Giant Water Bug

Abedus herberti

Classification:
Water bugs are members of the class Insecta. The giant water bug belongs to the family Belostomatidae, one of 50 families and countless species in the order Hemiptera. Members of this order are considered the "true bugs." There are approximately 100 species in the family Belostomatidae that live primarily in North America, South Africa and India.

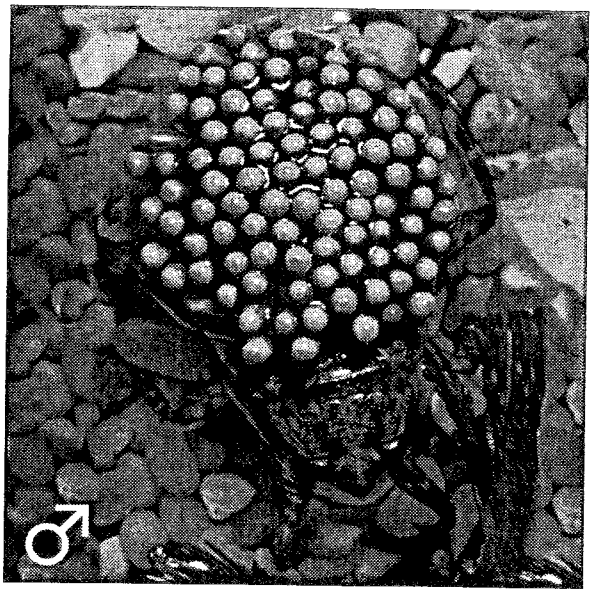


PHOTO BY GERI WEINRAUB

Habitat and Range:
The giant water bugs are located throughout Arizona and portions of adjacent states and Mexico. They are found in clear, freshwater streams and rivers, preferring those with aquatic vegetation.

Physical Characteristics:
Giant water bugs are approximately 1.5 inches (3.8 cm) in length. Some species grow to be as long as four inches (10 cm). They have one pair of tiny, almost inconspicuous, antennae which are located snugly below their compound eyes. The giant water bug's mouthparts are elongated into a beak-like structure designed for piercing and sucking.

The body is brown, flat and oval, giving them an appearance similar to that of a cockroach. The front legs are raptorial (grasping) for grabbing prey. Their other two pairs of legs are flattened, and fringed with hair to increase their surface area. These legs are used like paddles for propulsion. The adults have two pairs of wings, but rarely fly unless forced to by unfavorable water conditions or lack of an adequate food supply. The posterior end of a giant water bug has two retractable, semi-cylindrical appendages which, when held together, form a breathing tube. This is used for underwater breathing. When in flight, the air is exchanged through spiracles.

Additional Information:
During mating the female approaches the male and begins the courtship ritual which involves sparring and grasping the air. To ensure that he is the father, the male will copulate with the female and then allow her to lay the eggs on his back. He will only allow her to lay a few eggs after each mating. The ritual continues until the male's entire back is covered with approximately 150 eggs. The male will then take care of the eggs underwater, but he frequently exposes them to air to prevent the growth of mold or other aquatic organisms.

The eggs take approximately three weeks to hatch. After all the eggs have hatched, the glue attaching them to the male's back deteriorates and the egg cases fall off. Giant water beetle offspring are pale yellow in color. The young offspring spend much of their time near the surface of the water so they can stick their backsides out of the water occasionally. They do this in order to breathe. The larvae have small tubes located on their hind end. These tubes act like snorkels and carry the air throughout the animal's body. The metamorphosis of the giant water bug is incomplete so the nymphs look like a smaller version of their parents. The nymphs go through five instars over 8-10 weeks before becoming adults. Adult giant water beetles can live up to two years.

Giant water bugs are ambush hunters. They lie motionless and wait for their prey. Predators of the giant water bugs include birds, fish and other aquatic predators. When sitting motionless, giant water bugs resemble dead leaves. This allows them to hide from both potential prey and possible predators. However, their best defense is to run and hide when alarmed.

Diet:
At Woodland Park Zoo, the giant water bugs are fed crickets. In the wild the larvae eat small aquatic invertebrates, while the adults prey on any small animal they can manage, including insects and other aquatic invertebrates. They also hunt larger vertebrates such as tadpoles, salamanders and small fish.

Adult giant water bugs are able to capture these larger prey species by using their clawed front feet and chemicals which are injected into the body of the prey. The chemicals turn the prey's insides into liquid, which the giant water bug can then suck up.

Fascinating Facts:
Like terrestrial insects, these bugs respire through spiracles. When submerged, giant water bugs carry a temporary external air supply in the form of an air bubble. The air supply is in contact with the bug's spiracles located between their wings and their abdomen's upper surface. The air bubble works to extract oxygen from the water

- Half of the 27 orders of insects contain aquatic species which live part or all of their lives in close association with water.
- The name of the order Hemiptera means half-wings (Hemi = "half," Ptera = "wing").
- The metabolic rates and oxygen needs of insects increase during warmer weather, but at higher water temperatures, water holds relatively little dissolved oxygen. During the warm summer months, giant water bugs must make more frequent trips to the surface of the water to get oxygen than they would need to during the winter.
- Giant water bugs are sometimes called "toe biters" because, in self defense, they will bite people wading or swimming in the water.

Conservation Notes:
Giant water bugs are currently not endangered; however, water pollution can pose a threat to these animals. Water bugs in the genus Abedus are generally restricted to the South and especially the Southwest of the United States. They are usually found only in permanently flowing water. This limited habitat range puts them at a greater risk to water pollution than their less specialized relatives.

As human populations continue to increase, water pollution becomes a more pressing problem. Chemical pollutants from factories, farming and even our own gardens and houses can harm aquatic animals. We can make a difference in the future of these animals by conserving water and reducing the chemicals we put down the drain or into the soil.

Madagascar Hissing Cockroach

Gromphadorhina portentosa

Classification:
Cockroaches are insects that are classified in the order Blattaria. Five families of cockroaches are in this order: Cryptocercidae, Blattidae, Polyphagidae, Blattellidae and Blaberidae. The Madagascar hissing cockroach is in the family Blattidae.

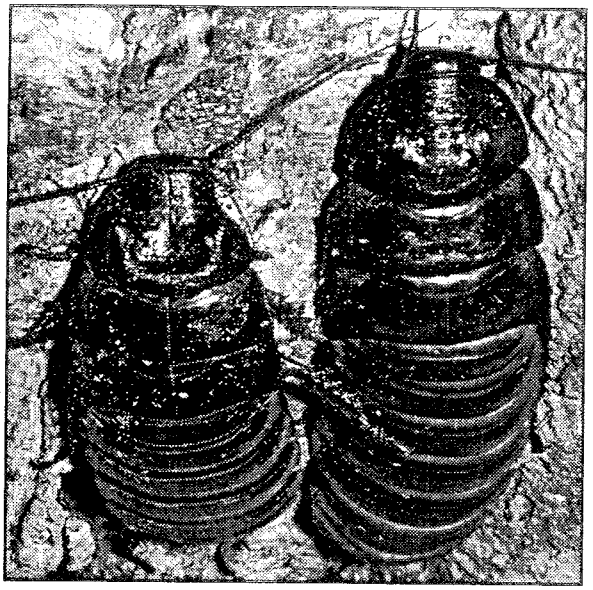


PHOTO BY GERI WEINRAUB

Habitat and Range:
Cockroaches are found on every continent, including Antarctica. However, as its name suggests, the Madagascar hissing cockroach is found only on the island of Madagascar. This species forages on the floor of tropical forests, near river banks and around logs or trees; it is nocturnally active.

Physical Characteristics:
The body of the Madagascar hissing cockroach can be up to three and one-half in (9 cm) long. Their weight varies, from one-half to one oz (14-28 gr.). No wings are present in this species, although some species of cockroaches are winged.

From a top view, a Madagascar hissing cockroach does not look like the typical insect, since it appears to have only one continuous body segment connected by its outer shell. The head is actually concealed by an extension of the outer shell. This outer shell also extends to protect the entire body of the Madagascar hissing cockroach.

Additional Information:
Mating for the Madagascar hissing cockroach can occur year-round, yet is contingent on warm temperatures. When a female is ready to mate, she may give off a special scent to attract prospective males. The male circles the female, hissing and touching her antennae. If the female is receptive, the pair position themselves rear to rear. The female extends her one inch (2.5 cm) long, yellowish egg case, the ootheca, out from underneath her abdomen. Mating then takes place, as the male deposits sperm. After separating, the female stores the eggs in the ootheca, which is retained within the female.

A few months later, when the eggs are ready to hatch, it appears as if the female is giving live birth. Fifteen to 40 cockroach babies, known as nymphs, are born. Nymphs are one-quarter inch (6.6 mm) in length, and flat, like a small watermelon seed. The mother appears to protect the young, as they stay with her for quite some time after hatching. Nymphs mature rapidly, in about five to 10 months. Once they reach juvenile stage, the nymphs are left on their own. One reaching the adult stage, Madagascar hissing cockroaches can live for two years. Once full grown, the Madagascar roaches exhibit sexual dimorphism, which means that the males and females act or look differently. Male Madagascar hissing cockroaches have a set of protrusions, resembling two humps, on the front of their body. They use these "horns" to ram other males when establishing or defending their territory.

All cockroaches have many predators, such as other insects, mammals, reptiles, amphibians or birds. Cockroaches must also contend with an even smaller species of insect, the cockroach mite (a parasite), which feeds on the cockroach's body. The Madagascar hissing cockroach has a unique defense mechanism. Along each side of its body is a row of holes (called spiracles), with which it respires. When the Madagascar hissing cockroach is threatened, it depresses its abdomen, ejecting air out of its spiracles. This produces a loud hissing noise which can startle a predator, giving the Madagascar cockroach a chance to escape. Additionally, hissing is used as a means of communication during courtship and mating, or by males to defend their territories from other males.

Diet:
In the wild cockroaches are primarily scavengers, eating various plant and animal matter. Woodland Park Zoo's keepers feed the cockroaches monkey chow and a variety of fruits and vegetables.

Fascinating Facts:
- Before dying of old age, females can produce up to 30 ootheca in one lifetime, resulting in over 750 young!
- The largest cockroaches in the world, Megaloblatta lonipennis, has a wingspan of up to seven in (18 cm) in width!
- There are over 3,500 species of cockroaches, but less than 30 species are considered pests to humans!
- Cockroaches are considered as one of the most primitive of winged insects, as they have changed very little in over 250 million years. Without a doubt, cockroaches are the one of the world's most rugged animals. For example, some species of cockroaches are immune to excessive levels of radioactivity, which would be considered lethal doses to humans.
- Certain cockroaches can also survive up to a week after losing their head; they die only from dehydration, for they have no mouth with which to drink water!

Conservation Notes:
For humans, cockroaches pose little threat; practically all cockroaches are beneficial to their environment, and they are an invaluable aid in recycling a large majority of the earth's dead or decaying plant and animal matter. For example, tropical forests have been called "green deserts," because their soils are poor in nutrients. The forest vegetation appears to be lush, but it has survived only through ingenious life-support systems. Cockroaches are the building block of the tropical forest's life support system. Without cockroaches, dead and decaying vegetation would smother tropical forests.

Many people associate cockroaches with the spread of disease. Unlike mosquitoes or fleas, cockroaches do not spread disease via direct transmission (i.e. though the blood as the result of a bite). Instead, cockroaches inhabit unsanitary areas of food storage, bringing with them microbacteria. In turn, these bacteria may contaminate our food supplies. It is these "hitchhikers" that cause disease, not the cockroaches. To help prevent cockroaches from becoming pests in your home, clean your kitchen often, store your foodstuffs properly, and quickly dispose of spoiled food.

Chilean Rose Tarantula

Phrixotrichus spatulata

Classification:
Tarantulas belong in the class of arthropods Arachnida. They are further classified into the order Araneae, and then into the family Theraphosidae.

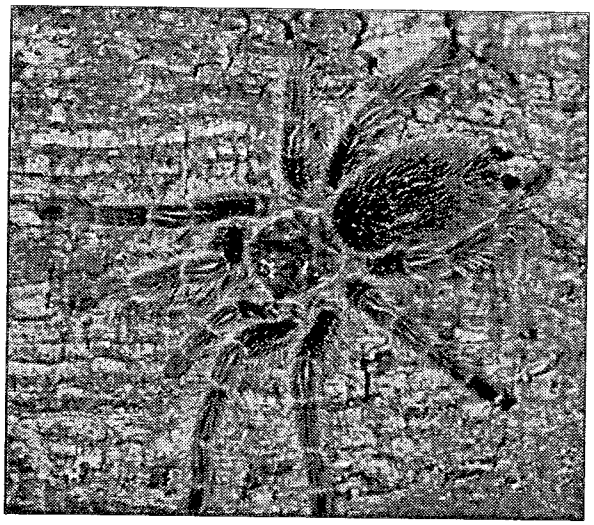


PHOTO BY EDGAR FORTUNE

Habitat and Range:
There are over 800 species of tarantula worldwide, found on every continent except Antarctica. There are several subspecies of rose tarantulas, yet Chilean rose tarantulas are found exclusively in Chile, South America. Chilean tarantulas were thought to be a burrowing species, but current observations indicate that they may hide out or make retreats above ground and hunt at night. Tarantulas in general live in burrows or trees.

Physical Characteristics:
The body of the Chilean rose tarantulas are approximately one and one-half inches (3.8 cm) or longer. They have leg spans of up to five and three-quarter inches (14.6 cm). These tarantulas vary in weight from one to two ounces (28.4-56.7 gr.). Females are larger and heavier than males.

Additional Information:
Mating can occur anytime of the year, and is highly dependent on the species or environmental conditions. Burrowing species of tarantula do not have good vision, so mating proceeds by sense of touch, smell and vibration. As a prospective male carefully approaches, the female rears back on her hind legs. The male rubs her with his pedipalps on the sternum to calm her down. As he pushes her upright, he uses his first set of legs to hook onto her fangs and to hoist her up. This prevents her from attacking him. The male then deposits sperm from each pedipalp. After detaching, he quickly backs away. Contrary to a popular myth, females rarely kill the male after mating; most male tarantulas live for another one to two years after they first begin mating.

Before laying her eggs, the female makes a silk egg capsule to protect them from predators and fluctuating environmental conditions. Between 100-500 eggs are laid in the egg sac, depending on the vitality of the female. Some species of tarantulas leave the egg capsule in their burrow; however, other species of tarantula carry the eggs with them. Young spiderling tarantulas hatch about six weeks later; sometimes incubation can take longer. Although the egg sac is well-guarded until the spiderlings hatch, the young are abandoned after hatching. Maturity for male tarantulas occurs in one to two years; they live for six to 18 months thereafter (in captivity). Female tarantulas take longer to mature; requiring three to10 years to become an adult.

Tarantulas have several predators such as large mammals, reptiles and birds. They must also evade other tarantulas, (most species are cannibalistic), and several different species of the pepsis hunting wasp. To hide, tarantulas construct an underground silk-lined burrow; anywhere from 10 in. to 30 feet (25.4 cm-10 m) deep. The burrow for the Chilean rose species is quite shallow. Unlike most species of spiders, some tarantulas cannot spin webs strong enough to hold their own weight. However, like all spiders, tarantulas are highly sensitive to vibration, and they rely on this sense to locate and identify their next meal. Cast out in front of their burrow, tarantulas use their silk like a fishing line to hunt for food. When an animal of the correct size trips on these lines, it alerts the tarantula to come out from its burrow to attack.

Hair covers the entire body of tarantulas; it is their most important means of sensory input, and serves several functions. Some hairs contain temperature or smell receptors. Other hairs can detect airborne vibration. Hairs in certain areas, mostly on the abdomen, can act as an itchy irritant to potential predators. At the end of each leg, there are two hidden tarsal claws, which yield great maneuverability for the burrowing tarantulas. For arboreal tarantulas, these claws provide stability in walking and allow the tarantula to hang on to vertical surfaces. Yet, the velvety pads of hair behind these claws are far more important, as they cushion the tarantula while it walks.

Within one week of hatching, tarantulas have their first molt. For juvenile tarantulas, molting occurs frequently; more than 10 molts may be necessary to reach maturity. As adults, female tarantulas molt only once a year. Generally, males don't molt again after reaching maturity. Molting can occur in a burrow sealed off with silk. Although it usually takes less than 24 hours, molting is an energy-consuming task for a tarantula which leaves it very vulnerable. There are four main steps to a molt. The first step is for the tarantula to position itself on its back or side. Next, the carapace is pushed off; this is called "popping its top." Then, the legs and the pedipalps are extracted from the old exoskeleton. Finally, the newly covered abdomen is pulled away or falls out onto the ground. The exoskeleton of spiders consists of many layers, but it is not the tarantula's skin. To grow, all spiders continuously reabsorb partial amounts of the internal layers of their exoskeleton some weeks preceding the molt. It is only during the final stages of the molt process when they actually shed the external layers of the exoskeleton as one complete shell.

Diet:

In the wild tarantulas generally eat insects and other arthropods. Occasionally they will eat other small animals. At Woodland Park Zoo we feed our tarantulas one cricket per week.

Fascinating Facts:

- The largest recorded spider in the world was a tarantula. It was a member of the species *Pseudotherathosa apophysis*, which had a leg span of almost 13 in (33 cm)!
- No human is ever known to have died of a tarantula bite!
- Tarantulas have two pairs of booklungs (most spiders have only one pair)!
- One tarantula laid 1,392 eggs!
- In captivity males can live up to 3.5 years; females, more than 20 years.

Conservation Notes:

The greatest threat to the tarantula's existence is habitat destruction. A tarantula's habitat can be affected by excessive forestry, agricultural/ residential/commercial development, or drainage of wetlands. Although several species of spiders are considered threatened or close to extinction, little is known about the future of tarantulas. It is quite possible that some tarantula species have yet to be discovered. Another threat to the existence of tarantulas is the rapidly expanding market for tarantulas as pets. There are few conservation measures for the preservation of tarantulas. However, there are many restrictions on import of tarantulas into the United States.

For humans, tarantulas pose little threat, and are an invaluable aid in destroying harmful, crop-eating insects. To conserve the habitat for tarantulas or other spiders, reduce your use of pesticides, and work to preserve vegetation in your neighborhood and in tropical regions.

Discover more about spiders by contacting the American Tarantula Society on the Internet at www.concentric.net/~DmaMarrtin/ats; or call (505) 748-2483.

GIANT MILLIPEDE

Archispirostreptus spirostreptidae

Classification and Range:
Millipedes belong in the subphylum Myriapoda, commonly recognized as arthropods that have multiple body segments, and identified by their many legs. The subphylum Myriapoda also includes centipedes. Millipedes are furthered classified under the class Diplopoda. There are at least 15 recognized orders of millipedes in this class, and the giant millipede is in the order Spirostreptida.

PHOTO BY AGNES OVERBAUGH

Habitat and Range:
There are over 10,000 species of millipedes worldwide, found in all temperate and tropical regions of the world. Millipedes are also found in caves, deserts, alpine habitats, tree canopies and along seashores. The giant millipede is found in both tropical and arid coastal forests of eastern Africa. Most species of millipedes are nocturnal. During the day they rest and hide among leaf fall, soil or rotting logs.

Physical Characteristics:
Millipedes can be up to 12 in (30 cm) length. They are long and cylindrical in shape. Their weight varies, from one to two ounces (28.35 - 56.7 gr.). Rather than simply expanding in size, millipedes grow by adding groups of three or more segments after each molt. Millipedes usually molt underneath the surface of the soil, in a hollowed-out chamber. This chamber provides shelter and protection from predators during the molting process.

Although their name literally means "thousand-legged," very few millipedes have even half as many. Most millipedes have no more than 300 legs. Millipedes have two pairs of legs per body segment, and a mature millipede has 40-60 segments. When first hatched, baby millipedes have only a few segments.

Additional Information:
The courtship of a millipede is simple and elegant. The male walks along side of the female and stimulates her with rhythmic pulses of his legs. If the female is ready, she raises the front segments of her body, allowing the male to slip underneath her. He then wraps his body around her, starting just behind her head. After wrapping their entire bodies for approximately two turns, the pair unites their genitalia, usually on their third or fourth body segments closer to the head. To assist in mating, the male's legs are modified on the seventh segment into special clasping organs, which enable him to hold the female closely. Once the genitalia are matched, the male deposits his sperm onto the female. She then transfers the sperm to her eggs. After slowly detaching from this delicate embrace, the male leaves the female. With millipedes, no particular pair bonds or family unit is formed, so both males and females can mate with the same or different partners more than once.

Before laying the eggs, the female makes a small nest of compressed soil just below ground level. Within a few weeks of mating, the female lays hundreds of eggs in this nest. The eggs do not become fertilized until after laying. Once in the nest, the eggs are covered with a tough, resistant coating to protect them from predators and fluctuating environmental conditions. Sometimes the female will guard the eggs until they hatch; typically three months later. Young millipedes grow quickly; however, once mature, adult millipedes grow very slowly. Maturity for millipedes occurs in about three years. Larger species can take up to 10 years to reach maturity. In the wild millipedes live up to seven years. In captivity they have been known to live up to 10 years.

Millipedes have many predators, such as spiders, mantids and even centipedes. All sorts of large mammals, reptiles or birds also prey on the millipede. Millipedes have been around for millions of years. Hence, they have developed unique defense mechanisms for survival. A typical defense strategy is for the millipede to curl up into a tight, flat, spiral. The coil protects not only the millipede's head, but its soft underside as well. Millipedes can also secrete a foul-smelling (as well as unpleasant tasting) fluid when disturbed. Alongside their body, near the legs on each segment, there are tiny little holes which emit this substance. This toxicity of this liquid varies from species to species. For example, some excretions can yellow human skin or irritate the eyes; others are corrosive, and some species even produce cyanide.

Diet:
Millipedes are herbivores, but technically they should be considered detrivores (animals that eat dead organic matter). They do not see well, so their antennae helps them find the next meal, determining if it has decayed enough for them to eat. Since the exoskeleton of millipedes is composed of calcium, they also need to find the occasional small stone or pebble on which to chew. In the wild millipedes primarily eat dead and decaying plant matter. At Woodland Park Zoo they are fed rotten fruits and vegetables.

Fascinating Facts:
- The largest millipede in the world is the Graphidostreptus gigas from Africa, over 11 in (27.5 cm) in length, 3/4 in (19 mm) in diameter!
- The millipede with the most legs was found to be the Illacme plenipes of California, with over 375 pairs of legs!
- Over 300 million years ago, a millipede roamed the forests in the present-day United Kingdom...it was over six feet (1.8m) long and more than one foot (30 cm) wide!

Millipedes and Centipedes:
Upon discovering a millipede, many people confuse them with centipedes. Millipedes and centipedes are actually in different classes but they do have several similarities. Both are myriapods, found throughout the world. Both animals hunt at night, using their antennae as sensing device.

One way to distinguish millipedes from centipedes is by the number of legs per segment. Centipedes have only one pair of legs per segment, with the legs emerging from the sides of each segment. On the other hand, millipedes have two pair of legs per segment, emerging from underneath each segment. Millipedes are also herbivores, while centipedes are carnivores. Millipedes are usually round and cylindrical, while centipedes are flat and thin.

Both centipedes and millipedes walk in a metachronal pattern—which means the front legs move first, with the rear ones following in unison. Millipedes move in a straightforward manner, while centipedes move in a snake-like serpentine pattern (like an "S").

Conservation Notes:
The Amazon rain forest is home to most species of millipede, and the greatest threat to their existence is habitat destruction. A millipede's habitat can be affected by cave damage, drainage of wetlands, excessive forestry, or agricultural/residential/ commercial development. Little is known about the future of millipedes. Additionally, it is quite possible that some millipede species have yet to be discovered. Unfortunately, no current conservation measures or protection for millipedes exist.

For humans, millipedes pose little threat, and are an invaluable aid in eating and recycling dead or decaying vegetative matter. *You* can help conserve the habitat for millipedes and other arthropods, by working together with your parents to reduce the use of pesticides and herbicides around your home. Research natural pesticides that only get rid of pest species without harming the natural environment. You can also work to preserve vegetation in your neighborhood and in tropical regions.

Common Earwig

Forficula auricularia

Classification:
Common earwigs are insects of the order Dermaptera and the family Forficulidae. There are approximately 1,100 species of earwigs worldwide, 20 of which are found in North America and distributed among five families.

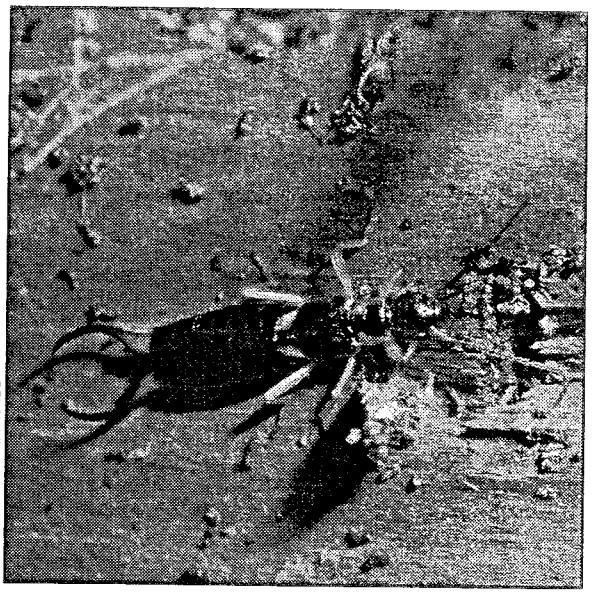


PHOTO BY GERI WEINRAUB

Range and Habitat:
The genus is world wide. *Forficula* is found in tropical, temperate and arid zones in a multitude of habitats. *Forficula auricularia* is the most common species of earwigs, which accounts for its name, the common (or European) earwig.

Physical Characteristics:
Earwigs are small in size. Common earwigs are generally 0.75 inches (18 mm) in length. They have slender, elongated and flattened bodies. Their color is a reddish-brown. Most earwigs have two pairs of wings. The forewings are thickened, leathery and short. The hind wings are membranous and at rest fold beneath the forewings. They are rarely wingless; however, common earwigs are one of the exceptions. They have two incomplete set of wings, making them virtually wingless and completely flightless.

Earwigs have chewing mouthparts and simple eyes. Their antennae are long and generally have 12-15 segments. The most obvious characteristic of earwigs is the strong pincers located on the tip of the abdomen, used for defense and for capturing food.

Additional Information:
Egg-laying occurs in the early spring. The female mates indiscriminately and then lays a clutch of 40-50 eggs in burrows in the soil. The female protects her eggs from any intruders, including her mate. She continues to guard the eggs and care for them, licking the eggs frequently to prevent them from becoming infested with fungi. The female cares for her young until they are old enough to fend for themselves.

Earwigs go through incomplete metamorphosis to reach the adult stage of growth. After reaching this stage they live eight to 10 months.

Earwigs are nocturnal in nature, coming out in the late evening; they are rarely seen during the daytime. They are usually found in secluded, undisturbed places such as wood piles, under stones or underneath debris. Common earwigs are often found in large sleeping colonies.

Predators of earwigs include mammals and birds. Some species of earwigs eject a foul-smelling liquid when threatened.

Diet:
Earwigs are primarily scavengers, eating organic and decaying matter. However, some species occasionally capture small flies or caterpillars with their pincers. At Woodland Park Zoo the earwigs are fed a scavenger's diet of apples, oranges, romaine lettuce and monkey chow.

Fascinating Facts:
- The name Dermaptera means "skin-winged" (Derma = "skin," Ptera = "winged"). This refers to the large, fragile hindwings of the earwigs.
- The name "earwig" came from an early misbelief that these insects would crawl into human ears and bite a person's eardrums with their pincers. Earwigs are harmless animals and do not attack humans in any way.

Conservation Notes:
Earwigs are common. Some earwigs are considered pests in buildings or may damage cultivated plants. They are also play a significant role in nature, as do all animals and plants. Like other scavengers, earwigs play an important part in putting nutrients back into the soil. These nutrients in turn help plants to grow and provide food for other animals and plants.

SOWBUGS AND PILLBUGS

There are many different genera and species

Classification:
Although their common names contain the word "bug" sowbugs and pillbugs are actually crustaceans in the order Isopoda. There are four families of sowbugs and pillbugs in the United States. These include the families Armadillidiidae (pillbugs), Oniscidae (sowbugs) and Porcellicnidae (sowbugs)

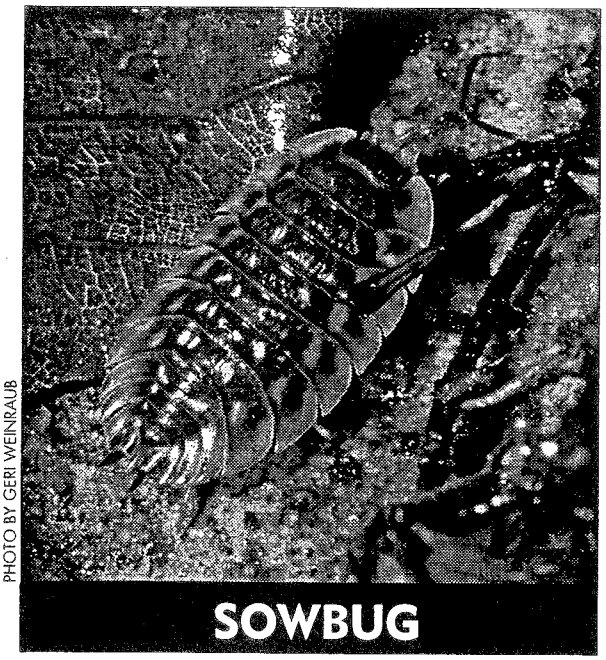


PHOTO BY GERI WEINRAUB

SOWBUG

It takes approximately one year for the young to become adults; metamorphosis is incomplete. Once adults, sowbugs and pillbugs continue to molt approximately every 28 days. A breeding female molts less often to permit time to incubate her young. Sowbugs and pillbugs molt in two phases. First they lose the rear half of the shell and, approximately 12 hours later, they lose the front half. They then eat the discarded shell to recycle the calcium. The adults live for two to three years.

Habitat and Range:
Sowbugs and pillbugs are widespread throughout North America. They are found in moist microclimates, damp dark spaces and wooded areas.

Physical Characteristics:
Although sowbugs and pillbugs are in different families, there are significant similarities between the groups. The primary difference between the two is that pillbugs can roll up in a ball, whereas sowbugs cannot.

Both animals are approximately 0.5 inch (12.5 mm) in length. They have one pair of elbowed antennae. The bodies of the sowbugs and pillbugs are flat and oval with seven pairs of legs. They are gray in color and covered with armor-like plates. Like all crustaceans, sowbugs and pillbugs are wingless.

Additional Information:
Reproductive efforts begin in March and April. Two to three broods are raised during the summer. Each brood consists of 30-40 young which are incubated for 34 days in the female's brood pouch. The brood pouch is located under the female's body between the second and fifth pair of legs. The pouch is filled with fluid which bathes the young while they are developing.

Sowbugs and pillbugs are both nocturnal scavengers. They are often found huddling together in groups to reduce evaporation and prevent dehydration.

Predators include many species of birds and some amphibians. The color of all four species also helps to camouflage these animals. As an added defense, pillbugs roll up into a ball. Their exoskeletons have 10 freely-articulating segments, which can contract to form a ball. Sowbugs lack this capability so they run away quickly and hide from predators.

Diet:
At Woodland Park Zoo sowbugs and pillbugs are fed apples, oranges, romaine lettuce and monkey chow. In the wild they eat rotting vegetation such as dead leaves and decaying wood.

Fascinating Facts:
- Sowbugs and pillbugs are terrestrial crustaceans.
- Sowbugs and pillbugs lack the spiracles possessed by many other arthropods.
- Sowbugs and pillbugs burrow during the day to stay moist which wets their gills. The gills are the primary breathing apparatus for all crustaceans and must remain moist in order to function.

Conservation Notes:

Neither sowbugs nor pillbugs are endangered. Both animals are common in backyards of our region. Sowbugs and pillbugs are often considered pests in greenhouses because they nibble at the roots of stems and seedlings. Pillbugs are very valuable however, because they provide food for other animals. As scavengers, they also play an important role in the environment by putting nutrients back into the soil when they eat decaying matter and then defecate.

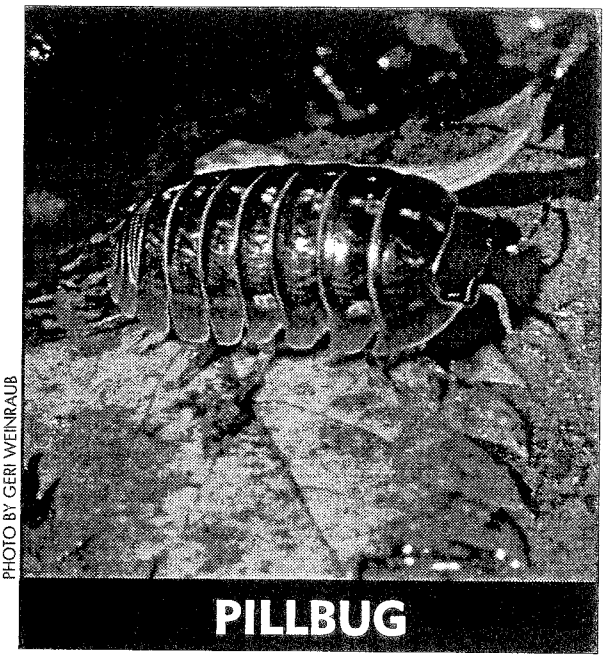


PHOTO BY GERI WEINRAUB

PILLBUG

ANGULAR-WINGED KATYDID

Microcentrum rhombifolium

Classification:
Katydids are in the class Insecta. They are further divided into the order of Orthoptera and the family Tettigoniidae. World wide there are 22,500 species of Orthoptera; approximately 1,015 are found in North America. Crickets and grasshoppers are also in the order Orthoptera.

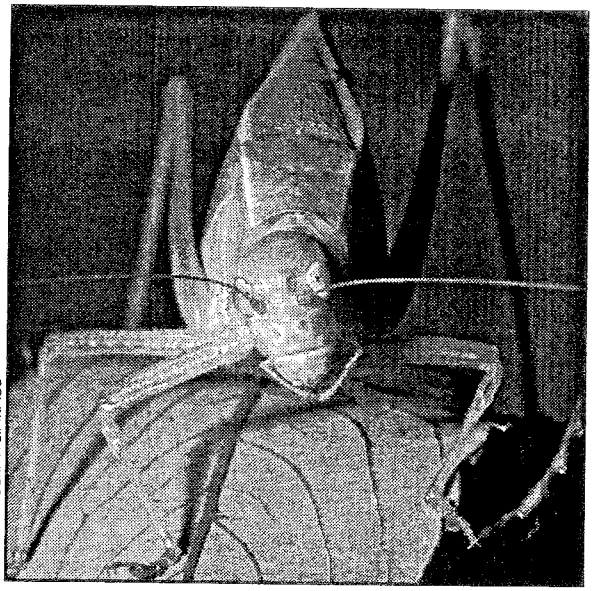


PHOTO BY GERI WEINRAUB

Habitat and Range:
Angular-winged katydids are found in the southern United States, in temperate and arid regions. There are many other species of katydids found throughout the world in habitats including tropical, temperate and arid.

Physical Characteristics:
Angular-winged katydids are two to two and one-half inches (5-6 cm) in length. They have chewing mouthparts, long slender antennae and are light green in color. Metamorphosis is incomplete. The adult katydids have two pairs of wings that are leaf-like in color and shape.

Additional Information:
Males and females look alike, except that the female has a hook-like ovipositor at the tip of her abdomen. A spermatophore is transferred from the male to the female's genital opening. Within 15-20 minutes, the sperm is moved into the female's body.

The eggs are tan and glued to the underside of leaves. It takes two to three months for the eggs to hatch. Metamorphosis is incomplete in katydids; therefore, the babies look like the adults except that they are very small and lack wings. Young katydids reach their adult stage in three to four months.

Most of the katydids' social behavior involves courtship and mating. Katydids are famous for their summertime singing; only the males sing.

Predators include birds and some amphibians. Katydids use their excellent camouflage as a defense; however when disturbed, they can fly away.

Diet:
At Woodland Park Zoo angular-winged katydids are fed willow leaves and romaine lettuce. In the wild they typically eat the leaves of willow, rosewood and citrus trees.

Fascinating Facts:

- There are many species of katydids in the rain forest. In fact katydids are often called the "plankton of the rain forest" because so many kinds of animals in the forest eat them.
- Katydids may be the primary source of protein for some species of monkeys, bats, marsupials, rodents, birds, snakes, frogs, spiders, ants and wasps.

Conservation Notes:
Katydids play a very important role in the web of life. They serve as food sources for a wide variety of species. The disappearance of katydids can have a negative domino effect on other species.

All animals and plants rely on many other species for their survival. If one species disappears, other species may lose an important food source, a source of protection or a benefactor. Therefore, it is important that we work to save not one species we find important, but all species because they are inextricably linked to one another and ourselves.

HONEY BEE

Apis mellifera

Classification:
Honey bees are in the class Insecta. There are approximately 20,000 species of bees within the order Hymenoptera. There are only seven species recognized as honey bees; these are in the family Apidae.

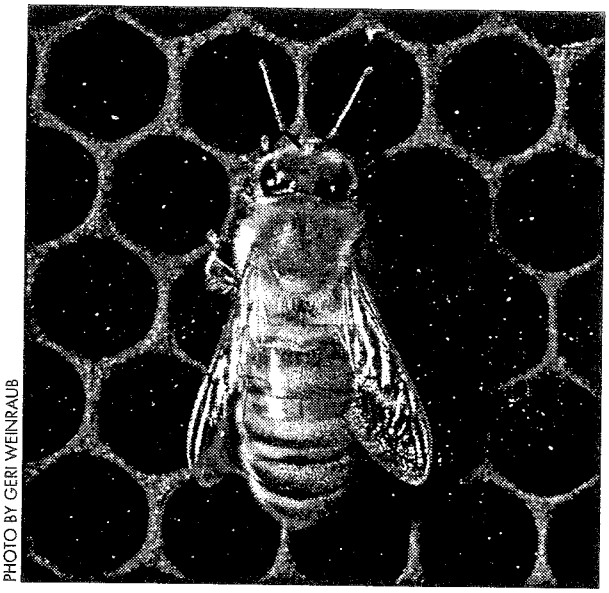


PHOTO BY GERI WEINRAUB

Habitat and Range:
Originally found only in Europe, honey bees are now naturalized worldwide. They were domesticated in the United States 200 years ago for honey production and pollination. Honey bees nest in tree hollows or other cavities in the wild. They are commercially bred worldwide by humans for pollination of flowering plants and for honey production

Physical Characteristics:
Honeybees have both chewing and sucking mouthparts. The chewing mouthparts are used to chew wax, mend parts of the hive and manipulate pollen. Bees have four wings and six legs. A honey bee's forelegs have a special structure for cleaning the antennae. The antennae are drawn through a small notch on the leg, fringed with hairs. The middle legs of the worker bees have a tibial spine used for loosening pollen pellets from hind legs. The pollen basket, which is used to transport pollen and propolis is located on the hind legs.

Wax glands, which are found on the underside of the abdomen, produce the wax that is used to construct the combs. The honey bee ovipositor has been modified into a sting and it possesses a gland that produces venom which is injected by the sting.

Additional Information:
There is one queen per hive and she is longer and larger in size than the other bees. The queen is the only reproductively mature female in the hive and she is responsible for all egg laying. The queen decides if an egg is going to be a drone or a worker. Unfertilized eggs are males (drones); fertilized eggs are females (workers). A queen can live up to 5 years and can lay 1,500 eggs in one day. When the queen dies, a new queen must be made.

Female worker bees perform all the work of the hive and make up 90% of the population of the hive during the spring and summer. There are 10,000 to 60,000 worker bees in a colony. At different stages, depending on age, they keep the hive clean, care for the eggs and larvae, build and prepare comb cells, convert the nectar into honey, care for the queen, scout for and collect nectar and pollen, defend the hive, and control the temperature in the hive. During the active season the workers live five to six weeks. Overwintering bees may live four to six months.

There is a division of labor in the hive which is determined primarily by the age of the bee:

Age of bee:	Responsibilities:
1-3 days	cleaning cells
3-6 days	patrolling, cleaning cells, feeding older larvae
3-11 days	feeding young larvae
13 days	cleaning the hive
13-17 days	packing the pollen to make bee bread, processing honey, producing wax and constructing combs
18-20 days	guarding the entrance
20+ days	become field bees

Materials collected by the bees include water, nectar, pollen and propolis, which is used as bee glue to seal cracks in the hive. Propolis is made by the bees. They collect sticky material, such as resin from trees, and mix it with enzymes produced by the bee. This forms a glue-like substance which can be used in making repairs on the hive.

Drones are all males. They are recognized by the compound eyes that come together at the top of their heads. Drones live four to six weeks. Their sole responsibility is to fertilize the queen, but mating is fatal. A drone dies after mating, because his genitalia break off during copulation.

Development:
Bees develop at different rates, depending on their position, or caste, in the hive. The following chart illustrates how many days it takes each caste to go through each stage of development:

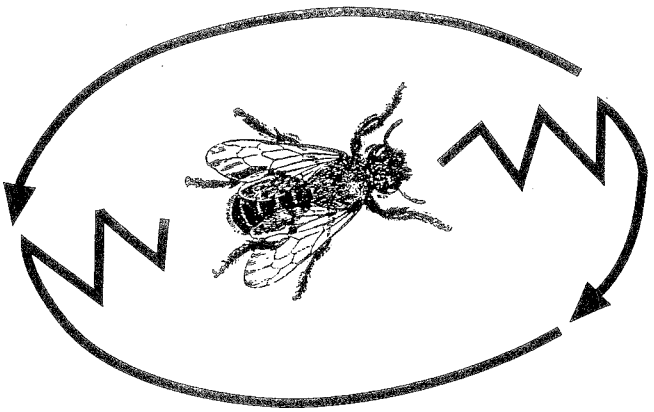
Caste	Egg Stage	Larval Stage	Pupal Stage	Total Days
Worker	3	6	12	21
Queen	3	5.5	7.5	16
Drone	3	6.5	14.5	24

Diet:
Royal jelly is a glandular secretion of young workers. When a hive needs a new queen or is preparing to swarm, the workers make special cells called queen cells. These cells are an extension of the wax and are shaped like peanuts. The royal jelly is placed in the queen cells, as food for larval queens. It is called royal jelly because it is the only food the queen larvae eats.

Worker and drone larvae are only fed royal jelly for their first four days, then for the rest of their larval stage they are fed bee bread. Pollen is collected in the field. Back at the hive, two pollen pellets are dropped into a cell. The pellets are then manipulated and mixed with honey and secretions from the bees. This mixture is then pushed into the cell until the cell is two thirds full. The product is then called bee bread.

The adult bees, including the queen, eat honey made by the workers. Field bees collect nectar and pollen. The nectar is brought back to the hive and placed in cells. Excess water is evaporated from the nectar and enzymes are added. The nectar cells are then capped and will become honey. During brood rearing a colony can consume 1.2 lbs (540 gr.) of honey daily.

The waggle dance is a dance that the worker bees do when they have returned to the hive from the field. The function of the dance is to indicate to other worker bees the location of a food source. The direction of the food source from the hive, in relation to the sun, is indicated by the angle of the waggle dance. If the dancing bee, dances at an angle 90° to the right of the vertical axis of the hive, then the other workers should travel at an angle 90° to the right of the sun. The distance of the food source from the hive is correlated with the length of the waggle portion of the dance and the number of waggles.



Fascinating Facts:
- Beekeeping was being practiced in ancient Egypt in 2500 BC.
- One pound of honey equals the life work of approximately 300 bees and a flight distance of two to three times around the earth.
- Honey tastes different depending on the type of flowers the bee visits.
- Honey should not be fed to babies. Honey contains bacteria which do not affect adults but can be very harmful to infants.

Conservation Notes:
Pesticides are extremely harmful to bees. Not only do the pesticides affect bees which come in direct contact with the chemicals, but pesticides are also taken back to the hive. Whole hives of bees can be destroyed as a result. Since honey bees are used for commercial honey making, there is an additional risk in that pesticides may end up in honey used for human consumption.

Darkling Beetle

Eleodes spp.

Classification:
Darkling beetles are in the class Insecta. They are in the order Coleoptera and the family Tenebrionidae. Darkling beetles represent what most people would consider the "typical beetle" (see physical characteristics).

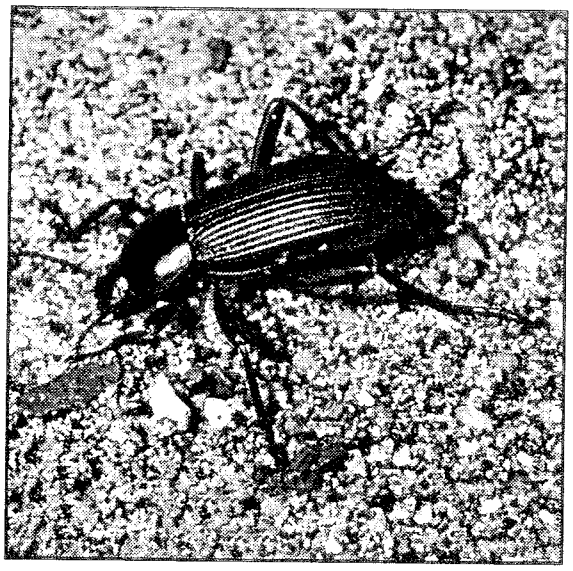


PHOTO BY GERI WEINRAUB

Habitat and Range:
Darkling beetles are found primarily in the western United States. There are approximately 1,400 species in North America; of these only 150 live in the eastern part of the United States. Darkling beetles are common in many habitats, but especially adapted to arid regions.

Physical Characteristics:
Darkling beetles are approximately one and a half inches (3-4 cm) in length. They have chewing mouthparts and one pair of antennae. The antennae are often segmented into 11 parts and are thread-like, bead-like or slightly cubed. The darkling beetle does not have any major distinguishing characteristics. There are no bumps or out growths, they are smooth and black and it is immediately easy to tell one end from the other. The wings of the darkling beetle are fused, rendering this beetle flightless.

Additional Information:
The female lays her eggs in the soil. When the larvae hatch they look similar to commercial mealworms (genus *Tenebrio*). The larvae are slender, cylindrical, light brown and worm-like, but with six legs. When the larva has reached the proper size, it will pupate in the soil and then an adult beetle will emerge. The adult beetles can live from 3-15 years.

Both the adult and the larvae are general feeders and scavengers, feeding on decaying fungi, leaves, seeds and other organic matter. They occasionally eat live plants. Darkling beetles are ground dwelling. They are active both day and night but spend the hottest part of the day under logs, fungi, rocks and other objects.

Predators of darkling beetles include some birds and amphibians. As a defense these beetles will stand on their heads and elevate their rear end while emitting a foul smelling odor. This emission makes them unpalatable to would-be predators. Hence the darkling beetle has an alternate common name of the stink beetle.

Diet:
In the wild, darkling beetles commonly eat decaying vegetation such as dead leaves or rotting wood. At Woodland Park Zoo, they are fed apples, oranges, romaine lettuce and monkey chow.

Fascinating Facts:
- These beetles do not need to drink and can produce water metabolically. Their wings are fused which also prevents water loss.
- Approximately 290,000 species of beetles have so far been described. That is almost one-third of all the insects that have been named.

Conservation Notes:
Darkling beetles are very common. Some species are considered pests to humans because they can be destructive to stored grain and flour. However, it is important to remember that even animals which we consider to be pests play a very important role in the environment, such as providing food sources for other animals. Their elimination can have serious effects on the ecological balance. Therefore it is important that we find a balance between our own needs and desires and the effects our actions have on the environment. Pesticides and other chemicals used in the elimination of pest species can have far reaching consequences and can affect many other species, including humans.

CRAYFISH

Nephropsida ssp.

Classification:
Crayfish are in the class Crustacea which comprises approximately 35,000 species worldwide. Their order name, Decapod, means ten-legged; they are in the family Nephropsida.

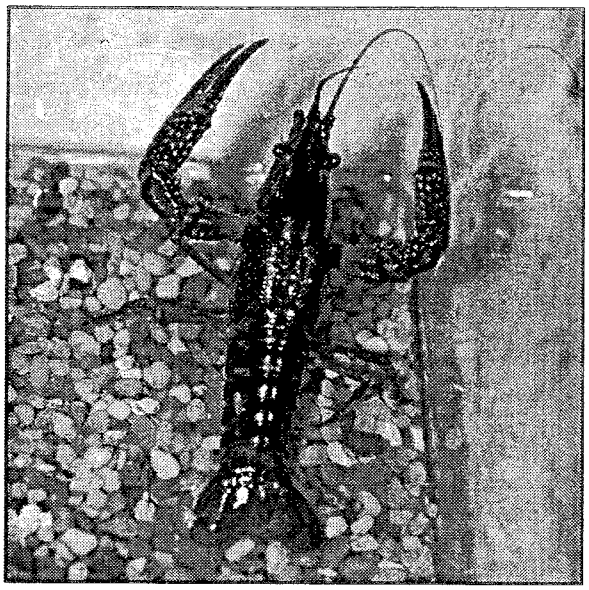


PHOTO BY AGNES OVERBAUGH

Habitat and Range:
Crayfish are found in freshwater streams, ponds and swamps on every continent, except Africa and Antarctica. There are approximately 330 species of crayfish in North America with a large percentage of those species being found in the southern portions of the United States.

Physical Characteristics:
Crayfish, also called crawfish or crawdads, can range from approximately four to10 inches (10-25 cm) in length with leg spans of up to 10 inches (25 cm). The compound eyes of crayfish are on stalks located on the cephalothorax. A shield-like covering called the carapace extends over the eyes providing protection. Crayfish use gills for underwater respiration. They can remain out of the water as long as their gills remain wet.

Crayfish have chewing mouthparts which are used for tearing and grinding the dead organic matter which comprises their diet. Like most other crustaceans, crayfish have two pairs of antennae. Crayfish come in many colors, from blue and green, to red and brown. Some, like the blind crayfish, are even white.

Crayfish generally have four pairs of legs on which they walk, and a fifth pair anterior to the others which forms a set of pincers or claws. These claws are used for defense as well as for capturing and tearing apart prey.

Additional Information:
Crayfish mate in early spring or fall. After finding a mate, the male crayfish deposits his sperm into a pocket on the underside of the female. As the female lays her eggs, they are fertilized by the deposited sperm. A stringy glue then attaches the eggs to the underside of the female's tail. A female crayfish holds 75-100 eggs under her tail. She then backs into a hiding place where she will remain until the eggs hatch. The young remain attached to the underside of their mother's abdomen for several weeks until they are able to swim away on their own. Adults live three to five years and continue to molt every spring or fall.

Crayfish are primarily bottom dwellers. Some are burrowers and others are found under or between sunken logs. Crayfish are territorial and a hierarchy will exist where many animals are found.

Predators include mammals (such as raccoons and otters), fish (such as bass and sunfish) and birds (such as herons and kingfishers). When threatened by predators, they can dart off quickly but crayfish are better adapted for walking on the bottom of the body of water in which they live.

Diet:
In the wild, crayfish are often scavengers, eating dead organic matter. However, they will also take small live animals such as worms, snails or tiny fish. At Woodland Park Zoo, they are fed crickets and mealworms.

Fascinating Facts:

- Crustaceans are one of the few arthropods which have been well preserved in fossil records. This has allowed scientists to follow, in depth, their evolutionary history.
- Crayfish are commonly used for human consumption, yet only a small portion of the nearly 100 million pound yearly crayfish harvest comes from the wild. The majority of the United States' supply of crayfish is farmed in Louisiana.
- Freshwater crayfish have the power to regenerate lost parts. A lost part is partially renewed at the next molting; after several moltings the part will be completely restored.

Conservation Notes:

Crayfish play a very important part in the ecosystem. Not only do they provide food for humans and many other animals, they also help to clean up waterways. Scavengers such as crayfish help to keep lakes and stream beds clean by eating rotting and decaying matter.

Many species of crayfish have highly specialized habitats and have very limited ranges. This puts them at great risk to threats such as water pollution. Scientists are also finding that many species of crayfish are losing out to more aggressive alien species coming into their areas. Approximately half of the known species of crayfish are currently endangered, including two crayfish species inhabiting the United States.

Water conservation efforts and reducing or eliminating pollutants we put into the water are ways that we can help make a difference in the future of animals like crayfish.

Australian Walkingstick

Extatasoma tiaratum

Classification:
Australian walkingsticks are one of 2,000 species of tropical walkingsticks. They are in the family Bacteriidae of the order Phasmatodea. Other common names for the Australian walkingstick include: Giant spiny and Meckay's Specter walkingsticks.

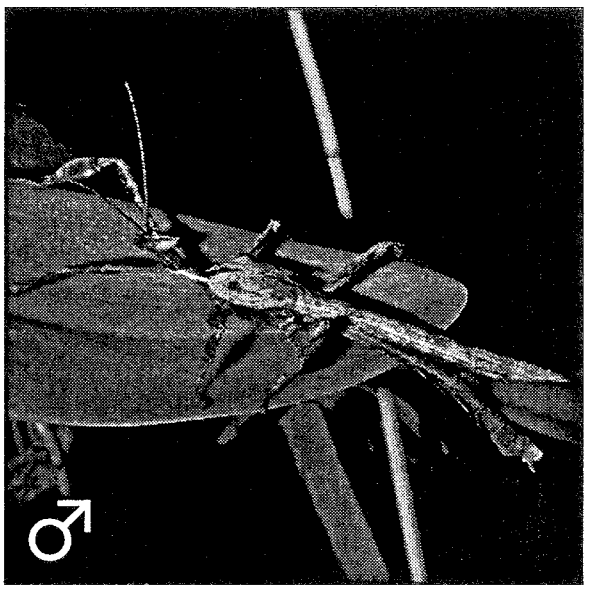


PHOTO BY GERI WEINRAUB

Habitat and Range:
Australian walkingsticks are found in the tropical regions of Northern Australia. They are also found in New Guinea. Their primary habitat is forested regions.

Physical Characteristics:
Female Australian walkingsticks reach approximately five inches (12 cm) in length, while the males are much smaller, attaining almost four inches (10 cm) in length. These walkingsticks have elongated, oval-shaped heads covered with spines. They also have long antennae and chewing mouthparts for eating plant matter.

Females are light tan in coloration with long, thick bodies. They have a pair of non-functioning wings. The males are dark brown in color. A full set of functional wings is present on the male. The forewings are dark in color, but the inside wings are often brightly colored and can be used as a warning to predators. The flash of color may also help to startle a predator long enough for the walkingstick to escape.

Additional Information:
There is no courtship between male and female walkingsticks. The male is attracted by the female's scent. He then crawls onto her back, bends his abdomen around and mates with her. The sperm is transferred in a packet which is called a spermatophore. Mating can take hours, with males often remaining on the female's back. Eggs are gray and buff in color. A female can lay up to 1,000 eggs in her lifetime.

Males do not have to be present for females to reproduce; parthenogenic (asexual) reproduction may occur. If males are present and the female mates with one, the eggs hatch within a few months. Parthenogenic eggs take longer to develop. Newly hatched nymphs are approximately 0.8 in (2 cm) in length. The metamorphosis of the Australian walkingstick is incomplete. It takes approximately three to four months for a nymph to reach adult stage. During this time the Australian walkingstick will go through six or seven molts. The adult's life-span is 4 to 6 months.

Australian walkingsticks are nocturnal, remaining mostly motionless during the day. Their predators include birds and small mammals. As a defense, walkingsticks remain motionless or sometimes they will rock back and forth to mimic a leaf shaking in the breeze.

Diet:
In the wild, Australian walkingsticks eat certain species of eucalyptus. At Woodland Park Zoo they are fed bramble.

Fascinating Facts:

- The order name, Phasmatodea, originates from the Latin word "Phasma" which means ghost. This is due to the excellent camouflage ability of the walkingsticks.
- Stick insects have both claws and sucker pads on their feet which allow them to walk straight up a vertical surface.
- One of the most interesting predators of some stick insects are the cleptid wasps. These wasps lay their own eggs on the eggs of the phasmid (FAZ-mid). The young wasps then grow by feeding on the eggs of the stick insect.
- The Australian walkingstick nymphs mimic scorpions to scare off predators.

Conservation Notes:

Australian walkingsticks are common; however, like the Vietnamese walkingstick, they could be threatened by the destruction of their habitat.

Currently walkingsticks are popular in the pet trade. However, because they are non-native insects and could be considered plant pests, it is illegal to own any stick insect without the proper permit. If you are considering housing these animals for use in your classroom, make sure you contact the U.S. Fish and Wildlife Service for information about keeping walkingsticks in the classroom.

PHOTO BY GERI WEINRAUB

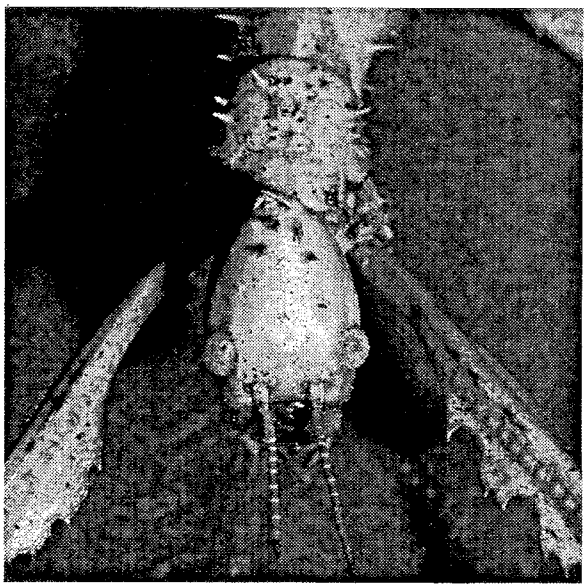


PHOTO BY GERI WEINRAUB

Vietnamese Walkingstick

Baculum extradentatum

Classification:
There are approximately 2,000 tropical species of walkingsticks and 10 species in North America. The Vietnamese walkingstick is a member of the Phasmidae family in the order Phasmatodea.

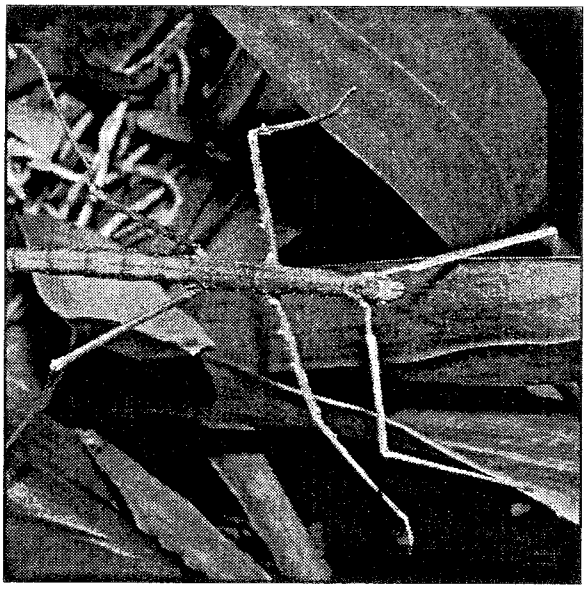


PHOTO BY GERI WEINRAUB

Habitat and Range:
Vietnamese walkingsticks are found in the tropical forests of Vietnam and Southeast Asia.

Physical Characteristics:
Vietnamese walkingsticks are approximately four to five inches (10-12 cm) in length. Their heads are elongated and oval shaped, with thread-like antennae and chewing mouthparts for eating plant matter. These walkingsticks are brownish in color, allowing them to be camouflaged in their surroundings. They have six legs characteristic of all insects. Male Vietnamese walkingsticks have a full set of wings while females have no wings. Males can fly around to find females in order to reproduce. Females can reproduce asexually if necessary; thus they do not need to fly in search of males for reproduction.

Additional Information:
Reproduction occurs mostly by parthenogenesis, or asexual reproduction. Males in this species are rare. The female drops hundreds of seed-like eggs to the forest floor. These eggs then hatch within a couple of months. The eggs are approximately 0.4 in. (1 cm) in length. Vietnamese walkingsticks go through an incomplete metamorphosis. The nymphs mature to their adult form in three months' time. Their life cycle is very short and the adults survive for only three to four months. Once reaching adult stage, however, they are able to reproduce immediately.

Primarily nocturnal in behavior, Vietnamese walkingsticks remain virtually motionless throughout the day. Their predators include birds and small mammals. The primary defense of this walkingstick is to remain motionless in order to be undetected, but they can move rapidly when threatened.

Diet:
In the wild, Vietnamese walkingsticks eat a variety of foliage. At the zoo they are fed primarily blackberry bramble.

Fascinating Facts:
- Walkingstick nymphs missing limbs are likely to regenerate the missing parts at the next molt. Adults cannot regenerate missing limbs.
- Some species of stick insects, such as the giant prickly walkingstick, can forcefully eject their eggs, thereby spreading them for some distance. Cyphocrania gigas can eject their eggs almost 20 ft (6 m). By shooting the eggs, the female helps to reduce predation on her eggs and ensure food availability for the offspring.
- Walkingsticks sometimes sway back and forth on a branch, trying to imitate a leaf blowing in the breeze. This helps them avoid detection by predators.

Conservation Notes:
Vietnamese walkingsticks are common in the wild. Due to the destruction of different habitats, however, the future of many arthropods is at risk. Since walkingsticks are frequently found in forested habitats, they are threatened by deforestation. There are many different causes of deforestation. Timber and paper industries cut down trees for lumber and paper. Destruction of forests is a result of the expansion of human dwellings, farming, recreation and more. We can all make a difference in saving these habitats by reducing the number of products we buy that deplete forests. Recycling can also make a difference because it reduces the numbers of trees that must be cut down.