

Phasmida

(Stick and leaf insects)

Class Insecta
Order Phasmida
Number of families 8

Photo: A leaf insect (*Phyllium bioculatum*) in Japan. (Photo by ©Ron Austing/Photo Researchers, Inc. Reproduced by permission.)



Evolution and systematics

The oldest fossil specimens of Phasmida date to the Triassic period—as long ago as 225 million years. Relatively few fossil species have been found, and they include doubtful records. Occasionally a puzzle to entomologists, the Phasmida (whose name derives from a Greek word meaning “apparition”) comprise stick and leaf insects, generally accepted as orthopteroid insects. Other alternatives have been proposed, however. There are about 3,000 species of phasmids, although in this understudied order this number probably includes about 30% as yet unidentified synonyms (repeated descriptions). Numerous species still await formal description.

Extant species usually are divided into eight families, though some researchers cite just two, based on a reluctance to accept Bradley and Galil’s 1977 rearrangement of the order. There are three suborders, the Anareolatae, Areolatae, and Timematodea. The Areolatae has five families, thought to be distinguished from the Anareolatae by the presence of a sunken area on the underside of the mid-tibia and hind tibia, but this is not always a reliable feature. The families include the Phylliidae (4 genera, 36 known species), Aschiphasmatidae (18 genera, c. 100 species), Bacillidae (48 genera, c. 230 species), Heteronemiidae (1 genus, 2 species), and Pseudophasmatidae (51 genera, c. 300 species). Two large families, the Diapheromeridae (180 genera, c. 1,600 species) and the Phasmatidae (100 genera, c. 700 species), represent the

Anareolatae. The Timematodea has only one family, the Timematidae (1 genus, 21 species). These small stick insects are not typical phasmids, having the ability to jump, unlike almost all other species in the order. It is questionable whether they are indeed phasmids, and phylogenetic research is not conclusive. Studies relating to phylogeny are scarce and limited in scope. The eggs of each phasmid are distinctive and are important in classification of these insects.

Physical characteristics

Stick insects range in length from *Timema cristinae* at 0.46 in (11.6 mm) to *Phobaeticus kirbyi* at 12.9 in (328 mm), or 21.5 in (546 mm) with legs outstretched. Numerous phasmid “giants” easily rank as the world’s longest insects. The largest leaf insect is *Phyllium (Pulchriphyllium) giganteum* from Malaysia, at 4.4 in (113 mm), while the smallest is *Nanophyllium pygmaeum*, at only 1.1 in (28 mm).

The elongate stick insects typically resemble twigs, and leaf insects (Phylliidae) look like broadened, flat leaves, providing one of the best camouflages in the animal world. Phasmids are smooth, scarcely or heavily granulated, and sometimes with extensive spines and tubercles. The legs are similar to one another. Cerci usually are short. Females often are larger than the typically very thin males. Wings are present in many species, but they may be shortened or even absent. While they



A Malaysian species, *Tagesoidea nigrofascia*, flashes its brilliant yellow wings in the face of a predator. (Illustration by Emily Damstra)

frequently are green or brown to better match vegetation, phasmids sometimes are brightly colored or boldly striped. Species with colorful hind wings rank among the most spectacular of all insects.

Most stick insects belong to the Diapheromeridae and Phasmatidae. The Diapheromeridae are a mixture of winged and wingless species, while the Phasmatidae include the world's longest insects as well as more bulky, often winged, insects. The Asian Aschiphematidae are mainly winged, although the forewings are usually only a stalk-like structure. The Bacillidae includes spectacular, broad-bodied species. The Neotropical Pseudophasmatidae have many beautiful winged species to rival Asian winged representatives of the Diapheromeridae. The Heteronemiidae has recently been reduced to only a single wingless genus. The leaf insects (Phylliidae) are mainly from Southeast Asia, although some have successfully spread elsewhere.

Distribution

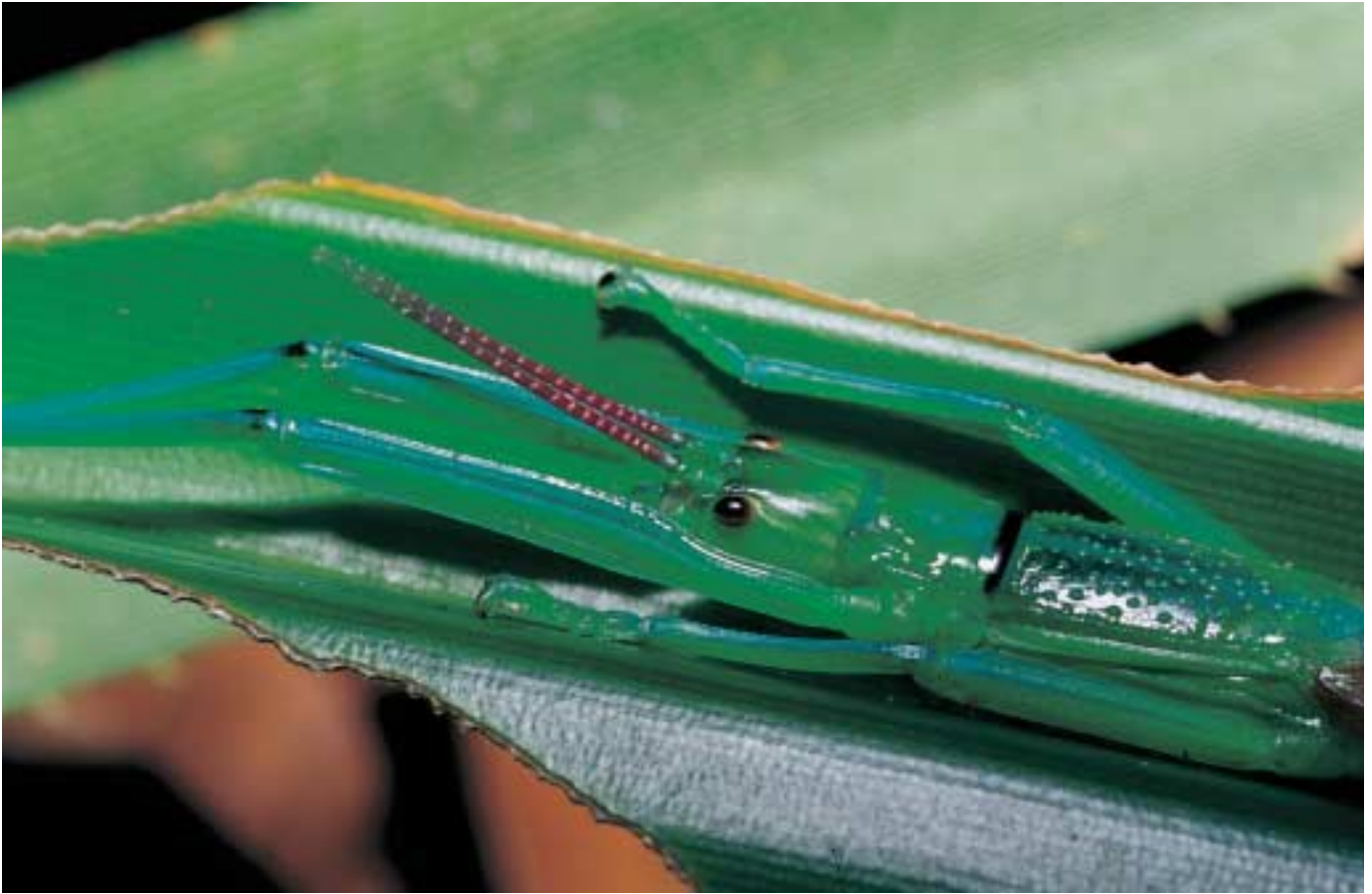
Phasmids are mostly tropical and subtropical throughout the world, although some hardy species persist in temperate areas. There even are three species of stick insects well established in the United Kingdom. Pet keepers occasionally deliberately discard stocks in the wild, and there also are accidental releases. Tropical species do not normally survive long in the United Kingdom, but escapees can become established in warmer climates.

Habitat

Found in a variety of habitats, phasmids can be abundant in wet and dry forests and in grasslands. In some countries they are common in gardens. Although they sometimes are found resting on or near their food plants in the daytime, they often are well hidden under leaves on the forest floor or in crevices. Tropical forests teem with these insects at night, when they move from their hiding places under cover of darkness. Some species frequent treetops and hence are seen rarely.

Behavior

Mostly nocturnal and remaining motionless in the daytime, phasmids blend in with the background; hence procrypsis (concealment from predators) is the primary defense. Some species even have the ability to change color to match their surroundings better, perhaps becoming a darker shade toward nighttime. Two-tone species with darker undersides are not uncommon. Many species feign death when disturbed, falling to the ground and remaining motionless; they may willingly shed a limb ("autotomy") in an effort to escape. The nymphs of some species (*Extatosoma tiaratum*) are thought to mimic ants. Many winged species flash open brightly colored wings or rustle their wings to startle predators; others fly away and "vanish" suddenly within vegetation. Some species, such as the *Eurycnema* from Australasia, use spines on their legs to strike out in attack. Certain stick insects, such as *Anisomorpha*



The peppermint stick insect (*Megacrania batesii*) is very rare and is found only on the pandanus plant. (Photo by ©B. G. Thomson/Photo Researchers, Inc. Reproduced by permission.)

buprestoides from the southeastern United States, exhibit warning colors on their bodies, perhaps stripes, and eject foul-smelling fluid from glands on the upper part of the thorax or from their mouthparts.

Feeding ecology and diet

Phasmids feed on leaves, taking large, circular bites out of the edges. A few species also eat flowers or bark. Some species have very few host plants, whereas many others accept the leaves of numerous different plants. It therefore is not surprising that pet keepers in different parts of the world often successfully rear phasmids in captivity on *Eucalyptus*, *Psidium*, *Rubus*, and *Quercus* species, regardless of their natural host plants.

Reproductive biology

Although they usually reproduce bisexually, many phasmids are able to reproduce parthenogenetically if males are absent, producing all-female offspring and thus enabling the species to survive. Only females are known in some species. Where males occur, mating typically involves the transfer of a spermatophore (sperm sac) from the male to the female. Hy-

bridization has been reported in *Bacillus* species from Europe. Between 100 and 2,000 eggs per species are either dropped or flicked to the ground; glued to surfaces, such as leaves, singly or in batches; or pierced into leaves. The eggs of many phasmids have a caplike structure, or operculum, on top, which assists ants in transferring the eggs to their underground nests. This benefits phasmids, since the ants eat only the caps, leaving the egg capsules to hatch later rather than being eaten on the forest floor. Nymphs hatch after a month to more than a year, depending on species, and frequently look rather like a miniature version of the adult. They can regrow lost limbs at the next nymphal molt. Nymphs typically molt six to seven times. Adults often live for several months and up to three years in a few species. In some genera, such as *Timema* in western North America, adult males mount females and remain there throughout their life span, in an effort to prevent the females from mating with rival males.

Conservation status

Many phasmids are known only from the originally described specimen(s), and their status is not known. The pet trade relies mainly on insects reared from captive stock. Showy species sometimes are imported in great numbers from



Walkingsticks (*Diaperomera arizonensis*) mating in Arizona, USA. (Photo by Bob Jensen. Bruce Coleman, Inc. Reproduced by permission.)

the wild, however, as with *Heteropteryx dilatata* from the Cameron Highlands of Malaysia. Trade declined by the early twenty-first century, although they still are collected widely for use in the framing industry. The spectacular Lord Howe Island (Australia) stick insect, *Dryococelus australis* (listed as Endangered by the IUCN), was thought to have become extinct following the introduction of rats to the island in 1918. The rediscovery of this species on a rugged and barren volcanic spire known as Balls Pyramid in 2001 caused great excitement. A captive-breeding project is under way by Australian authorities. The import of stick insects is regulated strictly in many countries, including the United States, as the insects may become pests.

Significance to humans

There are few reports of phasmids being eaten by humans. An old report states that natives of Goodenough Island, New Guinea, used the boldly spined hind legs of a *Eurycantha* species as fishhooks. The spectacular appearance of phasmids has led to their commercial use for framing (like butterflies, they are sold mainly to tourists as home decorations), in films, and on T-shirts, postcards, and toys. Phasmids are showy and relatively easy to look after, making them very popular insects in the pet trade. Nearly all species are harmless, but some need to be handled carefully, since they have shown aggressive defensive behavior. In extreme cases a few species squirt defensive sprays that have been known to cause temporary blindness in humans. Certain species are regarded as pests, with occasional population explosions resulting in severe defoliation of plants.