descendants, although some of the oldest forms possessed compound lateral eyes (like insects) and digitigrade walking legs (like crustaceans), as well as gills instead of book lungs, and they may have lacked pectines.

Scorpions were traditionally placed at the base of the arachnid evolutionary tree, as the closest relatives of all other arachnids, because they resemble extinct marine eurypterids (sea scorpions), the closest relatives of arachnids. Analyses of living species, based on morphology and DNA, suggest that scorpions are embedded deep within Arachnida, forming a natural group (Stomothecata) with harvestmen (Opiliones), and merely retain some of the primitive features of sea scorpions. This placement, however, becomes ambiguous when fossil scorpions are added to the analyses. Although the position of scorpions within the evolutionary tree of Chelicerata remains uncertain, there is no dispute that scorpions are a natural group, united by eleven unique features.

Scorpions are characterized by chelate pedipalps and chelicerae, pectines (chemo- and mechanoreceptors used to survey the texture of the ground surface and detect pheromones), and a narrow, flexible postabdomen bearing a telson with pair of venom glands and a terminal sting (aculeus). The cuticle of the scorpion exoskeleton contains coumarin, and the hemolymph contains hemocyanin for oxygen transport.

Scorpions are the fifth-most diverse order of arachnids in number of described species, but the known diversity is grossly underestimated. Estimates of total diversity run as high as 7,000 species. There are two reasons for this underestimate. (1) Scorpions are cryptic, seasonal, habitat specific, and difficult to collect without appropriate methods. Most habitats in which they occur have not been surveyed in appropriate seasons or with appropriate methods. (2) Scorpion species are often difficult to delimit. Scorpion taxonomists rely more than most arachnologists on the subspecies category. Although there are notable exceptions, scorpion genitalia provide insufficient characters at the species level in many families, so taxonomists traditionally resorted to subspecies for apportioning somatic variation. Many scorpion subspecies can be diagnosed using somatic characters, however, and represent good species that need to be elevated.

The approximately 2,000 described living species in approximately 180 genera and 18 families (depending on the authority) constitute a natural group that diversified in the Carboniferous (299 to 359 million years ago); 111 species, 71 genera, and 42 families of extinct scorpions predate this lineage. Unusually for arachnids, there are more scorpion species known from the Paleozoic than the Mesozoic or Cenozoic.

The phylogeny and higher classification of living scorpions is contentious and unstable. It is widely agreed that the earliest split separates Buthidae from all other “nonbuthid” families. This ancient divergence, supported by differences in male genitalia, sternum morphology, and the pattern of pedipalp trichobothria (sensory setae), as well as DNA sequence data, predates the breakup of Pangaea. Buthidae is the largest, most widely distributed scorpion family, comprising nearly half of scorpion diversity, with approximately ninety genera and 925 species, as well as almost all medically important scorpion species. A basal split between mostly New and Old World buthid genera has also been confirmed.

The superfamily Scorpionoidea, comprising six nonbuthid families (Diplocentridae, Heteroscorpionidae, Hemiscorpiidae, Liochelidae, Scorpionidae, and Urodacidae) uniquely characterized by katoikogenic embryological development, is also generally agreed to form a natural group. Katoikogenic scorpions occur mostly in the Old World and include many of the largest and most impressive scorpions, including those with advanced subsocial behavior and communal burrow construction. The Gondwanan family Bothriuridae, comprising species from South America, Africa and Australia, in turn appears to be most closely related to the katoikogenic lineage.

The phylogenetic relationships, generic placement, and familial composition of other nonbuthid scorpions, especially the “chactoid” families, which comprise about a quarter of scorpion diversity, including the most common North American species, remain to be satisfactorily assessed and justified with modern methods.

Two enigmatic nonbuthid families, Chaerilidae and Pseudochactidae, are of particular importance for resolving the basal relationships of living scorpions. Chaerilidae comprises a single genus and approximately thirty-five species endemic to tropical South and Southeast Asia. Pseudochactidae comprises three monotypic genera from Central Asia (Tajikistan and Uzbekistan) and Southeast Asia (Laos and Vietnam). Each family displays a different combination of buthid and nonbuthid characters, including unique pedipalp trichobothrial patterns. Mounting evidence suggests that Pseudochactidae and Chaerilidae are, respectively, the closest relatives of Buthidae and the other nonbuthid families.

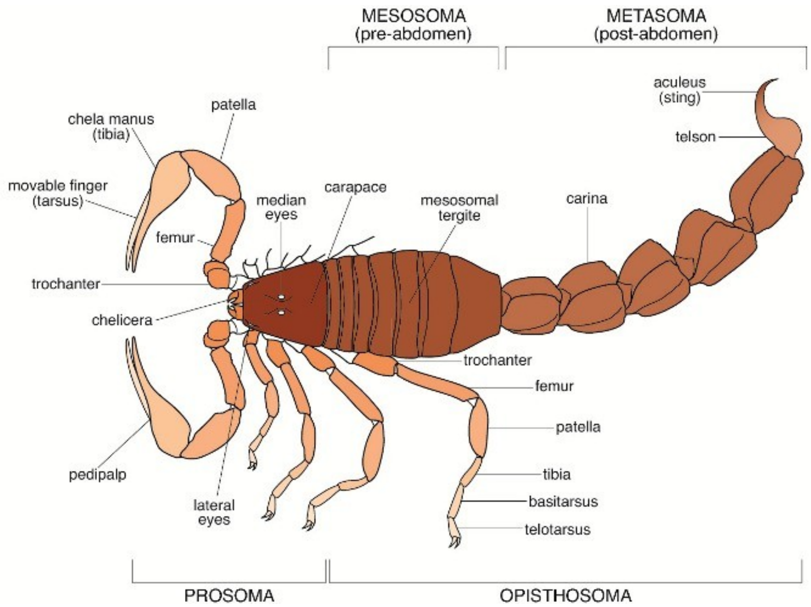
Fossil scorpions, far more diverse than living forms, are pivotal to resolving the phylogenetic position of scorpions and the basal lineages of living species, but their phylogeny and classification are also controversial and largely decoupled from that of living species. A revision of fossil scorpion diversity is needed to integrate those species into the phylogeny and classification of living scorpions.

Physical Characteristics

The scorpion body includes a cephalothorax (prosoma), which is covered by an unsegmented carapace and is broadly joined to a segmented abdomen (opisthosoma). The opisthosoma is differentiated into an anterior preabdomen (mesosoma) and a postabdomen (metasoma), which, together with the telson, constitute the “tail,” or cauda.

PHOTOS ILLUSTRATIONS

A scorpion (*Opistophthalmus wahlbergii*) in defensive posture. Ann & Steven Toon Wildlife Photography.



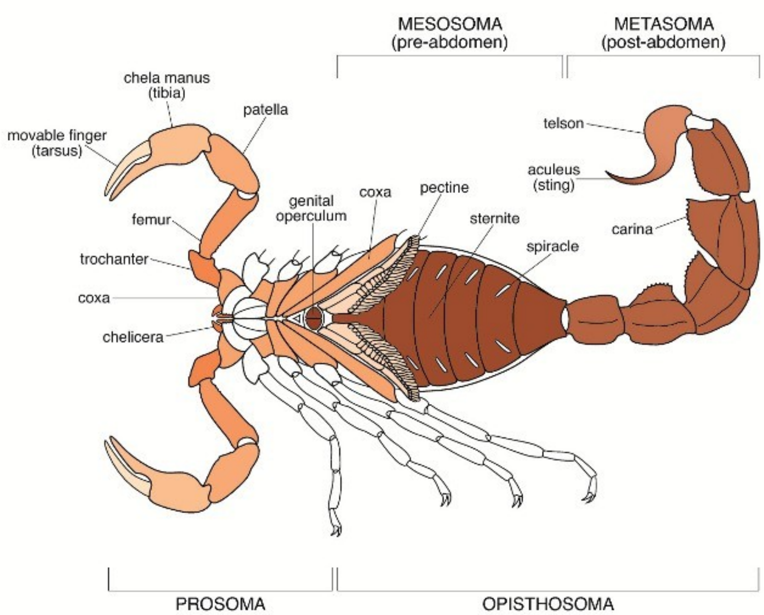
Scorpion Dorsal View. Illustration by Alexandra Westrich.

One pair of small, simple median eyes (ocelli) and, depending on the species, two to five (usually three) pairs of anterolateral eyes are situated on the carapace. Troglobitic (cave-living) scorpions lack all or some eyes (usually the median pair).

The cephalothorax bears the chelicerae, pedipalps, and four pairs of walking legs. Each chelicera comprises three segments, including a chela manus with fixed finger and a movable finger. Each pedipalp comprises a coxa, trochanter, femur, patella, chela manus with fixed finger (tibia), and movable finger (tarsus). Each walking leg comprises a coxa, trochanter, femur, patella, tibia, basitarsus, and telotarsus, terminating in a pair of ungues (claws). A series of trichobothria, the number and positions of which are taxonomically informative, is present on the pedipalp femur, patella, and tibia (chela manus and fixed finger).

The preabdomen includes seven segments (somites). Each somite is covered dorsally by a tergite and ventrally by a sternite. The genital aperture, covered by the genital operculum, opens ventrally on the first segment and bears a pair of papillae in the males of many species. A small, quadrate basal piece articulates laterally with the pectines on the second segment. The lateral areas of sternites III to VI possess four pairs of oblique, oval slits, which are the openings (spiracles or stigmata) of the internal respiratory organs (book lungs).

The postabdomen includes five metasomal segments, the last of which contains the anus and bears the telson. The telson consists of the vesicle, which holds a pair of venom glands, and the hypodermic aculeus, the venom-injecting sting. All scorpion species possess venom, which is used to kill or paralyze prey and as a defense against predators. The venom is a mixture of compounds (neurotoxins, enzyme inhibitors, etc.) each not only causing a different effect but also possibly targeting a specific animal. Each compound is made and stored in the venom glands and released, in a quantity regulated by the scorpion, through a pair of pores on the sting.



Scorpion Ventral View. Illustration by Alexandra Westrich.

Scorpions vary in color from translucent (unpigmented) through tan and brown to black, with combinations thereof (e.g., mottled, striped, or variegated, with pale legs and/or pedipalps contrasting with dark body or vice versa). Raised, linear, often darkened and/or granular ridges, called “keels,” or carinae, on the surfaces of the carapace, tergites, sternites, metasoma, pedipalps, and legs are taxonomically informative. Regardless of coloration, all scorpions fluoresce under long-wave ultraviolet light, because of the presence of two compounds (beta-carboline and 7-hydroxy-4-methylcoumarin) in the exocuticle. Fluorescence occurs as a result of sclerotization and increases in intensity with successive instars. The functional significance of the fluorescence remains unclear.

Hadogenes troglodytes (family Liochelidae) holds the length record for scorpions, at 8.3 in (21 cm), as a result of the narrow, elongated metasoma of the adult male. Several other species of the family Scorpionidae are shorter but heavier, including *Opistophthalmus gigas*, 6.3 in (16 cm); *Heterometrus swammerdami*, 6.6 in (16.8 cm); and *Pandinus imperator*, 7.1 to 7.9 in (18 to 20 cm). Although these scorpions are the world's largest living arachnids, some fossil species were an order of magnitude larger. For example, *Brontoscorpio anglicus* measured approximately 3.3 ft (1 m) in length.

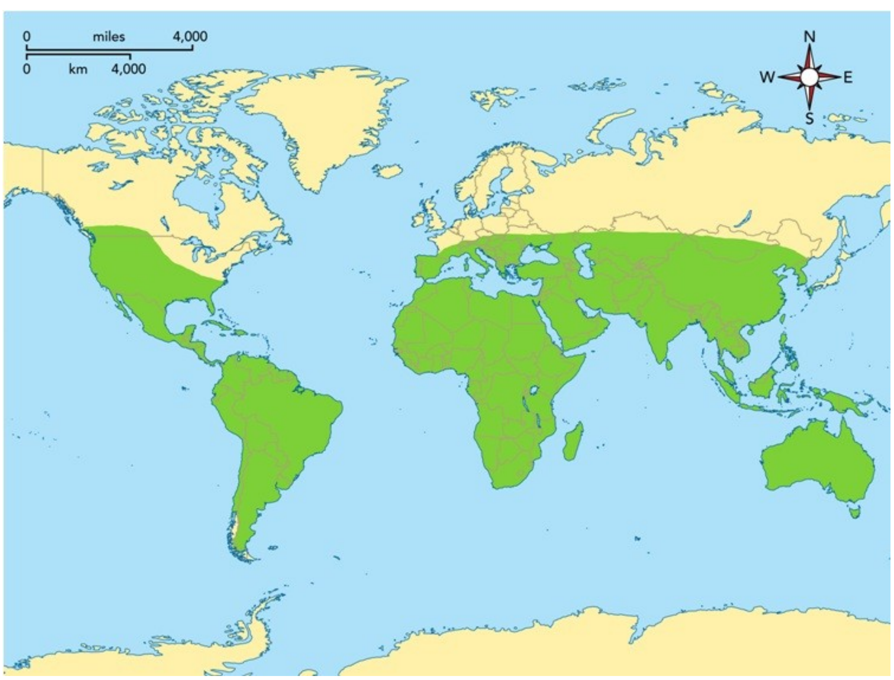
Distribution

Scorpions occur on all major terrestrial landmasses except Antarctica, as well as on many islands, but are most abundant and diverse in tropical and subtropical regions. Scorpions did not occur naturally in Great Britain, Japan, New Zealand, and some of the islands in Oceania (e.g. Hawaii), but have been accidentally introduced by human trade and commerce.

The greatest diversity of scorpions in the Northern Hemisphere occurs in subtropical latitudes between 23ºN and 38ºN. Diversity decreases northward of these latitudes. *Paruroctonus boreus* reaches 50ºN in British Columbia and Alberta in Canada, *Euscorpius germanus* reaches the Southern Alps of Europe, and *Mesobuthus eupeus* reaches 50ºN in Central Asia (Kazakhstan). Colonies of *Euscorpius flavicaudis*, established at Sheerness (51ºN) on the Isle of Sheppey, Great Britain, since the 1860s, represent the northernmost record for scorpions in the wild. The southern limits of scorpion distribution occur at the tip of the South American mainland in Patagonia (scorpions are absent from Tierra del Fuego and Chile south of Chiloe Island), the Cape Peninsula and Cape Agulhas in Africa, and the island of Tasmania, off the southeast coast of Australia.

Scorpion distribution has a strong biogeographical signal. For example, the families Chaerilidae and Pseudochactidae are restricted to Asia; Heteroscorpionidae to Madagascar; Urodacidae to Australia; and Vaejovidae to North America. Some families have disjunct distributions. For example, the family Bothriuridae occurs in South America, Africa, and Australia; Diplocentridae in the Middle East, the Caribbean, North America, Central America, and northern South America; Liochelidae in South America, Africa, Madagascar, India, and Australasia; and Scorpionidae in Africa, India, and Southeast Asia. Only three scorpion genera are shared between the New and Old World. Two of these genera (*Ananteris, Opisthacanthus*) are probably artificial. The third genus is represented in the New World only by a cosmotropical species (*Isometrus maculatus*).

The point diversity (the number of species co-occurring at one site) of scorpions peaks in subtropical deserts and is particularly high (six or seven on average; fourteen maximum) in Baja California and southern Africa. Two to five species per site is typical elsewhere.



Scorpion Distribution Map

The distributions of most scorpion species are restricted, sometimes markedly so, with many species known from single localities. However, several widespread "tramp" species exist. For example, *Liocheles australasiae* occurs throughout the Indo-Pacific tropics, from India to the Solomon Islands, and *Isometrus maculatus* is recorded from tropical and subtropical coastlines of continents and islands throughout the Atlantic, Indian, and Pacific Oceans.

Habitat

Scorpions prefer areas with temperature ranges of 68ºF to 99ºF (20ºC to 37ºC), but many species survive in areas of extreme heat and cold. *Scorpiops* species from the

Himalayas, *Orobothriurus* and *Urophonius* species from the Andes and Patagonia, and *Euscorpius* species from central Europe all survive winter temperatures of about -13ºF (-25ºC). Buthid scorpions from the Palearctic deserts of North Africa and Asia inhabit areas where temperatures fluctuate from -24ºF to 122ºF (-31ºC to 50ºC).

The greatest abundance and diversity of scorpions occurs in desert, semidesert, and savanna habitats, but they also occur in grasslands; in deciduous, coniferous, and tropical rain forests; on high mountain slopes in the Alps, Andes, and Himalayas (the altitude record is 16,110 ft [4,910 m] above sea level in the Andes—not 18,040 ft [5,500 m] as often reported); in some of the world's deepest caves (nearly 0.6 mi [1 km] below the surface); and in the intertidal zone. Scorpions are absent from boreal ecosystems such as the tundra, the high-altitude taiga, and permanently snow-covered mountaintops.

Although most scorpions are terrestrial, some are arboreal, inhabiting trees sometimes several meters above ground. Favored microhabitats include burrows (up to 3.3 ft (1 m) deep, to escape hot diurnal temperatures); holes in trees or logs; spaces under tree bark, logs, and stones; and rock crevices. Many species opportunistically use the burrows of other animals, including other scorpions.

Scorpions are often abundant in suitable habitat. Densities of one per square meter were reported for the Middle Eastern species *Leiurus quinquestriatus* and of eight to twelve per square meter for the intertidal species *Serradigitus littoralis* from Baja California.

Most scorpions are equilibrium species, inhabiting pristine habitats. A few tolerate disturbance, however, and adapt well to human environments. Many of the world's medically important species are synanthropic (associated with human habitation).

Behavior

Although most scorpions are superficially similar, with their morphology reflecting a hunting lifestyle, many are adapted to their habitat. Several families (e.g., Diplocentridae, Scorpionidae, and Urodacidae) are dominated by short-legged, heavy-set species equipped for excavating burrows in hard ground. Hairy, often streamlined species, modified for walking on and burrowing in loose sand, evolved in the sand dunes of North America (Vaejovidae), South America (Bothriuridae), sub-Saharan Africa (Buthidae, Scorpionidae), the Palearctic region from the Sahara to the deserts of Central Asia (Buthidae), and Australia (Urodacidae). Gracile, dorsoventrally compressed species, adapted for life in rock cracks, crevices, and talus slopes, also evolved independently in eight families around the world. Approximately forty cave-specialist scorpions, including eyeless, depigmented troglobites, are known, mostly from Mexico and Southeast Asia.

In addition to creating or selecting microhabitats that shelter them from harsh environments (e.g., excavating burrows or hiding under stones), many scorpions have remarkable behavioral and physiological adaptations for enduring extreme climatic conditions in the arid or montane ecosystems they inhabit. Some can withstand high diurnal temperatures (up to 122ºF [50ºC]), low nocturnal temperatures (they are able to supercool), and low relative humidity. Desert species can endure up to eighteen months without food or water and can remain underground for up to nine months in a state of diapause. Fossorial species can withstand up to forty-eight hours submerged underwater during times of flooding.

Scorpions are primarily nocturnal, sheltering during the day in the relative cool of underground holes or below rocks, and coming out at night to hunt and feed. Most species are active on warm, moonless nights when there is a high abundance of insect prey and a low risk of predation by vertebrate predators. Scorpions exhibit photophobic behavior, primarily to evade detection by vertebrate predators. The simple eyes of scorpions detect luminosity, but little else. Scorpions rely mostly on slit sense organs in the leg tarsi, pedipalp trichobothria, and the pectines to detect the vibrations and air currents caused by approaching prey, predators, and mates.

Although scorpions rely primarily on the venomous sting and, in some species, the powerful pedipalp chelae, some also produce sounds (by stridulation or percussion) to deter would-be predators.

Most scorpion species are solitary. Many are aggressive and cannibalistic, even toward their own kin. Subsocial behavior occurs in some species of *Heterometrus*, *Opisthacanthus*, and *Pandinus*: family groups with overlapping generations cooperate to construct and occupy communal burrows, which are inhabited by fifteen to twenty individuals of various ages. Aggregations of twenty to thirty individuals of buthid scorpions such as *Centruroides*, *Mesobuthus*, and *Uroplectes* have also been found in the winter months. Communication between members of the same species relies mostly on pheromones, vibrational techniques (percussion), and physical contact.

Feeding Ecology and Diet

Scorpions are generalist, opportunistic predators, eating almost anything they can overpower. Typical prey includes other terrestrial arthropods, especially insects and arachnids, as well as scorpions of the same or different species and (in many nonbuthid scorpion families) myriapods and terrestrial isopods. One Australian species, *Isometroides* *vescus*, reportedly specializes on trapdoor spiders. Scorpions have also been recorded catching and/or eating annelid worms, mollusks, and small vertebrates (including mammals, reptiles, frogs, and birds).

Prey is attacked and killed using the chelate pedipalps, venomous sting, or a combination thereof. Scorpions with slender pedipalps (for example, species of the family Buthidae) are more prone to sting their prey than those with robust pedipalps (for example, species of the family Scorpionidae), which usually crush prey mechanically. All scorpions conserve venom and venom toxins by reserving the sting for large and/or struggling prey and regulating the amount and content of venom injected.

The pedipalps are used to manipulate prey. The chelicerae are used to tear pieces off for mastication and digestion in a preoral cavity below the chelicerae and carapace. Scorpions ingest food in liquid form; they have external digestion. Digestive juices from the gut are egested onto the food and the digested liquid sucked into the gut. Indigestible solid matter (exoskeleton, fur, scales, etc.) is trapped by setae in the preoral cavity and later ejected.

Scorpions may consume large quantities of food at a sitting. They have an efficient food storage organ and a low metabolic rate combined with a relatively sedentary lifestyle. Scorpions also excrete very little waste, consisting mostly of insoluble nitrogenous compounds such as xanthine, guanine, and uric acid. These factors allow many species to survive long periods without food, up to three years in some cases.

Scorpions are often abundant in suitable habitat and are thus important consumers in ecological food webs. In arid ecosystems, they are dominant predators, important for controlling invertebrate populations, and are themselves important prey for other organisms. *Scorpio maurus* was reported to eat an annual average of 11 percent of the Israeli terrestrial isopod population, while *Urodacus yaschenkoi* was found to eat about 7.05 lb per acre [7.9 kg per hectare] 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 (e.g., centipedes) and vertebrates (e.g., owls, mongooses, possums, rodents, and lizards) are also important predators. Mortality is highest immediately after birth, lower for individuals of intermediate age, and high for adults; for example, for the Australian species *Urodacus manicatus*, these figures were found to be, respectively, 65 percent, 30 percent, and 60 percent per year. Mortality is particularly high among males because of increased mobility during the breeding season and cannibalism by females. Female-biased adult sex ratios of 1.2 to 1.4:1 are typical.

Reproductive Biology

Most scorpion species have male and female individuals and reproduce sexually. Males are rare or unknown, however, in *Liocheles australasiae* and several buthid species in the genera *Hottentotta* and *Tityus*, which usually reproduce through parthenogenesis, a process whereby unfertilized eggs develop into living embryos. Parthenogenesis is facultative in some of these species; sexual reproduction between males and females occurs in some populations.

Reproduction in scorpions is indirect; intromission occurs via a spermatophore. Scorpions possess a complex courtship and mating ritual to effect the transfer of a spermatophore from male to female. Male scorpions locate and identify females of the same species using a combination of pheromones, vibrational communication, and physical contact. Courtship aborts unless each has satisfied the other that they are the correct species and the opposite sex.

Courtship begins with a “dance” known as the *promenade à deux*, where the male grasps the female’s pedipalps with his own and leads the female around while searching for a place to deposit his spermatophore. Depending on the species, the courtship ritual may involve other behaviors such as a cheliceral “kiss,” where the male grasps the female’s chelicerae with his own; juddering, a rocking back and forth motion; and a “sexual sting,” where the male injects a small amount of venom into the female, probably as a means of pacification.

When the male has identified a suitable substrate, he deposits the spermatophore, which attaches with an adhesive “foot.” He then guides the female over the spermatophore until it enters her genital aperture. The species-specific spermatophore catapults the sperm mass into the female gonopore when a lever or trigger is touched (a lock-and-key mechanism). Fertilization is internal.

The courtship process can endure from one to more than twenty-five hours and depends on the ability of the male to find a suitable place to deposit the spermatophore. If courtship is protracted, the female may lose interest, breaking off the process. Male and female separate after mating, and the male retreats to avoid sexual cannibalism, which is fairly uncommon.

Scorpions resemble large vertebrates in life-history traits and are considered K-selected. They are unusual among arthropods in that all are viviparous—embryos develop inside the reproductive tract of the female and receive nourishment from yolk or maternal tissues. Two forms of embryonic development occur in scorpions. Katoikogenic development, where embryos develop in diverticula of the ovariuterus and obtain nutrition through specialized connections with digestive caeca, is restricted to the superfamily Scorpionoidea. Apoikogenic development, where embryos develop in the ovariuterine lumen (considered primitive), is exhibited by all other scorpion families.

Scorpions have very low reproductive rates in comparison with other terrestrial arthropods. Gestation times are long (several months to more than a year) and litter sizes often small (varying from one to 105, depending on the species). The size of the litter depends on the species and environmental factors, with an average of around eight offspring. Scorpion young, born singly, are large at birth and altricial, clinging to their mother until they have undergone at least one molt, before dispersing. Young scorpions cannot survive naturally without their mother before the first molt, as they depend on her for protection and to regulate their moisture levels. In many species, especially those with advanced subsocial behavior, young may remain associated with the mother long after the first molt. Even after dispersing, the offspring of many scorpions, especially fossorial species, may not move far from the mother. Philopatry—for example, where a maternal burrow is surrounded by the burrows of her offspring—leads to the development of patchily distributed local populations (demes) among which there is limited gene flow and a high potential for the evolution of new species over time.

Young scorpions generally resemble their parents. Growth is accomplished by periodic molting of the exoskeleton (ecdysis). A scorpion's developmental progress is measured in instars (the number of molts it has undergone). Scorpions have a finite number of instars. They typically require between five and seven molts to reach sexual maturity, and they do not molt thereafter. Molting commences with a split in the old exoskeleton just below the edge of the carapace (at the front of the prosoma). The scorpion then emerges from this split; the pedipalps and legs are first removed from the old exoskeleton, followed eventually by the metasoma. When the individual emerges, the new exoskeleton is soft, making the scorpion vulnerable to attack. The scorpion must constantly stretch while the new exoskeleton hardens to ensure that it can move when the hardening is complete. The process of hardening is called sclerotization. The soft, new exoskeleton does not fluoresce; as sclerotization occurs, the fluorescence gradually returns.

Scorpions are among the most long-lived terrestrial arthropods. Time to sexual maturity varies from two to eight years. Average longevity is around four years, but larger species live twenty-five to thirty years (twenty-five years is the maximum reported life span in the species *Hadrurus arizonensis*, while the life span of *Hadogenes* and *Urodacus* species are estimated at twenty-five to thirty years).

Conservation Status

Scorpions are charismatic "flagship" species for programs aimed at conserving terrestrial invertebrates. As K-selected, equilibrium species, comprising a major group of predatory arthropods (especially in arid ecosystems), scorpions are biological indicators. Their disappearance is a signal of habitat degradation. 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 scorpion species are habitat specific and range-restricted, exacerbating their risk of extinction due to human activities.

Scorpions are increasingly threatened by habitat destruction and harvesting for the souvenir and exotic pet trades. For example, approximately 105,000 live *Pandinus imperator* individuals are exported annually from three West African countries to pet shops in Europe, the United States, and Japan; the species is listed on Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). At least another fifty scorpion species, originating from various African, Asian, and New World countries, are offered for sale on the exotic pet market; the most sought-after fetch up to $300 each. Few scorpions receive formal protection, and many may disappear before being described. The threats to many scorpion species renders the task of inventorying their diversity and distribution an urgent priority if steps toward their conservation are to be implemented.

Significance to Humans

Scorpions are prominent in mythology and folklore. The toxicity and fearsome appearance of scorpions, notwithstanding the great age of their lineage, contribute to the fascination that has always and continues to surround them.

Among the earliest occurrences of the scorpion in culture is its inclusion, as Scorpio, in the twelve constellations of the Zodiac by the Sumerians and Babylonians, some 5,000 years ago. Scorpions are portrayed on countless objects from the ancient civilizations of the Assyrians, Aztecs, Egyptians, Etruscans, Greeks, Incas, Mayas, Romans, and Phoenicians, the most famous being the Egyptian goddess, Serket, often depicted as a scorpion. The scorpion often appears as a motif in art, especially in the Middle East. In the cultures of North Africa and India, it is perceived both as an embodiment of evil and as a protective force against evil, and may also portray human sexuality. *Alacranes*, as scorpions are called in many Latin American countries, are a frequent element in sculptures, pictures, objects, songs, and tattoos.

Scorpions are also an integral part of popular Western culture. Scorpio is the eighth component of the modern astrological horoscope and is linked to people born between October 23 and November 21. Scorpions feature on or in numerous books and films. The name *scorpio*, *scorpion*, or *scorpions* has been adopted by rock music bands, police squads, and models of cars and car tires, among others.

Scorpions are notorious worldwide. Excepting the disease-spreading mites, they are the most dangerous arachnids. Scorpion venoms contain multiple low-molecular-weight proteinaceous neurotoxins that block sodium and potassium channels, preventing the transmission of nerve impulses across synapses. In regions in which scorpion envenomation (scorpionism) represents a significant cause of morbidity and mortality (including Mexico, Brazil, North Africa, and the Middle East), scorpions are justifiably feared. Some 100,000 envenomations occur annually in Mexico, and up to 800 people (mostly young children and the elderly) die. The figures may be even higher in North Africa and the Middle East. Most scorpions are harmless, however. The sting may be painful, rather like a wasp or hornet sting, but not life endangering. *Centruroides exilicauda*, found in 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 sixteen years of age and to adults suffering from hypertension and general debility. Overall, about twenty-five species, mostly Buthidae, are considered medically important. Most of these occur in two New World genera (*Centruroides* and *Tityus*) and five Old World genera (*Androctonus*, *Buthus*, *Leiurus*, *Mesobuthus*, and *Parabuthus*).

Besides their essential roles in natural ecosystems in controlling terrestrial invertebrate populations and serving as prey for other terrestrial invertebrate and vertebrate animals, scorpions are of some direct benefit to humans. Scorpions form part of the diet of some tribal peoples in Africa, Asia, and the New World. Several species are also harvested and/or reared commercially for food, including *Mesobuthus martensii* in China and *Heterometrus* species in Southeast Asia. Scorpions are also used in folk medicine in many parts of the world, especially as antidotes for scorpion stings (e.g., scorpion wine in China). Scorpions are commercially reared and milked for their venoms, the neurotoxins of which are increasingly recognized for their pharmacological potential. For example, peptides from *Centruroides* venom are effective suppressants for autoimmune diseases such as multiple sclerosis, type I diabetes, psoriasis, inflammatory bowel disease, and rheumatoid arthritis, while peptides from *Leiurus* venom, once loaded with radioactive iodine, promise treatment for cancerous brain gliomas.

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